

System Storage DS3200 Storage Subsystem



# Installation, User's, and Maintenance Guide



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**Note:** Before using this information and the product it supports, read the general information in Appendix C, "Notices," on page 115 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 ασφάλειας (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)

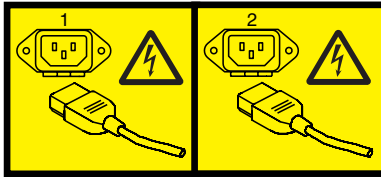




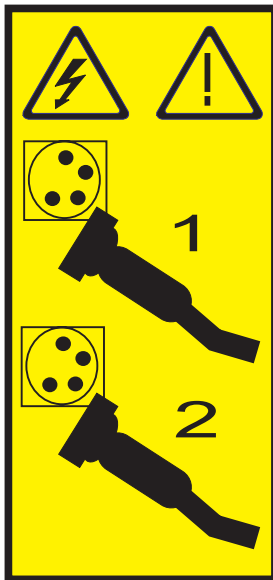
**DANGER**

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.

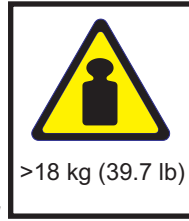
To connect:

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.

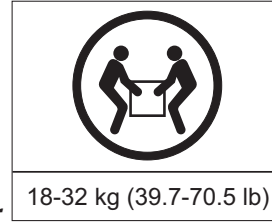
(D005a)



**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™ DS3200 storage subsystem (hereafter referred to as *DS3200* or *storage subsystem*).

This chapter also includes an inventory checklist and important information about best practices guidelines and product updates for your DS3200.

---

### Overview

The IBM System Storage DS3200 storage subsystem is designed to provide solutions to meet the needs of departmental and midrange storage requirements, delivering high performance and availability, advanced functionality, along with a modular and scalable storage capacity design. With direct-attached Serial Attached SCSI (SAS) connectivity and support for RAID levels 0, 1, 3, 5, and 6, the DS3200 provides an internal physical storage capacity that is scalable up to 5.4 TB (terabytes) when using 450 GB Serial Attached SCSI (SAS) hard disk drives or up to 12.0 TB (terabytes) when using 1000 GB Serial Advanced Technology Attachment (SATA) hard disk drives.

**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.

A 2U rack-mountable DS3200 enclosure houses one or two RAID controllers with up to four SAS ports per controller for attachment of host servers and storage expansion enclosures and up to twelve 3 Gbps SAS or SATA hard disk drives.

The DS3200 supports attachment of up to three storage expansion enclosures, resulting in the capability to connect to up to 48 hard disk drives and enabling storage configurations of over 21 TB using 450 GB SAS hard disk drives or 48 TB using 1000 GB SATA hard disk drives. The DS3200 supports configurations of SAS or SATA disks, or a combination of both types of hard disk drives in the same enclosure. Advanced DS3000 storage management and copy service options are available for the DS3200, including FlashCopy® and VolumeCopy.

The DS3200 supports up to three hosts in a redundant direct-attached SAS configuration.

The DS3000 Storage Manager version 10 software is also available for the DS3200. This storage-management software is designed to help centralize storage management, help simplify partitioning of the DS3000 series storage into as many as 32 virtual servers, and strategically allocate storage capacity to maximize storage space.

If firmware and documentation updates are available, you can download them from the IBM Web site. The DS3200 might have features that are not described in the documentation that comes with the unit, 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 DS3200 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 **IBM System Storage DS3200**.
4. Click **Go**.
5. Make the following selections:
  - For firmware updates, click the **Download** tab.

**Note:** Check the RAID controller management software for the firmware version that is installed on the environmental services module (ESM).

- 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 DS3200 comes with a limited warranty. For more information about the terms of your warranty, see the *Warranty Information* document that comes with the storage subsystem.

Record information about the DS3200 in Table 8 on page 109. You will need this information if you have to call for service.

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. The following illustration shows the serial number label, product name (DS3200), and machine type, model, and serial number label on the front of the DS3200.

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

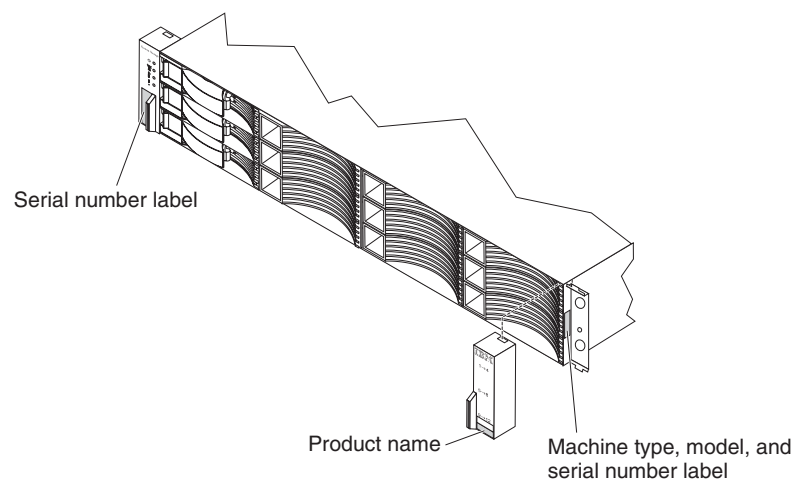


Figure 1. Example of DS3200 serial number label, product name, and machine type and model number locations

Use Table 9 on page 110 to keep a record of the hard disk drives that are installed in or attached to the DS3200. 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 DS3200 configuration.

---

## 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 DS3000 Support CD*. 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 DS3200. Depending on your DS3200 model, some features might not be available, or some specifications might not apply.

Table 1. Features and operating specifications

General:	AC power supply with built-in fan:	Heat output
<ul style="list-style-type: none"> <li>• Modular components               <ul style="list-style-type: none"> <li>– High-capacity disk drives</li> <li>– RAID controller modules</li> <li>– Power supplies with built-in fan units</li> </ul> </li> <li>• Technology               <ul style="list-style-type: none"> <li>– Supports disk array technology</li> <li>– SAS host interface, redundant data storage, power and cooling system, and SAS and SATA disk controllers</li> <li>– Hot-swap technology for hard disk drives, power supplies, and controllers</li> </ul> </li> <li>• User interface               <ul style="list-style-type: none"> <li>– Built-in power, activity, and fault LEDs, identification labeling on components, rear LEDs, and connectors</li> <li>– Easy-to-replace hard disk drives, power supplies with built-in fan units, and controllers</li> </ul> </li> </ul> <p><b>Hard disk drive storage:</b> Maximum hard disk drives per DS3200: 12 Drive type: SAS and SATA</p> <p><b>Controllers:</b></p> <ul style="list-style-type: none"> <li>• Technology and interfaces: SAS interface: Two 26-pin, mini-SAS connectors per controller (two more with optional SAS host port adapter installed)</li> </ul> <p><b>Acoustical noise emissions:</b> For maximum system configurations (12 hard disk drives installed)</p> <ul style="list-style-type: none"> <li>• Sound power (idling): 6.2 bels</li> <li>• Sound power (operating): 6.2 bels</li> <li>• Sound pressure (idling): 48 dBA</li> <li>• Sound pressure (operating): 48 dBA</li> </ul>	<ul style="list-style-type: none"> <li>• The DS3200 comes with two hot-swap 530-watt (115 - 230 V ac) power supplies.</li> <li>• The two power supplies provide redundant power to the DS3200.</li> </ul> <p><b>Size:</b></p> <ul style="list-style-type: none"> <li>• Height: 8.7 cm (3.4 in.)</li> <li>• Depth: 55.0 cm (21.6 in.)</li> <li>• Width: 44.7 cm (17.6 in.)</li> <li>• Weight: approximately 17.1 kg (37.6 lb) for a standard unit; when fully configured, 29.3 kg (64.6 lb)</li> </ul> <p><b>Environment:</b></p> <ul style="list-style-type: none"> <li>• Air temperature:               <ul style="list-style-type: none"> <li>– DS3200 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</li> <li>– DS3200 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</li> </ul> </li> <li>• Humidity:               <ul style="list-style-type: none"> <li>– DS3200 on: 20% to 80%</li> <li>– DS3200 off: 10% to 90%</li> <li>– Maximum dew point: 26°C (79°F)</li> <li>– Maximum humidity gradient: 10% per hour</li> </ul> </li> </ul>	<p>Approximate heat output in British thermal units (Btu) per hour:</p> <ul style="list-style-type: none"> <li>• Minimum configuration: 205 Btu (60 watts)</li> <li>• Maximum configuration 1235 Btu (361 watts)</li> </ul> <p><b>Electrical input:</b></p> <ul style="list-style-type: none"> <li>• Sine-wave input (50 - 60 Hz) required</li> <li>• Input voltage low range:               <ul style="list-style-type: none"> <li>– Minimum: 90 V ac</li> <li>– Maximum: 136 V ac</li> </ul> </li> <li>• Input voltage high range:               <ul style="list-style-type: none"> <li>– Minimum: 198 V ac</li> <li>– Maximum: 264 V ac</li> </ul> </li> <li>• Approximate input kilovolt-amperes (kVA):               <ul style="list-style-type: none"> <li>– Minimum: 0.06 kVA</li> <li>– Maximum: 0.38 kVA</li> </ul> </li> </ul> <p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> </ol>

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## Models and optional devices

The DS3200 RAID controller cache size, partitions, and other features vary depending the DS3200 model and optional devices.

Contact your IBM marketing representative or authorized reseller for more information about the DS3200 models and options.

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## Operating-system support

The following operating systems are supported for host servers that have mapped LUNs that are created in the DS3200 with storage expansion enclosures:

- Microsoft® Windows® Server 2003
- Red Hat® Enterprise Linux®
- SuSE Linux Enterprise Server
- Novell Netware
- VMware ESX Server

For additional host operating-system support, see the latest DS3000 Storage Manager Version 2 software readme file and the IBM DS3000 series products interoperability matrix at <http://www.ibm.com/systems/storage/disk/ds3000/ds3200/>.

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## Product updates

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

Download the latest version of the DS3000 Storage Manager software, DS3200 storage subsystem controller firmware, DS3000 series storage 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 support” page opens.
2. Click **add products**.
3. From the menu, select **Storage**.
4. In the next menu, and in subsequent menus, select the following topics:
  - **Computer Storage**
  - **Disk Storage Systems**
  - **System Storage DS3000**

**Note:** During this process a check list is displayed. Do not select any of the items in the check list until you complete the selections in the menus.

5. When you finish selecting the menu topics, select the boxes for the machine type of your DS3000 series product and any other attached DS3000 series products for which you want to receive information; then, click **Add products**. The “My support” page reopens.

6. On the “My support” page, click the **Edit profile** tab; then, click **Subscribe to email**.
7. In the menu, select **Storage**.
8. On the next page, select the check boxes for the following items:
  - **Please send these documents by weekly email**
  - **Downloads and drivers**
  - **Flashes**
  - Any other topics that you are interested inThen, click **Update**.
9. Click **Sign out** to log out of My Support.

---

## Best practices guidelines

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

- 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 DS3200 right and left power-supply units to two independent external power circuits through ac power distribution units (PDUs) inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the storage expansion enclosures (such as the EXP3000) that are attached to the DS3200 should be connected to the same two independent external power circuits as the DS3200. This ensures that the DS3200 and all its attached storage expansion enclosures will have power in the event that only one power circuit is available. In addition, having all the right or all the left power cables connected to the same power circuit enables the DS3000 devices in the configuration to power-on simultaneously during an unattended restoration of power.

**Note:** Do not overload the circuits that power your storage subsystem and storage expansion enclosures. Use additional pairs of ac 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 DS3000 Storage Manager Version 2 *Installation and User's Guide* for your operating system. Save the profile in a location other than in the logical drives that are created for the DS3200.
- 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 46. 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 46 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 DS3000 Storage Manager Version 2 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.

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## Storage subsystem components

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

- Up to twelve 3 Gbps SAS or SATA hard disk drives
- Up to two RAID controllers
- Two power supplies

## Disk drives and bezels

Figure 2 shows the locations of hot-swap disk drives and bezels. The hot-swap features enable you to remove and replace SAS or SATA hard disk drives, power supplies, and controllers (in a dual-controller storage subsystem) without turning off the storage subsystem. You can maintain the availability of the storage subsystem while you remove, install, or replace a hot-swap device.

The hot-swap drive bays that are accessible from the front of the storage subsystem are shown in Figure 2.

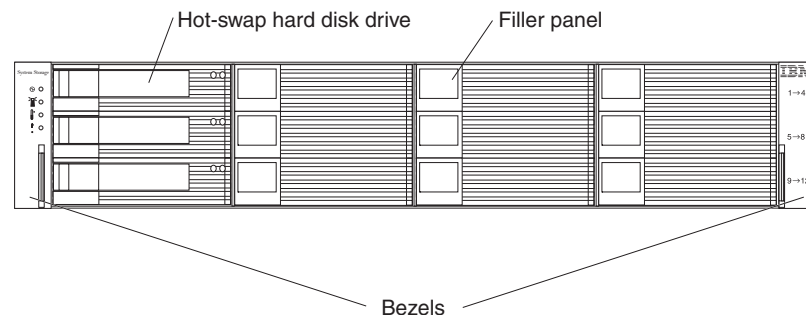


Figure 2. DS3200 hot-swap drive bays and bezels

### Hot-swap hard disk drive

You can install up to 12 hot-swap SAS or SATA hard disk drives in the DS3200.

### Filler panel

The DS3200 comes with filler panels in the drive bays. Before you install a hard disk drive, remove the filler panel and save it for future use. Each of the 12 drive bays must contain either a filler panel or a hard disk drive.

### Bezel (left side)

The left bezel contains the DS3200 LEDs, as shown in the following illustration. For a description of the LEDs, see “Front LEDs” on page 53.

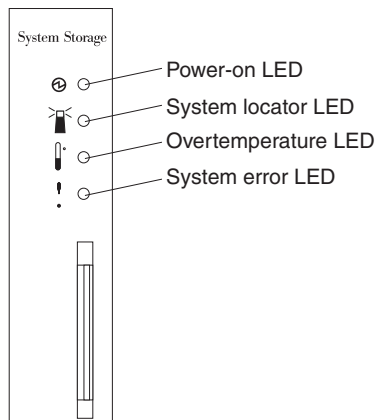


Figure 3. Bezel (left side)

### Bezel (right side)

The right bezel contains the hard disk drive identification information, as shown in the following illustration.

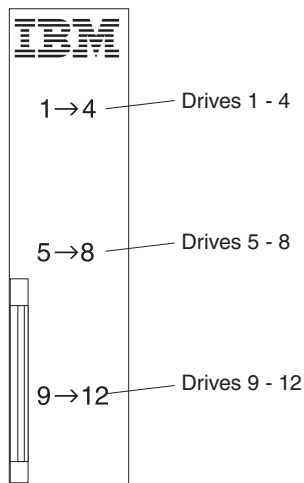


Figure 4. Bezel (right side)

The DS3200 supports up to twelve 3 Gbps SAS or SATA hard disk drives, which come preinstalled in drive trays. Install drives in the 12 drive bays on the front of the storage subsystem. 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 in the storage subsystem.

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 a nonsupported drive causes the drive to be locked out by the DS3200 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 reseat 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 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 DS3200 has one or two hot-swappable and redundant RAID controllers. The controllers are at the rear of the storage subsystem. The left controller is controller A, and the right controller is controller B. When the DS3200 has two controllers, one controller will continue to operate if the other controller fails.

The controllers contain the storage subsystem control logic, interface ports, and LEDs. A single-controller model comes with one SAS host port and can support two additional SAS host ports through an optional SAS host port adapter, which provides three SAS host ports on the controller.

A dual-controller model comes with one SAS host port on each controller; each controller can support two additional SAS host ports through an optional SAS host port adapter, which provides three SAS host ports on each controller.

Each controller has one SAS drive expansion port for connecting to the DS3000 storage expansion enclosures and one Ethernet port for DS3200 subsystem management purposes. See Figure 13 on page 23 and Figure 23 on page 35.

**Attention:** When a DS3200 has two controllers, the controllers must be identical to each other in hardware (part number, DIMM size) and firmware. If you install a SAS host port adapter in either controller, you must install an identical SAS host port adapter in the other controller.

The storage management software automatically sets the enclosure ID number for the controllers. You can change the enclosure ID setting through the DS3000 storage management software only. There are no switches on the DS3200 chassis to manually set the enclosure ID. Both controller enclosure ID numbers are identical under normal operating conditions.

Figure 5 shows a single-controller DS3200 without the optional SAS host port adapter installed.

Figure 6 shows a dual-controller DS3200 with the optional SAS host port adapter

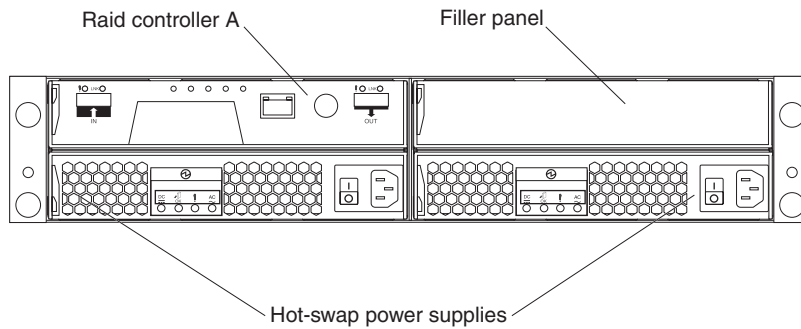


Figure 5. Rear view, single-controller model

installed in each controller.

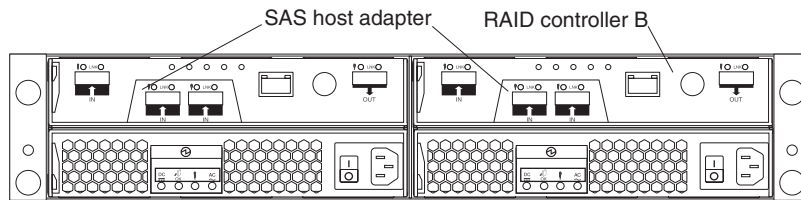


Figure 6. Rear view, dual-controller model (shown with optional SAS host port adapters installed)

## Power supply and fans

The storage subsystem has two removable power-supply units. Each power-supply unit contains one power supply and 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 of the fans in either fan housing fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem. The power supplies provide power to the internal components by converting incoming ac voltage to dc voltage. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage subsystem. To preserve the optimal airflow, do not remove a failed power-supply unit from the DS3200 chassis until you are ready to replace it with a new power-supply unit.

Figure 7 shows the power-supply unit components for the DS3200.

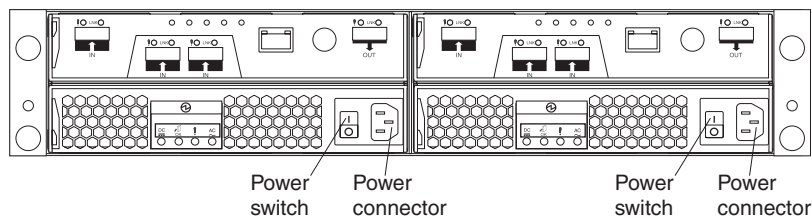


Figure 7. Power-supply unit components for DS3200

Figure 8 shows the airflow through the storage subsystem.

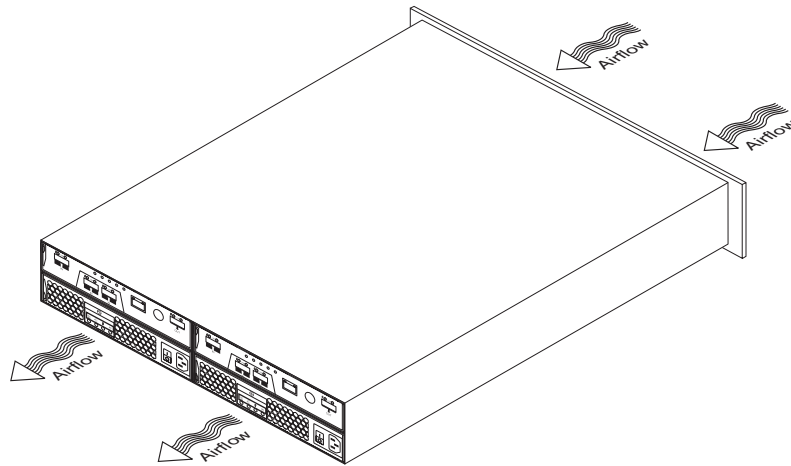


Figure 8. Airflow through the storage subsystem

## Battery units

Each RAID controller contains 512 MB of cache memory (or more, if you have upgraded the memory). It also contains a sealed, rechargeable lithium ion battery that maintains data in the cache for up to 3 days in the event of a power failure.

Figure 9 shows the locations of the battery and memory cache DIMM in the controller.

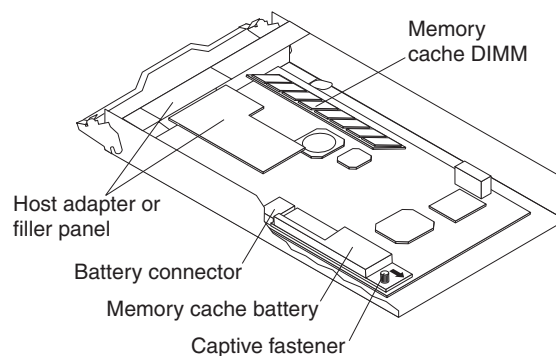


Figure 9. Battery unit

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 53 for the location of the battery fault LED and conditions that the LED indicates).

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## Software and hardware compatibility and upgrades

The latest DS3200 controller firmware and NVSRAM, the storage expansion enclosure (drive enclosure) ESM firmware, and the 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 DS3200, you *must* make sure that your system software and firmware are at the levels shown in Table 2, or later.

**Note:** SATA hard disk drive support requires that the DS3200 controller and any storage expansion enclosures are at the firmware levels listed in the following table.

Table 2. Software and firmware levels for the DS3200 storage subsystem

Software/firmware	Level
DS3000 Storage Manager software	10.35
DS3200 controller firmware	10.35.41.00 or later
DS3200 controller NVSRAM	Single controller: N1726D32LR335V02.dlp Dual controller: N1726D320R335V06.dlp
ESM firmware for attached storage expansion enclosures	1.96 or later
Drive firmware	You can find the latest drive firmware at the IBM DS3000 System Storage Web site:  <a href="http://www.ibm.com/servers/storage/support/disk/">http://www.ibm.com/servers/storage/support/disk/</a>

You can also find the latest DS3000 Storage Manager software, DS3200 controller firmware, and NVSRAM firmware at <http://www.ibm.com/servers/storage/support/disk/>.

See the *IBM System Storage DS3000 Storage Manager Version 2 Installation and Support Guide* for your operating system for instructions for installing the DS3000 Storage Manager host software. The *Installation and Support Guide* is in the Documentation folder on the *IBM System Storage DS3000 Support CD*.

## Determining firmware levels

To determine the firmware levels of the DS3200 storage subsystem, the connected storage expansion enclosures, and the installed hard disk drives, use the DS3000 Storage Manager software that is used to manage the DS3200 storage subsystem.

In the Subsystem Management window, click the **Summary** tab; then, click **Storage Subsystem Profile** in the Hardware Components 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.

### DS3000 Storage Server

- NVSRAM version
- Firmware version
- Appware version
- Bootware version

### Hard Disk Drives

- Firmware version

## Drive Enclosure

- ESM firmware version

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## Specifications

The specifications of the DS3200 are listed in Table 1 on page 4. This section provides additional site specifications for the DS3200 storage subsystem. 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 DS3200 storage subsystem installation, service, and operation.

## Area requirements

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

## Dimensions

Figure 10 shows the dimensions of the DS3200, which conforms to the 19-inch rack standard.

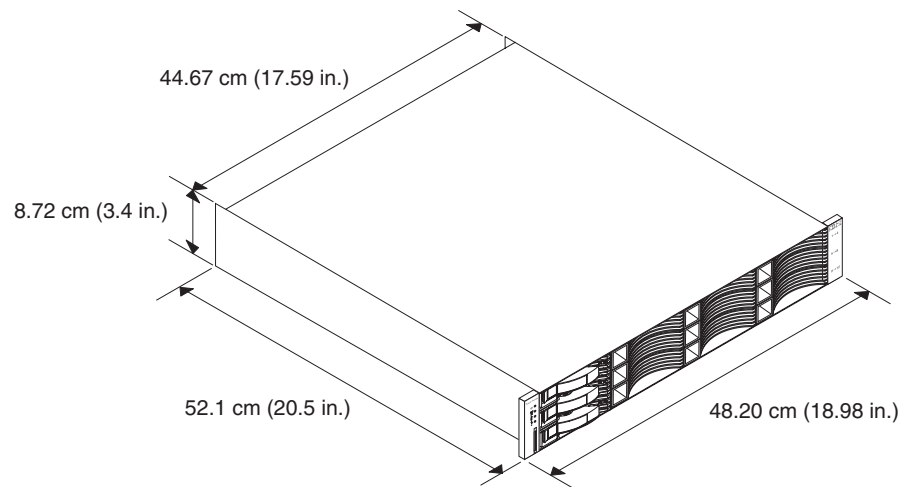


Figure 10. DS3200 dimensions

## Weight

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

Table 3. DS3200 weights

DS3200	Weight	
	Maximum <sup>1</sup>	Empty <sup>2</sup>
Single-controller unit	28.34 kg (62.49 lb)	9.71 kg (21.41 lb)
Dual-controller unit	29.32 kg (64.63 lb)	

Table 3. DS3200 weights (continued)

DS3200	Weight	
	Maximum <sup>1</sup>	Empty <sup>2</sup>

<sup>1</sup> Chassis with all components and 12 hard disk drives.

<sup>2</sup> Chassis without components and hard disk drives but with front cage frame, midplane, and hard disk drive filler panels.

Table 4. DS3200 component weights

Unit	Weight
Hard disk drive	0.95 kg (2.10 lb)
Power supply with fan	2.52 kg (5.55 lb)
Controller (including cache battery backup and host port adapter)	1.75 kg (3.85 lb)
Battery	0.22 kg (0.49 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 operating environment limits for longer than 60 days.
2. The storage environment must not exceed the operating environment limits for longer than 1 year.
3. Substantial deviations from the suggested operating range, in either direction, if sustained for extended periods of time, will expose the unit to greater risk of failure from external causes.

## 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 DS3200 storage subsystem 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 106 for more information.

## Heat output, airflow, and cooling

Figure 11 shows the intended airflow for the DS3200. Allow at least 30 inches in front of the storage subsystem and at least 24 inches behind the storage subsystem for service clearance, proper ventilation, and heat dissipation.

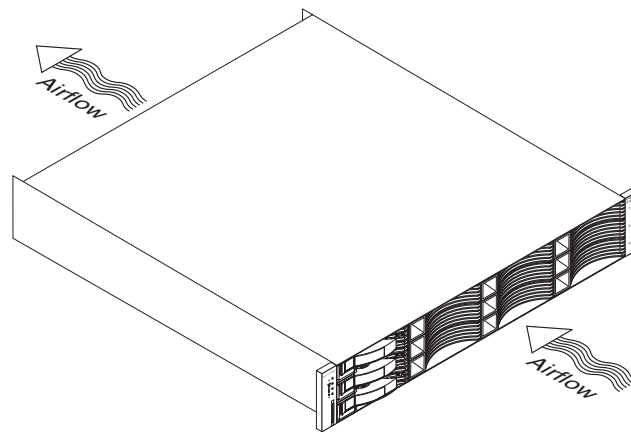


Figure 11. DS3200 airflow

When racks that contain many DS3200 storage subsystems are to be installed together, the following requirements must be met to ensure that the DS3200 storage subsystems 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 12 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 storage 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 12 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.

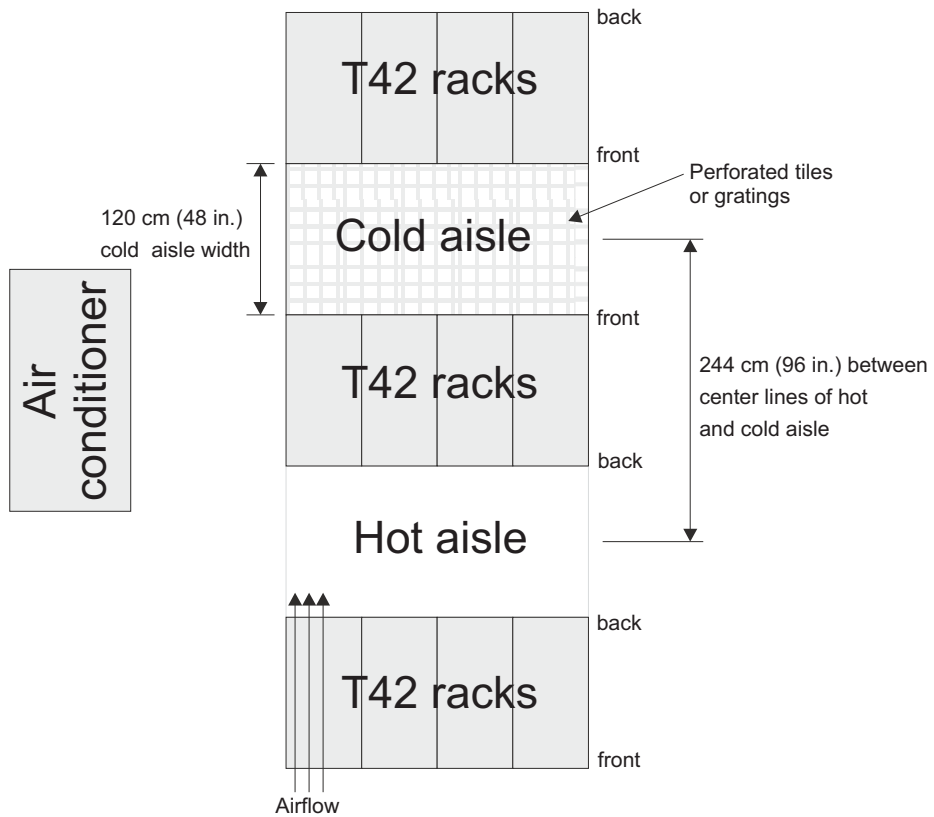


Figure 12. Example of cold aisle/hot aisle rack configuration

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## Chapter 2. Installing the storage subsystem

This chapter provides the information about installing the storage subsystem into a rack cabinet.

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

“Installation overview” on page 18 provides an overview of the entire DS3200 installation process. Read this overview before you begin the installation.

---

### Inventory checklist

After you unpack the DS3200, make sure that you have the following items. Depending on your DS3200 order, your shipping box might contain additional materials that are not in the following list.

- **Hardware**

- Hard disk drive filler panels (12) (Your storage subsystem might come with up to 12 hard disk drives.)
- RAID controllers (up to 2)
- Power supplies (2)
- Power cables (2 jumper line cords)
- Rack-mounting hardware kit (1), including:
  - Rails (2) (right and left assembly)
  - Rail end plate covers (2) (right and left assembly)
  - M5 black hex-head slotted screws (12)
  - Washers (8)

**Attention:** The DS3200 does not come with region-specific power cords. You must obtain the IBM-approved power cords for your region. See “Power cords” on page 106 for the IBM-approved power cords for your region.

- **Software and documentation**

- IBM *System Storage DS3000 Support CD*

The support CD contains the IBM DS3000 Storage Manager Version 2 host software. The CD also includes firmware, online help, and the following documentation in Adobe Acrobat Portable Document Format (PDF):

- *IBM System Storage DS3200 Storage Subsystem Installation, User's, and Maintenance Guide* (this document)
- *IBM System Storage DS3000 Storage Manager Version 2 Installation and Support Guide* for your operating system
- *IBM Systems Safety Notices*
- *IBM System Storage DS3200, DS3300, and DS3400 Quick Installation Guide*
- *Rack Installation Instructions*

Instructions for installing the DS3200 in a rack cabinet are provided in the *Rack Installation Instructions* document.

- Box of ID labels (used to label the enclosure IDs on the front of the DS3200)

If you ordered additional premium features or entitlements, the premium features activation or entitlement kits might also come inside the box.

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

Instructions for installing the DS3200 in a rack cabinet are provided in the *Rack Installation Instructions*.

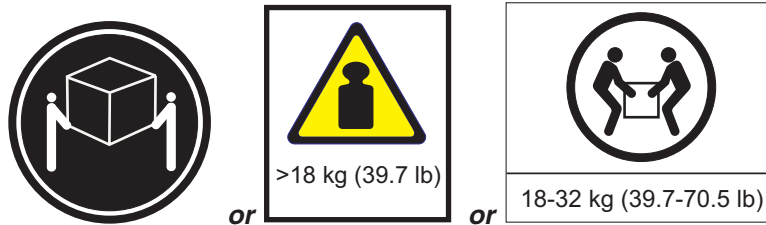
To connect your DS3200 to other devices, use the following options, which must be purchased separately:

- IBM IM SAS cable
- IBM 3M SAS cable
- Host bus adapters (HBAs) in the hosts

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## 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 DS3200 weighs up to 30 kg (66 lb). At least two people should lift the DS3200 from the shipping box. You might want to open the sides of the shipping box and remove the components from the DS3200 before you lift it from the shipping box, to lighten the storage subsystem.

The following steps summarize the DS3200 installation process:

1. Review the preparation recommendations. See “Preparing for installation” on page 20.
2. Prepare the installation site. See “Preparing the site” on page 21.
3. Prepare the rack cabinet. See the *Rack Installation Instructions*.
4. Record the serial number, machine type and model number, and RAID controller MAC addresses for your DS3200 storage subsystem in Appendix A, “Records,” on page 109. 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 DS3200 chassis and components in the rack cabinet. See the *Rack Installation Instructions*.
6. Install in the rack cabinet the storage expansion enclosure that you will cable to the DS3200. Follow the instructions in the *Rack Installation Instructions* for your storage expansion enclosure to set up and mount the storage expansion enclosures.

**Attention**

Before you power-on the storage subsystem, it must contain at least four drives. If at least four drives are not installed in each attached storage expansion enclosure and in the DS3200 storage subsystem, when you power-on the DS3200 and its attached storage expansion enclosures, your standard storage partition key might be lost and you must regenerate it, using instructions at <http://www.ibm.com/storage/fasttkeys/>.

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear to have failed, falsely indicating that the power supplies are bad. All drives in the DS3200 storage subsystem and the connected storage expansion enclosures must contain no prior configuration data.

7. Use SAS cables to cable the DS3200 to the storage expansion enclosures. See “Connecting storage expansion enclosures to the DS3200” on page 26.
8. Complete one of the following cabling tasks to enable management of the DS3200 configuration:
  - If you are using out-of-band management, cable the DS3200 Ethernet ports to either the management workstation or the host.
  - If you are using in-band management, cable the DS3200 hosts to the SAS host bus adapters (HBAs) in the hosts. See “Connecting hosts to the DS3200” on page 37.
9. Connect the power cables for the DS3200. See “Cabling the DS3200 power supplies” on page 43.
10. Power-on the attached storage expansion enclosure and the DS3200 storage subsystem, using the procedure in “Turning on the storage subsystem” on page 46.
11. Install the DS3000 Storage Manager Version 2 software on the management workstation (for out-of-band management) or on the host (for in-band management). See the *IBM System Storage DS3000 Storage Manager 2 Installation and Support Guide* for the management-workstation or host operating system for instructions for installing the DS3000 Storage Manager Version 2 software.
12. Use the DS3000 Storage Manager software to verify the configuration.
13. Review and perform the procedures in “Performing the DS3000 Health Check process” on page 45.

---

## 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 DS3200 storage subsystem, create a detailed plan of how this unit will be used in your storage configuration. The plan should include determining RAID levels, failover requirements, operating systems that are to be used, and total storage capacity requirements.

To prepare the DS3200 storage subsystem for installation into a rack cabinet, complete the following steps:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 13.
2. Move the shipping box that contains the DS3200 to the site.

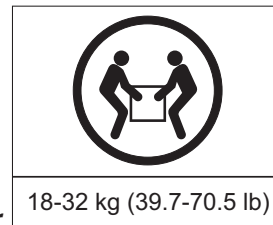
### CAUTION:



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)**

3. Make sure that you have the correct host software for your operating system. The support CD that comes with the DS3200 has the correct IBM DS3000 Storage Manager Version 2 host software. The CD also includes the DS3000 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 Storage Manager host software or DS3200 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 that are required for the DS3200
- 5/16 (8 mm) hex nut driver
- #0 and #1 Phillips screwdrivers
- Electrostatic-discharge protection (such as a grounding wrist strap)
- Ethernet interface cables and cable straps

- Rack power jumper cords that come with the DS3200
- Rack-mounting hardware that comes with the DS3200
- SAS cables (1-meter or 3-meter)

## Preparing the site

This section lists the floor space requirements and weight information for the DS3200. For information about interface cables and connections, see Chapter 3, “Cabling the storage subsystem,” on page 23.

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

- Sufficient space to install the DS3200
- Enough stability to support the weight of the fully configured DS3200 and associated systems (A fully configured DS3200 weighs 30 kg [66 lb].)

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

Continue with “Installing the DS3200 in a rack cabinet.”

---

## Installing the DS3200 in a rack cabinet

To install the DS3200 in a rack cabinet, follow the instructions in the *Rack Installation Instructions* that come with the DS3200. Then, continue with Chapter 3, “Cabling the storage subsystem,” on page 23.





## Chapter 3. Cabling the storage subsystem

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

### SAS controller connectors

Figure 13 shows controller A, the host ports, and the drive expansion port at the rear of a single-controller DS3200 storage subsystem.

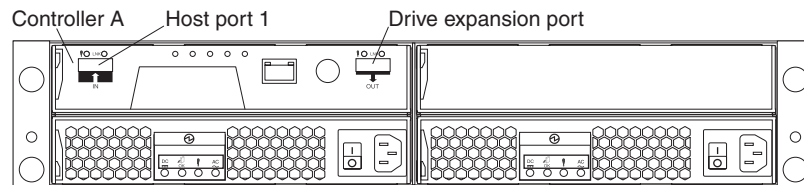


Figure 13. Single-controller DS3200 storage subsystem ports and controller

Figure 14 shows an optional host port adapter installed in both controllers. Controllers A and B, the host ports, and the drive expansion ports at the rear of a dual-controller DS3200 storage subsystem are shown.

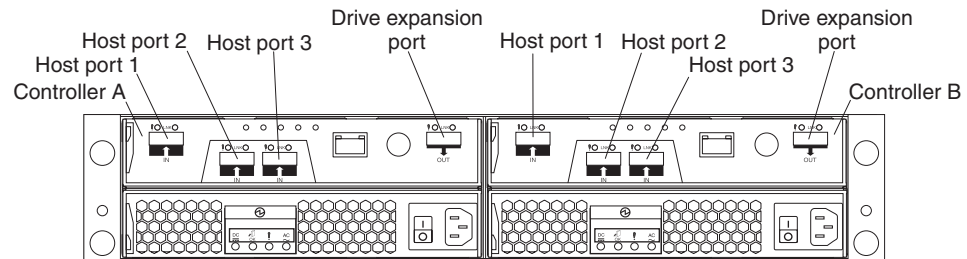


Figure 14. Dual-controller DS3200 storage subsystem ports and controllers (with an optional host port adapter)

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

The DS3200 host ports are each a x4 multilane, 3 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 controller automatically sets the enclosure ID number. You can change the setting through the storage management software, if necessary. Both controller enclosure ID numbers are identical under normal operating conditions.

The allowable range of enclosure ID settings is 0 through 99. However, for best results, do not set the enclosure ID to 00 or any number less than 80. The DS3200 enclosure ID is normally set to a value of 85 at the factory.

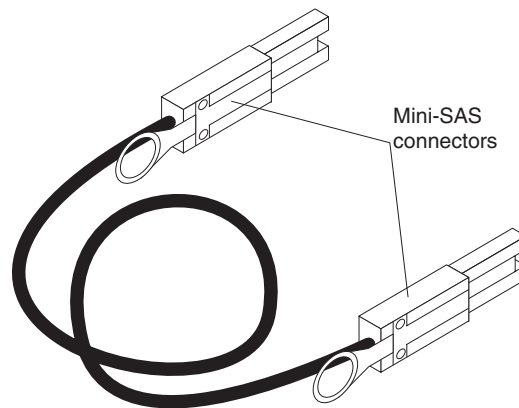
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## Working with SAS cables

Each DS3200 RAID controller has up to three 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 a storage expansion enclosure.

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



*Figure 15. 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 cabinet.
- 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.

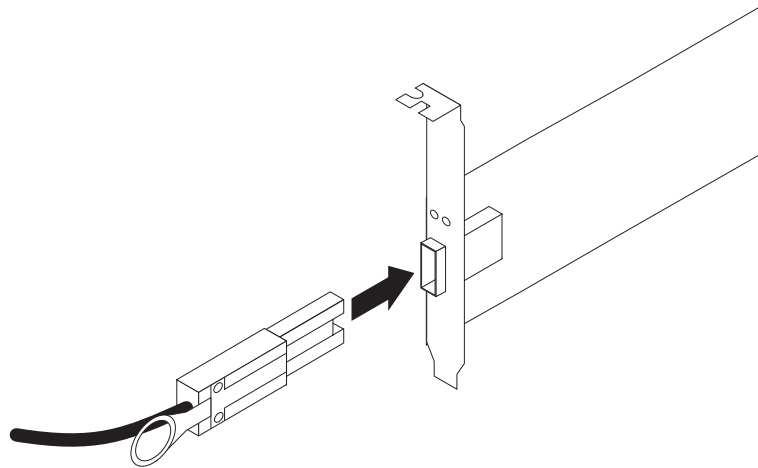


Figure 16. Connecting a mini-SAS cable

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.

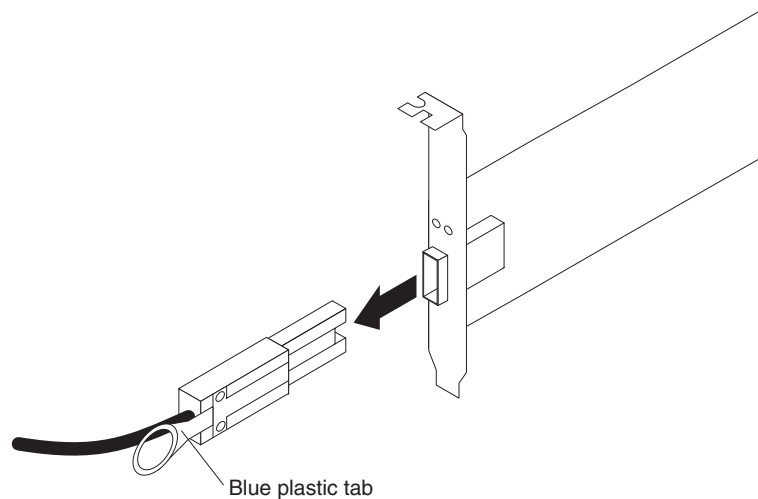


Figure 17. Removing a mini-SAS cable

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

---

## Connecting storage expansion enclosures to the DS3200

### Attention

Before you power-on the storage subsystem, it must contain at least four drives. If at least four drives are not installed in each attached storage expansion enclosure and in the DS3200 storage subsystem, when you power-on the DS3200 and its attached storage expansion enclosures, your standard storage partition key might be lost and must be regenerated, using instructions at <http://www.ibm.com/storage/fasttkeys/>.

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear to have failed, falsely indicating that the power supplies are bad. All drives in the DS3200 storage subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

In the initial installation of the DS3200, you can add only *new* storage expansion enclosures to the DS3200 storage subsystem. This means that there must be no existing configuration information about the storage expansion enclosures that you want to install.

**Note:** In this document, EXP3000 storage expansion enclosures are used as examples in text and illustrations.

If the storage expansion enclosures that you want to install currently contain logical drives or configured hot spares and you want them to be part of the DS3200 storage subsystem configuration, see the *IBM DS3000 Storage Manager Version 2 Installation and Support Guide*, which is in the Documentation folder on the IBM

System Storage DS3000 Support CD. Incorrect drive migration might cause loss of configuration and other storage subsystem problems. Contact your IBM technical-support representative for additional information.

## Redundant drive channel pair

Each RAID controller on the DS3200 has a drive expansion channel that contains an x4 SAS port. The storage 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 48. In a dual-controller DS3200, one drive channel from each controller combines to form a redundant drive-channel pair.

Figure 18 shows an example of a redundant drive-channel pair. If any component of the drive channel fails, the RAID controllers can still access the storage expansion enclosures in the redundant drive-channel pair.

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

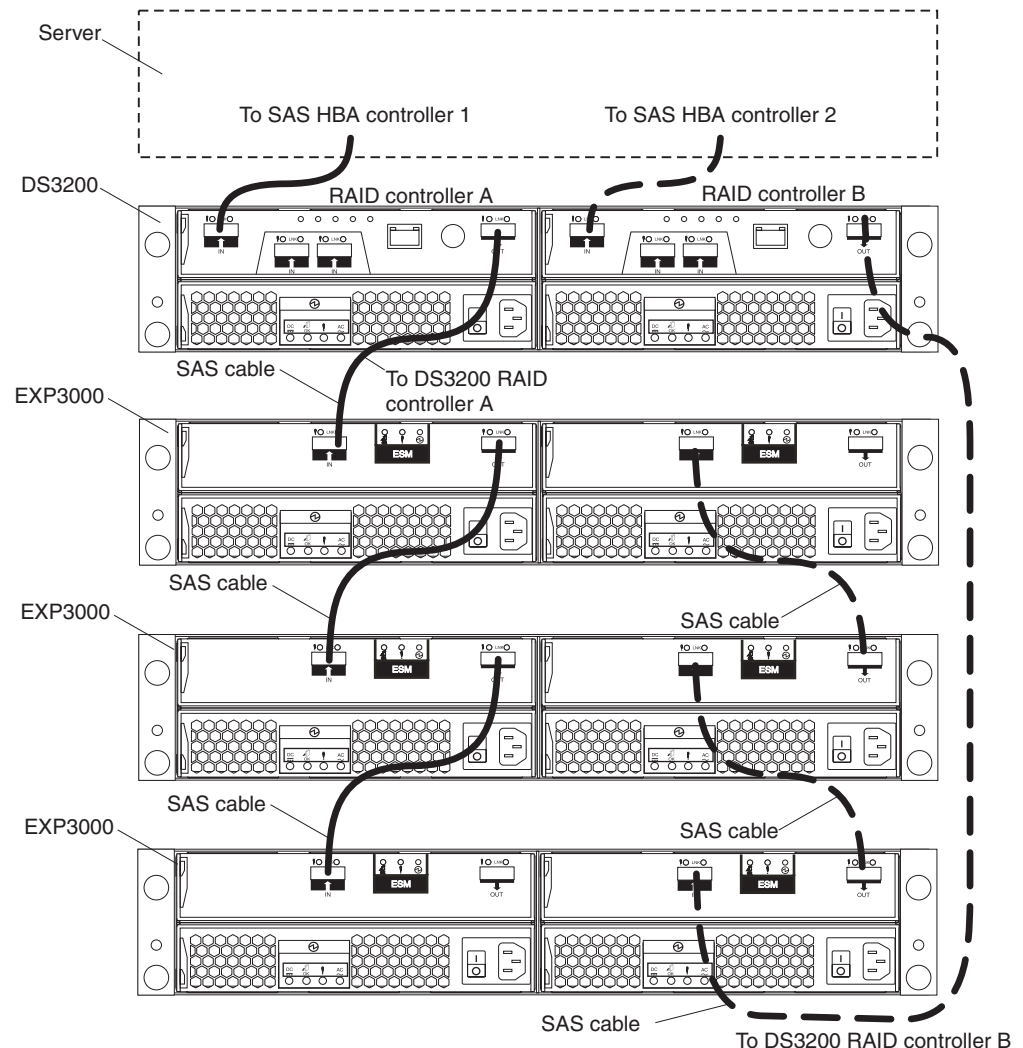


Figure 18. Example of a redundant drive path

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

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

1. Follow the instructions in the *Installation, User's, and Maintenance Guide* for your storage expansion enclosure and the *Rack Installation Instructions* to set up and mount the storage expansion enclosures.
2. Select a cabling topology applicable to the number of ESMs in the storage expansion enclosures that you will connect to the DS3200. If you are connecting external storage expansion enclosures to the DS3200, make sure that each storage expansion enclosure contains at least four drives before you power it on. In addition, make sure that the DS3200 storage subsystem contains at least four drives before you power it on.  
"DS3200 storage subsystem drive cabling topologies" describes the recommended schemes for cabling storage expansion enclosures with one ESM or two ESMs to the DS3200 and to each other (if you are connecting more than one storage expansion enclosure).
3. Follow the cabling diagram for your chosen topology.
4. If required, set unique enclosure IDs for all storage expansion enclosures that are cabled to the DS3200. See the *DS3000 Storage Manager Version 2 Installation and Support Guide* for information about setting the enclosure ID.

The DS3200 storage subsystem locates the drives in the storage expansion enclosures after you power-on the configuration. Always turn on the storage expansion enclosures first and then turn on the DS3200. After you have powered-on the configuration, use the DS3000 Storage Manager software to check the status of the new drives, correct any errors, and configure the new drives.

## DS3200 storage subsystem drive cabling topologies

This section describes the following preferred cabling topologies for cabling storage expansion enclosures to the DS3200 storage subsystem:

- "One single-controller DS3200 and one or more storage expansion enclosures" on page 29
- "One dual-controller DS3200 and one storage expansion enclosure" on page 30
- "One dual-controller DS3200 and two storage expansion enclosures" on page 30
- "One dual-controller DS3200 and three storage expansion enclosures" on page 31

Each example provides redundant paths to the drives. If one of these examples is suitable for your hardware and application, complete the cabling connections as 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.

### Important:

1. The DS3200 supports the connection of a maximum of three storage expansion enclosures.
2. The DS3200 supports one redundant drive-channel pair.
3. In storage 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 DS3200 and one or more storage expansion enclosures

To cable one single-controller DS3200 to one or more single-ESM storage expansion enclosures, connect them as shown in Figure 19.

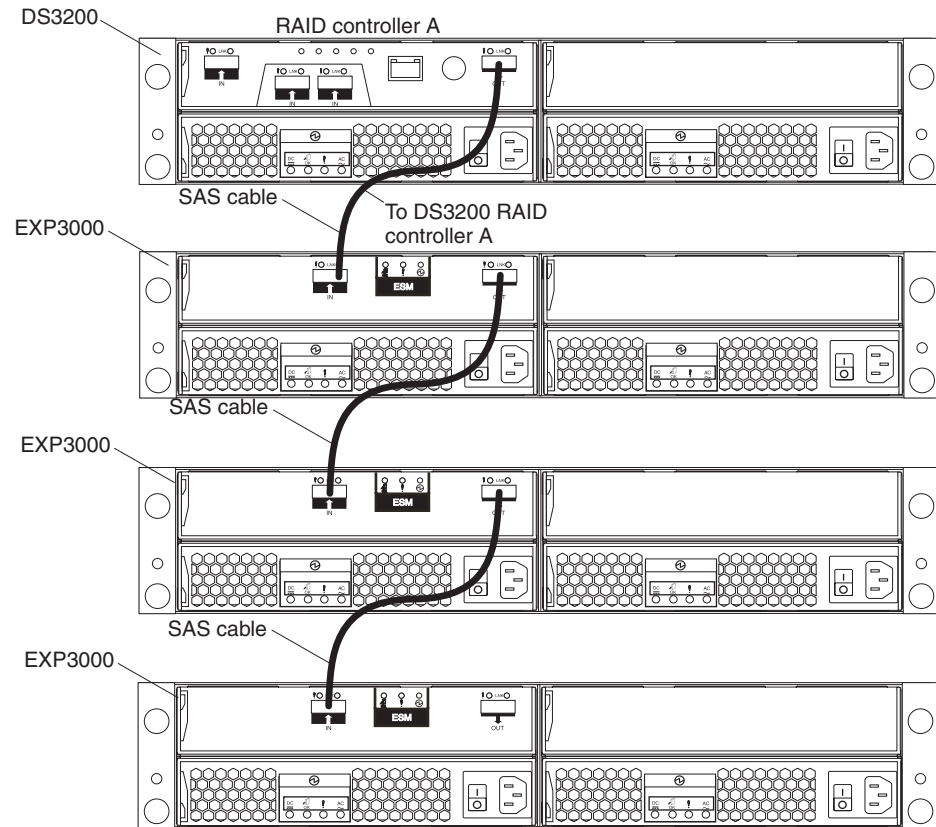


Figure 19. One single-controller DS3200 and multiple single-ESM storage expansion enclosures

**Note:** In storage 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 DS3200 and one storage expansion enclosure

To cable one dual-controller DS3200 to one storage expansion enclosure, connect them as shown in Figure 20.

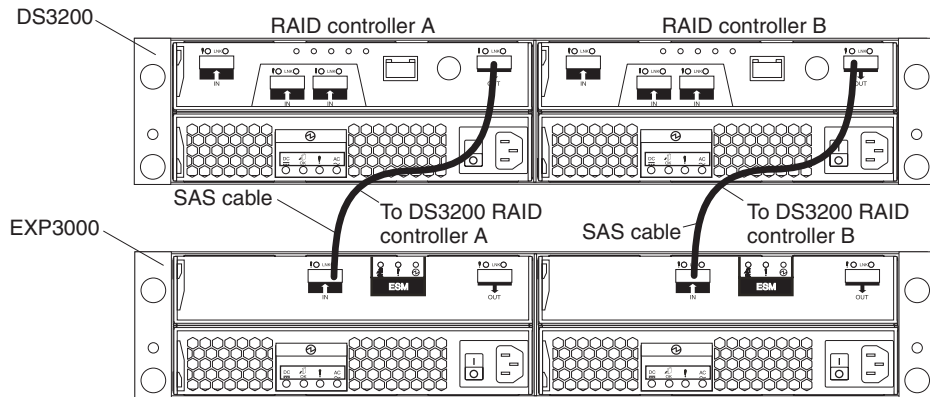


Figure 20. One dual-controller DS3200 and one storage expansion enclosure

## One dual-controller DS3200 and two storage expansion enclosures

To cable one dual-controller DS3200 and two storage expansion enclosures, connect them as shown in Figure 21.

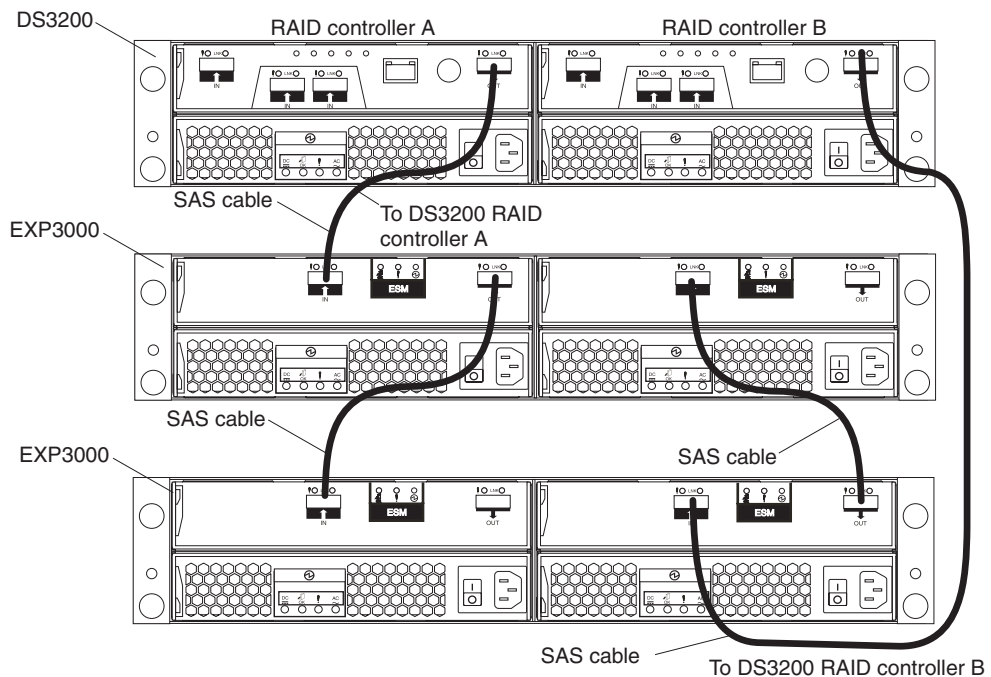


Figure 21. One dual-controller DS3200 and two storage expansion enclosures



## One dual-controller DS3200 and three storage expansion enclosures

To cable one dual-controller DS3200 and three storage expansion enclosures, connect them as shown in Figure 22.

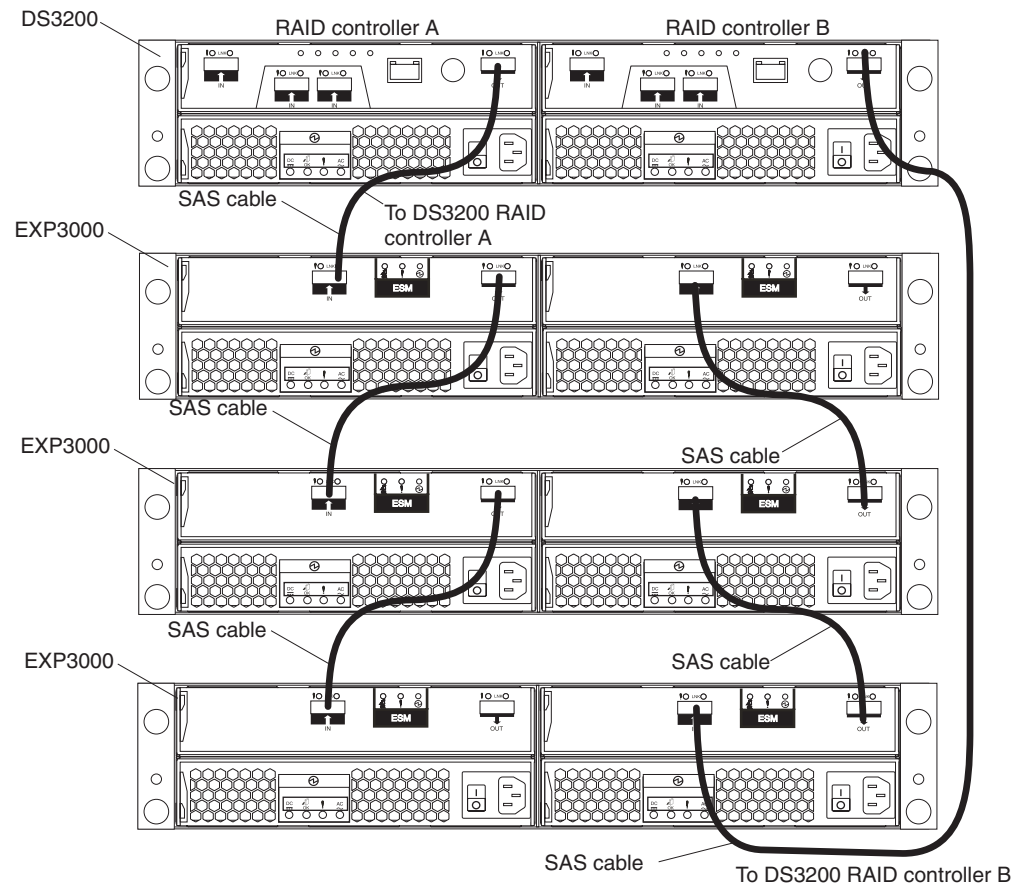


Figure 22. One dual-controller DS3200 and three storage expansion enclosures

## Adding a storage expansion enclosure to a dual-controller configuration that is running

The following procedures provide instructions for adding storage expansion enclosures to a dual-controller DS3200 storage subsystem that is running.

**Note:** Make sure that each storage expansion enclosure has two ESMs before you connect it to a dual-controller DS3200 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 storage expansion enclosure.

To add a storage expansion enclosure to a dual-controller DS3200 storage subsystem that is running, complete the following steps:

1. Make sure that the DS3200 storage subsystem status is Optimal in the Storage Manager software.
2. Use the storage expansion enclosure Rack Installation Instructions document to install the new storage expansion enclosure in the rack.
3. Connect the power cables to the new storage expansion enclosure.

4. Power-on the storage expansion enclosure.
5. Connect one end of a Serial Attached SCSI (SAS) cable to the Drive expansion port on Controller A in the DS3200 storage subsystem.
6. Connect the other end of the SAS cable to the In port on the left ESM in the storage expansion enclosure.
7. Connect one end of a second SAS cable to the Drive expansion port on Controller B in the DS3200 storage subsystem.
8. Connect the other end of the second SAS cable to the In port on the right ESM in the storage expansion enclosure.
9. Wait until the DS3200 storage subsystem status is Optimal in the Storage Manager software before proceeding to step 10.
10. Add the hard disk drives to the storage expansion enclosure. Make sure that you wait at least 30 seconds for the Storage Manager software to recognize each newly added drive before you install another drive.

To add additional storage expansion enclosures after the first expansion unit is connected to a dual-controller DS3200 storage subsystem that is running, complete the following steps:

1. Make sure that the DS3200 storage subsystem status is Optimal in the Storage Manager software.
2. Use the storage expansion enclosure Rack Installation Instructions document to install the new storage expansion enclosure in the rack.
3. Connect the power cables to the new storage expansion enclosure.
4. Power on the storage expansion enclosure.
5. Connect one end of a Serial Attached SCSI (SAS) cable to the In port on the left ESM in the storage 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 storage expansion enclosure in the configuration (this storage expansion enclosure is directly connected to the Drive expansion port on controller A of the DS3200).
7. On the last storage 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 storage 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 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 storage expansion enclosure and connect the other end to the In port on the right ESM in the storage expansion enclosure that was previously connected to controller B of the DS3200.
9. Wait until the DS3200 storage subsystem status is Optimal in the Storage Manager software before proceeding to step 10.
10. Add the hard disk drives to the storage expansion enclosure. Make sure that you wait at least 30 seconds for the 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 EXP3000 enclosure

If you are upgrading a single-controller DS3200 storage subsystem to a dual-controller DS3200 storage subsystem and there are no EXP3000 storage expansion enclosures attached to the DS3200 storage subsystem, see “Installing a controller” on page 64.

---

## Upgrading a single-controller to a dual-controller when there is one or more EXP3000 enclosures attached to the storage subsystem

Before you upgrade the DS3200 storage subsystem from a single-controller to a dual-controller, make sure that:

- You purchase a second environmental services module (ESM) for each EXP3000 storage expansion enclosure that is attached to the DS3200 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 DS3200 storage subsystem to a dual-controller DS3200 storage subsystem when there are EXP3000 storage expansion enclosures attached to the DS3200, complete the following steps:

1. Turn off the DS3200 storage subsystem and all attached EXP3000 storage expansion enclosures.
2. Install a second RAID controller in the DS3200 storage subsystem by using the instructions in “Installing a controller” on page 64.
3. Install a second ESM in each EXP3000 that is connected to the DS3200 storage subsystem:
  - a. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
  - b. Remove the ESM filler panel from the rightmost ESM bay of the EXP3000:
    - 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 EXP3000. 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 “DS3200 storage subsystem drive cabling topologies” on page 28, use SAS cables to create a redundant drive-channel path from the DS3200 RAID controllers to the EXP3000 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 36).

**Important:**

1. To minimize security risks, do not connect the DS3200 to a public LAN or public subnet. Use a local private network for the DS3200 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 23 shows the locations of the Ethernet management connectors on the DS3200 storage subsystem.

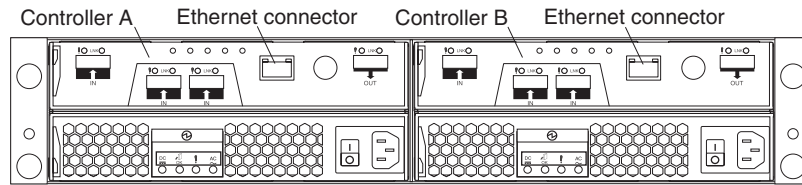


Figure 23. Ethernet port locations on a dual-controller DS3200

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## Configuring the storage subsystem

You must configure the storage subsystem after you install the storage subsystem in a rack cabinet. 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.

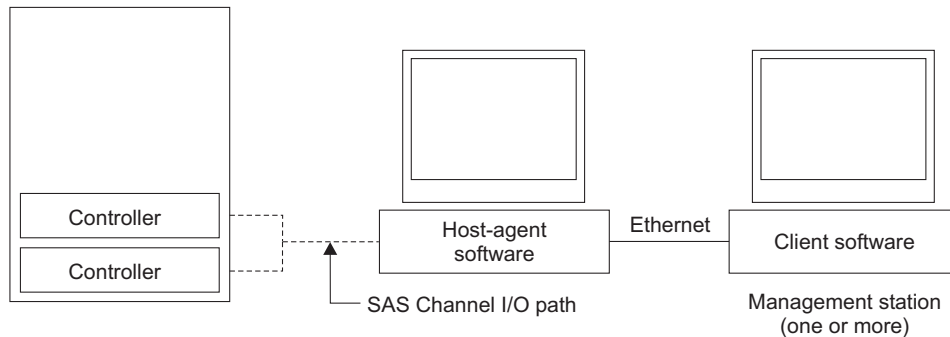
**Note:** For information about any in-band limitations or restrictions that are associated with particular combinations of controller and host bus adapter, see the DS3000 Storage Manager Version 2 readme file.

For more information about setting up in-band or out-of-band management connections, see the *DS3000 Storage Manager Version 2 Installation and Support Guide* for the operating system of the host server that you will use to manage the DS3200 storage subsystem. The *Installation and Support Guide* is in the Documentation folder on the IBM System Storage DS3000 Support CD.

**Important:** If the operating system of the host server that the storage subsystem logical drives are mapped to is not Microsoft Windows 2000 or Windows Server 2003, 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 DS3000 Storage Manager client program to manage the DS3200 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 24 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 24. 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 25 on page 37 shows the direct (out-of-band) management method.

**Note:** Do not connect the DS3200 storage subsystem Ethernet ports to a public network or public subnet. To minimize security risks, create a private network between the DS3200 storage subsystem and the management station.

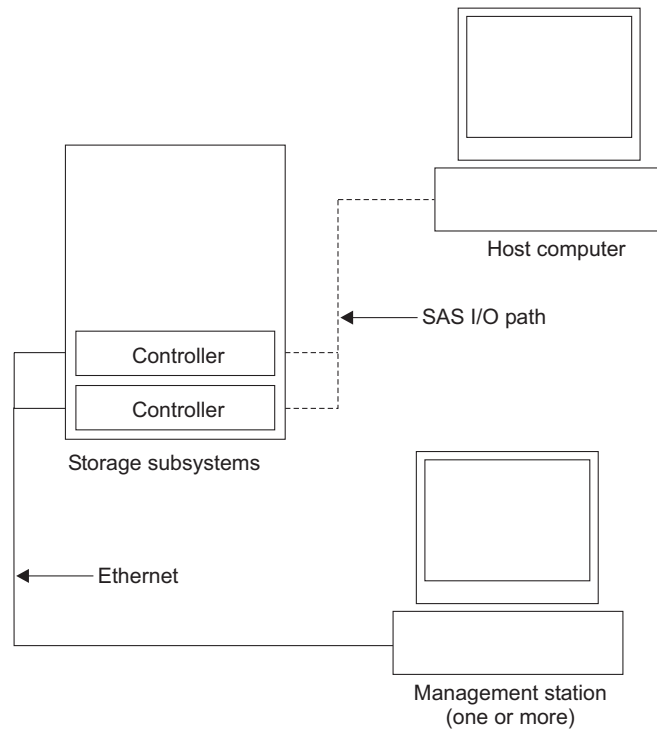


Figure 25. Direct (out-of-band) managed storage subsystems

## Installing the storage subsystem configuration

Using the information from the previous sections, install the host systems and host bus adapters (HBAs).

### Notes:

1. See the documentation that comes with the HBAs for installation requirements and procedures.
2. Use the correct HBA device driver. For the latest supported HBAs and device drivers, go to <http://www.ibm.com/servers/storage/support/disk/>

Attach a SAS cable to each HBA. Continue to “Connecting hosts to the DS3200” to connect the other end of each cable to a controller.

## Connecting hosts to the DS3200

The DS3200 can support up to fourteen hosts when attached to the SAS Connectivity Module for IBM BladeCenter and up to three hosts in a direct attached host environment. The number of supported hosts depends on the number of host ports installed on the DS3200 RAID controller. To protect against the loss of any one path from the host servers to the DS3200 storage subsystem, use redundant host connections.

**Note:** In a single-controller storage subsystem, the use of redundant host connections is possible only when the optional SAS host port adapter is installed in the controller. This provides path failover but limits the number of redundant host connections to one.

To connect a SAS host bus adapter (HBA) to the DS3200 storage subsystem, complete the following steps:

1. Connect a SAS cable from the DS3200 RAID controller host port to the SAS HBA that is in the host. Figure 13 on page 23 shows the location of the DS3200 host ports.
2. Create a redundant host connection:
  - If the DS3200 is a single-controller storage subsystem, connect a SAS cable from the second SAS HBA to another host port on the DS3200 RAID controller. You can create a maximum of one redundant host connection to a single-controller DS3200.
  - If the DS3200 is a dual-controller storage subsystem, connect a SAS cable from the second SAS HBA to a host port on the other RAID controller on the DS3200. You can create a maximum of three redundant host connections to a dual-controller DS3200.

See “Direct-attached single-controller connections” and “Direct-attached dual-controller connections” on page 40 for illustrations of host connections.

### Direct-attached single-controller connections

The following illustration shows a direct-attached SAS connection to a single host HBA.

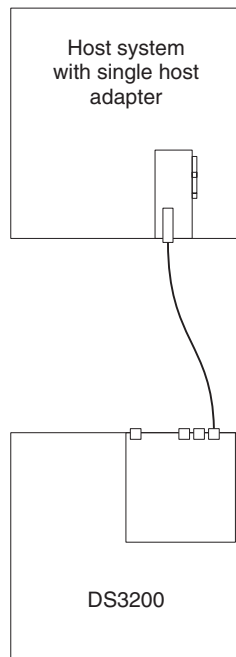


Figure 26. Single-controller direct-attached connection to a single-host HBA



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

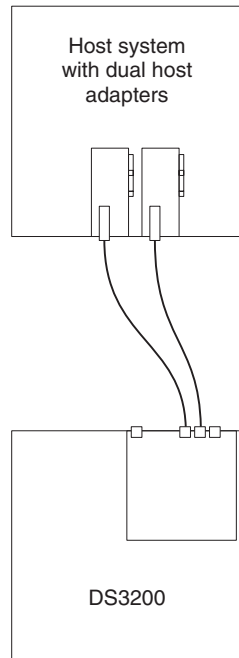


Figure 27. Single-controller direct-attached connection to dual HBAs in a single-host (redundant host connection)

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

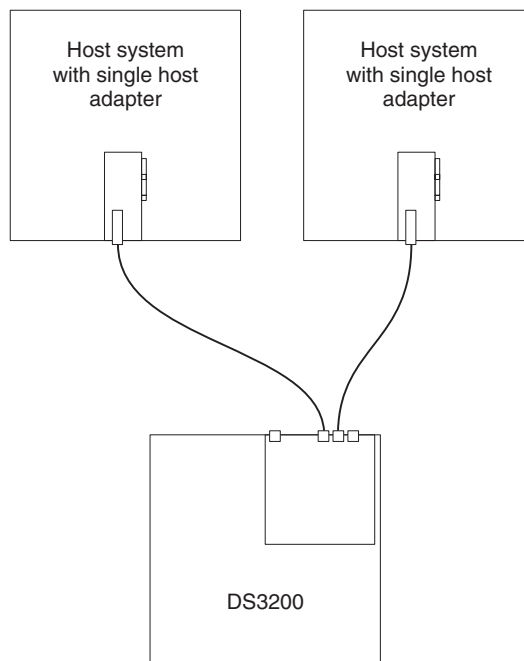
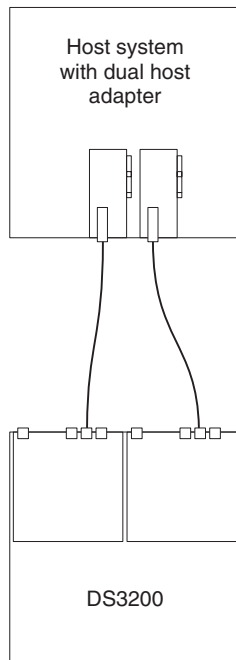


Figure 28. Single-controller direct-attached connection to single HBAs in multiple hosts

## 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 29. Dual-controller direct-attached 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.

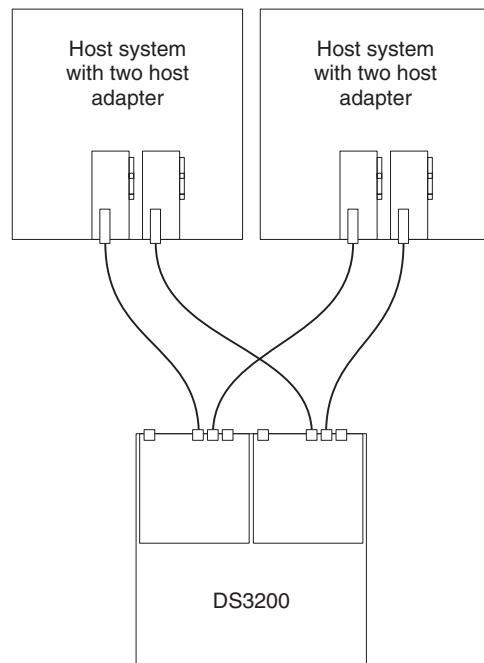


Figure 30. Dual-controller direct-attached connections to multiple HBAs in multiple hosts

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## Overview of installing an IBM BladeCenter configuration to connect to a DS3200

This section gives an overview and guidelines for installing an IBM BladeCenter configuration to connect to a DS3200.

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 DS3200, 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 DS3200. 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 DS3200.”

## Connecting BladeCenter hosts to the DS3200

The dual-controller DS3200 comes with one SAS host connector on each controller, enabling up to 14 blade servers in one BladeCenter unit to be redundantly connected to the DS3200.

To protect against the loss of any one path from the host blade servers to the DS3200, use redundant host connections. Figure 31 shows the locations of controllers A and B and the host connectors at the rear of the DS3200.

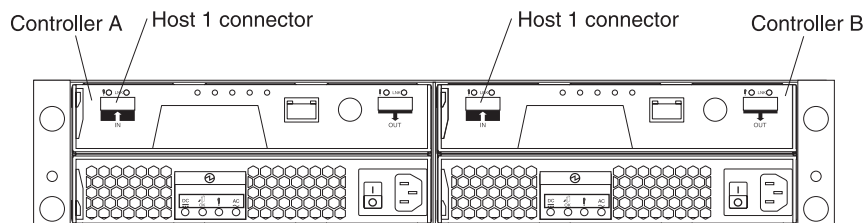


Figure 31. DS3200 controller connectors

To connect a SAS expansion card that is installed in a blade server to the DS3200, complete the following steps:

1. Connect a SAS cable from the SAS host connector on the DS3200 RAID controller to any SAS port on an IBM BladeCenter SAS Connectivity Module that is installed in a BladeCenter unit.
 

**Attention:** The optional SAS host port adapter with its two additional SAS connectors is not supported in this configuration. You must use the SAS host connector on the controller.
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 DS3200. You can create a maximum of two redundant host connections in a dual-controller DS3200.
 

**Attention:** You can connect only one DS3200 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 EXP3000 storage expansion enclosures to the DS3200. For an illustration showing how to configure the storage expansion enclosures, see Figure 18 on page 27.

Figure 32 shows an example of a DS3200 that is connected to one BladeCenter unit.

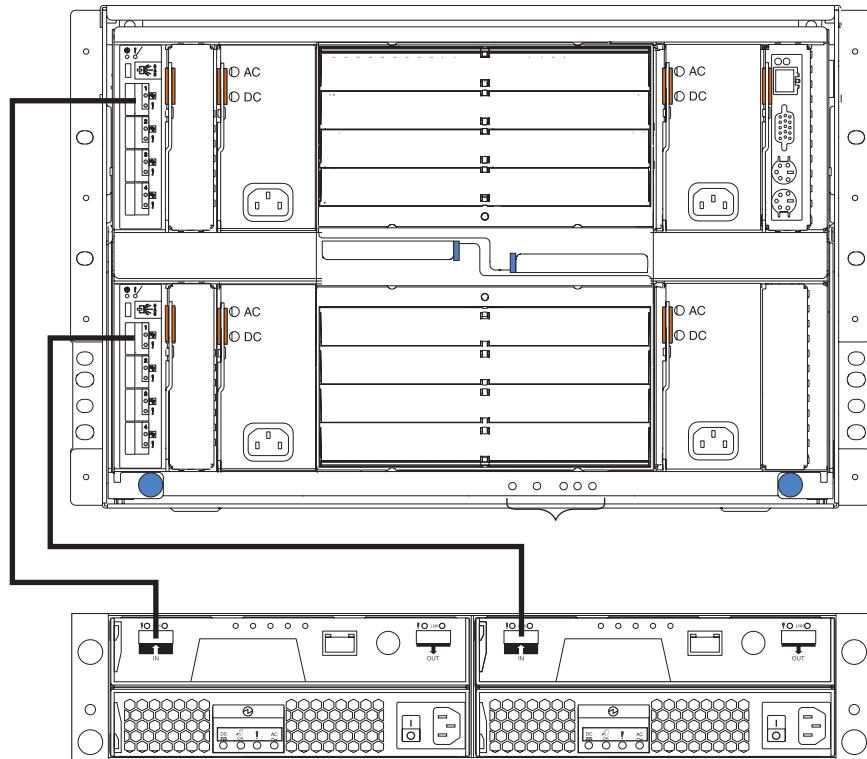


Figure 32. Example of a DS3200 that is connected to one BladeCenter unit

## Cabling the DS3200 power supplies

To connect the DS3200 power-supply cords, complete the following steps:

1. Connect a power cord to a power supply in the DS3200.
2. Attach the power cord to the strain relief guide that is on the underside of the power-supply handle.
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.



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## Chapter 4. Operating the storage subsystem

This chapter describes operating procedures for the DS3200.

To ensure optimal operation of the storage subsystem, see “Best practices guidelines” on page 6.

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### Performing the DS3000 Health Check process

The DS3000 Health Check process is a sequence of suggested actions that were developed by IBM to help you verify and maintain the optimal performance of the DS3200 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 DS3200 storage subsystems and after all configuration sessions. Set a regular schedule of periodic Health Check evaluations to keep the DS3200 code current and to preserve optimal data access and performance.

1. Monitor the Recovery Guru in the Storage Manager software for any obvious storage subsystem errors or problem conditions.
2. Gather and save the following DS3200 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 DS3000 Storage Manager Subsystem Management window.)
  - DS3200 storage subsystem management event log (MEL)
  - Storage Subsystem Profile or DS3200 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 DS3200 storage configuration failure. Do not save these event log files only to a LUN in the DS3200 storage subsystem.

3. Use the Storage Subsystem Profile or DS3200 Profile to make sure that the following firmware levels are at the latest versions that the DS3200 storage subsystem supports:
  - 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 DS3200 storage configuration. See “Overview” on page 1 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 DS3200 storage configuration failure.

4. Use the Storage Subsystem Profile or DS3000 Profile to make sure that the following functions are enabled:
  - For all DS3000 models, enable Media Scan both at the controller level and at the LUN level.
  - For all DS3000 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 DS3200 storage configuration. Periodically inspect the components of the DS3200 storage configuration.

For best results, follow these guidelines:

- Maintain an up-to-date storage subsystem profile for the DS3200 storage configuration. Save the profile to a server disk that will remain accessible in case of a DS3200 storage configuration failure. Do not save the profile only to a LUN in the DS3200 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 the applicable sections of this document.

In addition to these inspection and maintenance responsibilities, conduct DS3200 training for staff that support DS3200 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.

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## 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 55 contains instructions for turning off the storage subsystem under normal and emergency situations. When you turn on and turn off the DS3200, 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 57.



The following procedure addresses two situations:

- The entire storage subsystem has been shut down (the main circuit breakers for the rack cabinet are off).
- Some storage expansion enclosures are being powered-on while others remain online (the main circuit breakers for the rack cabinet are on). You might encounter this if you are adding a storage 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 DS3200 or storage 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 storage expansion enclosure in the rack cabinet 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 storage expansion enclosure before you turn on power to the DS3200 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 storage expansion enclosure that is attached to the storage subsystem. While each storage expansion enclosure powers up, the green and amber LEDs on the front and rear of the storage expansion enclosure turn on and off intermittently. Depending on the configuration, it can take several minutes for each storage expansion enclosure to power-on.

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

5. Turn on both ac power switches on the rear of the storage subsystem. Figure 33 shows the locations of the ac power switches on the DS3200.

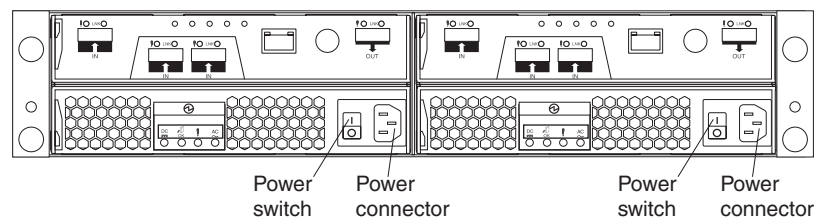


Figure 33. Power-supply switches and connectors for the DS3200

Depending on the number of storage 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 storage 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 storage expansion enclosures. Make sure that all the LEDs show normal status. For more information about LED status for storage expansion enclosures, see “Checking the LEDs” on page 52 or the *Installation, User’s, and Maintenance Guide* for the storage expansion enclosure.
  - 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 99.
  - c. Open the DS3000 Storage Manager 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 DS3000 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 99.
  - 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.

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## Installing the DS3000 Storage Manager Client

See the *IBM System Storage DS3000 Storage Manager Version 2 Installation and Support Guide* for the applicable operating system for instructions for installing the Storage Manager software. The *Installation and Support Guide* is in the Documentation folder on the *IBM System Storage DS3000 Support CD*. 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 DS3000 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 storage 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 DS3000 Storage Manager guide for the operating system. Save the profile in a location other than the logical drives that are created for the DS3200.

Always see the readme file that is included with the DS3200 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 DS3000 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 DS3000 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 DS3000 Storage Manager Event Monitor service as part of the storage-management software installation, the DS3000 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 *IBM System Storage DS3000 Storage Manager Version 2 Installation and Support Guide* for the applicable operating system for instructions for installing the DS3000 Storage Manager Version 2 software. The *Installation and Support Guide* is in the Documentation folder on the *IBM System Storage DS3000 Support CD*.

To download the latest version of the DS3000 Storage Manager software, the DS3200 storage subsystem controller firmware and NVSRAM, and the latest DS3000 ESM firmware, go to <http://www.ibm.com/servers/storage/support/disk/>.

The DS3000 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 DS3000 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 DS3000 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 DS3000 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 DS3200 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 storage expansion enclosures, the storage expansion enclosure ESM firmware, the DS3200 controller firmware, the hard disk drive firmware, and the NVSRAM (for controllers only) 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 Storage Manager software updates or any important information about the DS3000 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 storage expansion enclosures
2. Controller firmware
3. Controller NVSRAM
4. Drive firmware

## Troubleshooting the storage subsystem

The DS3000 Storage Manager software is the best way to monitor the storage subsystem, diagnose a problem, and recover from a hardware failure. Run the DS3000 Storage Manager 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 DS3000 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 storage expansion enclosure, you might have to cycle the power on the DS3200 storage subsystem and all remaining storage expansion enclosures that are connected to the storage subsystem. Contact your IBM technical-support representative before you power-off any attached storage expansion enclosures.

5. Check the LEDs on the front and the rear of the storage 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” on page 52.
  - **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.

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## Checking the LEDs

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

The DS3200 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 DS3200.

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 DS3200 power supplies.

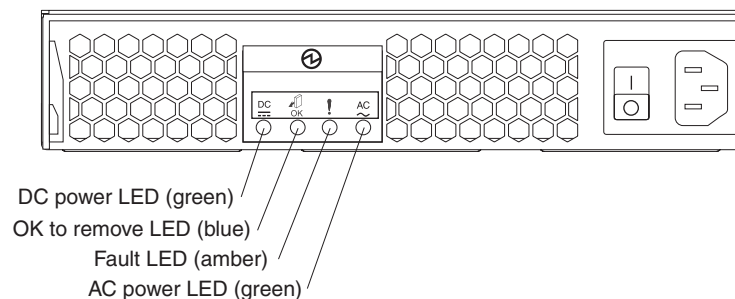


Figure 34. Power-supply LEDs

### DC power LED (green)

When this green LED is lit, it indicates that the DS3200 is turned on and is supplying both 5-volt and 12-volt dc power to the DS3200.

### OK to remove LED (blue)

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

### 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 DS3200 is receiving ac power.

## Front LEDs

This section describes the primary LEDs and controls on the front of the DS3200 storage subsystem.

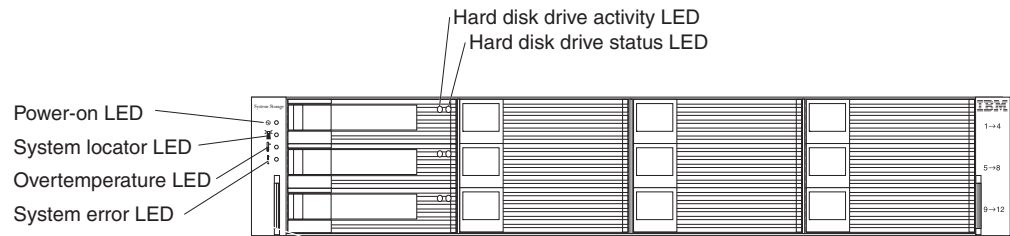


Figure 35. Front LEDs and controls

### 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 to the DS3200.

### System locator LED (blue)

This blue LED can be lit by the DS3000 Storage Manager software to aid in visually locating the DS3200.

### Overtemperature LED (amber)

When this amber LED is lit, it indicates that the DS3200 is in an overtemperature 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.

### 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 a drive identify or rebuild activity is in progress.

## Controller LEDs

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

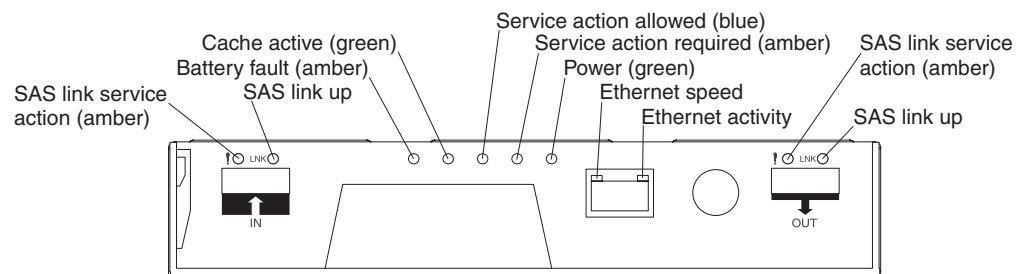


Figure 36. Controller LEDs

If the optional SAS host port adapter is installed in the RAID controller, the host port adapter contains two additional SAS host connectors with LEDs.

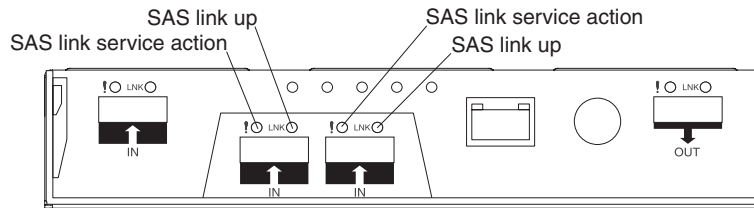


Figure 37. Host port adapter LEDs

#### **SAS link service action (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 (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.

#### **Battery fault (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.

#### **Cache active (green)**

When this LED is lit, it indicates that data is in the memory cache. When this LED is off, caching is turned off; no data is in the memory cache.

#### **Service action allowed (OK to remove) (blue)**

When this LED is lit, it indicates that it is safe to remove the controller from the DS3200; no activity is taking place, and no data remains in the memory cache. The normal condition of this LED is off.

#### **Service action required (fault) (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.

#### **Power (green)**

When this LED is lit, it indicates that the controller is receiving power. When this LED is off, the controller is not receiving power.

#### **Ethernet speed**

When this LED is lit, it indicates that the Ethernet speed between the controller and the management workstation is 100 Mbps. When this LED is off, it indicates that the Ethernet speed is 10 Mbps.

#### **Ethernet activity**

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.



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## Turning off the storage subsystem

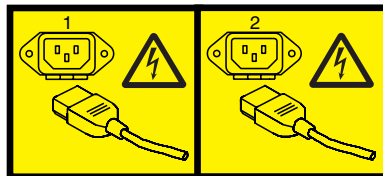
The DS3200 is designed to run continuously. After you turn it on, do not turn it off. Turn off the power only in the following situations:

- 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 57.

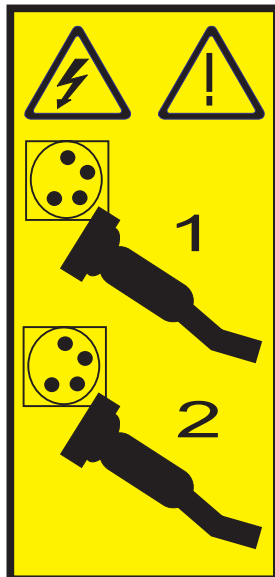
**Attention:** Except in an emergency, never turn off the power if any amber (needs attention) LEDs are lit. Correct the fault before you turn off the power. Use the DS3000 Storage Manager software and the amber LEDs to check the overall status of the DS3200. All LEDs should be green on the front of the storage subsystem. If they are not, use the DS3000 Storage Manager software to diagnose the problem so that the DS3200 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 storage 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 57. Figure 33 on page 47 shows the locations of the power switches on a storage subsystem.

Before you proceed, use the 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 storage 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 57.
  - **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 storage 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 storage expansion enclosure in the configuration.
  9. After you perform the necessary maintenance procedures, turn on the power, using the procedure in “Turning on the storage subsystem” on page 46.

## 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 DS3200 storage subsystem first and followed by the storage 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 storage expansion enclosure power switches are turned off before you reset circuit breakers in the rack cabinet. Resetting circuit breakers after an emergency situation while the storage subsystem and storage 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 46 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 DS3200 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 storage expansion enclosures and make sure that no ESM or power-supply fault LEDs are lit before you turn on the DS3200.

In addition, consider the following items:

- The storage subsystem supports simultaneous power-on of the system components; however, always follow the power-on sequence that is described in the “Turning on the storage enclosure” section of the applicable *Installation, User’s, and Maintenance Guide* during any attended power-on procedure.
- 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 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 DS3200. The green LEDs on the front and the rear of the DS3200 should remain lit. If other amber LEDs are lit, see Chapter 6, “Solving problems,” on page 99.

---

## 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-supply units 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-supply units
- Defective circuitry in a power supply
- Blocked air vents
- Failures in other devices in the configuration or rack cabinet

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 52 shows the location of the LEDs on the DS3200.

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 cabinet 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 DS3200 storage subsystem components when the power supplies automatically shut down, immediately remove all rack cabinet panels to help reduce the rack cabinet 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 51 to identify an overheating problem?
  - **Yes:** Go to step 2.
  - **No:** Perform the procedure in “Troubleshooting the storage subsystem” on page 51 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 storage expansion enclosures.
3. Take all or some of the following measures to alleviate the overheating problem:
  - Remove all panels from the rack cabinet immediately.
  - Use external fans to cool the area.
  - Shut down the power to the storage expansion enclosure, using the procedure that is described in “Performing an emergency shutdown” on page 57.
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 60.

- **No:** Go to step 6.
6. Turn off both power switches on the DS3200 (see Figure 33 on page 47) and then power-off all connected storage expansion enclosures. Wait 1 minute and then turn on power to all connected storage expansion enclosures.  
While a storage expansion enclosure powers-on, the LEDs on the front and the rear of the enclosure flash intermittently. Depending on your configuration, the storage expansion enclosure can take between 20 seconds and several minutes to power-on.
  7. Turn on both power switches on the rear of the DS3200. See Figure 33 on page 47.  
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 DS3200 flash intermittently.
  8. Check the LEDs on the front and rear of the DS3200 storage subsystem and each attached storage 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 52.
    - 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 storage expansion enclosure, if applicable.

---

## Cache memory and cache battery

Each RAID controller in the DS3200 storage subsystem supports either 512 MB or 1 GB of cache memory to store read and write operations. (Both RAID controllers in the DS3200 must have the same amount of cache memory.) The battery in each controller can maintain the data in the RAID controller cache for up to 3 days in the event that the DS3200 storage subsystem loses power.

**Attention:** There are different part numbers for a DS3200 replacement SAS controller, depending on whether the optional SAS host port adapter is installed in the existing controller. See the storage subsystem profile for information about the installed SAS host port adapter, if there is one, and see “Replaceable components” on page 105 for the correct part number for the replacement DS3200 controller.

## Cache memory

*Cache memory* is memory on the RAID controller that is used for intermediate storage of read and write data on the DS3200 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 if there is data in the cache, and it is off if there is no data in the cache.

If caching is enabled and the cache active LED 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. (In this case, the amber battery fault LED is lit.)

**Note:** Always use the DS3000 Storage Manager software to check the cache memory settings before you assume that a hardware failure has occurred.

See “Controller LEDs” on page 53 for the location of the cache active LED on a RAID controller.

## Controller cache battery

The battery in each controller provides backup power to maintain any cached data that was not written to disks, in the event of a power loss. The battery in a controller can provide power to the data cache in the controller for up to 3 days.



### **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 a battery in the DS3200 when it is identified as failing by the DS3000 Storage Manager Subsystem Management window, or when the battery fault LED on the RAID controller is lit. See “Controller LEDs” on page 53 for the location of the battery fault LED.

If the DS3200 has two RAID controllers, replace only the battery that is indicated as failed in the DS3000 Storage Manager Subsystem Management window. You do not have to replace the batteries in both controllers if only one battery has failed.

The controller performs a learn-cycle test every thirteen weeks. During the learn-cycle test, the controller cache battery is discharged and then recharged to determine the full charge capacity of the battery pack and to extend the life of the battery.

**Note:** The controller performs a learn-cycle test after a controller cache battery is replaced.

If the battery fails the learn-cycle test, the battery fault LED is lit, indicating a battery fault, and a Defect Battery error message is displayed in the event log.

In the Storage Manager software, if the battery age timer indicates that the battery is 2 years old, but the battery is not reported as failed, do not call your IBM technical-support representative to replace the battery. Instead, reset the battery age by using the procedure that is described in the Storage Manager software online help.

**Attention:** Write caching is suspended while a battery is either charging or performing learn-cycle testing.

## Controller battery age timer

The controller maintains a battery age timer for the controller cache battery. The timer is set to indicate when the battery is 2 years old. Thirty days before the battery expiration date, a warning message is displayed in the DS3000 Storage Manager software.

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

If the controller is running firmware version 07.35.41.00 or later, the controller uses a smart battery learn-cycle test. The smart battery learn-cycle determines when the cache battery is defective and needs to be replaced. The battery learn-cycle test removes the need to rely on the battery age timer to determine the expiration date of the cache battery. If the cache battery expiration message is still displayed after you replace a controller cache battery, reset the battery age timer.



---

## Chapter 5. Replacing components

This chapter contains information about replacing the storage subsystem components. It also contains information about installing an optional SAS host port adapter in a RAID controller.

**Attention:** Always replace a failed component as soon as possible. The Recovery Guru in the DS3000 Storage Manager software identifies failed components.

---

### Service action allowed LED

Each controller and power supply has a blue service action allowed LED. The purpose of the service action allowed LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any DS3200 component unless the component service action allowed LED is lit.

#### Attention

If you remove a controller or power supply when the service action allowed LED is not lit, a loss of data availability can result. If an amber LED is lit and the associated service action allowed LED is *not* lit, you must perform additional diagnostics *before* you can remove the indicated component. Use the Recovery Guru instructions in the DS3000 Storage Manager Subsystem Management window or see the applicable component replacement instructions in this chapter for the additional diagnostics that are required in this case.

The service action allowed 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 service action allowed LED stays lit when the amber LED is lit for the component.

---

### Removing a controller

**Attention:** Before you remove a controller in a single-controller DS3200, shut down the DS3200 to avoid data loss (see “Turning off the storage subsystem” on page 55).

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

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.

**Attention:** Never remove a controller unless the service action allowed 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 66.

**Attention:** Handle and install SAS cables correctly to avoid degraded performance or loss of communication with devices. When you work with SAS cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).

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

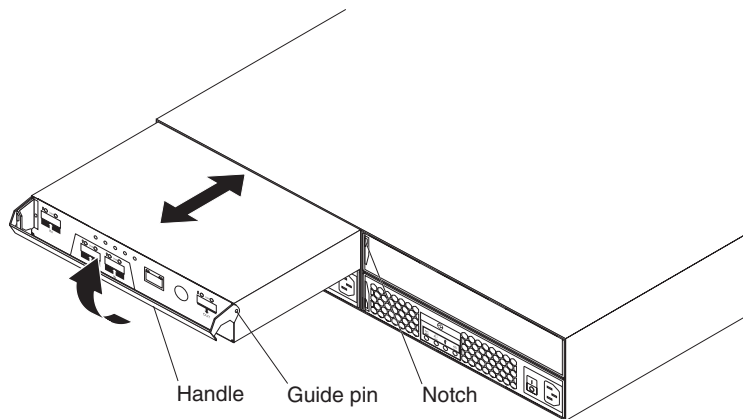


Figure 38. Removing a controller

- a. On the left side of the controller, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
- b. Slowly pull the handle away from the chassis to remove the controller from the bay, as shown in Figure 38.
- 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.

---

## Installing a controller

Use this procedure to install a new controller as the second controller, controller B (controller A is installed in the left controller bay; controller B is installed in the right controller bay).

**Attention:** Make sure that the two controllers have the same cache memory capacity and options (the optional SAS host port adapter is either installed in both controllers or is not installed in both controllers). An incompatible controller will be placed in a lockout state by the other controller in the DS3200.

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

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
2. Make sure that the second controller has the same DIMM size, and options (such as a host port adapter) as controller A.
3. Install new dual-controller NVSRAM on controller A. See “Downloading controller or NVSRAM” in the *System Storage DS3000 Storage Manager Installation and Support Guide* for information about how to download the NVSRAM software.

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

4. 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;"
```
5. Shut down the storage subsystem, and then start it again (see “Turning on the storage subsystem” on page 46). 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 on controller A and repeat steps 4 through 5.
6. Unpack the new controller. Save all packing materials in case you have to return a controller.
7. If controller A contains an optional SAS host port adapter, install an identical optional SAS host port adapter in the new controller. See “Installing an optional SAS host port adapter” on page 69 for instructions.
8. Remove the controller filler panel from the controller B bay:
  - a. On the left side of the filler panel, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
  - b. Slowly pull the handle away from the chassis to remove the filler panel from the bay, as shown in Figure 39.
  - 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.

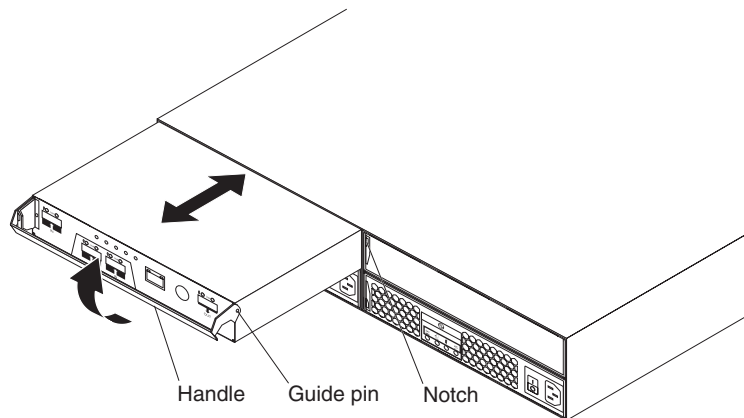


Figure 39. Installing a controller

- a. Slide the controller into the empty controller bay in the storage subsystem. Make sure that the handle is pulled straight out as you slide the controller into the bay.
  - b. Make sure that the guide pins on the side of the controller fit into the notches on the DS3200 chassis. See Figure 39.
  - c. After the guide pins fit into the notches and the controller fits snugly into the bay, push the handle downward to fully latch it into place.
10. Wait up to 5 minutes for the DS3000 Storage Manager software to recognize the new controller.
11. Connect the host interface cables to the controller. See “Working with SAS cables” on page 24.

12. Make sure that all storage expansion enclosure connections with each other have been completed (see the dual-controller topologies in “DS3200 storage subsystem drive cabling topologies” on page 28); then, connect the SAS drive expansion cable from the right ESM in the last storage expansion enclosure in the chain to the drive expansion port on controller B of the DS3200.
13. Wait up to 5 to 10 minutes for the DS3000 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 53. You can also use the DS3000 Storage Manager 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 DS3000 Storage Manager software to print a new storage subsystem profile.

---

## Replacing a controller

Use these instructions to replace a controller.

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

To replace a controller in a DS3200, 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 512 MB DIMM; if the capacity of the DIMM in the failed controller is larger than 512 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 DS3200, shut down the DS3200 before you remove the controller.
  1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
  2. In a single-controller storage subsystem, shut down the storage subsystem (see “Turning off the storage subsystem” on page 55 for the correct sequence of steps); then, continue with step 4.
  3. Use the DS3000 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 service action allowed 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 service action allowed 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 DS3000 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 SAS cables correctly to avoid degraded performance or loss of communication with devices. When you work with SAS cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).

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 57 for instructions.)
10. Remove the controller from the chassis.

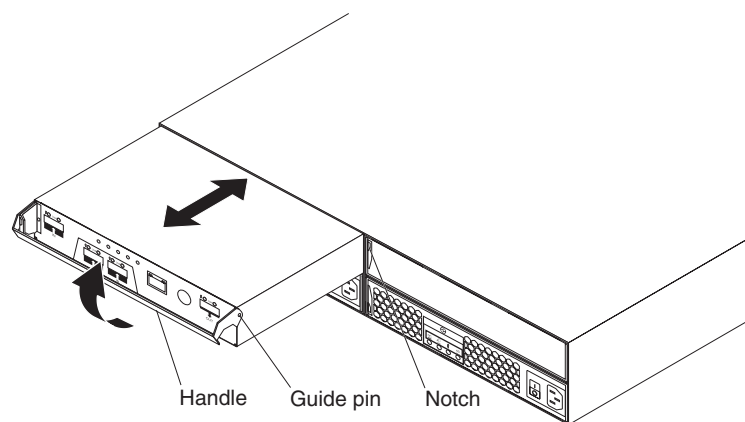


Figure 40. Removing and replacing a controller

- a. On the left side of the controller, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
- b. Slowly pull the handle away from the chassis to remove the controller from the bay, as shown in Figure 40.
- c. Place the controller on a level surface.

11. Remove the battery from the failed controller.

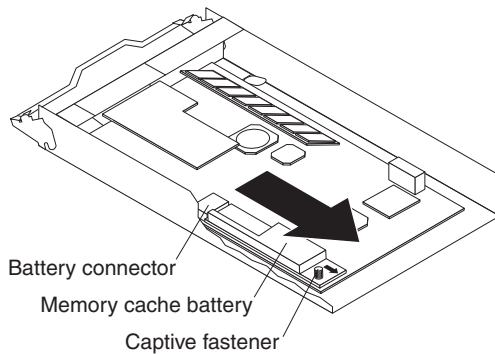


Figure 41. Removing the battery unit from the controller

- a. Turn the blue captive fastener counterclockwise 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.
12. If the capacity of the DIMM in the controller that you removed (the “old” controller) is greater than 512 MB, complete the following steps to transfer the DIMM to the new controller:
    - a. Remove the 512 MB DIMM from the new controller and set it aside (see “Replacing the memory cache DIMM” on page 89).
    - b. Wait 60 seconds (1 minute) to allow any residual charge to drain from the old controller; then, remove the DIMM from the old controller.
    - c. Insert the DIMM into the new controller (see “Installing the DIMM” on page 91 for instructions).
  13. Install the battery from step 11 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.
  14. Install the new controller.

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

    - a. Slide the controller into the empty controller bay in the storage subsystem. Make sure that the handle is pulled straight out as you slide the controller into the bay.
    - b. Make sure that the guide pins on the side of the controller fit into the notches on the DS3200 chassis. See Figure 40 on page 67.
    - c. After the guide pins fit into the notches and the controller fits snugly into the bay, push the handle downward to fully latch it into place.
  15. Connect the cables that you disconnected in step 8 on page 67.
  16. **(Single-controller only)** Turn on the DS3200 (see “Turning on the storage subsystem” on page 46).
  17. Wait up to 5 minutes for the DS3000 Storage Manager software to recognize the new controller.
  18. Complete any remaining Recovery Guru procedures for controller replacement.

19. Check the LEDs on the new controller to make sure that the controller is fully operational.
20. Use the DS3000 Storage Manager Subsystem Management window to check the status of all components in the storage subsystem.
  - If the new controller is online and the DS3000 Storage Manager Subsystem Management window indicates normal operation, go to step 23.
  - If the new controller is online and the DS3000 Storage Manager Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 51.
  - If the new controller is offline, continue with step 21.
21. If the newly inserted controller is in an offline state, see the DS3000 Storage Manager online help for instructions on bringing the controller online. If necessary, open the DS3000 Storage Manager Subsystem Management window and place the controller online; select the offline controller and click **Advanced** → **Recovery** → **Place controller online**.
22. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 53. You can also use the DS3000 Storage Manager 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 23.
23. Use the DS3000 Storage Manager software to print a new storage subsystem profile.

---

## Installing an optional SAS host port adapter

**Note:** The DS3200 SAS 2-Port Daughter Card option is referred to in this document as *host port adapter*.

This section explains how to install an optional SAS host port adapter into a controller.

**Attention:** If you install a host port adapter in a controller, you must make sure that an identical host port adapter is installed in the other controller on the DS3200, for correct operation of the controllers.

The SAS host port adapter adds two additional host ports to the controller.

To install a SAS 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 55.

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
2. Turn off the storage subsystem (see “Turning off the storage subsystem” on page 55).
3. Disconnect the cables that are connected to the controller.

4. Remove the controller from the chassis.

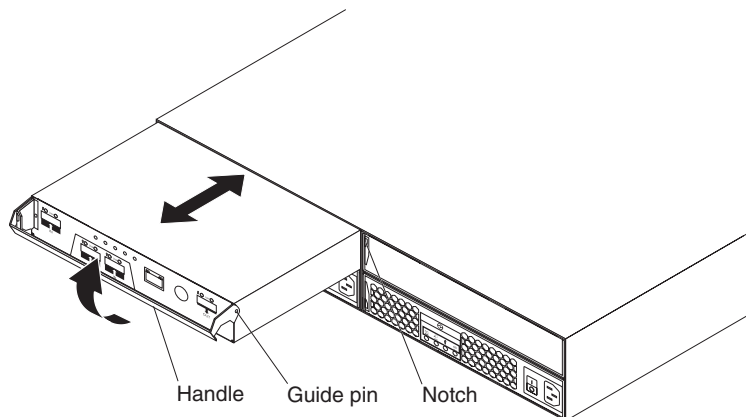


Figure 42. Removing and replacing controller A

- a. On the left side of the controller, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
  - b. Slowly pull the handle away from the chassis to remove the controller from the bay, as shown in Figure 42.
  - c. Turn over the controller and lay it on a flat, static-protective surface.
5. Remove the two screws that connect the SAS host port adapter filler panel to the controller and lift the filler panel out of the controller. Set the screws aside.

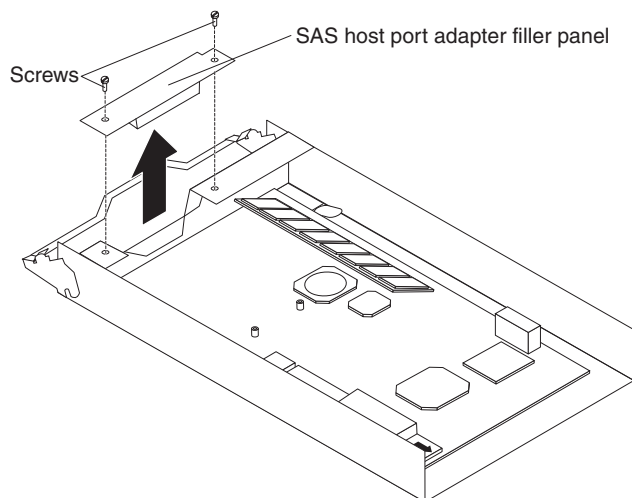


Figure 43. Removing the SAS host port adapter filler panel

6. Touch the static-protective package that contains the SAS host port adapter to any unpainted metal surface on the DS3200; then, remove the adapter from the package.



7. Align the SAS host port adapter as shown in the following illustration. Secure the front end of the adapter to the controller with the two screws that you removed in step 5 on page 70, and then tighten the two blue captive fasteners.

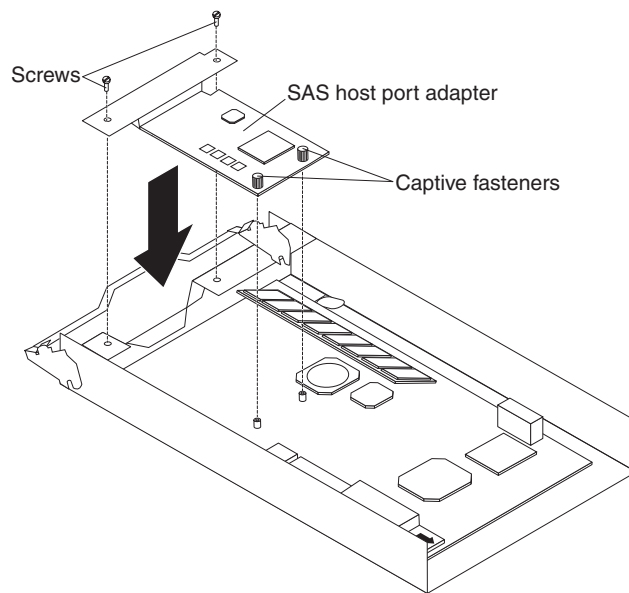


Figure 44. Installing a SAS host port adapter

8. Insert the controller into the chassis:
  - a. Slide the controller into the empty controller bay in the storage subsystem. Make sure that the handle is pulled straight out as you slide the controller into the bay.
  - b. Make sure that the guide pins on the side of the controller fit into the notches on the DS3200 chassis. See Figure 42 on page 70.
  - c. After the guide pins fit into the notches and the controller fits snugly into the bay, push the handle downward to fully latch it into place.
9. Reconnect the cables that you disconnected in step 3 on page 69.
10. Turn on the DS3200 (see “Turning on the storage subsystem” on page 46).
11. Wait up to 5 minutes for the DS3000 Storage Manager software to recognize the controller.
12. Check the LEDs on the controller to make sure that the controller is fully operational.
13. Use the DS3000 Storage Manager Subsystem Management window to check the status of all components in the storage subsystem.
  - If the controller is online and the DS3000 Storage Manager Subsystem Management window indicates normal operation, go to step 16 on page 72.
  - If the controller is online and the DS3000 Storage Manager Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 51.
  - If the controller is offline, continue with step 14.
14. If the newly inserted controller is in an offline state, see the DS3000 Storage Manager online help for instructions on bringing the controller online. If necessary, open the DS3000 Storage Manager Subsystem Management window and place the controller online; select the offline controller and click **Advanced** → **Recovery** → **Place controller online**.

15. Verify the state of the LEDs on the newly inserted controller. See “Controller LEDs” on page 53. You can also use the DS3000 Storage Manager 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 16.
16. Use the DS3000 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 xi 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 without a full set of drives (12) 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 of the 12 bays must always contain either a filler panel or a hot-swap hard disk drive.
- **Drives:**
  - The DS3200 supports 3 Gbps SAS or SATA hard disk drives.
  - 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.

### Attention

Before you power-on the storage subsystem, it must contain at least four drives. If at least four drives are not installed in each attached storage expansion enclosure and in the DS3200 storage subsystem, when you power-on the DS3200 and its attached storage expansion enclosures, your standard storage partition key might be lost and you must regenerate it, using instructions at <http://www.ibm.com/storage/fastkeys/>.

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear to have failed, falsely indicating that the power supplies are bad. All drives in the DS3200 storage subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

- **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 9 on page 110. 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.

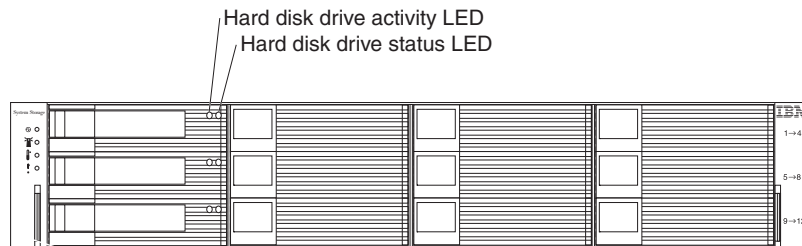


Figure 45. Hard disk drive LEDs

#### Activity LED (green)

When this LED flashes, it indicates that there is activity to the 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 DS3200 contains hardware that enables you to replace a failed hard disk drive without turning off the storage subsystem. You can continue to operate the DS3200 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 9 on page 110 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 xi and “Best practices guidelines” on page 6.

**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 DS3200 is turned off.

3. Remove the hard disk drive.

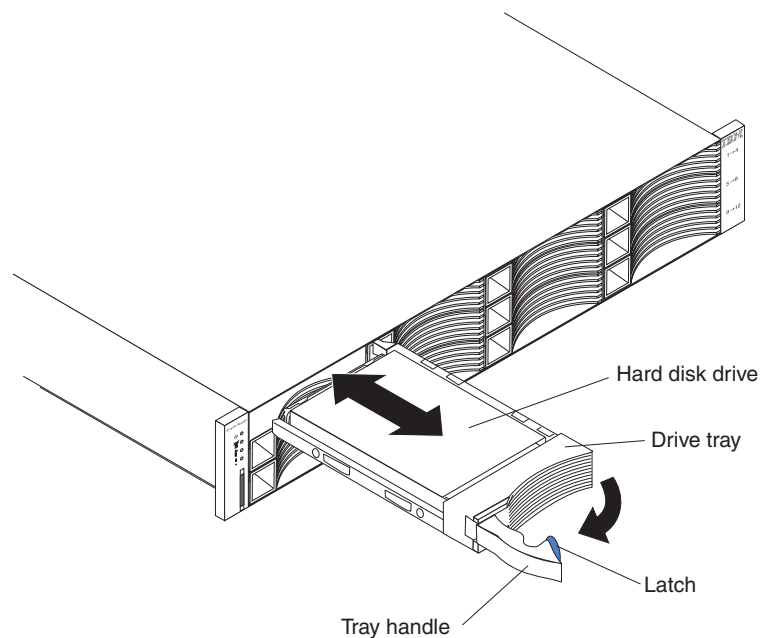


Figure 46. Removing a drive

- a. Press the latch on the right end of the tray handle to release it.
- b. Pull out the tray handle to the open position.
- c. 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.

Make sure that there is proper identification (such as a label) on the hard disk drive; then, gently slide the drive completely out of the DS3200. If the drive has failed, indicate that on the label.

4. Pull the drive out of the bay, as shown in Figure 46.
5. 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.

6. Repeat steps 3 through 5 for additional drives.

## Installing a hard disk drive

Except during the DS3200 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 reseat 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.

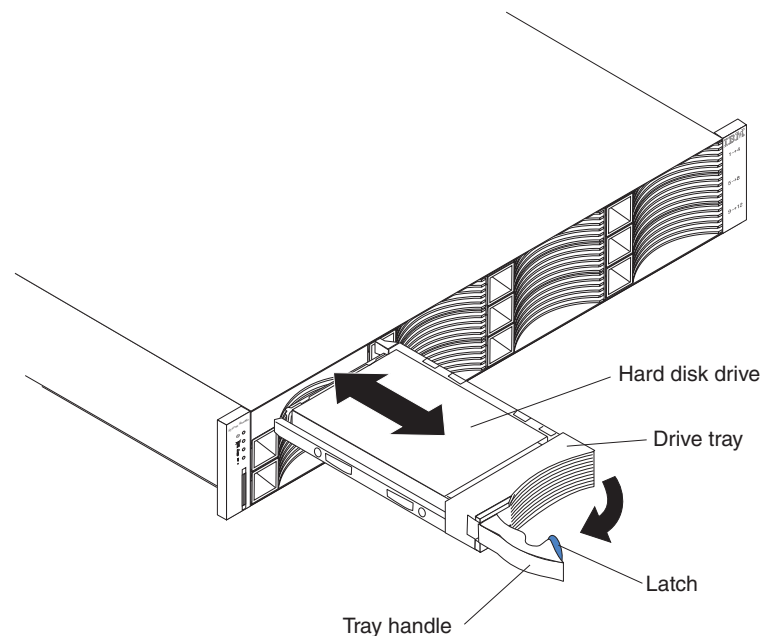


Figure 47. Installing and removing a hard disk drive

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
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. Press the latch on the right end of the drive tray handle to release it.
6. Pull out the tray handle to the open position.
7. Gently slide the drive all the way into the empty bay until the drive stops.
8. Push the tray handle into the closed (latched) position.
9. If you are installing additional drives, wait 30 seconds, and then repeat steps 5 through 8. Make sure that you 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 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 DS3200 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 xi and “Best practices guidelines” on page 6.
2. Use the DS3000 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:
  - a. Press the latch on the right end of the tray handle to release it.
  - b. Pull the tray handle out into the open position.
  - c. 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.

Make sure that there is identification (such as a label) on the drive, and then slide it completely out of the storage subsystem.

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

5. Unpack the new drive. Save all packing material in case you have to return the drive.

**Note:** Use Table 9 on page 110 to make sure that you replace the hard disk drive into the correct bay.

6. Install the new drive:
  - a. Press the latch on the right end of the tray handle to release it.
  - b. Pull out the tray handle to the open position.
  - c. Gently slide the drive all the way into the empty bay until the drive stops.
  - d. Push the tray handle into the closed (latched) position.
  - e. Wait 30 seconds for the system discovery process to be completed.
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 DS3000 Storage Manager 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 9 on page 110 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 DS3200 storage subsystem.

**Attention:** Turn off the DS3200 storage subsystem before you turn off the attached storage 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 78.

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

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

In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before 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 80.

Using this method, you can replace the drives while the storage expansion enclosures and the DS3200 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, or 5). 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 storage expansion enclosures and the DS3200, which makes the storage subsystem (and any attached storage 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 77, 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 DS3000 Storage Manager software to check the status of the DS3200. 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 storage expansion enclosures.
- b. Make sure that all of the green drive activity LEDs on the front of the storage subsystem (and on all attached storage expansion enclosures) are not flashing.
- c. Make sure that the green cache active LEDs are off. See “Controller LEDs” on page 53 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 storage 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 75 to remove the drives that you want to replace. Use the procedures in “Installing a hard disk drive” on page 75 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 off power to the storage subsystem.
- b. Turn on the storage 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 storage 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 DS3000 Storage Manager software for problem determination.

11. Use the DS3000 Storage Manager software to configure the new drives. See the DS3000 Storage Manager software online help for detailed instructions.
12. Restore the data from backup to all the drives.

### Replacing the drives one at a time

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

**Note:** If 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 reseat 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 77, 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 DS3000 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 DS3000 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 DS3000 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 75 to remove the failed drive. Use the procedures in “Installing a hard disk drive” on page 75 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 DS3000 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 DS3000 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.

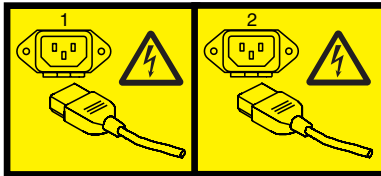
9. When reconstruction is finished on the new drive, repeat step 5 on page 81 through step 8 on page 81 for each additional drive that you want to install.
10. Use the DS3000 Storage Manager software to configure the additional space on the new drives.

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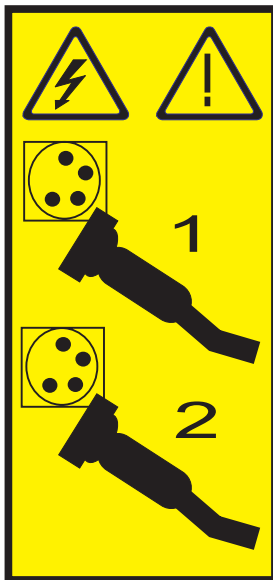
## Replacing a power supply



(L003)



or



The power-supply unit is a component that includes a 515-watt power supply and two fans. The power-supply units provide power and cooling for the DS3200. The power-supply units circulate air from the front to the rear of the storage subsystem.

The power-supply units are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported power-supply units for the specific 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 57.

If both power supplies fail or if the power supplies cannot maintain an internal temperature below 70°C (158°F), the power supplies in the storage subsystem 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 57.

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

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

To replace a power-supply unit, complete the following steps. Figure 48 on page 86 illustrates removing and inserting a unit.

**Attention:** To prevent damage to the storage subsystem components from overheating, replace a failed power-supply unit 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 DS3000 Storage Manager software to print a storage system profile.
2. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
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 unit. Save all packing material in case you have to return the failed power-supply unit.

**Note:** The new power-supply unit 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 service action allowed LED is lit. Do not remove the power supply if the LED is off. For more information about the service action allowed LED, see “Service action allowed LED” on page 63.



## 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. On the left side of the power supply, press the orange release tab to the right just enough to release the handle; then, rotate the handle downward.
11. Slowly pull the handle away from the chassis to remove the power-supply unit, as shown in Figure 48.

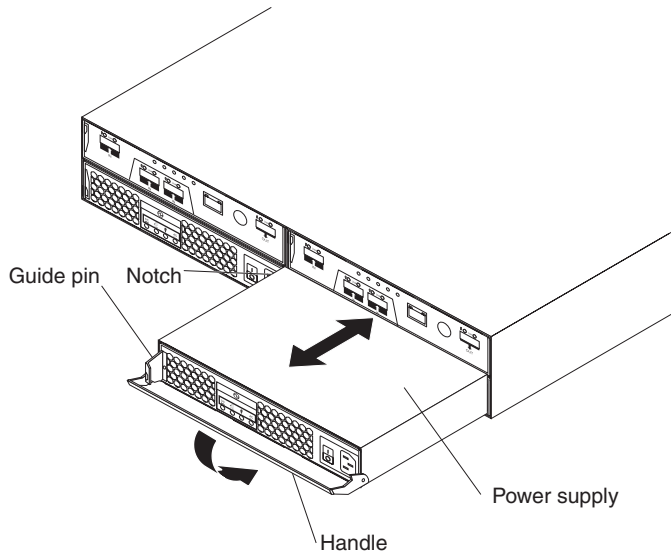


Figure 48. Replacing a power-supply unit

12. Place the power-supply unit on a level surface.
13. Slide the new power-supply unit into the power-supply bay. Make sure that the handle is pulled straight out as you slide the power-supply unit into the bay.
14. Make sure that the guide pins on the side of the power supply fit into the notches along the sides of the power-supply bay.
15. Push the handle upward to fully latch it into place. Gently push the front of the power-supply unit to make sure that it is fully seated.
16. Connect the power cord and turn on the power.
17. Check the power and fault LEDs on the new unit.
18. 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 unit is connected to. The power cord might be faulty. Go to step 19.
  - **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 20 on page 87.
19. 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 unit.  
If these tasks do not solve the problem, contact your IBM technical-support representative.
20. Complete any remaining Recovery Guru procedures, if needed.
  21. Check the status of each component in the storage subsystem.
  22. 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 23.
  23. Create, save, and print a new storage subsystem profile.

---

## Replacing a battery

Each RAID controller in the DS3200 Storage Subsystem contains a rechargeable battery that maintains data in the cache memory for 3 days without power to the unit. The cache battery is the only type of battery in the DS3200.

Use the following procedure if the DS3000 Storage Manager software instructs you to replace the battery because the current battery has failed. You can also use the DS3000 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 impact due to the disabling of the write-caching function.

The DS3200 storage subsystem controller cache battery timer is set to indicate when the battery is 2 years old. When the battery reaches 2 years of age, it does not mean that the battery has failed; but the battery might not be capable of maintaining cached controller data for up to 3 days in the event of a subsystem loss of power.

### Attention:

1. If you are also removing the memory cache DIMM, do not start with this procedure; instead, follow the instructions in “Replacing a controller” on page 66.
2. 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 DS3000 Storage Manager software to print a storage subsystem profile.
2. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
3. Locate the RAID controller that contains the failed battery unit (see “Controller LEDs” on page 53).

**Attention:** Before you remove a controller in a single-controller DS3200, shut down the DS3200 to avoid data loss (see “Turning off the storage subsystem” on page 55).

4. Remove the controller from the chassis.

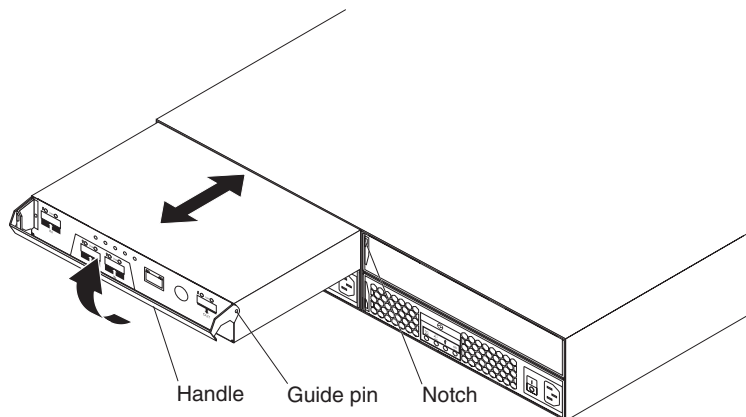


Figure 49. Removing and replacing a controller

- a. On the left side of the controller, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
  - b. Slowly pull the handle away from the chassis to remove the controller from the bay, as shown in Figure 49.
  - c. Place the controller on a level surface.
5. Remove the failed battery unit from the RAID controller.

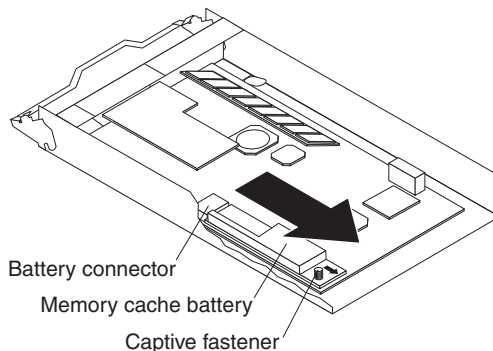


Figure 50. Removing a battery unit from the controller

- a. Turn the blue captive fastener counterclockwise 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.
6. 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.
  7. 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 (clockwise) to secure the battery pack in place.

8. Insert the controller into the chassis:
  - a. Slide the controller into the empty controller bay in the storage subsystem. Make sure that the handle is pulled straight out as you slide the controller into the bay.
  - b. Make sure that the guide pins on the side of the controller fit into the notches on the DS3200 chassis. See Figure 49 on page 88.
  - c. After the guide pins fit into the notches and the controller fits snugly into the bay, push the handle downward to fully latch it into place.

After you replace a controller cache battery, reset the battery age timer. For information about resetting the battery age timer, see the 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 66.

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

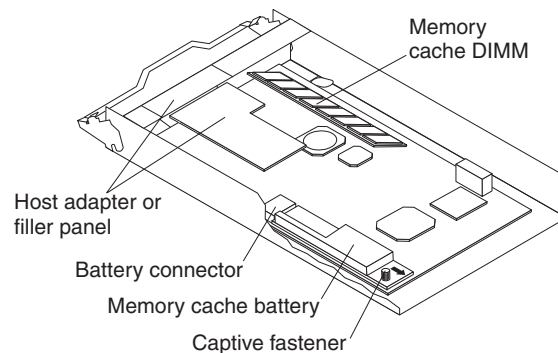


Figure 51. Memory cache DIMM location

## Removing the DIMM

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

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.

2. Remove the controller from the chassis.

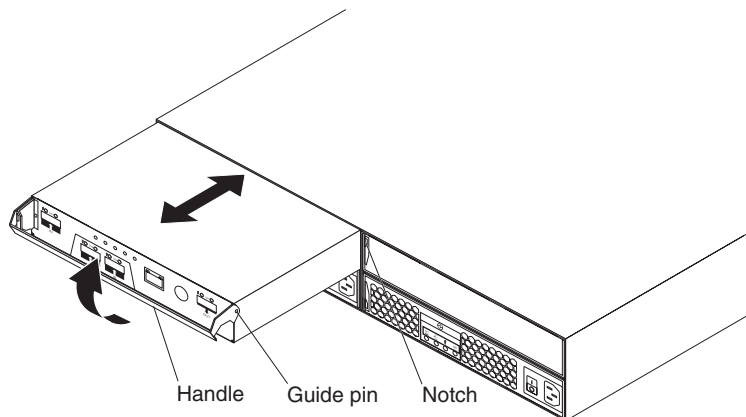


Figure 52. Removing a controller

- a. On the left side of the controller, press the orange release tab to the right just enough to release the handle; then, rotate the handle upward.
  - b. Slowly pull the handle away from the chassis to remove the controller from the bay.
  - c. Place the controller on a level surface.
3. Remove the battery from the controller.

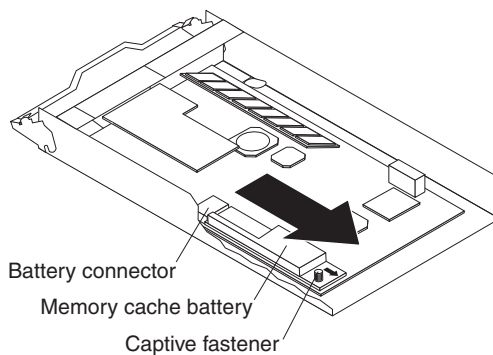


Figure 53. Removing the battery from the controller

- a. Turn the blue captive fastener counterclockwise 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 unit aside.

4. Remove the DIMM from the connector.

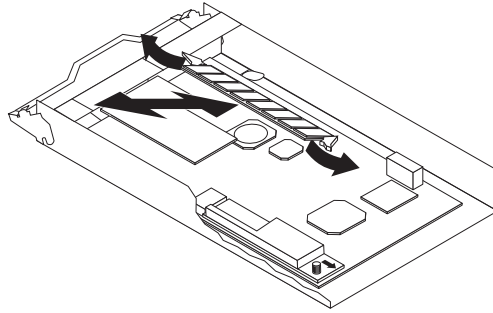


Figure 54. Removing the DIMM from the controller

- a. Wait 60 seconds before you proceed, to allow any residual charge to drain from the controller.
  - b. Open the retaining clip on each end of the DIMM connector.
  - c. Lift the DIMM out of the connector.
5. If the DIMM is functional (not failed), place the DIMM in a static-protective package until you are ready to install it.
  6. If you are removing the DIMM as part of replacing a controller, return to step 12b on page 68. Otherwise, continue to “Installing the DIMM” to install the new or replacement DIMM.

## Installing the DIMM

With the controller removed from the chassis and the battery removed from the controller, complete the following steps to install the DIMM in the controller:

1. Make sure that at least 60 seconds has elapsed since you removed the battery from the controller.
2. Open the retaining clip on each end of the DIMM connector.
3. Touch the static-protective package that contains the DIMM to any unpainted metal surface on the DS3200. Then, remove the DIMM from the package.

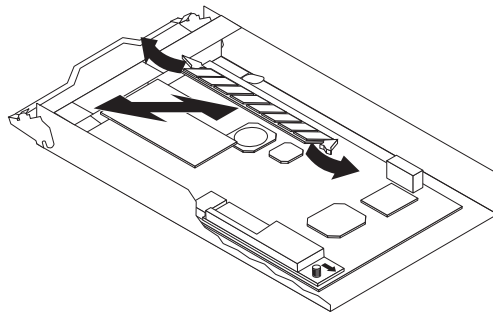


Figure 55. Installing the DIMM in the controller

4. Turn the DIMM so that the DIMM keys align correctly with the slot.
5. Match the angle of the DIMM with the angle of the connector.
6. 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.

7. If you are installing the DIMM as part of replacing a controller, return to step 13 on page 68. Otherwise, continue to step 8.
8. Reinstall the battery:
  - 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.
9. Reinstall the controller.

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

  - a. Slide the controller into the empty controller bay in the storage subsystem. Make sure that the handle is pulled straight out as you slide the controller into the bay.

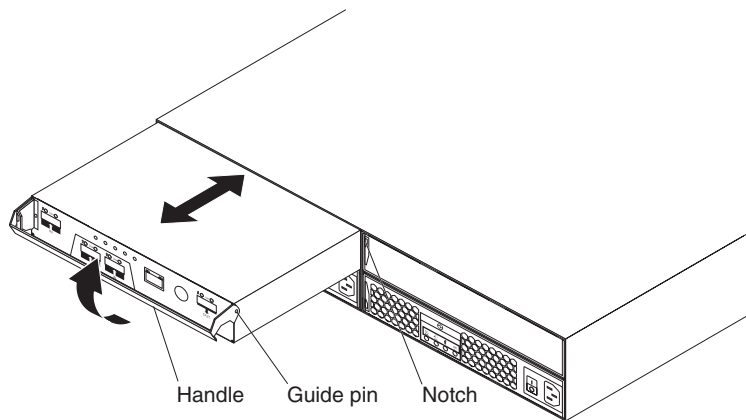


Figure 56. Reinstalling the controller

- b. Make sure that the guide pins on the side of the controller fit into the notches on the DS3200 chassis.
- c. After the guide pins fit into the notches and the controller fits snugly into the bay, push the handle downward to fully latch it into place.

---

## Replacing the bezels

The left bezel contains the LEDs; the right bezel contains the hard disk drive identification information. See the illustrations in “Disk drives and bezels” on page 7.

## Removing the bezels

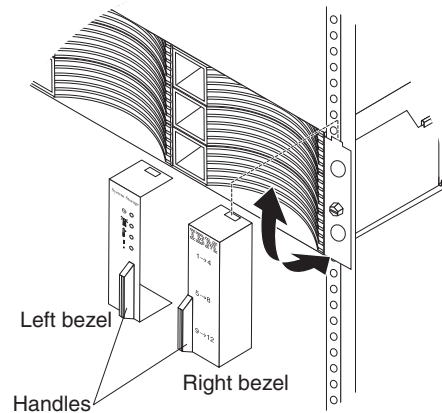


Figure 57. Removing the bezels

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

1. If the DS3200 is on a table or other flat surface, elevate the DS3200 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.

---

## Replacing the release tab on a controller or power supply

The miscellaneous hardware kit contains two replacement release tabs: one for a power supply and one for a controller or controller filler panel. Obtain a miscellaneous hardware kit if you have to replace a release tab (see Table 6 on page 106).

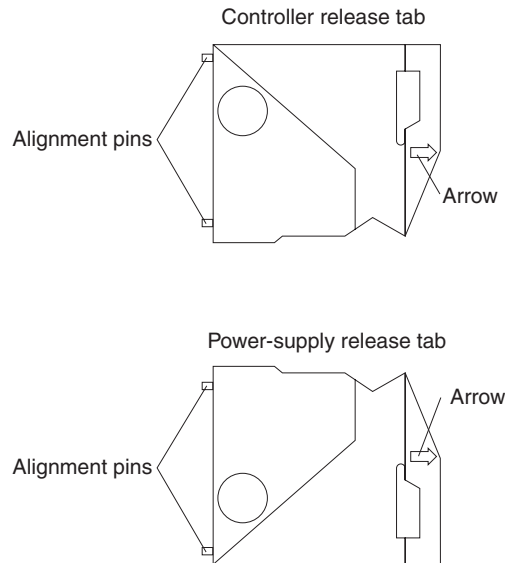


Figure 58. Controller and power supply release tabs

Before you replace a release tab, read the following important information:

- In this procedure, the term *controller* refers to a controller or controller filler panel.
- Make sure that you have a size #1 or #0 Phillips screwdriver.

To replace a release tab, complete the following steps:

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
2. Make sure that it is safe to proceed:
  - If you are replacing the release tab on the only controller in the DS3200, make sure that the DS3200 is shut down for maintenance.
  - If you are replacing a power-supply release tab, make sure that the power supplies are providing redundant power (on both power supplies, the ac power LED and dc power LEDs are lit, and the fault LED is off). If the power supplies are not providing redundant power, resolve the redundancy problem first, or wait until the DS3200 is shut down for maintenance, before you replace the release tab.
3. Remove the controller or power supply from the DS3200 chassis. See “Removing a controller” on page 63 or “Replacing a power supply” on page 82.



4. Close the handle to move it out of the way.

The following illustration shows how to remove the release tab on a power supply.

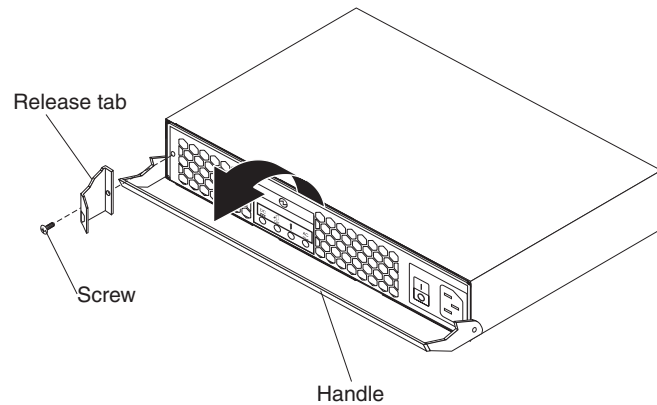


Figure 59. Removing the release tab on a power supply

5. Use a #1 or #0 Phillips screwdriver to remove the screw that secures the release tab to the controller or power supply; then, remove the release tab. Save the screw to install the new release tab.
6. Insert the alignment pins on the release tab into the holes in the left front of the controller or power supply and hold it in place.

**Note:** The arrow on the outside of the release tab points to the right.

7. Use a #1 or #0 Phillips screwdriver to install the screw that you removed in step 5.
8. Press the release tab gently to the right and open the handle on the controller or power supply.
9. Reinstall the controller or power supply. See “Replacing a controller” on page 66 or “Replacing a power supply” on page 82.

---

## Replacing a drive compatibility key

Each hard disk drive bay contains a drive compatibility key, which helps to ensure that you install only a supported drive in the bay.

**Important:** Do not attempt to install any hard disk drive other than a supported drive in any hard disk drive bay. See <http://www.ibm.com/systems/storage/disk/ds3000/ds3200/> for information about the DS3200 and an interoperability matrix that lists supported hard disk drives.

If a drive compatibility key breaks, you must replace it. The miscellaneous hardware kit contains several replacement drive compatibility keys; obtain a kit if you have to replace a drive compatibility key (see Table 9 on page 110).

The following illustration shows a drive compatibility key.

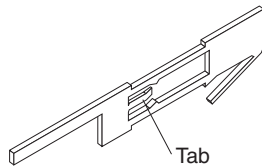


Figure 60. Drive compatibility key

To replace a drive compatibility key, complete the following steps:

1. Read the safety information that begins on page xi and “Best practices guidelines” on page 6.
2. Turn off the DS3200, or wait until the DS3200 is shut down for maintenance.
3. Remove the three hard disk drives that are in the column of bays that contain the broken drive compatibility key. See “Removing a hard disk drive” on page 74.
4. Remove the broken drive compatibility key:
  - a. Flex the rear of the key slightly toward the middle of the bay to release it from the tab that holds it.
  - b. Slide the key toward the front of the bay until it is released from the chassis.

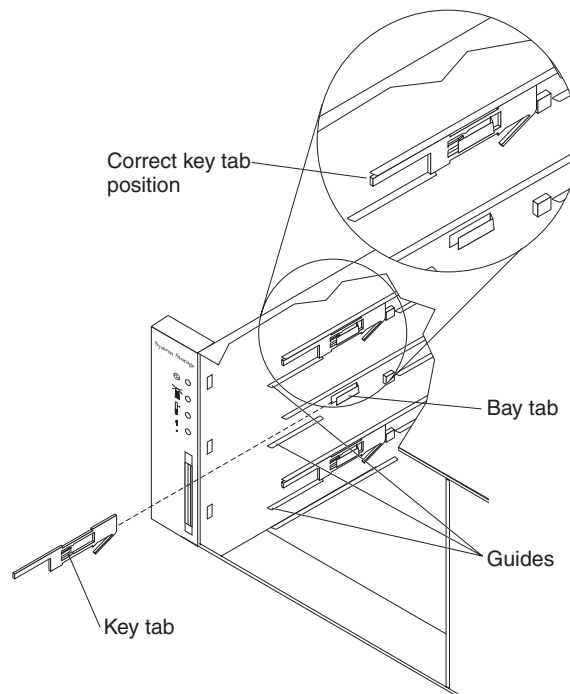


Figure 61. Installing a drive compatibility key

5. Install the replacement drive compatibility key:
  - a. Orient the key as shown in the illustration.
  - b. Place the key between the drive guides in the left wall of the bay, flush with the wall.
  - c. Slide the key tab under the metal tab that is on the left wall of the bay; then, slide the key toward the rear of the chassis until the key stops (the key is

flush with the side wall, the tab is covered, and the front of the key extends approximately 1 mm [0.04 in.] in front of the short metal upper guide).

6. Reinstall the hard disk drives in the bays from which they were removed. See “Replacing a hot-swap hard disk drive” on page 75.
7. If you turned off the DS3200 in step 2 on page 96, turn it on.



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## Chapter 6. Solving problems

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

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 113.

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 5 on page 100 and the DS3000 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 5 on page 100 for a replacement decision.

Table 5. Troubleshooting

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit	Drive (drive fault LED)	Drive failure	Replace the failed drive.
		Drive uncertified	Verify the drive and part number to make sure that it is supported by the DS3200. (See <a href="http://www.ibm.com/systems/storage/disk/ds3000/ds3200/">http://www.ibm.com/systems/storage/disk/ds3000/ds3200/</a> .)
	RAID controller (service action required LED)	RAID controller failure	Replace the RAID controller. See Chapter 5, "Replacing components," on page 63 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 DS3000 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.
	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 DS3000 Storage Manager Subsystem Management window and click <b>Recovery Guru</b> to see problems in the DS3200 configuration.  Some errors will cause the system error LED to be lit but will 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.
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.

Table 5. Troubleshooting (continued)

<b>Problem indicator</b>	<b>Component</b>	<b>Possible cause</b>	<b>Possible solutions</b>
Amber and green LEDs are lit	Power supply (fault and power LEDs are lit)	Power supply failure	Replace the failed power supply.
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"> <li>Storage expansion enclosures are not correctly connected to the DS3200.</li> <li>DS3200 does not have the correct firmware version.</li> </ul>	
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.
Amber LED is flashing	Drives (fault LED is lit)	Drive identify 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 DS3200. 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 DS3200 was not powered-on, or all SAS cable connections between the storage expansion enclosures and the DS3200 storage subsystem failed.	Perform one of the following actions: <ul style="list-style-type: none"> <li>Power-on the storage subsystem.</li> <li>Make sure that the SAS cable connections between the storage expansion enclosures and the DS3200 storage subsystem are made.</li> </ul>
	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 5. Troubleshooting (continued)

<b>Problem indicator</b>	<b>Component</b>	<b>Possible cause</b>	<b>Possible solutions</b>
Green LED is flashing slowly (once every 2 seconds)	Drives	The DS3200 was not powered-on, or all SAS connections between the storage expansion enclosures and the DS3200 storage subsystem have failed.	Perform one of the following actions: <ul style="list-style-type: none"> <li>• Power-on the storage subsystem.</li> <li>• Make sure that the SAS connections between the storage expansion enclosures and the DS3200 storage subsystem are made.</li> <li>• Make sure that all the storage expansion enclosures in the same channel pair have the same enclosure speed setting.</li> </ul>
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-supply units 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 DS3200. 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 DS3200. Contact your IBM technical-support representative.



Table 5. Troubleshooting (continued)

<b>Problem indicator</b>	<b>Component</b>	<b>Possible cause</b>	<b>Possible solutions</b>
Hard disk drive is not visible in the 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.
		Midplane failure	Replace the DS3200. Contact your IBM technical-support representative.
		A drive has an interface problem with the ESM or controller.	Replace the drive.
		Incorrect firmware version	Make sure that the DS3200 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.



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## Chapter 7. Parts listing, DS3200 storage subsystem

The replaceable components that are available for the DS3200 storage subsystem 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 DS3200**.
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.

Figure 62 and the following table provide a parts listing for the DS3200.

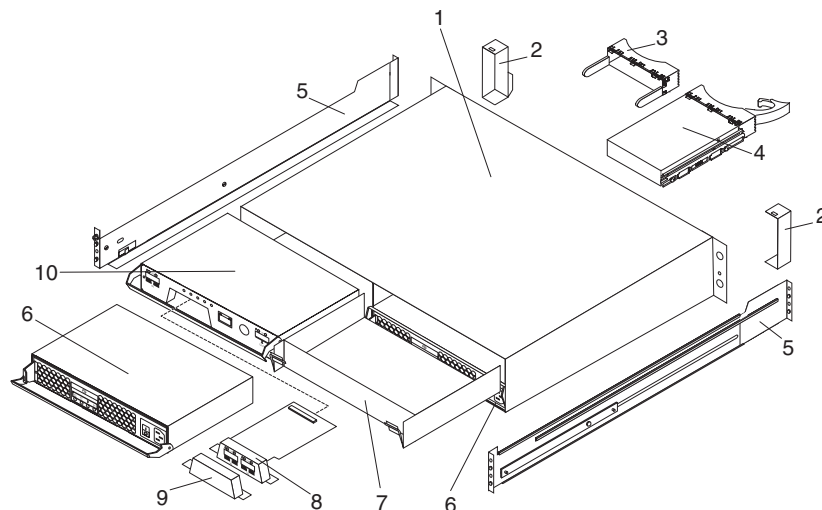


Figure 62. DS3200 storage subsystem parts

Table 6. Parts listing for DS3200

Index	Description	CRU part number (Tier 1)	CRU part number (Tier 2)	FRU part number
1	Chassis and midplane assembly			39R6545
2	Bezel kit - chassis	39R6546		
3	Filler panel, hard disk drive	39M4375		
4	Hard disk drive	varies		
5	2U rail kit	39R6550		
6	Power supply, ac	42C2140		
7	Filler panel, controller	39R6548		
8	SAS host port adapter		39R6510	
9	Filler panel, host port adapter	39R6543		
10	<b>For dual-controller DS3200 storage subsystem</b> SAS RAID controller replacement with 512 MB DIMM, no SAS host port expansion adapter		39R6508	
10	<b>For dual-controller DS3200 storage subsystem</b> SAS RAID controller replacement with SAS host port expansion adapter and 512 MB DIMM		39R6500	
10	<b>For single-controller DS3200 storage subsystem</b> SAS RAID controller replacement with 512 MB DIMM, no SAS host port expansion adapter		44W2172	
10	<b>For single-controller DS3200 storage subsystem</b> SAS RAID controller replacement with SAS host port expansion adapter and 512 MB DIMM		44W2169	
	DIMM, 1 GB cache memory		39R6518	
	Battery			39R6520
	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 hardware kit		39R6551	

## 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 7. IBM power cords*

<b>IBM power cord part number</b>	<b>Used in these countries and regions</b>
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

Table 7. IBM power cords (continued)

IBM power cord part number	Used in these countries and regions
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
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 DS3200, 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.

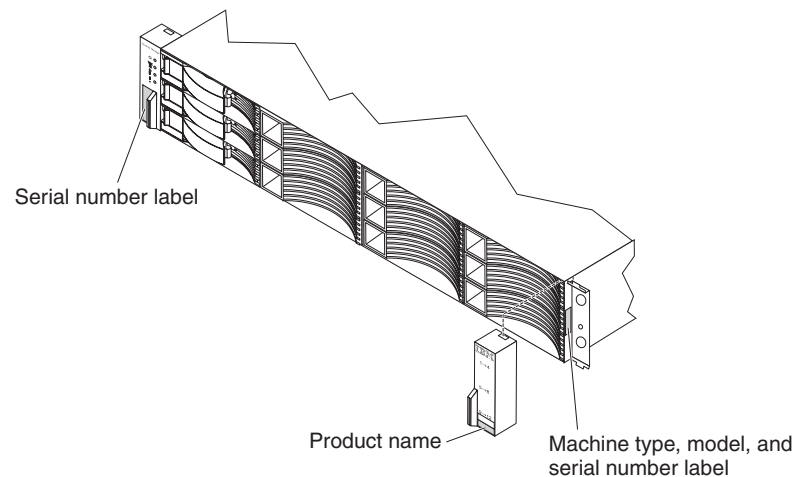
### Identification numbers

Record and retain the following information.

*Table 8. Product identification record*

<b>Product name</b>	IBM System Storage DS3200
<b>Machine type</b>	1726
<b>Model number</b>	
<b>Serial number</b>	

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 63. Serial number location on the DS3200*

---

## Hard disk drive locations

Use Table 9 to keep a record of the hard disk drives that are installed in or attached to the DS3200. 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 DS3200 configuration.

*Table 9. Drive location information record*

<b>Drive location</b>	<b>Drive part and model number</b>	<b>Drive serial number</b>
Bay 1		
Bay 2		
Bay 3		
Bay 4		
Bay 5		
Bay 6		
Bay 7		
Bay 8		
Bay 9		
Bay 10		
Bay 11		
Bay 12		



---

## Storage subsystem and controller information record

Table 10 provides a data sheet for recording storage subsystem names, management types, Ethernet hardware addresses, and IP addresses. Make a copy of this table and complete the information for your storage subsystems and controllers. Use the information to set up the BOOTP table for the network server and the host or Domain Name System (DNS) table. The information is also helpful if you add storage subsystems after initial installation. See the Storage Manager documentation for detailed instructions for obtaining the information. For a sample information record, see Table 11 on page 112.

Table 10. Storage subsystem and controller 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	

Table 11 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 11. 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/>.

---

### Getting help and information from the World Wide Web

On the World Wide Web, the IBM Web site has up-to-date information about IBM systems, optional devices, services, and support. The address for IBM System x<sup>®</sup> and xSeries<sup>®</sup> information is <http://www.ibm.com/systems/x/>. The address for IBM BladeCenter<sup>®</sup> information is <http://www.ibm.com/systems/bladecenter/>. The address for IBM IntelliStation<sup>®</sup> information is <http://www.ibm.com/intellistation/>.

You can find service information for IBM systems and optional devices at <http://www.ibm.com/systems/support/>.

---

## Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with System x and xSeries servers, BladeCenter products, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, see <http://www.ibm.com/services/sl/products/>.

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---

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

---

## IBM Taiwan product service

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台灣國際商業機器股份有限公司  
台北市松仁路7號3樓  
電話：0800-016-888

IBM Taiwan product service contact information:

IBM Taiwan Corporation  
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Taipei, Taiwan  
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---

## Appendix C. Notices

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## Important notes

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

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1 048 576 bytes, and GB stands for 1 073 741 824 bytes.

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

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

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---

## Particulate contamination

**Attention:** Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document. Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the device, IBM may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 12. Limits for particulates and gases

Contaminant	Limits
Particulate	<ul style="list-style-type: none"> <li>The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2<sup>1</sup>.</li> <li>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.</li> <li>The deliquescent relative humidity of the particulate contamination must be more than 60%<sup>2</sup>.</li> <li>The room must be free of conductive contamination such as zinc whiskers.</li> </ul>
Gaseous	<ul style="list-style-type: none"> <li>Copper: Class G1 as per ANSI/ISA 71.04-1985<sup>3</sup></li> <li>Silver: Corrosion rate of less than 300 Å in 30 days</li> </ul>

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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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## Documentation format

The publications for this product are in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when you use the PDF files and want to request a Web-based format or accessible PDF document for a publication, direct your mail to the following address:

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### Industry Canada Class A emission compliance statement

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### Avis de conformité à la réglementation d'Industrie Canada

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

### Australia and New Zealand Class A statement

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

### United Kingdom telecommunications safety requirement

#### Notice to Customers

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E-mail: tjahn@de.ibm.com

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