

IBM System Storage DS4700 Express Storage Subsystem



Installation, User's and Maintenance Guide

IBM System Storage DS4700 Express 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 217.

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Safety

The caution and danger statements that this document contains can be referenced in the multilingual *IBM® Safety Information* document that is provided with your IBM System Storage™ DS4700 Express Storage Subsystem. Each caution and danger statement is numbered for easy reference to the corresponding statements in the translated document.

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

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

Statement 1:



DANGER

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

To avoid a shock hazard:

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

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

Statement 2:



CAUTION:

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

Do not:

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

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

Statement 3:



CAUTION:

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

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



DANGER

<p>Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.</p> <p>Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.</p>
--

Class 1 Laser statement

Class 1 Laser Product
 Laser Klasse 1
 Laser Klass 1
 Luokan 1 Laserlaite
 Appareil À Laser de Calsse 1

IEC 825-11993 CENELEC EN 60 825

Statement 4:



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

CAUTION:

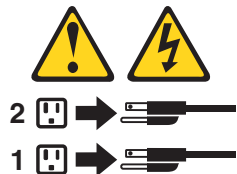
Use safe practices when lifting.

Statement 5:



CAUTION:

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



Statement 8:



CAUTION:

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



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

Statement 29:



CAUTION:

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment.

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. The DC system shall not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

Statement 30:



CAUTION:

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.
- Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).
- The branch circuit overcurrent protection must be rated 20 A.
- Use 12 American Wire Gauge (AWG) or 2.5 mm² copper conductor only, not exceeding 4.5 meters in length.
- Incorporate a readily available approved and rated disconnect device in the field wiring.



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



Cable Warning:

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

About this document

This document provides instructions for installing and customizing the configuration of your IBM System Storage DS4700 Express Storage Subsystem. It also provides maintenance procedures and troubleshooting information.

Who should read this document

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

How this document is organized

Chapter 1, "Introduction," on page 1 describes the IBM System Storage DS4700 Express 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 31 contains information on how to install the DS4700 Express Storage Subsystem in a standard rack cabinet and setting the interface options.

Chapter 3, "Cabling the storage subsystem," on page 55 contains fibre channel and power cabling information for the DS4700 Express Storage Subsystem.

Chapter 4, "Operating the storage subsystem," on page 115 contains information on how to power on and off the DS4700 Express Storage Subsystem, recover from an overheated power supply and fan unit, troubleshoot, and interpret LEDs.

Chapter 5, "Replacing components," on page 143 contains step-by-step instructions about how to install or remove customer replaceable units (CRUs), such as Enhanced Disk Drive Modules (E-DDMs), power supply and fan units, RAID controllers, battery units, bezels, filter and filter retainer, midplane, and SFP modules.

Chapter 6, "Hardware maintenance," on page 181 describes problems and symptoms that are specific to the DS4700 Express Storage Subsystem. It also provides a parts list for the DS4700 Express Storage Subsystem.

Appendix A, "Records," on page 189 provides a table that you can use to record and update important information about your DS4700 Express Storage Subsystem, including serial number and device records.

Appendix B, "Rack mounting template," on page 193 provides the rack mounting templates for installation of the DS4700 Express Storage Subsystem. 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 197 lists power cord information for the DS4700 Express Storage Subsystem.

Appendix D, "Additional DS4000 documentation," on page 201 lists additional DS4000 documents.

Appendix E, “Accessibility,” on page 211 details accessibility information.

Appendix F, “Product Recycling and Disposal,” on page 213 details the European directive about product recycling.

DS4000 Storage Subsystem installation tasks - General overview

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

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

Table 1. Where to find DS4000 installation and configuration procedures

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

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

	Installation task	Where to find information or procedures
3	Mount the DS4000 EXP storage expansion unit in the rack	<ul style="list-style-type: none"> • <i>DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide</i> • <i>DS4000 EXP420 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>FAStT EXP500 Installation and User's Guide</i>
4	Route the storage expansion unit Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
5	Route the host server Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
6	Power up the subsystem	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>

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

	Installation task	Where to find information or procedures
7	Configure DS4000 network settings	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
8	Zone the fabric switch (SAN-attached only)	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • <i>DS4000 Storage Manager Copy Services Guide</i> (describes switch zoning for the Remote Mirror Option) • See also the documentation provided by the switch manufacturer.
9	Install DS4000 Storage Manager software on the management station	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • DS4000 Storage Manager online help (for post-installation tasks)
10	Install host software (failover drivers) on host server	
11	Start DS4000 Storage Manager	
12	Set the DS4000 Storage Manager clock	
13	Set the DS4000 Storage Manager host default type	

Table 1. 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"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
15	Enable DS4000 Storage Manager premium feature keys	<p>Copy Services premium features <i>DS4000 Storage Manager Copy Services Guide</i></p> <p>FC/SATA Intermix premium feature <i>DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i></p> <p>Storage Partitioning (and general premium features information)</p> <ul style="list-style-type: none"> • <i>DS4000 Storage Manager Concepts Guide</i> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i>
16	Configure arrays and logical drives	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i>
17	Configure host partitions	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i>
18	Verify host access to DS4000 storage	<ul style="list-style-type: none"> • DS4000 Storage Manager online help

Getting information, help, and service

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

Before you call

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

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.

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

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

Using the documentation

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

Web sites

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

DS4000 Midrange Disk Systems

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

www-1.ibm.com/servers/storage/disk/ds4000/

IBM System Storage products

Find information about all IBM System Storage products:

www.storage.ibm.com/

Support for IBM System Storage disk storage systems

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

www-304.ibm.com/jct01004c/systems/support/supportsite.wss/brandmain?brandind=5345868

System Storage DS4000 interoperability matrix

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

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

DS4000 Storage Manager readme files

1. Go to the following Web site:

www-304.ibm.com/jct01004c/systems/support/supportsite.wss/brandmain?brandind=5345868

2. In the Product family drop-down menu, select **Disk systems**, and in the Product drop-down menu, select your Storage Subsystem (for example, **DS4800 Midrange Disk System**). Then click **Go**.
3. When the subsystem support page opens, click the **Install/use** tab, then click the **DS4000 Storage Manager Pubs and Code** link. The Downloads page for the subsystem opens.
4. When the download page opens, ensure that the **Storage Mgr** tab is selected. A table displays.
5. In the table, find the entry that lists the Storage Manager package for your operating system, then click on the corresponding **v9.xx** link in the “Current version and readmes” column. The Storage Manager page for your operating system opens.
6. Click the link for the readme file.

Storage Area Network (SAN) support

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

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

DS4000 technical support

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

www-304.ibm.com/jct01004c/systems/support/supportsite.wss/brandmain?brandind=5345868In the Product family drop-down menu, select **Disk systems**, and in the Product drop-down menu, select your Storage Subsystem (for example, **DS4800 Midrange Disk System**). Then click **Go**.

Premium feature activation

Generate a DS4000 premium feature activation key file by using the online tool:

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

IBM publications center

Find IBM publications:

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

Support for System p servers

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

www-304.ibm.com/jct01004c/systems/support/supportsite.wss/brandmain?brandind=5000025

Support for System x servers

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

www-304.ibm.com/jct01004c/systems/support/supportsite.wss/brandmain?brandind=5000008

Fix delivery center for AIX and Linux on POWER

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

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

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

@server System p and AIX information center

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

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

Support for Linux on System p

Find information about using Linux on System p servers:

www.ibm.com/servers/eserver/pseries/linux/

Linux on POWER resource center

Find information about using Linux on POWER servers:

www.ibm.com/servers/enable/linux/power/

Software service and support

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

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

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

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

Hardware service and support

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

www.ibm.com/planetwide/

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

Fire suppression systems

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

How to send your comments

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

E-mail

Submit your comments by e-mail to:

starpubs@us.ibm.com

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

Mail

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

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

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

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

Chapter 1. Introduction

This chapter describes the operating specifications, features, and components for the IBM System Storage DS4700 Express Storage Subsystem (hereafter referred to as *DS4700* or *storage subsystem*).

This chapter also includes an inventory checklist and important information on best practices guidelines and product updates for your DS4700 Express.

Overview

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

The IBM System Storage DS4700 Express Storage Subsystem (Machine Type 1814, Models 70A, 70H, 70S, 70T, 72A, 72H, 72S, and 72T) is designed to provide solutions to meet the needs of midrange/departmental storage requirements, delivering high performance, advanced function, high availability, modular and scalable storage capacity, with SAN-attached 4-Gbps Fibre Channel (FC) connectivity, and support for RAID levels 0, 1, 3, and 5 up to over 33 terabytes (TB) when using 300 GB hard drives and up to 56 TB when using 500 GB SATA Enhanced Disk Drive Modules (E-DDMs).

A 3-U rack-mountable enclosure houses the DS4700 Express redundant, dual-active RAID controllers with up to six fibre-channel ports per controller for attachment of host servers and DS4000 storage expansion enclosures and up to 16 4-Gbps fibre channel or SATA E-DDMs.

The DS4700 Express supports attachment of up to six EXP810, EXP710, or EXP100 storage expansion enclosures, resulting in the capability to connect to up to 112 disk drives and enabling storage configurations of over 33 TB using 300 GB fibre channel E-DDMs or 56 TB using 500 GB SATA E-DDMs. The DS4700 Express supports configurations of FC or Serial Advanced Technology Attachment (SATA) disks, or a mix of both types of disk drives by use of the optional DS4700 Express Fibre Channel/SATA Enclosure Intermix feature. Advanced DS4000 storage management, copy service options, and optional advanced disaster recovery functions are available for the DS4700 Express, including FlashCopy®, VolumeCopy, and Enhanced Remote Mirroring.

The DS4700 Express supports up to four hosts in a redundant direct-attached fibre channel configuration. When using fibre channel switches, you can redundantly connect up to 128 hosts to the DS4700 Express.

Depending on the model, the DS4700 Express Storage Subsystems are shipped with either AC or DC (-48V DC) power supply and fan unit CRUs. In addition, an DS4700 Express Telco bezel assembly with an integrated air filter can also be purchased for the operating environments that require it.

The DS4700 Express Storage Subsystem with DC power supply and fan units (1814-70/2S&T) supports both NEBS level 3/Telco operating environments and standard Information Technology (IT) and office environments. However, not all DS4700 Express models with AC power supplies (1814-70/2A&H) support both NEBS level 3/Telco operating environments and standard IT and office

environments. DS4700 Express Storage Subsystems that shipped before the introduction of the DS4700 Express models with DC power supply and fan units support standard IT and office operating environments only. You can identify whether a DS4700 Express Storage Subsystem is NEBS/Telco compliant by checking the serial number. Any DS4700 Express Storage Subsystem with serial numbers starting at 138500A and higher are NEBS level 3/Telco compliant.

The DS4000 Storage Manager client is also available for the DS4700 Express. This storage management software is designed to help centralize storage management, help simplify partitioning of the DS4000 series storage into as many as 64 virtual servers, and strategically allocate storage capacity to maximize storage space.

Models

The following DS4700 Express RAID controller cache size, partitions, and other features vary depending the DS4700 Express model:

- Model 70H comes with 1 GB cache per controller, two host ports per controller, and two storage partitions premium feature, which you can upgrade to 4, 8, 16 or 64 partitions when you purchase storage partitioning upgrades (2 to 4, 2 to 8, 2 to 16, 2 to 64, 4 to 8, 4 to 16, 4 to 64, 8 to 16, 8 to 64, and 16 to 64). Model 70H can also be upgraded to support Copy Services premium features such as FlashCopy, VolumeCopy and Enhanced Remote Mirroring when you purchase those additional Copy Services premium feature options. Model 70H also includes the Windows® Host kit as standard. Model 70H does not come with DS4000 drive expansion enclosure attachment entitlements. You can purchase 1 to 3 drive expansion and 4 to 6 drive expansion enclosures attachment entitlements to connect up to six enclosures. Model 70H comes with AC power supply and fan units.
- Model 70A is the same as Model 70H except that you can select to upgrade to 4, 8, 16 or 64 partitions when placing the order. You can also select a supported host kit.
- Model 70S is the same as Model 70A except that it has DC power supply and fan units instead of AC power supply and fan units.
- Model 70T is the same as Model 70H except that it has DC power supply and fan units instead of AC power supply and fan units.
- Model 72H comes with 2 GB cache per controller, four host ports per controller, and eight storage partitions premium feature, which you can upgrade to 16 or 64 partitions when you purchase storage partitioning upgrades (8 to 16, 8 to 64, and 16 to 64). Model 72H can also be upgraded to support Copy Services premium features such as FlashCopy, VolumeCopy and Enhanced Remote Mirroring when you purchase those additional Copy Services premium feature options. Model 72H also includes the Windows Host kit as standard. Model 72H comes with 1 to 3 DS4000 drive expansion enclosure attachment entitlements. You can upgrade to 4 to 6 drive expansion enclosures attachment entitlements.
- Model 72A is the same as Model 72H except that you can select to upgrade to 16 or 64 partitions when placing the order. You can also select a supported host kit. Model 72A comes with AC power supply and fan units.
- Model 72S is the same as Model 72A except that it comes with DC power supply and fan units instead of AC power supply and fan units.
- Model 72T is the same as Model 72H except that it comes with DC power supply and fan units instead of AC power supply and fan units.

Contact your IBM sales representatives or reseller for more information on the various DS4700 Express models and options.

Operating system support

Microsoft® Windows 2000 Server and Advance Server, Microsoft Windows 2003 Server and Enterprise Edition, Sun®Solaris, IBM AIX®, RedHat Enterprise Linux® Server, and SuSE Linux Enterprise Server, IBM Linux on POWER™ (LoP), HP HP-UX, Novell Netware and VMware ESX are the supported operating systems for host servers that have mapped LUNs created in the DS4700 Express with storage expansion enclosures. See the latest DS4000 Storage Manager host software readme file and the IBM DS4000 series products interoperability matrix at the following Web site for additional host operating system support:

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

Fibre channel defined

Fibre channel technology is outlined in the *SCSI-3 Fibre Channel Protocol* (SCSI-FCP) standard. Fibre channel is a high-speed data transport technology that is used for mass storage and networking.

Using a fibre channel arbitrated loop (FC-AL), more than 100 fibre-channel devices can be supported, compared to 15 small computer system interface (SCSI) devices. The fibre channel connection speed from the DS4700 Express to storage expansion enclosures is either 2 Gbps or 4 Gbps depending on the type of enclosures to which the DS4700 Express is connected, allowing data transfer rates up to 400 MBps half-duplex and 800 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 (<http://www.serialata.org>).

Inventory checklist

After you unpack the DS4700 Express, verify that you have the following items.

Note: Depending on your DS4700 Express order, your shipping box might contain additional materials not listed in the following checklist. Review the inventory checklist included in the DS4700 Express shipping box for any additional parts, and use that checklist in combination with the following information.

- **Hardware**
 - Blank trays (16) (Your storage subsystem might come with up to 16 E-DDMs.)
 - RAID controllers (2)
 - AC power supply and fan units (2) (Models 70A, 70H, 72A, and 72H only)
 - DC power supply and fan units (2) (Models 70S, 70T, 72S, and 72T only)
 - Battery units (2)
 - Power cables (2 rack jumper line cords) (Models 70A, 70H, 72A, and 72H only)

- DC power jumper cables (2) (Models 70S, 70T, 72S, and 72T only)
- Diagnostic wrap plug/coupler (1)
- Serial cable adapter (1)
- Rack-mounting hardware kit (1), including:
 - Rails (2) (right and left assembly)
 - M5 black hex-head slotted screws (12)
 - Washers (8)
- 4 Gbps SFPs (6) (Model 72A, 72H, 72S, and 72T only. The SFPs are installed in the DS4700 Express SFP ports.)
- 4 Gbps SFPs (4) (Model 70A, 70H, 70S, and 70T only. These SFPs are installed in the DS4700 Express SFP ports.)
- (Optional) DS4700 Express Telco bezel (1)

Attention: The DS4700 Express does not ship with region-specific AC power cords. You must obtain the IBM-approved power cords for your region. See Appendix C, “Power cords,” on page 197 for the IBM-approved power cords for your region.

- **Software and documentation**

- Host software attachment kit

Depending on the DS4700 Express model that you order, your DS4700 Express will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4700 Express. The kit includes a *DS4000 Storage Manager Support* CD that has the appropriate IBM DS4000 Storage Manager host software. The CD also includes firmware, online help, and publications in Adobe Acrobat Portable Document Format (PDF). (For a list of available IBM DS4000 publications, see Appendix D, “Additional DS4000 documentation,” on page 201.)

If you order more than one host software kit, the additional kits may also be shipped in the DS4700 Express shipping box.

Note: Depending on your DS4700 Express model, you may need to purchase the appropriate host software kit for your host server operating system. Contact your IBM representative or reseller for more information.

- Activation kit:
 - Two storage partitions activation kit (Model 70H and 70T)
 - Eight storage partitions activation kit (Model 72H and 72T)
 - Storage partition kit with the number of partitions you ordered (Models 70A, 70S, 72A, and 72S)
- *IBM System Storage DS4700 Express Storage Subsystem Installation, User’s, and Maintenance Guide*
- *IBM System Storage DS4700 Express Storage Subsystem Fibre Channel Cabling Guide*
- *IBM Safety Information*
- IBM License Agreement
- Statement of Limited Warranty
- Box ID labels (used to label the enclosure IDs on the front of the DS4700 Express)

Note: If you ordered additional premium features or entitlements, the premium features activation or entitlement kits may also be shipped inside the box.

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

A rack mounting template and instructions for installing the support rails and the storage subsystem are provided in “Installing the support rails” on page 36.

To connect your DS4700 Express 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.

Product updates

Important

In order to keep your system up to date with the latest firmware and other product updates, use the information below to register and use the **My support** Web site.

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

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

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

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

Perform the following steps to receive product updates:

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

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

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

Best practices guidelines

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

- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any Needs Attention LED is lit; be sure to resolve any error conditions before you shut down the system.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, plug the DS4700 Express right and left power supply and fan units into two independent external power circuits through AC power 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 DS4700 Express should be plugged into the same two independent external power circuits as the DS4700 Express. This ensures that the DS4700 Express and all its attached storage expansion enclosures will have power in the event that only one power circuit is available. In addition, having all the right or all the left power cables plug into the same power circuit enables the DS4000 devices in the configuration to power on simultaneously during an unattended restoration of power.

Note: Do not overload the circuits that power your storage subsystem and storage expansion enclosures. Use additional pairs of AC power distribution units (PDUs) if necessary. Refer to Table 18 on page 27 for information on storage subsystem power requirements. Contact your IBM service representative for additional information if needed.

- Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than in the logical drives created for the DS4700 Express.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in “Powering on the storage subsystem” on page 117. 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 “Powering on the storage subsystem” on page 117 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and subsystems are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and subsystems do not come online.
 - The storage subsystem logical drives and subsystems seem to be degraded.

Storage subsystem components

The storage subsystem has the following removable components. These components, called customer replaceable units (CRUs), are accessible from the front or back of the storage subsystem.

- Up to sixteen 2 or 4 Gbps fibre channel or SATA Enhanced Disk Drive Modules (E-DDMs)
- Two RAID controllers
- Two AC power supply and fan units (Models 70A, 70H, 72A, and 72H)
- Two DC power supply and fan units (Models 70S, 70T, 72S, and 72T)
- Two battery units
- SFP modules
- Bezel
- Filter and filter retainer

The hot-swap features enable you to remove and replace 2 or 4 Gbps fibre channel or SATA hard E-DDMs, power supply and fan units, and controllers without turning off the storage subsystem. You can maintain the availability of your system while a hot-swap device is removed, installed, or replaced.

Enhanced Disk Drive Modules (E-DDMs)

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

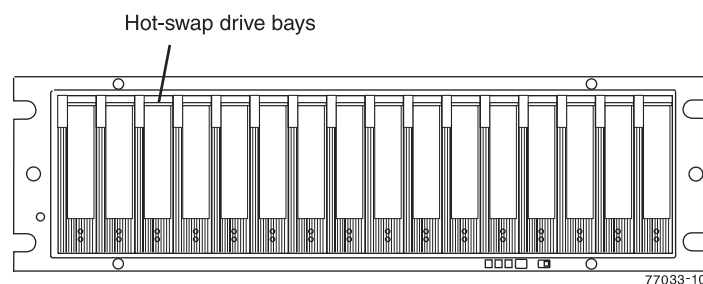


Figure 1. DS4700 Express hot-swap drive bays

The DS4700 Express supports both fibre channel (FC) and SATA E-DDMs intermixed in the storage subsystem drive chassis. The DS4700 Express supports up to sixteen 2 or 4 Gbps fibre channel (FC) or SATA E-DDMs.

SATA E-DDMs have an ATA translator card that converts the fibre channel protocol interface of the DS4700 Express drive channel/loop into the hard drive SATA protocol interface. It also provides dual paths to the SATA drive for drive CRU path redundancy. Each drive, ATA translator card (also referred to as interposer card), and carrier assembly are called SATA E-DDM CRUs. The fibre channel E-DDMs consisted of the fibre channel and the carrier assembly (drive tray).

Install E-DDM CRUs in the 16 drive bays on the front of the storage subsystem from the leftmost slot (slot 1) to the rightmost slot (slot 16). When an E-DDM is installed, the drive and tray slot designation is set automatically. The hardware addresses are based on the enclosure ID, which is set by the controller software, and on the E-DDM's physical location in the storage subsystem.

The DS4700 Express Storage Subsystem drive channel operates at either 2 or 4 Gbps fibre channel interface speed. Ensure that the DS4700 Express enclosure speed switch is set correctly for the 2 Gbps or 4 Gbps fibre channel E-DDM CRUs. The DS4700 Express Storage Subsystem SATA E-DDM CRUs have an ATA translator card that converts E-DDM 3 Gbps SATA drive interface protocol to either 2 Gbps or 4 Gbps fibre channel interface protocol. It is recommended to operate these SATA E-DDMs at 4 Gbps fibre channel operating speed whenever the configuration allows, for example, when no 2 Gbps fibre channel devices are in the configuration. The Link Rate setting speed must be set accordingly. See "Verifying the Link Rate setting" on page 159 for more information. The enclosure speed of the DS4000 Storage Subsystem must be the same as that of the storage expansion enclosures connected to it.

There are no serviceable parts in an E-DDM CRU. If it fails, it must be replaced in its entirety (E-DDM, ATA translator card, bezel, and tray). The DS4700 Express drive tray is not interchangeable with the drive tray of other DS4000 storage subsystems such as DS4100 or DS4300 storage subsystems. The DS4700 Express E-DDM option CRUs are not interchangeable with those of the DS4200 Express and EXP420. When replacing an E-DDM CRU, be sure to order and install the correct E-DDM CRU. Using non-supported E-DDM options or FRUs will result in the E-DDM being locked out by the DS4700 Express controller firmware and might also damage the drive connector in the enclosure midplane.

Attention:

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

Note: If the E-DDM you want to remove is not in a failed or bypass state, always use the Storage Manager client program either to place it in a failed state or to place the array that is associated with the E-DDM (or E-DDMs) in an offline state before you remove it from the enclosure.

Controllers

The DS4700 Express has two hot-swappable and redundant RAID controllers. The controllers are located at the back of the storage subsystem. The left controller is labeled controller A, and the right controller is labeled controller B. One controller will continue to operate if the other controller fails.

The controllers contain the storage subsystem control logic, interface ports, and LEDs. The controller on model 70 has two fibre channel host ports and the controller on model 72 has four fibre channel host ports that you could use to connect the storage subsystem to the host server. In addition, each controller for both DS4700 Express subsystem models 70 and 72 has two fibre channel drive ports for connecting to the DS4000 storage expansion enclosures and two Ethernet ports for DS4700 Express subsystem management purposes. See Figure 2 on page 10.

Although both controllers (A and B) are identical, they are seated in the DS4700 Express chassis in opposite orientations. See Figure 2 on page 10. If the controller cannot fully be inserted in the controller bay, flip it 180 degrees and reinsert it. Do not force fit because it may cause damage to the controller unit.

Connectors, switch, and enclosure ID

The controllers support fiber optic interfaces for both the host channel and drive channel ports. The controllers also contain two Ethernet ports for storage subsystem management purposes and a serial port that IBM Support uses to perform problem recovery and troubleshooting procedures.

The default IP addresses for the Ethernet ports on controller A are 192.168.128.101 and 192.168.129.101. The default IP addresses for the Ethernet ports on controller B are 192.168.128.102 and 192.168.129.102. The subnet mask for all cases are 255.255.255.0. See “Setting up IP addresses for DS4000 storage controllers” on page 11 for more information.

The enclosure ID, comprised of two seven-segment numbers, is located on the back of each controller next to the controller indicator lights. The two digits that comprise the enclosure ID are referred to as x10 and x1 digits. The enclosure ID provides a unique identifier for each enclosure in the storage subsystem. The storage management software automatically sets the enclosure ID number. You can only change the enclosure ID setting through the DS4000 storage management software. There are no switches on the DS4700 Express chassis to manually set the enclosure ID. Both controller enclosure ID numbers will be identical under normal operating conditions. The enclosure ID is set to a value of 85 from the factory.

Storage expansion enclosures in a DS4000 storage subsystem must also have unique enclosure IDs. In addition to having unique enclosure IDs for each storage expansion enclosure (including the DS4000 storage subsystems with drives installed) in the DS4000 storage subsystem configuration, ensure that the single digit (x1) of the enclosure ID for every storage expansion enclosure in a redundant drive channel/loop pair is unique.

If you do not set the single digit value of the enclosure IDs to be unique among storage expansion enclosures (including the DS4000 storage subsystem with drives installed) in a redundant drive channel/loop pair, then drive loop errors might be randomly posted in the DS4000 subsystem Major Event Log (MEL) when you intermix different types of storage expansion enclosures in a redundant drive loop pair (such as an EXP100 with an EXP810). For example, with four enclosures attached to a DS4500 in a redundant drive loop pair, the correct enclosure ID settings should be x1, x2, x3, and x4 (where x can be any digits that can be set). Examples of incorrect settings would be 11, 21, 31, 41; or 12, 22, 32 62. These examples are incorrect because the x1 digits are the same in all enclosure IDs (either 1 or 2).

If the enclosure IDs in your DS4000 subsystem configuration are not currently set to have unique single digit (x1) values for the enclosures in the same redundant drive channel/loop pair, make the changes to the enclosure IDs in the next maintenance schedule if you have storage expansion enclosures with mechanical switches such as EXP710s in the DS4000 configuration. This will prevent unnecessary downtime when you add enclosures of different types (especially EXP810s) to the existing enclosures in the redundant drive channel/loop pair. Storage expansion enclosures and DS4000 storage subsystems with mechanical enclosure ID switches require that you power cycle the configurations to activate the new enclosure ID settings. The EXP810 storage expansion enclosures do not required you to power cycle the DS4000 configuration to activate new enclosure ID settings.

Figure 2 shows the controllers for DS4700 Express model 70. Figure 3 on page 11 shows the controllers for DS4700 Express model 72.

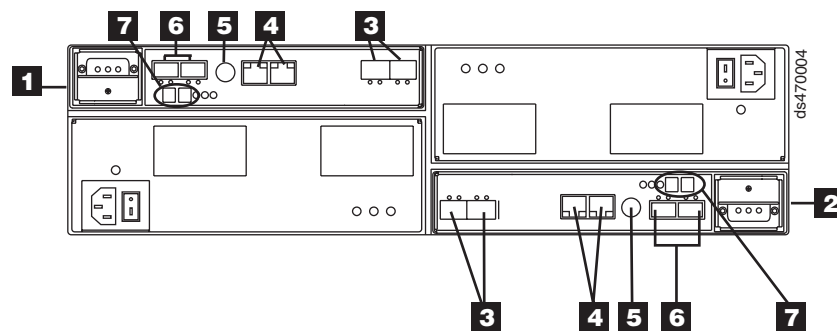


Figure 2. Back view; connectors, switch, ports, enclosure ID on model 70

Table 2. Description of Figure 2

Number	Description
1	Controller A
2	Controller B
3	Host channels
4	Ethernet ports
5	Serial port
6	Dual-ported drive channel
7	Enclosure ID

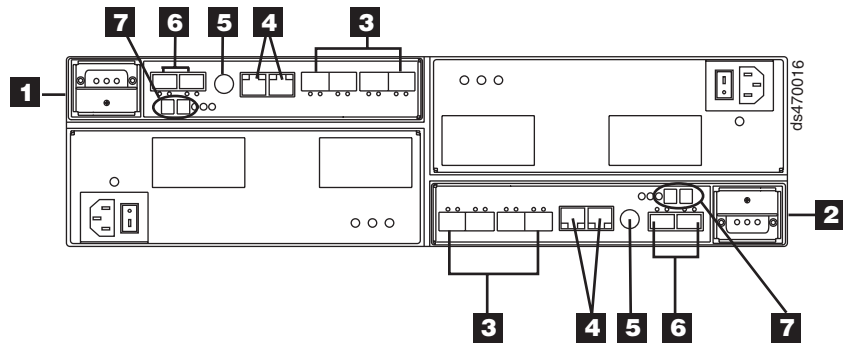


Figure 3. Back view; connectors, switch, ports, enclosure ID on model 72

Table 3. Description of Figure 3

Number	Description
1	Controller A
2	Controller B
3	Host channels
4	Ethernet ports
5	Serial port
6	Dual-ported drive channel
7	Enclosure ID

Setting up IP addresses for DS4000 storage controllers

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

- “Steps for setting up the DHCP/BOOTP server and network”
- “Steps for assigning static TCP/IP addresses to the DS4000 controllers” on page 12

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

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

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

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

1. Get the MAC address from each controller blade.
2. Complete whichever of the following steps is appropriate for your server:
 - On a DHCP server, create a DHCP record for each of the MAC addresses. Set the lease duration to the longest time possible.

- On a BOOTP server, edit the bootptab file to add in the entries that associate the MAC address tab with the TCP/IP address.
3. Connect the DS4000 storage subsystem Ethernet ports to the network.
 4. Boot the DS4000 storage subsystem.

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

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

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

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

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

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

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

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

AC power supply and fan units

The DS4700 Express Storage Subsystem (models 70A, 70H, 72A, and 72H) has two removable AC power supply and fan units. Each power supply and fan unit contains one power supply and two fans. The four fans pull air through the drive from front to back across the drives.

The fans provide redundant cooling, which means that if one of the fans in either fan housing fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem. The power supplies provide power to the internal components by converting incoming AC voltage to DC voltage. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage subsystem. To preserve the optimal airflow, do not remove a failed power supply and fan unit CRU from the DS4700 Express chassis until you are ready to replace it with a new CRU.

Figure 4 shows power supply and fan unit components for the DS4700 Express model 70 and Figure 5 on page 14 shows power supply and fan unit components for DS4700 Express model 72.

Note: Although both power supply and fan units (left and right) are identical, they are seated in the DS4700 Express chassis in opposite orientations. If the power supply and fan unit cannot fully be inserted in the power supply and fan unit bay, flip it 180 degree and reinsert it.

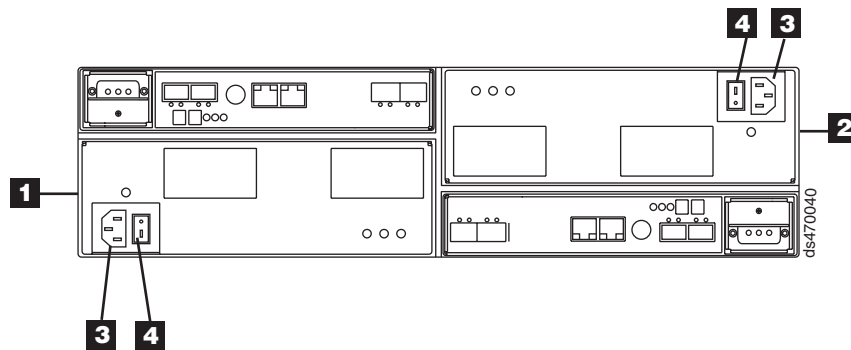


Figure 4. Power supply and fan unit components for DS4700 Express model 70

Table 4. Description of Figure 4

Number	Description
1	Power supply and fan unit A
2	Power supply and fan unit B
3	Power connector
4	Power switch

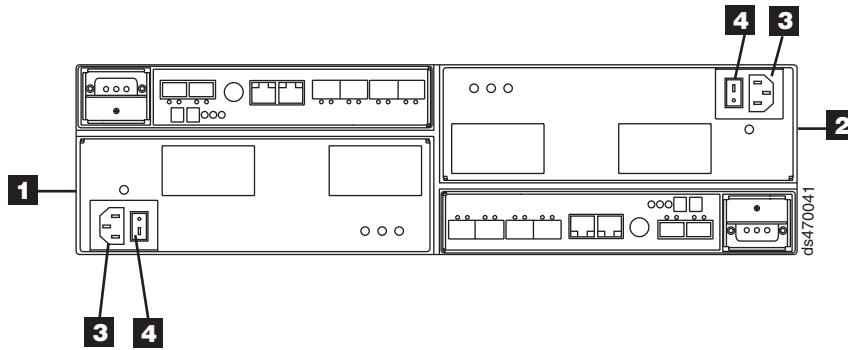


Figure 5. Power supply and fan unit components for DS4700 Express model 72

Table 5. Description of Figure 5

Number	Description
1	Power supply and fan unit A
2	Power supply and fan unit B
3	Power connector
4	Power switch

Figure 6 on page 15 shows a power supply and fan unit and the airflow through the storage subsystem.

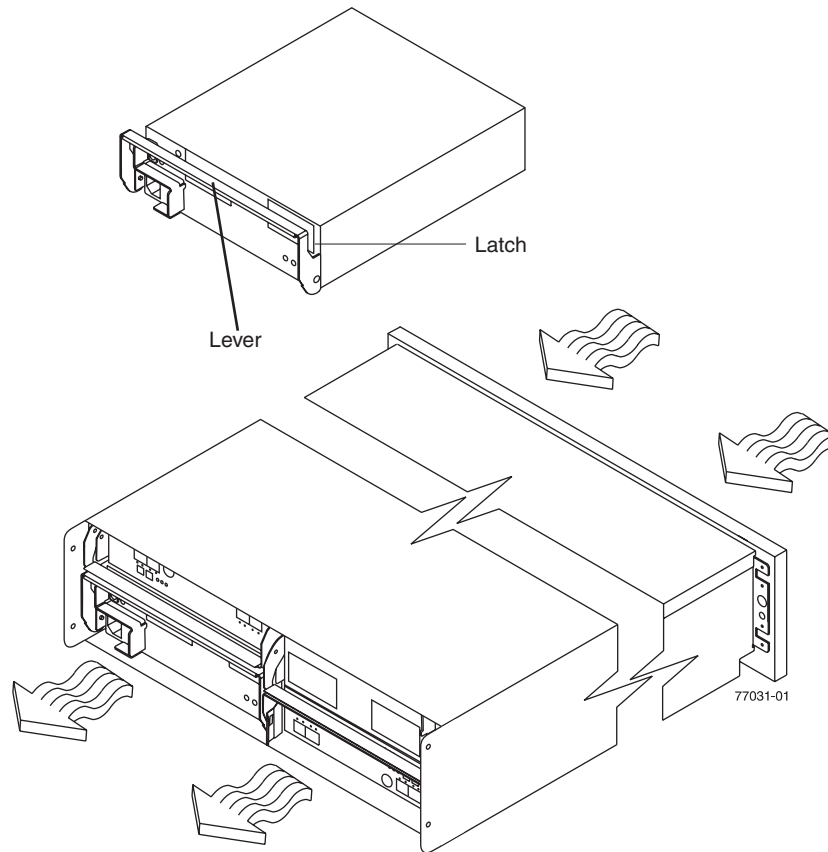


Figure 6. Power supply and fan unit and airflow

DC power supply and fan units

The DS4700 Express Storage Subsystem (models 70S, 70T, 72S, and 72T) has two removable DC power supply and fan units. Each DC power supply and fan unit contains one DC power supply and two fans. The four fans pull air through the drive from front to back across the drives.

The fans provide redundant cooling, which means that if one of the fans in either fan housing fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem. The power supplies provide power to the internal components. If one power supply is turned off or malfunctions, the other power supply maintains power to the storage subsystem. To preserve the optimal airflow, do not remove a failed DC power supply and fan unit CRU from the DS4700 Express chassis until you are ready to replace it with a new CRU.

Figure 6 shows a power supply and fan unit and the airflow through the storage subsystem.

Figure 7 on page 16 shows a side view of the DC power supply and fan units (**1**).

Note: Although both DC power supply and fan units (left and right) are identical, they are seated in the DS4700 Express chassis in opposite orientations. If the DC power supply and fan unit cannot fully be inserted in the DC power supply and fan unit bay, flip it 180 degree and reinsert it.

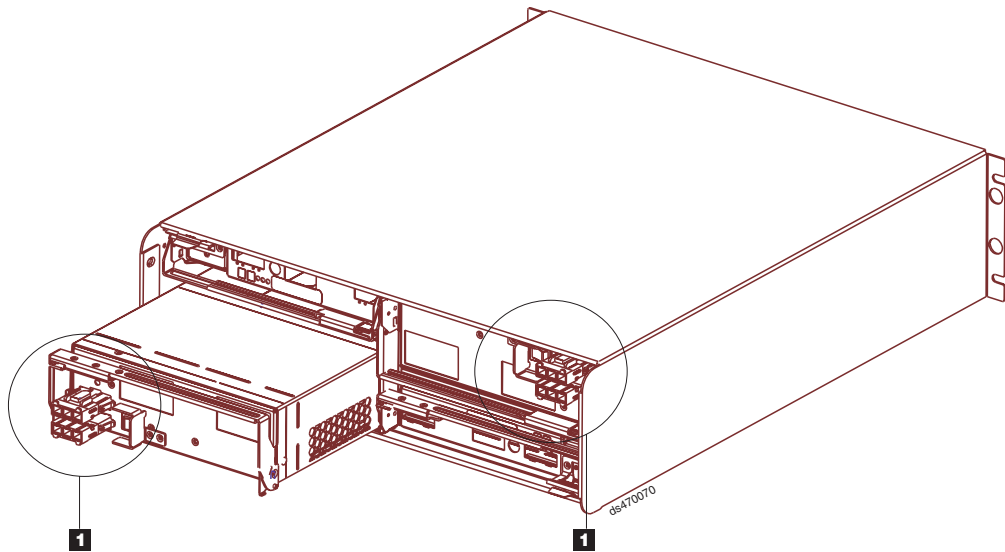


Figure 7. DC power supply and fan unit

Figure 8 shows the DC power supply and fan unit components for the DS4700 Express model 70 and Figure 9 on page 17 shows the DC power supply and fan unit components for the DS4700 Express model 72.

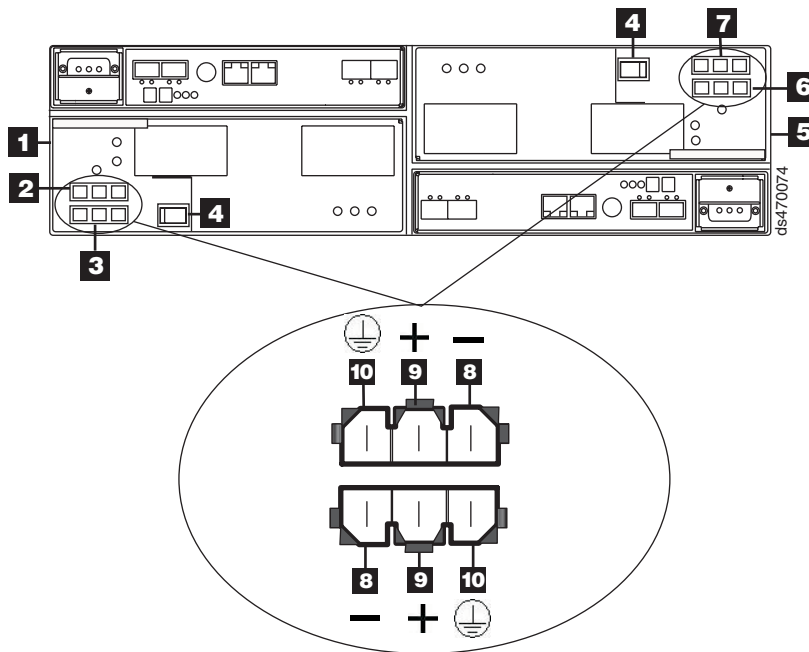


Figure 8. DC power supply and fan unit for DS4700 Express model 70

Table 6. DC power supply and fan unit description for DS4700 Express model 70

Number	Description
1	DC power supply and fan unit A
2	DC power connector A1 ¹

Table 6. DC power supply and fan unit description for DS4700 Express model 70 (continued)

Number	Description
3	DC power connector A2 ¹
4	DC power switch
5	DC power supply and fan unit B
6	DC power connector B1 ²
7	DC power connector B2 ²
8	Pin 1: -48 V DC
9	Pin 2: POS RTN
10	Pin 3: GND

Notes:

1. The A1 and A2 DC connectors are keyed so that the DC cables are connected to the A1 and A2 connectors in only one way and in opposite orientation from each other. If the DC cable does not fit the DC connector, flip it 180 degrees and try again. Do not force fit because you might damage the connectors and short out the power supply.
2. The B1 and B2 DC connectors are keyed so that the DC cables are connected to the B1 and B2 connectors in only one way and in opposite orientation from each other. If the DC cable does not fit the DC connector, flip it 180 degrees and try again. Do not force fit because you might damage the connectors and short out the power supply.

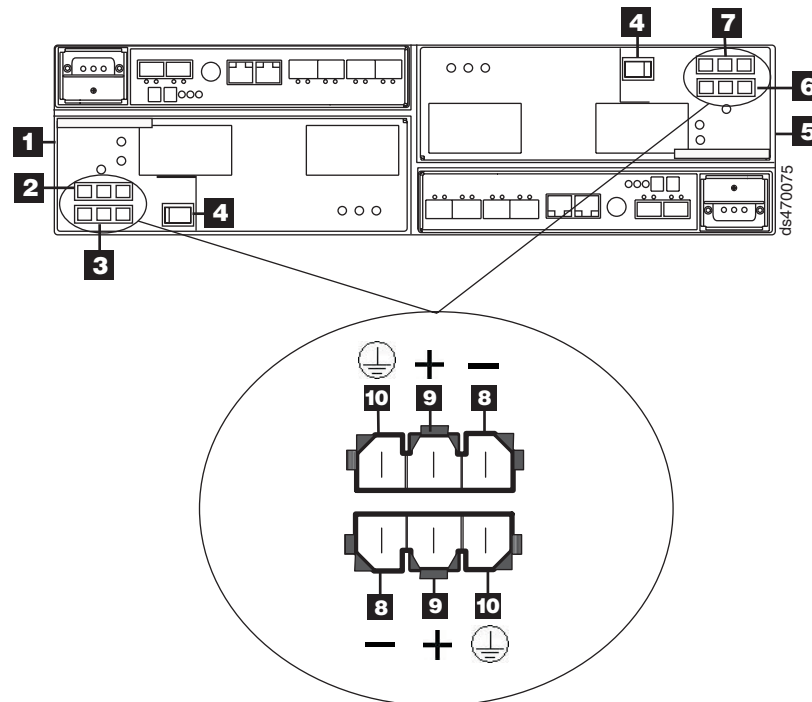


Figure 9. DC power supply and fan unit for DS4700 Express model 72

Table 7. DC power supply and fan unit description for DS4700 Express model 72

Number	Description
1	DC power supply and fan unit A
2	DC power connector A1 ¹

Table 7. DC power supply and fan unit description for DS4700 Express model 72 (continued)

Number	Description
3	DC power connector A2 ¹
4	DC power switch
5	DC power supply and fan unit B
6	DC power connector B1 ²
7	DC power connector B2 ²
8	Pin 1: -48 V DC
9	Pin 2: POS RTN
10	Pin 3: GND

Notes:

1. The A1 and A2 DC connectors are keyed so that the DC cables are connected to the A1 and A2 connectors in only one way and in opposite orientation from each other. If the DC cable does not fit the DC connector, flip it 180 degrees and try again. Do not force fit because you might damage the connectors and short out the power supply.
2. The B1 and B2 DC connectors are keyed so that the DC cables are connected to the B1 and B2 connectors in only one way and in opposite orientation from each other. If the DC cable does not fit the DC connector, flip it 180 degrees and try again. Do not force fit because you might damage the connectors and short out the power supply.

Battery units

Each controller also contains a rechargeable battery unit that maintains data in the cache in the event of a power failure.

Figure 10 on page 19 shows how the battery unit slides into the battery backup slot in controller A CRU.

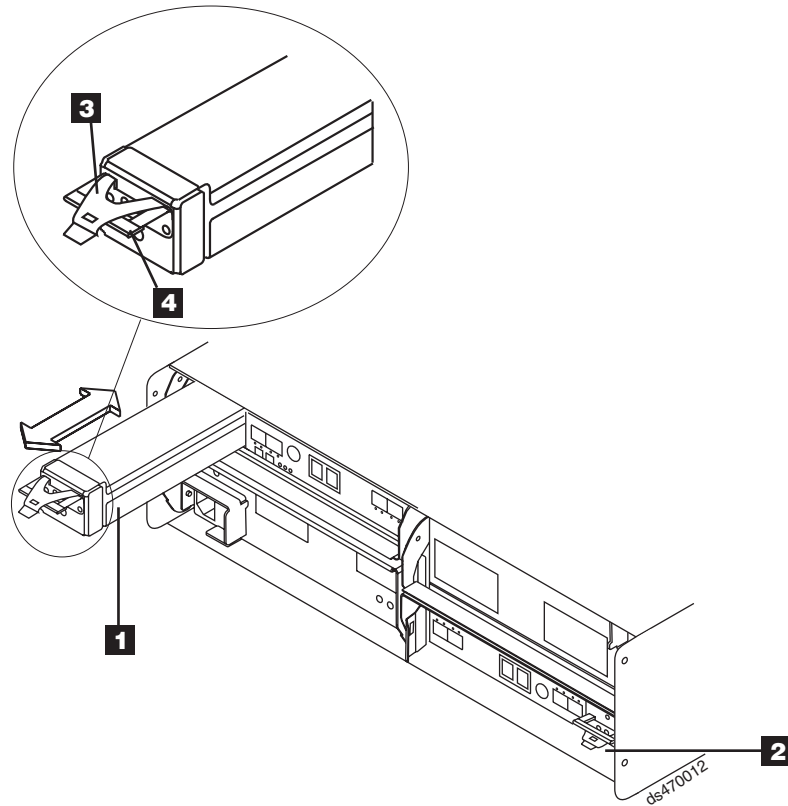


Figure 10. Battery unit

Table 8. Description of Figure 10

Number	Description
1	Controller A cache backup battery unit
2	Controller B cache backup battery unit
3	Latch
4	Pull handle

The battery unit provides backup power to each controller's cache memory. Each battery unit contains a sealed, rechargeable lithium ion battery. The battery unit can maintain data in the cache for three days.

The battery chargers in the power supply and fan units perform a battery test when the storage subsystem is started and on a regularly scheduled interval thereafter. Data caching starts after the battery completes its battery tests.

The battery unit is hot-swappable. You can remove the battery unit for servicing and then reinsert it while the DS4700 Express continues to perform I/O operations. However, write I/O caching is disabled when the battery is in a failed state. Replace the failed battery as soon as possible to minimize the time that the write IO caching is disabled.

Information about the condition of the battery unit is conveyed by indicator LEDs on the front of battery unit. ("Battery unit LEDs" on page 126 identifies the indicator LEDs on the battery unit and explains the conditions that each LED indicates.)

SFP modules

The DS4700 Express Storage Subsystem supports a fiber optic interface for host and storage expansion enclosure connections. You must install a Small Form-factor Pluggable (SFP) module in each interface connector on the controller where a fiber optic cable is to be installed. The DS4700 Express Storage Subsystem host ports support 1, 2 and 4 Gbps fibre channel speeds. The DS4700 Express Storage Subsystem drive ports support only 2 and 4 Gbps fibre channel speeds.

Attention: The maximum operating speed of the fibre channel port is determined by two factors: the speed of the SFP module that is installed and the speed of the fibre channel connection. For example, a 2-Gbps SFP that is plugged into a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps. Conversely, a 4-Gbps SFP that is plugged into a 2-Gbps-capable port will limit the speed of the port to a maximum of 2 Gbps. Carefully check the SFP's IBM part number, option number, and FRU part number to identify its speed. There are no physical features that distinguish a 4 Gbps from a 2 Gbps SFP.

Figure 11 shows an example of SFP module with fiber optic cable.

Note: The SFP module and the fibre optic cable shown are for illustrative purposes only. The actual SFP module and the fibre optic cable shape may look different from the figure shown.

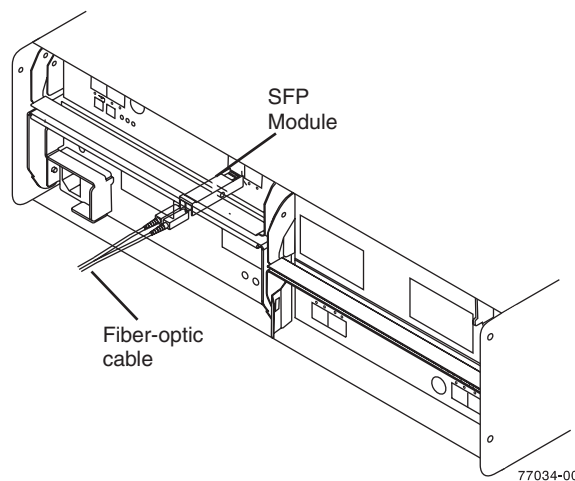


Figure 11. SFP module and fiber optic cable

Telco bezel

The DS4700 Express Storage Subsystem can be ordered with a Telco bezel. The Telco bezel also contains a filter and filter retainer. The replaceable filter is fitted inside the Telco bezel and limits impurities, dust, air particles and other external contaminants from adversely impacting the chassis, electronic CRUs, and hard drive operational effectiveness. IBM recommends that you replace the filter every three months or sooner, depending on your environment. Inspect the filter periodically and replace it as required.

Figure 12 on page 21 shows a front view of the bezel. Figure 13 on page 21 shows a side view of the bezel, filter, and filter retainer.

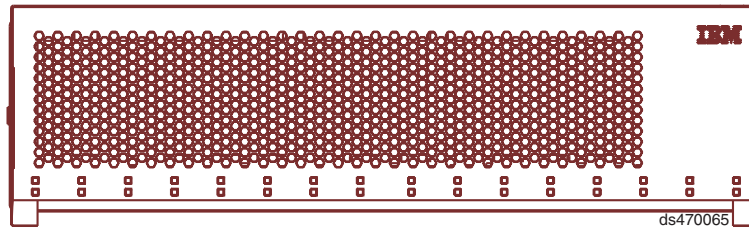


Figure 12. Bezel

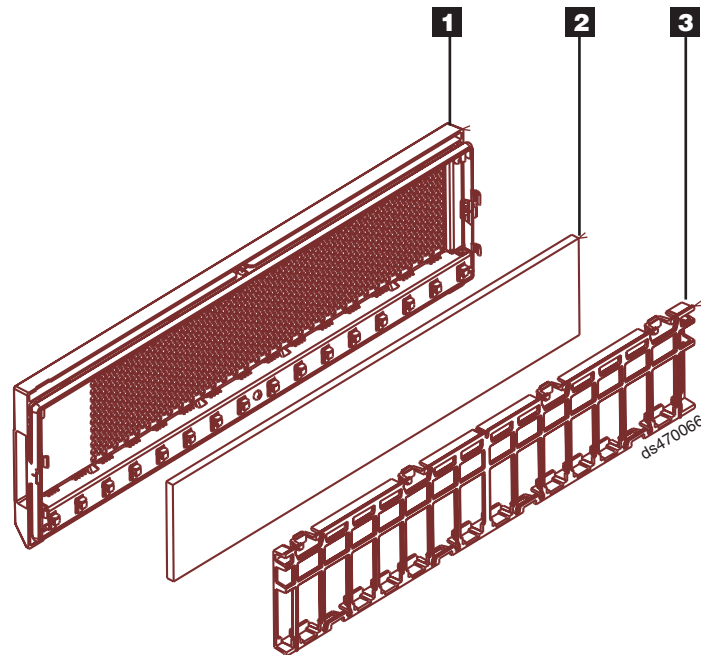


Figure 13. Filter and filter retainer

Table 9. Filter and filter retainer description

Number	Description
1	Bezel
2	Filter
3	Filter retainer

Software and hardware compatibility and upgrades

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

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

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

Software and firmware support code upgrades

To enable support for the DS4700 Express, you *must* ensure that your system's software and firmware are at the levels shown in Table 10:

Table 10. Software and firmware levels for the DS4700 Express Storage Subsystem

Software/firmware	Level
DS4000 Storage Manager software	9.23
DS4700 Express controller firmware and NVSRAM	06.23
ESM firmware for attached EXP810 storage expansion enclosures	9882 or higher
ESM firmware for attached EXP710 storage expansion enclosures	9643
ESM firmware for attached EXP100 storage expansion enclosures	9565
Drive firmware	You can find the latest drive firmware at the IBM DS4000 TotalStorage Support Web site: www.ibm.com/servers/storage/support/disk/

You can also find the latest DS4000 Storage Manager software, DS4700 Express controller firmware, and NVSRAM firmware at the IBM DS4000 System Storage Support Web site:

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

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

The DS4700 Express is shipped with controller firmware version 6.16.xx.xx, which supports EXP710 and EXP810 storage expansion enclosures only.

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

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

If you need further assistance, please contact IBM, your IBM reseller, or IBM representative.

Determining firmware levels

There are two different methods to determine the DS4000 storage subsystem and firmware versions. Each method uses the DS4000 Storage Manager client that manages the DS4700 Express Storage Subsystem.

Method One:

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

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

DS4000 Storage Server

- NVSRAM version
- Appware version
- Bootware version

Drives

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

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

ESM

- ESM card firmware version

Method Two:

Complete the appropriate procedure to obtain the specified firmware version.

To obtain the controller firmware version:

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

You must perform this step for each individual controller.

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

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

You must perform this step for each individual drive.

To obtain the ESM and drive enclosure component firmware versions:

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

Specifications

This section provides site specifications for the DS4700 Express Storage Subsystem. Before installing, you must either verify that your planned installation site meets these requirements, or prepare the site so that it does meet these requirements. Preparations might involve meeting area requirements, environmental requirements, and electrical requirements for DS4700 Express Storage Subsystem installation, service, and operation.

Area requirements

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

Dimensions

Figure 14 shows the dimensions of the DS4700 Express, which conforms to the 19-inch rack standard.

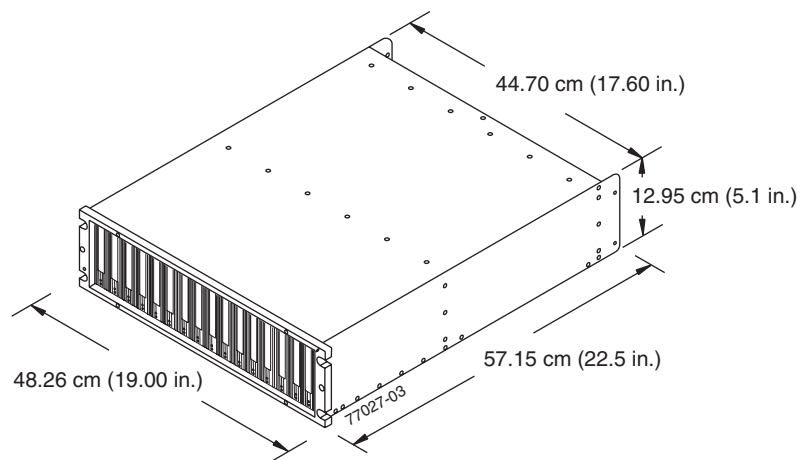


Figure 14. DS4700 Express dimensions

Weight

The total weight of the storage subsystem depends on the number of components installed. Table 11 lists the maximum, empty, and shipping weights for the storage subsystem in different configurations. Table 12 lists the weight of each component.

Table 11. DS4700 Express weights

Unit	Weight		
	Maximum ¹	Empty ²	Shipping
DS4700 Express	40 kg (88 lb)	16.4 kg (36.1 lb)	52.2 kg (115.0 lb)

¹ Chassis with all CRUs and 16 drives.

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

Table 12. DS4700 Express component weights

Unit	Weight
Drive	0.75 kg (1.65 lb)
Power supply and fan unit	3.60 kg (7.95 lb)
Controller (including cache battery backup unit)	2.8 kg (6.1 lb)
Battery unit	0.9 kg (2 lb)

Shipping dimensions

Table 13 on page 25 lists shipping carton dimensions. The height shown includes the height of the pallet.

Table 13. DS4700 Express shipping carton dimensions

Height	Width	Depth
45.7 cm (18.0 in.)	62.6 cm (24.5 in.)	80.7 cm (31.75 in.)

Environmental requirements and specifications

This section describes the environmental requirements and specifications for the DS4700 Express Storage Subsystem, including temperature and humidity, altitude, airflow and heat dissipation, shock and vibration requirements, and acoustic noise levels.

Temperature and humidity

Table 14 lists the acceptable temperature and humidity ranges for the DS4700 Express Storage Subsystem when in storage or in transit. Table 15 lists temperature and humidity ranges for the storage subsystem in typical Information Technology (IT) or office environments. Table 16 on page 26 lists temperature and humidity ranges for the storage subsystem in a Telco/NEBS-3 compliant environment.

Note: 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.

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

Table 14. Temperature and humidity requirements for storage subsystem when in storage or in transit

Condition	Parameter	Requirement
Temperature	Storage range	-10° - 65° C (14° - 149° F)
	Maximum rate of change	15° C (27° F) per hour
	Transit range	-40° C to 65° C (-40° F to 149° F)
	Maximum rate of change	20° C (36° F) per hour
Relative humidity (no condensation)	Storage range	8% to 90%
	Transit range	5% to 95%
	Maximum dew point	26° C (79° F)
	Maximum gradient	10% per hour

Table 15. Temperature and humidity requirements for storage subsystem in a typical Information Technology (IT) or office environment

Condition	Parameter	Requirement
Temperature	Operating range	10° - 35° C (50° - 95° F)
	Maximum rate of change	10° C (18° F) per hour
Relative humidity (no condensation)	Operating range	8% to 80%

Table 16. Temperature and humidity requirements for storage subsystem in a Telco/NEBS-3 compliant environment

Condition	Parameter	Requirement
Temperature ¹	Operating range	5° - 40° C (41° - 104° F)
	Short-term ²	-5° - 50° C (23° - 122° F)
	Maximum rate of change	30° C (54° F) per hour
Relative humidity ¹ (no condensation)	Operating range	5% to 85%
	Short-term ²	5% to 90% (not to exceed 0.024 kg water/kg of dry air)

Notes:

1. In a Telco/NEBS-3 compliant environment, conditions are measured at a location 1.5 m (59 in.) above the floor and 400 mm (15.8 in.) in front of the equipment.
2. Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in one year. (This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that one-year period.)

Altitude

Table 17 lists the acceptable altitudes for operating, storing, and shipping the DS4700 Express.

Table 17. DS4700 Express altitude ranges

Environment	Altitude
Operating	30.5 m (100 ft.) below sea level to 3000 m (9842 ft.) above sea level
Storage	30.5 m (100 ft.) below sea level to 3000 m (9842 ft.) above sea level
Transit	30.5 m (100 ft.) below sea level to 12,000 m (40,000 ft.) above sea level

Airflow and heat dissipation

Figure 15 on page 27 shows the intended airflow for the DS4700 Express. Allow at least 30 inches in front of the storage subsystem and at least 24 inches behind the storage subsystem for service clearance, proper ventilation, and heat dissipation.

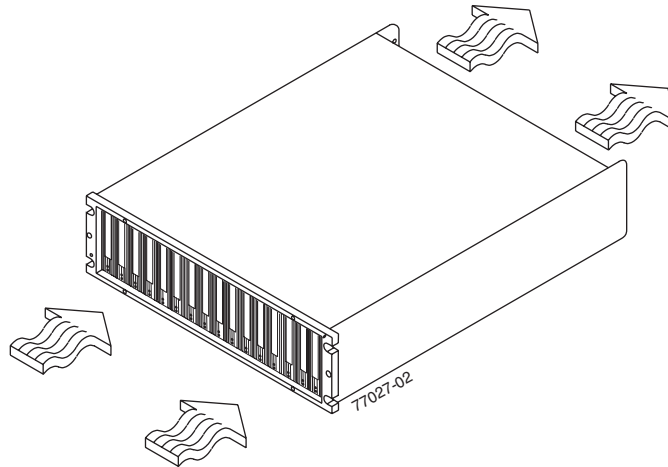


Figure 15. DS4700 Express airflow

Table 18 lists the KVA, watts, and Btu calculations. These values assume the power supplies have a 73 percent efficiency and a power factor of 0.99. These tabulated power and heat dissipation values are typical for the storage subsystem. Maximum configuration units are typically operated at higher data rates, have larger random access memory (RAM) capacities, or have different host interface boards.

Table 18. DS4700 Express power and heat dissipation

Parameter	KVA	Watts (AC)	Btu per hour
DS4700 Express	0.454	443	1516

Shock and vibration requirements

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

Operational Shock: The DS4700 Express will be able to withstand the following shock. Subjecting the equipment to a single shock pulse with the following characteristics will simulate this level of shock:

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

Operational Vibration (Random): While in its normal operating position, the DS4700 Express will continue operating when subjected to a random vibration test using the criteria shown in Table 19. This test uses the indicated spectral power density for 30 minutes in each of the three axes.

Table 19. Random vibration power spectral density

Hz	5	17	45	48	62	65	150	200	500
g ² /Hz	2.0x10 ⁻⁷	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵	2.2x10 ⁻⁵

Acoustic noise

Table 20 lists the maximum sound levels emitted by the storage subsystem.

Table 20. DS4700 Express sound levels

Measurement	Level
Sound power (normal operation)	6.8 bels

Table 20. DS4700 Express sound levels (continued)

Measurement	Level
Sound pressure (normal operation)	68 dBA

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

Electrical requirements

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

Consider the following information when preparing the installation site:

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

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

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

Table 21. DS4700 Express AC power requirements

	Low Range	High Range
Nominal Voltage	90 to 136 VAC	198 to 264 VAC
Frequency (Hertz)	50 to 60 Hz	50 to 60 Hz
Idle Current	3.86 A ^a	2.05 A ^b
Maximum Operating Current	4 A/4.54 A ^{a c}	2.12 A/2.41 A ^{b c}
Maximum Surge Current	5.04 A ^a	2.67 A ^b

^a. Typical voltage: 115 V AC, 60 Hz, assumes 72% power-supply efficiency and 0.99 power factor

^b. Typical voltage: 230 V AC, 60 Hz, assumes 72% power-supply efficiency and 0.99 power factor

^c. The higher number in this range applies when all of the drives are placed in Selfseek mode.

Table 22. DS4700 Express DC power requirements

	Requirement
Operating Voltage	-42 V to -60 V
Nominal Voltage	-48 V
Idle Current	11.8 A
Maximum Operating Current	15.8 A

Table 22. DS4700 Express DC power requirements (continued)

	Requirement
Maximum Surge Current	16 A

Power and site wiring requirements for models with AC power supply and fan units

The storage subsystem uses wide-ranging redundant power supplies that automatically accommodate voltages to the AC power source. The AC power supplies operate within the ranges specified in Table 21 on page 28. The AC power supplies meet standard voltage requirements for both domestic (inside USA) and international (outside USA) operation. They use standard industrial wiring with line-to-neutral or line-to-line power connections.

The agency ratings for the DS4700 Express Storage Subsystem (AC models) are 6 amps at 100 VAC and 2.5 amps at 240 VAC. These are the overall maximum operating currents for the DS4700 Express Storage Subsystem with AC power supply and fan unit CRUs.

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

Power cords and receptacles: The storage subsystem ships with two jumper cords used to connect to the rack PDU. You must purchase the power cords that are appropriate for use in a typical outlet in the destination country. See Appendix C, “Power cords,” on page 197 for more information.

Power and site wiring requirements for models with DC power supply and fan units

The storage subsystem uses wide-ranging redundant power supplies that automatically accommodate voltages to the DC power source. The DC power supplies operate within the ranges specified in Table 22 on page 28. The DC power supplies require a reliably grounded safety extra low voltage SELV source and an approved and rated disconnect device for the -48V line.

The agency rating for the DS4700 Express Storage Subsystem (DC models) is 16 amps at -42V to -60V DC. This is the overall maximum operating current for the DS4700 Express Storage Subsystem with DC power supply and fan unit CRUs.

DC power recovery: After a total DC power failure, after normal power is restored, the storage subsystem performs power-up recovery procedures automatically without operator intervention.

Power cords and receptacles: The storage subsystem ships with two DC power jumper cables used to connect to the DC power source. See “Cabling the DC power supply for DC models” on page 109 for more information.

Heat output, airflow, and cooling

See “Airflow and heat dissipation” on page 26 for heat output, airflow, and cooling specifications.

Note: In general, disk subsystem reliability tends to decrease as the ambient temperature of the environment in which it is being used increases. The

ambient temperature in the immediate area of the disk enclosure unit should be kept near 22° C (72° F), or lower, to provide better reliability.

When racks that contain many DS4700 Expresss are to be installed together, the following requirements must be met to ensure that the DS4700 Expresss are adequately cooled:

- Air enters at the front of the rack and leaves at the back. To prevent the air that is leaving the rack from entering the intake of another piece of equipment, you must position the racks in alternate rows, back-to-back and front-to-front. This arrangement is known as “cold aisle/hot aisle” and is shown in Figure 16.
- Where racks are in rows, each rack must touch the rack that is next to it to reduce the amount of hot air that can flow around from the back of the rack into the intakes of the storage expansion enclosures that are in that rack. You should use Suite Attach Kits to completely seal any gaps that remain between the racks. For details about Suite Attach Kits, contact your marketing representative.
- Where racks are in rows front-to-front or back-to-back, a gap of at least 1220 mm (48 in.) must separate the rows across the cold aisle.
- To ensure correct airflow in each rack, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the racks must be sealed, including the gaps between the storage subsystems.

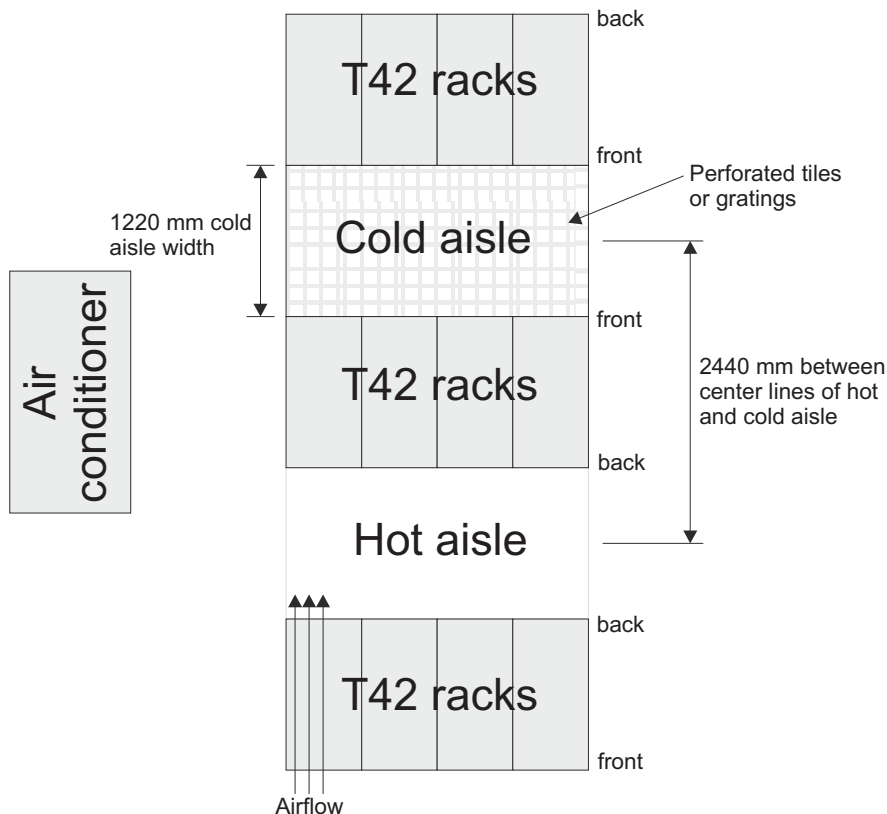


Figure 16. Example of cold aisle/hot aisle rack configuration

Chapter 2. Installing the storage subsystem

This chapter provides the information that you need to install the DS4700 Express storage subsystem into a rack cabinet.

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

“Installation overview” provides an overview of the entire DS4700 Express installation process. Read this overview before you begin the installation.

Installation overview

Statement 4:



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

CAUTION:

Use safe practices when lifting.

Attention: A fully configured DS4700 Express weighs up to 40 kg (88 lb). At least two other people should help you lift the DS4700 Express from the shipping box. If desired, open the sides of the shipping box and remove the CRUs from the DS4700 Express before you lift it from the shipping box in order to lighten the storage subsystem. See “Removing the CRUs” on page 40.

The following steps summarize the DS4700 Express installation process. Each step below is detailed in this chapter or next two chapters, Chapter 3, “Cabling the storage subsystem,” on page 55 and Chapter 4, “Operating the storage subsystem,” on page 115.

1. Review the preparation recommendations. See “Preparing for installation” on page 34.
2. Prepare the installation site. See “Preparing the site” on page 35.
3. Prepare the rack cabinet. See “Preparing the rack cabinet” on page 36.
4. Fold down and open the sides of the shipping box. Without removing the DS4700 Express from box, you can remove the DS4700 Express rack mounting rails and hardware from the box. The DS4700 Express rack mounting rails and hardware are placed on the bottom of the shipping box (under the DS4700 Express Storage Subsystem). Install the support rails in the rack cabinet. See “Installing the support rails” on page 36.

5. Before removing the DS4700 Express from the shipping box, remove the components from the DS4700 Express chassis to lighten the unit. See “Removing the CRUs” on page 40.
6. Record the serial number, machine type and model number, and RAID controller MAC addresses for your DS4700 Express Storage Subsystem in Appendix A, “Records,” on page 189.

The serial number, machine type, and model number are located on the left edge of the front unit as shown in Figure 17.

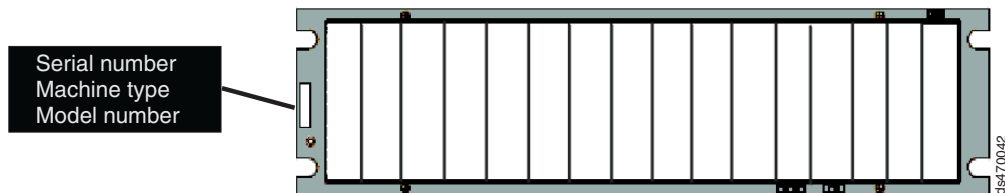


Figure 17. Example of DS4700 Express serial number, machine type, and model number location

The MAC addresses are located near the Ethernet ports on each RAID controller.

7. Install and secure the DS4700 Express chassis in the rack cabinet. See “Installing the DS4700 Express into a rack on the support rails” on page 46.
8. If needed, replace the components in the installed DS4700 Express chassis. See “Replacing the components” on page 48.
9. Install in the rack cabinet the DS4000 storage expansion enclosure or enclosures you will cable to the DS4700 Express. Follow the instructions in the Installation, User’s, and Maintenance Guide for your DS4000 storage expansion enclosure to set up and mount the storage expansion enclosures.

Attention

Before powering on the DS4700 Express Storage Subsystem, it must be populated with at least two E-DDMs. If at least two E-DDMs are not installed in each attached storage expansion enclosure or DS4700 Express Storage Subsystem, when you power on the DS4700 Express and its attached storage expansion enclosures, your standard storage partition key might be lost and must be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

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

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear as failed, falsely indicating the power supplies are bad. All E-DDMs in the DS4700 Express Storage Subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

10. Use SFP modules and fibre channel cables to cable the DS4700 Express to the DS4000 storage expansion enclosure or enclosures. See “Connecting storage expansion enclosures to the DS4700 Express” on page 67.
11. Set the enclosure IDs for all storage expansion enclosures in the configuration. See “Storage expansion enclosure settings” on page 96.

Note: Perform this step if the attached storage expansion enclosures are EXP710s or EXP100s only. The EXP810 storage expansion enclosure IDs are automatically set by the controllers to be unique when they are cabled together.

12. Perform one of the following cabling tasks to enable management of the DS4700 Express configuration:
 - If you are using out-of-band management, cable the DS4700 Express Ethernet ports to either the management workstation or the host.
 - If you are using in-band management, cable the DS4700 Express host channels to the fibre channel host bus adapters (HBAs) in either the hosts or the fibre channel switch that connects to the host HBAs. See “Connecting hosts to the DS4700 Express” on page 102.
13. Connect the power cables for the DS4700 Express. See “Cabling the AC power supply for AC models” on page 109.
14. Power on the attached storage expansion enclosure and the DS4700 Express Storage Subsystem using the procedure described in “Powering on the storage subsystem” on page 117.
15. Install the DS4000 Storage Manager host software on the management workstation (for out-of-band management) or on the host (for in-band management). Refer to the *IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager host software.
16. Use the DS4000 Storage Manager host software to verify the configuration.
17. Review and perform the procedures described in “Performing the DS4000 Health Check process” on page 115.

Handling static-sensitive devices

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

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

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

Preparing for installation




Before installing the DS4700 Express Storage Subsystem, create a detailed plan of how this unit will be used in your storage configuration. The plan should include determining RAID levels, fallover requirements, operating systems to be used, and total storage capacity requirements.

Complete the following steps to prepare the DS4700 Express Storage Subsystem for installation into a rack cabinet:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 23.
2. Move the shipping box that contains the DS4700 Express to the site.

Statement 4:



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

CAUTION:

Use safe practices when lifting.

3. Remove the mounting rails, mounting hardware, and line jumper cords from the DS4700 Express shipping box. Do not remove the DS4700 Express from the shipping box at this time.

Attention: The mounting rails, mounting hardware, and line jumper cords may be packed beneath the DS4700 Express in the shipping box. To remove these items from the shipping box without first removing the DS4700 Express, open the two long sides of the shipping box. Then open and fold flat the two short sides of the shipping box. This enables you to access the mounting rails, mounting hardware, and line jumper cords without first removing the DS4700 Express from the shipping box.

After you open the DS4700 Express shipping container and remove the mounting rails, mounting hardware, and line jumper cords, check the remaining contents (see “Inventory checklist” on page 3) without removing the DS4700 Express from the shipping box. If any items are missing, contact your IBM reseller or representatives before proceeding.

4. Verify that you have the appropriate host software kit for your operating system. Depending on the DS4700 Express model you order, your DS4700 Express will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4700 Express.

The kit includes a DS4000 Storage Manager Support CD that has the appropriate IBM DS4000 Storage Manager host software. If you order more than one host software kit, the additional kits may also be shipped in the DS4700 Express shipping box.

The CD also includes the DS4000 Storage Subsystem controller firmware 06.16.xx.xx or later. For the latest controller firmware, check the IBM support Web site for DS4000 storage products:

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

5. Read the appropriate readme files that are included in the Storage Manager host software or DS4700 Express controller firmware packages for any updated information about hardware, software, or firmware products.
6. Continue with “Preparing the site.”

Tools and hardware required

Gather the tools and equipment you will need for installation. These might include:

- Region-specific power cords required for the DS4700 Express
- 5/16 (8 mm) hex nut driver
- #2 Phillips screwdriver
- Antistatic protection (such as a grounding wrist strap)
- Fibre channel (FC) and Ethernet interface cables and cable straps
- Rack power jumper cords that are shipped with the DS4700 Express
- SFP modules
- Rack-mounting hardware that ships with the DS4700 Express

Preparing the site

This section lists the floor space requirements and weight information for the DS4700 Express. For information on interface cables and connections, see Chapter 3, “Cabling the storage subsystem,” on page 55.

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

- Sufficient space to install the DS4700 Express
- Enough stability to support the weight of the fully configured DS4700 Express and associated systems. A fully configured DS4700 Express weighs 40 kg (88 lb.).

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

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

Continue with “Preparing the rack cabinet” on page 36.

Preparing the rack cabinet

Important: Before you install the DS4700 Express in a rack cabinet, keep in mind the following considerations:

- Review the documentation that comes with your rack enclosure for safety and cabling considerations.
- Install the DS4700 Express in a recommended 22° C (72° F) environment. See “Environmental requirements and specifications” on page 25 for details.
- To ensure proper airflow, do not block the air vents; ensure at least 15 cm (6 in.) of air space.
- To ensure rack stability, load the rack starting at the bottom.
- If you install multiple components in the rack, do not overload the power outlets.
- Always connect the storage subsystem to a properly grounded outlet.
- Always connect the IBM-certified rack power distribution units (PDUs) to at least two independent power circuits or sources.

Complete the following steps to prepare the rack cabinet before you install the DS4700 Express:

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

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

Installing the support rails

Attention: Duplicate copies of the rack mounting templates are provided in Appendix B, “Rack mounting template,” on page 193. 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 193 rather than the copies provided in this section.

Use the following templates (Figure 18 on page 37 and Figure 19 on page 38) to identify the proper locations for inserting M5 screws when mounting the support rails and DS4700 Express Storage Subsystem to a rack cabinet. The locations for the M5 screws are highlighted in the templates.

Hold the appropriate template up to each side of the rack cabinet at the 3-U section where you will install the DS4700 Express. U boundaries are shown as horizontal dashed lines in the rack mounting templates. The highlighted squares on each side of the template mark the positions where you will thread the M5 screws that secure the rails and the DS4700 Express to the front and rear of the cabinet.

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

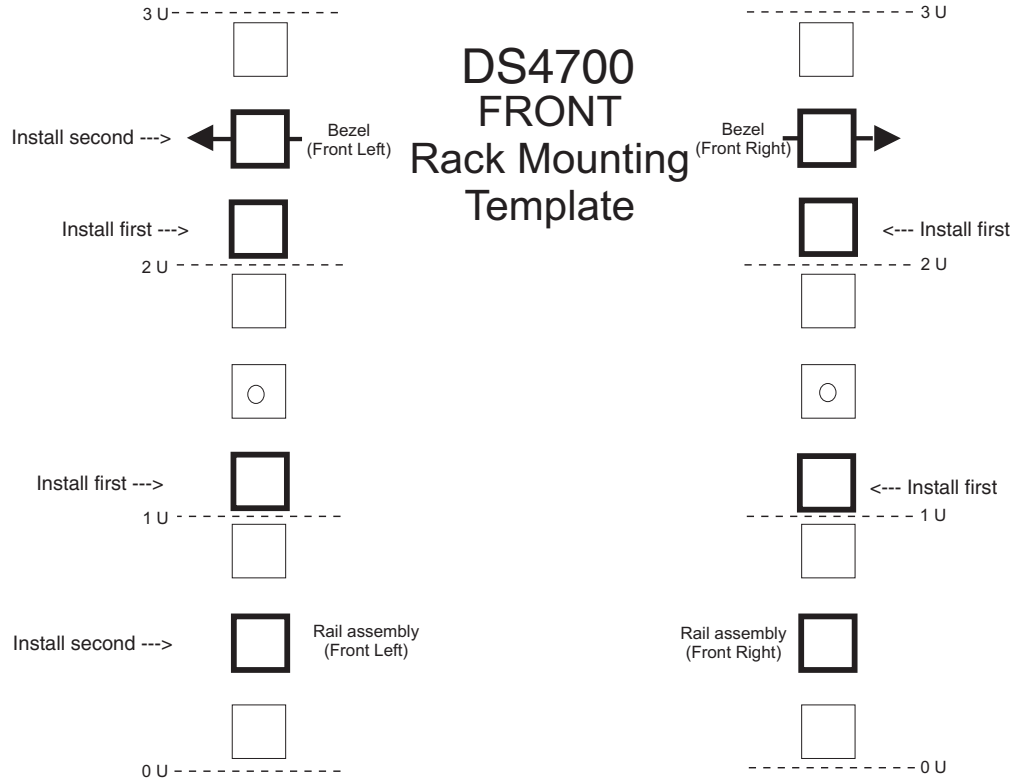


Figure 18. Front rack mounting template

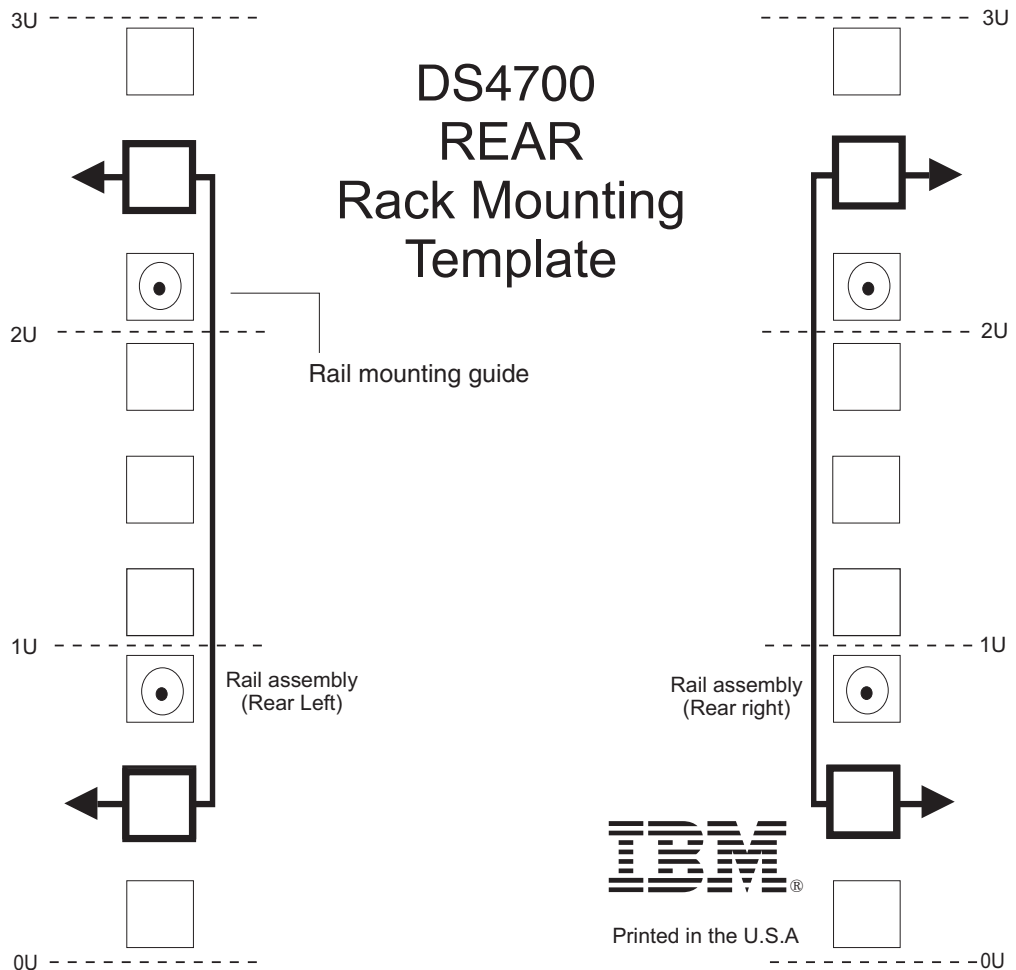


Figure 19. Rear rack mounting template

Before installing the DS4700 Express in a rack cabinet, you must install the rails and rack-mounting hardware that come with your storage subsystem. The DS4700 Express requires an Electronic Industries Association (EIA) 310-D Type A 19-inch rack cabinet. The distance between EIA rails, from the front to the rear of the rack, is 60.96 cm (24 in.) minimum and 81.28 cm (32 in.) maximum. This rack conforms to the EIA standard. Where you place the support rails in the rack depends on where you intend to position the storage subsystem.

Complete the following steps to install the support rails:

Note: Refer to Figure 20 on page 40 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 to prevent the rack from tipping forward while the DS4700 Express is being installed.
Refer to the installation and service guide, or equivalent, for the rack as required.
3. Locate the two support rails, eight of the twelve M5 screws, and eight washers that are supplied with the DS4700 Express.

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

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

Attention: Use the rack mounting template provided in Figure 18 on page 37 and Figure 19 on page 38 to locate the proper rack mounting holes for installing the support rails into the rack.

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

- If you are installing the DS4700 Express 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 DS4700 Express 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.
 - The lip on the rail should line up with the bottom of the storage subsystem (the 0U boundary in Figure 19 on page 38).
5. Using a #2 Phillips screwdriver, loosen the two screws on the left support rail that hold the two parts of the rail together (**5**).

Note: The support rails are not marked as left or right. However, each rail can be correctly mounted on only one side of the rack cabinet. The rails should be mounted with the alignment pins at the back of the rack. Figure 20 on page 40 shows the installation of the left support rail.

6. Hold the back of the rail against the inside of the rack-mounting flange. Make sure the rail mounting guide pins are in the correct holes. See Figure 19 on page 38 for an illustration.
7. Using the 5/16 (8 mm) hex nut driver, securely tighten the two M5 screws (**2**).

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

8. Extend the rail to the front of the rack until it makes contact with the front rack-mounting flange (**3**).
9. Securely tighten the M5 screws (**1**).

Note: Be sure to install the screw labeled *install first* in Figure 18 on page 37.

10. Securely tighten the two screws on the left support rail that hold the two parts of the rail together (**5**).
11. Repeat step 5 through step 10 for the right support rail.

Note: Because the mounting holes on the rack are not always the same size as the mounting screws, the lip (**6**) of each of the support rails may not line up evenly. Make minor adjustments as needed to ensure that the lip of the left and right support rails are lined up evenly on the racks. Failure to do so will cause the storage subsystem to fit unevenly in the rack.

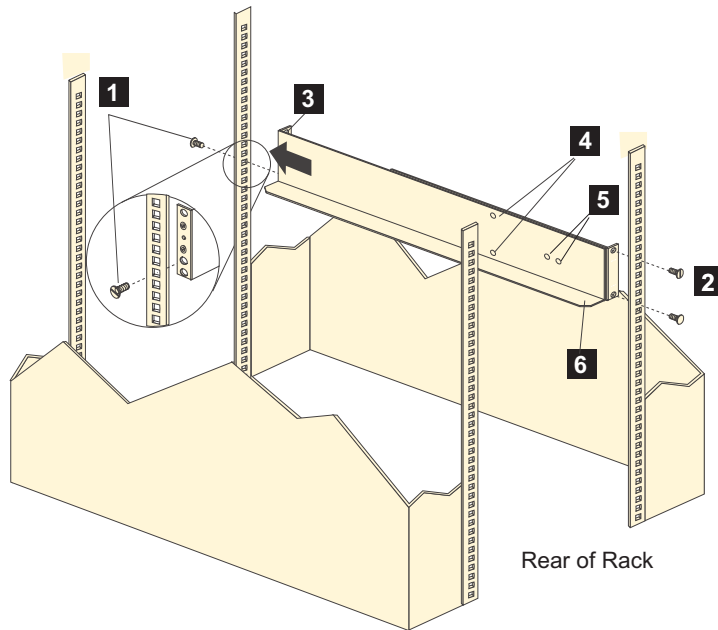


Figure 20. Installing the support rails

12. Continue with “Removing the CRUs.”

Installing the DS4700 Express

This section provides instructions on installing the DS4700 Express. The installation process includes:

- “Removing the CRUs”
- “Installing the DS4700 Express into a rack on the support rails” on page 46
- “Replacing the components” on page 48

Removing the CRUs

This section describes how to remove the CRUs to minimize the weight of the DS4700 Express before you install it in the rack. However, if you have three or more people available to lift and install the DS4700 Express in a rack, you might not find it necessary to remove the CRUs before you install the DS4700 Express. If this is the case, you can skip the CRU removal instructions provided in this section. Instead, continue with “Installing the DS4700 Express into a rack on the support rails” on page 46, and then skip the CRU replacement instructions provided in “Replacing the components” on page 48.

Attention: IBM strongly recommends that you remove CRUs from the DS4700 Express chassis to lessen the weight to make it easier to transfer the DS4700 Express Storage Subsystem from the shipping box to the rack.

Use the following procedures to remove the CRUs from the DS4700 Express before installation. Use these instructions after you have completed all applicable site, rack, and preparations (as listed in “Preparing for installation” on page 34) and installed the support rails (as listed in “Installing the support rails” on page 36). Alternately, if necessary, you can use these instructions to lighten the DS4700 Express before removing it from the shipping box. The shipping box opens to provide access to the storage subsystem CRUs.

The DS4700 Express comes with a rack-mounting hardware kit for installing it in a rack. It is easier to lift the DS4700 Express 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 33.



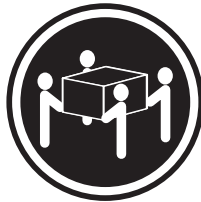
In the following procedure, you will remove the following CRUs from the storage subsystem before you install it in the rack:

- Controllers
- AC power supply and fan units (Models 70A, 70H, 72A, and 72H)
- DC power supply and fan units (Models 70S, 70T, 72S, and 72T)
- Hot-swap E-DDMs

You do not need to remove the blank trays.

Statement 4:



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

CAUTION:
Use safe practices when lifting.

Attention: The storage 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 controller

Complete the following steps to remove a controller:

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

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

2. Slowly pull the lever away from the chassis to remove the controller from the bay, as shown in Figure 21 on page 42.

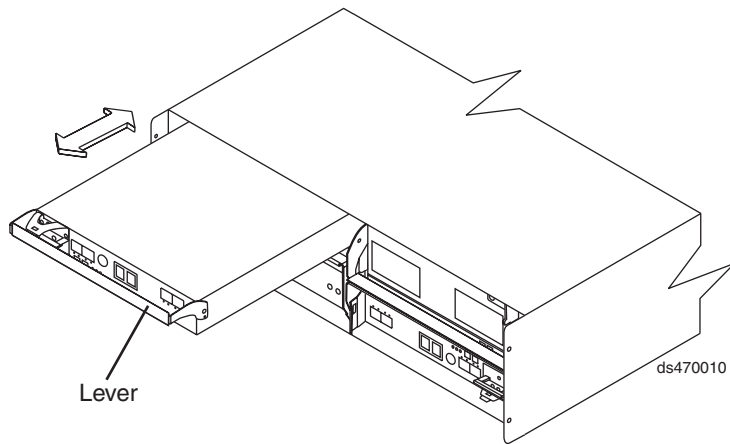


Figure 21. Removing and replacing a controller

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

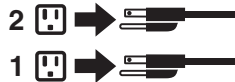
Removing an AC power supply and fan unit

Statement 5:



CAUTION:

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



CAUTION:

Disconnect the power cord before removing the power supply and fan unit.

Complete the following steps to remove a power supply and fan unit:

1. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply and fan unit from the latch. The latch is a coral colored tab on the lever.
2. Slowly pull the lever away from the chassis to remove the power supply and fan unit, as shown in Figure 22 on page 43.

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

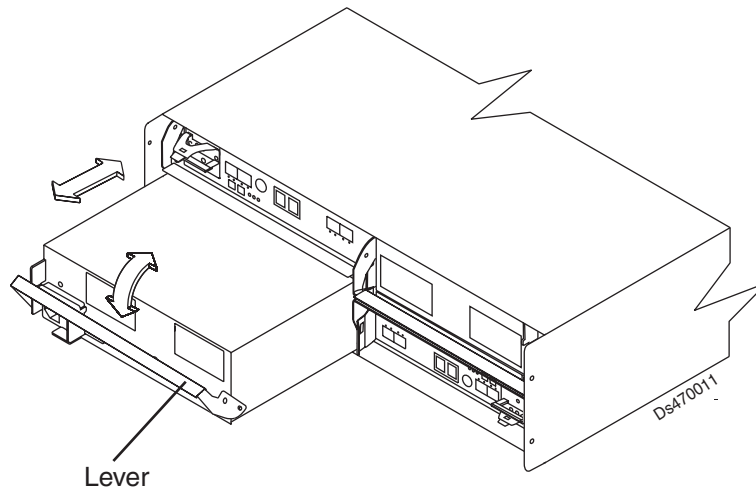


Figure 22. Removing a power supply and fan unit

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

Removing a DC power supply and fan unit



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



Statement 29:



CAUTION:

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment.

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. The DC system shall not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

Statement 30:**CAUTION:**

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.
- Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).
- The branch circuit overcurrent protection must be rated 20 A.
- Use 12 American Wire Gauge (AWG) or 2.5 mm² copper conductor only, not exceeding 4.5 meters in length.
- Incorporate a readily available approved and rated disconnect device in the field wiring.

CAUTION:

Disconnect the power cord before removing the DC power supply and fan unit.

Complete the following steps to remove a DC power supply and fan unit:

1. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the DC power supply and fan unit from the latch. The latch is a coral colored tab on the lever.
2. Slowly pull the lever away from the chassis to remove the DC power supply and fan unit, as shown in Figure 23 on page 45.

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

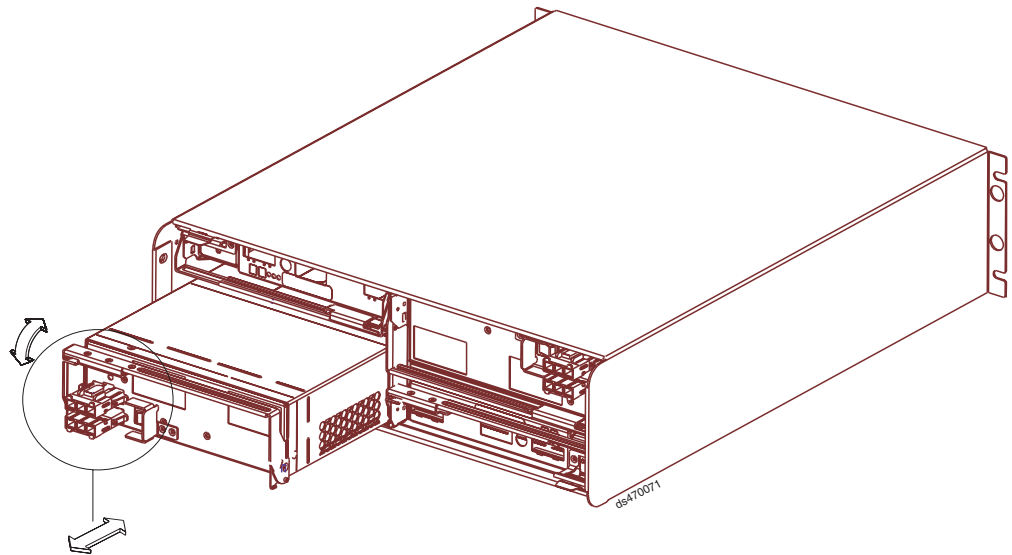


Figure 23. Removing a DC power supply and fan unit

3. Place the DC power supply and fan unit on a level surface.
4. Repeat step 1 on page 44 through step 3 for the second DC power supply.

Removing an E-DDM

Complete the following steps to remove a hot-swap E-DDM:

Note: The E-DDM comes installed in a drive tray. Do not attempt to detach the E-DDM from the tray.

1. Use Table 54 on page 192 to record the location and identify your E-DDMs. You must record this information to be able to replace the E-DDMs in their original order before they were removed.
2. Release the latch on the E-DDM CRU by pressing on the inside of the bottom of the tray handle.
3. Lift the closed latch to its open position. (The latch is at a 90° angle to the front of the E-DDM when open.)
4. Pull the E-DDM out of the bay, as shown in Figure 24 on page 46.

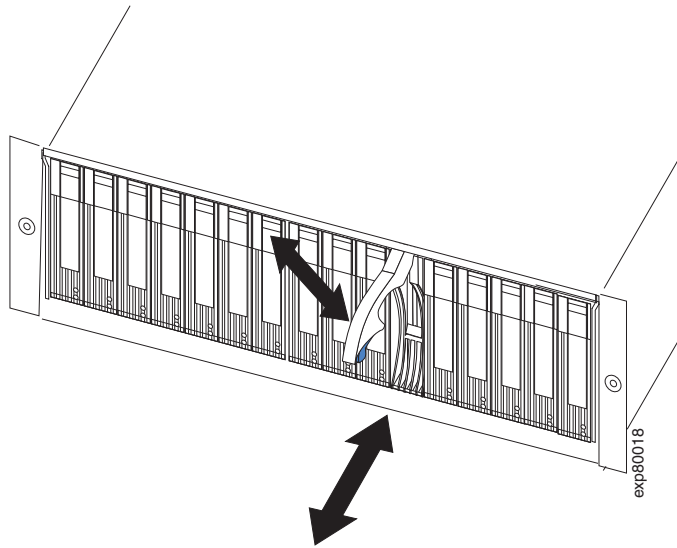


Figure 24. Removing a E-DDM CRU

5. Place the E-DDM CRU horizontally on a level surface.
Attention: Do not stack E-DDM CRUs on top of one another. Protect the E-DDM CRUs from vibrations or sudden shocks.
6. Repeat step 1 through step 4 on page 45 for additional E-DDM CRUs.

Installing the DS4700 Express into a rack on the support rails




Complete the following steps to install the DS4700 Express in the rack cabinet.

CAUTION:

Do not install modules or other equipment in the top half of a rackmount cabinet while the bottom half is empty. Doing so can cause the cabinet to become top-heavy and tip over. Always install hardware in the lowest available position in the cabinet.

Statement 4:



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

CAUTION:

Use safe practices when lifting.

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

2. Using a #2 Phillips screwdriver, remove the four screws from the rails (two screws in each rail). See **4** in Figure 20 on page 40. If you do not remove these screws, the storage subsystem will not fit securely.

Note: If the screws are shipped in the hardware pack instead of already installed in the rails, skip this step and go to step 3.

3. Place the storage subsystem in the rack.

Note: If you have removed the CRUs from the DS4700 Express, 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 DS4700 Express into the rack.

- a. Move the storage subsystem to the front of the rackmount cabinet.
- b. With help from another person, place the back of the storage subsystem on the support rails, and then slide the unit into the rack as shown in Figure 25.

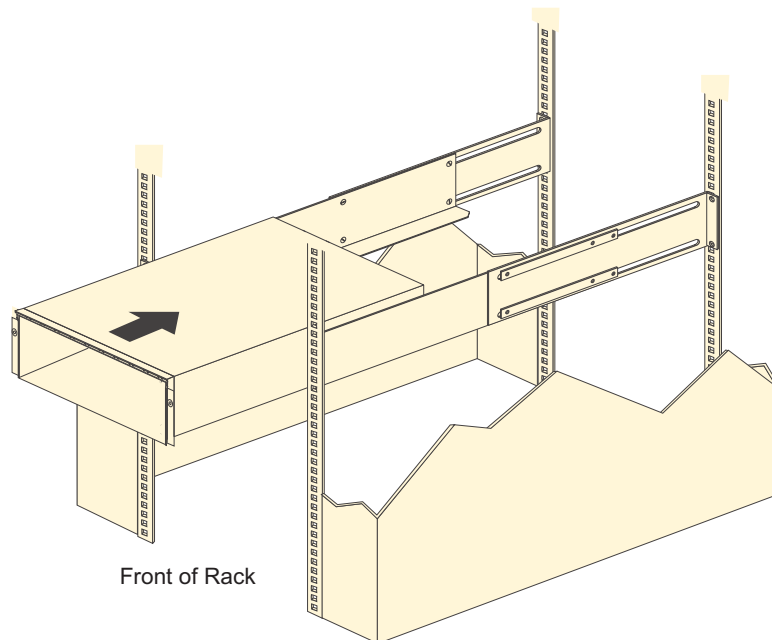


Figure 25. Installing the DS4700 Express

4. Secure the storage subsystem. Figure 26 on page 48 shows how to secure the storage subsystem to the rack.
 - 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. Using the screws that you removed in step 2, secure the sides in the back of the DS4700 Express to the rack rails.
 - c. Secure the front of the DS4700 Express using the four M5 screws as shown in Figure 26 on page 48.

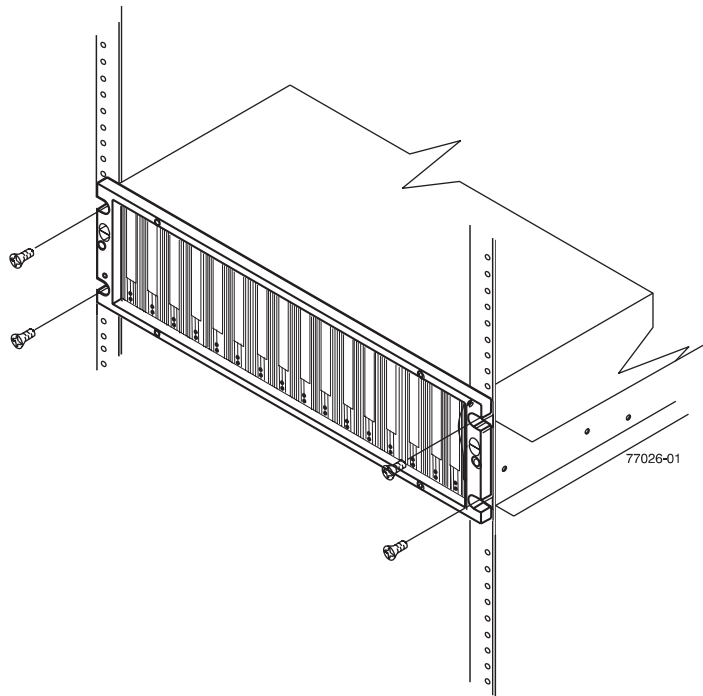


Figure 26. Securing the DS4700 Express to the rack cabinet

5. Continue with one of the following actions:
 - If you did remove the DS4700 Express CRUs before installation (as described in “Removing the CRUs” on page 40), continue with “Replacing the components.”
 - If you did not remove the DS4700 Express CRUs before installation, continue with Chapter 3, “Cabling the storage subsystem,” on page 55.

Replacing the components

If you removed components from the DS4700 Express Storage Subsystem before you installed it into a rack cabinet, use the following procedures to replace the components in the DS4700 Express after it is installed successfully in a rack cabinet.

Replacing a controller

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

Attention: After you remove an controller, wait 70 seconds before reseating or replacing the controller. Failure to do so may cause undesired events. The left and right controllers are seated in the DS4700 Express chassis in opposite orientations. If you cannot fully insert the controller into the controller bay, flip it 180° and reinsert it.

1. Slide one controller into the empty slot in the storage subsystem. Be sure that the lever is pulled straight out as you slide the controller in, as shown in Figure 27 on page 49.

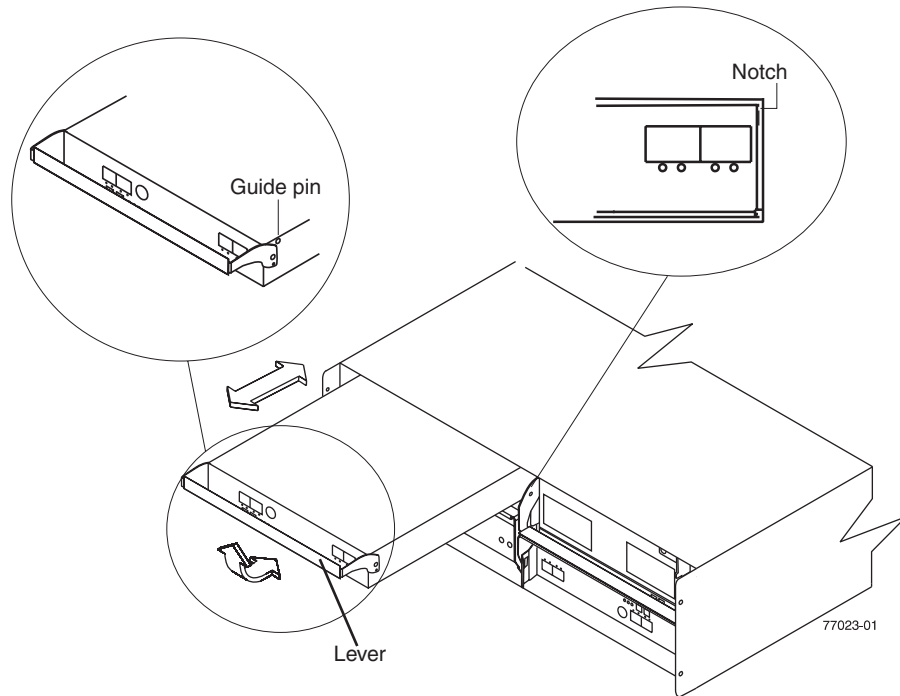


Figure 27. Removing and replacing a controller

2. As you slide the controller into the empty slot, make sure the guide pins on the side of the controller fit into the notches. After the guide pins fit into the notches and the controller fits snugly into the bay, push the lever downward or upward 90°, depending on whether the controller is inserted in the A or B controller bay to fully latch it into place. Do not force fit. The controller is designed to prevent it from being inserted into the chassis incorrectly.

Attention: Make sure that the levers lock into place in the storage subsystem chassis.

3. Repeat step 1 on page 48 and step 2 to replace the second controller.

Replacing an AC power supply and fan unit

Statement 5:



CAUTION:

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



CAUTION:

Disconnect the power cord before replacing the power supply and fan unit.

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

1. Slide one power supply and fan unit into the storage subsystem. Be sure to replace the power supply and fan units so that the lever on each power supply and fan unit opens toward the interior of the storage subsystem, as shown in Figure 28. Do not force fit. The power supply and fan unit is designed to prevent it from being inserted into the chassis incorrectly.

Attention: Be sure that the lever is pulled straight out as you slide the power supply and fan unit into the storage subsystem, as shown in Figure 28. The left and right power supply and fan units are seated in the DS4700 Express chassis in opposite orientations. If you cannot fully insert the power supply and fan unit into the power supply and fan unit bay, flip it 180° and reinsert it.

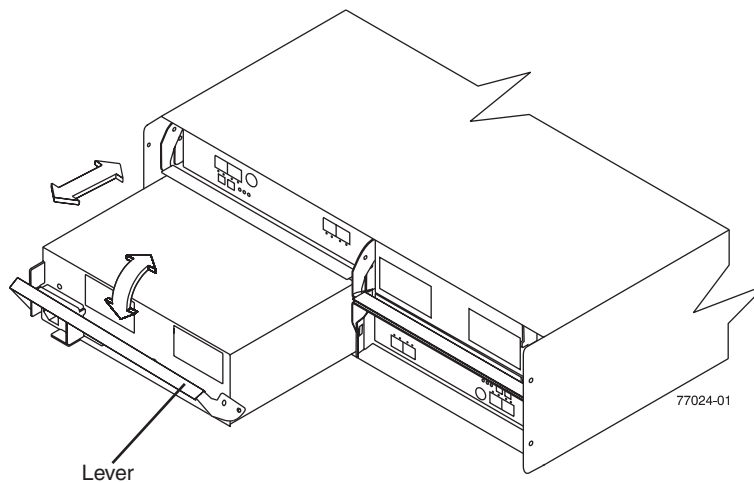


Figure 28. Replacing a power supply and fan unit

2. As you slide the power supply and fan unit into the empty slot, make sure the guide pins on the side of the power supply and fan unit fit into the notches along the sides of the power supply and fan unit bay. After the guide pins fit into the notches and power supply and fan unit fits snugly into the slot, push the lever upward or downward 90° depending on whether the power supply fan is inserted in the left or right bay to fully latch it into place. Then gently push the front of the power supply and fan unit to ensure that it is fully seated.
3. Repeat step 1 and step 2 to replace the second power supply and fan unit.

Replacing a DC power supply and fan unit

Statement 29:



CAUTION:

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment.

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. The DC system shall not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

Statement 30:



CAUTION:

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.
- Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).
- The branch circuit overcurrent protection must be rated 20 A.
- Use 12 American Wire Gauge (AWG) or 2.5 mm² copper conductor only, not exceeding 4.5 meters in length.
- Incorporate a readily available approved and rated disconnect device in the field wiring.

CAUTION:

Disconnect the power cord before replacing the power supply and fan unit.



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



Complete the following steps to replace the DC power supply and fan units that you removed before the installation:

1. Slide one DC power supply and fan unit into the storage subsystem. Be sure to replace the DC power supply and fan unit so that the lever on each DC power supply and fan unit opens toward the interior of the storage subsystem, as shown in Figure 29. Do not force fit. The DC power supply and fan unit is designed to prevent it from being inserted into the chassis incorrectly.

Attention: Be sure that the lever is pulled straight out as you slide the DC power supply and fan unit into the storage subsystem, as shown in Figure 29. The left and right DC power supplies are seated in the DS4700 Express chassis in opposite orientations. If you cannot fully insert the DC power supply and fan unit into the DC power supply and fan unit bay, flip it 180° and reinsert it.

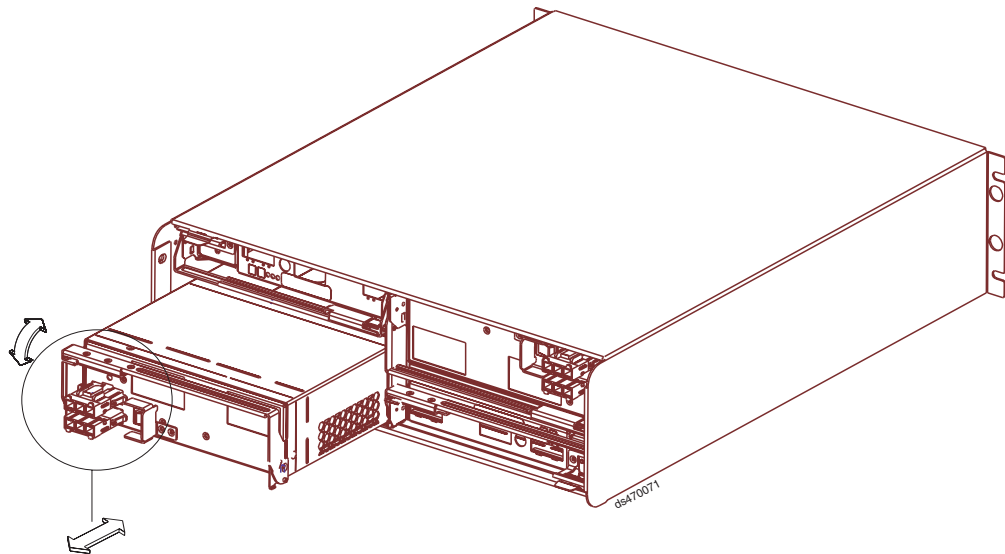


Figure 29. Replacing a DC power supply and fan unit

2. As you slide the DC power supply and fan unit into the empty slot, make sure the guide pins on the side of the DC power supply fit into the notches along the sides of the DC power supply bay. After the guide pins fit into the notches and DC power supply fits snugly into the slot, push the lever upward or downward 90° depending on whether the DC power supply is inserted in the left or right bay to fully latch it into place. Then gently push the front of the DC power supply to ensure that it is fully seated.
3. Repeat step 1 and step 2 to replace the second DC power supply and fan unit.

Replacing an E-DDM

Complete the following steps to replace the hot-swap E-DDMs that you removed before the installation.

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

Note: Use Table 54 on page 192 to verify the proper replacement locations of your E-DDMs.

1. Lift up on the handle and gently push the E-DDM CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem bezel, as shown in Figure 30.

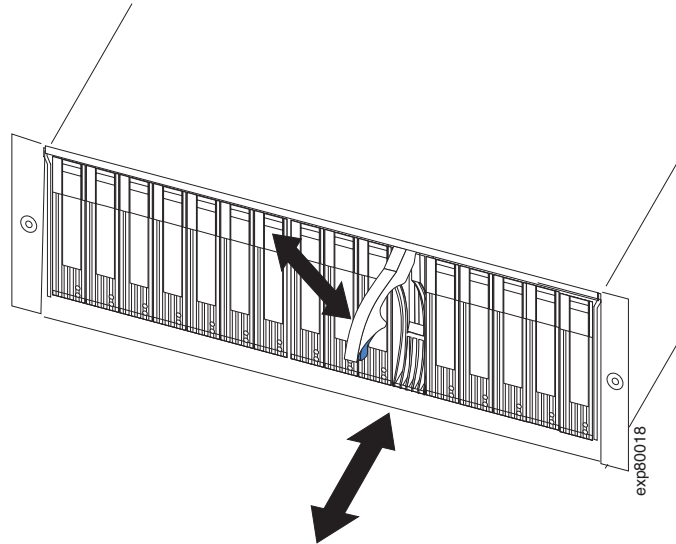


Figure 30. Replacing an E-DDM

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

Installing a Telco bezel

Complete the following step to install a bezel on a DS4700 Express Storage Subsystem if the storage subsystem is shipped with one:

- Grasp the sides of the bezel and snap it onto the DS4700 Express chassis, as shown in Figure 31 on page 54. The bezel is self-aligned in the recessed opening in the front of the DS4700 Express chassis.

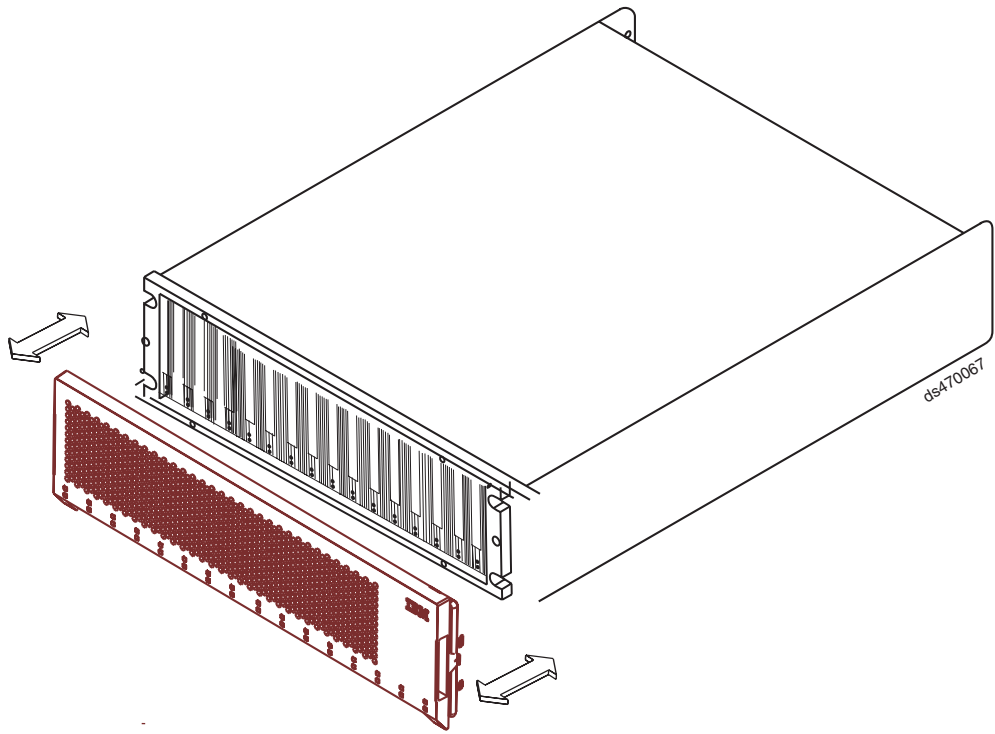


Figure 31. Installing a Telco bezel

Chapter 3. Cabling the storage subsystem

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

This chapter addresses the following cabling and configuration topics:

- “Enclosure ID settings ”
- “Fibre-channel loop and ID settings” on page 56
- “Working with SFPs and fiber-optic cables” on page 56
- “Connecting storage expansion enclosures to the DS4700 Express” on page 67
- “Intermixing storage expansion enclosures in the same drive loop” on page 98
- “Connecting hosts to the DS4700 Express” on page 102
- “Connecting secondary interface cables” on page 99
- “Configuring the storage subsystem” on page 100
- “Installing the storage subsystem configuration” on page 108
- “Cabling the AC power supply for AC models” on page 109
- “Cabling the DC power supply for DC models” on page 109

Enclosure ID settings

The enclosure ID, comprised of two seven-segment numbers, is located on the back of each controller next to the indicator lights. It provides a unique identifier for each enclosure in the DS4000 storage subsystem configuration.

The controller *automatically* sets the enclosure ID number. You can change the setting through the storage management software if necessary. Both controller enclosure ID numbers are identical under normal operating conditions. Each storage expansion enclosure (including the DS4700 Express Storage Subsystem) in the DS4000 storage subsystem configuration must have a unique storage enclosure ID. In addition, the single digits (x1) of the enclosure IDs of all storage expansion enclosures (including the DS4700 Express Storage Subsystem) in the redundant drive channel/loop pair must be unique.

The allowable ranges for enclosure ID settings are 0-99. However, IBM recommends that you do not set the enclosure ID to 00 or any number less than 80. The DS4700 Express enclosure ID is normally set to a value of 85 at the factory.

Figure 32 on page 56 shows the enclosure ID on models 70 and 72.

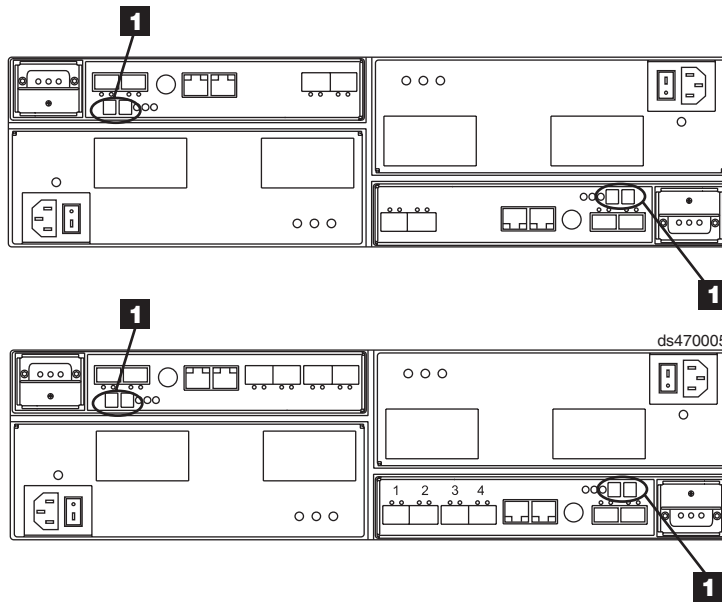


Figure 32. Storage subsystem seven-segment enclosure ID on models 70 and 72

Table 23. Description of Figure 32

Number	Description
1	Enclosure ID

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.

Working with SFPs and fiber-optic cables

Each DS4700 Express RAID controller has up to four single-ported host channel connections (depending on the model) and two dual-ported drive channel connections. You use a small-form factor pluggable transceiver (SFP) to connect each host channel port and drive channel port to hosts and storage expansion enclosures. The SFP is inserted into the port, and then a fiber-optic cable is inserted into the SFP. The other end of the fiber-optic cable connects to an external device. SFPs are laser products.

Statement 3:



CAUTION:

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

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

**DANGER**

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

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

Handling fiber-optic cables

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

- Do not route the cable along a folding cable-management arm.
- For devices on slide rails, leave enough slack in the cables so they do *not* bend to a diameter of less than 76 mm (3 in.), or a radius less than 38 mm (1.5 in.), when extended or become pinched when retracted.
- Route the cable away from places where it can be damaged by other devices in the rack cabinet.
- Do not use plastic cable ties in place of the provided cable straps.
- 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.
- The following are the recommended maximum cable lengths:
 - 1 Gbps: 500 meters 50/125 um fiber, 300 meters 62.5/125 um fiber
 - 2 Gbps: 300 meters 50/125 um fiber, 150 meters 62.5/125 um fiber
 - 4 Gbps: 150 meters 50/125 um fiber, 70 meters 62.5/125 um fiber

Installing SFP modules

The DS4700 Express requires SFP modules. SFP modules convert electrical signals to optical signals that are required for fibre channel transmission to and from RAID controllers. After you install the SFP modules, you use fiber-optic cables to connect the DS4700 Express to other fibre channel devices.

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

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

Attention: In addition, do not use long-wave SFPs or GBICs in any of the fibre channel ports in the DS4700 Express controllers. (Long-wave SFPs and GBICs are not supported for use in the DS4700 Express or any of the attached DS4000 storage expansion enclosures.)

- The SFP module housing has an integral guide key that is designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when inserting an SFP module into an SFP port. Forcing the SFP module into a port could cause damage to the SFP module or to the port.
- You can insert or remove the SFP module while the port is powered on.
- The operational or redundant loop performance is not affected when you install or remove an SFP module.
- You must insert the SFP module into a port before you connect the fiber-optic cable.
- You must remove the fiber-optic cable from the SFP module before you remove the SFP module from the port. Refer to “Removing SFP modules” on page 59 for more information.
- The maximum operating speed of the fibre channel port is determined by two factors: the speed of the SFP module that is installed and the speed of the fibre channel connection. For example, a 2-Gbps SFP that is plugged into a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps. Conversely, a 4-Gbps SFP that is plugged into a 2-Gbps-capable port will limit the speed of the port to a maximum of 2 Gbps.

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

Statement 3:



CAUTION:

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

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



DANGER

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

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

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 33.

To install an SFP module, complete the following steps:

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.

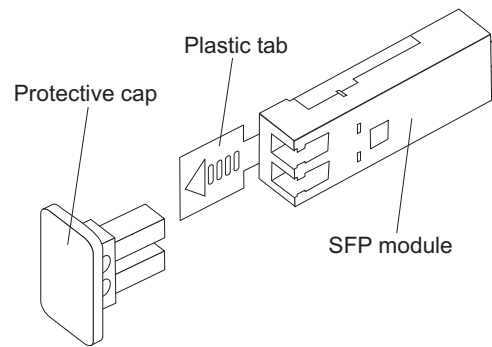


Figure 33. SFP module and protective cap

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

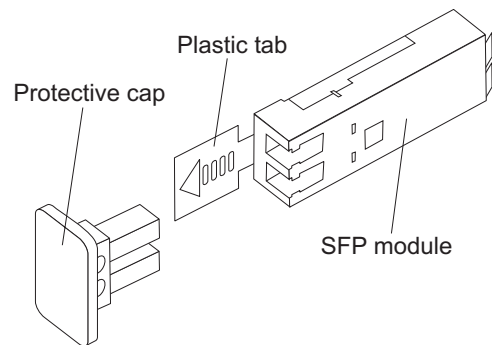


Figure 34. Installing an SFP module into the host port

5. Connect an LC-LC fibre-channel cable. For information about the LC-LC cable, see “Using LC-LC fibre-channel cables” on page 60.

Removing SFP modules

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

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

1. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see “Removing an LC-LC fibre-channel cable” on page 63.
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.

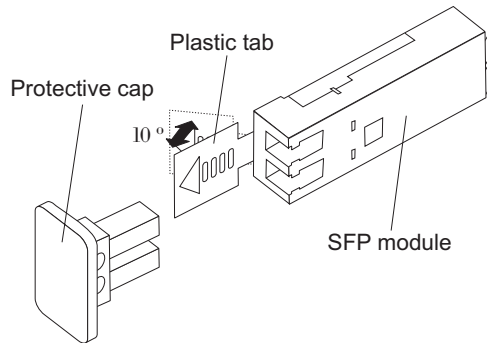


Figure 35. Unlocking the SFP module latch - plastic variety

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

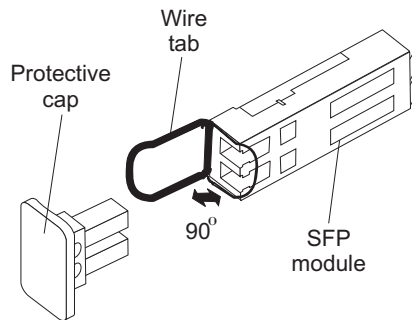


Figure 36. Unlocking the SFP module latch - wire variety

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 mini-hub port.
4. Replace the protective cap on the SFP module.
5. Place the SFP module into a static-protective package.
6. Replace the protective cap on the host port.

Using LC-LC fibre-channel cables

The LC-LC fibre-channel cable is a fiber-optic cable that you use to connect DS4700 Express fibre channel ports into one of the following devices:

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

See Figure 37 on page 61 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.

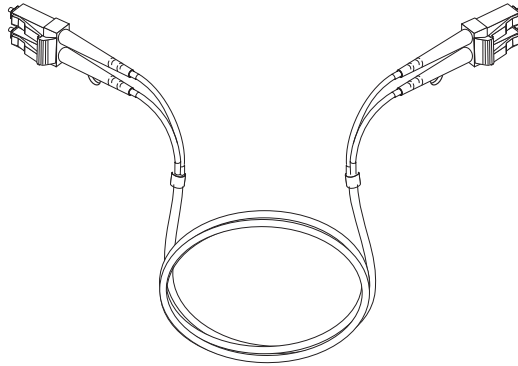


Figure 37. LC-LC fibre-channel cable

Connecting an LC-LC cable to an SFP module

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

Statement 3:



CAUTION:

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

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



DANGER

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

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

1. Read the information in “Handling fiber-optic cables” on page 57.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 33 on page 59. 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 38 on page 62. Save the protective caps for future use.

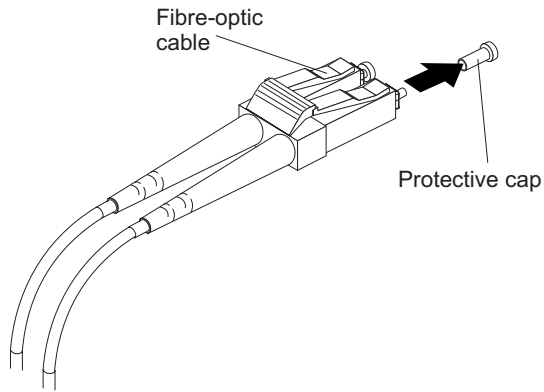


Figure 38. Removing fiber-optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the DS4700 Express. 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 39.

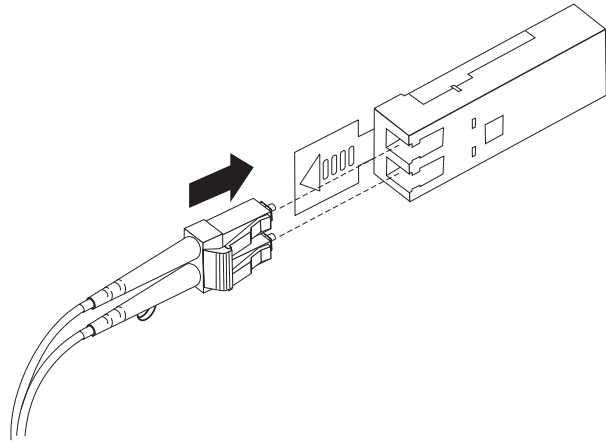


Figure 39. Inserting an LC-LC fibre-channel cable into an SFP module

5. Remove the two protective caps from the other end of the LC-LC cable. Save the protective caps for future use.
6. Connect this end of the LC-LC cable to one of the following devices:
 - An SFP module that is installed in a separate EXP810 or EXP710 storage expansion enclosure or other DS4000 storage expansion enclosure
 - An SFP module that is installed in a fibre channel switch port
 - A fibre channel host bus adapter port

Removing an LC-LC fibre-channel cable

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

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

- Press and hold the lever to release the latches before you remove the cable from the SFP module.
 - Ensure that the levers are in the released position when you remove the cable.
 - Do not grasp the SFP module plastic tab when you remove the cable.
1. On the end of the LC-LC cable that connects into the SFP module or host bus adapter, press down and hold the lever to release the latches, as shown in Figure 40.

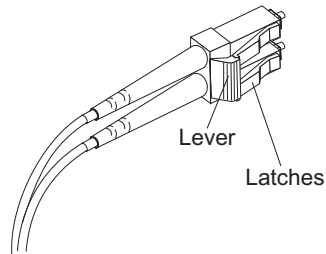


Figure 40. LC-LC fibre-channel cable lever and latches

2. While pressing down the cable lever, carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 41.

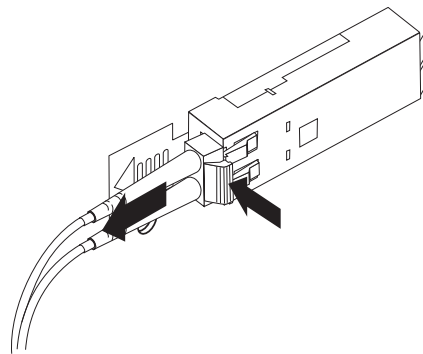


Figure 41. Removing the LC-LC fibre-channel cable

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

Using LC-SC fibre-channel cable adapters

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

- 1-Gbps fibre channel switch
- Fibre channel host bus adapter

Attention: The DS4700 Express does not support the attachment of storage expansion enclosures that operate at 1 Gbps, such as the EXP500.

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

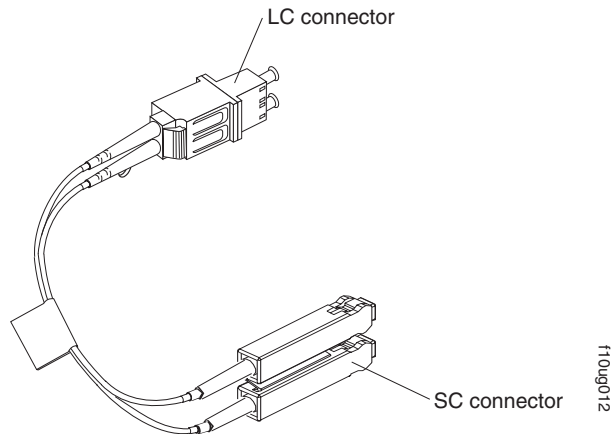


Figure 42. LC-SC fibre-channel cable adapter

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 57.

2. Connect one end of an LC-LC cable to an SFP module in the DS4700 Express. For instructions, see “Using LC-LC fibre-channel cables” on page 60.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 43. Save the protective caps for future use.

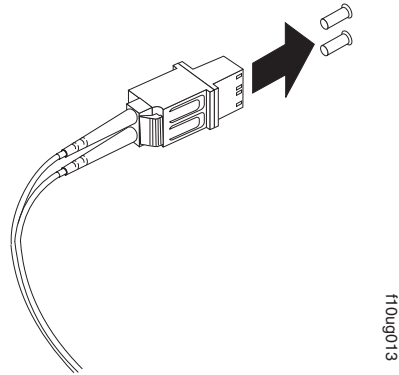


Figure 43. Removing the LC-SC cable adapter protective caps

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 44. Push in the connector until it clicks into place.

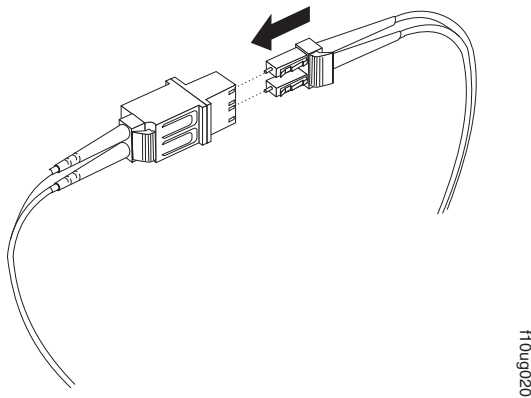


Figure 44. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the DS4700 Express 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 45 shows the location of the lever and latches.

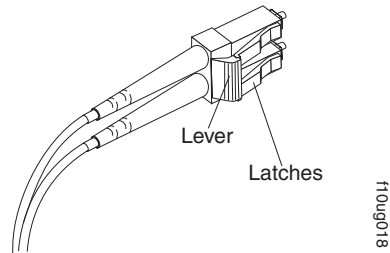


Figure 45. LC-LC fibre-channel cable lever and latches

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 46.

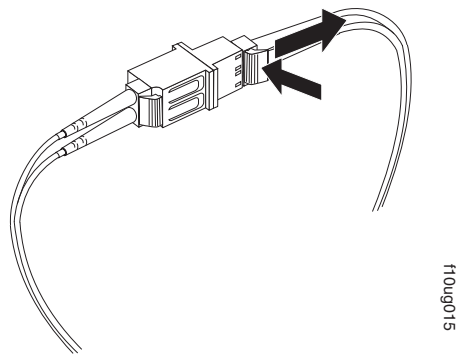


Figure 46. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter

3. Replace the protective caps on the cable ends.

Connecting storage expansion enclosures to the DS4700 Express

Attention

Before powering on the DS4700 Express Storage Subsystem, it must be populated with at least two E-DDMs. If at least two E-DDMs are not installed in each attached storage expansion enclosure or DS4700 Express Storage Subsystem, when you power on the DS4700 Express and its attached storage expansion enclosures, your standard storage partition key might be lost and must be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

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

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear as failed, falsely indicating the power supplies are bad. All drives in the DS4700 Express Storage Subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

In the initial installation of the DS4700 Express, you can add only *new* storage expansion enclosures to the DS4700 Express Storage Subsystem. This means there must be no existing configuration information on the storage expansion enclosures that you want to install.

If the storage expansion enclosures that you want to install currently contain logical drives or configured hot spares, and you want them to be part of the DS4700 Express Storage Subsystem configuration, refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*. Improper drive migration might cause loss of configuration and other storage subsystem problems. Contact your IBM technical support representative for additional information.

Redundant drive channel pair

Each controller on the DS4700 Express has a drive channel that contains two ports. The storage expansion enclosures that are connected to these two ports form a drive channel (also referred to as drive loop in certain DS4000 storage subsystem models). The maximum number of hard drives that can be installed in one drive channel is 112. One drive channel from each controller combines to form a redundant drive channel pair.

Figure 47 on page 68 shows an example of a redundant drive channel pair. If any component of the drive channel fails, the RAID controllers can still access the storage expansion enclosures in the redundant drive channel pair.

Note: In the following drive cabling figures, the DS4700 Express graphics are simplified to show only the drive ports of each controller.

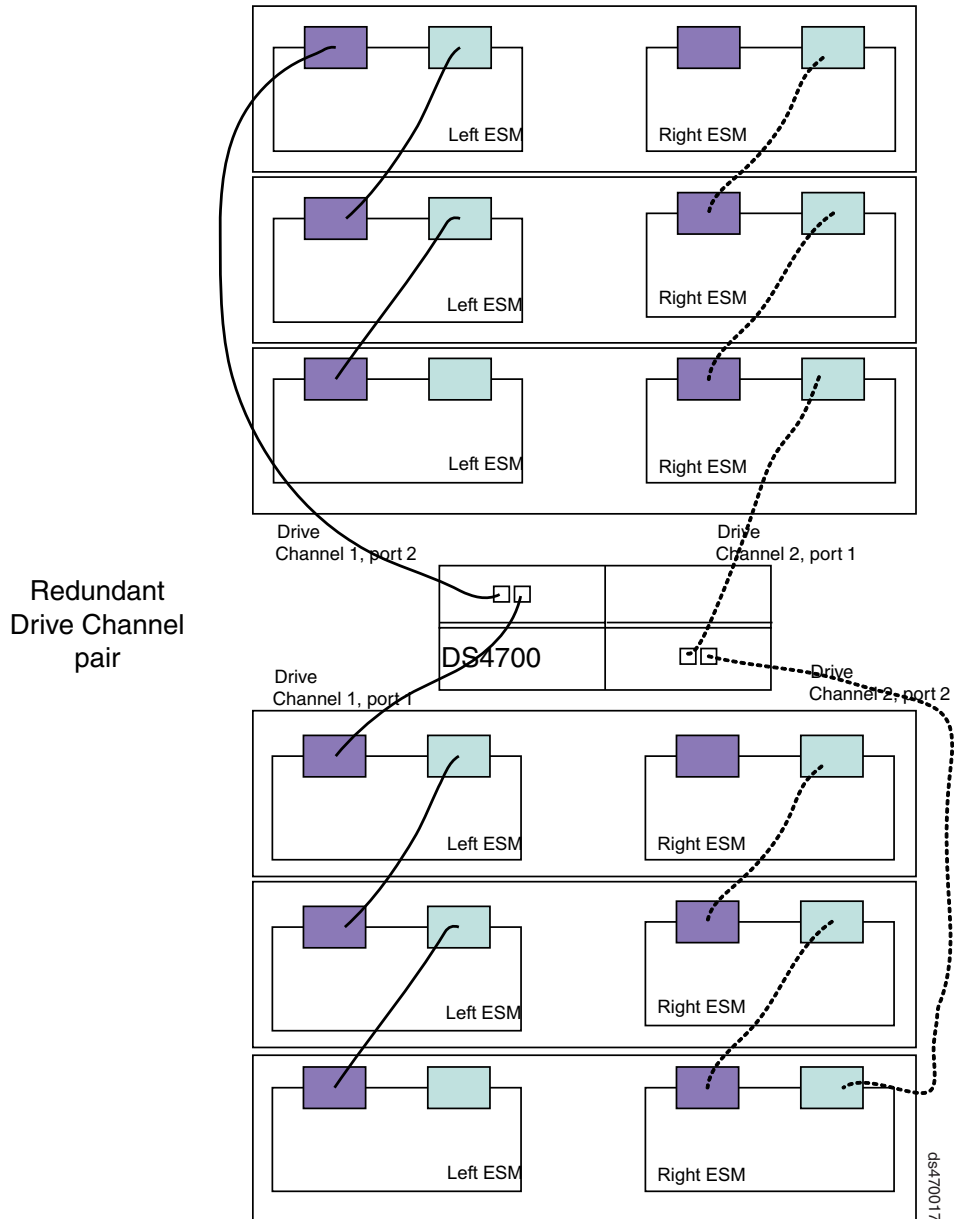


Figure 47. Example of a redundant drive channel pair

Overview of steps to connect storage expansion enclosures to a storage subsystem

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

Note: The following procedures are for "cold-case" procedures (in which the DS4700 Express is powered down when storage expansion enclosures are connected, as in the case of initial installation). For "hot-case" procedures (in which the DS4700 Express is powered on when storage expansion enclosures are connected), refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

1. Follow the instructions in the Installation, User's, and Maintenance Guide for your DS4000 storage expansion enclosure to set up and mount the storage expansion enclosures.
2. Select a cabling topology appropriate for the number of storage expansion enclosures you will connect to the DS4700 Express. If you are connecting external storage expansion enclosures to the DS4700 Express, ensure that the storage expansion enclosures are populated with at least two drives before you power them on. In addition, you must have at least two drives in the DS4700 Express Storage Subsystem before you power it on.
"DS4700 Express Storage Subsystem drive cabling topologies" describes the recommended schemes for cabling different numbers of storage expansion enclosures to the DS4700 Express and to each other (if you are connecting more than one storage expansion enclosure).
3. After you select the cabling topology for your configuration, follow the cabling diagram for your chosen topology and perform the steps identified in "DS4700 Express Storage Subsystem and supported storage expansion enclosure drive cabling schemes" on page 76.
4. If required, set unique enclosure IDs for all storage expansion enclosures that are cabled to the DS4700 Express. See "DS4000 storage expansion enclosure ID settings" on page 96, and then refer to your storage expansion enclosure installation manual for details on setting the enclosure ID.

The DS4700 Express Storage Subsystem locates the drives in the storage expansion enclosures after you power on the configuration. Always connect power to the storage expansion enclosures first and then connect power to the DS4700 Express. After you have powered on the configuration, use the DS4000 Storage Manager client to check the status of the new drives, correct any errors found, and configure the new drives.

DS4700 Express Storage Subsystem drive cabling topologies

This section provides preferred cabling topologies for cabling storage expansion enclosures to the DS4700 Express Storage Subsystem. The cabling topologies include the following:

- "One DS4700 Express and one storage expansion enclosure" on page 71
- "One DS4700 Express and two storage expansion enclosures" on page 71
- "One DS4700 Express and three storage expansion enclosures" on page 73
- "One DS4700 Express and four storage expansion enclosures" on page 73
- "One DS4700 Express and up to six storage expansion enclosures" on page 73
- "One DS4700 Express and two or more storage expansion enclosures in a mixed configuration" on page 75

Each example provides redundant paths to the drives. If one of these examples is suitable for your hardware and application, complete the cabling connections as described by the graphics. If you have hardware other than what is shown in these examples to include in your topology, use these examples as a starting point for creating your specific topology.

Attention: The DS4700 Express supports the connection of a maximum of six storage expansion enclosures per redundant drive channel pair. The DS4700 Express supports one redundant drive channel pair.

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

Figure 48 and Figure 49 show the locations of controllers A and B, the single-ported fibre-channel host channels, Ethernet ports, and dual-ported fibre-channel drive channels at the back of the DS4700 Express Storage Subsystem.

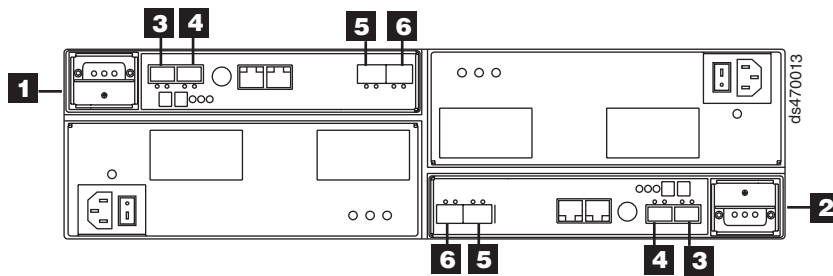


Figure 48. DS4700 Express Storage Subsystem (Model 70) ports and controllers

Table 24 provides a list of the drive channels that are associated with each of the controllers on the DS4700 Express Storage Subsystem (model 70).

Table 24. DS4700 Express Storage Subsystem (Model 70) host ports and drive channels

Number	Description
1	Controller A
2	Controller B
3	Drive Channel 1 - Port 2 on Controller A Drive Channel 2 - Port 2 on Controller B
4	Drive Channel 1 - Port 1 on Controller A Drive Channel 2 - Port 1 on Controller B
5	Host Port 2
6	Host Port 1

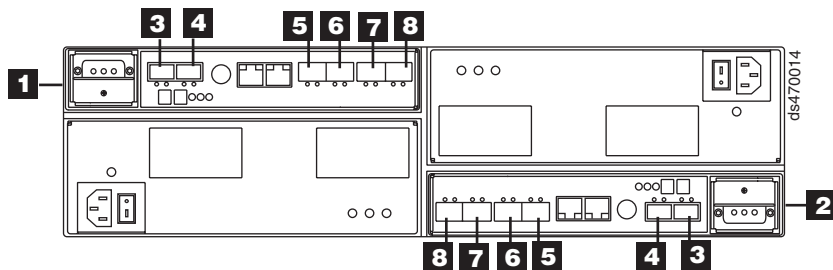


Figure 49. DS4700 Express Storage Subsystem (Model 72) ports and controllers

Table 25 provides a list of the drive channels that are associated with each of the controllers on the DS4700 Express Storage Subsystem (model 72).

Table 25. DS4700 Express Storage Subsystem (Model 72) host ports and drive channels

Number	Description
1	Controller A
2	Controller B

Table 25. DS4700 Express Storage Subsystem (Model 72) host ports and drive channels (continued)

Number	Description
3	Drive Channel 1 - Port 2 on Controller A Drive Channel 2 - Port 2 on Controller B
4	Drive Channel 1 - Port 1 on Controller A Drive Channel 2 - Port 1 on Controller B
5	Host Port 4
6	Host Port 3
7	Host Port 2
8	Host Port 1

One DS4700 Express and one storage expansion enclosure

If you are cabling one DS4700 Express Storage Subsystem to one storage expansion enclosure, Figure 50 shows the recommended cabling topology.

Note: Figure 50 illustrates the drive channel connections between the DS4700 Express and the storage expansion enclosures. Do not use Figure 50 as the cabling diagram. Follow the instructions in “DS4700 Express Storage Subsystem and supported storage expansion enclosure drive cabling schemes” on page 76 for specific cabling instructions.

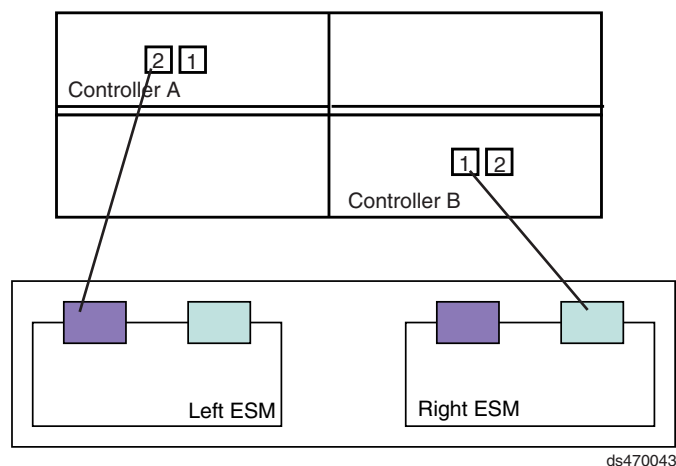


Figure 50. One DS4700 Express and one storage expansion enclosure — Recommended cabling

One DS4700 Express and two storage expansion enclosures

If you are cabling one DS4700 Express Storage Subsystem and two storage expansion enclosures, Connect one storage expansion enclosure per controller drive port as shown in Figure 51 on page 72. Figure 52 on page 72 shows that you can also connect two expansion enclosures together behind a single controller drive port. Although this is technically correct, use the topology as shown in Figure 51 on page 72.

As Figure 51 on page 72 shows, when you connect additional storage expansion enclosures, you can connect them by continuing the connection from the existing

redundant drive channel pair.

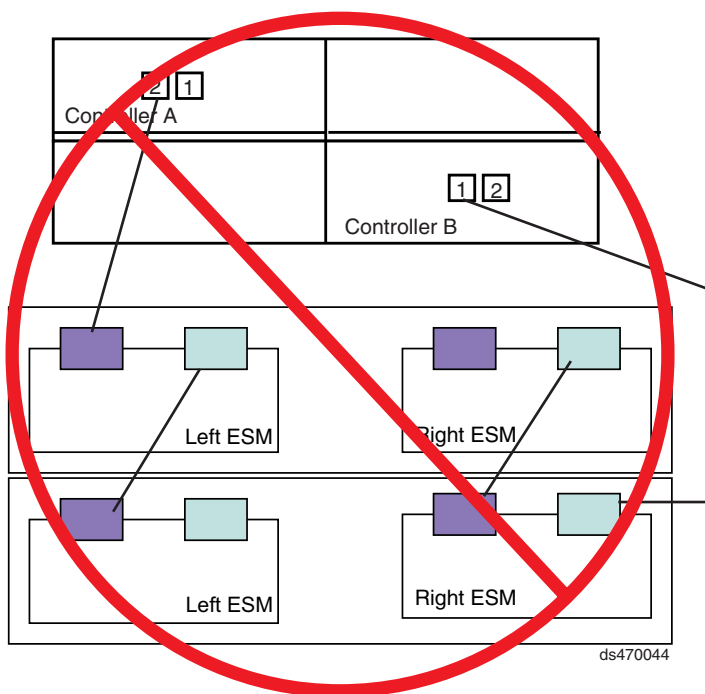


Figure 51. One DS4700 Express and two storage expansion enclosure — Not recommended cabling

As Figure 52 shows, when you connect additional storage expansion enclosures, you can connect them by using the additional port of the drive channel.

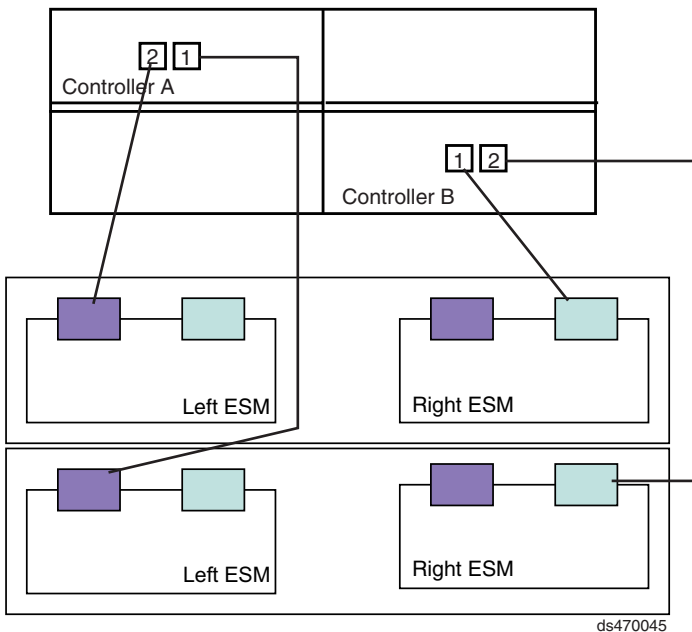


Figure 52. One DS4700 Express and two storage expansion enclosure — Recommended cabling

One DS4700 Express and three storage expansion enclosures

If you are cabling one DS4700 Express Storage Subsystem and three storage expansion enclosures, Figure 53 shows the recommended cabling topology.

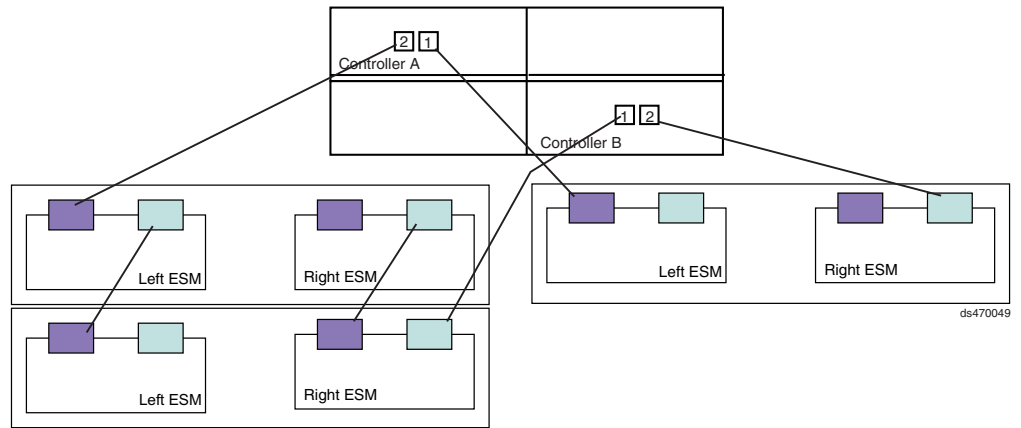


Figure 53. One DS4700 Express and three storage expansion enclosure — Recommended cabling

One DS4700 Express and four storage expansion enclosures

If you are cabling one DS4700 Express Storage Subsystem and four storage expansion enclosures, Figure 54 shows the recommended cabling topology.

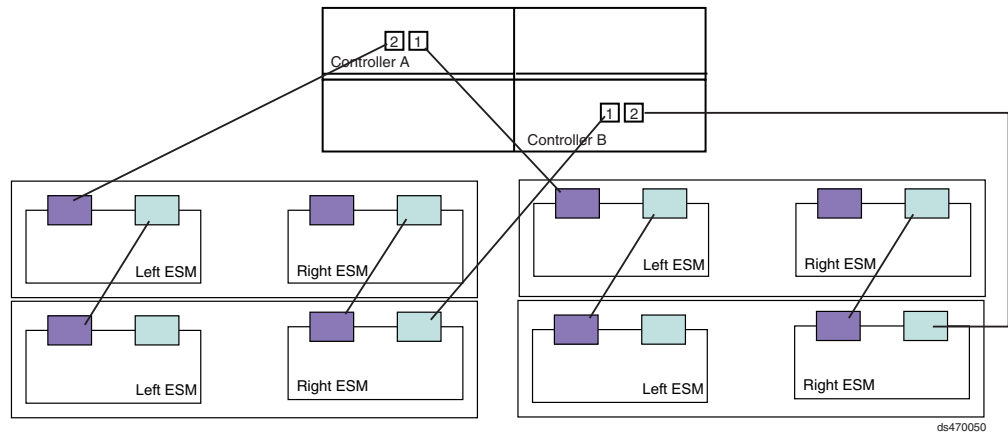


Figure 54. One DS4700 Express and four storage expansion enclosure — Recommended cabling

One DS4700 Express and up to six storage expansion enclosures

If you are cabling one DS4700 Express Storage Subsystem and up to six storage expansion enclosures, Figure 55 on page 74 shows the recommended cabling topology.

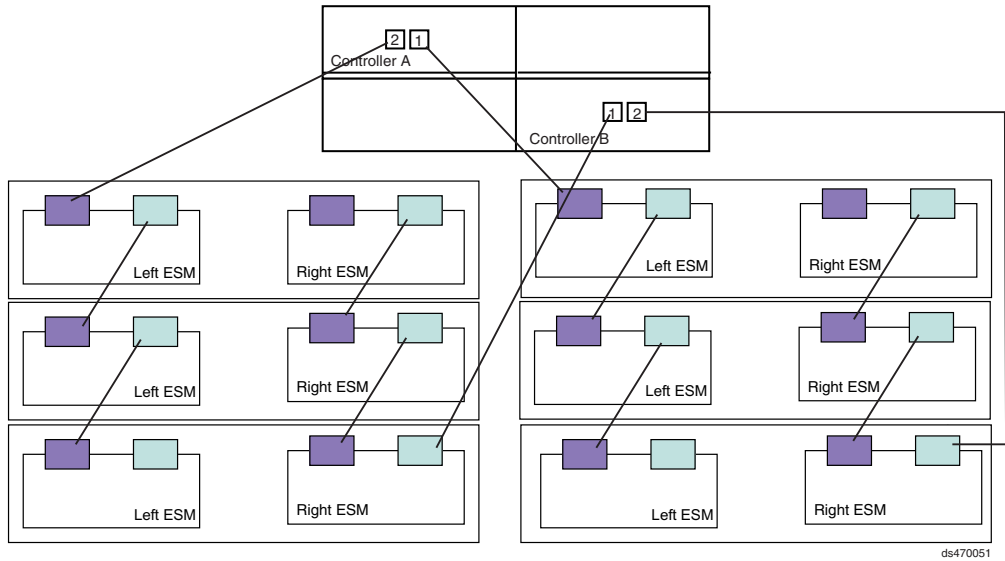


Figure 55. One DS4700 Express and up to six storage expansion enclosure — Recommended cabling

Figure 56 on page 75 shows a cabling topology that is not recommended because all six storage expansion enclosures are connected to a single drive port of the dual-ported drive channel in each controller.

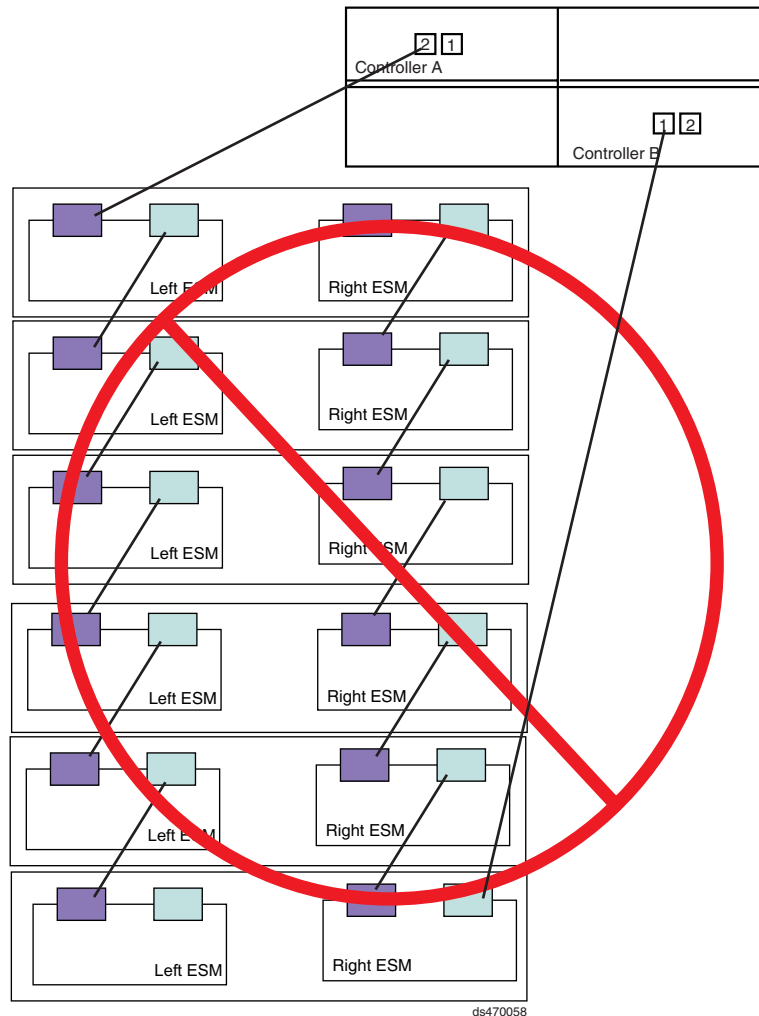


Figure 56. One DS4700 Express and up to six storage expansion enclosure — Not recommended

One DS4700 Express and two or more storage expansion enclosures in a mixed configuration

A mixed configuration is a configuration in which you have more than one type of storage expansion enclosure. If possible, it is recommended that you do not mix different types of storage expansion enclosures in the same drive channel pair. Figure 57 on page 76 shows the recommended cabling topology if you have three EXP710s and three EXP810s attached to the DS4700 Express. (The EXP710s are denoted in the graphic as **1** while the EXP810s are denoted as **2**.)

Note: If you are mixing EXP100s with EXP710s and EXP810s, Figure 57 on page 76 is not the recommended cabling topology. Additional cabling rules and restrictions apply. See “One DS4700 Express and two or more storage expansion enclosures in a mixed configuration” on page 93.

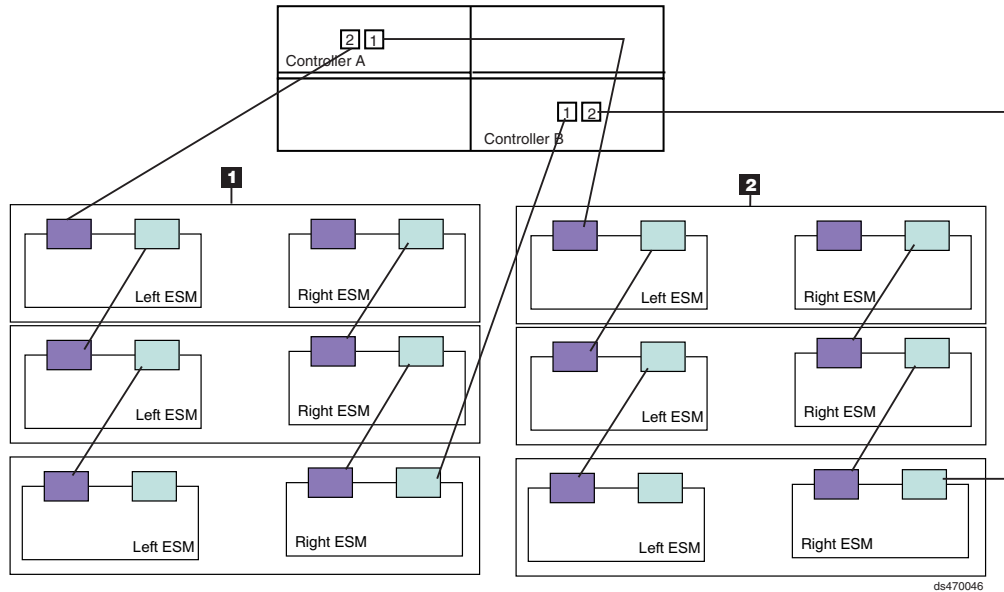


Figure 57. One DS4700 Express and two or more storage expansion enclosures in a mixed environment — Recommended cabling

DS4700 Express Storage Subsystem and supported storage expansion enclosure drive cabling schemes

The following sections show cabling schemes for supported storage expansion enclosures and the DS4700 Express Storage Subsystem:

- “One DS4700 Express and one EXP100 storage expansion enclosure” on page 79
- “One DS4700 Express and two EXP100 storage expansion enclosures” on page 80
- “One DS4700 Express and three or more EXP100 storage expansion enclosures” on page 81
- “One DS4700 Express and one EXP710 storage expansion enclosure” on page 84
- “One DS4700 Express and two EXP710 storage expansion enclosures” on page 84
- “One DS4700 Express and three or more EXP710 storage expansion enclosures” on page 85
- “One DS4700 Express and one EXP810 storage expansion enclosure” on page 88
- “One DS4700 Express and two EXP810 storage expansion enclosures” on page 88
- “One DS4700 Express and three or more EXP810 storage expansion enclosures” on page 89
- “One DS4700 Express and two or more storage expansion enclosures in a mixed configuration” on page 93

DS4700 Express Storage Subsystem drive cabling rules and recommendations

Refer to these general rules and recommendations when completing the cabling steps in the cabling schemes described in this section.

1. Do not connect a combination of more than six EXP810 storage expansion enclosures to the two ports of a dual-ported drive channel. Failure to observe this limitation might result in loss of data availability. In the DS4700 Express Storage Subsystem environment, no more than six EXP810 storage expansion enclosures can be connected to the two ports of a dual-ported drive channel because of the internal drive slots in the DS4700 Express Storage Subsystem.
2. Do not connect more than four EXP810 storage expansion enclosures to each port of a dual-ported drive channel.
3. It is recommended that you add storage expansion enclosures to the DS4800 drive ports in a round-robin fashion. For example, if you have four EXP810s to be cabled to the DS4800, instead of cabling all four EXP810s to one drive port of a drive channel, distribute the enclosures to all drive ports, which results in one enclosure per drive port of a drive channel.
4. Do not connect more than the recommended maximum number of enclosures per drive channel, which is eight for EXP810s. When mixing 14-drive storage expansion enclosures (such as EXP710s and EXP100s) and 16-drive storage expansion enclosures (such as EXP810s), the maximum number of expansion enclosures is seven per redundant drive channel pair.
5. The DS4700 Express Storage Subsystem supports the connection of a maximum of six storage expansion enclosures per redundant drive channel loop and supports one redundant drive channel loop pair. Failure to observe this limitation might result in loss of data availability. In the DS4700 Express Storage Subsystem environment, no more than six EXP810 and/or EXP710 or EXP100 storage expansion enclosures can be connected to the two ports of a dual-ported drive channel because of the internal drive slots in the DS4700 Express Storage Subsystem.
6. The DS4700 Express currently supports a maximum of 112 drives in six 16-drive storage expansion enclosures per drive channel in each controller. One drive channel from each of controllers A and B must be connected to the same set of storage expansion enclosures to provide drive channel redundancy. Do not connect a combination of more than six storage expansion enclosures to the two ports of a single drive channel.
7. When connecting six storage expansion enclosures to a DS4700 Express, use all ports in both drive channels. See Figure 55 on page 74 for the recommended cabling topology.
8. Connect a maximum of four EXP810s per DS4700 Express controller drive port.
9. When cabling different types of storage expansion enclosures, it is recommended that you do not mix different types of storage expansion enclosures in the same drive channel pair. Also, when mixing different types of storage expansion enclosures in the same drive channel pair, the Link Rate Setting must be the same for each storage expansion enclosure. IBM does not support different enclosure speed settings in the same drive channel. The EXP810 enclosure speed switch must be set to 2 Gbps when connecting to DS4300 or DS4500 storage subsystems or EXP100 and EXP710 storage expansion enclosures.
10. The controller drive ports of the DS4000 storage subsystem controllers must always be connected to ports labeled 1B in both the right and left ESMs of the EXP810s in the redundant drive channel/loop pair that is connected to the

DS4000 storage subsystem. Figure 58 shows the location of the ports.

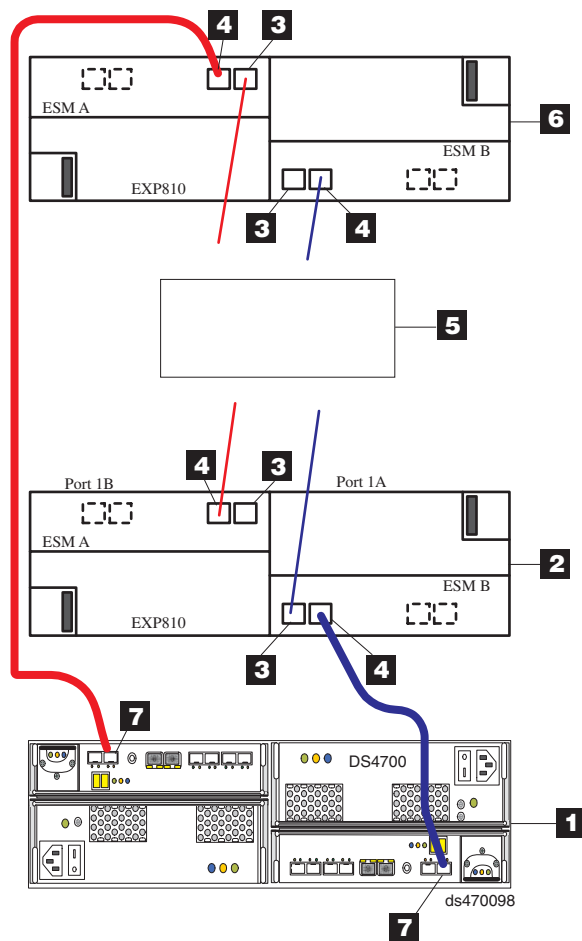


Figure 58. DS4700 Express drive ports connected to EXP810 ESM ports labeled 1B

Table 26. DS4700 Express drive ports connected to EXP810 ESM ports labeled 1B

Number	Description
1	DS4700 Express
2	First EXP810 storage expansion enclosure
3	ESM Port 1A
4	ESM Port 1B
5	Other storage expansion enclosures
6	Last EXP810 storage expansion enclosure
7	DS4700 drive port

- The DS4700 Express drive port must always be connected to the 14-drive storage expansion enclosure's (EXP710 or EXP100) left ESM IN port of the last enclosure in the group of enclosures that are cabled in a redundant drive loop pair. In addition, the DS4700 Express drive port must always be connected to the 14-drive storage expansion enclosure's right ESM OUT port of the first enclosure in the group of enclosures that are cabled in a redundant drive loop pair. Figure 59 on page 79 shows correct cabling to the 14-drive

storage expansion enclosure's ESM ports.

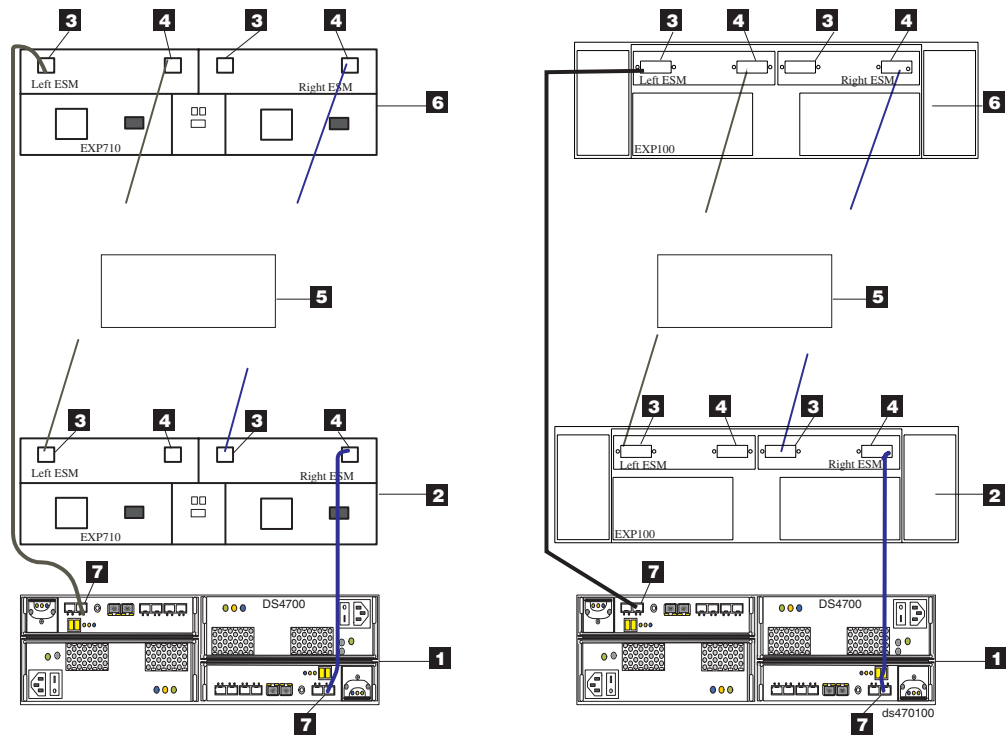


Figure 59. DS4700 Express drive ports connected to 14-drive storage expansion enclosure ESM In and Out ports

Table 27. DS4700 Express drive ports connected to 14-drive storage expansion enclosure ESM In and Out ports

Number	Description
1	DS4700 Express
2	First 14-drive storage expansion enclosure
3	ESM In port
4	ESM Out port
5	Other storage expansion enclosures
6	Last 14-drive storage expansion enclosure
7	DS4700 drive port

12. The DS4700 Express supports the intermix of SATA and fibre channel E-DDMs within the same drive enclosure.

One DS4700 Express and one EXP100 storage expansion enclosure

Figure 60 on page 80 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and one EXP100 storage expansion enclosure.

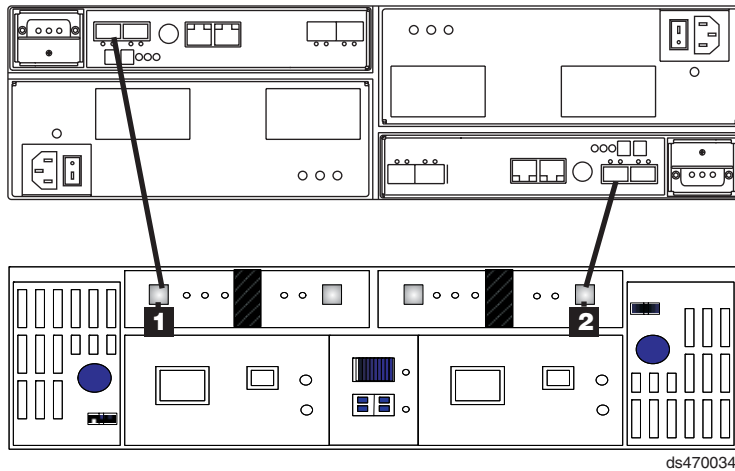


Figure 60. One DS4700 Express and one EXP100 storage expansion enclosure — Recommended cabling

Perform the following steps to create the recommended cabling scheme as shown in Figure 60:

1. Connect either port 2 or port 1 of the dual-ported drive channel 1 in controller A of the DS4700 Express to the IN port (**1**) on the left ESM of the EXP100.
2. Connect either port 1 or port 2 of the dual-ported drive channel 2 in controller B of the DS4700 Express to the OUT port (**2**) on the right ESM of the EXP100.

One DS4700 Express and two EXP100 storage expansion enclosures

Figure 61 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and two EXP100 storage expansion enclosures behind both ports of a dual-ported drive channel.

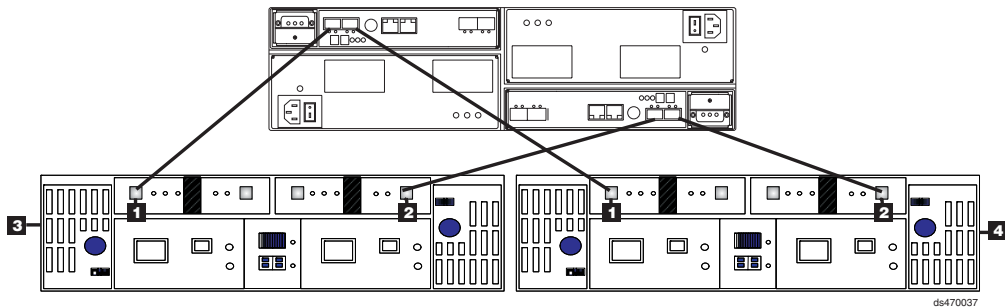


Figure 61. One DS4700 Express and two EXP100 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 61:

1. Connect port 2 of drive channel 1 on the DS4700 Express to the IN port (**1**) on the left ESM on the first EXP100 (**3**).
2. Connect the OUT port (**2**) on the right ESM in the first EXP100 (**3**) to port 1 of drive channel 1 on the DS4700 Express.
3. Connect port 1 of drive channel 1 on the DS4700 Express to the IN port (**1**) on the left ESM in the second EXP100 (**4**).

4. Connect the OUT port (**2**) on the right ESM in the second EXP100 (**4**) to port 2 of drive channel 2 on the DS4700 Express.

One DS4700 Express and three or more EXP100 storage expansion enclosures

To connect three or more storage expansion enclosures to a DS4700 Express Storage Subsystem, alternately connect a storage expansion enclosure to one of the drive ports of the dual-ported drive channel then connect to the other port until all of the storage expansion enclosures are attached. Figure 62 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and three EXP100 storage expansion enclosures behind both ports of a dual-ported drive channel.

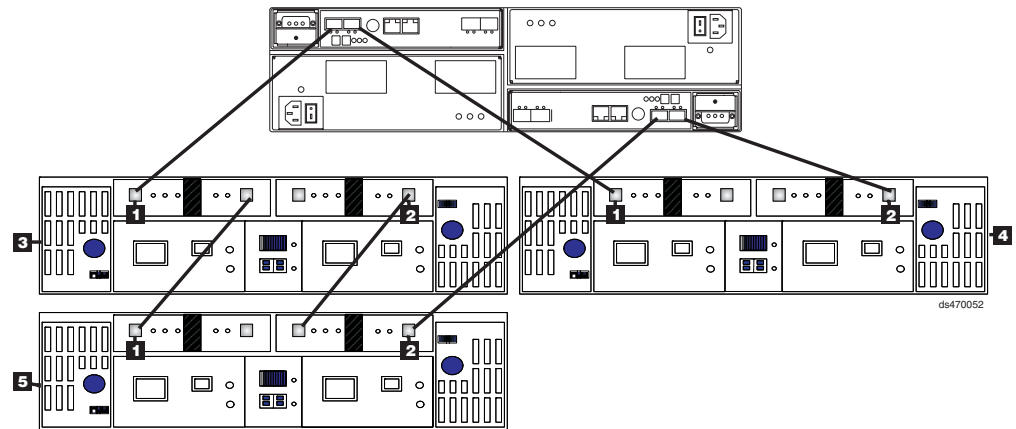


Figure 62. One DS4700 Express and three EXP100 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 62:

1. Connect the OUT port (**2**) on the left ESM in the first EXP100 (**3**) to the IN port (**1**) on the left ESM in the third EXP100 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP100 (**5**) to the OUT port (**2**) on the right ESM in the first EXP100 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP100 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the third EXP100 (**5**).
5. Connect the IN port (**1**) on the left ESM in the second EXP100 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
6. Connect the OUT port (**2**) on the right ESM in the second EXP100 (**4**) to port 2 of drive channel 2 on the DS4700 Express.

Figure 63 on page 82 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and four EXP100s behind both ports of a dual-ported drive channel.

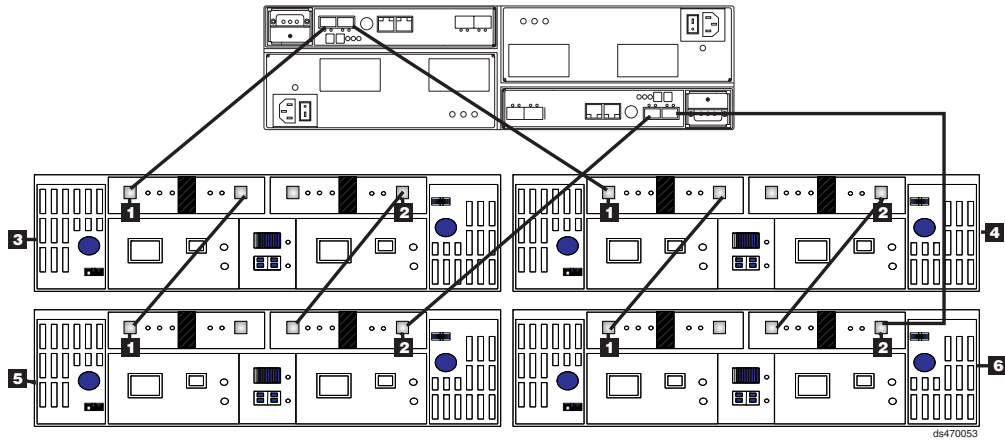


Figure 63. One DS4700 Express and four EXP100 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 63:

1. Connect the OUT port (**2**) on the left ESM in the first EXP100 (**3**) to the IN port (**1**) on the left ESM in the third EXP100 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP100 (**5**) to the OUT port (**2**) on the right ESM in the first EXP100 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP100 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the third EXP100 (**5**).
5. Connect the OUT port (**2**) on the left ESM in the second EXP100 (**4**) to the IN port (**1**) on the left ESM in the fourth EXP100 (**6**).
6. Connect the IN port (**1**) on the right ESM in the fourth EXP100 (**6**) to the OUT port (**2**) on the right ESM in the second EXP100 (**4**).
7. Connect the IN port (**1**) on the left ESM in the second EXP100 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
8. Connect port 2 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the fourth EXP100 (**6**).

Figure 64 on page 83 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and a maximum of six EXP100s behind both ports of a dual-ported drive channel.

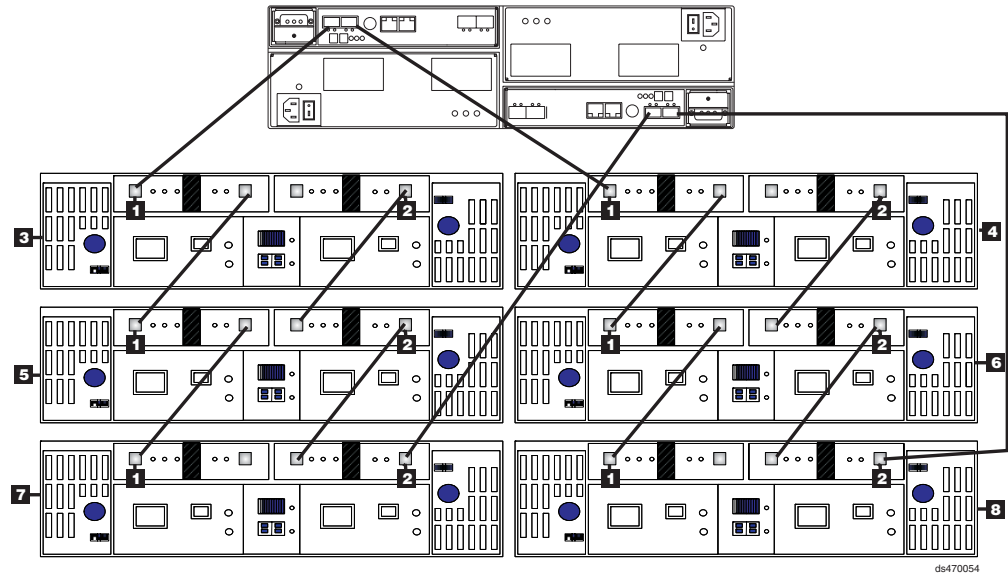


Figure 64. One DS4700 Express and a maximum of six EXP100 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 64:

1. Connect the OUT port (**2**) on the left ESM in the first EXP100 (**3**) to the IN port (**1**) on the left ESM in the third EXP100 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP100 (**5**) to the OUT port (**2**) on the right ESM in the first EXP100 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP100 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect the OUT port (**2**) on the left ESM in the third EXP100 (**5**) to the IN port (**1**) on the left ESM in the fifth EXP100 (**7**).
5. Connect the IN port (**1**) on the right ESM in the fifth EXP100 (**7**) to the OUT port (**2**) on the right ESM in the third EXP100 (**5**).
6. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the fifth EXP100 (**7**).
7. Connect the OUT port (**2**) on the left ESM in the second EXP100 (**4**) to the IN port (**1**) on the left ESM in the fourth EXP100 (**6**).
8. Connect the IN port (**1**) on the right ESM in the fourth EXP100 (**6**) to the OUT port (**2**) on the right ESM in the second EXP100 (**4**).
9. Connect the OUT port (**2**) on the left ESM in the fourth EXP100 (**6**) to the IN port (**1**) on the left ESM in the sixth EXP100 (**8**).
10. Connect the IN port (**1**) on the right ESM in the sixth EXP100 (**8**) to the OUT port (**2**) on the right ESM in the fourth EXP100 (**6**).
11. Connect the IN port (**1**) on the left ESM in the second EXP100 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
12. Connect port 2 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the sixth EXP100 (**8**).

One DS4700 Express and one EXP710 storage expansion enclosure

Figure 65 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and one EXP710 storage expansion enclosure.

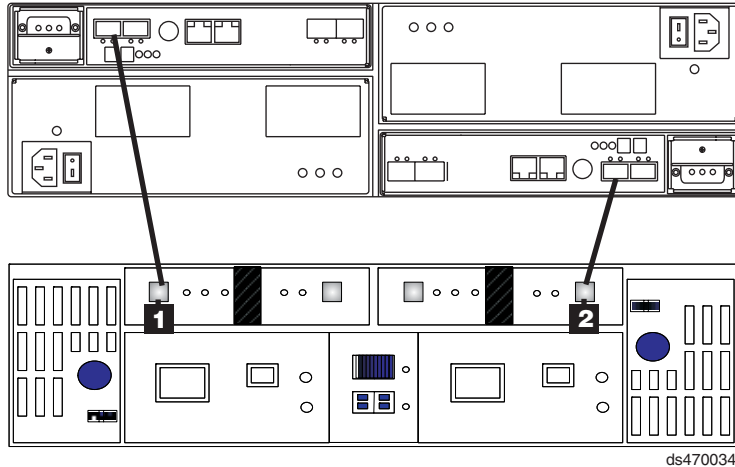


Figure 65. One DS4700 Express and one EXP710 storage expansion enclosure — Recommended cabling

Perform the following steps to create the recommended cabling scheme as shown in Figure 65:

1. Connect either port 2 or port 1 of the dual-ported drive channel 1 in controller A of the DS4700 Express to the IN port (**1**) on the left ESM of the EXP710.
2. Connect either port 1 or port 2 of the dual-ported drive channel 2 in controller B of the DS4700 Express to the OUT port (**2**) on the right ESM of the EXP710.

One DS4700 Express and two EXP710 storage expansion enclosures

Figure 66 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and two EXP710 storage expansion enclosures behind both ports of a dual-ported drive channel.

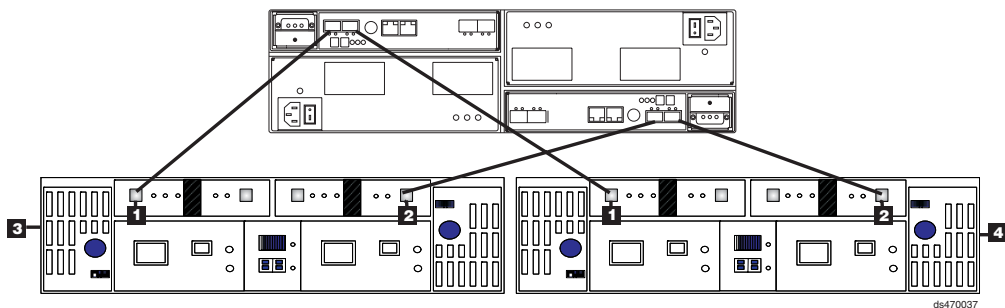


Figure 66. One DS4700 Express and two EXP710 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 66:

1. Connect port 2 of drive channel 1 on the DS4700 Express to the IN port (**1**) on the left ESM on the first EXP710 (**3**).

2. Connect the OUT port (**2**) on the right ESM in the first EXP710 (**3**) to port 1 of drive channel 1 on the DS4700 Express.
3. Connect port 1 of drive channel 1 on the DS4700 Express to the IN port (**1**) on the left ESM in the second EXP710 (**4**).
4. Connect the OUT port (**2**) on the right ESM in the second EXP710 (**4**) to port 2 of drive channel 2 on the DS4700 Express.

One DS4700 Express and three or more EXP710 storage expansion enclosures

To connect three or more storage expansion enclosures to a DS4700 Express Storage Subsystem, alternately connect a storage expansion enclosure to one of the drive ports of the dual-ported drive channel then connect to the other port until all of the storage expansion enclosures are attached. Figure 67 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and three EXP710 storage expansion enclosures behind both ports of a dual-ported drive channel.

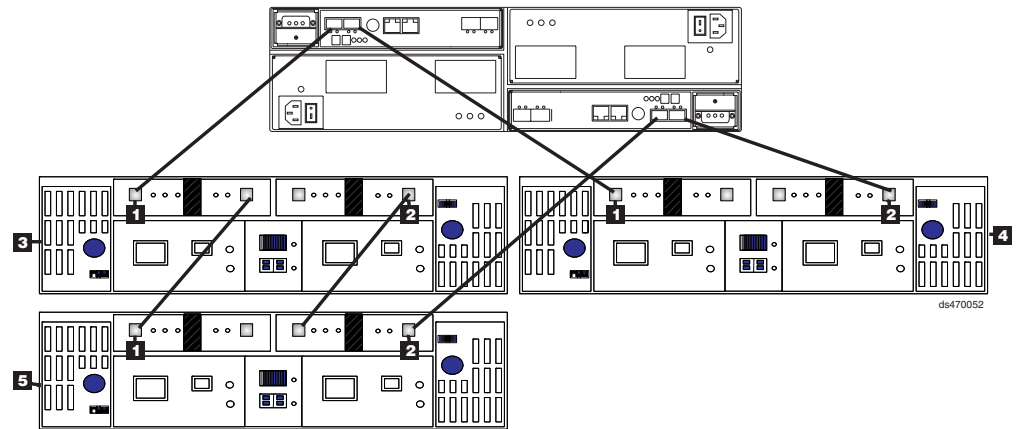


Figure 67. One DS4700 Express and three EXP710 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 67:

1. Connect the OUT port (**2**) on the left ESM in the first EXP710 (**3**) to the IN port (**1**) on the left ESM in the third EXP710 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP710 (**5**) to the OUT port (**2**) on the right ESM in the first EXP710 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP710 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the third EXP710 (**5**).
5. Connect the IN port (**1**) on the left ESM in the second EXP710 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
6. Connect the OUT port (**2**) on the right ESM in the second EXP710 (**4**) to port 2 of drive channel 2 on the DS4700 Express.

Figure 68 on page 86 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and four EXP710 storage expansion enclosures behind both ports of a dual-ported drive channel.

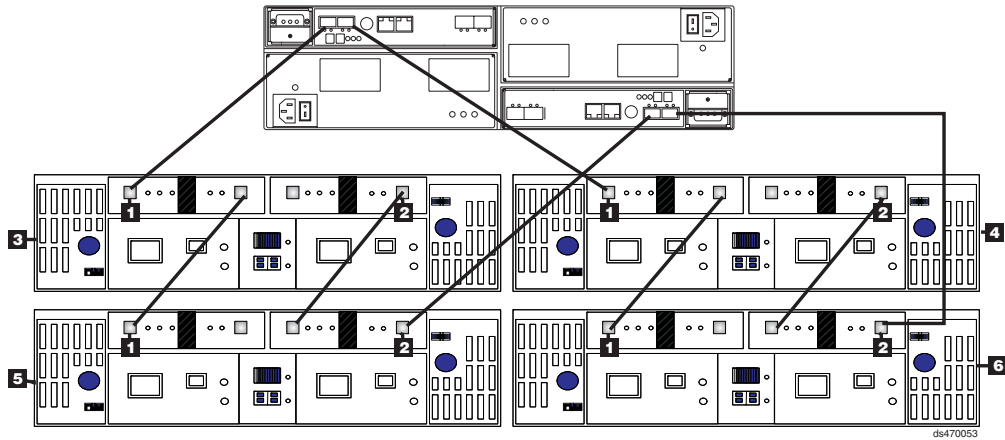


Figure 68. One DS4700 Express and four EXP710 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 68:

1. Connect the OUT port (**2**) on the left ESM in the first EXP710 (**3**) to the IN port (**1**) on the left ESM in the third EXP710 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP710 (**5**) to the OUT port (**2**) on the right ESM in the first EXP710 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP710 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the third EXP710 (**5**).
5. Connect the OUT port (**2**) on the left ESM in the second EXP710 (**4**) to the IN port (**1**) on the left ESM in the fourth EXP710 (**6**).
6. Connect the IN port (**1**) on the right ESM in the fourth EXP710 (**6**) to the OUT port (**2**) on the right ESM in the second EXP710 (**4**).
7. Connect the IN port (**1**) on the left ESM in the second EXP710 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
8. Connect port 2 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the fourth EXP710 (**6**).

Figure 69 on page 87 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and a maximum of six EXP710 storage expansion enclosures behind both ports of a dual-ported drive channel.

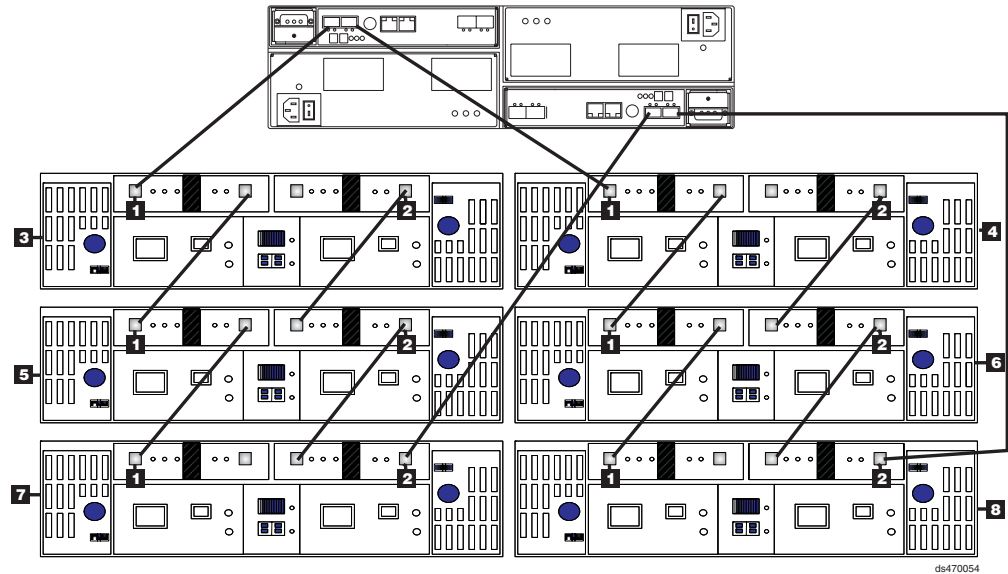


Figure 69. One DS4700 Express and a maximum of six EXP710 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 69:

1. Connect the OUT port (**2**) on the left ESM in the first EXP710 (**3**) to the IN port (**1**) on the left ESM in the third EXP710 (**5**).
2. Connect the IN port (**1**) on the right ESM in the third EXP710 (**5**) to the OUT port (**2**) on the right ESM in the first EXP710 (**3**).
3. Connect the IN port (**1**) on the left ESM in the first EXP710 (**3**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect the OUT port (**2**) on the left ESM in the third EXP710 (**5**) to the IN port (**1**) on the left ESM in the fifth EXP710 (**7**).
5. Connect the IN port (**1**) on the right ESM in the fifth EXP710 (**7**) to the OUT port (**2**) on the right ESM in the third EXP710 (**5**).
6. Connect port 1 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the fifth EXP710 (**7**).
7. Connect the OUT port (**2**) on the left ESM in the second EXP710 (**4**) to the IN port (**1**) on the left ESM in the fourth EXP710 (**6**).
8. Connect the IN port (**1**) on the right ESM in the fourth EXP710 (**6**) to the OUT port (**2**) on the right ESM in the second EXP710 (**4**).
9. Connect the OUT port (**2**) on the left ESM in the fourth EXP710 (**6**) to the IN port (**1**) on the left ESM in the sixth EXP710 (**8**).
10. Connect the IN port (**1**) on the right ESM in the sixth EXP710 (**8**) to the OUT port (**2**) on the right ESM in the fourth EXP710 (**6**).
11. Connect the IN port (**1**) on the left ESM in the second EXP710 (**4**) to port 1 of drive channel 1 on the DS4700 Express.
12. Connect port 2 of drive channel 2 on the DS4700 Express to the OUT port (**2**) on the right ESM in the sixth EXP710 (**8**).

One DS4700 Express and one EXP810 storage expansion enclosure

Figure 70 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and one EXP810 storage expansion enclosure.

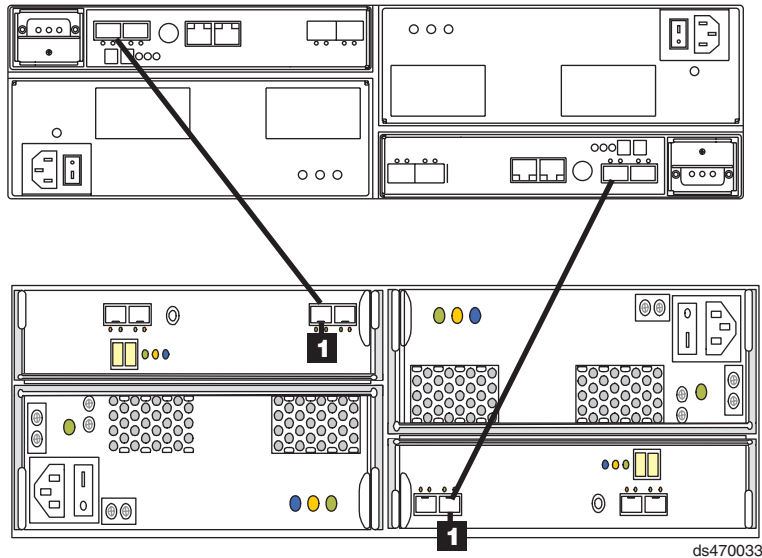


Figure 70. One DS4700 Express and one EXP810 storage expansion enclosure — Recommended cabling

Perform the following steps to create the recommended cabling scheme shown in Figure 70:

1. Connect either port 2 or port 1 of the dual-ported drive channel 1 in controller A on the DS4700 Express to port 1B (**1**) on the left ESM of the EXP810.
2. Connect either port 1 or port 2 of the dual-ported drive channel 2 in controller B on the DS4700 Express to port 1B (**1**) on the right ESM of the EXP810.

One DS4700 Express and two EXP810 storage expansion enclosures

Figure 71 on page 89 shows the cabling scheme for one DS4700 Express Storage Subsystem and two EXP810 storage expansion enclosures behind both ports of a dual-ported drive channel.

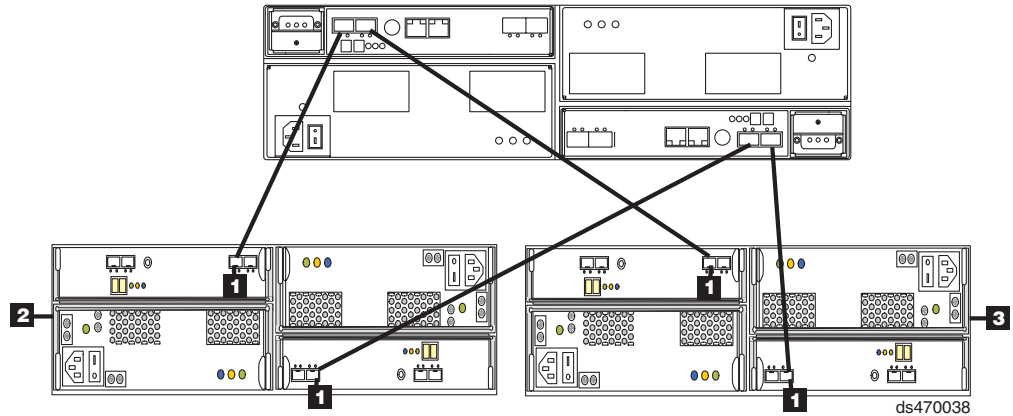


Figure 71. One DS4700 Express and two EXP810 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 71:

1. Connect port 2 of drive channel 1 on the DS4700 Express to port 1B (**1**) on the left ESM in the first EXP810 (**2**).
2. Connect port 1B (**1**) on the right ESM in the first EXP810 (**2**) to port 1 of drive channel 2 on the DS4700 Express.
3. Connect port 1 of drive channel 1 on the DS4700 Express to port 1B (**1**) on the left ESM in the second EXP810 (**3**).
4. Connect port 1B (**1**) on the right ESM in the second EXP810 (**3**) to port 2 of drive channel 2 on the DS4700 Express.

One DS4700 Express and three or more EXP810 storage expansion enclosures

To connect three or more storage expansion enclosures to a DS4700 Express Storage Subsystem, alternately connect a storage expansion enclosure to one of the drive ports of the dual-ported drive channel then connect to the other port until all of the storage expansion enclosures are attached. Figure 72 on page 90 shows the cabling scheme for one DS4700 Express Storage Subsystem and three EXP810 storage expansion enclosures behind both ports of a dual-ported drive channel.

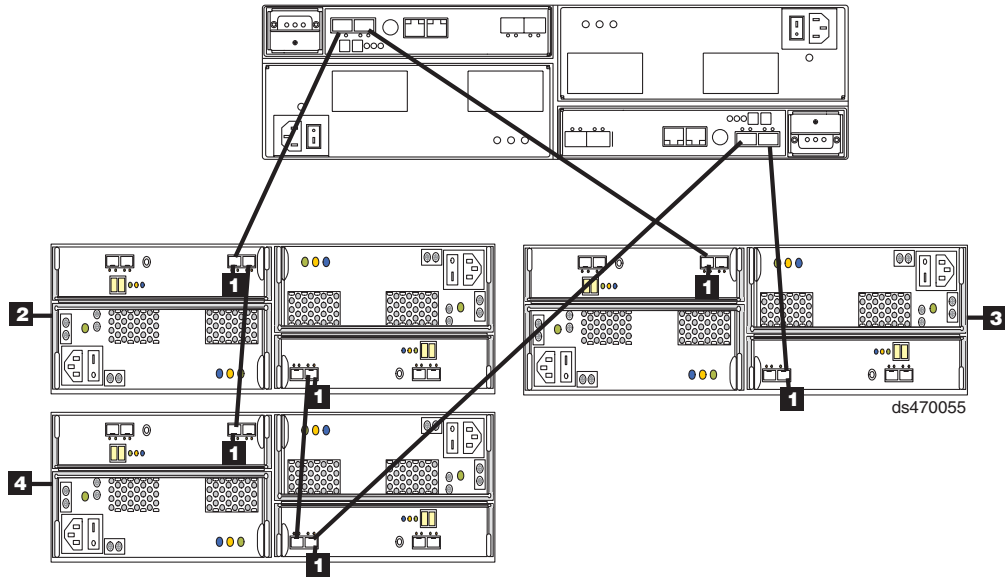


Figure 72. One DS4700 Express and three EXP810 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 72:

1. Connect port 1A on the left ESM in the first EXP810 (**2**) to port 1B (**1**) on the left ESM in the third EXP810 (**4**).
2. Connect port 1A on the right ESM in the third EXP810 (**4**) to port 1B (**1**) on the right ESM in the first EXP810 (**2**).
3. Connect port 1B (**1**) on the left ESM in the first EXP810 (**2**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to port 1B (**1**) on the right ESM in the third EXP810 (**4**).
5. Connect port 1B (**1**) on the left ESM in the second EXP810 (**3**) to port 1 of drive channel 1 on the DS4700 Express.
6. Connect port 1B (**1**) on the right ESM in the second EXP810 (**3**) to port 2 of drive channel 2 on the DS4700 Express.

Figure 73 on page 91 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and four EXP810 storage expansion enclosures behind both ports of a dual-ported drive channel.

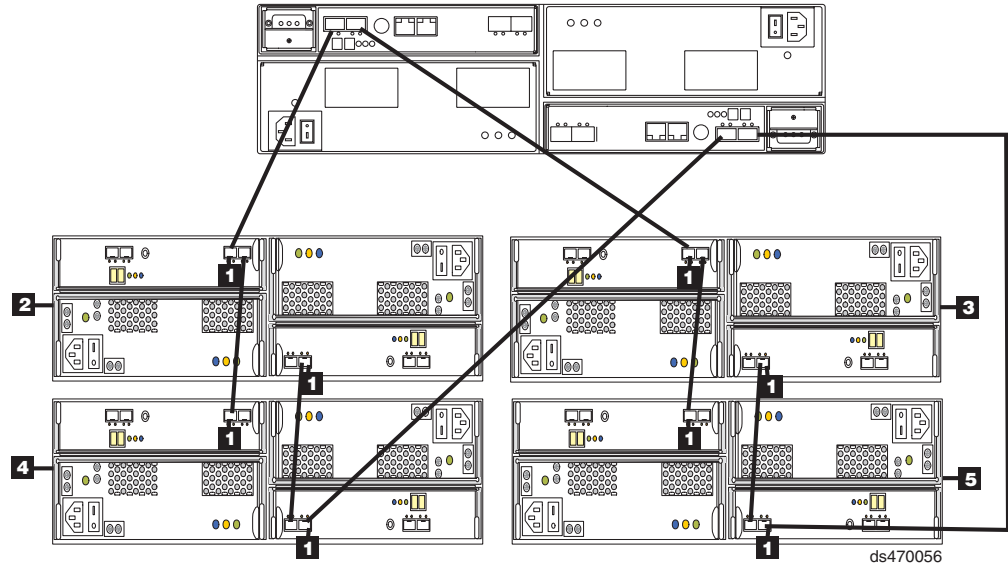


Figure 73. One DS4700 Express and four EXP810 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 73:

1. Connect port 1A on the left ESM in the first EXP810 (**2**) to port 1B (**1**) on the left ESM in the third EXP810 (**4**).
2. Connect port 1A on the right ESM in the third EXP810 (**4**) to port 1B (**1**) on the right ESM in the first EXP810 (**2**).
3. Connect port 1B (**1**) on the left ESM in the first EXP810 (**2**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1 of drive channel 2 on the DS4700 Express to port 1B (**1**) on the right ESM in the third EXP810 (**4**).
5. Connect port 1A on the left ESM in the second EXP810 (**3**) to port 1B (**1**) on the left ESM in the fourth EXP810 (**5**).
6. Connect port 1A on the right ESM in the fourth EXP810 (**5**) to port 1B (**1**) on the right ESM in the second EXP810 (**3**).
7. Connect port 1B (**1**) on the left ESM in the second EXP810 (**3**) to port 1 of drive channel 1 on the DS4700 Express.
8. Connect port 2 of drive channel 2 on the DS4700 Express to port 1B (**1**) on the right ESM in the fourth EXP810 (**5**).

Figure 74 on page 92 shows the recommended cabling scheme for one DS4700 Express Storage Subsystem and a maximum of six EXP810 storage expansion enclosures behind both ports of a dual-ported drive channel.

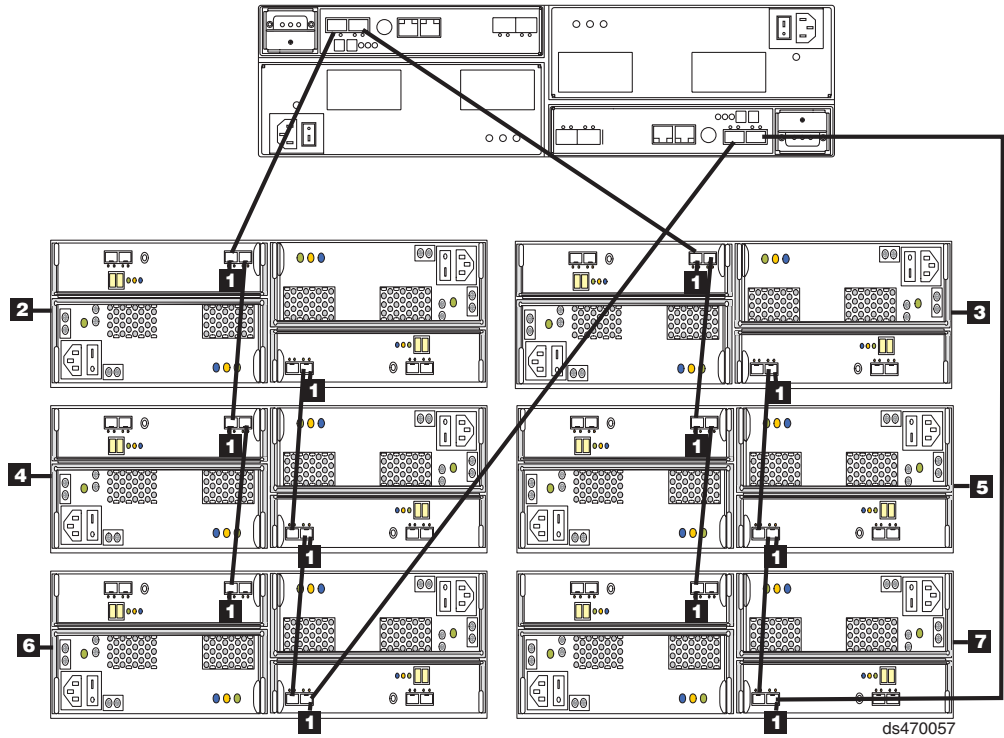


Figure 74. One DS4700 Express and a maximum of six EXP810 storage expansion enclosures behind a pair of DS4700 drive ports

Perform the following steps to create the recommended cabling scheme shown in Figure 74:

1. Connect port 1A on the left ESM in the first EXP810 (**2**) to port 1B (**1**) on the left ESM in the third EXP810 (**4**).
2. Connect port 1A on the right ESM in the third EXP810 (**4**) to port 1B (**1**) on the right ESM in the first EXP810 (**2**).
3. Connect port 1B (**1**) on the left ESM in the first EXP810 (**2**) to port 2 of drive channel 1 on the DS4700 Express.
4. Connect port 1A on the left ESM in the third EXP810 (**4**) to port 1B (**1**) on the left ESM in the fifth EXP810 (**6**).
5. Connect port 1A on the right ESM in the fifth EXP810 (**6**) to port 1B (**1**) on the right ESM in the third EXP810 (**4**).
6. Connect port 1 of drive channel 2 on the DS4700 Express to port 1B (**1**) on the right ESM in the fifth EXP810 (**6**).
7. Connect port 1A on the left ESM in the second EXP810 (**3**) to port 1B (**1**) on the left ESM in the fourth EXP810 (**5**).
8. Connect port 1A on the right ESM in the fourth EXP810 (**5**) to port 1B on the right ESM in the second EXP810 (**3**).
9. Connect port 1B (**1**) on the left ESM in the second EXP810 (**3**) to port 1 of drive channel 1 on the DS4700 Express.
10. Connect port 1A on the left ESM in the fourth EXP810 (**5**) to port 1B (**1**) on the left ESM in the sixth EXP810 (**7**).
11. Connect port 1A on the right ESM in the sixth EXP810 (**7**) to port 1B on the right ESM in the fourth EXP810 (**5**).

12. Connect port 2 of drive channel 2 on the DS4700 Express to port 1B (**1**) on the right ESM in the sixth EXP810 (**7**).

One DS4700 Express and two or more storage expansion enclosures in a mixed configuration

When you cable the DS4700 Express Storage Subsystem to storage expansion enclosures that are in a mixed configuration, it is recommended that you cable the same type of enclosures together. If it is not possible to cable each group of enclosures by model type (EXP100s, EXP710s, and EXP810s) in a separate redundant drive loop pair or behind each port of the dual-ported redundant drive channel pair, group them so that EXP810s are between EXP100s and EXP710s.

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

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

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

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

Figure 75 on page 94 shows an acceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4700 Express environment. The cabling is acceptable because it follows the cabling recommendations.

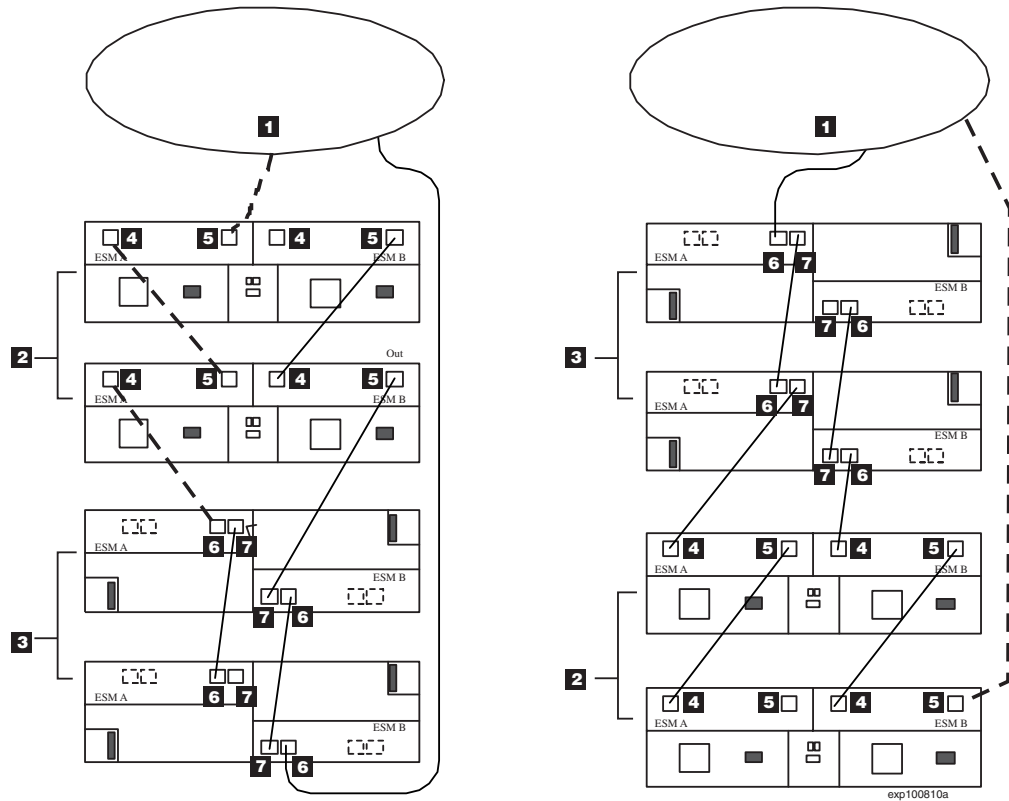


Figure 75. Acceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4700 Express Storage Subsystem environment

Table 28. Description of Figure 75

Number	Description
1	DS4700 Express Storage Subsystem
2	EXP100
3	EXP810
4	IN port
5	OUT port
6	Port 1B
7	Port 1A

Figure 76 on page 95 shows an unacceptable EXP710, EXP810, and EXP100 intermix configuration in a DS4700 Express Storage Subsystem environment. The cabling is unacceptable because storage subsystem controller is cabled to the IN port on the left ESM of the first EXP100.

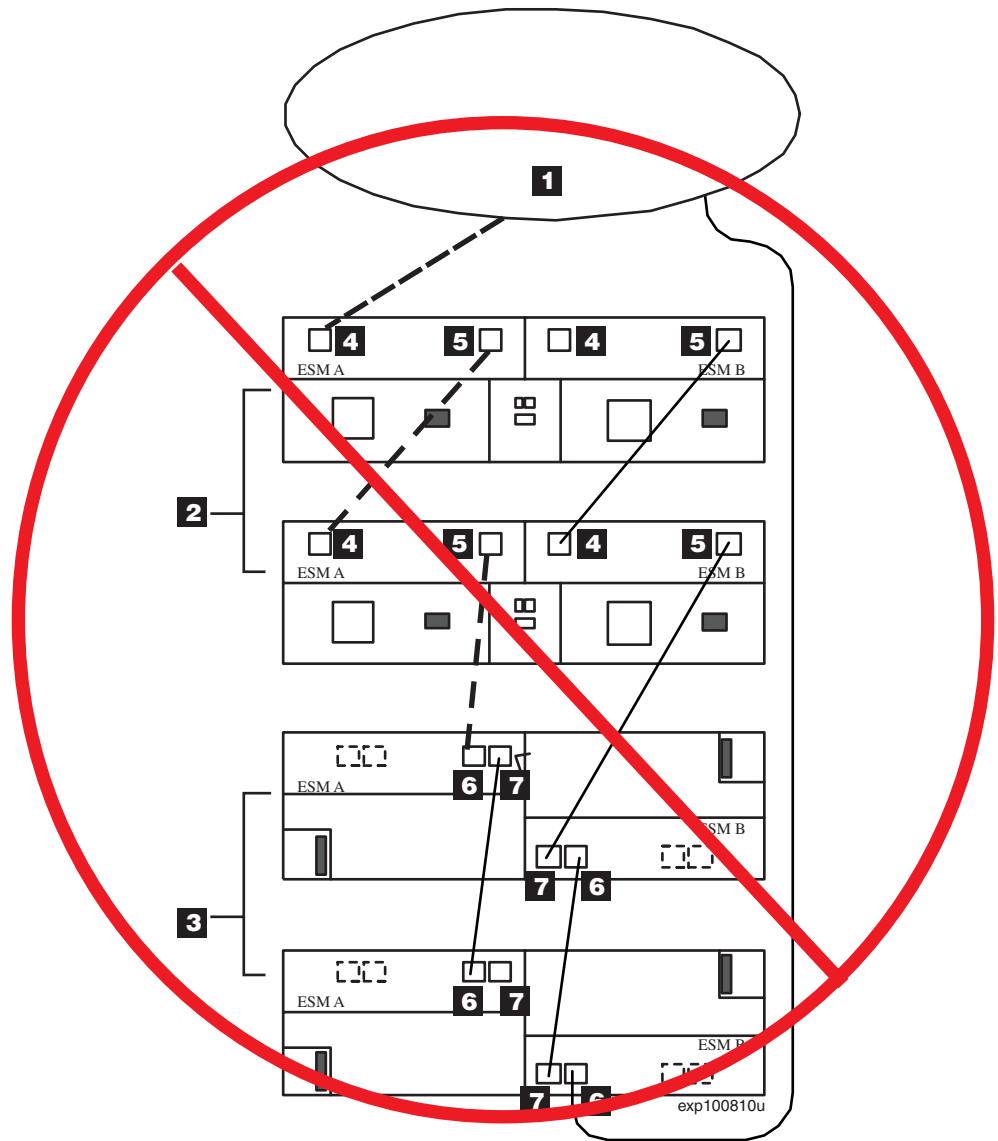


Figure 76. Unacceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4700 Express Storage Subsystem environment

Table 29. Description of Figure 76

Number	Description
1	DS4700 Express Storage Subsystem
2	EXP100
3	EXP810
4	IN port
5	OUT port
6	Port 1B
7	Port 1A

Figure 77 on page 96 shows cabling variations when intermixing EXP100, EXP710, and EXP810 storage expansion enclosures behind a DS4700 Express Storage

Subsystem.

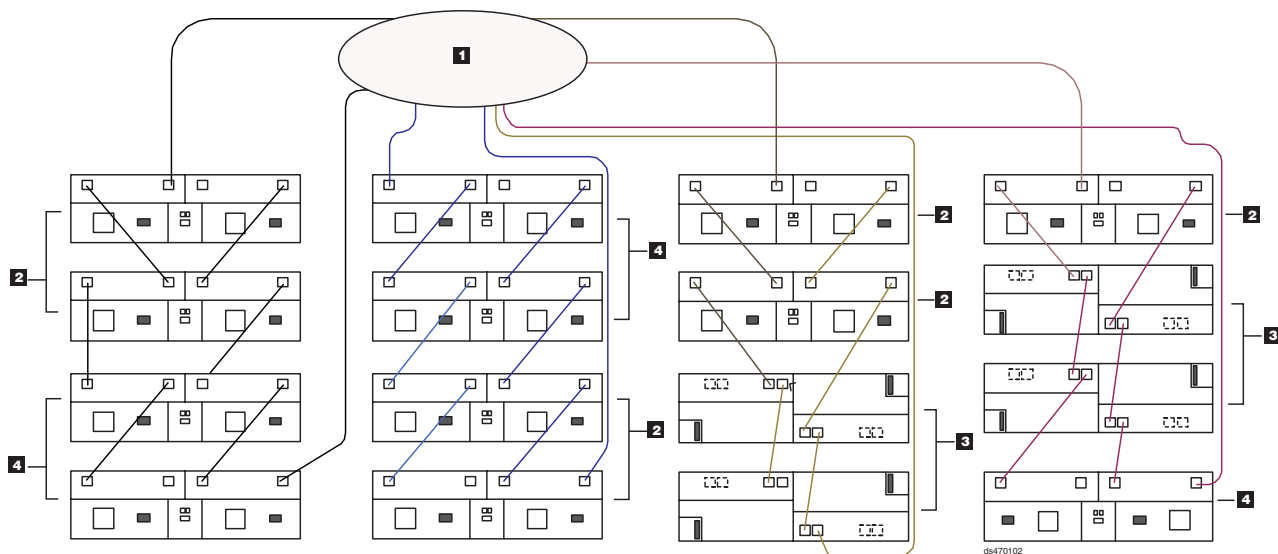


Figure 77. Cabling variations when intermixing EXP100, EXP710, and EXP810 storage expansion enclosures behind a DS4700 Express Storage Subsystem

Table 30. Description of Figure 77

Number	Description
1	DS4700 Express Storage Subsystem
2	EXP100
3	EXP810
4	EXP710

Storage expansion enclosure settings

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

Fibre channel loop and ID settings

When you install an E-DDM in the storage expansion enclosure, the E-DDM 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 E-DDM.

DS4000 storage expansion enclosure ID settings

Some DS4000 storage expansion enclosures, such as the EXP710 and EXP100, have an enclosure ID switch that is used to identify the DS4000 storage expansion enclosure on a fibre channel loop. The enclosure ID switch is located on the back of the unit. Other DS4000 storage expansion enclosures, such as the EXP810, do not have an enclosure ID switch because the controller automatically sets the enclosure ID number.

If required, use a small screwdriver or the tip of a pen to push the small buttons above and below each enclosure ID digit to change the enclosure ID setting. Press the button located above the digit to lower the digit by one. Press the button located below the digit to raise the digit by one.

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

Each storage expansion enclosure in a DS4000 Storage Subsystem drive loop must have a unique enclosure ID. DS4000 controllers use a combination of the enclosure ID and the number of the physical slot that a hard drive occupies to create a unique fibre channel loop address or arbitrated loop physical address (AL_PA) for each drive in a fibre channel drive loop. The enclosure ID consists of two digits, a tens digit (x10) and ones digit (x1).

Attention: When connecting storage expansion enclosures, you must use the tens digit (x10) enclosure ID setting to distinguish different redundant drive channel pairs and use the ones digit (x1) enclosure ID setting to distinguish storage expansion enclosures IDs within a redundant drive channel pair. For example, in a DS4700 Express configuration with six EXP710 or EXP100 storage expansion enclosures connected in a redundant drive channel/loop pair, the recommended enclosure ID settings for the enclosures are shown in Table 31. EXP810 storage expansion enclosures automatically set their enclosure IDs to be unique in a drive channel pair.

Table 31. Recommended enclosure ID settings scheme when connecting a DS4700 to EXP710s or EXP100s

	Enclosure ID of storage expansion enclosures in a redundant drive channel
Enclosure 1	11
Enclosure 2	12
Enclosure 3	13
Enclosure 4	14
Enclosure 5	15
Enclosure 6	16

The DS4700 Express normally ships with an enclosure ID outside the range of 00–77. However, if your DS4700 Express enclosure ID was set to a value within the range of 00–77, it may be in conflict with the enclosure ID of one of the drive expansion enclosures that you are trying to attach to the DS4700 Express. If this is the case, the amber ID Conflict LED on the storage expansion enclosure will light after you power on the storage subsystem.

Give each storage expansion enclosure in a redundant drive channel pair a unique ones digit (x1) ID. This setting will enforce hard AL_PAs (unchangeable between fibre channel Loop Initializations [LIPs]) for the drives and facilitate drive loop problem troubleshooting in the event of an error. If the one's digits are not unique, two or more devices will have the same hard AL_PA. In such a case, the DS4700 Express controller will use soft AL_PAs for the devices that have identical hard AL_PAs.

The problem with soft AL_PAs addressing is that addresses may change between LIPs. This possibility increases the difficulty of troubleshooting drive channel problems, since one cannot easily ascertain whether the same device with a different address or different device may be causing a problem. IBM recommends always setting the enclosure IDs in a given drive channel/loop pair to enforce hard AL_PAs addressing.

Intermixing storage expansion enclosures in the same drive loop

In a DS4700 Express configuration, you can intermix EXP810s, EXP710s, and EXP100s. When intermixing EXP810s with EXP710s or EXP100s in the same drive loop, the Link Rate switch for all storage expansion enclosures in the intermixed drive loop must be 2 Gbps because the EXP710 and EXP100 only operate at 2 Gbps.

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

Table 32 lists the numbers of 14-drive and 16-drive storage expansion enclosures you can combine for use in a single redundant drive channel/loop pair in a DS4700 Express configuration. Table 32 shows the supported storage expansion enclosures combinations per redundant drive channel/loop pair in a DS4700 Express configuration. The table assumes that a DS4700 Express storage subsystem is generally capable of addressing the maximum of 112 fibre channel hard drives for each redundant drive channel/loop pair.

Table 32. Possible combinations of 14-drive and 16-drive storage expansion enclosures per redundant drive/channel loop pair in a DS4700 Express configuration

Number of EXP810s (16 drives/unit)	Total number of drives in EXP810s	Number of EXP710/ EXP100s (14 drives/unit)	Total number of drives in EXP710/ EXP100s	Total number of drives in the DS4700 Express		Total number of drives in a mixed EXP710s and EXP810s drive loop
0	0	7	98	16	=	114
1	16	5	70	16	=	102
2	32	4	56	16	=	104
3	48	3	42	16	=	106
4	64	2	28	16	=	108
5	80	1	14	16	=	110
6	96	0	0	16	=	112

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

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

Connecting secondary interface cables

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

Use the Ethernet interface ports on the back of the storage subsystem to connect the controllers for direct management of the storage subsystems (see “Direct (out-of-band) management method” on page 101).

Important:

1. The serial interface ports are intended to be used by service technicians to perform diagnostic operations on the storage subsystem. Incorrect use of the serial port can result in loss of data access and, in some cases, in loss of data. Do not make connections to the serial port unless you do so under the direct supervision and guidance of IBM support personnel. The serial port connection requires a special PS2 DIN to DB9 male converter. (IBM Service and support personnel, see Serial cable adapter (RoHS) in “Parts listing” on page 186 for FRU P/N.)
2. To minimize security risks, do not connect the DS4700 Express in a public LAN or public subnet. Use a local private network for the DS4700 Express and the management station Ethernet ports.
3. To ensure proper EMI shielding, always use quality braided and shielded serial cables.

Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for controller A (located on the top) and controller B (located on the bottom) on the back of the storage subsystem. Figure 78 shows the location of the ports on the DS4700 Express Storage Subsystem model 70, and Figure 79 on page 100 shows the location of the ports on the DS4700 Express Storage Subsystem model 72. Only one Ethernet port connection from each controller is required to establish a direct (out-of-band) management connection to the DS4700 Express Storage Subsystem.

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

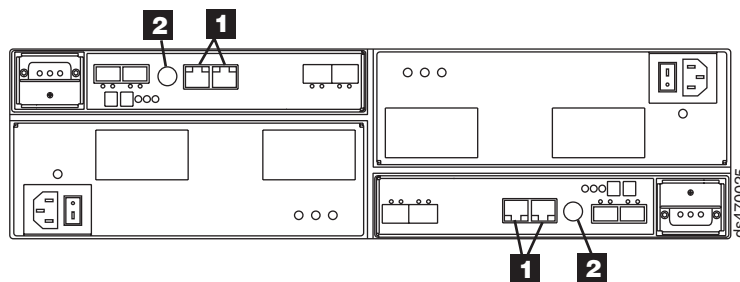


Figure 78. Ethernet and serial port locations on DS4700 Express model 70

Table 33. DS4700 Express Storage Subsystem (Model 72) location of host ports on controllers

Number	Description
1	Ethernet ports Note: Ethernet ports on the left controller are labeled 2 and 1. On the right controller, they are labeled 1 and 2.
2	Serial port

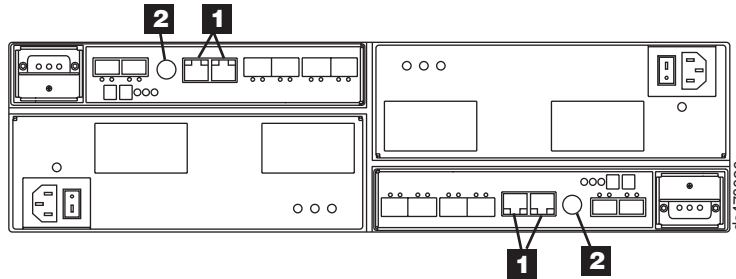


Figure 79. Ethernet and serial port locations on DS4700 Express model 72

Table 34. DS4700 Express Storage Subsystem (Model 72) location of host ports on controllers

Number	Description
1	Ethernet ports Note: Ethernet ports on the left controller are labeled 2 and 1. On the right controller, they are labeled 1 and 2.
2	Serial port

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 DS4700 Express Storage Subsystem.

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

Then, the server will be able to recognize the storage subsystem correctly for host-agent (in-band) management.

Host-agent (in-band) management method

This method requires host-agent software that you install on the host server. The host-agent software allows the DS4000 Storage Manager client program to manage the DS4000 Storage Subsystem using the same fibre channel connections between the host server and the storage subsystem. You must install at least one management station and a software agent host. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Figure 80 shows the host-agent (in-band) management method.

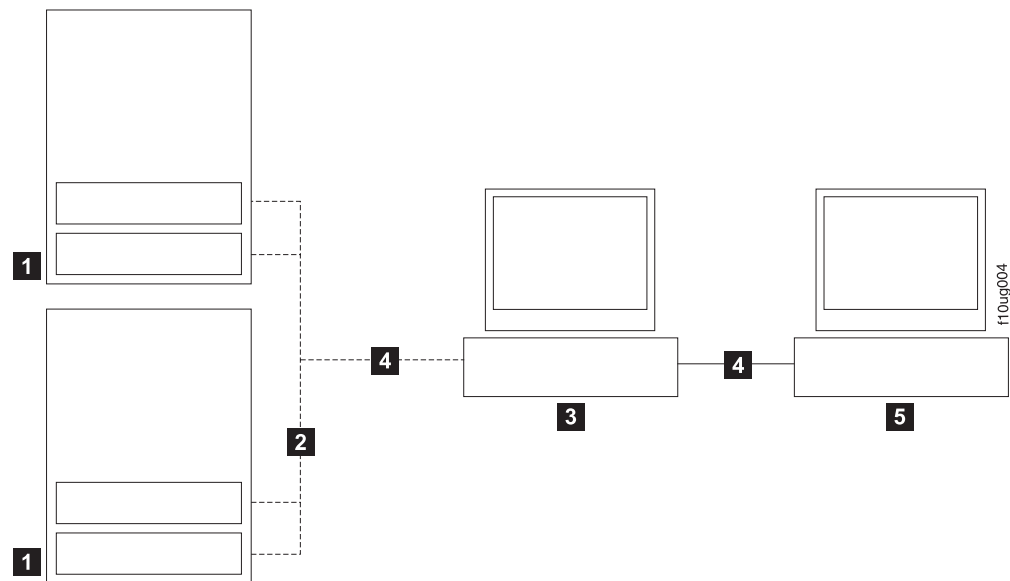


Figure 80. Host-agent (in-band) managed storage subsystems

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 81 on page 102 shows the direct (out-of-band) management method.

You can either use the default controller Ethernet IP addresses for out-of-band connection or change the default controller Ethernet IP addresses by using Dynamic Host Configuration Protocol (DHCP) or Storage Manager client. Refer to the DS4000 Storage Manager Installation, User's and Maintenance Guide for the appropriate operating system for more information on setting the management connections and installing the DS4000 storage subsystem management software.

For a listing of default IP addresses, see "Connectors, switch, and enclosure ID" on page 9.

Note: Do not connect the DS4700 Express Storage Subsystem Ethernet ports to a public network or public subnet. It is strongly recommended that you create a private network between the DS4700 Express Storage Subsystem and the management station.

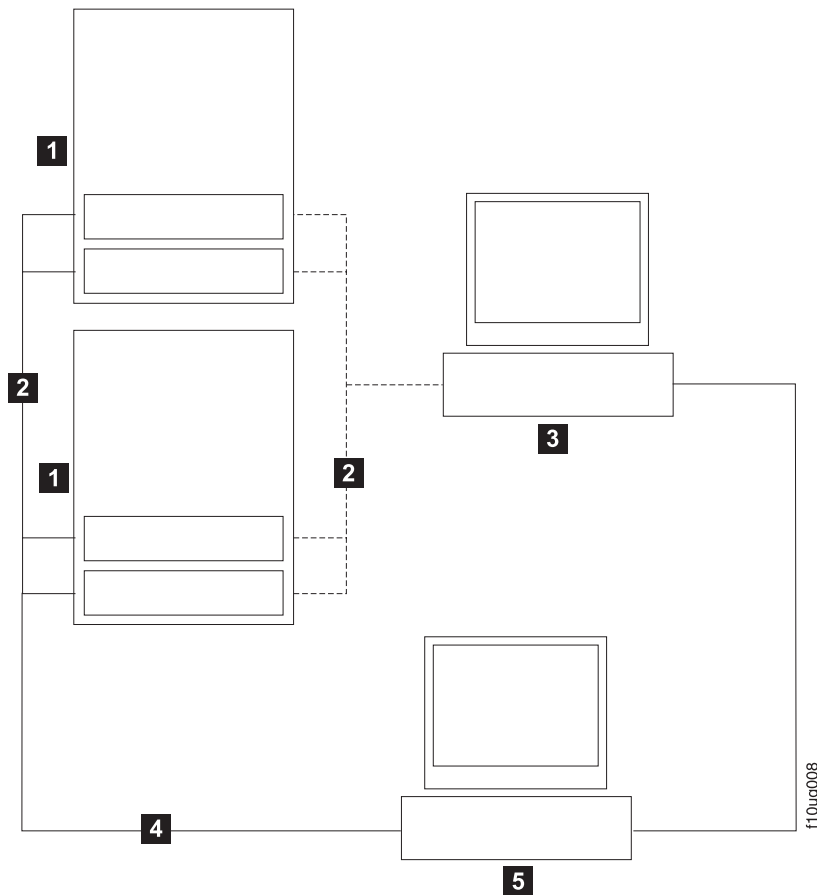


Figure 81. Direct (out-of-band) managed storage subsystems

Connecting hosts to the DS4700 Express

The DS4700 Express supports redundant direct attached connections to up to four hosts (models 72A and 72H). To ensure full protection against the loss of any one fibre channel path from the host servers to the DS4700 Express Storage Subsystem, always use redundant host connections by connecting each host to the appropriate single-ported host channels on both RAID controllers A and B. Using the fibre channel switches, up to 128 hosts can be redundantly attached to the DS4700 Express Storage Subsystem in a fibre channel SAN fabric.

To connect a host adapter to the DS4700 Express RAID controllers, perform the following steps:

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

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

- Connect the fibre channel cables from the SFP modules in the DS4700 Express RAID controller host ports to either the SFP modules in the fibre channel switch or the SFP modules of the host bus adapters. Figure 82 and Figure 83 show the location on the RAID controllers on models 70 and 72 of the DS4700 Express Storage Subsystem where the host-system cables connect.

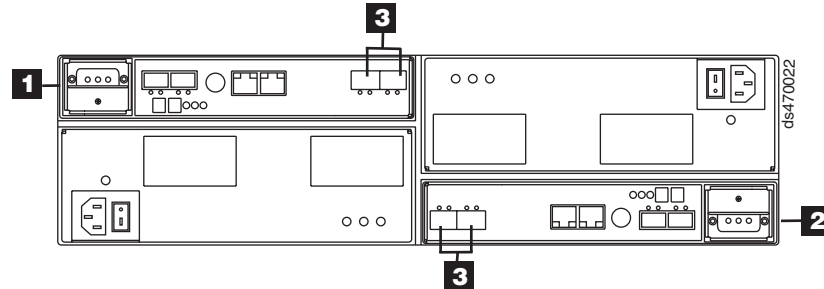


Figure 82. Location of host cables on RAID controllers on model 70 of the DS4700 Express

Table 35. DS4700 Express Storage Subsystem (Model 70) location of host ports on controllers

Number	Description
1	Controller A
2	Controller B
3	Host Ports

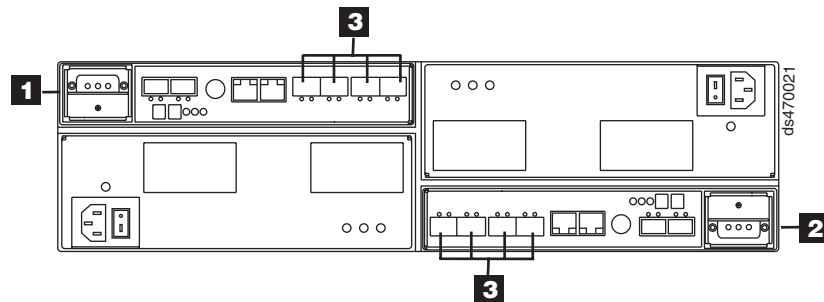


Figure 83. Location of host cables on RAID controllers on model 72 of the DS4700 Express

Table 36. DS4700 Express Storage Subsystem (Model 72) location of host ports on controllers

Number	Description
1	Controller A
2	Controller B
3	Host Ports

- Repeat steps 1 on page 102 and 2 for each additional redundant host connection. You can create a maximum of two redundant host connections for the DS4700 Express Storage Subsystem model 70, as shown in Figure 84 on page 104, or a maximum of four redundant host connections for the DS4700 Express Storage Subsystem model 72, as shown in Figure 85 on page 105.

Note: Figure 85 on page 105 shows a connection to a fibre channel host bus adapter in the DS4700 Express Storage Subsystem. You can also connect to fibre channel switch ports (not shown).

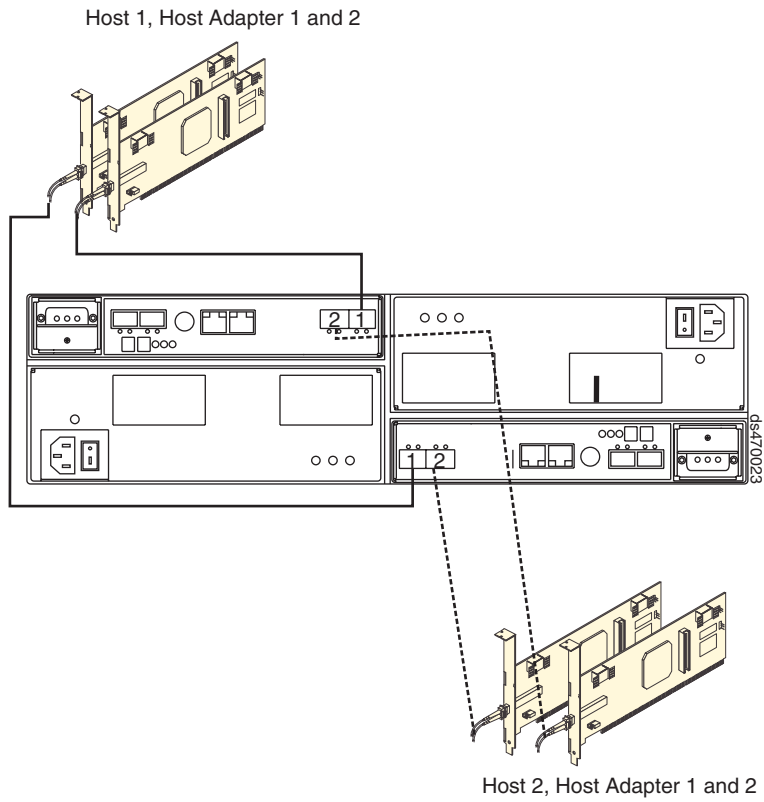


Figure 84. Cabling diagram for two redundant host connections

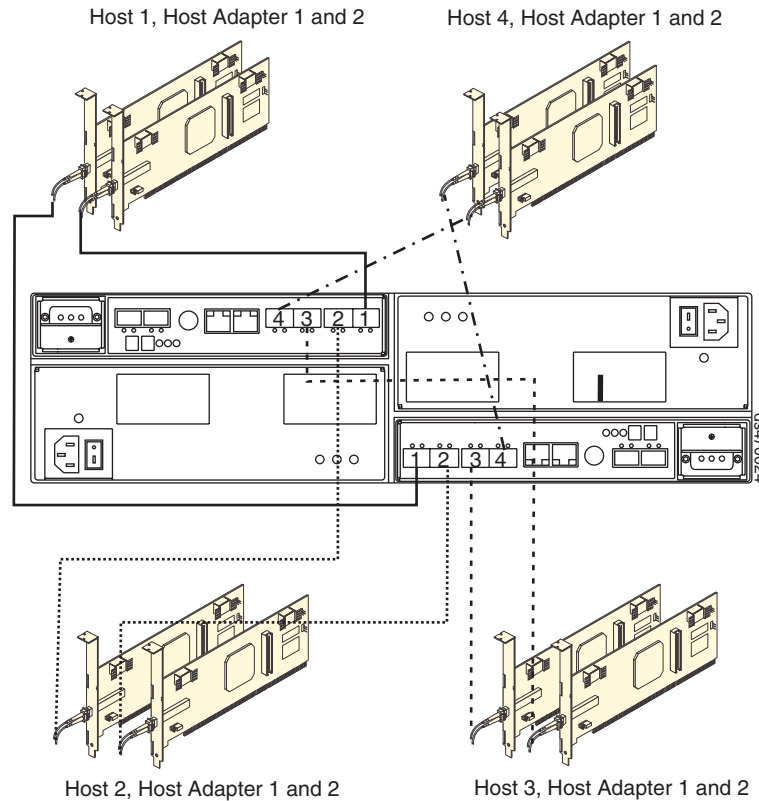


Figure 85. Cabling diagram for four redundant host connections

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

Fibre channel connections

The storage subsystem fibre channel connection consists of up to four host fibre-channel loops and a redundant drive fibre-channel loop. The host fibre-channel loops provide the fibre path for host attachment. They can consist of fibre-channel cables, SFPs, host bus adapters, fibre-channel switches, and RAID controllers. The redundant drive fibre-channel loop provides the fibre path from the DS4700 Express Storage Subsystem to the hard disk drives (HDDs) in the storage expansion enclosures. The redundant drive fibre-channel loop consists of the DS4700 Express Storage Subsystem, the storage expansion enclosures, fibre-channel cables, and SFPs.

The DS4700 Express supports redundant drive channel loop configurations. You can build a redundant drive channel 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, see “Connecting storage expansion enclosures to the DS4700 Express” on page 67.

Fibre channel host loop configurations

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

Note: The minimum DS4700 Express configuration is two partitions. The maximum is 64 partitions. Configuration upgrades are available as upgrade options. Contact your IBM reseller or marketing representative for more information.

Redundant host and drive loops

This section provides examples of DS4700 Express host fibre channel configurations.

DS4700 Express host configurations: This section provides the following examples of DS4700 Express host fibre channel configurations:

- Redundant host and drive fibre channel loop configurations, as shown in Figure 86
- Single SAN fabric configuration, as shown in Figure 87 on page 107
- Dual SAN fabric configuration, as shown in Figure 88 on page 107
- Two storage subsystems in a dual SAN fabric configuration, as shown in Figure 89 on page 108
- Two clusters, as shown in Figure 90 on page 108

Notes:

1. These configurations have host and drive path failover protection and are recommended for high availability.
2. The following illustrations do not accurately represent the controller locations or port locations in the DS4700 Express. The illustrations are for illustration purposes only.

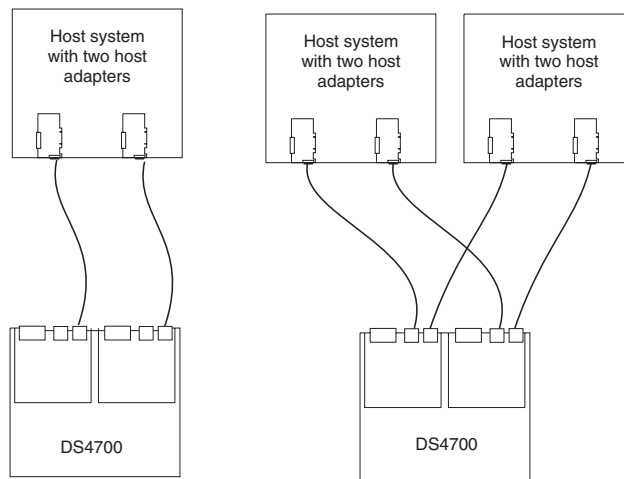


Figure 86. Examples of redundant host direct attached fibre channel configurations

In Figure 87 on page 107, the fibre channel switches are connected together via the inter-switch link (ISL) to form a single SAN fabric.

DS470027

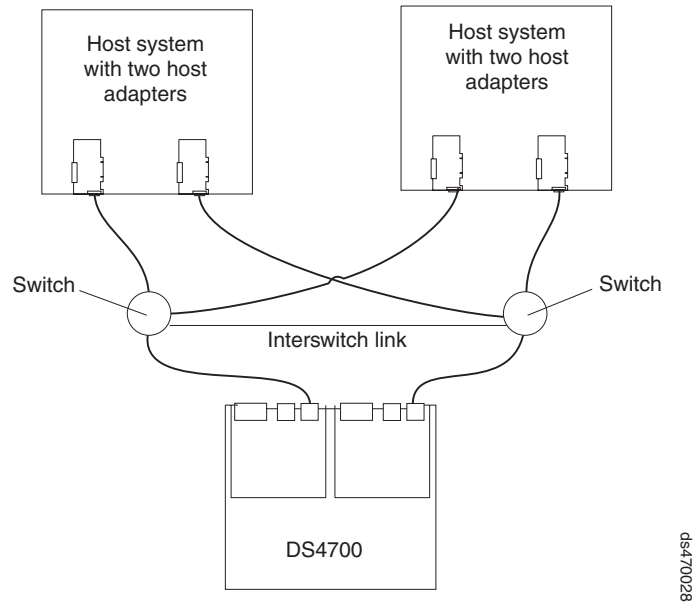


Figure 87. Example of a single SAN fabric configuration

In Figure 88, the fibre channel switches are connected together via the inter-switch link (ISL) to form a dual SAN fabric.

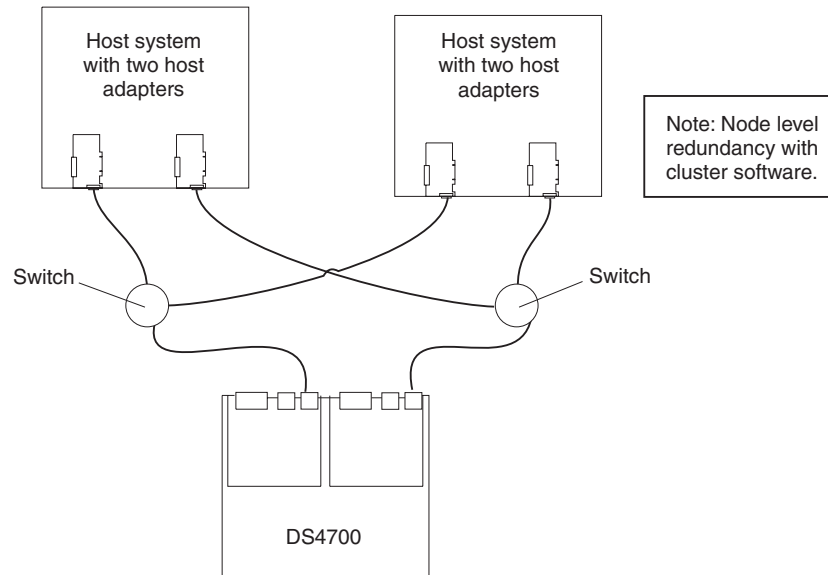


Figure 88. Example of a dual SAN fabric configuration

In Figure 89 on page 108, the fibre channel switches are not connected together. Each switch forms its own SAN fabric.

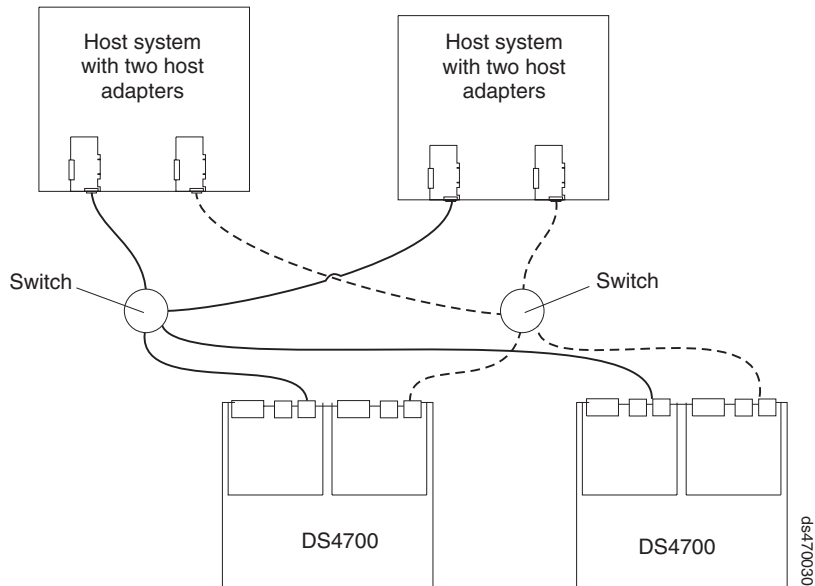


Figure 89. Example of two storage subsystems in a dual SAN environment

Figure 90 shows an example of a two-cluster configuration.

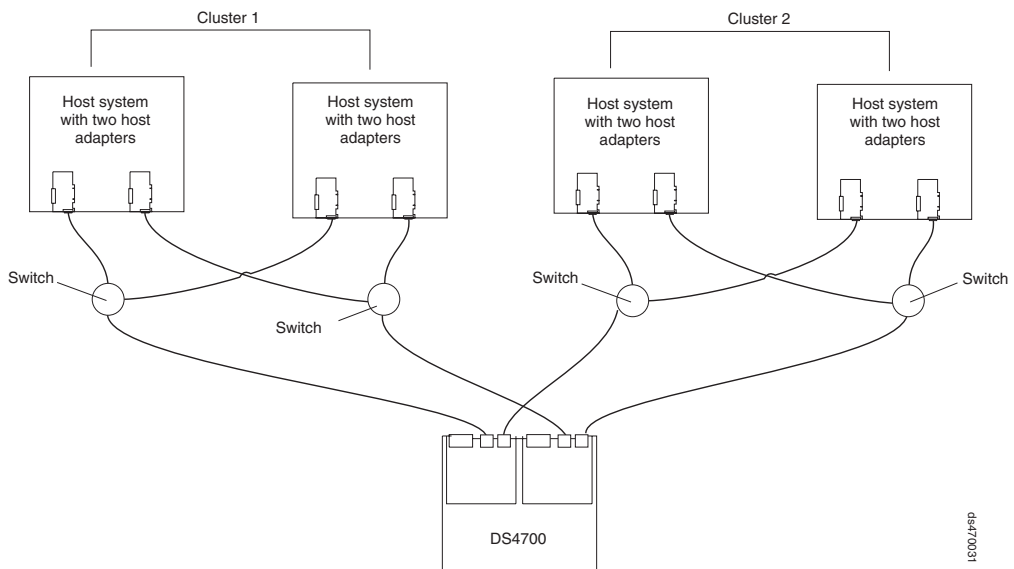


Figure 90. Example of a two-cluster configuration

Installing the storage subsystem configuration

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

Notes:

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

Attach fiber-optic interface cables to each host adapter. You will connect the other end of the cables to the controller later in the installation process. For more information about handling fiber-optic cables, see “Handling fiber-optic cables” on page 57.

Cabling the AC power supply for AC models

Complete the following steps to connect the AC power supply cable:

1. Using the supplied strap, tie the power supply cord to the rail to provide strain relief for the power cord.
2. Connect the power cable to the power supply.
3. Plug the supplied power cable into a properly grounded electrical outlet. For maximum protection against power loss, connect each of the two power supplies to a different power source.
4. Continue with “Powering on the storage subsystem” on page 117 for the initial startup of the storage subsystem.

Cabling the DC power supply for DC models

Statement 29:



CAUTION:

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment.

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. The DC system shall not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

Statement 30:



CAUTION:

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.
- Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).
- The branch circuit overcurrent protection must be rated 20 A.
- Use 12 American Wire Gauge (AWG) or 2.5 mm² copper conductor only, not exceeding 4.5 meters in length.
- Incorporate a readily available approved and rated disconnect device in the field wiring.



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



CAUTION:

There is current to the power supply and fan units even though the power supply switch is in the OFF position. Use a disconnect device to shut power off before unplugging the DC power jumper cable from the DC power supply connectors.

There are two ways to cable the DC power supply and fan units:

- Single-level redundant DC cabling
- Dual-level redundant DC cabling

Single-level redundant DC cabling

In a single-level redundant DC cabling scheme, the DS4700 Express NEBS models are connected to the DC power source using the two DC power cords that are shipped. Only one DC power connector in each of the DC power supply and fan units is connected to a DC power source. The other DC power connector in each DC power supply and fan unit is left open. The DC power connectors A1 (**5**) are connected to the left DC power source (**1**) while DC power connectors B1 (**6**) are connected to the right DC power source (**2**). This cabling scheme protects against any single failure such as failed DC source, DC power supply, or DC cable. Figure 91 on page 111 illustrates single-level redundant cabling.

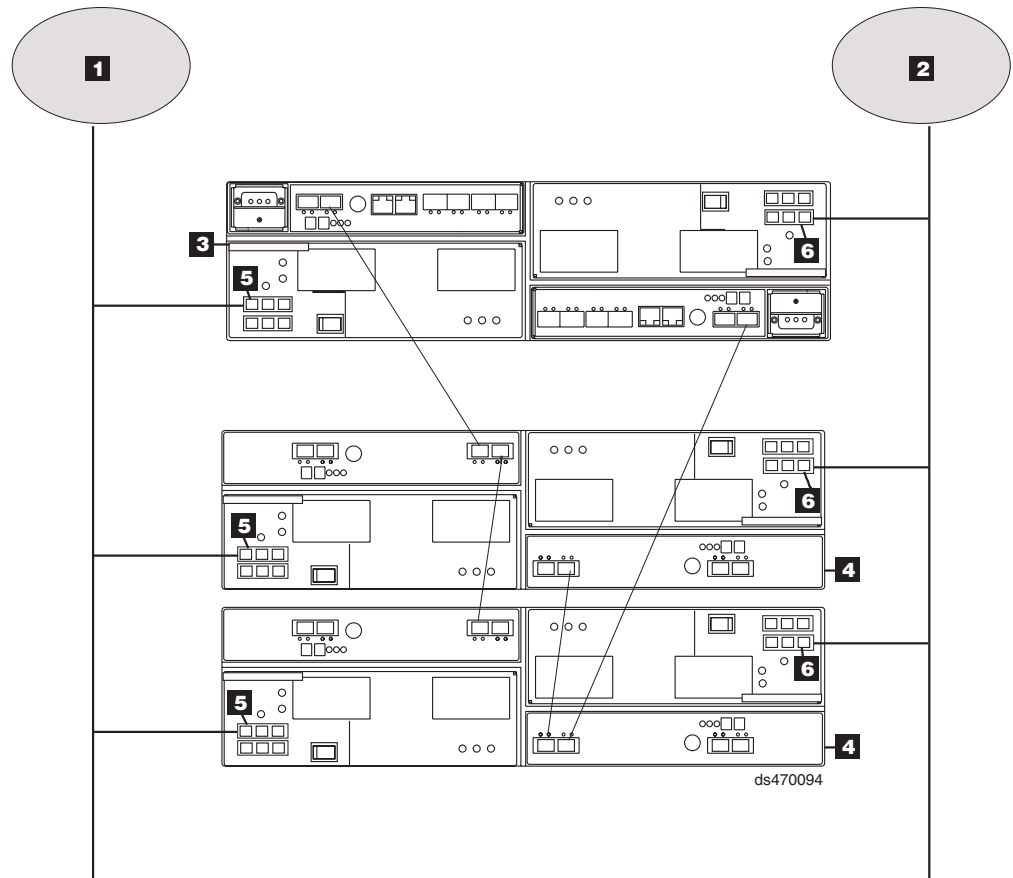


Figure 91. DC power supply and fan unit cabling scheme - single-level redundancy

Dual-level redundant DC cabling

In a dual-level redundancy DC cabling scheme, both DC power connectors in each of the DC power supply and fan units are connected to a DC power source. You will need two additional DC power cables (IBM Option P/N 42D3329) to cable in this way. The DC power connectors A1 (**5**) are connected to the left DC power source (**1**) and DC power connectors A2 (**7**) are connected to the right DC power source (**2**). DC power connectors B1 (**6**) are connected to the right DC power source (**2**) and DC power connectors B2 (**8**) are connected to the left DC power source (**1**). For maximum protection, connect DC power connectors A2 and B2 to a different set of DC power sources than DC power connectors A1 and B1 are connected to.

This cabling scheme protects against certain combinations of dual failures in the DC power supply connections such as a failed DC source and DC power supply and fan unit. For example, if the left DC power source (**1**) and the right side DC power supply and fan unit failed, the DS4700 Express Storage Subsystem remains operational because the DC power is supplied from the right DC power source (**2**) through the left DC power supply connector A2 (**7**).

Figure 92 on page 112 illustrates dual-level cabling.

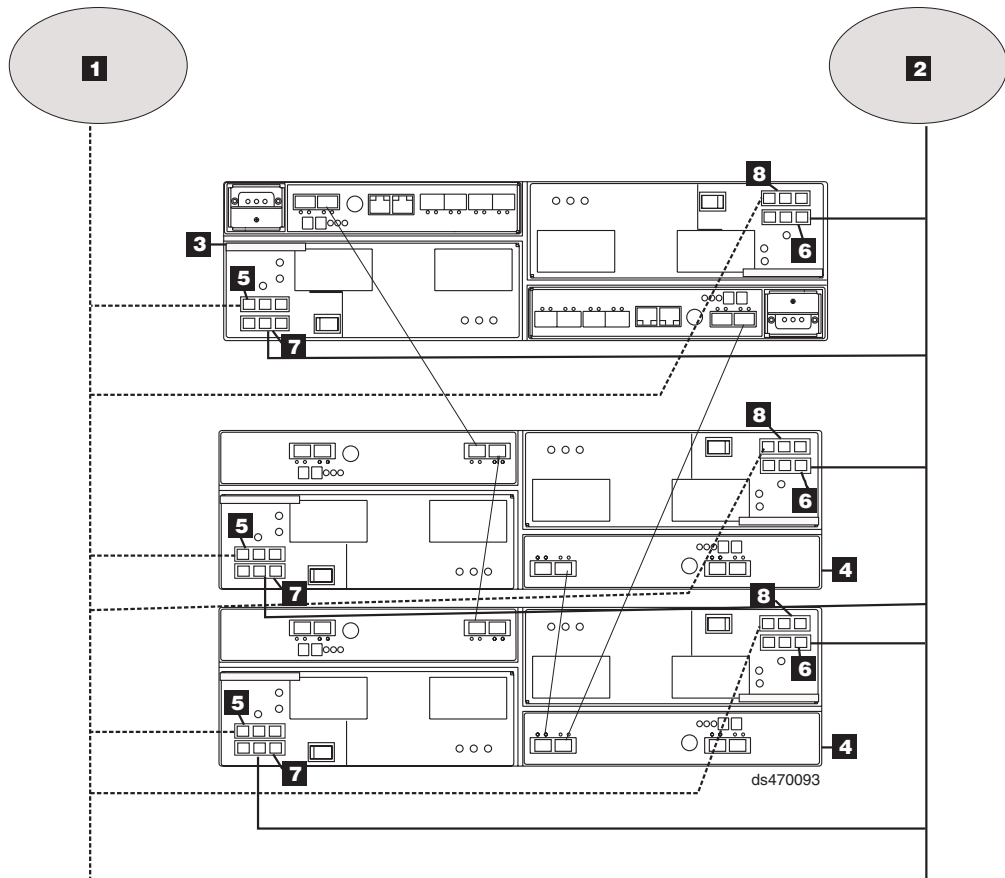


Figure 92. DC power supply and fan unit cabling scheme - dual-level redundancy

Complete the following steps to connect the DC power supply cable:

1. Using the supplied strap, tie the power supply cord to the rail to provide strain relief for the power cord.
2. Connect the DC power cable to the power supply. See Figure 93 for the DC power supply connector PIN positions.

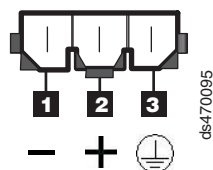


Figure 93. DC power supply connector - PIN positions

Table 37. DC power supply connector - PIN descriptions

Number	Description
1	Pin 1: -48 V DC
2	Pin 2: POS RTN
3	Pin 3: GND

3. Connect the - 48V line of the DC power cable to an approved and rated disconnect device. The disconnect device must be easily accessible from the back of the DS4700 Express unit.

- Complete the wiring from the disconnect device to the terminal marked -48V of the Reliably grounded safety extra low voltage (SELV) DC power source. Connect the POS RTN and ground lines of the DC power cable to the terminals marked POS RTN and GND on the DC power source, as shown in Figure 94. For maximum protection against power loss, connect each of the two DC power supplies to a different power source.

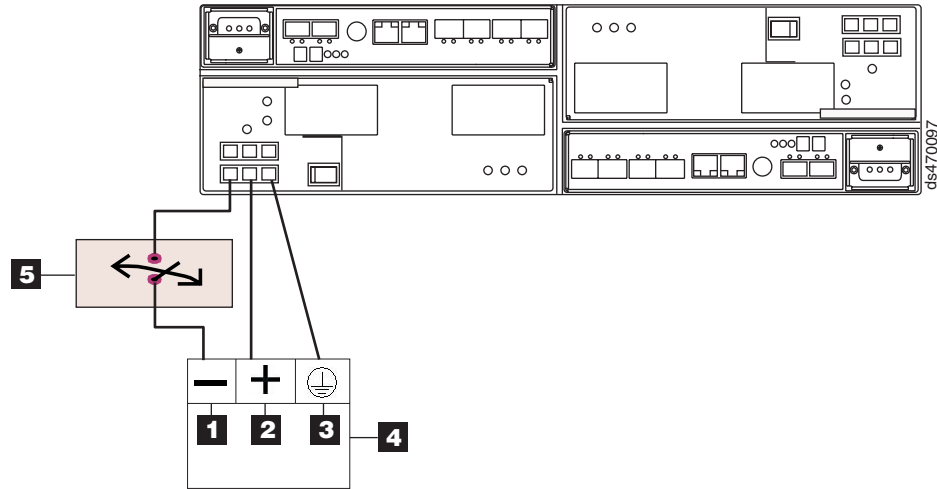


Figure 94. DC wiring from DS4700 Express to disconnect device and DC power source

Table 38. DC power source wiring descriptions

Number	Description
1	Pin 1: -48 V DC
2	Pin 2: POS RTN
3	Pin 3: GND
4	DC power source
5	Disconnect device

- Continue with “Powering on the storage subsystem” on page 117 for the initial startup of the storage subsystem.

Chapter 4. Operating the storage subsystem

This chapter describes operating procedures for the DS4700 Express.

To ensure optimal operation of your system, see “Best practices guidelines” on page 6

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 116 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-1.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.

The following guidelines are suggested:

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

Note: Some updates might require storage subsystem downtime.

- Use IBM-approved fibre channel cables for all situations. Note in your configuration documentation whether any cables are not IBM-approved.

- Create and maintain a cabling diagram of the current SAN configuration. Keep this diagram updated as you make configuration changes, and keep the cabling diagram available for review.
- Create and maintain a list of other components that are being used within the cabling diagram (such as the host system, fibre channel switches, and other SAN attachments).
- Ensure that all ESMs are properly seated.
- Ensure that all drives are properly seated.
- Ensure that all SFP modules are properly seated.
- Confirm fibre channel cable loop size. (IBM specifications call for at least 3-inch cable loops, but it is recommended that you use 6-inch cable loops or longer.)
- Ensure proper fibre channel cable management.
- Ensure proper air flow and temperature for all components in your EXP810 storage configuration.

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

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

Powering on the storage subsystem

This section contains instructions for turning the storage subsystem on under normal and emergency situations. When you turn on and turn off the DS4700 Express, be sure to use the startup sequence in this section. If you are turning on the storage subsystem after an emergency shutdown or power outage, see “Restoring power after an unexpected shutdown” on page 135.

Turning on the storage subsystem

The following procedure covers two situations:

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

Attention:

1. **Potential damage to E-DDMs** - Repeatedly turning the power off and on without waiting for the E-DDMs to spin down can damage them. Always wait at least 70 seconds from when you turn off the power until you turn it on again.
2. If you are connecting a power cord to a DS4700 Express Storage Subsystem or storage expansion enclosure, turn off both of its power switches first. If the main circuit breaker is off, be sure both power switches are off on each storage expansion enclosure in the cabinet before turning on the main circuit breakers.

1. Are the main circuit breakers turned on?

- **Yes** - Turn off **both** power switches on each enclosure that you intend to connect to the power.
 - **No** - Turn off **both** power switches on **all** enclosures in the storage subsystem. For DC power supply and fan units only, turn off the disconnect devices for all of the DC power supply and fan units.
2. Ensure that all power cords are connected. See “Cabling the AC power supply for AC models” on page 109 or “Cabling the DC power supply for DC models” on page 109 for details, depending on your model.

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

3. If the main circuit breakers are turned off, turn them on.
4. Verify that the link rate setting on the front of the storage expansion enclosure matches the speed of the drives in the subsystem.

Attention: You must turn on power to each attached storage expansion enclosure before turning on power to the DS4700 Express Storage Subsystem to ensure that the controllers recognize all drives in the configuration during the startup process.

5. (For models with DC power supply and fan units only) Verify that any attached disconnect devices are turned ON.
6. Turn on both power switches on the back of each storage expansion enclosure attached to the storage subsystem. While each storage expansion enclosure powers up, the green and amber LEDs on the front and back of the storage expansion enclosure turn on and off intermittently. Depending on your configuration, it can take several minutes for each storage expansion enclosure to power up.

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

Note: The drive activity LEDs will flash slowly (once every 2 seconds) until the drive is started by the DS4700 Express controller.

7. Turn on both power switches on the back of each controller in the storage subsystem. See Figure 4 on page 13 and Figure 5 on page 14 for power switch locations on AC power supply and fan units and see Figure 8 on page 16 and Figure 9 on page 17 for power switch locations on DC power supply and fan units.

Depending on the number of storage expansion enclosures in the configuration, the storage subsystem might take several minutes to power up. The battery self-test might take an additional 15 minutes. The LEDs will blink intermittently until the storage subsystem powers up and completes the battery self-test. The green Battery Charging LED will flash slowly (once every 2 seconds) until the battery is fully charged.

Before attempting any operations, wait at least five minutes for the storage subsystem to completely power up. A storage subsystem can take up to 10 minutes to power on and up to 15 more minutes to complete its controller battery self-test. During this time, the indicator lights on the front and back of the module blink intermittently.

8. Determine the status of all storage subsystems and components in the configuration by completing the following steps:
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status. For more information on LED status for storage expansion enclosures, see “Checking the LEDs” on page 123 or the Installation, User’s, and Maintenance Guide for your DS4000 storage expansion enclosure.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status. For information about LED status, see “Solving problems” on page 181.
 - c. Open the DS4000 Storage Manager Subsystem Management window, and display the Physical View for the configuration.
The status for each component will be either Optimal or Needs Attention.
 - d. Review the status of the configuration components shown in the Subsystem Management window by selecting the appropriate component button for each storage subsystem.
9. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes — End of procedure.
 - No — Go to step 10.
10. Diagnose and correct the fault by completing the following steps.
 - a. Run the DS4000 Storage Manager Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.
If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the specific failed component. For troubleshooting procedures, see Chapter 6, “Hardware maintenance,” on page 181.
 - c. When the recovery procedure is completed, select Recheck in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been corrected.
 - d. If the problem persists, contact your IBM service representative.

Installing the DS4000 Storage Manager client

Refer to the *IBM System Storage DS4000 Storage Manager Version 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 setup until you have completed the DS4000 Storage Manager installation.

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

- HBA drivers
- Controller firmware version listed in Table 10 on page 22
- IP addresses for RAID controllers (for in-band management only)
- Additional documentation for switches and HBAs, if needed

- Appropriate host kit for your operating system, which includes the *DS4000 Storage Manager Support CD* containing the appropriate Storage Manager version and storage subsystem controller firmware.

Depending on the DS4700 Express model you order, your DS4700 Express will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4700 Express. The kit includes a *DS4000 Storage Manager Support CD* that has the appropriate IBM DS4000 Storage Manager host software. The CD also includes controller firmware version 06.16.xx.xx.

For the latest controller firmware and the DS4000 Storage Manager host software for your operating systems, check the IBM support web site for DS4000 storage products.

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

Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than the logical drives created for the DS4700 Express.

Always refer to the readme that is included with the DS4700 Express Storage Subsystem firmware package (whether the firmware is accessed by the Web or CD) for any special requirements or restrictions that apply to that particular firmware version.

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

Monitoring status through software

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

Notes:

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

For more information, see the Enterprise Management online Help.

Important: Refer to the *IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager host software.

In addition, to download the latest version of the DS4000 Storage Manager host software, the DS4700 Express Storage Subsystem

controller firmware and NVSRAM, and the latest DS4000 ESM firmware, go to the following Web site:

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

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

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

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

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

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

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

Attention: Not following the software-recovery procedures can result in data loss. In addition, always replace a failing component as soon as possible to minimize additional failures that might occur, causing loss of data access.

Finding controller, storage expansion enclosure, and drive information

You can view a Storage Subsystem Profile to find controller, enclosure, and drive information for the DS4700 Express Storage Subsystem and attached storage expansion enclosures. To view a Storage System Profile, perform the following steps:

1. Open the DS4700 Express Storage Subsystem Management window from the DS4000 Storage Manager Enterprise Management window.
2. Select **Storage Subsystem** → **View** → **Profile**.
A Storage Subsystem Profile window opens.
3. Select the Controllers tab.
4. Scroll through the list to find Board ID, Submodel ID, Product ID, and Product revision for the DS4700 Express Storage Subsystem.
5. Select the Enclosures tab.
6. Scroll through the list to find the Product ID for supported storage expansion enclosures.
7. Select the Drives tab.

8. Scroll through the list to find the E-DDM values such as Product ID.

Firmware updates

Attention: Save the storage subsystem profile before performing any controller or ESM firmware upgrades. Save the DS4700 Express storage subsystem profile and all configuration (*.cfg) files to a server disk that will remain accessible in the event of a DS4000 storage configuration failure. Do not save these files only to a LUN in the DS4000 Storage Subsystem.

To ensure the optimal operation of the DS4700 Express and its attached storage expansion enclosures, the storage expansion enclosure ESM firmware, the DS4700 Express controller firmware, the hard drive firmware, and the NVSRAM (for controllers only) must be up to date. Go to the following Web site to get the latest updates.

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

Always check the readme files that are included with the firmware packages for the most up-to-date information about firmware prerequisites, firmware update instructions, and host I/O restrictions, if any. Apply the necessary updates before configuring the storage subsystem arrays and logical drives. Subscribe to My Support for automatic notifications of firmware or Storage Manager software updates or any important information about your DS4000 subsystems (see “Product updates” on page 5).

Attention: Read the readme file that is included in each firmware or DS4000 Storage Manager software package for any limitations, subsystem firmware prerequisites, or download-sequence information. For example, the controller firmware code might require the storage expansion enclosure ESM firmware to be upgraded first to a particular version, or the controller firmware download might require the halting of I/Os to the DS4700 Express’s logical drives. Failure to observe the limitations, prerequisites, and dependencies in the readme file might result in a loss of data access.

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

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

Troubleshooting the storage subsystem

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

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

1. Open the Subsystem Management window.

2. Select the component button for each storage expansion enclosure in this storage subsystem, and view the status of each of the components.
The status for each component is either Optimal or Needs Attention.
3. Does any component have a Needs Attention status?
 - **Yes** - Go to step 4.
 - **No** - All components are Optimal. Go to step 6.
4. Select the Recovery Guru toolbar button. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru might direct you to replace the failed component. If so, go to step 5.
Attention: If the fault requires you to power off an attached storage expansion enclosure, you might need to cycle the power on the DS4000 storage subsystem and all remaining storage expansion enclosures in the storage subsystem. Contact IBM Customer and Technical Support before powering off any attached storage expansion enclosures.
5. Mute the alarm, if needed.
6. Check the indicator LEDs on the front and the back of the storage expansion enclosure.
A green LED denotes a normal status; an amber LED denotes a hardware fault.
7. Is an amber LED on?
 - **Yes** - Locate and troubleshoot the failed components. See “Checking the LEDs.”
 - **No** - You are finished with this procedure. If you are still experiencing a problem with this storage subsystem, create, save, and print a storage subsystem profile. This information might be helpful when troubleshooting. Contact IBM Customer and Technical Support for assistance. When the recovery procedure is completed, select **Recheck** in the Recovery Guru to rerun the Recovery Guru and to ensure that the problem has been corrected.

Checking the LEDs

The LEDs display the status of the storage subsystem and components. The color of the LED is important.

- Green LEDs indicate a normal operating status
- Amber LEDs (Needs Attention) indicate a possible failure
- Blue LED on a CRU indicates that is safe to remove the component

The DS4700 Express Storage Subsystem also has a blue Global Locate LED that is lit when the menu function is selected in the Subsystem Management window, causing the LOCATE command to be sent to the DS4700 Express.

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

AC power supply and fan unit LEDs

This section describes the primary power supply and fan unit LEDs on the DS4700 Express Storage Subsystem (models 70A, 70H, 72A, and 72H).

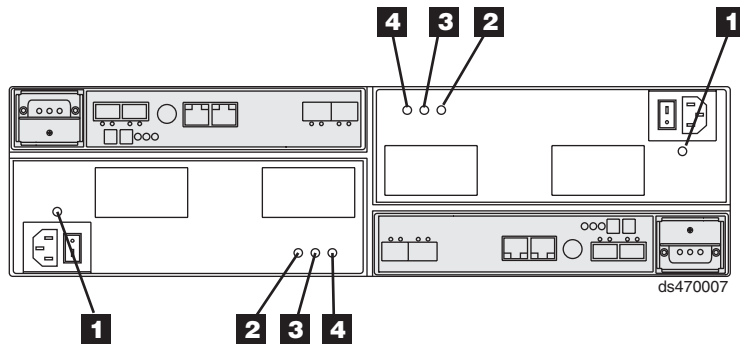


Figure 95. Power supply and fan unit LEDs

Table 39. Power supply and fan unit LEDs

Number	LED	Normal Status	Problem Status
1	Power supply and fan unit Power AC	On	Off
2	Service Action Allowed (OK to Remove) OK	Off	On
3	Service Action Required (Fault) !	Off	On
4	Direct Current Enabled DC	On	Off

DC power supply and fan unit LEDs

This section describes the primary DC power supply and fan unit LEDs on the DS4700 Express Storage Subsystem (models 70S, 70T, 72S, 72T).

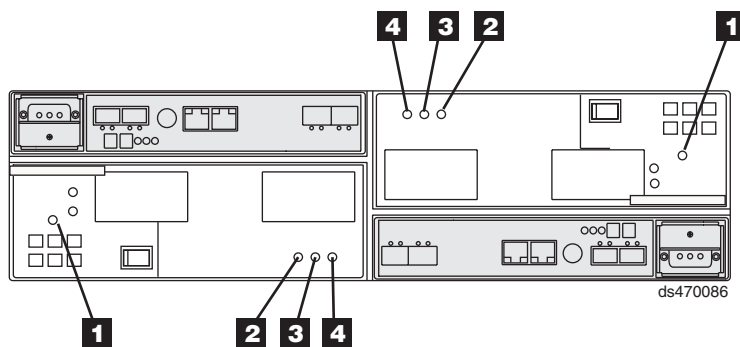






Figure 96. DC power supply and fan unit LEDs

Table 40. DC power supply and fan unit LEDs

Number	LED	Normal Status	Problem Status
1 ¹	DC power supply and fan unit power 	On	Off
2	Service Action Allowed (OK to Remove) 	Off	On ²
3	Service Action Required (Fault) 	Off	On ²
4 ¹	Direct Current Enabled 	On	Off

Notes:

1. Although the symbols for DC power supply and fan unit power and Direct Current Enabled LEDs are the same, the LEDs serve different purposes. The DC power supply and fan unit power LED indicates that DC inputs to the DC power supply and fan unit are present and good. The Direct Current Enabled LED indicates that the DC output from the DC power supply and fan unit to the internal circuitry is good.
2. Verify that any attached disconnect device is set to On and the power switch is in the On position when these LEDs are lit. If the disconnect device switch is at the On position, flip it to the Off position, wait at least 15 seconds and flip it again to the On position. If these LEDs did not change to an unlit state in 30 seconds, replace the DC power supply and fan unit CRU.

Front LEDs

This section describes the primary LEDs and controls on the front of the storage subsystem for all models.

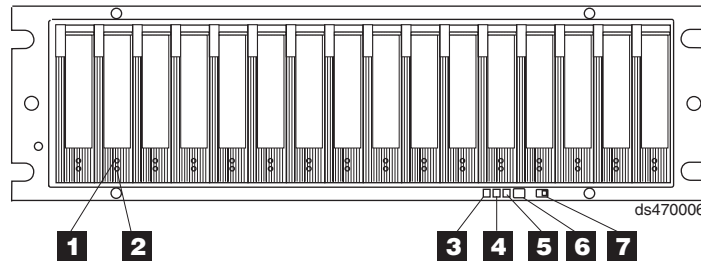





Figure 97. Front LEDs and controls

Table 41. Front LEDs and controls

Number	LED	Normal Status	Problem Status
1	Drive Activity LED	On (not blinking) - No data is being processed Blinking - data is being processed	Off

Table 41. Front LEDs and controls (continued)

Number	LED	Normal Status	Problem Status
2	Drive Fault LED	Off Blinking - Drive, volume, or storage array locate function	On (not blinking)
3	Global Locate 	On	N/A
4	Global Summary Fault 	Off	On
5	Global Power 	On	Off
6	Reset Alarm Mute Button	N/A	N/A
7	Link Rate Switch	Set to the 2 Gbps or 4 Gbps position, depending on your configuration.	N/A

Battery unit LEDs

This section describes the primary LEDs on the storage subsystem battery units for all models.

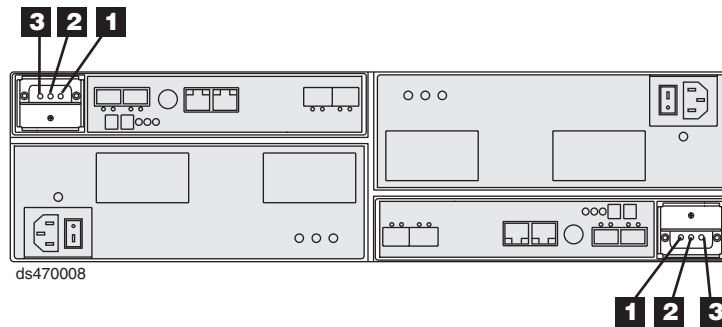


Figure 98. Battery unit LEDs

Table 42. Battery unit LEDs

Number	LED	Normal Status	Problem Status
1	Service Action Allowed (OK to Remove)	Off	On
2	Service Action Required (Fault)	Off	On
3	Battery Charging	Green means on, ready Blinking green means charging	Off

The Global Power, Global Summary Fault, and Global Locate LEDs are general indicators for the entire DS4700 Express Storage Subsystem (or configuration, in the case of the Global Summary Fault). The Global Summary Fault LED turns on if a fault condition is detected in any component in the storage subsystem configuration, including all attached storage expansion enclosures. The Global Power, Global Summary Fault, and Global Locate LEDs shine through the front bezel.

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

Controller LEDs

This section describes the primary LEDs, controls, and connectors on the rear of the storage subsystem controller for all models.

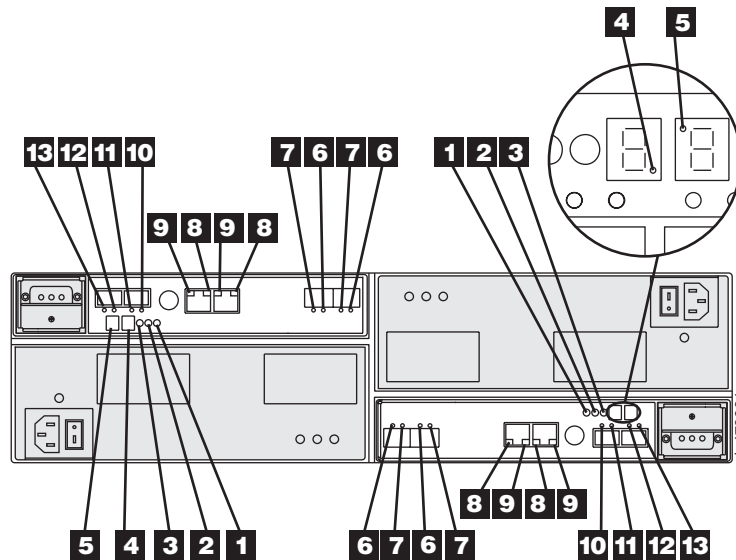


Figure 99. Rear controller LEDs, controls, and connectors - Model 70

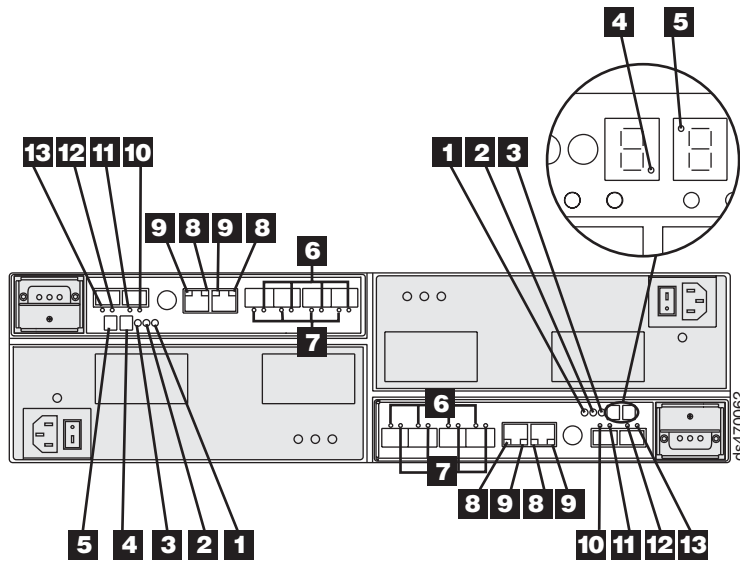


Figure 100. Rear controller LEDs, controls, and connectors - Model 72

Table 43. Rear controller LEDs, controls, and connectors




Number	LED	Normal Status	Problem Status
1	Service Action Allowed (OK to Remove) 	Off	On
2	Service Action Required (Fault) 	Off	On
3	Cache Active 	On - Data is in cache Off - Caching is turned off. No data in cache	Not applicable
4	Diagnostic	On - Seven-segment LEDs indicate diagnostic code Off - Seven-segment LEDs indicate enclosure ID	Not applicable
5	Heartbeat	Blinking	Off
6	Host Channel Speed - L1	See Table 44 on page 129.	
7	Host Channel Speed - L2	See Table 44 on page 129.	
8	Ethernet Link Speed	On - 100 Mbps Off - 10 Mbps	Not applicable
9	Ethernet Link Activity	On - link established Off - no link established Blinking - activity	Not applicable

Table 43. Rear controller LEDs, controls, and connectors (continued)

Number	LED	Normal Status	Problem Status
10	Drive Channel Port Bypass (One LED per port) Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that comprise a drive channel. The LED marked 13 shows the status of the other port.	Off (Also off if no SFP connected)	On - No valid device detected and port is bypassed
11	Drive Channel Speed - L1	See Table 44.	
12	Drive Channel Speed - L2	See Table 44.	
13	Drive Channel Port 2 Bypass (One LED per port) Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that comprise a drive channel. The LED marked 10 shows the status of the other port.	Off (Also off if no SFP connected)	On - No valid device detected and port is bypassed

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

Table 44. Host and drive channel LED definitions

L1	L2	Definition
Off	Off	When both LEDs for a host or drive channel are off, this indicates one or more of the following conditions: <ul style="list-style-type: none"> The host or drive channel ports are bad or the SFPs are faulty. An SFP module is inserted with no fibre channel cable attached. Note: If the SFP is inserted in a drive port with no fibre channel attached, the associated drive port bypassed LED will also be lit. In addition, the L1 and L2 LEDs will be unlit. No SFP module is inserted in one or both of the host or drive ports in the channel.
On	Off	The host or drive channel is operating at 1 Gbps. Note: This pattern is not applicable in the drive port because the DS4700 Express does not support 1 Gbps fibre channel speed.
Off	On	The host or drive channel is operating at 2 Gbps.
On	On	The host or drive channel is operating at 4 Gbps.

Seven-segment numeric display LEDs

The numeric display consists of two seven-segment LEDs that provide information about enclosure identification and diagnostics. Figure 101 shows the numeric display and the diagnostic LED.

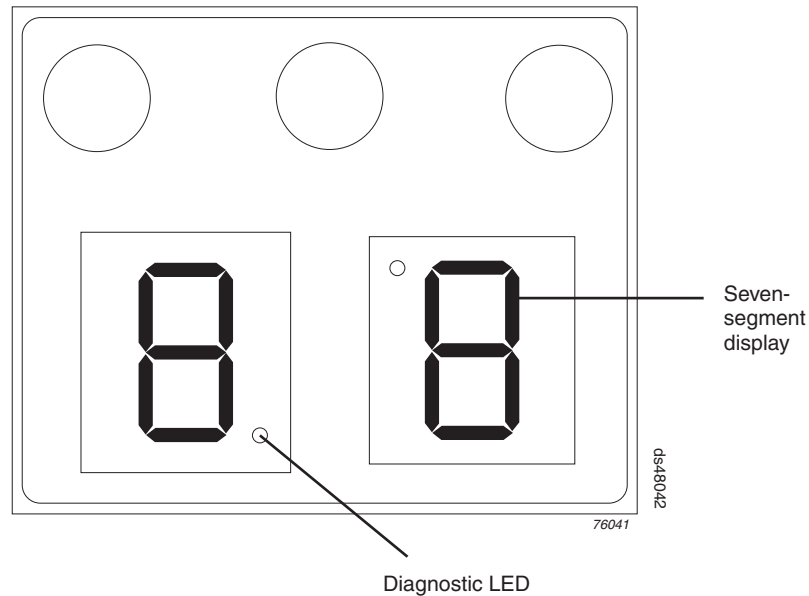


Figure 101. Numeric display LEDs

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

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

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

Diagnostic codes in the form of Lx or Hx, where x is a hexadecimal digit, indicate storage subsystem state information. In general, these codes are displayed only when the storage subsystem is in a non-operational state. The storage subsystem might be non-operational due to a configuration problem (such as mismatched types), or it might be non-operational due to hardware faults. If the storage subsystem is non-operational due to system configuration, the storage subsystem Needs Attention LED is off. If the storage subsystem is non-operational due to a hardware fault, the storage subsystem Needs Attention LED is on. The definitions for Lx diagnostic codes are listed in Table 45 on page 131.

Table 45. Numeric display diagnostic codes

Value	Controller State	Description	Storage Manager View
L0	Suspend	Mismatched controller board ID	Needs Attention condition for board ID mismatch
L2	Suspend	Persistent memory errors	Needs Attention condition for offline controller
L3	Suspend	Persistent hardware errors	Needs Attention condition for offline controller
L5	Offline	The alternate controller has incompatible firmware but automatic controller firmware synchronization (ACS) cannot be performed	Needs Attention condition for offline controller
L7	Suspend/Offline	Controller with different controller submodel ID inserted. A DS4200 Express controller is inserted in a DS4700 Express Storage Subsystem.	Needs Attention for offline controller
L8	Offline	Unsupported memory is present or memory is not populated in the correct memory slots	Need Attention because the controller is in offline/failed state
88	Reset	Controller is held in reset by the other controllers	Needs Attention condition for offline controller

Powering off the storage subsystem

The DS4700 Express is designed to run continuously. After you turn it on, do not turn it off. Turn off the power only in the following situations:

- Instructions in a hardware or software procedure require that you turn off the power.
- An IBM technical support representative instructs you to turn off the power.
- A power outage or emergency situation occurs, see “Restoring power after an unexpected shutdown” on page 135.

Turning off the storage subsystem

Use the following procedure to turn off the power for the DS4700 Express.

Attention: Except in an emergency, never turn off the power if any Needs Attention LEDs are on. Correct the fault before you turn off the power. Use the DS4000 Storage Manager client and the Needs Attention LEDs to check the overall status of the DS4700 Express. 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. This ensures that the DS4700 Express will power up correctly later.

The DS4700 Express is designed to run continuously. After you turn on the DS4700 Express, do not turn it off. Turn off the power only in the following situations:

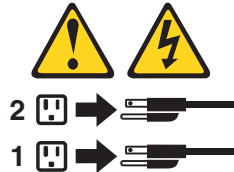
- Instructions in a hardware or software procedure require that you turn off the power.
- An IBM technical support representative instructs you to turn off the power.
- A power outage or emergency situation occurs, see “Restoring power after an unexpected shutdown” on page 135.

Statement 5:



CAUTION:

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



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



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

Power-off overview

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

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

1. Turn off power to the host before the storage subsystem. If the host must stay powered on to support an existing network, see the operating system documentation for information about disconnecting the storage subsystem logical drives from the host before the storage subsystem is powered off.
2. Turn off power to the storage subsystem before you turn off power to the storage expansion enclosures. Turn off both power supply switches on the back of the storage subsystem.
3. (DS4700 Express DC models only) Turn off power to attached disconnect devices.
4. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

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

Use the following procedure to turn off power to one or more storage subsystems for a planned shutdown. To turn off power for an unplanned shutdown, see “Restoring power after an unexpected shutdown” on page 135.

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

1. Stop all I/O activity to each storage subsystem.
2. Remove the front cover from the storage subsystem, if applicable.
3. Determine the status of all storage subsystems and components in the configuration by completing the following steps:
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status.
 - c. Open the Subsystem Management window for the configuration and display the Physical View for the configuration.
 - d. Review the status of the configuration components shown in the Subsystem Management window by selecting the appropriate component button for each storage subsystem.

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

4. Are the LEDs indicating normal operation, and is the status Optimal on all configuration components?
 - **Yes** - Go to step 6 on page 134.
 - **No** - Go to step 5.
5. To diagnose and correct the fault, complete the following steps:
 - a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.

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

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

Note: Until the power switch on each controller is turned off, power still remains turned on for the both controllers; therefore, the seven-segment display on each controller stays on until the power switch on each controller is turned off.

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

CAUTION:

The power switch on the power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.

10. (Models with DC power supplies and fan units only) Flip all of the disconnect devices to the OFF position.
11. Remove (unplug) all of the power cords from the DS4700 Express power supply connectors.
12. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage subsystem” on page 117.

Performing an emergency shutdown

Attention: Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This helps to safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage subsystem loses power unexpectedly, it might be due to a hardware failure in the power system or in the midplane.

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

1. If you have time, stop all I/O activity to the storage subsystem by shutting down the host or disconnecting the storage subsystem logical drives through the host.
2. Check the LEDs. Make note of any Needs Attention LEDs that are on so you can correct the problem when you turn on the power again.

3. Turn off all power supply switches, starting with the DS4700 Express storage subsystem first, and followed by the storage expansion enclosures. Then, unplug the power cables from the storage subsystem.

CAUTION:

The power switch on the power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.

Restoring power after an unexpected shutdown

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

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

1. After the emergency situation is over or power is restored, visually check the storage subsystem for damage. Is there evidence of damage to any of the storage subsystem components, cables, or equipment attached to the storage subsystem?

- Yes – Do not continue with this procedure. Contact your IBM service representative for assistance. Depending on the current service agreements, you might need to return the equipment to the factory or local service center for repair.
- No – Go to step 2.

Potential data loss – Before resetting circuit breakers in the cabinet, ensure that the storage subsystem and storage expansion enclosures power switches are turned off. Resetting circuit breakers after an emergency situation while the storage subsystem and storage expansion enclosure power switches are turned on can cause potential data loss because the configuration components might not be powered on in the correct sequence. See “Turning on the storage subsystem” on page 117 for details about the correct power-on sequence.

2. After you check the storage subsystem for damage, ensure that the power switches are in the off position; then plug in the DS4700 Express power cables, if required.
3. Check the system documentation of the hardware devices that you want to turn on and determine the proper startup sequence.

Note: Be sure to turn on all of the storage expansion enclosures and verify that there are not any ESM or power supply and fan unit fault LEDs lit before you turn on the DS4700 Express.

In addition, consider the following items:

- The storage subsystem supports simultaneous power-up of the system components; however, you should always follow the power-up sequence listed in the “Turning on the storage subsystem section” of the appropriate *DS4000 Storage Subsystem Installation, User’s, and Maintenance Guide* during any attended power-up procedure.
- A storage subsystem in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous

restoration of power to system components. After power is restored, contact IBM technical support if any of the following conditions occur:

- The storage subsystem logical drives and subsystems do not display in the Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and subsystems do not come online.
 - The storage subsystem logical drives and subsystems seem to be degraded.
4. Turn on the power to each device, based on the startup sequence.
 5. (DS4700 Express DC models only) Turn on any attached disconnect devices.
 6. Turn on both of the power supply switches on the DS4700 Express. The green LEDs on the front and the back of the DS4700 Express should remain lit. If other amber Fault LEDs light, see “Solving problems” on page 181.

Recovering from an overheated power supply and fan unit

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

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

The following factors can cause the power supplies to overheat:

- An unusually high room temperature
- Fan failures in the power supply and fan units
- Defective circuitry in the power supply
- Blocked air vents
- Failures in other devices in the configuration or cabinet
- Dirty filter in the Telco bezel

If a fan failure causes overheating or the operating environment becomes too hot (greater than 55° C), the Global Fault LED on the storage expansion enclosure turns on. The power supply and fan unit Fault and Service Action Allowed (SAA[®]) LEDs on the back of the storage subsystem also turn on. “Controller LEDs” on page 127 shows the location of these LEDs.

Attention: Because the power supply and fan unit CRU Fault and SAA LEDs are lit when the operating environment temperature is too hot (greater than 55° C), do not assume the power supply and fan unit CRU is bad. Take action to cool down the environment first. When the operating environment temperature is within the specified operating environment range, the power supply and fan unit Fault and SAA LEDs will be unlit if there are no problems with the power supply and fan unit CRU.

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

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

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

Attention: Risk of damage from overheating - The power supplies automatically shut down when the air temperature inside the cabinet reaches 68° C (154° F). If the power supplies shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and to prevent damage to the DS4000 storage subsystem configuration components.

1. Remove the front cover.
2. If applicable, mute the alarm.
3. Did you use the procedure “Troubleshooting the storage subsystem ” on page 122 to identify an overheating problem?
 - **Yes** - Go to step 4.
 - **No** - Perform the procedure “Troubleshooting the storage subsystem ” on page 122 to verify that the power supplies have shut down because of an overheating problem, and then go to step 4.
4. Stop I/O activity to the storage subsystem and all attached storage expansion enclosures.
5. Take all or some of the following measures to alleviate the overheating problem:
 - Removing all panels from the cabinet immediately
 - Using external fans to cool the area
 - Shutting down the power to the storage expansion enclosure, using the procedure described in “Performing an emergency shutdown” on page 134
6. Wait for the air temperature in and around the storage subsystem to cool. After the temperature inside the power supplies cools to below 65° C (149° F), the storage subsystem is capable of power-up recovery without operator intervention. After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers will reset and return to normal operation.
7. Did the power supply and fan units restart automatically?
 - **Yes** - Go to step 9 on page 138.
 - **No** - Go to step 8.
8. Turn off the power switch on each controller in the storage subsystem, power off all connected storage expansion enclosures, and flip the disconnected devices to the OFF position (for models with DC power supply and fan unit CRUs only). Wait 1 minute and then turn on power to all connected storage expansion enclosures and flip the disconnected devices to the ON position (for models with DC power supply and fan unit CRUs only).

CAUTION:

The power switch on the power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.

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

9. Turn on both power switches on the back of the storage subsystem.
A storage subsystem can take 10 seconds to power on and up to 15 minutes for the battery self-test to complete. During this time, the LEDs on the front and the back of the modules blink intermittently.
10. Check the status LEDs on the front and back of the storage subsystem.
 - a. Note the status of the LEDs on the front and back of each module.
A green LED indicates a normal status; amber LEDs indicate a hardware fault.
 - b. Open the Subsystem Management window for the storage array.
 - c. Select the appropriate components button for each module in the Physical View of the Subsystem Management window to view the status of its components.
The status for each component is either Optimal or Needs Attention.
11. Does each module display green LEDs only, and is the status Optimal for each module component?
 - **Yes** - Go to step 13.
 - **No** - Go to step 12.
12. Diagnose and correct the fault.
 - a. To run the Recovery Guru, select the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.
If the Recovery Guru directs you to replace a failed component, locate and troubleshoot that component. See “Checking the LEDs” on page 123.
 - c. When the procedure is completed, rerun the Recovery Guru to ensure that the problem has been corrected by selecting Recheck in the Recovery Guru.
 - d. If the problem persists, contact IBM Customer and Technical Support.
13. Replace the bezel on the storage expansion enclosure, if applicable.

Cache memory and cache battery

Each RAID controller in the DS4700 Express Storage Subsystem contains either 1 GB or 2 GB of cache memory to store read and write operations. (Both RAID controllers in the DS4700 Express must have the same amount of cache memory.) The battery unit in each controller can maintain the data in the RAID controller caches for up to three days in the event that the DS4700 Express Storage Subsystem loses power.

Attention: There are different replacement FRU part numbers for the DS4700 Express controller with certain cache sizes. The DS4700 Express Storage Subsystem profile has the information on the installed cache memory size in the DS4700 Express controllers. Refer to the storage subsystem profile and see “Parts listing” on page 186 for the correct FRU part number for the DS4700 Express controller.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data on the DS4700 Express RAID controllers. Using cache memory can increase system performance. The data for a read operation from the host might be in the cache memory from a previous operation (thus eliminating the need to access the drive itself), and a write operation is completed when it is written to the cache, rather than to the drives.

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

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

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

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

Figure 102 shows the locations of the Cache Active LEDs on the front of the RAID controllers.

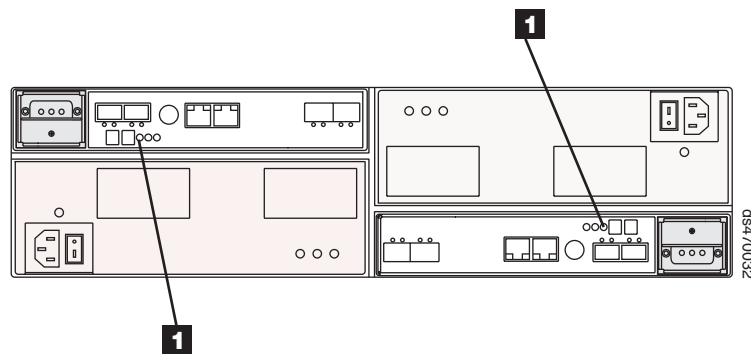


Figure 102. Cache Active LEDs

Table 46. Description of Figure 102

Number	Description
1	Cache Active LED

Subsystem cache battery

The battery unit in each controller provides backup power to maintain any cached data not written to disks in the event of a power loss. The battery units can provide power to the data caches in the RAID controllers for up to three days.

Statement 2:



CAUTION:

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

Do not:

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

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

Replace the battery units in the DS4700 Express when they are identified as failing by the DS4000 Storage Manager Subsystem Management window, or when the Battery LEDs or Battery Needs Attention LEDs light. These LEDs are located on the power supply and fan units and on the battery unit respectively, as shown in Figure 103 on page 141.

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

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

Each power supply and fan unit has green Battery LEDs on the back that indicates the battery status of each battery unit, 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 unit also has a battery failure indicator LED that is located on the battery unit. This LED will light if the battery fails to hold a charge.

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

Data caching starts after the battery completes the startup tests.

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

Figure 103 on page 141 shows the location of the Battery LEDs.

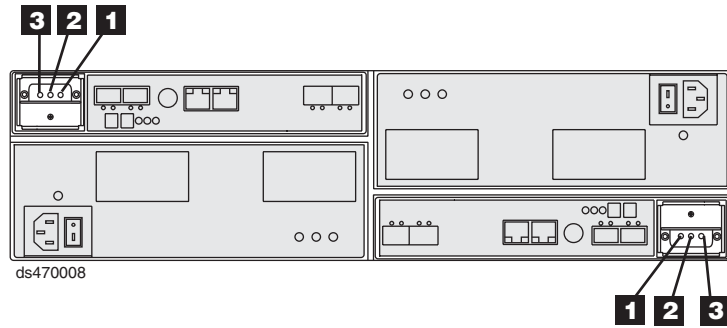


Figure 103. Battery unit LEDs

Table 47. Battery unit LEDs

Number	LED	Normal Status	Problem Status
1	Service Action Allowed (OK to Remove)	Off	On
2	Service Action Required (Fault)	Off	On
3	Battery Charging	Green means on, ready Blinking green means charging	Off

Chapter 5. Replacing components

This chapter contains information about replacing a controller, bezel, filter and filter retainer, E-DDM CRU, power supply and fan unit CRU, DC power supply and fan unit CRU, battery unit, SFP module, and midplane.

Attention: Always replace a failed component as soon as possible. The Recovery Guru menu function in the DS4700 Express Storage Subsystem identifies failed components.

Handling static-sensitive devices

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

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

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

Service Action Allowed Status LED

Each controller, power supply and fan unit, and battery unit has a blue Service Action Allowed status LED. The purpose of the Service Action Allowed status LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any DS4700 Express component unless the component's Service Action Allowed status LED is lit.

Attention

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

The Service Action Allowed status LED automatically turns on or off as conditions change. Wait at least two minutes after you replace each component for the controller to recognize the new component and update the LED status. In most cases when a single component fails, the Service Action Allowed status LED turns on steadily when the Needs Attention status LED is turned on for the component.

Replacing a controller

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

- The replacement controller part number matches the part number of the controller to be replaced. To provide full functionality, the two controllers should have the same cache memory capacity and FRU part number. Inserting a non-compatible controller causes the controller to be placed in a lockout state by the other controller in the DS4700 Express chassis.

Note: The DS4700 Express Storage Subsystem controller FRU is not compatible with the DS4200 Express Storage Subsystem controller FRU.

- Both power supply and fan units must be connected and powered on with no Needs Attention LEDs lit. Ensure that the Power LEDs on each of the power supply and fan units are lit. If either of the power supply and fan units is not optimal, it is recommended that you replace that component before you proceed with the controller replacement procedure.
- If you are replacing an optimal controller, first make sure that the other controller is optimal and that the fibre channel path from the hosts to the other controller is also optimal.

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

Use the following procedure to replace a controller in an DS4700 Express Storage Subsystem:

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

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

2. Locate the failed controller by checking the Needs Attention status LEDs on the controllers in the storage subsystem.
3. Is the Service Action Allowed status LED turned on?

- Yes – Go to step 4.
- No – Another component might require attention before you can remove the controller. Use the Recovery Guru function in the DS4700 Express Subsystem Management window to identify and correct any additional failures. If there are none, proceed with step 4 to replace the controller.

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

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

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

7. Disconnect all attached interface cables from the failed controller, including the SFP modules. Ensure that you label each cable so that you can reconnect them correctly to the new controller.

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 57.
- 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 104.

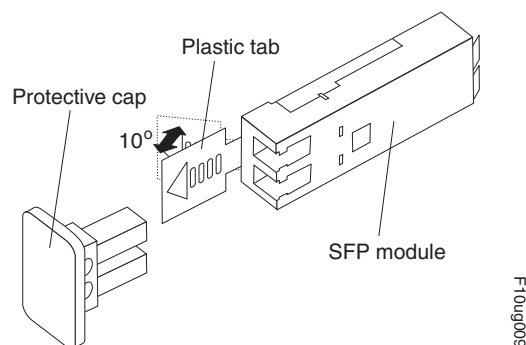


Figure 104. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 105 on page 146.

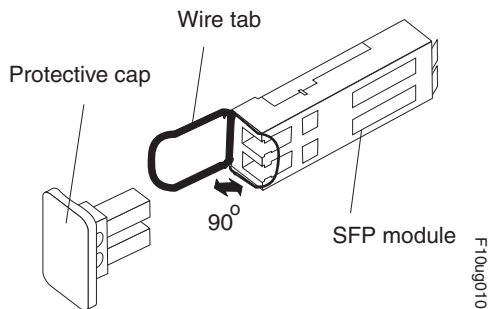


Figure 105. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract the SFP module.
 - For SFP modules that contain plastic tabs, slide the SFP module out of the port.
 - For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the minihub port.
 - d. Replace the protective cap on the SFP module.
 - e. Place the SFP module into a static-protective package.
 - f. Replace the protective cap on the port.
8. Squeeze the controller latch and pull the lever open 90° (so that the lever is horizontal) to release the controller from the latch. The controller latch is a coral colored tab on the lever.

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

9. Slowly pull the lever away from the chassis to remove the controller from the bay. Use two hands when releasing the controller levers. Figure 106 shows the controller sliding from the storage subsystem chassis.

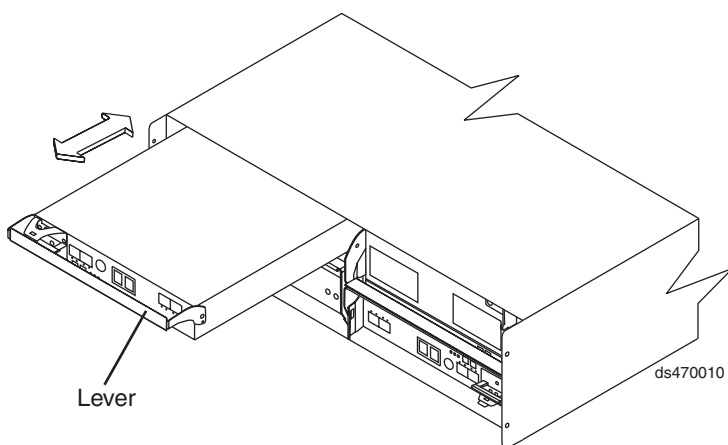


Figure 106. Removing a controller from the DS4700 Express

10. If the new controller does not have the cache battery backup unit already installed, follow the instructions in “Replacing a battery unit” on page 173 to remove the cache backup battery from the existing controller unit and insert it into the new controller CRU.
11. Install the new controller.

- a. Slide one controller into the empty slot in the storage subsystem. Be sure that the lever is pulled straight out as you slide the controller in, as shown in Figure 107.

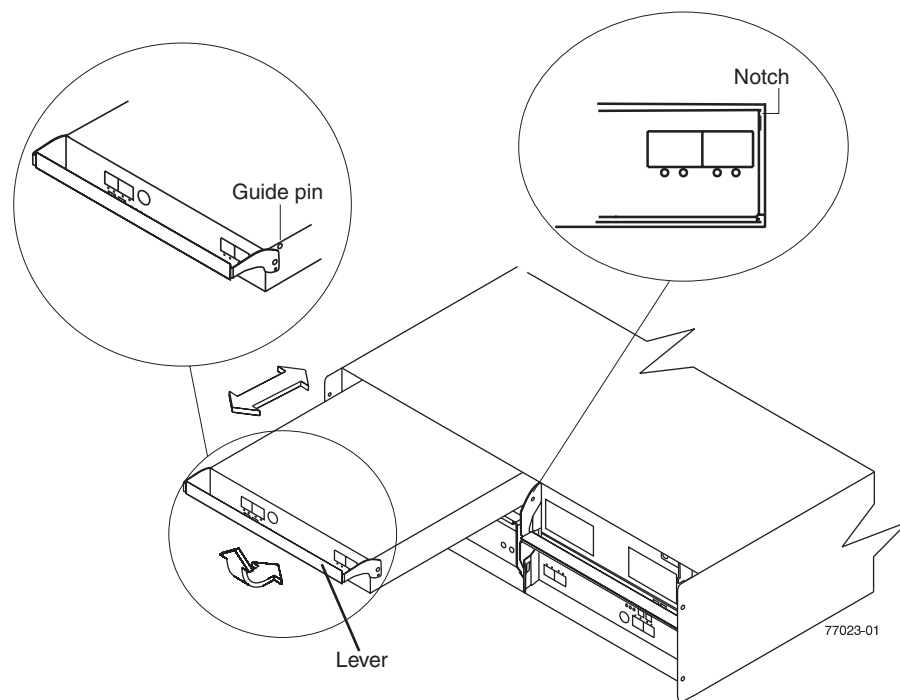


Figure 107. Installing a controller

- b. As you slide the controller into the empty slot, make sure the guide pins on the side of the controller fit into the notches. After the guide pins fit into the notches and the controller fits snugly into the bay, push the lever downward or upward 90°, depending on whether the controller is inserted in the A or B controller bay to fully latch it into place. Do not force fit. The controller is designed to prevent it from being inserted into the chassis incorrectly.

Attention: Make sure that the levers lock into place in the storage subsystem chassis.
 - c. Repeat step a and step b to replace the second controller.
12. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new controller.
 13. Complete any remaining Recovery Guru procedures for controller replacement, if needed.
 14. Check the LEDs on the new controller to verify that the controller is fully operational.
 15. Remove the antistatic protection.
 16. Use the DS4000 Storage Manager client Subsystem Management window to check the status of all components in the storage subsystem.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management window indicates normal operation, go to step 19 on page 148.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem ” on page 122.

- If the new controller is offline, go to step 17.
17. If the newly inserted controller is in an offline state, see the DS4000 Storage Manager client online help for instructions on bringing the controller online. If necessary, open the DS4000 Storage Manager Subsystem Management window and place the controller on-line; select the off-line controller and click **Advanced ► Recovery ► Place controller online**.
 18. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 127. You can also use the DS4000 Storage Manager client Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 19.
 19. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Removing and replacing a bezel

To access the filter and filter retainer as well as the E-DDMs, you must remove the DS4700 Express bezel.

To remove and replace a bezel, perform the following steps:

1. Grasp the sides of the bezel and pull it slowly toward you to remove it, as shown in Figure 108.
2. To replace the bezel, grasp the sides of the bezel and snap it onto the DS4700 Express chassis, as shown in Figure 108.

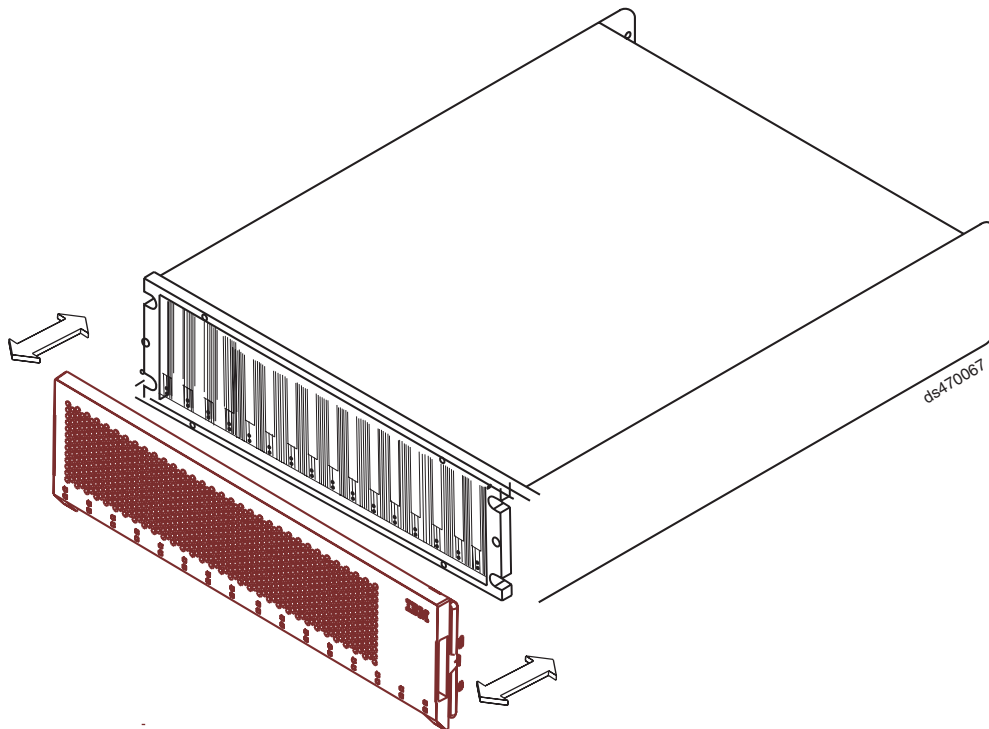


Figure 108. Removing and replacing a bezel

Replacing a filter and filter retainer

Note: Inspect the filter as needed. Replace the filter every three months or sooner, depending on your environment.

Complete the following steps to replace a filter and filter retainer:

1. Remove the bezel by grasping the sides of the bezel and pulling it slowly toward you, as shown in Figure 108 on page 148.
2. Place the bezel face down on a level surface.
3. Remove the filter retainer and filter from the bezel by pressing the blue tabs toward the edge of the bezel.
4. Flip the filter retainer over and remove the filter.
5. Remove the new filter from the packaging materials and carefully place it in the filter retainer.

Note: Make sure the filter is fitted under all the holding tabs on the filter retainer frame.

6. Flip the filter retainer over, line it up with the bezel opening and slightly push the retainer into place.
7. Grasp the sides of the bezel and snap it onto the DS4700 Express chassis, as shown in Figure 108 on page 148.

Working with hot-swap E-DDMs

This section explains how you can increase the storage subsystem capacity by adding more E-DDMs or by replacing existing E-DDMs with ones that have a larger capacity.

Before you begin, complete the following tasks:

- Read the safety and handling guidelines in “Safety” on page xv and in “Handling static-sensitive devices” on page 33.
- Ensure that your current system configuration is working properly.
- Back up all important data before you make changes to data storage devices.

Before you install or remove E-DDM CRUs, review the following information:

- **Blank trays:** A storage subsystem without a full set of E-DDMs (16) contains blank trays in the unused drive bays. Before installing new E-DDMs, you must remove these empty trays. Save the empty trays for future use. Each of the 16 bays must always contain either a blank tray or a hot-swap E-DDM.

For proper cooling and EMC protection, do not leave a drive slot open without either a drive blank or a E-DDM CRU inserted.

- **E-DDM CRUs:**

- The DS4700 Express Storage Subsystem supports 2 or 4 Gbps fibre channel and SATA E-DDMs. The Link Rate setting speed must be set accordingly. See “Verifying the Link Rate setting ” on page 159 for more information.
- When adding E-DDM CRUs, if you are not installing all 16 E-DDM CRUs into the storage subsystem, install the E-DDM CRUs from left to right consecutively.

- For optimum performance, never insert a E-DDM into a storage subsystem without first confirming the drive firmware level. In the event of a drive firmware mismatch, schedule down time as soon as possible to upgrade the drive firmware to the same version. For information about supported drive firmware versions, refer to the DS4000 Support Web site:
www.ibm.com/servers/storage/support/disk/
- Use of non-supported drives in the drive modules can cause the storage subsystem to fail.
- In configurations with mixed storage expansion enclosures, all storage expansion enclosures on a fibre loop must be operating at the same interface speed.
- Ensure that the speed of the E-DDM CRU you are adding is supported in the storage subsystem. For example, do not install a 2 Gbps E-DDM CRU in a storage subsystem that supports only 4 Gbps E-DDMs.
- E-DDM CRUs are not interchangeable between EXP710 and EXP810 storage expansion enclosures.
- After you remove a E-DDM CRU, wait 70 seconds before replacing or reseating it to allow it to properly spin down. Failure to do so may cause undesired events.

Attention

Before powering on the DS4700 Express Storage Subsystem, it must be populated with at least two E-DDMs. If at least two E-DDMs are not installed in each attached storage expansion enclosure or DS4700 Express Storage Subsystem, when you power on the DS4700 Express and its attached storage expansion enclosures, your standard storage partition key might be lost and must be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

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

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear as failed, falsely indicating the power supplies are bad. All drives in the DS4700 Express Storage Subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

- **E-DDM CRU labels:** A label is provided on the front of each E-DDM. Use this label to record the location information for each E-DDM before you remove it. Ensure that you keep track of the E-DDMs and their corresponding bays. Also, record the location information in Table 54 on page 192. If you install an E-DDM in the wrong bay, you might lose data.
- **E-DDM LEDs:** Each E-DDM CRU tray has two associated LEDs, a green Activity LED and an amber Fault LED. These LEDs indicate the status for that drive. See Table 48 for the E-DDM LED states and descriptions.
- E-DDM CRUs are not interchangeable between the DS4700 Express and other DS4000 storage subsystems.

Table 48. Drive LED activity

LED	LED state	Descriptions
Activity LED	Flashing green	The green LED flashes to indicate fibre-channel activity to the drive.

Table 48. Drive LED activity (continued)

LED	LED state	Descriptions
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 due to bad or uncertified drive. The green activity LED might flash once every 2 seconds, remain steady green, or be unlit.
Activity and Fault LEDs	All unlit	Check for and resolve one of the following situations: <ul style="list-style-type: none"> • DS4700 Express is turned off. • DS4700 Express link rate speed is not set correctly.
Activity LED	Flashing once every 2 seconds	Check for and resolve one of the following situations: <ul style="list-style-type: none"> • The controller did not complete the boot process. • DS4000 storage subsystem controller firmware is not 06.16.xx.xx and higher.
Activity and Fault LEDs	Flashing together in a certain pattern	Drive failure due to the incorrect link rate speed setting or internal drive hardware failures.

- **Fibre-channel loop IDs:** When you install a E-DDM in the storage subsystem, the drive tray connects into a printed circuit board called the *midplane*. The midplane sets the fibre-channel loop ID automatically, based on the setting of the enclosure ID switch and the physical location (bay) of the drive CRU.
- **Hot-swap hardware:** The DS4700 Express contains hardware that enables you to replace a failed E-DDM without turning off the storage subsystem. You can continue to operate your system while an E-DDM is removed or installed. These E-DDMs are known as hot-swap E-DDMs.

Installing hot-swap E-DDMs

With the exception of the DS4000 storage subsystem initial power up, add E-DDMs while the storage subsystem is turned on and running. Complete the following steps to install hot-swap E-DDMs in the storage subsystem:

Attention:

- After you remove a E-DDM CRU, wait 70 seconds before replacing or reseating it to allow it to properly spin down. Failure to do so may cause undesired events.
 - The DS4700 Express and EXP810 E-DDMs and FRUs are not compatible with the DS4200 Express and EXP420 EV-DDMs and FRUs.
1. Read the documentation that comes with the E-DDM.
 2. Check for Fault LEDs shown in Figure 109 on page 152. If any amber LEDs are lit, see “Solving problems” on page 181.

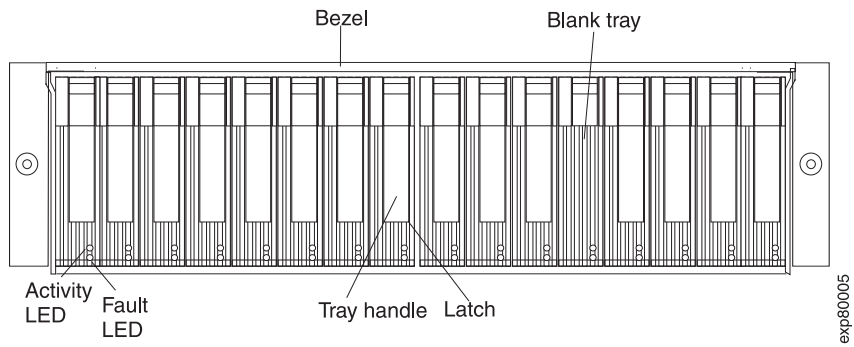


Figure 109. Hot-swap E-DDM LEDs

3. Determine the bay into which you want to install the E-DDM.
4. Remove the blank tray by doing the following:
 - a. Release the latch on the E-DDM CRU by pressing on the inside of the bottom of the tray handle.
 - b. Lift the closed latch to its open position. (The latch is at a 90° angle to the front of the E-DDM when open.)
 - c. Pull the blank tray out of the bay.
 - d. Save the blank tray for later use.
5. Install the E-DDM by doing the following:

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

- a. Release the latch on the drive CRU by pressing on the inside of the bottom of the tray handle.
- b. Pull the handle on the tray out so that it is in the open position, as shown in Figure 110.

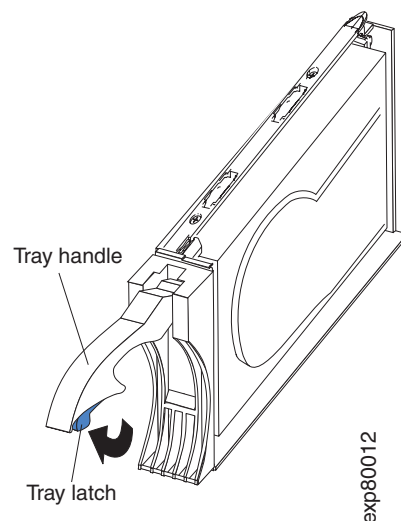


Figure 110. E-DDM CRU handle

- c. Slide the E-DDM CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem bezel or the adjacent E-DDM CRU bezel.

- Note:** Make sure that the EMC gasket does not snag on the bezel.
- d. Push the tray handle down until it latches into place.

Replacing hot-swap E-DDMs

E-DDM problems include any malfunctions that delay, interrupt, or prevent successful I/O activity between the hosts and the E-DDMs in the storage subsystem. This includes transmission problems between the host controllers and the E-DDMs. This section explains how to replace a failed E-DDM.

Note: If you want to remove an E-DDM that is not in a failed or bypass state, always use the Storage Manager client program either to place the E-DDM in a failed state or to place the array that is associated with the E-DDM (or E-DDMs) in an offline state before you remove it from the storage subsystem.

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

Complete the following steps to replace a hot-swap E-DDM:

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

Attention: Never hot-swap a E-DDM CRU when its associated green Activity LED is flashing. Hot-swap a E-DDM CRU only when its associated amber Fault LED is lit and not flashing.
3. Put on antistatic protection.
4. Remove the E-DDM CRU by doing the following:
 - a. Release the latch on the E-DDM CRU by pressing on the inside of the bottom of the tray handle, as shown by the arrow in Figure 110 on page 152.
 - b. Pull the tray handle out into the open position.
 - c. Pull the E-DDM CRU about 1/2 inch out of the bay and wait 70 seconds to allow the E-DDM to properly spin down and the storage subsystem controller to properly recognize that an E-DDM is removed from the configuration. .
 - d. Verify that there is proper identification (such as a label) on the E-DDM CRU, and then slide it completely out of the storage subsystem.
5. Unpack the new E-DDM. Save all packing material in case you need to return it.
6. Install the new E-DDM CRU by doing the following:
 - a. Gently push the E-DDM CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem enclosure bezel.
 - b. Push the tray handle down into the closed (latched) position.
7. Check the E-DDM LEDs by doing the following:
 - When a E-DDM is ready for use, the green Activity LED lights and the amber Fault LED is off.
 - If the amber Fault LED lights and is not flashing, remove the E-DDM from the unit and wait 70 seconds; then, install the E-DDM again.

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

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

Replacing multiple E-DDMs

This section provides guidelines for upgrading the E-DDMs 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.

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

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

The following are methods for upgrading E-DDMs:

- **Replacing all the E-DDMs at the same time**

This method requires that you back up the data on the affected E-DDMs and then turn off the DS4700 Express storage subsystem.

Attention: Turn off the DS4700 Express storage subsystem before you turn off the attached storage expansion enclosures.

After replacing all the E-DDMs, you must reconfigure the new E-DDMs and restore data from backup. See the procedure in “Replacing all E-DDMs at the same time” on page 155.

This is the safest way to exchange E-DDMs 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 E-DDMs one at a time**

In this method, you manually fail each E-DDM, replace it, and wait for the system to restore data to the new E-DDM before installing the next E-DDM. After you install the new E-DDMs, you can configure them to make the additional drive space available. See the procedure in “Replacing the E-DDMs one at a time” on page 157.

Using this method, you can replace the E-DDMs while the storage expansion enclosures and the DS4700 Express are running, eliminating the down time that is required if you replace all the E-DDMs at once. However, this method is more risky because you can lose data if the drive restoration or storage subsystem reconfiguration process fails. In addition, the reconstruction process might take a long time. This method works only on redundant logical drives (RAID 1, 3, or 5). You cannot use this method with any drives containing RAID 0 logical drives.

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

The method you use depends on the following considerations:

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

Replacing all E-DDMs at the same time

Use this procedure to replace all E-DDMs at the same time. You must use this method if you are upgrading E-DDMs containing RAID 0 logical drives. All the data currently on the E-DDMs is lost when you replace the E-DDMs; therefore, you must back up all data that is currently on the E-DDMs. This procedure also requires you to turn off the storage expansion enclosures and the DS4700 Express, which makes the storage subsystem (and any attached storage expansion enclosures) inaccessible to other users.

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

To replace all the E-DDMs at the same time, perform the following steps:

1. Read the following information:
 - The information in “Replacing multiple E-DDMs” on page 154, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
 - The information in your software documentation regarding E-DDM upgrades and installation
 - The documentation that comes with the new E-DDMs
Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the E-DDMs and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.
2. Use the DS4000 Storage Manager software to check the status of the DS4700 Express. Correct any problems that are reported.
3. Perform a complete backup of the E-DDMs that you are replacing.
You need the backup to restore data on the E-DDMs 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 33.

4. Unpack the new E-DDMs.
Set the E-DDMs on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return them.
5. Perform the following steps:
 - a. Stop all I/O activity to the storage subsystem and attached storage expansion enclosures. Make sure of the following:
 - 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. Refer to the *IBM System Storage DS4700 Storage Subsystem Installation, User's, and Maintenance Guide* for the location of the Cache active LEDs.
 - b. If applicable, use the operating system software to disconnect the storage subsystem logical drives from the host before you power off the storage subsystem.

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

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

CAUTION:

The power switch on the power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.

- c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).
7. Use the procedures in “Replacing hot-swap E-DDMs” on page 153 to remove the E-DDMs that you want to replace. Use the procedures in “Installing hot-swap E-DDMs” on page 151 to install the new E-DDMs into the storage subsystem.
8. After you install all the new E-DDMs, 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 E-DDMs are powered up after the storage subsystem. For instructions on powering up the storage subsystem, see the storage subsystem documentation.

- c. Turn on the power to the storage subsystem; then restart or turn on the power to the host.
9. Turn on the power to each device, based on the power-on sequence in step 8 on page 156. To turn on power to the storage subsystem and the storage expansion enclosures, turn on the power supply and fan unit switches on the back of the storage subsystem. You must turn on both power supply and fan unit switches to take advantage of the redundant power supplies.
10. Check the green Drive activity LEDs and the amber Drive fault LEDs above the new E-DDM 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 E-DDMs spin up.

- If the Drive activity LED is off, the E-DDM CRU might not be installed correctly. Remove the E-DDM CRU, wait 30 seconds, and then reinstall it.
 - If the Drive fault LED stays on or the Drive activity LED stays off, the new E-DDM might be faulty. See the DS4000 Storage Manager software for problem determination.
11. Use the DS4000 Storage Manager software to configure the new E-DDMs. See the DS4000 Storage Manager software online Help for detailed instructions.
 12. Restore the data from backup to all the E-DDMs.

Replacing the E-DDMs one at a time

Use this procedure to replace all the E-DDMs one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in “Replacing all E-DDMs at the same time” on page 155).

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

Attention: After you remove an E-DDM CRU, wait 70 seconds before replacing or reseating the E-DDM CRU to allow it to properly spin down. Failure to do so may cause undesired events.

To replace the E-DDMs one at a time, perform the following steps:

1. Read the following information:
 - “Replacing multiple E-DDMs” on page 154, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
 - Your software documentation regarding E-DDM upgrades and installation
 - The documentation that comes with the new E-DDMs

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

2. Use the DS4000 Storage Manager software to check the status of the unit. Correct any problems that are reported.
3. Back up the data in the arrays and logical drives that are configured using the E-DDMs 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 33.

4. Unpack the new E-DDMs.

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

5. Use the DS4000 Storage Manager software to ensure that the array that was defined using these E-DDMs is in optimal (not degraded) state before manually failing the first E-DDM 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 of the following:

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

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

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

6. Use the procedures in “Replacing hot-swap E-DDMs” on page 153 to remove the failed E-DDM. Use the procedures in “Installing hot-swap E-DDMs” on page 151 to install the new E-DDMs into the storage subsystem.

The new E-DDM 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 E-DDM until the data is reconstructed on the hot spare. This increases the time that is required to complete the procedure.

7. Check the green Drive activity LED and the amber Drive fault LED above the new E-DDM 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 E-DDMs spin up.

- If the Drive activity LED is off, the E-DDM CRU might not be installed correctly. Remove the E-DDM CRU, wait 30 seconds, and then reinstall it.

- If the Drive fault LED stays on or the Drive activity LED stays off, the new E-DDM might be faulty or might be an uncertified drive. See the DS4000 Storage Manager software for problem determination. In the case of an uncertified drive, verify that the drive options or drive FRU part number is correct for your storage subsystem.
8. Use the DS4000 Storage Manager software to monitor the status of the new E-DDM 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 E-DDM. In that case, use the host software to determine if the data reconstruction is finished.
 9. When reconstruction is finished on the new E-DDM, repeat step 5 on page 158 through step 8 for each additional E-DDM that you want to install.
 10. Use the DS4000 Storage Manager software to configure the additional space on the new E-DDMs.

Verifying the Link Rate setting

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

A Link Rate switch is located on the front of the storage subsystem as shown in Figure 112 on page 161. The Link Rate indicator LEDs are located on the back of the storage subsystem. The Link Rate switch enables you to select the data transfer rate between the controllers and the drives to either 2 Gbps or 4 Gbps. The Link Rate switch is only read when the storage subsystem is powered up.

Note: Do not mix storage subsystems with different Link Rate speed settings in the same drive loop.

The DS4700 Express Storage Subsystem drive channel operates at either 2 or 4 Gbps fibre channel interface speed. The DS4700 Express Storage Subsystem SATA E-DDM CRUs have an ATA translator card that converts E-DDM 3 Gbps SATA drive interface protocol to either 2 Gbps or 4 Gbps fibre channel interface protocol. It is recommended that the DS4700 Express enclosure speed is set at 4 Gbps when these SATA E-DDM CRUs are installed and connected to storage expansion enclosures running at 4 Gbps speed. The Link Rate setting speed must be set accordingly. See “Verifying the Link Rate setting ” for more information.

Do not mix 2 GB drives and 4 GB drives in the same storage subsystem. If drives of mixed speeds reside in the storage subsystem, the data transfer rate changes depending on the configuration. Table 49 on page 160 shows the data transfer rates for drives of different configurations.

CAUTION:

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

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

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

Table 49. Data transfer rates for drive modules

Link Rate Switch Setting	Storage Subsystem with 2 GB Drives	Storage Subsystem with 4 GB Drives	Storage Subsystem with Mixed Drives
2 Gbps	Drives function in 2 Gbps mode.	Drives work in 2 Gbps mode.	All drives work in 2 Gbps mode.
4 Gbps	Drives do not come online.	Drives work in 4 Gbps mode.	2 GB drives do not come online. 4 GB drives work in 4 Gbps mode.

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

1. Complete the power-off sequence described in “Turning off the storage subsystem” on page 132 ensuring that the DS4000 storage subsystem is turned off before any attached storage expansion enclosures.
2. Locate the Link Rate indicator LEDs. Figure 111 on page 161 shows the location of the Link Rate indicator lights on the back of the storage subsystem.

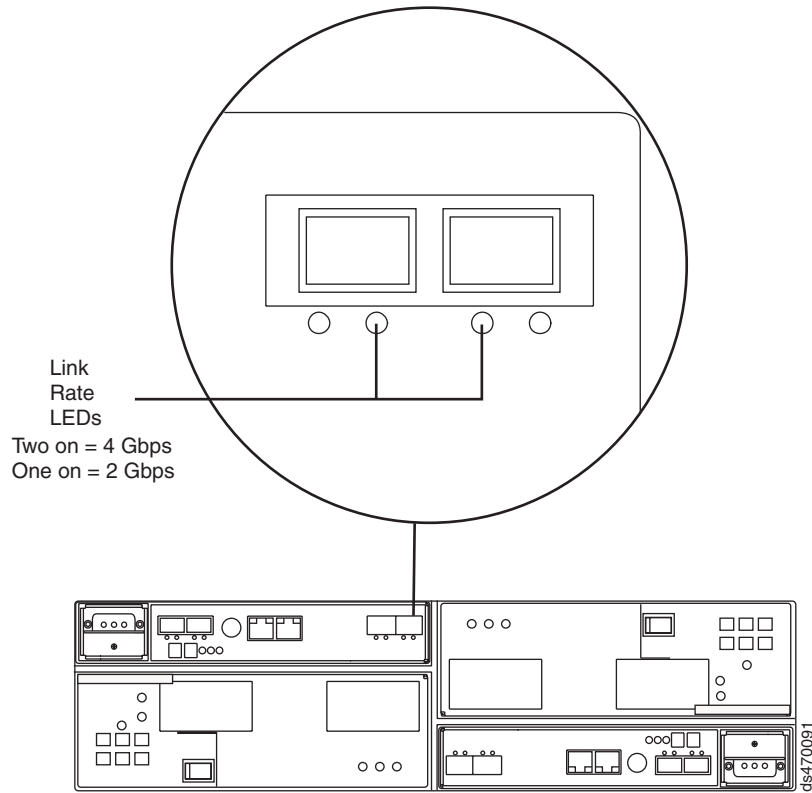


Figure 111. Link rate LEDs

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

3. Is the data transfer rate set correctly?
 - **Yes** - Go to step 8 on page 162.
 - **No** - Go to step 5 to change the setting.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 33.

4. Locate the Link Rate switch. Figure 112 shows the location of the Link Rate indicator light on the front of the command module.

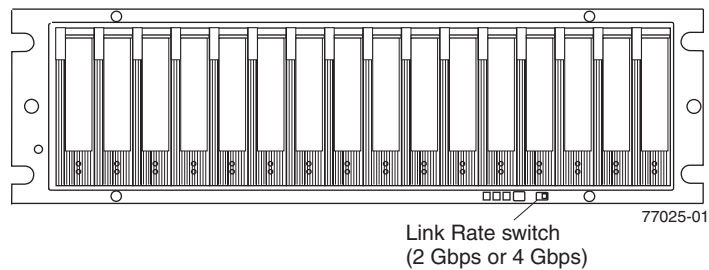


Figure 112. Link rate switch

5. Change the Link Rate switch setting by doing the following:
 - a. Put on antistatic protection.

- b. Use a small screwdriver or the tip of a ball point pen to slide the Link Rate switch to the left or right to set the desired fibre channel operating speed.
Attention: Although the Link Rate LED indicates the correct speed setting, the link rate speed does not change until after you cycle power to the storage subsystem.
6. Repeat step 1 on page 160 through step 5 on page 161 for all of the storage subsystems in the configuration.
7. Perform the power-on sequence as described in “Turning on the storage subsystem” on page 117.
8. Check the indicator lights on the front and back of all of the storage subsystem and expansion drive modules. All the green indicator LEDs should be on, and the amber indicator LEDs should be off. (No LEDs are displayed on blank drives.)
9. Are *only* the green indicator LEDs on?
 - **Yes** - The drive is working correctly.
 - **No** - If an amber Fault indicator LED is on, go to 10.
10. Diagnose and correct the fault.
 - a. To run the Recovery Guru, select the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.
 - c. When the procedure is completed, rerun the Recovery Guru to ensure that the problem has been corrected by selecting Recheck in the Recovery Guru.
11. If the problem persists, contact IBM Customer and Technical Support.

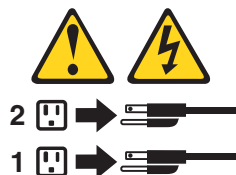
Replacing an AC power supply and fan unit

Statement 5:



CAUTION:

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



CAUTION:

Disconnect the power cord before replacing the power supply and fan unit.

The power supply and fan unit is a component that includes both a 600-W power supply unit and two fans. The power supply and fan units provide power and cooling for the DS4700 Express. The power supply and fan units are customer

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

Each power supply and fan unit has a built-in sensor that detects the following conditions:

- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. If the power remains off after the condition that causes it to go off, make sure that the environment is optimal (no overheating has occurred, all electrical outlets are working, and so on). For more information, see “Restoring power after an unexpected shutdown” on page 135.

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

If both power supply and fan units fail, or if the power supply and fan units cannot maintain an internal temperature below 68° C (154° F), the power supply and fan units in the unit will automatically shut down (an over-temperature condition). If this occurs, you must cool the unit and restart it. See “Restoring power after an unexpected shutdown” on page 135.

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

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

Use the following procedure to replace an AC power supply and fan unit. Figure 113 on page 166 illustrates removing and inserting a unit.

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

Statement 8:



CAUTION:

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



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

1. If needed, use the DS4000 Storage Manager client software to print a storage system profile.
2. Did the Recovery Guru direct you to replace a failed power supply and fan unit?
 - **Yes** - Go to step 3.
 - **No** - Run the Recovery Guru to identify the failed component, and then go to step 3.
3. Put on antistatic protection.
4. Unpack the new power supply and fan unit. Save all packing material in case you need to return the failed power supply and fan unit CRU.

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

5. Using the information provided on the instruction sheet, place the labels on the power supply and fan unit CRU to correctly mark the LEDs.
6. Turn off the power switch on the new unit.
7. Check the Fault LED to locate the failed power supply and fan unit. If a fault is detected, the amber Fault LED is on.
8. Verify that the Service Action Allowed LED is on. Do not remove the power supply and fan unit if the LED is off. For more information on the Service Action Allowed LED, see “Service Action Allowed Status LED” on page 143.

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.

9. Turn off the power switch, and unplug the power cord from the failed power supply and fan unit.
10. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply and fan unit from the latch. The latch is a coral colored tab on the lever.
11. Slowly pull the lever away from the chassis to remove the power supply and fan unit, as shown in Figure 113 on page 166.

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

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

Attention: The left and right power supply and fan units are seated in the DS4700 Express chassis in opposite orientations. If you cannot fully insert the power supply and fan unit into the power supply and fan unit bay, flip it 180° and reinsert it. Make sure that the levers lock into place in the storage subsystem chassis. Do not force fit. The power supply and fan unit is designed to prevent it from being inserted into the chassis incorrectly.

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

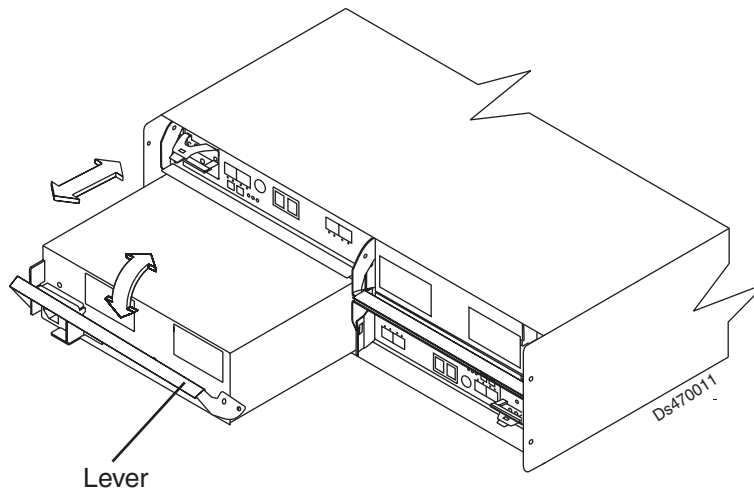


Figure 113. Replacing a power supply and fan unit

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

If the above tasks do not resolve the problem, contact IBM Customer and Technical Support
17. Complete any remaining Recovery Guru procedures, if needed.
18. Check the status of each component in the storage subsystem.

19. Do any components have a Needs Attention LED?
 - **Yes** - Select the Recovery Guru toolbar button in the Subsystem Management window and complete the recovery procedure. If a problem is still indicated, contact IBM Customer and Technical Support.
 - **No** - Go to step 20.
20. Create, save, and print a new storage subsystem profile.

Replacing a DC power supply and fan unit



CAUTION:

This unit has more than one power source. To remove all power from the unit, all DC MAINS must be disconnected.



Statement 29:



CAUTION:

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment.

This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. The DC system shall not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

Statement 30:



CAUTION:

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.
- Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).
- The branch circuit overcurrent protection must be rated 20 A.
- Use 12 American Wire Gauge (AWG) or 2.5 mm² copper conductor only, not exceeding 4.5 meters in length.
- Incorporate a readily available approved and rated disconnect device in the field wiring.

CAUTION:

Disconnect the DC power jumper cord from the DC connector on the DC power supply and fan unit before replacing the DC power supply and fan unit.

The DC power supply and fan unit is a component that includes both a -48 V power supply unit and two fans. The DC power supplies provide power and cooling for the DS4700 Express. The DC power supplies are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported DC power supplies for your specific storage subsystem.

Each DC power supply and fan unit has a built-in sensor that detects the following conditions:

- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. If the power remains off after the condition that causes it to go off, make sure that the environment is optimal (no overheating has occurred, all electrical outlets are working, and so on). For more information, see “Restoring power after an unexpected shutdown” on page 135.

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

If both DC power supplies fail, or if the DC power supplies cannot maintain an internal temperature below 68° C (154° F), the DC 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 unexpected shutdown” on page 135.

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

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

Use the following procedure to replace a DC power supply and fan unit. Figure 113 on page 166 illustrates removing and inserting a unit.

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

Statement 8:



CAUTION:

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



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

1. If needed, use the DS4000 Storage Manager client software to print a storage system profile.
2. Did the Recovery Guru direct you to replace a failed DC power supply and fan unit?
 - **Yes** - Go to step 3.
 - **No** - Run the Recovery Guru to identify the failed component, and then go to step 3.
3. Put on antistatic protection.
4. Unpack the new DC power supply and fan unit. Save all packing material in case you need to return the failed DC power supply and fan unit CRU.

Note: The new DC power supply and fan unit CRU comes with an instruction sheet and label sheet. The instruction sheet provides instructions on

placing the appropriate labels on the DC power supply and fan unit CRU to mark the LEDs correctly. The label sheet contains the peel-off labels that you actually place on the DC power supply and fan unit CRU.

5. Using the information provided on the instruction sheet, place the labels on the DC power supply and fan unit CRU to correctly mark the LEDs.
6. Turn off the power switch on the new unit.
7. Check the Fault LED to locate the failed DC power supply and fan unit. If a fault is detected, the amber Fault LED is on.
8. Verify that the Service Action Allowed LED is on. Do not remove the DC power supply and fan unit if the LED is off. For more information on the Service Action Allowed LED, see “Service Action Allowed Status LED” on page 143.

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

9. Turn off the DC power supply switch, set disconnect devices to the OFF position, and then unplug the power cord from the failed DC power supply and fan unit.

Attention:

- a. IBM recommends that you use the disconnect device to remove power before disconnecting the DC power cord.
 - b. The power switch on the DC power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem power supply and fan unit might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.
10. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the DC power supply and fan unit from the latch. The latch is a coral colored tab on the lever.
 11. Slowly pull the lever away from the chassis to remove the DC power supply and fan unit, as shown in Figure 114 on page 172.

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

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

Attention: The left and right DC power supplies are seated in the DS4700 Express chassis in opposite orientations. If you cannot fully insert the DC power supply and fan unit into the DC power supply and fan unit bay, flip it 180° and reinsert it. Make sure that the levers lock into place in the storage subsystem chassis. Do not force fit. The DC power supply and fan unit is designed to prevent it from being inserted into the chassis incorrectly.

13. Plug in the power cord, turn on any attached disconnect devices, and turn on the power to the DC power supply and fan unit.
14. Check the Power and Fault LEDs on the new unit.

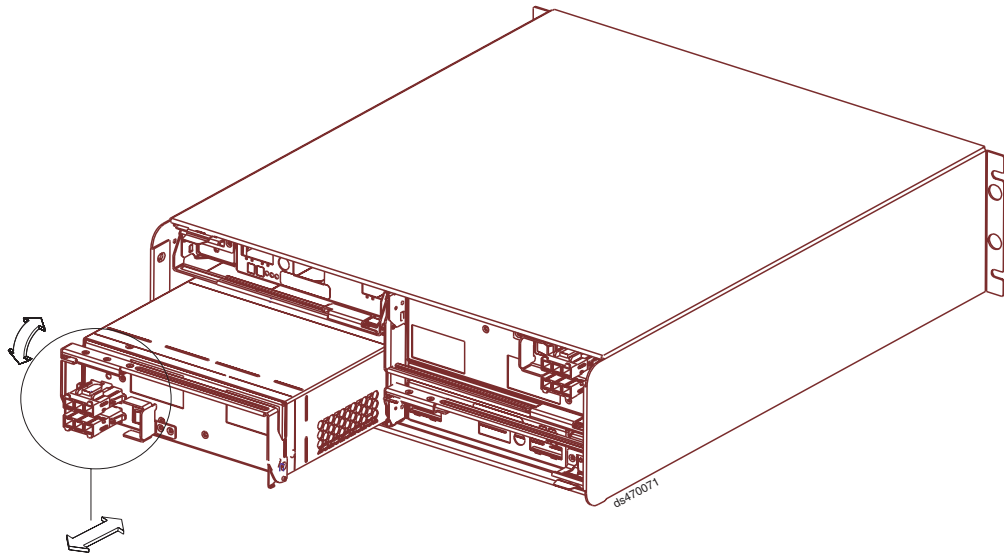


Figure 114. Replacing a DC power supply and fan unit

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

If the above tasks do not resolve the problem, contact IBM Customer and Technical Support
17. Complete any remaining Recovery Guru procedures, if needed.
18. Check the status of each component in the storage subsystem.
19. Do any components have a Needs Attention LED?
 - **Yes** - Select the Recovery Guru toolbar button in the Subsystem Management window and complete the recovery procedure. If a problem is still indicated, contact IBM Customer and Technical Support.
 - **No** - Go to step 20 on page 173.

20. Create, save, and print a new storage subsystem profile.

Replacing a battery unit

Each RAID controller in the DS4700 Express Storage Subsystem contains a rechargeable battery unit that maintains data in the cache memory for three days without power to the unit.

Use the following procedure if the DS4000 Storage Manager client instructs you to replace the battery unit because the current battery has failed. You can also use the DS4000 Storage Manager client to check the status of the battery. Because write-caching is disabled when either one of the battery units fail, IBM recommends that you replace the failed battery unit as soon as possible to minimize any impact due to the disabling of the write-caching function.

Replace only the battery unit that is indicated as failed by the LEDs. You do not need to replace both battery units when the Battery LEDs indicate that only one battery unit has failed.

Note: Unlike the batteries for other DS4000 Storage Subsystems, the DS4700 Express Storage Subsystem battery units do not have set expiration dates. Do not replace these batteries after a certain usage period.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 33.

Use the following procedure to replace a battery unit.

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
2. Locate the RAID controller that contains the failed battery unit.
3. Check the LEDs on the battery units to determine which of the two battery units has failed. (See “Battery unit LEDs” on page 126.) Replace only the battery unit that is indicated as failed by the LEDs.
4. Put on antistatic protection.
5. To remove the failed battery unit from the RAID controller, press the battery unit latch (the coral colored tab **3**) toward the black colored battery pull handle (**4**) to unlatch the battery from the DS4700 Express chassis and slowly pull the battery unit from the controller chassis using the black handle, as shown in Figure 115 on page 174.

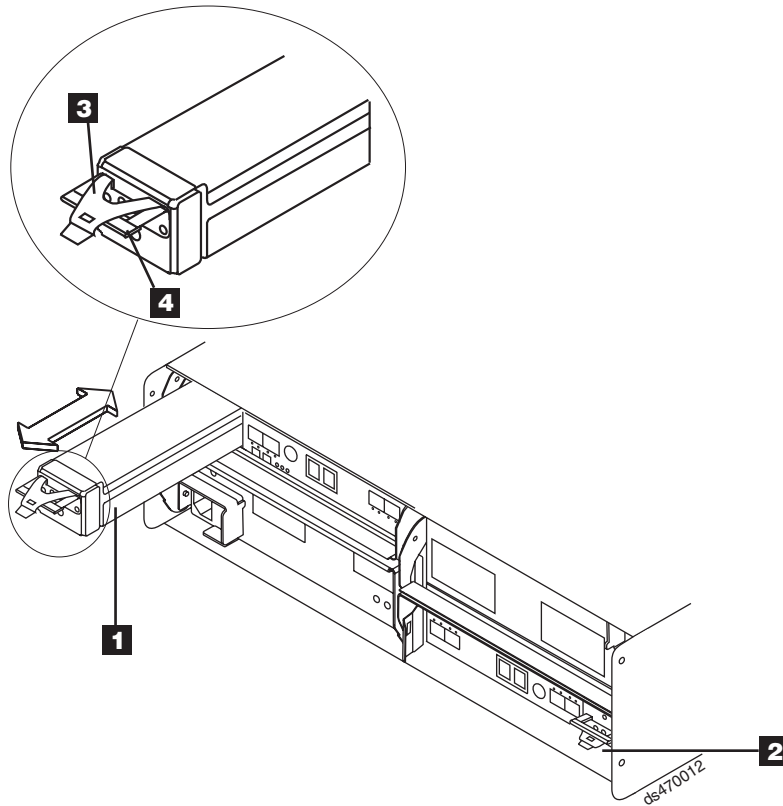


Figure 115. Removing and replacing a battery unit from the controller chassis



Attention: This product contains a sealed Lithium Ion battery. Discharged Lithium and Lithium Ion batteries are currently designated to be disposed of in normal trash. However, users should contact their municipal waste disposal facility prior to discarding any used battery in normal trash. Alternatively, IBM recommends users may return Lithium, Lithium Ion and Lithium Ion battery packs to IBM for recycling.

In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM Lithium, Lithium Ion and Lithium Ion battery packs. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

For information on disposal of sealed Lithium Ion batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

6. Place the battery unit that you removed on a level surface.
7. Unpack the new battery unit. Set the new battery unit on a dry, level surface.

- Save all packing materials in the event you need to return the new battery unit.
8. Insert the new battery unit into the controller chassis. Make sure the new battery unit is inserted in the correct orientation in the battery unit bay. Press the battery unit fully into the bay until it clicks into place. Do not force fit. The battery unit is designed to prevent it from being inserted into the chassis incorrectly.
- Note:** The green Battery Charging LED flashes until the battery is fully charged.
9. Reset the battery age in the DS4000 Subsystem Management window. Refer to the online help for instructions on how to reset the battery age, if required.

Replacing an SFP module

The speed of the SFP module determines the maximum operating speed of the fibre channel port in which the SFP is installed. For example, a 2-Gbps SFP that is plugged into a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.

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

Use the following procedure to replace a Small Form-factor Pluggable (SFP) module on the storage subsystem. The SFP module shown in this procedure might look different from those you are using, but the difference will not affect functionality. Figure 116 on page 176 illustrates installing an SFP module.

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

To replace an SFP module, do the following:

1. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.
2. Using the Recovery Guru, identify the failed component that needs to be replaced.
3. Check the Fault LEDs to locate the failed SFP module. If a fault is detected, the amber Fault LED is on.

Attention: Potential loss of data access - To prevent loss of access to data, remove only the SFP module that has a failed status in the storage management software and has Port Bypass LED lit.

4. Put on antistatic protection.
5. Unpack the new SFP module. Verify that it is the same type of module you are replacing. If it is not, contact IBM Customer and Technical Support.

Attention: The speed of the SFP module determines the maximum operating speed of the fibre channel port in which the SFP is installed. For example, a 2-Gbps SFP that is plugged into a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.

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

6. Disconnect the interface cables from the SFP module.
7. Remove the failed SFP module from the controller.

8. Install the new SFP module into the controller.
9. Reconnect the interface cable.

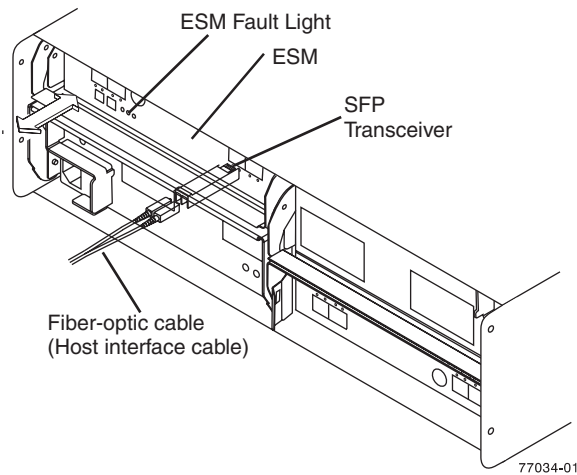


Figure 116. Replacing an SFP module

10. Check the Bypass and Fault LEDs for the new SFP module.
11. Based on the status of the Bypass and Fault LEDs, choose one of the following steps:
 - **Bypass LED or Fault LED is on** - Reinstall the SFP module and cables, and verify that the SFP module and cables are securely connected. Use the fibre channel loopback and the LC-LC connector to perform path diagnostics to ensure that the FC cable is good and the SFP on the other end of the fibre channel connection is working properly. When finished, go to step 12.
 - **Bypass LED and Fault LED are off** - Go to step 12.
12. Is the problem corrected?
 - **Yes** - Go to step 13.
 - **No** - Contact IBM Support.
13. Complete any remaining Recovery Guru procedures, if needed.
14. Use the DS4000 Storage Manager Subsystem Management window to check the status the status of all components in the storage subsystem.
15. Remove the antistatic protection.
16. Does any component have a Needs Attention status?
 - **Yes** - Select the Recovery Guru toolbar button in the Subsystem Management window, and complete the recovery procedure. If the problem persists, contact IBM Support.
 - **No** - Go to step 17.
17. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Replacing a midplane

Attention: Observe handling static-sensitive device precautions stated in “Handling static-sensitive devices” on page 33 when removing components.

Perform the following steps to replace a midplane:

1. Complete the power-off sequence described in “Turning off the storage subsystem” on page 132 ensuring that the DS4000 storage subsystem is turned off before any attached storage expansion enclosures.

Attention:

- a. The power switch on the power supply and fan unit does not turn off the electrical current supplied to the device. The DS4700 Express Storage Subsystem might also have more than one connection to DC power. To remove all electrical current from the device, ensure that all DC power cords are disconnected from the power supply and fan unit DC input connectors.
 - b. For a DS4700 Express Storage Subsystem with DC power supply and fan units only, turn off all of the attached disconnect devices. IBM recommends that you use the disconnect device to remove power before disconnecting the DC power cord.
2. Label and remove the power cords from the power supply and fan units of the DS4700 Express Storage Subsystem.
 3. Label the fibre channel cables that are attached to the rear of the controllers. Labeling the cables simplifies the re-cabling process.
 4. Remove the fibre channel cables that are attached to the rear of the controllers.
 5. Remove both controllers. To remove them do the following:
 - a. Squeeze the controller latch and pull the lever open 90° (so that the lever is horizontal) to release the controller from the latch. The controller latch is a coral colored tab on the lever.

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

- b. Slowly pull the lever away from the storage subsystem chassis to remove the controller from the controller bay, as shown in Figure 21 on page 42. (Remove the controllers from the chassis and place it on electrostatic discharge (ESD) protected surface.)
 - c. Repeat steps 5a and 5b for the other controller.
6. Remove both power supply and fan units. To remove them, do the following:
 - a. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply and fan unit from the latch. The latch is a coral colored tab on the lever.
 - b. Slowly pull the lever away from the chassis to remove the power supply and fan unit, as shown in Figure 22 on page 43. (Remove the power supply and fan unit from the chassis and place it on ESD protected surface.)

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

- c. Repeat steps 6a and 6b for the other power supply and fan unit.
7. Remove the Telco bezel if it is installed. See “Removing and replacing a bezel” on page 148 for instructions.
 8. Label the Enhanced Disk Drive Module (E-DDM) CRUs so you know their physical location in the midplane.
 9. Remove the E-DDM CRUs and any blank drive CRUs if the storage subsystem has them. See “Removing an E-DDM” on page 45 for instructions. Place E-DDMs on ESD protected surface.

Attention: Do not stack E-DDM CRUs on top of each other. Protect the E-DDM CRUs from vibrations or sudden shocks.

10. Use a #1 Phillips screwdriver to loosen the four front cage frame screws on the midplane, as shown in Figure 117.

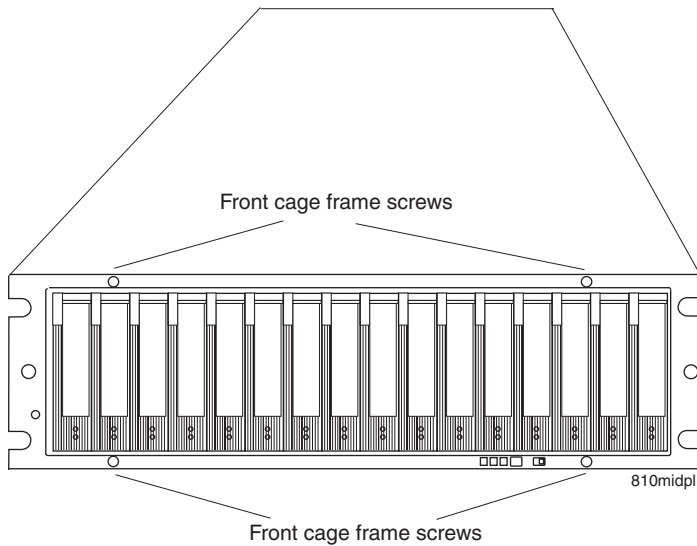


Figure 117. Front cage frame screw locations

11. On the back of the DS4700 Express, remove the four Phillips screws (two screws on each side) that hold the sides of the DS4700 Express chassis to the sides of the rails.
12. On the front of the DS4700 Express, remove the four M5 screws (two screws on each side) on the DS4700 Express chassis that hold the DS4700 Express to the rails.

Attention: The unit must be removed from the rack and placed on a level ESD protected surface before servicing it.

13. Pull the chassis outward from the front of the rack and remove from the rack. Place it on a level surface. Look for a row of three Phillips screws on top of the chassis and a row of four Phillips screws on the bottom of the chassis, as shown in Figure 118 on page 179. Remove the seven Phillips screws using the #1 Phillips screwdriver. Save these screws.

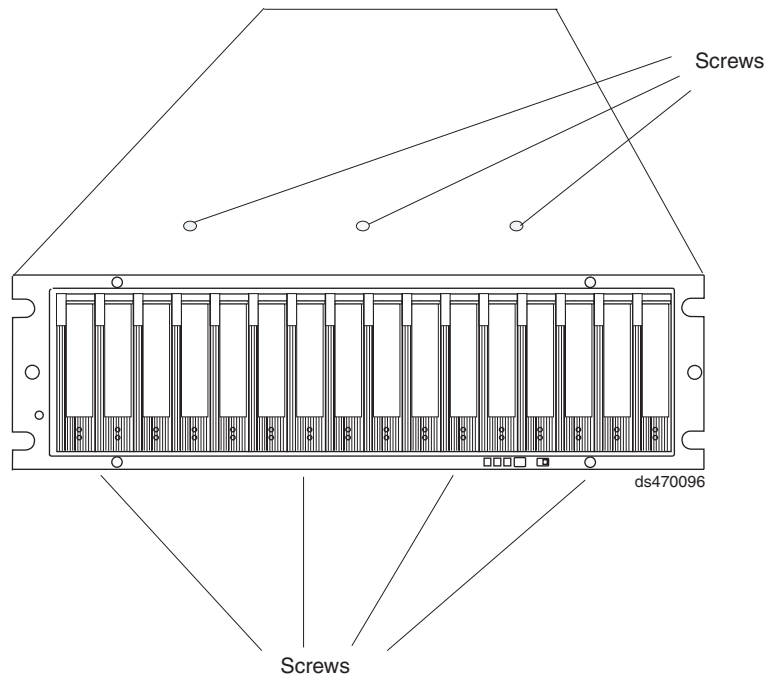


Figure 118. Screws holding the top and bottom sides of the chassis to the cage frame

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

Note: The front cage frame might be tightly secured in the chassis. IBM recommends mounting the DS4700 Express chassis back in the rack using the four M5 screws to hold the DS4700 Express chassis in place while you pull on the blue handle to separate the front cage frame from the chassis. Remove the DS4700 Express chassis from the rack and place it on a level surface after you remove the failed front cage frame for the next step.
15. Unpack the new front cage frame with the midplane. Save the packaging materials in case you need to return it.
16. Insert the new front cage plane/midplane by aligning it with the storage subsystem front opening and slowly sliding it into the storage subsystem chassis. Make sure that the front cage frame EMC gaskets do not snag between the frame and chassis.
17. Tighten the four front cage frame screws. See Figure 117 on page 178.
18. Install the seven Phillips screws (three on top and four on bottom) that hold the front cage frame to the EXP810 chassis that you removed in step 13 on page 178, as shown in Figure 118.
19. Push the chassis all the way back into the rail and install the four M5 screws along the side edges of the DS4700 Express chassis.
20. Install the four Phillips screws on the back along the sides of the DS4700 Express chassis that hold the DS4700 Express to the rails.
21. Insert the E-DDM CRUs. Be sure you insert them in the correct slots. Use the labels you put on them before you removed them to guide you.
22. Replace the Telco bezel, if applicable. See “Removing and replacing a bezel” on page 148 for instructions.

23. Re-insert the controllers and reconnect the fibre channel cables.
24. Re-insert the power supply and fan units and reconnect the power supply cords.
25. (For DS4700 Express Storage Subsystems with DC power supply and fan units only) Turn on all attached disconnect devices before proceeding to step 26.
26. Power on the attached storage expansion enclosures.
27. Wait at least 3 minutes and then power on the DS4700 Express Storage Subsystem. Verify the status of the configuration using LEDs and the DS4000 Storage Manager client program.
28. After removing the faulty cage frame with midplane assembly, transpose the DS4700 Express serial number, machine type, and model tag from the faulty cage frame assembly to the Repair Identification (RID) tag on the new cage frame assembly. The RID tag is important in transferring the serial number, machine type, and model from the faulty cage frame assembly to the new cage frame assembly. Ensure that the new RID tag is affixed to the new cage frame assembly before you dispose of the faulty cage frame with midplane assembly. This will ensure that the warranty coverage is not interrupted.

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 xxv.

General checkout

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

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

Solving problems

This section contains information to help you solve some of the problems you might have with your storage subsystem. Table 50 on page 182 contains the problem symptoms and error messages, along with suggested actions to take to resolve problems.

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

You can use Table 50 on page 182, which contains the problem symptoms and error messages, along with suggested actions as a guide for troubleshooting problems in addition to the DS4000 Storage Manager Recovery Guru in the Subsystem Management window. Do not depend solely Table 50 on page 182 for a FRU replacement decision.

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

Table 50. Symptom-to-FRU index

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit	Drive CRU (Drive Fault LED) Note: The green Drive Activity LED might also be lit.	Drive failure	Replace the failed drive. Note: The amber LED on the drive is also lit if the drive slot has a blank drive tray inserted.
		Drive uncertified	Verify the drive option and FRU part number to verify that it is supported by the DS4700 Express Storage Subsystem. (For FRU part numbers, see Table 51 on page 187.)
	RAID controller (Fault LED) Note: Controller Service Action Allowed LED will also be lit.	RAID controller failure	Replace the RAID controller. See your controller documentation for more information. See Chapter 5, "Replacing components," on page 143 for more information.
		Controller was placed offline by a user or the other controller.	Use the menu function in the DS4700 Express Subsystem Management window to place the controller back online. If the controller continues going to an offline state after being placed online, replace the RAID controller.
		Unsupported controller type. For example, a DS4200 Express FRU is inserted into a DS4700 Express chassis.	Use the Storage Manager Client Subsystem Management window and Recovery Guru to verify that the correct controller FRU is used. Replace with the correct DS4700 Express controller FRU.
	RAID controller (Port Bypass LED)	No incoming signal detected	Reconnect the SFP modules and the fibre-channel cables. Verify the input and output SFP using the path failure determination instruction in the <i>DS4000 Problem Determination Guide</i> and the FC loopback and female-female LC connector. Replace either input or output SFP modules or fibre channel cables as necessary.
		Incorrect enclosure speed setting	When connecting storage expansion enclosures to the existing operating redundant drive loop with a different speed setting, the port goes into bypass mode because mixing different speed enclosures within the same redundant drive loop/channel is not supported.
		RAID controller failure	If the RAID controller Fault LED is lit, also replace the RAID controller.

Table 50. Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit (continued)	Front panel (Global Summary Fault LED)	General machine fault	A Fault LED is lit somewhere on the storage subsystem (check for Amber LEDs on CRUs).
		General machine fault (continued)	Open the DS4700 Express Storage Subsystem Management window and click on the Recovery Guru to see problems in the DS4700 Express configuration. Some errors will cause the Global Summary Fault LED to be lit but will not cause any individual CRU Fault LEDs to be lit. (Drive PFA exceeded or nominal temperature exceeded errors are a few examples.) Follow the corrective actions in the Recovery Guru window.
		Fibre-channel connection failure	Check that the CRUs are properly installed. If none of the amber LEDs are lit on any of the CRUs, this indicates an SFP module transmission fault in the storage subsystem. Replace the failed SFP module. See the DS4000 Storage Manager software documentation for more information.
	Battery unit fault	Battery unit failure	Verify the failure using DS4000 Storage Manager Client and replace the failing battery.
Amber LED is lit and green LED is off	Power supply CRU	The power switch is turned off or there is an AC power failure.	Replace the failed power supply or turn on all power supply switches.
Amber and green LEDs are lit	Power supply CRU (Fault and Power LEDs lit; SAA lit; Direct Current Enable LED is not lit)	Power supply failure	Replace the failed power supply.
		Operating environment is too hot	Cool down the environment.
		Fan failure	Replace the power supply and fan unit CRU
All amber and green LEDs are slowly flashing	All drive CRUs	The DS4700 Express controllers are going through start-of-day process (booting up). Wait up to five minutes for the controllers to complete the booting process. If the drive Activity LEDs are not steady lit or momentarily flicker, and the amber LEDs are unlit after waiting more than six minutes, contact IBM support.	

Table 50. Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs are off	All CRUs	Subsystem power is off	Check that all storage subsystem power cables are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack are powered on.
		AC power failure	Check the main circuit breaker and AC outlet.
		Power supply failure	Replace the power supply.
		Operating environment is too hot	Cool down the environment.
Amber LED is flashing	Drive CRUs (Fault LED lit)	Drive identity is in process	No corrective action needed.
	RAID controller port bypass	An FC loop initialization process (LIP) is being generated in the drive loop due to a faulty component.	Use the Read Link Status window in the Storage Manager Client Subsystem Management window and the storage subsystem event logs to isolate the faulty component.
	Controller drive port bypass LED	The enclosure speed was set to 4 Gbps but the SFP inserted in the controller drive SFP port does not operate at 4 Gbps.	Use the Recovery Guru menu function in the Storage Manager Client Subsystem Management window to verify the problem and replace the SFP with a 4 Gbps SFP.
	General Fault LED (located on the front of the storage subsystem)	An intermittent failure in the DS4700 ExpressStorage Subsystem configuration. The problem could be directly related to the hardware in the configuration (hard drive or bad cable) or indirectly related to the DS4700 Express Storage Subsystem configuration (such as a fibre channel host bus adapter failure in the host server or the fibre channel switch in the SAN causing LUNs to be on a non-preferred path.)	Use the Recovery Guru menu function in the Storage Manager Client Subsystem Management window to diagnose the problem.

Table 50. Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs are off	Power supply CRUs	Power cable is unplugged or switches are turned off.	Make sure that the power cable is plugged in and that the switches are turned on.
	All drive CRUs	Midplane failure	Replace the midplane. Contact an IBM technical support representative.
	Several CRUs	Hardware failure	Replace the affected CRUs. If this does not correct the problem, replace the RAID controllers, followed by the midplane. Contact an IBM technical support representative.
	Front panel	Power supply problem	Make sure that the power cables are plugged in and that the power supplies are turned on.
Hardware failure		If any other LEDs are lit, replace the midplane. Contact an IBM technical support representative.	
Intermittent or sporadic power loss to the storage subsystem	Some or all CRUs	Defective AC power source or improperly connected power cable	Check the AC power source. Reseat all installed power cables and power supplies. If applicable, check the power components (power units or universal power supply). Replace defective power cables.
		Power supply failure	Check the power supply Fault LED on the power supply. If the LED is lit, replace the failed CRU.
		Midplane failure	Have the midplane replaced. Contact an IBM technical support representative.
Unable to access drives	Drives and fibre-channel loop	Incorrect storage subsystem ID settings	Ensure that the fibre-channel optical cables are undamaged and properly connected. Check the storage subsystem ID settings. Note: Change the switch position only when your storage subsystem is powered off.
		RAID controller failure	Replace one or both RAID controllers. Contact an IBM technical support representative.
		Drive or drives failed	Replace failed drive or drives.
Random errors	Subsystem	Midplane failure	Have the midplane replaced. Contact an IBM technical support representative.

Table 50. Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Hard disk drive not visible in RAID management software	Several CRUs	Drive or drives failed	Replace failed drive or drives.
		FC cable failed	Replace FC cable.
		SFP failed	Replace SFP.
		RAID controller failure	Replace RAID controller.
		Midplane failure	Have the midplane replaced. Contact an IBM technical support representative.
		Drive CRU has interface problem with the ESM or controller.	Replace the drive CRU.
		Incorrect firmware version	Verify that the DS4700 Express Storage Subsystem has the correct firmware version. Refer to "Software and hardware compatibility and upgrades" on page 21.
		A controller has failed in addition to the ESM failure in the drive channel that originates from the functioning controller.	Replace the failed controller and ESM.

Parts listing

Figure 119 on page 187 and the following table provide a parts listing for the DS4700 Express.

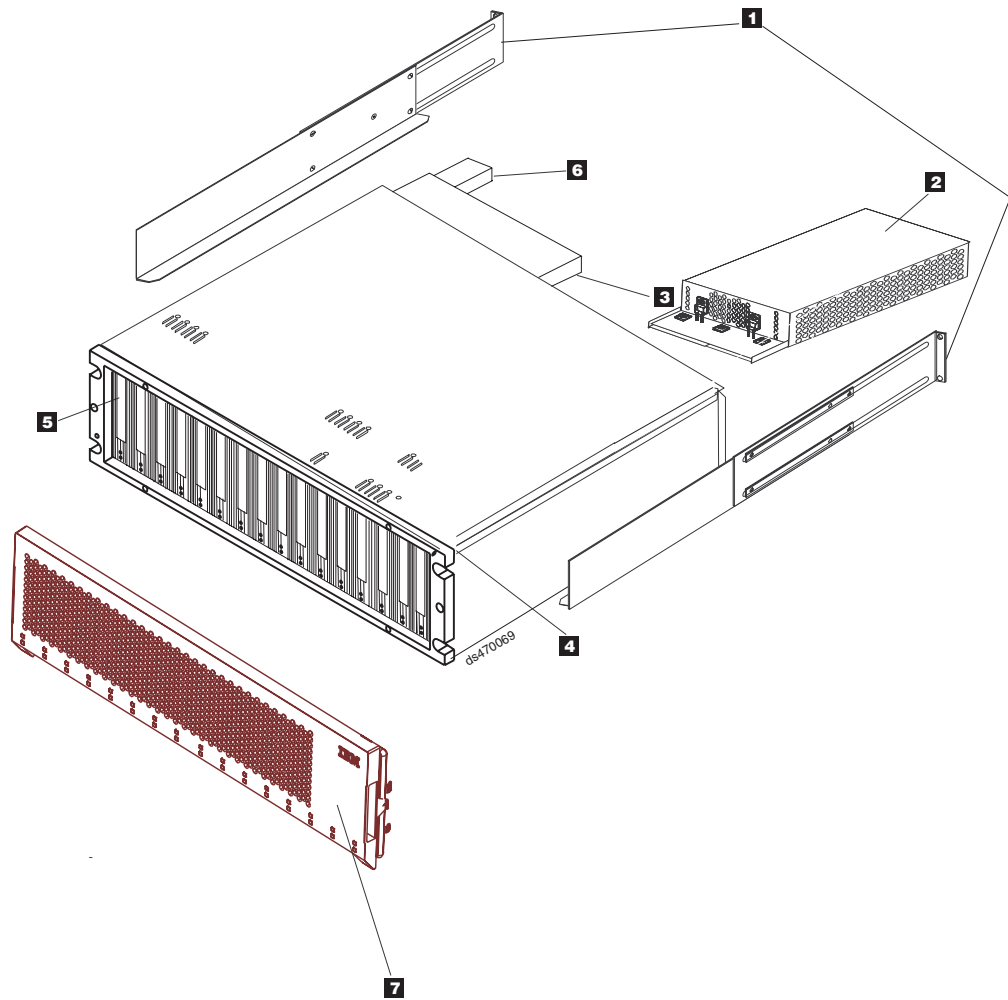


Figure 119. DS4700 Express Storage Subsystem parts list

Table 51. Parts listing (DS4700 Express Storage Subsystem)

Index	DS4700 Express Storage Subsystem	FRU P/N
1	Rail kit	41Y5152
2	AC power supply and fan unit FRU, 600 W (Models that are not NEBs Level 3/Telco compliant)	41Y5155
	AC power supply and fan unit FRU, 600 W (Models that are NEBs Level 3/Telco compliant) ¹	42D3346
	DC power supply and fan unit FRU	42D3290
3	Controller model 70	39M5896
	Controller model 72	41Y0676
4	Cage frame assembly, midplane	41Y0724

Table 51. Parts listing (DS4700 Express Storage Subsystem) (continued)

Index	DS4700 Express Storage Subsystem	FRU P/N
5	2 Gbps FC, 73.4 GB/10K drive module	42D0386
	2 Gbps FC, 146.8 GB/10K drive module	42D0369
	2 Gbps FC, 300 GB/10K drive module	42D0370
	2 Gbps FC, 36.4 GB/15K drive module	42D0371
	2 Gbps FC, 73.4 GB/15K drive module	42D0372
	2 Gbps FC, 146.8 GB 15K drive module	40D0373
	4 Gbps FC, 36.4GB/15K drive module	40K6815
	4 Gbps FC, 73.4GB/15K drive module	40K6819
	4 Gbps FC, 146.8GB/15K drive module	40K6823
	3 Gbps SATA, 500GB HS, 7200 RPM drive module	39M4557
6	Battery backup unit	41Y0679
7	Telco filter bezel assembly	42D3308
	Blank drive module	42D3315
	Cable, FRU-1M	39M5699
	Cable, FRU-5M	39M5700
	Cable, FRU-25M	39M5701
	Serial cable adapter (RoHS)	39M5942
	SFP LC (shortwave) 4 Gbps	22R6443
	LC wrap plug assembly	39M5914
	Power cord, 2.8M	39M5081
	AC power cord jumper	39M5377
	DC power cord jumper	42D3295
	Filter pack	42D3283
	Notes:	
1. To identify whether a DS4700 Express Storage Subsystem is NEBS/Telco compliant, check the serial number. Any DS4700 Express Storage Subsystem with serial numbers starting at 138500A and higher are NEBS level 3/Telco compliant.		

Appendix A. Records

Whenever you add options to your DS4700 Express, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact your IBM technical support representative.

Identification numbers

Record and retain the following information.

Product name:	IBM System Storage DS4000 DS4700 Express Storage Subsystem
Machine type:	1814
Model number:	70A, 70H, 70S, 70T, 72A, 72H, 72S, 72T
Serial number:	

The serial number is located on the bottom inside surface at the rear and on the left edge at the front of the DS4700 Express.

Sample information record

Table 53 shows a sample information record. This network contains storage subsystems that are managed by using both the direct-management and host-agent-management method.

Table 53. Sample information record

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

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 “Installing the support rails” on page 36.

Use the following templates (Figure 120 on page 194 and Figure 121 on page 195) to identify the proper locations for inserting M5 screws when mounting the support rails and DS4700 Express to a rack. The locations for the M5 screws are highlighted in the templates.

The DS4700 Express is 3 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

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

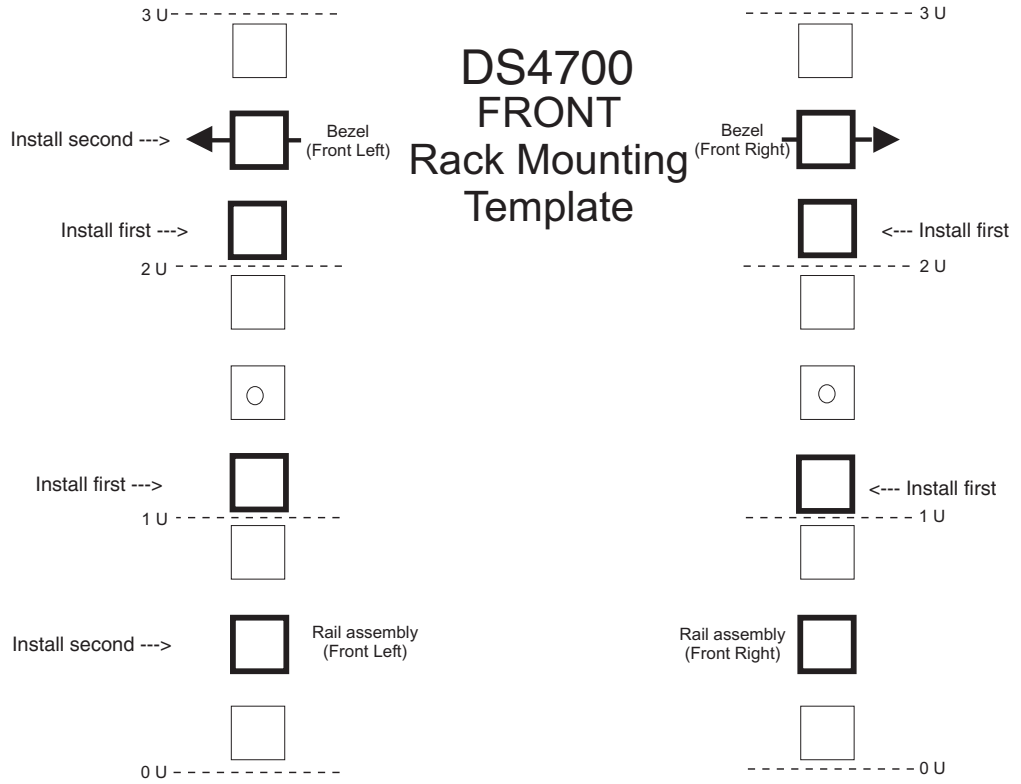


Figure 120. Front rack mounting template

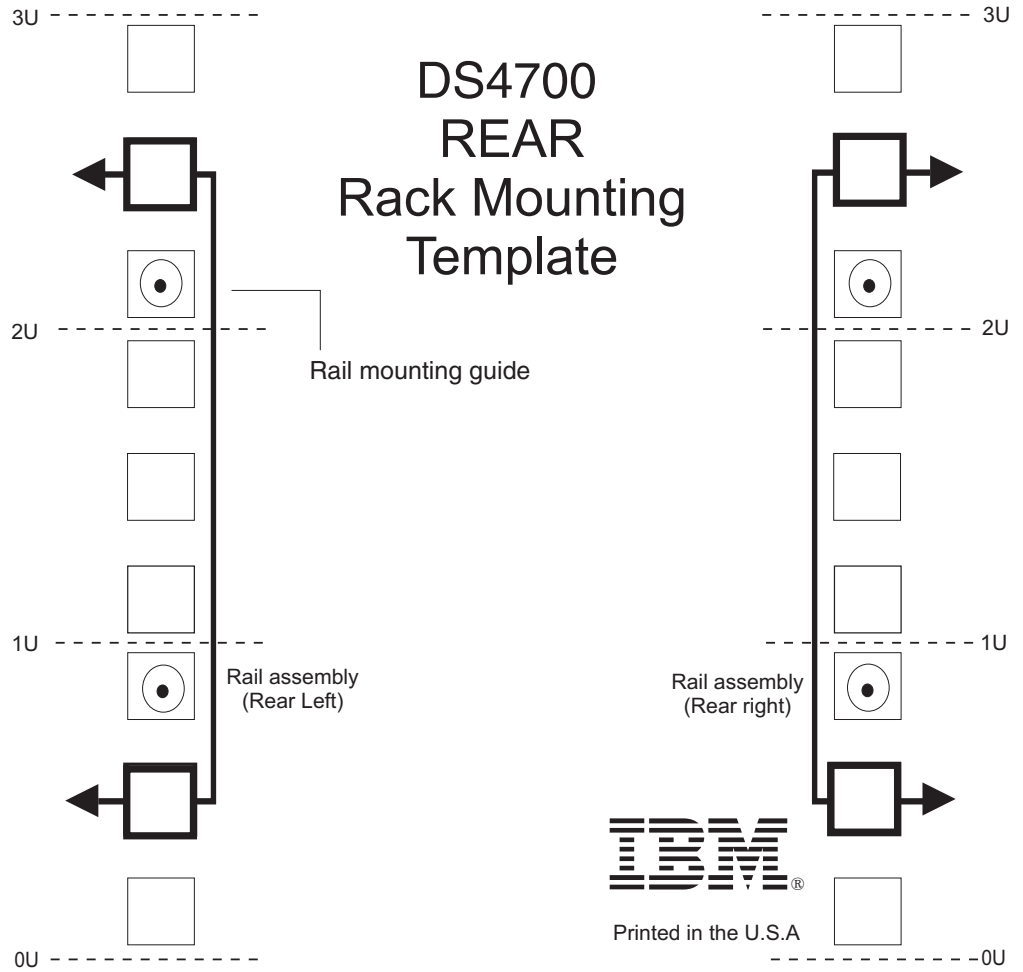


Figure 121. Rear rack mounting template

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.

Table 55. IBM power cords

IBM power cord part number	Feature code	Description	Used in these countries or regions
39Y7931	9800	Power Cord (125v, 10A, 4.3m)	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Thailand, Turks and Caicos Islands, United States, Venezuela

Table 55. IBM power cords (continued)

IBM power cord part number	Feature code	Description	Used in these countries or regions
39Y7917	9820	Power Cord (250v, 10A, 2.8m)	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Democratic Republic of), Congo (Republic of), Cote D'Ivoire (Ivory Coast), Croatia (Republic of), Czech Rep, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Gabon, Georgia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (Peoples Democratic Republic of), Latvia, Lebanon, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic of), Madagascar, Mali, Martinique, Mauritania, Mauritius, Mayotte, Moldova (Republic of), Monaco, Mongolia, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Reunion, Romania, Russian Federation Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia (Republic of), Somalia, Spain, Suriname, Sweden, Syrian Arab Republic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire
39Y7918	9821	Power Cord (250v, 10A, 2.8m)	Denmark

Table 55. IBM power cords (continued)

IBM power cord part number	Feature code	Description	Used in these countries or regions
39Y7923	9825	Power Cord (250v, 10A, 2.8m)	Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, Hong Kong, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Qatar, Saint Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad & Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe
39Y7920	9827	Power Cord (250v, 10A, 2.8m)	Israel
39Y7919	9828	Power Cord (250v, 10A, 2.8m)	Liechtenstein, Switzerland
39Y7922	9829	Power Cord (250v, 10A, 2.8m)	Bangladesh, Lesotho, Maceo, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
39Y7925	9845	Power Cord (250v, 12A, 2.8m)	Korea (Democratic Peoples Republic of)
39Y7921	9830	Power Cord (250v, 10A, 2.8m)	Chile, Italy, Libyan Arab Jamahiriya
39M7924	9831	Power Cord (250v, 10A, 2.8m)	Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea
39Y7930	9834	Power Cord (250v, 10A, 2.8m)	Argentina, Paraguay, Uruguay
39Y7928	9840	Power Cord (250v, 10A, 2.8m)	China
39M2830	9841	Power Cord 1.8m long	Taiwan
39Y7929	9842	Power Cord (125v, 10A, 2.8m)	Brazil
39Y7927	9843	Power Cord (250v, 10A, 2.8m)	India
39Y7926	9844	Power Cord (125v, 10A, 4.3m)	Japan
N/A	9986	Power Cord (125v, 10A, 1.8m) - US/Chicago	

Appendix D. Additional DS4000 documentation

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

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

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

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

DS4000 Storage Manager Version 9 library

Table 56 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 56. DS4000 Storage Manager Version 9 titles by user tasks

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

Table 56. DS4000 Storage Manager Version 9 titles by user tasks (continued)

Title	User tasks					
	Planning	Hardware installation	Software installation	Configuration	Operation and administration	Diagnosis and maintenance
<i>IBM System Storage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i>	✓	✓	✓	✓		

DS4800 Storage Subsystem library

Table 57 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 57. DS4800 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4800 Storage Subsystem Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4800 Storage Subsystem Installation and Cabling Overview</i>		✓				
<i>IBM TotalStorage DS4800 Controller Cache Upgrade Kit Instructions</i>	✓	✓		✓		

DS4700 Storage Subsystem library

Table 58 associates each document in the DS4700 Storage Subsystem library with its related common user tasks.

Table 58. DS4700 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4700 Storage Subsystem Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4700 Storage Subsystem Fibre Channel Cabling Guide</i>		✓				

DS4500 Storage Subsystem library

Table 59 associates each document in the DS4500 (previously FASiT900) Storage Subsystem library with its related common user tasks.

Table 59. DS4500 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4500 Storage Subsystem Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4500 Rack Mounting Instructions</i>	✓	✓				

DS4400 Storage Subsystem library

Table 60 associates each document in the DS4400 (previously FAStT700) Storage Subsystem library with its related common user tasks.

Table 60. DS4400 Storage Subsystem document titles by user tasks

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

DS4300 Storage Subsystem library

Table 61 associates each document in the DS4300 (previously FAStT600) Storage Subsystem library with its related common user tasks.

Table 61. DS4300 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4300 Rack Mounting Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 Storage Subsystem Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 SCU Base Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 SCU Turbo Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit</i>		✓	✓			

DS4200 Express Storage Subsystem library

Table 62 associates each document in the DS4200 Express Storage Subsystem library with its related common user tasks.

Table 62. DS4200 Express Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4200 Express Storage Subsystem Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4200 Express Storage Subsystem Cabling Guide</i>		✓				

DS4100 Storage Subsystem library

Table 63 associates each document in the DS4100 (previously FAStT100) Storage Subsystem library with its related common user tasks.

Table 63. DS4100 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4100 Storage Server Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4100 Storage Server Cabling Guide</i>		✓				

DS4000 Storage Expansion Enclosure documents

Table 64 associates each of the following documents with its related common user tasks.

Table 64. DS4000 Storage Expansion Enclosure document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4000 EXP810 Storage Expansion Enclosure Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM DS4000 EXP500 Installation and User's Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4000 EXP420 Storage Expansion Enclosure Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide</i>	✓	✓				

Other DS4000 and DS4000-related documents

Table 65 associates each of the following documents with its related common user tasks.

Table 65. DS4000 and DS4000–related document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM Safety Information</i>					✓	
<i>IBM TotalStorage DS4000 Hardware Maintenance Manual</i> ¹						✓
<i>IBM System Storage DS4000 Problem Determination Guide</i>						✓
<i>IBM Fibre Channel Planning and Integration: User's Guide and Service Information</i>	✓	✓			✓	✓
<i>IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM Netfinity® Fibre Channel Cabling Instructions</i>		✓				
<i>IBM Fibre Channel SAN Configuration Setup Guide</i>	✓		✓	✓	✓	

Notes:

1. The *IBM TotalStorage DS4000 Hardware Maintenance Manual* does not contain maintenance information for the IBM System Storage DS4100, DS4200, DS4300, DS4500, DS4700, or DS4800 storage subsystems. You can find maintenance information for these products in the *IBM System Storage DSx000 Storage Subsystem Installation, User's, and Maintenance Guide* for the particular subsystem.

Appendix E. Accessibility

This section provides information about alternate keyboard navigation, which is a DS4000 Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

By using the alternate keyboard operations that are described in this section, you can use keys or key combinations to perform Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the DS4000 Storage Manager version 9.14 - 9.23 (and later) software installation packages for Windows include a screen reader software interface.

To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14 - 9.23 (or later) on a Windows host/management station. Then, in the Select Product Features window, select Java Access Bridge in addition to the other required host software components.

Table 66 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 66. 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.

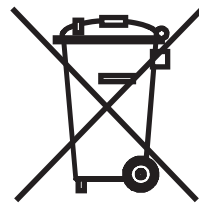
Table 66. DS4000 Storage Manager alternate keyboard operations (continued)

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.

Appendix F. 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 www.ibm.com/ibm/environment/products/prp.shtml.

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Appendix G. Battery Return Program

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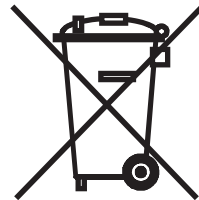
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台北市松仁路7號3樓
電話：0800-016-888

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Glossary

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This glossary also includes terms and definitions from:

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

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

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

See also

Refers you to a related term.

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

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

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

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

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

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

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

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

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

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

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

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

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

ATA. See *AT-attached*.

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

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

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

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as Fibre Channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the Fibre Channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

drive channels. The DS4200, DS4700, and DS4800 subsystems use dual-port drive channels that, from the physical point of view, are connected in the same way as two drive loops. However, from the point of view of the number of drives and enclosures, they are treated as a single drive loop instead of two different drive loops. A group of storage expansion enclosures are connected to the DS4000 storage subsystems using a drive channel from each controller. This pair of drive channels is referred to as a redundant drive channel pair.

drive loops. A drive loop consists of one channel from each controller combined to form one pair of redundant drive channels or a redundant drive loop. Each drive loop is associated with two ports. (There are two drive channels and four associated ports per controller.) For the DS4800, drive loops are more commonly referred to as drive channels. See *drive channels*.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the

receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

automatic ESM firmware synchronization. When you install a new ESM into an existing storage expansion enclosure in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, the firmware in the new ESM is automatically synchronized with the firmware in the existing ESM.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC. See *Fibre Channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

Fibre Channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel

(FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

heterogeneous host environment. A host system in which multiple host servers, which use different operating systems with their own unique disk storage subsystem settings, connect to the same DS4000 storage subsystem at the same time. See also *host*.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all

logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant Fibre Channel connections from the host computers, either directly or through a Fibre Channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry

Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture, Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring, Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, AIX, HP-UX, Solaris, and Linux on POWER host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, AIX, HP-UX, Solaris, and Linux on POWER host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between

optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol and SNMPv1*.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit known as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological

elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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