IBM

System x3690 X5
Types 7147, 7148, 7149, and 7192

Installation and User's Guide

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Note: Before using this information and the product it supports, read the general information in
"Notices" on page 153 and the *IBM Safety Information*, and *IBM Environmental Notices and User's
Guide* on the IBM *Documentation* CD, and the *IBM Warranty Information* document that comes with
the server.

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Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

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

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

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

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

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

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

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

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

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

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

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

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

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

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

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

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

Läs säkerhetsinformationen innan du installerar den här produkten.

Important:

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

For example, if a caution statement is labeled Statement 1, translations for that
caution statement are in the *Safety Information* document under Statement 1.

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

Statement 1

DANGER

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

To avoid a shock hazard:

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

To Connect:	To Disconnect:
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2

CAUTION:
When replacing the lithium battery, use only IBM Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

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

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

Statement 3

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

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

DANGER

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 Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

Statement 4

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

CAUTION:
Use safe practices when lifting.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
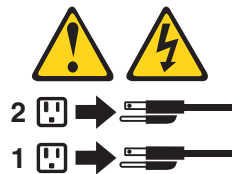
Statement 6

CAUTION:
Do not place any objects on top of a rack-mounted device unless that rack-mounted device is intended for use as a shelf.

Statement 8

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

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

Statement 12

CAUTION:
The following label indicates a hot surface nearby.

Statement 26

CAUTION:
Do not place any object on top of rack-mounted devices.

Statement 35:

CAUTION:
Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both.

This server is suitable for use on an IT power-distribution system whose maximum phase-to-phase voltage is 240 V under any distribution fault condition.

Important: Maschinenlärminformations-Verordnung - 3. GPSGV, der höchste Schalldruckpegel beträgt 70 dB(A) oder weniger.

United Kingdom - Notice to Customers:

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

Chapter 1. The System x3690 X5 Types 7147, 7148, 7149, and 7192 server

This *Installation and User's Guide* contains information and instructions for setting up your IBM® System x3690 X5 Types 7147, 7148, 7149, and 7192 server, instructions for installing some optional devices, and instructions for cabling, and configuring the server. This document also contains information and instructions for installing options in the optional IBM MAX5 for System x (MAX5) memory expansion module (see "IBM MAX5 for System x memory expansion module" on page 25 for more information about the optional MAX5). For removing and installing optional devices, diagnostics and troubleshooting information, see the *Problem Determination and Service Guide* on the IBM *Documentation* CD, which comes with the server.

Important: The IBM MAX5 for System x is a Listed Accessory for use with the IBM System x3690 X5 only.

In addition to the instructions in Chapter 2, "Installing optional devices," on page 33 for installing optional hardware devices, updating firmware and device drivers, and completing the installation, IBM Business Partners must also complete the steps in "Instructions for IBM Business Partners" on page 34.

The IBM System x3690 X5 Types 7147, 7148, 7149, and 7192 server is a 2-U-high rack model server for virtualization, database, and computational intensive computing. This high-performance, scalable server is ideally suited for enterprise environments that require superior input/output (I/O) flexibility, scalability, and high manageability.

Performance, ease of use, reliability, and expansion capabilities were key considerations in the design of the server. These design features make it possible for you to customize the system hardware to meet your needs today and provide flexible expansion capabilities for the future.

The server comes with a limited warranty. For information about the terms of the warranty and getting service and assistance, see the IBM *Warranty Information* document that comes with the server.

The server contains IBM X-Architecture® technologies, which help increase performance and reliability. For more information, see "What your server offers" on page 10 and "Reliability, availability, and serviceability" on page 15.

You can obtain up-to-date information about the server and other IBM server products at http://www.ibm.com/systems/x/. At http://www.ibm.com/support/mysupport/, you can create a personalized support page by identifying IBM products that are of interest to you. From this personalized page, you can subscribe to weekly e-mail notifications about new technical documents, search for information and downloads, and access various administrative services.

If you participate in the IBM client reference program, you can share information about your use of technology, best practices, and innovative solutions; build a

professional network; and gain visibility for your business. For more information about the IBM client reference program, see http://www.ibm.com/ibm/clientreference/.

The server supports up to 24 drives, using the supported drive backplane configurations. It supports 2.5-inch hot-swap Serial Attached SCSI (SAS) or SATA hard disk drives, 2.5-inch hot-swap SAS or SATA solid state drives (SSD), or 1.8-inch hot-swap solid state drives. See "Supported SAS/SATA drive backplane configurations" on page 61 for a complete list of the supported configurations. The illustrations in this document might differ slightly from your hardware.

The following illustration shows the front of the server.
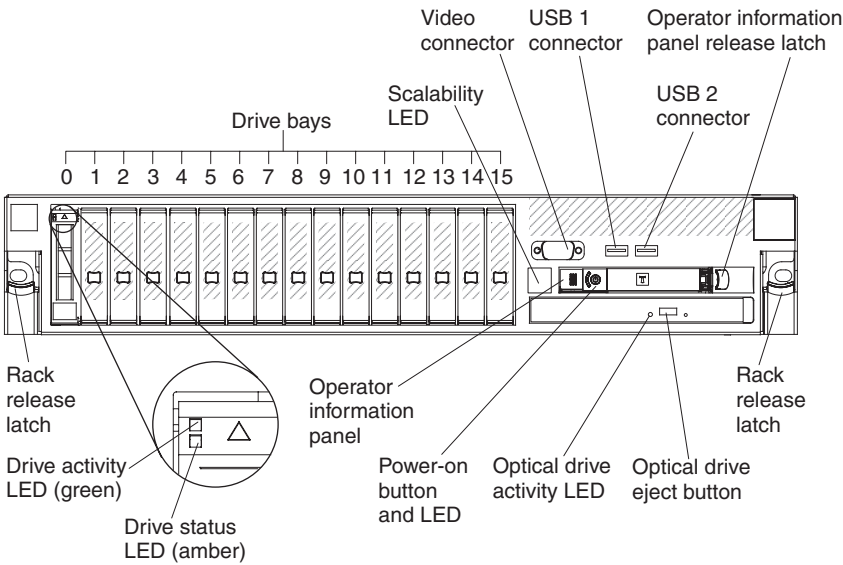
If firmware and documentation updates are available, you can download them from the IBM Web site. The server might have features that are not described in the documentation that comes with the server, and the documentation might be updated occasionally to include information about those features, or technical updates might be available to provide additional information that is not included in the server documentation. To check for updates, go to http://www.ibm.com/supportportal/.

Record information about the server in the following table.

Product name	IBM System x3690 X5 server
Machine type	7147, 7148, 7149, or 7192
Model number	_____
Serial number	_____

The model number and serial number are on the ID label on the front of the server, as shown in the following illustration.

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

ID label
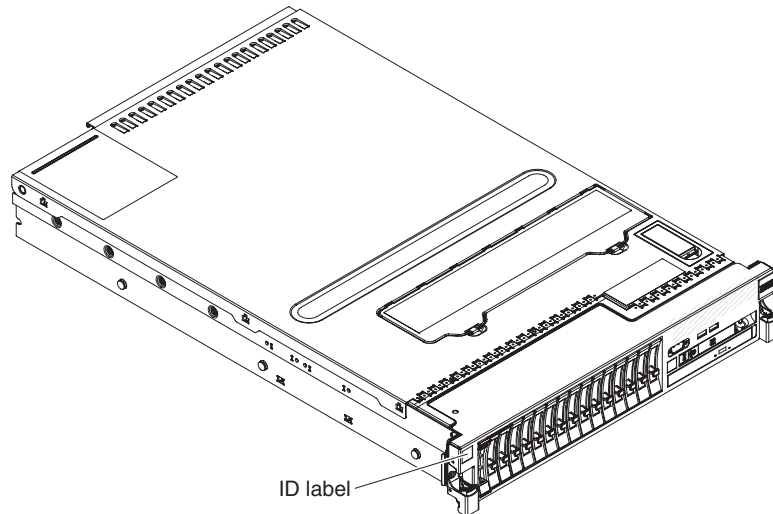
You can download an IBM *ServerGuide Setup and Installation* CD to help you configure the hardware, install device drivers, and install the operating system.

For a list of supported optional devices for the server, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.

See the *Rack Installation Instructions* document on the IBM *Documentation* CD for complete rack installation and removal instructions.

The IBM Documentation CD

The IBM *Documentation* CD contains documentation for the server in Portable Document Format (PDF) and includes the IBM Documentation Browser to help you find information quickly.

Hardware and software requirements

The IBM *Documentation* CD requires the following minimum hardware and software:

- Microsoft Windows XP, Windows 2000, or Red Hat Linux
- 100 MHz microprocessor
- 32 MB of RAM
- Adobe Acrobat Reader 3.0 (or later) or xpdf, which comes with Linux operating systems

Using the Documentation Browser

Use the Documentation Browser to browse the contents of the CD, read brief descriptions of the documents, and view documents, using Adobe Acrobat Reader or xpdf. The Documentation Browser automatically detects the regional settings in use in your server and displays the documents in the language for that region (if available). If a document is not available in the language for that region, the English-language version is displayed.

Use one of the following procedures to start the Documentation Browser:

- If Autostart is enabled, insert the CD into the CD or DVD drive. The Documentation Browser starts automatically.
- If Autostart is disabled or is not enabled for all users, use one of the following procedures:
  - If you are using a Windows operating system, insert the CD into the CD or DVD drive and click **Start -> Run**. In the **Open** field, type

    `e:\win32.bat`

    where *e* is the drive letter of the CD or DVD drive, and click **OK**.
  - If you are using Red Hat Linux, insert the CD into the CD or DVD drive; then, run the following command from the /mnt/cdrom directory:

    `sh runlinux.sh`

Select the server from the **Product** menu. The **Available Topics** list displays all the documents for the server. Some documents might be in folders. A plus sign (+) indicates each folder or document that has additional documents under it. Click the plus sign to display the additional documents.

When you select a document, a description of the document is displayed under **Topic Description**. To select more than one document, press and hold the Ctrl key while you select the documents. Click **View Book** to view the selected document or documents in Acrobat Reader or xpdf. If you selected more than one document, all the selected documents are opened in Acrobat Reader or xpdf.

To search all the documents, type a word or word string in the **Search** field and click **Search**. The documents in which the word or word string appears are listed in order of the most occurrences. Click a document to view it, and press Crtl+F to use the Acrobat search function, or press Alt+F to use the xpdf search function within the document.

Click **Help** for detailed information about using the Documentation Browser.

Related documentation

This *Installation and User's Guide* contains general information about the server including how to set up and cabling the server, how to install supported optional devices, and how to configure the server. The following documentation also comes with the server:

- *Problem Determination and Service Guide*

  This document is in PDF on the IBM *Documentation* CD. It contains information to help you solve problems yourself, and it contains information for service technicians.

- *Warranty Information*

  This document is in printed format and comes with the server. It contains warranty terms and a pointer to the IBM Statement of Limited Warranty on the IBM Web site.

- *Environmental Notices and User Guide*

  This document is in PDF format on the IBM *Documentation* CD. It contains translated environmental notices.

- *IBM License Agreement for Machine Code*

  This document is in PDF on the IBM *Documentation* CD. It provides translated versions of the *IBM License Agreement for Machine Code* for your product.

- *Licenses and Attributions Document*

  This document is in PDF on the IBM *Documentation* CD. It provides the open source notices.

- *Safety Information*

  This document is in PDF on the IBM *Documentation* CD. It contains translated caution and danger statements. Each caution and danger statement that appears in the documentation has a number that you can use to locate the corresponding statement in your language in the *Safety Information* document.

- *Rack Installation Instructions*

  This printed document contains instructions for installing the server in a rack.

  If you are adding an optional MAX5 , see the rack instructions that comes with the cable option kit.

Depending on the server model, additional documentation might be included on the IBM *Documentation* CD.

The ToolsCenter for System x and BladeCenter is an online information center that contains information about tools for updating, managing, and deploying firmware, device drivers, and operating systems. The ToolsCenter for System x and BladeCenter is at http://publib.boulder.ibm.com/infocenter/toolsctr/v1r0/index.jsp.

The server might have features that are not described in the documentation that you received with the server. The documentation might be updated occasionally to include information about those features, or technical updates might be available to provide additional information that is not included in the server documentation. These updates are available from the IBM Web site. To check for updates, go to http://www.ibm.com/supportportal/.

Notices and statements in this document

The caution and danger statements in this document are also in the multilingual *Safety Information* document, which is on the IBM *Documentation* CD. Each statement is numbered for reference to the corresponding statement in your language in the *Safety Information* document.

The following notices and statements are used in this document:

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

Server features and specifications

The following information is a summary of the features and specifications of the server. Depending on the model, some features might not be available, or some specifications might not apply.

Table 1. Server features and specifications

Microprocessor (depending on the model):	Memory (depending on the model):	Scalability:
• Supports up to two of the following Intel Xeon™ EX versions of the 6000 and 7000 Series or E7 Series microprocessors, depending on your model (the server comes with one microprocessor installed): – Four-core with 12 MB or 18 MB shared among cores – Six-core Turbo with 12 MB or 18 MB shared among cores – Eight-core Turbo with 18 MB or 24 MB shared among cores (depending on your model) – Ten-core Turbo with 24 MB or 30 MB shared among cores • Level-3 cache • Four QuickPath Interconnect (QPI) links speed up to 6.4 Giga Transfers (GT) per second, with four QPI links per microprocessor • Four Scalable Memory Interface (SMI) links speed up to 6.4 GT per second, with four SMI links per microprocessor • Intel EX core chipset (I/O Hub) • Intel 7500 or 7510 scalable memory buffer (depending on your model) with up to eight memory ports (memory channels) when the optional memory tray is installed (four ports on the system board and four ports on the optional memory tray). Each port controls four DIMMs. • HyperThreading **Note:** • Use the Setup utility program to determine the type and speed of the microprocessors. • For a list of supported microprocessors, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.	• Slots: 16 dual inline memory module connectors (on the system board). • Minimum: 2 GB • Maximum: 512 GB (on the base system board) **Note:** 1. If you purchase and install the optional 16-DIMM memory tray, another 512 GB of additional memory is available (depending on the model). 2. If you purchase and attach the optional 32-DIMM IBM MAX5 for System x memory expansion module, another TB of additional memory is available (depending on the model). 3. The server can support a total of 2 TBs of memory when both the optional memory tray and the MAX5 are installed (depending on the model). • Type: 1333 MHz PC3-10600R-999, 1333 MHz PC3L-10600, 1600 MHz PC3-12800, 1066 MHz PC3-8500, or (single-rank, double-rank, or quad-rank), ECC, 240 pin, DDR3 registered SDRAM DIMMs – PC3-10600R-999 is available in 2 GB, 4 GB, and 16 GB DIMMs – PC3L-10600 is available in 16 GB LP-DIMMs (for Machine Types 7147 and 7192 only) – PC3-12800 is available in 16 GB DIMMs – PC3-8500 is available in 8 GB, 16 GB, 32 GB DIMMs • Supports l.35-volt and 1.5-volt registered DIMMs (see "Installing a memory module" on page 50for more information).	• Scales with the IBM MAX5 for System x memory expansion module with QPI links for additional memory **Note:** When you add an optional MAX5 to your server configuration and you plan to use the optional USB flash device with VMware ESXi embedded hypervisor software, see the documentation that comes with the USB flash device and the operating system installation instructions for installing VMware ESXi (or ESX, depending on your environment) on your server at the IBM website at http://www.ibm.com/supportportal/. The documentation provides additional installation and configuration information that you need to follow before you use the MAX5. **Drive expansion bays, depending on the model):** • The server can support up to 24 hot-swap drives using the supported SAS\SATA backplane configurations. The following drives are supported: • 2.5-inch hot-swap SAS or hot-swap SATA hard disk drive • 1.8-inch hot-swap solid state drive (SSD) • 2.5-inch hot-swap solid state drive (SSD) **Note:** Configurations with all 1.8-inch drive backplanes can support one additional simple-swap drive if you purchase the optional Simple-swap 2.5-inch SATA Drive and Backplate kit.

Table 1. Server features and specifications (continued)

Optional SATA optical drives:	**Integrated functions:**	**Power supply:**
• optional DVD/CD-ROM BlueRay (cable comes mounted to the optical drive bracket in the server)	• Integrated Management Module (IMM), which provides service processor control and monitoring functions, video controller, and remote keyboard, video, mouse, and remote hard disk drive capabilities	• Server comes standard with one power supply • Maximum of four 675-watt ac (110 or 220 V ac auto-sensing) hot-swap power supplies for N+N redundancy support.
Hot-swap fans: The server comes standard with five speed-controlled hot-swap fans for N+1 redundancy.	• Broadcom BCM5709C Gb Ethernet controller with TCP/IP Offload Engine (TOE) and Wake on LAN support • Light path diagnostics • Eight Universal Serial Bus (USB) 2.0 ports:	**Note:** The server can run fully configured with two power supplies. For redundancy support, you must install the optional IBM Power Interposer for Redundant Power option kit.

PCI expansion slots (depending on your model):
• Two PCI riser-card slots on the system board provides up to five PCI adapter slots (depending on the riser card installed in the server):
	– Two on the front of the chassis
	  – Four on the rear of the chassis
	  – Two internal (on the low-profile riser-card in which one connection is for the optional USB flash device with embedded hypervisor software)
		Video controller (integrated into IMM):
		• Matrox G200eV (two analog ports - one front and one rear that can be connected at the same time)
		Note: The maximum video resolution is 1280 x 1024 at 75 Hz.

– PCI riser slot 1 supports the:
    - PCI riser card with two PCI Express Gen2 x8 adapter slots or the optional PCI riser cards with one PCI Express Gen2 x16 adapter slot
  – PCI riser slot 2 supports the:
    - PCI riser card with three PCI Express Gen2 x8, low-profile adapter slots
	• Two Ethernet ports on the system board and two additional ports when the optional Emulex 10GbE Custom Adapter for IBM System x or the optional Emulex 10GbE Integrated Virtual Fabric Adapter II for IBM System x is installed
	• One System Management RJ-45 on the rear to connect to a systems management network. This system management connector is dedicated to the IMM functions.
	• One serial port
	• Two QPI ports
		– SVGA compatible video controller
		  – DDR2 250 MHz SDRAM video memory controller
		  – Avocent Digital Video Compression
		  – Video memory is not expandable

Table 1. Server features and specifications (continued)

RAID controllers:

- A ServeRAID M1015 SAS/SATA adapter that provides RAID levels 0, 1, and 10 (comes standard on some models).
- An optional ServeRAID M5015 SAS/SATA adapter that provides RAID levels 0, 1, 5, 10, and 50 can also be purchased.
- An optional ServeRAID B5015 SSD adapter (for solid state drives) that provides RAID levels 1 and 5 can also be purchased.
- An optional ServeRAID M5016 SAS/SATA adapter that provides RAID levels 0, 1, and 10 support can also be purchased.
- An optional IBM 6 Gigabit SSD Host Bus Adapter can also be purchased.

Size:
- Height: 86 mm (3.5 inches, 2U)
- Depth: 698 mm (27.4 inches)
- Width: 429 mm (16.8 inches)
- Maximum weight: 31.3 kg (69 lb) when fully configured

Acoustical noise emissions:
- Sound power, idling: 6.2 bels maximum
- Sound power, operating: 6.6 bels maximum

Environment:
- Air temperature:
  - Enclosure on: 10° to 35°C (50° to 95°F); altitude: 0 to 914.4 m (3000 ft). Decreased system temperature by 0.75° for every 1000 ft. increase in altitude.
  - Enclosure off: 5° to 45°C (41° to 113`°F)
  - Shipment: -40°C to +60°C (-40°F to 140°F
- Humidity:
  - Enclosure on: 20% to 80%; maximum dew point: 21°C (70°F)
  - Enclosure off: 8% to 80%; maximum dew point: 27°C (80°F)
  - Shipment: 5% to 100%
- Particulate contamination:

  Attention: Airborne particulates and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the server. For information about the limits for particulates and gases, see "Particulate contamination" on page 155.

Airflow:
- Normal airflow: 40 cubic feet per minute (CFM)
- Typical airflow: 65 CFM
- Maximum airflow: 90 CFM

Heat output:

Approximate heat output:
- Minimum configuration: 662 Btu per hour (194 watts)
- Maximum configuration: 2302 Btu per hour (779 watts)

Electrical input:
- Sine-wave input (47 - 63 Hz) required
- Input voltage low range:
  - Minimum: 90 V ac
  - Maximum: 137 V ac
- Input voltage high range:
  - Minimum: 180 V ac
  - Maximum: 265 V ac
- Input kilovolt-amperes (kVA), approximately:
  - Minimum: 0.194 kVA
  - Maximum: 1.5 kVA

Notes:

1. Power consumption and heat output vary depending on the number and type of optional features installed and the power-management optional features in use.

2. The sound levels were measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779 and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average values stated because of room reflections and other nearby noise sources. The noise emission level stated in the declared (upper limit) sound-power level, in bels, for a random sample of system.

What your server offers

The server uses the following features and technologies:

- **Integrated Management Module**

  The Integrated Management module (IMM) combines service processor functions, video controller, and remote presence and blue-screen capture features in a single chip. The IMM provides advanced service-processor control, monitoring, and alerting function. If an environmental condition exceeds a threshold or if a system component fails, the IMM lights LEDs to help you diagnose the problem, records the error in the IMM event log, and alerts you to the problem. Optionally, the IMM also provides a virtual presence capability for remote server management capabilities. The IMM provides remote server management through the following industry-standard interfaces:

  - Intelligent Platform Management Interface (IPMI) version 2.0
  - Simple Network Management Protocol (SNMP) version 3
  - Common Information Model (CIM)
  - Web browser

  For additional information, see "Using the integrated management module" on page 142 and http://www.ibm.com/systems/support/supportsite.wss/ docdisplay?lndocid=MIGR-5079770&brandind=5000008.

- **UEFI-compliant server firmware**

  The IBM System x Server Firmware (server firmware) offers several features, including Unified Extensible Firmware Interface (UEFI) version 2.1 compliance, Active Energy Management (AEM) technology, enhanced reliability, availability, and serviceability (RAS) capabilities, and basic input/output system (BIOS) compatibility support. UEFI replaces the legacy BIOS and defines a standard interface between the operating system, platform firmware, and external devices. UEFI-compliant System x servers are capable of booting UEFI-compliant operating systems, BIOS-based operating systems, and BIOS-based adapters as well as UEFI-compliant adapters. For more information about UEFI-compliant firmware, go to http://www-947.ibm.com/systems/support/supportsite.wss/ docdisplay?lndocid=MIGR-5083207&brandind=5000008.

  Note: The server does not support DOS.

- **IBM Dynamic System Analysis (DSA) Preboot**

  The server comes with the Dynamic System Analysis (DSA) Preboot diagnostic program stored in the integrated USB memory on the server. DSA Preboot collects and analyzes system information to aid in diagnosing server problems, as well as offering a rich set of diagnostic tests of the major components of the server. DSA Preboot collects the following information about the server:

  - Drive health information
  - Event logs for ServeRAID controllers and service processors
  - Installed hardware, including PCI and USB information
  - Light path diagnostics status
  - Microprocessor, input/out hub, and UEFI error logs
  - Network interfaces and settings
  - RAID controller configuration
  - Scalability link status
  - Service processor (integrated management module) status and configuration
  - System configuration

– Vital product data, firmware, and UEFI configuration

DSA Preboot also provides diagnostics for the following system components (when they are installed):

– Broadcom network adapter
– IMM 12C bus
– Light path diagnostics panel
– Memory modules
– Microprocessors
– Optical devices (CD or DVD)
– SAS or SATA drives
– Tape drives (SCSI)

For information about both editions (DSA Preboot and Portable) of the Dynamic System Analysis (DSA) diagnostic programs, see the *Problem Determination and Service Guide* on the IBM *Documentation* CD.

- **Multi-core processors**

  The server supports up to two Intel Xeon™ EX versions of the 6000 and 7000 Series or Xeon EX versions of the E7 Series, four-core, six-core, eight-core, or ten-core microprocessors (depending on your model). The server comes with a minimum of one microprocessor installed.

- **IBM Systems Director DVD**

  IBM Systems Director is a platform-management foundation that streamlines the way you manage physical and virtual systems in a heterogeneous environment. By using industry standards, IBM Systems Director supports multiple operating systems and virtualization technologies for IBM and non-IBM x86 platforms. For more information, see the IBM Systems Director documentation on the *IBM Systems Director* DVD and "IBM Systems Director" on page 16.

- **IBM X-Architecture technology**

  IBM X-Architecture technology combines proven, innovative IBM designs to make your x86-processor-based server powerful, scalable, and reliable. For more information, see http://www.ibm.com/servers/eserver/xseries/xarchitecture/enterprise/index.html.

- **Memory ProteXion**

  The Memory ProteXion feature improves the reliability of memory through memory mirroring. Memory mirroring or Full Array Memory Mirroring redundancy (FAMM) provides a redundant copy of all code and data that are addressable in the configured memory map. Through the memory controller chip set, memory mirroring replicates and stores data on sets of four DIMMs within two memory ports simultaneously (the equivalent of a hot-spare drive in a RAID array). If a failure occurs, the memory controller switches from the primary set of DIMMs to the backup set of DIMMs. For more information about installing DIMMs for memory mirroring, see "Installing a memory module" on page 50.

- **Memory sparing**

  The server supports memory sparing. Memory sparing reserves memory capacity for failover in the event of a DIMM failure, and the reserved capacity is subtracted from the total available memory. Memory sparing provides less redundancy than memory mirroring does. If a predetermined threshold of correctable errors is reached, the contents of the failing DIMM are copied to the spare memory, and the failing DIMM or rank is disabled. To enable memory sparing through the Setup utility, select System Settings > Memory

- **VMware ESXi embedded hypervisor**

An optional USB flash device with VMware ESXi embedded hypervisor software is available for purchase. Hypervisor is virtualization software that enables multiple operating systems to run on a host system at the same time. The USB flash device installs in USB embedded hypervisor flash device connector on the low-profile, riser card in PCI riser slot 2 on the system board. See "Using the embedded hypervisor" on page 143 for additional information.

- **Remote presence and blue-screen capture features**

  The remote presence and blue-screen capture features are integrated functions of the integrated management module (IMM). The remote presence feature provides the following functions:

  - Remotely viewing video with graphics resolutions up to 1280 x 1024 at 75 Hz, regardless of the system state
  - Remotely accessing the server, using the keyboard and mouse from a remote client
  - Mapping the CD or DVD drive, diskette drive, and USB flash drive on a remote client, and mapping ISO and diskette image files as virtual drives that are available for use by the server
  - Uploading a diskette image to the IMM memory and mapping it to the server as a virtual drive

  The blue-screen capture feature captures the video display contents before the IMM restarts the server when the IMM detects an operating-system hang condition. A system administrator can use the blue-screen capture feature to assist in determining the cause of the hang condition.

  See "Using the remote presence and blue-screen capture features" on page 145 for additional information.

- **Large system-memory capacity**

  The server can support up to 2 TBs of system memory (if you install 32 GB DIMMs in all of the connectors on the system board, memory tray, and memory expansion module). The server base system board provides 16 DIMM connectors for up to 512 GB of memory . For additional memory capacity, an optional 16-DIMM memory tray is available for purchase that provides up to 512 GB of additional memory, and the optional 32-DIMM IBM MAX5 for System x memory expansion module is also available for purchase and provides up to 1 TB of additional memory. For more information about the MAX5 expansion module, see "IBM MAX5 for System x memory expansion module" on page 25. The server memory controller supports error correcting code (ECC) for up to 32 industry-standard PC3-10600R-999 1333 MHz, PC3L-10600 1333 MHz, PC3-12800 1600 MHz, and PC3-8500 1066 MHz (single-rank, dual-rank, or quad-rank), DDR3 (third-generation double-data-rate), registered, synchronous dynamic random access memory (SDRAM) dual inline memory modules (DIMMs).

- **IBM** *ServerGuide Setup and Installation* **CD**

  The *ServerGuide Setup and Installation* CD, which you can download from the Web, provides programs to help you set up the server and install a Windows operating system. The ServerGuide program detects installed optional hardware devices and provides the correct configuration programs and device drivers. For more information about the *ServerGuide Setup and Installation* CD, see "Using the ServerGuide Setup and Installation CD" on page 140.

- **Integrated network support**

  The server comes with an integrated dual-port Broadcom BCM5709C dual-Gigabit Ethernet controller, which supports connection to a 10 Mbps, 100 Mbps, or 1000 Mbps network. For more information, see "Configuring the Gigabit Ethernet controller" on page 146.

- **Integrated Trusted Platform Module (TPM)**

  This integrated security chip performs cryptographic functions and stores private and public secure keys. It provides the hardware support for the Trusted Computing Group (TCG) specification. You can download the software to support the TCG specification, when the software is available. See http://www.ibm.com/servers/eserver/xseries/scalable_family.html for details about the TPM implementation. You can enable TPM support through the Setup utility under the **System Security** menu choice (see"Using the Setup utility" on page 132).

- **Large data-storage capacity and hot-swap capability**

  The server can support a maximum of 24 drives, using the supported SAS\SATA backplane configurations. The server supports 2.5-inch hot-swap Serial Attached SCSI (SAS) hard disk drives or hot-swap Serial ATA (SATA) hard disk drives, 2.5-inch hot-swap solid state drives (SSD), or 1.8-inch hot-swap solid state drives.

  With the hot-swap feature, you can add, remove, or replace hard disk drives without turning off the server.

- **Light path diagnostics**

  Light path diagnostics provides LEDs to help you diagnose problems. For more information about the light path diagnostics, see "Light path diagnostics panel" on page 19 and the *Problem Determination and Service Guide* on the IBM *Documentation* CD.

- **PCI Express Gen2 adapter capabilities**

  The server provides two PCI riser-card slots on the system board. Standard models of the server come with two PCI Express riser assemblies. See "Installing an adapter" on page 69 for detailed information.

  – PCI riser slot 1 supports PCI Express Gen2 x8 full-height, three/fourth-length adapters, PCI Express Gen2 x8 full-height, half-length adapters, or PCI Express Gen2 x16 full-height, three/fourth length adapters or PCI Express Gen2 x16 full-height, full-length adapters.

  – PCI riser slot 2 supports low-profile, PCI Express Gen2 x8 (x4) adapters, the optional IBM 6 Gb SSD Host Bus Adapter, or the optional Emulex 10GbE Custom Adapter for IBM System x.

- **Active Energy Manager**

  The IBM Active Energy Manager solution is an IBM Systems Director extension that measures and reports server power consumption as it occurs. This enables you to monitor power consumption in correlation to specific software application programs and hardware configurations. You can obtain the measurement values through the systems-management interface and view them, using IBM Systems Director. For more information, including the required levels of IBM Systems Director and Active Energy Manager, see the IBM Systems Director documentation on the *IBM Systems Director* DVD, or see http://www.ibm.com/servers/systems/management/director/extensions/actengmgr.html/.

- **Redundant connection**

  The addition of an optional Emulex 10GbE Custom Adapter for IBM System x Ethernet adapter provides (dual-ports) failover capability to a redundant Ethernet connection with the applicable application installed. If a problem occurs with the primary Ethernet connection and the optional Ethernet adapter is installed in the server, all Ethernet traffic that is associated with the primary connection is automatically switched to an optional redundant Emulex 10GbE

Custom Adapter for IBM System x Ethernet adapter connection. If the applicable device drivers are installed, this switching occurs without data loss and without user intervention.

The Emulex 10GbE Custom Adapter for IBM System x is a virtual fabric adapter. You can configure the adapter into smaller virtual ports (for example, up to eight virtual NICs or combination of vNICs and CNA). You can also upgrade to Fiber Channel without purchasing a Fiber Channel adapter or an Ethernet adapter.

- **Redundant cooling and optional power capabilities**

  The server comes with one 675-watt hot-swap power supply and five fans installed. The server can run fully configured with two power supplies, but two power supplies do not provide redundancy support. The server supports a maximum of four 675-watt hot-swap power supplies and five speed-controlled hot-swap fans, which provide redundancy and hot-swap capability for a full configuration. The redundant cooling by the fans in the server enables continued operation if one of the fans fails. You can order an optional Power Interposer for Redundant Power Option Kit for full power-supply redundancy support.

- **ServeRAID support**

  A ServeRAID adapter provides hardware redundant array of independent disks (RAID) support to create configurations. Some models come standard with the ServeRAID M1015 SAS/SATA adapter which provides RAID levels 0, 1, 5, 6, 10, 50, and 60. Additional optional RAID adapters are available for purchase that provide other levels of RAID.

- **Systems-management capabilities**

  The server comes with an integrated management module (IMM). When the IMM is used with the systems-management software that comes with the server, you can manage the functions of the server locally and remotely. The IMM also provides system monitoring, event recording, and network alert capability. The systems-management connector on the rear of the server is dedicated to the IMM. The dedicated systems-management connector provides additional security by physically separating the management network traffic from the production network. You can use the Setup utility to configure the server to use a dedicated systems-management network or a shared network.

- **TCP/IP offload engine (TOE) support**

  The Ethernet controllers in the server support TOE, which is a technology that offloads the TCP/IP flow from the microprocessor and I/O subsystem to increase the speed of the TCP/IP flow. When an operating system that supports TOE is running on the server and TOE is enabled, the server supports TOE operation. See the operating-system documentation for information about enabling TOE.

  Note: As of the date of this document, the Linux operating system does not support TOE.

Reliability, availability, and serviceability

Three important computer design features are reliability, availability, and serviceability (RAS). The RAS features help to ensure the integrity of the data that is stored in the server, the availability of the server when you need it, and the ease with which you can diagnose and correct problems.

Your server has the following RAS features:
- 3-year parts and 3-year labor limited warranty (Machine Types 7147 and 7148) and 4-year parts and 4-year labor limited warranty (Machine Types 7149 and 7192)
- 24-hour support center
- Automatic error retry and recovery
- Automatic restart on nonmaskable interrupt (NMI)
- Automatic restart after a power failure
- Backup basic input/output system switching under the control of the integrated management module (IMM)
- Built-in monitoring for fan, power, temperature, voltage, and power-supply redundancy
- Cable-presence detection on most connectors
- Chipkill memory protection
- Double-device data correction (DDDC) for x4 DRAM technology DIMMs (available on 16 GB DIMMs only). Ensures that data is available on a single x4 DRAM DIMM after a hard failure of up to two DRAM DIMMs. One x4 DRAM DIMM in each rank is reserved as a space device.
- Diagnostic support for ServeRAID and Ethernet adapters
- Error codes and messages
- Error correcting code (ECC) L3 cache and system memory
- Full Array Memory Mirroring (FAMM) redundancy
- Hot-swap cooling fans with speed-sensing capability
- Hot-swap hard disk drives
- Information and light path diagnostics LED panels
- Integrated Management Module (IMM)
- Light path diagnostics LEDs for memory DIMMs, microprocessors, hard disk drives, solid state drives, power supplies, and fans
- Menu-driven setup, system configuration, and redundant array of independent disks (RAID) configuration programs
- Microprocessor built-in self-test (BIST), internal error signal monitoring, internal thermal trip signal monitoring, configuration checking, and microprocessor and voltage regulator module failure identification through light path diagnostics
- Memory mirroring support
- Memory error correcting code and parity test
- Memory down sizing (non-mirrored memory). After a restart of the server after the memory controller detected a non-mirrored uncorrectable error and the memory controller cannot recover operationally, the IMM logs the uncorrectable error and informs POST. POST logically maps out the memory with the uncorrectable error, and the server restrats with the remaining installed memory.
- Nonmaskable interrupt (NMI) button
- Parity checking on the small computer system interface (SCSI) bus and PCI buses
- Power management: Compliance with Advanced Configuration and Power Interface (ACPI)
- Power-on self-test (POST)
- Predictive Failure Analysis (PFA) alerts on memory, microprocessors, SAS/SATA hard disk drives or solid state drives, fans, power supplies, and VRM
- Redundant Ethernet capabilities with failover support

- Redundant hot-swap power supplies and redundant hot-swap fans
- Redundant network interface card (NIC) support
- Remind button to temporarily turn off the system-error LED
- Remote system problem-determination support
- ROM-based diagnostics
- ROM checksums
- Serial Presence Detection (SPD) on memory, VPD, system board, power supply, and hard disk drive or solid state drive backplane
- Single-DIMM isolation of excessive correctable error or multi-bit error by the Unified Extensible Firmware Interface (UEFI)
- Solid state drives
- Standby voltage for system-management features and monitoring
- Startup (boot) from LAN through remote initial program load (RIPL) or dynamic host configuration protocol/boot protocol (DHCP/BOOTP)
- System auto-configuring from the configuration menu
- System-error logging (POST and IMM)
- Systems-management monitoring through the Inter-Integrated Circuit (IC) protocol bus
- Uncorrectable error (UE) detection
- Upgradeable POST, Unified Extensible Firmware Interface (UEFI), diagnostics, IMM firmware, and read-only memory (ROM) resident code, locally or over the LAN
- Vital product data (VPD) on microprocessors, system board, power supplies, and SAS/SATA (hot-swap hard disk drive or solid state drive) backplane
- Wake on LAN capability

IBM Systems Director

IBM Systems Director is a platform-management foundation that streamlines the way you manage physical and virtual systems supports multiple operating systems and virtualization technologies in IBM and non-IBM x86 platforms.

Through a single user interface, IBM Systems Director provides consistent views for viewing managed systems, determining how these systems relate to one other, and identifying their statuses, helping to correlate technical resources with business needs. A set of common tasks that are included with IBM Systems Director provides many of the core capabilities that are required for basic management, which means instant out-of-the-box business value. The common tasks include the following:

- Discovery
- Inventory
- Configuration
- System health
- Monitoring
- Updates
- Event notification
- Automation for managed systems

The IBM Systems Director Web and command-line interfaces provide a consistent interface that is focused on driving these common tasks and capabilities:

- Discovering, navigating, and visualizing systems on the network with the detailed inventory and relationships to the other network resources

- Notifying users of problems that occur on systems and the ability to isolate the sources of the problems
- Notifying users when systems need updates and distributing and installing updates on a schedule
- Analyzing real-time data for systems and setting critical thresholds that notify the administrator of emerging problems
- Configuring settings of a single system and creating a configuration plan that can apply those settings to multiple systems
- Updating installed plug-ins to add new features and functions to the base capabilities
- Managing the life cycles of virtual resources

For more information about IBM Systems Director, see the documentation on the *IBM Systems Director* DVD that comes with the server, the IBM Systems Director Information Center at http://publib.boulder.ibm.com/infocenter/director/v6rlx/indel.jsp?topic=/director_6.1/fqm0_main.html, and the Systems Management Web page at http://www.ibm.com/systems/management/, which presents an overview of IBM Systems Management and IBM Systems Director.

Server controls, LEDs, and power

This section describes the controls and light-emitting diodes (LEDs) and how to turn the server on and off. For the locations of other LEDs on the system board, see "System-board LEDs" on page 40.

Front view

The following illustration shows the controls, LEDs, and connectors on the front of the hot-swap server model.
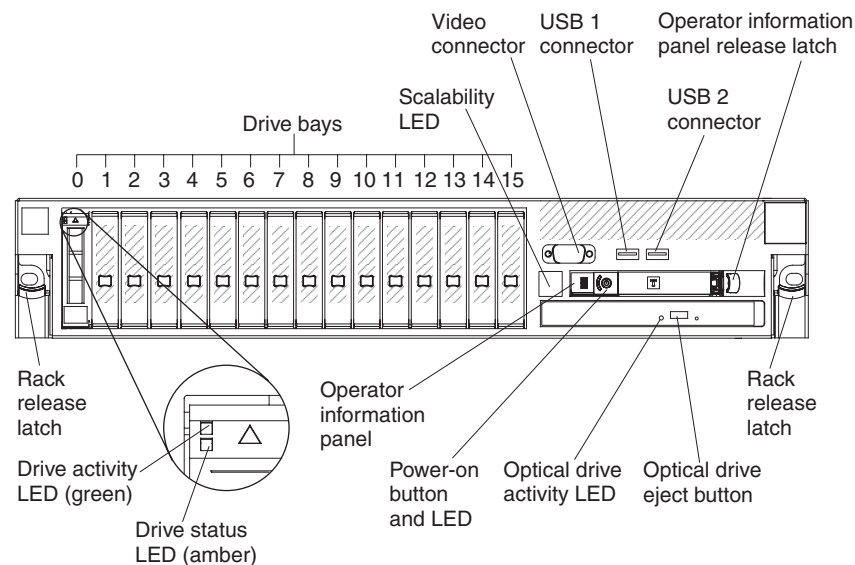
- **Rack release latches:** Press the latches on each front side of the server to slide it out of the rack.
- **Hard disk drive or solid state drive status LEDs:** These LEDs are used on SAS or SATA hard disk drives and solid state drives. When one of these LED are lit, it indicates that the drive has failed. If an optional IBM ServeRAID controller is installed in the server, when this LED is flashing slowly (one flash per second),

it indicates that the drive is being rebuilt. When the LED is flashing rapidly (three flashes per second), it indicates that the controller is identifying the drive.

- **Hard disk drive or solid state drive activity LEDs:** These LEDs are used on SAS or SATA hard disk drives and solid state drives. Each hot-swap drive has an activity LED, and when this LED is flashing, it indicates that the drive is in use.
- **CD-RW/DVD eject button (Optional):** Press this button to release a DVD or CD from the CD/DVD drive.
- **CD-RW/DVD drive activity LED (Optional):** When this LED is lit, it indicates that the CD-RW/DVD drive is in use.
- **Scalability LED:** When this (white) LED is lit, it indicates that the server is connected to another server or MAX5 to form a multi-node configuration.
- **Operator information panel:** This panel contains controls and LEDs that provide information about the status of the server. For information about the controls and LEDs on the operator information panel, see "Operator information panel."
- **Operator information panel release latch:** Push the blue release latch to the left and pull out the light path diagnostics panel to view the light path diagnostics LEDs and buttons. See "Light path diagnostics panel" on page 19 and the *Problem Determination and Service Guide* for more information about light path diagnostics.
- **Video connector:** Connect a monitor to this connector. The video connectors on the front and rear of the server can be used simultaneously.

  Note: The maximum video resolution is 1280 x 1024 at 75 Hz.
- **USB connectors:** Connect a USB device, such as a USB mouse, keyboard, or other device, to any of these connectors.

Operator information panel

The following illustration shows the controls and LEDs on the operator information panel.
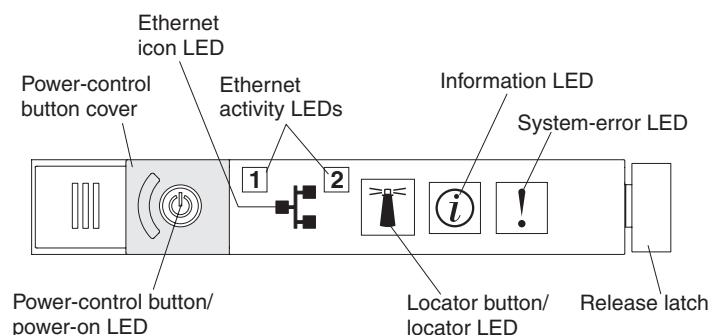
- **Power-control button and power-on LED:** Press this button to turn the server on and off manually or to wake the server from a reduced-power state. The states of the power-on LED are as follows:

  Off: AC power is not present, or the power supply or the LED itself has failed.

  Flashing rapidly (4 times per second): The server is turned off and is not ready to be turned on. The power-control button is disabled. This lasts approximately 1 to 3 minutes.

  Flashing slowly (once per second): The server is turned off and is ready to be turned on. You can press the power-control button to turn on the server.

  Lit: The server is turned on.

Fading on and off: The server is in a reduced-power state. To wake the server, press the power-control button or use the IMM Web interface. See "Logging on to the Web interface" on page 146 for information on logging on to the IMM Web interface.

- **Ethernet activity LEDs:** When any of these LEDs is flashing or flickering, it indicates that the server is transmitting to or receiving signals from the Ethernet LAN that is connected to the Ethernet port that corresponds to that LED.

- **Locator button/LED:** Use this blue LED to visually locate the server among other servers. This LED is also used as a presence detection button. You can use IBM Systems Director to light this LED remotely. This LED is controlled by the IMM. When you press the locator button, the LED will be lit and it will continue to be lit until you press it again to turn it off. Press the locator button to visually locate the server among the others servers. In a two-node configuration, this LED will be lit on the primary server and this LED will blink on the secondary server during POST, if the button is pressed or an IPMI command is issued to turn on the LED. It is also used as the physical presence for the Trusted Platform Module (TPM).

- **Information LED:** When this amber LED is lit, it indicates that a noncritical event has occurred. Check the system-event log for additional information. See the *Problem Determination and Service Guide* on the IBM *Documentation* CD for more information about event logs.

- **System-error LED:** When this amber LED is lit, it indicates that a system error has occurred. A system-error LED is also on the rear of the server. An LED on the light path diagnostics panel on the operator information panel is also lit to help isolate the error. This LED is controlled by the IMM.

Light path diagnostics panel

The light path diagnostics panel is on the top of the operator information panel. For additional information about the LEDs on the light path diagnostics panel, see *Problem Determination and Service Guide*.

Note: The system service label on the underside of the cover also provides information about the location of the light path diagnostics LEDs.

To access the light path diagnostics panel, push the blue release button on the operator information panel to the left. Pull forward on the unit until the hinge of the operator panel is free of the server chassis. Then pull down on the unit, so that you can view the light path diagnostics panel information.

Note: When you slide the light path diagnostics panel out of the server to check the LEDs or checkpoint codes, do not run the server continuously with light path diagnostics panel outside of the server. The panel should only be outside of the server a short time. The light path diagnostics panel must remain in the server when the server is running to ensure proper cooling.

Release
latch

Light path
diagnostic
LEDs

Operator
information
panel
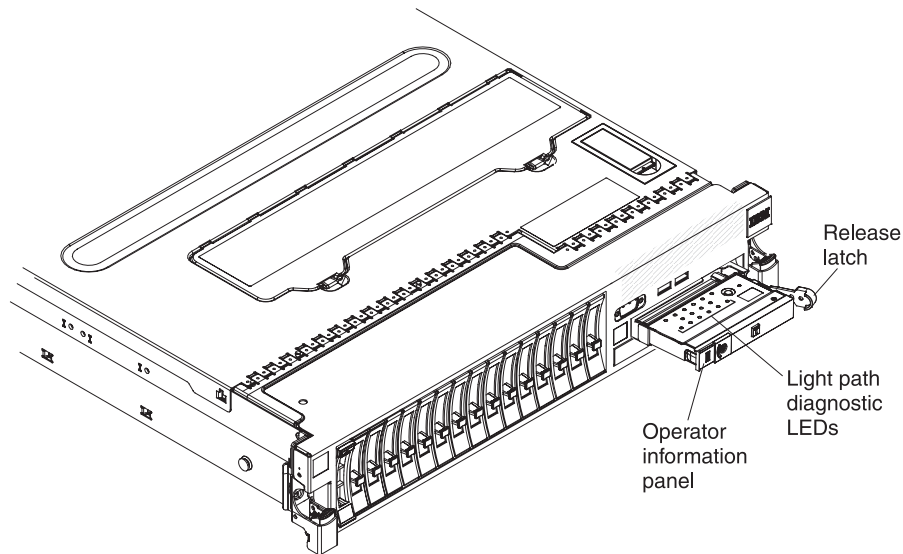
The following illustration shows the LEDs and controls on the light path diagnostics panel.

OVERSPEC LOG LINK PS PCI SP REMIND

FAN TEMP MEM NMI

CNFG CPU VRM DASD RAID BRD

NMI button

Checkpoint code

RESET

Light Path Diagnostics

- **Remind button:** This button places the system-error LED on the front panel into Remind mode. In Remind mode, the system-error LED flashes once every 2 seconds until the problem is corrected, the server is restarted, or a new problem occurs.

  By placing the system-error LED indicator in Remind mode, you acknowledge that you are aware of the last failure but will not take immediate action to correct the problem.

- **NMI button:** Press this button to force a nonmaskable interrupt to the microprocessor. You might have to use a pen or the end of a straightened paper clip to press the button. You can also use it to force a blue screen memory dump. Use this button only when you are directed to do so by the IBM service support.

- **Checkpoint code display:** This display provides a checkpoint code that indicates the point at which the system stopped during the boot block and POST. A checkpoint code is either a byte or a word value that is produced by UEFI. The display does not provide error codes or suggest components to be replaced.

- **Reset button:** Press this button to reset the server and run the power-on self-test (POST). You might have to use a pen or the end of a straightened paper clip to press the button. The Reset button is in the lower-right corner of the light path diagnostics panel.

For additional information about the LEDs on the light path diagnostics panel, see the Problem Determination and Service Guide.
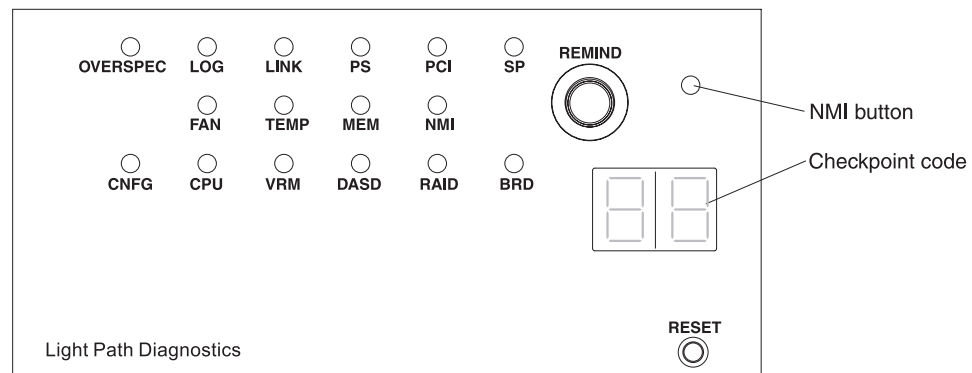
Rear view

The following illustrations show the connectors and LEDs on the rear of the server.
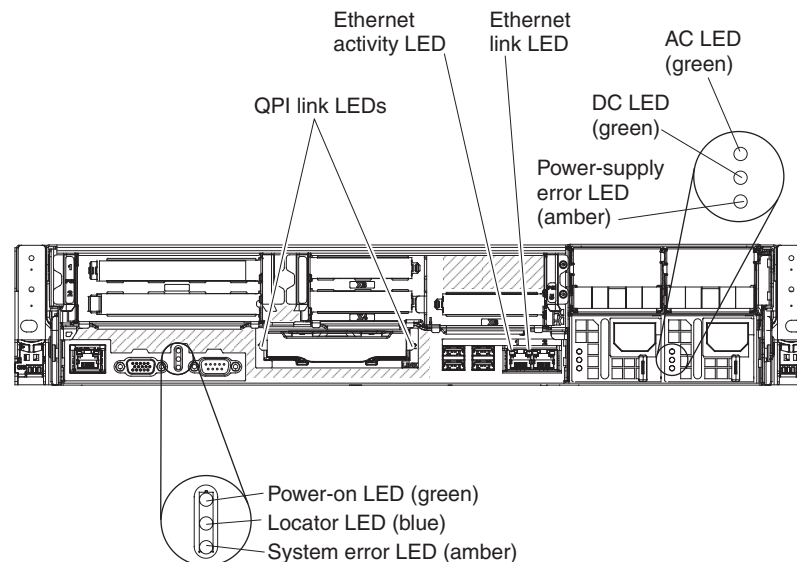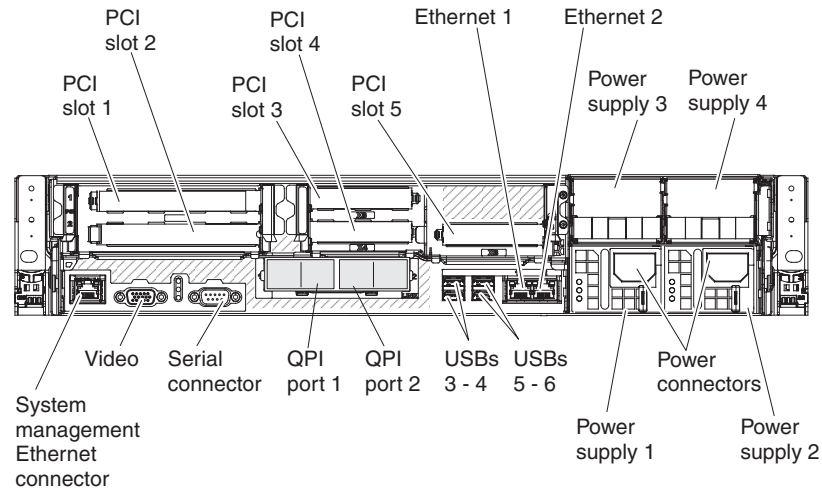
- **QPI ports:** Insert either a QPI cable or a filler panel in each of these connectors.
- **PCI riser slot 1:** Insert the PCI riser card with two slots or the PCI riser cards with one slot into this slot. Standard models of the server come with two PCI Express riser assemblies. See "Installing an adapter" on page 69 for the supported adapters for these riser-cards.
- **PCI riser slot 2:** Insert the PCI riser card with three slots into this slot. Standard models of the server come with two PCI Express riser assemblies. See "Installing an adapter" on page 69 for information about adapters that this riser card support.
- **Power connector:** Connect the power cord to this connector.
- **AC power LED:** Each hot-swap power supply has an ac power LED and a dc power LED. When the ac power LED is lit, it indicates that sufficient power is

being supplied to the power supply through the power cord. During normal operation, both the ac and dc power LEDs are lit. For any other combination of LEDs, see the *Problem Determination and Service Guide* on the IBM *Documentation* CD.

- **DC power LED:** Each hot-swap power supply has a dc power LED and an ac power LED. When the dc power LED is lit, it indicates that the power supply is supplying adequate dc power to the system. During normal operation, both the ac and dc power LEDs are lit. For any other combination of LEDs, see the *Problem Determination and Service Guide* on the IBM *Documentation* CD.

- **System-error LED:** When this LED is lit, it indicates that a system error has occurred. An LED on the light path diagnostics panel is also lit to help isolate the error. This LED is functionally equivalent to the system-error LED on the front of the server.

- **Power-on LED:** When this LED is lit and not flashing, it indicates that the server is turned on. This LED is functionally equivalent to the Power-on LED on the front of the server. The states of the power-on LED are as follows:

    Off: AC power is not present, or the power supply or the LED itself has failed.

    Flashing rapidly (4 times per second): The server is turned off and is not ready to be turned on. The power-control button is disabled. This lasts approximately 1 to 3 minutes.

    Flashing slowly (once per second): The server is turned off and is ready to be turned on. You can press the power-control button to turn on the server.

    Lit: The server is turned on.

    Fading on and off: The server is in a reduced-power state. To wake the server, press the power-control button or use the IMM Web interface. See "Logging on to the Web interface" on page 146 for information about logging on to the IMM Web interface.

- **Locator LED:** Use this LED to visually locate the server among other servers. You can use IBM Systems Director to light this LED remotely. This LED is functionally equivalent to the locator LED on the front of the server.

- **Video connector:** Connect a monitor to this connector. The video connectors on the front and rear of the server can be used simultaneously.

    Note: The maximum video resolution is 1280 x 1024 at 75 Hz.

- **Serial connector:** Connect a 9-pin serial device to this connector. The serial port is shared with the integrated management module (IMM). The IMM can take control of the shared serial port to redirect serial traffic, using Serial over LAN (SOL).

- **USB connectors:** Connect a USB device, such as a USB mouse, keyboard, or other device to any of these connectors.

- **Systems-management Ethernet connector:** Use this connector to manage the server, using a dedicated management network. If you use this connector, the IMM cannot be accessed directly from production network. A dedicated management network provides additional security by physically separating the management network traffic from the production network. You can use the Setup utility to configure the server to use a dedicated systems management network or a shared network.

- **QPI link LEDs**

    When these LEDs are lit, they indicate that there is an active link connection to the MAX5 or another x3690 server.

- **Ethernet activity LEDs:** When these LEDs are lit, they indicate that the server is transmitting to or receiving signals from the Ethernet LAN that is connected to the Ethernet port.
- **Ethernet link LEDs:** When these LEDs are lit, they indicate that there is an active link connection on the 10BASE-T, 100BASE-TX, or 1000BASE-TX interface for the Ethernet port.
- **Ethernet connectors:** Use either of these connectors to connect the server to a network. When you use the Ethernet 1 connector, the network can be shared with the IMM through a single network cable.

Server power features

When the server is connected to an ac power source but is not turned on, the operating system does not run, and all core logic except for the service processor (the Integrated Management Module) is shut down; however, the server can respond to requests to the service processor, such as a remote request to turn on the server. The power-on LED flashes to indicate that the server is connected to ac power but is not turned on.

Turning on the server

Approximately 5 seconds after the server is connected to ac power, one or more fans might start running to provide cooling while the server is connected to power and the power-on button LED will blink quickly. Approximately 1 to 3 minutes after the server is connected to ac power, the power-control button becomes active (the power-on LED will blink slowly), and one or more fans might start running to provide cooling while the server is connected to power. You can turn on the server by pressing the power-control button.

The server can also be turned on in any of the following ways:
- If a power failure occurs while the server is turned on, the server will restart automatically when power is restored.
- If your operating system supports the Wake on LAN feature, the Wake on LAN feature can turn on the server.

Note: When 4 GB or more of memory (physical or logical) is installed, some memory is reserved for various system resources and is unavailable to the operating system. The amount of memory that is reserved for system resources depends on the operating system, the configuration of the server, and the configured PCI options.

Turning off the server

When you turn off the server and leave it connected to ac power, the server can respond to requests to the service processor, such as a remote request to turn on the server. While the server remains connected to ac power, one or more fans might continue to run. To remove all power from the server, you must disconnect it from the power source.

Some operating systems require an orderly shutdown before you turn off the server. See your operating-system documentation for information about shutting down the operating system.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
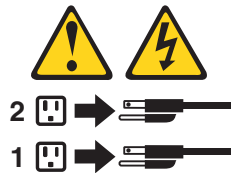
The server can be turned off in any of the following ways:

- You can turn off the server from the operating system, if your operating system supports this feature. After an orderly shutdown of the operating system, the server will turn off automatically.
- You can press the power-control button to start an orderly shutdown of the operating system and turn off the server, if your operating system supports this feature.
- If the operating system stops functioning, you can press and hold the power-control button for more than 4 seconds to turn off the server.
- The integrated management module (IMM) can turn off the server as an automatic response to a critical system failure.

IBM MAX5 for System x memory expansion module

If you purchased an optional IBM MAX5 for System x (MAX5) memory expansion module, it supports up to 32 DDR3 DIMMs, two 675-watt power supplies, and five 40 mm hot-swap speed-controlled fans. It provides added memory and multi-node scaling support for host servers. The MAX5 expansion module is based on eX5, the next generation of Enterprise X-Architecture. The MAX5 expansion module is designed for performance, expandability, and scalability; the fans and power supplies use hot-swap technology for easy replacement without requiring that expansion module be turned off.

Note:

1. Before you attach a MAX5 to the server and try to use it, you must update the server firmware with the latest level of firmware or code. If you attach and try to use the MAX5 without updating the server firmware, you might get unexpected system behavior or the server might not power on. For special instructions to follow before you attach the MAX5 to the server, go to http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-5085756.

2. When you add an optional MAX5 to your server configuration and you plan to use the optional USB flash device with VMware ESXi embedded hypervisor software, see the documentation that comes with the USB flash device and the operating system installation instructions for installing VMware ESXi (or ESX, depending on your environment) on your server at the IBM website at http://www.ibm.com/supportportal/. The documentation provides additional installation and configuration information that you need to follow before you use the MAX5.

If you are adding an optional MAX5 , see the rack instructions that comes with the cable option kit.

The following illustration shows the MAX5 memory expansion module. The illustrations in this document might differ slightly from your hardware.
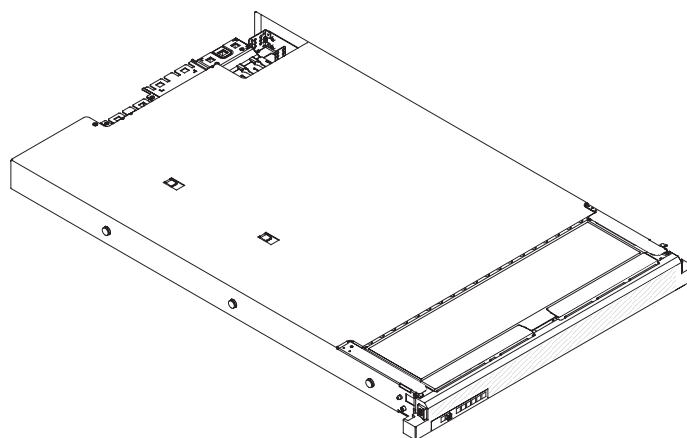
See http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/ for a list of supported optional devices for the MAX5 memory expansion module.

For information about the terms of the warranty for the MAX5 expansion module, see the documentation that comes with the expansion module.

Before you start the host server to power on the MAX5, make sure that the server has the latest level of code or firmware installed. To obtain the latest code or firmware and documentation, go to http://www.ibm.com/supportportal/.

MAX5 features and specifications

The following information is a summary of the features and specifications of the MAX5 memory expansion module:

Table 2. MAX5 expansion module features and operating specifications

• Intel 7500 or 7510 scalable memory buffer (depending on your model) with eight memory ports (four DIMMs on each port)
• Xcellerated Memory Technology
• EXA chip set
• QuickPath Interconnect (QPI) architecture technology:
  – Four 6.4 Giga Transfers (GT) per second QuickPath Interconnect links (for up to 2 microprocessors)
  – Three 10.0 GT per second EXA scalability links
• Scalability:
  – Connects to the x3690 X5 (2U) rack servers using QPI cables
	DIMMs (depending on the model):
	• Minimum: 2 DIMMs (two 2 GB DIMMs (4 GB))
	• Maximum: 32 DIMM connectors (up to 1 TB of memory, depending on the DIMM size)
	• Type of DIMMs: PC3-10600R-999, 1333 MHz, PC3L-10600 1333 MHz, or PC3-8500R, 1066 MHz, ECC, DDR3 registered SDRAM dual inline memory modules (DIMMs)
	  – PC3-10600R-999 is available in 2 GB, 4 GB, and 16 GB DIMMs
	  – PC3L-10600 is available in 16 GB LP-DIMMs (for MAX5s with Intel 7510 scalable memory buffer)
	  – PC3-8500 is available in 8 GB, 16 GB, 32 GB DIMMs
	• Supports l.35-volt (low-voltage) and 1.5-volt registered DIMMs (see "Installing a MAX5 memory module" on page 121 for more information).
	
	Fans:
	• Five hot-swap 40 mm fans
		Power supply:
		• One 675-watt (110 - 220 V ac auto-sensing) standard
		• Supports up to two 675-watt (110 - 220 V ac auto-sensing) hot-swap power supplies with built-in fans for redundancy support
		
		Light path diagnostics LEDs:
		• Board LED
		• Configuration LED
		• Fan LEDs
		• Link LED (for QPI and EXA links)
		• Locate LED
		• Memory LEDs
		• Power-on LEDs
		• Power supply LEDs

Table 2. MAX5 expansion module features and operating specifications (continued)

Acoustical noise emissions: For maximum system configurations (32 DIMMs installed)	Environment:	Heat output

• Sound power (idling): 6.2 bels
• Sound power (operating): 6.2 bels
• Sound pressure (idling): 48 dBA
• Sound pressure (operating): 48 dBA
 	
Size:
• Height: 4.4 cm (1.73 in.)
• Depth: 72.4 cm (28.5 in.)
• Width: 48.3 cm (19.0 in.)
• Weight: approximately 12.8 kg (28.2 lb) for a standard unit; when fully configured, 15.4 kg (33.9 lb)
	• Air temperature:
	  – Enclosure on: 10° to 35°C (50° to 95°F); altitude: 0 to 914.4 m (3000 ft). Decreased system temperature by 0.75° for every 1000 ft. increase in altitude.
	  – Enclosure off: 5° to 45°C (41° to 113`°F)
	  – Shipment: -40°C to +60°C (-40°F to 140°F
	• Humidity:
	  – Enclosure on: 20% to 80%; maximum dew point: 21°C (70°F)
	  – Enclosure off: 8% to 80%; maximum dew point: 27°C (80°F)
	  – Shipment: 5% to 100%
	• Particulate contamination:
	
	Attention: Airborne particulates and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the server. For information about the limits for particulates and gases, see "Particulate contamination" on page 155.
		Approximate heat:
		• Minimum configuration: 314 Btu per hour (92 watts)
		• Maximum configuration 2048 Btu per hour (600 watts)
		
		Electrical input:
		• Sine-wave input (50 - 60 Hz) required
		• Input voltage low range:
		  – Minimum: 90 V ac
		  – Maximum: 136 V ac
		• Input voltage high range:
		  – Minimum: 198 V ac
		  – Maximum: 264 V ac
		• Approximate input kilovolt-amperes (kVA):
		  – Minimum: 0.1 kVA
		  – Maximum: 0.6 kVA
		
		Note:
		
		1. Power consumption and heat output vary depending on the number and type of optional features that are installed and the power-management optional features that are in use.
		
		2. These levels were measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779 and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average stated values because of room reflections and other nearby noise sources. The declared sound-power levels indicate an upper limit, below which a large number of computers will operate.

What the MAX5 offers

The IBM MAX5 for System x (MAX5) memory expansion module provides several features for easy operation, including the following features:

- **Customer replaceable units (CRUs)**

  The major CRUs in the MAX5 expansion module are memory modules, fans, and power supplies. See "MAX5 components" on page 118 for the supported MAX5 components.

- **Light path diagnostics LEDs**

  The MAX5 expansion module has light path LEDs (front and rear) to indicate hardware, scaling, and power problems.

- **Redundant cooling and power capabilities**

  The MAX5 expansion module supports a maximum of two 675-watt hot-swap power supplies and five single-motor hot-swap fans, which provides redundancy and hot-swap capability. The redundant cooling by the fans enables continued operation if one fan fails. The MAX5 comes with one 675-watt hot-swap power supply and five fans. If a problem occurs with one of the power supplies, the other power supply can meet the power requirements.

- **Large memory capacity**

  The memory bus supports up to 1 TB of memory (depending on the size of the DIMMs). The memory controller supports error correcting code (ECC) for up to 32 industry-standard 1333 MHz PC3-10600R-999, 1333 MHz PC3L-10600, or 1333 MHz PC3-8500, DDR3 (third-generation double-data-rate), registered, synchronous dynamic random access memory (SDRAM) dual inline memory modules (DIMMs).

MAX5 reliability, availability, and serviceability features

Three of the most important features in product design are reliability, availability, and serviceability (RAS). These factors help to ensure that the integrity of the data processed in your MAX5 memory expansion module is preserved, that the expansion module is available when you want to use it, and should a failure occur, you can easily diagnose and repair the failure with minimal inconvenience.

The following is an abbreviated list of the RAS features that the expansion module supports:

- 1-year parts and 1-year labor limited warranty or it assumes the warranty of the x3690 server when attached, whichever is longer.
- Chipkill memory protection
- Hot-swap and redundant cooling with fan-speed-sensing capability (front serviceability)
- Hot-swap and redundant power supplies (rear serviceability)
- Information LED panel
- In-rack serviceability
- Memory redundant bit steering (RBS) and error correcting code (ECC)
- Memory mirroring support (mirrored DIMMs are mutually exclusive of each other)
- QuickPath Interconnect (QPI) fail down
- Rear serviceability power supplies

MAX5 indicators, LEDs, and power

This section describes the indicators and light-emitting diodes (LEDs) on the front and rear of the IBM MAX5 for System x (MAX5) memory expansion module.

Front view

The following illustration shows the indicators on the front of the MAX5 expansion module. All of the LEDs are controlled by the host server integrated management module (IMM).

Note: The MAX5 memory expansion module does not have a power-on. The MAX5 and all other functions are controlled by the host server to which it is connected.
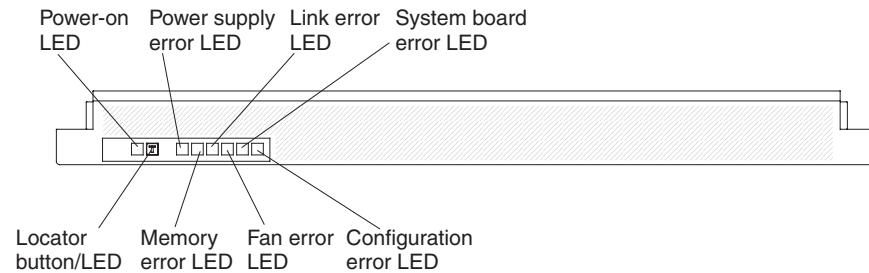
- **Information panel:** This panel contains the indicators for the MAX5 expansion module.
  - **Power-on LED:** When this green LED is lit, it indicates that the MAX5 is powered on.
  - **Locate LED:** Use this blue LED to locate the MAX5 expansion module. The locate LED also has a button that you can press to light up other servers or other MAX5 expansion modules to which the MAX5 expansion module is connected.
  - **Power supply fault (error) LED:** When this amber LED is lit, it indicates a faulty hot-swap power-supply.
  - **Memory error LED:** When this amber LED is lit, it indicates a DIMM problem.
  - **Link error LED:** When this amber LED is lit, indicates that a QPI link fault or a EXA link fault has occurred. The port LED for the link that has been disconnected will not be lit on the rear of the MAX5. EXA link LEDs are on the rear of the MAX5 expansion module, and the QPI link LEDs are on the server to which the MAX5 is connected.
  - **Fan error LED:** When this amber LED is lit, it indicates a fan error.
  - **System board error LED:** When this amber LED is lit, it indicates a MAX5 system-board tray error.
  - **Configuration error LED:** When this amber LED is lit, it indicates a configuration error. The memory LED might be lit to indicate a memory configuration error.

Rear view

The following illustration shows the indicators on the rear of the IBM MAX5 for System x (MAX5) memory expansion module.
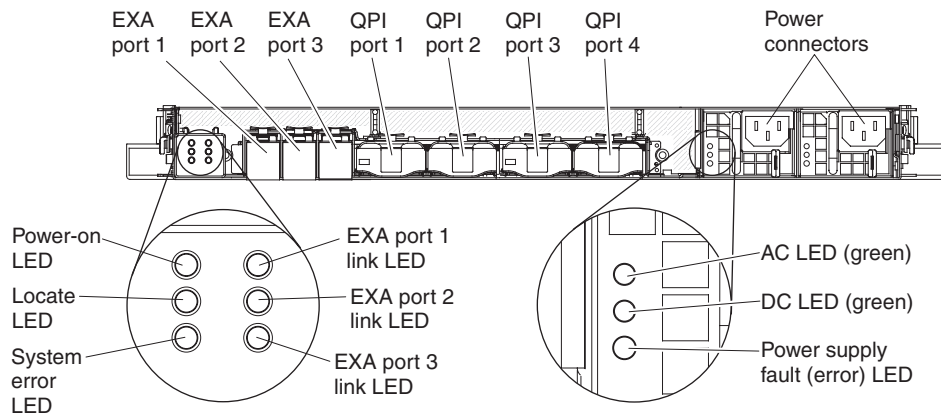
- **Power-on LED:** When this green LED is lit, it indicates that the MAX5 is powered on. This LED is functionally equivalent to the power-on LED on the front of the MAX5.
- **Locate LED:** When this blue LED is lit, it indicates that the command from the server IMM to the MAX5 expansion module is complete. Use this blue LED to locate the MAX5 expansion module. The front locate LED also has a button that you can press to light up other servers or other MAX5 expansion modules to which the MAX5 is connected to. This LED is functionally equivalent to the Locate LED on the front of the MAX5.
- **System error LED:** When this LED is lit, it indicates that a system error has occurred.
- **QPI ports:** Insert either a QPI cable or a filler panel in each of these connectors.

    Attention: When you handle the QPI cables, take precautions to avoid damaging the high density interface. Dropping and incorrectly connecting the QPI cables can damage the high density interface. Store the protective covers that come on the end of the QPI cables for reuse when you perform maintenance on the server or MAX5 or when you remove the cables for some reason.
- **Power connector:** Connect the power cord to this connector.
- **AC power LED:** Each hot-swap power supply has an ac power LED and a dc power LED. When the ac power LED is lit, it indicates that sufficient power is being supplied to the power supply through the power cord. During normal operation, both the ac and dc power LEDs are lit.
- **DC power LED:** Each hot-swap power supply has a dc power LED and an ac power LED. When the dc power LED is lit, it indicates that power supply is supplying adequate dc power to the MAX5 expansion module. During normal operation, both the ac and dc power LEDs are lit.
- **Power supply fault (error) LED:** When this amber LED is lit, it indicates a faulty hot-swap power supply.
- **EXA link LED:** When this green LED is lit, it indicates that an EXA link is functioning.

Turning the MAX5 on and off

Because the MAX5 expansion module is controlled by the server, turning on the MAX5 refers to connecting the MAX5 power cord to the power source and pressing the power-control button on the host server that is connected to the MAX5 expansion module and is configured to identify the expansion module. Normally, the operating system on the server starts, and the server issues a power-on request to the MAX5. The IBM MAX5 for System x (MAX5) memory expansion module is turned off only if the connected server issues a power-off request and you disconnect the MAX5 power cord from the power source. You cannot turn off the MAX5 expansion module manually.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
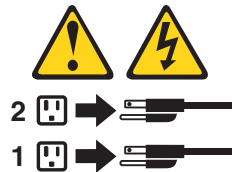
You can disconnect the MAX5 expansion module power cords from the power source to shut off all power immediately without damaging the MAX5, but it might cause an unrecoverable error and loss of data on the connected server.

Chapter 2. Installing optional devices

This chapter provides detailed instructions for installing optional hardware devices in the server and the IBM MAX5 for System x memory expansion module.

In addition to the instructions in this chapter for installing optional hardware devices, updating the firmware and device drivers, and completing the installation, IBM Business Partners must also complete the steps in "Instructions for IBM Business Partners" on page 34.

Important: To help ensure that the devices that you install work correctly and do not introduce problems, observe the following precautions:

1. Make sure that the server and the installed firmware levels support the devices that you are installing. If necessary, update the UEFI and IMM firmware and any other firmware that is stored on the system board. For information about where firmware is stored in the server, see "Configuration information and instructions," in the *Problem Determination and Service Guide*.

2. Make sure that the server and the installed firmware levels (and the MAX5, if one is connected to the server) support the devices that you are installing. If necessary, update the server UEFI and IMM firmware and any other firmware that is stored on the system board. For information about where firmware is stored in the server, see "Configuration information and instructions," in the *Problem Determination and Service Guide*. For a list of supported optional devices for the server and the MAX5, go to http://www.ibm.com/systems/info/ x86servers/serverproven/compat/us/.

3. Before you install optional hardware devices, make sure that the server is working correctly. Start the server and make sure that the operating system starts, if an operating system is installed, or that a 19990305 error code is displayed, indicating that an operating system was not found but the server is otherwise working correctly. If the server is not working correctly, see the *Problem Determination and Service Guide* for information about how to run diagnostics.

4. Follow the installation procedures in this chapter and use the correct tools. Incorrectly installed device can cause system failure because of damaged pins in sockets or connectors, loose cabling, or loose components.

5. Use the best practices to apply current firmware and device-driver updates for the server and optional devices. To download the *IBM System x Firmware Update Best Practices* document, go to http://www.ibm.com/support/entry/portal/ docdisplay?brand=50000020&lndocid=MIGR-5082923. Additional hints and tips are available from the following sites:
   - IBM support: http://www.ibm.com/supportportal/
   - System x configuration tools: http://www.ibm.com/systems/x/hardware/ configtools.html

Installing hardware devices in the server

This following sections provide detailed instructions for installing optional hardware devices in the server.

Instructions for IBM Business Partners

In addition to the instructions in this chapter for installing optional hardware devices, updating firmware and device drivers, and completing the installation, IBM Business Partners must also complete the following steps:

1. After you have confirmed that the server starts correctly and recognizes the newly installed devices and that no error LEDs are lit, run the Dynamic System Analysis (DSA) stress test. For information about using DSA, see the *Problem Determination and Service Guide* on the IBM *Documentation CD* that comes with your server.
2. Shut down and restart the server multiple times to ensure that the server is correctly configured and functions correctly with the newly installed devices.
3. Save the DSA log as a file and send it to IBM. For information about transferring data and logs, see "How to send DSA data to IBM."
4. To ship the server, repackage it in the original undamaged packing material and observe IBM procedures for shipping.

Support information for IBM Business Partners is available at http:// www.ibm.com/partnerworld/pwhome.nsf/weblook/index_us.html.

How to send DSA data to IBM

Before you send diagnostic data to IBM, read the terms of use at http://www.ibm.com/de/support/ecurep/terms.html.

You can use any of the following methods to send diagnostic data to IBM:

- **Standard upload:** http://www.ibm.com/de/support/ecurep/send_http.html
- **Standard upload with the system serial number:** http://www.ecurep.ibm.com/ app/upload_hw
- **Secure upload:** http://www.ibm.com/de/support/ecurep/ send_http.html#secure
- **Secure upload with the system serial number:** http://https:// www.ecurep.ibm.com/app/upload_hw

Server components

The following illustration shows the major components in the server. The illustrations in this document might differ slightly from your hardware.
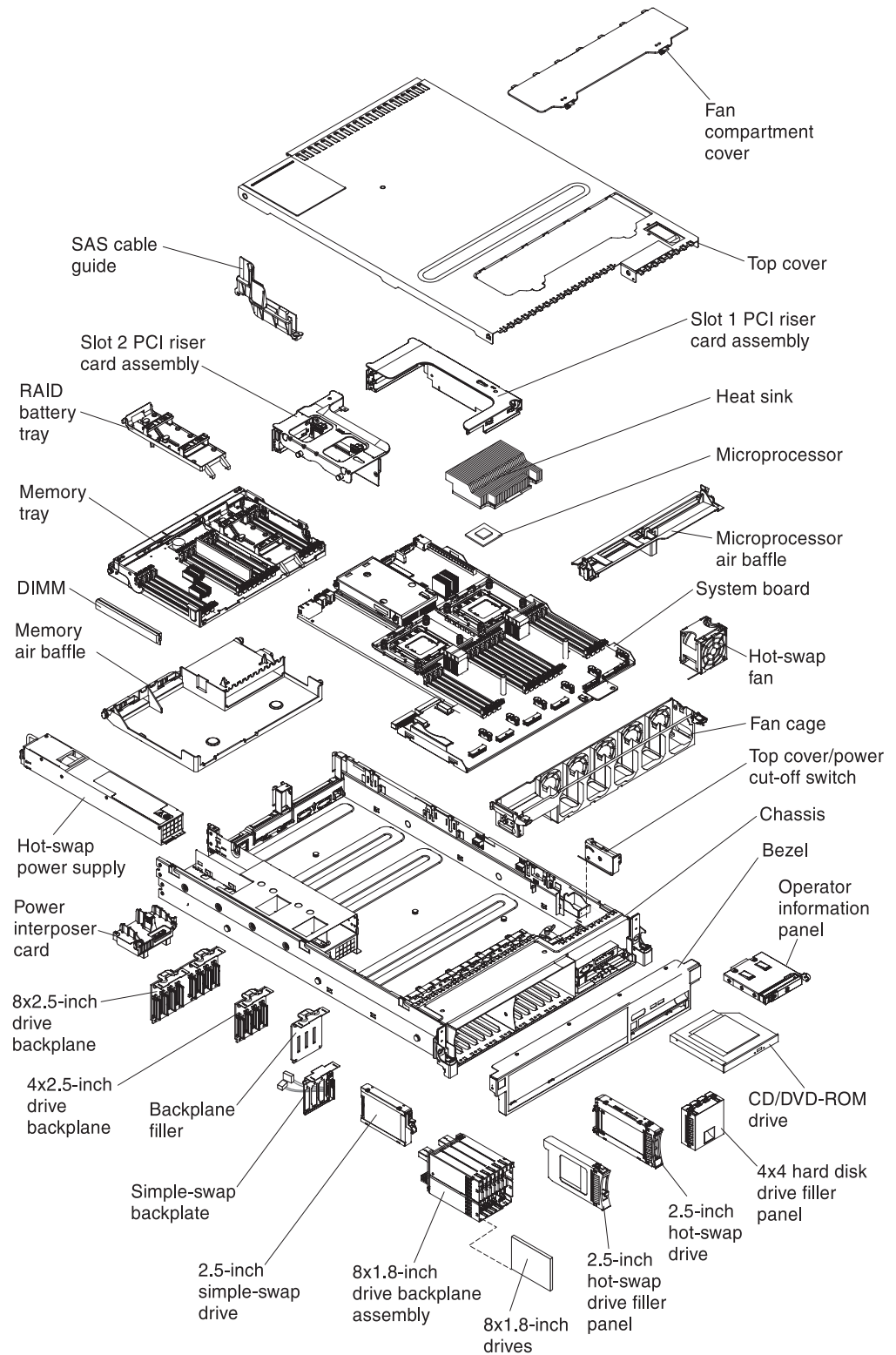
Blue on a component indicates touch points, where you can grip the component to remove it from or install it in the server, open or close a latch, and so on.

Orange on a component or an orange label on or near a component indicates that the component can be hot-swapped, which means that if the server and operating system support hot-swap capability, you can remove or install the component while the server is running. (Orange can also indicate touch points on hot-swap components.) See the instructions for removing or installing a specific hot-swap component for any additional procedures that you might have to perform before you remove or install the component.
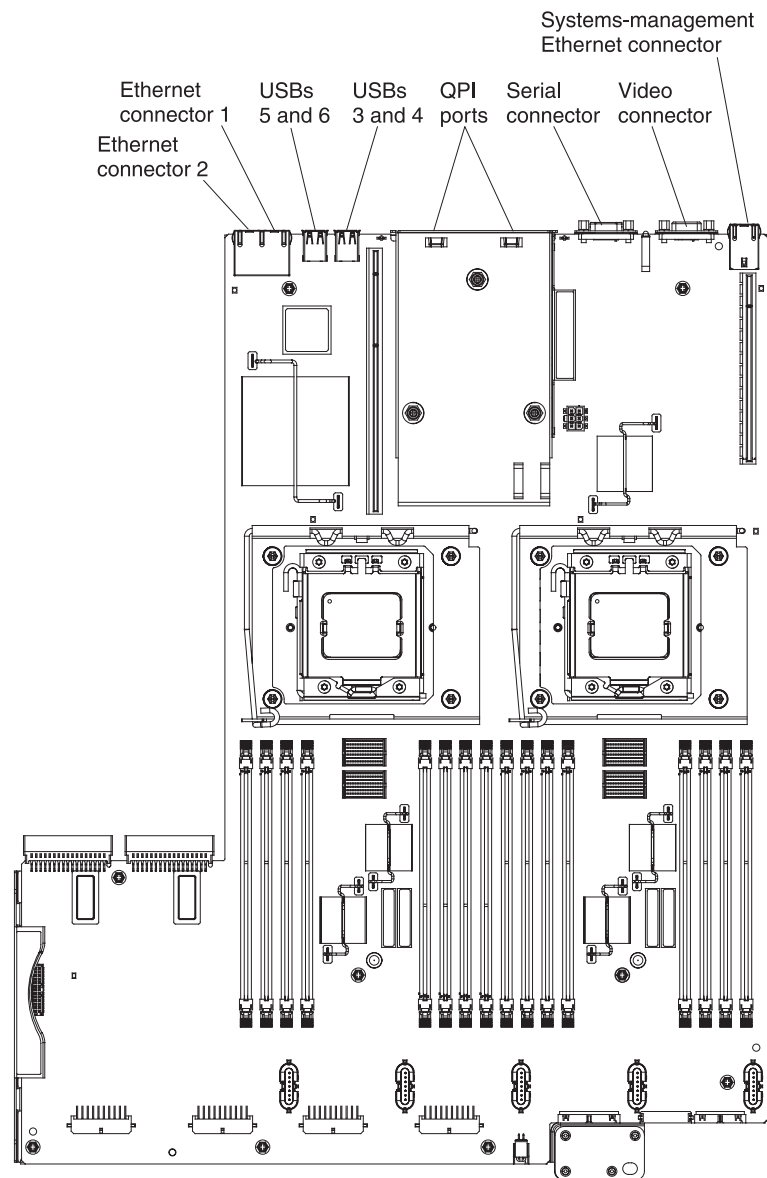
System-board internal connectors

The following illustration shows the internal connectors on the system board.
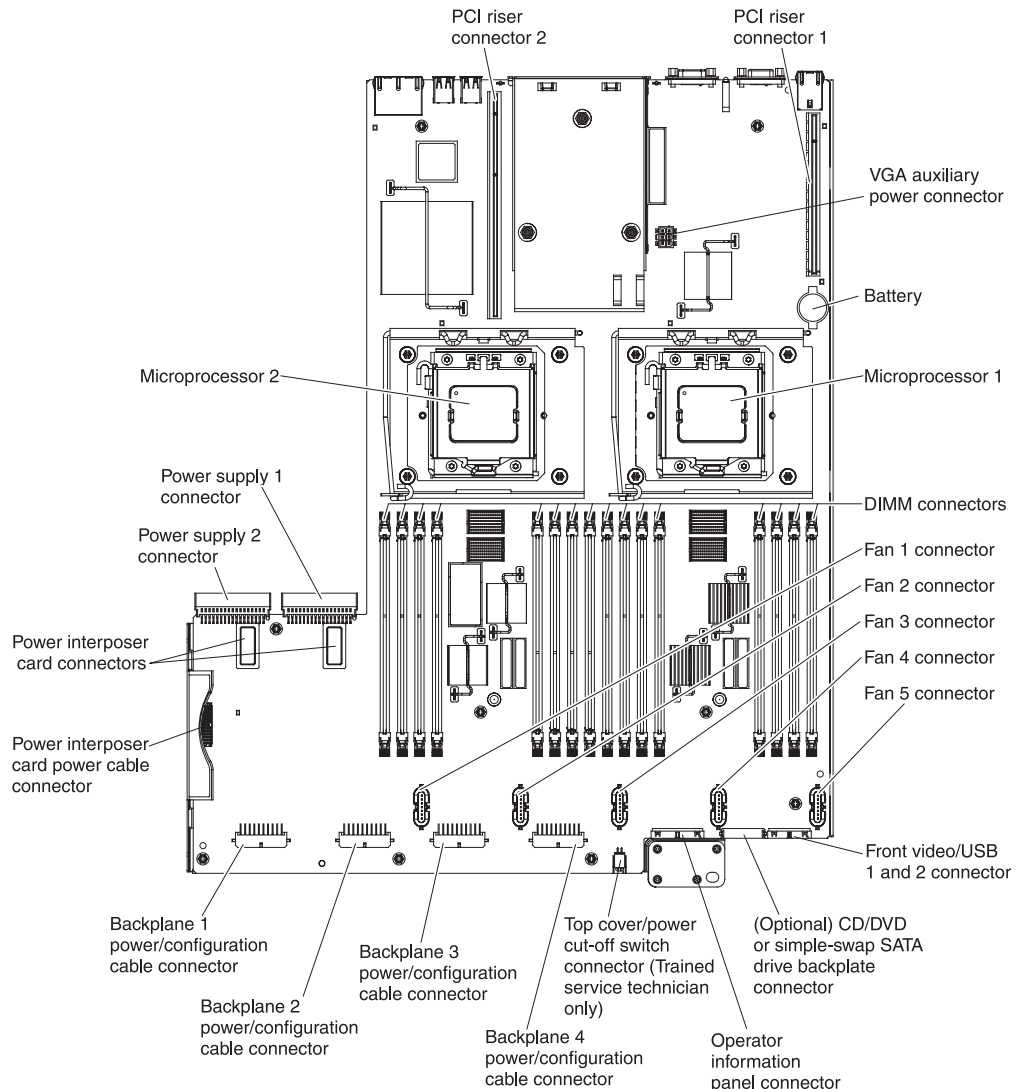
System-board external connectors

The following illustration shows the external input/output connectors on the system board.

System-board switches and jumpers

The following illustration shows the location and description of the switches and jumpers.

Note: If there is a clear protective sticker on the top of the switch block, you must remove and discard it to access the switch.
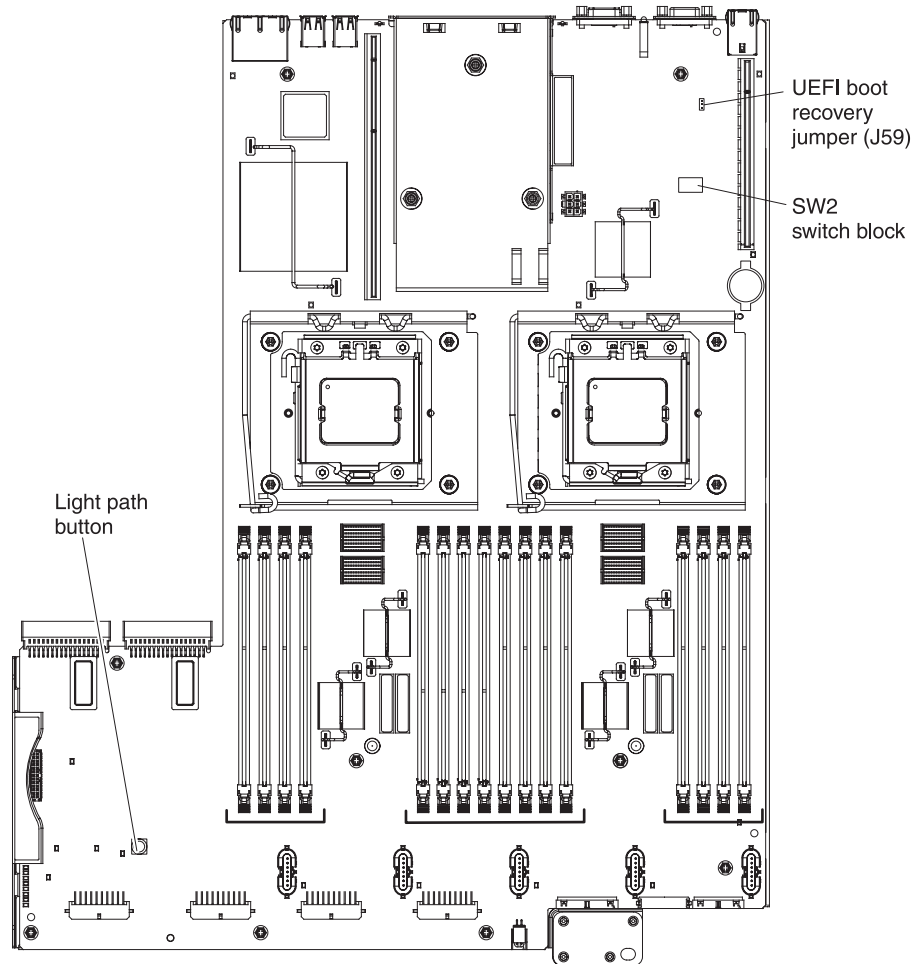
The following table describes the jumper on the system board.

Table 3. System board jumper

Jumper number	Jumper name	Jumper setting
J59	UEFI boot recovery jumper	• Pins 1 and 2: Normal (default) Loads the primary server firmware ROM page. • Pins 2 and 3: Loads the secondary (backup) server firmware ROM page.

Table 3. System board jumper (continued)

Jumper number	Jumper name	Jumper setting
Note:		
1. If no jumper is present, the server responds as if the pins are set to 1 and 2.		
2. Changing the position of the UEFI boot recovery jumper from pins 1 and 2 to pins 2 and 3 before the server is turned on alters which flash ROM page is loaded. Do not change the jumper pin position after the server is turned on. This can cause an unpredictable problem.		

Light path button: Press this button to light the LEDs on the system board when the power source has been removed from the server after the server automatically shuts down because the cover was removed while the server was running.

The following table describes the functions of the SW2 switch block on the system board:

Table 4. System board SW2 switch block definition

Switch number	Default position	Description
1	Off	Clear CMOS memory. When this switch is toggled to On, it clears the data in CMOS memory, which clears the power-on password.
2	Off	Reserved.
3	Off	Power-on password override. Changing the position of this switch bypasses the power-on password check the next time the server is turned on and starts the Setup utility so that you can change or delete the power-on password. You do not have to move the switch back to the default position after the power-on password in overridden.

Changing the position of this switch does not affect the administrator password check if an administrator password is set.

See "Passwords" on page 137 for additional information about passwords. |
4	Off	Reserved
5	Off	Reserved
6	Off	Reserved
7	Off	Reserved
8	Off	Reserved

Important:

1. Before you change any switch settings or move any jumpers, turn off the server; then, disconnect all power cords and external cables. Review the

information in "Safety" on page v, "Installation guidelines" on page 43, "Handling static-sensitive devices" on page 45, and "Turning off the server" on page 24.

2. Any system-board switch or jumper blocks that are not shown in the illustrations in this document are reserved.

System-board LEDs

The following illustration shows the light-emitting diodes (LEDs) on the system board.
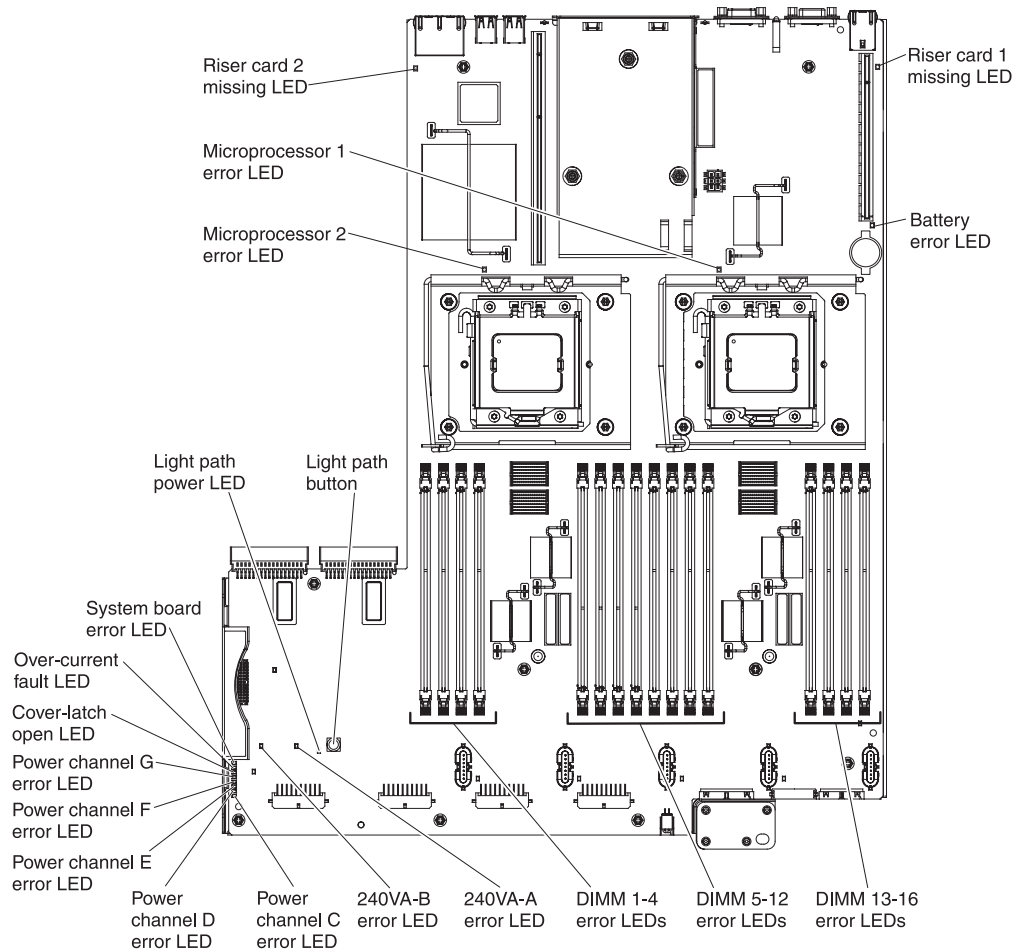
System-board optional device connectors

The following illustration shows the connectors on the system board for user-installable optional devices.

Optional 16-DIMM memory tray

The following illustration shows the connectors and LEDs on the optional 16-DIMM memory tray:
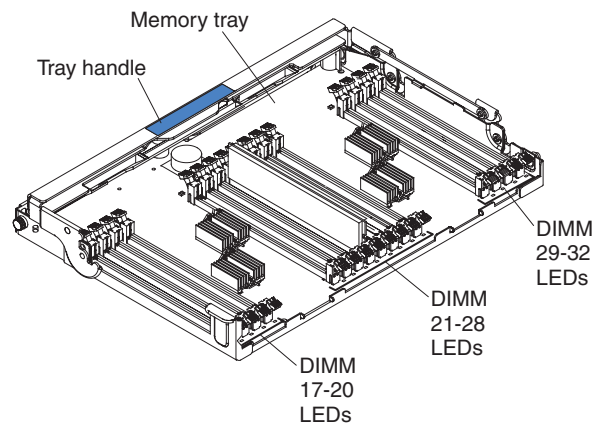
PCI riser card with three slots
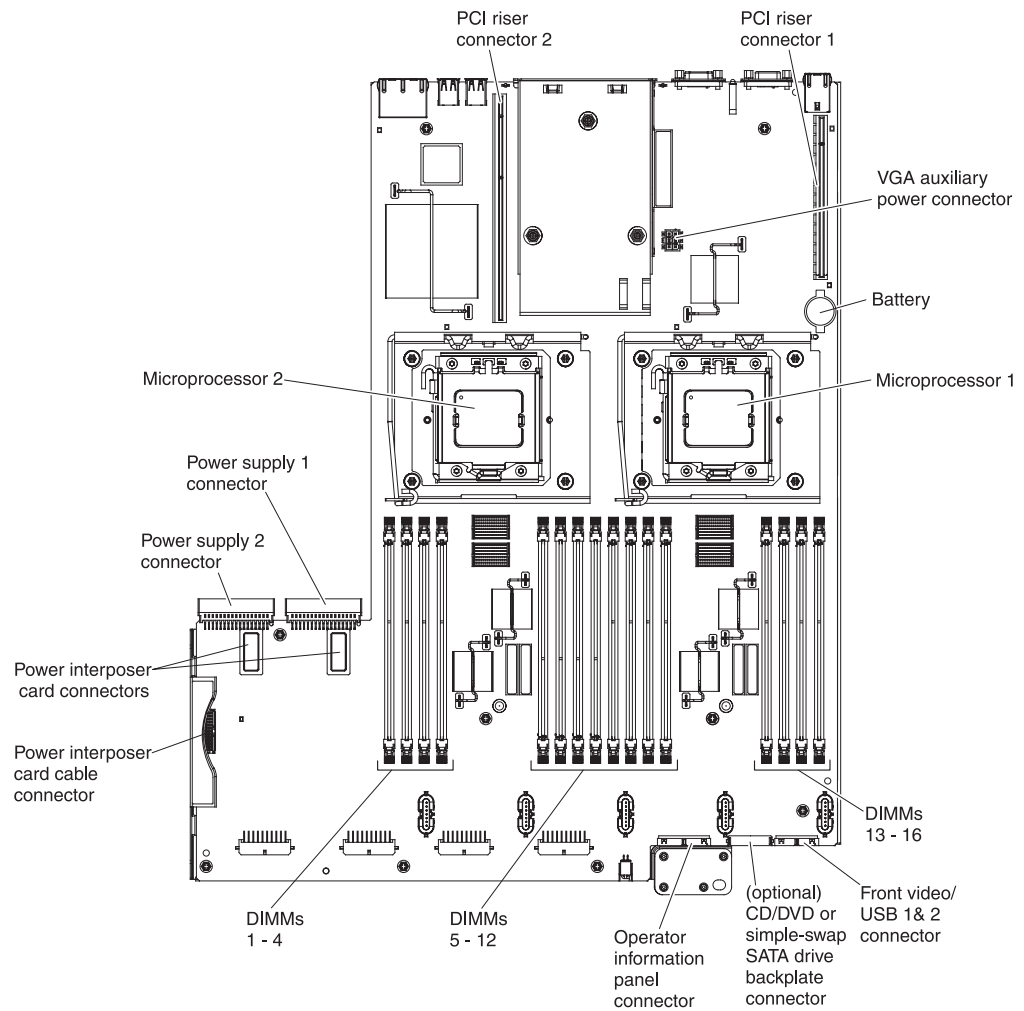
The following illustrations show the connectors and LEDs on the optional three-slot PCI riser card:

Side 1:

Slot 3, PCI Express
Gen2 x8, low profile

Slot 4, PCI Express
Gen2 x8 (x4), low profile

PCI riser card

Side 2:

PCI slot 3
error LEDs

PCI slot 4
error LEDs

PCI slot 5
error LEDs

USB embedded
hypervisor flash
device connector

USB connector

PCI riser card

Slot 5, PCI Express
Gen2 x8, low profile
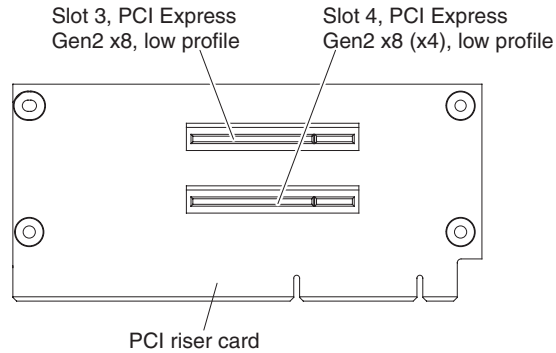
PCI riser card with two slots

The following illustrations show the connectors and LEDs on the optional two-slot PCI riser card:

Slot 1,
PCI Express
Gen2 x8

Slot 2,
PCI Express
Gen2 x8

PCI slot 1
error LED

PCI slot 2
error LED

PCI riser card

PCI riser card with one slot

The following illustration shows the connector and LEDs on the optional one-slot PCI riser card:
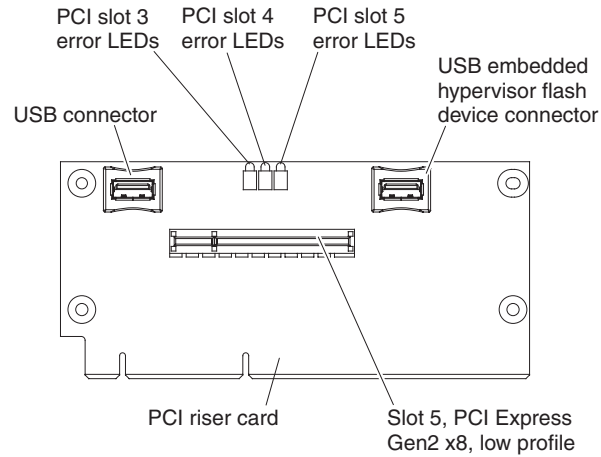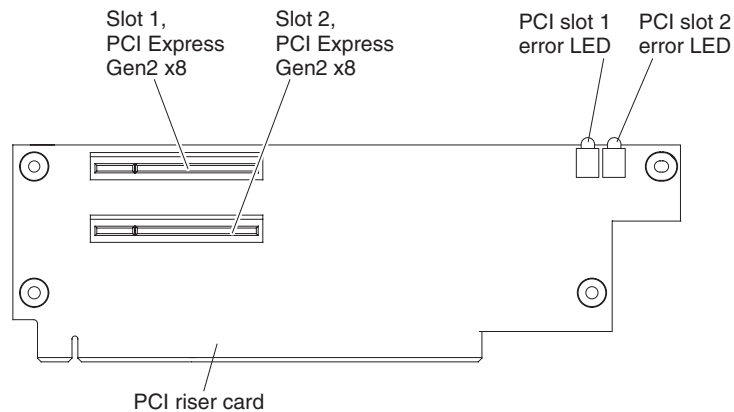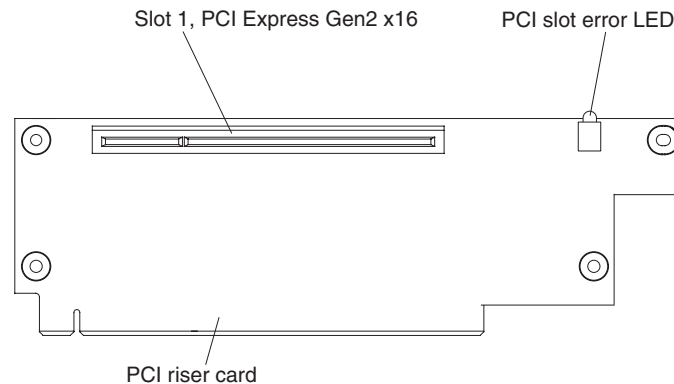
Slot 1, PCI Express Gen2 x16   PCI slot error LED

PCI riser card

Installation guidelines

Attention: Static electricity that is released to internal server components when the server is powered-on might cause the system to halt, which might result in the loss of data. To avoid this potential problem, always use an electrostatic-discharge wrist strap or other grounding system when removing or installing a hot-swap devices.

Before you install optional devices, read the following information:

- Read the safety information that begins on page "Safety" on page v and the guidelines in "Handling static-sensitive devices" on page 45. This information will help you work safely.
- Make sure that the devices that you are installing are supported.
- Make sure that the devices that you are installing are supported. For a list of supported optional devices for the server (or the MAX5, if one is connected to the server) go to http://www.ibm.com/systems/info/x86servers/serverproven/ compat/us/.
- When you install your new server, take the opportunity to download and apply the most recent firmware updates. This step will help to ensure that any known issues are addressed and that your server is ready to function at maximum levels of performance. To download firmware updates for your server, go to http://www.ibm.com/support/fixcentral/.

  Important: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

  For additional information about tools for updating, managing, and deploying firmware, see the ToolsCenter for System x and BladeCenter at http://publib.boulder.ibm.com/infocenter/toolsctr/v1r0/index.jsp.
- Before you install optional hardware, make sure that the server is working correctly. Start the server, and make sure that the operating system starts, if an operating system is installed, or that a 19990305 error code is displayed, indicating that an operating system was not found but the server is otherwise working correctly. If the server is not working correctly, see the *Problem Determination and Service Guide* on the IBM *Documentation* CD for information about how to run diagnostics.

- Observe good housekeeping in the area where you are working. Place removed covers and other parts in a safe place.
- Do not attempt to lift an object that you think is too heavy for you. If you have to lift a heavy object, observe the following precautions:
  - Make sure that you can stand safely without slipping.
  - Distribute the weight of the object equally between your feet.
  - Use a slow lifting force. Never move suddenly or twist when you lift a heavy object.
  - To avoid straining the muscles in your back, lift by standing or by pushing up with your leg muscles.
- Make sure that you have an adequate number of properly grounded electrical outlets for the server, monitor, and other devices.
- Back up all important data before you make changes to disk drives.
- Have a small flat-blade screwdriver available.
- To view the error LEDs on the system board and internal components, leave the server connected to power.
- You do not have to turn off the server to install or replace hot-swap power supplies, hot-swap fans, or hot-plug Universal Serial Bus (USB) devices. However, you must turn off the server before you perform any steps that involve removing or installing adapter cables and you must disconnect the power source from the server before you perform any steps that involve removing or installing a riser card.
- Blue on a component indicates touch points, where you can grip the component to remove it from or install it in the server, open or close a latch, and so on.
- Orange on a component or an orange label on or near a component indicates that the component can be hot-swapped, which means that if the server and operating system support hot-swap capability, you can remove or install the component while the server is running. (Orange can also indicate touch points on hot-swap components.) See the instructions for removing or installing a specific hot-swap component for any additional procedures that you might have to perform before you remove or install the component.
- When you are finished working on the server, reinstall all safety shields, guards, labels, and ground wires.

System reliability guidelines

To help ensure proper system cooling and system reliability, make sure that the following requirements are met:

- Each of the drive bays has a drive or a filler panel and electromagnetic compatibility (EMC) shield installed in it.
- If the server has redundant power, each of the power-supply bays has a power supply installed in it.
- There is adequate space around the server to allow the server cooling system to work properly. Leave approximately 50 mm (2.0 in.) of open space around the front and rear of the server. Do not place objects in front of the fans. For proper cooling and airflow, replace the server cover before you turn on the server.
- You have followed the cabling instructions that come with optional adapters.
- You have replaced a failed fan within 48 hours.
- You have replaced a hot-swap fan within 30 seconds of removal.
- You have replaced a hot-swap drive within 2 minutes of removal.
- You do not operate the server without the air baffles installed. Operating the server without the air baffles might cause the microprocessor to overheat.

Handling static-sensitive devices

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

To reduce the possibility of damage from 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 circuitry.
- Do not leave the device where others can handle and damage it.
- While the device is still in its static-protective package, touch it to an unpainted metal surface on the outside of the server for at least 2 seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into the server without setting down the device. If it is necessary to set down the device, put it back into its static-protective package. Do not place the device on the server cover or on a metal surface.
- Take additional care when handling devices during cold weather. Heating reduces indoor humidity and increases static electricity.

Removing the server top cover

Attention: If you release the cover latch and remove the cover while the server is running, the server will lose power and turn off automatically. After you reinstall the cover, you can turn on the server again.

Before you install optional hardware devices, make sure that the server is working correctly. Start the server, and make sure that the operating system starts, if an operating system is installed, or that a 19990305 error code is displayed, indicating that an operating system was not found but the server is otherwise working correctly. If the server is not working correctly, see the *Problem Determination and Service Guide*.

To remove the server top cover, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. If the server has been installed in a rack, slide the server out from the rack enclosure.
4. Press in on the blue tab on the cover-release latch and lift the cover-release latch up (the cover slides to the rear). Lift the cover off the server and set it aside.
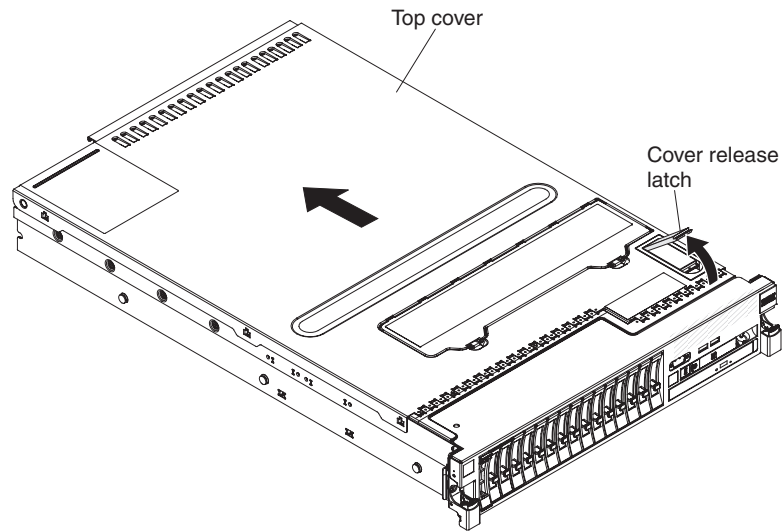
Top cover

Cover release
latch

If you have other devices to install or remove, do so now. Otherwise, go to
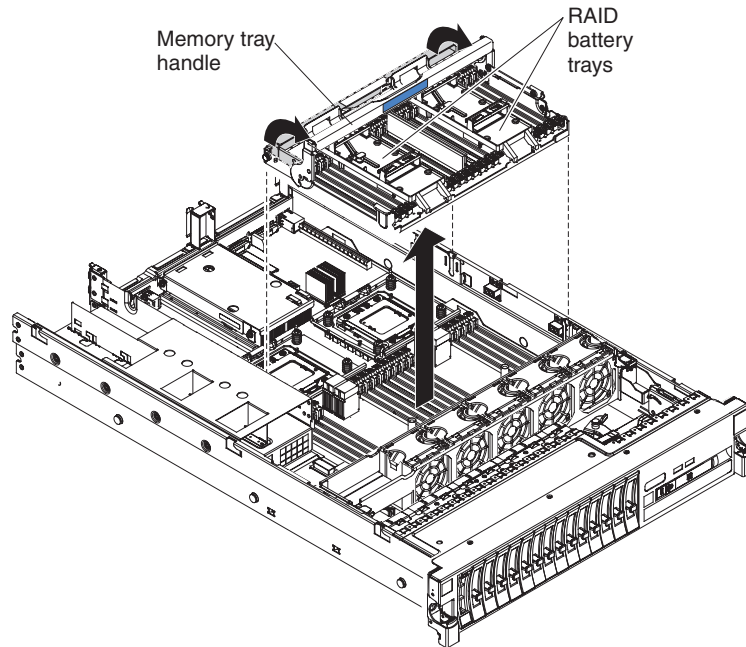"Completing the installation" on page 113.

Removing the memory tray

To remove the memory tray, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and
   "Installation guidelines" on page 43.

2. Turn off the server and all attached peripheral devices. Disconnect all power
   cords; then, disconnect all external cables from the server.

   Note: When the cover is removed from the server, the server automatically
   powers off. To view any LEDs on the system board, press the **Light path
   button** to light the LEDs.

3. If the server has been installed in a rack, slide the server out from the rack
   enclosure.

4. Remove the top cover (see "Removing the server top cover" on page 45.

5. If any remote RAID adapter batteries are stored in the RAID battery trays on
   top of the memory tray, remove the battery tray and set it aside; then, grasp the
   memory tray handle by the blue touch points and rotate it all the way up (this
   disengages the memory tray from the connectors on the system board).

Memory tray
handle

RAID
battery
trays

6. Lift the memory tray from the server and set it on a flat surface to avoid
   damaging the connector pins on the bottom of the tray.

If you have other devices to install or remove, do so now. Otherwise, go to
"Completing the installation" on page 113.

Removing the DIMM air baffle

To remove the DIMM air baffle, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and
   "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached
   peripheral devices. Disconnect all power cords; then, disconnect all external
   cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. If any remote RAID adapter batteries are stored in the RAID battery trays on
   top of the DIMM air baffle, remove the battery tray and set it aside.

RAID battery trays
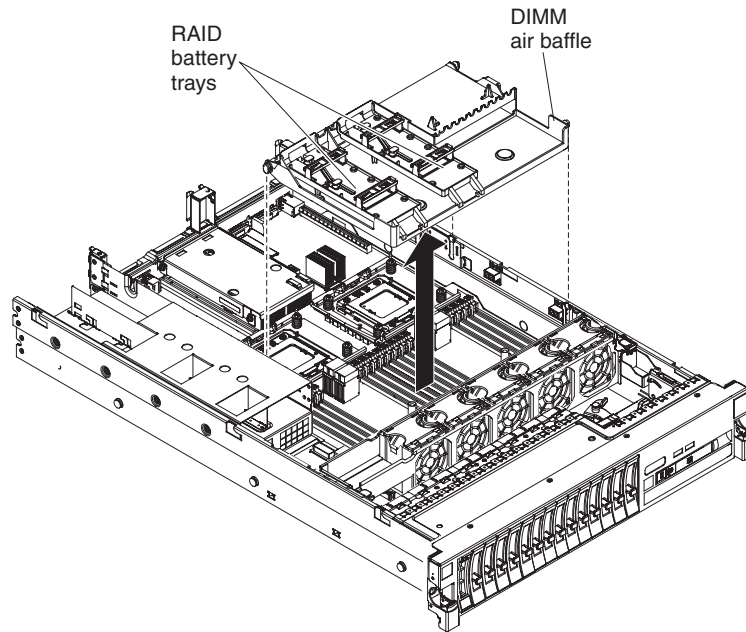
DIMM air baffle

5. Lift the DIMM air baffle from the server and set it aside.

   Attention: For proper cooling and airflow, replace the air baffle before you turn on the server. Operating the server with the air baffle removed might damage server components.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Removing the microprocessor air baffle

To remove the microprocessor air baffle, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. If a riser-card assembly is installed in PCI riser slot 1, disconnect the cables that are connected to the adapters. Grasp the riser-card assembly and lift it out of the PCI riser-card slot on the system board.
5. Grasp the tabs on both sides of the baffle and pull the tabs away from the holes on the power supply cage and chassis wall to release it; then, slide both ends of the baffle all the way up out of the slots and set the baffle aside.
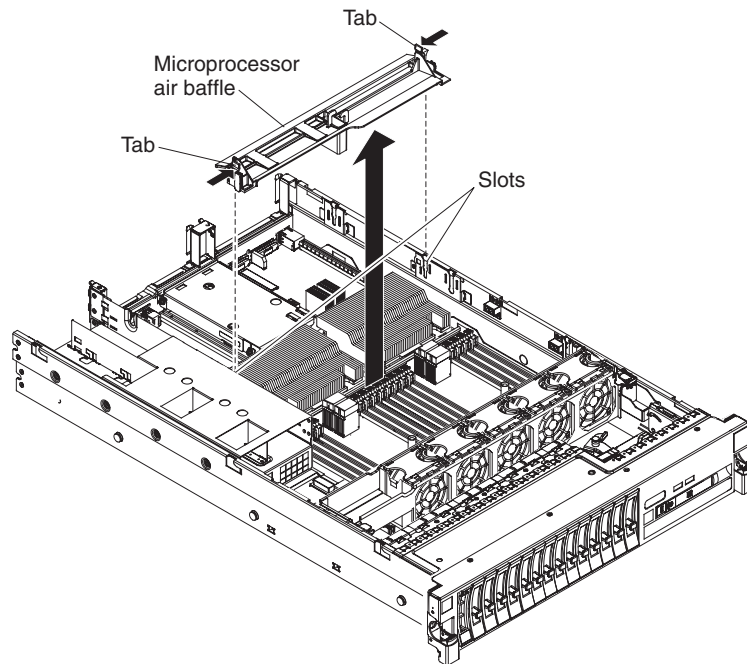
Attention: For proper cooling and airflow, replace the air baffle before you turn on the server. Operating the server with the air baffle removed might damage server components.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Removing the fan cage assembly

To remove the fan cage assembly, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. If the server is in a rack, slide the server out of the rack.
4. Remove the top cover (see "Removing the server top cover" on page 45).
5. Squeeze the tabs on the ends of the fan cage assembly release latches and rotate the release latches up until the assembly disengages from the chassis; then, lift the fan cage assembly out of the server.
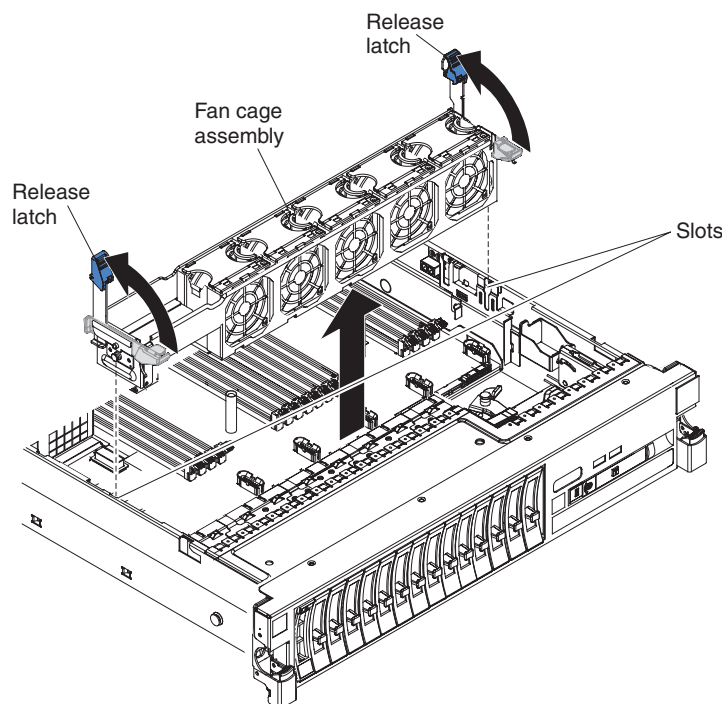
If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing a memory module

The following notes describe the types of dual inline memory modules (DIMMs) that the server supports and other information that you must consider when you install DIMMs (see "System-board optional device connectors" on page 41 for the location of the DIMM connectors):

- Confirm that the server supports the DIMM that you are installing, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.

- The server supports only industry-standard double-data-rate 3 (DDR3), 1333 MHz PC3-10600R-999, 1333 MHz PC3L-10600, 1066 MHz PC3-8500, or 1600 MHz PC3-12800, (single-rank, dual-rank, or quad-rank), registered, synchronous dynamic random-access memory (SDRAM) dual inline memory modules (DIMMs) with error correcting code (ECC).

  – The specifications of a DDR3 DIMM are on a label on the DIMM, in the following format.

    gGB eR$x$$f$-PC3-$wwwww$m-a-b-c-d

    where:

    - gGB is the total capacity of the DIMM (for example, 1GB, 2GB, or 4GB)
    - eR is the number of ranks

        1R = single-rank

        2R = dual-rank

        4R = quad-rank

    - x f is the device organization or bit width (for example, x4, x8, or x16)

        4 = x4 organization (4 DQ lines per SDRAM)

        8 = x8 organization

        16 = x16 organization

- *wwwww* is the DIMM bandwidth, in MBps

    6400 = 6.40 GBps (PC3-800 SDRAMs, 8-byte primary data bus)

    8500 = 8.53 GBps (PC3-1066 SDRAMs, 8-byte primary data bus)

    10600 = 10.66 GBps (PC3-1333 SDRAMs, 8-byte primary data bus)

    12800 = 12.80 GBps PC3-1600 SDRAMs, 8-byte primary data bus)

  - *m* is the DIMM type

    E = Unbuffered DIMM (UDIMM) with ECC (x72-bit module data bus)

    R = Registered DIMM (RDIMM)

    U = Unbuffered DIMM with no ECC (x64-bit primary data bus)

  - *a* is the CAS latency, in clocks at maximum operating frequency
  - *b* is the JEDEC SPD Revision Encoding and Additions level
  - *c* is the reference design file for the design of the DIMM
  - *d* is the revision number of the reference design of the DIMM
- The server supports 1.35-volt (low-voltage) and 1.5-volt DIMMs. In addition, support is based on machine type as noted below:
  - Machine Types 7148 and 7149:
    - Supports 1.5-volt DIMMs at capacities of 2 GB, 4 GB, 8 GB, and 16 GB only
    -
  - Machine Types 7147 and 7192:
    - Supports low-voltage (1.35-volt) DIMMs at capacities of 4 GB, 8 GB, 16 GB, and 32 GB only.
    - When you mix 1.35-volt and 1.5-volt DIMMs in the server, the server will operate at the 1.5-volt rate.
    - You can enable all DIMMs (1.35-volt and 1.5-volt) to operate at 1.5-volt in the Setup utility.
- Some server models come with the Intel 7500 scalable memory buffer or the Intel 7510 scalable memory buffer:
  - Machine Types 7148 and 7149 comes with the Intel 7500 scalable memory buffer
  - Machine Types 7147 and 7192 comes with the Intel 7510 scalable memory buffer
- Double-device data correction support is only available when 16 GB x4 DRAM technology DIMMs are installed in the server.
- The following table provides information about the maximum amount of memory that the server can support when you fully populate the server, the optional memory tray, and the optional IBM MAX5 for System x memory expansion module using the supported DIMMs.

Table 5. The maximum amount of memory that server can support

Number of DIMM connectors	Maximum memory
16 DIMMs on system board	up to 512 GB
16 DIMMs on the optional memory tray	up to 512 GB
32 DIMMs on the optional IBM MAX5 for System x memory expansion module	up to 1 TB
	Total = 2 TBs of memory

Table 5. The maximum amount of memory that server can support (continued)

Number of DIMM connectors	Maximum memory
Note: The server can support a maximum 2 TBs of system memory when both the optional memory tray and an optional IBM MAX5 for System x memory expansion module is installed and fully populated with 32 GB (when supported and depending on the model) DIMMs.	

- The server supports a maximum of 16 DIMMs (single-rank, dual-rank, or quad-rank) on the base system board. If you mix single-rank, dual-rank, or quad-rank DIMMs in the server, quad-rank DIMMs must be installed first.

  Note: To determine the type of a DIMM, see the label on the DIMM. The information on the label is in the format xxxxx nRxxx PC3-xxxxx-xx-xx-xxx. The numeral in the sixth numerical position indicates whether the DIMM is single-rank (n=1) or dual-rank (n=2).

- The DIMM options that are available for the server are 2 GB, 4 GB, 8 GB, 16 GB, 32 GB (when available and depending on the model).

- The server supports memory sparing. Memory sparing reserves memory capacity for failover in the event of a DIMM failure, and the reserved capacity is subtracted from the total available memory. Memory sparing provides less redundancy than memory mirroring does. If a predetermined threshold of correctable errors is reached, the contents of the failing DIMM are copied to the spare memory, and the failing DIMM or rank is disabled. To enable memory sparing through the Setup utility, select System Settings > Memory.

- The server system board supports a minimum of 2 GB and a maximum of 512 GB of system memory. However, the server can support an additional 512 GB of memory when a 16-DIMM optional memory tray is installed in the server, and an additional 1 TB of memory when an optional 32-DIMM IBM MAX5 for System x memory expansion module is attached to the server, for a total of 2 TBs of system memory, depending on the model.

  Note: The amount of usable memory is reduced depending on the system configuration. A certain amount of memory must be reserved for system resources. To view the total amount of installed memory and the amount of configured memory, run the Setup utility. For additional information, see Chapter 3, "Configuring the server," on page 131.

- The server system board provides four memory ports (memory channels) for each microprocessor and each memory port supports up to four DIMMs. The optional memory tray also provides four memory ports that supports up to four DIMMs per memory port.

- The following table shows the DIMM connectors on the system board and the memory tray that are associated with each microprocessor when the memory tray is also installed in the server:

Table 6. DIMM connectors associated with each microprocessor

Microprocessor	DIMM connectors
Microprocessor socket 1	1 through 16
Microprocessor socket 2	17 through 32

  Note: When the memory tray is not installed in the server, DIMMs 1 through 16 are solely associated with microprocessor 1. Microprocessor 2 has access to DIMMs 1 through 16, but access is through microprocessor 1. This is important if load balancing is a necessity for your operating system or software load.

- When you replace a DIMM, the server provides automatic DIMM enablement capability without you having to go to Setup to enable the new DIMM manually.
- DIMMs must be installed in matched pairs for non-mirroring mode or matched sets of four for memory mirroring mode.
- A minimum of two DIMMs must be installed for each microprocessor. For example, you must install a minimum of four DIMMs if the server has two microprocessors installed. However, to improve system performance, install a minimum of four DIMMs for each microprocessor.
- The maximum operating speed of the server is determined by the slowest DIMM installed in the server.
- The server comes with a minimum of two DIMMs installed in slots 1 and 8. When you install additional DIMMs, install them in the order shown in the information in the following tables to optimize system performance.
- The server supports non-mirroring mode and memory-mirroring mode.
- **Non-mirroring mode**: When you use the non-mirroring mode, install DIMMs as indicated in the following tables.
    - The following table lists the DIMM installation sequence for non-mirroring mode when one or two microprocessors and no memory tray installed in the server:

Table 7. Non--mirroring mode (normal) DIMM population sequence when one or two microprocessors and no memory tray is installed

Pairs of DIMMs	Number of installed microprocessors	DIMM connector population sequence with no memory tray installed
Pair 1	1 or 2	1, 8
Pair 2	1 or 2	9, 16
Pair 3	1 or 2	3, 6
Pair 4	1 or 2	11, 14
Pair 5	1 or 2	2, 7
Pair 6	1 or 2	10, 15
Pair 7	1 or 2	4, 5
Pair 8	1 or 2	12, 13

    - The following table lists the DIMM installation sequence for non-mirroring mode when two microprocessors and a memory tray is installed in the server:

Table 8. Non-mirroring mode (normal) DIMM population sequence when two microprocessors and a memory tray is installed

Pairs of DIMMs	Number of installed microprocessors	DIMM connector population sequence on the system board	DIMM connector population sequence on the memory tray
Pair 1	2	1, 8	17, 24
Pair 2	2	9, 16	25, 32
Pair 3	2	3, 6	19, 22
Pair 4	2	11, 14	27, 30
Pair 5	2	2, 7	18, 23
Pair 6	2	10, 15	26, 31

Table 8. Non-mirroring mode (normal) DIMM population sequence when two microprocessors and a memory tray is installed (continued)

Pairs of DIMMs	Number of installed microprocessors	DIMM connector population sequence on the system board	DIMM connector population sequence on the memory tray
Pair 7	2	4, 5	20, 21
Pair 8	2	12, 13	28, 29

- **Memory-mirroring mode**: When you use the memory mirroring feature, consider the following information:
  - Memory-mirroring mode replicates and stores data on two pairs of DIMMs simultaneously. If a failure occurs, the memory controller switches from the primary pair of memory DIMMs to the backup pair of DIMMs. To enable memory mirroring through the Setup utility, select **System Settings → Memory**. For more information, see "Using the Setup utility" on page 132.
  - DIMMs must be installed in sets of four. The DIMMs in each set must be the same size and type. This is applicable also when an optional memory tray is installed in the server and an optional IBM MAX5 for System x memory expansion module attached to the server. You must install DIMMs in sets of four DIMMs for memory-mirroring mode in each (server, memory tray, and the MAX5).
  - The maximum available memory is reduced to half of the installed memory when memory mirroring is enabled. For example, if you install 64 GB of memory, only 32 GB of addressable memory is available when you use memory mirroring.
  - The following table lists the DIMM installation sequence for memory-mirroring mode when one or two microprocessors and no memory tray is installed in the server:

Table 9. Memory-mirroring mode DIMM population sequence when one or two microprocessors and no memory tray is installed

Sets of DIMMs	Number of installed microprocessors	DIMM connector population sequence with no memory tray
Set 1	1 or 2	1, 8, 9, 16
Set 2	1 or 2	3, 6, 11, 14
Set 3	1 or 2	2, 7, 10, 15
Set 4	1 or 2	4, 5, 12, 13

  - The following table lists the DIMM installation sequence for memory-mirroring mode when two microprocessors and a memory tray is installed in the server:

*Table 10. Memory-mirroring mode DIMM population sequence when two microprocessors and a memory tray is installed*

Sets of DIMMs	Number of installed microprocessors	DIMM connector population sequence on the system board	DIMM connector population sequence on the memory tray
Set 1	2	1, 8, 9, 16	17, 24, 25, 32
Set 2	2	3, 6, 11, 14	19, 22, 27, 30
Set 3	2	2, 7, 10, 15	18, 23, 26, 31

Table 10. Memory-mirroring mode DIMM population sequence when two microprocessors and a memory tray is installed (continued)

Sets of DIMMs	Number of installed microprocessors	DIMM connector population sequence on the system board	DIMM connector population sequence on the memory tray
Set 4	2	4, 5, 12, 13	20, 21, 28, 29

- When you install or remove DIMMs, the server configuration information changes. When you restart the server, the system displays a message that indicates that the memory configuration has changed.

The following illustration shows the location of the DIMMs connectors on the system board.
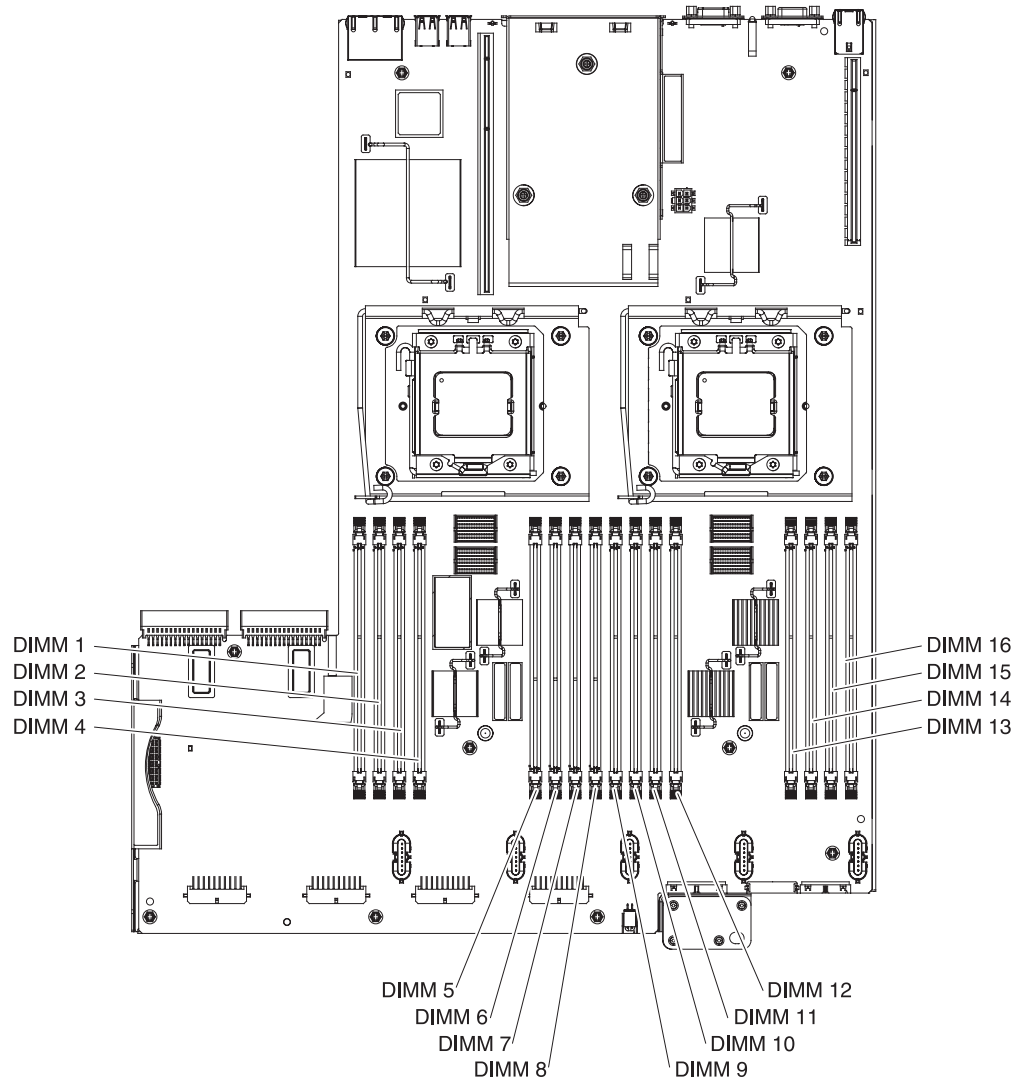

The following illustration shows the location of the DIMMs on the optional memory tray:

DIMM 29 - 32

DIMM 21 - 28

DIMM 17 - 20
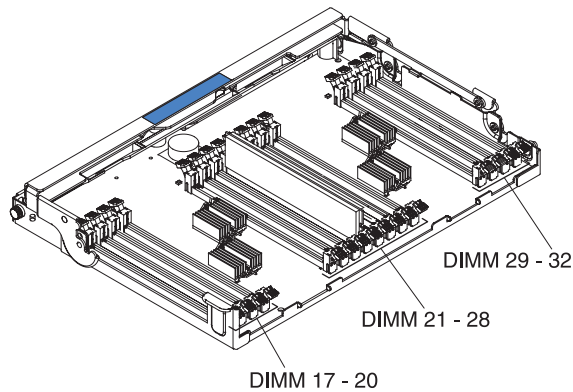
To install a DIMM, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Open the retaining clip on each end of the DIMM connector.

   Attention: To avoid breaking the retaining clips or damaging the DIMM connectors, open and close the clips gently.

DIMM

Retaining clip
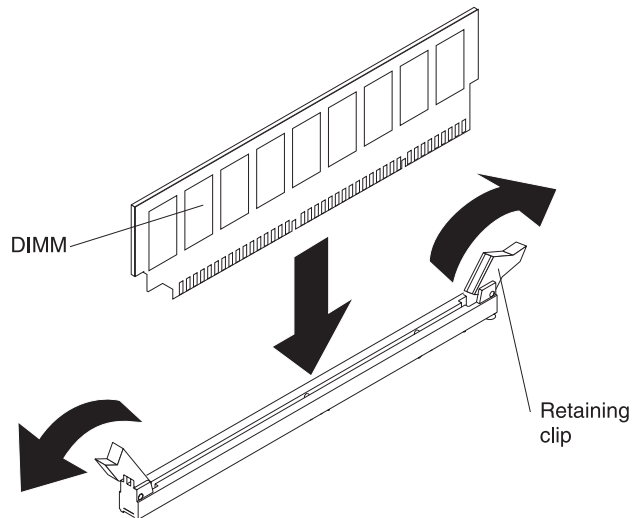
5. Touch the static-protective package that contains the DIMM to any unpainted metal surface on the outside of the server. Then, remove the DIMM from the package.

6. Turn the DIMM so that the DIMM keys align correctly with the connector.

7. Insert the DIMM into the connector by aligning the edges of the DIMM with the slots at the ends of the DIMM connector (see "System-board optional device connectors" on page 41 for the locations of the DIMM connectors).

8. Firmly press the DIMM straight down into the connector by applying pressure on both ends of the DIMM simultaneously. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector.

Note: If there is a gap between the DIMM and the retaining clips, the DIMM has not been correctly inserted; open the retaining clips, remove the DIMM, and then reinsert it.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing drives

The following notes describe the type of drives that the server supports and other information that you must consider when you install a drive. To confirm that the server supports the drive that you are installing, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.

- Locate the documentation that comes with the drive and follow those instructions in addition to the instructions in this chapter.
- Make sure that you have all the cables and other equipment that are specified in the documentation that comes with the drive.
- Select the bay in which you want to install the drive.
- The server supports one optional ultra-slim SATA CD-RW/DVD-ROM optical drive.
- The server can support up to 24 hot-swap drives, using the supported SAS\SATA backplane configurations. The server supports 2.5-inch hot-swap SAS or hot-swap SATA hard disk drives, 2.5-inch hot-swap solid state drives, or 1.8-inch hot-swap solid state drives (see "Supported SAS/SATA drive backplane configurations" on page 61 for the supported configurations).

  Note: Configurations with all 1.8-inch drive backplanes can support one additional simple-swap drive if you purchase the optional Simple-swap 2.5-inch SATA Drive and Backplate kit. See "Supported SAS/SATA drive backplane configurations" on page 61 and "Installing the optional simple-swap SATA drive and backplate assembly" on page 102 for more information.
- You can mix 2.5-inch hot-swap SAS and SATA hard disk drives, 2.5-inch hot-swap solid state drives, and 1.8-inch hot-swap solid state drives in the same server as long as you do not mix drives on the same array.
- When upgrading drive backplane configurations, all 1.8-inch SSD drive backplanes must be installed to the right of all 2.5-inch HDD or 2.5-inch SSD drive backplanes. All 2.5-inch backplanes installs to the left of all 1.8-inch backplanes. See "IDs for hot-swap drives" on page 60 for drive ID assignment information and "Supported SAS/SATA drive backplane configurations" on page 61 for information about the combination of supported drive backplane configurations.
- If you install the optional simple-swap SATA drive and backplate assembly, the backplate must be installed in the backplane slot closest to the information panel and the SATA drive must be installed in the drive-bay closest to the information panel.
- The electromagnetic interference (EMI) integrity and cooling of the server are protected by having all bays and PCI Express slots covered or occupied. When you install a drive, save the EMC shield and filler panel from the bay in the event that you later remove the device.

## Installing 2.5-inch and 1.8-inch hot-swap drives

To install a hot-swap SAS or SATA drive, complete the following steps.

Note: If you install only one drive, you must install it in drive bay 0.

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Touch the static-protective package that contains the drive to any unpainted metal surface on the server; then, remove the drive from the package and place it on a static-protective surface.
3. Install a 2.5-inch drive:
   a. Remove the filler panel from the empty drive bay.
   b. Make sure that the drive-tray handle is in the open (unlocked) position.
   c. Align the drive assembly with the guide rails in the bay.
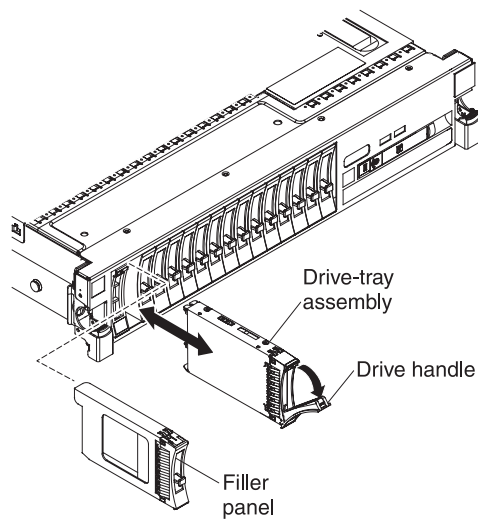
   d. Gently push the drive assembly into the drive bay until the drive stops.
   e. Rotate the drive-tray handle to the closed (locked) position.
   f. Skip to step 6.
4. Install a 1.8-inch drive:
   a. Remove the filler panel.
   b. Grasp the orange release latch on the drive tray handle of the drive tray in which you want to install the drive and slide the release latch down to unlock the drive tray handle; then, rotate the drive tray handle down and the pull the handle toward you to slide the drive tray out of the drive bay.

1.8-inch filler panel

Drive tray handle

Release latch
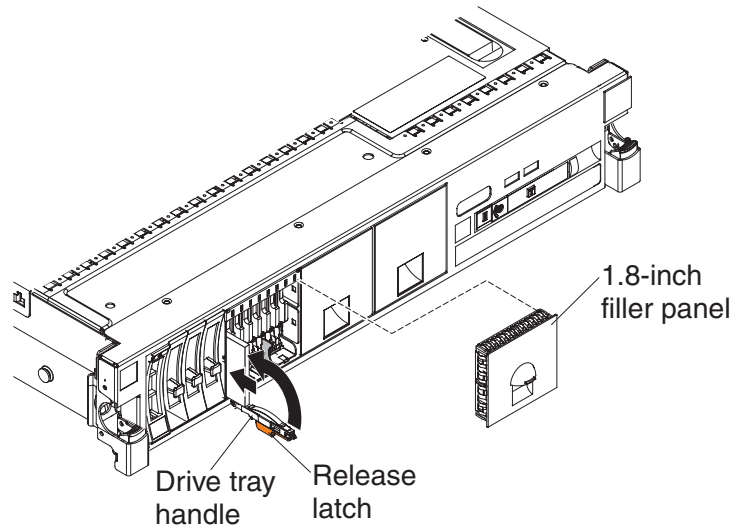
   c. Insert the drive into the drive tray with the label side of the drive facing the right side of the server and push the drive tray toward the server to slide the drive into the drive bay.

   d. Rotate the drive tray handle to the closed position and slide the release latch up to secure the drive tray handle in place.

5. Check the drive status LED to verify that the drive is operating correctly. If the amber drive status LED for a drive is lit continuously, that drive is faulty and must be replaced. If the green drive activity LED is flashing, the drive is being accessed.

   Note: If the server is configured for RAID operation using a ServeRAID adapter, you might have to reconfigure your disk arrays after you install drives. See the ServeRAID adapter documentation for additional information about RAID operation and complete instructions for using the ServeRAID adapter.

6. If you are installing additional hot-swap drives, do so now.

7. Restart the server. Confirm that it starts correctly and recognizes the newly installed devices, and make sure that no error LEDs are lit.

8. Complete the additional steps in "Instructions for IBM Business Partners" on page 34.

For information on the supported combination of drive backplane configurations, see "Supported SAS/SATA drive backplane configurations" on page 61.
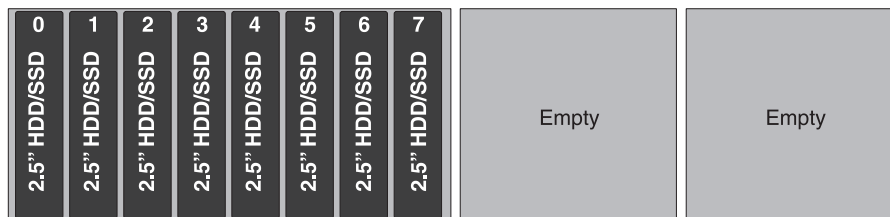
IDs for hot-swap drives

The hot-swap-drive ID that is assigned to each drive is printed on the front of the server. The following illustrations show the location of the IDs of the drives. The ID numbers and the drive bay numbers are the same.
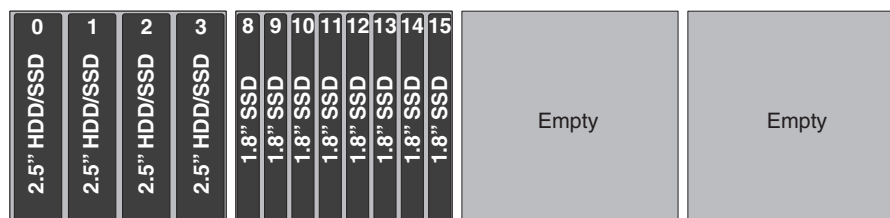
Note:

1. The drive bay IDs can vary, depending on the combination of the SAS/SATA backplanes installed in the server.

2. When upgrading drive backplane configurations, all 1.8-inch SSD drive backplanes must be installed to the right of all 2.5-inch HDD or 2.5-inch SSD drive backplanes. All 2.5-inch backplanes installs to the left of all 1.8-inch backplanes.

3. When you mix 2.5-inch and 1.8-inch drive backplane configurations in the same server, IMM resets the drive bay ID numbering by skipping bay ID numbers based on the number of 2.5-inch drive backplanes that are installed to the left of the 1.8-inch drives backplanes.

   For example, if the server has a 4x2.5-inch. drive backplane and a 8x1.8-inch backplane configuration, the drive bay IDs for the four drives in the 4x2.5-inch drive backplane is 0 through 3. IMM assigns the drive bay IDs for the eight drives in the 8x1.8-inch drive backplane to start with an ID of 8 through 15. Since the drive bay IDs for the drives in the 4x2.5-inch backplane were 0 through 3, IMM reset the IDs by a gap of four (because the backplane supports four drives), then the drive IDs in the 8x1.8-inch drive backplane starts with an ID of 8 through 15. If a 8x2.5inch drive backplane had been installed, instead of the 4x2.5-inch drive backplane, IMM would reset the IDs by a gap of eight, then the drive IDs for the drives in the 8x1.8-inch drive backplane would start at 16 through 23. See the following example illustrations and the illustrations in "Supported SAS/SATA drive backplane configurations" on page 61 for more information.

In the following illustration, the drive bay IDs are in sequential order because all of the drive backplanes are 2.5-inch backplanes.

| 0	1	2	3	4	5	6	7		
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	Empty	Empty

In the following illustration, you have a combination of drive backplanes. This example shows a 2.5-inch drive backplane and a 1.8-inch drive backplane installed in the server. In this instance, the drive bay IDs will require a gap in the bay ID numbering between the drive IDs in the 2.5-inch and 1.8-inch drive backplanes.
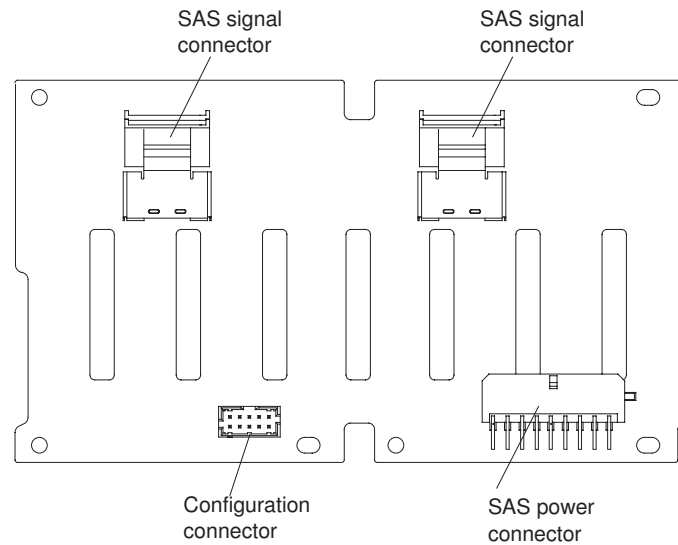
0	1	2	3	8 9 10 11 12 13 14 15		
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	Empty	Empty

Supported SAS/SATA drive backplane configurations

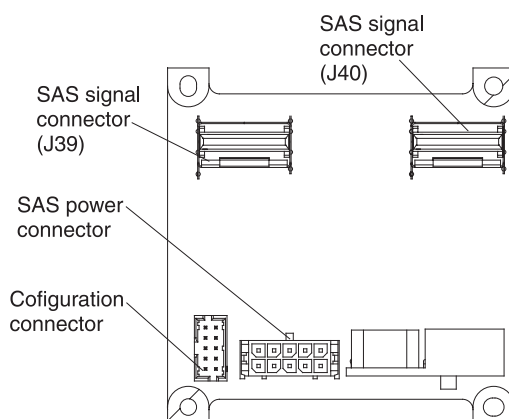The following are illustrations of the hot-swap drive backplanes that are supported on the server.

4x2.5-inch drive backplane rear view:
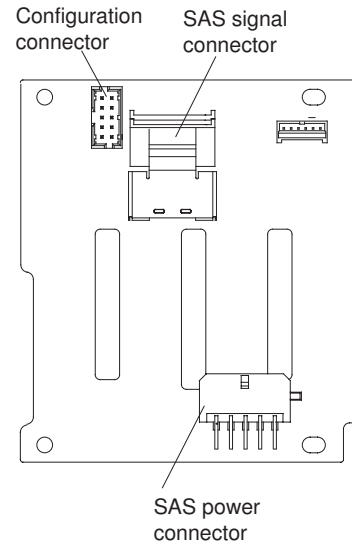
8x2.5-inch drive backplane rear view:


8x1.8-inch drive backplane rear view:

SAS signal
connector
(J40)

SAS signal
connector
(J39)

SAS power
connector

Cofiguration
connector

You can install a combination of 2.5-inch and 1.8-inch SAS/SATA drive backplanes in the server for the maximum drive capacity. However, any SAS/SATA adapter that you install in the server must be capable of supporting two internal, 4-lane SAS/SATA signal connectors. The following illustrations show the supported SAS/SATA drive backplane configurations:

Note:

1. When upgrading drive backplane configurations, all 1.8-inch SSD drive backplanes must be installed to the right of all 2.5-inch drive backplanes. All 2.5-inch backplanes installs to the left of all 1.8-inch backplanes.
2. The drive bay IDs can vary, depending on the combination of the SAS/SATA drive backplanes installed in the server (see "IDs for hot-swap drives" on page 60 for more information).
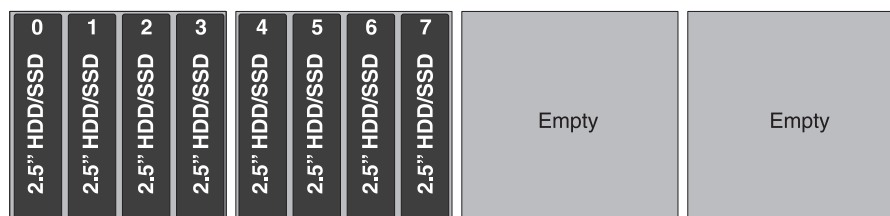
The following illustration shows the supported backplane configuration that you can use to support four drives:

This configuration consists of one 4x2.5-inch drive backplane and requires one SAS signal cable.
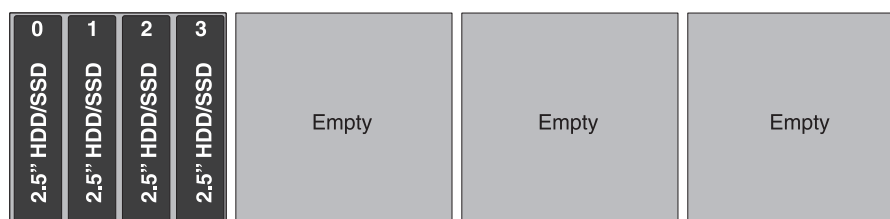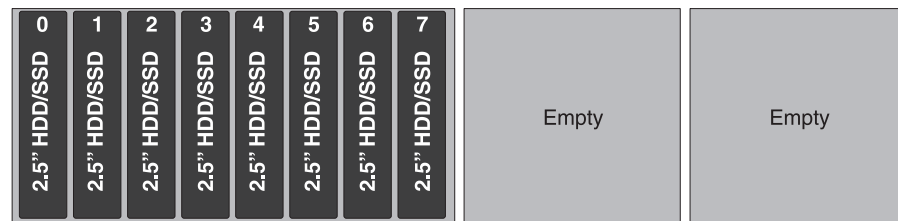

The following illustrations show the supported combination of drive backplane configurations that you can use to support eight drives:

This configuration consists of two 4x2.5-inch drive backplanes and requires two SAS signal cables.

This configuration consists of one 8x2.5-inch drive backplane and requires two SAS signal cables.
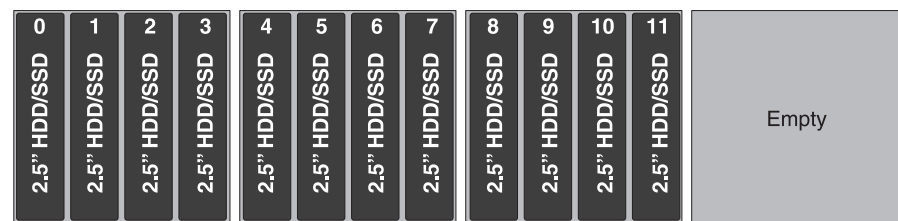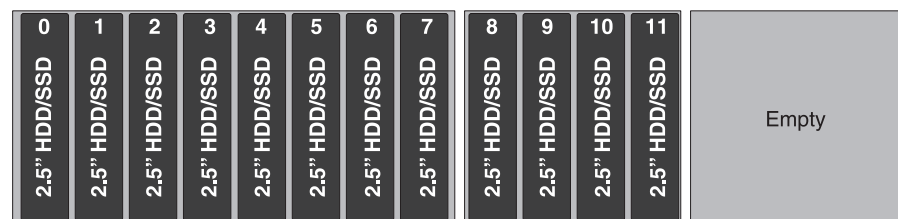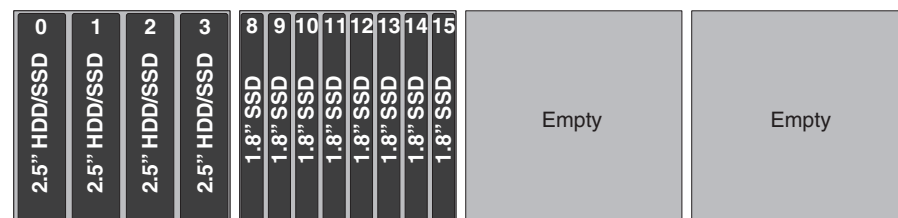
0	1	2	3	4	5	6	7		
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	Empty	Empty

This configuration consists of one 8x1.8-inch drive backplane and requires two SAS signal cables. You can also install the optional simple-swap 2.5-inch SATA drive kit in this configuration.

0	1	2	3	4	5	6	7			
1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	Empty	Empty	Possible single SATA drive

The following illustrations show the supported combination of drive backplane configurations that you can use to support 12 drives:

This configuration consists of three 4x2.5-inch drive backplanes and requires three SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	Empty

This configuration consists of one 8x2.5-inch drive backplane and one 4x2.5-inch drive backplane and requires three SAS signal cables.
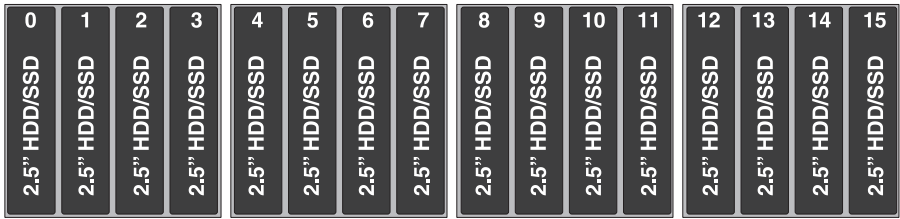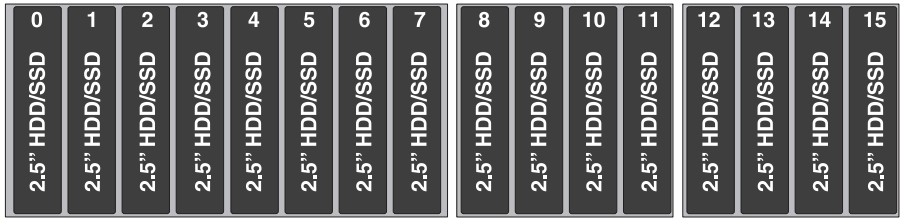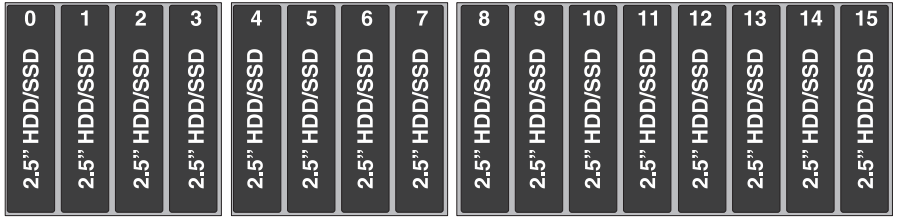
0	1	2	3	4	5	6	7	8	9	10	11	
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	Empty

This configuration consists of one 4x2.5-inch drive backplane and one 8x1.8-inch drive backplane and requires three SAS signal cables.

0	1	2	3	8	9	10	11	12	13	14	15		
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	Empty	Empty

The following illustrations show the supported combination of drive backplane configurations that you can use to support 16 drives:

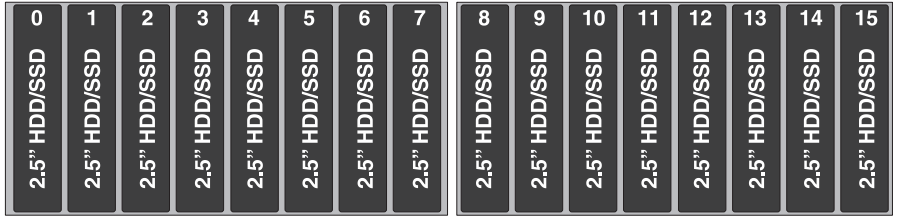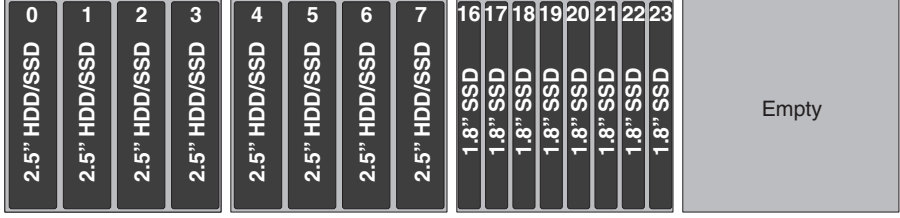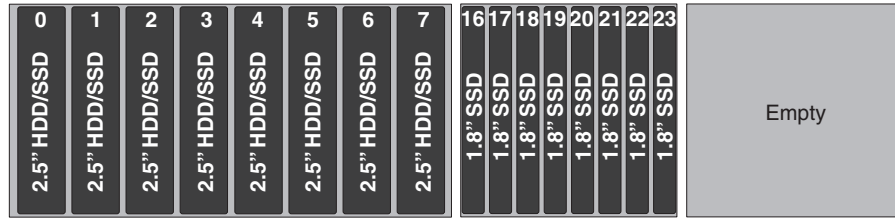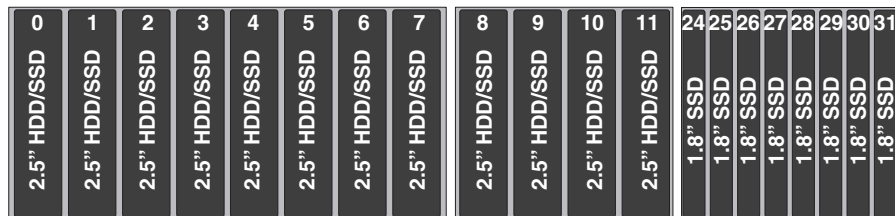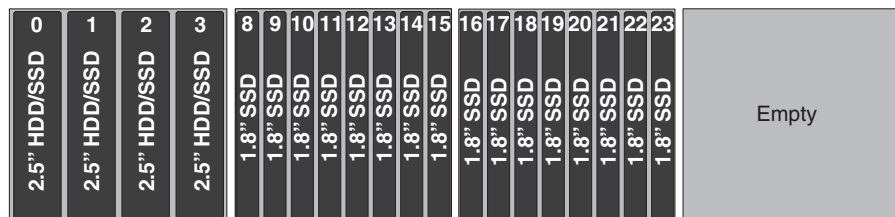This configuration consists of four 4x2.5-inch drive backplanes and requires four SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD

This configuration consists of one 8x2.5-inch drive backplane and two 4x2.5-inch drive backplanes and requires four SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD

This configuration consists of two 4x2.5-inch drive backplanes and one 8x2.5-inch drive backplane and requires four SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD

This configuration consists of two 8x2.5-inch drive backplanes and requires four SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD

This configuration consists of two 4x2.5-inch drive backplanes and one 8x1.8-inch drive backplane and requires four SAS signal cables.

0	1	2	3	4	5	6	7	16	17	18	19	20	21	22	23	
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	Empty

This configuration consists of one 8x2.5-inch drive backplane and one 8x1.8-inch drive backplane and requires four SAS signal cables.

| 0	1	2	3	4	5	6	7	16 17 18 19 20 21 22 23	
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	Empty

This configuration consists of two 8x1.8-inch drive backplanes and requires four SAS signal cables. You can also install the optional simple-swap 2.5-inch SATA drive kit in this configuration.

| 0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 15		
1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	Empty	Possible single SATA drive

The following illustrations show the supported combination of drive backplane configurations that you can use to support 20 drives:

This configuration consists of three 4x2.5-inch drive backplanes and one 8x1.8-inch drive backplane and requires five SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	24 25 26 27 28 29 30 31
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD

This configuration consists of one 8x2.5-inch drive backplane, one 4x2.5-inch drive backplane, and one 8x1.8-inch drive backplane and requires five SAS signal cables.

0	1	2	3	4	5	6	7	8	9	10	11	24 25 26 27 28 29 30 31
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD

This configuration consists of one 4x2.5-inch drive backplane and two 8x1.8-inch drive backplanes and requires five SAS signal cables.

0	1	2	3	8 9 10 11 12 13 14 15	16 17 18 19 20 21 22 23	
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD 1.8" SSD	Empty

The following illustrations show the supported combination of drive backplane configurations that you can use to support 24 drives:

This configuration consists of two 4x2.5-inch drive backplanes and two 8x1.8-inch drive backplanes and requires six SAS signal cables.

0	1	2	3	4	5	6	7	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD

This configuration consists of one 8x2.5-inch drive backplane and two 8x1.8-inch drive backplanes and requires six SAS signal cables.

0	1	2	3	4	5	6	7	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	2.5" HDD/SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD

This configuration consists of three 8x1.8-inch drive backplanes and requires six SAS signal cables. You can also install the optional simple-swap 2.5-inch SATA drive kit in this configuration.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Possible single SATA drive
1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	1.8" SSD	

Installing an optional CD/DVD drive

To install an optional CD/DVD drive, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. Locate the blue release tab on the rear of the drive bay; then, while you press the tab, push the CD/DVD filler toward the front of the server.

CD/DVD-ROM
drive
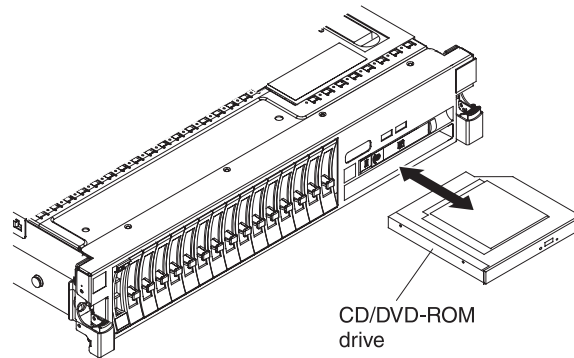
5. Pull the CD/DVD drive filler out of the front of the server.
6. Remove the retention clip from the side of the drive filler.

Drive retention clip

Alignment pins
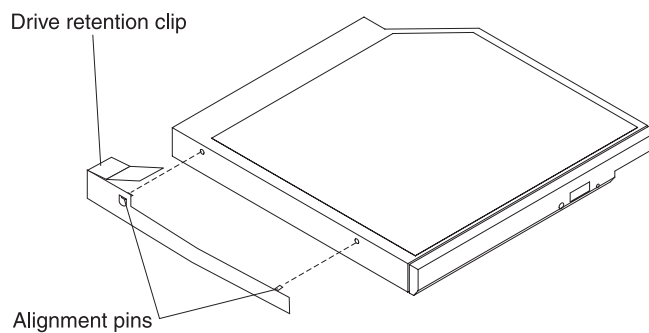
Note: If you are installing a drive that contains a laser, observe the following safety precaution.

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 Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

7. Touch the static-protective package that contains the new optical drive to any unpainted metal surface on the server; then, remove the optical drive from the package and place it on a static-protective surface.
8. Attach the drive retention clip that you removed from the previous drive to the side of the new drive.
9. Align the drive in the drive bay and slide the drive into the CD/DVD drive bay until the drive clicks into place.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing a PCI riser-card assembly

To install a PCI riser-card assembly, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and the "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. Install the adapter in the PCI riser-card assembly (see "Installing an adapter" on page 69).
5. Align the PCI riser-card assembly with the PCI slot connector on the system board and align nailheads with the slots on the chassis; then, press down firmly until the riser-card assembly is seated correctly in the connector on the system board.
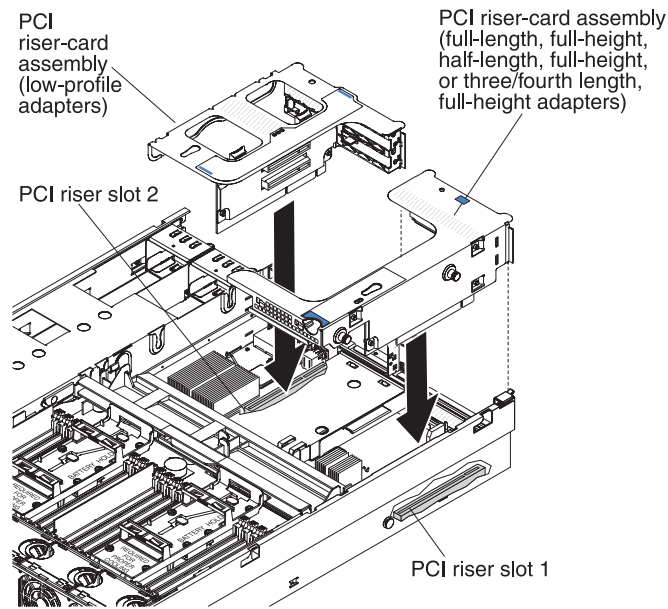
PCI
riser-card
assembly
(low-profile
adapters)

PCI riser-card assembly
(full-length, full-height,
half-length, full-height,
or three/fourth length,
full-height adapters)

PCI riser slot 2

PCI riser slot 1

If you have other devices to install or remove, do so now. Otherwise, go to
"Completing the installation" on page 113.

Installing an adapter

The following notes describe the types of adapters that the server supports and
other information that you must consider when you install an adapter:

- To confirm that the server supports the adapter that you are installing, see
  http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.
- The server supports several adapters. The ServeRAID M1015 SAS/SATA adapter
  comes installed on some models of the server and supports RAID levels 0, 1,
  and 10. You can replace the IBM ServeRAID M1015 SAS/SATA adapter with the
  optional IBM ServeRAID M5015 SAS/SATA adapter, which provides RAID
  levels 0, 1, 5, 10, and 50.

  Note: When you install an IBM ServeRAID M5015 SAS/SATA adapter or a
  ServeRAID M5014 SAS/SATA adapter that has an M5000 battery in the server,
  you must also use the ServeRAID M5000 Series Battery Remote Mount Cable
  option to mount the battery remotely in the server.

  The optional IBM ServeRAID M5016 SAS/SATA adapter comes with a
  ServeRAID M5100 Series 1 GB Flash/RAID 5 Upgrade for IBM System x cache
  card, which provides additional support for RAID levels 5 and 50.

  The optional IBM ServeRAID B5015 SSD adapter and the optional IBM 6 Gb
  Solid State Drive (SDD) Host Bus Adapter are also available for purchase.

  In addition, the IBM 4x4 Drive Backplane ServeRAID Expansion Adapter is
  available for purchase and provides additional SAS signal connectors to help
  support up to six SAS cables. See Table 11 on page 70 for the PCI slot priority
  installation sequence and the number of each adapter that can be installed in the
  server.

  Use the documentation that comes with the adapter and follow those
  instructions, in addition to the instructions in this section. For configuration
  information, see the documentation that comes with the adapter or the
  ServeRAID documentation at http://www.ibm.com/supportportal/.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.
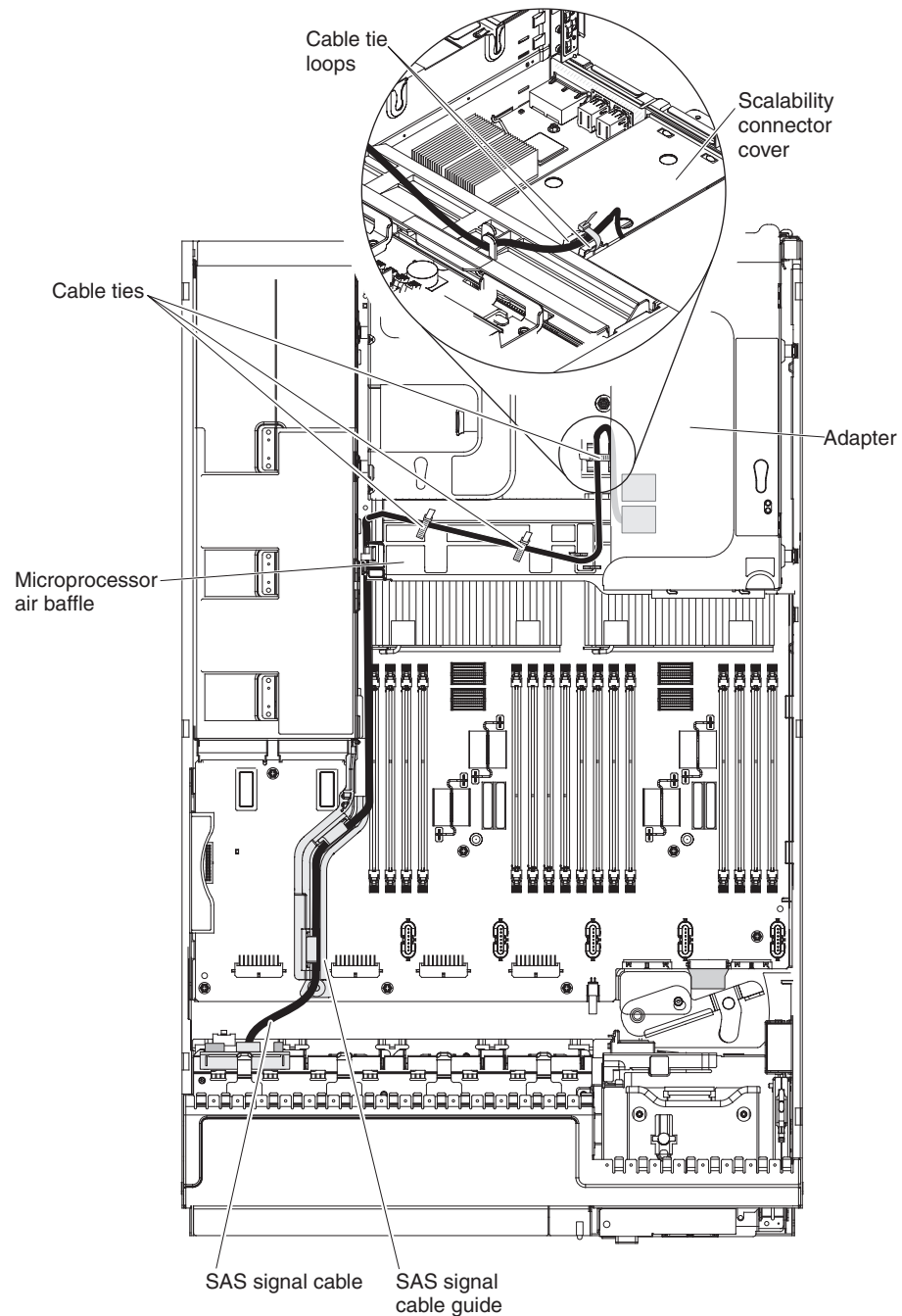
- Standard models of the server come with two PCI riser-cards installed. The server provides up to five PCI adapter slots (depending on the PCI riser-cards installed in the server). See "System-board optional device connectors" on page 41 for the location of the riser-card slots.

- Do not set the maximum digital video adapter resolution above 1280 x 1024 at 75 Hz for an LCD monitor. This is the highest resolution that is supported for any add-on video adapter that you install in the server.

- Any high-definition video-out connector or stereo connector on any add-on video adapter is not supported.

- The server does not support PCI-X adapters or legacy 5 V PCI adapters.

- When you install any PCI adapter, the power cords must be disconnected from the power source before you remove the PCI Express riser-card assembly. Otherwise, the active power management event signal will be disabled by the system-board logic, and the Wake on LAN feature might not work. However, after the server is powered-on locally, the active power manager active power management event signal will be enabled by the system-board logic.

- The following table provides information about the suggested PCI slot priority sequence in which to install the adapters and how many of each adapter the server supports. The slot priority sequence is dependent on the PCI riser cards installed in the server and other adapters that are installed in the riser cards. See "PCI riser card with three slots" on page 42, "PCI riser card with two slots" on page 42, and "PCI riser card with one slot" on page 43 for the locations of the PCI slots on the riser cards.

Table 11. PCI slot priority sequence to install the adapter and the maximum number of cards allowed

Name of the Adapter	Suggested slot priority sequence in which to install the adapter	Maximum number of this adapter allowed in the server
IBM 4x4 Drive Backplane ServeRAID Expansion adapter	Slot 1 (only)	1
Emulex 10GB Dual-port Ethernet Custom Adapter of IBM System x	Slot 5 (only)	1
Emulex 10GbE Integrated Virtual Fabric Adapter II for IBM System x	Slot 5 (only)	1
IBM ServeRAID M1015 SAS/SATA Controller	2, 4, 3, and then 1	2
IBM ServeRAID M5015 SAS/SATA Controller	2, 4, 3, and then 1	4
IBM ServeRAID M5016 SAS/SATA Controller	2, 4, 3, and then 1	4
IBM ServeRAID B5015 Solid State Drive (SSD) Controller	4, 3, 1, and then 2	4
IBM 6Gb Solid State Drive (SSD) Host Bus Adapter	4, 3, 1, and then 2	4

Note: When you install an IBM ServeRAID M5015 SAS/SATA adapter or a ServeRAID M5014 SAS/SATA adapter that has an M5000 battery in the server, you must also use the ServeRAID M5000 Series Battery Remote Mount Cable option to mount the battery remotely in the server.

- The server provides two PCI riser-card slots on the system board. The supported riser-cards provide up to five PCI adapter slots (depending on the riser cards installed in the server). Some models come with PCI riser-card assemblies with brackets installed. The following table lists the PCI slots on the supported riser cards and the supported adapters that you can install on the riser cards:

Table 12. Supported riser cards and supported PCI adapters

Riser cards supported	Slot on the system board to install the riser card	PCI adapters that you can install in the riser card
PCI riser card with two PCI Express Gen2 x8 adapter slots	PCI riser slot 1	• PCI Express Gen2 x8 three/fourth-length, full-height adapter • PCI Express Gen2 x8 half-length, full-height adapter
(Optional) PCI riser cards with one PCI Express Gen2 x16 adapter slot	PCI riser slot 1	• PCI Express Gen2 x16 full-length, full-height adapter **Note:** You cannot install the full-length, full-height adapter in the server when the optional memory tray is installed. • PCI Express Gen2 x16 three/fourth-length, full-height adapter
PCI riser card with three PCI Express Gen2 x8 (x4) adapter slots	PCI riser slot 2	• PCI Express Gen2 x8 low-profile adapter • PCI Express Gen2 x8 (x4) low-profile adapter

Important: The x8 (x4) designation for a PCI slot identifies a x8 slot that is wired for x4. If you install a x8 adapter in slot 4 that can downshift to the x4 bandwidth, it will run at the x4 bandwidth. The x8 connector can be used for x4 and x8 adapters. Check the information that comes with your adapter for compatibility information.

To install an adapter, complete the following steps:

Note:
1. The instructions in this section apply to any PCI adapter (for example, video graphics adapters or network adapters).
2. Do not set the maximum digital video adapter resolution above 1280 x 1024 at 75 Hz for an LCD monitor. This is the highest resolution that is supported for any add-on video adapter that you install in the server.
3. Any high-definition video-out connector or stereo connector on any add-on video adapter is not supported

1. Read the safety information that begins on page "Safety" on page v and the "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. Follow the cabling instructions, if any come with the adapter. Route the adapter cables before you install the adapter.

5. Insert the adapter into the riser-card assembly, aligning the edge connector on the adapter with the connector on the riser-card assembly. Press the edge of the connector *firmly* into the riser-card assembly. Make sure that the adapter snaps into the riser-card assembly securely.

Attention: When you install an adapter, make sure that the adapter is correctly seated in the riser-card assembly and that the riser-card assembly is securely seated in the riser-card connector on the system board before you turn on the server. An incorrectly seated adapter might cause damage to the system board, the riser-card assembly, or the adapter.
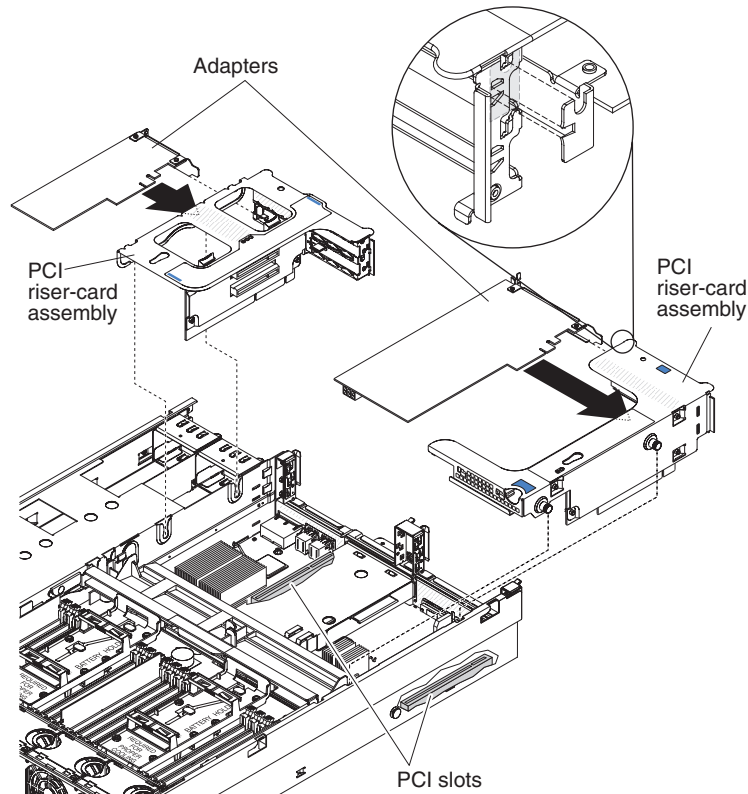
6. Install the riser-card assembly in the server (see "Installing a PCI riser-card assembly" on page 68).
7. Perform any configuration tasks that are required for the adapter.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing an IBM ServeRAID M1015 SAS/SATA Controller

Note:

1. Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplane you install in the server).

2. This adapter can only be used with the 4x2.5-inch drive backplane or the 8x2.5-inch backplane installed in the server.

3. You can use this adapter only with 2.5-inch hot-swap drives.

4. When the IBM 4x4 Drive Backplane ServeRAID Expansion adapter is installed in the server, this adapter installs in slot 2 on the two-slot PCI riser card (see Table 11 on page 70).

Some server models come with an IBM ServeRAID M1015 SAS/SATA Controller installed. This adapter can be installed only in the PCI slots listed in Table 11 on page 70. The IBM ServeRAID M1015 SAS/SATA enables integrated RAID levels 0, 1, and 10 capability on hot-swap drives. For configuration information, see the ServeRAID documentation at http://www.ibm.com/systems/support/. To install the adapter if your server model did not come with this adapter, complete the following steps.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Grasp the riser-card assembly by the blue touch points and pull it up until the riser-card assembly disengages from the connector on the system board; then, set it aside.

5. Touch the static-protective package that contains the ServeRAID M1015 SAS/SATA adapter to any unpainted surface on the outside of the server; then, grasp the adapter by the top edge or upper corners of the adapter and remove it from the package.
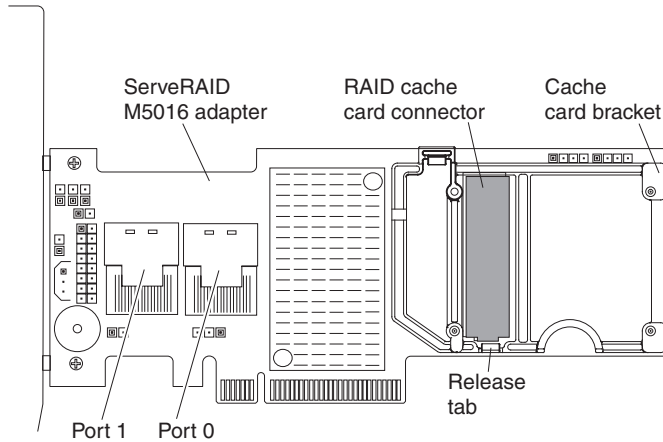
6. Align the ServeRAID M1015 SAS/SATA adapter so that the keys align correctly with the connector on the riser-card assembly.

7. Insert the SAS/SATA adapter into the connector on the riser-card assembly until it is firmly seated.

   Attention: Incomplete insertion might cause damage to the server or the adapter.

8. Reinstall the riser-card assembly onto the system board.

9. Connect the power/configuration cable to the drive backplane and the system board.

10. Connect the signal cables to the drive backplane and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use

the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the way or get damaged.
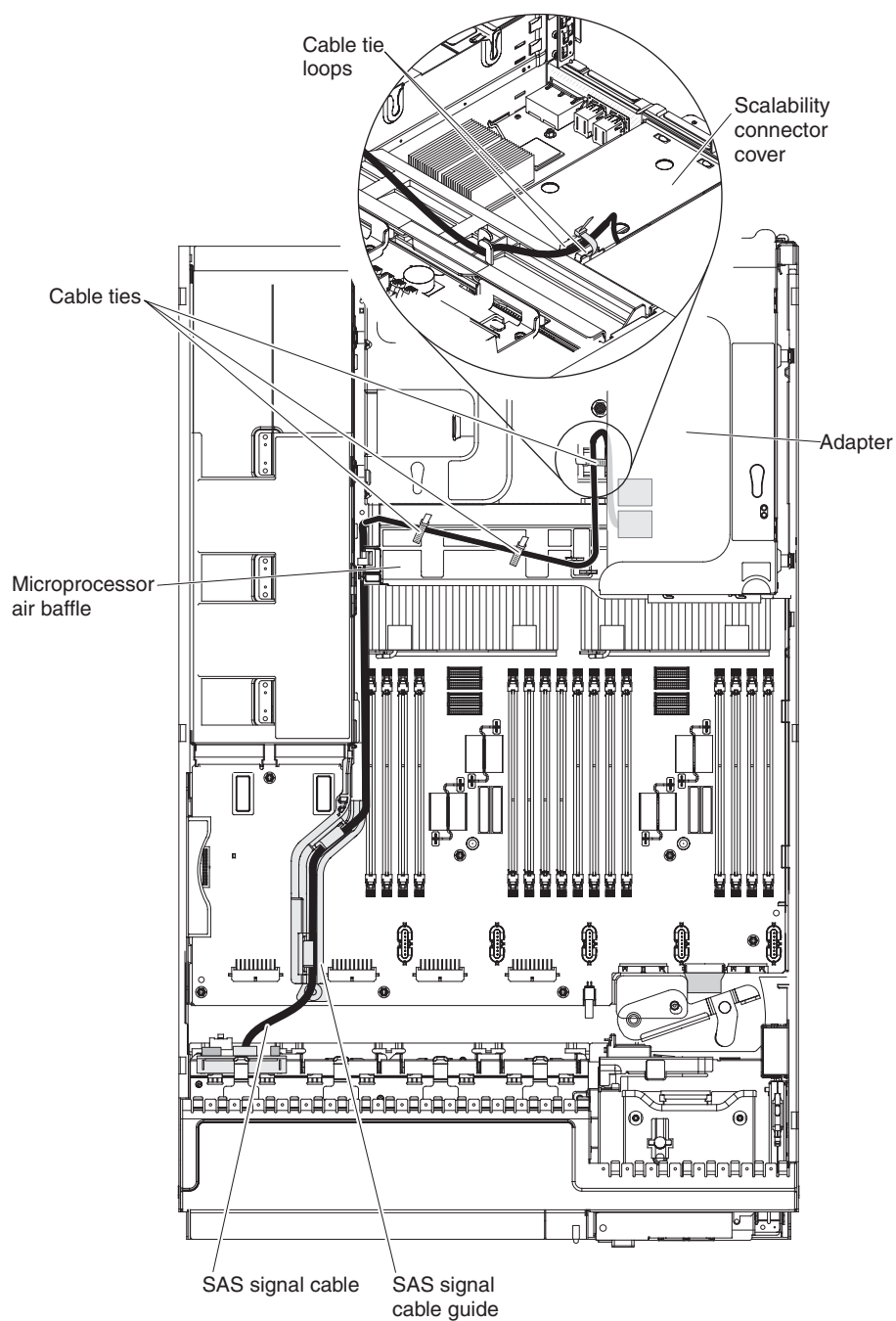
Note: Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplanes you installed in the server).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing an optional IBM ServeRAID M5015 SAS/SATA Controller

ServeRAID M5015 controller

Port 1
(ports 7-4)

Port 0
(ports 0-3)

You can purchase an optional IBM ServeRAID M5015 SAS/SATA controller. This adapter can be installed only in the PCI slots listed in Table 11 on page 70. For configuration information, see the ServeRAID documentation at http://www.ibm.com/systems/support/.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

Note:

1. Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplane you install in the server).

2. When you install an IBM ServeRAID M5015 SAS/SATA adapter or an IBM ServeRAID M5014 SAS/SATA adapter that has an M5000 battery in the server, you must also use the IBM ServeRAID M5000 Series Battery Remote Mount Cable option to mount the battery remotely in the server.

3. When the IBM 4x4 Drive Backplane ServeRAID Expansion adapter is installed in the server, this adapter installs in slot 2 on the two-slot PCI riser card (see Table 11 on page 70).

To install the IBM ServeRAID M5015 SAS/SATA adapter, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Carefully grasp the riser-card assembly by the blue touch points and pull it until the riser-card assembly disengages from the connector on the system board; then set it aside.

5. Touch the static-protective package that contains the ServeRAID M5015 SAS/SATA adapter to any unpainted surface on the outside of the server; then, grasp the adapter by the top edge or upper corners of the adapter and remove it from the package.
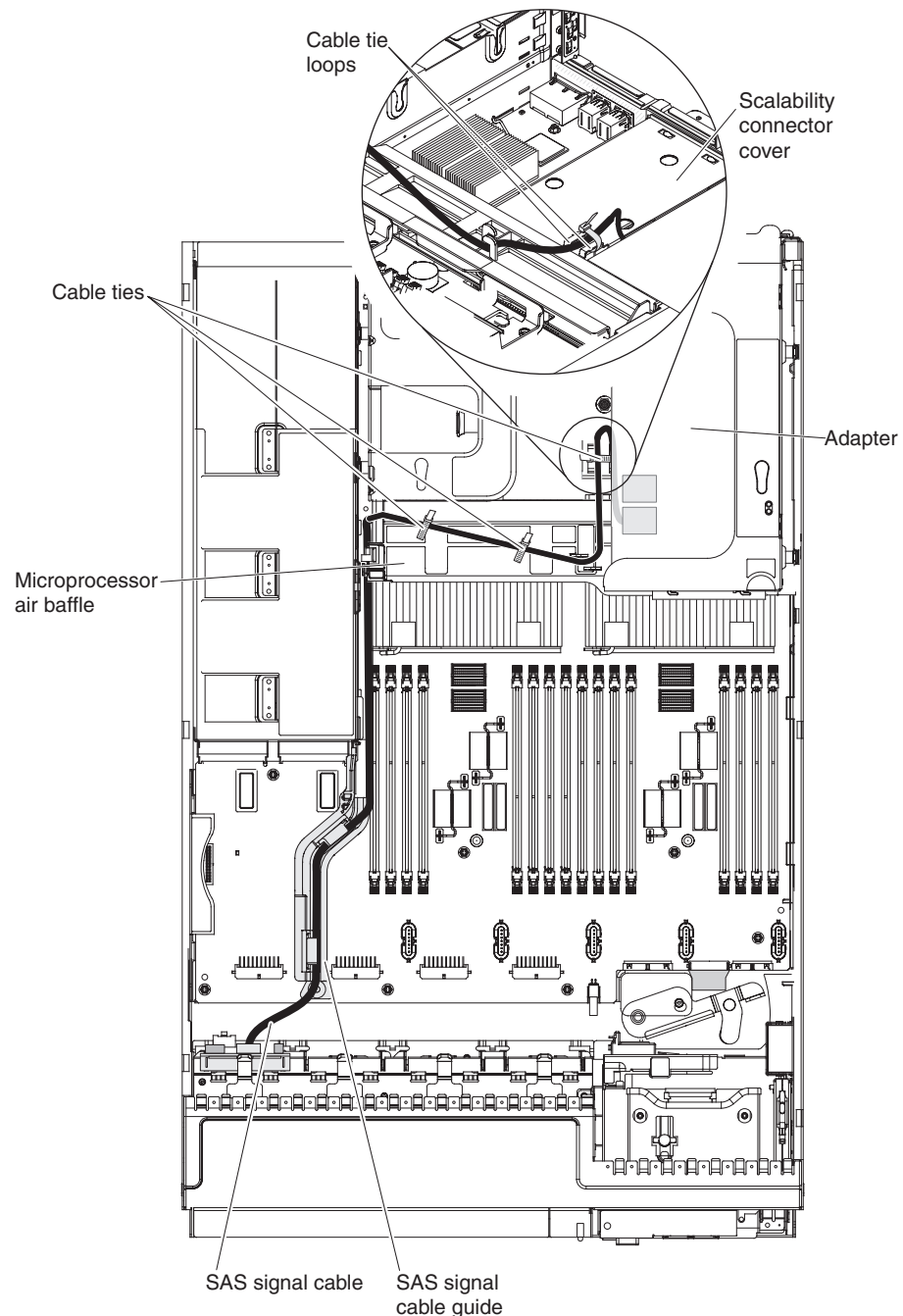
6. Align the ServeRAID M5015 SAS/SATA adapter so that the keys align correctly with the connector on the riser-card assembly.

7. Insert the SAS/SATA adapter into the connector on the SAS/SATA riser-card until it is firmly seated.

   Attention: Incomplete insertion might cause damage to the server or the adapter.

8. Reinstall the riser-card assembly onto the system board.

9. Connect the power/configuration cable to the drive backplane and the system board.

10. Connect the signal cable to the drive backplane and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the way or get damaged.

    Note: Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplanes you installed in the server).

Cable tie loops

Scalability connector cover

Cable ties

Adapter

Microprocessor air baffle

SAS signal cable

SAS signal cable guide

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing an optional IBM ServeRAID M5016 SAS/SATA Controller

You can purchase an optional IBM ServeRAID M5016 SAS/SATA controller. This adapter can be installed only in the PCI slots listed in Table 11 on page 70. For configuration information, see the ServeRAID documentation at http://www.ibm.com/systems/support/.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

Note:

1. Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplane you install in the server).

2. The RAID flash power module that comes with this adapter must be installed remotely in the server.

3. When the IBM 4x4 Drive Backplane ServeRAID Expansion adapter is installed in the server, this adapter installs in slot 2 on the two-slot PCI riser card (see Table 11 on page 70).

To install the IBM ServeRAID M5016 SAS/SATA adapter, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Carefully grasp the riser-card assembly by the blue touch points and pull it until the riser-card assembly disengages from the connector on the system board; then set it aside.

5. Touch the static-protective package that contains the ServeRAID M5016 SAS/SATA adapter to any unpainted surface on the outside of the server; then, grasp the adapter by the top edge or upper corners of the adapter and remove it from the package.

6. Align the ServeRAID M5016 SAS/SATA adapter so that the keys align correctly with the connector on the riser-card assembly.

7. Insert the SAS/SATA adapter into the connector on the SAS/SATA riser-card until it is firmly seated.

   Attention: Incomplete insertion might cause damage to the server or the adapter.

8. Reinstall the riser-card assembly onto the system board.

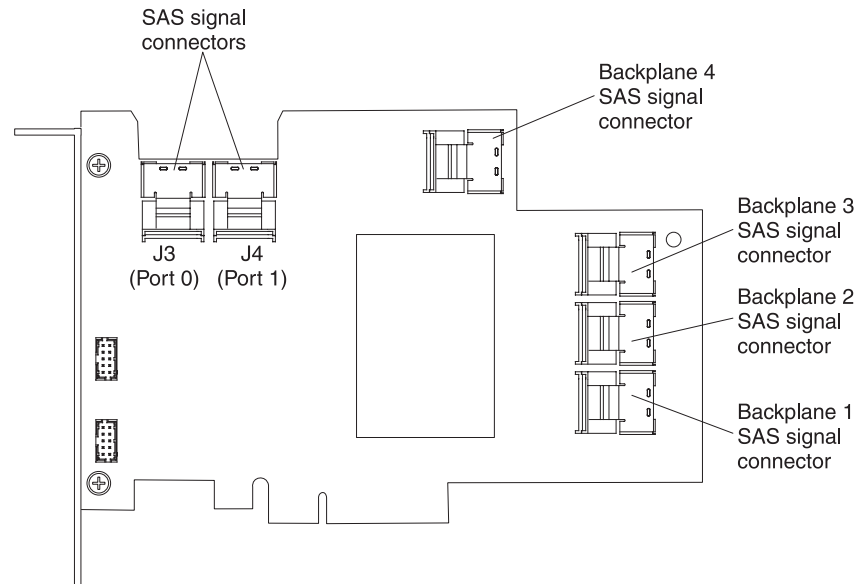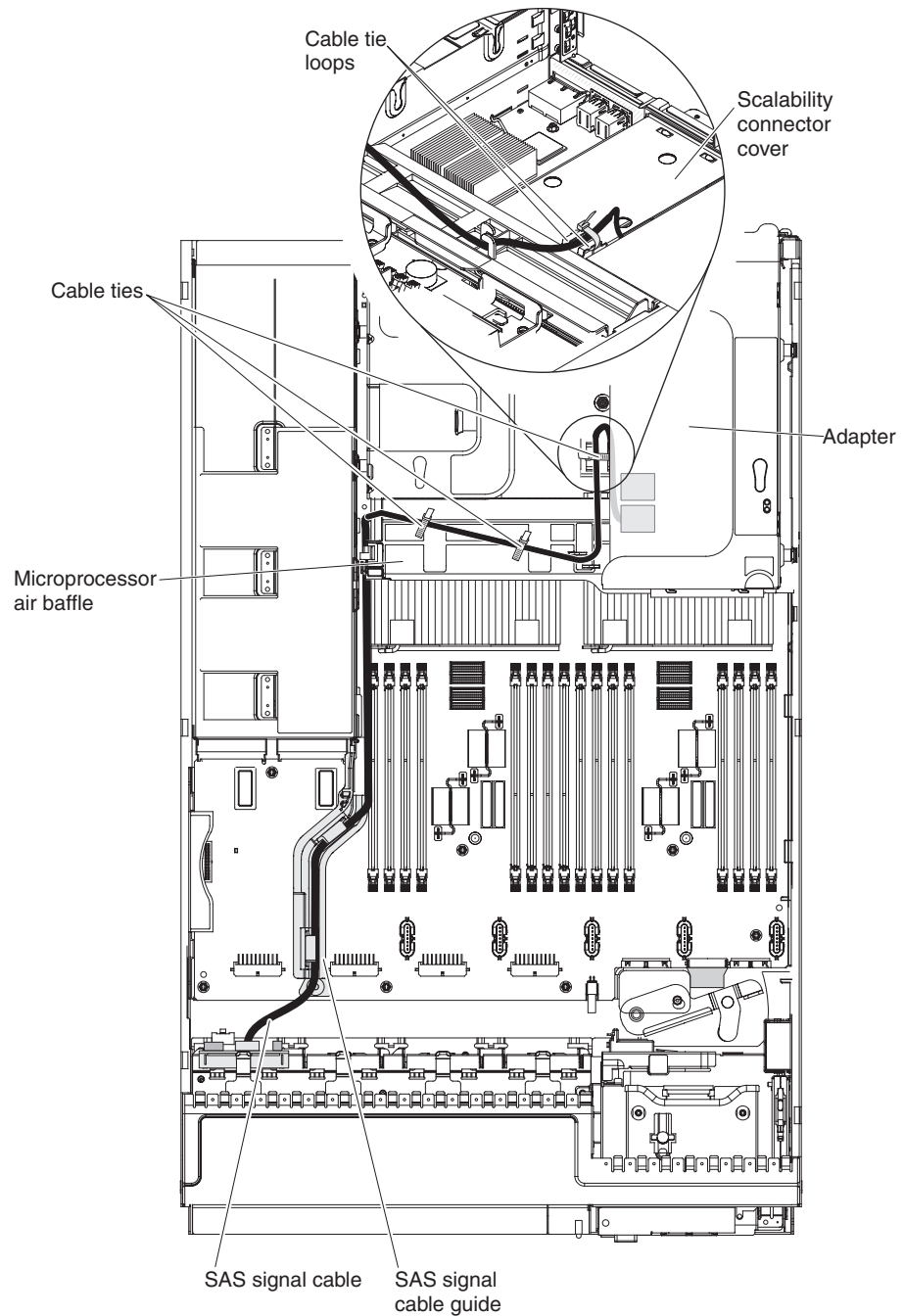9. Connect the power/configuration cable to the drive backplane and the system board.

10. Connect the signal cable to the drive backplane and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the way or get damaged.

    Note: Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplanes you installed in the server).

Cable tie
loops

Scalability
connector
cover

Cable ties

Adapter

Microprocessor
air baffle

SAS signal cable   SAS signal
                     cable guide

If you have other devices to install or remove, do so now. Otherwise, go to
"Completing the installation" on page 113.

Installing an optional IBM ServeRAID B5015 SSD Controller
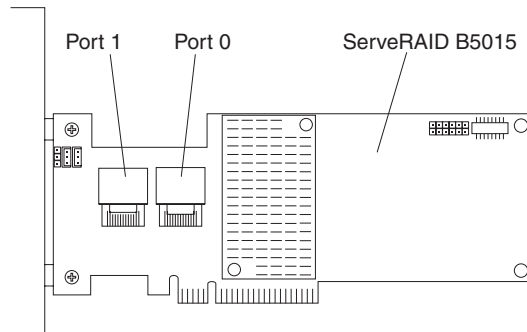
You can purchase an optional IBM ServeRAID B5015 solid state drive (SSD) SAS/SATA controller. This adapter can be installed only in the PCI slots listed in Table 11 on page 70. For configuration information, see the ServeRAID documentation at http://www.ibm.com/systems/support/.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

Note:
1. Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplane you install in the server).
2. This adapter can only be used with the 8x1.8-inch drive backplane.
3. You can only use 1.8-inch hot-swap drives with this adapter.

To install the IBM ServeRAID B5015 SSD adapter, complete the following steps:
1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. Carefully grasp the riser-card assembly by the blue touch points and pull it up until the riser-card assembly disengages from the connector on the system board; then set it aside.
5. Touch the static-protective package that contains the ServeRAID B5015 SSD adapter to any unpainted surface on the outside of the server; then, grasp the adapter by the top edge or upper corners of the adapter and remove it from the package.
6. Align the ServeRAID B5015 SSD adapter so that the keys align correctly with the connector on the riser-card assembly.
7. Insert the adapter into the connector on the riser-card until it is firmly seated.

   Attention: Incomplete insertion might cause damage to the server or the adapter.
8. Reinstall the riser-card assembly onto the system board.
9. Connect the power/configuration cable to the drive backplane and the system board.

10. Connect the signal cables to the drive backplane and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the way or get damaged.

   Note: Follow the general rule for connecting the SAS signal cables to the adapter and drive backplane, port 0 on the adapter to port 0 on the drive backplane; then port 1 on the adapter to port 1 on the drive backplane, port 2 to port 2, and port 3 to port 3 (depending on the drive backplanes you installed in the server).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing an optional IBM 4x4 Drive Backplane ServeRAID Expansion adapter

You can purchase an optional IBM 4x4 drive backplane ServeRAID expansion adapter. This adapter can be installed only in slot 1 on the two-slot PCI riser card. See "PCI riser card with two slots" on page 42 and Table 11 on page 70 for more information on the slot location and the dedicated slot for this adapter. For configuration information, see the ServeRAID documentation at http://www.ibm.com/systems/support/.

Attention: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

Note:
1. You can only use this adapter with the ServeRAID M1015 SAS/SATA adapter and the ServeRAID M5015 SAS/SATA adapter. This adapter must be installed in PCI slot 1 and the ServeRAID M1015 or ServeRAID M5015 adapter (whichever is installed) must be installed in PCI slot 2 on the two-slot PCI riser card.
2. You can only use the 2.5-inch hot-swap drive backplanes with this adapter.

To install the IBM 4x4 drive backplane ServeRAID expansion adapter, complete the following steps:
1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Carefully grasp the riser-card assembly by the blue touch points and pull it up until the riser-card assembly disengages from the connector on the system board; then set it aside.

5. Touch the static-protective package that contains the ServeRAID expansion adapter to any unpainted surface on the outside of the server; then, grasp the adapter by the top edge or upper corners of the adapter and remove it from the package.

6. Align the ServeRAID expansion adapter so that the keys align correctly with the connector on the riser-card assembly.

7. Insert the adapter into the connector on the riser-card until it is firmly seated.

   Attention: Incomplete insertion might cause damage to the server or the adapter.

8. Reinstall the riser-card assembly onto the system board.

9. Connect the power/configuration cable to the drive backplane and the system board.

10. Connect the two shortest signal cables to port 0 on the adapter to port J3 on the ServeRAID expansion adapter and port 1 on the adapter to J4 on the ServeRAID expansion adapter.

11. Route the signal cables through the SAS cable guide and connect the signal cables to the drive backplane and to the adapter as shown in the following example illustration.

Cable tie
loops

Scalability
connector
cover

Cable ties

Adapter

Microprocessor
air baffle

SAS signal cable   SAS signal
cable guide

12. Connect the other SAS signal cables to port 1 on the ServeRAID expansion
    adapter to port 0 on the drive backplane; then port 2 on the expansion
    adapter to port 1 on the drive backplane, port 3 on the expansion adapter to
    port 2 the drive backplane, and port 4 on the expansion adapter to port 3 on
    the drive backplane (depending on the drive backplane you install in the
    server).

If you have other devices to install or remove, do so now. Otherwise, go to
"Completing the installation" on page 113.

Installing a second microprocessor and heat sink

The following notes describe the type of microprocessor that the server supports and other information that you must consider when you install a microprocessor and heat sink:

- Be extremely careful, the contacts are very fragile.
- The server supports up to two Intel Xeon four-core, six-core, or eight-core microprocessors (depending on your model). To confirm that the server supports the microprocessor, see http://www.ibm.com/systems/info/x86servers/ serverproven/compat/us/ for a list of supported microprocessors.
- Do not mix four-core, six-core, and eight-core microprocessors in the same server.
- The microprocessor options that IBM supports are limited by the capacity and capability of the server. Any microprocessor options that you install must have the same specifications as the microprocessor(s) that came with the server.
- The first microprocessor must always be installed in microprocessor socket 1 on the system board.
- When one microprocessor is installed, a heat sink filler is not required for microprocessor socket 2, however, the microprocessor air baffle, the DIMM air baffle, or the memory tray must be installed to provide proper system cooling.
- Do not remove the first microprocessor from the system board when you install the second microprocessor.
- When you install the second microprocessor, you must also install additional memory. See "Installing a memory module" on page 50 for details about the installation sequence.
- To ensure proper server operation when you install an additional microprocessor, use microprocessors that have the same QuickPath Interconnect (QPI) link speed, integrated memory controller frequency, core frequency, power segment, internal cache size, and type.
- Mixing microprocessors of different stepping levels within the same server model is supported.
- When mixing microprocessors with different stepping levels within the same server model, you do not have to install the microprocessor with lowest stepping level and features in microprocessor socket 1.
- Do not mix Intel Xeon™ EX versions of the 6000 and 7000 Series and the E7 Series microprocessors in the same server, it is not supported. In addition:
  - Intel Xeon EX versions of the 6000 and 7000 Series microprocessors are supported only on machine types 7148 and 7149.
  - Intel Xeon EX E7 Series microprocessors are supported only on machine types 7147 and 7192.
- Both microprocessor voltage regulator modules are integrated on the system board.
- If you have to replace a microprocessor, call for service.
- Read the documentation that comes with the microprocessor, so that you can determine whether you have to update the server firmware. To download the latest level of the server firmware and other code updates for your server, go to http://www.ibm.com/supportportal/.
- If the thermal-grease protective cover (for example, a plastic cap or tape liner) is removed from the heat sink, do not touch the thermal grease on the bottom of the heat sink or set down the heat sink. For details, see the information about thermal grease in the *Problem and Determination Service Guide*.

Note: Removing the heat sink from the microprocessor destroys the even distribution of the thermal grease and requires replacing the thermal grease.

- To order an additional optional microprocessor, contact your IBM marketing representative or authorized reseller.
- The following table shows the DIMM connectors on the system board and the memory tray that are associated with each microprocessor:

Table 13. DIMM connectors associated with each microprocessor

Microprocessor	DIMM connectors
Microprocessor socket 1	1 through 16
Microprocessor socket 2	17 through 32

Note: When the memory tray is not installed in the server, DIMMs 1 through 16 are solely associated with microprocessor 1. Microprocessor 2 has access to DIMMs 1 through 16, but access is through microprocessor 1. This is important if load balancing is a necessity for your operating system or software load.

To install an additional microprocessor and heat sink, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling these devices, see "Handling static-sensitive devices" on page 45.
3. Remove the server top cover (see "Removing the server top cover" on page 45).
4. Locate microprocessor socket 2 on the system board.
5. Disconnect any cables from the adapters that are installed in the PCI riser-card in slot 1 on the system board.
6. Remove memory tray, if one is installed (see "Removing the memory tray" on page 46).
7. Remove the DIMM air baffle, if one is installed (see "Removing the DIMM air baffle" on page 47).
8. Remove the riser-card assembly from slot 1 on the system board. Grasp the riser-card assembly by the front and rear and pull it out of the slot on the system board.
9. Remove the microprocessor air baffle (see "Removing the microprocessor air baffle" on page 48).
10. Rotate the heat-sink release lever to the fully open position and lift the heat-sink filler off the microprocessor socket.
11. Install the microprocessor:
    a. Press down and out on the release lever on microprocessor socket 2 and lift up the microprocessor release lever until it stops in the fully open position.
    b. Lift the hinged microprocessor bracket frame into an open position.

       Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling these devices, see "Handling static-sensitive devices" on page 45.

Microprocessor
bracket frame

Microprocessor
release lever
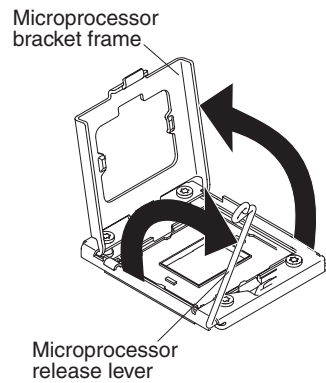
c. Remove the socket cover from the microprocessor socket. The
    microprocessor socket might have the socket cover style shown in
    illustration A or the style shown in illustration B.

A

Socket
dust cover

B

Socket
dust cover
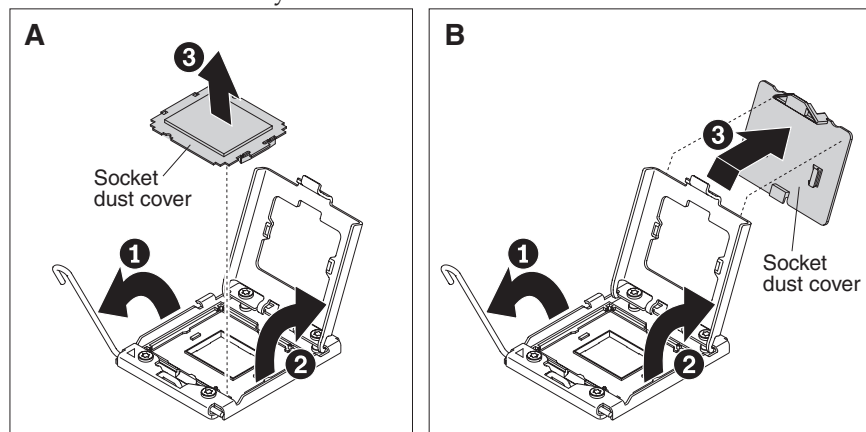
d. Remove the static-protective bag that contains the new microprocessor, and
    the foam surrounding the bag, from the box.

e. Touch the static-protective package that contains the new microprocessor to
    any *unpainted* metal surface on the server; then, carefully remove the
    microprocessor from the package.

Attention:

- Do not touch the microprocessor contacts; handle the microprocessor by the edges only. Contaminants on the microprocessor contacts, such as oil from your skin, can cause connection failures between the contacts and the socket.
- Handle the microprocessor carefully. Dropping the microprocessor during installation or removal can damage the contacts.

f. If there is a plastic protective cover on the bottom of the microprocessor,

Protective cover
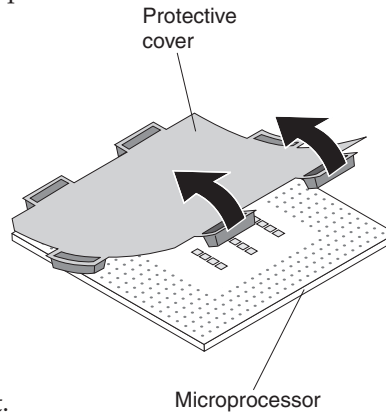
Microprocessor

carefully remove it.

g. Locate the microprocessor installation tool that comes with the new microprocessor.

Note: If you are installing E7 series microprocessors in your server, you must use the microprocessor installation tool with the text "X7500 + E7" on the bottom of the tool (see the following illustration). Tools that do not have this text on the bottom will not work correctly with the E7 series microprocessors.

X7500
+
E7
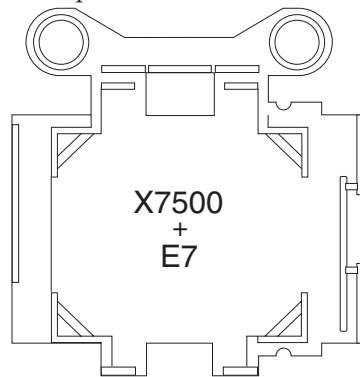
h. Twist the handle of the installation tool counterclockwise so that it is in the open position.

i. Align the triangle alignment mark on the microprocessor installation tool with the triangle alignment mark on the microprocessor, then place the microprocessor on the bottom of the tool so that the tool can grasp the microprocessor correctly onto the bottom of the installation tool.

j. Twist the handle of the installation tool clockwise to secure the microprocessor in the tool.

Note: You can pick up or release the microprocessor by twisting the microprocessor installation tool handle.
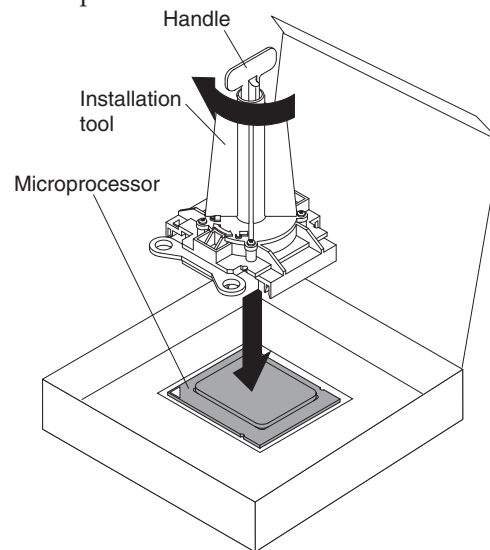
k. Carefully align the microprocessor installation tool over the microprocessor socket. Twist the handle of the microprocessor tool counterclockwise to insert the microprocessor into the socket.

Note: The microprocessor fits only one way in the socket.
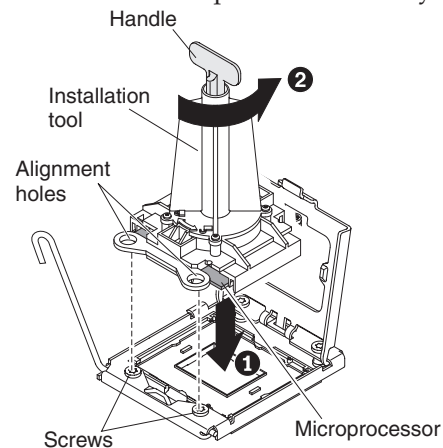
l. Close the microprocessor bracket frame.

m. Carefully close the microprocessor release lever to the closed position to secure the microprocessor in the socket.

12. Install the heat sink that came with the microprocessor:

a. Remove the plastic protective cover from the bottom of the heat sink.

Attention: Do not touch the thermal grease on the bottom of the heat sink after you remove the plastic cover. Touching the thermal grease will contaminate it. See "Thermal grease" on page 92 for more information.

b. Align the heat sink on top of the microprocessor with the thermal grease side down.

Thermal grease
Heat sink
Flange
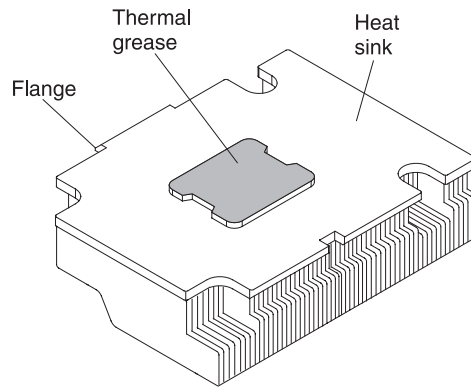
   c. Lower the flange of the heat sink into the opening in the retainer bracket and press down firmly on the rear of the heat sink until it is seated securely.

Flange
Microprocessor
Retention module
Heat sink release lever
Slot opening
Lock tab
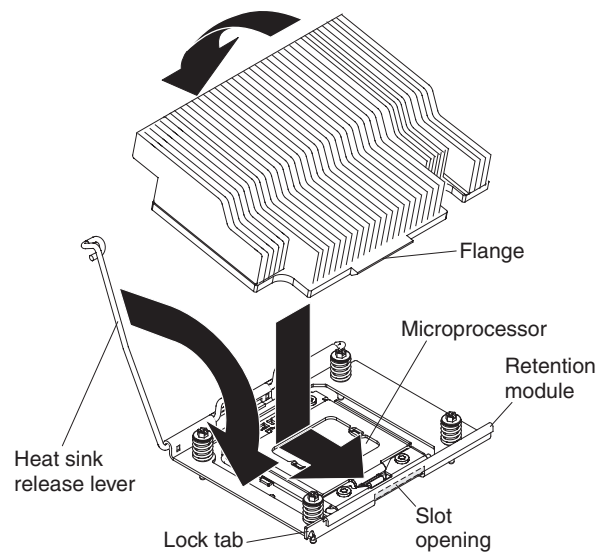
   d. Rotate the heat-sink release lever to the closed position and hook it underneath the lock tab.

13. Reinstall the microprocessor air baffle, (see "Replacing the microprocessor air baffle" on page 114).

14. Reinstall the riser-card assembly on the system board (see "Installing a PCI riser-card assembly" on page 68).

15. Reinstall the memory tray, if one was removed (see"Replacing the memory tray" on page 114).

16. Reinstall the DIMM air baffle, if one was removed (see "Replacing the DIMM air baffle" on page 113).

17. Reconnect any cables that your disconnected from the adapters or system board.

If you have other options to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Thermal grease

The thermal grease must be replaced whenever the heat sink has been removed from the top of the microprocessor and is going to be reused or when debris is found in the grease.

When you are installing the heat sink on the same microprocessor that is was removed from, make sure that the following requirements are met:

- The thermal grease on the heat sink and microprocessor is not contaminated.
- Additional thermal grease is not added to the existing thermal grease on the heat sink and microprocessor.

Note:

- Read the Safety information on page "Safety" on page v.
- Read the "Installation guidelines" on page 43.
- Read "Handling static-sensitive devices" on page 45.

To replace damaged or contaminated thermal grease on the microprocessor and heat sink, complete the following steps:

1. Place the heat sink on a clean work surface.
2. Remove the cleaning pad from its package and unfold it completely.
3. Use the cleaning pad to wipe the thermal grease from the bottom of the heat sink.

   Note: Make sure that all of the thermal grease is removed.

4. Use a clean area of the cleaning pad to wipe the thermal grease from the microprocessor; then, dispose of the cleaning pad after all of the thermal grease is removed.
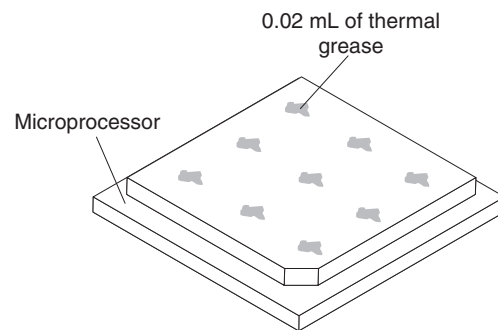
5. Use the thermal-grease syringe to place 9 uniformly spaced dots of 0.02 mL each on the top of the microprocessor. The outermost dots must be within approximately 5 mm of the edge of the microprocessor; this is to ensure uniform distribution of the grease.
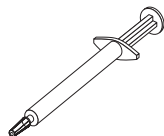
   Note: If the grease is properly applied, approximately half of the grease will remain in the syringe.

6. Install the heat sink onto the microprocessor as described in 12 on page 90.

Installing a hot-swap power supply

The following notes describe the type of power supply that the server supports and other information that you must consider when you install a power supply:

- To confirm that the server supports the power supply that you are installing, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.
- The server comes standard with one 675-watt hot-swap 12-volt output power supply. The input voltage is 110 V ac or 220 V ac auto-sensing.

  Note: You cannot mix 110 V ac and 220 V ac power supplies in the server, it is not supported.
- These power supplies are designed for parallel operation. In the event of a power-supply failure, the redundant power supply continues to power the system. The server supports a maximum of four power supplies.
- The server can run fully configured with two power supplies. For redundancy support, you must install the optional IBM Power Interposer for Redundant Power Option kit, if one is not installed in your model.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
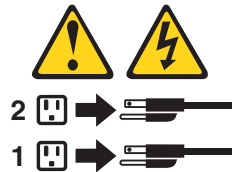
Statement 8

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

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

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

1. Read the safety information that begins "Safety" on page v and "Installation guidelines" on page 43.
2. Touch the static-protective package that contains the hot-swap power supply to any unpainted metal surface on the server; then, remove the power supply from the package and place it on a static-protective surface.
3. If you are installing a hot-swap power supply into an empty bay, remove the power-supply filler panel from the power-supply bay.
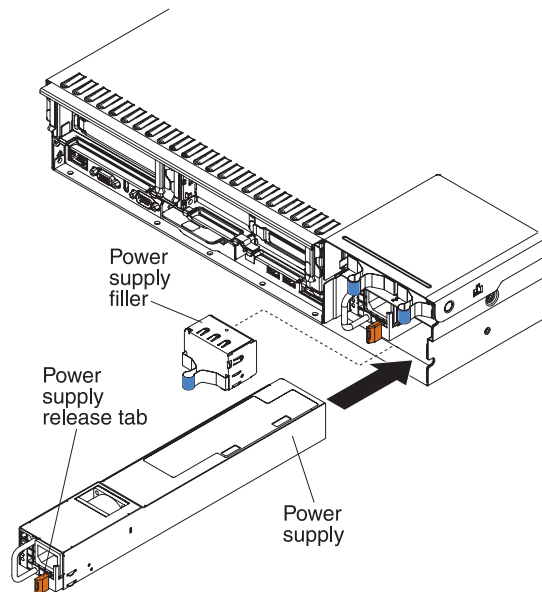
4. Grasp the handle on the rear of the power supply and slide the power supply forward into the power-supply bay until it clicks. Make sure that the power supply connects firmly into the power-supply connector.
5. Route the power cord through the cable retainer clip on the rear of the server so that it does not accidentally become unplugged.
6. Connect the power cord for the new power supply to the power-cord connector on the power supply.
7. Connect the other end of the power cord to a properly grounded electrical outlet.

8. Make sure that the ac power LED and the dc power LED on the power supply are lit, indicating that the power supply is operating correctly. The two green LEDs are to the right of the power-cord connector.

9. Restart the server. Confirm that it starts correctly and recognizes the newly installed device, and make sure that no error LEDs are lit.

10. Complete the additional steps in "Instructions for IBM Business Partners" on page 34.

Installing the optional power interposer card assembly

The power interposer card assembly option enables redundancy power support. To install the optional power interposer card assembly, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Connect the power interposer power cable to the power interposer card and to the power interposer card connectors on the system board.
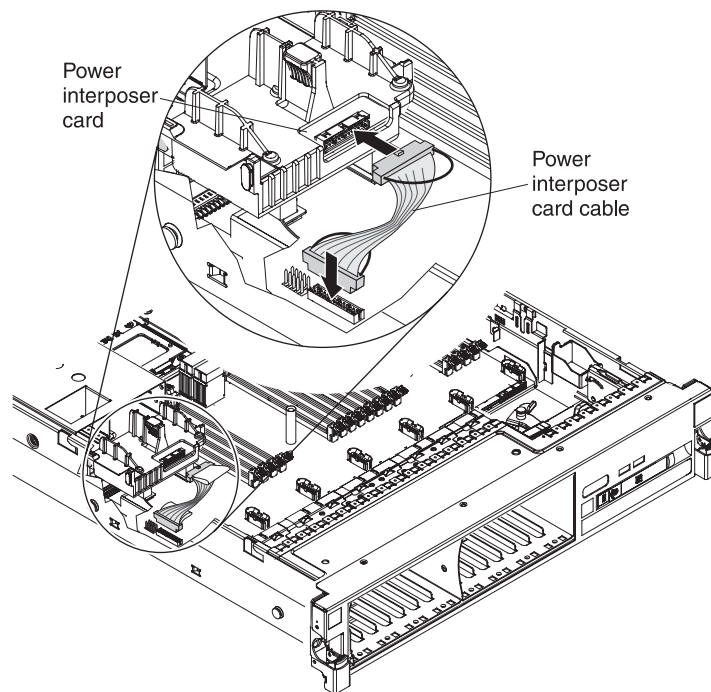
5. Align the power connectors on the power interposer card so that they are facing the power supply cage and the power interposer card is also aligned with the power interposer card connectors on the system board; then, press down on the assembly until it is firmly seated in the connectors on the system board.

Power supply
connector 3

Power supply
connector 4

Power interposer
card

Power cable
connector

Power header
connectors

Power
interposer
card

Alignment
tabs
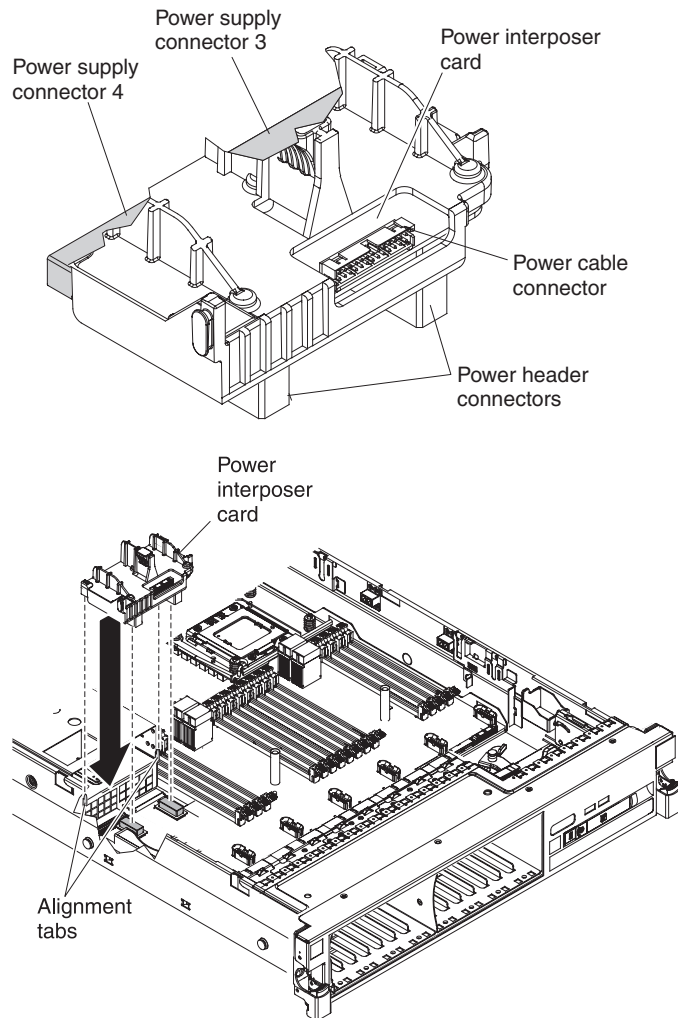
6. Install the power supplies that came with the power interposer card option (see "Installing a hot-swap power supply" on page 93).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing a USB embedded hypervisor flash device

To install a hypervisor flash device, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Locate the embedded hypervisor USB flash device connector on the one-slot side of the three-slot PCI riser card as shown in the following illustration:

PCI slot 3 error LEDs PCI slot 4 error LEDs PCI slot 5 error LEDs

USB connector

USB embedded hypervisor flash device connector

PCI riser card

Slot 5, PCI Express Gen2 x8, low profile
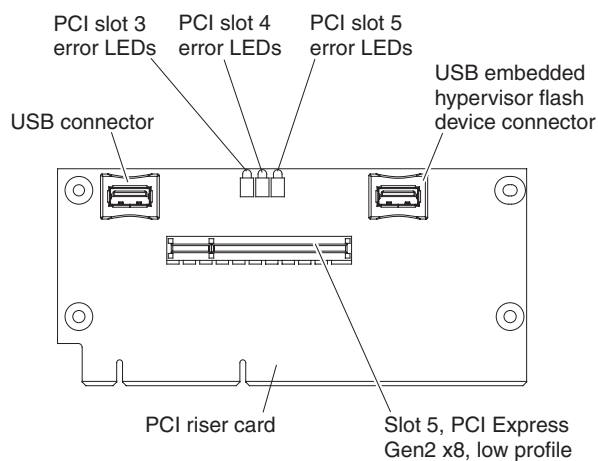
5. Align the USB flash device with the connector on the x8 low-profile riser-card assembly and push it into the connector until it is firmly seated.

6. Slide the lockbar toward the riser-card assembly to the locked position until it is seated firmly.
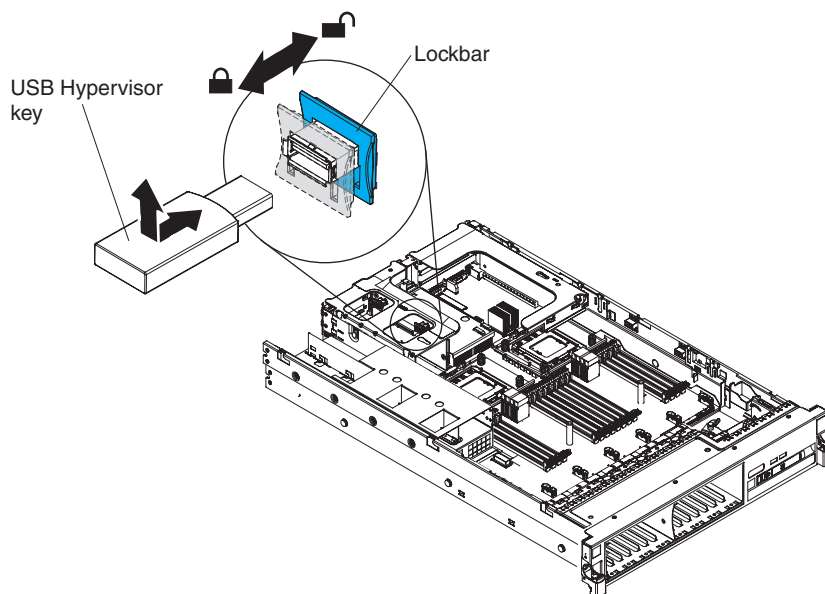
Lockbar

USB Hypervisor key

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing a RAID adapter battery remotely in the server

When you install multiple RAID adapters in the server that come with batteries, the RAID batteries must be installed remotely to prevent the batteries from overheating. The batteries must be installed in the RAID battery trays on top of the memory tray or the DIMM air baffle (whichever one is installed in the server). To install a RAID adapter battery remotely in the server, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server and peripheral devices and disconnect all power cords and external devices; then, remove the top cover (see "Removing the server top cover" on page 45).

   Note: If your adapter was not shipped with the battery and battery carrier attached, go to step 5.

3. Remove the riser-card assembly from the server and set it aside (see "Installing a PCI riser-card assembly" on page 68).

4. If the RAID adapter was shipped with a battery and battery carrier are attached, disconnect the battery carrier cable from the battery and remove the three screws that secure the battery carrier to the adapter. Set the battery and battery carrier aside.
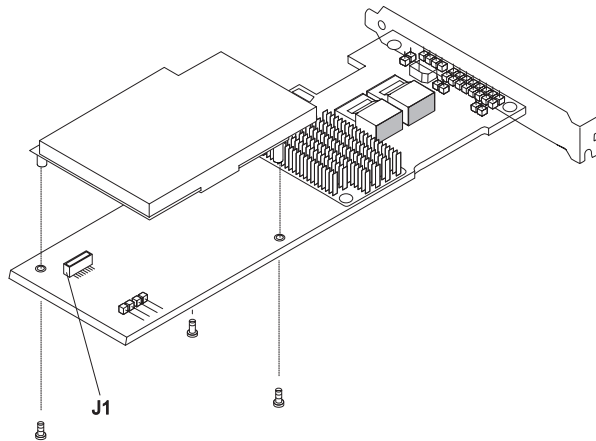
5. Install the interposer card in the interposer card connector on the RAID adapter:

   a. Remove the interposer card and the screw from the bag.

   b. Rotate the plastic standoff on the interposer card so that it aligns with the hole on the RAID adapter; then, align the connector on interposer card with the interposer card connector on the RAID adapter.

Plastic standoff   Interposer card

Screw   Interposer card connector
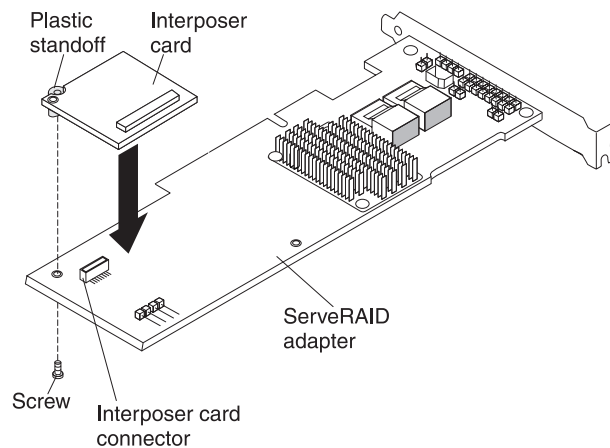
ServeRAID adapter

c. Press the interposer card down onto the interposer card connector on the RAID adapter until it is firmly seated.

d. From underneath the RAID adapter, insert the screw that you took from the bag and tighten the screw to secure the interposer card to the RAID adapter.

6. Connect one end of the remote battery cable to the interposer card.

   Attention: To avoid damage to the hardware, make sure that the black dot on the remote battery cable connector faces away from the interposer card on the adapter. Do not force the remote battery cable into the connector.

Remote battery cable connector

Remote battery cable
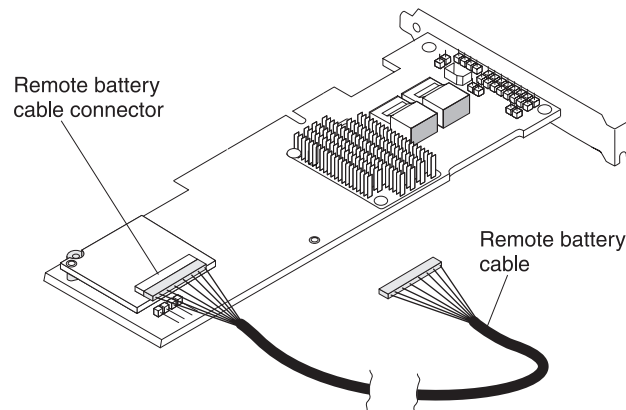
7. Install the RAID adapter on the riser-card and install the riser-card assembly in the server (see "Installing a PCI riser-card assembly" on page 68).

8. Connect the other end of the remote battery cable to the remote battery cable connector on the battery carrier.

   Attention: To avoid damage to the hardware, make sure that the black dot on the remote battery cable connector faces away from the interposer card on the adapter. Do not force the remote battery cable into the connector.

9. Route the remote battery cable in server and through the slots on the RAID battery tray as shown in the following illustrations (depending on the PCI slot in which the RAID adapter is installed.

   Attention: Make sure that the cable is not pinched and does not cover any connectors or obstruct any components on the system board.

PCI riser assembly (slot 2)   Remote battery cable

RAID battery

RAID battery tray

Remote battery cable

PCI riser assembly (slot 1)

RAID battery
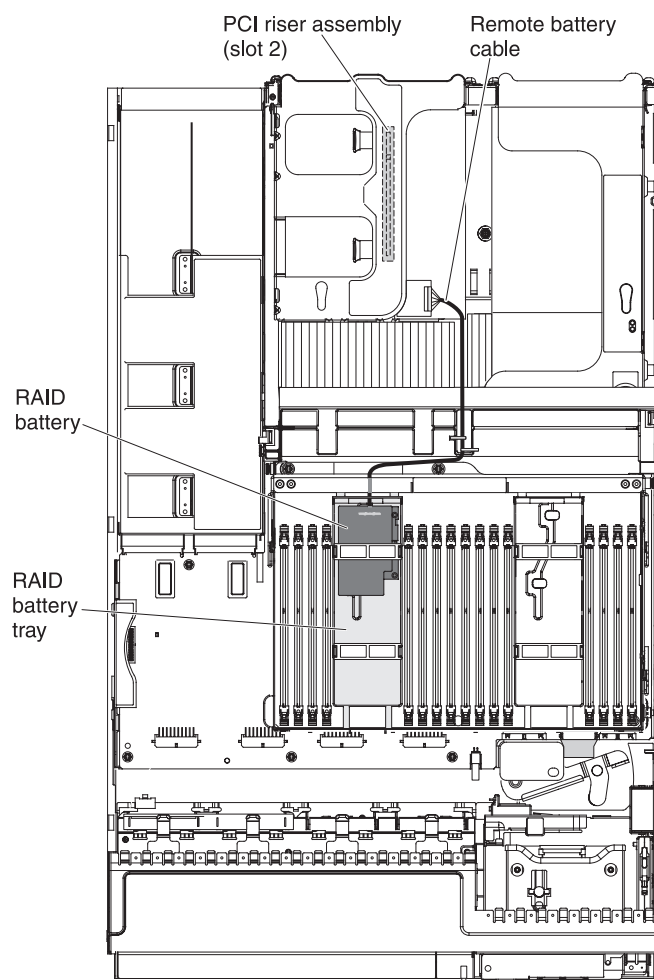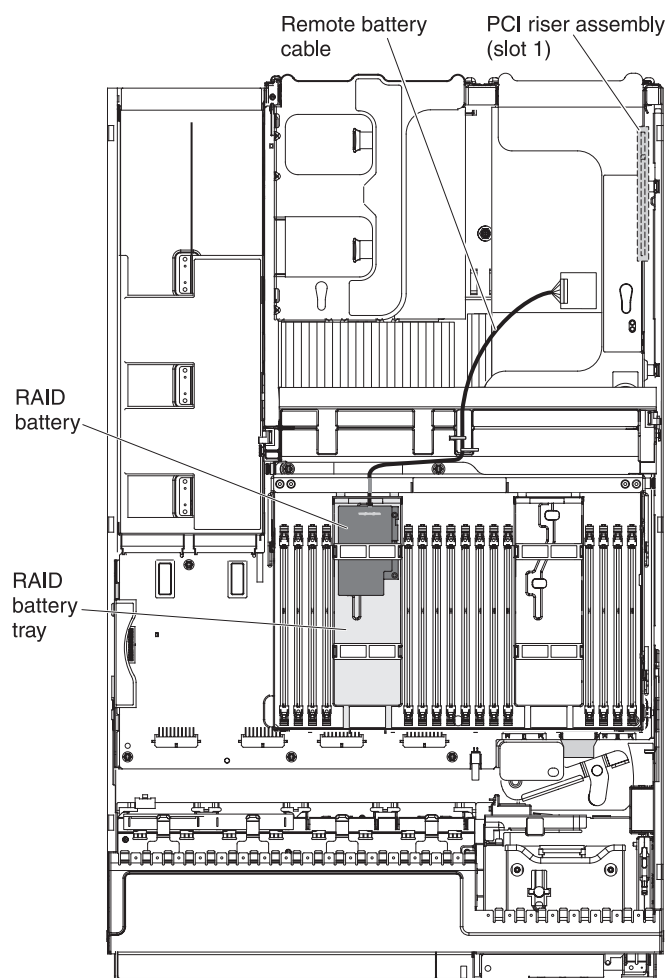
RAID battery tray

10. Install the battery on the RAID battery tray:

Battery retention clip

Battery

Posts

Rings

RAID battery tray
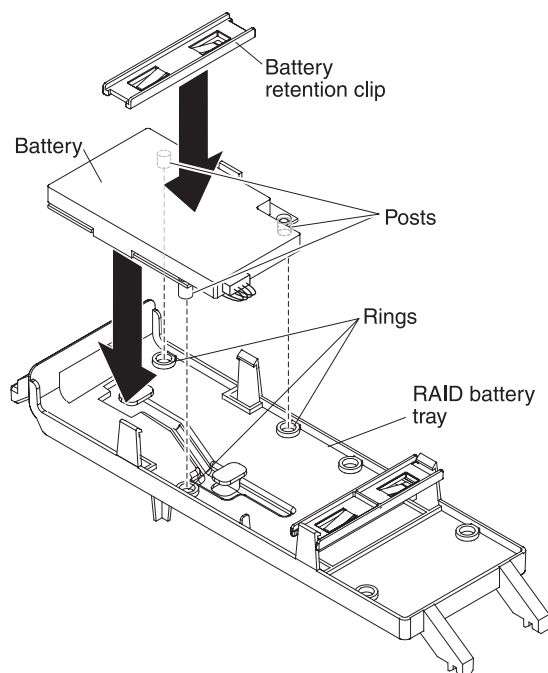
11. Take the battery retention clip and place it underneath the other tab while pressing the release tab toward the side of the server; then, press it down until it snaps in place to hold the battery carrier firmly in place.
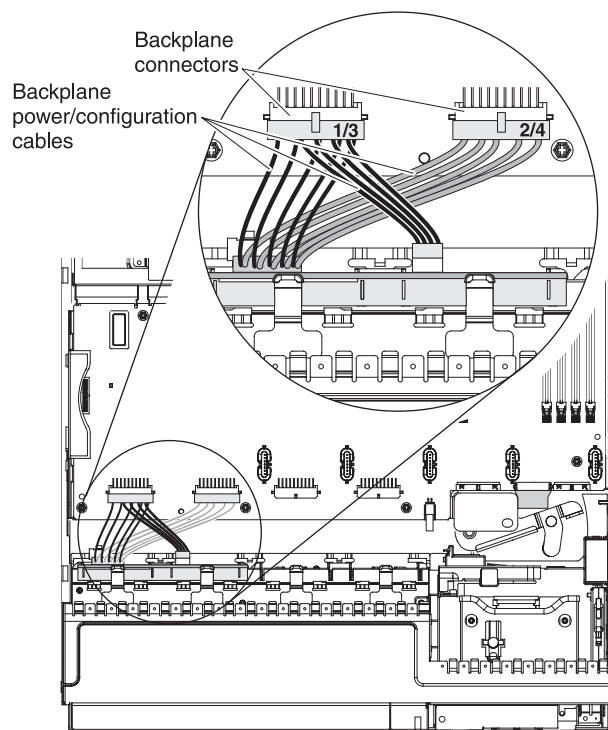
If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

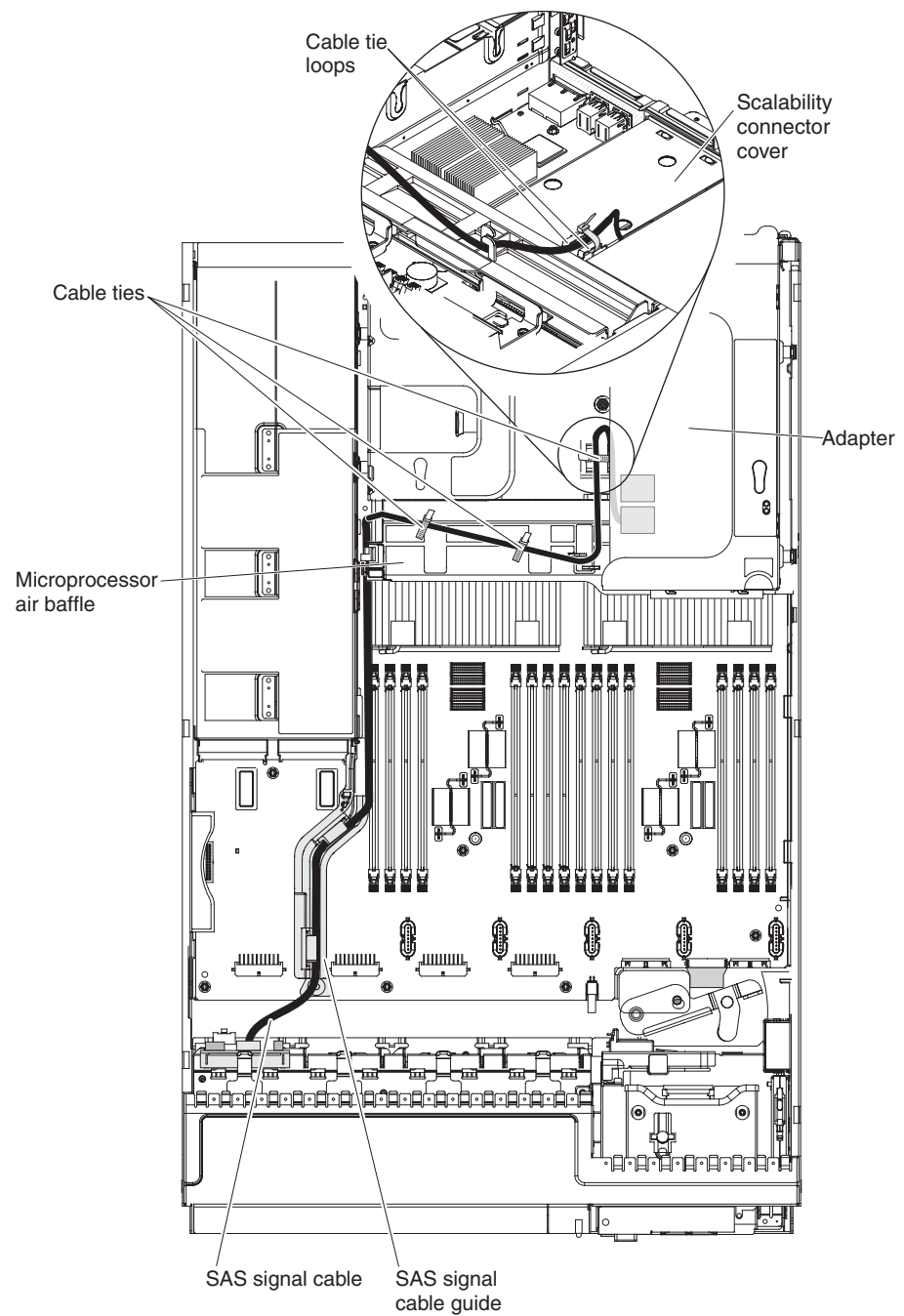## Installing the optional simple-swap SATA drive and backplate assembly

To install the optional simple-swap SATA drive and backplate assembly, complete the following steps:

Note:

1. If you install the simple-swap SATA drive and backplate assembly in the server, the backplate must be installed in the backplane slot closest to the information panel and the SATA drive must be installed in the drive-bay closest to the information panel.
2. When you install this option in the server, you will no longer be able to install the optional CD-DVD ROM drive in the server because you will need to connect the cable for this simple-swap SATA drive option to the CD/DVD-ROM drive connector on the system board. That is, you cannot have the simple-swap SATA drive and backplate assembly and the CD/DVD-ROM drive installed in the server at the same time. They both connect to the same connector on the system board.

Note:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.
3. Remove the top cover (see "Removing the server top cover" on page 45).
4. Remove the fan cage assembly (see "Removing the fan cage assembly" on page 49).
5. If a backplane filler panel is installed in the slot where you are installing the backplate assembly, remove the backplane filler panel.
6. Align the tabs on the bottom of the drive backplate with the backplate slots on the bottom of the backplane cage.
7. Insert the drive backplate tabs into the slots on the bottom of the backplate cage and lift up the retention latch on top of the backplane cage; then, rotate the drive backplate assembly forward until the backplate snaps into place into the retention latch on the drive cage.
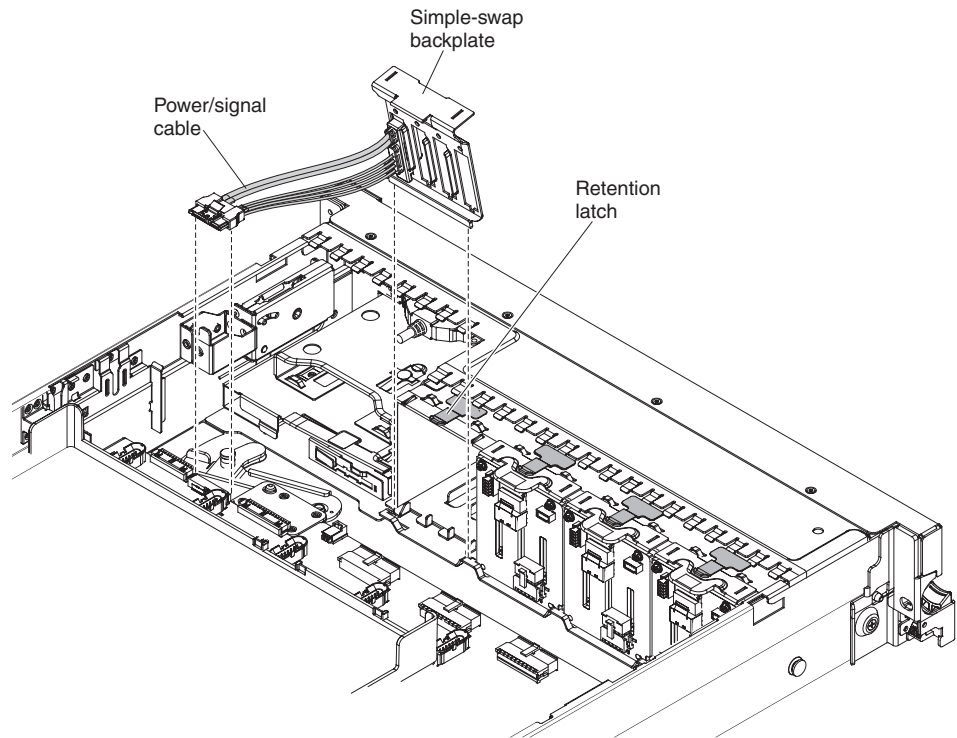
8. If a CD/DVD drive is installed in the server, disconnect the CD/DVD drive cable from the connector on the system board.

9. Take the clamp that comes with the simple-swap drive and backplate assembly kit and remove the paper label from the bottom of the clamp; then, stick the clamp onto the top of the operator information panel (see illustration below). Take the end of the CD/DVD drive cable that you disconnect from the system board and insert the cable into the clamp and twist the loops at the top of the clamp across each other to secure the cable in place.
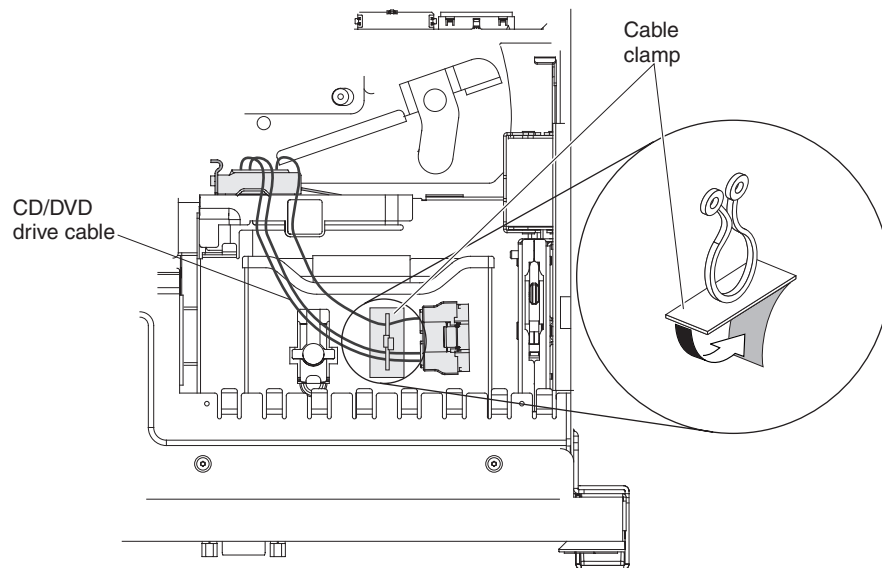
10. Connect the backplate cable to the CD/DVD/simple-swap SATA drive backplate connector on the system board.

11. Install the simple-swap drive into the drive bay nearest the operator information panel.

a. Remove the 4x2.5-inch filler panel on the front of the server next to the information panel.

b. Touch the static-protective package that contains the new drive to any unpainted metal surface on the server; then, remove the drive from the package and place it on a static-protective surface.

c. Grasp the black drive handle and press down on the blue release latch and align the drive assembly with the guide rails in the drive bay.

Drive bay
spacer filler

2.5-inch
simple-swap
drive

4x4 hard disk
drive filler
panel
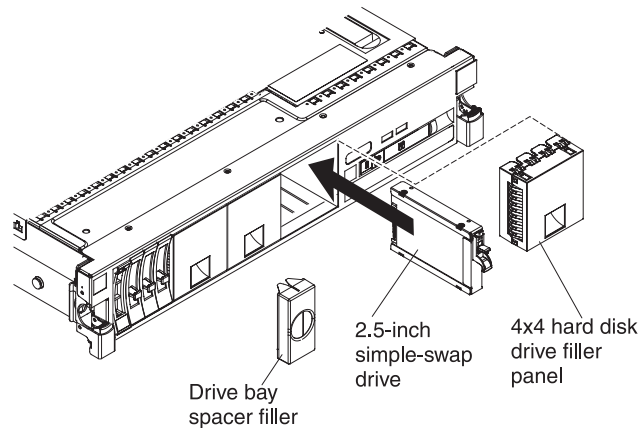
d. Gently push the drive assembly into the drive bay until the drive stops.

e. Install the plastic drive-bay spacer into the first two bays to the left of the SATA drive.

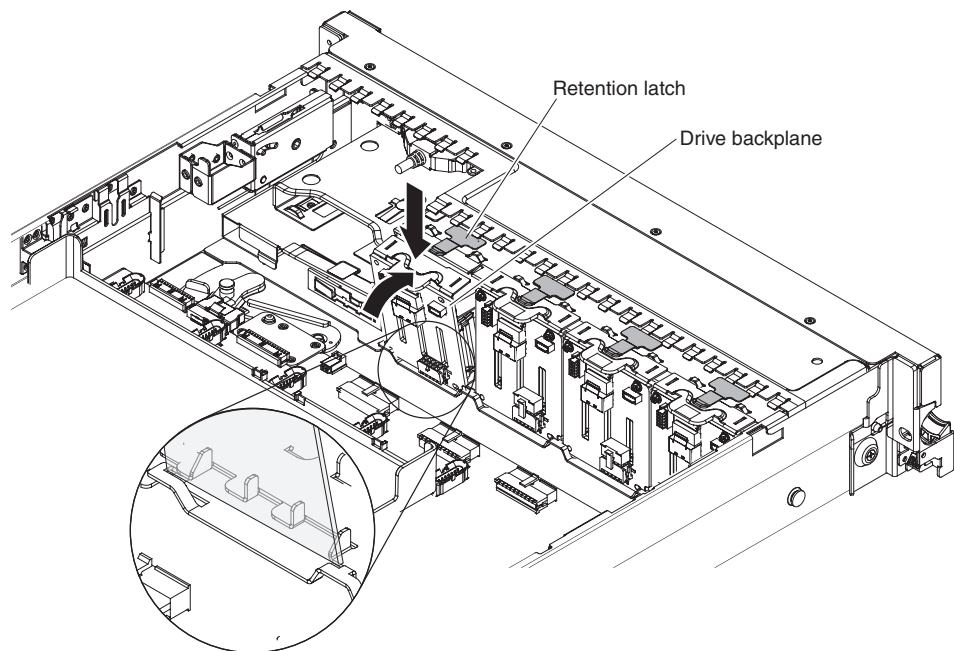12. Reinstall the fan cage assembly. (see "Replacing the fan cage assembly" on page 115).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

## Installing the 8x1.8-inch hot-swap drive backplane assembly

To install the 8x1.8-inch hot-swap drive backplane assembly, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Remove the fan cage assembly (see "Removing the fan cage assembly" on page 49).

5. If a backplane filler panel is installed in the slot where you are installing the backplane assembly, remove the backplane filler panel.

6. Align the drive backplane assembly with the drive-bay slots in which you want to install the assembly.

8x1.8-inch
drive backplane
assembly

1.8-inch
filler panel
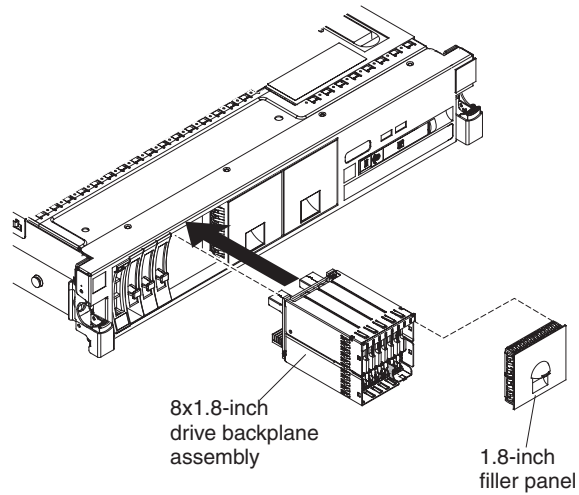
7. Slide the drive backplane assembly into the slot until it clicks into place.
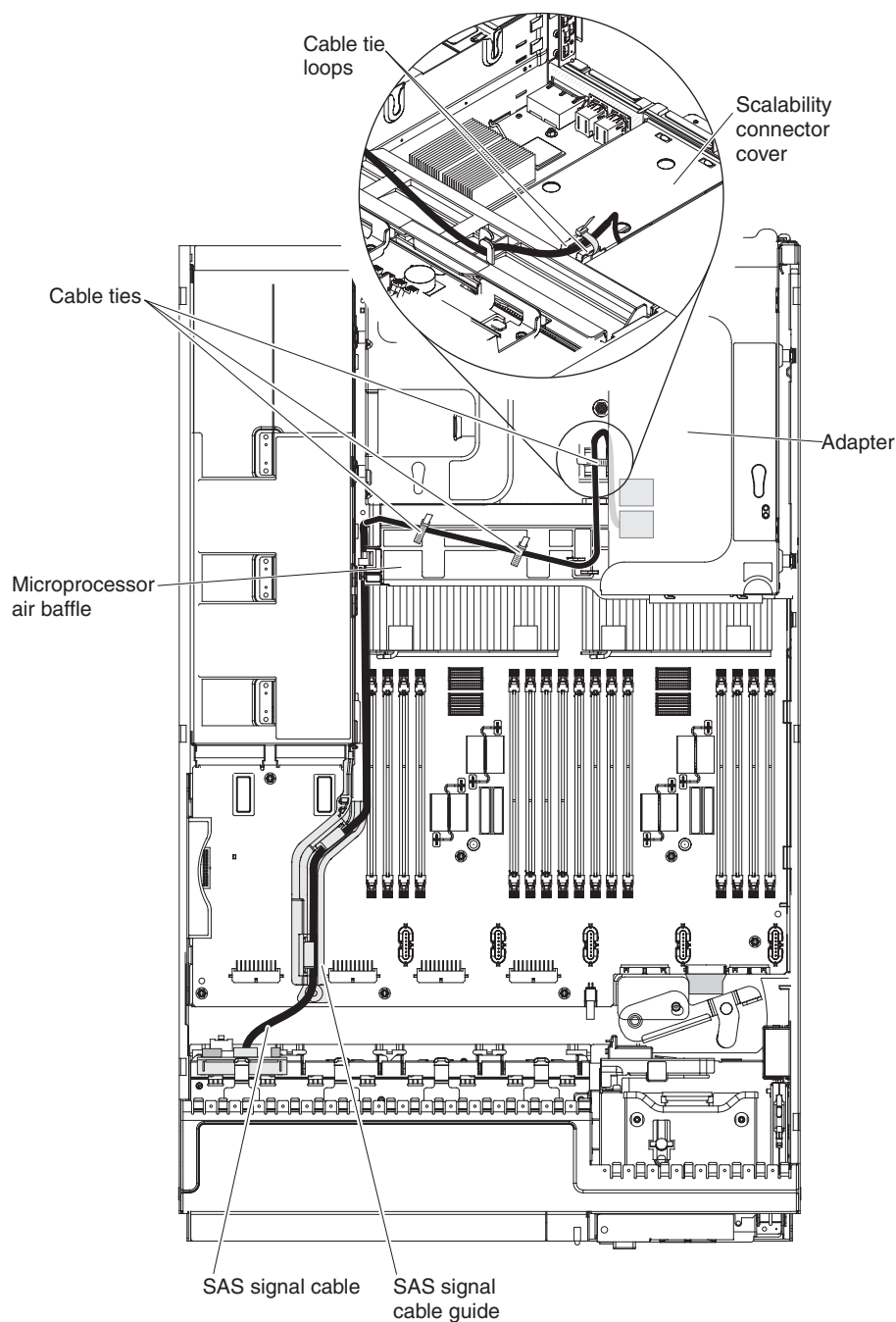
8. Connect the combination power/configuration cable end to the power and configuration connectors on the backplane assembly; then connect the power connector on the other end of the cable to the power backplane connector on the system board. See the following example illustration.

Backplane
connector

Backplane
power/configuration
cable
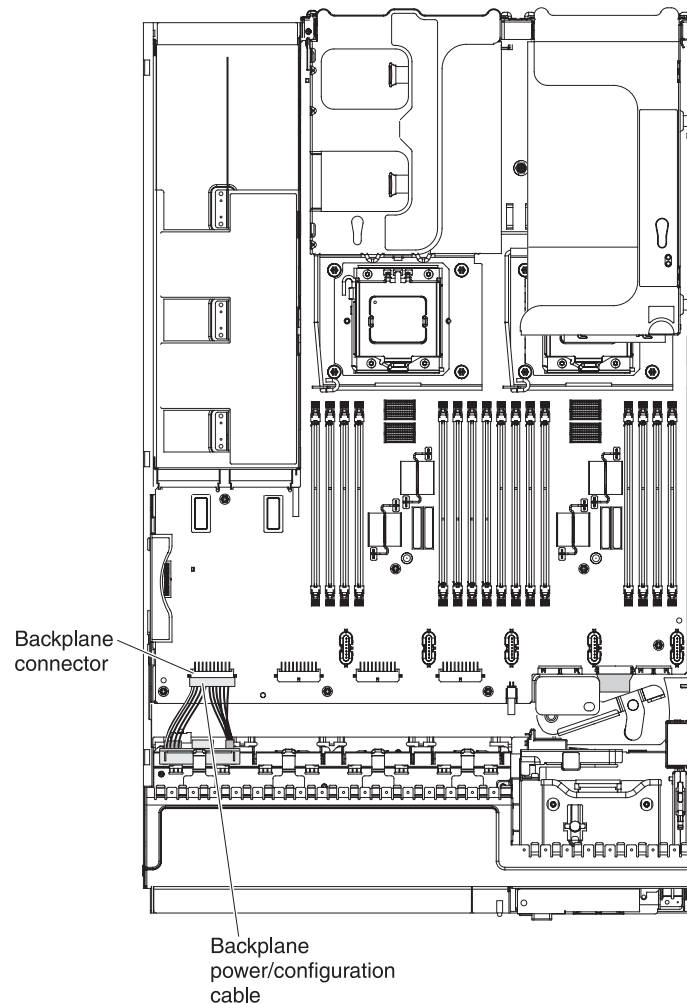
9. Connect the signal cables to the drive backplane assembly and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the way or get damaged.
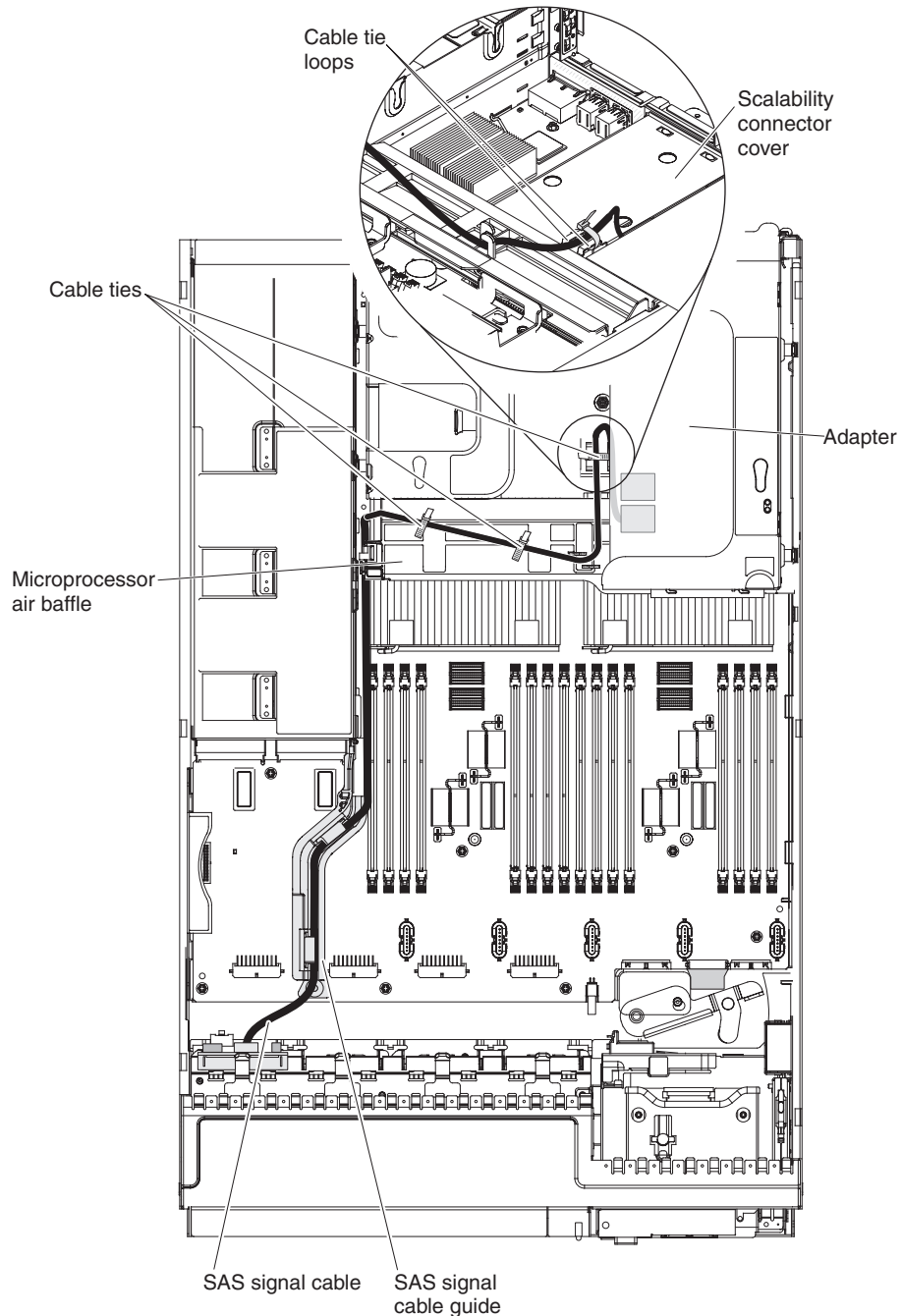
10. Install the drive filler panel.
11. Reinstall the fan cage assembly (see "Replacing the fan cage assembly" on page 115).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing the 8x2.5-inch hot-swap drive backplane

SAS signal
connector

SAS signal
connector

Configuration
connector

SAS power
connector
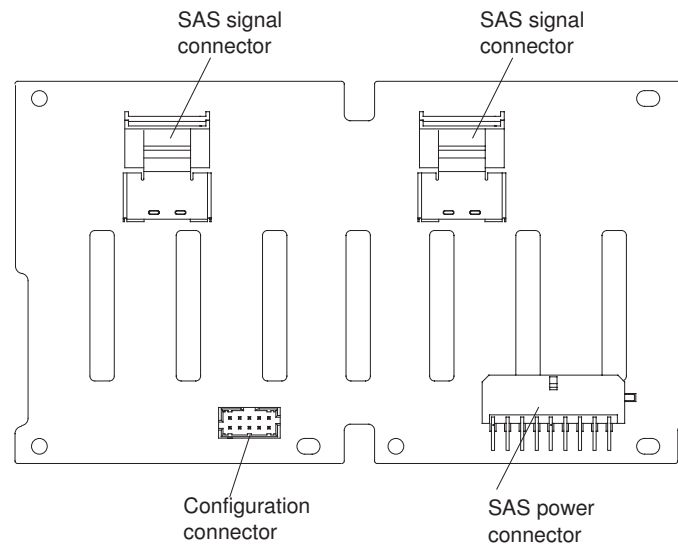
To install the 8x2.5-inch hot-swap drive backplane, complete the following steps:
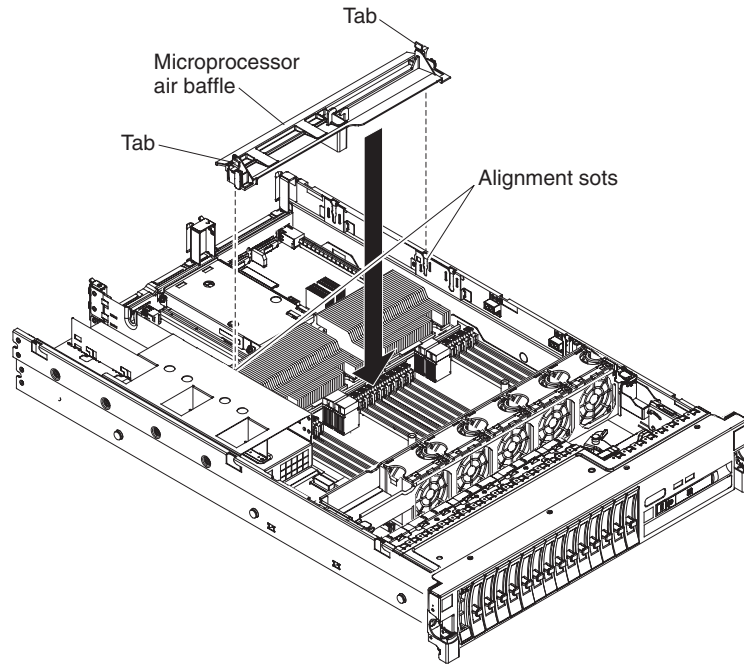
1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Remove the fan cage assembly (see "Removing the fan cage assembly" on page 49).

5. If a backplane filler panel is installed in the slot where you are installing the drive backplane, remove the backplane filler panel.

6. Insert the drive backplane tabs into the slots on the bottom of the backplane cage and lift up the retention latch on top of the drive cage; then, rotate the drive backplane assembly forward until the backplane is latched.

7. Connect the combination power/configuration cable end to the power and configuration connectors on the drive backplane. Connect the two power connectors on the other end of the cable to the power backplane connectors on the system board. The power connector on the end of the black cable (which might be labelled 1/3) connects to backplane connectors 1 or 3 on the system board. The power connector on the end of the gray cable (which might be labelled 2/4) connects to backplane connectors 2 or 4 on the system board.

Backplane
connectors

Backplane
power/configuration
cables

1/3   2/4

8. Connect the signal cables to the drive backplane assembly and to the adapter.
   Be sure to route the signal cables through the SAS cable guide and up and
   over the rear of the microprocessor air baffle; then, through the loops on the
   scalability connector cover and then to the adapter (see the following
   illustration). Use the cable ties (as shown in the illustration) that come with
   the drive backplane to secure the SAS cables so that they do not get in the

way or get damaged.

Cable tie loops

Scalability connector cover

Cable ties

Adapter

Microprocessor air baffle

SAS signal cable   SAS signal cable guide

9. Install the drive filler panel.
10. Reinstall the fan cage assembly (see "Replacing the fan cage assembly" on page 115).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Installing the 4x2.5-inch hot-swap drive backplane

To install the 4x2.5-inch hot-swap drive backplane, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Turn off the server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server.

3. Remove the top cover (see "Removing the server top cover" on page 45).

4. Remove the fan cage assembly (see "Removing the fan cage assembly" on page 49).

5. If a backplane filler panel is installed in the slot where you are installing the drive backplane, remove the backplane filler panel.

6. Insert the drive backplane tabs into the slots on the bottom of the backplane cage and lift up the retention latch on top of the drive cage; then, rotate the drive backplane assembly forward until the backplane is latched.

7. Connect the combination power/configuration cable end to the power and configuration connectors on the drive backplane; then connect the power

connector on the other end of the cable to the power backplane connector on the system board. See the following example illustration.

Backplane connector

Backplane power/configuration cable
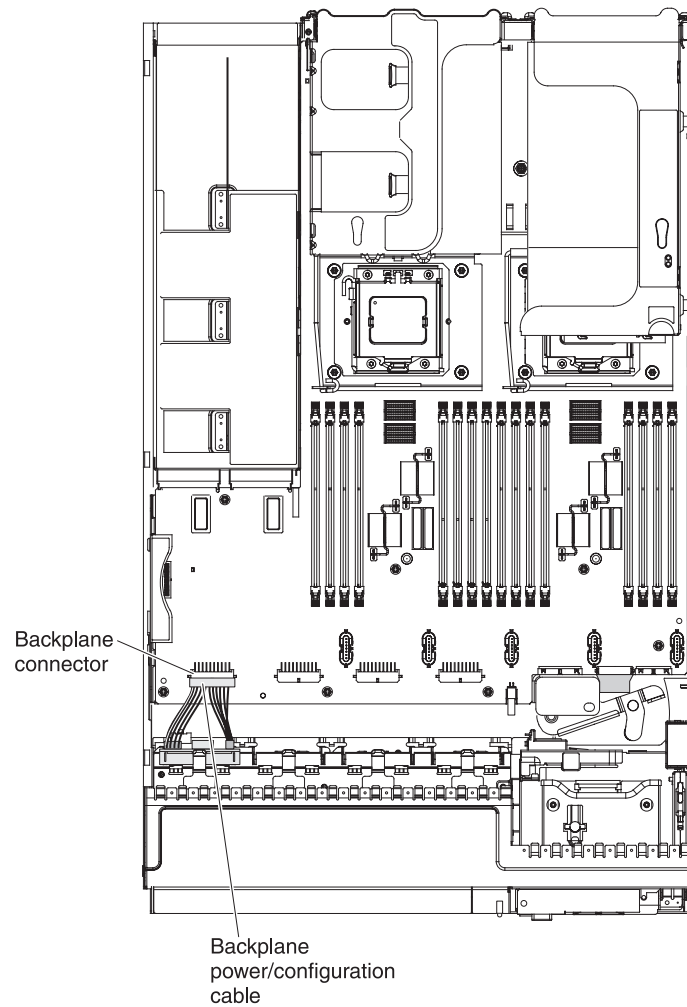
8. Connect signal cables to the drive backplane assembly and to the adapter. Be sure to route the signal cables through the SAS cable guide and up and over the rear of the microprocessor air baffle; then, through the loops on the scalability connector cover and then to the adapter (see the following illustration). Use the cable ties (as shown in the illustration) that come with the drive backplane to secure the SAS cables so that they do not get in the

way or get damaged.

9. Install the drive filler panel.
10. Reinstall the fan cage assembly (see "Replacing the fan cage assembly" on page 115).

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the installation" on page 113.

Completing the installation

To complete the installation, complete the following steps:

1. If you removed any air baffles or the memory tray, reinstall them (see "Replacing the DIMM air baffle," "Replacing the memory tray" on page 114, and "Replacing the microprocessor air baffle" on page 114).

2. Replace the fan cage assembly, if removed (see "Replacing the fan cage assembly" on page 115).

3. Reconnect the cables and power cords (see "Connecting the cables" on page 117).

4. Update the server configuration (see "Updating the server configuration" on page 118).

5. If you removed the server cover, replace it (see "Replacing the server top cover" on page 116).

6. Start the server. Confirm that is starts correctly and recognizes the newly installed devices, and make sure that no error LEDs are lit.

7. Complete the additional steps in "Instructions for IBM Business Partners" on page 34.

8. Install the server in the rack cabinet (see the *Rack Installation Instructions* that come with the server for instructions).

Replacing the DIMM air baffle

To install the DIMM air baffle, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Align the tabs on the sides of the DIMM air baffle with the slots on the power supply cage and the chassis wall and lower the DIMM air baffle into the server.
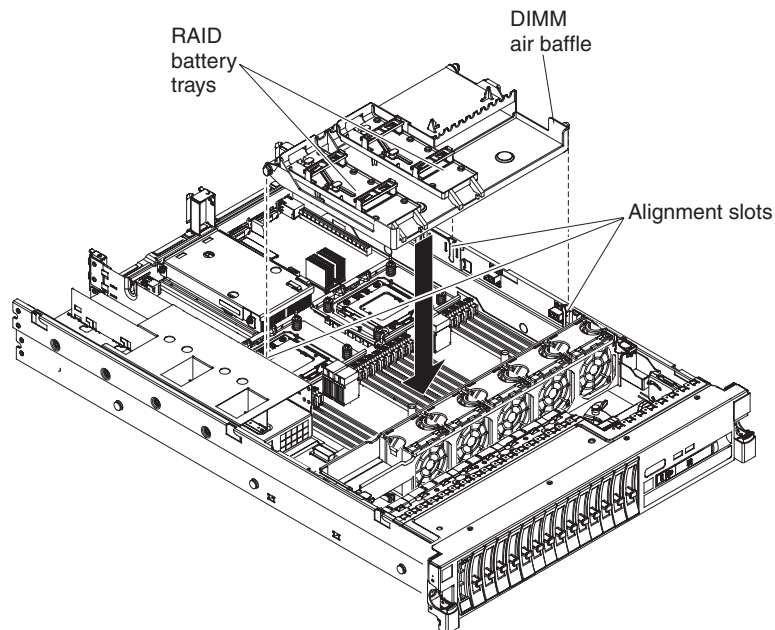
Replacing the microprocessor air baffle

To install the microprocessor air baffle, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Align the tabs on the air baffle with the slots on the power supply cage and the chassis wall; then, slide the air baffle down until it is seated firmly with the baffle tabs in the holes on the power supply cage and chassis wall.

Replacing the memory tray

To replace the memory tray, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Align the tabs on the sides of the memory tray with the slots on the power supply cage and the chassis wall and lower the memory tray into the server.

Memory tray handle

RAID battery trays

Alignment slots
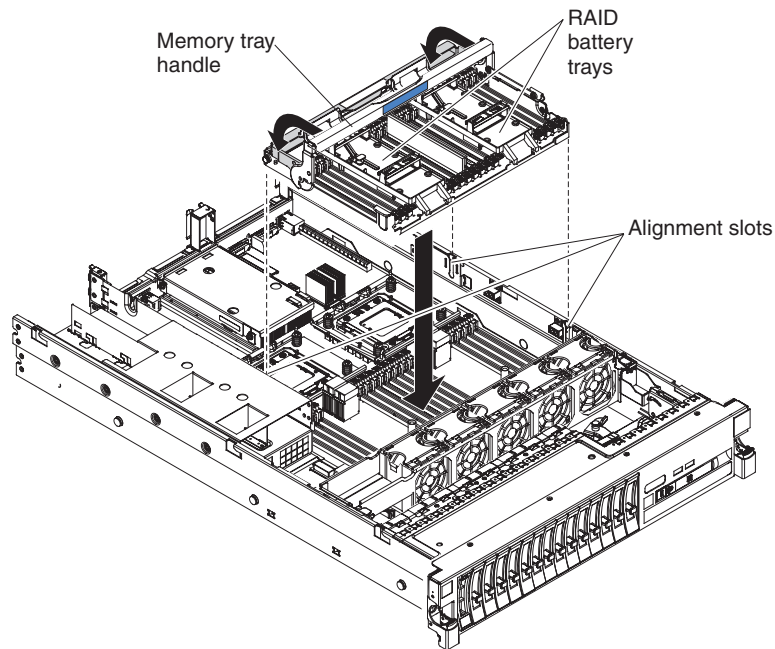
3. Reinstall the RAID battery tray on the memory tray.

4. Rotate the memory tray handle toward the rear of the server until the memory tray is seated firmly and the handle is locked in place.

Replacing the fan cage assembly

To replace the fan cage assembly, complete the following steps:

1. Align the tabs on the fan cage assembly with the slots on both sides of the chassis and lower it into the server.

Release latch

Fan cage assembly

Release latch

Slots
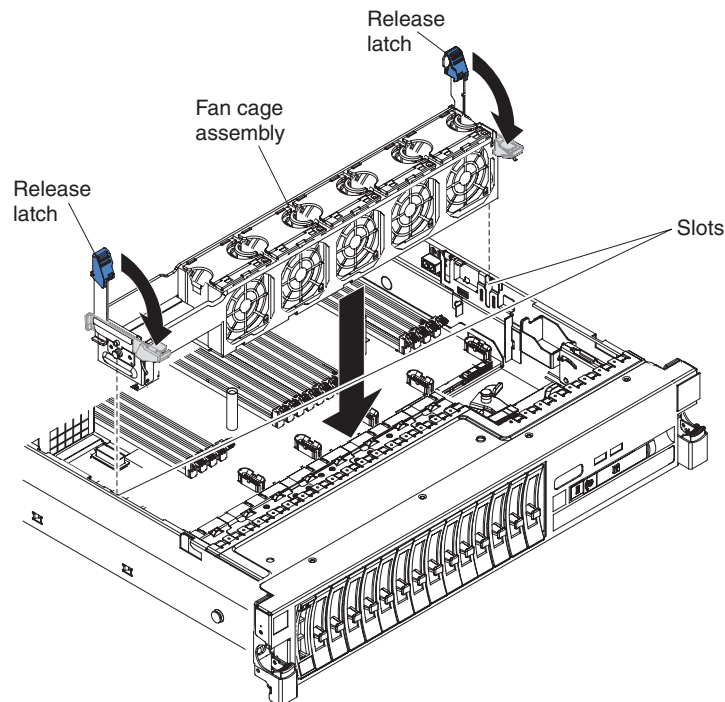
2. Squeeze the tabs on the ends of the fan cage assembly release latches and hold them while rotating the release latches down until the release latches are in the locked position.

   Note: It is easier to rotate the release latches to the locked position in the server when you squeeze the tabs and hold them.

Replacing the server top cover

To replace the server cover, complete the following steps:

1. Make sure that all cables, adapters, and other components are installed and seated correctly and that you have not left loose tools or parts inside the server. Also, make sure that all internal cables are correctly routed.

2. Align the cover over the server (toward the rear of the server) until the cover edges slip into position over the chassis.

   Important: Before sliding the cover forward, make sure that all the tabs on the cover engage the chassis correctly. If all the tabs do not engage the chassis correctly, it will be hard to remove the cover later.
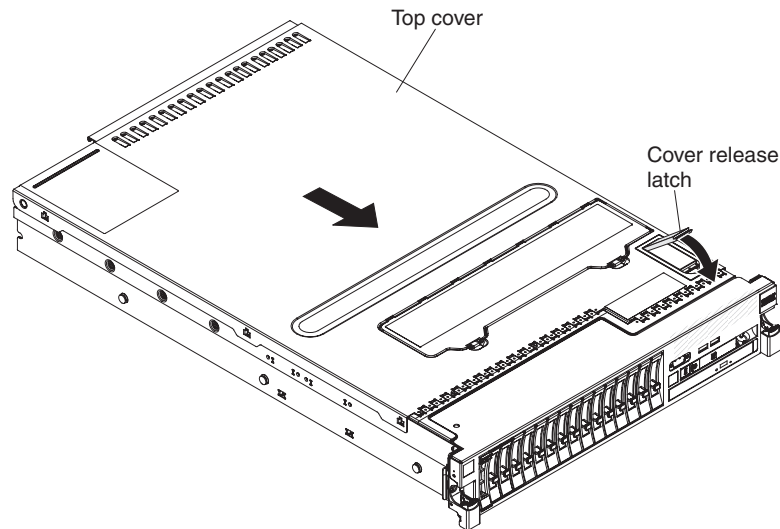
3. Slightly slide the cover toward the front of the server until the inset tabs start to engage on the server; then, press down on the cover release latch until it clicks into place.

Connecting the cables

The following illustration shows the locations of the input and output connectors on the front of the server.

Video connector   USB 1 connector   Operator information panel release latch

Scalability LED   USB 2 connector

Drive bays

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Rack release latch   Operator information panel   Rack release latch

Drive activity LED (green)   Power-on button and LED   Optical drive activity LED   Optical drive eject button

Drive status LED (amber)

The following illustration shows the locations of the input and output connectors on the rear of the server.

PCI slot 2   PCI slot 4   Ethernet 1   Ethernet 2

PCI slot 1   PCI slot 3   PCI slot 5   Power supply 3   Power supply 4

Video   Serial connector   QPI port 1   QPI port 2   USBs 3 - 4   USBs 5 - 6   Power connectors

System management Ethernet connector   Power supply 1   Power supply 2
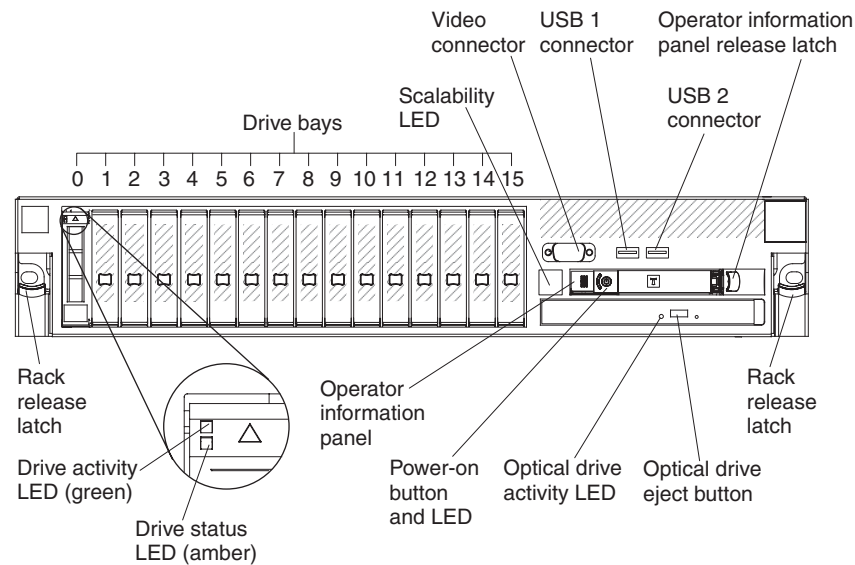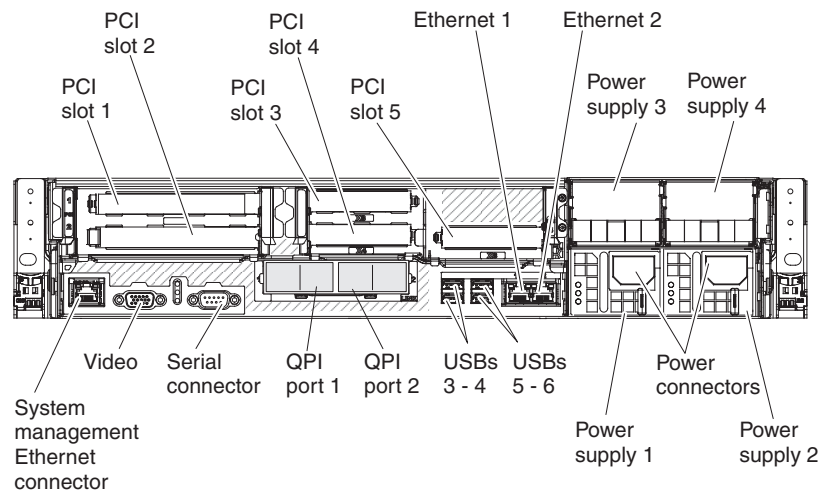
You must turn off the server before you connect or disconnect cables.

See the documentation that comes with any external devices for additional cabling instructions. It might be easier for you to route cables before you connect the devices to the server.

For information about cabling the server and MAX5 in a rack cabinet, see the documentation that comes with the QPI cabling option and the EXA cabling option.

Updating the server configuration

When you start the server for the first time after you add or remove a device, you might receive a message that the configuration has changed. The Setup utility starts automatically so that you can save the new configuration settings.

Some optional devices have device drivers that you must install. For information about installing device drivers, see the documentation that comes with each device.

Before you attach a MAX5 to the server and try to use it, you must update the server firmware with the latest level of firmware or code. If you attach and try to use the MAX5 without updating the server firmware, you might get unexpected system behavior or the server might not power on. For special instructions to follow before you attach the MAX5 to the server, go to http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-5085756.

If the server has an optional RAID adapter and you have installed or removed a hard disk drive, see the documentation that comes with the RAID adapter for information about reconfiguring the disk arrays.

The server comes with at least one microprocessor. If more that one microprocessor is installed, the server can operate as a symmetric multiprocessing (SMP) server. You might have to upgrade the operating system to support SMP. For more information, see "Typical operating-system installation" on page 141 and the operating-system documentation.

For information about configuring the integrated Gigabit Ethernet controller, see "Configuring the Gigabit Ethernet controller" on page 146.

Installing hardware devices in the MAX5 expansion module

The following sections provide detailed instructions for installing optional hardware devices in the optional IBM MAX5 for System x memory expansion module.

MAX5 components

The following illustration shows the major components in the MAX5 memory expansion module. The illustrations in this document might differ slightly from your hardware.

DIMM filler

EXA filler

QPI filler

Chasis

5-drop fan cable

DIMM

Hot-swap power supply

Hot-swap fan

Power supply filler

System-board tray assembly

Air baffle

Bezel

Information panel assembly
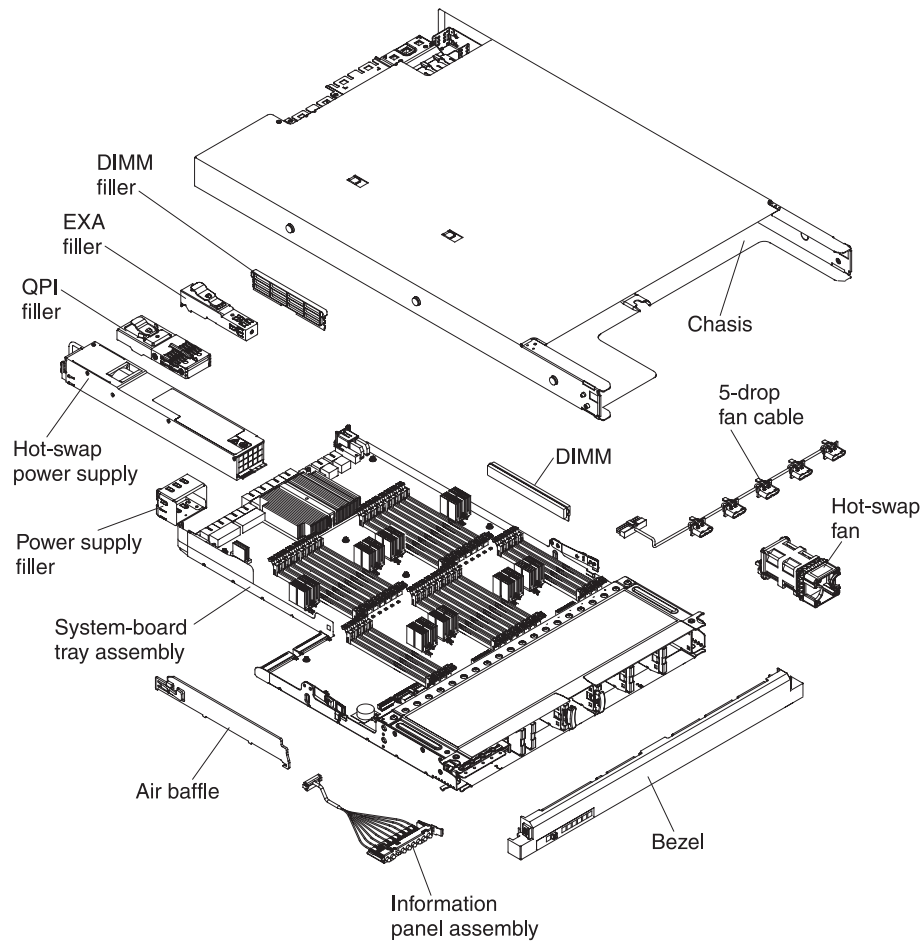
Removing the MAX5 bezel

To remove the MAX5 expansion module bezel, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Press in on the release tabs on both end of the bezel and pull it off the chassis.
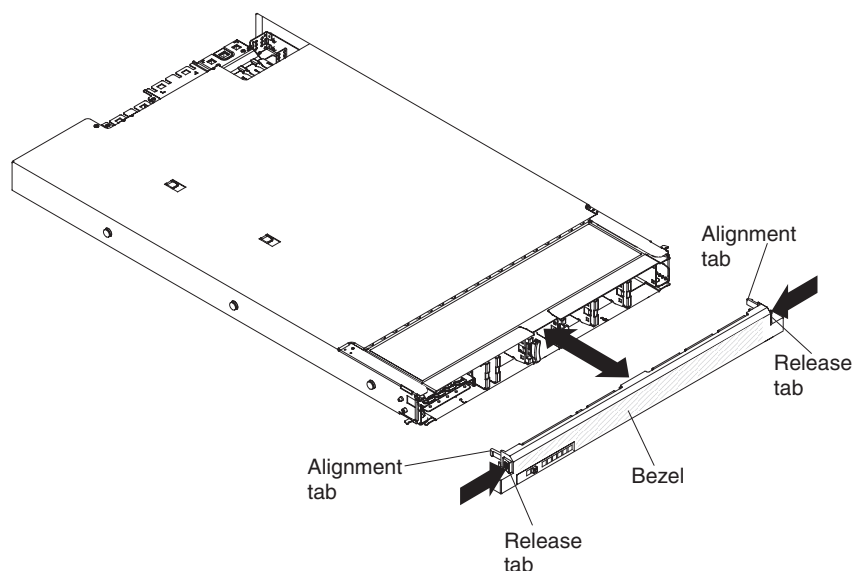
Removing the MAX5 system-board tray

To remove the MAX5 system-board tray, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the host server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server. Disconnect all power cords from the MAX5; then, disconnect all external cables from the MAX5.
3. Remove the bezel (see "Removing the MAX5 bezel" on page 119).
4. Grasp the blue release latches on the system-board tray handles and press release latches in opposite directions and rotate the handles to the fully open position.
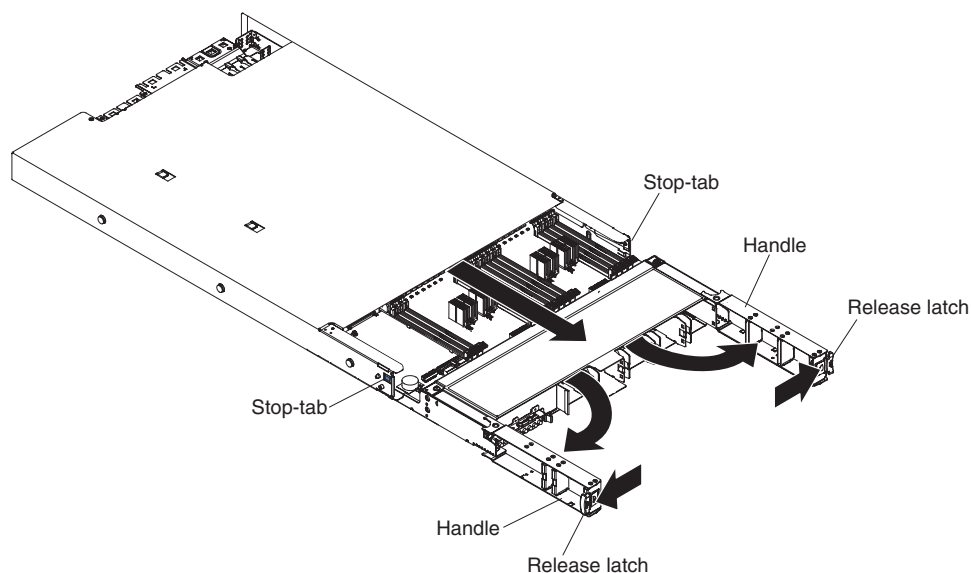
5. Grasp the handles and pull the system-board tray out until it stops; then, press inward the blue stop-tabs on both sides of the system-board tray and pull the tray out of the chassis.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the MAX5 installation" on page 128.

Installing a MAX5 memory module

The following notes describe the types of DIMMs that the MAX5 memory expansion module supports and other information that you must consider when you install DIMMs.

- Confirm that the MAX5 supports the DIMM that you are installing, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.
- The MAX5 supports a maximum of 32 DIMMs (single-rank, dual-rank, or quad-rank).

    Note: To determine the type of a DIMM, see the label on the DIMM. The information on the label is in the format xxxxx nRxxx PC3-xxxxx-xx-xx-xxx. The numeral in the sixth numerical position indicates whether the DIMM is single-rank (n=1) or dual-rank (n=2).

- The DIMM options that are available for the MAX5 are 2 GB, 4 GB, 8 GB, 16 GB, and 32 GB (when available and depending on the model).
- If you install 32 GB DIMMs in the MAX5, all of the DIMMs must be 32 GB capacity DIMMs. You cannot mix the 32 GB DIMMs with other capacity DIMMs in the system.
- The MAX5 supports a minimum of 4 GB and a maximum of 1 TB of system memory.
- The MAX5 supports 1.35-volt (low-voltage) and 1.5-volt DIMMs. In addition, support is dependent on the host server machine type that the MAX5 is connected to as noted below:
  - When connecting the MAX5 to IBM System x3690 X5 Machine Types 7148 and 7149:
    - Install only 1.5-volt DIMMs in the MAX5.
  - When connecting the MAX5 to IBM System x3690 X5 Machine Types 7147 and 7192:
    - The MAX5 supports low-voltage (1.35-volt) DIMMs at capacities of 4 GB, 8 GB, 16 GB, and 32 GB only.
    - If you install 32 GB DIMMs in the MAX5, all of the DIMMs must be 32 GB capacity DIMMs. You cannot mix the 32 GB DIMMs with other capacity DIMMs in the system.
    - When you mix 1.35-volt and 1.5-volt DIMMs in the MAX5, the MAX5 will operate at the 1.5-volt rate.
    - You can enable all DIMMs (1.35-volt and 1.5-volt) to operate at 1.5-volt in the host server Setup utility.
- Some MAX5 models come with the Intel 7500 scalable memory buffer or the Intel 7510 scalable memory buffer. See the parts listing table under "Replaceable MAX5 components" in the *Problem Determination and Service Guide* for information about the Intel memory buffer that is supported on the MAX5 system board tray.
- Double-device data correction support is only available when 16 GB x4 DRAM technology DIMMs are installed in the MAX5 and the MAX5 is connected to a host server.
- The MAX5 does not support memory sparing. However, the host server does support memory sparing. For more information about installing memory on the host server and memory sparing, see "Installing a memory module" on page 50.

- When you populate DIMMs in the MAX5, populate the larger capacity DIMMs first; then the smaller capacity DIMMs. See Table 16 on page 123 for non-mirroring mode DIMM population sequence and Table 17 on page 124 for memory-mirroring mode DIMM population sequence.
- The MAX5 provides eight memory ports (memory channels) and each memory port supports up to four DIMMs. Do not mix DIMMs with by x4 technology (DIMMs with DRAMs that are organized with 4 data lanes) and x8 technology (DIMMs with DRAMs that are organized with 8 data lanes) in the same memory port. The following table shows the DIMM connectors on the eight memory ports.

Table 14. DIMM connectors on each memory port

Memory ports	DIMM connectors
1	1, 2, 7, and 8
2	3, 4, 5, and 6
3	9, 10, 15, and 16
4	11, 12, 13, and 14
5	17, 18, 23, and 24
6	19, 20, 21, and 22
7	25, 26, 31, and 32
8	27, 28, 29, and 30
Note: 2 GB, 4 GB, and 8 GB DIMMs are x4 technology DIMMs. 16 GB and 32 GB DIMMs are x8 technology DIMMs.	

- Do not mix DIMMs with 1 Gb (gigabit) DRAM technology, 2 Gb DRAM technology, or other gigabit DRAM technologies in banks of eight DIMMs on memory ports (memory channels) that are on the same memory controller. This is not supported on the MAX5. The following table lists the DIMM connectors for each bank of eight DIMMs that are on the memory ports within the same memory controller.

Table 15. DIMM connectors on memory ports with the same memory controller

Bank of DIMMs	DIMM connectors
1st bank of DIMMs	1, 2, 3, 4, 5, 6, 7, and 8
2nd bank of DIMMs	9, 10, 11, 12, 13, 14, 15, and 16
3rd bank of DIMMs	17, 18, 19, 20, 21, 22, 23, and 24
4th bank of DIMMs	25, 26, 27, 28, 29, 30, 31, and 32

- DIMMs must be installed in pairs for non-mirroring mode and in sets of four for memory-mirroring mode.
- A minimum of two DIMMs must be installed in the MAX5 for each microprocessor in the host server.
- The maximum operating speed of the MAX5 is determined by the slowest DIMM installed in the MAX5.
- The MAX5 does not come with any DIMMs installed when you purchase it as a option. When you install DIMMs, install them in the order shown in the following tables to optimize system performance.
- The MAX5 supports non-mirroring mode and memory-mirroring mode through the host server.

– **Non-mirroring mode**. When you use the non-mirroring mode, install DIMMs as indicated in the following table:

Table 16. Non-mirroring mode DIMM population sequence for the MAX5 memory expansion module

Pairs of DIMMs	DIMM connector population sequence
Pair 1	28, 29
Pair 2	9, 16
Pair 3	1, 8
Pair 4	20, 21
Pair 5	26, 31
Pair 6	11, 14
Pair 7	3, 6
Pair 8	18, 23
Pair 9	27, 30
Pair 10	10, 15
Pair 11	2, 7
Pair 12	19, 22
Pair 13	25, 32
Pair 14	12, 13
Pair 15	4, 5
Pair 16	17, 24

Note: When you populate DIMMs in the MAX5, populate the larger capacity DIMMs first; then the smaller capacity DIMMs.

– **Memory-mirroring mode**. When you use the mirroring mode feature, consider the following information:

- Memory-mirroring mode replicates and stores data on sets of DIMMs simultaneously. If a failure occurs, the memory controller switches from the primary set of DIMMs to the backup set of DIMMs. To enable memory mirroring through the Setup utility, select **System Settings → Memory**. For more information, see "Using the Setup utility" on page 132.

- DIMMs must be installed in sets of four. The DIMMs in each set must be the same size and type. This is applicable also when the MAX5 expansion module is attached to a host server and the host server has an optional memory tray installed in the server. You must install DIMMs in sets of four DIMMs for memory-mirroring mode in each (server, memory tray, and the MAX5).

- The maximum available memory is reduced to half of the installed memory when memory mirroring is enabled. For example, if the MAX5 expansion module has 64 GB of memory installed, only 32 GB of addressable memory is available when you use memory mirroring.

- The following table lists the DIMM installation sequence for memory-mirroring mode.

Table 17. Memory-mirroring mode DIMM population sequence for the MAX5 memory expansion module

Sets of 4 DIMMs	DIMM connector population sequence
Set 1	9, 16, 28, 29
Set 2	1, 8, 20, 21
Set 3	11, 14, 26, 31
Set 4	3, 6, 18, 23
Set 5	10, 15, 27, 30
Set 6	2, 7, 19, 22
Set 7	12, 13, 25, 32
Set 8	4, 5, 17, 24

Note: When you populate DIMMs in the MAX5, populate the larger capacity DIMMs first; then the smaller capacity DIMMs.

The following illustration shows the location of the DIMMs connectors on the system-board tray.
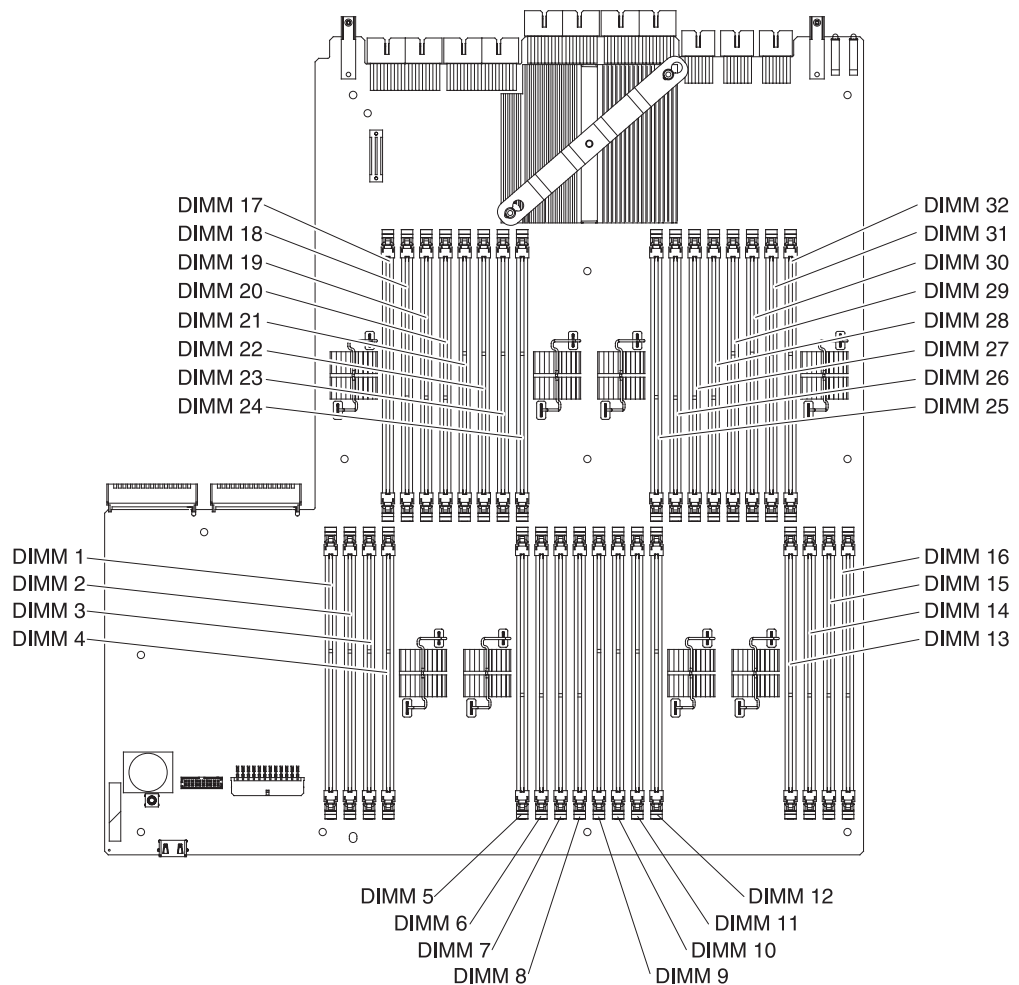
To install a memory module in the MAX5 expansion module, complete the following steps.

Note: The MAX5 might come with DIMM fillers on DIMM connectors that are not populated. Remove them before you install DIMMs in those connectors.

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.
2. Turn off the host server (see "Turning off the server" on page 24) and all attached peripheral devices. Disconnect all power cords; then, disconnect all external cables from the server. Disconnect all power cords from the MAX5; then, disconnect all external cables from the MAX5.
3. Remove the bezel (see "Removing the MAX5 bezel" on page 119).
4. Remove the system-board tray (see "Removing the MAX5 bezel" on page 119).
5. Remove any DIMM fillers from the DIMM slots that you want to populate.
6. Touch the static-protective package that contains the new DIMM to any unpainted metal surface on the outside of the MAX5; then, remove the DIMM from the package.
7. Carefully open both retaining clips on each end of the DIMM connector.

   Attention: To avoid breaking the retaining clips or damaging the DIMM connectors, open and close the clips gently.
8. Turn the DIMM so that the DIMM keys align correctly with the connector.
9. Insert the DIMM into the connector by aligning the edges of the DIMM with the slots at the ends of the DIMM connector.
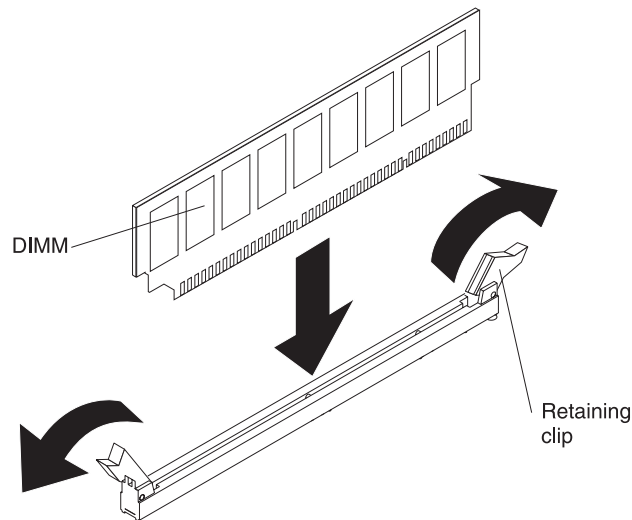
10. Firmly press the DIMM straight down into the connector by applying pressure on both ends of the DIMM simultaneously. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector.

    Note: If there is a gap between the DIMM and the retaining clips, the DIMM has not been correctly inserted; open the retaining clips, remove the DIMM, and then reinsert it.
11. Replace the system-board tray ("Replacing the MAX5 system-board tray" on page 128). Grasp the system-board tray on both sides (near the stop-tabs) and align the system-board tray with the chassis.

12. Slide the system-board tray forward until the tabs on the bottom of the handles touch the chassis; then, close the handles and press firmly on the release latches to snap them into the locked position.

If you have other devices to install or remove, do so now. Otherwise, go to "Completing the MAX5 installation" on page 128.

Installing a MAX5 hot-swap power supply

The following notes describe the type of power supply that the MAX5 expansion module supports and other information that you must consider when you install a power supply:

- Confirm that the MAX5 supports the power supply that you are installing, see http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/.
- The IBM MAX5 for System x memory expansion module comes with one 675-watt hot-swap 12-volt output power supply. The input voltage is 110 V ac or 220 V ac auto-sensing. Two power supplies must be installed for redundancy support.

  Note: You cannot mix 110 V ac and 220 V ac power supplies in the MAX5, it is not supported.
- These power supplies are designed for parallel operation. In the event of a power-supply failure, the redundant power supply continues to power the system. The server supports a maximum of two power supplies.

Statement 5

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

Statement 8

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

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

To install a hot-swap power supply in the MAX5 memory expansion module, complete the following steps:

1. Read the safety information that begins "Safety" on page v and "Installation guidelines" on page 43.
2. If the server is in a rack, at the back of the server, pull back the cable-management arm to gain access to the rear of the server and the power supply.
3. If you are installing a hot-swap power supply into an empty bay, remove the power-supply filler panel from the power-supply bay.
4. Touch the static-protective package that contains the hot-swap power supply to any unpainted metal surface on the server; then, remove the power supply from the package and place it on a static-protective surface.
5. Grasp the handle on the rear of the power supply and slide the power supply forward into the power-supply bay until it clicks. Make sure that the power supply connects firmly into the power-supply connector.
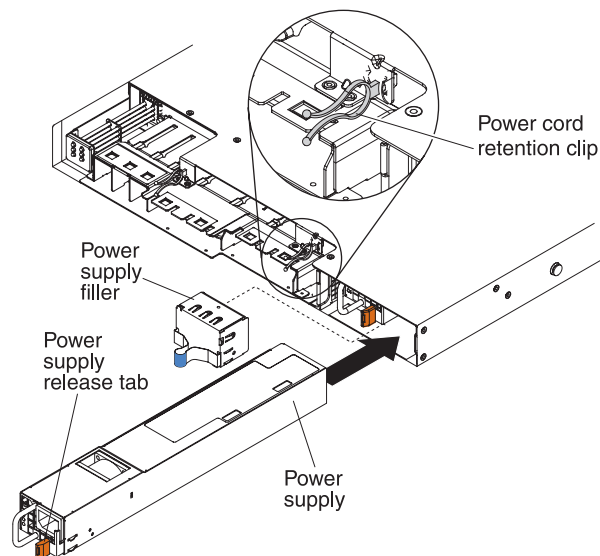
6. Route the power cord through the power cord retention clip so that it does not accidentally become disconnected.
7. Connect the power cord for the new power supply to the power-cord connector on the power supply.

8. Connect the other end of the power cord to a properly grounded electrical outlet.

9. Make sure that the ac power LED and the dc power LED on the power supply are lit, indicating that the power supply is operating correctly. The two green LEDs are to the right of the power-cord connector.

10. Restart the host server. Confirm that it starts correctly and recognizes the newly installed devices, and make sure that no error LEDs are lit.

11. Complete the additional steps in "Instructions for IBM Business Partners" on page 34.

Completing the MAX5 installation

To complete the MAX5 expansion module installation, complete the following steps:

1. Reinstall the system-board tray (see "Replacing the MAX5 system-board tray.").

2. Reinstall the MAX5 bezel (see "Replacing the MAX5 bezel" on page 129).

3. Reconnect the cables and power cords (see "Connecting the MAX5 cables" on page 129).

4. Turn on the peripheral devices and the host server.

5. Confirm that the host server start correctly and recognizes the newly installed devices, and make sure that no error LEDs are lit.

6. Slide the MAX5 and the server back into the rack, if necessary.

Replacing the MAX5 system-board tray

To replace the system-board tray, complete the following step:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Grasp the system-board tray on both sides (near the stop-tabs) and align the system-board tray with the chassis.
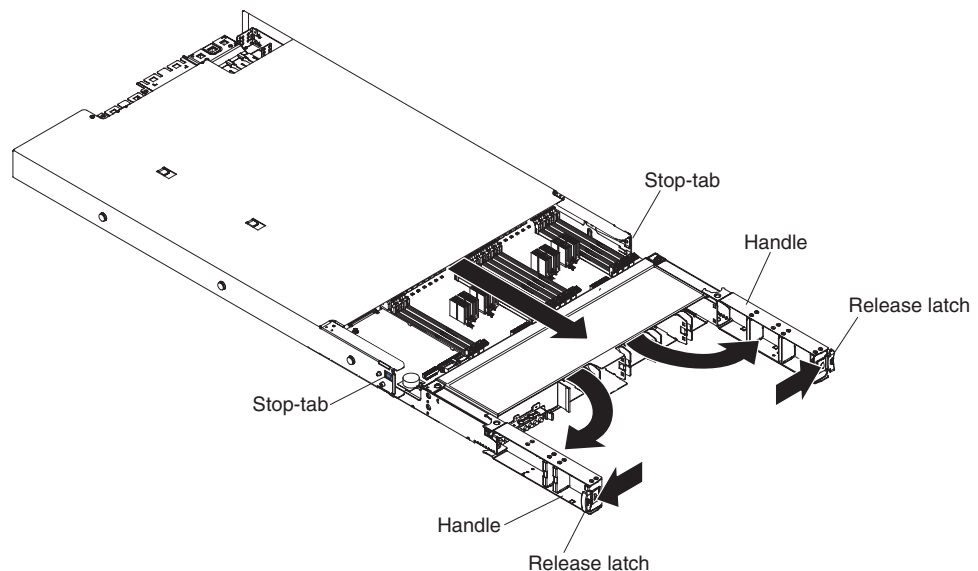
3. Slide the system-board tray forward until the tabs at the bottom of the handles touch the chassis; then, close the handles and press firmly on the release latches to snap them into the locked position.

4. Replace the bezel (see "Replacing the MAX5 bezel" on page 129).

Replacing the MAX5 bezel

To replace the MAX5 bezel, complete the following steps:

1. Read the safety information that begins on page "Safety" on page v and "Installation guidelines" on page 43.

2. Align the bezel alignment tabs with the chassis and press the bezel onto the chassis until it snaps into place.
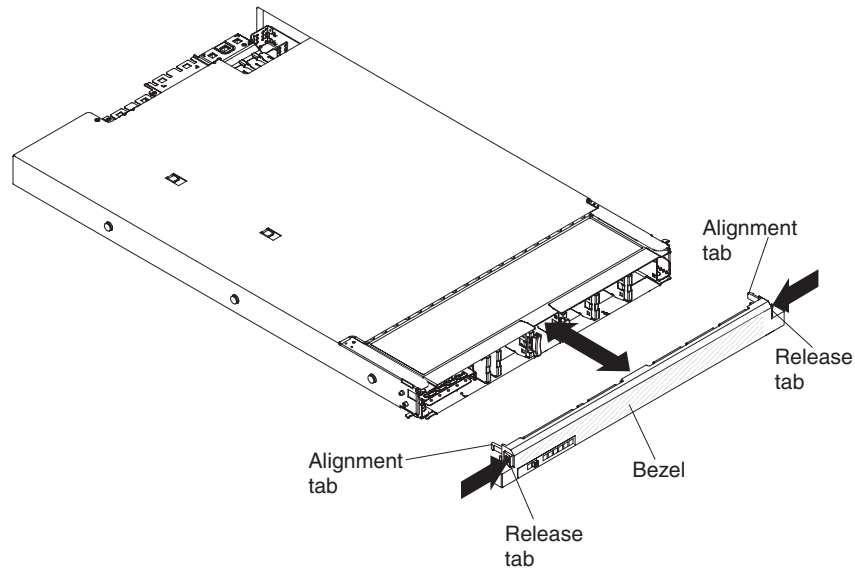
Connecting the MAX5 cables

To cable the MAX5 to the host server, see the QPI cable option documentation and the EXA cable option documentation. Be sure to turn off the host server before you connect any cables to or disconnect any cables from the MAX5 memory expansion module.

The following illustration shows the locations of the connectors on the rear of the MAX5.
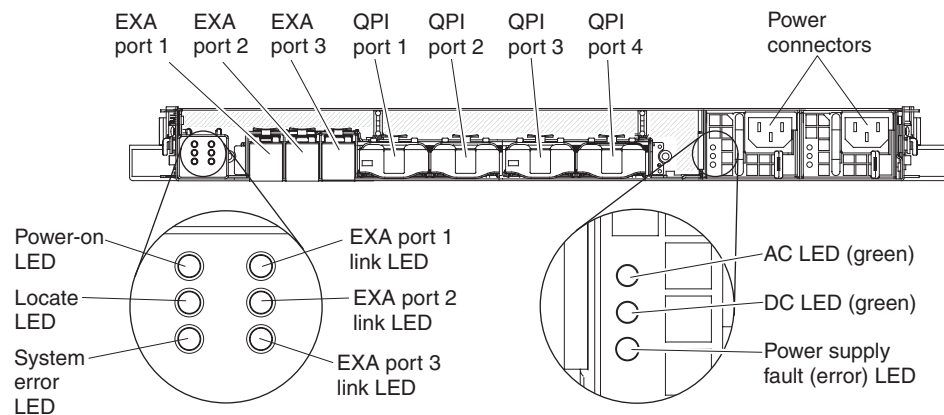
Updating the MAX5 configuration

No configuration updates are required to be made directly to the MAX5 memory expansion module. When the host server configuration is updated, the updates are automatically applied to the MAX5 through the host server IMM.

Chapter 3. Configuring the server

The following configuration programs come with the server:

- **Setup utility**

  The UEFI Setup Utility program is part of the basic input/output system firmware. Use it to change interrupt request (IRQ) settings, change the startup-device sequence, set the date and time, and set passwords. For information about using this program, see "Using the Setup utility" on page 132.

- **Boot Manager program**

  The Boot Manager program is part of the server firmware. Use it to override the startup sequence that is set in the Setup utility and temporarily assign a device to be first in the startup sequence. For more information about using this program, see "Using the Boot Manager program" on page 139.

- **IBM** *ServerGuide Setup and Installation* **CD**

  The ServerGuide program provides software-setup tools and installation tools that are designed for the server. Use this CD during the installation of the server to configure basic hardware features, such as an integrated SAS/SATA controller with RAID capabilities, and to simplify the installation of your operating system. For information about using this CD, see "Using the ServerGuide Setup and Installation CD" on page 140.

- **Integrated Management Module**

  Use the integrated management module (IMM) for configuration, to update the firmware and sensor data record/field replaceable unit (SDR/FRU) data, and to remotely manage a network. For information about using the IMM, see "Using the integrated management module" on page 142 and the *Integrated Management Module User's Guide* at http://www.ibm.com/systems/support/supportsite.wss/ docdisplay?lndocid=MIGR-5079770&brandind=5000008.

- **VMware ESXi embedded hypervisor**

  An optional USB flash device with VMware ESXi embedded hypervisor software is available for purchase. Hypervisor is virtualization software that enables multiple operating systems to run on a host system at the same time. The USB embedded hypervisor flash device installs in USB connector 1 on the low-profile, SAS/SATA riser card in PCI riser slot 2. For more information about using the embedded hypervisor, see "Using the embedded hypervisor" on page 143.

- **Remote presence capability and blue-screen capture**

  The remote presence and blue-screen capture features are integrated functions of the Integrated Management Module (IMM). The remote presence feature provides the following functions:

  – Remotely viewing video with graphics resolutions up to 1280 x 1024 at 75 Hz, regardless of the system state

  – Remotely accessing the server, using the keyboard and mouse from a remote client

  – Mapping the CD or DVD drive, diskette drive, and USB flash drive on a remote client, and mapping ISO and diskette image files as virtual drives that are available for use by the server

  – Uploading a diskette image to the IMM memory and mapping it to the server as a virtual drive

  The blue-screen capture feature captures the video display contents before the IMM restarts the server when the IMM detects an operating-system hang

condition. A system administrator can use the blue-screen capture feature to assist in determining the cause of the hang condition.

- **Ethernet controller configuration**

  For information about configuring the Ethernet controller, see "Configuring the Gigabit Ethernet controller" on page 146.

- **Configuring RAID arrays**

  For information about configuring RAID arrays, see "Configuring RAID arrays" on page 147.

- **IBM Advanced Settings Utility (ASU) program**

  Use this program as an alternative to the Setup utility for modifying UEFI settings and IMM settings. Use the ASU program online or out of band to modify UEFI settings from the command line without the need to restart the server to access the Setup utility. For more information about using this program, see "IBM Advanced Settings Utility program" on page 147.

Using the Setup utility

Use the Unified Extensible Firmware Interface (UEFI) Setup Utility program to perform the following tasks:

- View configuration information
- View and change assignments for devices and I/O ports
- Set the date and time
- Set and change passwords
- Set the startup characteristics of the server and the order of startup devices
- Set and change settings for advanced hardware features
- View, set, and change settings for power-management features
- View and clear error logs
- Change interrupt request (IRQ) settings
- Resolve configuration conflicts

Starting the Setup utility

To start the Setup utility, complete the following steps:

1. Turn on the server.

   Note: Approximately 1 to 3 minutes after the server is connected to ac power, the power-control button becomes active.

2. When the prompt `<F1> Setup` is displayed, press F1. If you have set an administrator password, you must type the administrator password to access the full Setup utility menu. If you do not type the administrator password, a limited Setup utility menu is available.

3. Select **System Settings** to view or change the server component settings.

Setup utility menu choices

The following choices are on the Setup utility main menu for the UEFI. Depending on the version of the IBM System x Server Firmware (server firmware), some menu choices might differ slightly from these descriptions. For more information on UEFI-compliant firmware, go to http://www-947.ibm.com/systems/support/supportsite.wss/docdisplay?lndocid=MIGR-5083207&brandind=5000008.

- **System Information**

  Select this choice to view information about the server. When you make changes through other choices in the Setup utility, some of those changes are reflected in the system information; you cannot change settings directly in the system information. This choice is on the full Setup utility menu only.

  – **System Summary**

    Select this choice to view configuration information, including the ID, speed, and cache size of the microprocessors, machine type and model of the server, the serial number, the system UUID, and the amount of installed memory. When you make configuration changes through other options in the Setup utility, the changes are reflected in the system summary; you cannot change settings directly in the system summary.

  – **Product Data**

    Select this choice to view the system-board identifier, the revision level or issue date of the firmware, the integrated management module and diagnostics code, and the version and date.

  This choice is on the full Setup utility menu only.

- **System Settings**

  Select this choice to view or change the server component settings.

  – **Adapters and UEFI Drivers**

    Select this choice to view information about the adapters and device drivers installed in the server that are compliant with UEFI 1.10 and UEFI 2.0.

  – **Network Configuration**

    Select this choice if you want to use the driver's own configuration capability to configure the device.

  – **Processors**

    Select this choice to view or change the processor settings.

  – **Memory**

    Select this choice to view or change the memory settings. To configure memory mirroring, select **System Settings ➔ Memory ➔ Memory Mirroring Mode ➔ Mirrored**.

  – **Devices and I/O Ports**

    Select this choice to view or change assignments for devices and input/output (I/O) ports. You can configure the serial ports; configure remote console redirection; enable or disable integrated Ethernet controllers, the SAS/SATA adapter, SATA optical drive channels, and PCI slots; and view the system Ethernet MAC addresses. If you disable a device, it cannot be configured, and the operating system will not be able to detect it (this is equivalent to disconnecting the device).

  – **Power**

    Select this choice to view or change power capping to control consumption, processors, and performance states.

    - **Active Energy Manager**

Select this choice to enable or disable power capping. If you enable power capping, the Active Energy Manager program will limit the maximum power that is consumed by the server.

- **Power Restore Policy**

    Select this choice to determine the mode of operation to which the server will be restored after a power outage occurs. You can select **Always Off**, **Restore**, or **Always On** to restore the server the state that it was set to at the time of the power outage.

– **Operating Modes**

    Select this choice to view or change the operating profile (performance and power utilization). This choice specify a preset operating mode to configure the server for maximum power savings, maximum efficiency, and maximum performance.

- **Efficiency mode**

    Select this choice to maintain the optimal balance between performance and power consumption. The server generally produces the best performance per watt while it is in this mode.

- **Acoustic mode**

    Select this choice to configure the server to draw the minimum amount of power and generate the least noise. Server performance might be degraded depending on the application that you are running.

- **Performance mode**

    Select this choice to achieve the highest absolute performance for most server applications. The power consumption in this mode is often higher than in the Efficiency or the Acoustics mode.

- **Custom mode**

    Select this choice only if you understand the functions of the low-level IMM settings. This is the only choice that enables you to change the low-level IMM settings that affect the performance and power consumption of the server.

– **Integrated Management Module**

    Select this choice to view or change the settings for the integrated management module.

- **POST Watchdog Timer**

    Select this choice to view or enable the POST watchdog timer.

- **POST Watchdog Timer Value**

    Select this choice to view or set the POST loader watchdog timer value.

- **Reboot System on NMI**

    Enable or disable restarting the server whenever a nonmaskable interrupt (NMI) occurs. **Disabled** is the default.

- **Commands on USB Interface Preference**

    Select this choice to enable or disable the Ethernet over USB interface on IMM.

- **Network Configuration**

    Select this choice to view the system management network interface port, the IMM MAC address, the current IMM IP address, and the host name; define the static IMM IP address, subnet mask, and gateway address; specify whether to use the static IP address or have DHCP assign the IMM IP address; save the network changes; and reset the IMM.

- **Reset IMM to Defaults**

Select this choice to view or reset IMM to the default settings.

    - **Reset IMM**

    Select this choice to reset the IMM settings.

  – **Legacy Support**

  Select this choice to view or set legacy support.

    - **Force Legacy Video on Boot**

    Select this choice to force INT video support, if the operating system does not support UEFI video output standards.

    - **Rehook INT**

    Select this choice to enable or disable devices from taking control of the boot process. The default is **Disable**.

    - **Legacy Thunk Support**

    Select this choice to enable or disable UEFI to interact with PCI mass storage devices that are non-UEFI compliant.

  – **System Security**

  Select this choice to view or configure Trusted Platform Module (TPM) support.

  – **iSCSI Configuration**

  Select this choice to configure the iSCSI parameters.

  – **Network Device List**

  Select this choice to view or configure the network device options, such as iSCSI, PXE, and network devices. There might be additional configuration choices for optional network devices that are compliant with UEFI 2.1 and later.

- **Date and Time**

  Select this choice to set the date and time in the server, in 24-hour format (*hour*:*minute*:*second*).

  This choice is on the full Setup utility menu only.

- **Start Options**

  Select this choice to view or change the start options, including the startup sequence, keyboard NumLock state, PXE boot option, and PCI device boot priority. Changes in the startup options take effect when you start the server.

  The startup sequence specifies the order in which the server checks devices to find a boot record. The server starts from the first boot record that it finds. If the server has Wake on LAN hardware and software and the operating system supports Wake on LAN functions, you can specify a startup sequence for the Wake on LAN functions. For example, you can define a startup sequence that checks for a disc in the CD-RW/DVD drive, then checks the hard disk drive, and then checks a network adapter.

  This choice is on the full Setup utility menu only.

- **Boot Manager**

  Select this choice to view, add, delete, or change the device boot priority, boot from a file, select a one-time boot, or reset the boot order to the default setting.

- **System Event Logs**

  Select this choice to enter the System Event Manager, where you can view the POST event log and the system-event log. You can use the arrow keys to move between pages in the error log.

  The POST event log contains the three most recent error codes and messages that were generated during POST.

The system-event log contains POST and system management interrupt (SMI) events and all events that are generated by the baseboard management controller that is embedded in the integrated management module (IMM).

Important: If the system-error LED on the front of the server is lit but there are no other error indications, clear the system-event log. Also, after you complete a repair or correct an error, clear the system-event log to turn off the system-error LED on the front of the server.

– **POST Event Viewer**

Select this choice to enter the POST event viewer to view the POST event log.

– **System Event Log**

Select this choice to view the system event log.

– **Clear System Event Log**

Select this choice to clear the system event log.

- **User Security**

Select this choice to set, change, or clear passwords. See "Passwords" on page 137 for more information.

This choice is on the full and limited Setup utility menu.

– **Power-on Password**

Select this choice to set or change a power-on password. See "Power-on password" on page 137 for more information.

– **Administrator Password**

Select this choice to set or change an administrator password. An administrator password is intended to be used by a system administrator; it limits access to the full Setup utility menu. If an administrator password is set, the full Setup utility menu is available only if you type the administrator password at the password prompt. For more information, see "Administrator password" on page 139.

- **Save Settings**

Select this choice to save the changes that you have made in the settings.

- **Restore Settings**

Select this choice to cancel the changes that you have made in the settings and restore the previous settings.

- **Load Default Settings**

Select this choice to cancel the changes that you have made in the settings and restore the factory settings.

- **Exit Setup**

Select this choice to exit from the Setup utility. If you have not saved the changes that you have made in the settings, you are asked whether you want to save the changes or exit without saving them.

Passwords

From the **User Security** menu choice, you can set, change, and delete a power-on password and an administrator password. The **User Security** choice is on the full Setup utility menu only.

If you set only a power-on password, you must type the power-on password to complete the system startup and to have access to the full Setup utility menu.

An administrator password is intended to be used by a system administrator; it limits access to the full Setup utility menu. If you set only an administrator password, you do not have to type a password to complete the system startup, but you must type the administrator password to access the Setup utility menu.

If you set a power-on password for a user and an administrator password for a system administrator, you can type either password to complete the system startup. A system administrator who types the administrator password has access to the full Setup utility menu; the system administrator can give the user authority to set, change, and delete the power-on password. A user who types the power-on password has access to only the limited Setup utility menu; the user can set, change, and delete the power-on password, if the system administrator has given the user that authority.

Power-on password

If a power-on password is set, when you turn on the server, the system startup will not be completed until you type the power-on password. You can use any combination of 6 to 20 printable ASCII characters for the password.

When a power-on password is set, you can enable the Unattended Start mode, in which the keyboard and mouse remain locked but the operating system can start. You can unlock the keyboard and mouse by typing the power-on password.

If you forget the power-on password, you can regain access to the server in any of the following ways:
- If an administrator password is set, type the administrator password at the password prompt. Start the Setup utility and reset the power-on password.
- Remove the battery from the server and then reinstall it. See the *Problem Determination and Service Guide* on the IBM *Documentation* CD for instructions for removing the battery.
- Change the position of the power-on password switch (enable switch 3 of the system board switch block (SW2) to bypass the power-on password check (see Table 4 on page 39 for more information).

UEFI boot recovery jumper (J59)

1
2
3

1 2 3 4 5 6 7 8

OFF

SW2 switch block
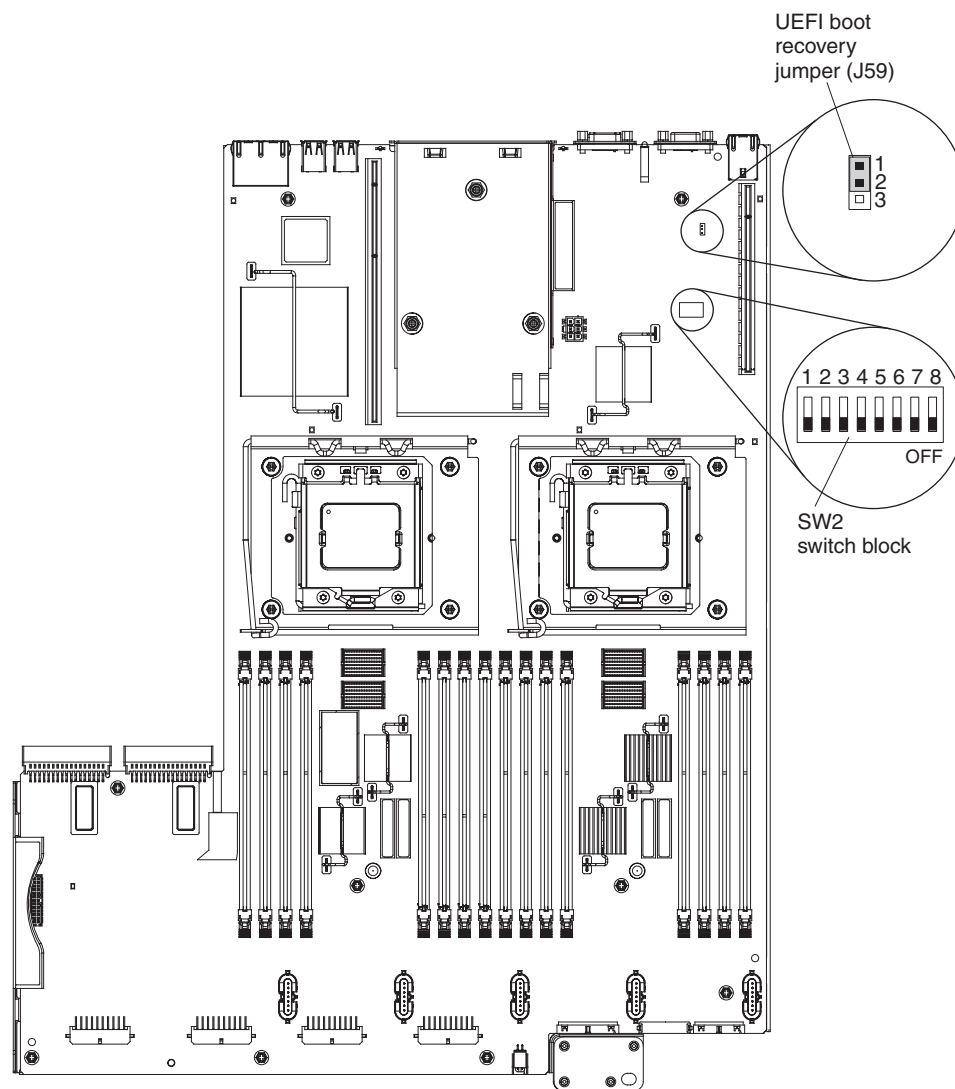
Attention: Before you change any switch settings or move any jumpers, turn off the server; then, disconnect all power cords and external cables. See the safety information that begins on page "Safety" on page v. Do not change settings or move jumpers on any system-board switch or jumper blocks that are not shown in this document.

The default for all of the switches on switch block (SW2) is Off.

While the server is turned off, move switch 3 of the switch block (SW2) to the On position to enable the power-on password override. You can then start the Setup utility and reset the power-on password. You do not have to return the switch to the previous position.

The power-on password override switch does not affect the administrator password.

Administrator password

If an administrator password is set, you must type the administrator password for access to the full Setup utility menu. You can use any combination of 6 to 20 printable ASCII characters for the password.

Attention: If you set an administrator password and then forget it, there is no way to change, override, or remove it. You must replace the system board.

Using the Boot Manager program

The Boot Manager program is a built-in, menu-driven configuration utility program that you can use to temporarily redefine the first startup device without changing settings in the Setup utility.

To use the Boot Manager program, complete the following steps:
1. Turn off the server.
2. Restart the server.
3. When the prompt `<F12> Select Boot Device` is displayed, press F12. If a bootable USB mass storage device is installed, a submenu item (**USB Key/Disk**) is displayed.
4. Use the Up arrow and Down arrow keys to select an item from the **Boot Selection Menu** and press **Enter**.

The next time the server starts, it returns to the startup sequence that is set in the Setup utility.

Starting the backup server firmware

The system board contains a backup copy area for the server firmware. This is a secondary copy of the server firmware that you update only during the process of updating the server firmware. If the primary copy of the server firmware becomes damaged, use this backup copy.

To force the server to start from the backup copy, turn off the server; then, place the J59 jumper in the backup position (pins 2 and 3).

Use the backup copy of the server firmware until the primary copy is restored. After the primary copy is restored, turn off the server; then, move the J59 jumper back to the primary position (pins 1 and 2).

The Update*Xpress* System Pack Installer

The Update*Xpress* System Pack Installer detects supported and installed device drivers and firmware in the server and installs available updates. For additional information and to download the Update*Xpress* System Pack Installer, go to the ToolsCenter for System x and BladeCenter at http://publib.boulder.ibm.com/infocenter/toolsctr/v1r0/index.jsp and click **UpdateXpress System Pack Installer**.

Using the ServerGuide Setup and Installation CD

The *ServerGuide Setup and Installation* CD provides software setup tools and installation tools that are designed for your server. The ServerGuide program detects the server model and optional hardware devices that are installed and uses that information during setup to configure the hardware. The ServerGuide simplifies the operating-system installations by providing updated device drivers and, in some cases, installing them automatically.

You can download a free image of the *ServerGuide Setup and Installation CD* or purchase the CD from the ServerGuide fulfillment Web site at http://www.ibm.com/systems/management/serverguide/sub.html. To download the free image. click **IBM Service and Support Site**.

Note: Changes are made periodically to the IBM Web site. The actual procedure might vary slightly from what is described in this document.

The ServerGuide program requires a supported IBM server with an enabled startable (bootable) CD drive. In addition to the *ServerGuide Setup and Installation* CD, you must have your operating-system CD to install the operating system.

To start the *ServerGuide Setup and Installation* CD, complete the following steps:

1. Insert the CD, and restart the server. If the CD does not start, see "ServerGuide Problems" in the *Problem Determination and Service Guide* on the IBM *Documentation* CD.
2. Follow the instructions on the screen to complete the following steps:
   a. Select your language.
   b. Select your keyboard layout and country.
   c. View the overview to learn about ServerGuide features.
   d. View the readme file to review installation tips for your operating system and adapter.
   e. Start the operating-system installation. You will need your operating-system CD.

ServerGuide features

Features and functions can vary slightly with different versions of the ServerGuide program. To learn more about the version that you have, start the *ServerGuide Setup and Installation* CD and view the online overview. Not all features are supported on all server models.

The ServerGuide program performs the following tasks:
- Sets system date and time
- Detects the RAID adapter or controller and runs the SAS/SATA RAID configuration program
- Checks the microcode (firmware) levels of a ServeRAID adapter and determines whether a later level is available from the CD
- Detects installed hardware options and provides updated device drivers for most adapters and devices
- Provides diskette-free installation for supported Windows operating systems
- Includes an online readme file with links to tips for your hardware and operating-system installation

Setup and configuration overview

When you use the *ServerGuide Setup and Installation* CD, you do not need setup diskettes. You can use the CD to configure any supported IBM server model. The setup program provides a list of tasks that are required to set up your server model. On a server with a ServeRAID adapter or SAS/SATA controller with RAID capabilities, you can run the SAS/SATA RAID configuration program to create logical drives.

Note: Features and functions can vary slightly with different versions of the ServerGuide program.

Typical operating-system installation

The ServerGuide program can reduce the time it takes to install an operating system. It provides the device drivers that are required for your hardware and for the operating system that you are installing. This section describes a typical ServerGuide operating-system installation.

Note: Features and functions can vary slightly with different versions of the ServerGuide program.

1. After you have completed the setup process, the operating-system installation program starts. (You will need your operating-system CD to complete the installation.)
2. The ServerGuide program stores information about the server model, service processor, hard disk drive controllers, and network adapters. Then, the program checks the CD for newer device drivers. This information is stored and then passed to the operating-system installation program.
3. The ServerGuide program presents operating-system partition options that are based on your operating-system selection and the installed hard disk drives.
4. The ServerGuide program prompts you to insert your operating-system CD and restart the server. At this point, the installation program for the operating system takes control to complete the installation.

Installing your operating system without using ServerGuide

If you have already configured the server hardware and you are not using the ServerGuide program to install your operating system, you download operating-system installation instructions for the server from http://www.ibm.com/supportportal/.

Using the integrated management module

The integrated management module (IMM) is a second generation of the functions that were formerly provided by the baseboard management controller hardware. It combines service processor functions, video controller, and remote presence function in a single chip.

The IMM supports the following basic systems-management features:
- Active Energy Manager.
- Alerts (in-band and out-of-band alerting, PET traps - IPMI style, SNMP, e-mail).
- Auto Boot Failure Recovery (ABR).
- Automatic microprocessor disable on failure and restart in a two-microprocessor configuration when one microprocessor signals an internal error. When one of the microprocessors fail, the server will disable the failing microprocessor and restart with the other microprocessor.
- Automatic Server Restart (ASR) when POST is not complete or the operating system hangs and the operating system watchdog timer times-out. The IMM might be configured to watch for the operating system watchdog timer and reboot the system after a timeout, if the ASR feature is enabled. Otherwise, the IMM allows the administrator to generate a nonmaskable interrupt (NMI) by pressing an NMI button on the light path diagnostics panel for an operating-system memory dump. ASR is supported by IPMI.
- A virtual media key, which enables remote presence support (remote video, remote keyboard/mouse, and remote storage).
- Boot sequence manipulation.
- Command-line interface.
- Configuration save and restore.
- DIMM error assistance. The Unified Extensible Firmware Interface (UEFI) disables a failing DIMM that is detected during POST, and the IMM lights the associated system error LED and the failing DIMM error LED.
- Environmental monitor with fan speed control for temperature, voltages, fan failure, power supply failure, and power backplane failure.
- Intelligent Platform Management Interface (IPMI) Specification V2.0 and Intelligent Platform Management Bus (IPMB) support.
- Invalid system configuration (CNFG) LED support.
- Light path diagnostics LEDs indicators to report errors that occur with fans, power supplies, microprocessor, hard disk drives, and system errors.
- Nonmaskable interrupt (NMI) detection and reporting.
- Operating-system failure blue screen capture.
- PCI configuration data.
- PECI 2 support.
- Power/reset control (power-on, hard and soft shutdown, hard and soft reset, schedule power control).
- Query power-supply input power.

- ROM-based IMM firmware flash updates.
- Serial over LAN (SOL).
- Serial port redirection over telnet or ssh.
- SMI handling
- System event log (SEL).

The IMM also provides the following remote server management capabilities through the OSA SMBridge management utility program:

- **Command-line interface (IPMI Shell)**

  The command-line interface provides direct access to server management functions through the IPMI 2.0 protocol. Use the command-line interface to issue commands to control the server power, view system information, and identify the server. You can also save one or more commands as a text file and run the file as a script.

- **Serial over LAN**

  Establish a Serial over LAN (SOL) connection to manage servers from a remote location. You can remotely view and change the UEFI settings, restart the server, identify the server, and perform other management functions. Any standard Telnet client application can access the SOL connection.

For more information about IMM, see the *Integrated Management Module User's Guide* at http://www.ibm.com/systems/support/supportsite.wss/docdisplay?lndocid=MIGR-5079770&brandind=5000008.

Using the embedded hypervisor

The VMware ESXi embedded hypervisor software is available on the optional IBM USB flash device with embedded hypervisor. The USB flash device can be installed in the USB connector on the low-profile (see the following illustration), SAS/SATA riser card in PCI riser slot 2 on the system board. Hypervisor is virtualization software that enables multiple operating systems to run on a host system at the same time. The USB flash device is required to activate the hypervisor functions.

Note: When you add an optional MAX5 to your server configuration and you plan to use the optional USB flash device with VMware ESXi embedded hypervisor software, see the documentation that comes with the USB flash device and the operating system installation instructions for installing VMware ESXi (or ESX, depending on your environment) on your server at the IBM website at http://www.ibm.com/systems/support/. The documentation provides additional installation and configuration information that you need to follow before you use the MAX5.

PCI slot 3   PCI slot 4   PCI slot 5
error LEDs   error LEDs   error LEDs

                                               USB embedded
                                               hypervisor flash
                                               device connector
USB connector

PCI riser card   Slot 5, PCI Express
                               Gen2 x8, low profile
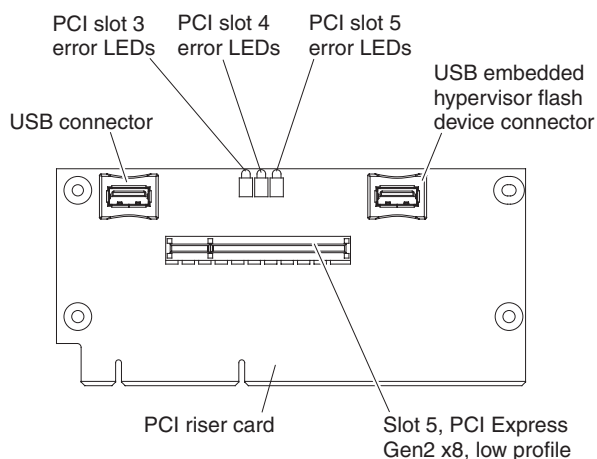
To start using the embedded hypervisor functions, you must add the USB flash
device to the startup sequence in the Setup utility.

To add the USB flash device to the startup sequence, complete the following steps:

1. Turn on the server.

   Note: Approximately 1 to 3 minutes after the server is connected to ac power,
   the power-control button becomes active.

2. When the prompt <F1> Setup is displayed, press F1.

3. From the Setup utility main menu, select **Boot Manager**.

4. Select **Add Boot Option**; then, select **USB Storage**. Press Enter, and then select
   Esc.

5. Select **Change Boot Order** and then select **Commit Changes**; then, press Enter.

6. Select **Save Settings** and then select **Exit Setup**.

If the embedded hypervisor flash device image becomes corrupt, you can use the
VMware Recovery CD that comes with the system to recover the flash device image.
To recover the flash device image, complete the following steps:

1. Turn on the server.

   Note: Approximately 1 to 3 minutes after the server is connected to ac power,
   the power-control button becomes active.

2. Insert the VMware Recovery CD into the CD or DVD drive.

3. Follow the instructions on the screen.

For additional information and instructions, see the *VMware ESXi Server 31
Embedded Setup Guide* a http://www.vmware.com/pdf/vi3_35/esx_3i_e/r35/
vi3_35_25_3i_setup.pdf

Using the remote presence and blue-screen capture features

The remote presence and blue-screen capture features are integrated functions of the integrated management module (IMM). The remote presence feature provides the following functions:

- Remotely viewing video with graphics resolutions up to 1280 x 1024 at 75 Hz, regardless of the system state
- Remotely accessing the server, using the keyboard and mouse from a remote client
- Mapping the CD or DVD drive, diskette drive, and USB flash drive on a remote client, and mapping ISO and diskette image files as virtual drives that are available for use by the server
- Uploading a diskette image to the IMM memory and mapping it to the server as a virtual drive

The blue-screen capture feature captures the video display contents before the IMM restarts the server when the IMM detects an operating-system hang condition. A system administrator can use the blue-screen capture to assist in determining the cause of the hang condition.

Obtaining the IP address for the IMM

To access the Web interface to use the remote presence feature, you need the IP address of the IMM. You can obtain the IMM IP address through the Setup utility. The server comes with a default IP address for the IMM of 192.168.70.125. To locate the IP address, complete the following steps:

1. Turn on the server.

   Note: Approximately 1 to 3 minutes after the server is connected to ac power, the power-control button becomes active.

2. When the prompt `<F1> Setup` is displayed, press F1. (This prompt is displayed on the screen for only a few seconds. You must press F1 quickly.) If you have set both a power-on password and an administrator password, you must type the administrator password to access the full Setup utility menu.
3. From the Setup utility main menu, select **System Settings**.
4. On the next screen, select **Integrated Management Module**.
5. On the next screen, select **Network Configuration**.
6. Find the IP address and write it down.
7. Exit from the Setup utility.

Logging on to the Web interface

To log on to the IMM Web interface, complete the following steps:

1. Open a Web browser on a computer that connects to the server and in the **Address** or **URL** field, type the IP address or host name of the IMM to which you want to connect.

   Note: If you are logging on to the IMM for the first time after installation, the IMM defaults to DHCP. If a DHCP host is not available, the IMM assigns a static IP address of 192.168.70.125. The MAC address tag provides the default hostname of the IMM and does not require you to start the server.

2. On the Login page, type the user name and password. If you are using the IMM for the first time, you can obtain the user name and password from your system administrator. All login attempts are documented in the event log.

   Note: The IMM is set initially with a user name of USERID and password of PASSW0RD (passw0rd with a zero, not a the letter O). You have read/write access. You must change the default password the first time you log on.

3. On the Welcome page, type a timeout value (in minutes) in the field that is provided. The IMM will log you off of the Web interface if your browser is inactive for the number of minutes that you entered for the timeout value.

4. Click **Continue** to start the session. The System Health page provides a quick view of the system status.

Enabling the Broadcom Gigabit Ethernet Utility program

The Broadcom Gigabit Ethernet Utility program is part of the server firmware. You can use it to configure the network as a startable device, and you can customize where the network startup option appears in the startup sequence. Enable and disable the Broadcom Gigabit Ethernet Utility program from the Setup utility.

Configuring the Gigabit Ethernet controller

The Ethernet controllers are integrated on the system board. They provide an interface for connecting to a 10 Mbps, 100 Mbps, or 1 Gbps network and provide full-duplex (FDX) capability, which enables simultaneous transmission and reception of data on the network. If the Ethernet ports in the server support auto-negotiation, the controllers detect the data-transfer rate (10BASE-T, 100BASE-TX, or 1000BASE-T) and duplex mode (full-duplex or half-duplex) of the network and automatically operate at that rate and mode.

You do not have to set any jumpers or configure the controllers. However, you must install a device driver to enable the operating system to address the controllers. For device drivers and information about configuring the Ethernet controllers, see the *Broadcom NetXtreme II Gigabit Ethernet Software* CD that comes with the server. To find updated information about configuring the controllers, see http://www.ibm.com/supportportal/.

Configuring RAID arrays

Through the Setup utility, you can access utilities to configure RAID arrays. The specific procedure for configuring arrays depends on the RAID controller that you are using. For details, see the documentation for your RAID controller. To access the utility for your RAID controller, complete the following steps:

1. Turn on the server.

   Note: Approximately 1 to 3 minutes after the server is connected to ac power, the power-control button becomes active.

2. When prompted, <F1> Setup is displayed, press F1. If you have set an administrator password, you must type the administrator password to access the full Setup utility menu. If you do not type the administrator password, a limited Setup utility menu is available.

3. Select **System Settings → Adapters and UEFI drivers**.

4. Press Enter to refresh the list of device drivers.

5. Select the device driver for your RAID controller and press Enter.

6. Follow the instructions in the documentation for your RAID controller.

IBM Advanced Settings Utility program

The IBM Advanced Settings Utility (ASU) program is an alternative to the Setup utility for modifying UEFI settings. Use the ASU program online or out of band to modify UEFI settings from the command line without the need to restart the system to access the Setup utility.

You can also use the ASU program to configure the optional remote presence features or other IMM settings. The remote presence features provide enhanced systems-management capabilities.

In addition, the ASU program provides limited settings for configuring the IPMI function in the IMM through the command-line interface.

Use the command-line interface to issue setup commands. You can save any of the settings as a file and run the file as a script. The ASU program supports scripting environments through a batch-processing mode.

For more information and to download the ASU program, go to http://www.ibm.com/systems/support/supportsite.wss/docdisplay?lndocid=TOOL-ASU&brandind=5000008.

Updating IBM Systems Director

If you plan to use IBM Systems Director to manage the server, you must check for the latest applicable IBM Systems Director updates and interim fixes.

Note: Changes are made periodically to the IBM Web site. The actual procedure might vary slightly from what is described in this document.

To locate and install a newer version of IBM Systems Director, complete the following steps:

1. Check for the latest version of IBM Systems Director:
    a. Go to http://www.ibm.com/systems/management/director/downloads.html.
    b. If a newer version of IBM Systems Director than what comes with the server is shown in the drop-down list, follow the instructions on the Web page to download the latest version.
2. Install the IBM Systems Director program.

If your management server is connected to the Internet, to locate and install updates and interim fixes, complete the following steps:

1. Make sure that you have run the Discovery and Inventory collection tasks.
2. On the Welcome page of the IBM Systems Director Web interface, click **View updates**.
3. Click **Check for updates**. The available updates are displayed in a table.
4. Select the updates that you want to install, and click **Install** to start the installation wizard.

If your management server is not connected to the Internet, to locate and install updates and interim fixes, complete the following steps:

1. Make sure that you have run the Discovery and Inventory collection tasks.
2. On a system that is connected to the Internet, go to http://www.ibm.com/eserver/support/fixes/fixcentral/.
3. From the **Product family** list, select **IBM Systems Director**.
4. From the **Product** list, select **IBM Systems Director**.
5. From the **Installed version** list, select the latest version, and click **Continue**.
6. Download the available updates.
7. Copy the downloaded files to the management server.
8. On the management server, on the Welcome page of the IBM Systems Director Web interface, click the **Manage** tab, and click **Update Manager**.
9. Click **Import updates** and specify the location of the downloaded files that you copied to the management server.
10. Return to the Welcome page of the Web interface, and click **View updates**.
11. Select the updates that you want to install, and click **Install** to start the installation wizard.

Appendix. 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.

Use this information to obtain additional information about IBM and IBM products, determine what to do if you experience a problem with your IBM system or optional device, and determine 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.

If you believe that you require IBM to perform warranty service on your IBM product, the IBM service technicians will be able to assist you more efficiently if you prepare before you call.

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Check for updated firmware and operating-system device drivers for your IBM product. The IBM Warranty terms and conditions state that you, the owner of the IBM product, are responsible for maintaining and updating all software and firmware for the product (unless it is covered by an additional maintenance contract). Your IBM service technician will request that you upgrade your software and firmware if the problem has a documented solution within a software upgrade.
- If you have installed new hardware or software in your environment, check http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/ to make sure that the hardware and software is supported by your IBM product.
- Go to http://www.ibm.com/supportportal/ to check for information to help you solve the problem.
- Gather the following information to provide to IBM Support. This data will help IBM Support quickly provide a solution to your problem and ensure that you receive the level of service for which you might have contracted.
  - Hardware and Software Maintenance agreement contract numbers, if applicable
  - Machine type number (IBM 4-digit machine identifier)
  - Model number
  - Serial number
  - Current system UEFI and firmware levels
  - Other pertinent information such as error messages and logs
- Go to http://www.ibm.com/support/electronic/portal/ to submit an Electronic Service Request. Submitting an Electronic Service Request will start the process of determining a solution to your problem by making the pertinent information available to IBM Support quickly and efficiently. IBM service technicians can start working on your solution as soon as you have completed and submitted an Electronic Service Request.

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

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files.

See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/supportportal/ .

You can find the most up-to-date information for System x products at http://www.ibm.com/systems/x/ .

Getting help and information from the World Wide Web

Up-to-date information about IBM products and support is available on the World Wide Web.

On the World Wide Web, up-to-date information about IBM systems, optional devices, services, and support is available at http://www.ibm.com/supportportal/ . IBM System x information is at http://www.ibm.com/systems/x/ . IBM BladeCenter information is at http://www.ibm.com/systems/bladecenter/ . IBM IntelliStation information is at http://www.ibm.com/systems/intellistation/ .

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with your IBM products.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/ or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services.

To locate a reseller authorized by IBM to provide warranty service, go to
http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the
right side of the page. For IBM support telephone numbers, see
http://www.ibm.com/planetwide/ . In the U.S. and Canada, call 1-800-IBM-SERV
(1-800-426-7378).

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

IBM Taiwan product service

Use this information to contact IBM Taiwan product service.

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

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

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

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

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

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

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Particulate contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document.

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

Table 18. Limits for particulates and gases

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2[1]. • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60%[2]. • The room must be free of conductive contamination such as zinc whiskers.
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-1985[3] • Silver: Corrosion rate of less than 300 Å in 30 days
1. ASHRAE 52.2-2008 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.	
2. The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction.	
3. ANSI/ISA-71.04-1985. Environmental conditions for process measurement and control systems: Airborne contaminants. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.	

Documentation format

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

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IBM Corporation
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P.O. Box 12195
Research Triangle Park, North Carolina 27709-2195
U.S.A.

In the request, be sure to include the publication part number and title.

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Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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

Industry Canada Class A emission compliance statement

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

Avis de conformité à la réglementation d'Industrie Canada

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Responsible manufacturer:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European Community contact:

IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Telephone: +49 7032 15 2941
Email: lugi@de.ibm.com

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Technical Regulations, Abteilung M372
IBM-Allee 1, 71139 Ehningen, Germany
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高調波ガイドライン適合品

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