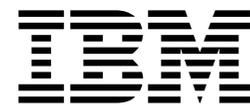


IBM FAStT200 and FAStT200 High
Availability Storage Servers



Installation and User's Guide



IBM FAStT200 and FAStT200 High
Availability Storage Servers



Installation and User's Guide

Note: Before using this information and the product it supports, be sure to read the general information in Appendix D, "Warranty information" on page 77 and Appendix E, "Notices" on page 87.

Second Edition (April 2002)

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Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية.

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

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

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

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

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

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

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

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

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

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

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

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

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

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

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si pečítajte Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

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

Läs säkerhetsinformationen innan du installerar den här produkten.

Statement 1



<p>Danger</p> <p>Electrical current from power, telephone, and communication cables is hazardous.</p> <p>To avoid a shock hazard:</p> <ul style="list-style-type: none">• Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.• Connect all power cords to a properly wired and grounded electrical outlet.• Connect to properly wired outlets any equipment that will be attached to this product.• When possible, use one hand only to connect or disconnect signal cables.• Never turn on any equipment when there is evidence of fire, water, or structural damage.• Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.• Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.

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

Statement 3



CAUTION:

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

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



Danger

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

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

Class 1 laser statement

Class 1 Laser Product

Laser Klasse 1

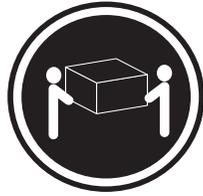
Laser Klass 1

Luokan 1 Laserlaite

Appareil À Laser de Classe 1

IEC 825-1:1993 CENELEC EN 60 825

Statement 4



≥18 kg (37 lbs)



≥32 kg (70.5 lbs)



≥55 kg (121.2 lbs)

CAUTION:
Use safe practices when lifting.

Statement 5



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



Statement 8:



CAUTION:

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



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

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About this book

This book provides instructions for installing the IBM FAStT200 and FAStT200 High Availability Storage Servers.

How this book is organized

Chapter 1, "Introduction" on page 1 describes the storage server. This chapter includes an overview of the storage server features and components.

Chapter 2, "Installing the storage server" on page 9 contains information about installing the storage subsystem configuration and gives Fibre Channel loop configuration examples.

Chapter 3, "Cabling the storage server" on page 17 contains information about cabling the storage server to other devices.

Chapter 4, "Operating the storage server" on page 25 describes the tasks that are required to operate the storage server, including the proper sequences for powering the storage subsystem on and off.

Chapter 5, "Installing and replacing components" on page 35 contains step-by-step instructions for installing and removing the storage server components.

Chapter 6, "Solving problems" on page 63 contains storage server problem symptoms and possible solutions.

Appendix A, "Records" on page 67 provides a form on which you can record and update important information about your storage server, including serial number and device records. When you add components to your storage server, be sure to update the information in this appendix.

Appendix B, "Rack mounting template and instructions" on page 69 contains information about installing the storage server in a rack. Use the information in this appendix if you misplace the template and rack mounting instructions that come with the storage server.

Appendix C, "Getting help and technical assistance" on page 75 provides information about how to obtain help, service, or technical assistance.

Appendix D, "Warranty information" on page 77 provides warranty statements for IBM FAStT200 and FAStT200 HA Storage Servers.

Appendix E, "Notices" on page 87 provides product notices and trademark information.

Notices used in this book

This book contains notices to highlight information or provide safety information:

- **Notes**

These notices provide important tips, guidance, or advice.

- **Attention**

These notices indicate possible damage to programs, devices, or data.

An attention notice is placed just *before* the instruction or situation in which damage could occur.

- **Caution**

These notices indicate situations that can be potentially hazardous to you. A caution notice is placed just *before* descriptions of potentially hazardous procedure steps or situations.

Related publications

The following publications are available in Adobe Acrobat Portable Document Format (PDF) on the IBM FAStT Storage Manager Version 7.10 CD and on the World Wide Web at <http://www.ibm.com/pc/support/>.

- *IBM FAStT200 and FAStT200 High Availability Storage Servers Installation and User's Guide* (this book)¹
- *IBM FAStT Storage Manager Version 7.10 for Microsoft® Windows NT® and Windows 2000 Installation and Support Guide.*
- *IBM FAStT Storage Manager Version 7.10 for Novell NetWare and Red Hat Linux Installation and Support Guide*
- *IBM FAStT Storage Manager Version 7.10 Concepts Guide.*

1. Publications that are printed and come with the IBM FAStT200 and FAStT200 HA Storage Servers.

Chapter 1. Introduction

Thank you for purchasing an IBM® FAStT product. IBM FAStT (Fibre Array Storage Technology) solutions support the large and growing data storage requirements of business-critical applications. These scalable IBM FAStT solutions offer you data access and protection to meet your existing enterprise storage requirements and prepare for the future.

The IBM FAStT Storage Server is available in two models. The IBM FAStT200 High Availability (HA) Storage Server (Model 3542-2RU) comes with two RAID controllers, two power supplies, and two cooling units and provides dual, redundant controllers, redundant cooling, redundant power, and battery backup of the RAID controller cache.

The IBM FAStT200 Storage Server (Model 3542-1RU) comes with one RAID controller, two power supplies, and two cooling units and provides battery backup of the RAID controller cache. A FAStT200 Redundant RAID Controller option is available for purchase. Contact your IBM reseller or IBM marketing representative.

The IBM FAStT200 HA Storage Server is designed to provide maximum host and drive side redundancy. Each RAID controller supports direct attachment of one host containing one or two host adapters. Using external managed hubs and switches in conjunction with the storage server, you can build even larger configurations. (Throughout this book, the use of hub or external hub refers to a managed hub.)

Fibre Channel is a new technology, similar to a high-speed network, that you can use to connect large amounts of disk storage to a server or cluster of servers. Fibre Channel technology supports increased performance, scalability, availability, and distance for attaching storage subsystems to network servers. The storage server provides for the attachment of Fibre Channel disk drives to give superior performance and redundancy.

Fibre Channel technology supports applications that require large amounts of disk storage that is shared by two or more servers. With Fibre Channel, you can see a higher throughput rate over longer distances than is possible with small computer system interface (SCSI) or with serial storage architecture (SSA) technology.

After you review the introductory information that is provided in this chapter, go to Chapter 2, "Installing the storage server" on page 9 to begin the installation process.

Note: Throughout this book, the term *storage server* refers to both the IBM FAStT200 Storage Server (Model 3542-1RU) and the IBM FAStT200 HA Storage Server (Model 3542-2RU). Model-specific information is noted where applicable.

Features at a glance

The following table summarizes the features of the storage server. For a list of the operating specifications, such as weight, height, and heat output, see “Operating specifications” on page 7.

Table 1. Features at a glance

General <ul style="list-style-type: none">• Modular components:<ul style="list-style-type: none">— High-capacity disk drives— RAID controllers— Power supplies— Cooling fans• Technology:<ul style="list-style-type: none">— Support for disk arrays— Support for clustering— Fibre Channel host interface— Redundant data storage, cooling system, power system, and RAID controllers— Hot-swap technology for drives, power supplies, fans, and RAID controllers	<ul style="list-style-type: none">• User interface:<ul style="list-style-type: none">— Built-in power, activity, and fault Light Emitting Diodes (LEDs)— Identification labeling on customer replaceable units (CRUs), rear LEDs, switches, and connectors— Easy-to-replace drives, power supplies, RAID controllers, and fans <p>Disk drive storage</p> <p>Maximum drives per storage server: 10</p>	RAID controllers <ul style="list-style-type: none">• Technology and interfaces:<ul style="list-style-type: none">— Fibre Channel: 40-pin FC disk drives— Fibre Channel interface: Four Gigabit Interface Converter (GBIC) connectors for incoming and outgoing FC cables (two GBICs on each RAID controller)
---	--	--

Clustering support

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

Clustering requires additional hardware and specialized software. For more information about clustering, visit the following IBM Web site:
<http://www.ibm.com/pc/us/netfinity/clustering>

Getting help on the World Wide Web

You can obtain up-to-date information about your storage server, a complete listing of the options that are supported on your model, and information about other IBM server products by accessing the IBM Web page. For more information, see Appendix C, “Getting help and technical assistance” on page 75.

Inventory checklist

After you unpack your storage server, verify that you have the following items:

Hardware

IBM FASTT200 HA Storage Server (Machine Type 3542, Model 2RU) comes with the following components:

- Two RAID controllers
- Two fan units
- Two power supplies
- Two power cords

IBM FASTT200 Storage Server (Machine Type 3542, Model 1RU) comes with the following removable components:

- One RAID controller
- Two fan units
- Two power supplies
- Two power cords

The following hardware comes with Models 1RU and 2RU:

- One RS-232 cable (for performing diagnostic operations)
- Rack-mounting hardware kit (1)
 - Two rails (right and left assembly)
 - Ten M6 screws
 - Ten M6 cage nuts
 - Ten M6 clip nuts

Software and documentation (both models):

- IBM FASTT Storage Manager Version 7.10 CD including:
 - IBM FASTT Storage Manager Version 7.10
 - Publications and online help in Adobe Acrobat Portable Document Format (PDF)

For a list of available IBM FASTT publications, see “Related publications” on page xviii.

- Rack Mounting Assembly kit, including:
 - Rack mounting installation instructions
 - Rack mounting template (for aligning the rails properly)
 - White tape dots for marking the holes in the rack
- Fibre Channel cabling instructions

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

If you have not already done so, record your storage-server serial number in the table in Appendix A, “Records” on page 67.

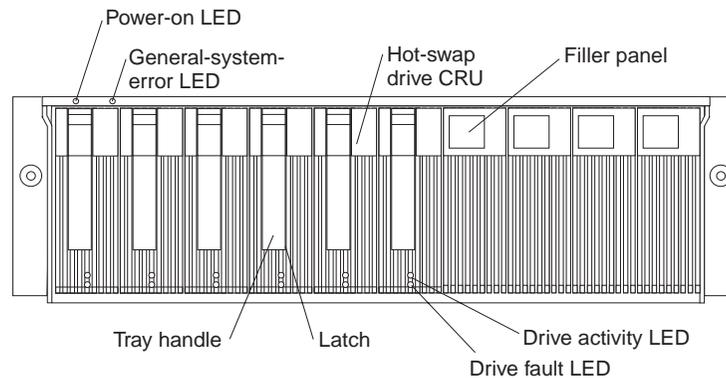
Storage server components

The following sections show the components of the storage server.

The hot-swap features of the storage server enable you to remove and replace hard disk drives, power supplies, RAID controllers, and fans without turning off the storage server. Therefore, you can maintain the availability of your system while a hot-swap device is removed, installed, or replaced.

Front view

The following illustration shows the components and controls on the front of the storage server.



Power-on LED

When on, this green light indicates that the unit has good dc power.

General-system-error LED

When on, this amber LED indicates that the storage server has a fault, such as in a power supply, fan unit, or hard disk drive.

Note: If the General-system-error LED is on continuously (not flashing), there is a problem with the storage server. Use the storage-management software to diagnose and repair the problem. For more information, see “Checking the LEDs” on page 29.

Hot-swap drive CRU

You can install up to 10 hot-swap drive *customer replaceable units* (CRUs) in the storage server. Each drive CRU consists of a hard disk drive and tray.

Filler panel

The storage server comes without drives installed and contains filler panels in the unused drive bays. Before installing new drives, you must remove the filler panels and save them. Each of the 10 bays must always contain either a filler panel or a drive CRU. Each filler panel contains a filler piece for use with a slim drive.

Drive activity LED

Each drive CRU has a green Drive activity LED. When flashing, this green LED indicates drive activity. When on continuously, this green LED indicates that the drive is properly installed.

Drive fault LED

Each drive CRU has an amber Drive fault LED. When on, this amber LED indicates a drive failure. When flashing, this amber LED indicates that a drive identify or rebuild process is in progress.

Latch This multipurpose blue latch releases or locks the drive CRU in place.

Tray handle

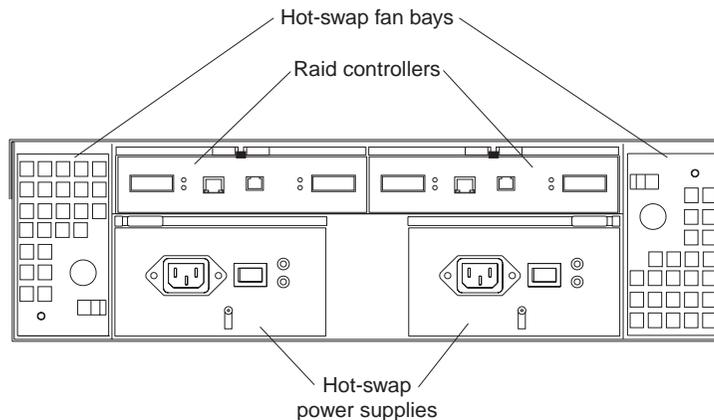
You can use this multipurpose handle to insert and remove a drive CRU in the bay.

For information on installing and replacing drive CRUs, see “Working with hot-swap drives” on page 35. For more information about the LEDs, see “Checking the LEDs” on page 29.

Back view

The following illustration shows the components at the back of the IBM FASTT200 HA Storage Server.

Note: If your storage server is a Model 1RU, there is only one RAID controller. There is a blank panel in the second RAID controller opening. The blank panel must remain in place to maintain proper cooling.



RAID controller

The storage server comes with one or two hot-swap RAID controllers. Each RAID controller contains two ports for Gigabit Interface Converters (GBICs) which connect to the Fibre Channel cables. One GBIC connects to a host system. The other GBIC is used to connect additional expansion units to the storage server.

Each RAID controller also contains a battery to maintain cache data in the event of a power failure. For more information, see “Cache memory and RAID controller battery” on page 33.

Hot-swap fans

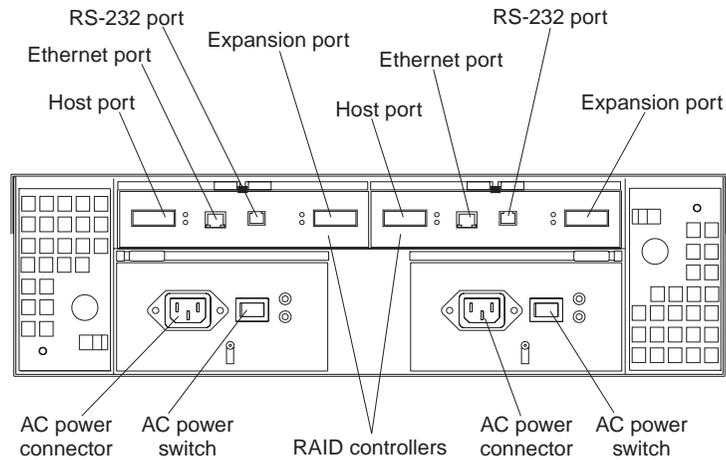
The storage server has two interchangeable hot-swap and redundant fan CRUs. Each fan CRU contains two fans. If one fan CRU fails, the second fan CRU continues to operate. Both fan CRUs must be installed to maintain proper cooling within your storage server, even if one fan CRU is not operational.

Hot-swap power supplies

The storage server comes with two hot-swap power supplies. Both power supplies must be installed to maintain proper cooling.

Interface ports and switches

The following illustration shows the ports and switches on the back of the storage server.



RAID controller

Each RAID controller contains several connectors and LEDs. Each controller has one host port and one expansion port for connecting the storage server to hosts or expansion units. You first insert GBICs into the ports and then connect the Fibre Channel cables.

Host port

The host port is used to connect a Fibre Channel cable from the host system. You first insert a GBIC into the port and then connect a Fibre Channel cable.

Ethernet port

The Ethernet port is for an RJ-45 10 BASE-T or 100 BASE-T Ethernet connection. Use the Ethernet connection to directly manage storage subsystems.

Expansion port

The expansion port is used to connect additional expansion units to the RAID controllers. You first insert a GBIC into the port and then connect a Fibre Channel cable.

RS-232 port

The RS-232 port is a TJ-6 modular jack and is used for an RS-232 serial connection. The RS-232 port is used by service personnel to perform diagnostic operations on the RAID controllers. An RS-232 cable comes with the storage server.

Operating specifications

The following table summarizes the operating specifications of the storage server.

Table 2. Model 3542-2RU storage server operating specifications

<p>Size (with front panel and without mounting rails)</p> <ul style="list-style-type: none"> • Depth: 57.5 cm (22.6 in) • Height: 13.2 cm (5.2 in) • Width: 48 cm (18.9 in) <p>Weight</p> <ul style="list-style-type: none"> • Standard storage server as shipped: 25.74 kg (56.7 lb) • Typical storage server fully configured: 37.65 kg (83 lb) <p>Electrical input</p> <ul style="list-style-type: none"> • Sine-wave input (50 to 60 Hz) is required • Input voltage: <ul style="list-style-type: none"> — Low range: <ul style="list-style-type: none"> – Minimum: 90 V ac – Maximum: 136 V ac — High range: <ul style="list-style-type: none"> – Minimum: 198 V ac – Maximum: 264 V ac — Input kilovolt-amperes (kVA) approximately: <ul style="list-style-type: none"> – Minimum configuration: 0.06 kVA – Maximum configuration: 0.37 kVA 	<p>Environment</p> <ul style="list-style-type: none"> • Air temperature: <ul style="list-style-type: none"> — Storage server on: <ul style="list-style-type: none"> 10° to 35°C (50° to 95°F) — Storage server off: <ul style="list-style-type: none"> Altitude: 0 to 914 m (3000 ft) • Humidity: <ul style="list-style-type: none"> — 8% to 80% 	<p>Acoustical noise emissions values For open bay (0 drives installed) and typical system configurations (8 hard disk drives installed).</p> <ul style="list-style-type: none"> • Sound power (idling): <ul style="list-style-type: none"> — 6.3 bels (open bay) — 6.5 bels (typical) • Sound power (operating): <ul style="list-style-type: none"> — 6.3 bels (open bay) — 6.8 bels (typical) • Sound pressure (idling): <ul style="list-style-type: none"> — 47 dBA (open bay) — 65 dBA (typical) • Sound pressure (operating): <ul style="list-style-type: none"> — 47 dBA (open bay) — 68 dBA (typical) <p>These levels are measured in controlled acoustical environments according to ISO 7779 and are reported in accordance with ISO 9296. The declared sound power levels indicate an upper limit, below which a large portion of machines operate. Sound pressure levels in your location might exceed the average 1-meter values stated because of room reflections and other nearby noise.</p>
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Chapter 2. Installing the storage server

This chapter contains information about installing the storage subsystem configuration and preparing to install the storage server in a rack.

Storage subsystem configuration

You must set up your storage subsystem configuration before you can install the storage server in a rack. Use the information in the following sections to install the storage subsystem configuration.

Storage subsystem management methods

Before you install the storage subsystem configuration, determine which method of storage subsystem management you want to use. You can manage the storage subsystems in either of two ways.

Host-agent management method:

This method uses host-agent software that is installed on the host server. You must install at least one management station and a software-agent host. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. The following illustration shows the host-agent management method.

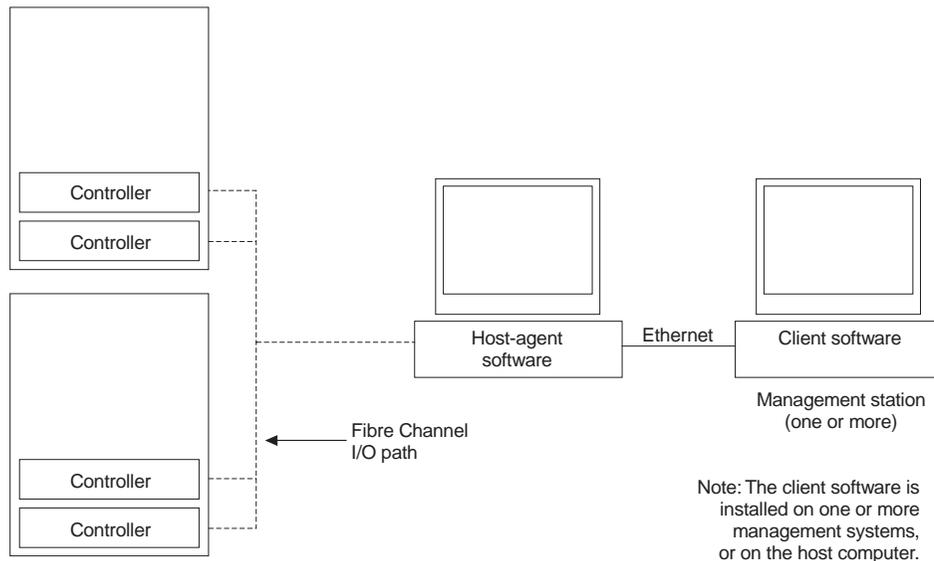


Figure 1. Host-agent managed storage subsystems

Direct-management method:

This method uses Ethernet connections from a management station to each controller. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Attach Ethernet cables to each management station (one pair per storage server). You will connect the cables to each controller later when you install the storage server. The following illustration shows the direct management method.

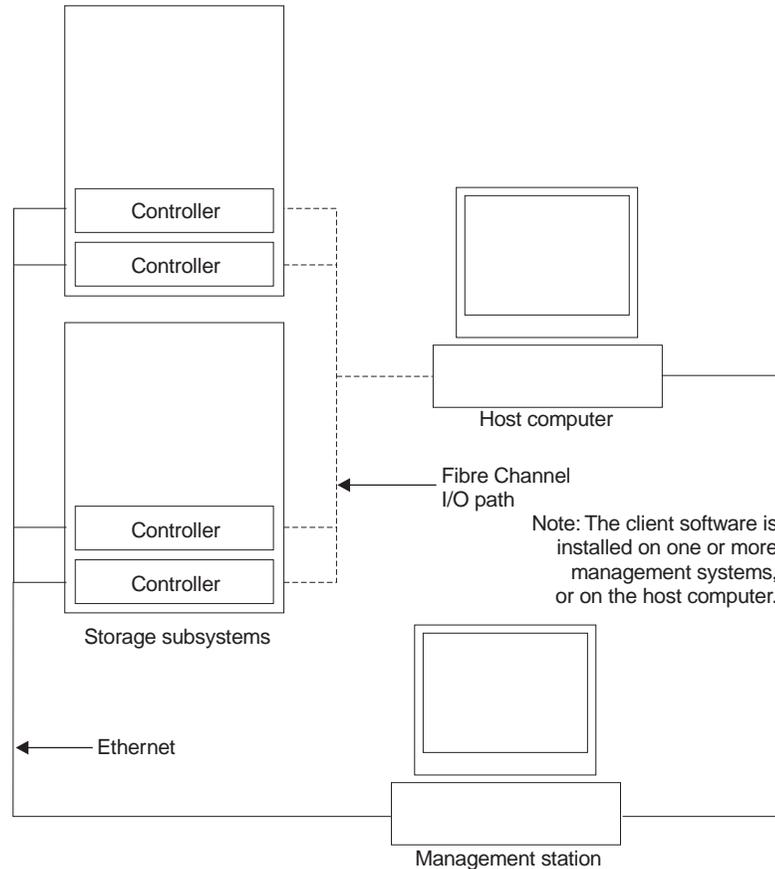


Figure 2. Direct-managed storage subsystems

Fibre Channel connections

The storage server Fibre Channel consists of a host Fibre Channel loop and a drive Fibre Channel loop. The host Fibre Channel loop provides the fibre path for host attachment. It can consist of Fibre Channel cables, GBICs, host bus adapters, Fibre Channel switches, Fibre Channel managed hubs, and RAID controllers. The drive Fibre Channel loop provides the fibre path to the hard disk drives (HDDs). The drive Fibre Channel loop consists of Fibre Channel HDDs and optional drive expansion units, Fibre Channel cables, and GBICs.

The Model 3542-2RU storage server supports redundant disk-drive-loop configurations. Each RAID controller has two GBIC ports. These GBIC ports are labeled FC-Host and FC-Expansion Units. You can build a redundant drive loop by connecting one or more expansion units to the redundant RAID controllers. Then, use dual fiber-optic cables to connect one expansion unit to another in a daisy-chain. For more information about adding expansion units, see "Connecting additional expansion units" on page 22.

Note: The Model 3542-1RU storage server supports a single Fibre Channel host and drive loop.

Fibre Channel loop configurations

You must determine how the host systems will connect to the storage server. You can connect one host system directly to the storage server or connect multiple hosts to the storage server through managed hubs and switches. The illustrations in the following sections show common host system configurations.

Redundant host and drive loops: The following illustration shows examples of redundant host and drive loop Fibre Channel configurations.

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

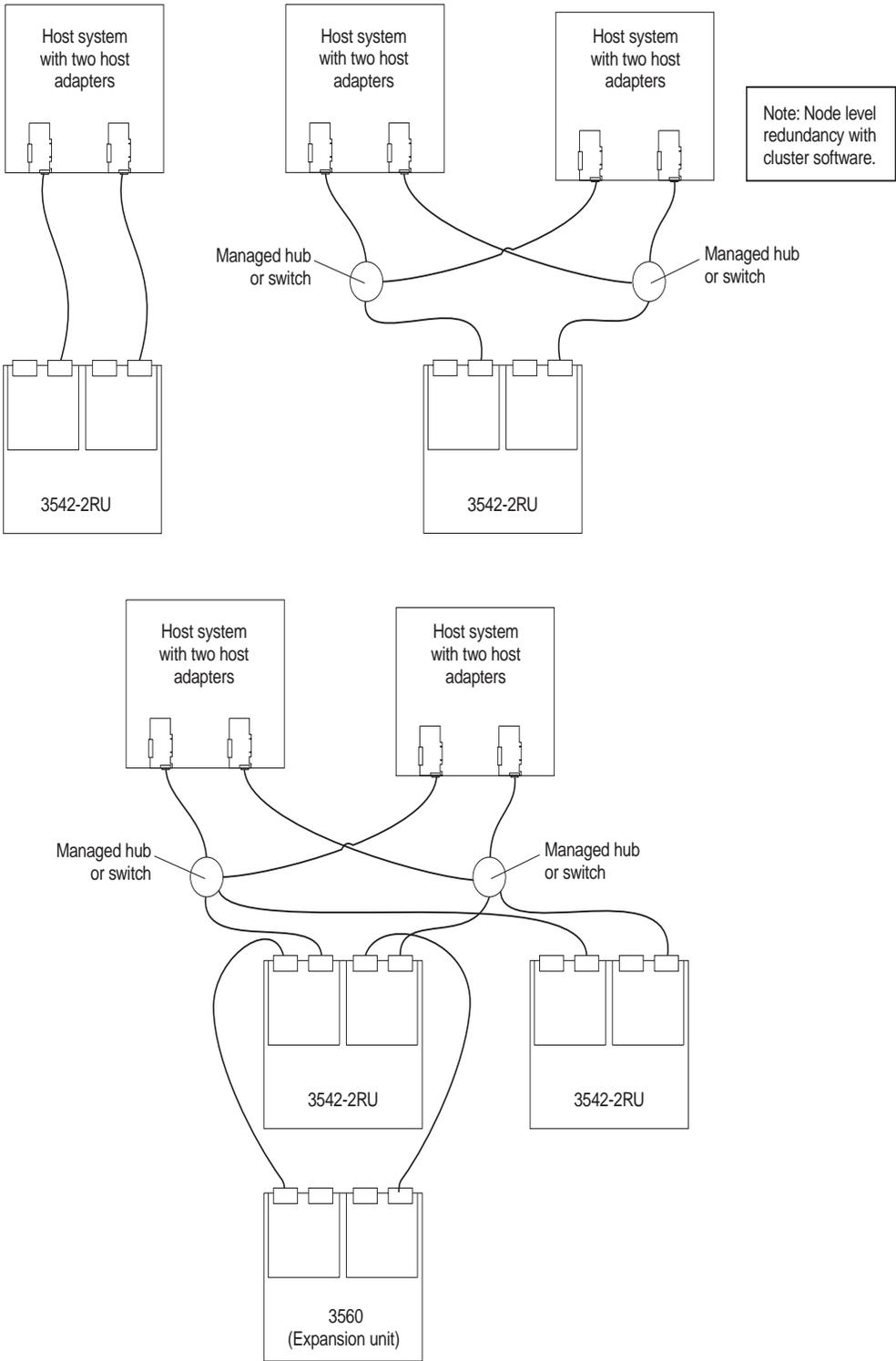


Figure 3. Redundant host and drive Fibre Channel loop configurations

Partially-redundant host and redundant drive

loops: The following illustration shows examples of configurations that have partially-redundant host loops. Partially-redundant host loops have a single link or device in the path between the host and the RAID controller. The single links and devices on the host Fibre Channel loop are single points of failure. If the single link or device fails, the host is not able to access storage until the link is repaired. The host links that have multiple paths to the storage server have path failover protection.

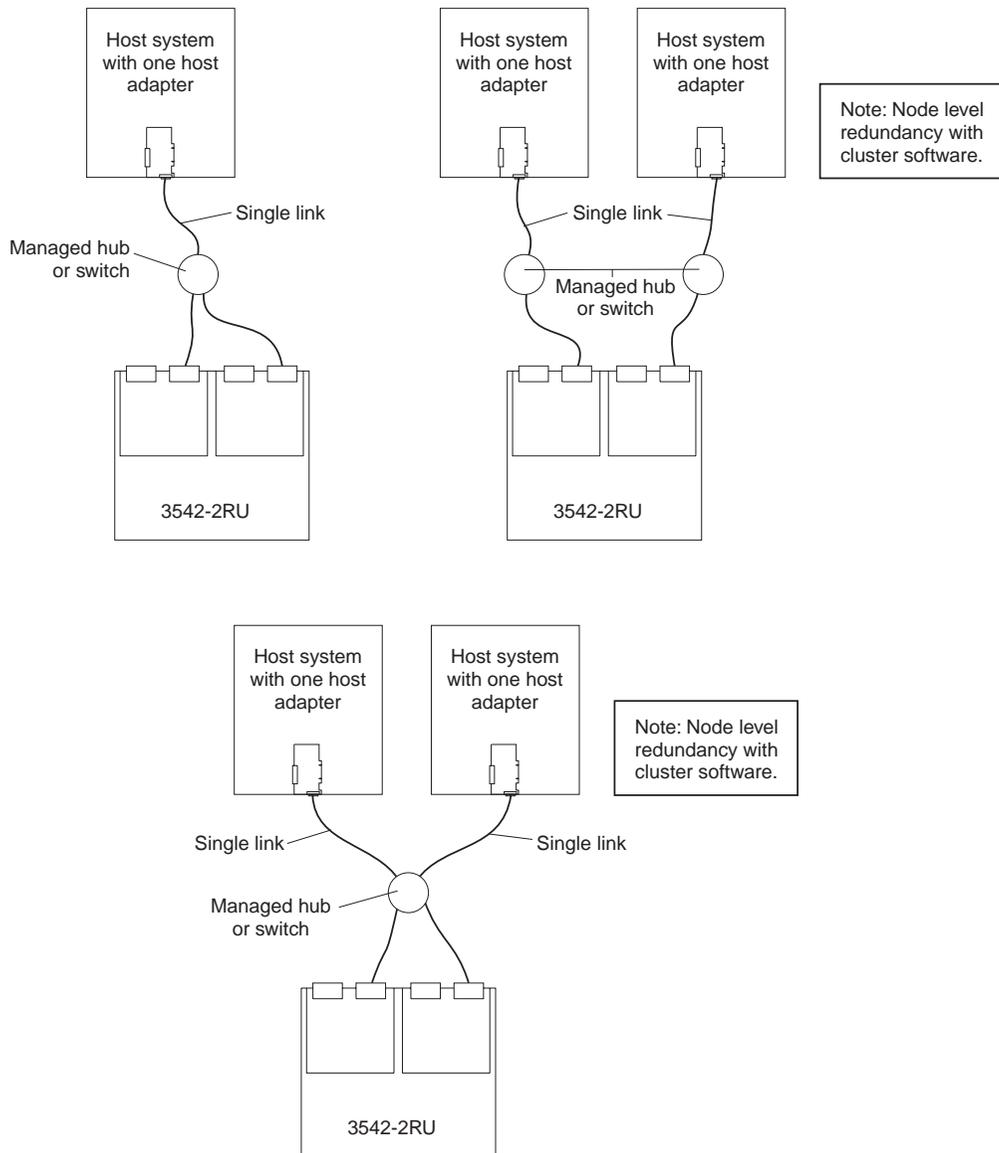


Figure 4. Partially-redundant host Fibre Channel loop, and redundant drive Fibre Channel loop configurations

Non-redundant host and drive loops: The following illustration shows examples of configurations that have non-redundant host and drive Fibre Channel. These configurations have a single path on the host and drive Fibre Channel loop. If either path fails, the host is not able to access storage until the path is repaired. The single controller (Model 3542-1RU) configurations have a single Fibre Channel loop to the hard disk drives. These configurations have no path failover protection.

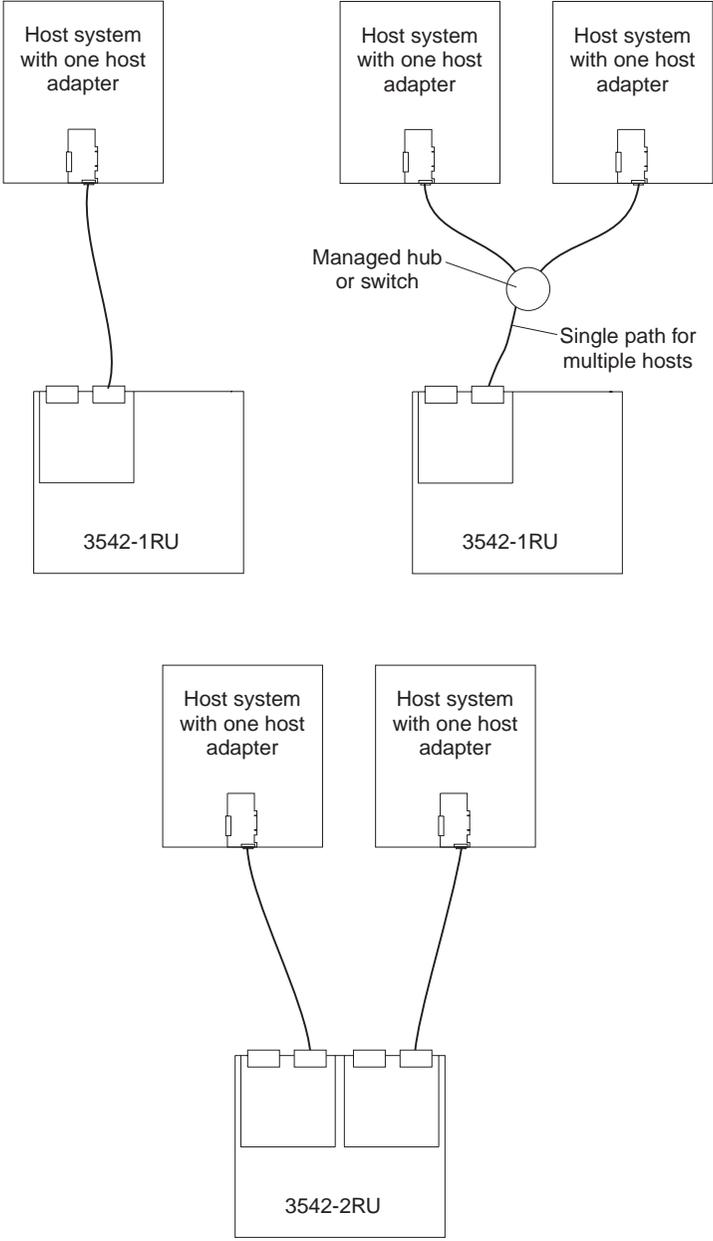


Figure 5. Non-redundant host and drive Fibre Channel loop configurations

Installing the storage subsystem

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

Notes:

1. Refer to the documentation provided with your host adapters for installation requirements and procedures.
2. Use the correct host adapter driver. For the latest supported host adapters and drivers, go to <http://www.ibm.com/pc/support/>.

Attach fiber-optic interface cables to each host adapter. You will connect the other end of the cables to the controller later in the installation process. For more information about handling fiber-optic cables, see “Installing fiber-optic cables” on page 19.

Note: Do not install the storage-management software at this time, if it is not already installed. Install the storage server completely before installing the software, because you cannot test the software installation until the hardware is connected.

Getting started

Use the following list to prepare a storage server for installation:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Operating specifications” on page 7.
2. Move the storage server and its rack cabinet to the site.
3. Remove the storage server from its shipping container and check the contents (for a list of items, see “Inventory checklist” on page 3.) If any items are missing, contact your IBM reseller before proceeding.
4. Assemble the tools and equipment that you will need for installation. These might include:
 - Power cords (come with the storage server)
 - Screwdrivers (various sizes)
 - Antistatic protection (such as a grounding wrist strap)
 - Gigabit Interface Converters (GBICs)
 - Fibre Channel and Ethernet interface cables and cable straps
 - Rack-mounting hardware (comes with the storage server)
 - Storage-management software to configure the storage subsystems (comes with the storage server on the *IBM FAStT Storage Manager Version 7.10* installation CD.)
5. Install the storage server in the rack. Rack mounting instructions and a template for aligning the holes in the rails and the rack, come with the storage server. If you have misplaced these items, see Appendix B, “Rack mounting template and instructions” on page 69.
6. After you install the storage server in the rack, go to Chapter 3, “Cabling the storage server” on page 17.

Chapter 3. Cabling the storage server

This chapter provides the storage server Fibre Channel and power cabling information. After you attach your storage server power cables, use the instructions that are provided in "Turning the storage server on and off" on page 25 for the initial startup of the storage server.

Working with GBICs and fiber-optic cables

Each RAID controller has one host port and one expansion port. A Gigabit Interface Converter (GBIC) is used to connect each host port and expansion port to hosts and expansion units. The GBIC is inserted into the port, and then a fiber-optic cable is inserted into the GBIC. The other end of the fiber-optic cable connects to an external device.

Installing GBICs

Observe the following GBIC installation tips:

- The GBIC module housing has an integral guide key to prevent you from inserting the GBIC improperly.
- Use minimal pressure when inserting the GBIC into a port. Forcing the GBIC into a port could cause damage to the GBIC or the port.
- GBICs are hot pluggable. You can insert or remove the GBIC while the storage server is powered on.
- The operational loop performance is not affected when you install or remove a GBIC.
- You must connect the fiber-optic interface cable to the GBIC module after you insert the GBIC into the port.

Statement 3



CAUTION:

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

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



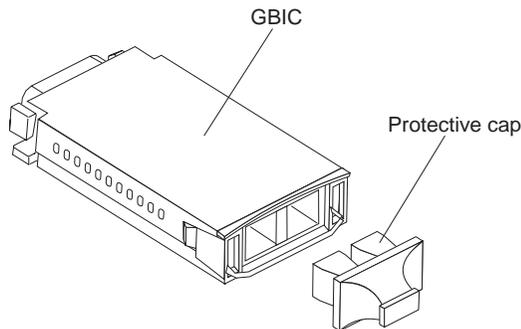
Danger

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

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

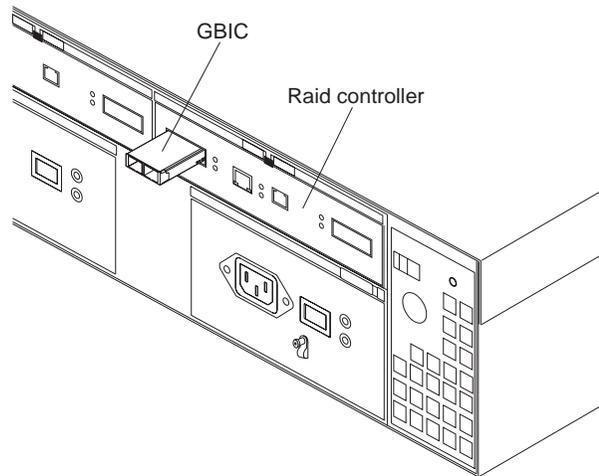
To install a GBIC, do the following:

1. Remove the protective cap from the GBIC, as shown in the following illustration.



2. If the GBIC that you are installing has a metal latch, move the latch to the unlocked (center) position.

3. Insert the GBIC into the host or expansion port on the RAID controller, as shown in the following illustration.



4. After the GBIC is inserted into the port completely, rotate the GBIC latch outward to the locked position (flush with the rear of the GBIC).

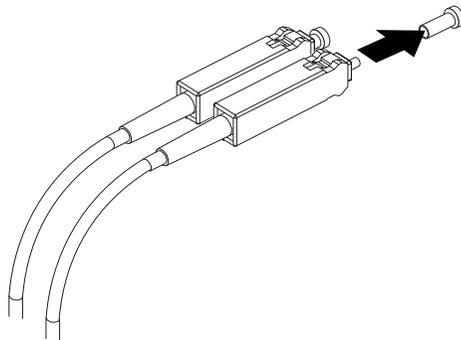
Installing fiber-optic cables

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

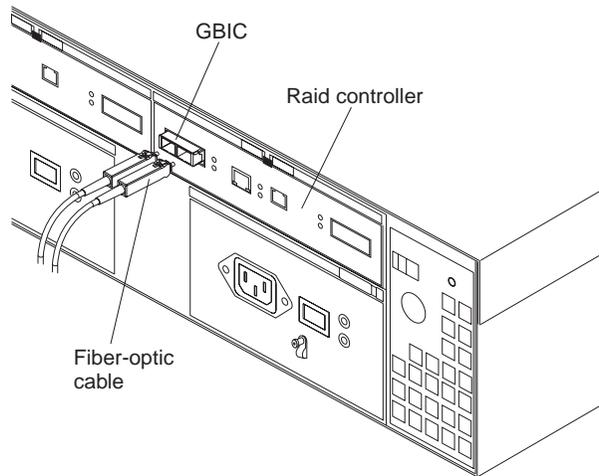
- Do not route the cable along a folding cable-management arm.
- When attaching fiber-optic cables to a device on slide rails, leave enough slack in the cable so that it does not bend to a radius smaller than 76 mm (3 in.) when extended or become pinched when retracted.
- Route the cable away from places where it can snag on other devices in the rack.
- Do not overtighten the cable straps or bend the cables to a radius smaller than 76 mm (3 in.).
- Do not put excess weight on the cable at the connection point and be sure that it is well supported.

To connect the fiber-optic cables, do the following.

1. Remove the protective caps from the fiber-optic cable.



2. Connect the fiber-optic cable to the installed GBIC, as shown in the following illustration.



3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Fault LED is off. For information about the status of the RAID controller LEDs, see Table 4 on page 30.

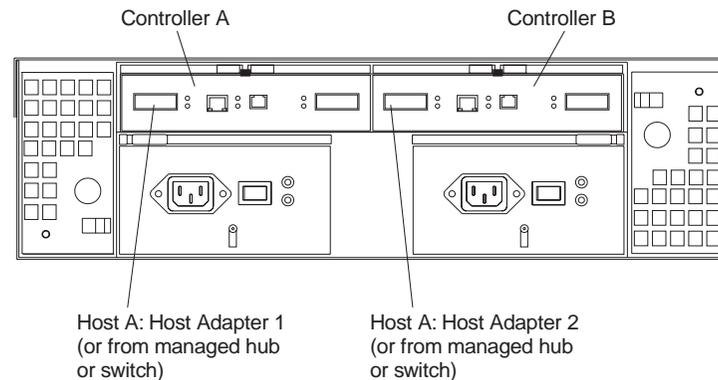
To remove the fiber-optic cables and GBICs, do the following:

1. Gently pull the fiber-optic cable from the GBIC; then, replace the protective caps.
2. Move the metal latch on the GBIC to the unlocked (center) position.
3. Gently pull the GBIC out of the port; then, replace the protective cap.

Connecting hosts to the RAID controllers

To connect a host adapter to the RAID controller, do the following:

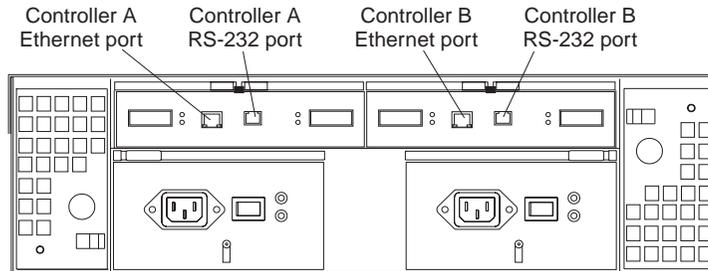
1. Install a GBIC in the host port on the RAID controller.
2. Connect the host-system cables to the RAID controller or to managed hubs and switches. The following illustration shows the location on the RAID controllers where the host-system cables connect.



For examples of redundant, partially-redundant, and non-redundant host and drive loop configurations, see “Fibre Channel loop configurations” on page 11.

Connecting secondary interface cables

Use the Ethernet interface ports on the back of the storage server to connect the controllers for direct management of the storage subsystems. Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for Controller A (located on the left) and Controller B (located on the right) on the back of the storage server. The following illustration shows the location of the ports.



Note: The serial (RS-232) interface ports are intended to be used by service technicians to perform diagnostic operations on the storage server.

Installing the storage-management software

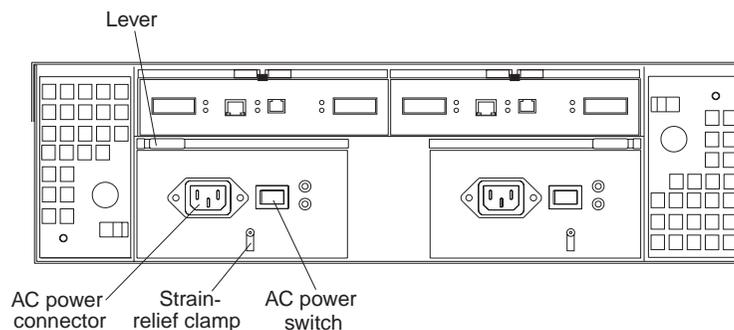
Install the storage-management software using the procedures in the software Installation and Support Guide for your operating system. Use that book and the online help to configure the logical drives, partitions and so on for the RAID controllers. Use your operating system documentation to make the new logical drives accessible to the operating system.

Note: Make sure that you start the storage-management software to continuously monitor the status of the storage server. For information about the importance of this information, see “Monitoring status through software” on page 28.

Power cabling

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

If you have not already done so, attach the power cords, using the following illustration for the location of the component parts.



1. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power supply connection end.
2. Attach the power-supply nut, and tighten it securely.

3. Connect the power cord to the power supply.
4. Plug the power cord into a properly grounded electrical outlet.
5. Go to “Turning the storage server on and off” on page 25 for the initial startup of the storage server.

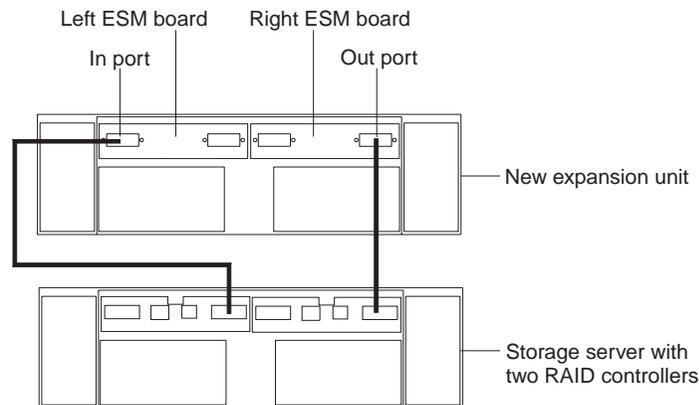
Connecting additional expansion units

After you install the storage server, you can connect additional expansion units. You can do this at any time after you install the storage server, even while it is turned on and processing data. You can even install one expansion unit now, and an additional expansion unit later.

Attention: You can add only *new* expansion units to the storage server. This means that there must be no existing configuration information on the expansion unit you want to install. If the expansion unit that you want to install currently contains logical drives or configured hot spares, you must delete them before connecting the expansion unit to the storage server.

To connect an additional expansion unit, do the following:

1. Follow the instructions in your expansion unit installation manual to set up and mount the new expansion unit.
2. Use the following procedure and illustration to connect a single expansion unit to the storage server:
 - a. Use a fiber-optic cable to connect to the FC-Expansion Units port on the left RAID controller in the storage server to the In port on the left ESM board of the expansion unit.
 - b. Use a second fiber-optic cable to connect the FC-Expansion Units port on the right RAID controller in the storage server to the Out port on the right ESM board of the expansion unit.
 - c. Ensure that the left and right ESM board IDs (switch settings) are set to an identical value.



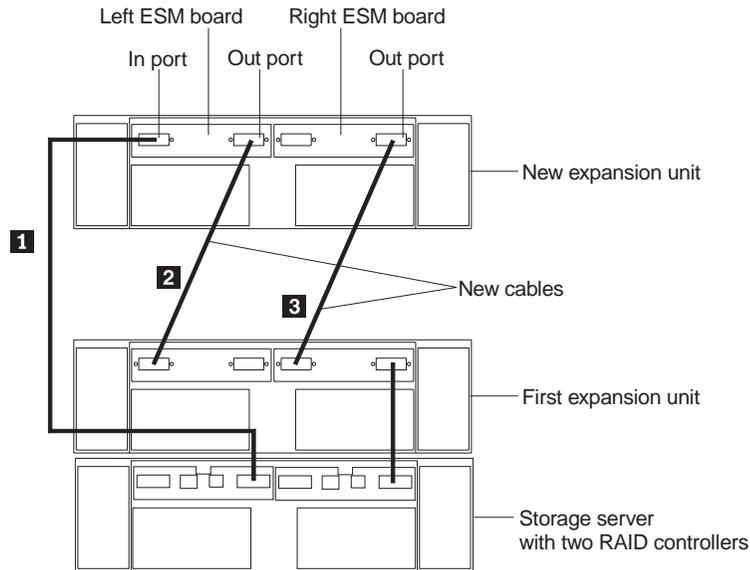
After you complete all connections, the storage server locates the new drives.

3. Use the storage-management software to check the status of the new drives, correct any errors found, and configure the new drives.

Use the following procedure and illustration to connect a second expansion unit to the storage server after previously adding the first expansion unit.

1. Disconnect cable **1** from its current connection and connect it to the In port on the left ESM board on the new expansion unit.

2. Connect cable **2** to the In port you disconnected in step 1 and the Out port on the left ESM board on the new expansion unit.
3. Connect a third cable **3** to the In port on the right ESM board on the first expansion unit and the Out port on the right ESM board on the new expansion unit.
4. Make sure that each expansion unit has a unique ID (switch setting) and that the left and right ESM board switch settings on each expansion unit are set to an identical value.



After you complete all connections, the storage server locates the new drives.

5. Use the storage-management software to check the status of the new drives, correct any errors found, and configure the new drives.

For more detailed information about cabling the storage server and expansion units, refer to the IBM FAST200 Fibre Channel Cabling Instructions that come with the storage server.

Chapter 4. Operating the storage server

This chapter describes the tasks that are required to operate the storage server.

Turning the storage server on and off

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

If you are turning on the storage server after an emergency shutdown or power outage, refer to “Restoring power after an emergency shutdown” on page 28.

Turning on the storage server

Use this procedure to turn on the power for the initial startup of the storage server.

1. Verify that:
 - a. All communication and power cables are plugged into the back of the storage server and a properly grounded ac electrical outlet
 - b. All hard disk drives are locked securely in place. For more information, see “Installing hot-swap drives” on page 36.

Attention: If you are restarting the system after a normal shutdown, wait at least 10 seconds before you turn on the power using the power-on sequence in step 2.

2. Check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:
 - a. Turn on the power to the supporting devices (for example, Ethernet switches, managed hubs, and management stations) before the storage server.
 - b. You must turn on the expansion units before the storage server. The controllers might not recognize the correct configuration if the drives are powered up after the storage server. For instructions on powering up the expansion units, refer to the expansion-unit documentation.
 - c. Turn on the power to the storage server; then, restart or turn on the power to the host.
3. Turn on the power to each device, based on the power-on sequence in step 2.. To turn on power to the storage server, turn on the power-supply switches on the back of the storage server. You must turn on both power-supply switches to take advantage of the redundant power supplies.
4. Use the storage-management software and the Fault LEDs to check the overall status of the storage server and its components. All LEDs should be green on the front of the storage server. If they are not, use the storage-management software to diagnose the problem (see “Monitoring status through software” on page 28).

Note: The green Drive active LED and amber Drive fault LED below the drive CRUs might flash intermittently as the drives spin-up. Wait until the storage server is finished powering up before checking the LEDs on the front of the storage server. For more information, see “Checking the LEDs” on page 29.

Turning off the storage server

Attention: Except in an emergency, never turn off the power if any storage server Fault LEDs are on. Correct the fault before you turn off the power, using the proper troubleshooting or servicing procedure. This ensures that the storage server will power up correctly later. For more information, see “Troubleshooting” on page 63.

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

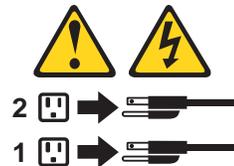
- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A power outage or emergency situation occurs (see “Performing an emergency shutdown” on page 27).

Statement 5



CAUTION:

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



Use this procedure to turn off the power:

1. Before proceeding, use the storage-management 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.
 2. Use the storage-management software to check the status of the storage server. Correct problems that are reported before you turn off the power.
 3. Do the following:
 - a. Stop all I/O activity to the storage server and attached expansion units. Make sure that:
 - All of the green Drive active LEDs on the front of the storage server (and on all attached expansion units) are not flashing.
 - The green Cache active LEDs on the back of the storage server are off.
 - b. If applicable, use the operating-system software to disconnect the storage server logical drives from the host before the storage server is powered off.
- Attention:** To turn off all power to the storage server, you must turn off both power-supply switches and disconnect both power cords. Use the procedure in step 4. for the proper shutdown sequence.
4. Turn off the power to each device based on the following shutdown sequence:
 - a. Turn off power to the host before the storage server. If the host must stay powered on to support an existing network, refer to the operating system documentation for information about disconnecting the storage server logical drives from the host before the storage server is powered off.
 - b. Turn off power to the storage server before you turn off power to the expansion units. Turn off both power supply switches on the back of the storage server.

- c. Turn off power to other supporting devices (for example, management stations, Fibre Channel switches, Fibre Channel managed hubs, or Ethernet switches).

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

5. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage server” on page 25.

Restoring power after an unexpected shutdown

The storage server might shut down unexpectedly under any of the following conditions.

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

- The internal temperature of the storage server exceeds the maximum operating temperature (an overtemperature condition).

If both fan CRUs fail or are unable to maintain an internal temperature below 70°C (158°F), one or both of the power supplies in the storage server will shut down. If both power supplies shut down, the unit is inoperable.

The storage-management software warns you if the temperature of the unit is rising, before it has risen sufficiently to shut down the power supplies. The first warning comes when the storage server internal temperature exceeds 45°C (113°F). The storage server shuts down if the temperature rises to 70°C (158°F).

- There is a general power failure or a loss of power to the unit.
- You are forced to shut down the storage server without performing the normal shutdown procedures (listed in “Turning off the storage server” on page 25) because of an emergency situation.

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

If the storage server shuts down unexpectedly, but there is still power to the site, use the storage-management software to determine if the storage server has overheated.

- If an overtemperature condition is indicated, use the procedure in “Restoring power after an overtemperature shutdown” on page 28 to restart the storage server.
- If the storage server has shut down because of a power failure or an emergency shutdown, use the procedure in “Restoring power after an emergency shutdown” on page 28 to restart the storage server.

Performing an emergency shutdown

Attention: Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This will help safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage server loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see “Troubleshooting” on page 63).

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

1. If you have time, stop all I/O activity to the storage server by shutting down the host or disconnecting the storage server logical drives through the host.

2. Check the LEDs (front and back). Make note of any Fault LEDs that are on so you can correct the problem when you turn on the power again.
3. Turn off all power-supply switches; then, unplug the power cords from the storage server.

Restoring power after an emergency shutdown

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

1. After the emergency situation is over or power is restored, check the storage server for damage. If there is no visible damage, continue with step 2; otherwise, have your system serviced.
2. After you have checked for damage, ensure that the power-supply switches are off; then, plug in the storage-server power cords.
3. Complete step 2 on page 25 to determine the proper power-on sequence for your system.
4. Complete steps 3 and 4 on page 25 to turn on power to the devices in your system and to check the status of the storage server.

Restoring power after an overtemperature shutdown

Use this procedure to restart the storage server after an unexpected shutdown due to of an overtemperature condition:

1. Make sure that the power-supply switches on the back of the storage server are turned off.
2. Do whatever is necessary to cool the unit (replace the fans, use external fans to cool the room, and so on).
3. Check all components and cables for visible damage. *Do not start the storage server if you find evidence of damage.*
4. Complete step 2 on page 25 to determine the proper power-on sequence for your system.
5. When the internal temperature of the storage server is below 45°C (113°F), complete steps 3 and 4 on page 25 to turn on power to the devices in your system and to check the status of the storage server.

Monitoring status through software

Use the storage-management software to monitor the status of the storage server. Run the software constantly, and check it frequently.

The storage-management software provides the best way to diagnose and repair storage-server failures. The software can help you:

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

Although the storage server has fault LEDs, these lights do not necessarily indicate which component has failed or needs to be replaced, or which type of recovery procedure that you must perform. In some cases (such as loss of redundancy in various components), the fault LED does not turn on. Only the storage-management software can detect the failure.

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

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

Recovering from a storage-server failure might require you to perform procedures other than replacing the component (such as backing up the logical drive or failing a drive before removing it). The storage-management software gives these procedures.

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

Checking the LEDs

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

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

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

- Figure 6
- Table 3 on page 30

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

- Figure 8 on page 32
- Table 4 on page 30
- Table 5 on page 32

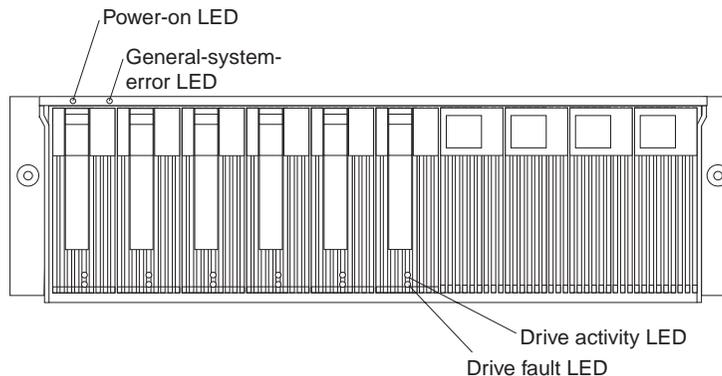


Figure 6. Storage server LEDs (front)

Table 3. Storage server LEDs (front)

LED	Color	Operating states ¹
Drive active	Green	<ul style="list-style-type: none"> • On - Normal operation. • Flashing - The drive is reading or writing data. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> — The storage server has no power. — The storage subsystem has no power. — The drive is not properly seated in the storage server. — The drive has not spun up.
Drive fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • Flashing - The storage-management software is locating a drive, logical drive, or storage subsystem. • On - The drive has failed, or a user failed the drive.
Power	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> — The storage server has no power. — The storage subsystem has no power. — The power supply has failed. — There is an overtemperature condition.
General-system-error	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - A storage server component has failed².

¹ Always use the storage-management software to identify the failure.

² Not all component failures turn on this LED. For more information, see “Monitoring status through software” on page 28.

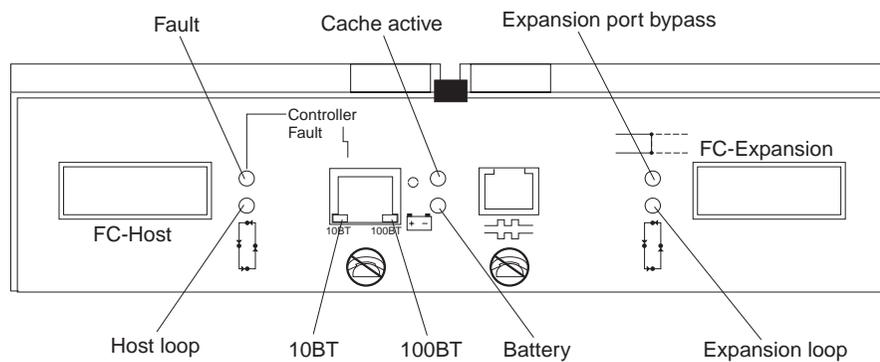


Figure 7. RAID controller LEDs

Table 4. RAID Controller LEDs

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

Table 4. RAID Controller LEDs (continued)

Icon	LED	Color	Operating states ¹
	Host loop	Green	<ul style="list-style-type: none"> • On - Normal operation • Off - One of the following situations has occurred: <ul style="list-style-type: none"> — The host loop is down, not turned on, or not connected. — A GBIC has failed, or the host port is not occupied. — The RAID controller circuitry has failed, or the RAID controller has no power.
	Cache active	Green	<ul style="list-style-type: none"> • On - There is data in the RAID controller cache. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> — There is no data in cache. — There are no cache options selected for this array. — The cache memory has failed, or the battery has failed.
	Battery	Green	<ul style="list-style-type: none"> • On - Normal operation. • Flashing - The battery is recharging or performing a self-test. • Off - The battery or battery charger has failed.
	Expansion port bypass	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - One of the following situations has occurred: <ul style="list-style-type: none"> — The expansion port is not occupied. — The Fibre Channel cable is not attached to an expansion unit. — The attached expansion unit is not turned on. — A GBIC has failed, a Fibre Channel cable has failed, or a GBIC has failed on the attached expansion unit.
	Expansion loop	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - The RAID controller circuitry has failed, or the RAID controller has no power.
No icon	10BT	Green	<ul style="list-style-type: none"> • If the Ethernet connection is 10BASE-T: The 10BT LED is on, 100BT LED flashes faintly. • If the Ethernet connection is 100BASE-T: 10BT LED is off, 100BT LED is on. • If there is no Ethernet connection - Both LEDs are off.
No icon	100BT		
¹ Always use the storage-management software to identify the failure.			

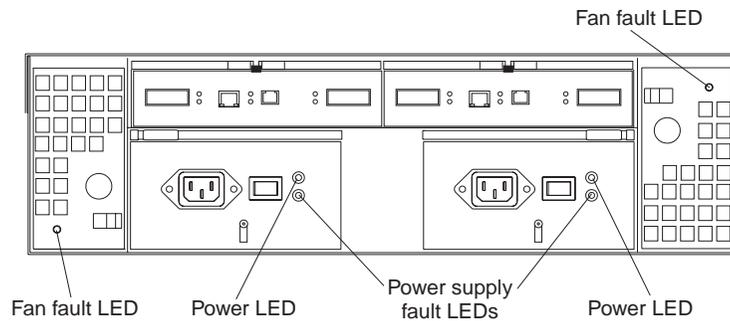


Figure 8. Fan and power supply LEDs

Table 5. Fan LED

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - The fan CRU has failed.
¹ Always use the storage-management software to identify the failure.		

Table 6. Power supply LEDs

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - One of the following situations has occurred: <ul style="list-style-type: none"> — The power supply has failed. — An overtemperature condition has occurred. — The power supply is turned off.
Power	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> — The power supply is disconnected. — The power supply is seated incorrectly. — The storage server has no power.
¹ Always use the storage-management software to identify the failure.		

Cache memory and RAID controller battery

Each RAID controller contains 4 KB of cache data. It also contains a rechargeable battery that maintains data in the cache in the event of a power failure. The following sections describe these features and their associated LEDs.

Cache memory

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

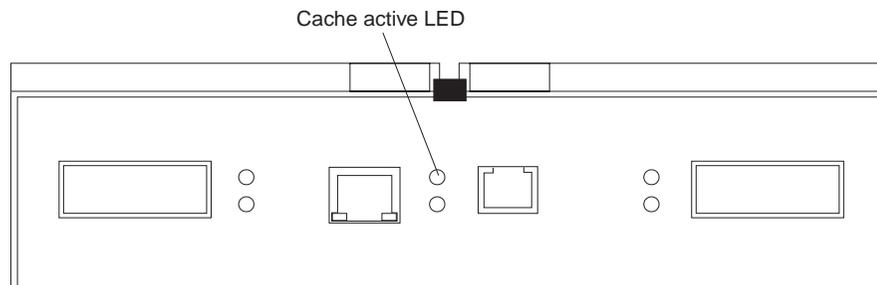
See the storage-management software documentation for information on setting cache memory options.

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

If caching is enabled and the Cache active LED never comes on during I/O activity, it indicates that the cache memory has failed or the battery has failed (the green Battery LED will be off).

Note: Always use the storage-management software to check your cache memory settings before assuming a hardware failure.

The following illustration shows the location of the Cache active LED on the front of the RAID controller.



RAID controller cache battery

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

The service life of the battery is three years, after which time the battery must be replaced. Refer to the storage-management software for information on how to view and set the battery expiration date.

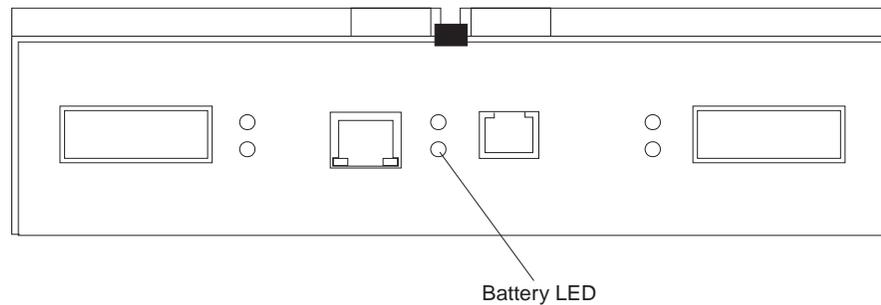
Each RAID controller has a green Battery LED on the back that indicates the battery status, as follows:

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

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

Data caching starts after the battery completes the startup tests.

The following illustration shows the location of the Battery LED on the front of the RAID controller.



Chapter 5. Installing and replacing components

This chapter provides instructions to help you install or remove customer replaceable units (CRUs), such as hot-swap drives, fans, RAID controllers, and power supplies.

Handling static-sensitive devices

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

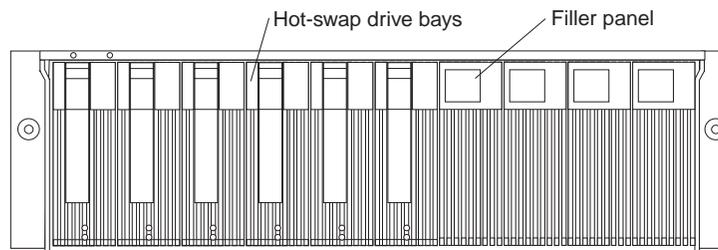
To reduce the possibility of electrostatic discharge, observe the following precautions:

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

Working with hot-swap drives

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

The following illustration shows the location of the hot-swap drive bays that are accessible from the front of the storage server. In this illustration, six of the 10 bays contain drive CRUs and four bays contain filler panels. To maintain proper cooling within the storage server, always keep a filler panel in each drive bay that does not contain a drive CRU.



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

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

Filler panels

Storage servers without a full set of drives (10) contain filler panels in the unused drive bays. Before installing new drives, you must remove the filler panels. Save the filler panels for future use. Each of the 10 bays must always contain either a filler panel or a drive CRU. Each filler panel contains a filler piece for use with a slim drive.

Drive CRUs

The RAID controller supports up to 10 (half-high or slim) 40-pin Fibre Channel hard disk drives. These drives come preinstalled in drive trays. This drive-and-tray assembly is called a *drive CRU* (customer replaceable unit). You can install the drive CRUs in the 10 drive bays on the front of the storage server.

Drive LEDs

Each drive CRU has two LEDs, which indicate the status for that particular drive. For information about the drive LED operating states and descriptions, see Figure 6 on page 29 and Table 3 on page 30.

Fibre Channel loop IDs

When you install a drive CRU in the storage server, the drive CRU connects into a printed circuit board called the *midplane*. The midplane automatically sets the Fibre Channel loop ID to the default value 00.

Hot-swap hardware

The storage server contains hardware that you can use to replace a failed hard disk drive without turning off the storage server. Therefore, you can continue operating the system while a hard disk drive is removed or installed. These drives are known as *hot-swap* drives.

Slim drives

You can install slim, hot-swap drive CRUs, which are slightly smaller than the standard disk drive. These drive CRUs do not fill the entire drive bay. To maintain proper airflow and cooling when you install a slim drive, you must also install one of the filler pieces that are provided in the filler panels.

Installing hot-swap drives

Before you begin, do the following:

- Read the safety and handling guidelines that are provided in “Safety” on page iii and “Handling static-sensitive devices” on page 35.
- Ensure that the current system configuration is working properly.
- Back up all important data before you make changes to storage devices, such as hard disk drives.

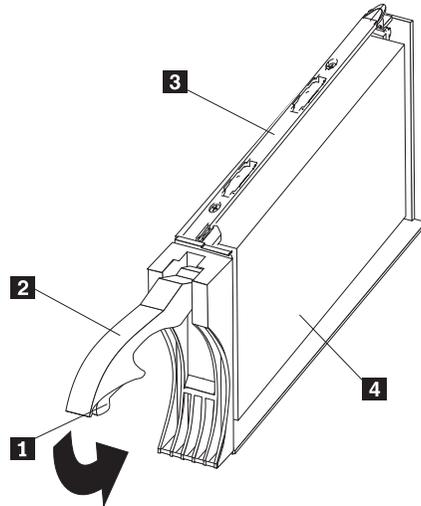
Use the following procedure to install drives in the storage server. You can install additional drives while the storage server is powered up and running.

Note: If you are replacing a drive, see “Replacing hot-swap drives” on page 39.

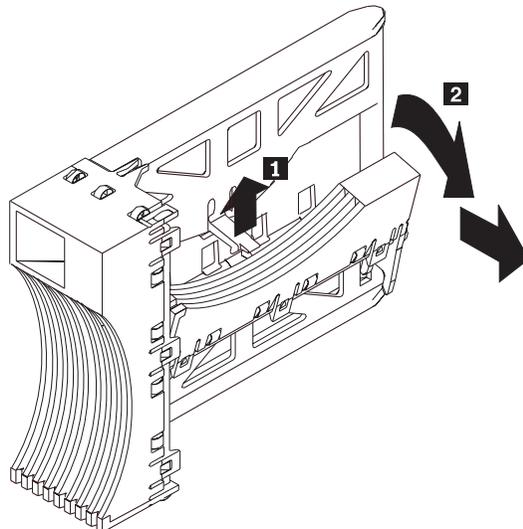
1. Read the instructions that come with the drive CRU.
2. Check for Fault LEDs. If any amber LEDs are lit, see “Checking the LEDs” on page 29 and “Troubleshooting” on page 63.
3. Determine the bay into which you want to install the drive.
4. Remove the filler panel.

- a. Insert a finger into the square hole at the top of the filler panel to grip and pull the tray out of the drive bay.
 - b. Save the filler panel for later use.
5. Install the drive CRU:

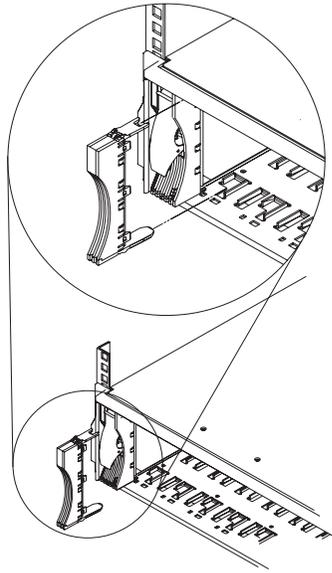
Note: The hard disk drive comes with a tray already attached. Do not attempt to detach the drive **4** from the tray **3**.



- a. Release the blue latch **1** on the drive CRU by pressing on the inside of the bottom of the tray handle.
 - b. Pull the handle **2** on the tray out into the open position.
 - c. Slide the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.
 - d. Push the tray handle **2** down into the closed (latched) position.
6. If you are installing a slim drive, continue with step 6a. Otherwise, go to step 7 on page 38.
- a. Locate the filler piece on the inside of the filler panel.
 - b. Pull up on the small latch **1** inside the filler panel to release the filler piece.
 - c. Tilt the filler piece up from the filler panel **2**; then, remove it from the tray as shown in the following illustration.



- d. Insert the filler piece into the empty space that is left in the drive bay, as shown in the following illustration.



7. Check the drive LEDs.
 - a. When a drive is ready for use, the green Activity LED is on and the amber Drive fault LED is off.
 - b. If the amber Drive fault LED is completely on and not flashing, remove the drive from the unit and wait 10 seconds; then, reinstall the drive.
8. Use the storage-management software to configure the drive.
9. Update the information in Appendix A, "Records" on page 67.

Replacing hot-swap drives

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

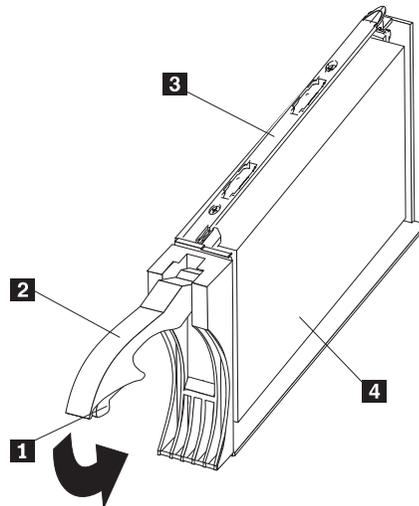
Attention: Failure to replace the drives in their correct bays might result in loss of data. If you are replacing a drive that is part of a RAID level 1 or RAID level 5 logical drive, ensure that you install the replacement drive in the correct bay.

Use the following procedure to replace host-swap drives.

1. Check the hardware and software documentation that is provided with the system to see if there are restrictions regarding hard disk drive configurations. Some system Fibre Channel configurations might not allow mixing different drive capacities or types within an array.
2. Check the storage-management software for recovery procedures for a drive that has failed. Follow the steps in the software procedure before continuing with this procedure.
3. Determine the location of the drive that you want to remove.

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

4. Remove the drive CRU.
 - a. Press on the inside of the bottom of the tray handle to release the blue latch **1**.
 - b. Pull the handle **2** on the tray **3** out into the open position.
 - c. Lift the drive CRU partially out of the bay.
 - d. To avoid possible damage to the drive **4**, wait at least 20 seconds before fully removing the drive CRU from the storage server to allow for the drive to spin down.



- e. Verify that there is proper identification (such as a label) on the drive CRU, and then slide it completely out of the storage server.
 - f. If you are replacing a slim drive, ensure that the filler piece remains in place for use with the new drive.
5. Install the new drive CRU.

- a. Gently push the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.
 - b. Push the tray handle **2** down into the closed (latched) position.
6. Check the drive LEDs.
- a. When a drive is ready for use, the green Activity LED is on, and the amber Drive fault LED is off.
 - b. If the amber Drive fault LED is on and not flashing, remove the drive from the unit and wait 10 seconds; then, reinstall the drive.
7. Return to normal operation.

Upgrading drives

You can upgrade drives in two ways:

- Adding drives to empty slots in the storage server (see “Installing hot-swap drives” on page 36).
- Replacing existing drives with larger capacity drives.

Adding larger-capacity drives

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

There are two methods for upgrading drives:

Replacing all the drives at the same time

This method requires that you back up the data on the affected drives and then turn off the storage server. After replacing all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in “Replacing all drives at the same time” on page 41.

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 server (or any expansion units attached to the storage server) until you finish the procedure. You must use this method on RAID 0 logical drives.

Replacing the drives one at a time

In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before installing the next drive. After you install the new drives, you can configure them to make the additional drive space available. See the procedure in “Replacing the drives one at a time” on page 42.

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

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

The method you use depends on the following considerations:

- Which method most closely matches the recommended drive upgrade procedure that is provided in the operating system or the 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

Replacing all drives at the same time

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

To replace all the drives at the same time, do the following.

1. Read the following:

- The information in “Adding larger-capacity drives” on page 40, particularly the paragraphs that discuss the differences between the two possible upgrade procedures.
- The information in your software documentation regarding drive upgrades and installation.
- The documentation that comes with the new drives.

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

2. Use the storage-management software to check the status of the storage server. 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 35.

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 need to return the drives.

5. Do the following:

- a. Stop all I/O activity to the storage server and attached expansion units. Make sure that:
 - 1) All of the green Drive activity LEDs on the front of the storage server (and on all attached expansion units) are not flashing.
 - 2) The green Cache active LEDs are off on the front of the RAID controllers.
- b. If applicable, use the operating system software to disconnect the storage server logical drives from the host before the storage server is powered off.

Attention: To turn off all power to the storage server, you must turn off both power-supply switches and disconnect both power cords. Use the procedure in step 6 on page 42 for the proper shutdown sequence.

6. Turn off the power to each device based on the following shutdown sequence:
 - a. Turn off power to the host before the storage server. If the host must stay powered on to support an existing network, refer to the operating system documentation for information about disconnecting the storage server logical drives from the host before the storage server is powered off.
 - b. Turn off power to the storage server before you turn off power to the expansion units. Turn off both power supply switches on the back of the storage server.
 - c. Turn off power to other supporting devices (for example, management stations, Fibre Channel switches, Fibre Channel managed hubs, or Ethernet switches).

Note: You do not need to perform this step if you are servicing only the storage server.
7. Use the procedures in “Replacing hot-swap drives” on page 39 to remove the drives that you want to replace. Use the procedures in “Installing hot-swap drives” on page 36 to install the new drives into the storage server.
8. After you install all the new drives, check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:
 - a. Turn on the power to the supporting devices (for example, Ethernet switches, managed hubs, and management stations) before the storage server.
 - b. You must turn on the expansion units before the storage server. The controllers might not recognize the correct configuration if the drives are powered up after the storage server. For instructions on powering up the expansion units, refer to the expansion-unit documentation.
 - c. Turn on the power to the storage server; then, restart or turn on the power to the host.
9. Turn on the power to each device, based on the power-on sequence in step 8.. To turn on power to the storage server, turn on the power-supply switches on the back of the storage server. You must turn on both power-supply switches to take advantage of the redundant power supplies.
10. Check the green Drive activity LED and the amber Drive fault LED below the new drive CRUs.

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

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

 - If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
 - If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. Refer to the storage-management software for problem determination.
11. Use the storage-management software to configure the new drives. See the storage-management 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 41).

Note: If your storage subsystem has hot spares assigned, you might want to unassign the hot spares while you perform this procedure. If you do not,

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

To replace the drives one at a time, do the following:

1. Read the following:

- The information in “Adding larger-capacity drives” on page 40, particularly the paragraphs that discuss the differences between the two possible upgrade procedures.
- The information in your software documentation regarding drive upgrades and installation.
- The documentation that comes with the new drives.

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

2. Use the storage-management software to check the status of the unit. Correct any problems that are reported.

3. Back up the data on the drives that you are replacing (optional).

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 35.

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 need to return the drives.

5. Using the storage-management software, manually fail the first drive that you want to replace. Make sure that:

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

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

If you remove an active drive accidentally, wait at least 30 seconds and then reinstall it. Refer to the storage-management software for further recovery instructions.

6. Use the procedures in “Replacing hot-swap drives” on page 39 to remove the failed drive. Use the procedures in “Installing hot-swap drives” on page 36 to install the new drives into the storage server.

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

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

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

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

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

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

- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
- If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. Refer to the storage-management software for problem determination.

8. Use the storage-management 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 will continue to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine if the data reconstruction is finished.

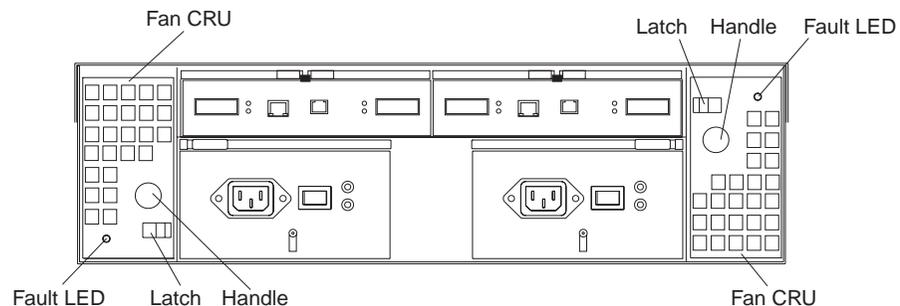
9. When reconstruction is finished on the new drive, repeat step 5 on page 43 through step 8. for each additional drive that you want to install.
10. Use the storage-management software to configure the additional space on the new drives.

Working with hot-swap cooling fans

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

If two fans fail, or the fans cannot maintain an internal temperature below 70°C (158°F), the power supplies in the unit will automatically shut down (an overtemperature condition). If this occurs, you must cool the unit and restart it. See “Restoring power after an overtemperature shutdown” on page 28.

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



Fan CRUs

The two fan CRUs are hot-swappable and redundant.

Fault LEDs

These amber LEDs light when a fan failure occurs.

Latches and handles

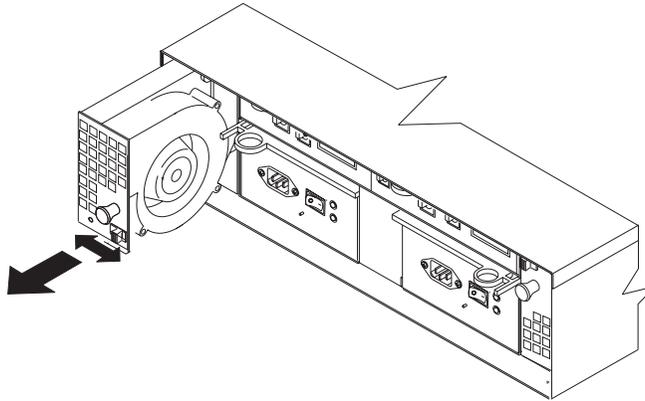
Use the latches and handles to remove or install the fan CRUs.

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

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

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

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



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

The Fault LEDs turn off after a few seconds; if they remain on, refer to “Troubleshooting” on page 63.

Working with hot-swap power supplies

The storage server power system consists of two power supply CRUs. The power supply CRUs provide power to the internal components by converting incoming ac voltage to dc voltage. One power supply CRU can maintain electrical power to the unit if the other power supply is turned off or malfunctions. The power supply CRUs are interchangeable (by reversing the locking levers).

Each power supply CRU has a built-in sensor that detects the following conditions:

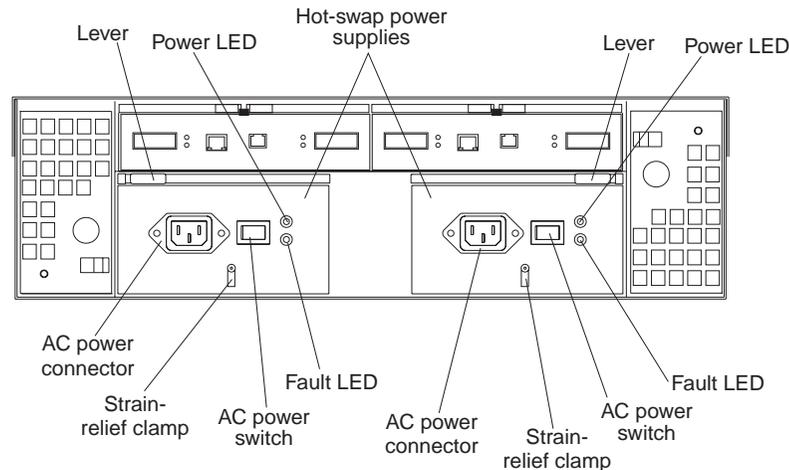
- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. All power remains off until you cycle the power switches (turn the power switches off, wait at least 30 seconds, then turn the power switches on). For more information, see “Restoring power after an unexpected shutdown” on page 27 and “Restoring power after an overtemperature shutdown” on page 28.

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

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

The power-supply controls on the rear of the storage server are shown in the following illustration.



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

Power LED

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

Fault LEDs

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

AC power switches

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

AC power connectors

This is the connection for the ac power cord.

Strain-relief clamp

Use this clamp to provide strain relief on the power cord.

Removing a hot-swap power supply

Statement 8



CAUTION:

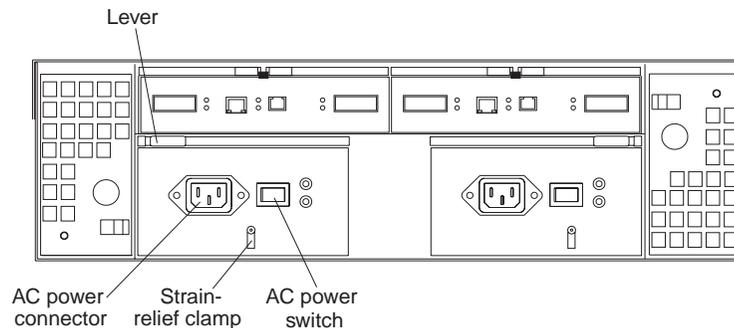
Never remove the cover on a power supply or any part that has the following label attached.



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

To remove a hot-swap power supply:

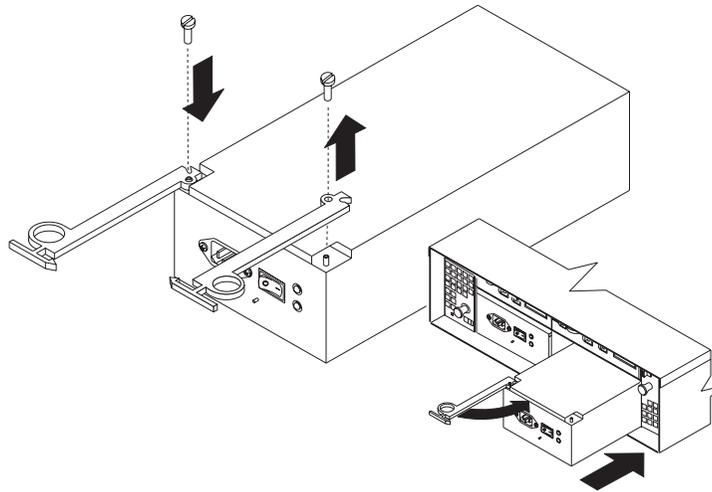
1. Turn off the ac power switch.



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

Installing a hot-swap power supply

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



To install a hot-swap power supply:

Statement 8



CAUTION:

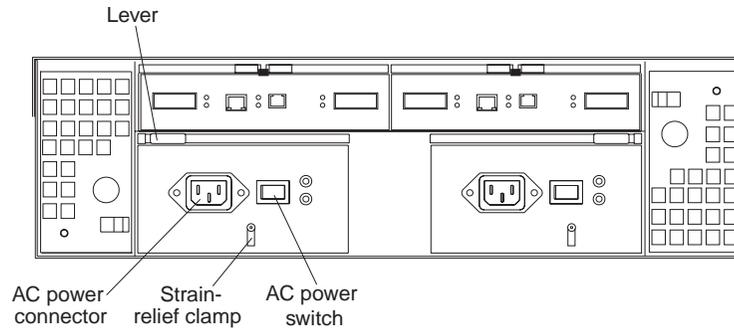
Never remove the cover on a power supply or any part that has the following label attached.



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

1. Ensure that the ac power switch is off on the power supply that you are installing.

2. Install the power supply in the storage server, as follows:
 - a. Slide the power supply into the storage server. Make sure that the lever is pulled straight out as you slide the power supply into the storage server.
 - b. Close the lever until the pull-ring latch locks in place. Make sure that the lever locks into place in the storage-server chassis.
3. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power-supply connection end.
4. Attach the power-supply nut, and tighten it securely.
5. Connect the power cord to the AC power connector.



6. Plug the power cord into a properly grounded electrical outlet.
7. Turn on the power-supply switch.
8. Make sure that the green Power LED on the new power-supply CRU is on and the amber Fault LED is off.
 - If the Power LED is off, the power-supply CRU might not be installed correctly. Remove it and then reinstall it.
 - If the Fault LED is on or the Power LED stays off, refer to the storage-management software for problem determination.

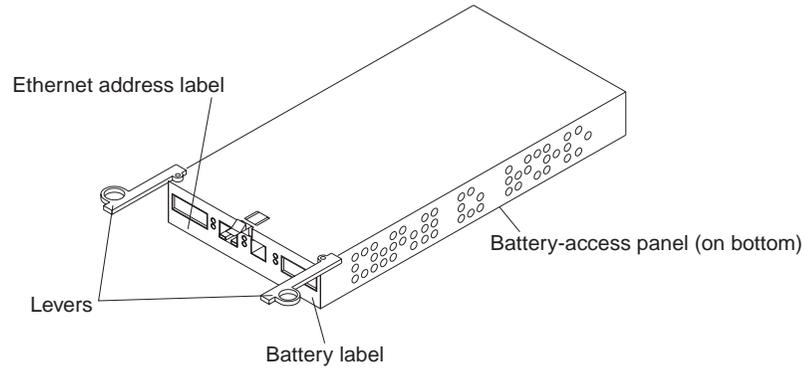
For more information about the LEDs, see “Checking the LEDs” on page 29.

Working with hot-swap RAID controllers

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

- Battery
- Cache memory
- One host port and one expansion port
- One Ethernet port
- One RS-232 port

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the installation and expiration date of the battery. The following illustration shows the location of these items.



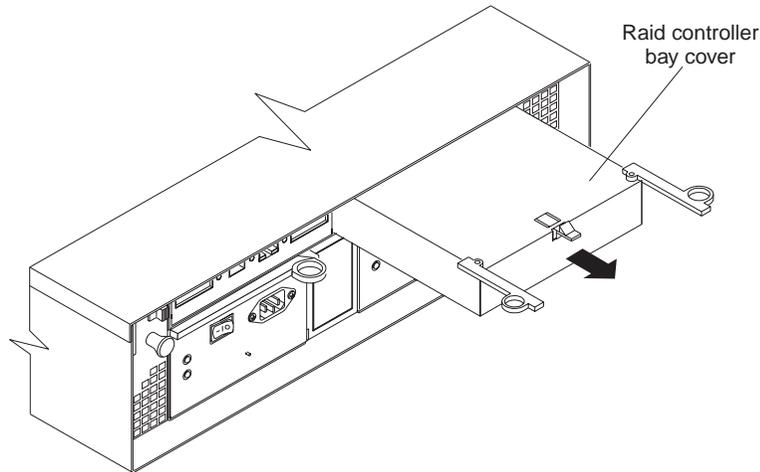
For information about the RAID controller cache memory and rechargeable battery, see “Cache memory and RAID controller battery” on page 33.

Adding a second RAID controller

Use the following procedure to install a second RAID controller if you have Model 3542-1RU storage server and have purchased the FAST200 Redundant RAID Controller option.

Note: The FAST200 Redundant RAID Controller option comes with a RAID controller cache battery installed.

1. To remove the RAID controller bay cover, use the following illustration and procedure:

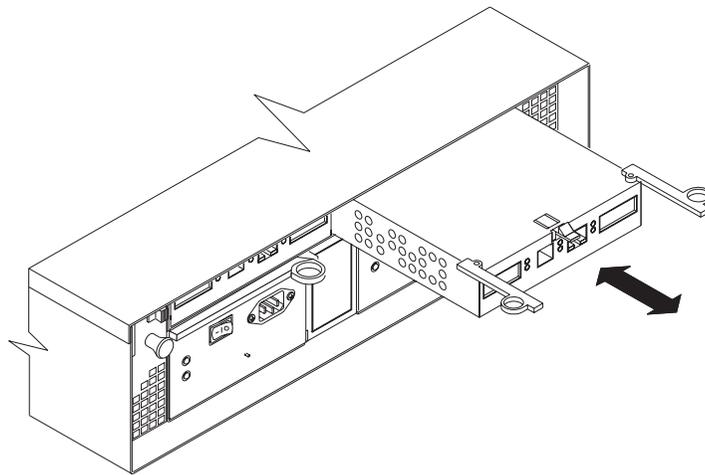


- a. Push down on the latch (centered above the RAID controller bay cover). The levers pop out of the locked position.
- b. Grasp the pull-rings; then, pull on the levers and remove the RAID controller bay cover.

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 35.

2. Unpack the new RAID controller.

Set the RAID controller on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the RAID Controller CRU.
3. Review all documentation that comes with the new RAID controller for updated replacement procedures and other information.
4. Write the battery replacement information on the label on the front of the new RAID controller CRU.
 - Date of Installation – Write today’s date
 - Replacement Date – Write the date three years from now
5. Install the new RAID controller, as shown in the following illustration.



- a. Slide the RAID controller all the way into the empty slot.
- b. Close both levers until the latch locks into place.

Attention: When you add a second RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After adding a second RAID controller, always use the storage-management software to verify the firmware levels and non-volatile static random access memory (NVS RAM) files.

6. Insert the GBICs according to the instructions in “Installing GBICs” on page 17.
7. Connect the Fibre Channel cables, using the instructions in “Installing fiber-optic cables” on page 19. For information about connecting the storage server to other devices, see “Fibre Channel loop configurations” on page 11 and Chapter 3, “Cabling the storage server” on page 17.

8. Wait approximately one minute, and then check the green Host Loop LED, the green Expansion Loop LED, and the amber Fault LED on the new RAID controller CRU.
 - If the Host loop LED or the Expansion Loop LED is off, the RAID controller CRU might not be inserted correctly. Remove the CRU and reinsert it.
 - If the Fault LED is on, the Host loop LED and the Expansion loop LED stay off, or any other Fault LED is on, refer to the storage-management software for problem determination.
9. Refer to the storage-management software online help for instructions about downloading the redundant 3542-2RU NVSRAM files and bringing the controller online.

Replacing a RAID controller

When instructed to do so by the storage-management software, replace a RAID controller that has failed.

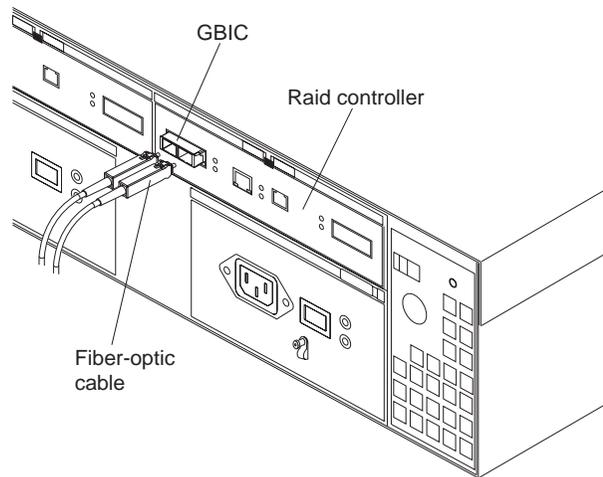
Note: The replacement RAID controller CRU does not come with a RAID controller cache battery installed. You must remove the cache battery that is inside the existing RAID controller that you are replacing, and install that battery inside the replacement RAID controller CRU. The steps to remove and replace the battery are included in the following procedure.

To replace a RAID controller, do the following:

1. Check the storage-management software for instructions on RAID controller failure-recovery procedures. Follow the steps provided in the software documentation before continuing with step 2.
2. If you have redundant RAID controllers (dual-controller configuration), use the storage-management software to take the RAID controller that has failed offline.

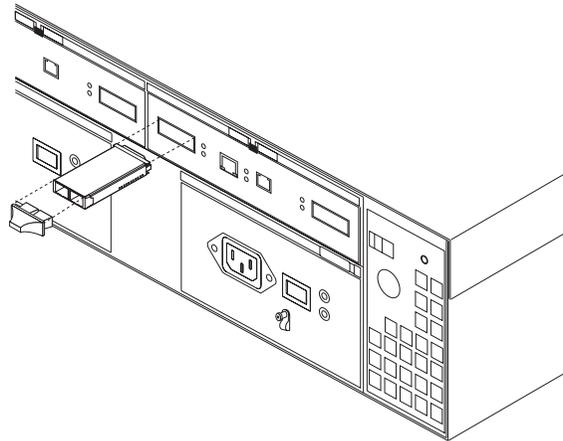
Attention: To prevent data loss if you have a single controller configuration, you must shutdown your system before you can replace the RAID controller. For the proper shutdown sequence, see “Turning off the storage server” on page 25.
3. Label each cable that connects to the RAID controller that has failed. This ensures that all cables will be properly reconnected to the new RAID controller.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 76 mm (3 in.).
4. From the RAID controller that has failed, remove the Fibre Channel cables from the GBICs. The location of these components is shown in the following illustration.

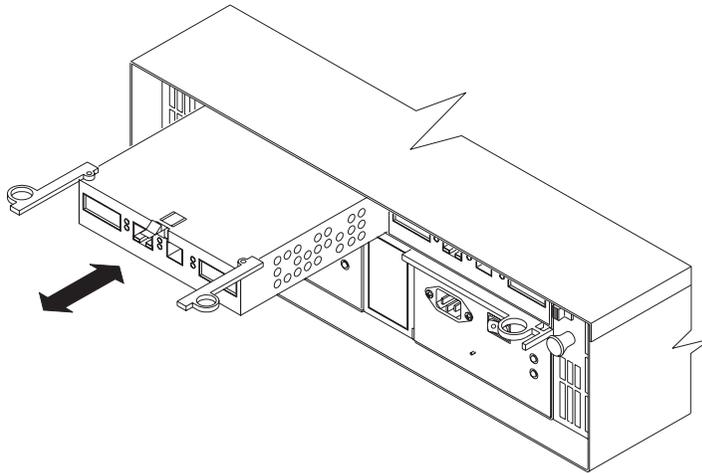


After removing the Fibre Channel cables, insert the protective caps.

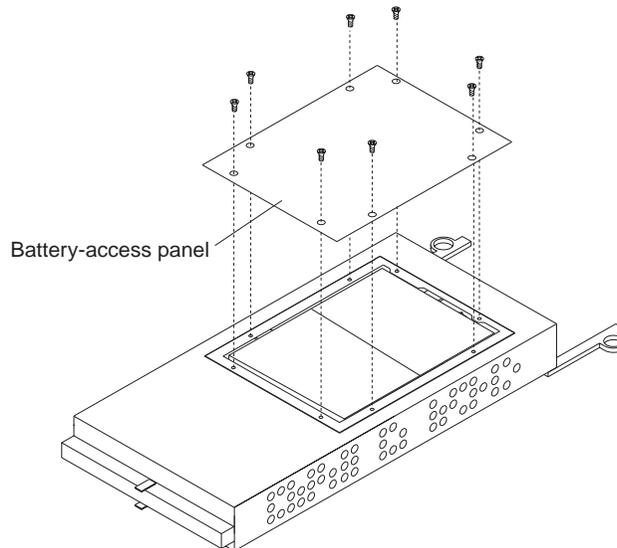
5. Use the following procedure to remove the GBICs from the RAID controller that has failed.
 - a. Move the metal latch on the GBIC to the unlocked (center) position.



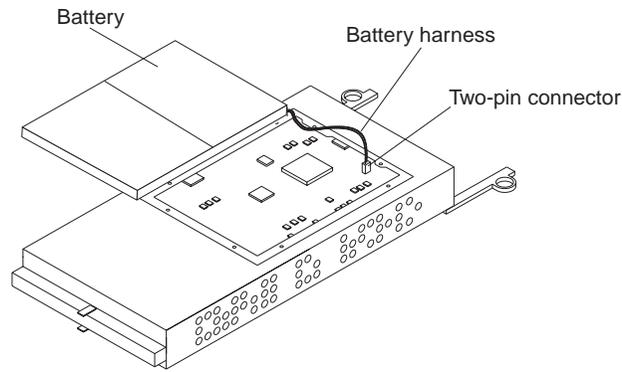
- b. Pull the GBIC out of the port.
 - c. Insert the protective cap on the GBIC.
 6. Remove the failed RAID controller (the Fault LED is on), as follows:
 - a. Push down on the latch (centered above the RAID controller). The levers pop out of the locked position.



- b. Grasp the pull-rings; then, pull on the levers and remove the RAID controller.
7. To remove the cache battery, using a Phillips head screwdriver, remove the eight screws from the battery access panel on the bottom of the RAID controller that you just removed, as shown in the following illustration.



8. Lift the battery out of the RAID controller.
- Note:** If you cannot lift out the battery, turn over the RAID controller and hold it upside-down so that the battery is close above a flat surface and let it fall out. Do not let the battery pull on the battery harness.
9. Disconnect the battery harness on the battery from the two-pin connector on the controller board, and remove the battery, as shown in the following illustration.



Set the battery on a dry, level surface.

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 35.

10. Unpack the new RAID controller.

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

11. Using a Phillips head screwdriver, remove the eight screws from the battery access panel on the bottom of the replacement RAID controller CRU.
12. Connect the battery harness on the battery to the two-pin connector on the controller board.
13. Position the battery inside the replacement RAID controller, and replace the battery-access panel.
14. Copy the battery replacement information from the label on the front of the failed RAID controller to the label on the front of the replacement RAID controller CRU.
15. Install the new RAID controller, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.

Attention: When you replace the failed RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After replacing a controller, always use the storage-management software to verify the firmware levels and NVSRAM files.

16. Insert the GBICs according to the instructions in “Installing GBICs” on page 17.
17. Connect the Fibre Channel cables to their original locations, according to the instructions in “Installing fiber-optic cables” on page 19.
18. If you have a single-controller configuration, turn on power to the storage server and attached devices. For the proper power-on sequence, see “Turning on the storage server” on page 25.
19. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.
 - If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the CRU and reinsert it.
 - If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, refer to the storage-management software for problem determination.

20. Refer to the storage-management software online help for instructions on bringing the controller online.

Replacing the battery in the RAID controller

Each RAID controller contains a rechargeable battery that maintains the data in the cache memory.

Use the following procedure if the storage-management software instructs you to replace the battery because the current battery has failed or is nearing its expiration date.

1. Check the storage-management software for instructions on battery replacement procedures. If you are not using write-cache mirroring, this might involve clearing cache memory on the RAID controller that contains the battery that has failed.

Follow the steps given in the software procedure before continuing with this procedure.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 35.

2. Unpack the new battery.

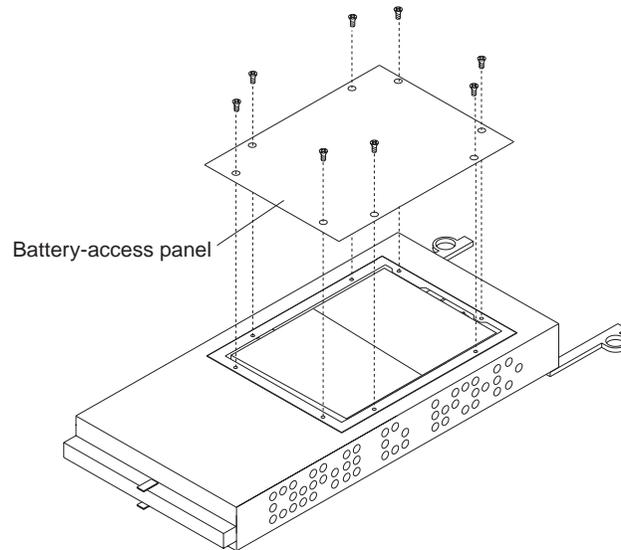
Set the new battery on a dry, level surface. Save all packing materials in case you need to return the battery.

Note: The battery comes with a new battery label. You will need this label later in the procedure.

3. Review all documentation that comes with the new battery for updated replacement procedures and other information.
4. Use the storage-management software to locate the RAID controller containing the failed battery (the RAID controller Fault LED might be on).
5. Label each cable that connects to the RAID controller that contains the battery that has failed. This ensures that all cables will be properly reconnected to the RAID controller after you replace the battery.
6. If you have redundant RAID controllers (dual-controller configuration), use the storage-management software to take offline the RAID controller that contains the battery that has failed.

Attention: To prevent data loss if you have a single-controller configuration, you must shutdown your system before you can replace the RAID controller battery. For the proper shutdown sequence, see “Turning off the storage server” on page 25.

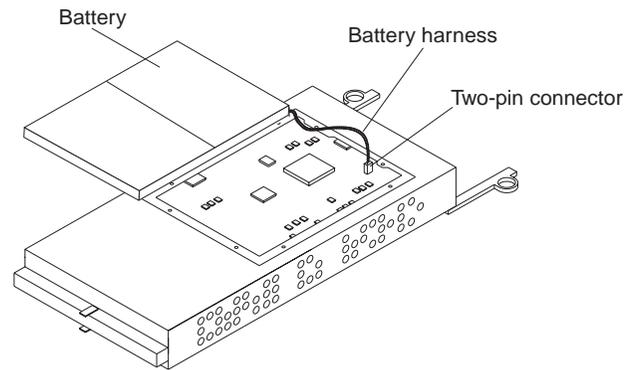
7. From the RAID controller that contains the battery that has failed, remove the Fibre Channel cables and then the GBICs. For more information, see “Working with GBICs and fiber-optic cables” on page 17.
8. Remove the RAID controller as described in “Replacing a RAID controller” on page 52.
9. Using a Phillips head screwdriver, remove the eight screws from the battery access panel on the bottom of the RAID controller CRU, as shown in the following illustration.



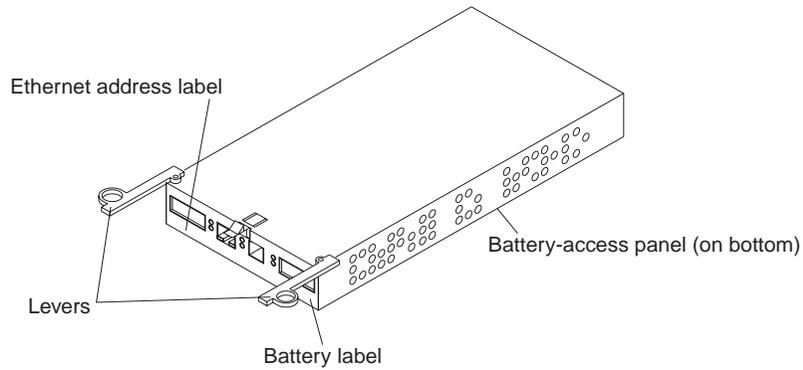
10. Lift the old battery out of the RAID controller CRU.

Note: If you cannot lift out the battery, turn over the RAID controller and hold it upside-down so that the battery is close above a flat surface and let it fall out. Do not let the battery pull on the battery harness.

11. Disconnect the battery harness on the old battery from the two-pin connector on the controller board, and remove the battery, as shown in the following illustration.



12. Connect the battery harness on the new battery to the two-pin connector on the controller board.
13. Position the battery inside the RAID controller, and replace the battery-access panel.
14. Put the new battery label on the front of the RAID controller, over the old battery label. The location of the battery label is shown in the following illustration.



15. Write the battery replacement information on the label on the front of the new RAID controller CRU.

- Date of Installation – Write today's date
- Replacement Date – Write the date three years from now



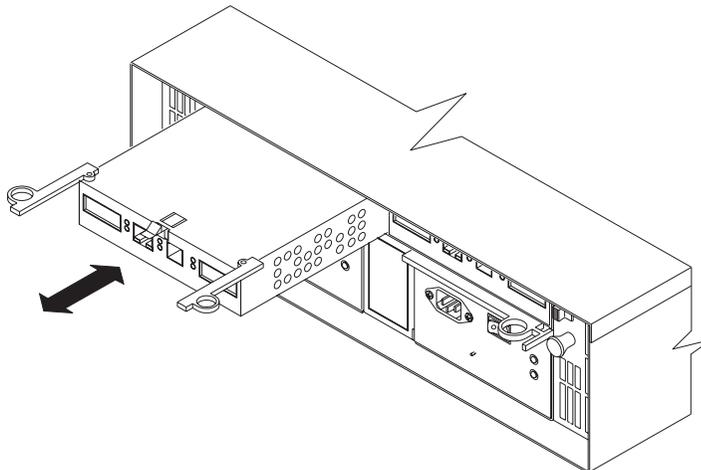
CONTAINS
SEALED LEAD
BATTERY.
BATTERY
MUST BE
RECYCLED.

Pb

CAUTION:

Use proper facilities to recycle the used battery CRU. If the battery CRU is physically damaged or leaking electrolyte gel, *do not* ship it to a recycling center. The battery contains sealed lead-acid batteries that might be considered hazardous material. You must handle this unit in accordance with all applicable local and federal regulations.

16. Dispose of the used battery CRU according to local and federal regulations, which might include hazardous material handling procedures.
17. Install the RAID controller, as shown in the following illustration.



- Slide the RAID controller all the way into the empty slot.
- Close both levers until the latch locks into place.

18. Install the GBICs and then connect the Fibre Channel cables to their original locations.
19. If you have a single-controller configuration, turn on power to the storage server and attached devices. For the proper power-on sequence, see “Turning on the storage server” on page 25.
20. Wait approximately one minute, and then check the green Host Loop LED, the green Expansion Loop LED, and the amber Fault LED on the new RAID controller.
 - If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the RAID controller and reinsert it.
 - If the Fault LED is on, the Host Loop LED and Expansion Loop LED stay off, or any other Fault LED is on, refer to the storage-management software for problem determination.
21. Refer to the storage-management software online help for instructions on bringing the controller online and resetting the battery age.

Note: There are two cache batteries in the unit (one for each controller). Make sure that you reset the age for the correct battery. Also, you might get a software message indicating that the new battery has failed or is nearing its expiration date. This message will disappear after you reset the battery age through the software and battery charging is completed.

Installing GBICs and fiber-optic Cables

Each RAID controller unit has one host port and one expansion unit port. Gigabit Interface Converters (GBICs) are inserted into the ports, and then Fibre Channel cables are connected to the GBICs. This section provides information on installing GBICs. The GBICs are laser products.

Statement 3



CAUTION:

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

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



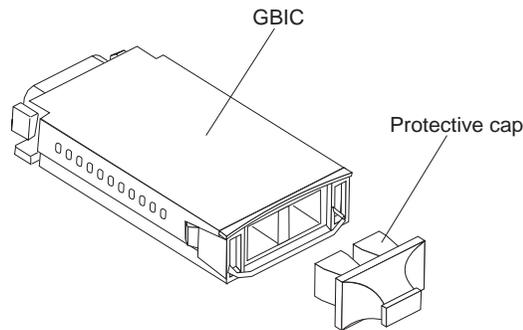
Danger

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

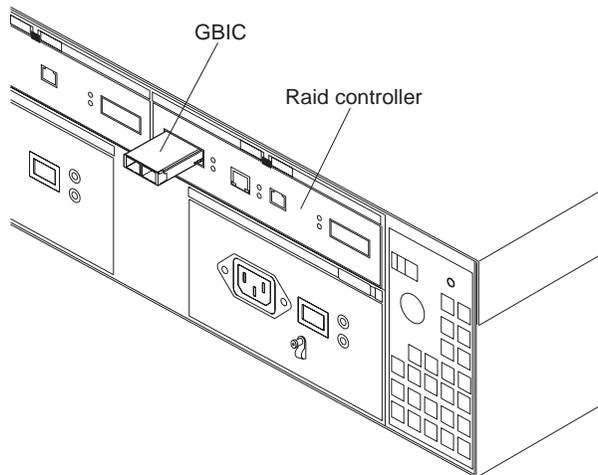
Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

To install a GBIC, do the following:

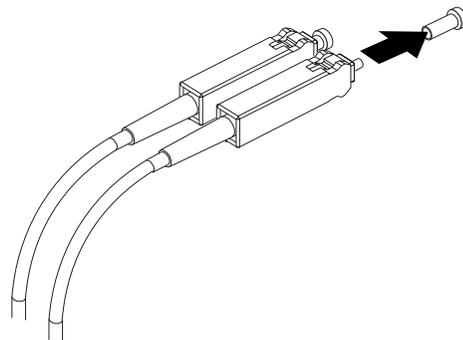
1. Remove the protective cap from the GBIC, as shown in the following illustration.



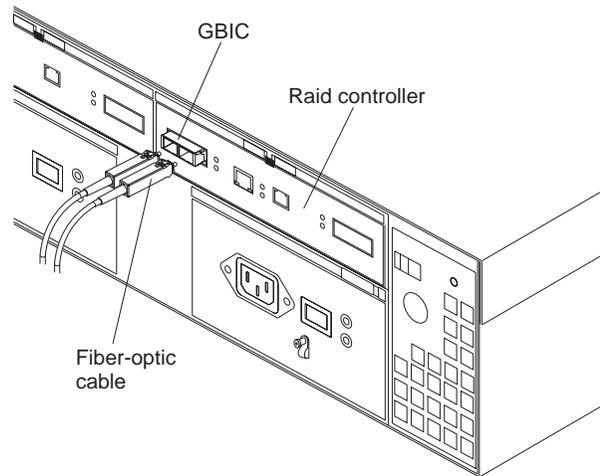
2. If the GBIC that you are installing has a metal latch, move the latch to the unlocked (center) position.
3. Insert the GBIC into the host or expansion port on the RAID controller, as shown in the following illustration.



4. After the GBIC is inserted all the way into the port, rotate the GBIC latch outward to the locked position (flush with the rear of the GBIC).
5. Move the GBIC latch to the unlocked (center) position.
6. Insert the GBIC into the GBIC port on the RAID controller.
7. Move the GBIC latch back to the locked position (flush with the rear of the GBIC).
8. Remove the protective caps from the fiber-optic cable.



9. Connect the fiber-optic cable to the installed GBIC, as shown in the following illustration.



Note: The fiber-optic cable connection is keyed for proper insertion.

Chapter 6. Solving problems

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

For instructions on how to obtain service and technical assistance for your storage server and other IBM products, refer to Appendix C, "Getting help and technical assistance" on page 75.

Troubleshooting

Always use the storage-management software to diagnose storage server problems and component failures. You can use this table to find solutions to problems that have definite symptoms.

Table 7. Storage server troubleshooting

Problem indicator	Component	Possible cause	Possible solutions	
Amber LED on	Drive CRU	Drive has failed	Replace the drive that has failed.	
	Fan CRU	Fan failure	Replace the fan that has failed.	
	RAID controller Fault LED	RAID controller has failed	If the RAID controller Fault LED is on, replace the RAID controller.	
	Expansion port bypass LED		GBIC port empty	No corrective action is needed if the system is properly configured.
			Fibre Channel cable is not attached to the expansion unit	No corrective action is needed.
			No incoming signal detected	Reattach the GBICs and Fibre Channel cables. Replace input and output GBICs or cables as necessary.
Front panel	General system error	Indicates that a Fault LED somewhere on the storage server has turned on. (Check for amber LEDs on CRUs.)		
Amber LED is on and green LED off	Power-supply CRU	Power switch is turned off or ac power failure	Turn on all power-supply power switches.	
Amber and green LEDs on	Power-supply CRU	Power supply failure	Replace the failed power-supply CRU.	

Table 7. Storage server troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs off	All CRUs	Subsystem power is off	Check that all storage-server power cords are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack are turned on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Power supply failure	Replace the power supply.
		Midplane failure	Have the storage server serviced.
Amber LED flashing	Drive CRUs	Drive rebuild or identity is in process	No corrective action is needed.

Table 7. Storage server troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs off	Power supply CRUs	Power cord unplugged or switches turned off	Make sure that the power cord is plugged in and the power-supply switches are turned on.
	All drive CRUs	Midplane failure	Have the midplane replaced (service technician only).
	Front panel	Power supply problem	Make sure that the cords are plugged in and power supplies are turned on.
		Hardware failure	If any other LEDs are on, replace the midplane (service technician only).
	Battery	Battery failure	Replace the battery.
	Cache active	The cache is disabled, the cache has failed, battery failure	Use the storage-management software to enable the cache; replace the RAID controller; replace the battery
	Host loop	Host, managed hub, or switch is off or has failed	Check if host managed hub or switch is on. Replace attached devices that have failed.
		Fibre Channel cable has failed	Ensure that the Fibre Channel cables are undamaged and properly connected.
		GBIC has failed	Ensure GBIC is seated properly; replace GBIC
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace RAID controller
	Expansion loop	Drives are improperly installed or not installed	Ensure that the drives are properly installed.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace the RAID controller.
		3542 drive failure	Replace the drive.
		Externally attached expansion port device has failed	Replace the drive; replace the expansion unit GBIC or Fiber Channel cable
Intermittent or sporadic power loss to the storage server	Some or all CRUs	Defective ac power source or partially plugged-in power cord	Check the ac power source. Reseat all installed power cables and power supplies. If applicable, check the power components. Replace defective power cords.
		Power supply has failed	Check for a Fault LED on the power supply, and replace the failed CRU.
		Midplane has failed	Have the midplane replaced (service technician only).

Table 7. Storage server troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Unable to access drives	Drives and Fibre Channel loop	Fibre Channel cabling has failed.	Ensure that the Fibre Channel cables are undamaged and properly connected.
		RAID controller has failed	Replace the RAID controller.
		GBIC has failed	Ensure GBIC is seated properly; replace GBIC
Random errors	Subsystem	Midplane has failed	Have the midplane replaced (service technician only)

Appendix A. Records

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

Identification numbers

Record and retain the following information.

Product name:	IBM FAStT200 Storage Server and IBM FAStT200 HA Storage Server
Machine:	3542
Model number:	_____
Serial number:	_____

The serial number is located on the front bottom-right corner of the chassis and on the rear of the storage server.

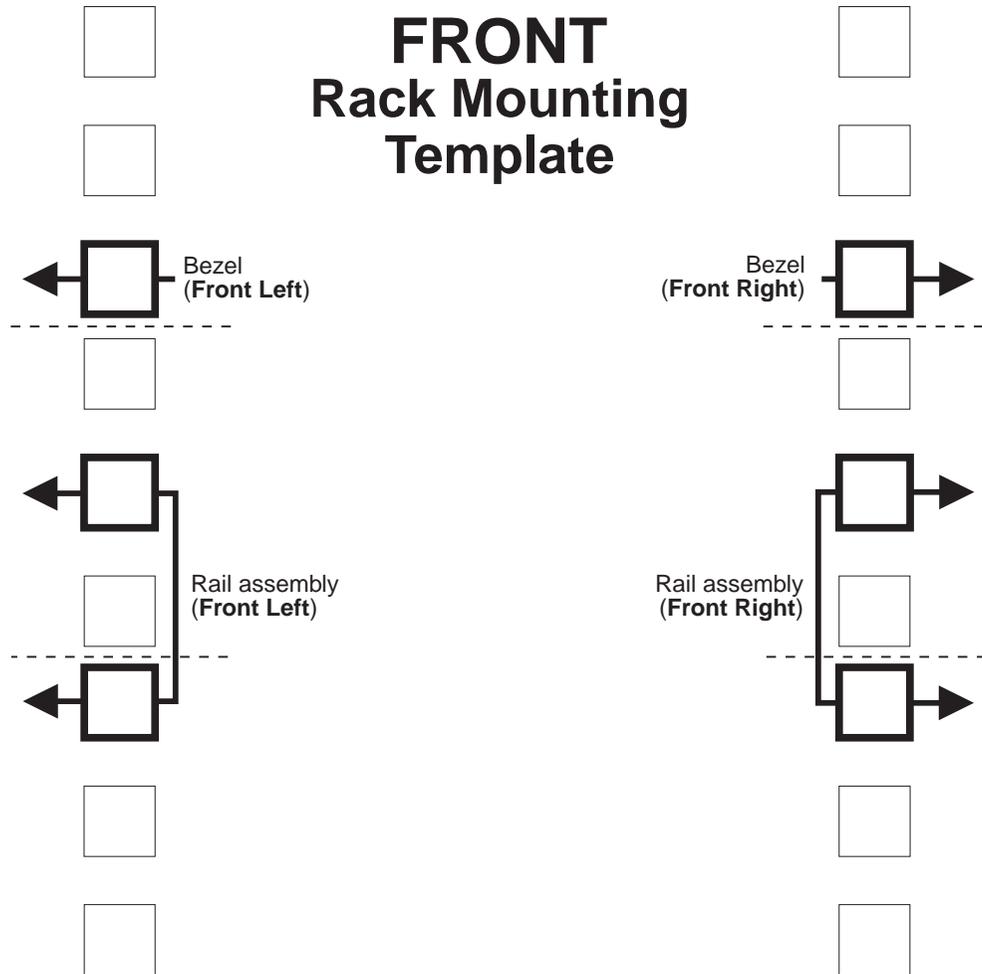
Installed-device records

Use the following table to keep a record of the options that are installed in or attached to your controller unit. This information can be helpful when you install additional options or if you ever need to report a hardware problem. Copy these tables before recording information in them, in case you need extra space to write new values later, when you update your system configuration.

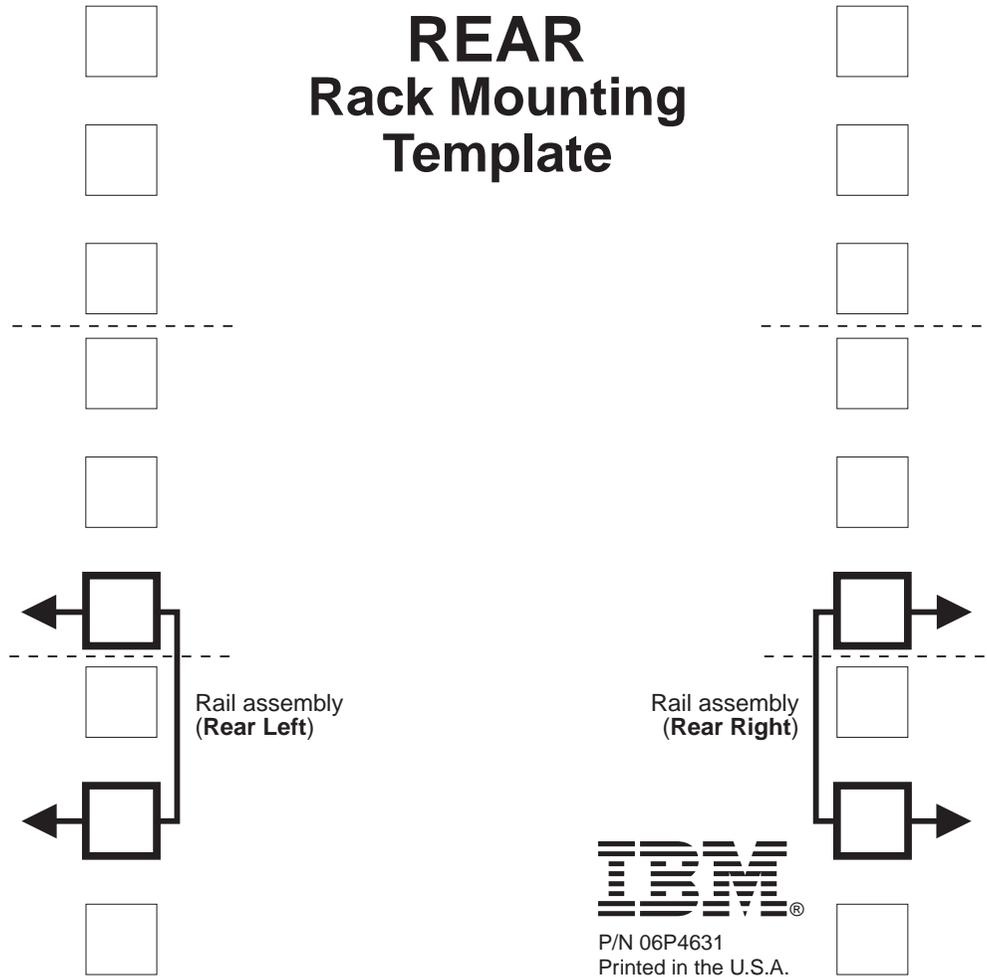
Drive location	Drive part and model numbers	Drive serial number
Bay 1		
Bay 2		
Bay 3		
Bay 4		
Bay 5		
Bay 6		
Bay 7		
Bay 8		
Bay 9		
Bay 10		

Appendix B. Rack mounting template and instructions

A rack mounting template and instructions come with the storage server. If you have misplaced these items, use the following template and instructions.



REAR Rack Mounting Template



Rack Mounting Instructions

Review the documentation that comes with your rack cabinet for safety and cabling information. When installing your storage server in a rack, consider the following:

- Ensure the room air temperature is below 35°C (95°F).
- Do not block any air vents, usually 15 cm (6 in.) of air space provides proper airflow.
- Plan the device installation starting from the bottom of the rack.
- Install the heaviest device in the bottom of the rack.
- Do not extend more than one device out of the rack at the same time.
- Remove the rack doors and side panels to provide easier access during installation.
- Connect all power cords to properly wired and grounded electrical outlets.
- Take precaution to prevent overloading the power outlets when you install multiple devices in a rack.



Use safe practices when lifting.



≥18 kg (37 lbs)



≥32 kg (70.5 lbs)

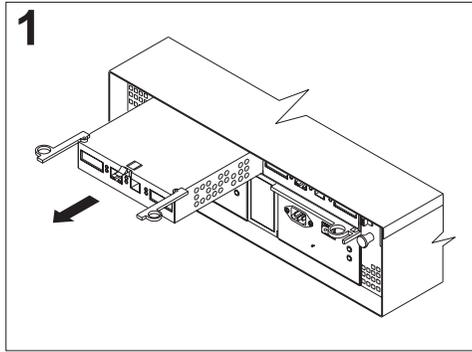


≥55 kg (121.2 lbs)

You will need a flat-blade and a Phillips screwdriver during the installation. The following is a list of items that come with your option. If any items are missing or damaged, contact your place of purchase.

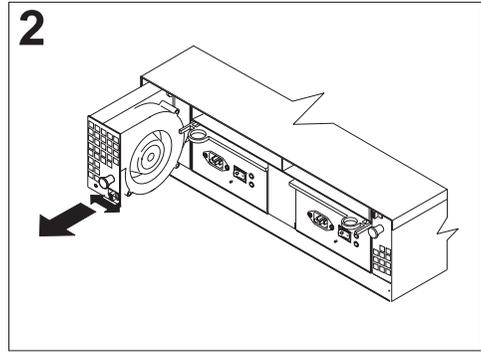
- Cage nuts (10)
- Clip nuts (10)
- M6 screws (10)
- Side rails (2)

Note: Refer to your storage server documentation for handling guidelines before removing any ESD-sensitive devices. The first four steps of the installation procedure involve removing some components from the storage server in order to reduce the weight of the storage server for easier installation.



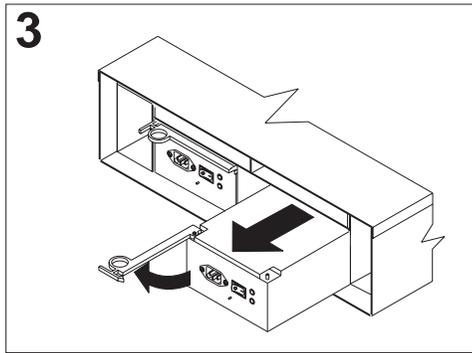
To remove a RAID controller, push down on the latch centered above the controller; then, grasp the pull-rings on the levers and pull them to remove the RAID controller and set it aside for later installation.

If you have a second RAID controller, repeat this step for the second controller.



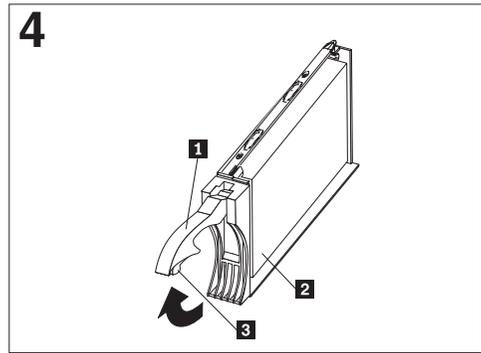
To remove a hot-swap fan, slide the latch on the fan to unlock it; then, pull the handle and remove the fan from the storage server.

Repeat this step for the other fan and set both fans aside for later installation.



To remove a power supply, grasp the pull-ring on the power supply lever and squeeze to release it; then, pull the lever fully open and remove the power supply from the storage server.

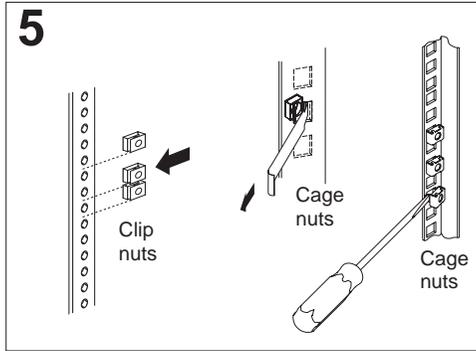
Repeat this step for the other power supply; then, set both power supplies aside for later installation.



To remove a hard disk drive **2**, press the blue latch **3** and pull the handle **1** upwards; then, carefully pull the drive from the storage server.

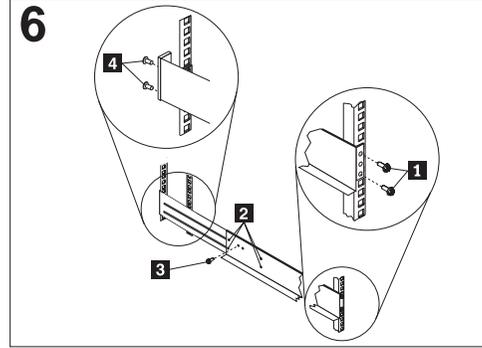
Note: Before you remove any hard disk drives, make sure that you mark their location so that you can reinstall them in the same location.

Repeat this step for all hard disk drives.



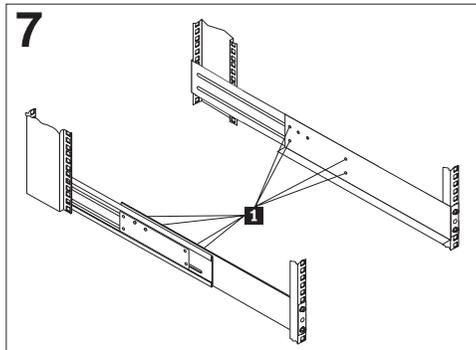
Use the attached template and stickers to mark the appropriate holes on your rack; then, install clip nuts or cage nuts as required for your rack cabinet.

Note: Use the cage-nut-insertion tool or a flat-blade screwdriver to install cage nuts.

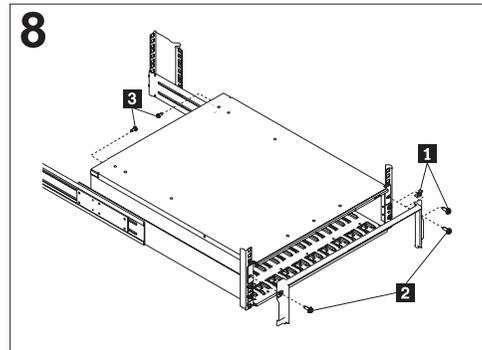


On the rail marked **R**, remove the 6-32 in. screw **3** and loosen the four screws **2**; then, hold the front of the rail against the outside of the right rack-mounting-flange and loosely install two M6 screws **1**.

Extend the rear of the rail outside of the rear rack-mounting-flange; then, install and tighten two M6 screws **4**. Tighten the front screws **1** and repeat this step for the other rail.



Tighten the rail adjustment screws **1** on both rails.



Remove the white screws and nuts **1** from the storage server bezel; then, slide the storage server into the rack. Align the bezel locator pins and attach the bezel with two M6 screws **2**; then, install and tighten the 6-32 in. screws **3**.

9 Reverse step 1 through step 4 to reinstall the components that you removed; then, refer to your storage server documentation to complete your installation. Store this information with your storage server documentation for future use.

Appendix C. 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 appendix contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your xSeries or IntelliStation® system, and whom to call for service, if it is necessary.

Before you call

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

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system.
- Go to the IBM Support Web site at <http://www.ibm.com/pc/support/> to check for technical information, hints, tips, and new device drivers.
- Use an IBM discussion forum on the IBM Web site to ask questions.

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

Using the documentation

Information about your IBM xSeries or IntelliStation system and preinstalled software, if any, is available in the documentation that comes with your system. That documentation includes printed books, online books, 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/pc/support/> and follow the instructions. Also, you can order publications through the IBM Publications Ordering System at <http://www.elink.ibm.com/public/applications/publications/cgibin/pbi.cgi>.

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 xSeries and IntelliStation products, services, and support. The address for IBM xSeries information is <http://www.ibm.com/eserver/xseries/>. The address for IBM IntelliStation information is <http://www.ibm.com/pc/intellistation/>.

You can find service information for your IBM products, including supported options, at <http://www.ibm.com/pc/support/>. If you click **Profile** from the support page, you can

create a customized support page. The support page has many sources of information and ways for you to solve problems, including:

- Diagnosing problems, using the IBM Online Assistant
- Downloading the latest device drivers and updates for your products
- Viewing Frequently Asked Questions (FAQ)
- Viewing hints and tips to help you solve problems
- Participating in IBM discussion forums
- Setting up e-mail notification of technical updates about your products

Software service and support

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

For more information about Support Line and other IBM services, go to <http://www.ibm.com/services/>, or go to <http://www.ibm.com/planetwide/> for support telephone numbers.

Hardware service and support

You can receive hardware service through IBM Integrated Technology Services or through your IBM reseller, if your reseller is authorized by IBM to provide warranty service. Go to <http://www.ibm.com/planetwide/> for support telephone numbers.

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.

Appendix D. Warranty information

This appendix contains the warranty period for your product, information about obtaining warranty service and support, and the IBM Statement of Limited Warranty.

Warranty period

Contact your place of purchase for warranty service information. Some IBM Machines are eligible for on-site warranty service depending on the country or region where service is performed.

Machine - IBM FAStT200 and IBM FAStT200 High Availability Storage Servers
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Warranty period - Three years

Warranty service and support

With the original purchase of an IBM server product, you have access to extensive support. During the IBM Machine warranty period, you may call IBM or your reseller for problem-determination assistance under the terms of the IBM Statement of Limited Warranty.

The following services are available during the warranty period:

- **Problem determination** - Trained personnel are available to assist you with determining if you have a hardware problem and deciding what action is necessary to fix the problem.
- **IBM hardware repair** - If the problem is determined to be caused by IBM hardware under warranty, trained service personnel are available to provide the applicable level of service, either on-site or at an IBM service center as determined by IBM.
- **Engineering Change management** - Occasionally, there might be changes that are required after a product has been shipped from IBM. In those instances, IBM will make Engineering Changes (ECs) available that apply to your hardware.

The following items are not covered under warranty service:

- Replacement or use of non-IBM parts. All IBM parts contain a 7-character identification in the format IBM FRU XXXXXXX.
- Identification of non-IBM software problem sources.
- Installation of customer replaceable units (CRUs).
- Installation and configuration of machine code or licensed internal code that is designated as customer installable.

If you do not register your server with IBM, you might be required to present proof of purchase to obtain warranty service.

Before you call for service

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the publications that are provided with your server and software.

Most computers, operating systems, and application programs come with information that contains troubleshooting procedures and explanations of error messages and error codes. The information that comes with your server also describes the diagnostic tests that you can perform.

If you suspect a software problem, refer to the information for the operating system or application program.

Calling for service

Please have the following information ready:

- Machine type, model, and serial number
- Description of the problem
- Exact wording of any error messages
- Hardware and software configuration information

For more information about getting help from IBM, see Appendix C, “Getting help and technical assistance” on page 75.

IBM Statement of Limited Warranty Z125-4753-06 8/2000

Part 1 - General Terms

This Statement of Limited Warranty includes Part 1 - General Terms and Part 2 - Country-unique Terms. The terms of Part 2 replace or modify those of Part 1. The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you purchase for your use, and not for resale, from IBM or your reseller. The term “Machine” means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. The term “Machine” does not include any software programs, whether pre-loaded with the Machine, installed subsequently or otherwise. Unless IBM specifies otherwise, the following warranties apply only in the country where you acquire the Machine. Nothing in this Statement of Limited Warranty affects any statutory rights of consumers that cannot be waived or limited by contract. If you have any questions, contact IBM or your reseller.

The IBM Warranty for Machines: IBM warrants that each Machine 1) is free from defects in materials and workmanship and 2) conforms to IBM's Official Published Specifications (“Specifications”). The warranty period for a Machine is a specified, fixed period commencing on its Date of Installation. The date on your sales receipt is the Date of Installation unless IBM or your reseller informs you otherwise.

If a Machine does not function as warranted during the warranty period, and IBM or your reseller are unable to either 1) make it do so or 2) replace it with one that is at least functionally equivalent, you may return it to your place of purchase and your money will be refunded.

Extent of Warranty: The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product

for which IBM is not responsible. The warranty is voided by removal or alteration of Machine or parts identification labels.

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Items Not Covered by Warranty: IBM does not warrant uninterrupted or error-free operation of a Machine. Any technical or other support provided for a Machine under warranty, such as assistance via telephone with “how-to” questions and those regarding Machine set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND.**

Warranty Service: To obtain warranty service for a Machine, contact IBM or your reseller. If you do not register your Machine with IBM, you may be required to present proof of purchase.

During the warranty period, IBM or your reseller, if approved by IBM to provide warranty service, provides without charge certain types of repair and exchange service to keep Machines in, or restore them to, conformance with their Specifications. IBM or your reseller will inform you of the available types of service for a Machine based on its country of installation. At its discretion, IBM or your reseller will 1) either repair or exchange the failing Machine and 2) provide the service either at your location or a service center. IBM or your reseller will also manage and install selected engineering changes that apply to the Machine.

Some parts of IBM Machines are designated as Customer Replaceable Units (called “CRUs”), e.g., keyboards, memory, or hard disk drives. IBM ships CRUs to you for replacement by you. You must return all defective CRUs to IBM within 30 days of your receipt of the replacement CRU. You are responsible for downloading designated Machine Code and Licensed Internal Code updates from an IBM Internet Web site or from other electronic media, and following the instructions that IBM provides.

When warranty service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item. Many features, conversions, or upgrades involve the removal of parts and their return to IBM. A part that replaces a removed part will assume the warranty service status of the removed part.

Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and

3. where applicable, before service is provided:
 - a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provides;
 - b. secure all programs, data, and funds contained in a Machine;
 - c. provide IBM or your reseller with sufficient, free, and safe access to your facilities to permit them to fulfill their obligations; and
 - d. inform IBM or your reseller of changes in a Machine's location.

IBM is responsible for loss of, or damage to, your Machine while it is 1) in IBM's possession or 2) in transit in those cases where IBM is responsible for the transportation charges.

Neither IBM nor your reseller is responsible for any of your confidential, proprietary or personal information contained in a Machine which you return to IBM or your reseller for any reason. You should remove all such information from the Machine prior to its return.

Limitation of Liability: Circumstances may arise where, because of a default on IBM's part or other liability, you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages from IBM (including fundamental breach, negligence, misrepresentation, or other contract or tort claim), except for any liability that cannot be waived or limited by applicable laws, IBM is liable for no more than

1. damages for bodily injury (including death) and damage to real property and tangible personal property; and
2. the amount of any other actual direct damages, up to the charges (if recurring, 12 months' charges apply) for the Machine that is subject of the claim. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code.

This limit also applies to IBM's suppliers and your reseller. It is the maximum for which IBM, its suppliers, and your reseller are collectively responsible.

UNDER NO CIRCUMSTANCES IS IBM LIABLE FOR ANY OF THE FOLLOWING: 1) THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, YOUR RECORDS OR DATA; OR 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES, LOST PROFITS OR LOST SAVINGS, EVEN IF IBM, ITS SUPPLIERS OR YOUR RESELLER IS INFORMED OF THEIR POSSIBILITY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

Governing Law: Both you and IBM consent to the application of the laws of the country in which you acquired the Machine to govern, interpret, and enforce all of your and IBM's rights, duties, and obligations arising from, or relating in any manner to, the subject matter of this Agreement, without regard to conflict of law principles.

Part 2 - Country-unique Terms

AMERICAS

BRAZIL

Governing Law: *The following is added after the first sentence:*

Any litigation arising from this Agreement will be settled exclusively by the court of Rio de Janeiro.

NORTH AMERICA

Warranty Service: *The following is added to this Section:*

To obtain warranty service from IBM in Canada or the United States, call 1-800-IBM-SERV (426-7378).

CANADA

Governing Law: *The following replaces “laws of the country in which you acquired the Machine” in the first sentence:*
laws in the Province of Ontario.

UNITED STATES

Governing Law: *The following replaces “laws of the country in which you acquired the Machine” in the first sentence:*
laws of the State of New York.

ASIA PACIFIC

AUSTRALIA

The IBM Warranty for Machines: *The following paragraph is added to this Section:*
The warranties specified in this Section are in addition to any rights you may have under the Trade Practices Act 1974 or other similar legislation and are only limited to the extent permitted by the applicable legislation.

Limitation of Liability: *The following is added to this Section:*

Where IBM is in breach of a condition or warranty implied by the Trade Practices Act 1974 or other similar legislation, IBM's liability is limited to the repair or replacement of the goods or the supply of equivalent goods. Where that condition or warranty relates to right to sell, quiet possession or clear title, or the goods are of a kind ordinarily acquired for personal, domestic or household use or consumption, then none of the limitations in this paragraph apply.

Governing Law: *The following replaces “laws of the country in which you acquired the Machine” in the first sentence:*
laws of the State or Territory.

CAMBODIA, LAOS, AND VIETNAM

Governing Law: *The following replaces “laws of the country in which you acquired the Machine” in the first sentence:*
laws of the State of New York.

The following is added to this Section:

Disputes and differences arising out of or in connection with this Agreement shall be finally settled by arbitration which shall be held in Singapore in accordance with the rules of the International Chamber of Commerce (ICC). The arbitrator or arbitrators designated in conformity with those rules shall have the power to rule on their own competence and on the validity of the Agreement to submit to arbitration. The arbitration award shall be final and binding for the parties without appeal and the arbitral award shall be in writing and set forth the findings of fact and the conclusions of law.

All proceedings shall be conducted, including all documents presented in such proceedings, in the English language. The number of arbitrators shall be three, with each side to the dispute being entitled to appoint one arbitrator.

The two arbitrators appointed by the parties shall appoint a third arbitrator before proceeding upon the reference. The third arbitrator shall act as chairman of the proceedings. Vacancies in the post of chairman shall be filled by the president of the ICC. Other vacancies shall be filled by the respective nominating party. Proceedings shall continue from the stage they were at when the vacancy occurred.

If one of the parties refuses or otherwise fails to appoint an arbitrator within 30 days of the date the other party appoints its, the first appointed arbitrator shall be the sole arbitrator, provided that the arbitrator was validly and properly appointed.

The English language version of this Agreement prevails over any other language version.

HONG KONG AND MACAU

Governing Law: *The following replaces “laws of the country in which you acquired the Machine” in the first sentence:*
laws of Hong Kong Special Administrative Region.

INDIA

Limitation of Liability: *The following replaces items 1 and 2 of this Section:*

1. liability for bodily injury (including death) or damage to real property and tangible personal property will be limited to that caused by IBM's negligence;
2. as to any other actual damage arising in any situation involving nonperformance by IBM pursuant to, or in any way related to the subject of this Statement of Limited Warranty, IBM's liability will be limited to the charge paid by you for the individual Machine that is the subject of the claim.

JAPAN

Governing Law: *The following sentence is added to this Section:*
Any doubts concerning this Agreement will be initially resolved between us in good faith and in accordance with the principle of mutual trust.

NEW ZEALAND

The IBM Warranty for Machines: *The following paragraph is added to this Section:*
The warranties specified in this Section are in addition to any rights you may have under the Consumer Guarantees Act 1993 or other legislation which cannot be excluded or limited. The Consumer Guarantees Act 1993 will not apply in respect of any goods which IBM provides, if you require the goods for the purposes of a business as defined in that Act.

Limitation of Liability: *The following is added to this Section:*

Where Machines are not acquired for the purposes of a business as defined in the Consumer Guarantees Act 1993, the limitations in this Section are subject to the limitations in that Act.

PEOPLE'S REPUBLIC OF CHINA (PRC)

Governing Law: *The following replaces this Section:*
Both you and IBM consent to the application of the laws of the State of New York (except when local law requires otherwise) to govern, interpret, and enforce all your and IBM's rights, duties, and obligations arising from, or relating in any manner to, the subject matter of this Agreement, without regard to conflict of law principles.

Any disputes arising from or in connection with this Agreement will first be resolved by friendly negotiations, failing which either of us has the right to submit the dispute to the China International Economic and Trade Arbitration Commission in Beijing, the PRC, for arbitration in accordance with its arbitration rules in force at the time. The arbitration tribunal will consist of three arbitrators. The language to be used therein will be English and Chinese. An arbitral award will be final and binding on all the parties, and will be enforceable under the Convention on the Recognition and Enforcement of Foreign Arbitral Awards (1958).

The arbitration fee will be borne by the losing party unless otherwise determined by the arbitral award.

During the course of arbitration, this Agreement will continue to be performed except for the part which the parties are disputing and which is undergoing arbitration.

EUROPE, MIDDLE EAST, AFRICA (EMEA)

THE FOLLOWING TERMS APPLY TO ALL EMEA COUNTRIES:

The terms of this Statement of Limited Warranty apply to Machines purchased from IBM or an IBM reseller.

Warranty Service: If you purchase an IBM Machine in Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland or United Kingdom, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM. If you purchase an IBM Personal Computer Machine in Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Kazakhstan, Kirghizia, Federal Republic of Yugoslavia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, or Ukraine, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

If you purchase an IBM Machine in a Middle Eastern or African country, you may obtain warranty service for that Machine from the IBM entity within the country of purchase, if that IBM entity provides warranty service in that country, or from an IBM reseller, approved by IBM to perform warranty service on that Machine in that country. Warranty service in Africa is available within 50 kilometers of an IBM authorized service provider. You are responsible for transportation costs for Machines located outside 50 kilometers of an IBM authorized service provider.

Governing Law: The applicable laws that govern, interpret and enforce rights, duties, and obligations of each of us arising from, or relating in any manner to, the subject matter of this Statement, without regard to conflict of laws principles, as well as Country-unique terms and competent court for this Statement are those of the country in which the warranty service is being provided, except that in 1) Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Hungary, Former Yugoslav Republic of Macedonia, Romania, Slovakia, Slovenia, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan, the laws of Austria apply; 2) Estonia, Latvia, and Lithuania, the laws of Finland apply; 3) Algeria, Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Djibouti, Democratic Republic of Congo, Equatorial Guinea, France, Gabon, Gambia, Guinea, Guinea-Bissau, Ivory Coast, Lebanon, Mali, Mauritania, Morocco, Niger, Senegal, Togo, and Tunisia, this Agreement will be construed and the legal relations between the parties will be determined in accordance with the French laws and all disputes arising out of this Agreement or related to its violation or execution, including summary proceedings, will be settled exclusively by the Commercial Court of Paris; 4) Angola, Bahrain, Botswana, Burundi, Egypt, Eritrea, Ethiopia, Ghana, Jordan, Kenya, Kuwait, Liberia, Malawi, Malta, Mozambique,

Nigeria, Oman, Pakistan, Qatar, Rwanda, Sao Tome, Saudi Arabia, Sierra Leone, Somalia, Tanzania, Uganda, United Arab Emirates, United Kingdom, West Bank/Gaza, Yemen, Zambia, and Zimbabwe, this Agreement will be governed by English Law and disputes relating to it will be submitted to the exclusive jurisdiction of the English courts; and 5) in Greece, Israel, Italy, Portugal, and Spain any legal claim arising out of this Statement will be brought before, and finally settled by, the competent court of Athens, Tel Aviv, Milan, Lisbon, and Madrid, respectively.

THE FOLLOWING TERMS APPLY TO THE COUNTRY SPECIFIED:

AUSTRIA AND GERMANY

The IBM Warranty for Machines: *The following replaces the first sentence of the first paragraph of this Section:*

The warranty for an IBM Machine covers the functionality of the Machine for its normal use and the Machine's conformity to its Specifications.

The following paragraphs are added to this Section:

The minimum warranty period for Machines is six months. In case IBM or your reseller is unable to repair an IBM Machine, you can alternatively ask for a partial refund as far as justified by the reduced value of the unrepaired Machine or ask for a cancellation of the respective agreement for such Machine and get your money refunded.

Extent of Warranty: *The second paragraph does not apply.*

Warranty Service: *The following is added to this Section:*

During the warranty period, transportation for delivery of the failing Machine to IBM will be at IBM's expense.

Limitation of Liability: *The following paragraph is added to this Section:*

The limitations and exclusions specified in the Statement of Limited Warranty will not apply to damages caused by IBM with fraud or gross negligence and for express warranty.

The following sentence is added to the end of item 2:

IBM's liability under this item is limited to the violation of essential contractual terms in cases of ordinary negligence.

EGYPT

Limitation of Liability: *The following replaces item 2 in this Section:*

as to any other actual direct damages, IBM's liability will be limited to the total amount you paid for the Machine that is the subject of the claim. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code.

Applicability of suppliers and resellers (unchanged).

FRANCE

Limitation of Liability: *The following replaces the second sentence of the first paragraph of this Section:*

In such instances, regardless of the basis on which you are entitled to claim damages from IBM, IBM is liable for no more than: *(items 1 and 2 unchanged).*

IRELAND

Extent of Warranty: *The following is added to this Section:*

Except as expressly provided in these terms and conditions, all statutory conditions,

including all warranties implied, but without prejudice to the generality of the foregoing all warranties implied by the Sale of Goods Act 1893 or the Sale of Goods and Supply of Services Act 1980 are hereby excluded.

Limitation of Liability: *The following replaces items one and two of the first paragraph of this Section:*

1. death or personal injury or physical damage to your real property solely caused by IBM's negligence; and
2. the amount of any other actual direct damages, up to 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim.

Applicability of suppliers and resellers (unchanged).

The following paragraph is added at the end of this Section:

IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

ITALY

Limitation of Liability: *The following replaces the second sentence in the first paragraph:*

In each such instance unless otherwise provided by mandatory law, IBM is liable for no more than:

1. *(unchanged)*
2. as to any other actual damage arising in all situations involving nonperformance by IBM pursuant to, or in any way related to the subject matter of this Statement of Warranty, IBM's liability, will be limited to the total amount you paid for the Machine that is the subject of the claim.

Applicability of suppliers and resellers (unchanged).

The following replaces the third paragraph of this Section:

Unless otherwise provided by mandatory law, IBM and your reseller are not liable for any of the following: *(items 1 and 2 unchanged)* 3) indirect damages, even if IBM or your reseller is informed of their possibility.

SOUTH AFRICA, NAMIBIA, BOTSWANA, LESOTHO AND SWAZILAND

Limitation of Liability: *The following is added to this Section:*

IBM's entire liability to you for actual damages arising in all situations involving nonperformance by IBM in respect of the subject matter of this Statement of Warranty will be limited to the charge paid by you for the individual Machine that is the subject of your claim from IBM.

UNITED KINGDOM

Limitation of Liability: *The following replaces items 1 and 2 of the first paragraph of this Section:*

1. death or personal injury or physical damage to your real property solely caused by IBM's negligence;
2. the amount of any other actual direct damages or loss, up to 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim;

The following item is added to this paragraph:

3. breach of IBM's obligations implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982.

Applicability of suppliers and resellers (unchanged).

The following is added to the end of this Section:

IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

Appendix E. Notices

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

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

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IBM	Wake on LAN
Netfinity	
Predictive Failure Analysis	

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Important notes

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

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

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

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居住的環境中使用時，可
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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.

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13F9997	Denmark
14F0015	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka
14F0033	Antigua, Bahrain, Brunei, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Dubai, Fiji, Ghana, India, Iraq, Ireland, Kenya, Kuwait, Malawi, Malaysia, Malta, Nepal, Nigeria, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, United Kingdom, Yemen, Zambia
14F0051	Liechtenstein, Switzerland
14F0069	Chile, Ethiopia, Italy, Libya, Somalia
14F0087	Israel
1838574	Thailand
6952301	Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Korea (South), Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Suriname, Taiwan, Trinidad (West Indies), United States of America, Venezuela

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