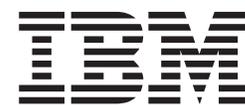


System Storage DS3500 and EXP3500



Installation, User's, and Maintenance Guide

System Storage DS3500 and EXP3500



Installation, User's, and Maintenance Guide

Note: Before using this information and the product it supports, read the general information in Appendix C, "Notices," on page 147 and see the *Warranty Information* document that comes with the storage subsystem.

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Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 **Safety Information** (安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφαλείας (safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si pečítajte Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Important:

Each caution and danger statement in this document is labeled with a number. This number is used to cross reference the English-language caution or danger statement with translated versions of the caution or danger statement in the *IBM Systems Safety Notices* document.

For example, if a caution statement is labeled “D005a,” translations for that caution statement are in the *IBM Systems Safety Notices* document under “D005a.”

Be sure to read all caution and danger statements in this document before you perform the procedures. Read any additional safety information that comes with the server or optional device before you install the device.



DANGER

Hazardous voltage, current, or energy levels are present inside any component that has this label attached. Do not open any cover or barrier that contains this label.

(L001)



DANGER

Rack-mounted devices are not to be used as shelves or work spaces.

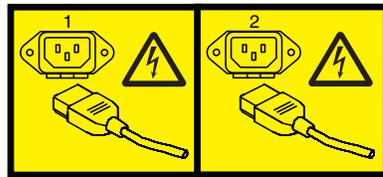
(L002)



DANGER

Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.

(L003)



or





DANGER

When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- Connect power to this unit only with the provided power cord. Do not use the provided power cord for any other product.
- Do not open or service any power supply assembly.
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- 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 procedures when installing, moving, or opening covers on this product or attached devices.

To disconnect:

1. Turn off everything (unless instructed otherwise).
2. Remove the power cords from the outlets.
3. Remove the signal cables from the connectors.
4. Remove all cables from the devices.

To connect:

1. Turn off everything (unless instructed otherwise).
2. Attach all cables to the devices.
3. Attach the signal cables to the connectors.
4. Attach the power cords to the outlets.
5. Turn on the devices.

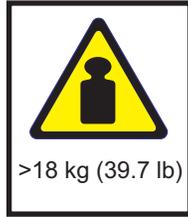
(D005a)



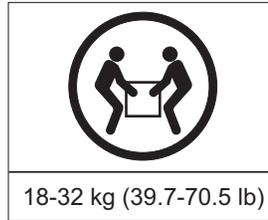
CAUTION:



or



or



The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

Chapter 1. Introduction

This chapter describes the operating specifications, features, and components of the IBM® System Storage® DS3500 storage subsystem and the EXP3500 expansion enclosure. The DS3500 storage subsystem and EXP3500 expansion enclosure consist of the following models:

- DS3512 storage subsystem
- DS3524 storage subsystem
- EXP3512 expansion enclosure
- EXP3524 expansion enclosure

This chapter also includes an inventory checklist and important information about best practices guidelines and product updates for your DS3500 storage subsystem and EXP3500 expansion enclosure.

If firmware and documentation updates are available, you can download them from the IBM Web site. The DS3500 storage subsystem and EXP3500 expansion enclosure might have features that are not described in the documentation that comes with the device, and the documentation might be updated occasionally to include information about those features, or technical updates might be available to provide additional information that is not included in the DS3500 storage subsystem and EXP3500 expansion enclosure documentation.

To check for updates, complete the following steps:

1. Go to <http://www.ibm.com/servers/storage/support/>.
2. On the “Support for System Storage and TotalStorage products” page, under **Select your product**, in the **Product family** field, select **Disk systems**.
3. In the **Product** field, select **DS3500** or **EXP3500**.
4. Click **Go**.
5. Make the following selections:
 - For firmware updates, click the **Download** tab.
 - For documentation updates, click the **Install and use** tab.

Note: Changes are made periodically to the IBM Web site. Procedures for locating firmware and documentation might vary slightly from what is described in this document.

The DS3500 storage subsystem and EXP3500 expansion enclosure come with a limited warranty. For more information about the terms of your warranty, see the *Warranty Information* document that comes with the device.

Record information about the DS3500 storage subsystem and EXP3500 expansion enclosure in Table 14 on page 141. You will need this information if you have to call for service.

Figure 1 on page 2 shows the location of the serial number label, and the product name, and machine type, model, and serial number label.

Note: The illustrations in this document might differ slightly from your hardware.

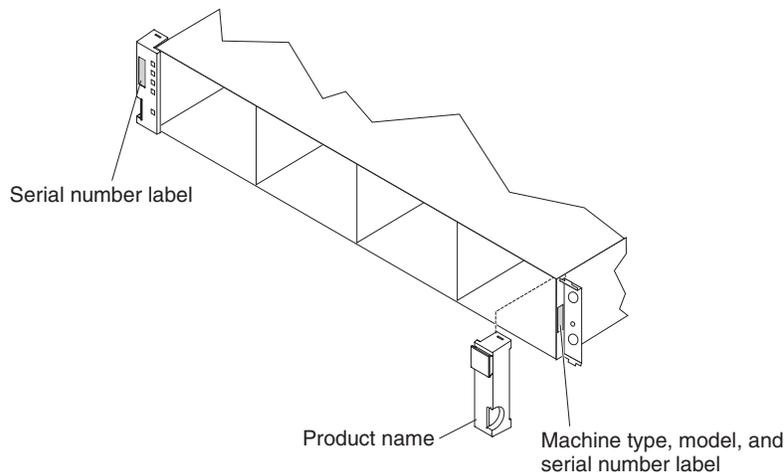


Figure 1. Serial number label, and product name, machine type, and model number label locations

Use Table 15 on page 142 to keep a record of the hard disk drives that are installed in or attached to the DS3500 storage subsystem and EXP3500 expansion enclosure. This information can be helpful when you install additional hard disk drives or if you have to report a hardware problem. Make a copy of this table before you record information in it, in case you need extra space to write new values later, or when you update the DS3500 storage subsystem and EXP3500 expansion enclosure configuration.

DS3500 storage subsystem overview

With direct-attached Serial Attached SCSI (SAS) connectivity and support for RAID levels 0, 1, 3, 5, and 6, the DS3500 storage subsystem provides an internal physical storage capacity that is scalable up to 24 TB (terabytes) for the DS3512 and 12 TB for the DS3524 storage subsystem.

Notes:

1. RAID 6 uses a P+Q design implementation.
2. When RAID level 1 is implemented and the number of hard disk drives increases to more than two, RAID level 10 is automatically implemented.

The DS3500 is a 2U rack-mountable storage subsystem that supports up to two redundant, dual-active RAID controllers. The DS3500 storage subsystem comes standard with two 6 Gbps x4 SAS host ports and a single 6 Gbps x4 SAS expansion port per controller. Each RAID controller contains 1 GB of cache memory that is upgradable to 2 GB of cache. Also, each controller supports the installation of the following host port adapters:

- 6 Gbps SAS
- 8 Gbps FC
- 1 Gbps iSCSI

The DS3500 storage subsystem supports up to 96 hard disk drives when attached to EXP3500 expansion enclosures. The DS3500 storage subsystem and EXP3500 expansion enclosures support configurations of 6 Gbps SAS, Near Line (NL) SAS, 6 Gbps SAS Full Disk Encryption (FDE) disk drives, or a mix of disk drives. To use the FDE disk encryption functionality, you must purchase the Full Disk Encryption option.

Advanced DS3500 storage management, copy service options, and optional advanced disaster recovery functions are available for the DS3500, including FlashCopy®, VolumeCopy, and Enhanced Remote Mirroring.

The DS3500 storage subsystem comes with redundant 585-watt ac power supplies and fan units.

The DS Storage Manager version 10 software is also available for the DS3500. This storage-management software is designed to help centralize storage management, simplify partitioning of the DS3500 series storage into as many as 64 virtual servers, and strategically allocate storage capacity to maximize storage space.

The hot-swap features enable you to remove and replace SAS hard disk drives, power supplies, and controllers (in a dual-controller storage subsystem).

EXP3500 expansion enclosure overview

The EXP3500 is a 2U rack-mountable expansion enclosure with redundant 585-watt ac power supplies and fan units. The EXP3500 comes with a single environmental services module (ESMs) that is expandable to dual redundant ESMs when you install the optional ESM kit. The EXP3512 expansion enclosure supports up to 12 hard disk drives and the EXP3524 expansion enclosure supports up to 24 hard disk drives.

Notices and statements in this document

The caution and danger statements in this document are also in the multilingual *IBM Systems Safety Notices* document, which is in the Documentation folder on the *IBM System Storage DS3500 Support DVD*. Each statement is followed by a reference number that you can use to locate the corresponding statement in your language in the *IBM Systems Safety Notices* document.

The following notices and statements are used in this document:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Features and operating specifications

Table 1 contains a summary of the features and operating specifications of the DS3500 storage subsystem and EXP3500 expansion enclosure. Depending on your model, some features might not be available, or some specifications might not apply.

Table 1. Features and operating specifications

| | | |
|---|---|---|
| <p>General:</p> <ul style="list-style-type: none"> • Modular components <ul style="list-style-type: none"> – High-capacity disk drives – (DS3500) RAID controller modules – (EXP3500) environmental services modules (ESMs) – Power supplies with built-in fans • Technology <ul style="list-style-type: none"> – Supports disk array technology – Redundant data storage, power and cooling system, (DS3500) SAS disk controllers, and (EXP3500) ESMs – Hot-swap technology for hard disk drives, power supplies, (EXP3500) ESMs, and (DS3500) controllers – (DS3500) Host port adapter. Each controller supports one host port adapter. Support for: <ul style="list-style-type: none"> - 6 Gbps SAS - 8 Gbps FC - 1 Gbps iSCSI • User interface <ul style="list-style-type: none"> – Built-in power, activity, and fault LEDs, identification labeling on components, rear LEDs, and connectors – Easy-to-replace hard disk drives, power supplies with built-in fans, and controllers <p>Acoustical noise emissions:</p> <ul style="list-style-type: none"> • DS3512 and EXP3512 fully populated with 12 hard disk drives <ul style="list-style-type: none"> – Sound power (idling): 6.2 bels – Sound power (operating): 6.2 bels – Sound pressure (idling): 62 dBA – Sound pressure (operating): 62 dBA • DS3524 and EXP3524 fully populated with 24 hard disk drives <ul style="list-style-type: none"> – Sound power (idling): 6.4 bels – Sound power (operating): 6.4 bels – Sound pressure (idling): 64 dBA – Sound pressure (operating): 64 dBA | <p>Power supply with built-in fans:</p> <ul style="list-style-type: none"> • Two hot-swap 585-watt (100 - 240 V ac) standard • Provides redundant power <p>Size:</p> <ul style="list-style-type: none"> • DS3512 and EXP3512: <ul style="list-style-type: none"> – Height: 8.6 cm (3.4 in.) – Depth: 54.0 cm (21.3 in.) – Width: 44.9 cm (17.7 in.) – (DS3512) Weight: Single controller: 17.2 kg (38.0 lb) Dual controller: 18.5 kg (40.7 lb) – (EXP3512) Weight: 16.9 kg (37.3 lb) • DS3524 and EXP3524: <ul style="list-style-type: none"> – Height: 8.8 cm (3.5 in.) – Depth: 48.7 cm (19.2 in.) – Width: 44.9 cm (17.7 in.) – (DS3524) Weight: Single controller: 20.2 kg (44.5 lb) Dual controller: 21.4 kg (47.2 lb) – (EXP3524) Weight: 19.9 kg (43.8 lb) <p>Environment:</p> <ul style="list-style-type: none"> • Air temperature: <ul style="list-style-type: none"> – On: 10° to 35°C (50.0° to 95°F); altitude: 30.5 (100 ft) below to 3000 m (9840 ft) above sea level; temperature change: 10°C (18°F) per hour – Off: -10° to 50°C (14.0° to 120.0°F); maximum altitude: 3000 m (9840 ft); temperature change: 15°C (27.0°F) per hour • Humidity: <ul style="list-style-type: none"> – On: 20% to 80% – Off: 10% to 90% – Maximum dew point: 26°C (79°F) – Maximum humidity gradient: 10% per hour <p>Hard disk drives:</p> <ul style="list-style-type: none"> • DS3512 and EXP3512: 12 LFF 3.5-inch 6 Gbps • DS3524 and EXP3524: 24 SFF 2.5-inch 6 Gbps <p>Drive type: SAS and NL SAS</p> | <p>Controllers:</p> <p>(DS3500) SAS interface: Three 26-pin, mini-SAS connectors per controller</p> <p>ESMs:</p> <p>(EXP3500) SAS interface: Three 26-pin, mini-SAS connectors per ESM</p> <p>Heat output</p> <p>Approximate heat output in British thermal units (Btu) per hour:</p> <ul style="list-style-type: none"> • Minimum configuration: 205 Btu (60 watts) • Maximum configuration 1235 Btu (361 watts) <p>Electrical input:</p> <ul style="list-style-type: none"> • Sine-wave input (50 - 60 Hz) required • Input voltage low range: <ul style="list-style-type: none"> – Minimum: 90 V ac – Maximum: 136 V ac • Input voltage high range: <ul style="list-style-type: none"> – Minimum: 198 V ac – Maximum: 264 V ac • Approximate input kilovolt-amperes (kVA): <ul style="list-style-type: none"> – Minimum: 0.06 kVA – Maximum: 0.38 kVA <p>Notes:</p> <ol style="list-style-type: none"> 1. Power consumption and heat output vary depending on the number and type of optional features that are installed and the power-management optional features that are in use. 2. These levels were measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779 and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average stated values because of room reflections and other nearby noise sources. The declared sound-power levels indicate an upper limit, below which a large number of computers will operate. |
|---|---|---|

Models and optional devices

The DS3500 storage subsystem RAID controller cache size, partitions, and other features vary depending the model and optional devices.

Contact your IBM marketing representative or authorized reseller for more information about the models and options.

Operating-system support

The following operating systems are supported for host servers that have mapped LUNs that are created in the DS3500 storage subsystem with expansion enclosures:

- IBM AIX
- IBM Linux on POWER (LoP)
- Microsoft® Windows® Server 2003
- Microsoft Windows Server 2008
- Red Hat® Enterprise Linux®
- SuSE Linux Enterprise Server
- VMware ESX Server

For additional host operating-system support, see the latest DS Storage Manager software readme file and the IBM DS3000 series products interoperability matrix at <http://www.ibm.com/systems/storage/disk/>.

Product updates

Important: To keep your storage subsystem up-to-date with the latest firmware and other product updates, register the storage subsystem for technical support notifications. Go to <http://www.ibm.com/servers/storage/support/disk/>. From the menu at the top of the page, click **My IBM** and select **My Technical Support**. On the next page, click **register now**.

Download the latest version of the DS Storage Manager software, DS3500 storage subsystem controller firmware, DS3000 series expansion enclosure firmware, and drive firmware when you initially install the storage subsystem and when product updates become available.

To receive product updates, complete the following steps:

1. After you have registered, type your user ID and password to log in to the site. The “My notifications for technical support” page opens.
2. From the **Subscribe** tab, click **Storage disk systems**.
3. Click the box next to the product you want to receive information about.
4. Click **Continue**.
5. Under **Notify me by**, click **e-mail**.
6. Click the **Submit** button to complete the notifications process.

Best practices guidelines

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

- Make sure that the storage subsystem is in an optimal state before you shut it down. Never turn off the power if any amber LED is lit; be sure to resolve any error conditions before you shut down the storage subsystem.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, connect the DS3500 storage subsystem and EXP3500 expansion enclosure right and left power supplies to two independent external power circuits through ac power distribution units (PDUs) inside a rack or directly into external receptacles. This ensures that all devices in the configuration have power in the event that only one power circuit is available. In addition, having all the right or all the left power cables connected to the same power circuit enables the 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 expansion enclosures. Use additional pairs of ac PDUs. See Table 1 on page 4 for information about storage subsystem power requirements. Contact your technical-support representative for additional information.

- 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 *DS Storage Manager 10 Installation and Host Support Guide* for your operating system. Save the profile in a location other than in the logical drives that are created for the DS3500 storage subsystem and EXP3500 expansion enclosure.
- During any maintenance or attended power-on procedure, carefully follow the power-on sequence that is described in “Turning on the storage subsystem” on page 68. Make sure that each component of the storage subsystem is powered-on in the correct order during this entire power-on procedure to make sure that the controller will be able to optimally access all of the storage subsystems.
- The storage subsystem supports simultaneous power-on to the system components; however, you should always follow the power-on sequence that is described in “Turning on the storage subsystem” on page 68 during any attended power-on 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, call your IBM technical-support representative if any of the following conditions occur:
 - The storage subsystem logical drives and subsystems are not displayed in the DS Storage Manager graphical user interface.
 - The storage subsystem logical drives and subsystems do not come online.
 - The storage subsystem logical drives and subsystems seem to be degraded.

DS3500 storage subsystem and EXP3500 expansion enclosure components

The DS3500 storage subsystem and EXP3500 expansion enclosure have the following removable components. These components, called customer replaceable units (CRUs), are accessible from the front or rear of the storage subsystem.

- (DS3512 and EXP3512) Up to 12 LFF 3.5-inch 6 Gbps SAS or NL SAS hard disk drives and drive filler panels.
- (DS3524 and EXP3524) Up to 24 SFF 2.5-inch 6 Gbps SAS or NL SAS hard disk drives and drive filler panels.

- (DS3512 and DS3524) Up to two RAID controllers. Each controller supports the installation one of the following optional host port adapters:
 - 6 Gbps SAS
 - 8 Gbps FC
 - 1 Gbps iSCSI
- (EXP3512 and EXP3524) Up to two ESM modules.
- Two power supplies.

Disk drives and bezels

The hot-swap drive bays that are accessible from the front of the DS3512 storage subsystem and EXP3512 expansion enclosure are shown in Figure 2. The hot-swap drive bays that are accessible from the front of the DS3524 storage subsystem and EXP3524 expansion enclosure are shown in Figure 3.

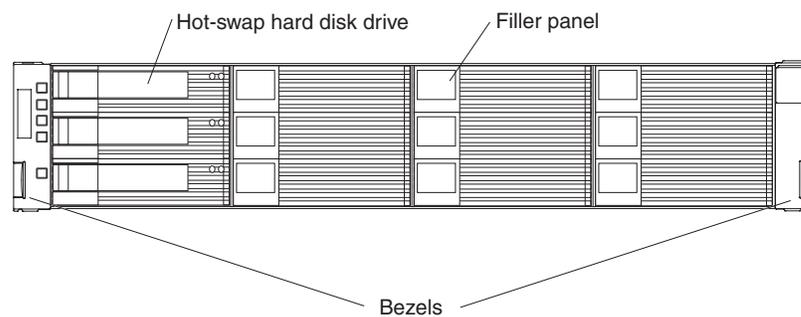


Figure 2. DS3512 storage subsystem and EXP3512 expansion enclosure hot-swap drive bays and bezels

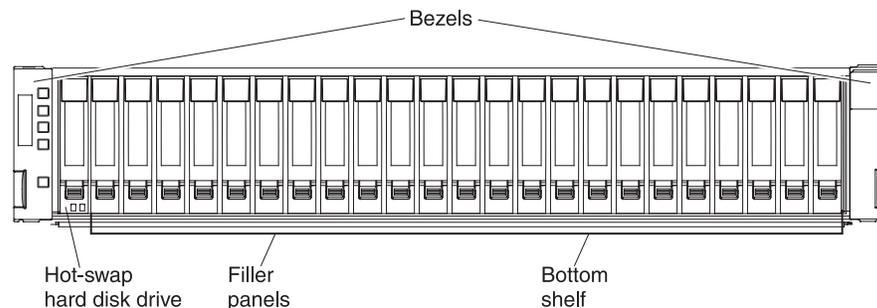


Figure 3. DS3524 storage subsystem and EXP3524 expansion enclosure hot-swap drive bays and bezels

Hot-swap hard disk drive

You can install up to 12 hot-swap SAS or NL SAS hard disk drives in the DS3512 storage subsystem and EXP3512 expansion enclosure. You can install up to 24 hot-swap SAS or NL SAS hard disk drives in the DS3524 storage subsystem and EXP3524 expansion enclosure.

Filler panel

The DS3500 storage enclosure and EXP3500 expansion enclosure come with filler panels in the empty drive bays. Before you install a hard disk drive, remove the filler panel and save it for future use. Each of the drive bays must contain either a filler panel or a hard disk drive.

Left-side bezel

The left-side bezel contains the LEDs, as shown in the following illustration.

For a description of the LEDs, see “Front LEDs” on page 74.

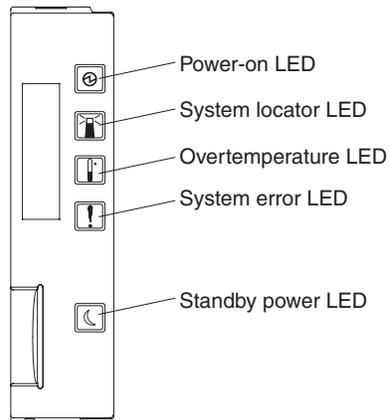


Figure 4. Left-side bezel

Right-side bezel and bottom shelf

The right-side bezel and bottom shelf contain the hard disk drive identification information. Figure 5 shows the right-side bezel of the DS3512 storage subsystem and EXP3512 expansion enclosure. Figure 6 shows the bottom shelf of the DS3524 storage subsystem and EXP3524 expansion enclosure.

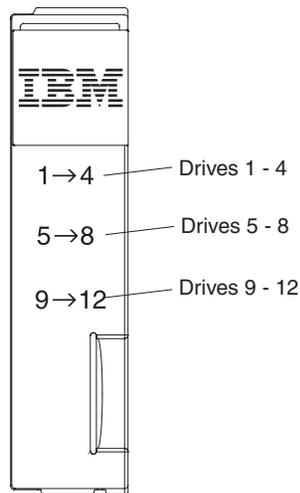


Figure 5. Right-side bezel (DS3512 and EXP3512)

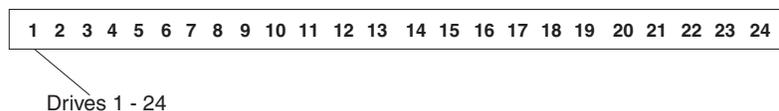


Figure 6. Bottom shelf (DS3524 and EXP3524)

The hard disk drives come preinstalled in drive trays. Install drives in the drive bays on the front of the storage subsystem or expansion enclosure. When a drive is installed, the drive and tray bay designation is set automatically. The hardware addresses are based on the enclosure ID setting on the controller and on the physical locations of the drives.

There are no serviceable parts in a drive assembly. If it fails, it must be replaced in its entirety (drive, bezel, and tray). When you replace a drive, be sure to order and install the correct drive. Using an unsupported drive causes the drive to be locked out by the controller firmware.

Attention:

1. After you remove a drive from a bay, wait 70 seconds to allow the drive to spin down before you replace or reseal the drive. Failure to do so might cause unpredictable results.
2. Never hot-swap a drive when its associated green activity LED is flashing or its associated amber fault LED is flashing. Hot-swap a drive only when its associated amber fault LED is lit continuously or when the drive is inactive and its associated green activity LED is not flashing.

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

Controllers

The DS3500 storage subsystem comes with one or two RAID controllers. When the DS3500 storage subsystem has two controllers, the controllers are hot-swappable and redundant. The controllers contain the storage subsystem control logic, interface ports, and LEDs. Each controller contains the following ports:

- Two 6 Gbps SAS host ports
- One SAS drive port to connect EXP3500 expansion enclosures
- Two Ethernet ports for subsystem management
- Support for one optional host port adapter:
 - Two-port 6 Gbps SAS
 - Four-port 8 Gbps FC
 - Four-port 1 Gbps iSCSI

The Ethernet ports come with the following default IP addresses:

Port 1 on controller A is 192.168.128.101
Port 2 on controller A is 192.168.129.101
Port 1 on controller B is 192.168.128.102
Port 2 on controller B is 192.168.129.102

The subnet mask for both Ethernet ports is 255.255.255.0.

Attention: When a DS3500 storage subsystem has two RAID controllers, the controllers must be identical to each other in hardware (host port adapter and cache size) and firmware. If you install a host port adapter in one controller, you must install an identical host port adapter in the other controller.

The storage management software automatically sets the enclosure ID for the controllers. You can change the enclosure ID setting through the DS Storage Manager software only. There are no switches on the DS3500 chassis to manually set the enclosure ID. Both controller enclosure IDs are identical under normal operating conditions.

Figure 7 on page 10 shows a single-controller storage subsystem without an optional host port adapter installed. See “Cabling the DS3500 storage subsystem” on page 23 for illustrations of the storage subsystem with optional host port

adapters installed in the controllers.

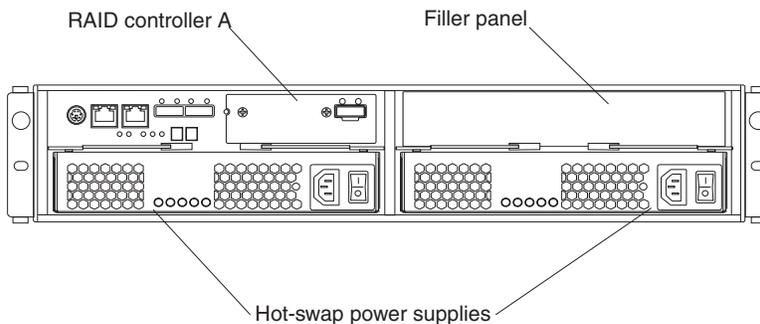


Figure 7. Rear view, single-controller model (shown without an optional host port adapter)

Environmental service modules

The EXP3500 expansion enclosure comes with a single ESM. An optional ESM is available for redundant configurations. If the RAID controller connected to the ESM supports more than one EXP3500 expansion enclosure per physical port, you can connect two or more EXP3500 expansion enclosures by chaining them together. For information about connecting an EXP3500 expansion enclosure to a DS3500 storage subsystem, see “Connecting expansion enclosures to the DS3500” on page 40.

Figure 8 shows an EXP3512 expansion enclosure containing one ESM and a filler panel over the blank ESM bay.

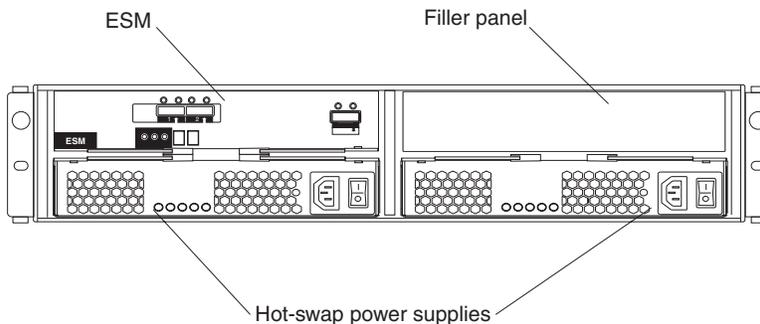


Figure 8. Rear view, single ESM model expansion enclosure

Power supply and fans

The DS3500 storage enclosure and EXP3500 expansion enclosure have two removable power supplies. Each power supply contains two fans. The four fans pull air through the drives from front to back across the drives.

The fans provide redundant cooling, which means that if one fan fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem or expansion enclosure. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage subsystem or expansion enclosure. To preserve the optimal airflow, do not remove a failed power supply from the chassis until you are ready to replace it with a new power supply.

Figure 9 on page 11 shows the power supply components.

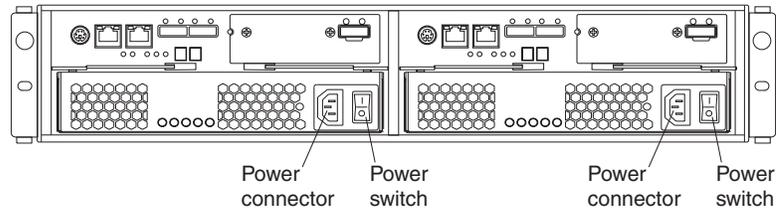


Figure 9. Power supply components

Battery units

Each RAID controller contains 1024 MB of cache memory (minimum). It also contains a sealed, rechargeable lithium ion battery that maintains data in the cache so that it can be transferred to flash memory in the event of a power failure.

Figure 10 shows the locations of the battery and memory cache DIMM in the controller.

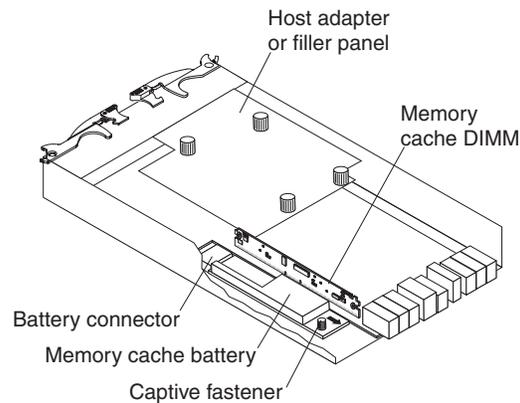


Figure 10. Battery unit

The battery chargers in the power supplies perform a battery test when the storage subsystem is started and on a regularly scheduled interval thereafter. Data caching starts after the battery tests are completed.

The condition of the battery is indicated by an LED on the rear of the controller (see “Controller LEDs” on page 75 for the location of the battery fault LED and conditions that the LED indicates).

Software and hardware compatibility and upgrades

The latest controller firmware, NVSRAM firmware, ESM firmware, and hard disk drive firmware must be installed to ensure optimal functionality, manageability, and reliability.

Software and firmware support code upgrades

To enable support for the DS3500, you *must* make sure that your system software and firmware are at the latest levels. To find the latest DS Storage Manager software, controller firmware, NVSRAM, ESM firmware, and hard disk drive firmware, check the firmware readme files.

See the *DS Storage Manager 10 Installation and Host Support Guide* for your operating system for instructions that describe how to install the DS3500 controller firmware, EXP3500 ESM firmware, and Storage Manager host software.

Determining firmware levels

To determine the firmware levels of the DS3500 storage subsystem, the connected expansion enclosures, and the installed hard disk drives, use the DS Storage Manager software that is used to manage the DS3500 storage subsystem.

In the Subsystem Management window, click the **Summary** tab; then, click **Storage Subsystem Profile** in the Status section. When the Storage Subsystem Profile window opens, click the **All** tab and scroll through the **Profile For Storage Subsystem** to locate the following information.

Note: The **Profile For Storage Subsystem** contains all the profile information for the entire subsystem. Therefore, you might have to scroll through a large amount of information to locate the firmware version numbers.

DS3500 Storage Server

- Firmware version
- NVSRAM version

Hard Disk Drives

- Firmware version

Drive Enclosure

- ESM firmware version

Specifications

The specifications of the DS3500 storage subsystem and EXP3500 expansion enclosure are listed in Table 1 on page 4. This section provides additional site specifications for the DS3500 storage subsystem and EXP3500 expansion enclosure. Before you install the storage subsystem, you must either make sure 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 DS3500 storage subsystem and EXP3500 expansion enclosure installation, service, and operation.

Area requirements

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

Dimensions

Figure 11 on page 13 shows the dimensions of the DS3512 storage subsystem and EXP3512 expansion enclosure, which conforms to the 19-inch rack standard.

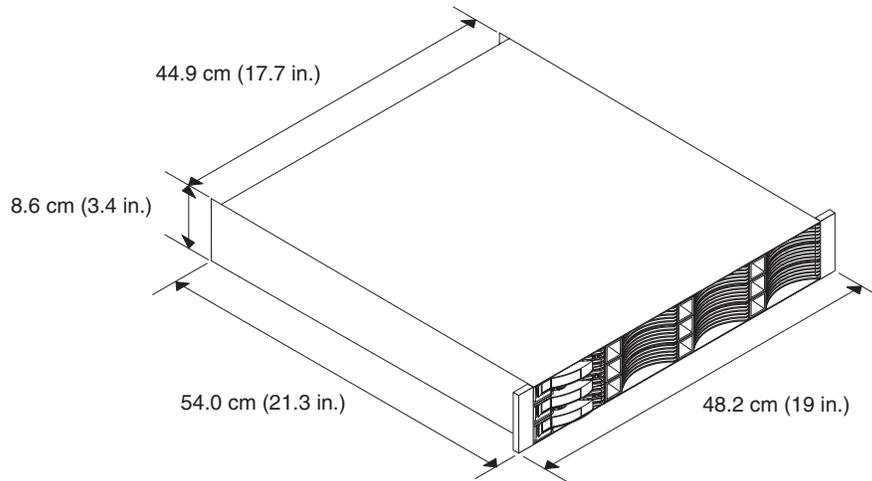


Figure 11. DS3512 storage subsystem and EXP3512 expansion enclosure dimensions

Figure 12 shows the dimensions of the DS3524 storage subsystem and EXP3524 expansion enclosure, which conforms to the 19-inch rack standard.

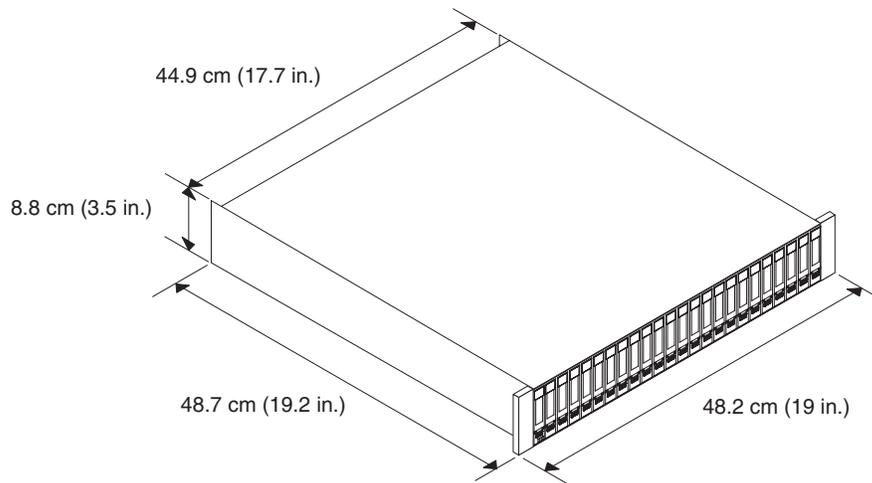


Figure 12. DS3524 storage subsystem and EXP3524 expansion enclosure dimensions

Weight

The total weight of the storage subsystem and expansion enclosure depends on the number of installed components. Table 2 lists the maximum and empty weights for the DS3512 storage subsystem and EXP3512 expansion enclosure in different configurations. Table 3 on page 14 lists the maximum and empty weights for the DS3524 storage subsystem and EXP3524 expansion enclosure in different configurations. Table 4 on page 14 lists the weight of each component.

Table 2. DS3512 storage subsystem and EXP3512 expansion enclosure weights

| Model | Maximum ¹ | Empty ² |
|---------|----------------------|--------------------|
| DS3512 | 27.0 kg (59.6 lb) | 8.4 kg (18.5 lb) |
| EXP3512 | 26.3 kg (57.9 lb) | |

¹ Chassis with dual controller or ESMs and 12 hard disk drives.

² Chassis without power supplies, controllers or ESMs, and hard disk drive filler panels.

Table 3. DS3524 storage subsystem and EXP3524 expansion enclosure weights

| Model | Maximum ¹ | Empty ² |
|---------|----------------------|--------------------|
| DS3524 | 25.9 kg (57.2 lb) | 10.7 kg (23.6 lb) |
| EXP3524 | 25.2 kg (55.5 lb) | |

¹ Chassis with dual controller or ESMs and 24 hard disk drives.

² Chassis without power supplies, controllers or ESMs, and hard disk drive filler panels.

Table 4. DS3500 component weights

| Unit | Weight |
|--|-------------------|
| 2.5-inch hard disk drive | 0.25 kg (0.55 lb) |
| 3.5-inch hard disk drive | 0.78 kg (1.72 lb) |
| Power supply with fan | 2.50 kg (5.31 lb) |
| Controller (including cache battery backup and no host port adapter) | 2.05 kg (4.52 lb) |
| Fibre channel host daughter card | .08 kg (.18 lb) |
| iSCSI host daughter card | .05 kg (.11 lb) |
| SAS host daughter card | .07 kg (.15 lb) |
| Battery | .15 kg (.33 lb) |
| ESM | 1.75 kg (3.86 lb) |

Temperature and humidity

Table 1 on page 4 lists the acceptable temperature and humidity ranges in which the storage subsystem is designed to operate.

Notes:

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

Electrical requirements

Consider the following information when you prepare 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-on recovery sequence without operator intervention after power is restored.

Site wiring and power

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

The agency ratings for the DS3500 storage subsystem and EXP3500 expansion enclosure are 6 amps at 100 V ac and 2.5 amps at 240 V ac. These are the overall maximum operating currents for this system.

AC power recovery

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

Power cords and receptacles

The storage subsystem comes with two jumper cords that are used to connect to the rack PDU. You must purchase the power cords that are applicable for use in a typical receptacle in your country. See “Power cords” on page 138 for more information.

Heat output, airflow, and cooling

Air enters at the front of the DS3500 storage subsystem and EXP3500 expansion enclosure and leaves at the back. Allow at least 30 inches in front of the DS3500 storage subsystem and EXP3500 expansion enclosure and at least 24 inches at the rear for service clearance, proper ventilation, and heat dissipation.

When racks that contain many DS3500 storage subsystems and EXP3500 expansion enclosures are to be installed together, the following requirements must be met to ensure that the devices 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 13 on page 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 expansion enclosures that are in that rack. Use Suite Attach Kits to completely seal any gaps that remain between the racks. For details about Suite Attach Kits, contact your IBM marketing representative or authorized reseller.
- Where racks are in rows front-to-front or back-to-back, gaps of at least 122 cm (48 in.) must separate the rows across the cold aisle (see Figure 13 on page 16).
- To 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.

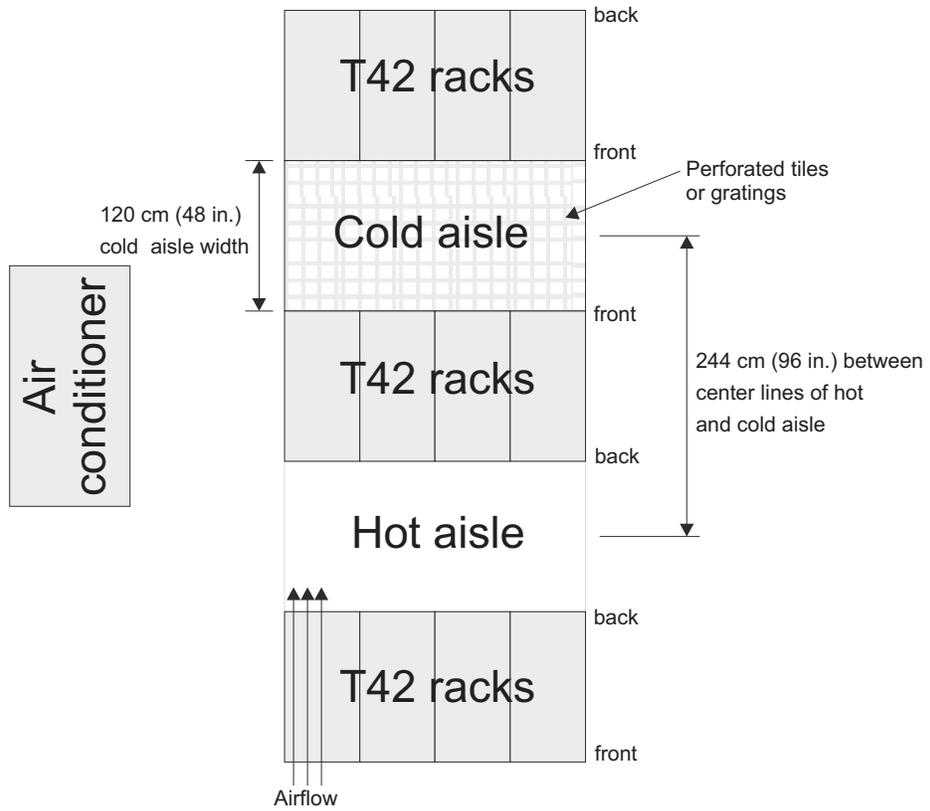


Figure 13. Example of cold aisle/hot aisle rack configuration

Chapter 2. Installing the storage subsystem and expansion enclosure

This chapter provides instructions for installing the DS3500 storage subsystem and the EXP3500 expansion enclosure in a rack. To install the DS3500 storage subsystem in a rack, see “Installing the DS3500 storage subsystem.” To install the EXP3500 expansion enclosure in a rack, see “Installing the EXP3500 expansion enclosure” on page 21.

Before you begin the installation, review the safety information in “Safety” on page xiii and “Handling static-sensitive devices” on page 19.

Installing the DS3500 storage subsystem

This section provides instructions for installing the DS3500 storage subsystem in a rack.

Inventory checklist

After you unpack the DS3500 storage subsystem, make sure that you have the following items. Depending on your order, your shipping box might contain additional items that are not on the list.

- **Hardware**

- Hard disk drives or drive filler panels:
 - DS3512 (12)
 - DS3524 (24)
- RAID controllers (up to 2)
- Power supplies (2)
- Power cables (2 jumper line cords)
- Rack installation hardware kit:
 - Support rails (2) (right and left assembly)
 - M5 black hex-head slotted screws (8)
 - M5 Washers (6)
 - Small diameter spacers (8) (these come installed, four in each rail)
 - Large diameter spacers (8)
 - M4 pan-head screws (2)

Attention: The DS3500 storage subsystem does not come with region-specific power cords. You must obtain the IBM-approved power cords for your region. See “Power cords” on page 138 for the IBM-approved power cords for your region.

- **Software and documentation**

- IBM *System Storage DS3500 Support DVD*

The support DVD contains the IBM DS Storage Manager host software. The DVD also includes firmware, online help, and the following documentation in Adobe Acrobat Portable Document Format (PDF):

 - *IBM System Storage DS3500 and EXP3500 Installation, User's, and Maintenance Guide* (this document)
 - *DS Storage Manager 10 Installation and Host Support Guide* for your operating system

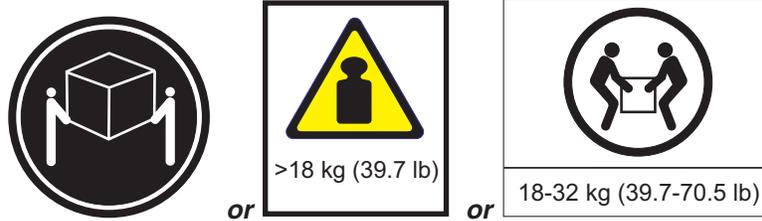
- IBM Systems Safety Notices
- IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide

Premium features activation or entitlement kits might also come inside the box, if you ordered them.

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

DS3500 installation overview

CAUTION:



The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

Attention: A fully configured DS3500 storage subsystem weighs up to 27 kg (60 lb). At least two people should lift the DS3500 storage subsystem from the shipping box. You might want to open the sides of the shipping box and remove the components from the DS3500 storage subsystem before you lift it from the shipping box, to lighten the storage subsystem.

The following steps summarize the installation process:

1. Review the preparation recommendations. See "Preparing for installation" on page 19.
2. Prepare the installation site. See "Preparing the site" on page 20.
3. Prepare the rack. See the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
4. Record the serial number, machine type and model number, and RAID controller MAC addresses for your DS3500 storage subsystem in Appendix A, "Records," on page 141. See Figure 1 on page 2 for the location of the serial number.
The MAC addresses are labeled near the Ethernet port on each RAID controller.
5. Install and secure the DS3500 chassis and components in the rack. See the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
6. Install the expansion enclosure in the rack, if you are installing one or more expansion enclosures. Follow the instructions in the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
7. Cable the DS3500 storage subsystem to the expansion enclosures. See "Connecting expansion enclosures to the DS3500" on page 40.
8. Complete one of the following cabling tasks to enable management of the DS3500 configuration:
 - If you are using out-of-band management, cable the DS3500 Ethernet ports to either the management workstation or the host.

- If you are using in-band management, cable the DS3500 hosts to the host bus adapters (HBAs) in the hosts. See “Connecting iSCSI hosts to the DS3500” on page 59.
9. Connect the power cables. See “Cabling the DS3500 and EXP3500 power supplies” on page 65.
 10. Power-on the expansion enclosure and the DS3500 storage subsystem, using the procedure in “Turning on the storage subsystem” on page 68.
 11. Install the DS Storage Manager host software on the management workstation (for out-of-band management) or on the host (for in-band management). See the *DS Storage Manager 10 Installation and Host Support Guide* for the management-workstation or host operating system for installation instructions for installing the DS Storage Manager host software.
 12. Use the DS Storage Manager host software to verify the configuration.
 13. Review and perform the procedures in “Performing the health check process” on page 67.

Handling static-sensitive devices

Attention: Static electricity can damage the storage subsystem and other electronic devices. 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 damage it.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the system unit for at least 2 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 down the device, put it back into its static-protective package. Do not place the device on your system unit cover or on a metal surface.
- Take additional care when you handle devices during cold weather. Heating reduces indoor humidity and increases static electricity.

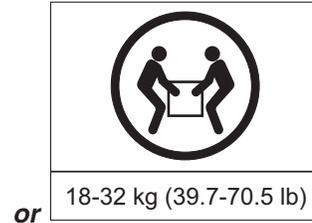
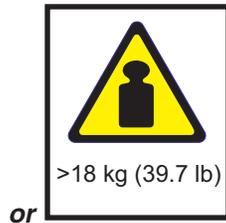
Preparing for installation

Before you install the DS3500 storage subsystem, create a detailed plan of how the device will be used in your storage configuration. The plan should include determining RAID levels, failover requirements, operating systems that are to be used, and total storage capacity requirements.

To prepare the DS3500 storage subsystem for installation in a rack, complete the following steps:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 12.
2. Move the shipping box that contains the DS3500 to the site.

CAUTION:



The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

3. Make sure that you have the correct host software for your operating system. The support DVD that comes with the DS3500 has the correct DS Storage Manager host software. The DVD also includes the storage subsystem controller firmware. For the latest controller firmware, see <http://www.ibm.com/servers/storage/support/disk/>.
4. Read the applicable readme files that are included in the DS Storage Manager host software or DS3500 controller firmware packages for any updated information about hardware, software, or firmware products.
5. Continue with “Required tools and hardware.”

Required tools and hardware

Have the following tools and equipment available:

- Region-specific power cords
- 5/16 (8 mm) hex nut driver
- #0 and #1 Phillips screwdrivers
- Electrostatic-discharge protection (such as a grounding wrist strap)
- Rack power jumper cords
- Rack-mounting hardware
- Ethernet interface cables and cable straps (depending on configuration)
- SAS cables (depending on configuration)
- Fibre Channel cables, interface cables, and cable straps (depending on configuration)
- SFP modules (depending on configuration)

Preparing the site

This section lists the floor space requirements and weight information for the DS3500. For information about interface cables and connections, see Chapter 3, “Cabling the storage subsystem and expansion enclosure,” on page 23.

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

- Sufficient space to install the DS3500 storage subsystem
- Enough stability to support the weight of the fully configured DS3500 storage subsystem and associated devices (see “Weight” on page 13).

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

- Make sure that there is enough room to move around the rack and install the modules.
- Install uninterruptible-power-supply devices.

- If applicable, install host servers with host bus adapters (HBAs), switches, or other devices.
- Route interface cables from the HBA ports in the hosts or switches to the installation area.
- Route main power cords to the installation area.

Continue with “Installing the DS3500 storage subsystem in a rack.”

Installing the DS3500 storage subsystem in a rack

To install the DS3500 in a rack, follow the instructions in the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*. Then, continue with Chapter 3, “Cabling the storage subsystem and expansion enclosure,” on page 23.

Installing the EXP3500 expansion enclosure

This section provides instructions for installing the EXP3500 expansion enclosure in a rack. The EXP3500 connects to a DS3500 storage subsystem.

Inventory checklist

After you unpack the EXP3500 expansion enclosure, make sure that you have the following items. Depending on your order, your shipping box might contain additional materials that are not in the following list.

- **Hardware:**
 - Hard disk drives or drive filler panels:
 - EXP3512 (12)
 - EXP3524 (24)
 - ESMs (up to 2)
 - Power supplies (2)
 - Power cables (2 jumper line cords)
 - Rack installation hardware kit:
 - Support rails (2) (right and left assembly)
 - M5 black hex-head slotted screws (8)
 - M5 Washers (6)
 - Small diameter spacers (8) (these come installed, four in each rail)
 - Large diameter spacers (8)
 - M4 pan-head screws (2)
- **Printed documents:**
 - *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide*
- **Online documents:**
 - *IBM System Storage DS3500 and EXP3500 Installation, User's, and Maintenance Guide* (this document)
 - *IBM Systems Safety Notices*

All documents are available on the IBM *Documentation CD* or from the IBM support Web site at <http://www.ibm.com/servers/storage/support/>.

Installing the EXP3500 expansion enclosure in a rack

You can install the EXP3500 storage subsystem in an Electronic Industries Association (EIA) 310 standard rack. For complete rack installation instructions, see *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide*.

Chapter 3. Cabling the storage subsystem and expansion enclosure

This chapter provides information and instructions for cabling the DS3500 storage subsystem and the EXP3500 expansion enclosure. To cable the DS3500 storage subsystem, see “Cabling the DS3500 storage subsystem.” To cable the EXP3500 expansion enclosure, see “Cabling the EXP3500 expansion enclosure” on page 37.

Cabling the DS3500 storage subsystem

The section provides information and instructions for cabling the DS3500 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.

Controller connectors (with Fibre Channel host port adapters)

Figure 14 shows the optional Fibre Channel host port adapter installed in both controllers at the rear of the DS3500 storage subsystem.

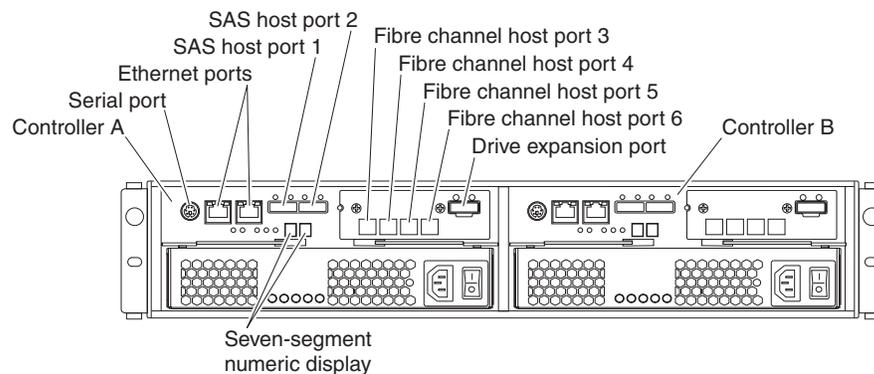


Figure 14. Dual-controller DS3500 storage subsystem ports and controllers (with optional Fibre Channel host port adapter)

Fibre Channel 1, Fibre Channel 2

Each Fibre Channel host port supports a small-form-factor pluggable (SFP) transceiver and is capable of operating at 8 Gbps, 4 Gbps, or 2 Gbps.

Drive expansion port

The drive expansion port is a x4 multilane SAS port. Connect a SAS cable to this port and to a drive expansion enclosure.

Controller connectors (with iSCSI host port adapters)

Figure 15 on page 24 shows the optional iSCSI host port adapter installed in both controllers at the rear of the DS3500 storage subsystem.

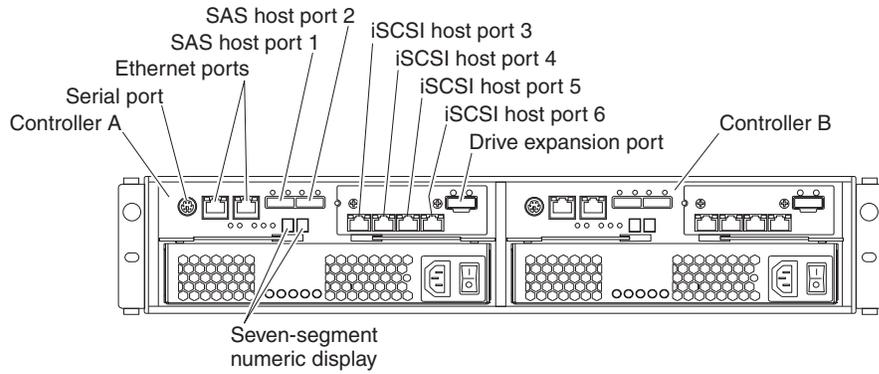


Figure 15. Dual-controller DS3500 storage subsystem ports and controllers (with optional iSCSI host port adapter)

Host port 1 and Host port 2

The iSCSI host ports are auto-negotiated 100/1000 Mbps Ethernet ports that support iSCSI off load. The host ports also provide support for both Internet Protocol version 4 (IPv4) and IPv6, and have the advanced networking functions of jumbo frames, IEEE 802.1p, and virtual local area network (VLAN) support.

Drive expansion port

The drive expansion port is a x4 multilane SAS port. Connect a SAS cable to this port and to a drive expansion enclosure.

Controller connectors (with SAS host port adapters)

Figure 16 shows the optional SAS host port adapter installed in both controllers at the rear of the DS3500 storage subsystem.

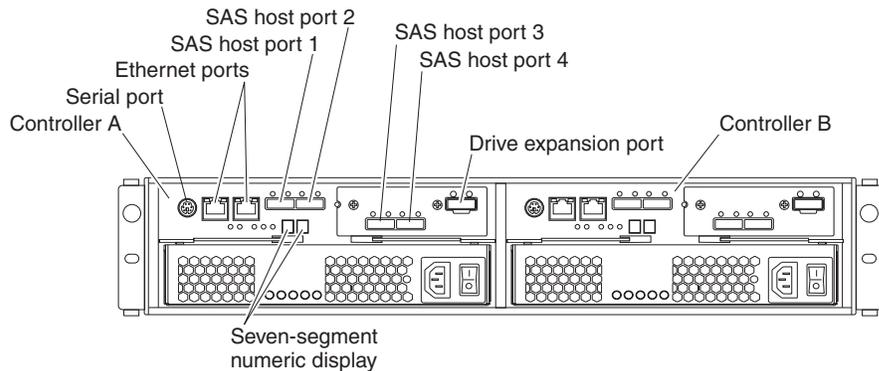


Figure 16. Dual-controller DS3500 storage subsystem ports and controllers (with an optional SAS host port adapter)

Host port 1, Host port 2, and Host port 3

The DS3500 host ports are each a x4 multilane, 6 Gbps universal mini-SAS port. Connect a SAS cable from your host system SAS host bus adapter to a host port on each controller.

Drive expansion port

The drive expansion port is a x4 multilane SAS port. Connect a SAS cable to this port and to a drive expansion enclosure.

Enclosure ID settings

The enclosure ID is a unique two-digit identifier for each enclosure in the storage subsystem configuration. In a dual controller or ESM configuration, both enclosure IDs are identical under normal operating conditions. Each EXP3500 storage expansion enclosure and DS3500 storage subsystem in the storage subsystem configuration must have a unique storage enclosure ID.

The controller automatically sets the enclosure ID. You can change the setting through the DS Storage Manager software, if necessary. The range of supported enclosure ID settings is 0 through 99. The enclosure ID is normally set to a value of 00 at the factory.

The enclosure ID is displayed on the seven-segment numeric display located on the back of each controller and ESM.

Working with SAS cables

Each DS3500 RAID controller has up to four x4 multilane SAS host ports and a single x4 multilane SAS port for drive channel connections.

Use a 1M or 3M (1-meter or 3-meter) SAS cable with a mini-SAS 4x multilane SAS connector on each end to connect a controller host port to a host HBA and to connect the drive expansion port to an expansion enclosure.

The following illustration shows the 1M and 3M mini-SAS cable.

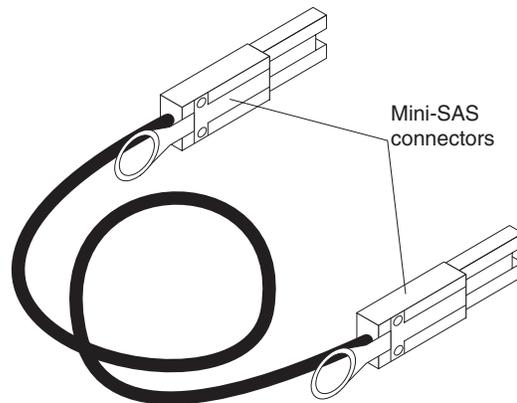


Figure 17. Mini-SAS cable

The 1M and 3M SAS cables have a universal key connector that enables the cable to be used in all mini-SAS ports.

Attention: To avoid damage to the SAS cables, consider the following precautions:

- When you route the cable along a folding cable-management arm, leave enough slack in the cable.
- Route the cable away from places where it can be damaged by other devices in the rack.
- Do not put excess weight on the cable at the connection point. Make sure that the cable is well supported.

To connect a mini-SAS cable, insert the mini-SAS connector into a mini-SAS port. Make sure that it locks into place.

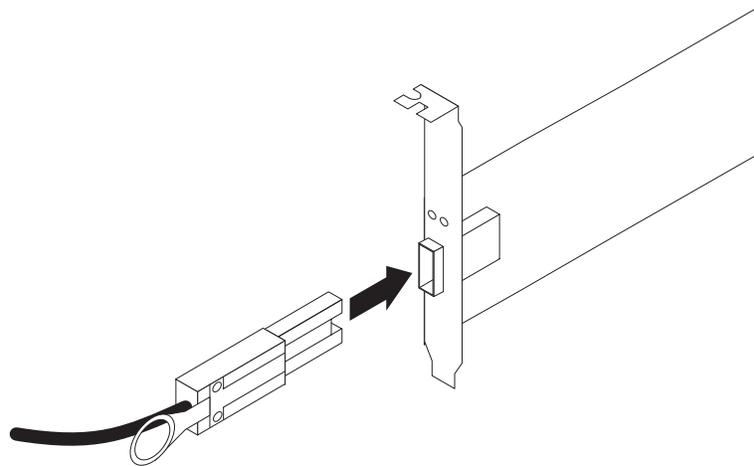


Figure 18. Connecting a mini-SAS cable

To remove a mini-SAS cable, complete the following steps:

1. Put one finger into the hole on the blue plastic tab on the mini-SAS connector and gently pull on the tab to release the locking mechanism.

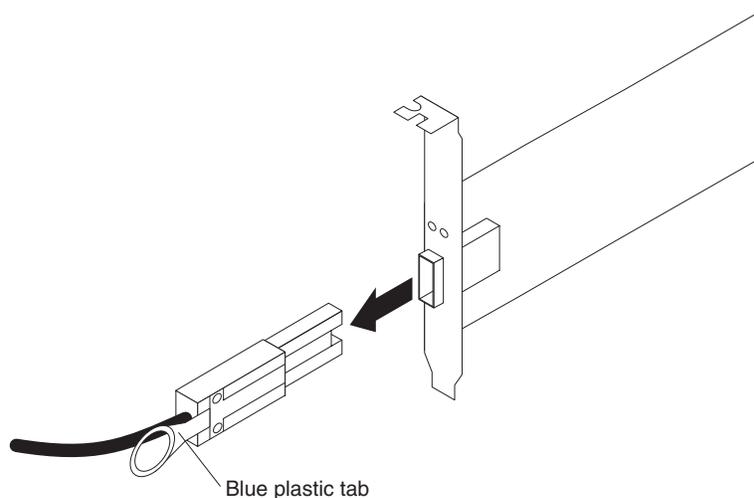


Figure 19. Removing a mini-SAS cable

2. As you pull on the tab, pull out the connector to remove it from the port.

Working with SFP modules and fiber optic cables

Each RAID controller can have up to four Fibre Channel host ports. You use a small-form-factor pluggable (SFP) module to connect a host port to a host. The SFP module is inserted into the port, and then a fiber optic cable is inserted into the SFP module. The other end of the fiber optic cable connects to an optical interface connector in a Fibre Channel HBA on a host. SFP modules are laser products.



CAUTION:

This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. Note the following information:

- **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 the controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**

(C026)



CAUTION:

Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. (C027)

Handling fiber optic cables

Attention: To avoid damage to the 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.
 - 2 Gbps: 300 m (984 ft.) of 50/125 um fiber, 150 m (492 ft.) of 62.5/125 um fiber
 - 4 Gbps: 150 m (492 ft.) of 50/125 um fiber, 70 m (230 ft.) of 62.5/125 um fiber
 - 8 Gbps: 50 m (164 ft.) of 50/125 um fiber, 35 m (115 ft.) of 62.5/125 um fiber
- The following are the recommended maximum lengths of OM2 category Fibre Channel cable.

- 4 Gbps: 150 m (492 ft.) of 50/125 um fiber, 300 m (984 ft.) of 62.5/125 um fiber
- 8 Gbps: 50 m (164 ft.) of 50/125 um fiber, 150 m (492 ft.) of 62.5/125 um fiber

Installing SFP modules

The storage subsystem 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 storage subsystem to other Fibre Channel devices.

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

- Do not mix long-wave SFP modules and short-wave SFP modules on a single storage subsystem. Use only short-wave SFP modules. You can use the DS Storage Manager Client to view the Storage Subsystem Profile to make sure that you are not mixing long-wave and short-wave SFP modules.

Attention: Do not use long-wave SFP modules or Gigabit Interface Converters (GBICs) in any of the Fibre Channel ports in the storage subsystem controllers. (Long-wave SFP modules and GBICs are not supported for use in the storage subsystem or any of the attached expansion enclosures. Long-wave SFP modules and GBICs are supported only in the Fibre Channel switch ports to which the storage subsystem connects.)

- The SFP module housing has an integral guide key that is designed to prevent you from inserting the SFP module incorrectly.
- Use minimal pressure when inserting an SFP module into a Fibre Channel 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. See “Removing SFP modules” on page 30 for more information.
- The speed of the SFP module determines the maximum operating speed of the Fibre Channel port in which the SFP module is installed. For example, a 2-Gbps SFP module that is connected to a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.

Attention: Carefully check the IBM part number, option number, and FRU part number of the SFP module to identify its speed. There are no physical features that distinguish an 8 Gbps, 4 Gbps, or 2 Gbps SFP module from each other.



CAUTION:

This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. Note the following information:

- 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 the controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.

(C026)



CAUTION:

Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. (C027)

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 19.

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 20. Save the protective cap for future use.

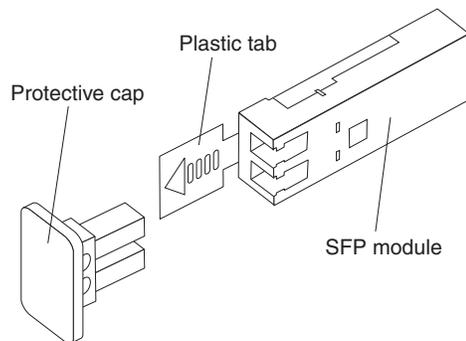


Figure 20. SFP module and protective cap

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 21 on page 30.

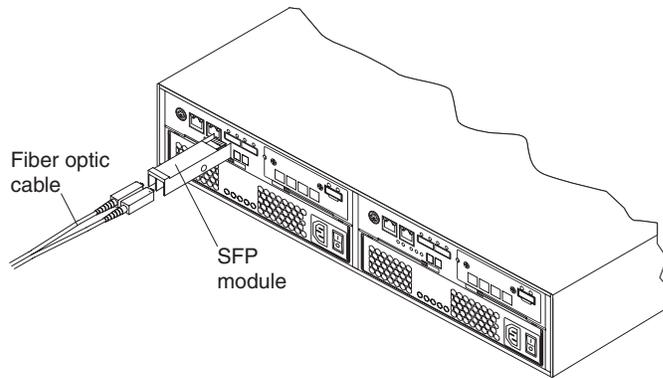


Figure 21. Installing an SFP module into the host port

5. Connect an LC-LC Fibre Channel cable. For information about the LC-LC cable, see “Using LC-LC Fibre Channel cables” on page 31.

Removing SFP modules

To remove the SFP module from the host port, complete the following steps:

Attention: To avoid damage to the cable or to the SFP module, make sure that you disconnect 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 33.
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 22.

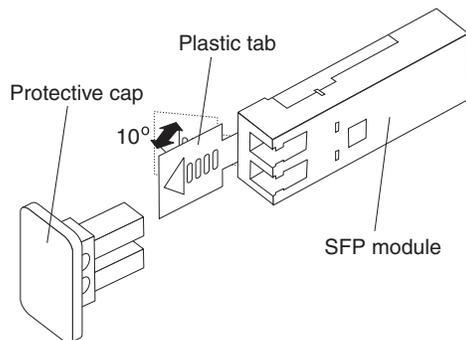


Figure 22. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 23 on page 31.

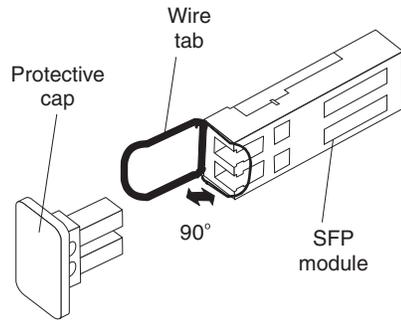


Figure 23. Unlocking the SFP module latch - wire variety

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

Using LC-LC Fibre Channel cables

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

- An SFP module installed in a Fibre Channel switch port
- A Fibre Channel host bus adapter port (optical interface connector)

See Figure 24 for an illustration of the LC-LC Fibre Channel cable.

For more information, see the documentation that comes with the LC-LC Fibre Channel cable.

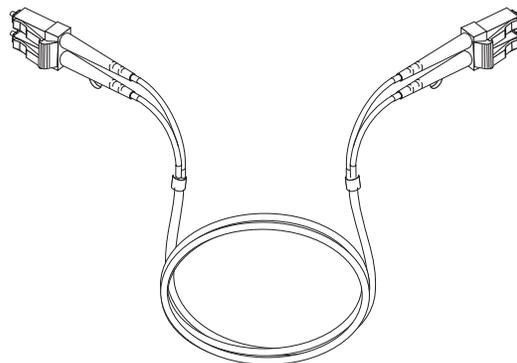


Figure 24. LC-LC Fibre Channel cable

Connecting an LC-LC cable to an SFP module: To connect an LC-LC Fibre Channel cable to an SFP module, complete the following steps.



CAUTION:

This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. Note the following information:

- 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 the controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.

(C026)



CAUTION:

Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. (C027)

1. Read the information in “Handling fiber optic cables” on page 27.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 20 on page 29. 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 25. Save the protective caps for future use.

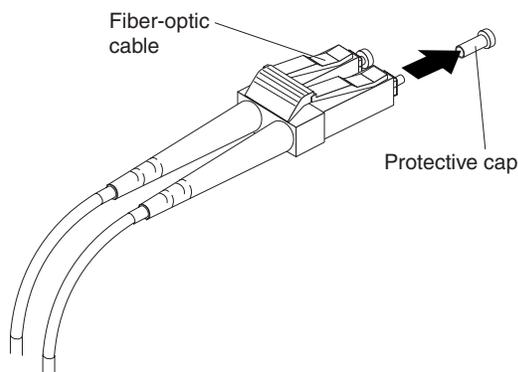


Figure 25. Removing fiber optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the storage subsystem. The cable connector is keyed for correct installation. Holding the connector, push in the cable until it clicks into place, as shown in Figure 26 on page 33.

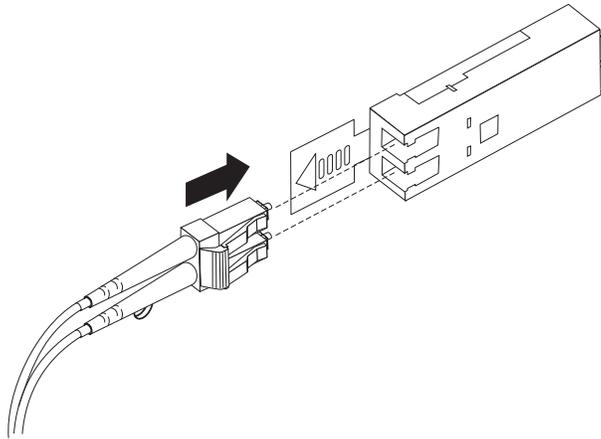


Figure 26. Inserting an LC-LC Fibre Channel cable into an SFP module

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 Fibre Channel switch port
 - A Fibre Channel host bus adapter port

Removing an LC-LC Fibre Channel cable: To remove an LC-LC Fibre Channel cable, complete the following steps.

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.
 - Make sure 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 27.

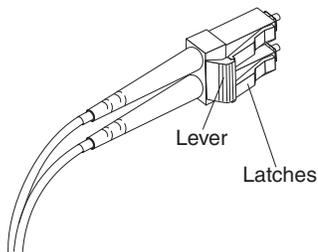


Figure 27. LC-LC Fibre Channel cable lever and latches

2. While pressing down the cable lever, carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 28 on page 34.

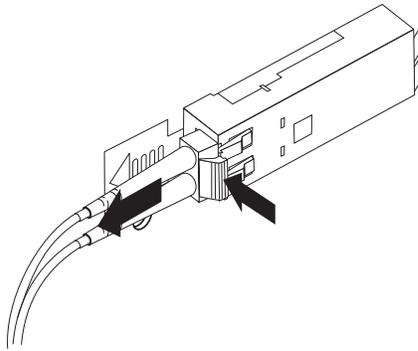


Figure 28. Removing the LC-LC Fibre Channel cable

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 to one of the following devices that require SC connectors:

- 1-Gbps Fibre Channel switch
- Fibre Channel host bus adapter

For more information, see the documentation that comes with the LC-SC Fibre Channel cable adapter.

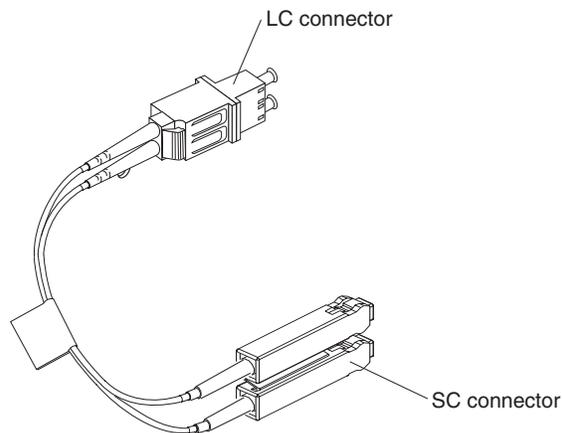


Figure 29. LC-SC Fibre Channel cable adapter

The following sections provide the procedures for correctly connecting and removing an LC-SC Fibre Channel cable.

Connecting an LC-SC cable adapter to a device: To connect an LC-SC Fibre Channel cable adapter to a device, complete the following steps.



CAUTION:

This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. Note the following information:

- 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 the controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.

(C026)



CAUTION:

Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. (C027)

1. Read the information in “Handling fiber optic cables” on page 27.
2. Connect one end of an LC-LC cable to an SFP module in the DS3500. For instructions, see “Using LC-LC Fibre Channel cables” on page 31.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 30. Save the protective caps for future use.

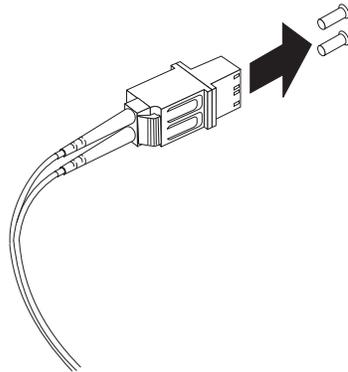


Figure 30. Removing the LC-SC cable adapter protective caps

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 31 on page 36. Push in the connector until it clicks into place.

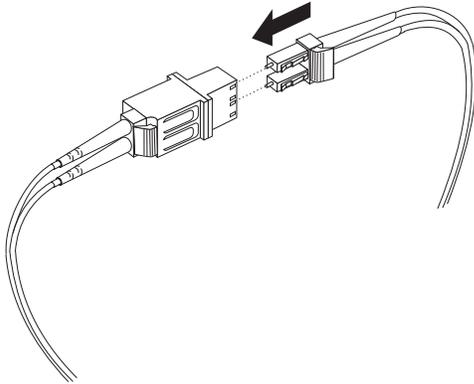


Figure 31. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the storage subsystem 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: To remove an LC-LC cable from an LC-SC cable adapter, complete the following steps.

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. 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 32 shows the location of the lever and latches.

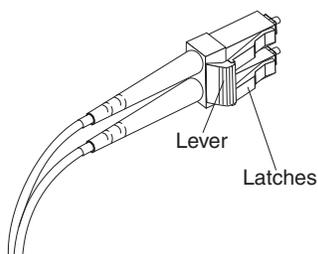


Figure 32. LC-LC Fibre Channel cable lever and latches

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 33 on page 37.

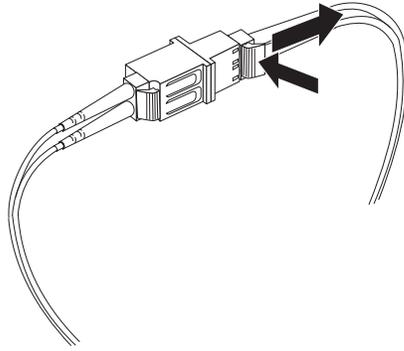


Figure 33. Removing the LC-LC Fibre Channel cable from an LC-SC Fibre Channel cable adapter

3. Replace the protective caps on the cable ends.

Cabling the EXP3500 expansion enclosure

The EXP3500 expansion enclosure comes with one ESM, which enables you to connect the EXP3500 expansion enclosure to a DS3500 storage subsystem. If you are attaching the EXP3500 to a dual controller DS3500 storage subsystem, you must add a second ESM to the EXP3500 expansion enclosure to provide a redundant drive path.

ESM connectors

Figure 34 shows the connectors on the ESM.

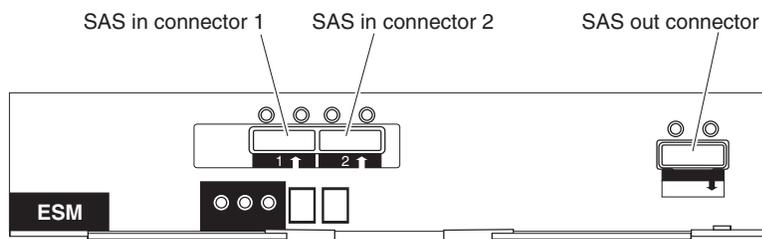


Figure 34. ESM connectors

SAS In 1

Connect a SAS cable to this connector and to either an IBM SAS RAID controller or the SAS Out (↓) connector of another EXP3500.

SAS In 2

Connect a SAS cable to this connector and to either an IBM SAS RAID controller or the SAS Out (↓) connector of another EXP3500.

SAS Out

Connect a SAS cable to this connector and to the SAS In (↑) connector of another EXP3500.

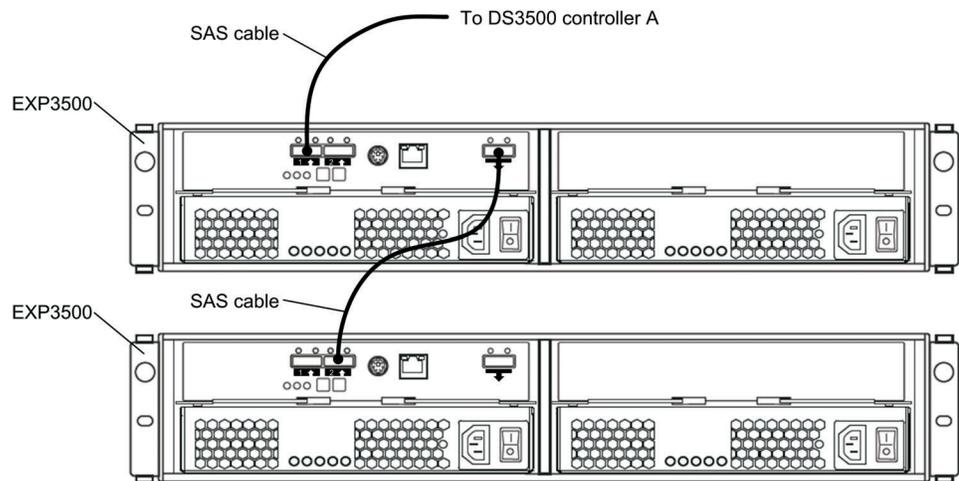
Note: Each ESM contains two SAS In connectors. You can use either SAS In connector but only one SAS In connector can be used at a time.

Single-ESM configuration

The DS3500 RAID controller supports more than one EXP3500 expansion enclosure per drive expansion port. You can connect two or more EXP3500

expansion enclosures by chaining them together. To connect a RAID controller to one or more EXP3500 expansion enclosures that have one ESM each, complete the following steps:

1. Connect one EXP3500 expansion enclosure to the RAID controller:
 - a. Connect one end of a SAS cable to the drive expansion port on the RAID controller.
 - b. Connect the other end to one of the In (↑) SAS connectors on the ESM in the EXP3500 expansion enclosure.

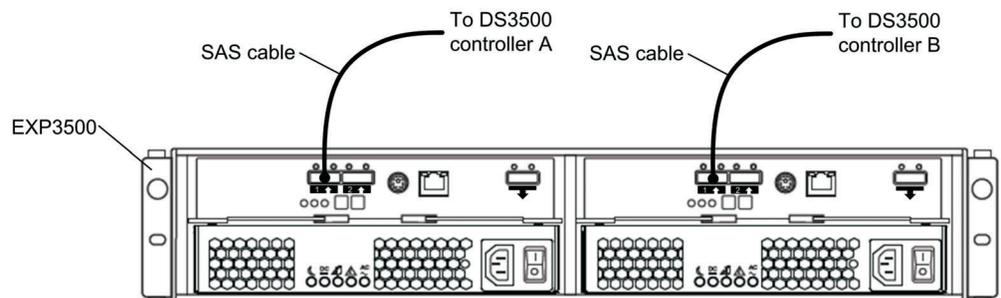


2. Connect a second EXP3500 expansion enclosure to the first EXP3500 expansion enclosure:
 - a. Connect one end of a SAS cable to the Out (↓) SAS connector on the ESM of the EXP3500 expansion enclosure that you just connected.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the ESM on the next EXP3500 expansion enclosure.
 - c. Repeat steps 2a and 2b for each EXP3500 expansion enclosure that you add.

Dual-ESM configuration

The EXP3500 expansion enclosure comes with one ESM. If your DS3500 storage subsystem is a dual RAID controller configuration, it supports redundant drive paths. You must install a second ESM. See “Installing an additional ESM” on page 123 before attaching any EXP3500 expansion enclosures.

Dual-ESM configuration with a single EXP3500 expansion enclosure:



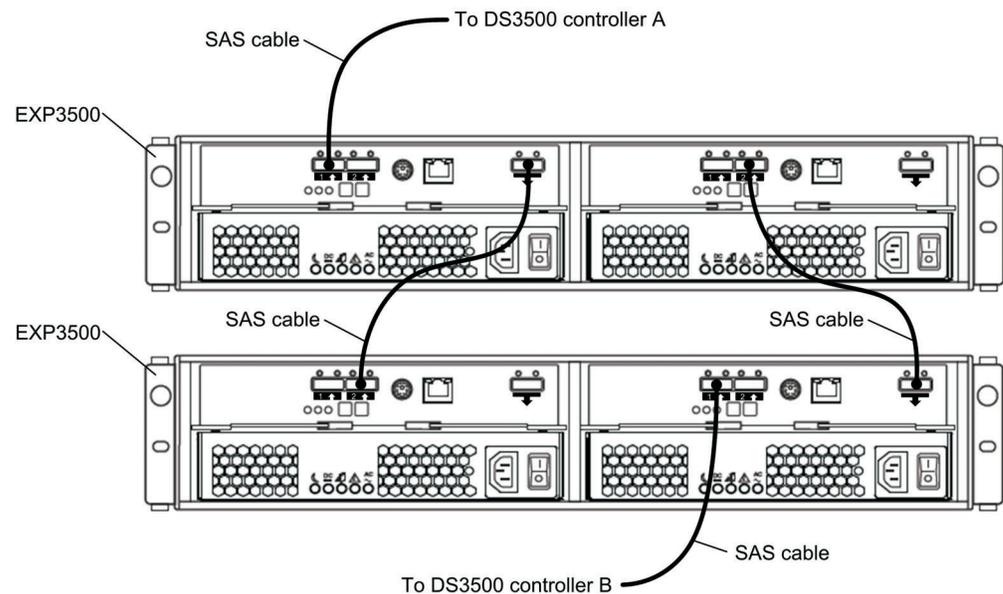
To connect RAID controllers A and B to one EXP3500 expansion enclosure that has two ESMs, complete the following steps:

1. Connect the EXP3500 expansion enclosure to RAID controller A:

- a. Connect one end of a SAS cable to RAID controller A.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the EXP3500 expansion enclosure.
2. Connect the EXP3500 expansion enclosure to RAID controller B:
 - a. Connect one end of a SAS cable to RAID controller B.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM in the EXP3500 expansion enclosure.

Dual-ESM configuration with two or more EXP3500 expansion enclosures:

The DS3500 controllers support more than one EXP3500 expansion enclosure per physical port, so multiple EXP3500 expansion enclosures can be connected by chaining them together.



To connect DS3500 RAID controllers A and B to multiple EXP3500 expansion enclosures that have two ESMs each, complete the following steps:

1. Connect one EXP3500 expansion enclosure to RAID controller A:
 - a. Connect one end of a SAS cable to the drive expansion port on the DS3500 RAID controller A.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the EXP3500 expansion enclosure.
2. Connect the left ESM of the EXP3500 expansion enclosure to the next EXP3500 expansion enclosure in the chain:
 - a. Connect one end of a SAS cable to the Out (↓) SAS connector on the left ESM of the EXP3500 expansion enclosure that you just connected.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the next EXP3500 expansion enclosure in the chain.
 - c. Repeat steps 2a and 2b for each EXP3500 expansion enclosure that you add.
3. Connect the last EXP3500 expansion enclosure in the chain to RAID controller B:
 - a. Connect one end of a SAS cable to the drive expansion port on the DS3500 RAID controller B.

- b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM in the last EXP3500 expansion enclosure of the chain that you created.
 4. In reverse order (last in chain to first in chain), connect the right ESMs in the EXP3500 expansion enclosures in the chain:
 - a. Connect one end of a SAS cable to the Out (↓) SAS connector on the right ESM of the EXP3500 expansion enclosure that you just connected.
 - b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM of the previous EXP3500 expansion enclosure in the chain.
 - c. Repeat steps 4a and 4b until you connect the right ESM of the first EXP3500 expansion enclosure in step 2 on page 39 to the right ESM of the EXP3500 expansion enclosure in step 1 on page 39.

Connecting expansion enclosures to the DS3500

The DS3500 supports the attachment of either the EXP3512 or EXP3524 expansion enclosure. The DS3500 supports a total of 96 hard disk drives, so the total number of expansion enclosures supported varies depending on the model of DS3500 storage subsystem and EXP3500 expansion enclosure.

Table 5 shows the maximum number of EXP3512 and EXP3524 expansion enclosures that can be attached to either a DS3512 or a DS3524 storage subsystem and not exceed the 96 total disk drives. Any combination of EXP3512 or EXP3524 expansion enclosures can be attached to a DS3512 or a DS3524 as long as the total number of disk drives does not exceed 96 disk drives. See the *Hard Disk Drive and Storage Expansion Enclosure Installation and Migration Guide* for more information.

Table 5. Maximum number of EXP3512 and EXP3524 expansion enclosures

| DS3512 | | DS3524 | |
|-----------------|----------|-----------------|----------|
| Expansion units | Quantity | Expansion units | Quantity |
| EXP3512 | 7 | EXP3524 | 6 |
| EXP3524 | 0 | EXP3512 | 0 |
| or | | or | |
| EXP3512 | 5 | EXP3524 | 4 |
| EXP3524 | 1 | EXP3512 | 1 |
| or | | or | |
| EXP3512 | 3 | EXP3524 | 2 |
| EXP3524 | 2 | EXP3512 | 2 |
| or | | or | |
| EXP3512 | 1 | EXP3524 | 0 |
| EXP3524 | 3 | EXP3512 | 3 |

Redundant drive channel pair

Each RAID controller on the DS3500 has a drive expansion channel that contains an x4 SAS port. The expansion enclosures that are connected to this connector form a drive channel. The maximum number of hard disk drives that can be installed in one drive channel is 96. In a dual-controller DS3500, one drive channel from each controller combines to form a redundant drive-channel pair.

Figure 35 shows an example of a redundant drive-channel pair. If any component of the drive channel fails, the RAID controllers can still access the expansion enclosures in the redundant drive-channel pair.

Note: In expansion enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths.

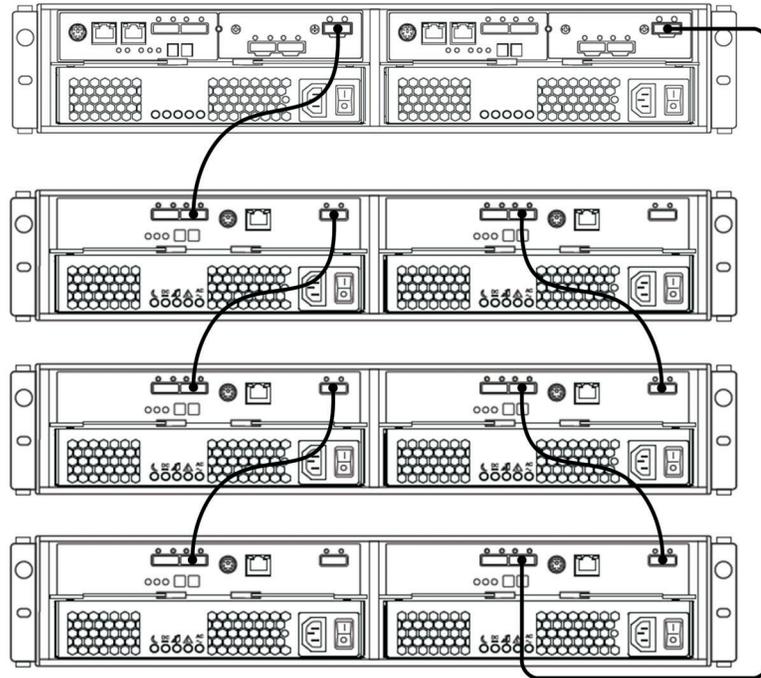


Figure 35. Example of a redundant drive path

Overview of steps to connect expansion enclosures to a storage subsystem

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

1. Follow the instructions in the *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide* for your expansion enclosure and the rack installation instructions to set up and mount the expansion enclosures.
2. Select a cabling topology applicable to the number of ESMs in the expansion enclosures that you will connect to the DS3500. “DS3500 storage subsystem drive cabling topologies” on page 42 describes the recommended schemes for cabling expansion enclosures with one ESM or two ESMs to the DS3500 and to each other (if you are connecting more than one expansion enclosure).
3. Follow the cabling diagram for your chosen topology.
4. If required, set unique enclosure IDs for all expansion enclosures that are cabled to the DS3500. See the *DS Storage Manager 10 Installation and Host Support Guide* for information about setting the enclosure ID.

The DS3500 storage subsystem locates the drives in the expansion enclosures after you power-on the configuration. Always turn on the expansion enclosures first and then turn on the DS3500. After you have powered-on the configuration, use the DS Storage Manager software to check the status of the new drives, correct any errors, and configure the new drives.

DS3500 storage subsystem drive cabling topologies

This section describes the following preferred cabling topologies for cabling expansion enclosures to the DS3500 storage subsystem:

- “One single-controller DS3500 and one or more expansion enclosures”
- “One dual-controller DS3500 and one expansion enclosure”
- “One dual-controller DS3500 and two expansion enclosures” on page 43
- “One dual-controller DS3500 and up to eight expansion enclosures” on page 43

If one of these examples is suitable for your hardware and application, complete the cabling connections as shown in the illustrations. 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.

Note: In expansion enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths.

One single-controller DS3500 and one or more expansion enclosures: To cable one single-controller DS3500 to one or more single-ESM expansion enclosures, connect them as shown in Figure 36.

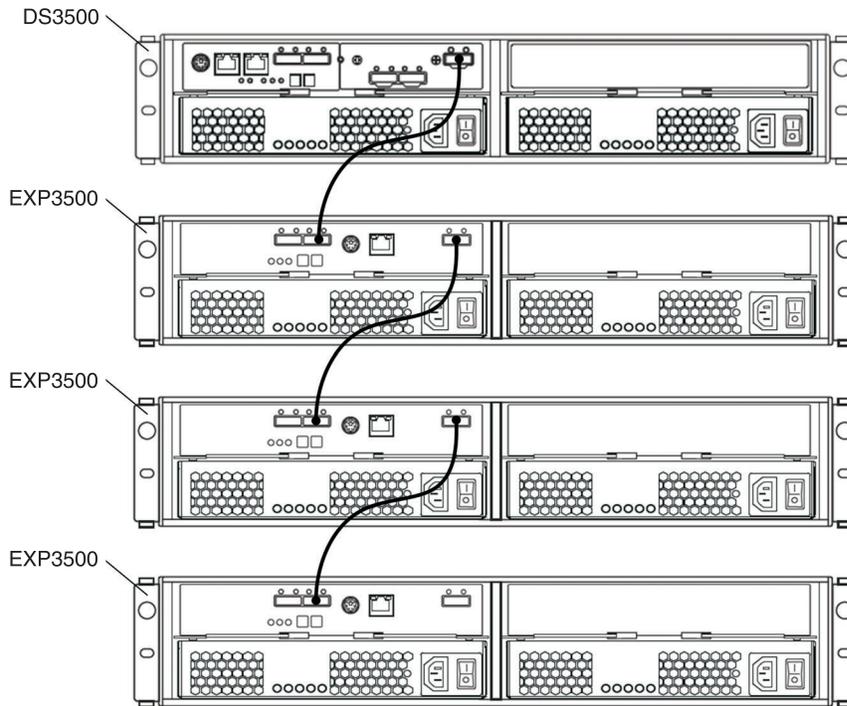


Figure 36. One single-controller DS3500 and multiple single-ESM expansion enclosures

Note: In expansion enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths, and must use one of the dual-controller topologies that are described in this section.

One dual-controller DS3500 and one expansion enclosure: To cable one dual-controller DS3500 to one expansion enclosure, connect them as shown in

Figure 37.

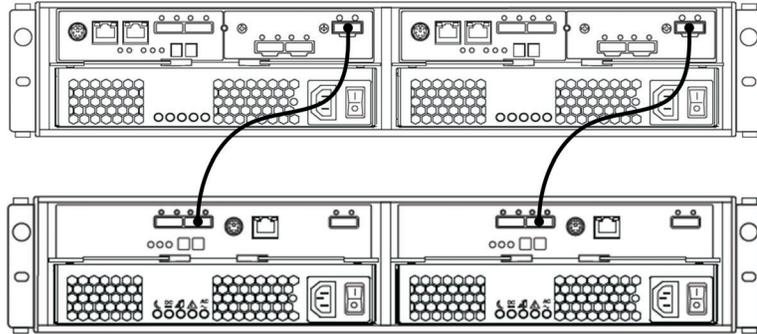


Figure 37. One dual-controller DS3500 and one expansion enclosure

One dual-controller DS3500 and two expansion enclosures: To cable one dual-controller DS3500 and two expansion enclosures, connect them as shown in Figure 38.

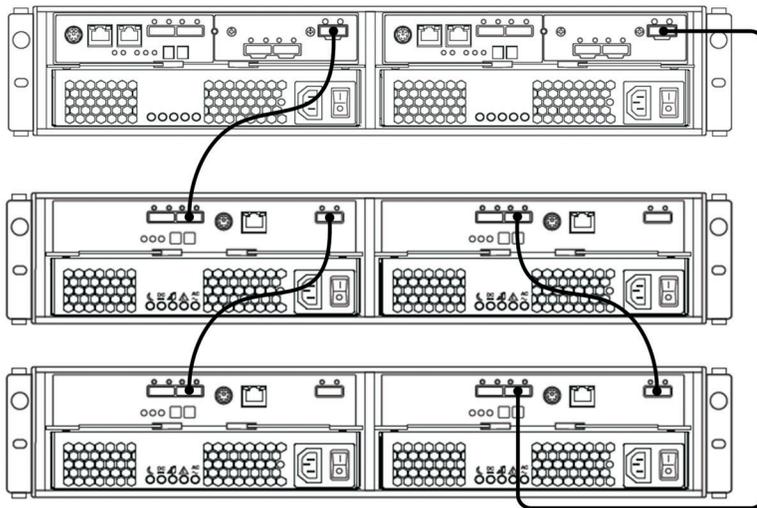


Figure 38. One dual-controller DS3500 and two expansion enclosures

One dual-controller DS3500 and up to eight expansion enclosures: To cable one dual-controller DS3500 and up to eight expansion enclosures, connect them as shown in Figure 39 on page 44.

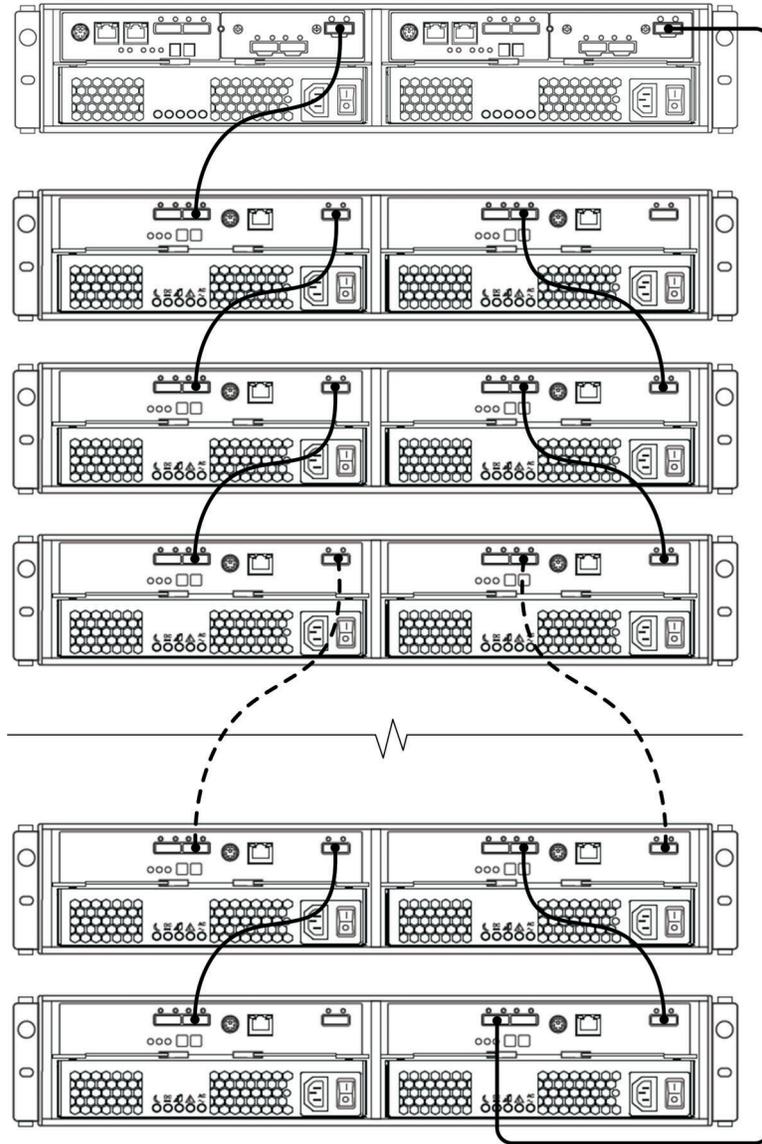


Figure 39. One dual-controller DS3500 and three expansion enclosures

Adding an expansion enclosure to a running dual-controller configuration

The following procedures provide instructions for adding expansion enclosures to a running dual-controller DS3500 storage subsystem.

Note: Make sure that each expansion enclosure has two ESMs before you connect it to a dual-controller DS3500 storage subsystem. The second ESM must be purchased separately. Contact your IBM marketing representative or authorized reseller for more information about purchasing a second ESM. For more information about installing a second ESM, see the Installation Guide that comes with the expansion enclosure.

To add an expansion enclosure to a dual-controller DS3500 storage subsystem that is running, complete the following steps:

1. Make sure that the DS3500 storage subsystem status is Optimal in the DS Storage Manager software.
2. Use the expansion enclosure Rack Installation Instructions document to install the new expansion enclosure in the rack.
3. Connect the power cables to the new expansion enclosure.
4. Power-on the expansion enclosure.
5. Connect one end of a Serial Attached SCSI (SAS) cable to the Drive expansion port on Controller A in the DS3500 storage subsystem.
6. Connect the other end of the SAS cable to either of the In ports on the left ESM in the expansion enclosure.
7. Connect one end of a second SAS cable to the Drive expansion port on Controller B in the DS3500 storage subsystem.
8. Connect the other end of the second SAS cable to the In port on the right ESM in the expansion enclosure.
9. Wait until the storage subsystem status is Optimal in the DS Storage Manager software before proceeding to step 10.
10. Add the hard disk drives to the expansion enclosure. Make sure that you wait at least 30 seconds for the DS Storage Manager software to recognize each newly added drive before you install another drive.

To add additional expansion enclosures after the first expansion unit is connected to a dual-controller DS3500 storage subsystem that is running, complete the following steps:

1. Make sure that the storage subsystem status is Optimal in the DS Storage Manager software.
 2. Use the expansion enclosure Rack Installation Instructions document to install the new expansion enclosure in the rack.
 3. Connect the power cables to the new expansion enclosure.
 4. Power on the expansion enclosure.
 5. Connect one end of a Serial Attached SCSI (SAS) cable to the In port on the left ESM in the expansion enclosure that is being added to the configuration.
 6. Connect the other end of the SAS cable to the Out port on the left ESM in the last expansion enclosure in the configuration (this expansion enclosure is directly connected to the Drive expansion port on controller A of the DS3500).
 7. On the last expansion enclosure in the configuration, disconnect the SAS cable from the In port on the right ESM and connect it to the In port on the right ESM on the new expansion enclosure that is being added to the configuration.
- Note:** When the SAS cable is disconnected in step 7, a loss of path redundancy occurs and an error message is displayed in the DS Storage Manager Recovery Guru. Disregard the error message. The redundant path is restored in step 8 after the SAS cable is connected.
8. Connect a SAS cable to the Out port on the right ESM of the new expansion enclosure and connect the other end to either of the In port on the right ESM in the expansion enclosure that was previously connected to controller B of the DS3500.
 9. Wait until the storage subsystem status is Optimal in the DS Storage Manager software before proceeding to step 10.
 10. Add the hard disk drives to the expansion enclosure. Make sure that you wait at least 30 seconds for the DS Storage Manager software to recognize each newly added drive before you install another drive.

Upgrading a single-controller to a dual-controller when there is no attached EXP3500 enclosure

If you are upgrading a single-controller DS3500 storage subsystem to a dual-controller DS3500 storage subsystem and there are no EXP3500 expansion enclosures attached to the DS3500 storage subsystem, see “Installing a controller” on page 95.

Upgrading a single-controller to a dual-controller when there is one or more EXP3500 enclosures attached to the storage subsystem

Before you upgrade the DS3500 storage subsystem from a single-controller to a dual-controller, make sure that:

- You purchase a second environmental services module (ESM) for each EXP3500 expansion enclosure that is attached to the DS3500 storage subsystem. You install the second ESM during this procedure.
- You purchase the SAS cables that are required to create a redundant drive enclosure path.

To upgrade a single-controller DS3500 storage subsystem to a dual-controller DS3500 storage subsystem when there are EXP3500 expansion enclosures attached to the DS3500, complete the following steps:

1. Turn off the DS3500 storage subsystem and all attached EXP3500 expansion enclosures.
2. Install a second RAID controller in the DS3500 storage subsystem by using the instructions in “Installing a controller” on page 95.
3. Install a second ESM in each EXP3500 that is connected to the DS3500 storage subsystem:
 - a. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
 - b. Remove the ESM filler panel from the rightmost ESM bay of the EXP3500:
 - 1) On the left side of the ESM filler panel, press the orange release tab to the right just enough to release the handle (no more than 6 mm [0.25 in.]) as you rotate the handle upward.
 - 2) Using the handle, gently slide the ESM filler panel out of the EXP3500. Save the ESM filler panel for future use.
 - c. Hold the new ESM so that the handle is fully extended.
 - d. Gently slide the ESM into the bay until it stops. Rotate the handle downward into the closed position until it clicks.
4. Using the information provided in “DS3500 storage subsystem drive cabling topologies” on page 42, use SAS cables to create a redundant drive-channel path from the DS3500 RAID controllers to the EXP3500 ESMs.

Connecting secondary interface cables

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

Use the Ethernet management port on the rear of the storage subsystem to connect the controllers for direct management of the storage subsystems (see “Direct (out-of-band) management method” on page 48).

Important:

1. To minimize security risks, do not connect the DS3500 to a public LAN or public subnet. Use a local private network for the DS3500 and the management station Ethernet connectors.
2. For proper EMI shielding, always use quality braided and shielded serial cables.

Connect an Ethernet cable from the management station to the Ethernet connector on controller A on the rear of the storage subsystem. For a dual-controller storage subsystem, you can connect a second Ethernet cable from the management station to the Ethernet connector on controller B. Figure 40 shows the locations of the Ethernet management connectors on the DS3500 storage subsystem.

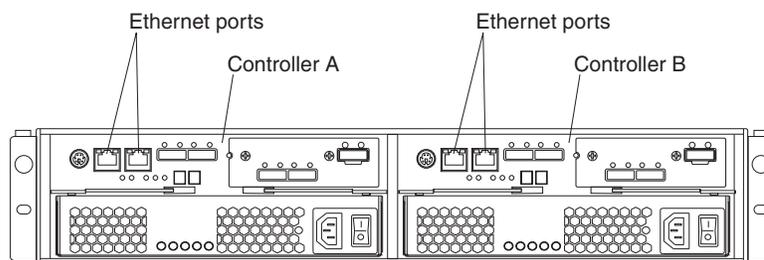


Figure 40. Ethernet port locations on a dual-controller DS3500

Configuring the storage subsystem

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

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.

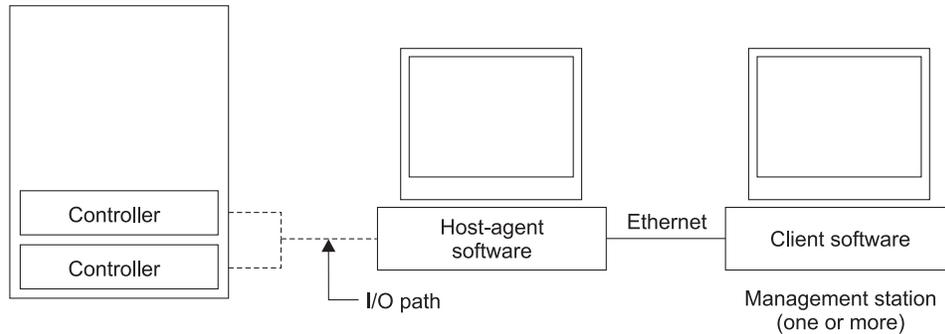
Note: For information about any in-band limitations or restrictions that are associated with particular combinations of controller and host bus adapter, see the DS Storage Manager readme file.

For more information about setting up in-band or out-of-band management connections, see the *DS Storage Manager 10 Installation and Host Support Guide* for the operating system of the host server that you will use to manage the DS3500 storage subsystem. The document is in the Documentation folder on the IBM *System Storage DS3500 Support DVD*.

Important: If the operating system of the host server that the storage subsystem logical drives are mapped to is not Microsoft Windows Server 2003 or Windows Server 2008, you must 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 that host-agent software be installed on the host server. The host-agent software enables the DS Storage Manager software client program to manage the storage subsystem by using the same 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. The client software is installed on the management station. Figure 41 shows the host-agent (in-band) management method.



Note: The client software is installed on one or more management systems, or on the host computer.

Figure 41. 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 in the storage subsystem. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. The client software is installed on the management station. 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 42 on page 49 shows the direct (out-of-band) management method.

Note: Do not connect the DS3500 storage subsystem Ethernet ports to a public network or public subnet. To minimize security risks, create a private network between the DS3500 storage subsystem and the management station.

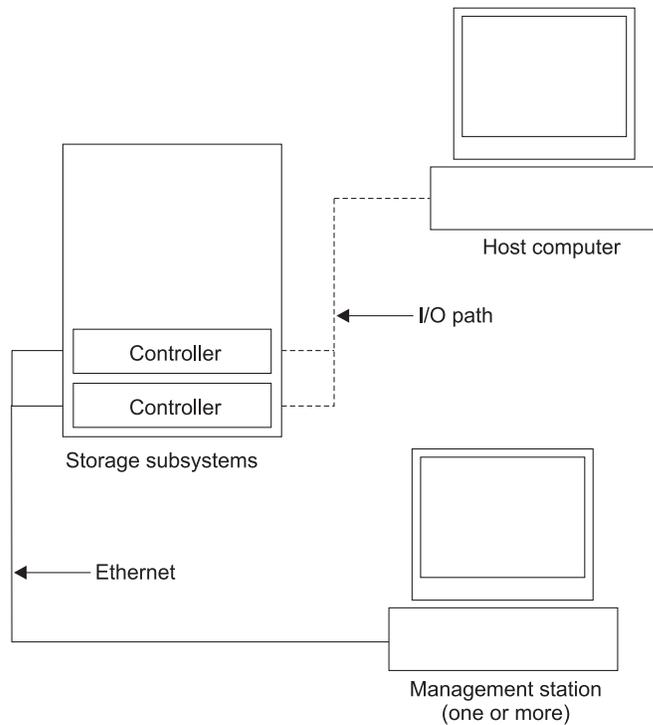


Figure 42. Direct (out-of-band) managed storage subsystems

Installing the storage subsystem configuration

Before attempting to attach hosts to the storage subsystem, make sure that the host systems and host bus adapters (HBAs) are installed correctly and updated with the latest firmware and drivers.

Notes:

1. See the documentation that comes with the HBA for installation requirements and procedures.
2. Use the correct HBA firmware and device driver. For the latest supported HBAs and device drivers, consult the readme that comes with the DS3500 controller firmware.

For a SAS attached host, attach a SAS cable to each HBA. Continue with “Connecting SAS hosts to the DS3500” to connect the other end of each cable to a controller.

For a Fibre Channel attached host, attach a fibre channel cable to each HBA. Continue with “Connecting Fibre Channel hosts to the DS3500” on page 53 to connect the other end of each cable to the controller.

For an iSCSI attached host, attach an Ethernet cable to each host. Continue with “Connecting iSCSI hosts to the DS3500” on page 59 to connect the other end of each cable to the controller.

Connecting SAS hosts to the DS3500

The DS3500 can support up to 28 hosts when attached to the SAS Connectivity Module for IBM BladeCenter and up to four hosts in a direct attached host environment. The number of supported hosts depends on the number of host ports

installed on the RAID controller. To protect against the loss of any one path from the host servers to the DS3500 storage subsystem, use redundant host connections.

Notes:

1. In a single-controller storage subsystem, the use of redundant host connections is supported. Redundant host connections provide path failover but limit the number of redundant host connections to one.
2. The DS3500 ships with four storage partitions by default. For additional storage partitions, purchase an optional Storage Partition Premium Feature upgrade. Contact your IBM reseller or marketing representative for more information.

To connect a SAS host bus adapter (HBA) to the storage subsystem, complete the following steps:

1. Connect a SAS cable from the RAID controller host port to the SAS HBA that is in the host. Figure 16 on page 24 shows the location of the host ports.
2. Create a redundant host connection:
 - If the storage subsystem is a single-controller storage subsystem, connect a SAS cable from the second SAS HBA to another host port on the RAID controller. You can create a maximum of one redundant host connection to a single-controller storage subsystem.
 - If the storage subsystem is a dual-controller storage subsystem, connect a SAS cable from the second SAS HBA to a host port on the other RAID controller. You can create a maximum of three redundant host connections to a dual-controller storage subsystem.

See “Direct-attached single-controller connections” and “Direct-attached dual-controller connections” on page 52 for illustrations of host connections.

Direct-attached single-controller connections: The following illustration shows a direct-attached SAS connection to a single host HBA.

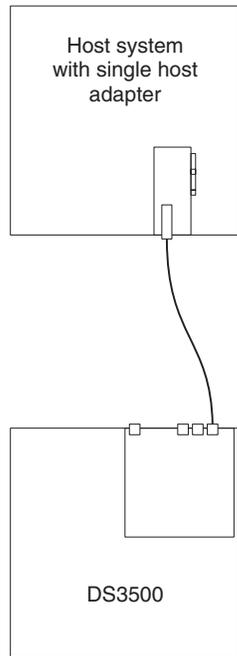


Figure 43. Single-controller direct-attached SAS connection to a single-host HBA

The following illustration shows a direct-attached SAS connection to dual HBAs in a single-host (redundant host connection).

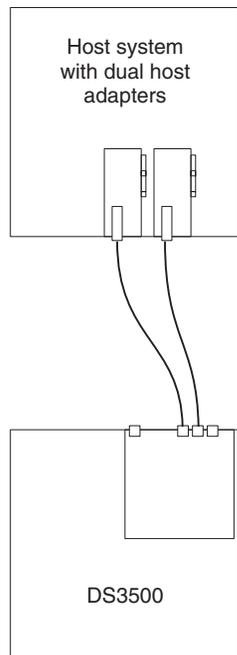


Figure 44. Single-controller direct-attached SAS connection to dual HBAs in a single-host (redundant host connection)

The following illustration shows a direct-attached SAS connection to single HBAs in multiple hosts.

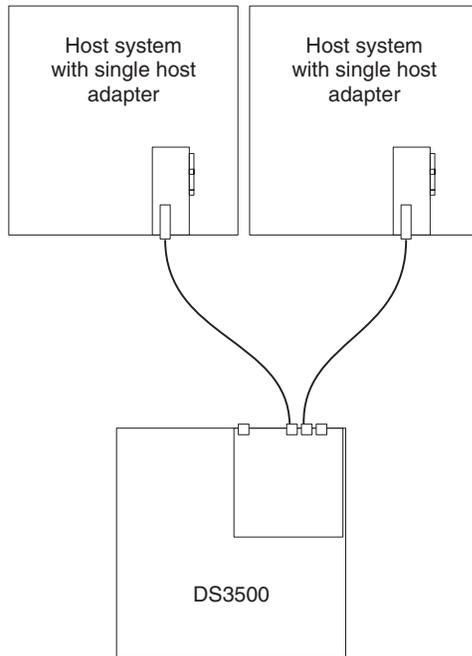


Figure 45. Single-controller direct-attached SAS connection to single HBAs in multiple hosts

Direct-attached dual-controller connections: The following illustration shows a direct-attached SAS connection from each controller to a single HBA in the same host (redundant host connection).

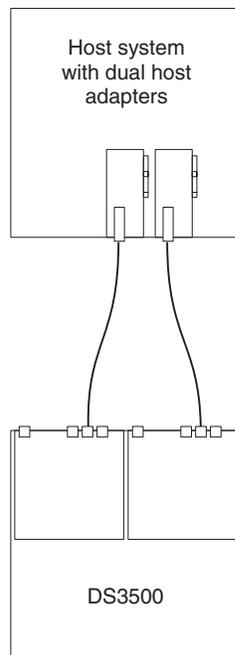


Figure 46. Dual-controller direct-attached SAS connection to two HBAs in the same host (redundant host connection)

The following illustration shows multiple redundant direct-attached SAS host connections. This configuration is also the configuration to use for a dual-node cluster configuration.

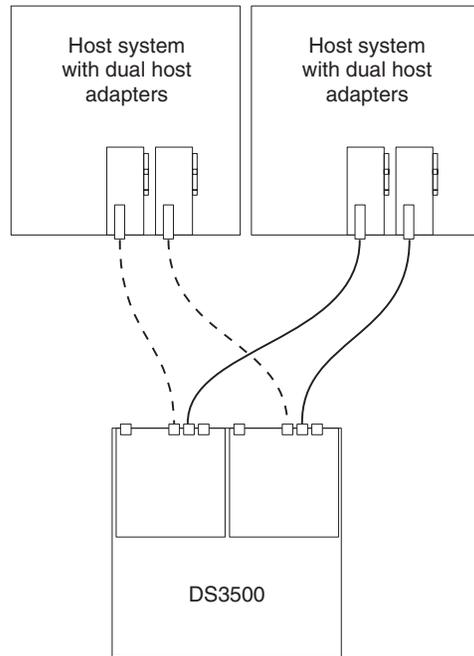


Figure 47. Dual-controller direct-attached SAS connections to multiple HBAs in multiple hosts

Connecting Fibre Channel hosts to the DS3500

Using Fibre Channel switches, up to 64 hosts can be redundantly attached to the DS3500 storage subsystem in a Fibre Channel storage area network (SAN) fabric.

Note: The DS3500 ships with four storage partitions by default. For additional storage partitions, purchase an optional Storage Partition Premium Feature upgrade. Contact your IBM reseller or marketing representative for more information.

To connect a host to the RAID controllers, complete the following steps:

1. Install SFP modules in the host ports on RAID controllers A and B.
2. Connect the Fibre Channel cables to the SFP modules in the RAID controller host ports and to either the SFP modules in the Fibre Channel switch or the optical interface connector on the host bus adapters. Figure 48 on page 54 shows the location on the RAID controllers of the storage subsystem ports where the host-system cables connect.

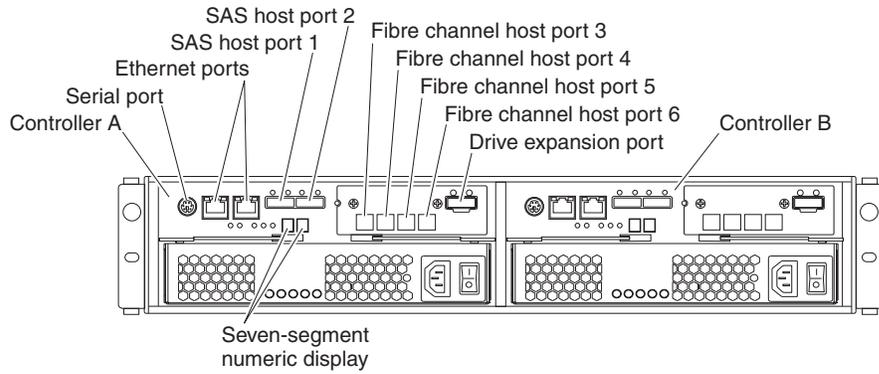


Figure 48. Location of host connectors on RAID controllers

- Repeat steps 1 on page 53 and 2 on page 53 for an additional redundant host connection. In a direct connection configuration, you can create a maximum of two redundant host connections for the storage subsystem.

See “Direct-attached single-controller connections” and “Direct-attached dual-controller connections” on page 56 for illustrations of host connections.

For examples of redundant, partially-redundant, and non-redundant host and drive loop configurations, see “Fibre Channel host loop configurations” on page 57.

Direct-attached single-controller connections: The following illustration shows a direct-attached connection to a single host HBA.

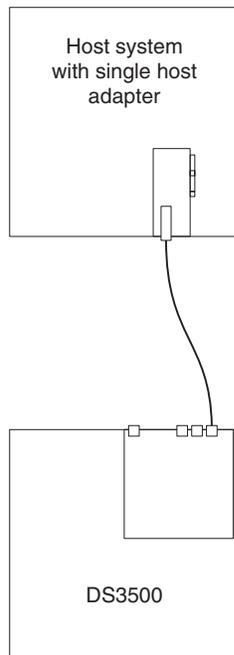


Figure 49. Single-controller direct-attached Fibre Channel connection to a single host HBA

The following illustration shows a direct-attached connection to dual HBAs in a single host (redundant host connection).

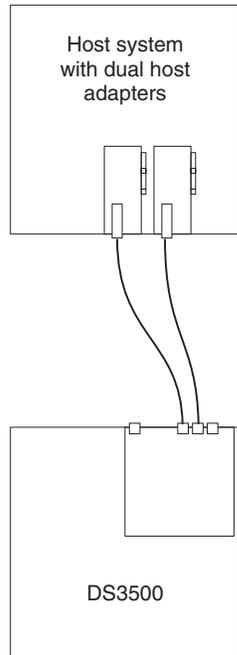


Figure 50. Single-controller direct-attached Fibre Channel connection to dual HBAs (redundant host connection)

The following illustration shows a direct-attached connection to single HBAs in multiple hosts.

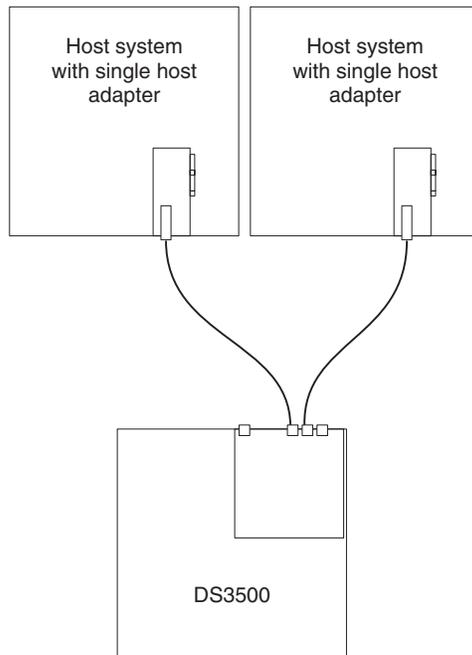


Figure 51. Single-controller direct-attached Fibre Channel connection to single HBAs in multiple hosts

Direct-attached dual-controller connections: The following illustration shows a direct-attached connection from each controller to a single HBA in the same host (redundant host connection).

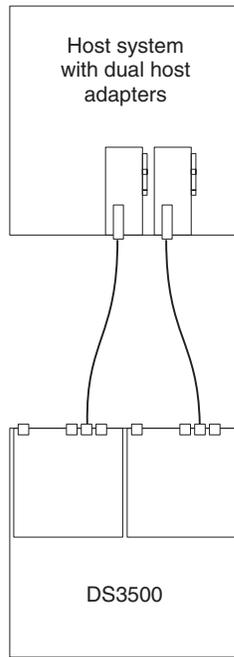


Figure 52. Dual-controller direct-attached Fibre Channel connection to two HBAs in the same host (redundant host connection)

The following illustration shows multiple redundant direct-attached host connections.

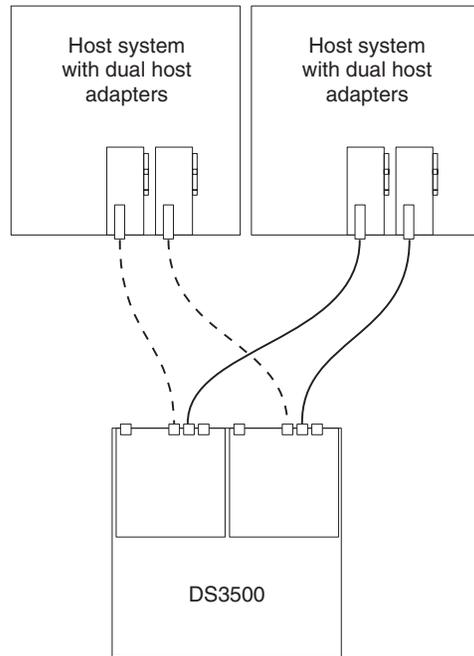


Figure 53. Dual-controller direct-attached Fibre Channel connections to multiple HBAs in multiple hosts

Fibre Channel connections: The storage subsystem Fibre Channel connection consists of up to two host Fibre Channel loops. The host Fibre Channel loops provide the fibre path for host attachment. They can consist of Fibre Channel cables, SFP modules, host bus adapters, Fibre Channel switches, and RAID controllers.

Fibre Channel host loop configurations: You must determine how the host systems will connect to the storage subsystem. You can connect up to two host systems directly to the storage subsystem. The illustrations in the following sections show common host system configurations.

Redundant host loops: This section provides examples of host Fibre Channel configurations.

Host Fibre Channel configurations: This section provides the following examples of host Fibre Channel configurations.

- Single SAN fabric configuration, as shown in Figure 54 on page 58
- Dual SAN fabric configuration, as shown in Figure 55 on page 58
- Two storage subsystems in a dual SAN fabric configuration, as shown in Figure 56 on page 59

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

In Figure 54 on page 58, the Fibre Channel switches are connected together through the Inter-Switch Link (ISL) to form a single SAN fabric.

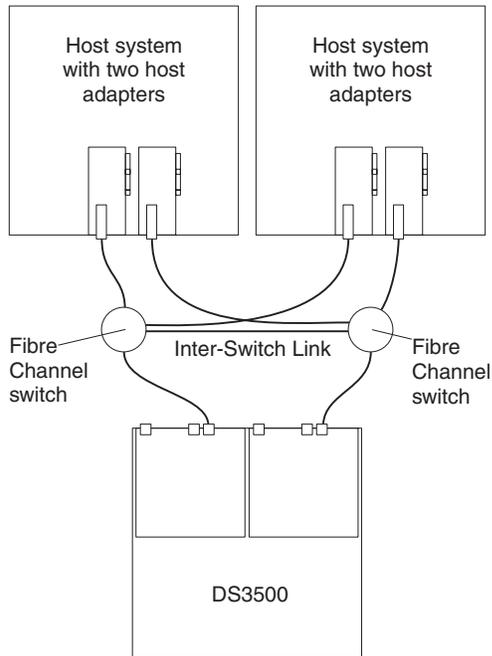


Figure 54. Example of a single Fibre Channel SAN fabric configuration

In Figure 55, the Fibre Channel switches are *not* connected together through an ISL. Each switch forms its own SAN fabric. This configuration is also the configuration to use for a dual-node cluster configuration.

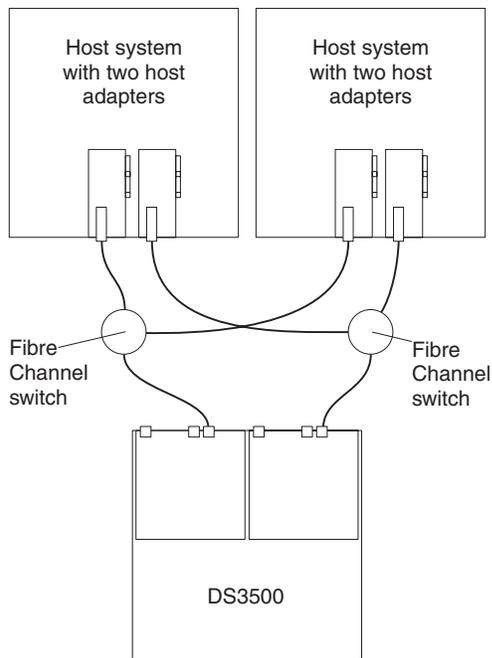


Figure 55. Example of a dual Fibre Channel SAN fabric configuration

In Figure 56 on page 59, the Fibre Channel switches are not connected together. Each switch forms its own SAN fabric.

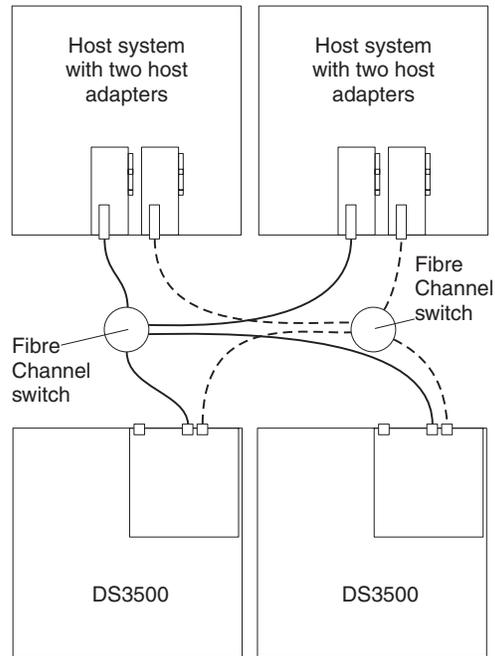


Figure 56. Example of two storage subsystems in a dual Fibre Channel SAN environment

Connecting iSCSI hosts to the DS3500

The DS3500 can support up to 64 hosts, depending on the number of host ports and host partitions that are used on the RAID controller. To protect against the loss of any one path from the host servers to the storage subsystem, use redundant host connections.

To connect a hardware or software iSCSI initiator to the storage subsystem, complete the following steps:

1. Connect a Category 5e or Category 6 Ethernet cable from the RAID controller host port to a gigabit Ethernet switch, and then connect an Ethernet cable from the switch to the host iSCSI initiator port. Figure 15 on page 24 shows the host ports.
2. Create a redundant host connection:
 - If the storage subsystem is a single-controller storage subsystem, connect an Ethernet cable from the second host port on the RAID controller to a gigabit Ethernet switch.
 - If the storage subsystem is a dual-controller storage subsystem, connect an Ethernet cable from the host port on the other RAID controller on the storage subsystem to a gigabit Ethernet switch.

Notes:

1. Do not configure any two interfaces on the same subnet.
2. If you are using DHCP on more than one interface, multiple interfaces can end up on the same subnet.
3. Direct iSCSI connections from the host to the storage subsystem are not supported.

For illustrations of host connections, see “Single-controller iSCSI connections” on page 60 and “Dual-controller iSCSI configurations” on page 62.

Single-controller iSCSI connections: The following illustration shows a single controller storage subsystem that is attached to a single host. This configuration has no redundancy.

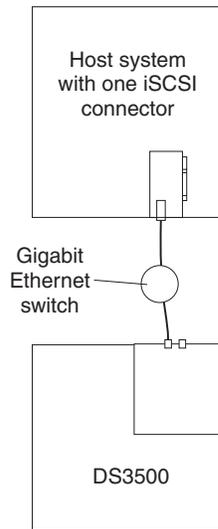


Figure 57. Single-host, single-controller iSCSI configuration

A system with dual iSCSI ports can provide enhanced performance compared to a system that uses only one iSCSI port.

The following illustration is an example of a host that is using multiple ports that are attached to a single-controller configuration. This configuration provides some path redundancy.

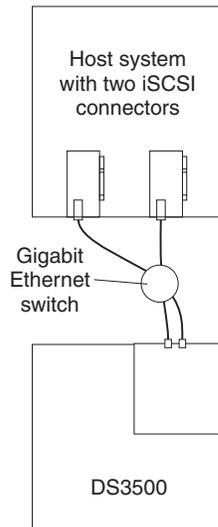


Figure 58. Multiple-port, single-controller iSCSI configuration

The following illustration is an example of multiple single-port host systems that are connected to a single-controller DS3500 using multiple connections.

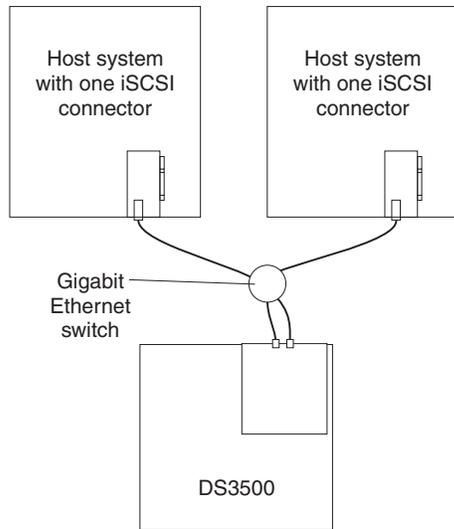


Figure 59. Multiple single-port hosts, single-controller iSCSI configuration

For cluster configurations, the following illustration is an example of a multiple-host, multiple-port, single-controller, and redundant-path configuration.

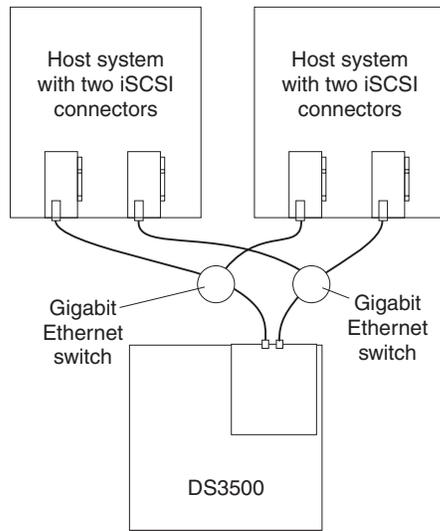


Figure 60. Multiple-host, multiple-port, single-controller, and redundant-path iSCSI configuration

You can replace the two gigabit Ethernet switches that are shown in Figure 60 and Figure 61 on page 62 with one large gigabit Ethernet switch that has the required number of ports. Virtual local area network (VLAN) can also be used to isolate the two iSCSI networks, instead of a single switch.

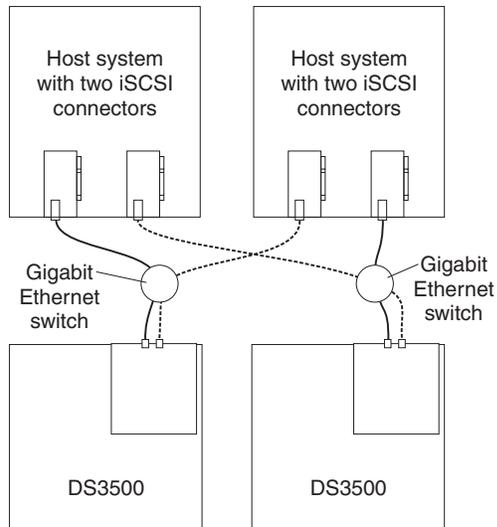


Figure 61. Multiple-host, multiple-port, multiple-storage-subsystem iSCSI configuration

Dual-controller iSCSI configurations: The following illustration is an example of a multiple port, single-host configuration. A system that uses multiple iSCSI ports can provide enhanced performance compared to a single-port iSCSI connection.

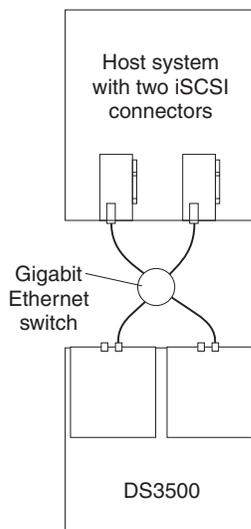


Figure 62. Single-host, multiple-port, dual-controller iSCSI configuration

For cluster configurations, the following illustration is an example of a multiple-host, multiple-port, and redundant path and controller configuration.

You can replace the two gigabit Ethernet switches that are shown in Figure 63 on page 63 with one large gigabit Ethernet switch that has the required number of ports. Virtual local area network (VLAN) can also be used to isolate the two iSCSI networks, instead of a single switch.

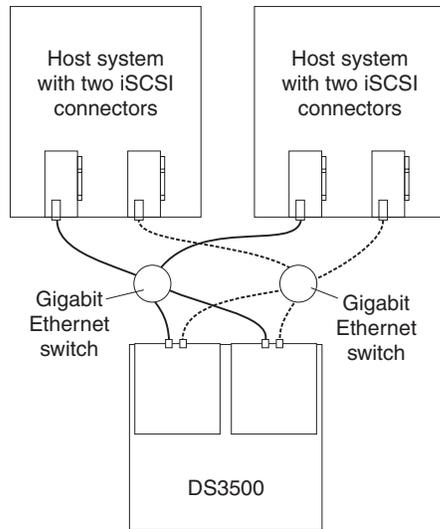


Figure 63. Multiple-host, multiple-port, dual-controller iSCSI configuration

Figure 64 shows an example of a multiple-host, multiple-port, and multiple-fabric (Fibre Channel or iSCSI, and SAS) configuration.

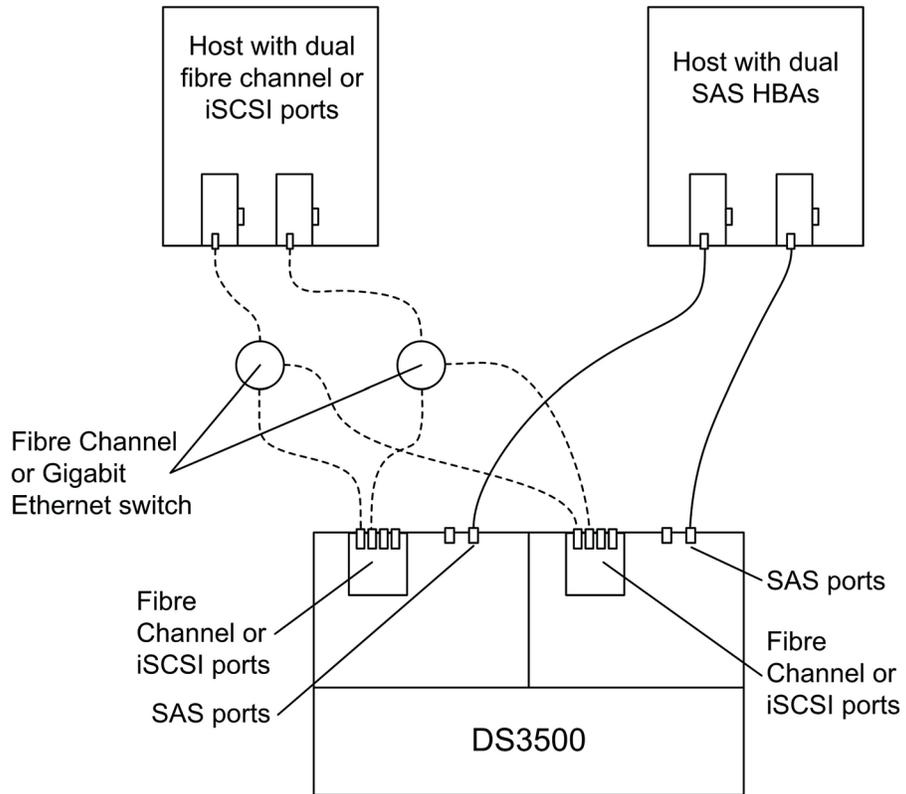


Figure 64. Example of a multiple-host, multiple-port, and multiple-fabric (Fibre Channel or iSCSI, and SAS) configuration

Overview of installing an IBM BladeCenter configuration to connect to a DS3500

This section gives an overview and guidelines for installing an IBM BladeCenter configuration to connect to a DS3500.

Before you install the BladeCenter configuration, consider the following information:

- Make sure that the BladeCenter chassis, blade server, SAS connectivity module, and SAS expansion card are supported. Go to <http://www.ibm.com/servers/storage/support/disk/>, select the link for the DS3500, and see the interoperability matrix.
- Make sure that an Advanced Management Module is installed in the BladeCenter chassis. The latest level of management-module firmware is available at <http://www.ibm.com/bladeCenter/>.
- For the latest SAS connectivity module firmware, SAS expansion card firmware, blade server BIOS code, and device drivers, see <http://www.ibm.com/systems/support/>.

Installing the BladeCenter configuration

To install the IBM BladeCenter SAS Expansion Card (CFFv), IBM BladeCenter SAS Connectivity Module, and blade server, complete the following general steps:

1. Install an IBM BladeCenter SAS Expansion Card (CFFv) in each blade server that you want to connect to the DS3500. See the documentation that comes with the SAS expansion card for installation requirements and procedures.
2. Install the blade servers in the BladeCenter chassis. See the documentation that comes with the blade server for installation requirements and procedures.
3. Install the IBM BladeCenter SAS Connectivity Modules in the I/O bays in BladeCenter unit. See the documentation that comes with the SAS connectivity modules for installation requirements and procedures.
4. Go to “Connecting BladeCenter hosts to the DS3500.”

Connecting BladeCenter hosts to the DS3500

The dual-controller DS3500 comes with two SAS host connectors on each controller, enabling up to 28 blade servers in one BladeCenter unit to be redundantly connected to the storage subsystem.

To protect against the loss of any one path from the host blade servers to the DS3500, use redundant host connections.

To connect a SAS expansion card that is installed in a blade server to the DS3500, complete the following steps:

1. Connect a SAS cable from the SAS host connector on the DS3500 RAID controller to any SAS port on an IBM BladeCenter SAS Connectivity Module that is installed in a BladeCenter unit.
2. To create a redundant host connection, connect a SAS cable from a second SAS connectivity module to a host connector on the other RAID controller in the DS3500. You can create a maximum of two redundant host connections in a dual-controller DS3500.

Attention: You can connect only one DS3500 to the BladeCenter SAS Connectivity Module. No other external devices can be connected to the SAS connectivity module.

3. (Optional) For additional storage, you can connect EXP3500 expansion enclosures to the DS3500. For an illustration showing how to configure the expansion enclosures, see Figure 35 on page 41.

Figure 65 shows an example of a DS3500 that is connected to one BladeCenter unit.

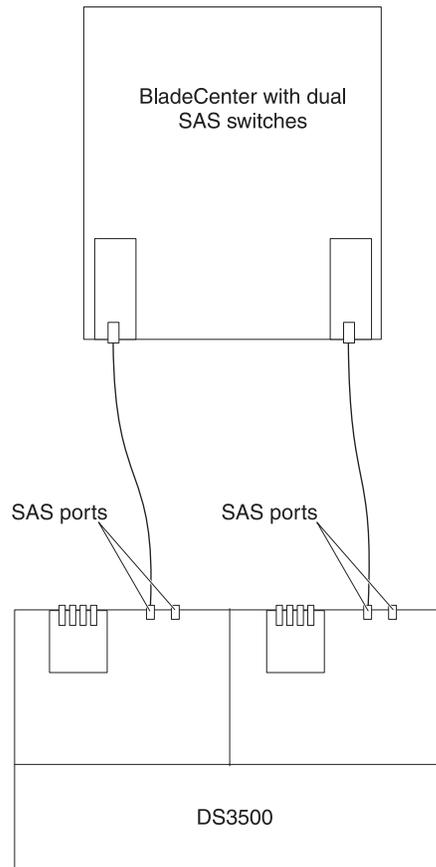


Figure 65. Example of a DS3500 that is connected to one BladeCenter unit

Cabling the DS3500 and EXP3500 power supplies

To connect the DS3500 and EXP3500 power-supply cords, complete the following steps:

1. Connect a power cord to a power supply in the DS3500 or EXP3500.
2. Attach the power cord to the strain relief guide.
3. Repeat steps 1 and 2 for the second power supply.
4. Connect the other end of each power cord to a correctly grounded electrical receptacle. For maximum protection against power loss, connect each of the two power supplies to a different power source.

Chapter 4. Operating the storage subsystem and expansion enclosure

This chapter describes operating procedures for the storage subsystem and expansion enclosure.

To ensure optimal operation of the storage subsystem and expansion enclosure, see “Best practices guidelines” on page 5.

Performing the health check process

Use the health check process to help you verify and maintain the optimal performance of the storage configuration. The information that you collect in these steps also helps provide IBM Service with important information that is needed during a service call.

Perform the following health check tasks after the initial configuration of the storage subsystem and after all configuration sessions. Set a regular schedule of periodic health check evaluations to keep the firmware levels current and to preserve optimal data access and performance.

1. Monitor the Recovery Guru in the DS Storage Manager software for any obvious storage subsystem errors or problem conditions.
2. Gather and save the following 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 compress them into a single file by clicking the **Support** tab and then **Gather Support Information** in the Subsystem Management window.)
 - DS3500 storage subsystem management event log (MEL)
 - Storage Subsystem Profile or DS3500 Profile
 - SAS PHY error log

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 DS3500 storage configuration failure. Do not save these event log files only to a LUN in the DS3500 storage subsystem.

3. Use the Storage Subsystem Profile or DS3500 Profile to make sure that the following firmware levels are at the latest versions:
 - Controller firmware
 - ESM firmware
 - Drive firmware

If the firmware is not up-to-date, upgrade the firmware and software to the latest level that is applicable to the storage configuration. See “Software and hardware compatibility and upgrades” on page 11 for information about where to find the latest firmware and software.

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

Save the storage subsystem profile before you perform 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 DS3500 storage configuration failure.

4. Use the Storage Subsystem Profile or DS3500 Profile to make sure that the following functions are enabled:
 - For all DS3500 models, enable Media Scan both at the controller level and at the LUN level.
 - For all DS3500 models, enable the read/write cache. In addition, use the Storage Subsystem Profile to make sure that cache is matched between the controllers.

Hardware inspection

In addition to the health check process, regular hardware inspection and maintenance helps to support the optimal performance of the storage configuration. Periodically inspect the components of the storage configuration.

For best results, follow these guidelines:

- Maintain an up-to-date storage subsystem profile for the storage configuration. Save the profile to a server disk that will remain accessible in case of a DS3500 storage configuration failure. Do not save the profile only to a LUN in the 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 applicable IBM-approved cables for all situations. Note in the configuration documentation whether any cables are not IBM-approved.
- Create and maintain a cabling diagram of the current 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 and other attached devices).
- Make sure that all controllers and ESMs are correctly seated.
- Make sure that all drives are correctly seated.
- Make sure that cables are managed correctly.
- Ensure proper air flow and temperature for all components in the storage configuration.

You can find details about many of these inspection and maintenance responsibilities in other sections of this document.

In addition to these inspection and maintenance responsibilities, conduct training for staff that support storage configurations. Although training is not a part of the health check process, training reduces the potential for configuration problems and contributes to the correct operation of the system.

Turning on the storage subsystem

This section contains instructions for turning on the storage subsystem under normal situations. “Turning off the storage subsystem” on page 81 contains instructions for turning off the storage subsystem under normal and emergency situations. When you turn on and turn off the storage subsystem, be sure to use the startup sequence that is described 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 83.

The following procedure addresses two situations:

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

Attention:

1. Repeatedly turning the power off and on without waiting for the drives to spin down can damage the drives. Always wait at least 70 seconds after you turn off the power before you turn it on again.
2. If you are connecting a power cord to a storage subsystem or expansion enclosure, turn off both of its power switches first. If the main circuit breaker is off, make sure that both power switches are off on each expansion enclosure in the rack before you turn 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.
2. Make sure that all power cords are connected.

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

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

Attention: You must turn on power to each attached expansion enclosure before you turn on power to the storage subsystem so that the controllers recognize all drives in the configuration during the startup process.

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

Check the LEDs on the front and rear of all the expansion enclosures. Make sure that no amber LEDs are lit on any of the expansion enclosures.

5. Turn on both ac power switches on the rear of the storage subsystem. Figure 66 shows the locations of the ac power switches.

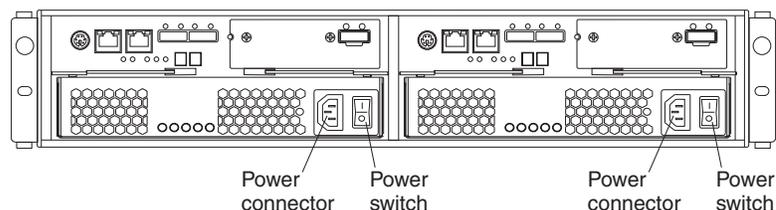


Figure 66. Power-supply switches and connectors for the DS3500

Depending on the number of expansion enclosures in the configuration, the storage subsystem might take up to 10 minutes to fully power-on. While each storage enclosure powers-on, the green and amber LEDs on the front and rear of the expansion enclosure turn on and off intermittently. The cache battery

backup self-test might take up to an additional 15 minutes to be completed. During this time, the LEDs on the front and rear of the storage subsystem might flash intermittently.

6. Determine the status of all storage subsystems and components in the configuration by completing the following steps:
 - a. Check all LEDs on each component in the expansion enclosures. Make sure that all the LEDs show normal status. For more information about LED status for expansion enclosures, see “Checking the LEDs” on page 73.
 - b. Check all LEDs on each component in the storage subsystem. Make sure that all the LEDs show normal status. For information about LED status, see Chapter 6, “Solving problems,” on page 127.
 - c. Open the Subsystem Management window, and display the status of the storage subsystem.
7. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - **Yes:** The procedure is complete.
 - **No:** Go to step 8.
8. Diagnose and correct the fault by completing the following steps:
 - a. Run the DS Storage Manager Recovery Guru by clicking **Recovery Guru** in the Subsystem Management window toolbar.
 - 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, “Solving problems,” on page 127.
 - c. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This action runs the Recovery Guru again to make sure that the problem is corrected.
 - d. If the problem remains, contact your IBM technical-support representative.

Installing the DS Storage Manager Client

See the *DS Storage Manager 10 Installation and Host Support Guide* for the applicable operating system for instructions for installing the DS Storage Manager software. The document is in the Documentation folder on the IBM *System Storage DS3500 Support DVD*. Use that document and the online help to configure the logical drives, partitions, and so on for the RAID controllers. Follow the instructions in the 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 DS Storage Manager installation.

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

- HBA device drivers
- Controller firmware
- IP addresses for RAID controllers (for out-of-band management only)
- Additional documentation for hosts, HBAs, and expansion enclosures

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 *DS Storage Manager 10 Installation and Host Support*

Guide for the operating system. Save the profile in a location other than the logical drives that are created for the storage subsystem.

Always see the readme file that is included with the DS3500 Storage Subsystem firmware package (whether the firmware is accessed by the Web or a CD) for any special requirements or restrictions that apply to that firmware version.

Note: Be sure to install the DS 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 DS Storage Manager software to monitor the status of the storage subsystem. Run the software constantly, and check it frequently.

Notes:

1. You can monitor only storage subsystems that are within the management domain of the storage-management software.
2. If you have not installed the DS Storage Manager Event Monitor service as part of the storage-management software installation, the DS 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: See the *DS Storage Manager 10 Installation and Host Support Guide* for the applicable operating system for instructions for installing the DS Storage Manager software. The document is in the Documentation folder on the IBM *System Storage DS3500 Support DVD*.

To download the latest version of the DS Storage Manager software, controller firmware, NVSRAM firmware, and the latest ESM firmware, go to <http://www.ibm.com/servers/storage/support/disk/>.

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

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

Amber (needs attention) LEDs do not necessarily indicate which component has failed or must be replaced or which type of recovery procedure you must perform. In some cases (such as when a hard disk drive exceeds its Predictive Failure Analysis [PFA] threshold), the amber LED is not lit. Only the DS Storage Manager software can detect the failure.

For example, the recovery procedure for a 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 DS Storage Manager software can identify the risk level and provide the necessary recovery procedures.

Note: For PFA flags, the system-error LED and hard disk drive status LEDs are not lit, so checking the LEDs will not notify you of the failure, even if the risk of data loss is high.

Recovering from a storage-subsystem failure might require you to perform procedures other than replacing the component (such as backing up the logical drive). The DS Storage Manager software provides 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.

Firmware updates

Attention: Save the storage subsystem profile before you perform any controller or ESM firmware upgrades. Save the profile and all configuration (.cfg) files to a server disk that will remain accessible in the event of a DS3500 storage configuration failure. Do not save these files only to a LUN in the storage subsystem.

To ensure the optimal operation of the storage subsystem and its attached expansion enclosures, the ESM firmware, controller firmware, hard disk drive firmware, and the NVSRAM firmware must be up-to-date. Go to <http://www.ibm.com/servers/storage/support/disk/> to get the latest updates.

Always see the readme files that are included with the firmware packages for the most up-to-date information about firmware prerequisites, firmware update instructions, download-sequence information, and host I/O restrictions, if any. Apply the necessary updates before you configure the storage subsystem arrays and logical drives. Subscribe to My Support for automatic notifications of firmware or DS Storage Manager software updates or any important information about the DS3500 storage subsystems (see “Product updates” on page 5).

Attention: Failure to observe the limitations, prerequisites, sequences, 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, perform firmware upgrades in the following sequence:

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

Troubleshooting the storage subsystem

The DS Storage Manager software is the best way to monitor the storage subsystem, diagnose a problem, and recover from a hardware failure. Run the DS Storage Manager software continuously, and frequently check the configuration status.

To check the status of and identify a problem with the storage subsystem, complete the following steps. If a problem has occurred, use the DS Storage Manager software and the LEDs on the storage subsystem to help locate a failed component.

1. Open the Subsystem Management window.
2. Click the **Summary** tab, and view the status of the storage subsystem.

3. Does any storage subsystem have a Needs Attention status?
 - **Yes:** Go to step 4.
 - **No:** All components are Optimal. Go to step 5.
4. Click **Recovery Guru** on the toolbar. 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 expansion enclosure, you might have to cycle the power on the DS3500 storage subsystem and all remaining expansion enclosures that are connected to the storage subsystem. Contact your IBM technical-support representative before you power-off any attached expansion enclosures.
5. Check the LEDs on the front and the rear of the expansion enclosure. A green LED indicates a normal status; an amber LED indicates a hardware fault.
6. Is an amber LED lit?
 - **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 the storage subsystem, create, save, and print a storage subsystem profile, and contact your IBM technical-support representative for assistance. When the recovery procedure is completed, select **Recheck** in the Recovery Guru to run the Recovery Guru again to make sure that the problem is corrected.

Checking the LEDs

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

The DS3500 also has a blue system locator LED that is lit when the menu function is selected in the Subsystem Management window, causing the Locate command to be sent to the DS3500.

Check all the LEDs on the front and rear of the storage subsystem when you turn on the power. During power-on, the LEDs flash intermittently as the storage subsystem and components complete the power-on process. In addition to checking for faults, you can use the LEDs on the front of the storage subsystem to determine whether the drives are responding to I/O transmissions from the host.

Power-supply LEDs

This section describes the primary LEDs on the DS3500 power supplies.

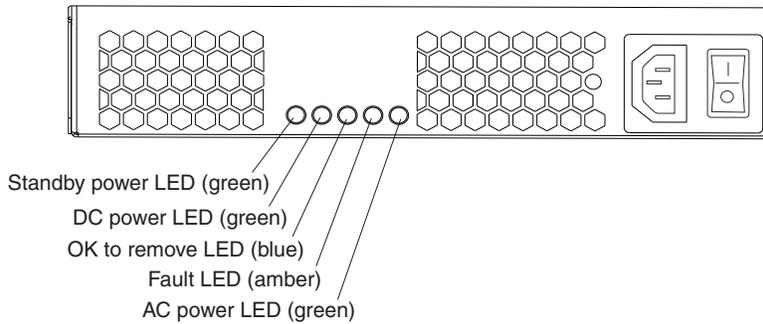


Figure 67. Power-supply LEDs

Standby power LED (green)

Future use only.

DC power LED (green)

When this green LED is lit, it indicates that the DS3500 is turned on and is supplying both 5-volt and 12-volt dc power.

OK to remove LED (blue)

When this blue LED is lit, it indicates that it is safe to remove the power supply.

Fault LED (amber)

When this amber LED is lit, it indicates that a power supply or fan has failed or that a redundant power supply is not turned on.

AC power LED (green)

When this green LED is lit, it indicates that the storage subsystem is receiving ac power.

Front LEDs

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

The front LEDs and controls on the DS3512 storage subsystem and EXP3512 expansion enclosure are shown in Figure 68. The front LEDs and controls on the front of the DS3524 storage subsystem and EXP3524 expansion enclosure are shown in Figure 69 on page 75.

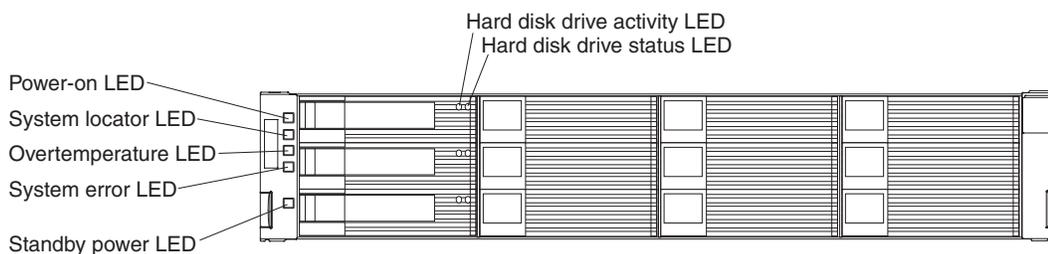


Figure 68. DS3512 storage subsystem and EXP3512 expansion enclosure front LEDs and controls

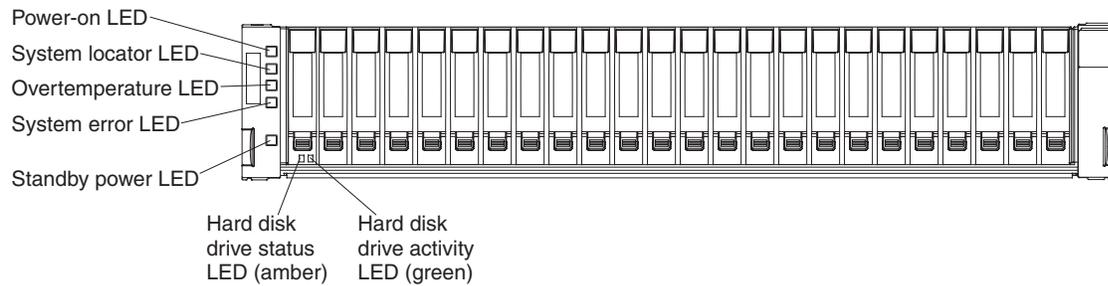


Figure 69. DS3524 storage subsystem and EXP3524 expansion enclosure front LEDs

Power-on LED (green)

When this green LED is lit, it indicates that the power supply is turned on and is supplying both 5-volt and 12-volt dc power.

System locator LED (blue)

This blue LED can be lit by the DS Storage Manager software to aid in visually locating the storage subsystem.

Overtemperature LED (amber)

When this amber LED is lit, it indicates that the storage subsystem is in an over temperature condition.

System error LED (amber)

When this amber LED is lit, it indicates that the unit has a fault, such as in a power supply, controller, or hard disk drive.

Standby power LED (green)

Future use only.

Hard disk drive activity LED (green)

Each hard disk drive has an activity LED. When this green LED is flashing, it indicates drive activity.

Hard disk drive status LED (amber)

Each hard disk drive has a status LED. When this amber LED is lit continuously, it indicates a drive failure. When it is flashing, it indicates that the controller is identifying or building a drive.

Controller LEDs

This section describes the controller LEDs on the rear of the storage subsystem.

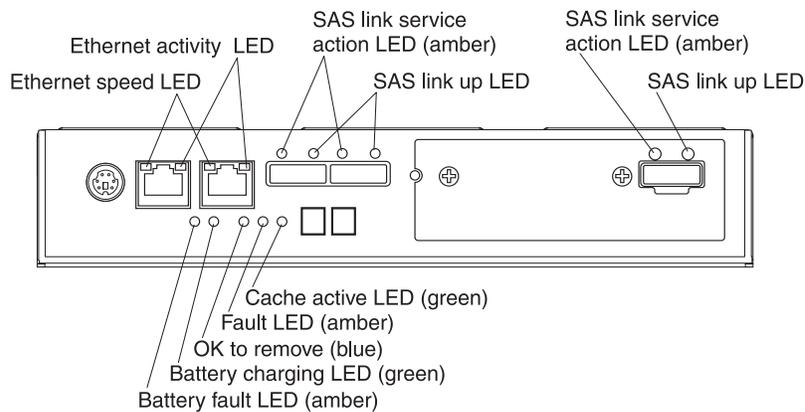


Figure 70. Controller LEDs

Ethernet speed LED

When this LED is lit, it indicates that the Ethernet speed between the controller and the management workstation is 1000 Mbps. When this LED is off, it indicates that the Ethernet speed is 100 Mbps.

Ethernet activity LED

When this LED is lit, it indicates that the link is established between the controller and the management workstation. When this LED is flashing, there is activity between the controller and the management workstation. When this LED is off, no link is established between the controller and the management workstation.

SAS link service action LED (amber)

When this LED is lit, it indicates a problem with the SAS link that requires service action. The normal condition of this LED is off.

SAS link up LED (green)

When this LED is lit, it indicates that the link is established between the controller and a host. When this LED is flashing, it indicates activity on the link. When this LED is off, no link is established.

Cache active LED (green)

When this LED is lit, it indicates that battery backup has been enabled and data is in the memory cache. When this LED is blinking, cache offload is in process. When this LED is off, caching is turned off and no data is in the memory cache.

Fault LED (amber)

When this LED is lit, it indicates that a fault has occurred in the controller and the controller must be replaced. The normal condition of this LED is off.

OK to remove LED (blue)

When this LED is lit, it indicates that it is safe to remove the controller from the DS3500; no activity is taking place, and no data remains in the memory cache. The normal condition of this LED is off.

Battery charging LED (green)

When this LED is lit, the battery is fully charged. When this LED is blinking, the battery is charging. When this LED is off, the battery either failed or has been removed from the controller.

Battery fault LED (amber)

When this LED is lit, it indicates that the battery fails to hold a charge and should be replaced. The normal condition of this LED is off.

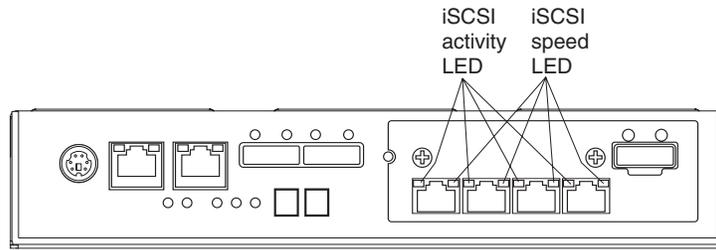


Figure 71. iSCSI host port adapter LEDs

iSCSI activity LED (green)

When this LED is lit, it indicates that the link is established with the controller. When this LED is flashing, there is activity on this port. When this LED is off, no link is established with this port.

iSCSI speed LED (amber)

When this LED is lit, it indicates that the port is operating at 1000 Mbps. When this LED is off, it indicates that the speed of the port is 100 Mbps.

If the optional Fibre Channel host port adapter is installed in the RAID controller, the host port adapter contains four additional Fibre Channel host connectors with LEDs.

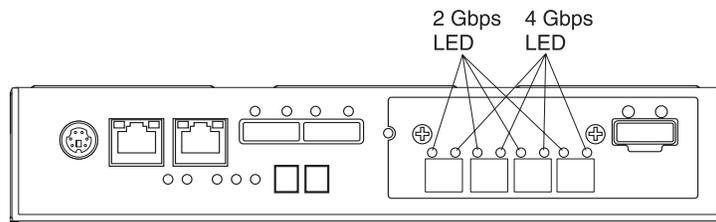


Figure 72. Fibre Channel host port adapter LEDs

Fibre Channel speed LEDs 2 Gbps and 4 Gbps

These LEDs in combination indicate the speed of the Fibre Channel host port.

Table 6. Fibre Channel port LEDs

| 2 Gbps LED | 4 Gbps LED | Host port speed |
|------------|------------|--|
| On | Off | 2 Gbps |
| Off | On | 4 Gbps |
| On | On | 8 Gbps |
| Off | Off | No SFP module is present or the SFP module is faulty |

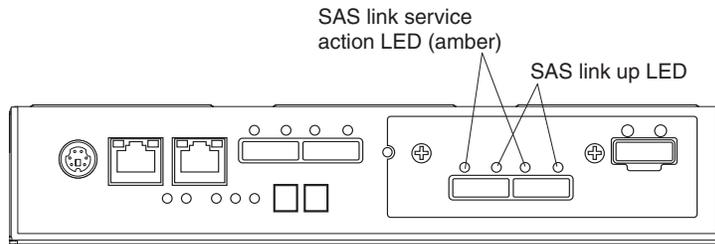


Figure 73. SAS host port adapter LEDs

SAS link service action LED (amber)

When this LED is lit, it indicates a problem with the SAS link that requires service action. The normal condition of this LED is off.

SAS link up LED (green)

When this LED is lit, it indicates that the link is established between the controller and a host. When this LED is flashing, it indicates activity on the link. When this LED is off, no link is established.

Seven-segment numeric display LEDs

The seven-segment numeric display LEDs provide information about enclosure identification and diagnostics. Figure 74 shows the numeric display LEDs.

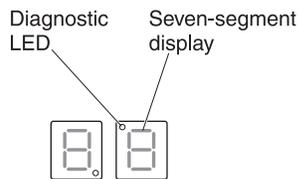


Figure 74. Numeric display LEDs

When you turn on the power to the storage or expansion enclosure, the numeric display LEDs cycle through various codes as the controller or ESM firmware starts to boot.

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 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 7.

Table 7. Controller numeric display diagnostic codes

| Value | Description |
|--------------|--|
| L0 | Mismatched controller board ID. |
| L1 | Missing interconnect canister. |
| L2 | Persistent memory errors. |
| L3 | Persistent hardware errors. |
| L4 | Persistent data protection errors. |
| L5 | ACS failure. |
| L6 | Unsupported host card. |
| L7 | Submodel identifier not set or mismatched. |
| L8 | Memory configuration error. |
| L9 | Link speed mismatch. |
| LA | Reserved. |
| LB | Host card configuration error. |
| LC | Persistent cache backup configuration error. |
| LD | Mixed cache memory DIMMs. |
| LE | Uncertified cache memory DIMM sizes. |
| LF | Lockdown with limited SYMbol support. |
| LH | Controller firmware mismatch. |

Table 8. ESM numeric display diagnostic codes

| Value | Description |
|--------------|---|
| FF | ESM Boot Diagnostic executing. |
| 88 | This ESM is being held in Reset by the other ESM. |
| AA | ESM-A application is booting up. |
| bb | ESM-B application is booting up. |
| L0 | Mismatched ESM types. |
| L2 | Persistent memory errors. |
| L3 | Persistent hardware errors. |
| L9 | Over Temperature. |
| LL | Cannot read midplane EEPROMs. |
| LP | Missing Drive Port Mapping table. |
| Ln | ESM not valid for enclosure. |
| H2 | Invalid/Incomplete Configuration. |
| LF | Lockdown with limited SYMbol support. |
| LH | Controller firmware mismatch. |
| H3 | Maximum Reboot Attempts Exceeded. |
| H4 | Cannot Communicate with Other ESM. |
| H5 | Midplane Harness Failure. |
| H6 | Firmware Failure. |

Table 8. ESM numeric display diagnostic codes (continued)

| Value | Description |
|-------|---|
| H9 | Non-Catastrophic HW. ESM operational, but in a degraded mode. |
| J0 | Incompatible module. |

ESM LEDs

This section describes the ESM LEDs. Figure 75 shows the LEDs on the ESM.

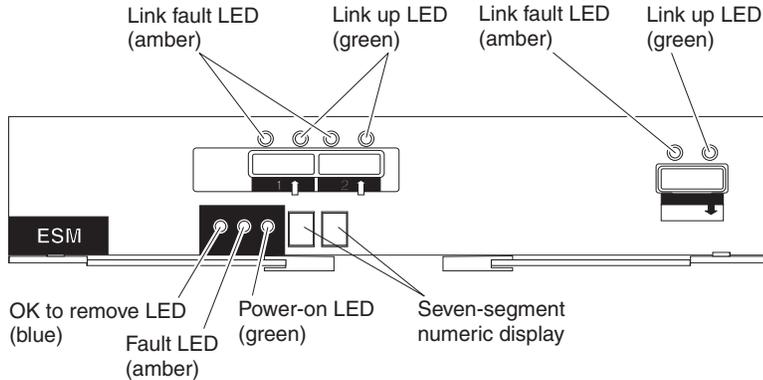


Figure 75. ESM LEDs

Link fault LED (amber)

When this amber LED is lit, it indicates that the link through the SAS cable is not successful.

Link up LED (green)

When this green LED is lit, it indicates that the link through the SAS cable is successful.

OK to remove LED (blue)

This LED is supported only when the EXP3500 is attached to a DS3500 controller. Do not remove the ESM unless this blue LED is lit.

Fault LED (amber)

When this amber LED is lit, it indicates that the ESM has failed.

Power-on LED (green)

When this green LED is lit, it indicates that the ESM is receiving power.

Turning off the storage subsystem

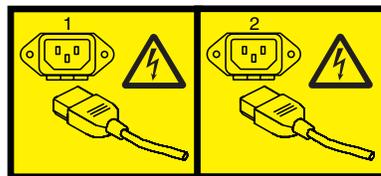
The DS3500 is designed to run continuously. After you turn it on, do not turn it off. Turn off the power only in the following situations:

- 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 83.

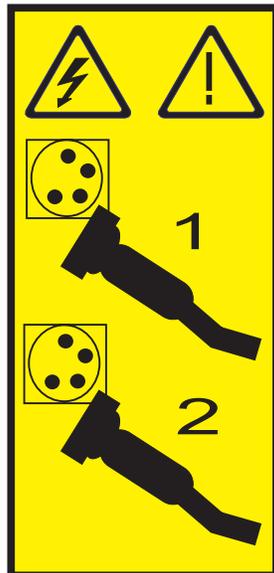
Attention: Except in an emergency, never turn off the power if any amber (needs attention) LEDs are lit. Correct the fault before you turn off the power. Use the DS Storage Manager software and the amber LEDs to check the overall status of the DS3500. All LEDs should be green on the front of the storage subsystem. If they are not, use the DS Storage Manager software to diagnose the problem so that the DS3500 will power-on correctly later.



(L003)



or



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 wait at least 70 seconds after you turn off the power before you turn on the power again.

Power-off overview

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

Turn off the power to each device according to the following shutdown sequence:

1. Turn off power to the host before the storage subsystem. If the host must stay powered-on to support a 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 expansion enclosures. Turn off both power-supply switches on the rear of the storage subsystem.
3. Turn off power to other supporting devices (for example, management stations).

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

To turn off power to one or more storage subsystems for a planned shutdown, complete the steps in the following procedure. To turn off power for an unplanned shutdown, see “Restoring power after an unexpected shutdown” on page 83. Figure 66 on page 69 shows the locations of the power switches on a storage subsystem.

Before you proceed, use the DS Storage Manager software 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. 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 expansion enclosures. Make sure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the storage subsystem. Make sure that all the LEDs show normal status.
 - c. Review the status of the configuration in the Subsystem Management window by clicking the **Summary** tab.

The status is either Optimal or Needs Attention.

3. Do the LEDs indicate normal operation, and is the status Optimal on all configuration components?
 - **Yes:** Go to step 5 on page 83.
 - **No:** Go to step 4.
4. To diagnose and correct the fault, complete the following steps:
 - a. Run the Recovery Guru by clicking **Recovery Guru** in the toolbar 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, click **Recheck** in the Recovery Guru. This action runs the Recovery Guru again to make sure that the problem is corrected.
 - d. If the problem has not been corrected, contact your IBM technical-support representative. Do not turn off power until all problems are corrected.
5. Check the cache active LED, and make sure that it is off.
If the cache active LED is lit, the cache contains data. Wait for the data to clear from cache memory before you turn off the power.
 6. Check the LEDs on the expansion enclosures to make sure that all drive activity LEDs are off.
If one or more LEDs are flashing, data is being written to or from the drives. Wait for all activity LEDs to stop flashing.
 7. Turn off the ac power switch on the rear of each controller in the storage subsystem.

Note: Until the power switch on each controller is turned off, power remains turned on for both controllers.
 8. Turn off both power switches on the rear of each expansion enclosure in the configuration.
 9. After you perform the necessary maintenance procedures, turn on the power, using the procedure in “Turning on the storage subsystem” on page 68.

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.

To shut down the system during an emergency, complete the following steps:

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 amber LEDs that are lit so that you can correct the problem when you turn on the power again.
3. Turn off all power-supply switches, starting with the storage subsystem first and followed by the expansion enclosures. Then, disconnect the power cables from the storage subsystem.

Restoring power after an unexpected shutdown

To restore power to the storage subsystem in a configuration after an unplanned shutdown, complete the following steps.

DANGER

Never turn on any equipment when there is evidence of fire, water, or structural damage.

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 that is attached to the storage subsystem?

- **Yes:** Do not continue with this procedure. Contact your IBM technical-support representative for assistance. Depending on the current service agreements, you might have to return the equipment to the factory or local service center for repair.

- **No:** Go to step 2.

Attention: To avoid potential data loss, make sure that the storage subsystem and expansion enclosure power switches are turned off before you reset circuit breakers in the rack. Resetting circuit breakers after an emergency situation while the storage subsystem and expansion enclosure power switches are turned on can cause data loss, because the configuration components might not be powered-on in the correct sequence. See “Turning on the storage subsystem” on page 68 for details about the correct power-on sequence.

2. After you check the storage subsystem for damage, make sure that the power switches are off; then connect the DS3500 power cables, if required.
3. Check the system documentation of the hardware devices that you want to turn on and determine the correct startup sequence.

Be sure to turn on all of the expansion enclosures and make sure that no ESM or power-supply fault LEDs are lit before you turn on the storage subsystem.

In addition, consider the following items:

- The storage subsystem supports simultaneous power-on of the system components; however, always check the system documentation of the hardware devices that you want to turn on and determine the correct startup sequence.
- A storage subsystem in an optimal state recovers automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, contact your IBM technical-support representative if any of the following conditions occur:
 - The storage subsystem logical drives and subsystems are not displayed in the DS Storage Manager graphical user interface.
 - 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, according to the startup sequence.
5. Turn on both of the power-supply switches on the DS3500. The green LEDs on the front and the rear of the DS3500 should remain lit. If other amber LEDs are lit, see Chapter 6, “Solving problems,” on page 127.

Recovering from an overheated power supply

Each storage subsystem contains two power supplies. Each power supply contains a built-in temperature sensor to prevent the power supply 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 supplies maintain a suitable 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 storage subsystem has no power, and all LEDs are off.

The following factors can cause the power supplies to overheat:

- An unusually high room temperature

- Fan failures in the power supplies
- Defective circuitry in a power supply
- Blocked air vents
- Failures in other devices in the configuration or rack

If a fan failure causes overheating, the system-error LED and overtemperature LEDs on the storage subsystem are lit. The fault LED on the power supply might also be lit. “Checking the LEDs” on page 73 shows the location of the LEDs on the DS3500.

If the storage subsystem temperature exceeds 45°C (113°F), the storage management software displays a Needs Attention icon in the Subsystem Management window. If the air temperature inside the rack reaches 65°C (149°F), the power supplies automatically shut down. If event monitoring is enabled and event notification is configured, the software issues two critical-problem notifications.

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

Attention: To prevent damage to the storage subsystem components when the power supplies automatically shut down, immediately remove all rack panels to help reduce the rack air temperature.

To resume normal operation after a power-supply shutdown, complete the following steps:

1. Did you use the procedure “Troubleshooting the storage subsystem” on page 72 to identify an overheating problem?
 - **Yes:** Go to step 2.
 - **No:** Perform the procedure in “Troubleshooting the storage subsystem” on page 72 to make sure that the power supplies have shut down because of an overheating problem, and then go to step 2.
2. Stop I/O activity to the storage subsystem and all attached expansion enclosures.
3. Take all or some of the following measures to alleviate the overheating problem:
 - Remove all panels from the rack immediately.
 - Use external fans to cool the area.
 - Shut down the power to the expansion enclosure, using the procedure that is described in “Performing an emergency shutdown” on page 83.
4. Wait for the air in and around the storage subsystem to cool.

After the temperature inside the power supplies drops to below 65°C (149°F), the storage subsystem is capable of power-on 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.
5. Did the power supplies restart automatically?
 - **Yes:** Go to step 8 on page 86.
 - **No:** Go to step 6 on page 86.

6. Turn off both power switches on the DS3500 (see Figure 66 on page 69) and then power-off all connected expansion enclosures. Wait 1 minute and then turn on power to all connected expansion enclosures.

While an expansion enclosure powers-on, the LEDs on the front and the rear of the enclosure flash intermittently. Depending on your configuration, the expansion enclosure can take between 20 seconds and several minutes to power-on.

7. Turn on both power switches on the rear of the storage subsystem. See Figure 66 on page 69.

A storage subsystem can take 10 seconds to power-on and up to 15 minutes for the battery self-test to be completed. During this time, the LEDs on the front and the rear of the DS3500 flash intermittently.

8. Check the LEDs on the front and rear of the storage subsystem and each attached expansion enclosure (a green LED indicates a normal status; an amber LED indicates a hardware fault); then, check the array status in the Subsystem Management window.

- a. Open the Subsystem Management window for the storage array.
- b. Click the **Summary** tab and review the status of the configuration.

The status is either Optimal or Needs Attention.

9. Does each module (RAID controller, power supply, ESM) display green status LEDs only, and is the status Optimal for each module component?

- **Yes:** Go to step 11.
- **No:** Go to step 10.

10. Diagnose and correct the fault.

- a. To run the Recovery Guru, click **Recovery Guru** in the toolbar 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 73.

- c. When the procedure is completed, select **Recheck** in the Recovery Guru. This runs the Recovery Guru again to make sure that the problem is corrected.
- d. If the problem remains, contact your IBM technical-support representative.

11. Replace the bezel on the expansion enclosure, if applicable.

Cache memory and cache battery

Each RAID controller in the DS3500 storage subsystem contains 1 GB or 2 GB of cache memory to store read and write operations. In a dual RAID controller configuration, both controllers in the DS3500 must have the same amount of cache memory. The battery unit contains enough charge to back up the cached data in each controller to a flash drive in the event of a DS3500 power failure.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data on the DS3500 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 indicates the current status of the cache. The LED is lit when there is data in the cache, and it is off when there is no data in the cache.

If caching is enabled and the cache active LED is not lit 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

Note: Always use the DS Storage Manager client to check the cache memory settings before you assume that a hardware failure has occurred.

See “Controller LEDs” on page 75 for the location of the cache active LED on a RAID controller.

Controller cache battery

The backup battery unit provides power to back up the cache memory of each controller onto flash drives in the event of a power failure. Each battery unit contains a sealed, rechargeable SMART lithium ion battery.



CAUTION:

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (C007)

Replace the battery units in the DS3500 when they are identified as failing by the DS Storage Manager Subsystem Management window, or when the battery fault LEDs light. See “Controller LEDs” on page 75 for the location of the battery fault LED.

Replace only the battery unit that is indicated as failed by the LEDs or in the DS Storage Manager Subsystem Management window. In a dual controller configuration, you do not need to replace both battery units when the Battery fault LEDs indicate that only one battery unit has failed. Each RAID controller has a green Battery charging LED that indicates the status of the battery unit.

- The LED is on when the battery is fully charged
- The LED flashes when the battery is charging or performing a self-test
- The LED is off when the battery or the battery charger has failed or is missing

Cache battery learn cycle

The battery performs a learn cycle the first time the storage subsystem is turned on, and again every eight weeks thereafter, to assess the charge capacity of the battery. If the battery fails the learn cycle or takes too much time to reach full charge, the Battery charging LED turns off, the Battery fault LED turns on and the DS Storage Manager identifies the battery as failed.

The learn cycle takes up to three hours. During this time, the cache will be active if the battery is in optimal condition. If the learn cycle is interrupted, the current learn

cycle will be terminated and the battery will perform a new learn cycle at the next scheduled interval (eight weeks from the current learn cycle). A learn cycle interruption is caused by removing the battery from the controller chassis, resetting the power to the storage subsystem, or if an expansion enclosure or battery overheats.

Data caching starts after the battery is charged to the programmed voltage level, which occurs when the storage subsystem power is first turned on, when a new battery is installed to replace a failed battery, or when the subsystem power is turned on after months of inactivity.

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

EXP3500 expansion enclosure power features

This section contains instructions for turning the expansion enclosure on and off in normal and emergency situations.

If you are turning on the expansion enclosure after an emergency shutdown or power outage, see “Turning on the expansion enclosure after an emergency” on page 90.

Turning on the expansion enclosure

To turn on the power for the initial startup, complete the following steps:

1. Make sure that:
 - a. All cables are correctly connected.
 - b. Both power cords are connected into the rear of the expansion enclosure and into properly grounded electrical outlets.
 - c. All hard disk drives are locked securely in place.

Important: You must install a minimum of four hard disk drives for both power supplies to operate in a redundant mode.
2. Check the system documentation for all the hardware devices that you want to turn on and to determine the correct power-on sequence.

Note: Be sure to turn on the expansion enclosure before or at the same time as you turn on the device that contains the RAID controller.

3. Turn on both power supplies on the rear of the unit.

The expansion enclosure might take a few seconds to turn on. During this time, you might see the amber fault LED, green power LED, power supply LEDs, and blue system locator LED turn on and off intermittently. When the power-on sequence is completed, only the green power LEDs on the front and rear should remain lit. If one or more amber fault LEDs remain lit, see Chapter 6, “Solving problems,” on page 127.

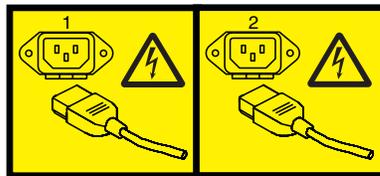
Turning off the expansion enclosure

Attention: Except in an emergency situation, never turn off the power if any fault LEDs are lit on the expansion enclosure. Correct the fault before you attempt to turn off the power, using the correct troubleshooting or servicing procedure. This ensures that the expansion enclosure turns on correctly later. For more information, see Chapter 6, “Solving problems,” on page 127.

DANGER

Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.

(L003)



or



The EXP3500 expansion enclosure is designed to run continuously, 24 hours a day. Turn off the power only under one or more of the following conditions:

- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.

- A power outage or emergency situation occurs. See “Turning off the expansion enclosure in an emergency.”

To turn off the expansion enclosure, complete the following steps:

1. Make sure that all amber status or fault LEDs are off. If any status or fault LEDs are lit (on hard disk drives, power supplies, or ESMs), identify or correct the problems before you turn off the power. For more information, see Chapter 6, “Solving problems,” on page 127.
2. On the server to which the expansion enclosure is connected, either directly or through another supported device that contains a RAID controller, close all operating-system windows and programs; then, shut down the server.
3. Shut down any device that contains a RAID controller to which the expansion enclosure is connected.
4. Turn off both EXP3500 expansion enclosure power supplies.

Turning off the expansion enclosure in an emergency

Attention: If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This will help safeguard your equipment from potential damage due to electrical surges when power is restored. If the expansion enclosure loses power unexpectedly, it might be due to a hardware failure in the power system or midplane. See Chapter 6, “Solving problems,” on page 127.

To turn off the expansion enclosure during an emergency situation, complete the following steps:

1. If you have time, stop all activity and check the LEDs (front and rear). Make note of any status or fault LEDs that are lit so that you can correct the problem when you turn on the power again.

Note: See the documentation that comes with your RAID controller for information about correcting the problem.

2. On the server to which the expansion enclosure is connected, either directly or through another supported device that contains a RAID controller, close all operating-system windows and programs; then, shut down the server.
3. Shut down any device that contains a RAID controller to which the expansion enclosure is connected.
4. Turn off both power supplies; then, disconnect the power cables.

Turning on the expansion enclosure after an emergency

To restart the expansion enclosure if you turned off the power supplies during an emergency shutdown, or if a power failure or a power outage occurred, complete the following steps:

1. After the emergency situation is over or power is restored, check the expansion enclosure for damage. If there is no visible damage, continue with step 2; otherwise, have your unit serviced.
2. Check the system documentation for the hardware devices that you intend to turn on, and determine the correct power-on sequence.

Note: Be sure to turn on the expansion enclosure before or at the same time you turn on the device that contains the RAID controller to which the expansion enclosure is connected.

3. Turn on each connected device, according to the power-on sequence that is described in the documentation that comes with the device.
4. Connect the power cables and turn on both power switches on the rear of the expansion enclosure.
5. Make sure that only the power (green) LEDs on the front and rear are lit. If one or more of the fault (amber) LEDs are lit, see Chapter 6, “Solving problems,” on page 127 for instructions.
6. Use the RAID controller management software as applicable to check the status of the expansion enclosure.

Chapter 5. Replacing components

This chapter contains information about replacing the storage subsystem and expansion enclosure components and installing optional devices.

Attention: Always replace a failed component as soon as possible. The Recovery Guru in the DS Storage Manager software identifies failed components.

OK to remove LED

Each controller, ESM, and power supply has a blue OK to remove LED. The purpose of the OK to remove LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any component unless the component OK to remove LED is lit.

Attention

If you remove a controller, ESM, or power supply when the OK to remove LED is not lit, a loss of data availability can result. If an amber LED is lit and the associated OK to remove LED is *not* lit, you must perform additional diagnostics *before* you can remove the indicated component. Use the Recovery Guru instructions in the Subsystem Management window or see the applicable component replacement instructions in this chapter for the additional diagnostics that are required in this case.

The OK to remove LED automatically turns on or off as conditions change. Wait at least 2 minutes after you replace a component for the storage subsystem to recognize the new component and update the LED status. In most cases, when a single component fails, the OK to remove LED stays lit when the amber LED is lit for the component.

Working with controllers

This section describes how to remove a controller, remove and install a cover, install a controller, replace a controller, and dispose of the system-board battery on the controller.

Removing a controller

Attention: Before you remove a controller in a single-controller storage subsystem, shut down the storage subsystem to avoid data loss (see “Turning off the storage subsystem” on page 81).

To remove a controller from the storage subsystem, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.

Attention: Never remove a controller unless the OK to remove LED is lit. Doing so can result in a loss of data.

2. If the controller has failed, do not continue with this procedure. Instead, go to “Replacing a controller” on page 96.

Attention: Handle and install cables correctly to avoid degraded performance or loss of communication with devices. See “Cabling the DS3500 storage subsystem” on page 23 for more information.

3. Disconnect all attached interface cables from the controller. Be sure to label each cable so that you can reconnect it correctly.
4. Remove the controller from the chassis.

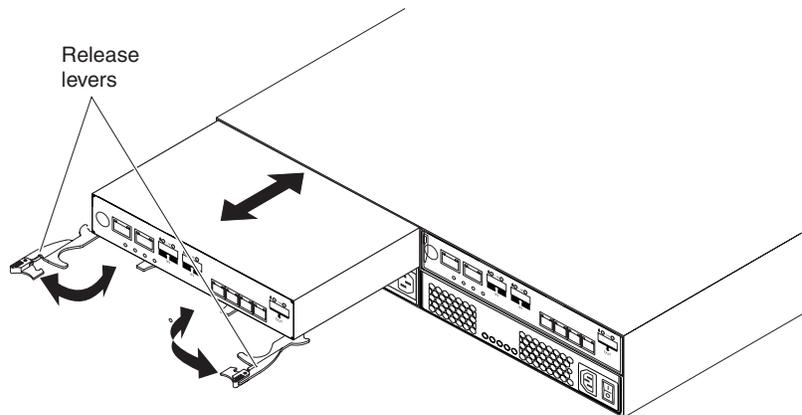


Figure 76. Removing a controller

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
- b. Pull the controller out of the bay.
- c. Place the controller on a level surface.

Attention: After you remove a controller, wait 70 seconds before you reseal or replace the controller. Failure to do so might cause unpredictable results.

Removing and installing a cover

To remove a cover from a controller, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Press on the two release buttons and slide the cover toward the rear of the controller.

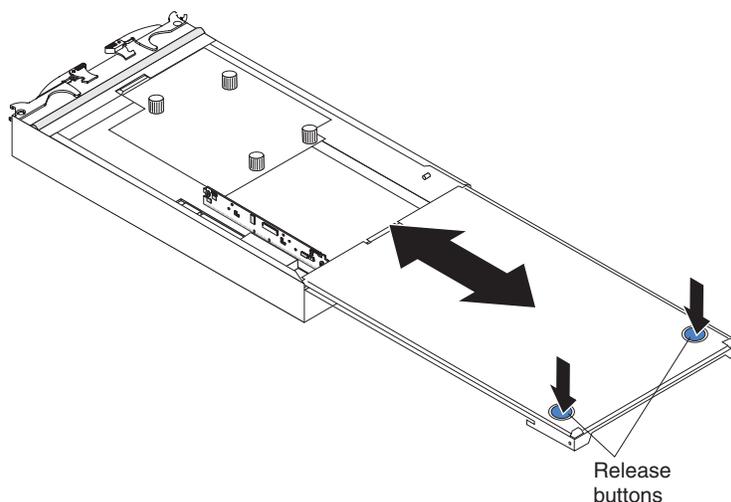


Figure 77. Removing the cover

3. Remove the cover and save it for future use.

To install a cover on a controller, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Align the cover on the controller and slide it toward the front of the controller to install it.

Installing a controller

Use this procedure to install a second controller. The second controller is controller B. If the storage subsystem contains only one controller, that controller is controller A.

Attention: Make sure that the two controllers have the same host port adapter, DIMM size, and options. An incompatible controller will be placed in a lockout state by the other controller.

To install a controller in the storage subsystem, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Install new dual-controller NVSRAM firmware on controller A. See “Downloading controller or NVSRAM” in the *DS Storage Manager 10 Installation and Host Support Guide* for information about how to download the NVSRAM firmware.

Note: Obtain the latest dual-controller NVSRAM firmware from <http://www.ibm.com/servers/storage/support/disk/>.

3. Start the command-line interface; then, enter the following command to change controller A from simplex (single-controller) mode to duplex (dual-controller) mode:

```
Smcli ctlr_A_IP_address -c "set storageSubsystem redundancyMode=duplex;"
```
4. Shut down the storage subsystem, and then start it again (see “Turning on the storage subsystem” on page 68). If controller A was successfully converted to duplex mode, the subsystem reports an alternate controller missing error message. If the error message is not reported, reinstall the new dual-controller NVSRAM firmware on controller A and repeat steps 3 through 4.
5. Unpack the new controller. Save all packing materials in case you have to return a controller.
6. Make sure that both controllers have the same host port adapter, DIMM size, and options.
7. If controller A contains an optional host port adapter, install an identical optional host port adapter in the new controller. See “Installing an optional host port adapter” on page 101 for instructions.
8. Remove the controller filler panel from the bay:
 - a. Open the two release levers. The filler panel moves out of the bay approximately 0.6 cm (0.25 inch).
 - b. Pull the filler panel out of the bay.
 - c. Place the filler panel in a safe place for future use.
9. Install the new controller.

Note: The following illustration shows installing controller A. Be sure to install the new controller in the rightmost bay, as controller B.

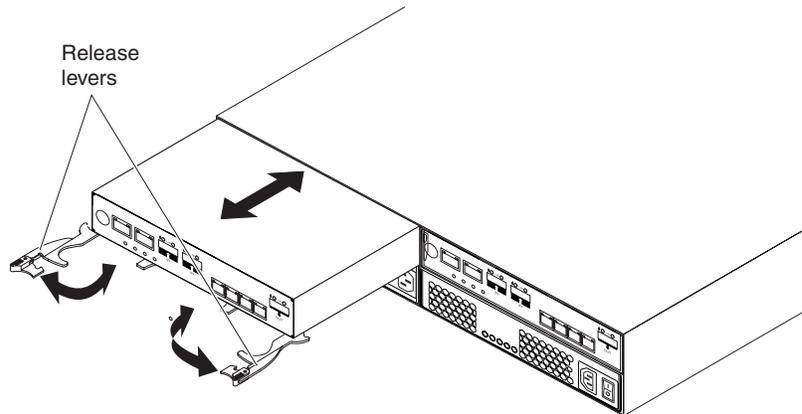


Figure 78. Installing a controller

- a. Make sure that the release levers on the controller are in the open position.
 - b. Slide the controller into the bay until it stops.
 - c. Push the release levers to the closed position.
10. Wait up to 5 minutes for the DS Storage Manager software to recognize the new controller.
 11. Connect the host interface cables to the controller. See “Cabling the DS3500 storage subsystem” on page 23 for more information.
 12. Make sure that all expansion enclosure connections have been completed (see the dual-controller topologies in “DS3500 storage subsystem drive cabling topologies” on page 42); then, connect the SAS drive expansion cable from the right ESM in the last expansion enclosure in the chain to the drive expansion port on controller B of the DS3500.
 13. Wait up to 5 to 10 minutes for the DS Storage Manager software to report the drives and the redundant drive path.
 14. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 75. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
 - **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.
 - **No:** Go to step 15.
 15. Use the DS Storage Manager software to print a new storage subsystem profile.

Replacing a controller

Attention: Make sure that both power supplies are connected and powered-on and no amber LEDs are lit. Make sure that the power LEDs on both power supplies are lit. If the status of either of the power supplies is not Optimal, replace that power supply before you proceed with the controller replacement procedure.

To replace a controller in a storage subsystem, complete the following steps.

Attention:

- If you are replacing a failed controller with a replacement controller from IBM Service, you will transfer the controller battery to the replacement controller. The replacement controller contains a 1024 MB DIMM; if the capacity of the DIMM in the failed controller is larger than 1024 MB, you will also transfer that DIMM to the replacement controller. Transfer the DIMM and battery exactly as described in this procedure; failure to remove and insert these items in the correct sequence can damage the DIMM.
- In a single-controller storage subsystem, shut down the storage subsystem before you remove the controller.
 1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
 2. In a single-controller storage subsystem, shut down the storage subsystem (see “Turning off the storage subsystem” on page 81 for the correct sequence of steps); then, continue with step 4.
 3. Use the DS Storage Manager software to print a storage subsystem profile. Move logical drive ownership to the other controller. If the controller that you are replacing has failed but is still operating, move the failed controller to the Offline state.

Attention: Never remove a controller unless the OK to remove LED is lit. Doing so can result in a loss of data.

4. Locate the failed controller by checking the amber LEDs on the controllers in the storage subsystem.
5. Is the OK to remove LED lit?
 - **Yes:** Go to step 6.
 - **No:** Another component might require attention before you can remove the controller. Use the Recovery Guru in the Subsystem Management window to identify and correct any additional failures. If there are none, proceed with step 6 to replace the controller.

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

6. Unpack the new controller. Save all packing materials in case you have to return the new controller.
7. Determine whether the replacement controller will be controller A or controller B (controller A is installed in the left controller bay; controller B is installed in the right controller bay), and then apply the controller labels for host ports and drive expansion ports to the replacement controller. The controller labels and instructions are included with the replacement controller. Make sure that the labels are aligned correctly and do not cover any connectors or LEDs.

Attention: Handle and install cables correctly to avoid degraded performance or loss of communication with devices. See “Cabling the DS3500 storage subsystem” on page 23 for more information.

8. Disconnect all attached interface cables from the failed controller. Be sure to label each cable so that you can reconnect it correctly to the new controller.
9. If the controller has failed in a single-controller storage subsystem, turn off the power immediately (see “Performing an emergency shutdown” on page 83 for instructions).
10. Remove the controller from the chassis.

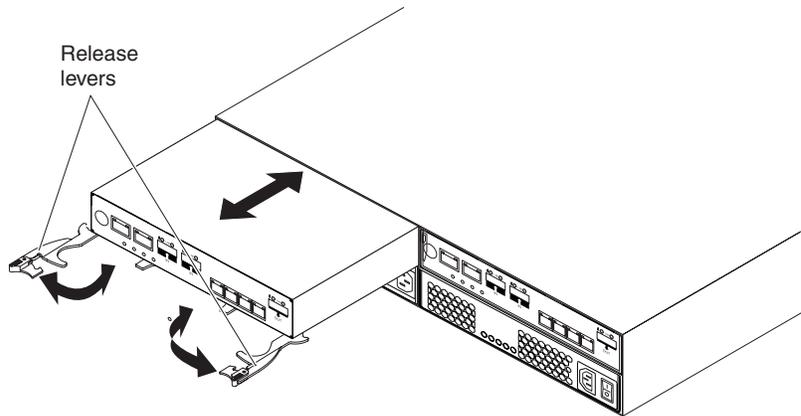


Figure 79. Removing and replacing a controller

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
- b. Pull the controller out of the bay.
- c. Place the controller on a level surface.

Attention: The DS3500 replacement controller ships with a temporary filler. Place the temporary filler in the controller chassis bay after the failed controller is removed, to maintain proper airflow and cooling.

11. Remove the cover (see “Removing and installing a cover” on page 94).
12. Remove the battery from the failed controller.

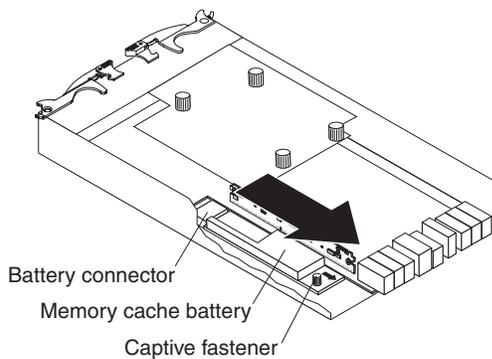


Figure 80. Removing the battery unit from the controller

- a. Loosen the blue captive fastener until the battery can move in the direction that is indicated by the arrow.
 - b. Slide the battery unit out of the controller in the direction that is indicated by the arrow.
 - c. Set the battery aside.
13. If the capacity of the DIMM in the controller that you removed is greater than 1024 MB, complete the following steps to transfer the DIMM to the new controller:
 - a. Remove the 1024 MB DIMM from the new controller and set it aside (see “Replacing the memory cache DIMM” on page 120).
 - b. Insert the DIMM into the new controller (see “Installing the DIMM” on page 121 for instructions).

14. Install the battery from step 12 into the new controller:
 - a. Slide the battery into the controller until the battery connector pins are firmly seated in the controller battery connector.
 - b. Turn the captive fastener clockwise to secure the battery in place.
15. Install the cover (see “Removing and installing a cover” on page 94).

Attention: Remove the temporary filler before you install the replacement controller.
16. Install the new controller.
 - a. Make sure that the release levers on the controller are in the open position.
 - b. Slide the controller into the bay until it stops.
 - c. Push the release levers to the closed position.
17. Connect the cables that you disconnected in step 8 on page 97.
18. **(Single-controller only)** Turn on the storage subsystem (see “Turning on the storage subsystem” on page 68).
19. Wait up to 5 minutes for the DS Storage Manager software to recognize the new controller.
20. Complete any remaining Recovery Guru procedures for controller replacement.
21. Check the LEDs on the new controller to make sure that the controller is fully operational.
22. Use the Subsystem Management window to check the status of all components in the storage subsystem.
 - If the new controller is online and the Subsystem Management window indicates normal operation, go to step 25.
 - If the new controller is online and the Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 72.
 - If the new controller is offline, continue with step 23.
23. If the newly inserted controller is in an offline state, see the DS Storage Manager online help for instructions on bringing the controller online. If necessary, open the Subsystem Management window and place the controller online; select the offline controller and click **Advanced** → **Recovery** → **Place controller online**.
24. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 75. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
 - **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.
 - **No:** Go to step 25.
25. Use the DS Storage Manager software to print a new storage subsystem profile.

Removing and disposing of the system-board lithium battery

When you disassemble the storage subsystem for disposal, use the information in this section to locate, remove, and dispose of the lithium batteries that are on the system boards in controller A and controller B.

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**

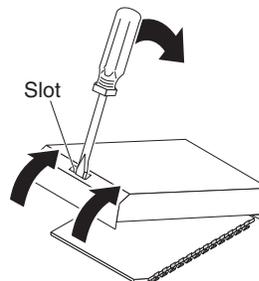
Dispose of the battery as required by local ordinances or regulations.

To remove the batteries for disposal, complete the following steps:

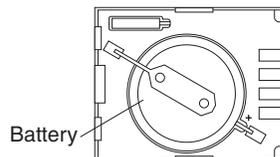
1. Locate the battery compartment on the system board in the RAID controller.

Notes:

- a. The battery compartment is located near the edge of the controller system board next to the mounting posts for the optional host daughter cards.
 - b. If a host daughter card is installed on the controller, you must remove the card to gain access to the battery compartment.
2. Insert the flat blade of a small screwdriver into the slot on the battery-compartment cover.



3. Move the screwdriver as shown in the illustration until the cover is released from the battery-compartment base.
4. Lift the contact tab; then, slide the battery out of the battery compartment.



5. Repeat Steps 1 through 4 to locate and remove the lithium battery in Controller B; then, continue with Step 6.
6. Dispose of the batteries as required by local ordinances or regulations.

The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, see <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used batteries. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333.

Installing an optional host port adapter

Attention: If you install a host port adapter in a controller and the storage subsystem contains two controllers, you must make sure that an identical host port adapter is installed in the other controller.

To install a host port adapter, complete the following steps.

Attention: To prevent data loss, you must shut down the storage subsystem before you remove the controller from the chassis. For the correct shutdown sequence, see “Turning off the storage subsystem” on page 81.

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Turn off the storage subsystem (see “Turning off the storage subsystem” on page 81).
3. Disconnect the cables that are connected to the controller.
4. Remove the controller from the chassis.

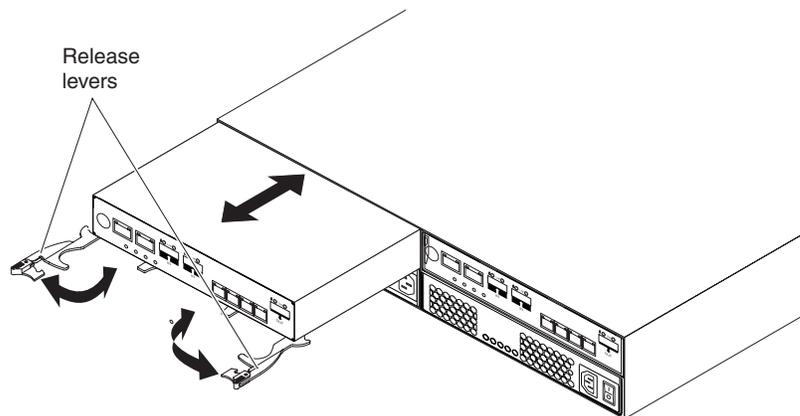


Figure 81. Removing a controller

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
- b. Pull the controller out of the bay.
- c. Place the controller on a level surface.
5. Remove the cover (see “Removing and installing a cover” on page 94).
6. Remove the two screws from the cover plate. Rotate the cover plate to release the alignment tab and remove the cover plate from the controller.

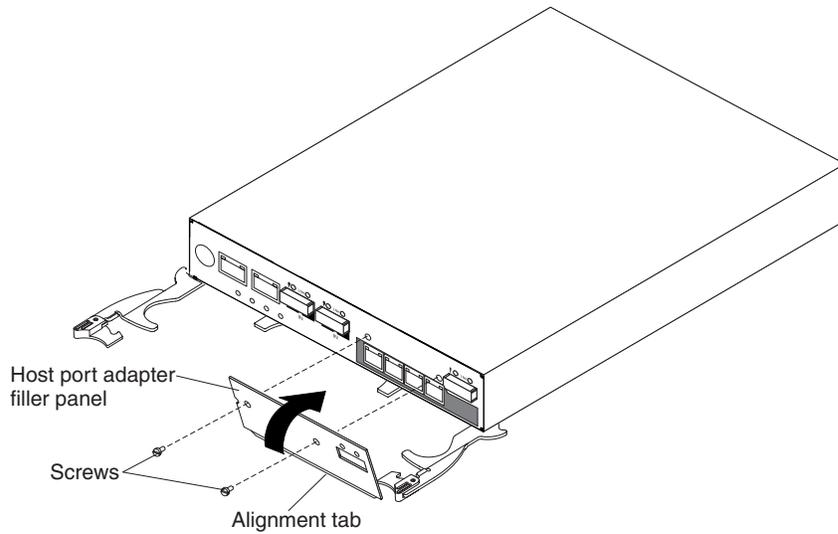


Figure 82. Removing the host port adapter filler panel

7. Touch the static-protective package that contains the host port adapter to any unpainted metal surface on the storage subsystem; then, remove the adapter from the package.
8. Align the host port adapter as shown in the following illustration.

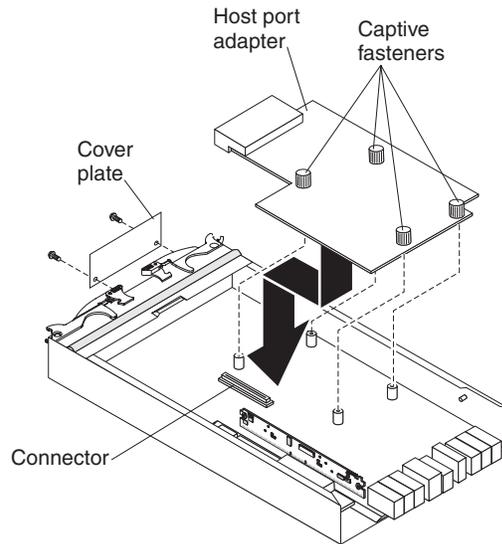


Figure 83. Installing a host port adapter

9. Press the card in the connector and tighten the four captive fasteners.
10. Use the alignment tab to align the cover plate that comes with the optional host port adapter.
11. Secure the cover plate with two screws.
12. Install the cover (see “Removing and installing a cover” on page 94).
13. Insert the controller into the chassis.
 - a. Make sure that the release levers on the controller are in the open position.
 - b. Slide the controller into the bay until it stops.
 - c. Push the release levers to the closed position.

14. Reconnect the cables that you disconnected in step 3 on page 101.
15. Turn on the storage subsystem (see “Turning on the storage subsystem” on page 68).
16. Wait up to 5 minutes for the DS Storage Manager software to recognize the controller.
17. Check the LEDs on the controller to make sure that the controller is fully operational.
18. Use the Subsystem Management window to check the status of all components in the storage subsystem.
 - If the controller is online and the Subsystem Management window indicates normal operation, go to step 21.
 - If the controller is online and the Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 72.
 - If the controller is offline, continue with step 19.
19. If the newly inserted controller is in an offline state, see the DS Storage Manager online help for instructions on bringing the controller online. If necessary, open the Subsystem Management window and place the controller online; select the offline controller and click **Advanced** → **Recovery** → **Place controller online**.
20. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 75. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
 - **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.
 - **No:** Go to step 21.
21. Use the DS Storage Manager software to print a new storage subsystem profile.

Working with hot-swap hard disk drives

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

Before you begin, complete the following tasks:

- Read the safety information that begins on page xiii and “Handling static-sensitive devices” on page 19.
- Make sure that the current system configuration is working correctly.
- Back up all important data before you make changes to data storage devices.

Before you install or remove drives, review the following information:

- **Filler panels:** A storage subsystem contains filler panels in the unused drive bays. Before you install new drives, you must remove these filler panels. Save the filler panels for future use. For proper cooling and EMC protection, each bay must always contain either a filler panel or a hot-swap hard disk drive.
- **Drives:**
 - The DS3500 supports the following hard disk drives:

- Up to 12 LFF 3.5-inch 6 Gbps SAS or NL SAS hard disk drives (DS3512 and EXP3512)
- Up to 24 SFF 2.5-inch 6 Gbps SAS or NL SAS hard disk drives (DS3524 and EXP3524)
- For optimum performance, never insert a drive into the storage subsystem without first confirming the drive firmware level. Contact your IBM technical-support representative for information about supported drive firmware levels.
- Use of unsupported drives can cause the storage subsystem to fail.
- After you remove a drive, wait 70 seconds before you replace or reseat the drive to allow the drive to spin down. Failure to do so might cause unpredictable results.
- **Drive labels:** A label is provided on the front of each hard disk drive. Use this label to record the location information for each drive before you remove it. Be sure to keep a record of the drives and their corresponding bays. Also, record the location information in Table 15 on page 142. If you install a drive in the wrong bay, you might lose data.
- **Drive LEDs:** Each drive tray has two associated LEDs, a green activity LED and an amber status LED. These LEDs indicate the status for that drive.
The hard disk drive LEDs on the DS3512 storage subsystem and EXP3512 expansion enclosure are shown in Figure 84. The hard disk drive LEDs on the DS3524 storage subsystem and EXP3524 expansion enclosure are shown in Figure 85.

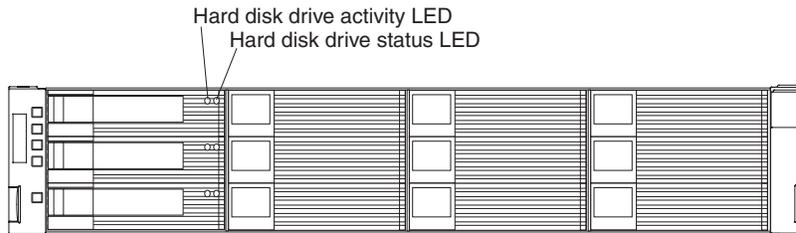


Figure 84. DS3512 storage subsystem and EXP3512 expansion enclosure hard disk drive LEDs

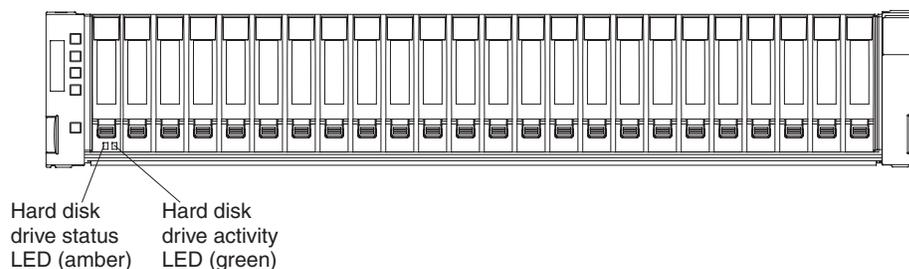


Figure 85. DS3524 storage subsystem and EXP3524 expansion enclosure hard disk drive LEDs

Hard disk drive activity LED (green)

When this LED flashes, it indicates that there is activity to the drive.

Hard disk drive status LED (amber)

When this LED flashes, it indicates that the drive has been identified by the software. When this LED is lit and not flashing, it indicates that the drive has failed.

- **Hot-swap hardware:** The storage subsystem contains hardware that enables you to replace a failed hard disk drive without turning off the storage subsystem. You can continue to operate the storage subsystem while a hard disk drive is being removed or installed. These drives are known as hot-swap hard disk drives.

Removing a hard disk drive

To remove a hot-swap hard disk drive, complete the following steps.

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

1. Use Table 15 on page 142 to record the location and identify the hard disk drives. Record this information so that you can replace the hard disk drives in the same bays from which you removed them.
2. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.

Attention: Never remove a hard disk drive when its green activity LED is flashing. Remove a drive only when its amber status LED is lit (not flashing), when the drive is inactive (activity LED is off), or when the storage subsystem is turned off.

3. (DS3512 and EXP3512) Remove the hard disk drive.

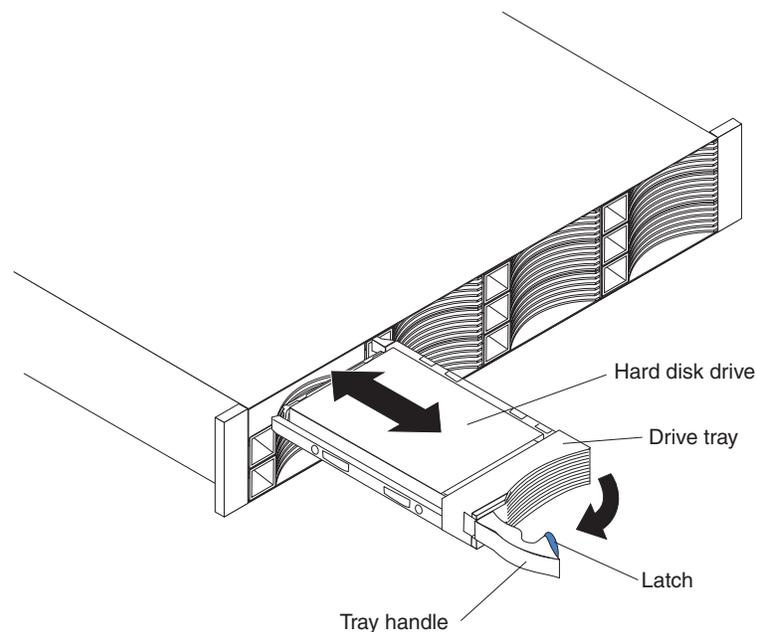


Figure 86. Removing a drive from a DS3512 or EXP3512

- a. Press the latch on the end of the tray handle to release it, then pull out the tray handle to the open position.
 - b. Pull the drive approximately 12 mm (0.5 in.) out of the bay and wait 70 seconds to allow the drive to spin down and the storage subsystem controller to recognize that a drive is removed from the configuration.
4. (DS3524 and EXP3524) Remove the hard disk drive.

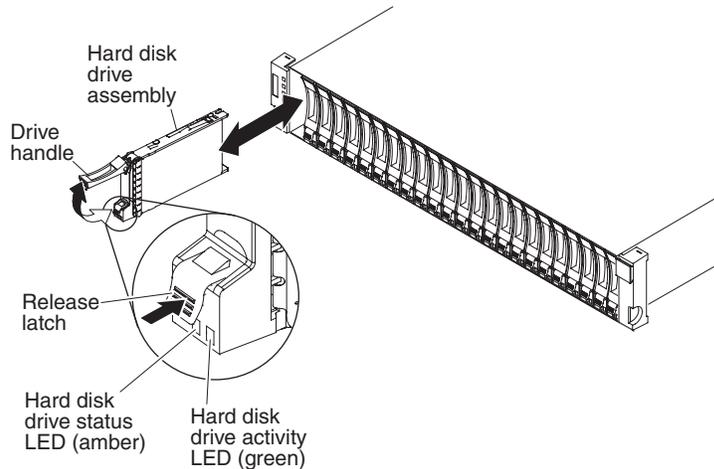


Figure 87. Removing a drive from a DS3524 or EXP3524

- a. Push up the latch on the handle, then open the drive handle and pull the hard disk drive assembly out of the server.
- b. Pull the drive approximately 12 mm (0.5 in.) out of the bay and wait 70 seconds to allow the drive to spin down and the storage subsystem controller to recognize that a drive is removed from the configuration.
5. Make sure that there is proper identification (such as a label) on the hard disk drive; then, slide the drive completely out of the bay. If the drive has failed, indicate that on the label.
6. Place the drive horizontally on a level surface.

Attention: Handle hard disk drives gently and do not stack them. Follow all precautions for static-sensitive devices.

Installing a hard disk drive

Except during the storage subsystem initial power-on, you can add hard disk drives while the storage subsystem is turned on and running. To install hot-swap hard disk drives in the storage subsystem, complete the following steps.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseal the drive. Failure to do so might cause unpredictable results.

Note: The hard disk drive comes with a tray already attached. Do not attempt to detach the drive from the tray.

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Read the documentation that comes with the hard disk drive.
3. Remove the filler panel from the bay in which you will install the drive. Save the filler panel for later use.
4. Unpack the new drive. Save all packing material in case you have to return the drive.
5. (DS3512 and EXP3512) Install the hard disk drive.

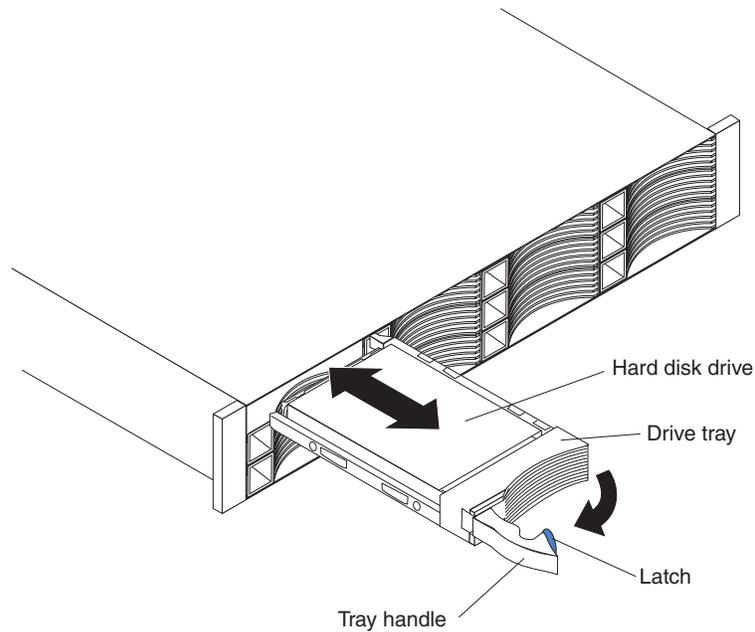


Figure 88. Installing a drive in a DS3512 or EXP3512

- a. Press the latch on the end of the drive tray handle to release it, then pull out the tray handle to the open position.
 - b. Slide the drive all the way into the empty bay until the drive stops.
 - c. Push the tray handle into the closed (latched) position.
6. (DS3524 and EXP3524) Install the hard disk drive.

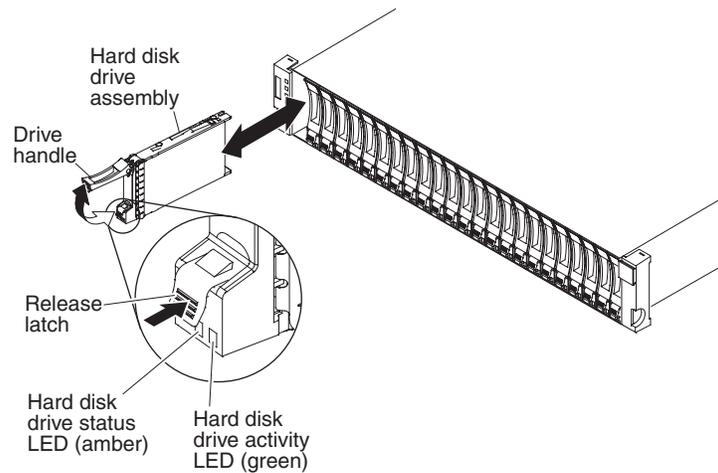


Figure 89. Installing a drive in a DS3524 or EXP3524

- a. Push up the latch on the handle to release it then, pull out the tray handle to the open position.
 - b. Slide the drive all the way into the empty bay until the drive stops.
 - c. Push the tray handle into the closed (latched) position.
7. If you are installing additional drives, wait at least 30 seconds before you install each drive.

Replacing a hot-swap hard disk drive

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

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

Attention: Failure to replace a hard disk drive in its correct bay might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, be sure to install the replacement hard disk drive in the correct bay. See the hardware and software documentation that comes with the DS3500 to determine whether there are restrictions regarding hard disk drive configurations.

To replace a hot-swap hard disk drive, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Use the Storage Manager software to print a new storage system profile.
3. Determine the location of the drive that you want to remove.
Attention: Never hot-swap a drive when its associated green activity LED is flashing. Hot-swap a drive only when its associated amber status LED is lit and not flashing.
4. Remove the drive (see “Removing a hard disk drive” on page 105).
5. Unpack the new drive. Save all packing material in case you have to return the drive.

Note: Use Table 15 on page 142 to make sure that you replace the hard disk drive into the correct bay.

6. Install the new drive (see “Installing a hard disk drive” on page 106).
7. Check the drive LEDs:
 - When a drive is ready for use, the green activity LED is lit and the amber status LED is off.
 - If the amber status LED is lit and is not flashing, remove the drive from the unit and wait 70 seconds; then, install the drive again.
8. Make sure that the drive is shown in the Subsystem Management window.

Note: If you are replacing more than one hard disk drive, replace only one drive at a time.

Replacing multiple drives

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

Notes:

1. Instructions that are provided with the software supersede any instructions and information in this document.

2. Use Table 15 on page 142 to make sure that you replace the hard disk drives into the correct bays.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseal the drive. Failure to do so might cause unpredictable results.

There are two methods for upgrading drives:

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

This method requires that you back up the data on the affected drives and then turn off the DS3500 storage subsystem.

Attention: Turn off the DS3500 storage subsystem before you turn off the attached expansion enclosures.

After you replace all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in “Replacing all drives at the same time” on page 110.

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

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

In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before you install the next drive. After you install the new drives, you can configure them to make the additional drive space available. See the procedure in “Replacing the drives one at a time” on page 112.

Using this method, you can replace the drives while the expansion enclosures and the DS3500 are running, eliminating the downtime that is required if you replace all the drives at once. However, this method is more risky because you can lose data if the drive restoration or storage subsystem reconfiguration process fails. In addition, the reconstruction process might take a long time. This method works only on redundant logical drives (RAID 1, 3, 5, or 6). You cannot use this method with any drives that contains 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 that 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 storage-management software documentation.
- Which RAID level is used on the affected drives (RAID 0 requires you to replace all the drives at the same time).
- How much downtime is acceptable as you swap the drives.
- The number of drives in an array. Replacing drives one at a time is better suited to arrays that consist of three to five drives. If you have more than 10 drives, consider replacing all drives at the same time.
- How much risk of losing data is acceptable. Because the array is in a degraded state during the RAID array reconstruction and copyback process as result of replacing a drive in the array, any new drive failure will cause the array to fail

(causing a loss of data availability and even a loss of data). The duration of the reconstruction and copyback process can be quite long, depending on the size of the RAID array.

- How extensively the data will be changed while the array is in a degraded state during the RAID array reconstruction and copyback process as a result of replacing a drive in the array. The more extensive the data changes are, the more work that will have to be performed to restore the data in the event that the array fails because an additional drive fails while the array is in a degraded state.

Replacing all drives at the same time

Use this procedure to replace all drives at the same time. You must use this method if you are upgrading drives that contain RAID 0 logical drives. All the data that is currently on the drives is lost when you replace the drives; therefore, you must back up all data that is currently on the drives. This procedure also requires you to turn off the expansion enclosures and the DS3500, which makes the storage subsystem (and any attached expansion enclosures) inaccessible to other users.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseal the drive. Failure to do so might cause unpredictable results.

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

1. Read the following information:
 - The information in “Replacing multiple drives” on page 108, particularly the paragraphs that explain the differences between the two possible upgrade procedures
 - The information in the software documentation about drive upgrades and installation
 - The documentation that comes with the new drives

Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information about the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine whether you must modify this procedure.
2. Use the DS Storage Manager software to check the status of the DS3500. Correct any problems that are reported.
3. Perform a complete backup of the drives that you are replacing.
You need the backup to restore data on the drives later in this procedure.
Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 19.
4. Unpack the new drives.
Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you have to return the drives.
5. Complete the following steps:
 - a. Stop all I/O activity to the storage subsystem and attached expansion enclosures.
 - b. Make sure that all of the green drive activity LEDs on the front of the storage subsystem (and on all attached expansion enclosures) are not flashing.
 - c. Make sure that the green cache active LEDs are off. See “Controller LEDs” on page 75 for the location of the cache active LEDs.

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

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

6. Turn off the power to each device according to 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 a 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 expansion enclosures. Turn off both power-supply switches on the rear of the storage subsystem.
 - c. Turn off power to other supporting devices (for example, management stations or Ethernet switches).
7. Use the procedures in “Replacing a hot-swap hard disk drive” on page 108 to remove the drives that you want to replace. Use the procedures in “Installing a hard disk drive” on page 106 to install the new drives in the storage subsystem.
8. After you install all the new drives, check the system documentation for the hardware devices that you intend to power-on, and then determine the correct 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 on power to the storage subsystem.
 - b. Turn on the expansion enclosures before the storage subsystem. The controllers might not recognize the correct configuration if the drives are powered-on after the storage subsystem. For instructions for powering-on 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, according to the power-on sequence in step 8. To turn on power to the storage subsystem and the expansion enclosures, turn on the power-supply switches on the rear of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.
10. Check the green drive activity LEDs and the amber drive fault LEDs above the new drives.

Make sure that the drive activity LEDs are lit and the drive fault LEDs are off.

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

- If a drive activity LED is off, the drive might not be installed correctly. Remove the drive, wait 70 seconds, and then reinstall it.
 - If the drive fault LED stays lit or the drive activity LED stays off, the new drive might be faulty. See the Storage Manager software for problem determination.
11. Use the DS Storage Manager software to configure the new drives. See the DS Storage Manager software online help for detailed instructions.

12. Restore the data from backup to all the drives.

Replacing the drives one at a time

Use this procedure to replace all the drives one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in “Replacing all drives at the same time” on page 110).

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

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseal the drive. Failure to do so might cause unpredictable results.

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

1. Read the following information:
 - “Replacing multiple drives” on page 108, particularly the paragraphs that explain the differences between the two possible upgrade procedures
 - Your software documentation about drive upgrades and installation
 - The documentation that comes with the new drivesRead all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information about the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine whether you must modify this procedure.
2. Use the DS Storage Manager software to check the status of the unit. Correct any problems that are reported.
3. Back up the data in the arrays and logical drives that are configured, using the drives that you are replacing.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 19.

4. Unpack the new drives.

Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you have to return the drives.
5. Use the DS Storage Manager software to make sure that the array that was defined using these drives is in Optimal (not Degraded) state before you manually fail the first drive that you want to replace. If the array is in a Degraded state, use the recovery procedures to bring the array into the optimal state.

Make sure that:

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

Attention: Removing the wrong drive can cause data loss. Make sure that you remove only the failed drive. A lit drive fault LED indicates the failed drive.

If you remove an active drive accidentally, wait at least 70 seconds and then reinstall it. Because you have failed two drives in a RAID array, the array might be marked as failed by the controller. This array will not be available to the host for I/O. See the DS Storage Manager software for further recovery instructions. Do not attempt to replace any drives until the array is brought back to Optimal state.

6. Use the procedures in “Replacing a hot-swap hard disk drive” on page 108 to remove the failed drive. Use the procedures in “Installing a hard disk drive” on page 106 to install the new drives in the storage subsystem.

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

During data reconstruction, the amber drive fault LED might be lit for a few minutes and 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 the storage subsystem has active hot spares, data might not start copying to the new drive until the data is reconstructed on the hot spare. This increases the time that is required to complete the procedure.

7. Check the green drive activity LED and the amber drive fault LED on each of the new drives.

Make sure that the drive activity LEDs are lit and the drive fault LEDs are off.

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

- If the drive activity LED is off, the drive might not be installed correctly. Remove the drive, wait 70 seconds, and then reinstall it.
- If the drive fault LED stays lit or the drive activity LED stays off, the new drive might be faulty or might be an uncertified drive. Use the DS Storage Manager software for problem determination. In the case of an uncertified drive, make sure that the drive options or drive FRU part number is correct for the storage subsystem.

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

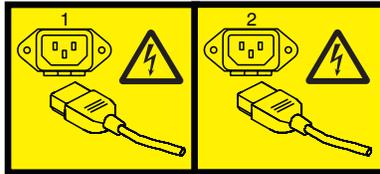
Note: The drive activity LED continues to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine whether the data reconstruction is finished.

9. When reconstruction is finished on the new drive, repeat step 5 on page 112 through step 8 for each additional drive that you want to install.
10. Use the DS Storage Manager software to configure the additional space on the new drives.

Replacing a power supply



(L003)



or



The power supplies are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported power supplies for the storage subsystem.

Each power supply 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 (does not automatically restart), make sure that the environment is optimal (no overheating has occurred, all electrical receptacles are working, and so on). For more information, see “Restoring power after an unexpected shutdown” on page 83.

If both power supplies fail or if the power supplies cannot maintain an internal temperature below 65°C (149°F), the power supplies will automatically shut down (an overtemperature condition). If this occurs, you must cool the storage subsystem and restart it. See “Restoring power after an unexpected shutdown” on page 83.

Attention: The fans in the power supplies draw in fresh air and force out hot air. The power supplies are hot-swappable and redundant; however, if the fans in one power supply fail, you must replace the entire failed power supply within 72 hours to maintain redundancy and optimum cooling. Do not remove the failed power supply until you have the replacement power supply. When you do remove the failed power supply, be sure to install the second power supply 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.

To replace a power supply, complete the following steps.

Attention: To prevent damage to the storage subsystem components from overheating, replace a failed power supply within 10 minutes of removal. If replacing it will take longer than 10 minutes, stop all I/O activity to the storage subsystem and turn off the power until you complete the replacement.



(L001)



1. If necessary, use the DS Storage Manager software to print a storage system profile.
2. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
3. Did the Recovery Guru direct you to replace a failed power supply?
 - **Yes:** Go to step 4.
 - **No:** Run the Recovery Guru to identify the failed component, and then go to step 4.
4. Unpack the new power supply. Save all packing material in case you have to return the failed power supply.

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

5. Using the information on the instruction sheet, place the labels on the power supply 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. If a fault is detected, the amber fault LED is lit.
8. Make sure that the OK to remove LED is lit. Do not remove the power supply if the LED is off. For more information about the OK to remove LED, see “OK to remove LED” on page 93.



DANGER

When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- Connect power to this unit only with the provided power cord. Do not use the provided power cord for any other product.
- Do not open or service any power supply assembly.
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- 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 procedures when installing, moving, or opening covers on this product or attached devices.

To disconnect:

- a. Turn off everything (unless instructed otherwise).
- b. Remove the power cords from the outlets.
- c. Remove the signal cables from the connectors.
- d. Remove all cables from the devices.

To connect:

- a. Turn off everything (unless instructed otherwise).
- b. Attach all cables to the devices.
- c. Attach the signal cables to the connectors.
- d. Attach the power cords to the outlets.
- e. Turn on the devices.

(D005a)

9. Turn off the power switch and disconnect the power cord from the failed power supply.
10. Remove the power supply from the bay:

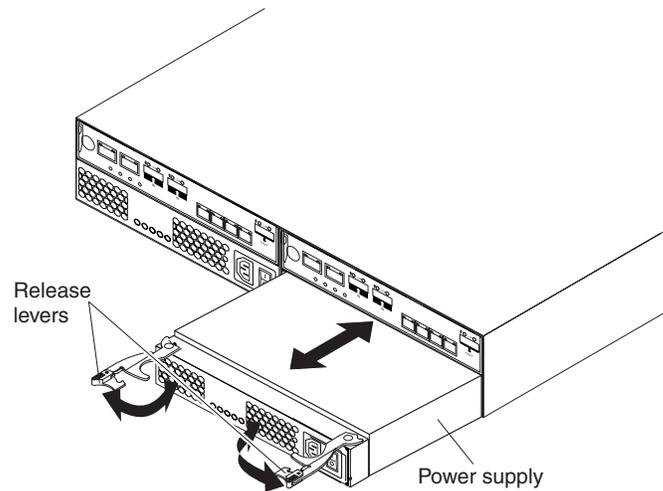


Figure 90. Replacing a power supply

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
- b. Slide the power supply out of the bay and set it aside.
11. Place the replacement power supply on a level surface.
12. Make sure that the release levers on the power supply are in the open position.
13. Slide the power supply into the bay until it stops.
14. Push the release levers to the closed position.
15. Connect the power cord and turn on the power.
16. Check the power and fault LEDs on the new unit.
17. According to the status of the power and fault LEDs, use one of the following procedures:
 - **The fault LED is lit and the ac and dc power LEDs are off:** The new unit might be installed incorrectly. The power-supply switch might not be turned on. The power cord connector might not be fully inserted into the power receptacle or the power-supply ac socket. There might not be any power to the receptacle that the power supply is connected to. The power cord might be faulty. Go to step 18.
 - **The fault and ac power LEDs are lit but the dc power LED is off:** The power supply is faulty. Turn off the power switch and contact your IBM technical-support representative for a replacement power supply.
 - **The ac and dc power LEDs are lit but the fault LED is off:** Go to step 19 on page 118.
18. Perform the following task or tasks to solve the problem:
 - Make sure that the power switch is turned to the on position.
 - Make sure that there is power at the ac outlet and no circuit breaker has tripped.
 - Make sure that the power cord is working and fully seated into the electrical receptacle and the power supply ac connector.

- Reinstall the power supply.
If these tasks do not solve the problem, contact your IBM technical-support representative.
19. Complete any remaining Recovery Guru procedures, if needed.
 20. Check the status of each component in the storage subsystem.
 21. Are any amber LEDs lit on any of the components?
 - **Yes** : Click **Recovery Guru** in the Subsystem Management window toolbar and complete the recovery procedure. If a problem is still indicated, contact your IBM technical-support representative.
 - **No**: Go to step 22.
 22. Create, save, and print a new storage subsystem profile.

Replacing a battery

The RAID controller in the storage subsystem contains a rechargeable battery backup unit that provides power to back up the cache memory onto flash drives in the event of a power failure. Each battery unit contains a sealed, rechargeable SMART lithium ion battery. The cache battery is the only replaceable battery in the storage subsystem.

Use the following procedure if the DS Storage Manager software instructs you to replace the battery because the current battery has failed. You can also use the DS Storage Manager software to check the status of the battery. Because write-caching is disabled when the battery fails, replace the failed battery as soon as possible to minimize any performance impact due to the disabling of the write-caching function.

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 19.

To replace a battery unit, complete the following steps.

1. Use the DS Storage Manager software to print a storage subsystem profile.
2. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
3. Locate the RAID controller that contains the failed battery unit (see “Controller LEDs” on page 75).

Attention: Before you remove a controller in a single-controller DS3500, shut down the DS3500 to avoid data loss (see “Turning off the storage subsystem” on page 81).

4. Remove the controller from the chassis.

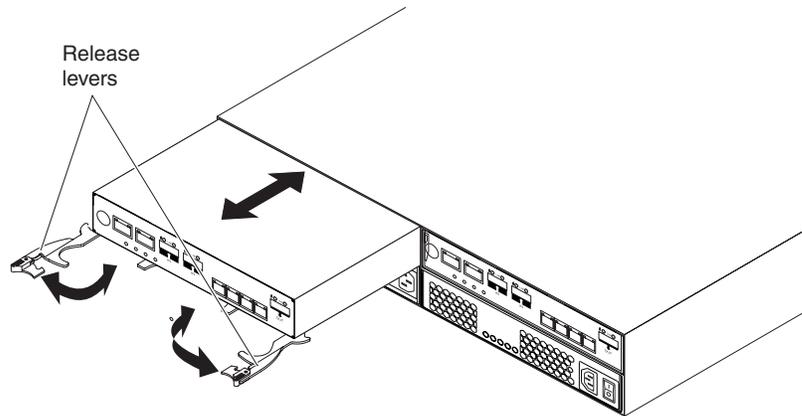


Figure 91. Removing a controller

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
 - b. Pull the controller out of the bay.
 - c. Place the controller on a level surface.
5. Remove the cover (see “Removing and installing a cover” on page 94).
 6. Place the controller on a flat surface.
 7. Remove the failed battery unit from the controller.

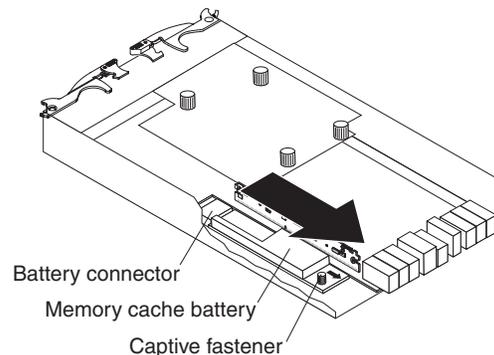


Figure 92. Removing a battery unit from the controller

- a. Loosen the blue captive fastener until the battery can move in the direction that is indicated by the arrow.
 - b. Slide the battery unit out of the controller in the direction that is indicated by the arrow.
 - c. Dispose of the battery as required by local ordinances or regulations. For more information, see the *IBM Systems Environmental Notices and User's Guide* on the IBM Support DVD.
8. Unpack the new battery unit. Set the new battery unit on a dry, level surface. Save all packing materials in case you have to return the new battery unit.
 9. Insert the new battery unit into the controller chassis:
 - a. Slide the battery pack into the controller until the battery-pack connector pins are firmly seated in the controller battery connector.
 - b. Tighten the captive fastener to secure the battery pack in place.
 10. Install the cover (see “Removing and installing a cover” on page 94).

11. Insert the controller into the chassis.
 - a. Make sure that the release levers on the controller are in the open position.
 - b. Slide the controller into the bay until it stops.
 - c. Push the release levers to the closed position.

After you replace a controller cache battery, reset the battery age timer. For information about resetting the batter age timer, see the DS Storage Manager software online help.

Replacing the memory cache DIMM

Attention: To avoid damage to the DIMM, you must first remove the memory cache battery and wait the required time period before you install or remove the DIMM. Follow the instructions in this procedure exactly.

Use these procedures if you are replacing a failed DIMM or if you are removing and installing the DIMM as directed in “Replacing a controller” on page 96.

The following illustration shows the location of the memory cache DIMM.

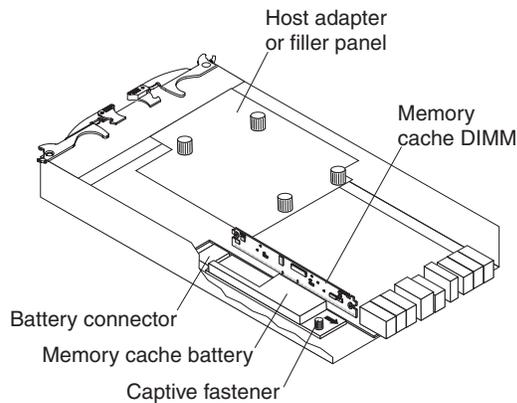


Figure 93. Memory cache DIMM location

Removing the DIMM

To remove the DIMM from the controller, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Remove the controller from the chassis.

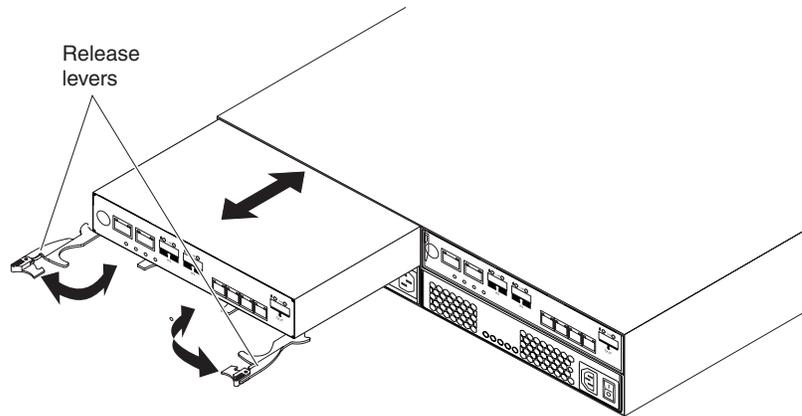


Figure 94. Removing a controller

- a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
 - b. Pull the controller out of the bay.
 - c. Place the controller on a level surface.
3. Remove the cover (see “Removing and installing a cover” on page 94).
 4. Remove the DIMM from the connector.

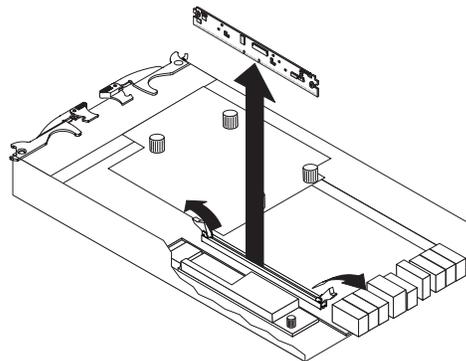


Figure 95. Removing the DIMM from the controller

- a. Open the retaining clip on each end of the DIMM connector.
 - b. Lift the DIMM out of the connector.
5. If the DIMM is functional, place the DIMM in a static-protective package until you are ready to install it.

Installing the DIMM

Complete the following steps to install the DIMM in the controller:

1. Open the retaining clip on each end of the DIMM connector.
2. Touch the static-protective package that contains the DIMM to any unpainted metal surface on the storage subsystem. Then, remove the DIMM from the package.

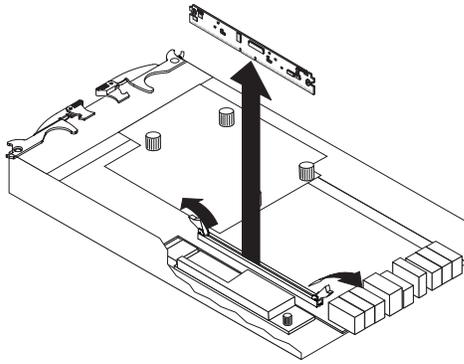


Figure 96. Installing the DIMM in the controller

3. Turn the DIMM so that the DIMM keys align correctly with the slot.
4. Match the angle of the DIMM with the angle of the connector.
5. Firmly press the DIMM into the connector. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector. If there is a gap between the DIMM and the retaining clips, the DIMM has not been correctly inserted; open the retaining clips, remove the DIMM, and then reinsert it.
6. Install the cover (see “Removing and installing a cover” on page 94).
7. Insert the controller into the chassis.
 - a. Make sure that the release levers on the controller are in the open position.
 - b. Slide the controller into the bay until it stops.
 - c. Push the release levers to the closed position.

Attention: After you remove a controller, wait 70 seconds before you reseat or replace the controller. Failure to do so might cause unpredictable results.

Replacing the bezels

This section describes how to remove and install the bezels.

Removing the bezels

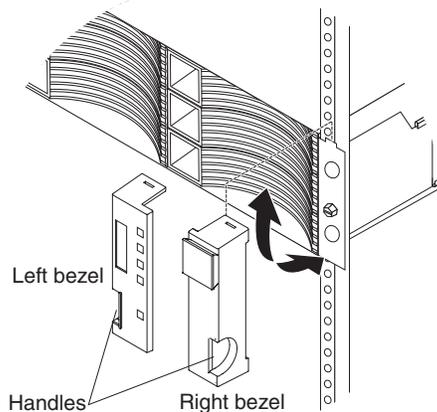


Figure 97. Removing the bezels

To remove either the left or right bezel, complete the following steps:

1. If the storage subsystem is on a table or other flat surface, elevate the storage subsystem front slightly or extend the front over the table edge.
2. Grasp the handle on the front of the bezel and pull until the bezel is clear of the bottom tab on the chassis flange.
3. Lift the bezel off the chassis flange.

Installing the bezels

To install either the left or right bezel, complete the following steps:

1. Fit the cutout that is on the top of the bezel over the tab on the chassis flange.
2. Rotate the bezel down until it snaps into place. Make sure that the inside surface of the bezel is flush with the chassis.

Working with environmental service modules

This section describes how to add or replace an ESM.

Installing an additional ESM

The expansion enclosure comes with one environmental services module (ESM). If your RAID controller supports redundant drive paths (see the documentation that comes with the RAID controller or the device that contains the RAID controller), you can install a second ESM.

To install a second ESM, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. Remove the ESM filler panel from the rightmost ESM bay:
 - a. Open the two release levers. The ESM filler panel moves out of the bay approximately 0.6 cm (0.25 inch).
 - b. Slide the ESM filler panel out of the bay and set it aside.
3. Place the ESM on a level surface.
4. Make sure that the release levers on the ESM are in the open position.

5. Slide the ESM into the bay until it stops.
6. Push the release levers to the closed position.
7. Connect the SAS cable or cables to the ESM. See Chapter 3, “Cabling the storage subsystem and expansion enclosure,” on page 23 for more information.

Replacing an ESM

If you are replacing the only ESM in the EXP3500 expansion enclosure, you must turn off power to the expansion enclosure before you replace the ESM. See “Turning off the expansion enclosure” on page 89 or see the documentation that comes with your RAID controller for additional information and instructions.

To replace an ESM, complete the following steps:

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. If the EXP3500 expansion enclosure contains only one ESM, turn off the power to the expansion enclosure. See “Turning off the expansion enclosure” on page 89 or see the documentation that comes with your RAID controller for additional information and instructions.
3. Disconnect the cable from the ESM.
4. Open the two release levers. The ESM moves out of the bay approximately 0.6 cm (0.25 inch).

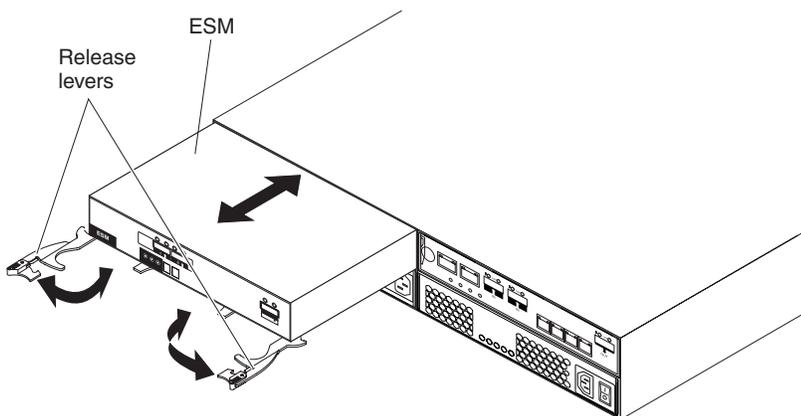


Figure 98. Removing an environmental service module

5. Slide the ESM out of the bay and set it aside.
6. Make sure that the release levers on the ESM are in the open position.
7. Slide the ESM into the bay until it stops.
8. Push the release levers to the closed position.
9. Connect the cable to the ESM.
10. Turn on the power. For more information, see “Turning on the expansion enclosure” on page 88.
11. Go to <http://www.ibm.com/servers/storage/support/> to check for ESM code updates. For more information, see the download instructions on page 1.

Replacing a midplane assembly

The midplane assembly must be replaced only by a trained service provider.

To replace the midplane assembly, complete the following steps.

Attention: To prevent data loss, you must shut down the storage subsystem or expansion enclosure before you begin the procedure to replace the midplane assembly.

1. Read the safety information that begins on page xiii and “Best practices guidelines” on page 5.
2. (DS3512 and DS3524) Turn off the storage subsystem (see “Turning off the storage subsystem” on page 81).
3. (EXP3512 and EXP3524) Turn off the expansion enclosure (see “Turning off the expansion enclosure” on page 89).
4. Remove the hard disk drives (see “Removing a hard disk drive” on page 105).
5. Remove the power supplies (see “Replacing a power supply” on page 114).
6. (DS3512 and DS3524) Remove the controllers (see “Removing a controller” on page 93).
7. (EXP3512 and EXP3524) Remove the ESMs (see “Replacing an ESM” on page 124).
8. (DS3512 AND EXP3512) Replace the midplane assembly.

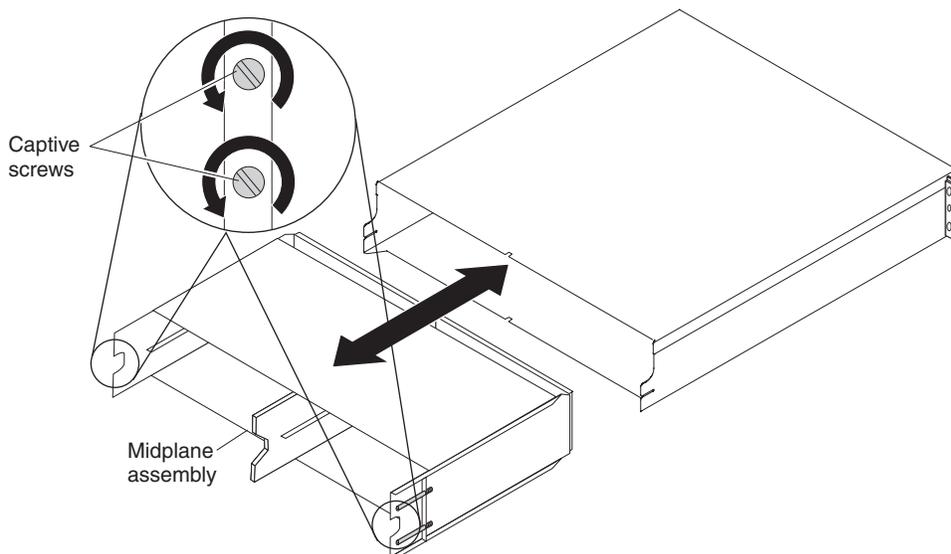


Figure 99. Replacing the midplane assembly in a DS3512 or EXP3512

- a. Loosen the four captive screws at the rear of the chassis.
 - b. Remove the failed midplane from the chassis and insert the replacement midplane.
 - c. Tighten the four captive screws.
9. (DS3524 AND EXP3524) Replace the midplane assembly.

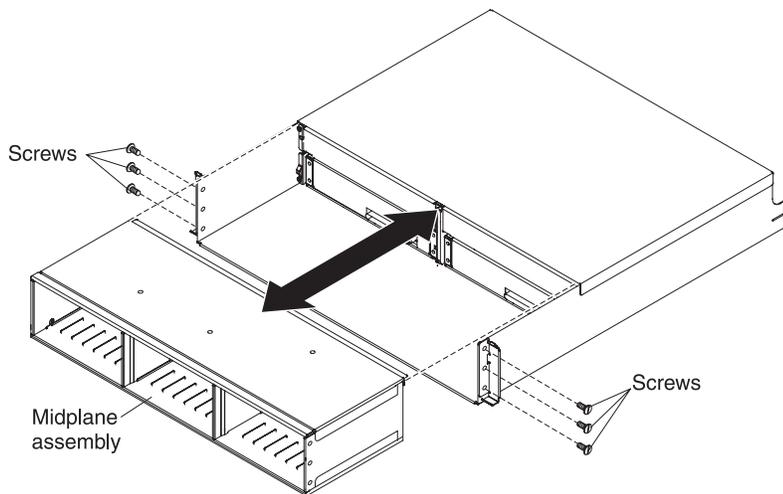


Figure 100. Replacing the midplane assembly in a DS3524 or EXP3524

- a. Remove the six screws from the sides of the chassis.
 - b. Remove the failed midplane from the chassis and insert the replacement midplane.
 - c. Secure with the six screws.
10. (EXP3512 and EXP3524) Reinstall the ESMs (see “Replacing an ESM” on page 124).
 11. (DS3512 and DS3524) Reinstall the controllers (see “Installing a controller” on page 95).
 12. Reinstall the power supplies (see “Replacing a power supply” on page 114).
 13. Reinstall the hard disk drives (see “Installing a hard disk drive” on page 106).
 14. (DS3512 and DS3524) Turn on the storage subsystem (see “Turning on the storage subsystem” on page 68).
 15. (EXP3512 and EXP3524) Turn on the expansion enclosure (see “Turning on the expansion enclosure” on page 88).
 16. Check the LEDs to make sure that the storage subsystem or expansion enclosure is fully operational (see “Checking the LEDs” on page 73).

Chapter 6. Solving problems

This section contains information to help you solve some of the problems that you might have with the storage subsystem or expansion enclosure. It describes the problem indicators, error messages, and suggested actions.

Solving problems in the DS3500 storage subsystem

For instructions for obtaining service and technical assistance for the storage subsystem and other IBM products, see Appendix B, “Getting help and technical assistance,” on page 145.

Use the LEDs, the diagnostics and test information, the symptom-to-FRU index, and the connected server *Hardware Maintenance Manual* or *Problem Determination and Service Guide* to diagnose problems.

Use Table 9 on page 128 and the DS Storage Manager Recovery Guru to diagnose storage subsystem problems and component failures and find solutions to problems that have definite symptoms. Do not depend solely on Table 9 on page 128 for a replacement decision.

Table 9. Troubleshooting

| Problem indicator | Component | Possible cause | Possible solutions |
|--------------------------------|---|--|---|
| Amber LED is lit | Drive (drive fault LED) | Drive failure | Replace the failed drive. See Chapter 5, "Replacing components," on page 93 for more information. |
| | | Drive uncertified | Verify the drive and part number to make sure that it is supported by the DS3500. See http://www.ibm.com/systems/storage/disk/ . |
| | RAID controller (service action required LED) | RAID controller failure | Replace the RAID controller. See Chapter 5, "Replacing components," on page 93 for more information. |
| | | The controller was placed offline by a user or the other controller. | Use the 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. |
| | RAID controller (battery fault LED) | Battery unit failure | Use the DS Storage Manager software to confirm the failure; then, replace the failed battery unit. |
| | RAID controller (SAS link service action LED) | SAS cable failure | Replace the SAS cable. |
| | | SAS host bus adapter failure | Check the SAS host bus adapter in the host and replace the adapter if necessary. |
| | | SAS port failure | Replace the controller. See Chapter 5, "Replacing components," on page 93 for more information. |
| Front bezel (system error LED) | General machine fault | A fault LED is lit somewhere on the storage subsystem (check for amber LEDs on components). | |
| | General machine fault (continued) | Open the Subsystem Management window and click Recovery Guru to see problems in the DS3500 configuration. Some errors cause the system error LED to be lit but not cause any individual component fault LEDs to be lit. (Drive PFA exceeded or nominal temperature exceeded errors are examples.) Follow the corrective actions in the Recovery Guru window. | |

Table 9. Troubleshooting (continued)

| Problem indicator | Component | Possible cause | Possible solutions |
|--|--|--|---|
| Amber LED is lit (continued) | RAID controller fault LED (service action LED may also be lit) | Unsupported controller | Controller configurations do not match. Check that host daughter card and cache memory are the same in both controllers. |
| | Front panel | Fibre Channel connection | Check that the CRUs are properly installed. If no amber LEDs are lit, suspect failure of the SFP module. Verify the failure using the DS Storage Manager Client. If all Fibre Channel connections failed, suspect failure of the Fibre Channel host daughter card. |
| | | SAS connection | Check the SAS connection to verify that the CRUs are properly installed. If the SAS port LED is off, suspect failure of the SAS host daughter card. |
| | | iSCSI connection | Check the iSCSI connection to verify that the CRUs are properly installed. If the iSCSI port LED is off, check the Ethernet cable or verify the link speed. If all the iSCSI port LEDs are off, suspect failure of the iSCSI host daughter card. |
| Battery fault | Battery unit failure | Verify the failure using the DS Storage Manager Client and replace the failed battery. | |
| Amber LED is lit and green LED is off | Power supply (fault and power LEDs are lit) | The power switch is turned off or there is an ac power failure. | Replace the failed power supply or turn on all power-supply switches. |
| Amber and green LEDs are lit | Power supply (fault and power LEDs are lit) | Power supply failure | Replace the failed power supply. See Chapter 5, "Replacing components," on page 93 for more information. |
| All amber and green LEDs are slowly flashing | All drives (activity and fault LEDs are not lit) | Check for and solve one of the following situations: <ul style="list-style-type: none"> Expansion enclosures are not correctly connected to the DS3500. DS3500 does not have the correct firmware version. | |

Table 9. Troubleshooting (continued)

| Problem indicator | Component | Possible cause | Possible solutions |
|--------------------------------|---------------------------|---|---|
| All green LEDs are off | All components | Subsystem power is off | Make sure that all storage subsystem power cables are connected and that the power-supply switches are on. If applicable, make sure that the main circuit breakers for the rack are turned on. |
| | | AC power failure | Check the main circuit breaker and ac receptacle. |
| | | Power-supply failure | Replace the power supply. |
| | | Operating environment is too hot | Cool down the environment. |
| Amber LED is flashing | Drives (fault LED is lit) | Drive identification is in process | No corrective action is needed. |
| One or more green LEDs are off | Power supplies | Power cable is disconnected or switches are turned off | Make sure that the power cord is connected and that the switches are turned on. |
| | All drives | Midplane failure | Replace the DS3500. Contact your IBM technical-support representative. |
| | Several components | Hardware failure | Replace the affected components. If this does not correct the problem, replace the RAID controllers. Contact your IBM technical-support representative. |
| | | The DS3500 was not powered-on, or all SAS cable connections between the expansion enclosures and the DS3500 storage subsystem failed. | Perform one of the following actions: <ul style="list-style-type: none"> • Power-on the storage subsystem. • Make sure that the SAS cable connections between the expansion enclosures and the DS3500 storage subsystem are made. |
| | Front panel | Power supply problem | Make sure that the power cables are connected and that the power supplies are turned on. |
| Hardware failure | | If any other LEDs are lit, replace the midplane. Contact your IBM technical-support representative. | |

Table 9. Troubleshooting (continued)

| Problem indicator | Component | Possible cause | Possible solutions |
|--|------------------------|--|--|
| Green LED is flashing slowly (once every 2 seconds) | Drives | The DS3500 was not powered-on, or all SAS connections between the expansion enclosures and the DS3500 storage subsystem have failed. | Perform one of the following actions: <ul style="list-style-type: none"> • Power-on the storage subsystem. • Make sure that the SAS connections between the expansion enclosures and the DS3500 storage subsystem are made. • Make sure that all the expansion enclosures in the same channel pair have the same enclosure speed setting. |
| Intermittent or sporadic power loss to the storage subsystem | Some or all components | Defective ac power source or incorrectly connected power cable | Check the ac power source. Reseat all installed power cords and power supplies. If applicable, check the power components (power supplies or uninterruptible power supply). Replace defective power cords. |
| | | Power supply failure | Check the fault LED on the power supply. If the LED is lit, replace the failed component. |
| | | Midplane failure | Replace the DS3500. Contact your IBM technical-support representative. |
| Unable to access drives | Drives | Incorrect storage subsystem ID settings | Make sure that the SAS cables are undamaged and correctly connected. Check the storage subsystem ID settings. |
| | | RAID controller failure | Replace one or both RAID controllers. Contact an IBM technical-support representative. |
| | | Drive failure | Replace the failed drive or drives. |
| Random errors | Subsystem | Midplane failure | Replace the DS3500. Contact your IBM technical-support representative. |

Table 9. Troubleshooting (continued)

| Problem indicator | Component | Possible cause | Possible solutions |
|---|--------------------|---|--|
| Hard disk drive is not visible in the DS Storage Manager software | Several components | Drive failure | Replace the failed drive or drives. |
| | | SAS cable failed | Replace the SAS cable. |
| | | RAID controller failure | Replace RAID controller. See Chapter 5, "Replacing components," on page 93 for more information. |
| | | Midplane failure | Replace the DS3500. Contact your IBM technical-support representative. |
| | | A drive has an interface problem with the ESM or controller. | Replace the drive. See Chapter 5, "Replacing components," on page 93 for more information. |
| | | Incorrect firmware version | Make sure that the DS3500 has the correct firmware version. See "Software and hardware compatibility and upgrades" on page 11. |
| | | In a dual-controller storage subsystem, one controller has failed, and in the drive channel that originates from the other (functioning) controller, an ESM has failed. | Replace the failed controller and ESM. See Chapter 5, "Replacing components," on page 93 for more information. |
| Storage expansion enclosure is not detected | Storage subsystem | Expansion enclosure is not supported | Verify that the expansion unit is supported by the DS3500 storage subsystem. |
| | | SAS cable failed | Replace the SAS cable. |

Solving problems in the EXP3500 expansion enclosure

The following table contains troubleshooting information to help you solve some basic problems that you might have with the EXP3500 expansion enclosure.

Table 10. Troubleshooting information

| Component | Problem indicator | Possible cause | Possible solutions |
|-----------------|---------------------|-----------------------|---|
| Hard disk drive | Amber fault LED lit | Drive failure | Replace the failed hard disk drive. See Chapter 5, "Replacing components," on page 93 for more information. |
| ESM | | Board failure | Replace the failed ESM. See Chapter 5, "Replacing components," on page 93 for more information. |
| Front panel | | General machine fault | A status or fault LED is lit. Check for amber LEDs on components. See "Checking the LEDs" on page 73. |

Table 10. Troubleshooting information (continued)

| Component | Problem indicator | Possible cause | Possible solutions |
|------------------------------|---|---|---|
| All components | All green LEDs off | The EXP3500 is turned off | Make sure that all power cables are connected and that the power is on. If applicable, make sure that the main circuit breakers for the rack are turned on. |
| | | ac or dc power failure | Check the main circuit breaker and ac or dc outlet. |
| | | Power-supply failure | Replace the power supply. See Chapter 5, "Replacing components," on page 93 for more information. |
| | | Midplane failure | Contact your IBM technical-support representative. |
| Hard disk drives | Amber fault LED flashing | Drive rebuild or identity in process | No action is required. |
| Power supply | Amber fault LED lit; green dc power LED off | Power supply failure; power supply turned off; minimum hard disk drives not installed | If the power-supply switch is on, turn off the power supply and then turn it on again. If the condition remains, replace the power supply. |
| Power supply | Amber fault LED lit; green ac power LED off | No ac power to power supply | Check the ac power cord or breaker. <ul style="list-style-type: none"> If ac power is good at the source, replace the power cord. If the power supply has failed, replace the power supply. |
| ESM | Link fault amber LED lit | SAS communication failure | <ol style="list-style-type: none"> Reconnect the SAS cable. Replace the SAS cable. If the LED is still lit, replace either the ESM or the controller or device into which the other end of the SAS cable is connected. |
| One or more hard disk drives | One or more green LEDs off | No activity to the drives | No action is required. |
| All hard disk drives | | No activity to the drives | No action is required. |
| | | Damaged or loose SAS cables | Check the SAS cables and connections. |
| | | ESM failure | Use the RAID controller management software to check the drive status. Replace the ESM. |
| | | Midplane failure | Contact your IBM technical-support representative. |
| Front panel | | Power supply | Make sure that the cables are connected and the power supplies are turned on. |
| | Hardware failure | If any other LEDs are lit, contact your IBM technical-support representative. | |

Table 10. Troubleshooting information (continued)

| Component | Problem indicator | Possible cause | Possible solutions |
|------------------------|-------------------------------------|---|--|
| Some or all components | Intermittent or sporadic power loss | Defective ac or dc power source or partially connected power cord | <ol style="list-style-type: none"> 1. Check the ac or dc power source. 2. Secure all installed power cables and power supplies. 3. If applicable, check the power components (power supplies, uninterruptible power supply, and so on). 4. Replace defective power cables. |
| | | Power-supply failure | Check for a fault LED on the power supply and replace the failed power supply. See "Checking the LEDs" on page 73. |
| | | Midplane failure | Contact your IBM technical-support representative. |
| Drives | Unable to access any drives | SAS cable | <ol style="list-style-type: none"> 1. Make sure that the SAS cables are undamaged and correctly connected. 2. Replace the cables. |
| | | ESM failure | Contact your IBM technical-support representative. |
| Subsystem | Random errors | Midplane failure | Contact your IBM technical-support representative. |

Chapter 7. Parts listing, DS3500 storage subsystem and EXP3500 expansion enclosure

The replaceable components that are available for the DS3500 storage subsystem and EXP3500 expansion enclosure are described in this chapter. To check for an updated parts listing on the Web, complete the following steps:

1. Go to <http://www.ibm.com/servers/storage/support/>.
2. On the “Support for System Storage and TotalStorage products” page, under **Select your product**, in the **Product family** field, select **Disk systems**.
3. In the **Product** field, select **IBM System Storage DS3500**.
4. Click **Go**.
5. For documentation updates, click the **Install/Use** tab.

Replaceable components

Replaceable components are of three types:

- **Tier 1 customer replaceable unit (CRU):** Replacement of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request, you will be charged for the installation.
- **Tier 2 customer replaceable unit:** You may install a Tier 2 CRU yourself or request IBM to install it, at no additional charge, under the type of warranty service that is designated for your server.
- **Field replaceable unit (FRU):** FRUs must be installed only by trained service technicians.

For information about the terms of the warranty and getting service and assistance, see the *Warranty Information* document that comes with the storage subsystem and expansion enclosure.

DS3512 storage subsystem and EXP3512 expansion enclosure parts listing

Figure 101 on page 136 and the following table provide a parts listing for the DS3512 storage subsystem and EXP3512 expansion enclosure.

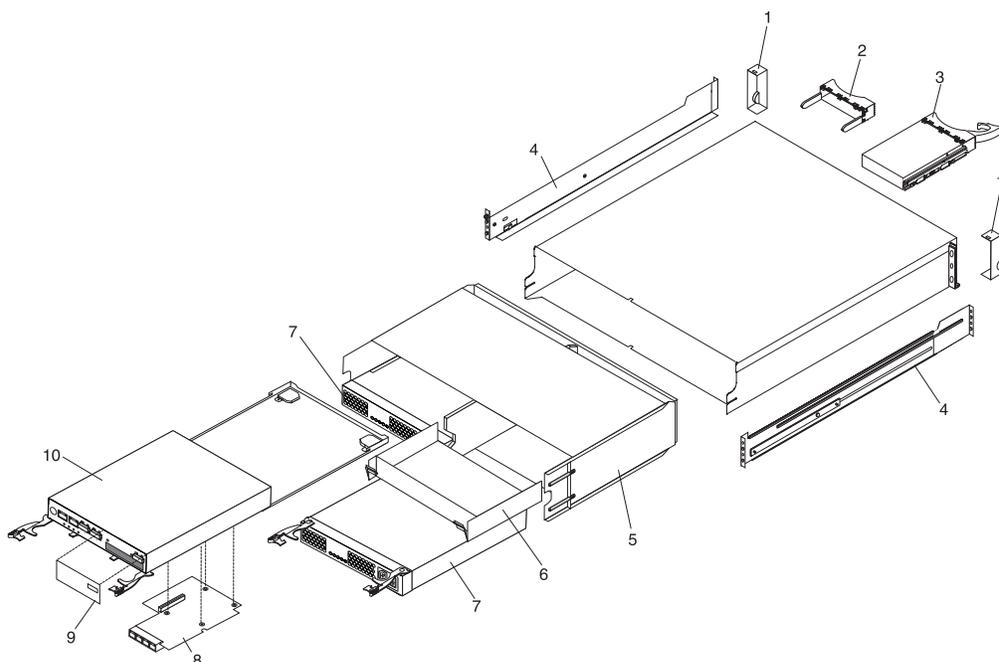


Figure 101. DS3512 storage subsystem and EXP3512 expansion enclosure storage subsystem parts

Table 11. Parts listing for DS3500

| Index | Description | CRU part number (Tier 1) | CRU part number (Tier 2) | FRU part number |
|-------|---|--------------------------|--------------------------|-----------------|
| 1 | DS3512 and EXP3512 bezel kit | 69Y0203 | | |
| 2 | Filler panel, 3.5-inch hard disk drive | 42D3315 | | |
| 3 | Hard disk drive | varies | | |
| 4 | 2U rail kit | 39R6550 | | |
| 5 | DS3512 and EXP3512 midplane | | | 69Y0249 |
| 6 | Controller or environmental service module filler panel | 69Y0194 | | |
| 7 | Power supply, ac | 69Y0201 | | |
| 8 | 6 GB SAS 2-port host port adapter | 69Y2840 | | |
| 8 | 8 GB FC 4-port host port adapter | 69Y2841 | | |
| 8 | 1 GB iSCSI 4-port host port adapter | 69Y2842 | | |
| 9 | Filler panel, host port adapter | 39R6543 | | |
| 10 | Controller with 1 GB DIMM, no host port expansion adapter | 68Y8481 | | |
| | DIMM, 2 GB cache memory | 69Y2843 | | |
| | Backup battery module | 69Y2844 | | |
| | IBM 1-meter mini-SAS cable | 39R6530 | | |
| | IBM 3-meter mini-SAS cable | 39R6532 | | |

Table 11. Parts listing for DS3500 (continued)

| Index | Description | CRU part number (Tier 1) | CRU part number (Tier 2) | FRU part number |
|-------|--|--------------------------|--------------------------|-----------------|
| | Service cable | | | 13N1932 |
| | Power cord, rack jumper, 2.8-meter | 39M5377 | | |
| | Miscellaneous rack mounting hardware kit | 39R6551 | | |
| | Environmental service module | 69Y0189 | | |
| | 1 GB shortwave SFP transceiver | 69Y2899 | | |

DS3524 storage subsystem and EXP3524 expansion enclosure parts listing

Figure 102 and the following table provide a parts listing for the DS3524 storage subsystem and EXP3524 expansion enclosure.

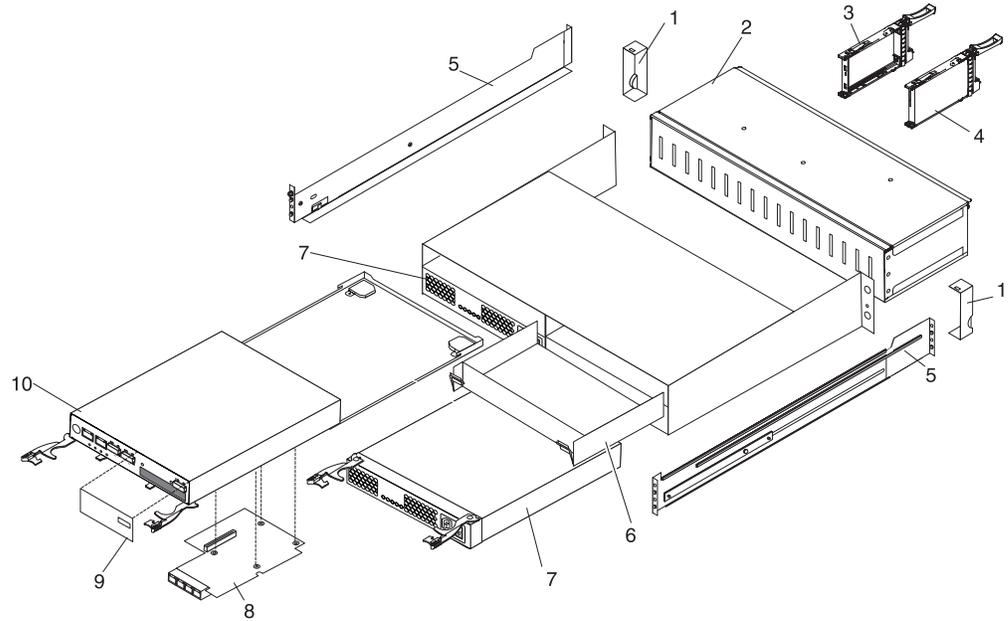


Figure 102. DS3524 storage subsystem and EXP3524 expansion enclosure parts

Table 12. Parts listing for DS3500

| Index | Description | CRU part number (Tier 1) | CRU part number (Tier 2) | FRU part number |
|-------|---|--------------------------|--------------------------|-----------------|
| 1 | DS3524 and EXP3524 bezel kit | 69Y0213 | | |
| 2 | DS3524 and EXP3524 midplane assembly | | | 69Y0259 |
| 3 | Filler panel, 2.5-inch hard disk drive | 68Y8493 | | |
| 4 | Hard disk drive | varies | | |
| 5 | 2U rail kit | 39R6550 | | |
| 6 | Controller or environmental service module filler panel | 69Y0194 | | |

Table 12. Parts listing for DS3500 (continued)

| Index | Description | CRU part number (Tier 1) | CRU part number (Tier 2) | FRU part number |
|-------|---|--------------------------|--------------------------|-----------------|
| 7 | Power supply, ac | 69Y0201 | | |
| 8 | 6 GB SAS 2–port host port adapter | 69Y2840 | | |
| 8 | 8 GB FC 4–port host port adapter | 69Y2841 | | |
| 8 | 1 GB iSCSI 4–port host port adapter | 69Y2842 | | |
| 9 | Filler panel, host port adapter | 39R6543 | | |
| 10 | Controller with 1 GB DIMM, no host port expansion adapter | 68Y8481 | | |
| | DIMM, 2 GB cache memory | 69Y2843 | | |
| | Backup battery module | 69Y2844 | | |
| | IBM 1-meter mini-SAS cable | 39R6530 | | |
| | IBM 3-meter mini-SAS cable | 39R6532 | | |
| | Service cable | | | 13N1932 |
| | Power cord, rack jumper, 2.8-meter | 39M5377 | | |
| | Miscellaneous rack mounting hardware kit | 39R6551 | | |
| | Environmental service module | 69Y0189 | | |
| | 1 GB shortwave SFP transceiver | 69Y2899 | | |

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 receptacle.

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 13. IBM power cords

| IBM power cord part number | Used in these countries and regions |
|----------------------------|---|
| 39M5206 | China |
| 39M5102 | Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea |
| 39M5123 | 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 Republic, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (People's 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 |
| 39M5130 | Denmark |
| 39M5144 | Bangladesh, Lesotho, Macao, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda |
| 39M5151 | Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Dominica, Gambia, Ghana, Grenada, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Polynesia, Qatar, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad and Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe |
| 39M5158 | Liechtenstein, Switzerland |
| 39M5165 | Chile, Italy, Libyan Arab Jamahiriya |
| 39M5172 | Israel |
| 39M5095 | 220 - 240 V Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States of America, Venezuela |

Table 13. IBM power cords (continued)

| IBM power cord part number | Used in these countries and regions |
|----------------------------|--|
| 39M5081 | 110 - 120 V Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Caicos Islands, Canada, Cayman Islands, Colombia, Costa Rica, 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, Taiwan, United States of America, Venezuela |
| 39M5219 | Korea (Democratic People's Republic of), Korea (Republic of) |
| 39M5199 | Japan |
| 39M5068 | Argentina, Paraguay, Uruguay |
| 39M5226 | India |
| 39M5233 | Brazil |

Appendix A. Records

Whenever you add optional devices to the DS3500 storage subsystem or EXP3500 expansion enclosure, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other devices and provide needed data whenever you contact your IBM technical-support representative.

Identification numbers

Record and retain the following information.

Table 14. Product identification record

| | |
|----------------------|--------------------------------------|
| Product name | IBM System Storage DS3500 or EXP3500 |
| Machine type | 1746 |
| Model number | |
| Serial number | |

The serial number is on the label in the vertical recess on the left bezel. The serial number is also on the left chassis flange and on the rear of the chassis. A label that includes the machine type, model, and serial number is on the top front right chassis corner.

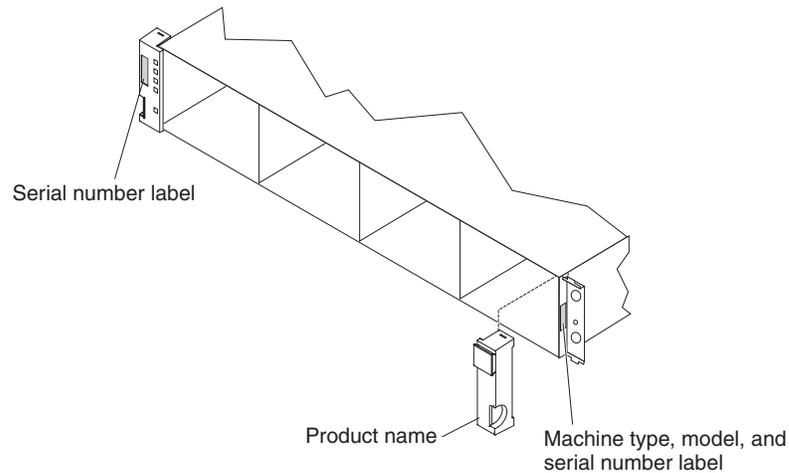


Figure 103. Serial number location on the DS3500

Hard disk drive locations

Use Table 15 to keep a record of the hard disk drives that are installed in or attached to the DS3500 or EXP3500. This information can be helpful when you install additional hard disk drives or if you have to report a hardware problem. Make a copy of this table before you record information in it, in case you need extra space to write new values later, or when you update the configuration.

Table 15. Drive location information record

| Drive location | Drive part and model number | Drive serial number |
|----------------|-----------------------------|---------------------|
| Bay 1 | | |
| Bay 2 | | |
| Bay 3 | | |
| Bay 4 | | |
| Bay 5 | | |
| Bay 6 | | |
| Bay 7 | | |
| Bay 8 | | |
| Bay 9 | | |
| Bay 10 | | |
| Bay 11 | | |
| Bay 12 | | |
| Bay 13 | | |
| Bay 14 | | |
| Bay 15 | | |
| Bay 16 | | |
| Bay 17 | | |
| Bay 18 | | |
| Bay 19 | | |
| Bay 20 | | |
| Bay 21 | | |
| Bay 22 | | |
| Bay 23 | | |
| Bay 24 | | |

Table 17 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 17. Sample information record

| Storage subsystem name | Management method | Controller 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. Getting help and technical assistance

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

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the *IBM Documentation CD* that comes with your system.
- Go to the IBM support Web site at <http://www.ibm.com/systems/support/> to check for technical information, hints, tips, and new device drivers or to submit a request for information.

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

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, 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. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to <http://www.ibm.com/systems/support/> and follow the instructions. Also, some documents are available through the IBM Publications Center at <http://www.ibm.com/shop/publications/order/>.

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台北市松仁路7號3樓
電話：0800-016-888

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Table 18. Limits for particulates and gases

| Contaminant | Limits |
|-------------|---|
| Particulate | <ul style="list-style-type: none"> The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2¹. Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. The deliquescent relative humidity of the particulate contamination must be more than 60%². The room must be free of conductive contamination such as zinc whiskers. |
| Gaseous | <ul style="list-style-type: none"> Copper: Class G1 as per ANSI/ISA 71.04-1985³ Silver: Corrosion rate of less than 300 Å in 30 days |

¹ ASHRAE 52.2-2008 - *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

² The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction.

³ ANSI/ISA-71.04-1985. *Environmental conditions for process measurement and control systems: Airborne contaminants*. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.

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