

lenovo

ThinkServer TD350
User Guide and Hardware Maintenance
Manual

ThinkThink**ThinkServer**Think

Machine Types: 70DG, 70DH, 70DJ, 70DK, 70DL, 70DM, 70DN,
and 70DQ

Note:

Before using the information and the product it supports, be sure to read and understand the following:

- The *Read Me First* that comes with your product
- “Safety information” on page iii
- Appendix A “Notices” on page 177

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Safety information

Note: Before using the product, be sure to read and understand the multilingual safety instructions on the documentation DVD that comes with the product.

قبل استخدام المنتج، تأكد من قراءة إرشادات الأمان متعددة اللغات وفهمها، وتوجد هذه الإرشادات في قرص DVD الوثائقي الذي يأتي مع المنتج.

Antes de usar o produto, leia e entenda as instruções de segurança multilíngues no DVD de documentação que o acompanha.

Преди да използвате този продукт, задължително прочетете и вникнете в многоезичните инструкции за безопасност в DVD диска с документация, който се предоставя с продукта.

Prije upotrebe ovog proizvoda obavezno pročitajte višejezične sigurnosne upute koje se nalaze na DVD-u s dokumentacijom koji dobivate uz proizvod.

Před použitím produktu je třeba si přečíst a porozumět bezpečnostním pokynům uvedeným na disku DVD s dokumentací, který je dodáván s produktem.

Før du bruger produktet, skal du sørge for at læse og forstå de sikkerhedsforskrifter, der findes på flere sprog, på den dokumentations-dvd, der følger med produktet.

Lue tuotteen mukana toimitetulla DVD-tietolevyllä olevat monikieliset turvaohjeet ennen tämän tuotteen käyttöä.

Avant d'utiliser le produit, veuillez à bien lire et comprendre les instructions de sécurité multilingues figurant sur le DVD de documentation fourni avec le produit.

Πριν χρησιμοποιήσετε το προϊόν, βεβαιωθείτε ότι έχετε διαβάσει και κατανοήσει τις οδηγίες ασφάλειας, οι οποίες είναι διαθέσιμες σε διάφορες γλώσσες στο DVD τεκμηρίωσης που συνοδεύει το προϊόν.

Vor Verwendung des Produkts sollten Sie unbedingt die mehrsprachigen Sicherheitsanweisungen auf der Dokumentations-DVD lesen, die im Lieferumfang des Produkts enthalten ist.

לפני השימוש במוצר, הקפידו לקרוא ולהבין את הוראות הבטיחות, המופיעות בשפות שונות ב-DVD התיעוד המצורף למוצר.

A termék használata előtt mindenképpen olvassa el és értelmezze a termékhez kapott dokumentációs DVD lemezen található, több nyelven elolvasható biztonsági előírásokat.

Prima di utilizzare il prodotto, accertarsi di leggere e comprendere le informazioni sulla sicurezza multilingue disponibili sul DVD di documentazione fornito con il prodotto.

製品をご使用になる前に、製品に付属の Documentation DVD に収録されているマルチリンガルの「安全に正しくご使用いただくために」を読んで理解してください。

제품을 사용하기 전에 제품과 함께 제공되는 문서 DVD의 다국어 안전 지침을 주의 깊게 읽어보십시오.

Voordat u het product gebruikt, moet u ervoor zorgen dat u de meertalige veiligheidsinstructies op de documentatie-dvd van het product hebt gelezen en begrijpt.

Przed skorzystaniem z produktu należy zapoznać się z wielojęzycznymi instrukcjami bezpieczeństwa znajdującymi się na płycie DVD z dokumentacją dostarczoną wraz z produktem.

Antes de utilizar o produto, leia atentamente as instruções de segurança multilíngues que constam no DVD de documentação fornecido com o produto.

Înainte de a utiliza produsul, asigurați-vă că ați citit și înțeles instrucțiunile de siguranță în mai multe limbi de pe DVD-ul cu documentație care însoțește produsul.

Før du bruker produktet, må du lese og forstå den flerspråklige sikkerhetsinformasjonen på DVDen med dokumentasjon som følger med produktet.

Прежде чем использовать этот продукт, внимательно ознакомьтесь с инструкциями по технике безопасности на разных языках, которые можно найти на DVD-диске с документацией в комплекте с продуктом.

在使用本产品之前，请务必先阅读和了解产品附带的文档 DVD 中的多语言安全说明。

Pre nego to upotrebite proizvod obavezno paljivo pročitajte i prouite viejziko uputstvo za bezbednost na dokumentacionom DVD-u koji ste dobili uz proizvod.

Pred pouvanm produktu si pretajte viacjazyn bezpenostn pokyny na disku DVD s dokumentciou dodanom s produktom.

Preden začnete uporabljati izdelek, je pomembno, da preberete in razumete večjezična varnostna navodila na DVD-ju z dokumentacijo, ki ste ga prejeli skupaj z izdelkom.

Antes de utilizar el producto, asegúrese de leer y comprender las instrucciones de seguridad multilingües del DVD de documentación que se proporciona con el producto.

Var noga med att läsa säkerhetsinstruktionerna på dokumentations-DVD-skivan som följer med produkten innan du börjar använda produkten.

使用本產品之前，請務必閱讀並瞭解產品隨附的文件 DVD 上的多國語言版本安全資訊。

Bu ürünün kullanmadan önce, ürünle birlikte gönderilen belge DVD'si üzerindeki çok dil içeren güvenlik yönergelerini okuyup anladığınızdan emin olun.

Перед використанням цього продукту уважно ознайомтеся з інструкціями з техніки безпеки на різних мовах, що можна знайти на DVD-диску з документацією в комплекті з продуктом.

Important: For translated versions of the caution or danger statement, refer to the *Safety, Warranty, and Support Information* document.

Ensure that you read and understand all caution and danger statements in this document before you perform the procedures. Read and understand any additional safety information that is included with the server or optional device before you install, remove, or replace 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.
- Ensure that all power cord connectors are securely and completely plugged into receptacles.
- 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:

1. Turn everything OFF.
2. First, attach all cables to devices.
3. Attach signal cables to connectors.
4. Attach power cords to outlets.
5. Turn devices ON.

To disconnect:

1. Turn everything OFF.
2. First, remove power cords from outlets.
3. Remove signal cables from connectors.
4. Remove all cables from devices.

Statement 2



DANGER

Danger of explosion if battery is incorrectly replaced.

When replacing the lithium coin cell battery, use only the same or an equivalent type that is recommended by the 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.

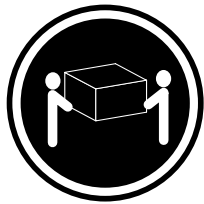


DANGER

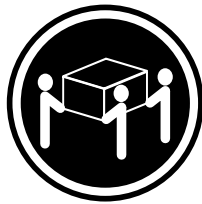
Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following:

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

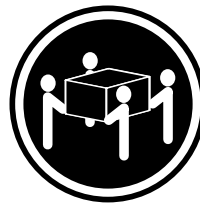
Statement 4



≥ 18 kg (39.7 lb)
< 32 kg (70.5 lb)



≥ 32 kg (70.5 lb)
< 55 kg (121.2 lb)



≥ 55 kg (121.2 lb)
< 100 kg (220.5 lb)

CAUTION:

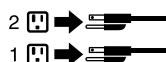
Use safe practices when lifting.

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:

If you install a strain-relief bracket option over the end of the power cord that is connected to the device, you must connect the other end of the power cord to a power source that is easily accessible in case it needs to be disconnected.

Statement 7



CAUTION:

If the device has doors, ensure that you remove or secure the doors before moving or lifting the device to protect against personal injury. The doors will not support the weight of the device.

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 9



CAUTION:

Disconnect the hot-swap fan cables before removing the fan from the device to protect against personal injury.

Statement 10



CAUTION:

The following label indicates a sharp-edge hazard.



Statement 11



CAUTION:

The following label indicates a potential heat hazard.



Statement 12



DANGER

Overloading a branch circuit is a potential fire hazard and a shock hazard under certain conditions. To avoid these hazards, ensure that your system electrical requirements do not exceed branch current ratings at the installation site.

Statement 13



CAUTION:

Ensure that the rack is secured properly to avoid tipping when the server unit is extended on the rails.

Statement 14



CAUTION:

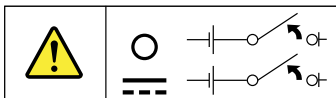
Some accessory or option board outputs exceed Class 2 or limited power source limits. You must install the appropriate interconnecting cabling in accordance with your local electrical code requirements.

Statement 15



CAUTION:

The power-control button on the device may put the device in standby mode instead of turning off the device. In addition, the device might have multiple connections to dc power. To remove all electrical current from the device, ensure that all connections to dc power are disconnected at the dc power input terminals.



Statement 16



CAUTION:

To reduce the risk of electric shock or energy hazards:

- This equipment must be installed by trained service personnel in a restricted-access location, as defined by your local electrical code and the latest edition of IEC 60950.
- The branch circuit overcurrent protection must be rated in accordance with local electrical code requirements.
- Use 1.3 mm² or 16 American Wire Gauge (AWG) copper conductor only, not exceeding 3 meters in length.
- Torque the wiring-terminal screws to 1.4 newton-meters or 12 inch-pounds.
- Provide a readily available, approved and rated disconnect device in the field wiring.

Statement 17



CAUTION:

This product contains a Class 1M laser. Do not view directly with optical instruments.

Statement 18



CAUTION:

Do not place any object on top of rack-mounted products.

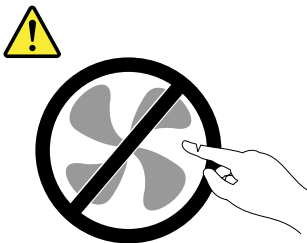


Statement 19



CAUTION:

Hazardous moving parts. Keep fingers and other body parts away.



Statement 20



CAUTION:

A lithium ion battery is provided. To avoid possible explosion, do not burn the battery. Replace the battery only with the Lenovo-approved part. Recycle or discard the battery as instructed by local regulations.

Products that are not assessed

Typical products that are **not assessed** include but not limited to the following:

- Server and IT-rack components (for example, uninterruptible power supplies and current distribution systems)
- Devices in IT rooms (for example, bulk storage units and network products)
- Industrial low-voltage switchgear

Safety inspection guide

The purpose of this inspection guide is to assist you in identifying potentially unsafe conditions. As each machine was designed and built, required safety items were installed to protect users and service technicians from injury. This guide addresses only those items. You should use good judgment to identify potential safety hazards due to attachment of non-ThinkServer features or options not covered by this inspection guide.

If any unsafe conditions are present, you must determine how serious the apparent hazard could be and whether you can continue without first correcting the problem.

Consider these conditions and the safety hazards they present:

- Electrical hazards, especially primary power (primary voltage on the frame can cause serious or fatal electrical shock)
- Explosive hazards, such as a damaged Cathode Ray Tube (CRT) monitor or a bulging capacitor
- Mechanical hazards, such as loose or missing hardware

To determine whether there are any potentially unsafe conditions, use the following checklist at the beginning of every service task. Begin the checks with the power off, and the power cords disconnected.

Checklist:

1. Check exterior covers for damage (loose, broken, or sharp edges).
2. Power off the server. Disconnect the power cords.
3. Check the power cord for:
 - a. A third-wire ground connector in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and the frame ground.
 - b. The power cord should be the authorized type specified for your server. Go to: <http://www.lenovo.com/serviceparts-lookup>
 - c. Insulation must not be frayed or worn.
4. Check for cracked or bulging batteries.
5. Remove the cover.
6. Check for any obvious non-ThinkServer alterations. Use good judgment as to the safety of any non-ThinkServer alterations.

7. Check inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
8. Check for worn, frayed, or pinched cables.
9. Check that the power-supply cover fasteners (screws or rivets) have not been removed or tampered with.

Grounding requirements

Electrical grounding of the server is required for operator safety and correct system function. Proper grounding of the electrical outlet can be verified by a certified electrician.

Chapter 1. General information

This chapter provides some general information about your product.

This chapter contains the following items:

- “Introduction” on page 1
- “Server documentation” on page 2

Introduction

This user guide for your Lenovo® ThinkServer® product contains information about the server features, specifications, component locations, configuration instructions, hardware replacement procedures, and basic troubleshooting and diagnostics.

Your server comes with a documentation DVD that contains various server documents to help you use and maintain the server.

The Lenovo Limited Warranty (LLW) contains the warranty terms that apply to the product you purchased from Lenovo. Read the LLW on the documentation DVD that comes with your server. A printable generic version of the latest LLW also is available in more than 30 languages at http://www.lenovo.com/warranty/llw_02. If you cannot obtain the LLW through the documentation DVD or Lenovo Web site, contact your local Lenovo office or reseller to obtain a printed version of the LLW, free of charge.

For warranty service, consult the worldwide Lenovo Support telephone list. Telephone numbers are subject to change without notice. The most up-to-date telephone list for Lenovo Support is always available on the Web site at <http://www.lenovo.com/support/phone>. If the telephone number for your country or region is not listed, contact your Lenovo reseller or Lenovo marketing representative.

To obtain the most up-to-date information about the server, go to:
<http://www.lenovo.com/thinkserver>

Lenovo maintains pages on the World Wide Web where you can get the latest technical information and download documentation or device drivers and updates. To access the Lenovo Support Web site, go to:
<http://www.lenovo.com/support>

Record information about your server in the following table. You will need the information if you ever need to have your server serviced.

For where to find the product information label on the chassis, see “Machine type, model, and serial number label” on page 16.

Product name	_____
Machine type and model (MT-M)	_____
Serial number (S/N)	_____
Date of purchase	_____

You can register your server with Lenovo by following the instructions at:
<http://www.lenovo.com/register>

When you register your server, information is entered into a database, which enables Lenovo to contact you in case of a recall or other severe problem. After you register your server with Lenovo, you will receive quicker service when you call Lenovo for help. In addition, some locations offer extended privileges and services to registered users.

Server documentation

This topic provides general descriptions of the various documentation for your server and instructions on how to obtain all the documentation.

Printed document

The following documents are printed out and contained in your server package.

- *Read Me First*

This is a multilingual document you should read first. This document provides instructions on how to access the complete safety, warranty, and support information on the documentation DVD that comes with your server. This document also provides instructions on how to find the most up-to-date information on the Lenovo Support Web site.

- *Rack Installation Instructions* (available on some models)

This document provides instructions on how to install your server into a standard rack cabinet by using the rail kit shipped with the server. The rail kit is available on some models.

Depending on the model, a printed English version of this document might be included in your server package. PDF versions of other languages are provided on the documentation DVD that comes with the server.

Documentation DVD

The documentation DVD, which comes with your server, contains various documents for your server in Portable Document Format (PDF). To view the documentation, have the Adobe Reader program installed. You can download the desired language version of the latest Adobe Reader program from the Adobe Web site at: <http://www.adobe.com>

To start the documentation DVD, insert the DVD into the optical drive. The DVD is AutoPlay enabled and starts automatically in most Microsoft® Windows® environments. If the DVD fails to start or if you are using a Linux® operating system, open the launch.htm file located in the root directory of the DVD.

Note: Lenovo maintains pages on the World Wide Web where you can get the latest technical information and download documentation or device drivers and updates. Some information in the documents on the documentation DVD might change without notice after the first release of the DVD. You can always obtain all the most up-to-date documentation for your server from the Lenovo Web site at: <http://www.lenovo.com/UserManuals>

The following documents are on the documentation DVD that comes with your server:

- *Safety, Warranty, and Support Information*

This is a multilingual document that includes all the safety statements for your product in more than 30 languages. Be sure to read and understand all the safety statements before using the product. This document also includes the Lenovo warranty statement, Customer Replaceable Units (CRUs) information, and information about how to contact the Lenovo Customer Support Center.

- *Lenovo License Agreement*

This document includes the terms and conditions of the Lenovo License Agreement.

- *User Guide and Hardware Maintenance Manual*

This document provides detailed information to help you get familiar with your server and help you use, configure, and maintain your server.

- *Rack Installation Instructions* (available on some models)

This document provides instructions on how to install your server into a standard rack cabinet by using the rail kit shipped with the server. The rail kit is available on some models.

- *ThinkServer System Manager User Guide*

This document provides information about server remote management. This document is in English only. You might find this document on the documentation DVD that comes with your server. If not, download it from the Lenovo Web site at: <http://www.lenovo.com/UserManuals>

Note: To obtain advanced remote management functions, install a ThinkServer System Manager Premium (TSM Premium) on the TSM Premium connector on the system board. See “Installing or removing the ThinkServer System Manager Premium” on page 99.

- *MegaRAID SAS Software User Guide*

This document provides information about Redundant Array of Independent Disks (RAID) and how to use the utility programs to configure, monitor, and maintain your server RAID and related devices. This document is in English only.

- *Other documents*

You might find other documents for the Host Bus Adapter (HBA), Ethernet card, or other optional parts on the documentation DVD.

Chapter 2. Server setup road map

This chapter provides a general road map to guide you through setting up your server.

The server setup procedure varies depending on the configuration of the server when it was delivered. In some cases, the server is fully configured. Connect the server to the network and an ac power source, and then you can turn on the server. In other cases, the server needs to have hardware devices installed, requires hardware and firmware configuration, and requires an operating system to be installed.

The general procedure for setting up your server is:

1. Unpack the server package. See “Server package” on page 7.
2. Install any required hardware or server option. See the related topic in Chapter 6 “Replacing hardware” on page 63.
3. Depending on the model, install the server into a standard rack cabinet by using the rail kit shipped with the server. See *Rack Installation Instructions* that comes with your server. The rail kit and *Rack Installation Instructions* are available on some models.
4. Connect the Ethernet cable and power cords to the server. See “Rear view of the server” on page 22 to locate the connectors.
5. Turn on the server to verify operation. See “Turning on the server” on page 49.
6. Review the Unified Extensible Firmware Interface (UEFI) Basic Input Output System (BIOS) settings and customize as needed. See “Using the Setup Utility program” on page 51.
7. Configure RAID and install the operating system and basic drivers. See “Lenovo ThinkServer Deployment Manager” on page 14 and “Configuring RAID” on page 58.
8. Install any additional drivers required for added features. Refer to the instructions that come with the hardware option.
9. Configure Ethernet settings in the operating system by referring to the operating system help. This step is not required if the operating system was installed using the Lenovo ThinkServer Deployment Manager program.
10. Check for firmware and driver updates. See “Updating the firmware” on page 61.
11. Install management applications and any other applications. Refer to the documentation that comes with the applications that you want to install.

Chapter 3. Product overview

This chapter contains the following items:

- “Server form factor” on page 7
- “Server package” on page 7
- “Features” on page 8
- “Specifications” on page 12
- “Software” on page 13
- “Locations” on page 16

Server form factor

The server is designed to support both tower and rack form factors. Most server components are the same between the two form factors. The difference is that the tower-form-factor server models come with foot stands, and the rack-form-factor server models come with rack handles. Most illustrations shown in this documentation are based on the tower-form-factor server model.

Server package

Note: Depending on the model, your server might look different from the following illustration.

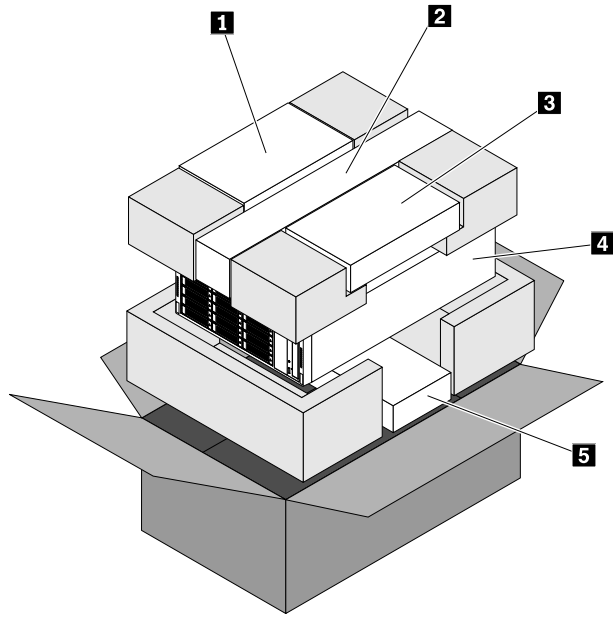


Figure 1. Server package

- 1 Cable management bar (available on some models)
- 2 Rail kit (available on some models)
- 3 Keyboard
- 4 Server
- 5 Material box, including power cords, printed documentation, and a documentation DVD

Features

This topic provides general information about the server features for various models. Depending on your specific model, some features might vary or not be available. For information about your specific model, use the Setup Utility program. See “Viewing information in the Setup Utility program” on page 51. You also can refer to the Product Specifications Reference document for ThinkServer products at: <http://www.lenovo.com/psref/>

Microprocessor

One or two Intel® Xeon® microprocessors (internal cache size varies by model)

For a list of ThinkServer microprocessor options, go to:
<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Memory

Your server has 16 memory slots. For more information, see “System board components” on page 41 and “Memory module installation rules” on page 76.

Power supply

Your server comes with one of the following power supply configurations:

- One or two hot-swap 550-watt power supplies (universal input and compliant with 80 PLUS Platinum)
- One or two hot-swap 750-watt power supplies (universal input and compliant with 80 PLUS Platinum)
- One or two hot-swap 750-watt power supplies (universal input and compliant with 80 PLUS Titanium)
- One or two hot-swap 1100-watt power supplies (universal input and compliant with 80 PLUS Platinum)

Airflow and cooling

- One or two heat sinks for microprocessor cooling
- Four system fans

Internal drives

Internal drives are devices that your server uses to read and store data. The internal drives supported by your server vary by model.

- Internal storage drive

Depending on the model, your server supports different storage drives, such as hard disk drives or solid-state drives. The term “2.5-inch hot-swap drives” or “2.5-inch drives” hereinafter refers to all the supported types of 2.5-inch drives, including the solid-state drives.

Drive bay	Supported drive type
Eight 2.5-inch drive bays	Hot-swap, SATA Hard disk drive
Eight 2.5-inch drive bays	Hot-swap, SATA or SAS Hard disk drive or solid-state drive
Sixteen 2.5-inch drive bays	Hot-swap, SATA or SAS Hard disk drive or solid-state drive
Five 3.5-inch drive bays	Easy-swap, SATA Hard disk drive
Five 3.5-inch drive bays	Hot-swap, SATA Hard disk drive
Fifteen 3.5-inch drive bays	Hot-swap, SATA or SAS Hard disk drive or solid-state drive

Note: For server models with fifteen 3.5-inch-drive bays, you can install 2.5-inch drives and 3.5-inch drives into the same server. For more information, see “Installing a 2.5-inch drive into a 3.5-inch-drive bay” on page 134.

- Optical drive
 - Up to two 5.25-inch SATA optical drives

The server has two optical drive bays. The lower optical-drive bay is installed with a 5.25-inch SATA optical drive. The upper bay is for a secondary optical drive. Some server models come with a secondary optical drive installed in the upper bay.

- Tape drive

Your server supports an internal tape drive that enables you to store data on tape media. For more information, see “Installing or replacing an internal tape drive” on page 120.

To locate the internal drives or drive bays, see “Front view of the server” on page 17.

External drives

If your server has a host bus adapter (HBA) installed, an external storage device can be connected to store data. For more information, refer to the documentation that comes with the external storage device.

Expansion slots

The server has seven expansion slots on the system board for installing appropriate Peripheral Component Interconnect Express (PCIe) cards. For detailed information, see “System board components” on page 41.

Input/Output (I/O) features

- One serial connector on the rear panel
- One Video Graphics Array (VGA) DB-15 connector on the rear panel
- Three RJ-45 Ethernet connectors on the rear panel
- Four USB 3.0 connectors on the rear panel
- Two USB 2.0 connectors on the front panel

To locate the connectors, refer to the related topics in “Locations” on page 16.

Video subsystem

An integrated graphics controller in the ThinkServer System Manager (TSM), which also is known as the Baseboard Management Controller (BMC) chip, is installed on the system board to support a VGA connector on the rear panel for connecting video devices.

Ethernet connectivity

The server comes with an integrated Intel Gigabit Ethernet controller as well as an Ethernet physical layer (PHY) of the Open Systems Interconnection model (OSI model). They provide the server with the ability to support two Ethernet connectors on the rear panel with 10 megabits per second (Mbps), 100 Mbps, or 1000 Mbps network connectivity. For more information, see “Rear view of the server” on page 22.

You can install an Ethernet card to enable more Ethernet connectors. However, you must install a device driver to enable the operating system to recognize the Ethernet connectors. The device drivers are available for download at:

<http://www.lenovo.com/drivers>

Reliability, availability, and serviceability

Reliability, availability, and serviceability (hereinafter referred to as RAS) are three important server design features. The RAS features help you to ensure the integrity of the data stored on 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:

- **Security features**

- Server cover lock (see “Server cover lock” on page 24)
- Administrator password and user password to help protect unauthorized access to the server (see “Using passwords” on page 54)
- ThinkServer Trusted Platform Module (TPM), which is a security chip, to help enhance server security

Note: The TPM is only available on some models.

- Remote monitoring or control by an administrator to provide protection or help
- Hot-swap redundant power supplies to help avoid significant interruption to the operation of the system when a power supply fails

- **Basic system management features**

- Ability to store the power-on self-test (POST) hardware test results
- BIOS Setup Utility program

The BIOS Setup Utility program helps you view the server information and configure the server in the pre-operating system environment. See “Using the Setup Utility program” on page 51.

- TSM (also known as BMC), and Intelligent Platform Management Interface (IPMI) 2.0

The system board platform management subsystem is based on the integrated ThinkServer System Manager (TSM) features. The TSM is a management chip that is integrated on the system board of your server. With the TSM chip, no matter what condition the server operating system is in and no matter if the server is on or off, as long as the server is connected to network and an ac power source, the interaction with the TSM-controlled servers can be achieved through system network. The user can obtain the server hardware health information and system event log (SEL), and is able to conduct the operations including turning on or off the server, restarting the server, and so on. This part of server management is independent of the operating system and is called out-of-band management.

The system board platform management subsystem consists of the integrated TSM, communication buses, sensors, BIOS, and server management firmware. It is responsible for error reporting, system power control, thermal monitoring, system fan control, and other management features. The TSM provides system management and monitoring features based on the IPMI 2.0 specification. IPMI helps lower the overall costs of server management. You can find more information about IPMI 2.0 from the Web site of Intel. The TSM also supports some non-IPMI features, such as the Dynamic Host Configuration Protocol (DHCP) and the Platform Environment Control Interface (PECI), to provide more system management functions.

You can find the default user name, password, and other information for the TSM in the *ThinkServer System Manager User Guide*, which is available for download at:
<http://www.lenovo.com/UserManuals>

- Hot-swap feature

Some models support hot-swap storage drives and all models support hot-swap power supplies and hot-swap system fans. With the hot-swap feature, you can install, remove, or replace storage drives, a failing power supply, or a failing system fan without turning off the server.

- Preboot Execution Environment (PXE)

The Intel PXE technology enables you to boot your computers, load an operating system, or deploy executable images from a remote server by using a network interface. The operation can be done independently of local data storage devices (such as storage drives) or operating systems.

- Redundant Array of Independent Disks (RAID)

Your server supports onboard SATA software RAID. Your server also supports advanced SATA/SAS hardware RAID configurations if you have a required RAID card installed. For detailed information, see “Configuring RAID” on page 58.

- Status light-emitting diodes (LEDs) and diagnostic LEDs
For information about the LEDs for your server, refer to the related topics in “Locations” on page 16.
- Software programs
For information about the software programs, see “Software” on page 13.
- Wake on LAN
When the Wake on LAN feature is enabled on a computer that is connected to a local area network (LAN), a network administrator can remotely turn on or wake up the computer from a management console using remote network management software. Besides, many other functions, such as data transfer and software updates, can be performed remotely without remote attendance and can be done after normal working hours and on weekends to save time and increase productivity.

- **Advanced system management features**

The advanced system management features are only available when the TSM detects the presence of a ThinkServer System Manager Premium (TSM Premium), which also is known as the integrated keyboard, video, and mouse (iKVM) key. The TSM Premium is a remote management module. You can purchase a TSM Premium from Lenovo and install it on the TSM Premium connector (also known as iKVM connector) on the system board of your server to enable the iKVM function and activate the advanced system management features.

For more information about advanced system management, refer to the *ThinkServer System Manager User Guide*, which is available for download at:
<http://www.lenovo.com/UserManuals>

Specifications

This topic lists the physical specifications for your server.

Dimensions

- For tower form factor
 - Width: 173 mm (6.81 inches)
 - Height: 459 mm (18.07 inches) with foot stands
 - Depth: 685 mm (26.97 inches) including the front door
- For rack form factor
 - Width: 482 mm (18.98 inches) with rack handles
 - Height: 173 mm (6.81 inches)
 - Depth: 664 mm (26.14 inches)

Weight

The product weight varies depending on different system configurations.

Range of product weight without package: 22 kg (48.5 lb) to 41.5 kg (91.49 lb)

Range of product weight with package: 31 kg (68.34 lb) to 50.5 kg (111.33 lb)

Electrical input

Universal input:

- Minimum:
 - 90 V ac for 550-watt, 750-watt, and 1100-watt redundant power supplies compliant with 80 PLUS Platinum

180 V ac for 750-watt redundant power supplies compliant with 80 PLUS Titanium

- Maximum: 264 V ac
- Input frequency range: 47 to 63 Hz

Environment

Depending on the hardware configuration, some server models comply with ASHRAE class A4 specifications. The other server models comply with ASHRAE class A3 specifications.

- For server models that meet all of the following configuration requirements at the same time:

These server models comply with ASHRAE class A4 specifications, such as air temperature, altitude, and humidity as listed.

Hardware configuration requirements:	Environment information:
<ul style="list-style-type: none">– Easy-swap-drive bays or eight 2.5-inch-drive bays– CPU: Lenovo-qualified; a maximum of 120-W thermal design power; not low-power type (no L-suffix in the CPU name)– Do not have internal tape drives installed– Two power supplies installed for redundancy– PCIe card: Lenovo-qualified; power consumption of each card does not exceed 15 W	<ul style="list-style-type: none">– Dry-bulb temperature:<ul style="list-style-type: none">Operating: From 5°C (41°F) to 45°C (113°F)Storage: From -40°C (-40°F) to 60°C (140°F) in original shipping package– Altitude: From 0 m (0 ft) to 3048 m (10 000 ft)– Humidity:<ul style="list-style-type: none">Operating: From 8% to 90% (non-condensing)Storage: From 8% to 90% (non-condensing)

Note: When the altitude exceeds 900 m (2953 ft), the defined maximum dry-bulb temperature for operation becomes a dependent variable. This temperature value decreases by 1 °C (33.8 °F) with every 125 m (410 ft) of altitude increase.

- For the other server models:

These server models comply with ASHRAE class A3 specifications, such as the air temperature, altitude, and humidity information as listed.

- Dry-bulb temperature:

Operating: From 5°C (41°F) to 40°C (104°F)

Storage: From -40°C (-40°F) to 60°C (140°F) in original shipping package

- Altitude: From 0 m (0 ft) to 3048 m (10 000 ft)

- Humidity:

Operating: From 8% to 85% (non-condensing)

Storage: From 8% to 90% (non-condensing)

Note: When the altitude exceeds 900 m (2953 ft), the defined maximum dry-bulb temperature for operation becomes a dependent variable. This temperature value decreases by 1 °C (33.8 °F) with every 175 m (574 ft) of altitude increase.

Software

This topic provides information about the software programs that you can use to set up, use, and maintain the server.

To download the software programs, go to the Lenovo Support Web site at <http://www.lenovo.com/support> and follow the instructions on the Web page.

BIOS and TSM update utilities

The BIOS and TSM (also known as BMC) firmware keeps updating after the shipment of the server. Lenovo maintains pages on the Support Web site and provides the BIOS and TSM update utilities with instructions for download to help you update the BIOS and TSM firmware if needed. For more information, see “Updating or recovering the BIOS” on page 56 and “Updating the firmware” on page 61.

Lenovo Partner Pack for Microsoft System Center Operations Management

The Lenovo Partner Pack for Microsoft System Center Operations Management program automatically detects the managed servers of your ThinkServer server and provides detailed system information about the managed servers. The system information includes component inventory, component status, and sensor status. The program also enables users to perform management tasks, such as restarting or turning off your ThinkServer server, and accessing the TSM interface.

For detailed information about using the program, refer to the help system of the program.

Lenovo ThinkServer Deployment Manager

The Lenovo ThinkServer Deployment Manager program (hereinafter referred to as Deployment Manager) simplifies the process of configuring RAID, configuring BIOS settings, and updating the firmware. The program works in conjunction with your Windows or Linux operating system installation disc to automate the process of installing the operating system and associated device drivers. The program is part of the server firmware. The help system for the program can be accessed directly from the program interface.

Deployment Manager has the following features:

- Easy-to-use, language-selectable interface
- Integrated help system
- Automatic hardware detection
- Selectable partition size and file system type
- Ability to install the operating system and device drivers in an unattended mode to save time
- Ability to create a reusable response file that can be used with similarly configured Lenovo servers to make future installations even faster
- Contains RAID configuration utility
- Provides device drivers based on the server model and detected devices
- Supports BIOS settings configuration
- Supports firmware and applications update

To use Deployment Manager, do the following:

1. Launch the program through one of the following methods:
 - Turn on the server. Press F10 as soon as you see the logo screen. Then, wait for several seconds. Deployment Manager opens.
 - Start the Setup Utility program. Select **Boot Manager** → **Launch TDM**. Deployment Manager opens.
2. Read and accept the license agreement.

3. Select the language in which you want to view the program. Then, follow the instructions on the screen to use the program.

Before installing a Windows or a Linux operating system using Deployment Manager, it is recommended that you do the following:

1. Download the latest device driver bundle file for your server. To find and download the bundle file, go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page.
2. Launch Deployment Manager and click **Platform Update** on the left pane.
3. Select **Application** and then click **Next**.
4. Click **Browse** to select the corresponding bundle file and then click **OK**. The version information is displayed.
5. Click **Flash** to apply the bundle file and update the current device drivers.

Note: If you want to install a VMware hypervisor or any other supported operating system using Deployment Manager, the device driver bundle file is not needed.

To download the latest Deployment Manager, go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page.

Lenovo ThinkServer Diagnostics

The Lenovo ThinkServer Diagnostics program enables you to diagnose server problems, perform some diagnostic tests, and collect system information. Examples of the system information include basic operating-system information, hardware information, SEL, RAID log, and so on. Depending on the model, your server might come with one of the following diagnostic programs:

- Lenovo ThinkServer Diagnostics Linux Edition
- Lenovo ThinkServer Diagnostics Standalone Edition
- Lenovo ThinkServer Diagnostics Windows Edition

For detailed information about using the Lenovo ThinkServer Diagnostics program, refer to the help system for the program.

Lenovo ThinkServer Energy Manager

The Lenovo ThinkServer Energy Manager program is a program for data center energy management. It monitors the power and temperature at the server level and the group level. By analyzing the monitored power and temperature information, Energy Manager helps you improve the business continuity and energy efficiency.

For detailed information about using the Energy Manager program, refer to the help system for the program.

Lenovo ThinkServer Power Planner

The Lenovo ThinkServer Power Planner program provides information about data maintenance, power consumption, electric current calculations, and so on. The program helps you conveniently manage servers and devices to increase the deployment efficiency significantly.

For detailed information about using the Lenovo ThinkServer Power Planner program, refer to the help system of the program.

Lenovo ThinkServer System Manager

The Lenovo ThinkServer System Manager (TSM) is a management solution that provides comprehensive and secure management features. These features enable you to manage your servers remotely using a one-to-one or one-to-many method.

The TSM provides a one-to-one web-based console. The web-based console is developed in HTML 5 and structured in the way that makes platform management intuitive and efficient. The TSM also provides a secure command-line interface for improved efficiency and functionality.

For detailed information about using the Lenovo ThinkServer System Manager program, refer to the help system of the program.

Lenovo ThinkServer System Manager Premium

Lenovo ThinkServer System Manager Premium provides you a solution that enables you to receive all the benefits and features provided by both the Lenovo ThinkServer System Manager program and the Lenovo ThinkServer Energy Manager program. It also enables you to control the server remotely using Lenovo virtual keyboard, video, and mouse.

For detailed information about using the program, refer to the help system of the program.

Locations

This topic provides information to help you locate your server components.

Machine type, model, and serial number label

When you contact Lenovo for help, the machine type, model, and serial number information helps support technicians to identify your server and provide faster service.

The following illustration is an example of the machine type, model, and serial number label on the server.

Note: Depending on the model type, your server might look different from this illustration.

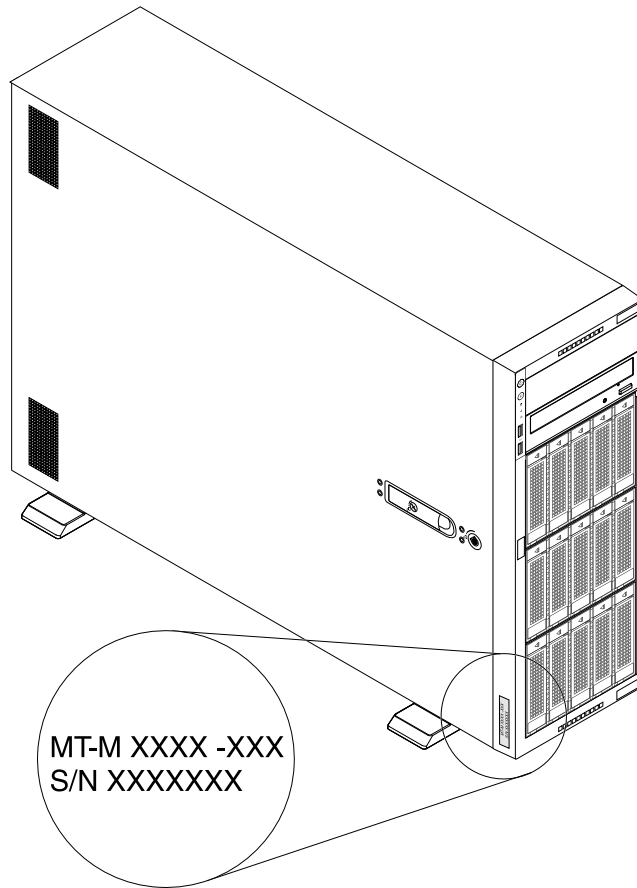


Figure 2. Machine type, model, and serial number label

Front view of the server

The front view of the server varies by model. Your server might look different from the illustrations in this topic.

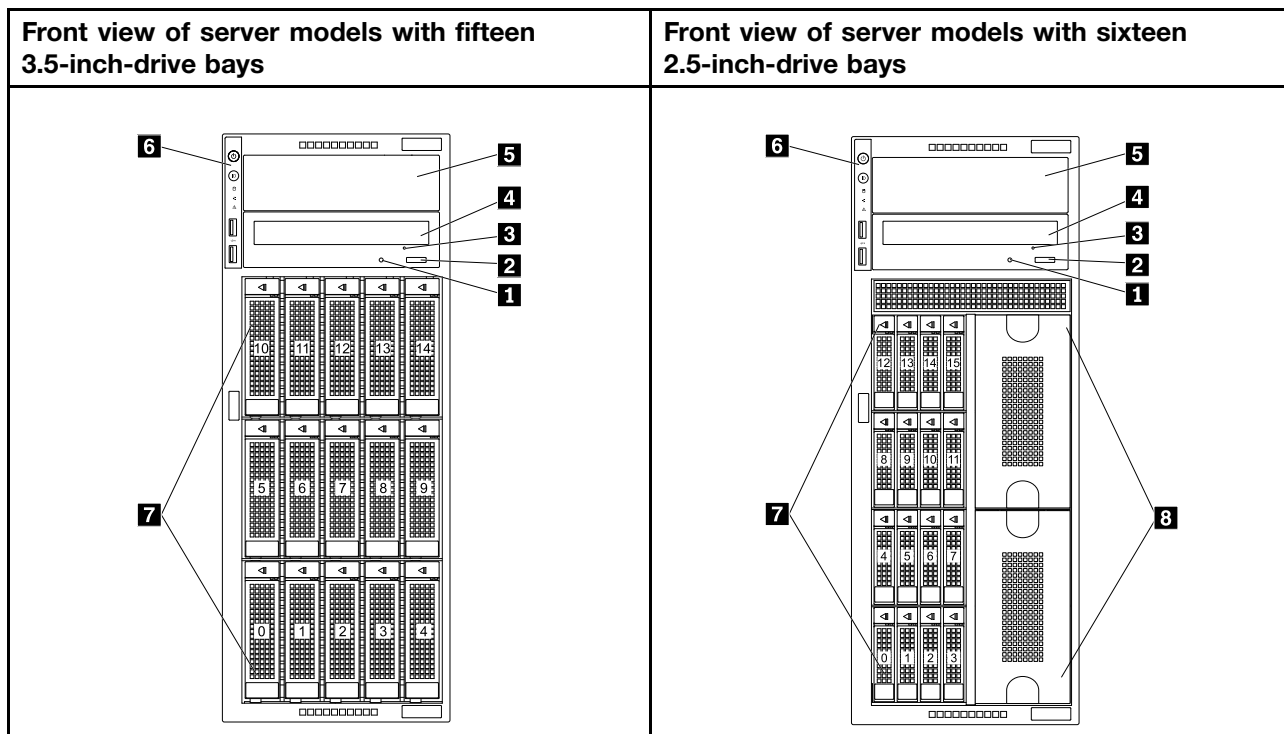


Figure 3. Front view of the server

1 Optical-drive status LED	2 Optical-drive eject/close button
3 Optical-drive manual-eject hole	4 Optical-drive bay 1
5 Optical-drive bay 2	6 Front panel
7 Storage-drive bays	8 Metal protective shields

1 Optical-drive status LED

The optical-drive status LED is blinking in green when the optical drive is working or in the POST process.

2 Optical-drive eject/close button

Press this button to eject or close the optical drive when the server power is on.

3 Optical-drive manual-eject hole

Insert a straightened paper clip into the optical-drive manual-eject hole to eject the disc tray when the eject/close button does not work.

4 Optical-drive bay 1

Your server comes with either an optical drive or a tape drive installed in the 5.25-inch optical-drive bay 1.

5 Optical-drive bay 2

The 5.25-inch optical-drive bay 2 is for a secondary optical drive. Some models have a secondary optical drive installed. For more information, see “Installing or replacing an optical drive” on page 109.

6 Front panel

For detailed information about the control, connectors, and status LEDs on the front panel, see “Front panel” on page 20.

7 Storage-drive bays

The storage-drive bays are used to install 3.5-inch or 2.5-inch internal storage drives. Depending on the model, your server supports one of the following storage-drive bay configurations:

- Five 3.5-inch-drive bays
- Fifteen 3.5-inch-drive bays
- Eight 2.5-inch-drive bays
- Sixteen 2.5-inch-drive bays

Note: For server models with fifteen 3.5-inch-drive bays, you can install 2.5-inch drives and 3.5-inch drives into the same server. For more information, see “Installing a 2.5-inch drive into a 3.5-inch-drive bay” on page 134.

8 Metal protective shields

The metal protective shields are used to cover vacant storage-drive bays.

Attention: An unoccupied storage-drive bay without any other protection might impact the EMI integrity and cooling of the server, which might result in overheating or component damage.

Front panel

The following illustration shows the control, connectors, and LEDs on the front panel of the server.

Note: Depending on the model, your server might look different from the illustration in this topic.

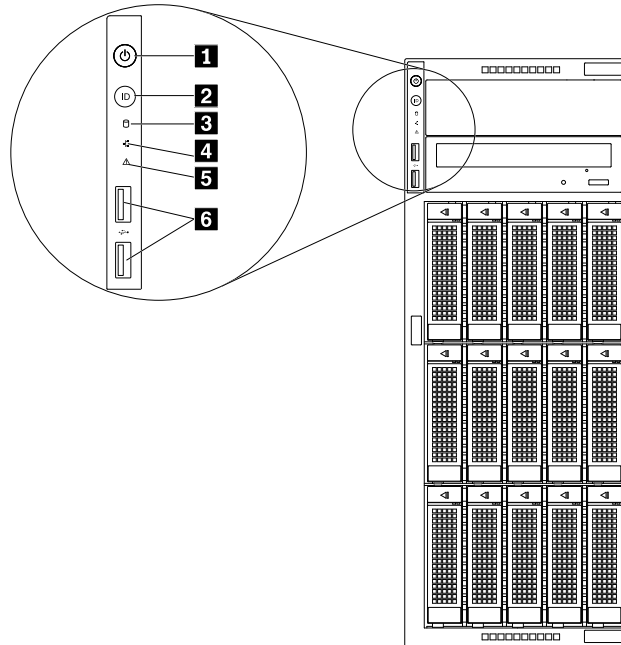


Figure 4. Front panel

1 Power button with power status LED	2 System ID button with ID LED
3 Storage-drive activity LED	4 Network status LED
5 System health LED	6 USB 2.0 connectors (2)

1 Power button with power status LED

Press the power button to turn on the server when you finish setting up the server. Hold the power button for several seconds to turn off the server if you cannot turn it off from the operating system. See Chapter 4 “Turning on and turning off the server” on page 49. The power status LED helps you to identify the current power status.

Power status LED	Color	Description
On	Green	The server is on.
Off	None	The server is off.

2 System ID button with ID LED

When you press the system ID button, the ID LEDs on both the front and rear of the server are lit. As a result, you can locate the server among other servers. You also can turn on the ID LEDs using a remote management program for server presence detection.

ID LED	Color	Description
On	Blue	The server is identified.
Off	None	The ID LED is not in use or the server is not identified.

3 Storage-drive activity LED

Note: The storage-drive activity LED is only for server models with easy-swap storage drives.

Storage-drive activity LED	Color	Description
On	Green	The storage drive is active and data is being transferred.
Off	None	The storage drive is not in use.

4 Network status LED

The network status LED indicate the LAN status for the Ethernet connectors on the rear of the server.

Network status LED	Color	Description
On	Green	The server is connected to a LAN.
Off	None	The server is disconnected from a LAN.
Blinking	Green	The LAN is connected and active.

5 System health LED

The system health LED helps you to identify if there are any system errors.

- **Off:** The server is off or the server is on and working normally.
- **Blinking:** The BMC is initiating.
- **Amber:** The server has potential system errors. Check the information in the following table for potential system errors and corresponding solutions.

Potential system error (system health LED: amber)	Solution
The temperature of the server reached the non-critical temperature threshold.	Check the BMC for errors and check the system fans.
The voltage of the server reached the non-critical voltage threshold.	Replace the system board. Note: This action must be performed only by Lenovo service personnel. See Chapter 8 “Getting information, help, and service” on page 173.
A fan is running at low speed.	Check the system fans.
The power supply has a critical error.	Check the BMC for detailed information.

Potential system error (system health LED: amber)	Solution
A power cord has been disconnected or a redundant power supply has been removed.	<ol style="list-style-type: none"> 1. Ensure that the power supplies are installed securely. 2. Ensure that the power cords are connected securely to the power supplies. 3. Install a new power supply to replace the removed one.
The system is overheated.	Check the BMC for errors and then check the system fans.

6 USB 2.0 connectors (2)

Used to connect USB devices (USB 1.0, USB 1.1, and USB 2.0 compatible), such as a USB keyboard, mouse, scanner, or printer. If you have more than six USB devices, you can purchase a USB hub, which you can use to connect additional USB devices.

Rear view of the server

Note: Depending on the model, your server might look slightly different from the illustration in this topic.

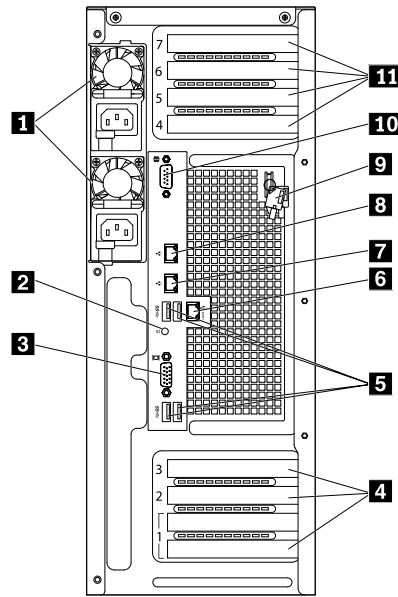


Figure 5. Rear view of the server with two hot-swap redundant power supplies

1 Hot-swap power supplies (2)	2 ID LED
3 VGA DB-15 connector	4 PCIe card slots (3)
5 USB 3.0 connectors (4)	6 Ethernet RJ-45 connector 0
7 Ethernet RJ-45 connector 2	8 Ethernet RJ-45 connector 1
9 Server cover key	10 Serial connector
11 PCIe card slots (4)	

1 Hot-swap power supplies

Your server model might have one or two hot-swap power supplies. Each hot-swap power supply has one power cord connector on the rear. On each power supply, there are three status LEDs near the power cord connector. For information about the status LEDs, see “Power supply status LEDs” on page 31.

2 ID LED

When you press the system ID button, the ID LEDs on both the front and rear of the server are lit. As a result, you can locate the server among other servers. You also can turn on the ID LEDs using a remote management program for server presence detection.

ID LED	Color	Description
On	Blue	The server is identified.
Off	None	The ID LED is not in use or the server is not identified.

3 VGA DB-15 connector

Used to attach a VGA-compatible video device, such as a VGA monitor.

4 11 PCIe card slots

Your server has seven PCIe card slots on the system board for you to install appropriate PCIe cards. For information about the PCIe card slots, see “System board components” on page 41.

5 USB 3.0 connectors

Used to connect USB devices (USB 1.0, USB 1.1, USB 2.0, and USB 3.0 compatible), such as a USB keyboard, mouse, scanner, or printer. If you have more than six USB devices, you can purchase a USB hub, which you can use to connect additional USB devices.

6 7 8 Ethernet RJ-45 connectors

Used to attach an Ethernet cable for a LAN. Each Ethernet connector has two status LEDs to help you identify the Ethernet connectivity, activity, and connection speed.

The Ethernet connector 0 (callout **6**) marked with “MGMT” is for system management by default. If you want to use remote management functions, connect an Ethernet cable to the Ethernet connector 0. You also can set the Ethernet connector 1 for system management. See “Setting an Ethernet connector for system management” on page 56.

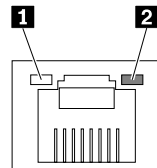


Figure 6. Ethernet status LEDs

Ethernet status LED	Color	Status	Description
1 Left: data speed	Amber	On	The connection speed is 1000 Mbps.
	Green	On	The connection speed is 100 Mbps.
	None	Off	The connection speed is 10 Mbps.
2 Right: link and activity	Green	On	The server is connected to a LAN.
	None	Off	The server is disconnected from a LAN.
	Green	Blinking	The LAN is connected and active.

9 Server cover key

Used to open or lock the server cover. Save the key in a safe place to avoid loss.

10 Serial connector

Used to attach a device that uses a 9-pin serial connector.

Server cover lock

The server cover lock **1** prevents unauthorized access to the inside of your server. You can remove the key attached on the rear of the server and use it to open or lock the server cover.

Note: Depending on the model, your server might look slightly different from the illustration in this topic.

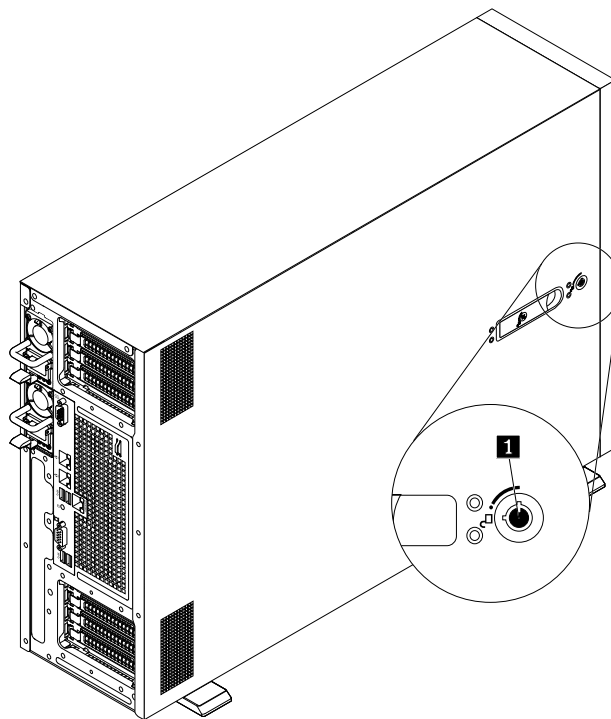


Figure 7. Server cover lock

Server components

To access the inside of the server and view the server components, remove the server cover. See “Removing the server cover” on page 66.

The chassis configuration varies by model. The following illustrations show the three chassis configurations based on the supported backplane or module.

- Server models with one 3.5-inch hot-swap-drive backplane
- Server models with one 2.5-inch hot-swap-drive backplanes
- Server models with one 3.5-inch easy-swap-drive module

Note: Depending on the model, your server might look different from the illustrations in this topic.

The following illustration shows the components of server models with one 3.5-inch hot-swap-drive backplane.

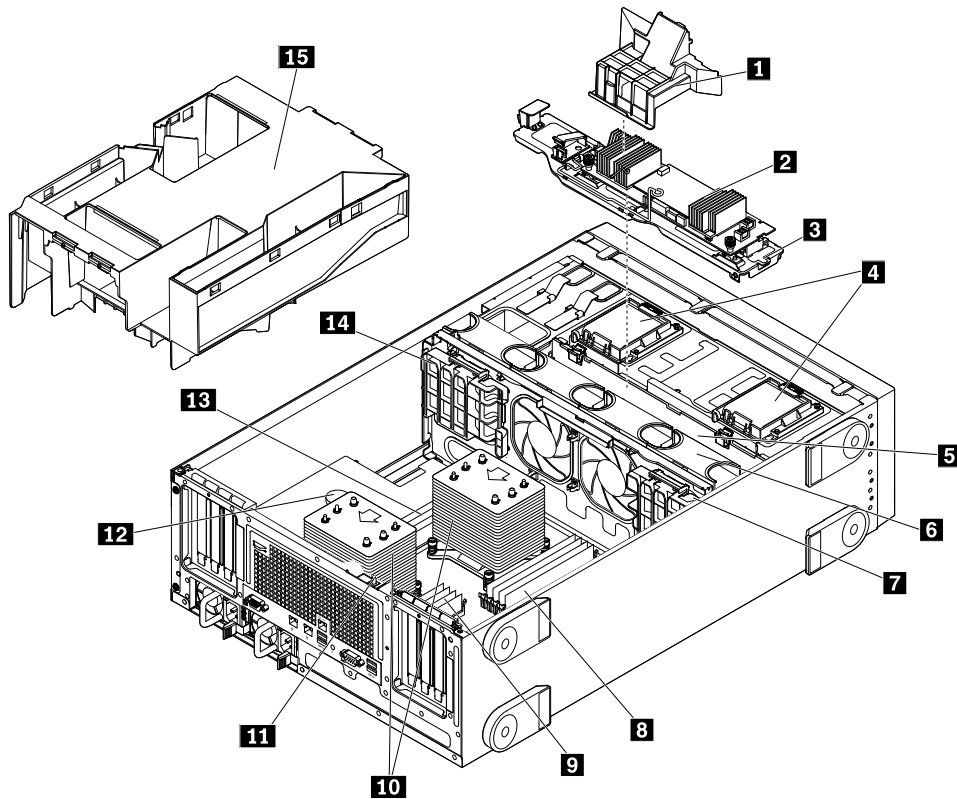


Figure 8. Components of server models with one 3.5-inch hot-swap-drive backplane

1 AnyRAID-adapter air duct (available on some models)	2 AnyRAID adapter (available on some models)
3 AnyRAID-adapter tray	4 ThinkServer RAID Super Capacitor Modules (available on some models)
5 3.5-inch hot-swap-drive backplane	6 System fans
7 PCIe card holder	8 CPU1 DIMMs (vary by model)
9 CPU2 DIMMs (vary by model)	10 Heat sinks (vary by model)
11 Intrusion switch (available on some models)	12 Coin-cell battery
13 CPU1 DIMMs (vary by model)	14 PCIe card holder
15 Cooling shroud	

The following illustration shows the components of server models with one 2.5-inch hot-swap-drive backplane.

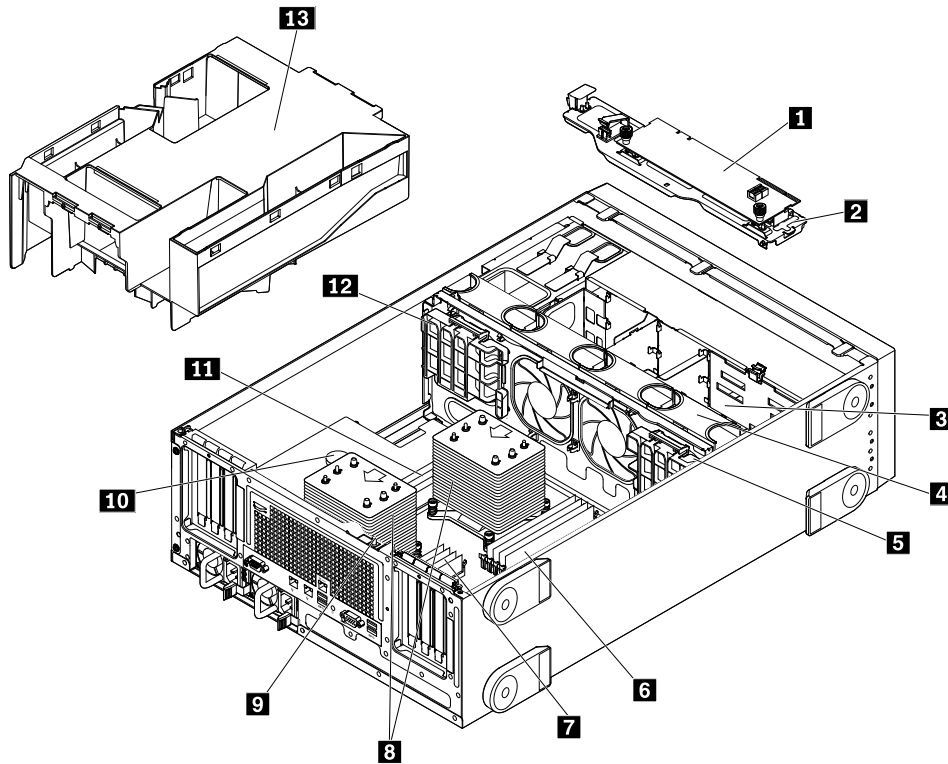


Figure 9. Components of server models with one 2.5-inch hot-swap-drive backplane

1 Pass-through board (available on some models)	2 AnyRAID-adapter tray
3 2.5-inch hot-swap-drive backplane	4 System fans
5 PCIe card holder	6 CPU1 DIMMs (vary by model)
7 CPU2 DIMMs (vary by model)	8 Heat sinks (vary by model)
9 Intrusion switch (available on some models)	10 Coin-cell battery
11 CPU1 DIMMs (vary by model)	12 PCIe card holder
13 Cooling shroud	

The following illustration shows the components of server models with one easy-swap-drive module.

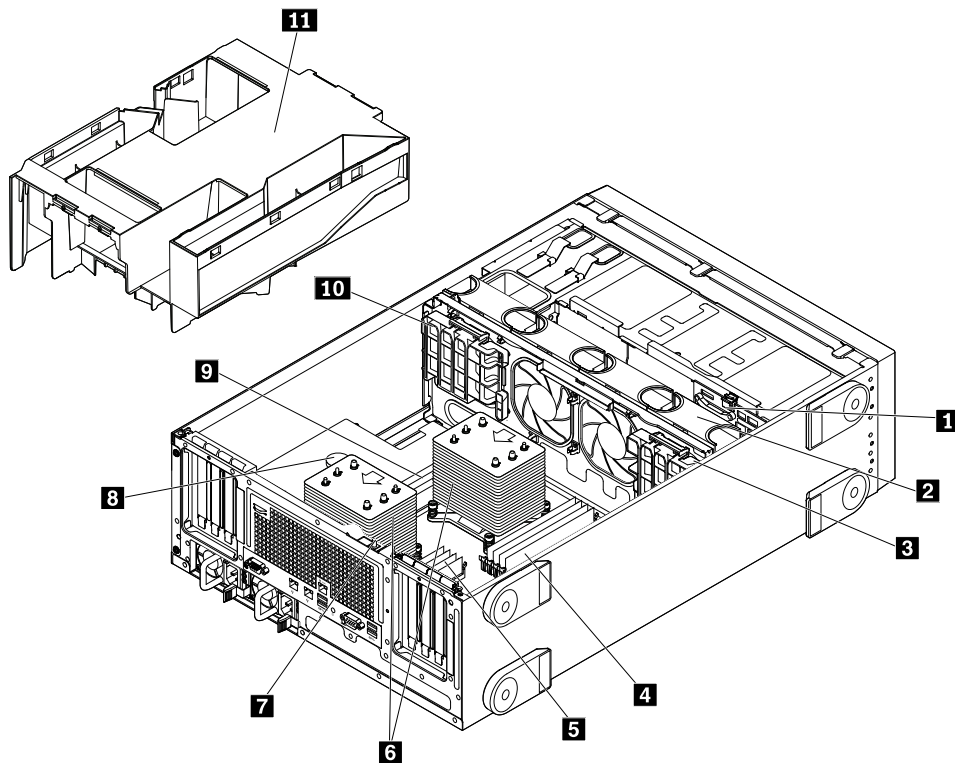


Figure 10. Components of server models with one easy-swap-drive module

1 Easy-swap-drive module	2 System fans
3 PCIe card holder	4 CPU1 DIMMs (vary by model)
5 CPU2 DIMMs (vary by model)	6 Heat sinks (vary by model)
7 Intrusion switch (available on some models)	8 Coin-cell battery
9 CPU1 DIMMs (vary by model)	10 PCIe card holder
11 Cooling shroud	

CRU identification

CRUs are parts that can be upgraded or replaced by the customer. If a CRU is determined to be defective during the warranty period, a replacement CRU will be provided to the customer. Customers are responsible for installing the self-service CRUs for this product. Customers also can install optional-service CRUs, which might require some technical skills or tools, or request that a technician install the optional-service CRU under the terms of the applicable warranty service type for your country or region.

Non-CRUs must be replaced only by trained service technicians.

The following table lists the major FRUs in your server and the CRU identification information. For a complete listing of FRU information, such as FRU part numbers and supported server models, go to: <http://www.lenovo.com/serviceparts-lookup>

Notes:

- Before servicing a Lenovo product, ensure that you read and understand “Safety information” on page iii.
- Use only parts provided by Lenovo.

Description	Self-service CRU	Optional-service CRU
AnyRAID adapter (available on some models)	No	Yes
AnyRAID-adapter air duct (available on some models)	Yes	No
Coin-cell battery	Yes	No
Cooling shroud	Yes	No
Easy-swap storage drive (available on some models)	Yes	No
Easy-swap-drive module (available on some models)	No	Yes
Front bezel	Yes	No
Front door (available on some models)	Yes	No
Front-panel board	Yes	No
Heat sink	Yes	No
Hot-swap storage drive (available on some models)	Yes	No
Hot-swap-drive backplane (available on some models)	No	Yes
Hot-swap power supply	Yes	No
Internal tape drive (available on some models)	Yes	No
Intrusion switch (available on some models)	No	Yes
Memory module	Yes	No
Microprocessor	No	Yes
Optical drive (available on some models)	Yes	No
PCIe card (available on some models)	Yes	No
Power interface board	No	No
SD module (available on some models)	No	Yes
System board	No	No
System fan	Yes	No
ThinkServer RAID 110i pass-through board	No	Yes
ThinkServer RAID 110i upgrade key (available on some models)	Yes	No
ThinkServer RAID 510i upgrade key (available on some models)	Yes	No
ThinkServer RAID Super Capacitor Module (available on some models)	Yes	No
ThinkServer System Manager Premium (available on some models)	Yes	No
ThinkServer Trusted Platform Module (available on some models)	Yes	No

Hot-swap-drive LEDs

This topic applies only to server models with hot-swap internal storage drives.

Each hot-swap storage drive has two LEDs on the front.

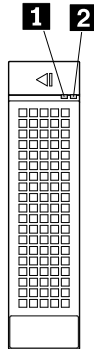


Figure 11. Hot-swap-drive LEDs

1 Activity LED	2 Status LED	Description
Off	Off	The drive has failed or is not present.
On, green	Off	The drive is present but not in use.
Blinking, green	Off	The drive is active and data is being transferred.
On, green	Blinking rapidly (about four flashes per second), amber	The RAID controller is identifying the drive.
On, green	On, amber	The RAID array has failed and cannot be recovered. You must recreate a new array.
Blinking, green	Blinking slowly (about one flash per second), amber	The drive is being rebuilt.

System-fan status LEDs

Your server has four system fans and each system fan has one corresponding status LED on the chassis. Remove the server cover to view the system-fan status LEDs.

Note: Depending on the model, your server might look slightly different from the illustration in this topic.

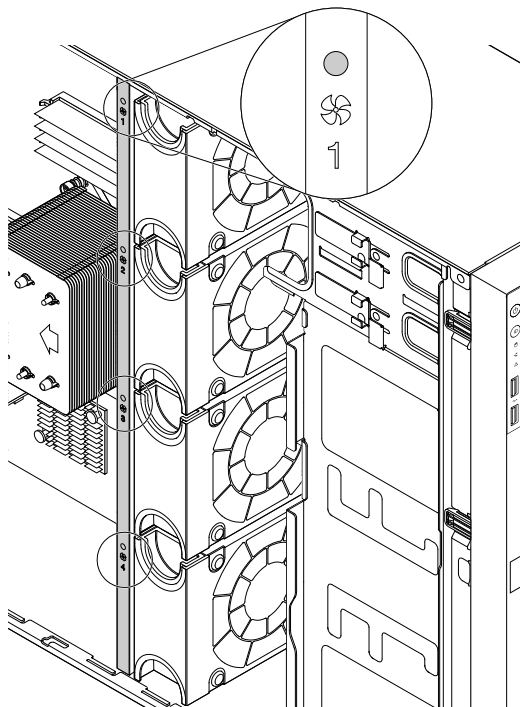


Figure 12. System-fan status LEDs

System-fan status LED	Color	Description
Off	None	The corresponding system fan is operating normally.
On	Amber	The corresponding system fan is running at low speed or has been removed. Check the BMC for errors and run the diagnostic programs. See “Lenovo ThinkServer Diagnostics” on page 15.

Power supply status LEDs

Each hot-swap power supply has three status LEDs.

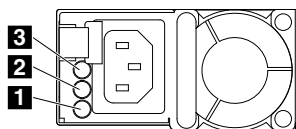


Figure 13. Power supply status LEDs

LED	Status	Description	Action
1 Input status LED	Off	The power supply is disconnected from the ac power source.	No action is needed.
	On, green	The power supply is connected to the ac power source.	No action is needed.
2 Output status LED	Off	The server is off or the power supply is not working normally.	Replace the power supply. See “Installing or replacing a hot-swap redundant power supply” on page 131.
	Blinking, green (about one flash every two seconds)	The power supply is in the cold redundancy active mode.	No action is needed.
	Blinking, green (about two flashes per second)	The power supply is in the cold redundancy sleep mode.	No action is needed.
	On, green	The server is on and the power supply is working normally.	No action is needed.
3 Fault LED	Off	The power supply is working normally.	No action is needed.
	On, amber	The power supply has failed.	Replace the power supply. See “Installing or replacing a hot-swap redundant power supply” on page 131.

AnyRAID adapter, RAID card, and pass-through board

This topic provides information to help you locate the connectors on the AnyRAID adapter, RAID card, and pass-through board.

The AnyRAID adapter and RAID card provide advanced SATA/SAS hardware RAID functions. The pass-through board provides SATA software RAID functions. You can purchase a supported AnyRAID adapter, RAID card, or pass-through board from the Lenovo Web site at: <http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Note: The option kit for AnyRAID adapter, RAID card, or pass-through board is designed for different types of servers and might contain additional cables that are not required for your server.

For information about the installation or replacement, refer to the following topics:

- “Replacing the AnyRAID adapter or the pass-through board” on page 143
- “Installing or removing a PCI Express card: Ethernet card, RAID card, or other supported types of PCI Express cards” on page 84

Your server supports the following AnyRAID adapter, RAID card, and pass-through board:

AnyRAID adapters (supported type varies by server model):

- Lenovo ThinkServer RAID 510i AnyRAID Adapter
- Lenovo ThinkServer RAID 720i AnyRAID Adapter
- Lenovo ThinkServer RAID 720ix AnyRAID Adapter

Use Lenovo ThinkServer RAID 720ix AnyRAID Adapter for server models supporting the internal tape drive.

RAID card:

- Lenovo ThinkServer 9286 RAID card

Pass-through board:

- Lenovo ThinkServer RAID 110i pass-through board

Use Lenovo ThinkServer RAID 110i pass-through board for server models that support only hot-swap SATA storage drives.

Note: Depending on the configuration, the AnyRAID adapter, RAID card, or pass-through board installed in your server might look slightly different from the illustrations in this topic.

Lenovo ThinkServer RAID 510i AnyRAID Adapter

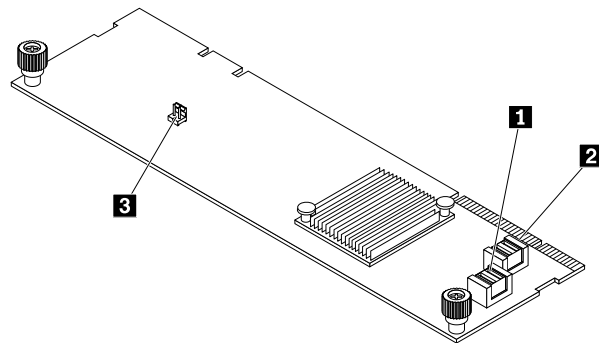


Figure 14. Lenovo ThinkServer RAID 510i AnyRAID Adapter

1 PCI-E 0 connector

2 PCI-E 1 connector

Used to connect to the AnyRAID connector 1–2 on the system board. See “System board components” on page 41.

3 RAID upgrade key connector

Used to connect a ThinkServer RAID 510i upgrade key.

Lenovo ThinkServer RAID 720i AnyRAID Adapter

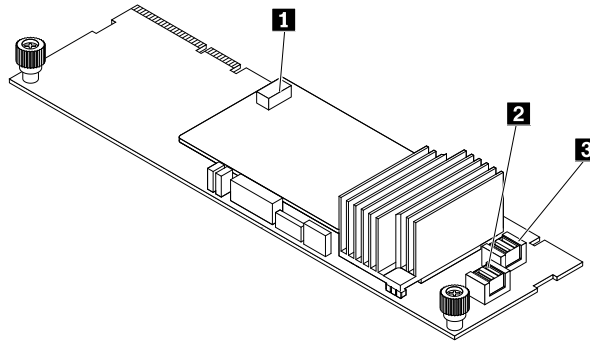


Figure 15. Lenovo ThinkServer RAID 720i AnyRAID Adapter

1 ThinkServer RAID Super Capacitor Module connector (available on some models)

Used to connect the ThinkServer RAID Super Capacitor Module. See “Server components” on page 25.

2 PCI-E 0 connector

3 PCI-E 1 connector

Used to connect to the AnyRAID connector 1–2 on the system board. See “System board components” on page 41.

Lenovo ThinkServer RAID 720ix AnyRAID Adapter

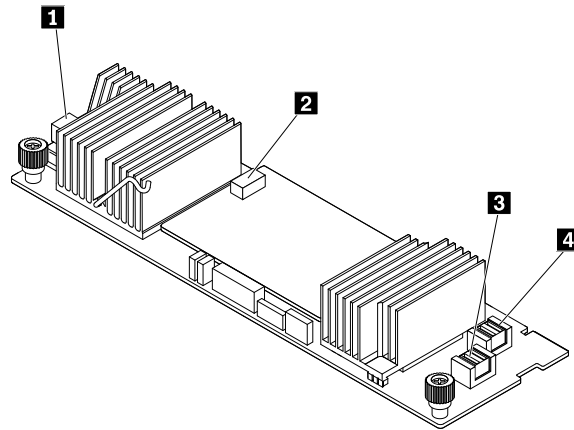


Figure 16. Lenovo ThinkServer RAID 720ix AnyRAID Adapter

1 SATA connector

Used to connect the signal cable from the internal tape drive.

2 ThinkServer RAID Super Capacitor Module connector

Used to connect the ThinkServer RAID Super Capacitor Module. See “Server components” on page 25.

3 PCI-E 0 connector

4 PCI-E 1 connector

Used to connect to the AnyRAID connector 1–2 on the system board. See “System board components” on page 41.

Lenovo ThinkServer 9286 RAID card

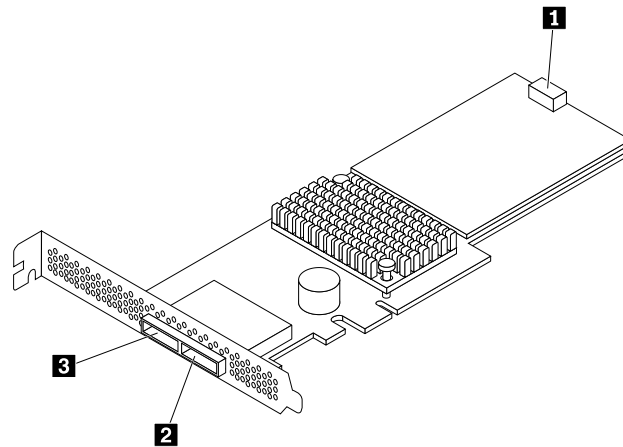


Figure 17. Lenovo ThinkServer 9286 RAID card

1 ThinkServer RAID Super Capacitor Module connector

Used to connect the ThinkServer RAID Super Capacitor Module. See “Server components” on page 25.

2 SAS connector 0–3

3 SAS connector 4–7

Used to connect external storage devices.

Lenovo ThinkServer RAID 110i pass-through board

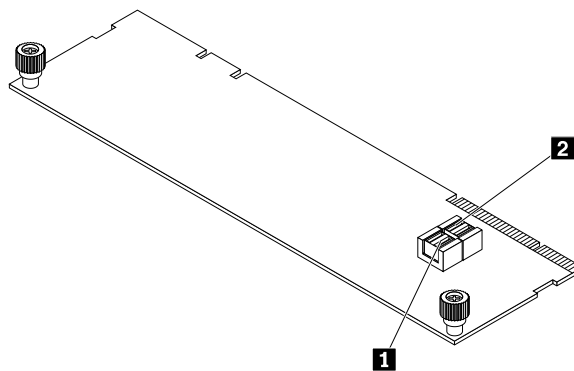


Figure 18. Lenovo ThinkServer RAID 110i pass-through board

1 SATA connector 0–3

2 SATA connector 4–7

Used to connect to the SATA connector 0 (ports 0–3) and SATA connector 1 (ports 4–7) on the system board. See “System board components” on page 41.

Hot-swap-drive backplane

Your server comes with one of the following drive bay and backplane configurations:

- Five 3.5-inch-drive bays with one backplane
- Fifteen 3.5-inch-drive bays with one backplane
- Eight 2.5-inch-drive bays with one backplane
- Sixteen 2.5-inch-drive bays with two backplanes

The following illustration shows the location of the hot-swap-drive backplane. To access the backplane, open the server cover and remove the AnyRAID adapter or pass-through board. See “Removing the server cover” on page 66 and “Replacing the AnyRAID adapter or the pass-through board” on page 143.

Notes:

- Depending on the model, your server might look different from the following illustration.
- The following illustration is based on server models that have fifteen 3.5-inch-drive bays with one backplane **1**.

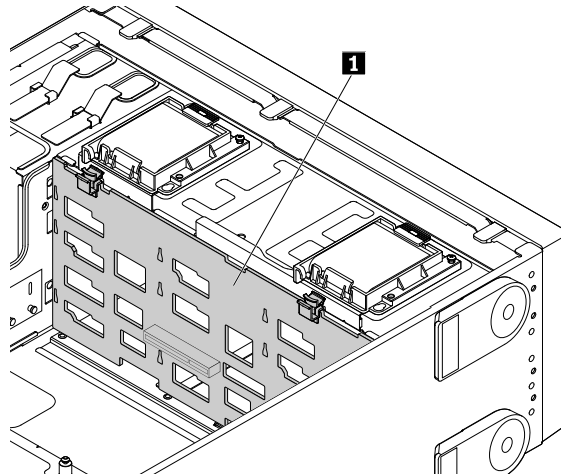


Figure 19. Backplane location

3.5-inch hot-swap-drive backplane

The following illustrations show the connectors on a 3.5-inch hot-swap-drive backplane.

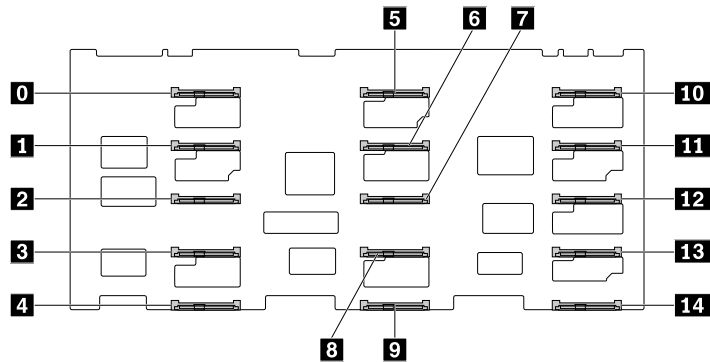


Figure 20. Front view of the 3.5-inch hot-swap-drive backplane

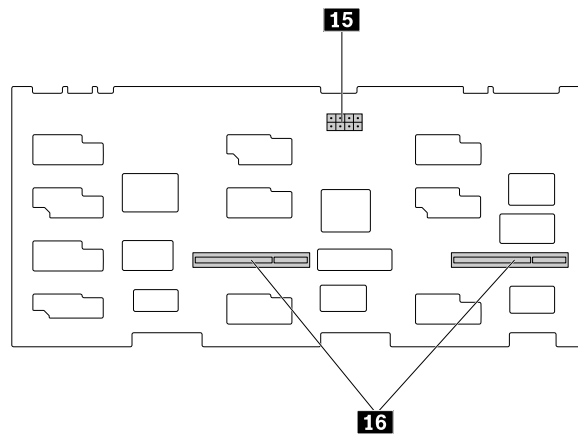


Figure 21. Rear view of the 3.5-inch hot-swap-drive backplane

0 – 14 Slot 0 – slot 14

Used to connect 3.5-inch hot-swap drives.

15 8-pin power connector

Used to connect a power cable to provide power to the backplane.

16 AnyRAID-adaptor slots

Used to connect an AnyRAID adapter or a pass-through board.

2.5-inch hot-swap-drive backplane

The following illustrations show the connectors on a 2.5-inch hot-swap-drive backplane.

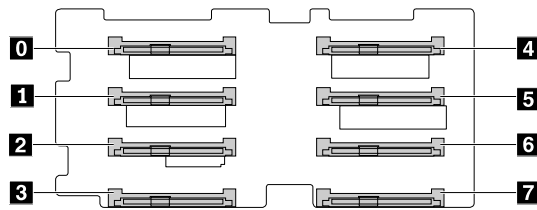


Figure 22. Front view of the 2.5-inch hot-swap-drive backplane

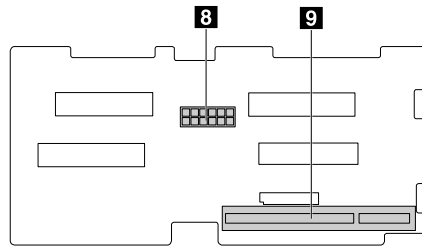


Figure 23. Rear view of the 2.5-inch hot-swap-drive backplane

0 – 7 Slot 0 – slot 7

Used to connect 2.5-inch hot-swap drives.

8 10-pin power connector

Used to connect a power cable to provide power to the backplane.

9 AnyRAID-adaptor slot

Used to connect an AnyRAID adapter or a pass-through board.

Connecting cables

This topic provides instructions on how to connect cables:

- “Connecting the mini-SAS to PCIe signal cable from the system board to the AnyRAID adapter” on page 39.
- “Connecting the SATA signal cable from the system board to the pass-through board” on page 40.
- “Connecting the easy-swap-drive module to the system board” on page 40.

Connecting the mini-SAS to PCIe signal cable from the system board to the AnyRAID adapter

This topic applies only to server models that have an AnyRAID adapter installed.

To connect the mini-SAS to PCIe signal cable (hereinafter referred to as the Y cable) from the system board to the AnyRAID adapter, do the following:

1. Use one Y cable. Connect the dual-in connectors on one end of the Y cable to the PCI-E 0 connector and the PCI-E 1 connector on the AnyRAID adapter.

2. Connect the single connector on the other end of the Y cable to the AnyRAID connector 1–2 on the system board.

To locate the connectors, refer to the related topics in “Locations” on page 16.

Connecting the SATA signal cable from the system board to the pass-through board

This topic applies only to server models that have a pass-through board installed.

To connect the SATA signal cable from the system board to the pass-through board, do the following:

1. Use one SATA signal cable. Connect one end of the SATA signal cable to the SATA connector 0–3 and the SATA connector 4–7 on the pass-through board.
2. Connect the other end of the SATA signal cable to the SATA connector 0 and the SATA connector 1 on the system board.

To locate the connectors, refer to the related topics in “Locations” on page 16.

Connecting the easy-swap-drive module to the system board

This topic applies only to server models that come with an easy-swap-drive module.

To connect the easy-swap-drive module to the system board, do the following:

1. Connect the signal cable of the easy-swap-drive module to the SATA connector 0 and SATA connector 1 on the system board.
2. Connect the power cable of the easy-swap-drive module to the backplane power connector 1 on the system board.

To locate the connectors on the system board, see “System board components” on page 41.

System board components

The following illustration shows the component locations on the system board.

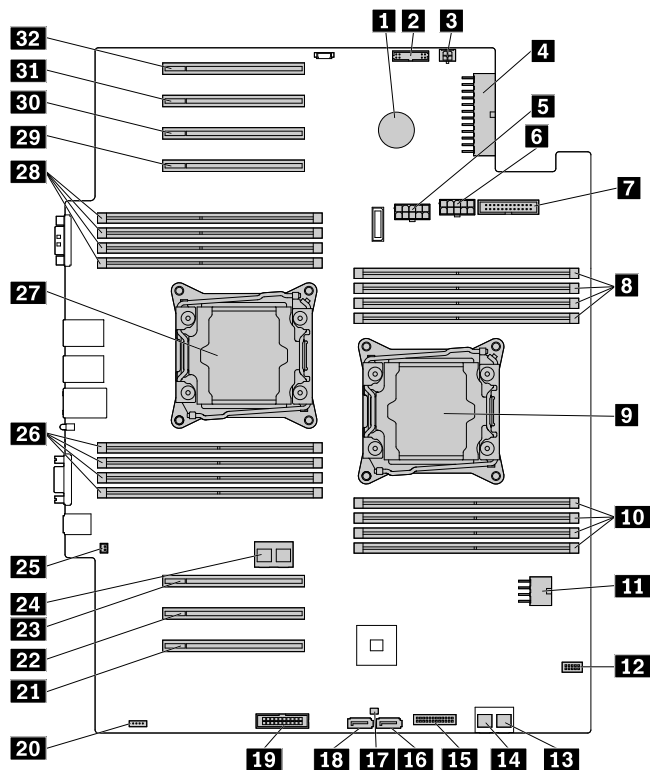


Figure 24. System board components

1 Coin-cell battery	2 System-board signal connector
3 Optical-drive power connector	4 System-board power connector 1
5 Backplane power connector 2	6 Backplane power connector 1
7 System fan connector	8 Memory slots for microprocessor 1 (4)
9 Microprocessor socket 1	10 Memory slots for microprocessor 1 (4)
11 System-board power connector 2	12 SD-module connector
13 SATA connector 0 (ports 0–3)	14 SATA connector 1 (ports 4–7)
15 Front panel connector	16 Optical-drive 2 signal connector
17 RAID upgrade key connector	18 Optical-drive 1 signal connector
19 TPM connector	20 TSM Premium connector
21 PCIe card slot 1	22 PCIe card slot 2
23 PCIe card slot 3	24 AnyRAID connector 1–2
25 Intrusion switch connector	26 Memory slots for microprocessor 2 (4)
27 Microprocessor socket 2	28 Memory slots for microprocessor 2 (4)
29 PCIe card slot 4	30 PCIe card slot 5
31 PCIe card slot 6	32 PCIe card slot 7

1 Coin-cell battery

Your server has a special type of memory that maintains the date, time, and configuration information for built-in features. The coin-cell battery keeps the information active when you turn off the server.

2 System-board signal connector

Used to connect the signal cable of the power interface board.

3 Optical-drive power connector

Used to connect the power cable of the optical drive.

4 System-board power connector 1

11 System-board power connector 2

Used to connect the power cables of the power interface board to provide power to your server.

5 Backplane power connector 2

6 Backplane power connector 1

Used to connect the power cable from the backplanes.

7 System fan connector

Used to connect the cable of the system fans and system-fan status LEDs.

8 10 26 28 Memory slots

Your server system board provides 16 memory slots to support up to 16 memory modules. For more information, see “Memory module installation rules” on page 76.

9 Microprocessor socket 1

27 Microprocessor socket 2

If the server has two microprocessors, each of the microprocessor is secured in the microprocessor socket on the system board and a heat sink is installed above the microprocessor to provide cooling. If the server has only one microprocessor, the microprocessor socket 2 is protected by a microprocessor socket cover.

12 SD-module connector

Used to connect the signal cable of the SD module if the server has one installed.

13 SATA connector 0 (ports 0–3)

14 SATA connector 1(ports 4–7)

Used to connect the SATA signal cable from the system board to the pass-through board.

15 Front panel connector

Used to connect the front panel cable.

16 Optical-drive 2 signal connector

Used to connect the signal cable of the second optical drive if the server has two optical drives installed.

17 RAID upgrade key connector

Used to install a RAID upgrade key.

18 Optical-drive 1 signal connector

Used to connect the signal cable of the optical drive.

19 TPM connector

Used to connect a ThinkServer Trusted Platform Module (TPM), which is a security chip, to enhance server security. See “Installing or removing the ThinkServer Trusted Platform Module” on page 102.

20 TSM Premium connector

Used to connect a server option named ThinkServer System Manager Premium (TSM Premium) to enable advanced remote management functions on your server. See “Installing or removing the ThinkServer System Manager Premium” on page 99.

21 22 23 29 30 31 32 PCIe card slots

The server has seven PCIe card slots on the system board for installing appropriate PCIe cards, including a converged network adapter (CNA).

Slot	Physical link width	Negotiable link width	Supported card length and height
21 PCIe card slot 1	x16	x16, x8, x4, x2, x1	Full-length, full-height, and double-width card
22 PCIe card slot 2	x16	x8, x4, x2, x1	Full-length, full-height card
23 PCIe card slot 3	x16	x8, x4, x2, x1	Full-length, full-height card
29 PCIe card slot 4	x16	x8, x4, x2, x1	Full-length, full-height card
30 PCIe card slot 5	x16	x16, x8, x4, x2, x1	Full-length, full-height card
31 PCIe card slot 6	x16	x8, x4, x2, x1	Full-length, full-height card
32 PCIe card slot 7	x16	x8, x4, x2, x1	Full-length, full-height card

Note: If a ThinkServer host bus adapter (HBA) is available, refer to the user guide for detailed information. The user guide is available for download at: <http://www.lenovo.com/UserManuals>

24 AnyRAID connector 1–2

Used to connect the signal cable from the system board to an AnyRAID adapter.

25 Intrusion switch connector

Used to connect the intrusion switch cable.

System board jumpers

A jumper is a short length of conductor used to set up or adjust printed circuit boards, such as the system board of a computer. A jumper usually is encased in a non-conductive block of plastic for convenient use and to avoid any possible damage to a live circuit. Jumper pins arranged in groups on the system board are called jumper blocks. When two or more jumper pins are capped with a jumper cap, an electrical connection is made between the pins. As a result, the equipment is instructed to activate certain settings accordingly.

The following illustration shows a jumper in the default setting position (pin 1 and pin 2). The default setting position is the correct position for normal operation.

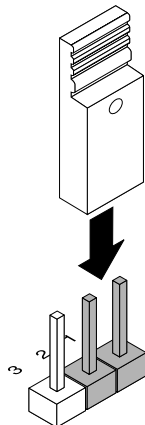


Figure 25. Default jumper setting

The following illustration shows the status of the jumpers on the system board of your server.

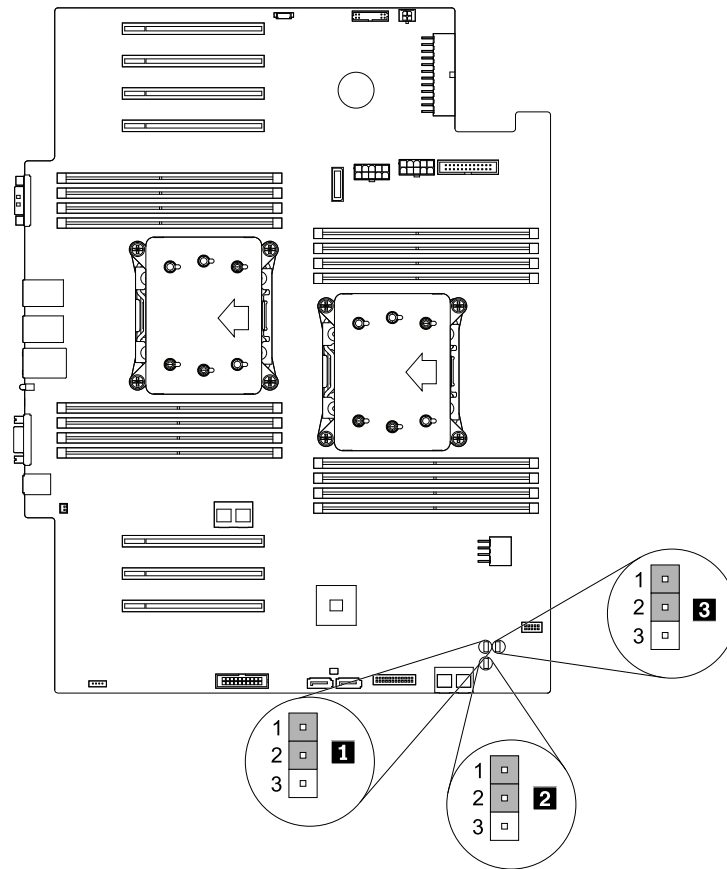


Figure 26. System board jumpers

Table 1. System board jumpers

1 Clear password jumper	2 BIOS default settings jumper
3 BIOS recovery jumper	

Attention: To set the jumpers, remove the server cover and the cooling shroud to access the system board. Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

1 Clear password jumper

Use the jumper to erase forgotten passwords, such as an administrator password and a user password.

To clear passwords, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.

4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the clear password jumper on the system board. Then, remove any parts and disconnect any cables that might impede your access to the jumper.
6. Move the clear password jumper from the default normal position (pin 1 and pin 2) to the short-circuited position (pin 2 and pin 3).
7. Reinstall any parts and reconnect any cables. Then, reinstall the server cover. See “Completing the parts replacement” on page 164.
8. Connect the server to an ac power source and wait several seconds. Then, turn on the server. The BIOS passwords are erased, including the administrator password and user password.
9. Repeat step 1 through step 4. Then, move the clear password jumper back to the normal position (pin 1 and pin 2).
10. Reinstall any parts and reconnect any cables. Then, reinstall the server cover. See “Completing the parts replacement” on page 164.
11. Connect the server to an ac power source and wait several seconds. Then, turn on the server.

Note: To set new passwords, see “Using passwords” on page 54.

2 BIOS default settings jumper

Use the jumper to recover the BIOS to the factory default settings.

Note: After the recovery, all your BIOS passwords are erased and the BIOS recovers to the factory default settings.

To recover your server to the factory default settings, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the BIOS default settings jumper on the system board. Then, remove any parts and disconnect any cables that might impede your access to the jumper.
6. Move the BIOS default settings jumper from the default normal position (pin 1 and pin 2) to the short-circuited position (pin 2 and pin 3).
7. Reinstall any parts and reconnect any cables. Then, reinstall the server cover. See “Completing the parts replacement” on page 164.
8. Connect the server to an ac power source and wait several seconds. Then, turn on the server. The BIOS passwords are erased and the BIOS recovers to the factory default settings.
9. Repeat step 1 through step 4. Then, move the BIOS default settings jumper back to the normal position (pin 1 and pin 2).
10. Reinstall any parts and reconnect any cables. Then, reinstall the server cover. See “Completing the parts replacement” on page 164.
11. Connect the server to an ac power source and wait several seconds. Then, turn on the server.

Note: To set new passwords, see “Using passwords” on page 54.

3 BIOS recovery jumper

If the power to your server is interrupted while the BIOS is being updated, your server might not restart correctly. If this happens, set the BIOS recovery jumper to recover from the BIOS update failure. See “Recovering from a BIOS update failure” on page 57.

Chapter 4. Turning on and turning off the server

This chapter provides information about turning on and turning off the server.

Turning on the server

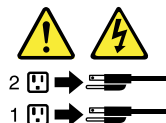
The server can be turned on in one of the following ways:

- After you finish unpacking and setting up the server, connect it to an ac power source. Press the power button on the front panel to turn on the server. See “Front panel” on page 20. The server needs about 90 seconds for the TSM to initialize whenever you connect the server to an ac power source. If you press the power button on the front panel during this period, the server will not start immediately; it will start after the TSM initialization finishes.
 - When the Wake on LAN feature is enabled on the server that is connected to an ac power source and a LAN, a network administrator can remotely turn on or wake up the server from a management console using remote network management software.
 - You also can use the related TSM feature to remotely turn on the server through the management LAN. For more information about the TSM, refer to the *ThinkServer System Manager User Guide*, which is available for download at:
<http://www.lenovo.com/UserManuals>
-

Turning off the server

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 one of the following ways:

- 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. For instructions on how to shut down your specific operating system, refer to the related documentation or help system for the operating system.
- Press the power button on the front panel to start an orderly shutdown of the operating system and turn off the server, if your operating system supports this feature.
- If your server stops responding and you cannot turn it off, press and hold the power button on the front panel for four seconds or more. If you still cannot turn off the server, disconnect all power cords from the server.
- If the server is connected to a LAN, a network administrator can remotely turn off the server from a management console using remote network management software.
- You also can use the related TSM feature to remotely turn off the server through the management LAN. For more information about the TSM, refer to the *ThinkServer System Manager User Guide*, which is available for download at:
<http://www.lenovo.com/UserManuals>

- The server might be turned off as an automatic response to a critical system failure.

Notes:

- When you turn off the server and leave it connected to an ac power source, the server also can respond to a remote request to turn on the server. To remove all power from the server, you must disconnect the server from the ac power source.
- For information about your specific operating system, refer to the related documentation or help system for the operating system.

Chapter 5. Configuring the server

This chapter provides the following information to help you configure the server:

- “Using the Setup Utility program” on page 51
- “Configuring RAID” on page 58
- “Updating the firmware” on page 61

Using the Setup Utility program

This topic provides information about using the Setup Utility program.

The Setup Utility program is part of the server firmware. You can use the Setup Utility program to view and change the configuration settings of your server, regardless of which operating system you are using. However, the operating system settings might override any similar settings in the Setup Utility program.

Starting the Setup Utility program

To start the Setup Utility program, do the following:

1. Connect the server to an ac power source and press the power button on the front panel to turn on the server. See “Turning on the server” on page 49.
2. Press the F1 key as soon as you see the logo screen. Then, wait for several seconds, and the Setup Utility program opens. If you have set a password, type the correct password to enter the Setup Utility program. For password information, see “Using passwords” on page 54.

Viewing information in the Setup Utility program

The Setup Utility program menu lists various items about the system configuration. Select a desired item to view information or change settings.

When working with the Setup Utility program, you must use the keyboard. The keys used to perform various tasks are displayed on the right bottom pane of each screen. You also can press the F1 key for general help about the keys. For most items, the corresponding help message is displayed on the right top pane of the screen when the item is selected. If the item has submenus, you can display the submenus by pressing Enter.

Setup Utility program interface

Depending on the BIOS version of your server, some menu or item information might differ slightly from the information in this topic.

Notes:

- The default settings already are optimized for you. Use the default value for any item you are not familiar with. Do not change the value of unfamiliar items to avoid unexpected problems. If you consider changing the server configuration, proceed with extreme caution. Setting the configuration incorrectly might cause unexpected results. If you cannot turn on the server because of incorrect BIOS settings, use the BIOS default settings jumper to restore the BIOS settings to the factory default settings. See “System board jumpers” on page 44.
- If you have changed any hardware in the server, it is recommended that you reflash the BIOS and the TSM firmware.

The Setup Utility program main interface consists of the following menus:

- “System Information menu” on page 52
- “Advanced Settings menu” on page 52
- “System Security menu” on page 53
- “TSM Settings menu” on page 53
- “Boot Manager menu” on page 53
- “Save & Exit menu” on page 53

Lenovo provides the BIOS update utility on the Lenovo Support Web site. You can download the BIOS update utility to update the BIOS. See “Updating or recovering the BIOS” on page 56. After updating the BIOS, all the BIOS settings become the default settings of the updated BIOS version. Check and reconfigure the BIOS settings for your specific needs.

If the power to your server is interrupted while the BIOS is being updated and your server cannot start correctly, use the BIOS recovery jumper to recover from a BIOS update failure. See “System board jumpers” on page 44.

System Information menu

After entering the Setup Utility program, you can see the **System Information** menu, which lists basic information about the BIOS, microprocessor type, memory, system date and time, and so on.

To set the system date and time on the **System Information** menu, see “Setting the system date and time” on page 54.

Advanced Settings menu

You can view or change various server component settings on the **Advanced Settings** menu in the Setup Utility program. The **Advanced Settings** menu contains various configuration submenus and items. On each submenu, press Enter to show selectable options and select a desired option by using the up and down arrow keys or type desired values from the keyboard. Some items are displayed on the menu only if the server supports the corresponding features.

Notes:

- **Enabled** means that the function is configured.
- **Disabled** means that the function is not configured.

The **Advanced Settings** menu contains the following submenus. For more information, enter the corresponding submenu and refer to the instructions on the screen.

- **Processor Settings:** View information about the installed microprocessors and set microprocessor configuration parameters.
- **Memory Settings:** View information about the installed memory modules and set memory configuration parameters.
- **Advanced Power Settings:** View and set power parameters.
- **PCI/PCIE Settings:** View and set PCI or PCIe configuration parameters.
- **SATA Settings:** Set onboard SATA parameters.
- **USB Settings:** View and set USB configuration parameters, such as enabling or disabling USB devices.
- **Serial Settings:** View and set configuration parameters for the serial connector.
- **Wakeup Settings:** View and configure the wakeup timing and set the power state after a power failure.

- **Miscellaneous Settings:** View and configure some miscellaneous items, such as the NumLock key on the keyboard and the boot status code.

System Security menu

You can set passwords and configure the TPM function on the **System Security** menu in the Setup Utility program. For each menu item, press Enter to show selectable options and select a desired option by using the up and down arrow keys or type desired values from the keyboard. Some items are displayed on the menu only if the server supports the corresponding features.

Notes:

- **Enabled** means that the function is configured.
- **Disabled** means that the function is not configured.

The **System Security** menu contains the following items:

- **Administrator Password:** Set an administrator password to protect against unauthorized access to your server. See “Using passwords” on page 54.
- **User Password:** Set a user password to protect against unauthorized access to your server. See “Using passwords” on page 54.
- **Secure Boot:** Set secure boot parameters.
- **TPM Settings:** Configure the TPM function if your server has a TPM installed in the TPM connector on the system board. See “Configuring the TPM function” on page 56.

TSM Settings menu

You can view or change event log and BMC settings on the **TSM Settings** menu in the Setup Utility program. On each submenu, press Enter to view the information or show selectable options and select a desired option by using the up and down arrow keys. Some items are displayed on the menu only if the server supports the corresponding features.

The **TSM Settings** menu contains the following submenus. For more information, enter the corresponding submenu and refer to the instructions on the screen.

- **TSM Network Settings:** Set BMC management network configuration parameters.
- **User Account Settings:** Set BMC user account parameters.

Boot Manager menu

The **Boot Manager** menu in the Setup Utility program lists all the bootable devices installed in your server and the listed items vary depending on your server configuration.

The **Boot Sequence** submenu in the **Boot Manager** menu provides an interface to help you view or change the server startup options, including the startup sequence and boot priority for various devices. Changes in the startup options take effect when the server starts. 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. For example, you can define a startup sequence that checks a disc in the optical drive, then checks the internal storage drive, and then checks a network device. For information about setting the startup sequence or selecting a startup device, see “Selecting a startup device” on page 55.

Save & Exit menu

After you finish viewing or changing settings in the Setup Utility program, you can choose a desired action from the **Save & Exit** menu to save changes, discard changes, or load default values, and exit the program. Press Enter to select the item on the **Save & Exit** menu, and then select **Yes** when prompted to confirm the action. For information about exiting the Setup Utility program, see “Exiting the Setup Utility program” on page 56.

The **Save & Exit** menu contains the following items:

- **Save Changes and Reset:** Save changes and then continue with further configuration in the Setup Utility program.
- **Discard Changes and Exit:** Discard changes, load previous values, and then exit the Setup Utility program.
- **Load Optimized Defaults:** Return to the optimized default settings.
- **Save as User Defaults:** Save the current settings as user default values.
- **Restore User Defaults:** Restore the user default values for all the items.
- **Pure UEFI OS Optimized Defaults:** Enable or disable optimized default settings for the pure UEFI operating system.

Setting the system date and time

To set the system date and time in the Setup Utility program, do the following:

1. Start the Setup Utility program. See “Starting the Setup Utility program” on page 51.
2. On the **System Information** menu, select **System Date** or **System Time**.
3. Use the Tab key to switch between data elements and type the numbers from the keyboard to set the system date and time.
4. Press F10 to save settings and exit the Setup Utility program.

Using passwords

By using the Setup Utility program, you can set a password to prevent unauthorized access to your server.

You do not have to set a password to use your server. However, using a password improves computing security. If you decide to set a password, read the following topics.

Setup Utility program password types

The following types of passwords are available in the Setup Utility program:

- **Administrator password**

Setting an administrator password deters unauthorized users from changing configuration settings. If you are responsible for maintaining the configuration settings of several computers, you might want to set an administrator password. When an administrator password is set, you are prompted to type a valid password each time you try to access the Setup Utility program. The Setup Utility program cannot be accessed until a valid password is typed in.

- **User password**

When a user password is set, the server cannot be used until a valid password is typed in.

Note: If both the administrator password and user password are set, you can type either password to use the server. However, you must use your administrator password to change any configuration settings.

Password considerations

For security reasons, it is recommended to use a strong password that cannot be easily compromised.

Notes:

- The Setup Utility program passwords are not case sensitive.
- The server supports Setup Utility program passwords that consist of three to 32 characters.

To set a strong password, use the following guidelines:

- Have at least eight characters in length
- Contain at least one alphabetic character and one numeric character
- Not be your name or your user name
- Not be a common word or a common name
- Be significantly different from your previous passwords

Besides the alphabetic characters (a-z) and numeric characters (0-9), the server also supports characters typed using special keys on the keyboard for a password. Refer to the help message on the screen when setting a password to determine the valid special characters.

Setting, changing, or deleting a password

To set, change, or delete a password in the Setup Utility program, do the following:

1. Start the Setup Utility program. See “Starting the Setup Utility program” on page 51.
2. On the **System Security** menu, select **Administrator Password** to set an administrator password or select **User Password** to set a user password.
3. See “Password considerations” on page 54. Then, follow the instructions on the screen to set or change a password.
4. If you want to delete a password, type your current password. Press Enter when you are prompted to type a new password. Then, press Enter to confirm the new password. The previous password will be cleared.

Note: For security reasons, it is recommended that you always set a password for your server.

5. Press F10 to save settings and exit the Setup Utility program.

If you have forgotten the password, you can use the clear password jumper on the system board to erase the password. See “System board jumpers” on page 44. Then, set a new password for the server.

Selecting a startup device

If your server does not start up from a desired device such as the disc or storage drive as expected, do one of the following to select the startup device you want.

Note: Not all discs, storage drives, or other removable devices are bootable.

- To select a temporary startup device, do the following:

Note: Selecting a startup device using the following method does not permanently change the startup sequence.

1. Turn on or restart your server.
 2. When you see the logo screen, press F10 if your server is connected to a network and you want to start up the server from the network. Otherwise, press F11 to display the boot menu. The boot device selection window opens.
 3. In the boot device selection window, use the up and down arrow keys on the keyboard to switch between the selections. Press Enter to select the device of your choice. Then, the server will start up from the selected device.
- To view or permanently change the configured startup device sequence, do the following:
 1. Start the Setup Utility program. See “Starting the Setup Utility program” on page 51.
 2. On the **Boot Sequence** submenu under the **Boot Manager** menu, follow the instructions on the screen to set the startup device for **Boot Option #1** to **Boot Option #5** depending on your needs. You also can set the boot priority for various devices. See “Boot Manager menu” on page 53.

3. Press F10 to save settings and exit the Setup Utility program. The server will follow the startup device sequence you have set each time you turn on the server.

Configuring the TPM function

The TPM works as a hardware security solution to help you to encrypt data and protect the server. The TPM function is only available when there is a TPM installed in your server. See “Installing the TPM” on page 103. You can purchase a TPM from the Lenovo Web site at:
<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

After installing a TPM, check if the TPM function is enabled in the Setup Utility program.

To enable the TPM function in the Setup Utility program, do the following:

1. Start the Setup Utility program. See “Starting the Setup Utility program” on page 51.
2. On the **System Security** menu, select **TPM Settings → TPM Support**. Ensure that **TPM Support** is set to **Enabled**.
3. When **TPM Support** is set to **Enabled**, the **TPM State** item is displayed. Set **TPM State** to **Enabled**.
4. Press F10 to save settings and exit the Setup Utility program. The server will restart to enable the TPM function.

Setting an Ethernet connector for system management

There are three RJ-45 Ethernet connectors on the rear of the server. The Ethernet connector 0 is for system management by default. However, you also can set the Ethernet connector 1 for system management use. To locate the three Ethernet connectors, see “Rear view of the server” on page 22.

To set the Ethernet connector for system management, do the following:

1. Start the Setup Utility program. See “Starting the Setup Utility program” on page 51.
2. On the **TSM Settings** menu, select **TSM Network Settings → TSM NIC Selection**.
3. Do one of the following:
 - To set the Ethernet connector 0 for system management, select **Dedicated Port**.
 - To set the Ethernet connector 1 for system management, select **Shared NIC Port**.
4. Press F10 to save settings and exit the Setup Utility program.

Exiting the Setup Utility program

After you finish viewing or changing settings, press Esc to return to the Setup Utility program main interface. If you are on a nested submenu, press Esc repeatedly until you reach the main interface. Then, you can do one of the following to exit the Setup Utility program:

- If you want to save the new settings and exit the Setup Utility program, press F10 or select **Save & Exit → Save Changes and Reset**. Otherwise, your changes will not be saved.
- If you do not want to save the new settings, select **Save & Exit → Discard Changes and Exit**.
- If you want to return to the default settings, press F9 or select **Save & Exit → Load Optimized Defaults**.

For more information about the **Save & Exit** menu in the Setup Utility program, see “Save & Exit menu” on page 53.

Updating or recovering the BIOS

This topic provides instructions on how to update the BIOS and how to recover from a POST and BIOS update failure.

System programs are the basic layer of software built into your server. System programs include the POST, the UEFI BIOS, the Setup Utility program, and the TSM firmware. The POST is a set of tests and procedures that are performed each time you turn on your server. The UEFI BIOS is a layer of software that translates instructions from other layers of software into electrical signals that the server hardware can execute. You can use the Setup Utility program to view or change the configuration settings of your server. See “Using the Setup Utility program” on page 51. The TSM firmware provides remote management features.

Lenovo might make changes and enhancements to the BIOS and TSM firmware. When updates are released, they are available for download on the Lenovo Web site at <http://www.lenovo.com/drivers>. You can update the server firmware by downloading an update package and following the instructions on the Web page.

Updating (flashing) the BIOS

This topic provides instructions on how to update (flash) the BIOS.

Notes:

- Update the BIOS on your server only if the newer BIOS version specifically solves a problem you have. We do not recommend BIOS updates for servers that do not need them. You can view the updated information for the new BIOS version in the installation instructions for the BIOS update utility program.
- Downgrading the BIOS to an earlier version is not recommended and might not be supported. An earlier BIOS version might not support the latest system configurations.
- If the power to your server is interrupted while the POST and BIOS are being updated, your server might not restart correctly. Ensure that you perform the BIOS update procedure in an environment with a steady power supply. Besides, ensure that your server can restart successfully without encountering hardware problems.

To update (flash) the BIOS, do the following:

1. Go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page to locate the BIOS update package.
2. Download the BIOS update package and the TXT file that contains installation instructions.
3. Print the TXT file and follow the instructions to update (flash) the BIOS.
4. Check and reconfigure the BIOS settings for your specific needs based on your note or refer to “Using the Setup Utility program” on page 51 after the BIOS update process is completed.

Recovering from a BIOS update failure

If the power to your server is interrupted while the BIOS is being updated, your server might not restart correctly. If this happens, perform the following procedures to recover from the BIOS update failure.

Note: If the operating system of your server is installed under EFI mode, you must reinstall the operating system after recovering the BIOS.

To recover from a BIOS update failure, do one of the following:

• Using the automatic recovery feature

1. Reconnect the server to an ac power source.
2. After the system health LED turns off, press the power button to turn on the server. The server is turned on and then turned off automatically. Then, the recovery process starts. The recovery process lasts about four minutes. After the recovery process is completed, the server starts automatically.
3. Check and configure the BIOS settings for your specific needs. See “Using the Setup Utility program” on page 51.

- **Using the BIOS recovery jumper**

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the BIOS recovery jumper on the system board. See “System board jumpers” on page 44. Then, remove any parts and disconnect any cables that might impede your access to the jumper.
6. Move the BIOS recovery jumper from the default off position to the on position.
7. Connect the server to an ac power source. The server turns on and then turns off automatically.
8. Move the BIOS recovery jumper back to the off position.
9. Wait for several minutes. When the BIOS recovery process is completed, the server turns on automatically.
10. Ensure that the Setup Utility program starts normally. See “Starting the Setup Utility program” on page 51. Then, disconnect the server from the ac power source.
11. Reinstall any parts and reconnect any cables. Then, reinstall the server cover. See “Completing the parts replacement” on page 164.
12. Connect the server to an ac power source and turn on the server. The BIOS settings recover to the factory default settings. Check and configure the BIOS settings for your specific needs. See “Using the Setup Utility program” on page 51.

Note: If you cannot recover the BIOS after using the instructions in this topic, the BIOS read-only memory (ROM) might be damaged. You must replace the system board. Contact the Lenovo Customer Support Center.

Configuring RAID

This topic provides information about RAID and the utility programs that are available for you to configure RAID.

This topic contains the following items:

- “About RAID” on page 58
- “Configuring RAID using the Lenovo ThinkServer Deployment Manager program” on page 60
- “Configuring the advanced SATA or SAS hardware RAID” on page 60

About RAID

RAID, an acronym for Redundant Array of Independent Disks, is a technology that provides increased storage functions and reliability through redundancy. This is achieved by combining multiple hard disk drives into a logical unit, where data is distributed across the drives in one of several ways called RAID levels.

When a group of independent physical hard disk drives are set up to use RAID technology, they are in a RAID array. This array distributes data across multiple hard disk drives, but the array appears to the host server as one single storage unit. Creating and using RAID arrays provides high performance, such as the expedited I/O performance, because several drives can be accessed simultaneously.

RAID drive groups also improve data storage reliability and fault tolerance compared with single-drive storage systems. Data loss resulting from a drive failure can be prevented by reconstructing missing data from the remaining drives.

The following list describes some of the most commonly used RAID levels:

- **RAID 0:** block-level striping without parity or mirroring

Simple stripe sets are normally referred to as RAID 0. RAID 0 uses striping to provide high data throughput, especially for large files in an environment that does not require fault tolerance. RAID 0 has no redundancy and it provides improved performance and additional storage without fault tolerance. Any drive failure destroys the array and the likelihood of failure increases with more drives in the array. RAID 0 does not implement error checking, so any error is uncorrectable. More drives in the array means higher bandwidth, but greater risk of data loss.

RAID 0 requires a minimum number of two hard disk drives.

- **RAID 1:** mirroring without parity or striping

RAID 1 uses mirroring so that data written to one drive is simultaneously written to another drive. This is good for small databases or other applications that require small capacity but complete data redundancy. RAID 1 provides fault tolerance from disk errors or failures and continues to operate as long as at least one drive in the mirrored set is functioning. With appropriate operating system support, there can be increased read performance and only a minimal write performance reduction.

RAID 1 requires a minimum number of two hard disk drives.

- **RAID 5:** block-level striping with distributed parity

RAID 5 uses disk striping and parity data across all drives (distributed parity) to provide high data throughput, especially for small random access. RAID 5 distributes parity along with the data and requires all drives but one to be present to operate; drive failure requires replacement, but the array is not destroyed by a single drive failure. Upon drive failure, any subsequent read operations can be calculated from the distributed parity so that the drive failure is masked from the end user. The array will have data loss in the event of a second drive failure and is vulnerable until the data that was on the failing drive is rebuilt onto a replacement drive. A single drive failure in the set will result in reduced performance of the entire set until the failing drive has been replaced and rebuilt.

RAID 5 requires a minimum number of three hard disk drives.

- **RAID 6:** block-level striping with distributed parity

RAID 6 uses distributed parity, with two independent parity blocks per stripe, and disk striping. A RAID 6 virtual drive can survive the loss of any two drives without losing data. A RAID 6 drive group is similar to a RAID 5 drive group. Blocks of data and parity information are written across all drives. The parity information is used to recover the data if one or two drives fail in the drive group.

RAID 6 requires a minimum number of three hard disk drives.

- **RAID 10:** a combination of RAID 0 and RAID 1

RAID 10 consists of striped data across mirrored spans. A RAID 10 drive group is a spanned drive group that creates a striped set from a series of mirrored drives. RAID 10 allows a maximum of eight spans. You must use an even number of drives in each RAID virtual drive in the span. The RAID 1 virtual drives must have the same stripe size. RAID 10 provides high data throughput and complete data redundancy but uses a larger number of spans.

RAID 10 requires a minimum number of four hard disk drives and also requires an even number of drives, for example, six hard disk drives or eight hard disk drives.

- **RAID 50:** a combination of RAID 0 and RAID 5

RAID 50 uses distributed parity and disk striping. A RAID 50 drive group is a spanned drive group in which data is striped across multiple RAID 5 drive groups. RAID 50 works best with data that requires high reliability, high request rates, high data transfers, and medium-to-large capacity.

Note: Having virtual drives of different RAID levels, such as RAID 0 and RAID 5, in the same drive group is not allowed. For example, if an existing RAID 5 virtual drive is created out of partial space in an array, the next virtual drive in the array has to be RAID 5 only.

RAID 50 requires a minimum number of six hard disk drives.

- **RAID 60:** a combination of RAID 0 and RAID 6

RAID 60 uses distributed parity, with two independent parity blocks per stripe in each RAID set, and disk striping. A RAID 60 virtual drive can survive the loss of two drives in each of the RAID 6 sets without losing data. RAID 60 works best with data that requires high reliability, high request rates, high data transfers, and medium-to-large capacity.

RAID 60 requires a minimum number of six hard disk drives.

For detailed information about RAID, refer to “Introduction to RAID” in the *MegaRAID SAS Software User Guide* on the documentation DVD that comes with your server.

Configuring RAID using the Lenovo ThinkServer Deployment Manager program

Deployment Manager simplifies the process of configuring supported RAID. The help system for the program can be accessed directly from the program interface.

Deployment Manager has the following features for RAID configuration:

- For use with all supported RAID controllers
- Automatically detects hardware and lists all supported RAID configurations
- Configures one or more disk arrays per controller depending on the number of drives attached to the controller and the RAID level selected
- Supports hot-spare drives
- Creates a RAID response file that can be used to configure RAID controllers on similarly configured Lenovo servers

See “Lenovo ThinkServer Deployment Manager” on page 14 and view the help system for the program.

Configuring the advanced SATA or SAS hardware RAID

Your server comes with an AnyRAID adapter to provide advanced SATA or SAS hardware RAID functions.

Note: Depending on the operating system, the total drive capacity of the primary RAID might be limited to 2 TB.

You can use the following programs or tools to configure the advanced SATA or SAS hardware RAID.

- MegaRAID Human Interface Infrastructure (HII) configuration utility
This utility enables you to configure RAID independently of the operating system. To display the HII configuration utility interface, start the server and press the F1 key as soon as you see the logo screen to enter the Setup Utility program. Then, select **Boot Manager → Adapters and UEFI Drivers**.
- MegaRAID Storage Manager program
This program provides graphical user interface (GUI) for you to create and manage storage configurations in an operating system environment.
- Storage Command Line Tool (StorCLI)
This is a command-line management tool that is used to configure RAID in an operating system environment.

To download the MegaRAID Storage Manager program and StorCLI, go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page.

For more information about how to configure and manage the advanced SATA or SAS hardware RAID, refer to the *MegaRAID SAS Software User Guide* on the documentation DVD that comes with your server. This

document also is available on the Lenovo Web site at:
<http://www.lenovo.com/UserManuals>

Updating the firmware

When you replace a device in the server, you might have to either update the server with the latest version of the firmware that is stored in memory on the device or reflash the BIOS, the TSM firmware, and the FRU/SDR.

To update the firmware, do one of the following:

- Go to <http://www.lenovo.com/drivers>. Then, follow the instructions on the Web page to check for the latest level of firmware, such as the BIOS updates and device drivers.
- Use the Lenovo ThinkServer Deployment Manager program to update the firmware. For more information, see “Lenovo ThinkServer Deployment Manager” on page 14.

Chapter 6. Replacing hardware

This chapter provides instructions on how to install, remove, or replace hardware for your server.

This chapter contains the following items:

- “Guidelines” on page 63
- “Removing the server cover” on page 66
- “Removing and reinstalling the rack handles” on page 67
- “Removing and reinstalling the cooling shroud” on page 68
- “Removing and reinstalling the front bezel” on page 70
- “Removing and reinstalling the PCIe card holder” on page 74
- “Installing, removing, or replacing hardware” on page 76
- “Completing the parts replacement” on page 164

For a list of ThinkServer options, go to:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Guidelines

This topic provides some guidelines that you should read and understand before using your server.

Precautions

Before you use the server, ensure that you read and understand the following precautions:

- Before using the product, ensure that you read and understand the multilingual safety instructions and the Lenovo Limited Warranty (LLW) on the documentation DVD that comes with the product. Reading and understanding the safety instructions reduces the risk of personal injury and damage to your product.
- 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.lenovo.com/drivers> and follow the instructions on the Web page. See “Updating the firmware” on page 61 for more information.
- Before you install optional hardware devices, ensure that the server is working correctly. If the server is not working correctly, see Chapter 7 “Troubleshooting and diagnostics” on page 167 to do basic troubleshooting. If the problem cannot be solved, see Chapter 8 “Getting information, help, and service” on page 173.
- Observe good housekeeping in the area where you are working. Put removed covers and other parts in a safe place.
- If you must turn on the server while the server cover is removed, ensure that no one is near the server and that no tools or other objects have been left inside the server.
- 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:
 - Ensure 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.

- Ensure 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 drives.
- Have a small flat-blade screwdriver available.
- You do not have to turn off the server to install or replace a hot-swap redundant power supply, a hot-swap internal storage drive, or a hot-plug USB device. However, you must turn off the server and remove the ac power sources, such as hot-swap redundant power supplies, from the server before performing any step that involves installing, removing, or replacing adapter cables or non-hot-swap devices or components.
- To view the LEDs, leave the server connected to power.
- When you are finished working on the server, reinstall all safety shields, guards, labels, and ground wires.
- When working inside the server, you might find some tasks easier if you lay the server on its side.

Handling static-sensitive devices

Attention: Do not open the static-protective package that contains the new part until the defective part has been removed from the server and you are ready to install the new part. Static electricity, although harmless to you, can seriously damage server components and parts.

Any server part containing transistors or integrated circuits (ICs) should be considered sensitive to electrostatic discharge (ESD). ESD damage can occur when there is a difference in charge between objects. Protect against ESD damage by equalizing the charge so that the machine, the part, the work mat, and the person handling the part are all at the same charge.

Notes:

- Use product-specific ESD procedures when they exceed the requirements noted in this topic.
- Ensure that the ESD protective devices you use have been certified (ISO 9000) as fully effective.

When you handle server parts and components, take these precautions to avoid static-electricity damage:

- Limit your movement. Movement can cause static electricity to build up around you.
- Always carefully handle the parts and other components (such as PCI Express cards, memory modules, system boards, and microprocessors) by edges or frame. Do not touch solder joints, pins, or exposed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- Before you replace a new part, touch the static-protective package containing the new part to an unpainted metal part of the server for at least two seconds. This reduces static electricity from the package and your body.
- Remove the new part from the static-protective package and directly install it in the server without placing it on any other surface. If it is hard for you to do this in your specific situation, place the static-protective package of the new part on a smooth, level surface, and then place the new part on the static-protective package.
- Do not place the part on the server cover or other metal surface.
- Take additional care when handling devices during cold weather. Heating reduces indoor humidity and increases static electricity.
- Use a grounded work mat to provide a static-free work surface. The mat is especially useful when handling ESD-sensitive devices.
- Prevent the part from touching your clothing. Most clothing is insulative and retains a charge even when you are wearing a wrist strap.

- The use of a grounding system is recommended. For example, it is recommended to wear an electrostatic discharge (ESD) wrist strap, if one is available. Ensure that you work in an ESD-safe area. Select a grounding system, such as those listed below, to provide protection that meets the specific service requirement.

Note: The use of a grounding system to guard against ESD damage is desirable but not necessary.

- Attach the ESD ground clip to any frame ground, ground braid, or green-wire ground.
- When working on a double-insulated or battery-operated system, use an ESD common ground or reference point. You can use coax or connector-outside shells on these systems.
- Use the ground prong of the ac plug on ac-operated servers.

System reliability guidelines

To help ensure proper cooling and system reliability, strictly follow these guidelines:

- Each of the drive bays has a drive or a dummy tray installed; or there is an electromagnetic interface (EMI) protective panel or EMI shield installed to protect the drive cage.
- If the server supports hot-swap redundant power supplies, each of the power supply bay has a redundant power supply installed, or one bay has a redundant power supply installed while the other bay is covered by a shield.
- Leave adequate space around the server to ensure that the server cooling system works well. Leave approximately 50 mm (2 inches) 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, install the server cover before you turn on the server. Operating the server for extended periods of time (more than 30 minutes) with the server cover removed might damage server components.
- Properly route the cables. For some options, such as PCI Express cards, follow the cabling instructions that come with the options in addition to the instructions in this manual.
- Ensure that you replace a failing fan within 48 hours.
- When replacing a hot-swap drive, install the new hot-swap drive within two minutes of removal.
- If your server has air ducts or air baffles, do not remove them while the server is running. Operating the server without the air ducts or air baffles might cause the microprocessors to overheat.
- For servers that support up to two microprocessors, ensure that the second microprocessor socket always contains a microprocessor or is protected by a microprocessor socket cover.

Working inside the server with the power on

Attention: Static electricity that is released to internal server components when the server is turned on might cause the server to halt, which might result in the loss of data. To avoid this potential problem, always use an ESD wrist strap or other grounding system when you work inside the server with the power on.

The server supports hot-swap devices and is designed to operate safely while it is turned on and the cover is removed. Follow these guidelines when you work inside the server with the power on:

- Avoid wearing loose-fitting clothing on your forearms. Button long-sleeved shirts before working inside the server; do not wear cuff links while you are working inside the server.
- Do not allow your necktie or scarf to hang inside the server.
- Remove jewelry, such as bracelets, necklaces, rings, and loose-fitting wrist watches.
- Remove items from your shirt pocket, such as pens and pencils. These items might fall into the server as you lean over it.
- Avoid dropping any metallic objects into the server, such as paper clips, hairpins, and screws.

Removing the server cover

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To remove the server cover, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Use the key attached on the rear of the server to unlock the cover lock **2**. Then, use a screwdriver to turn the cover-handle lock **1** to the unlocked position.

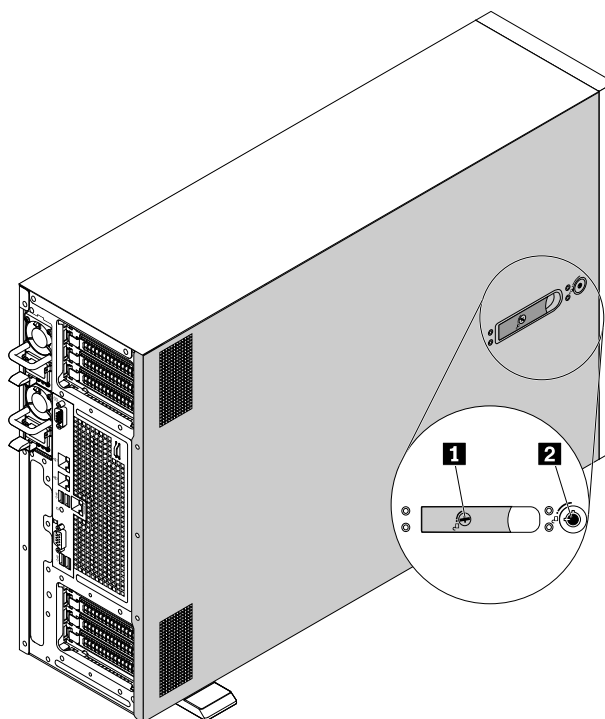


Figure 27. Unlocking the cover lock and the cover-handle lock

4. Fully open the cover handle and slide the server cover to the rear until it is disengaged from the chassis. Then, lift the server cover off the chassis and set it aside.

Note: It is recommended that you wait several minutes to let the server cool before removing the server cover.

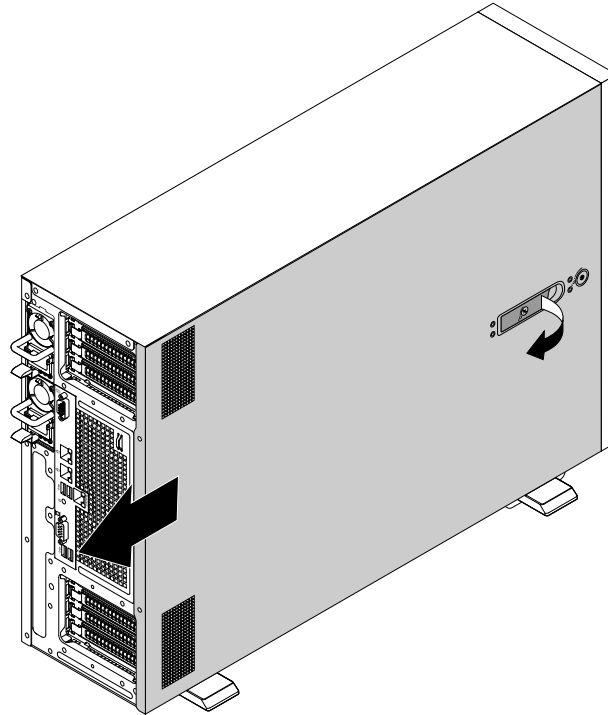


Figure 28. Removing the server cover

Attention: For proper cooling and airflow, install the server cover before turning on the server. Operating the server for more than 30 minutes with the server cover removed might damage server components.

To reinstall the server cover, see “Reinstalling the server cover and reconnecting cables” on page 164.

Removing and reinstalling the rack handles

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: The rack handles are available only on rack-form-factor server models. Depending on the model, your server might look slightly different from the illustrations in this topic.

To remove and reinstall the rack handles, do the following:

1. On each side of the server, remove the screws that secure the rack handle and then remove the rack handle from the chassis.

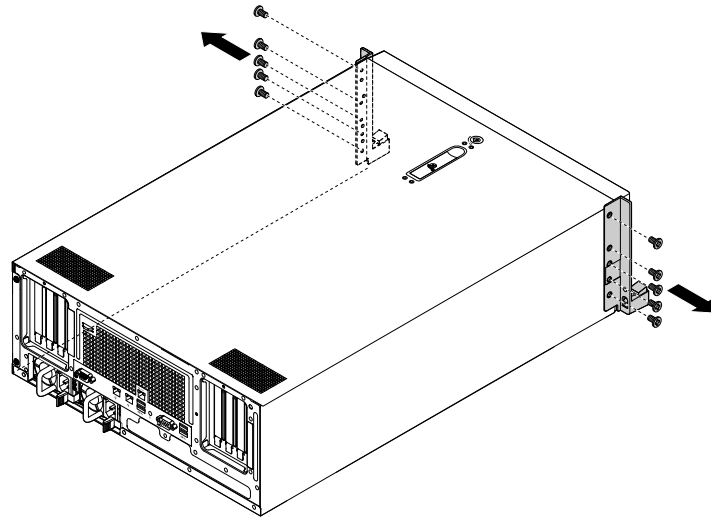


Figure 29. Removing the rack handles

2. To reinstall the rack handles, align the screw holes in the rack handle with the corresponding holes in the chassis. Install the screws to secure the rack handle on each side of the server.

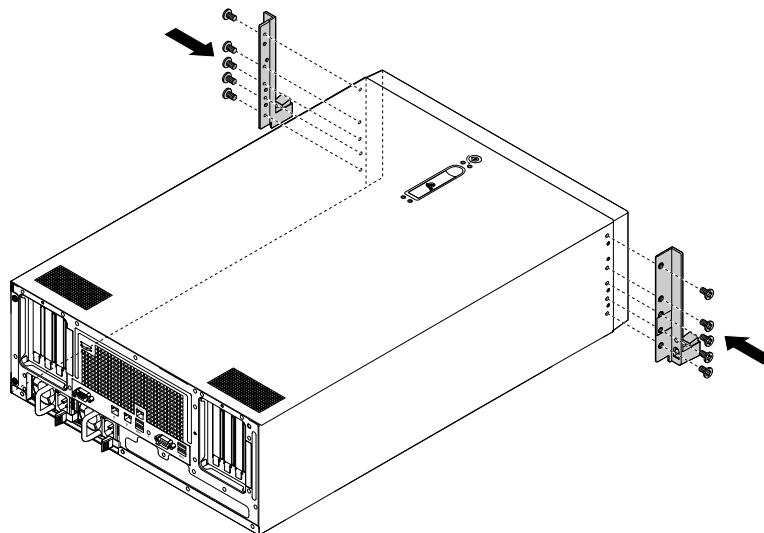


Figure 30. Installing the rack handles

Removing and reinstalling the cooling shroud

The cooling shroud must be removed to allow access to most server components. This topic provides instructions on how to remove and reinstall the cooling shroud.

Removing the cooling shroud

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustration in this topic.

To remove the cooling shroud, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the cooling shroud and lift it out of the server.

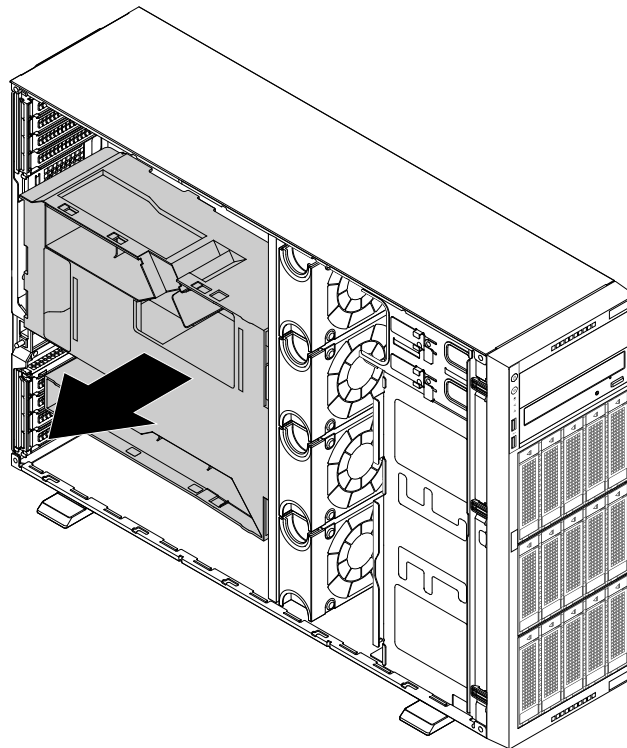


Figure 31. Removing the cooling shroud

Attention: For proper cooling and airflow, reinstall the cooling shroud before turning on the server. Operating the server for more than 30 minutes with the cooling shroud removed might damage server components.

Reinstalling the cooling shroud

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustration in this topic.

To reinstall the cooling shroud, do the following:

1. Ensure that all components have been reassembled correctly and that no tools or loose screws are left inside your server.
2. Ensure that all cables inside the server have been properly routed so that they will not interfere with installing the cooling shroud.
3. Note the orientation of the cooling shroud and then place it above the server. Align the tabs on both sides of the cooling shroud with the corresponding gaps in both sides of the chassis. Then, lower the cooling shroud into the chassis until it snaps into position.

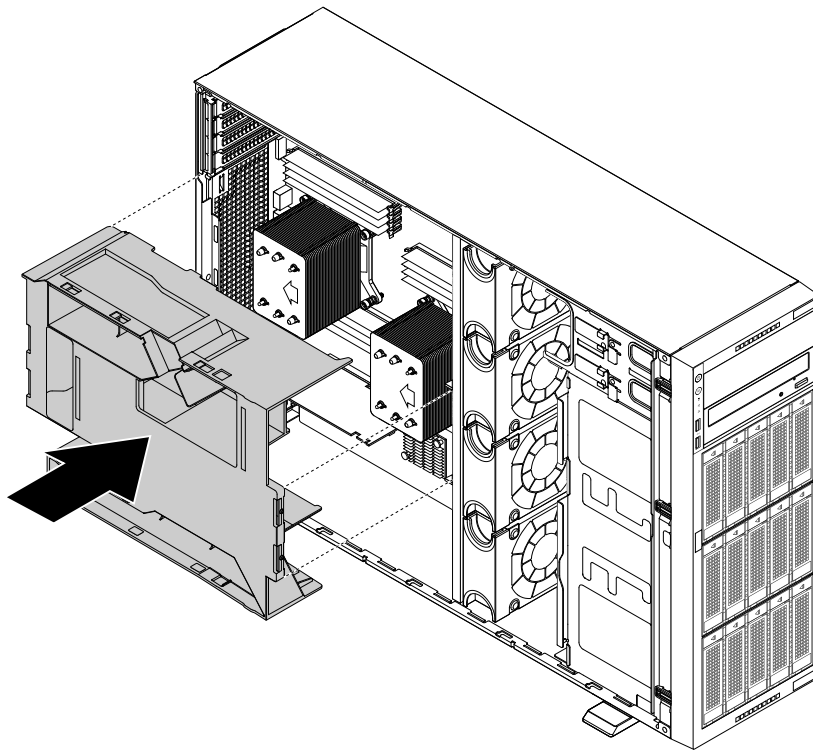


Figure 32. Reinstalling the cooling shroud

4. Go to “Reinstalling the server cover and reconnecting cables” on page 164.

Removing and reinstalling the front bezel

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To remove and reinstall the front bezel, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Depending on the model, do one of the following:
 - Remove the rack handles. See “Removing and reinstalling the rack handles” on page 67.
 - Open the front door, and then remove the front door by lifting it slightly upward until you can completely remove it.

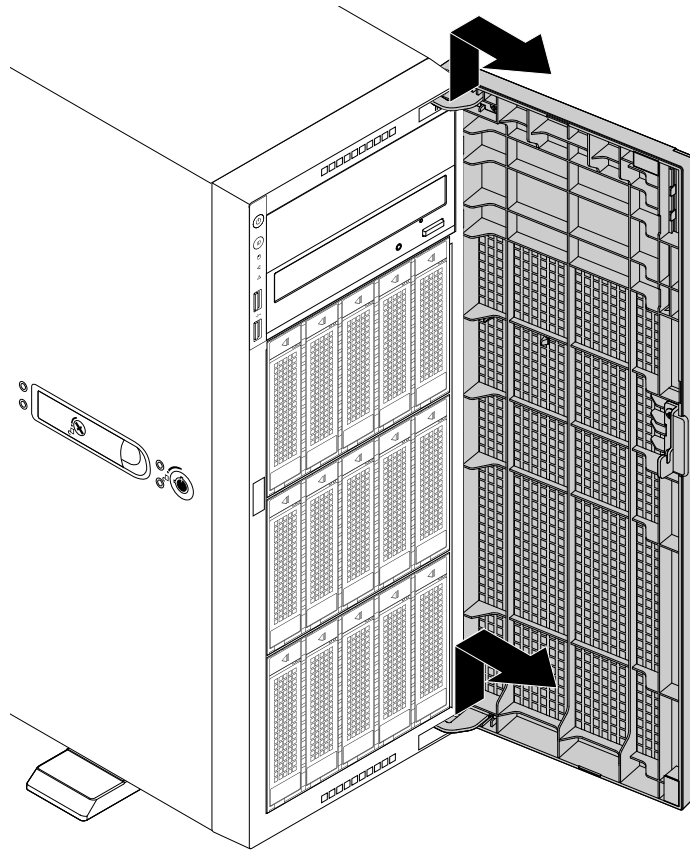


Figure 33. Removing the front door

4. Remove the server cover. See “Removing the server cover” on page 66.
5. Remove all drives, dummy trays, or protective shields. See the related topics in Chapter 6 “Replacing hardware” on page 63.

6. Press the three plastic tabs on the right side first, and then release the three plastic tabs on the left side. Then, pivot the front bezel outward to remove it.

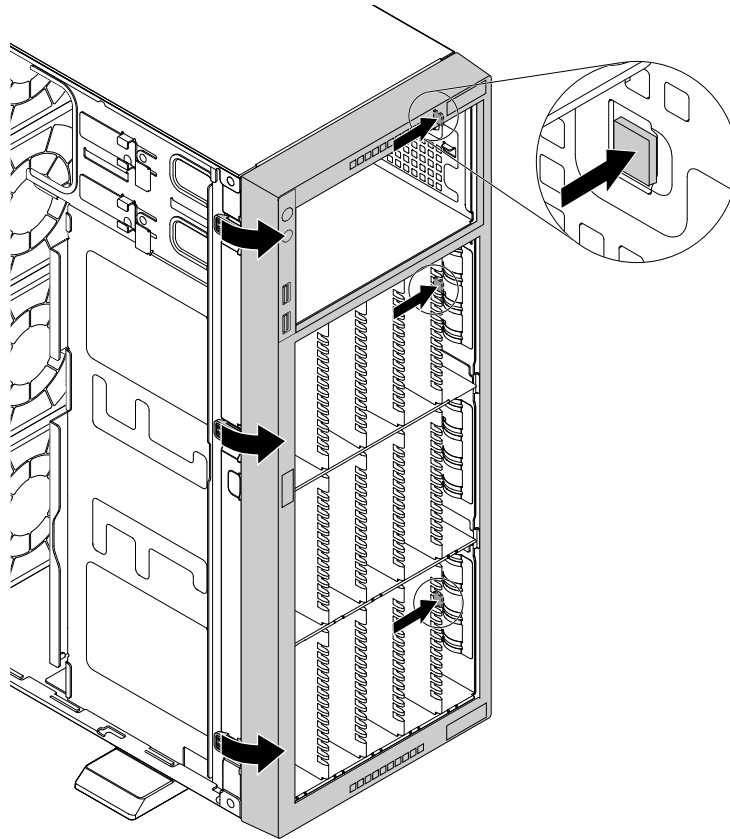


Figure 34. Removing the front bezel

7. To reinstall the front bezel, align the six plastic tabs with the corresponding notches in the chassis. Then, press the front bezel inward until it snaps into position.

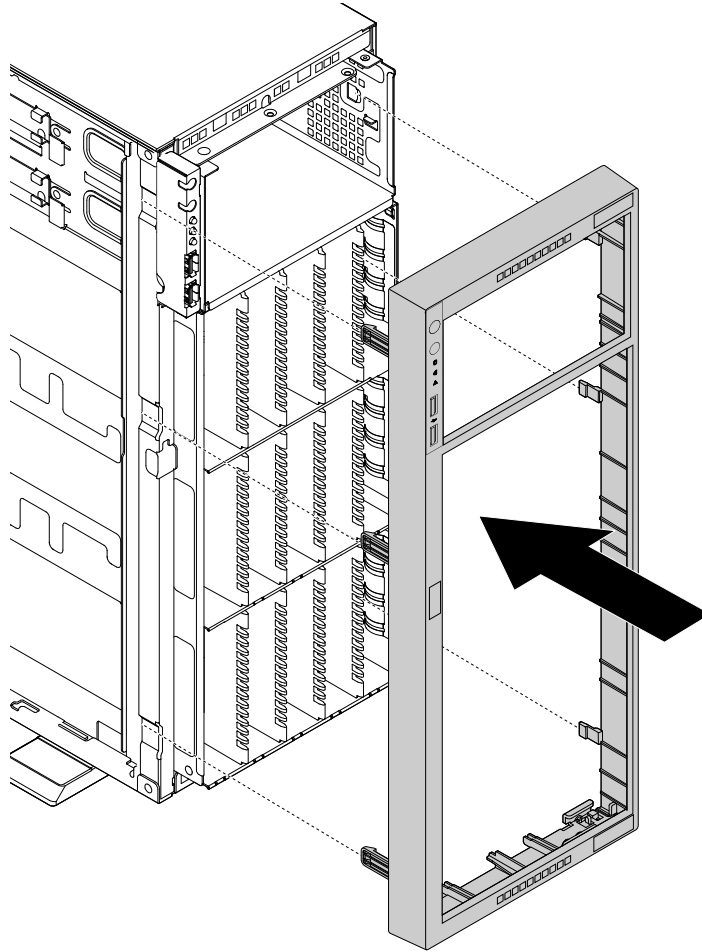


Figure 35. Reinstalling the front bezel

8. Reinstall all drives, dummy trays, or protective shields. See the related topics in Chapter 6 “Replacing hardware” on page 63.
9. Reinstall the server cover. See “Reinstalling the server cover and reconnecting cables” on page 164.
10. Depending on the model, do one of following:
 - Reinstall the rack handles. See “Removing and reinstalling the rack handles” on page 67.

- Align the two plastic tabs of the front door with the corresponding holes in the chassis. Then, move the front door inward and then pull it slightly downward until it is secured in place by the tabs.

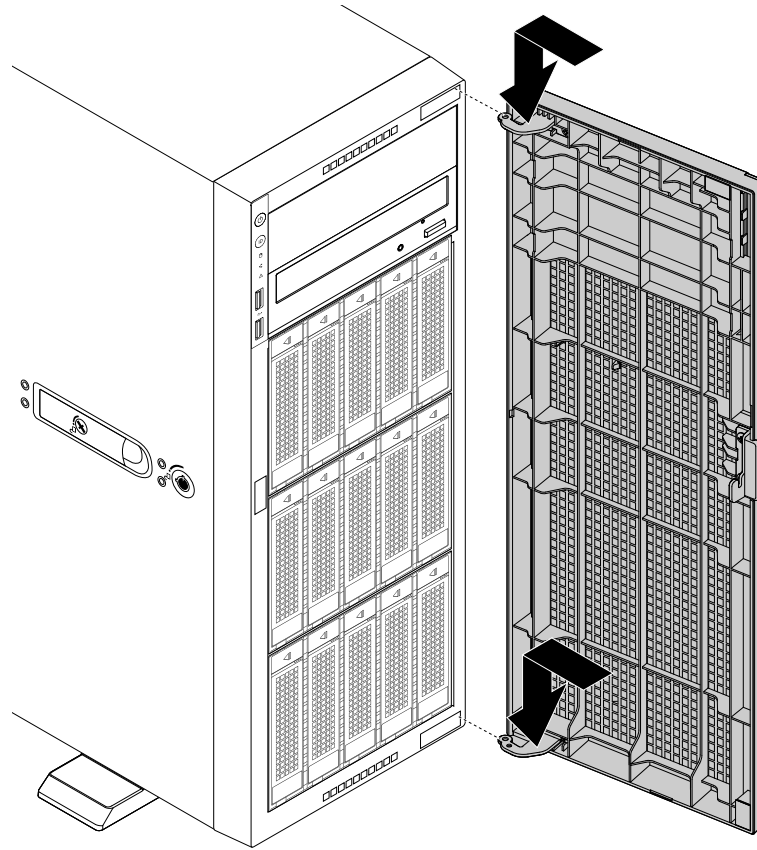


Figure 36. Reinstalling the front door

11. Go to “Completing the parts replacement” on page 164.

Removing and reinstalling the PCIe card holder

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To remove and reinstall the PCIe card holder, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.

4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. To remove the PCIe card holder, press the release tab **1** and carefully disengage the PCIe card holder from the chassis at the same time.

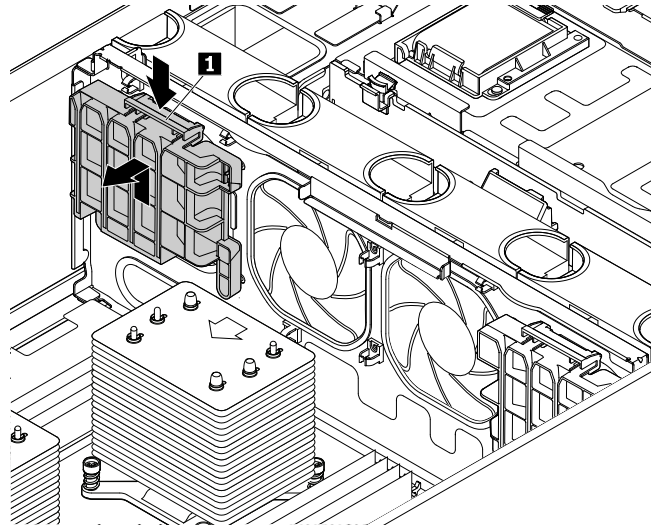


Figure 37. Removing the PCIe card holder

6. Before you reinstall the PCIe card holder, locate the correct place in the chassis for installing the holder. Your server comes with two PCIe card holder and there is a mark on the rear of each holder.
 - Install the PCIe card holder marked with A to the bracket marked with A in the chassis.
 - Install the PCIe card holder marked with B to the bracket marked with B in the chassis.
7. To reinstall the PCIe card holder, note the orientation and the type of the PCIe card holder. Align the holes in the PCIe card holder with the corresponding mounting stubs on the chassis. Then, slightly press the PCIe card holder until it snaps into position.

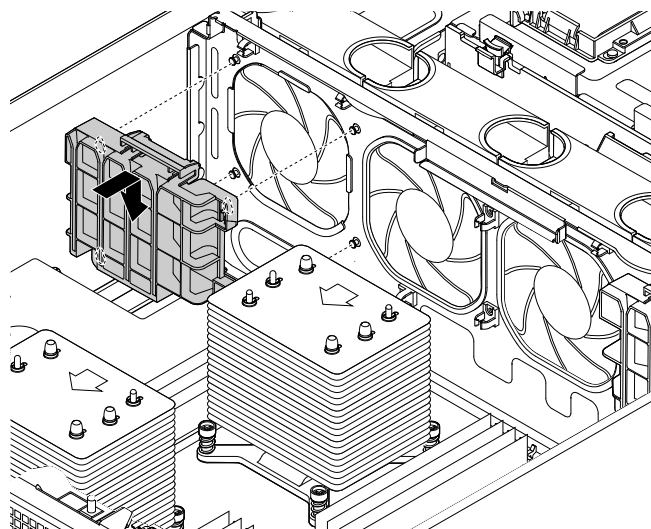


Figure 38. Installing the PCIe card holder

Installing, removing, or replacing hardware

This topic provides instructions on how to install, remove, or replace hardware for your server. You can expand the capabilities of your server by adding new hardware devices, such as memory modules or other server options, and maintain your server by replacing the failing hardware devices.

If you are handling a server option, refer to the appropriate installation and or removal instructions in this topic along with the instructions that come with the option.

Notes:

- Use only parts provided by Lenovo.
- Depending on the model, your server might look slightly different from the illustrations in this topic.

The EMI integrity and cooling of the server are protected by having all drive bays covered or occupied. When you install an internal drive, save the EMI shield or dummy tray from the drive bay in the event that you later remove the device.

Attention: An unoccupied drive bay without a cover, shield, dummy tray, filler, or any other protection might impact the EMI integrity and cooling of the server, which might result in overheating or component damage.

Installing or removing a memory module

This topic contains the following items:

- “Memory module installation rules” on page 76
- “Installing a memory module” on page 81
- “Removing a memory module” on page 83

Note: The memory modules are sensitive to ESD. Ensure that you read and understand “Handling static-sensitive devices” on page 64 first and carefully perform the operation.

Memory module installation rules

Your server has 16 memory slots and it has the following features:

- Each slot supports 32 GB double data rate 4 low-voltage registered dual inline memory modules (DDR4 LV RDIMMs).
- Each slot supports 4 GB, 8 GB, and 16 GB DDR4 RDIMMs.
- Your server supports up to eight memory modules when one microprocessor is installed and up to 16 memory modules when two microprocessors are installed.
- The minimum system memory for RDIMMs is 4 GB (only one microprocessor installed and only one 4 GB RDIMM installed in the CPU1 DIMMA1 slot).
- The minimum system memory for LV RDIMMs is 32 GB (only one microprocessor installed and only one 32 GB LV RDIMM installed in the CPU1 DIMMA1 slot).
- The maximum system memory for RDIMMs is 256 GB (two microprocessors installed and one 16 GB RDIMM installed in each of the 16 memory slots).
- The maximum system memory for LV RDIMMs is 512 GB (two microprocessors installed and one 32 GB LV RDIMM installed in each of the 16 memory slots).

For more information about the memory modules in your specific server model, use the Setup Utility program. See “Viewing information in the Setup Utility program” on page 51.

For a list of supported ThinkServer memory module options, go to:
<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Before installing a memory module, ensure that you observe the following guidelines:

- All memory modules to be installed must be the same type (LV RDIMM or RDIMM).
- When you install memory modules with different ranks in one channel, start from the farthest memory slot in the channel and install the memory module that has the most ranks first.
- If you install 1.35 V memory modules and 1.50 V memory modules into the memory slots for the same microprocessor, you must configure the working voltage in the BIOS so that all the memory modules run at 1.50 V.
- When you install memory modules with different frequencies into the memory slots for the same microprocessor, all the memory modules run at the lowest frequency.
- It is recommended that you install the low-voltage memory modules into the memory slots for the same microprocessor to ensure low power consumption.
- It is recommended that you install the high-frequency memory modules into the memory slots for the same microprocessor to ensure high performance.

The following illustration shows the locations of all memory slots on a system board that has two microprocessors (also known as CPUs) installed.

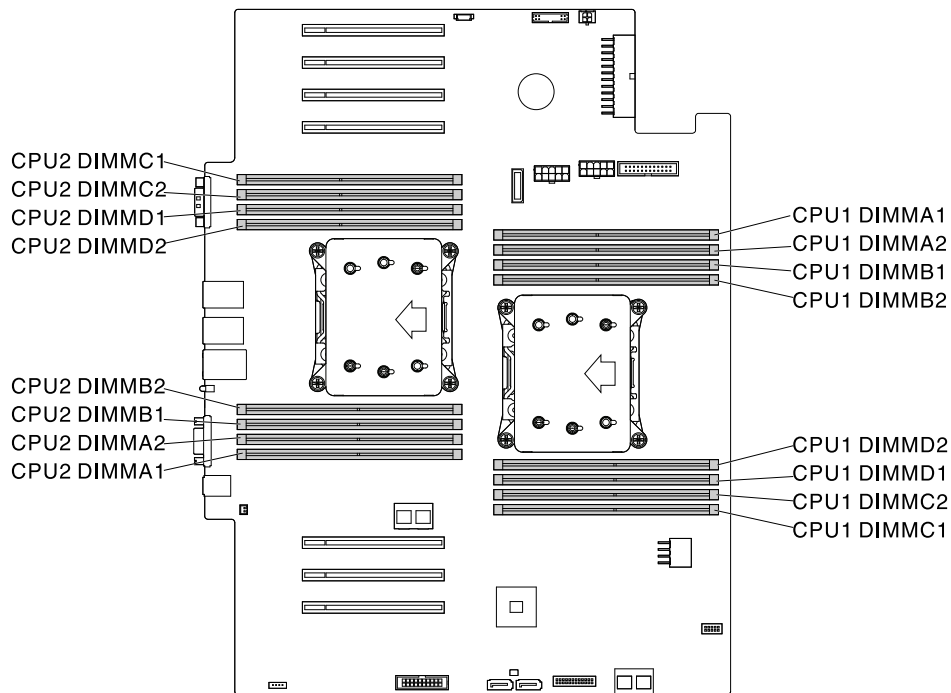


Figure 39. Memory slots on the system board

The following table explains the memory module installation rules for servers that have only one microprocessor (CPU1) installed. The “X” mark indicates the memory slots into which the memory modules should be installed in different situations.

Note: Ensure that you observe the installation guidelines at the beginning of this topic.

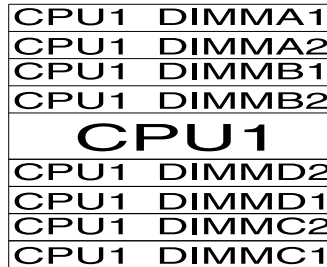


Figure 40. CPU1 DIMMs

Table 2. Memory module installation rules for servers with one microprocessor

CPU1 DIMM	A1	A2	B1	B2	C1	C2	D1	D2
1 DIMM	X							
2 DIMMs	X		X					
4 DIMMs	X		X		X		X	
8 DIMMs	X	X	X	X	X	X	X	X

The following table explains the memory module installation rules for servers that have two microprocessors (CPU1 and CPU2) installed. The “X” mark indicates the memory slots into which the memory modules should be installed in different situations.

Note: Ensure that you observe the installation guidelines at the beginning of this topic.

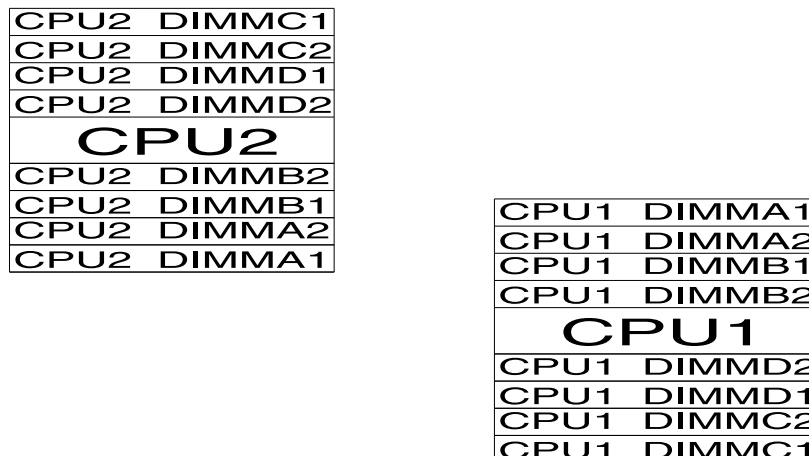


Figure 41. CPU1 DIMMs and CPU2 DIMMs

Table 3. Memory module installation rules for servers with two microprocessors

	CPU1 DIMM								CPU2 DIMM							
	A1	A2	B1	B2	C1	C2	D1	D2	A1	A2	B1	B2	C1	C2	D1	D2
4 DIMMs	X		X						X		X					
8 DIMMs	X		X		X		X		X		X		X		X	
16 DIMMs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The following section explains the memory module installation rules in independent mode, mirroring mode, sparing mode, and lockstep mode.

Memory module installation order in independent mode

In independent mode, the RAS features are not available. For information about the RAS features, refer to the related section in “Features” on page 8.

Note: All memory modules to be installed must be the same type (LV RDIMM or RDIMM). It is also recommended that all memory modules have the same frequency, voltage, and number of ranks.

The following table explains the memory module installation order for servers that have only one microprocessor (CPU1) installed.

Table 4. Memory module installation order in independent mode for servers with one microprocessor

CPU1 DIMM	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	5	2	6	3	7	4	8

The following table explains the memory module installation order for servers that have two microprocessors (CPU1 and CPU2) installed.

Table 5. Memory module installation order in independent mode for servers with two microprocessors

	CPU1 DIMM								CPU2 DIMM							
	A1	A2	B1	B2	C1	C2	D1	D2	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	9	3	11	5	13	7	15	2	10	4	12	6	14	8	16

Memory module installation order in mirroring mode

In mirroring mode, the server maintains two identical copies of all data in memory and the RAS features are available. For information about the RAS features, refer to the related section in “Features” on page 8.

Note: All memory modules to be installed must be the same type (LV RDIMM or RDIMM). It is also recommended that all memory modules have the same frequency, voltage, and number of ranks.

The following table explains the memory module installation order for servers that have only one microprocessor (CPU1) installed.

Table 6. Memory module installation order in mirroring mode for servers with one microprocessor

CPU1 DIMM	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	5	2	6	3	7	4	8

The following table explains the memory module installation order for servers that have two microprocessors (CPU1 and CPU2) installed.

Table 7. Memory module installation order in mirroring mode for servers with two microprocessors

	CPU1 DIMM								CPU2 DIMM							
	A1	A2	B1	B2	C1	C2	D1	D2	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	9	2	10	5	13	6	14	3	11	4	12	7	15	8	16

Memory module installation order in sparing mode

The sparing mode provides memory redundancy. In this mode, the RAS features are available. For information about the RAS features, refer to the related section in “Features” on page 8.

Note: All memory modules to be installed must be the same type (LV RDIMM or RDIMM). It is also recommended that all memory modules have the same frequency, voltage, and number of ranks.

Your server supports rank sparing mode. In rank sparing mode, one rank of a memory module works as the spare rank for the other ranks on the same channel. The spare rank is not available as system memory. To enable rank sparing mode, ensure that:

- At least three ranks are available in one channel.
- The capacity of the spare rank must be the same with or larger than the capacity of other ranks within the same channel.

The following table explains the memory module installation order for servers that have only one microprocessor (CPU1) installed.

Table 8. Memory module installation order in sparing mode for servers with one microprocessor

CPU1 DIMM	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	2	3	4	5	6	7	8

The following table explains the memory module installation order for servers that have two microprocessors (CPU1 and CPU2) installed.

Table 9. Memory module installation order in sparing mode for servers with two microprocessors

	CPU1 DIMM								CPU2 DIMM							
	A1	A2	B1	B2	C1	C2	D1	D2	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	2	5	6	9	10	13	14	3	4	7	8	11	12	15	16

Memory module installation order in lockstep mode

In lockstep mode, the RAS features are available. For information about the RAS features, refer to the related section in “Features” on page 8.

Note: All memory modules to be installed must be the same type (LV RDIMM or RDIMM). It is also recommended that all memory modules have the same frequency, voltage, and number of ranks.

The following table explains the memory module installation order for servers that have only one microprocessor (CPU1) installed.

Table 10. Memory module installation order in lockstep mode for servers with one microprocessor

CPU1 DIMM	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	5	2	6	3	7	4	8

The following table explains the memory module installation order for servers that have two microprocessors (CPU1 and CPU2) installed.

Table 11. Memory module installation order in lockstep mode for servers with two microprocessors

	CPU1 DIMM								CPU2 DIMM							
	A1	A2	B1	B2	C1	C2	D1	D2	A1	A2	B1	B2	C1	C2	D1	D2
DIMM installation order	1	9	2	10	5	13	6	14	3	11	4	12	7	15	8	16

Installing a memory module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- To optimize system performance, ensure that you follow the memory module installation rules when performing the operation. See “Memory module installation rules” on page 76.
- Use any documentation that comes with the memory module and follow those instructions in addition to the instructions in this topic.

To install a memory module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the memory slots on the system board. See “System board components” on page 41.
6. Remove any parts and disconnect any cables that might prevent your access to the memory slots.

7. Open the retaining clips of the appropriate memory slot. See “Memory module installation rules” on page 76 for the installation sequence information.

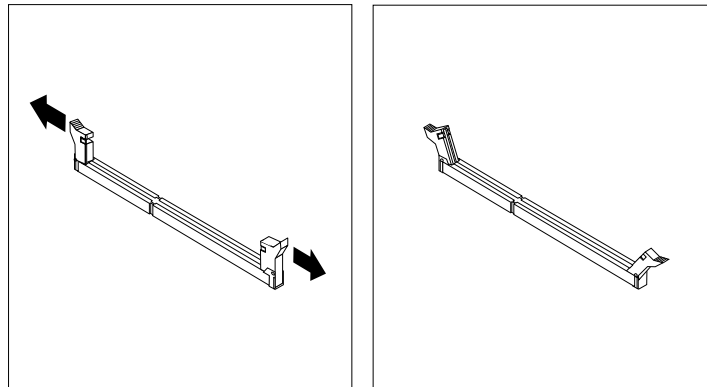


Figure 42. Opening the retaining clips of the memory slot

8. Touch the static-protective package that contains the new memory module to any unpainted surface on the outside of the server. Then, take the new memory module out of the package.

Note: Carefully handle the memory module by its edges.

9. Position the new memory module over the memory slot. Ensure that the notch **1** on the new memory module is aligned with the key **2** in the memory slot. Then, press the new memory module straight down into the memory slot until the retaining clips close and the new memory module snaps into position.

Note: If there is a gap between the memory module and the retaining clips, the memory module has not been installed correctly. Open the retaining clips, remove the memory module, and then reinstall it into the memory slot until the retaining clips are completely closed.

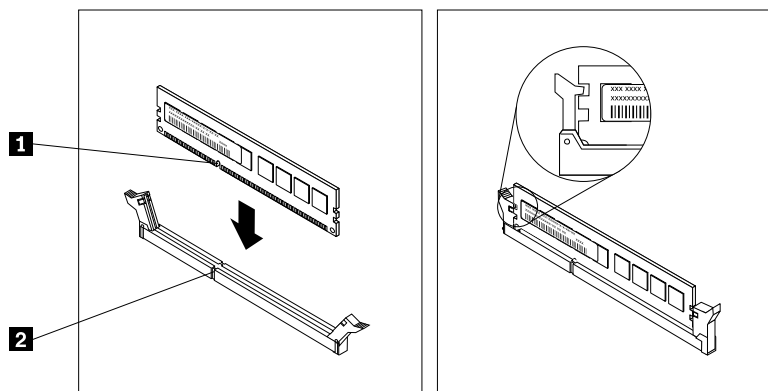


Figure 43. Installing a memory module

10. Reinstall any parts and reconnect any cables that you have removed.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

Removing a memory module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: To optimize system performance, ensure that you follow the memory module installation rules when performing the operation. See “Memory module installation rules” on page 76.

To remove a memory module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the memory slots on the system board. See “System board components” on page 41.
6. Remove any parts and disconnect any cables that might prevent your access to the memory slots.
7. Locate the memory module that you want to remove and open the retaining clips on both ends of the memory slot. Then, grasp the memory module by its edges and carefully pull it straight up to remove it from the memory slot.

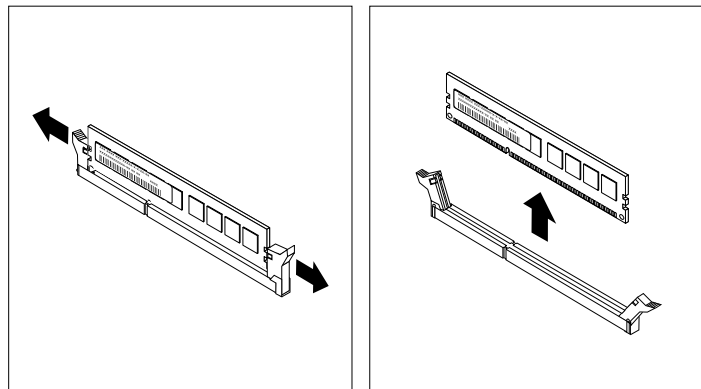


Figure 44. Removing a memory module

8. Reinstall any parts and reconnect any cables that you have removed.
9. If you are instructed to return the old memory module, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or removing a PCI Express card: Ethernet card, RAID card, or other supported types of PCI Express cards

Your server comes with seven PCI Express (PCIe) card slots. Depending on your needs, you can install a PCIe card to obtain the corresponding function or remove the card if necessary. PCIe cards vary by type, but the installation and removal procedures are the same.

Note: The PCIe cards are sensitive to ESD. Ensure that you read and understand “Handling static-sensitive devices” on page 64 first and carefully perform the operation.

Installing a PCIe card

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the specific type, the PCIe card might look different from the illustrations in this topic.
- Use any documentation that comes with the PCIe card and follow those instructions in addition to the instructions in this topic.
- Ensure that you back up your data before installing a RAID card because you might need to reconfigure RAID and reinstall the operating system after installing the RAID card.

To install a PCIe card, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate an appropriate PCIe card slot on the system board for installing the PCIe card. For information about the PCIe card slots, see “System board components” on page 41.
6. Remove any parts and disconnect any cables that might impede your operation.

7. Pivot the latch for the PCIe card slot to the open position.

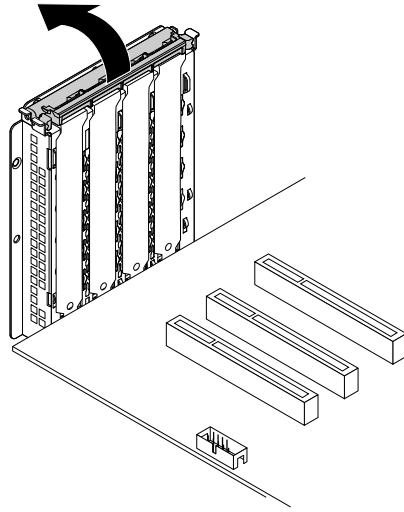


Figure 45. Pivoting the latch for the PCIe card slot to the open position

8. Remove the bracket for the PCIe card slot. Store the bracket for the PCIe card slot in case that you later remove the PCIe card and need the bracket to cover the place.

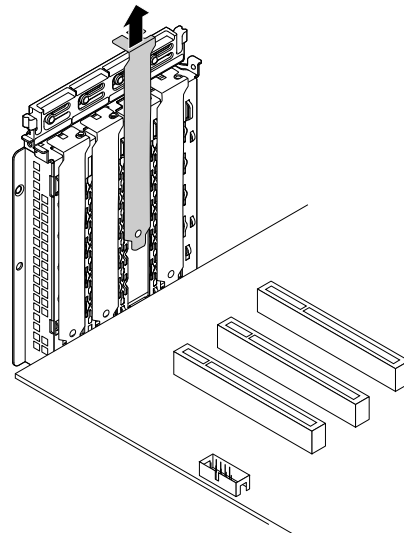


Figure 46. Removing the bracket for the PCIe card slot

9. Touch the static-protective package that contains the PCIe card to any unpainted surface on the outside of the server. Then, carefully handle the PCIe card by its edges and take it out of the package.

10. Position the new PCIe card over the PCIe card slot. Then, carefully press the PCIe card straight down until it is securely seated in the slot.

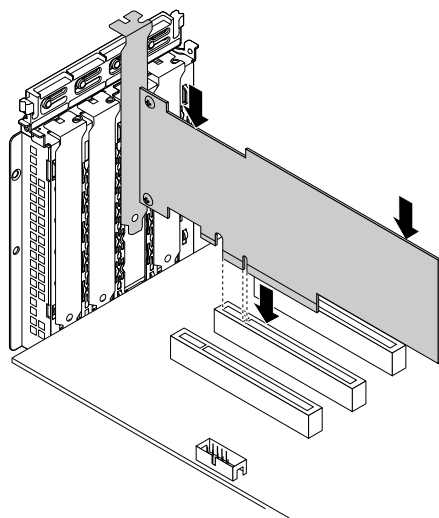


Figure 47. Installing the PCIe card

11. Close the latch for the PCIe card slot to secure the installed PCIe card.

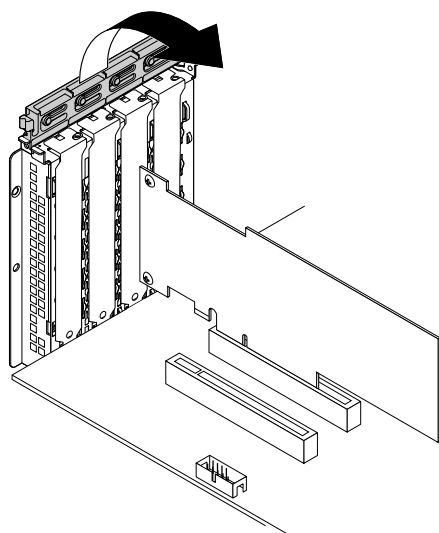


Figure 48. Closing the latch for the PCIe card slot

12. Depending on the type of the PCIe card, you might need to connect any required cables. Refer to the documentation that comes with the PCIe card for specific information.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

- If you are installing an Ethernet card, continue to install the Ethernet card driver. This step is not required if the operating system was installed using the Lenovo ThinkServer Deployment Manager program. To install the Ethernet card driver manually, visit the Lenovo Web site at <http://www.lenovo.com/drivers> and follow the instructions on the screen.
- If you are installing a RAID card, do the following:
 1. Configure RAID for your server. See “Configuring RAID” on page 58.
 2. Check the version of the new RAID card firmware by pressing Ctrl+H when starting the Setup Utility program.
 3. Go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page to download the latest version of firmware. Then, install the firmware to your server.

Removing a PCIe card

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Use any documentation that comes with the PCIe card and follow those instructions in addition to the instructions in this topic.
- Depending on the specific type, the PCIe card might look different from the illustrations in this topic.

To remove a PCIe card, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the PCIe card.
6. Depending on the type of the PCIe card, you might also need to disconnect all cables from the PCIe card, the system board, or the backplane.
7. Pivot the latch for the PCIe card slot that secures the PCIe card to the open position.

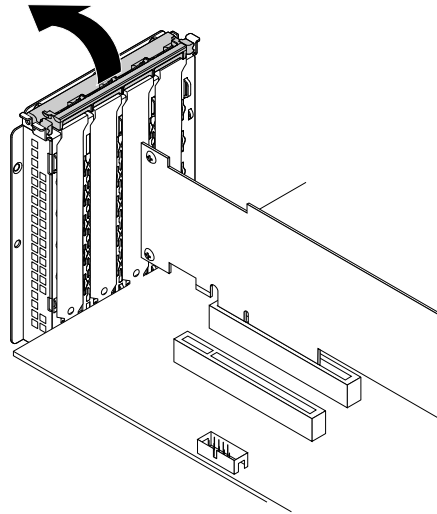


Figure 49. Pivoting the latch for the PCIe card slot to the open position

8. Grasp the PCIe card by its edges and carefully pull it out of the PCIe card slot. The PCIe card fits tightly into the PCIe card slot. If necessary, alternate moving each side of the PCIe card a small and equal amount until it is completely removed from the slot.

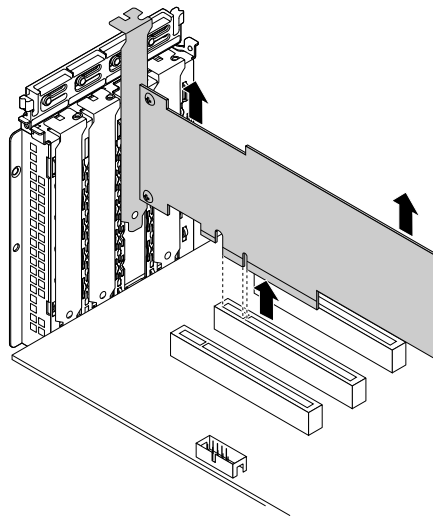


Figure 50. Removing the PCIe card

9. Install a new PCIe card to replace the old one. See “Installing a PCIe card” on page 84. Otherwise, install the bracket for the PCIe card slot to cover the place.
10. Close the latch for the PCIe card slot.
11. If you are instructed to return the old PCIe card, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.

- To complete the removal procedure, go to “Completing the parts replacement” on page 164.
- If you are removing a RAID card, reconfigure RAID for your server. See “Configuring RAID” on page 58.

Installing or removing the SD module

This topic contains the following items:

- “Installing the SD module” on page 89
- “Removing the SD module” on page 90

Installing the SD module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Use any documentation that comes with the SD module and follow those instructions in addition to the instructions in this topic.

To install the SD module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Remove any parts and disconnect any cables that might impede your operation.
6. Locate the SD-module connector on the system board. See “System board components” on page 41.
7. Touch the static-protective package that contains the SD module to any unpainted surface on the outside of the server. Then, take the SD module out of the package.
8. Insert the SD card into the SD card slot. The card might stop before it is completely installed into the SD module. Ensure that you insert the card firmly until you hear a click.

9. Ensure that the two holes in the SD module are aligned with the two plastic pins on the system board. Then, lower the SD module straight down until it is securely seated.

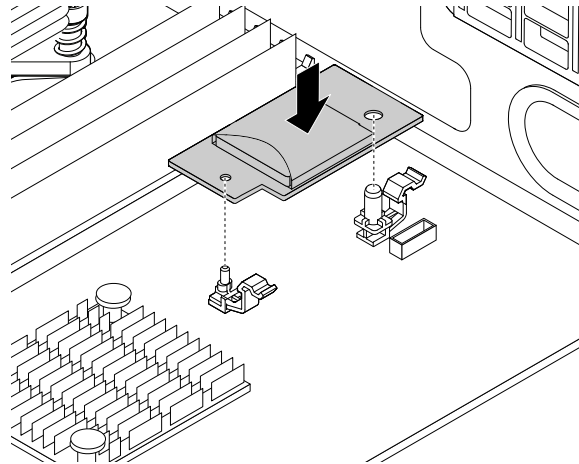


Figure 51. Installing the SD module

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

Removing the SD module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Use any documentation that comes with the SD module and follow those instructions in addition to the instructions in this topic.

If your server has an SD module installed, do the following when you want to remove the SD module:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Remove any parts and disconnect any cables that might impede your operation.
6. Locate the SD module on the system board.

7. Press the two release tabs **1** and grasp the SD module by its edges at the same time. Then, lift the SD module straight up and off the system board.

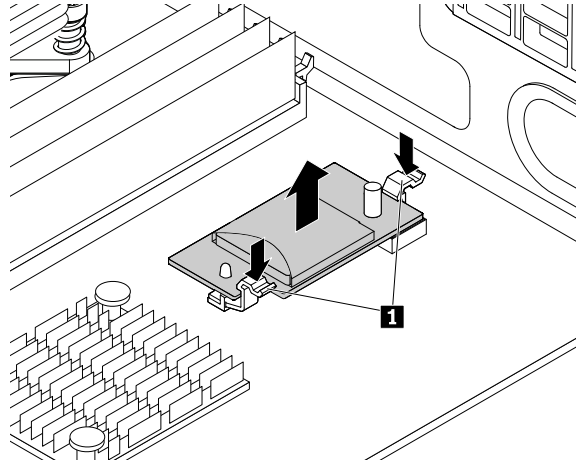


Figure 52. Removing the SD module

8. Push the SD card inward a little until you hear a click. Then, the SD card ejects. Gently slide the card out of the card slot.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or removing the Lenovo ThinkServer RAID 110i upgrade key

The Lenovo ThinkServer RAID 110i upgrade key expands the capability of the system board by activating RAID 5 for the onboard SATA software RAID. You can purchase a Lenovo ThinkServer RAID 110i upgrade key (hereinafter referred to as the RAID 110i upgrade key) from the Lenovo Web site at: <http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the RAID 110i upgrade key

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Use any documentation that comes with the RAID 110i upgrade key and follow those instructions in addition to the instructions in this topic.

To install the RAID 110i upgrade key, do the following:

Attention: Installing the RAID 110i upgrade key might impact your RAID configurations. Back up your data before you begin to avoid any data loss due to a RAID configuration change.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.

2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Touch the static-protective package that contains the RAID 110i upgrade key to any unpainted surface on the outside of the server. Then, take the RAID 110i upgrade key out of the package.
6. Locate the connector for the RAID 110i upgrade key on the system board. Then, insert the RAID 110i upgrade key into the upgrade key connector. Ensure that the RAID 110i upgrade key is securely seated on the system board.

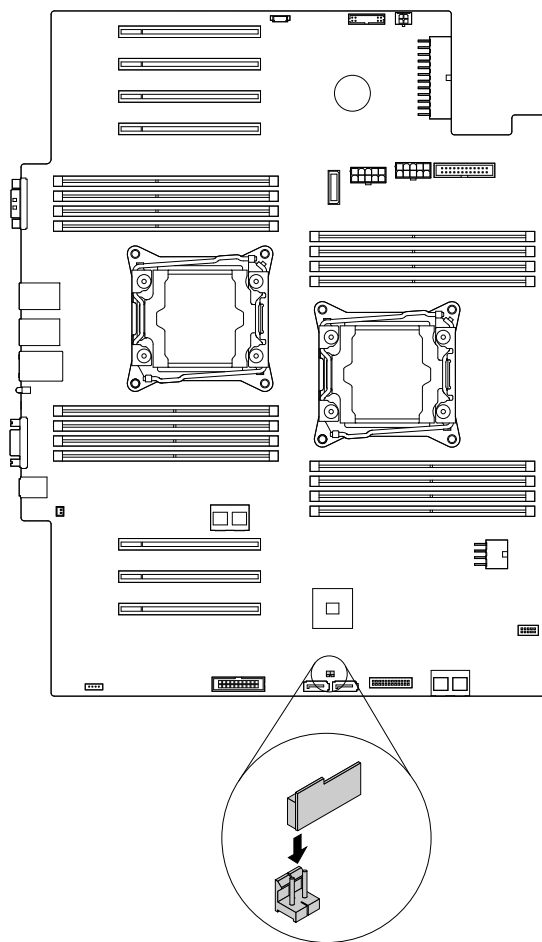


Figure 53. Installing the RAID 110i upgrade key

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164. Then, the onboard SATA software RAID 5 is available for your server if your server has the required number of storage drives installed. To configure RAID, see “Configuring RAID” on page 58.

Removing the RAID 110i upgrade key

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- If you remove the RAID 110i upgrade key, the onboard SATA software RAID 5 will be unavailable.
- Use any documentation that comes with the RAID 110i upgrade key and follow those instructions in addition to the instructions in this topic.

If your server has a RAID 110i upgrade key installed, do the following when you want to remove the RAID 110i upgrade key:

Attention: Removing the RAID 110i upgrade key might impact your RAID configurations. Back up your data before you begin to avoid any data loss due to a RAID configuration change.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.

5. Locate the RAID 110i upgrade key on the system board. Then, lift the RAID 110i upgrade key straight up to remove it from the upgrade key connector.

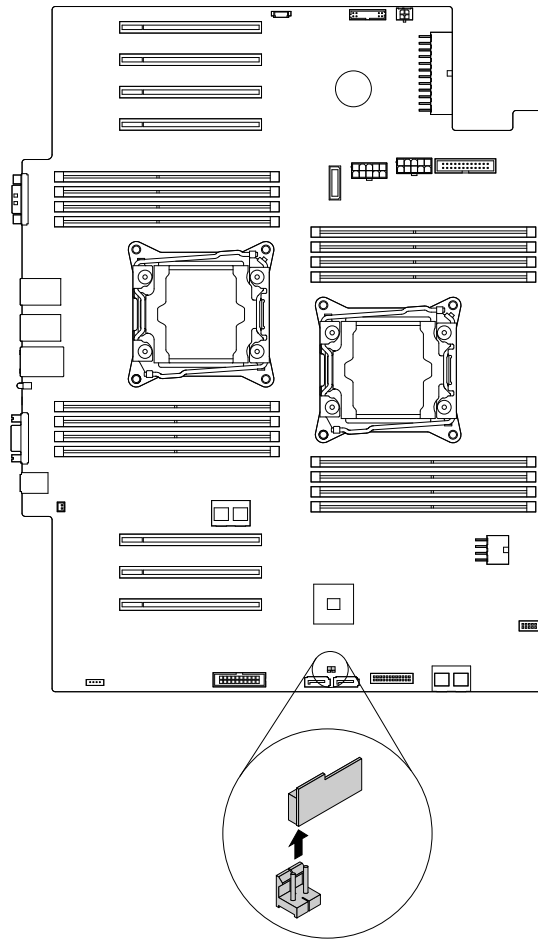


Figure 54. Removing the RAID 110i upgrade key

6. If you are instructed to return the old RAID 110i upgrade key, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164. As the onboard SATA software RAID 5 is not available without the RAID 110i upgrade key, you might need to reconfigure RAID for your server. See “Configuring RAID” on page 58.

Installing or removing the Lenovo ThinkServer RAID 510i upgrade key

The Lenovo ThinkServer RAID 510i upgrade key is used to be installed onto the Lenovo ThinkServer RAID 510i AnyRAID adapter for providing the adapter with the RAID 5 and RAID 50 capability. You can purchase a Lenovo ThinkServer RAID 510i upgrade key (hereinafter referred to as the RAID 510i upgrade key) from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the RAID 510i upgrade key

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Use any documentation that comes with the RAID 510i upgrade key and follow those instructions in addition to the instructions in this topic.

To install the RAID 510i upgrade key, do the following:

Attention: Installing the RAID 510i upgrade key might impact your RAID configurations. Back up your data before you begin to avoid any data loss due to a RAID configuration change.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Touch the static-protective package that contains the RAID 510i upgrade key to any unpainted surface on the outside of the server. Then, take the RAID 510i upgrade key out of the package.
5. Locate the Lenovo ThinkServer RAID 510i AnyRAID Adapter. See “Server components” on page 25.
6. Locate the connector for the RAID 510i upgrade key on the Lenovo ThinkServer RAID 510i AnyRAID Adapter. Then, insert the RAID 510i upgrade key into the connector. Ensure that the RAID 510i upgrade key is securely seated on the AnyRAID adapter.

Note: If necessary, remove the Lenovo ThinkServer RAID 510i AnyRAID Adapter first for easier operation. Then, reinstall the Lenovo ThinkServer RAID 510i AnyRAID Adapter. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.

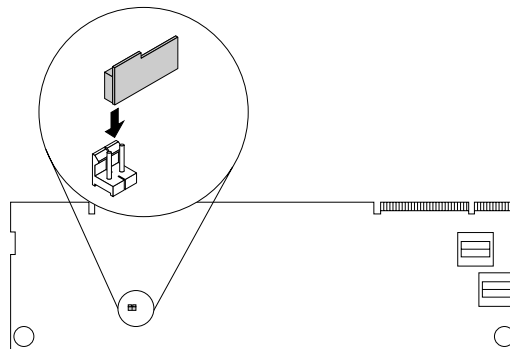


Figure 55. Installing the RAID 510i upgrade key

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164. Then, the hardware RAID 5 and RAID 50 levels are available for your server if your server has the required number of storage drives installed. For information about how to configure the hardware RAID, refer to the *MegaRAID SAS Software User Guide* on the documentation DVD that comes with your server.

Removing the RAID 510i upgrade key

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- After you remove the RAID 510i upgrade key, the hardware RAID 5 and RAID 50 levels are unavailable.
- Use any documentation that comes with the RAID 510i upgrade key and follow those instructions in addition to the instructions in this topic.

If your server has a RAID 510i upgrade key installed, do the following when you want to remove the RAID 510i upgrade key:

Attention: Removing the RAID 510i upgrade key might impact your RAID configurations. Back up your data before you begin to avoid any data loss due to a RAID configuration change.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the Lenovo ThinkServer RAID 510i AnyRAID Adapter. See “Server components” on page 25.
5. Remove any parts and disconnect any cables that might impede your operation.

6. Remove the RAID 510i upgrade key from the Lenovo ThinkServer RAID 510i AnyRAID Adapter.

Note: If necessary, remove the Lenovo ThinkServer RAID 510i AnyRAID Adapter first for easier operation. Then, reinstall the Lenovo ThinkServer RAID 510i AnyRAID Adapter. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.

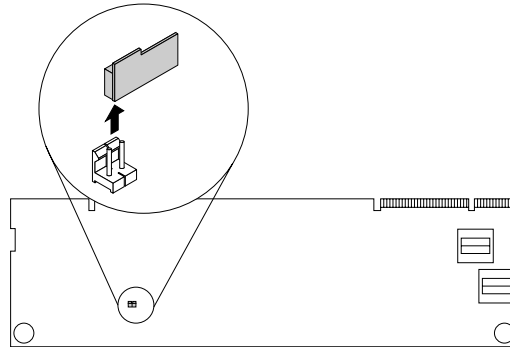


Figure 56. Removing the RAID 510i upgrade key

7. Reinstall any parts and reconnect any cables that you have removed.
8. If you are instructed to return the old RAID 510i upgrade key, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164. Because the hardware RAID 5 and 50 levels are not available without the RAID 510i upgrade key, you might need to reconfigure RAID for your server. For information about how to configure the hardware RAID, refer to the *MegaRAID SAS Software User Guide* on the documentation DVD that comes with your server.

Installing or removing the flash module

This topic applies only to AnyRAID adapters that support the flash module.

The flash module works as the cache memory of the installed AnyRAID adapter. You can purchase a flash module from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the flash module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Use any documentation that comes with the flash module and follow those instructions in addition to the instructions in this topic.
- Depending on the specific type, your AnyRAID adapter and the flash module might look different from the illustration in this topic.

To install the flash module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the AnyRAID adapter. See “Server components” on page 25.
5. Remove any parts and disconnect any cables that might impede your operation.
6. Position the flash module above the AnyRAID adapter and align the two holes in the flash module with the two pins on the AnyRAID adapter. Then, lower the flash module straight down until it is securely seated.

Note: If necessary, remove the AnyRAID adapter first for easier operation. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.

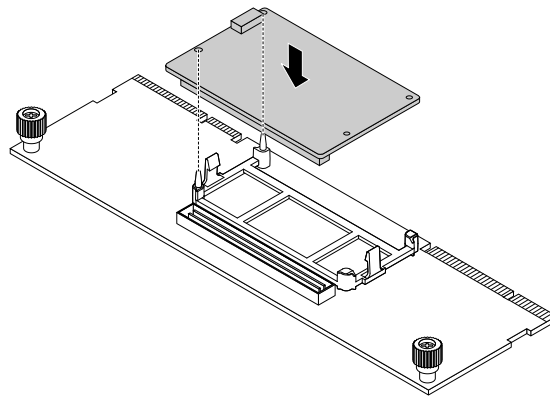


Figure 57. Installing the flash module

7. Reinstall any parts and reconnect any cables that you have removed.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

Removing the flash module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the specific type, your AnyRAID adapter and the flash module might look different from the illustration in this topic.

If the AnyRAID adapter in your server has a flash module installed, do the following when you want to remove the flash module:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.

2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the AnyRAID adapter. See “Server components” on page 25.
5. Remove any parts and disconnect any cables that might impede your operation.
6. Press the two release tabs **1** and lift the flash module straight up and out of the AnyRAID adapter.

Note: If necessary, you can remove the AnyRAID adapter first before removing the flash module. Then, reinstall the AnyRAID adapter. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.

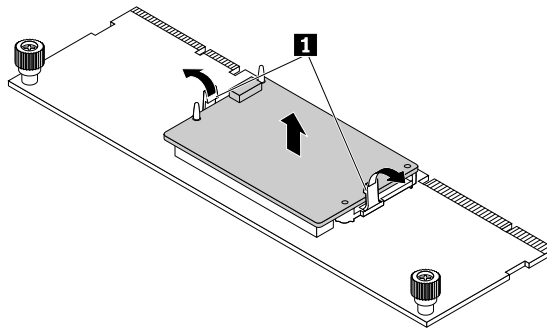


Figure 58. Removing the flash module

7. Reinstall any parts and reconnect any cables that you have removed.
8. If you are instructed to return the old flash module, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or removing the ThinkServer System Manager Premium

The ThinkServer System Manager Premium (hereinafter referred to as the TSM Premium) offers convenient, remote KVM access and control through the LAN or Internet. You can use the TSM Premium to gain location-independent remote access to respond to critical incidents and to undertake necessary maintenance. Therefore, working as an integrated solution in your server, the TSM Premium provides an increased level of manageability over the basic server management available. You can purchase a TSM Premium from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the TSM Premium

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Use any documentation that comes with the TSM Premium and follow those instructions in addition to the instructions in this topic.
- Depending on the model, your server might look slightly different from the illustration in this topic.

To install the TSM Premium, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Touch the static-protective package that contains the TSM Premium to any unpainted surface on the outside of the server. Then, take the TSM Premium out of the package.
6. Locate the TSM Premium connector on the system board, and then insert the TSM Premium into the TSM Premium connector. Ensure that the TSM Premium is securely seated on the system board.

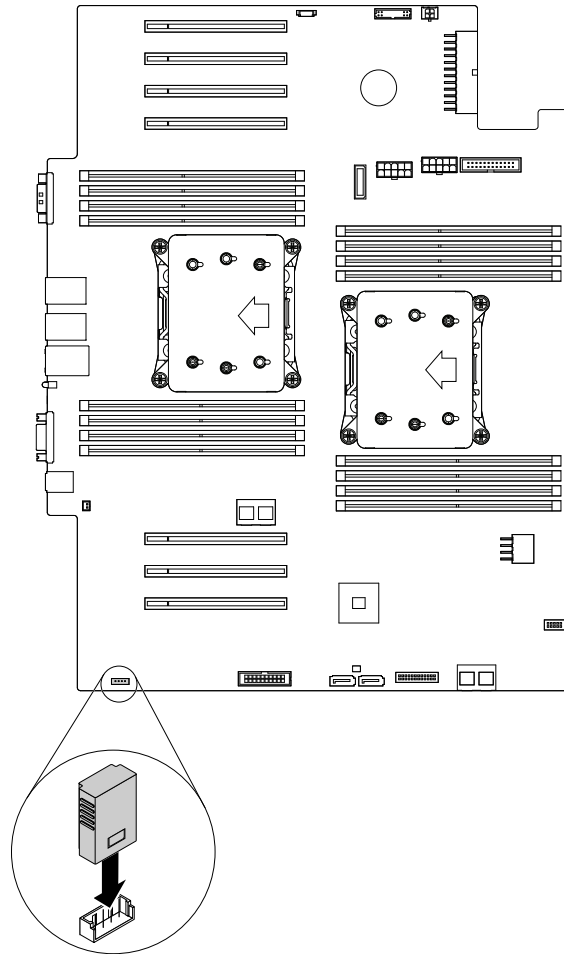


Figure 59. Installing the TSM Premium

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164. For information about server remote management, refer to the *ThinkServer System Manager User Guide*, which is available for download at <http://www.lenovo.com/UserManuals>.

Removing the TSM Premium

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- If you remove the TSM Premium, the iKVM function for server remote management will be unavailable.
- Use any documentation that comes with the TSM Premium and follow those instructions in addition to the instructions in this topic.
- Depending on the model, your server might look slightly different from the illustration in this topic.

If your server has a TSM Premium installed, do the following when you want to remove the TSM Premium:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.

5. Locate the TSM Premium on the system board. Lift the TSM Premium straight up to remove it from the connector.

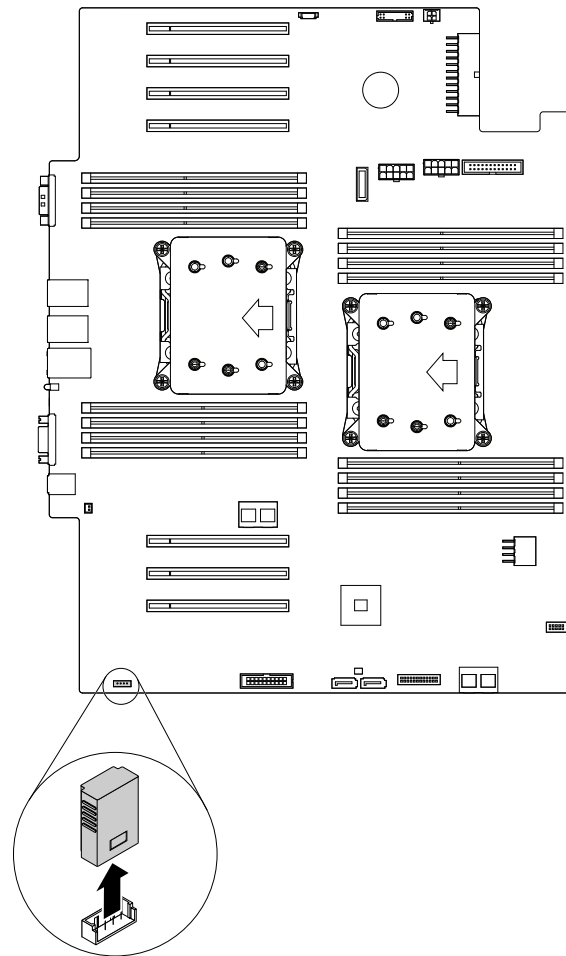


Figure 60. Removing the TSM Premium

6. If you are instructed to return the old TSM Premium, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or removing the ThinkServer Trusted Platform Module

ThinkServer Trusted Platform Module (hereinafter referred to as the TPM) is a security chip designed by the Trusted Computing Group (TCG) to provide a hardware method of data encryption. It stores passwords, encryption keys, and digital certificates to help provide security solutions and protect the computer. You can purchase a TPM option from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the TPM

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Use any documentation that comes with the TPM and follow those instructions in addition to the instructions in this topic.
- Depending on the model, your server might look slightly different from the illustration in this topic.

To install the TPM, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Touch the static-protective package that contains the TPM to any unpainted surface on the outside of the server. Then, take the TPM out of the package.

Note: Carefully handle the TPM by its edges.

6. Locate the TPM connector on the system board. Insert the TPM into the TPM connector.

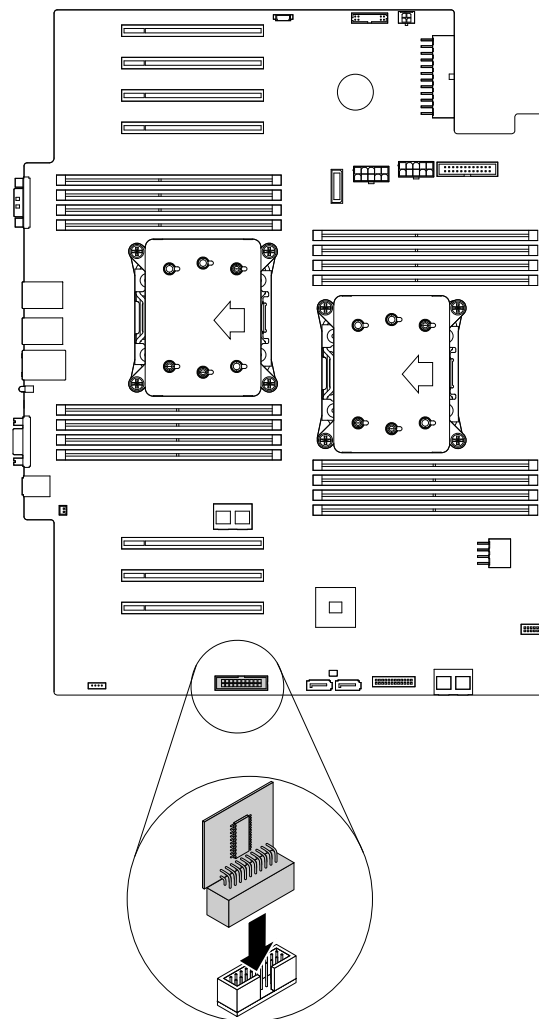


Figure 61. Installing the TPM

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164. Then, you can configure the TPM function in the Setup Utility program. See “Configuring the TPM function” on page 56.

Removing the TPM

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- If you remove the TPM, the TPM function will be unavailable.
- Use any documentation that comes with the TPM and follow those instructions in addition to the instructions in this topic.
- Depending on the model, your server might look slightly different from the illustration in this topic.

If your server has a TPM installed, do the following when you want to remove the TPM:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.

5. Locate the TPM on the system board. Lift the TPM straight up to remove it from the TPM connector.

Note: Carefully handle the TPM by its edges.

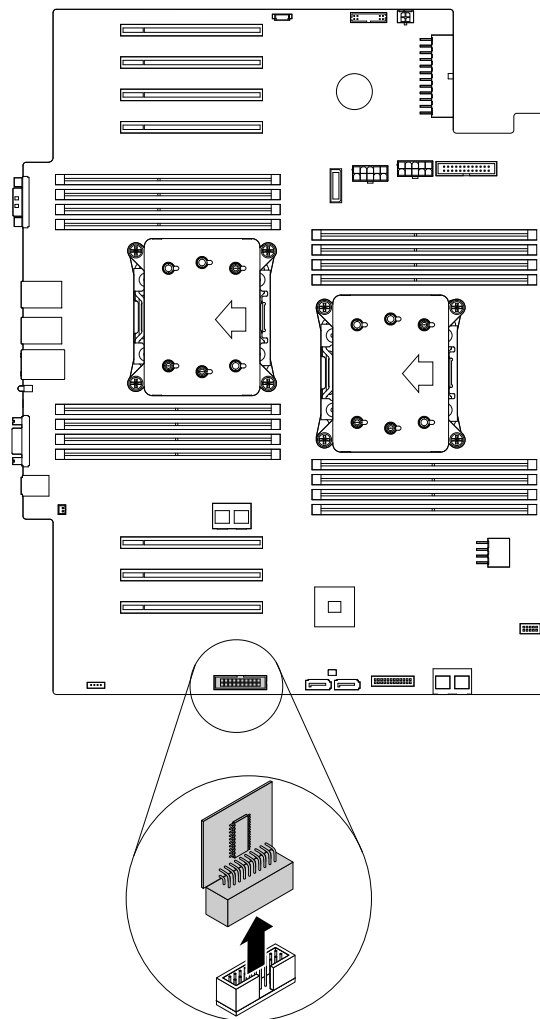


Figure 62. Removing the TPM

6. If you are instructed to return the old TPM, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or removing the intrusion switch

The intrusion switch informs you that the server cover is not properly installed or closed by creating an event in the system event log (SEL). You can purchase an intrusion switch from the Lenovo Web site at: <http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Installing the intrusion switch

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Use any documentation that comes with the intrusion switch and follow those instructions in addition to the instructions in this topic.

To install the intrusion switch, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing and reinstalling the cooling shroud” on page 68.
5. Touch the static-protective package that contains the intrusion switch to any unpainted surface on the outside of the server. Then, take the intrusion switch out of the package.
6. Insert the intrusion switch into the chassis. Then, push the new intrusion switch in the direction as shown until it is seated securely.

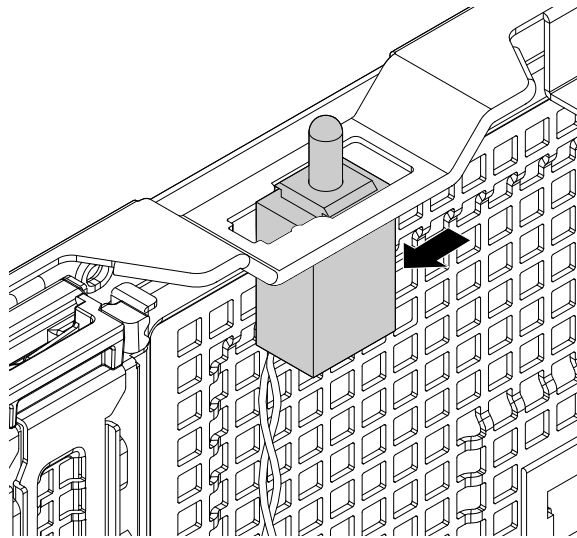


Figure 63. Installing the intrusion switch

7. Connect the intrusion switch cable to the intrusion switch connector on the system board. See “System board components” on page 41.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

Removing the intrusion switch

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- If you remove the intrusion switch, you will not get the warning message when logging in to your server with the cover removed.
- Use any documentation that comes with the intrusion switch and follow those instructions in addition to the instructions in this topic.

To remove the intrusion switch, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing and reinstalling the cooling shroud” on page 68.
5. Locate the intrusion switch. See “Server components” on page 25.
6. Disconnect the intrusion switch cable from the intrusion switch connector on the system board. See “System board components” on page 41.
7. Slide the intrusion switch as shown to remove it from the chassis.

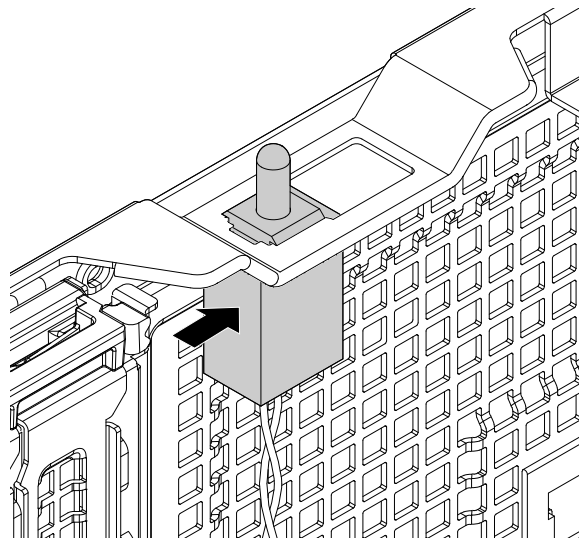


Figure 64. Removing the intrusion switch

8. If you are instructed to return the old intrusion switch, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.

- To complete the removal procedure, go to “Completing the parts replacement” on page 164.

Installing or replacing an optical drive

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

The EMI integrity and cooling of the server are protected by having all drive bays covered or occupied. Your server has two optical-drive bays. If only one optical drive is installed in the lower bay, the upper bay is covered by a protective shield. When you install a secondary optical drive, save the removed protective shield in the event that you later remove the drive and need the protective shield to cover the drive bay.

Attention: An unoccupied drive bay without any other protection might impact the EMI integrity and cooling of the server, which might result in overheating or component damage. To maintain the EMI integrity and cooling of the server, install a new optical drive as soon as you remove the failing one or the protective shield.

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.

Before you begin, review the following optical drive installation rules:

- The server has two optical-drive bays. If your server has only one optical drive installed, ensure that the optical drive is installed in the lower bay (optical-drive bay 1). The upper bay is for a secondary optical drive.
- The following table provides information about the recommended power connector and signal connector on the system board for the installed optical drive. To locate the connectors on the system board, see “System board components” on page 41.

Drive bay	Drive	Power connector	Signal connector
Optical-drive bay 1 (lower bay)	An optical drive installed	Optical-drive power connector	Optical-drive 1 signal connector
Optical-drive bay 2 (upper bay)	An optical drive installed in some models	Optical-drive power connector	Optical-drive 2 signal connector

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the optical drive and follow those instructions in addition to the instructions in this topic.

To install or replace an optical drive, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the optical-drive bays. See “Front view of the server” on page 17. Read the optical drive installation rules in this topic.
5. Depending on whether you are installing or replacing an optical drive, do one of the following:
 - If you are installing a secondary optical drive in the lower optical-drive bay, insert a finger into the hole as shown to push the protective shield until it is projected from the front of the chassis. Then, hold the protective shield from the front and completely slide it out of the chassis.

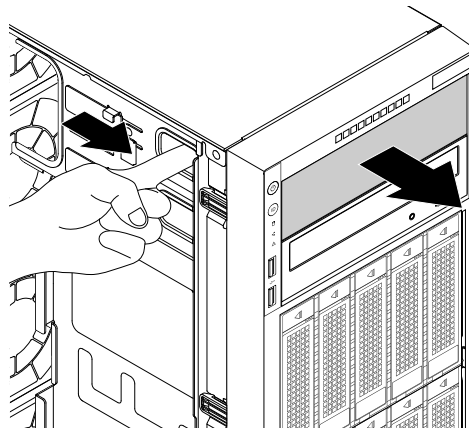


Figure 65. Removing the protective shield of the optical-drive bay

- If you are replacing an optical drive, disconnect the signal cable and the power cable from the rear of the optical drive. Lift the release button **1** in the direction as shown and push the optical drive from the rear until it is projected from the front of the chassis. Then, hold the optical drive from the front and completely slide it out of the chassis.

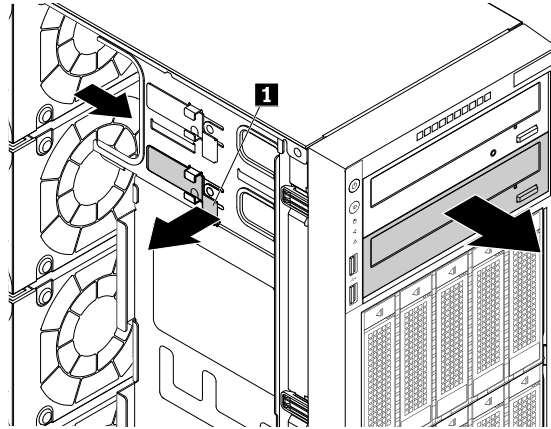


Figure 66. Removing the optical drive

6. Touch the static-protective package that contains the new optical drive to any unpainted surface on the outside of the server. Then, take the new optical drive and the signal cable out of the package.
7. Lift the release button **1** in the direction as shown and slide the new optical drive into the drive bay from the front until it snaps into position.

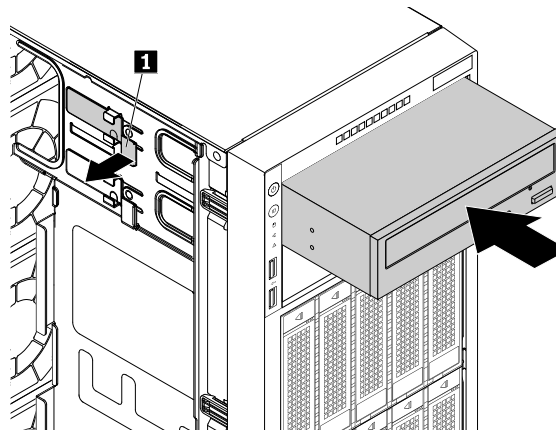


Figure 67. Installing the optical drive

8. Connect the power cable **1** and the signal cable **2** to the rear of the new optical drive.

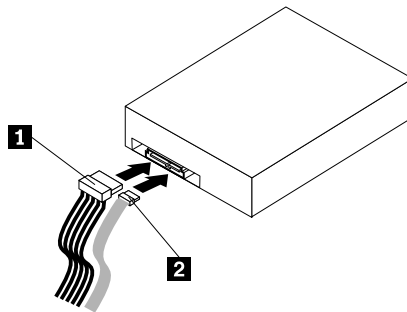


Figure 68. Connecting cables to the rear of the optical drive

9. If necessary, connect the other end of the signal cable to the appropriate connector on the system board. See “System board components” on page 41.
10. Do one of the following:
 - If you are installing an optical drive, save the removed protective shield in the event that you later remove the drive and need the protective shield to cover the drive bay.
 - If you are replacing an optical drive and are instructed to return the old optical drive, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation or replacement, go to “Completing the parts replacement” on page 164.

Installing or replacing a hot-swap internal storage drive

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have hot-swap storage drives installed, such as hard disk drives or solid-state drives. See “Features” on page 8 for more information about the supported hot-swap storage drives.

For a list of ThinkServer storage drive options, go to:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

You can install or replace a hot-swap storage drive without turning off the server, which helps you avoid significant interruption to the operation of the system.

The EMI integrity and cooling of the server are protected by having all storage-drive bays covered or occupied. The number of the installed storage drives in your server varies depending on the server model. The vacant bays are either covered by metal protective shields or occupied by dummy storage-drive trays. When you install a hot-swap storage drive, save the removed dummy storage-drive tray from the drive bay in the event that you later remove the hot-swap storage drive and need the dummy tray to cover the place.

Attention: An unoccupied drive bay without any other protection might impact the EMI integrity and cooling of the server, which might result in overheating or component damage. To maintain the EMI integrity and cooling of the server, install a new hot-swap storage drive as soon as you remove the failing one or the dummy tray.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look different from the illustrations in this topic.
- Use any documentation that comes with the hot-swap storage drive and follow those instructions in addition to the instructions in this topic.

To install or replace a hot-swap storage drive, do the following:

1. Read the following storage drive installation rules:
 - Follow the order of the storage drive bays when installing a storage drive. See “Front view of the server” on page 17 to locate the storage drive bays in your server.
 - For RAID configuration, the storage drives must be the same type with the same capacity if they are within a single RAID array. For more information, see “Configuring RAID” on page 58.
 - For storage drives with different capacities, install the storage drive by following the order of the storage drive bays as well as the order from the lowest capacity to the highest capacity.
2. Open the front door (if available).
3. Locate the appropriate storage-drive bay. See “Front view of the server” on page 17.
4. Press the release button **1** to open the handle of the hot-swap storage drive or the dummy tray.

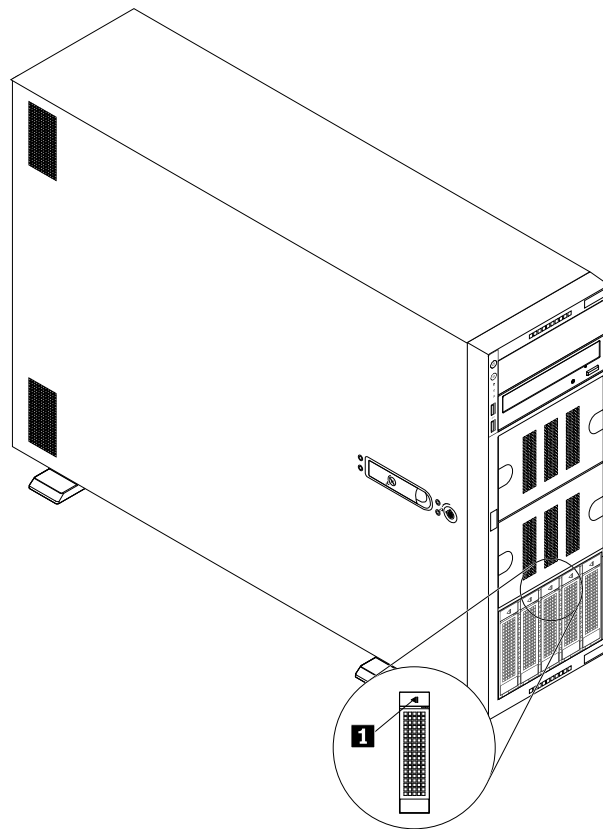


Figure 69. Opening the handle of the hot-swap storage drive or the dummy tray

5. Pull the handle and carefully slide the hot-swap storage drive or the dummy tray out of the front of the chassis.

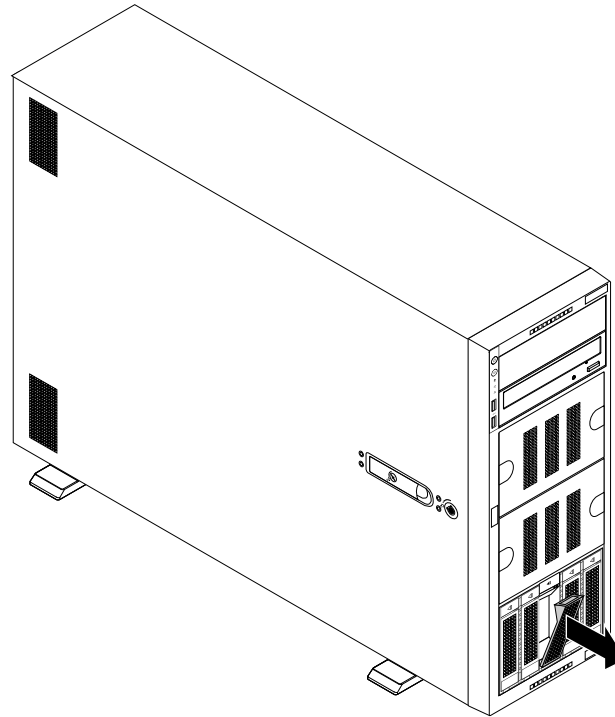


Figure 70. Removing the hot-swap storage drive or the dummy tray

6. Touch the static-protective package that contains the new hot-swap storage drive to any unpainted surface on the outside of the server. Then, take the new hot-swap storage drive out of the package.

Note: Do not touch the circuit board on the storage drive.

- Slide the new hot-swap storage drive into the drive bay from the front until it snaps into position, and then completely close the handle.

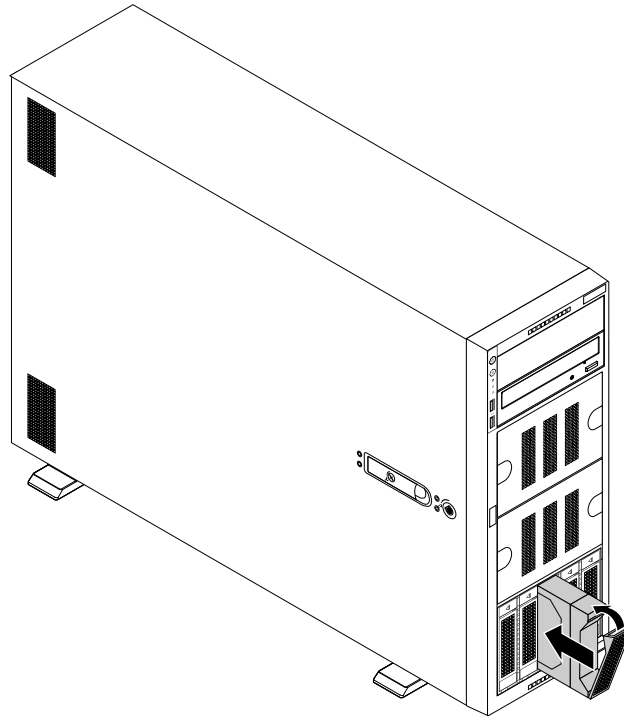


Figure 71. Installing the hot-swap storage drive

- Check the hot-swap-drive status LEDs to ensure that the storage drive is operating correctly. You might have to restart the server for the newly-installed storage drive to be recognized. See “Hot-swap-drive LEDs” on page 30. If the storage drive is faulty, reinstall or replace it until it is operating correctly.
- Close the front door (if available).
- Do one of the following:
 - If you are installing a hot-swap storage drive, save the removed dummy storage-drive tray in the event that you later remove the hot-swap storage drive and need a dummy tray to cover the drive bay.
 - If you are replacing a hot-swap storage drive and are instructed to return the old hot-swap storage drive, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To configure RAID, go to “Configuring RAID” on page 58.

Installing or replacing an easy-swap drive

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have easy-swap drives installed. See “Features” on page 8 for information about the supported easy-swap drives.

For a list of ThinkServer storage drive options, go to:
<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

The EMI integrity and cooling of the server are protected by having all storage-drive bays covered or occupied. The number of the installed storage drives in your server varies depending on the server model. The vacant bays are either covered by metal protective shields or occupied by dummy storage-drive trays. When you install an easy-swap storage drive, save the removed dummy storage-drive tray from the drive bay in case that you later remove the easy-swap storage drive and need the dummy tray to cover the place.

Attention: An unoccupied drive bay without any other protection might impact the EMI integrity and cooling of the server, which might result in overheating or component damage. To maintain the EMI integrity and cooling of the server, install a new easy-swap drive as soon as you remove the failing one or the dummy tray.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the easy-swap drive and follow those instructions in addition to the instructions in this topic.

To install or replace an easy-swap drive, do the following:

1. Read the following storage drive installation rules:
 - Follow the order of the storage drive bays when installing a storage drive. See “Front view of the server” on page 17 to locate the storage drive bays in your server.
 - For RAID configuration, the storage drives must be the same type with the same capacity if they are within a single RAID array. For more information, see “Configuring RAID” on page 58.
 - For storage drives with different capacities, install the storage drive by following the order of the storage drive bays as well as the order from the lowest capacity to the highest capacity.
2. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
3. Open the front door (if available).
4. Locate the appropriate storage-drive bay. See “Front view of the server” on page 17.

5. Use a screwdriver to turn the handle lock **1** to the unlocked position. The handle opens automatically.

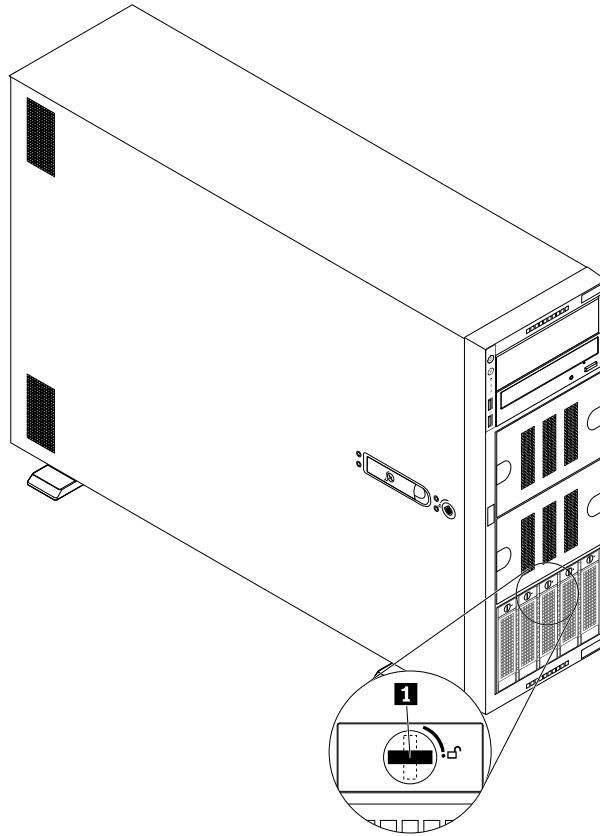


Figure 72. Opening the handle of the easy-swap drive or the dummy tray

6. Pull the handle and carefully slide the easy-swap drive or the dummy tray out of the front of the chassis.

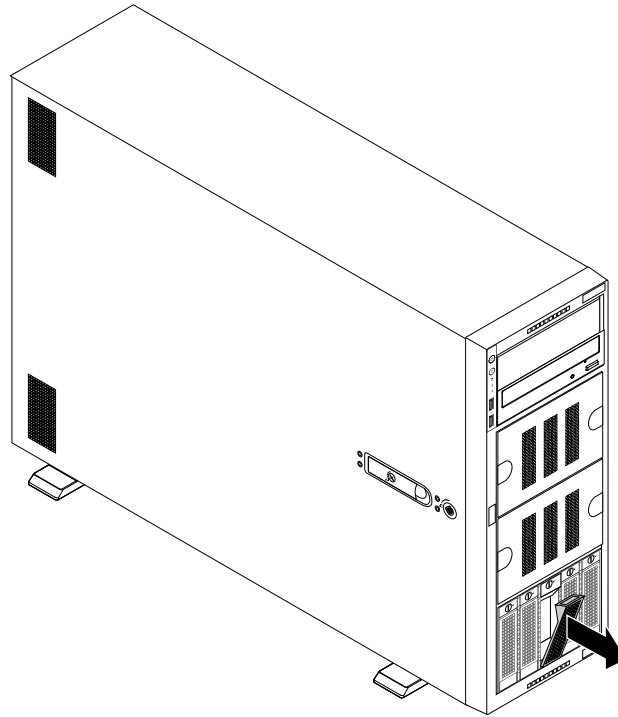


Figure 73. Removing the easy-swap drive or the dummy tray

7. Do one of the following:

- If you are replacing an easy-swap drive, remove the four screws to remove the failing drive from the drive tray.

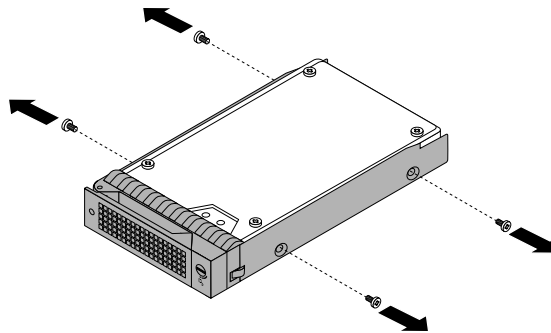


Figure 74. Removing the drive from the drive tray

- If you are installing an easy-swap drive, go to the next step.

 8. Touch the static-protective package that contains the new easy-swap drive to any unpainted surface on the outside of the server. Then, take the new easy-swap drive out of the package.

- Align the holes in the drive tray with the corresponding ones on the new easy-swap drive. Then, install the four screws to secure the drive to the drive tray.

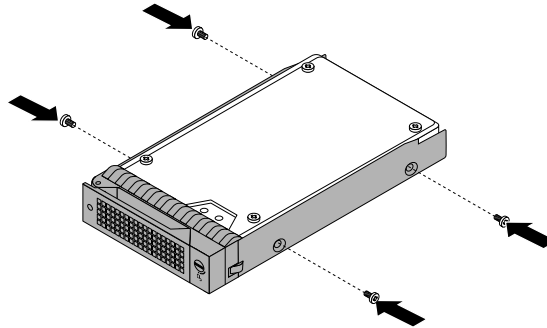


Figure 75. Installing the drive to the drive tray

- Slide the new easy-swap drive into the drive bay from the front until it snaps into position, and then close the handle.

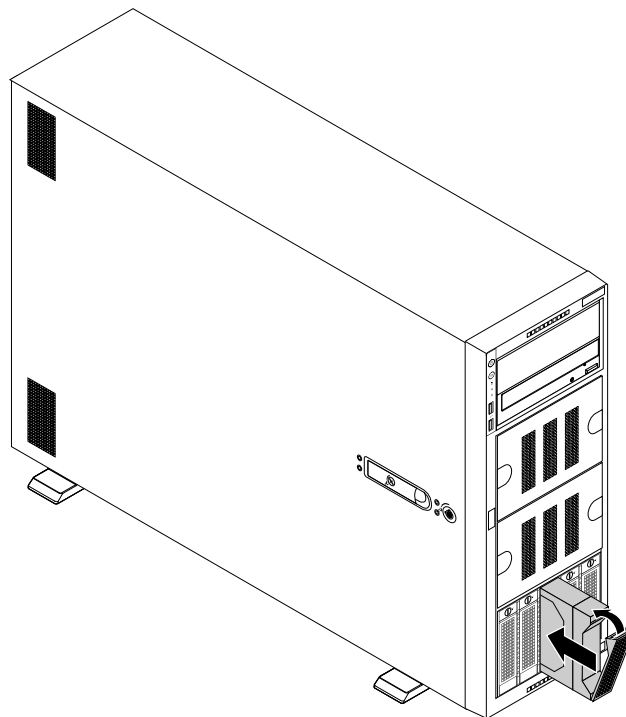


Figure 76. Installing the easy-swap drive

- Close the front door (if available).
- Do one of the following:
 - If you are installing an easy-swap drive, save the removed dummy tray in case that you later remove the easy-swap drive and need a dummy tray to cover the drive bay.
 - If you are replacing an easy-swap drive and are instructed to return the old easy-swap drive, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To configure RAID, go to “Configuring RAID” on page 58.

Installing or replacing an internal tape drive

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the tape drive and follow those instructions in addition to the instructions in this topic.

To install or replace an internal tape drive, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Depending on whether you are installing or replacing a tape drive, do one of the following:
 - If you are installing a tape drive, push the protective shield as shown until it is projected from the front of the chassis. Then, hold the protective shield from the front and completely slide it out of the chassis.

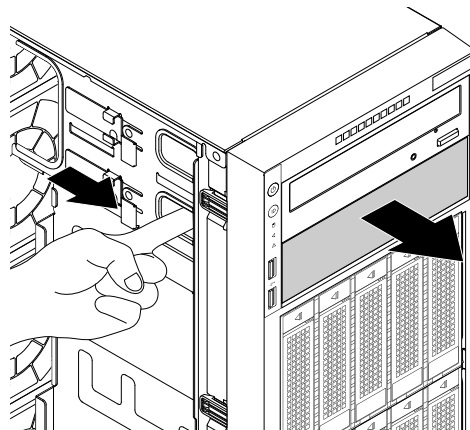


Figure 77. Removing the protective shield of the optical-drive bay

- If you are replacing a tape drive, disconnect the power and signal cable from the rear of the tape drive. Lift the release button **1** in the direction as shown and push the tape drive from the rear until it is projected from the front of the chassis. Then, hold the tape drive from the front and completely slide it out of the chassis.

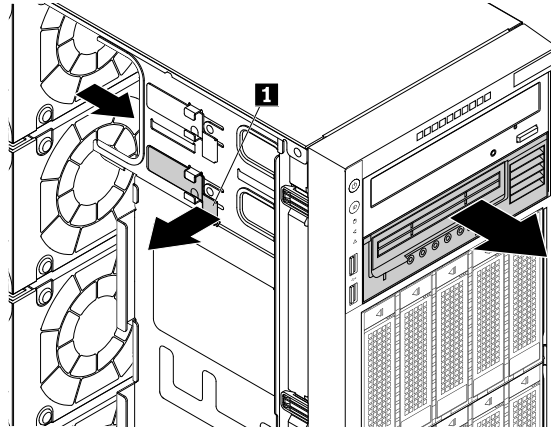


Figure 78. Removing the tape drive

5. Touch the static-protective package that contains the new tape drive to any unpainted surface on the outside of the server. Then, take the new tape drive and the cable out of the package.
6. Lift the release button **1** in the direction as shown and slide the new tape drive into the lower optical-drive bay from the front until it snaps into position.

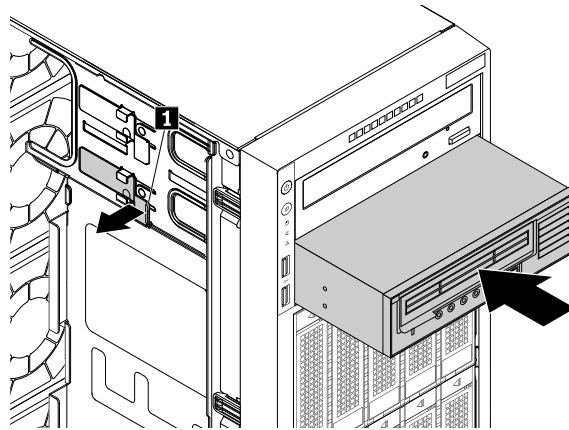


Figure 79. Installing the tape drive

7. Connect the power and signal cable **1** to the rear of the tape drive.

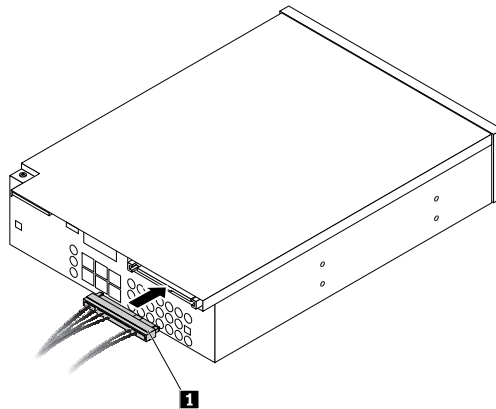


Figure 80. Connecting the power and signal cable to the rear of the tape drive

8. Do one of the following:

- If you are installing a tape drive, save the removed protective shield in case that you later remove the drive and need the protective shield to cover the drive bay.
- If you are replacing a tape drive and are instructed to return the old tape drive, follow all packaging instructions. Then, use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation or replacement, go to “Completing the parts replacement” on page 164.

Installing or replacing the microprocessor

This topic contains the following items:

- “Installing the second microprocessor” on page 122
- “Replacing the microprocessor” on page 126

Installing the second microprocessor

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Depending on the model, your server might come with one or two microprocessors. For server models with one microprocessor, the microprocessor is installed in the microprocessor socket 1 and the microprocessor socket 2 is protected by a plastic socket cover. You can purchase a microprocessor option kit from Lenovo and install the second microprocessor to expand system capabilities.

CAUTION:



Turn off the server and wait several minutes to let the server cool before removing the server cover.



Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Ensure that you install the correct type of microprocessor option your server supports. When two microprocessors are installed, both must have the same core voltage and core speed.
- Use any documentation that comes with the microprocessor option kit and follow those instructions in addition to the instructions in this topic.
- Your microprocessor, socket, and socket cover might look slightly different from the illustrations in this topic.

To install the second microprocessor, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the microprocessor socket 2 on the system board. See “System board components” on page 41.
6. Open the small handle **1** first by gently pressing down the handle a little bit and then pushing the handle inward to release it from the secured position. Then, open the other small handle **2** in the same way.

Note: There are two marks on the microprocessor retainer. Open the small handle marked with  first and then open the other small handle marked with . Always follow the correct sequence when you open the small handles.

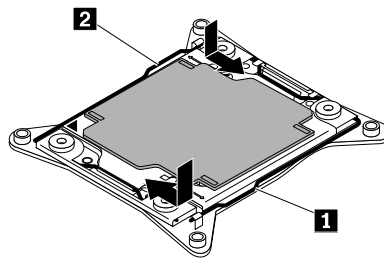


Figure 81. Opening the handles

7. Gently press the microprocessor retainer as shown to open it. Ensure that the small handles and the microprocessor retainer are in the fully open position.

Note: Do not drop anything onto the microprocessor socket while it is exposed. The socket pins must be kept as clean as possible.

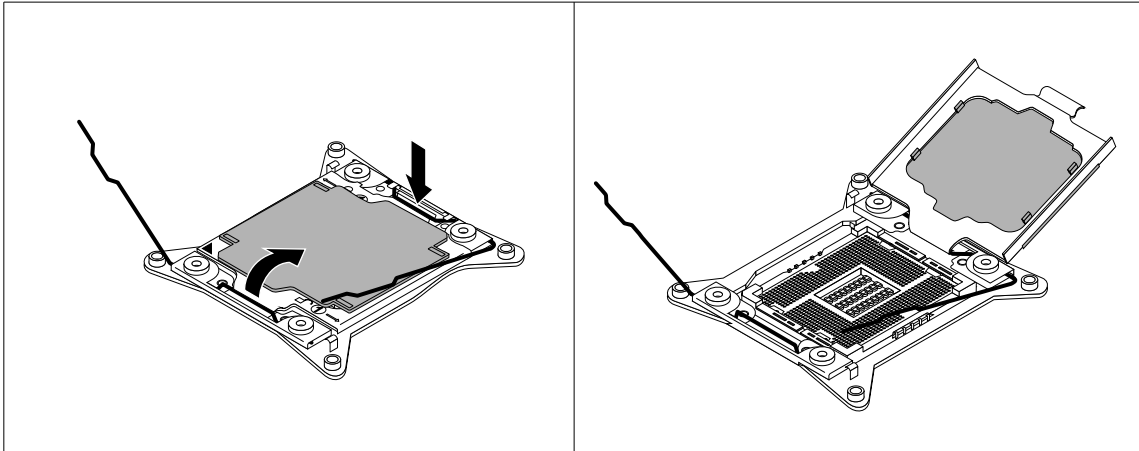


Figure 82. Opening the microprocessor retainer

8. Touch the static-protective package that contains the new microprocessor to any unpainted surface on the outside of the server. Then, remove the new microprocessor from the package.
9. Remove the protective cover that protects the gold contacts on the bottom of the new microprocessor. Do not touch the pins on the microprocessor socket and the gold contacts on the bottom of the new microprocessor.

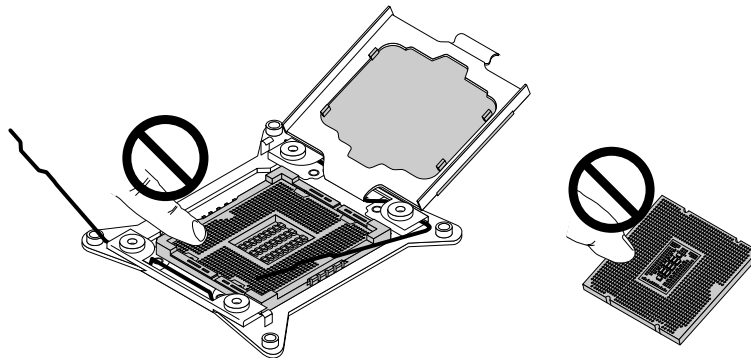


Figure 83. Do not touch the pins

10. Note the orientation of the new microprocessor. Hold the new microprocessor by its edges and align the notches **1** on it with the tabs **2** in the microprocessor socket. Then, carefully lower the new microprocessor straight down into the microprocessor socket.

Note: The small triangle **3** on one corner of the new microprocessor is the microprocessor orientation indicator. The new microprocessor is in the correct orientation when this indicator faces the beveled corner **4** of the microprocessor socket.

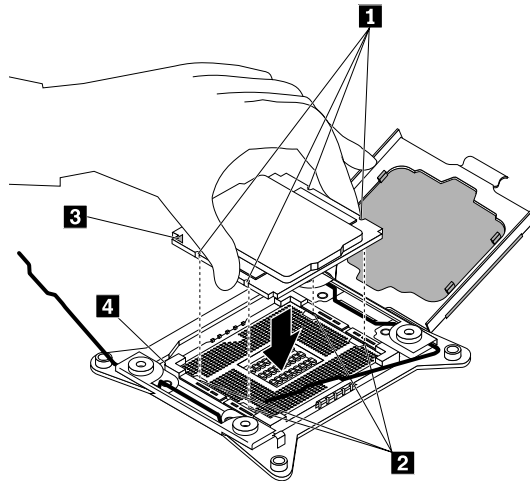


Figure 84. Installing the microprocessor

11. Remove the plastic microprocessor socket cover. Store the microprocessor socket cover in the event that you later remove the microprocessor and need the socket cover to protect the pins on the socket.

Note: Do not remove the socket cover until you install a microprocessor into the socket. If you remove the microprocessor, install the socket cover or a new microprocessor in the first place.

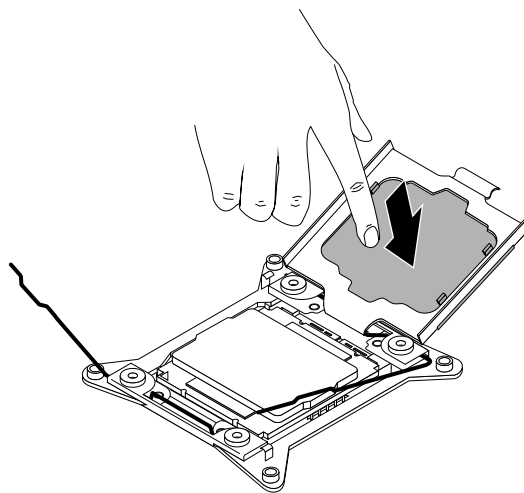


Figure 85. Removing the microprocessor socket cover

12. Close the small handle **1** first and then close the small handle **2** to lock the retainer and secure the new microprocessor in the socket.

Note: There are two marks on the microprocessor retainer. Ensure that you close the small handle marked with **1** first and then close the small handle marked with **2**. Always follow the correct sequence when you close the small handles.

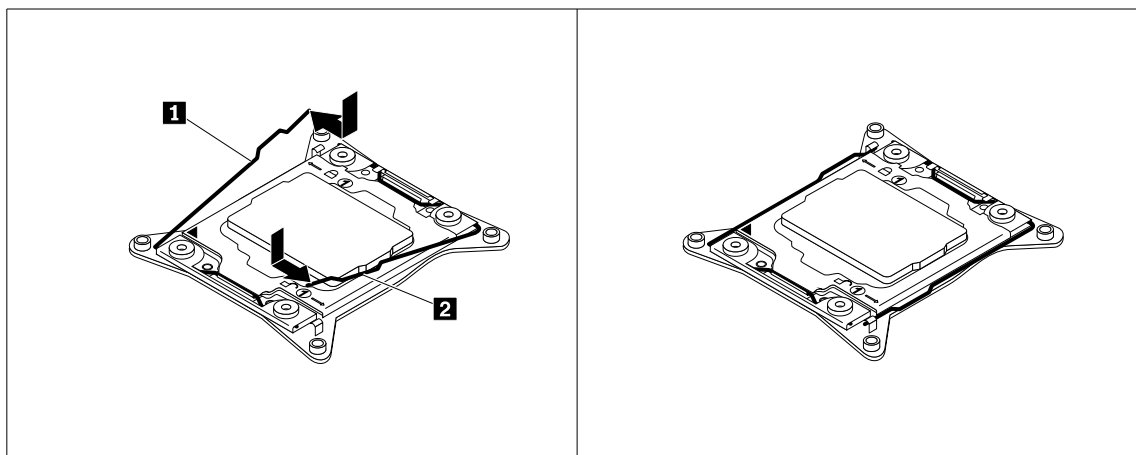


Figure 86. Securing the microprocessor in the socket

13. Install the new heat sink that comes with the microprocessor option kit. See “Replacing the heat sink” on page 154.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the installation, go to “Completing the parts replacement” on page 164.

Replacing the microprocessor

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

CAUTION:



The heat sink and the microprocessor might be very hot. Turn off the server and wait several minutes to let the server cool before removing the server cover.



Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Ensure that the new microprocessor is the correct type your server supports. When two microprocessors are installed, both must have the same core voltage and core speed.
- Use any documentation that comes with the microprocessor option kit and follow those instructions in addition to the instructions in this topic.
- Your microprocessor, socket, and socket cover might look slightly different from the illustrations in this topic.

To replace the microprocessor, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Remove the heat sink. See “Replacing the heat sink” on page 154.
6. Open the small handle **1** first by gently pressing down the handle a little bit and then pushing the handle inward to release it from the secured position. Then, open the other small handle **2** in the same way.

Note: There are two marks on the microprocessor retainer. Open the small handle marked with  first and then open the other small handle marked with . Always follow the correct sequence when you open the small handles.

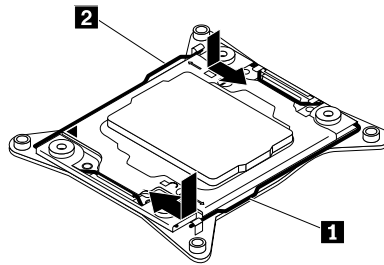


Figure 87. Opening the handles

7. Gently press the microprocessor retainer as shown to open it. Ensure that the small handles and the microprocessor retainer are in the fully open position.

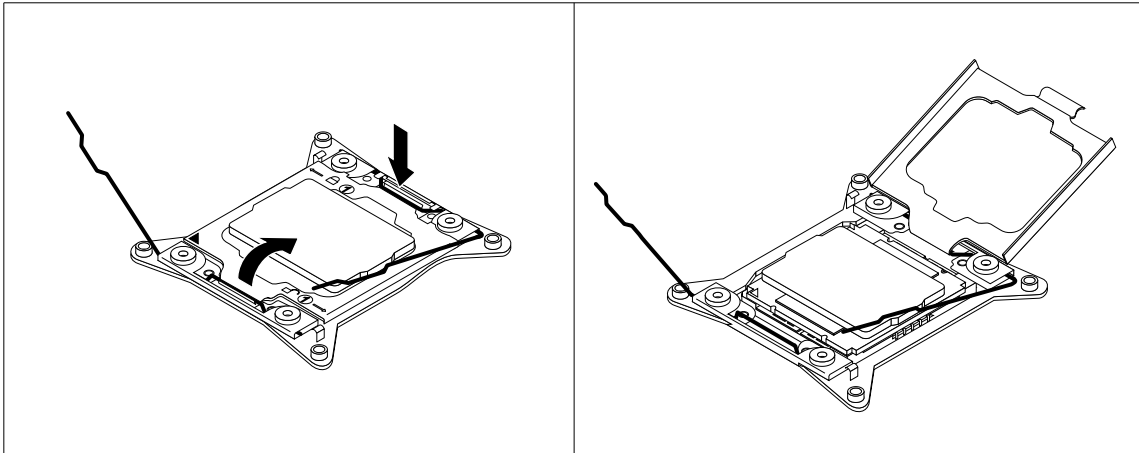


Figure 88. Opening the microprocessor retainer

8. Touch only the edges of the microprocessor and carefully lift it straight up and out of the microprocessor socket. Place the old microprocessor on a static-protective surface.

Notes:

- Do not touch the gold contacts on the bottom of the microprocessor.
- Do not drop anything onto the microprocessor socket while it is exposed. The socket pins must be kept as clean as possible.

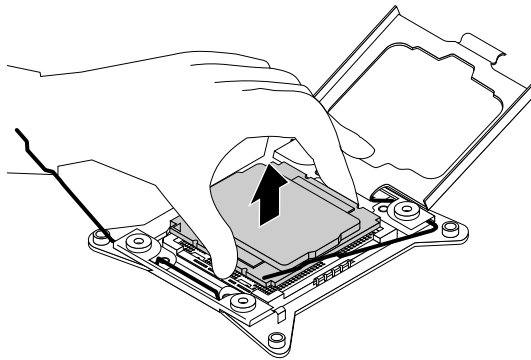


Figure 89. Removing the microprocessor

9. Touch the static-protective package that contains the new microprocessor to any unpainted surface on the outside of the server. Then, remove the new microprocessor from the package.

10. Remove the new microprocessor from the protective cover that protects the gold contacts on the bottom of the new microprocessor. Do not touch the pins on the microprocessor socket and the gold contacts on the bottom of the new microprocessor.

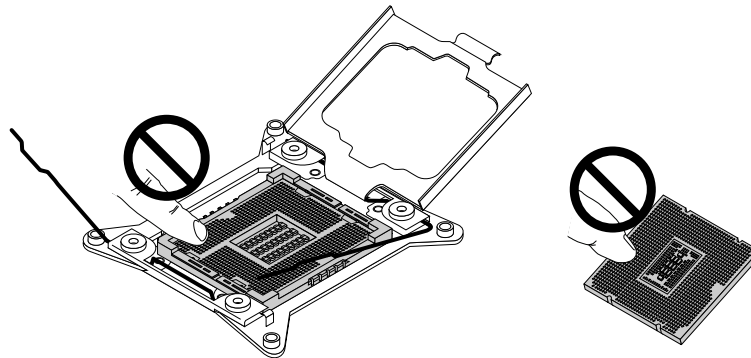


Figure 90. Do not touch the pins

11. Note the orientation of the new microprocessor. Hold the new microprocessor by its edges and align the notches **1** on it with the tabs **2** in the microprocessor socket. Then, carefully lower the new microprocessor straight down into the microprocessor socket.

Note: The small triangle **3** on one corner of the new microprocessor is the microprocessor orientation indicator. The new microprocessor is in the correct orientation when this indicator faces the beveled corner **4** of the microprocessor socket.

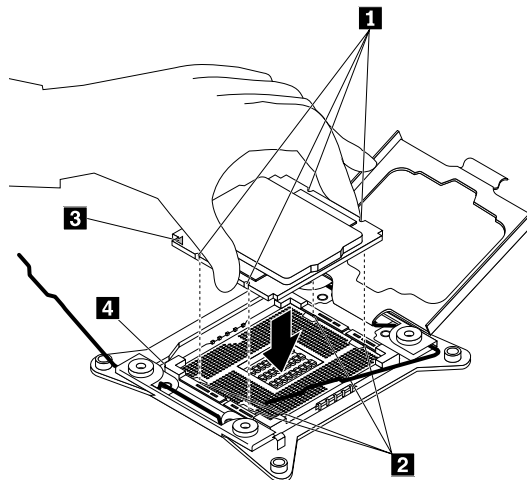




Figure 91. Installing the microprocessor

12. Close the small handle **1** first and then close the small handle **2** to lock the retainer and secure the new microprocessor in the socket.

Note: There are two marks on the microprocessor retainer. Ensure that you close the small handle marked with  first and then close the small handle marked with . Always follow the correct sequence when you close the small handles.

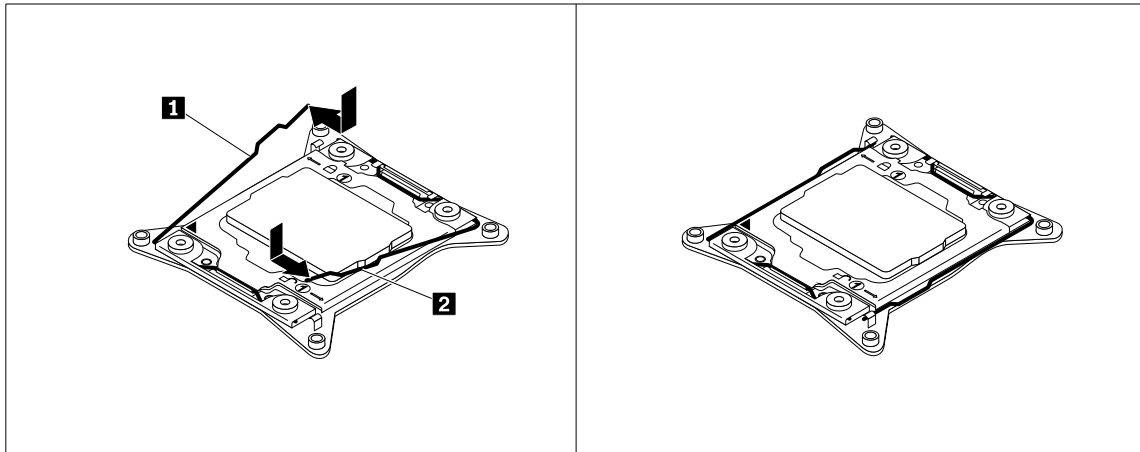


Figure 92. Securing the microprocessor in the socket

13. Use a cleaning pad to wipe the thermal grease from the removed heat sink. Dispose of the cleaning pad after all of the thermal grease is removed.
14. Use one of the following methods to apply appropriate amount of thermal grease to the top of the newly installed microprocessor in the shape of a cross or a circle as shown. Using too much or too little thermal grease can cause a thermal problem due to imperfect contact with the components.

Notes:

- Do not touch the thermal grease.
- Keep the thermal grease off the system board.

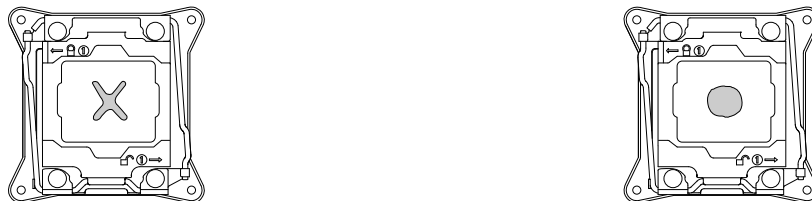


Figure 93. Applying the thermal grease to the top of the microprocessor

15. Reinstall the heat sink. See “Replacing the heat sink” on page 154.
16. If you are instructed to return the old microprocessor, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Installing or replacing a hot-swap redundant power supply

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

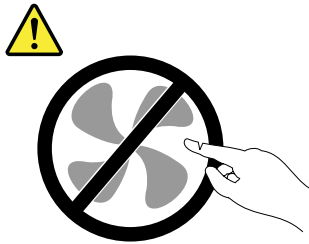
Depending on the model, your server might come with one or two hot-swap redundant power supplies. When the server is populated with two hot-swap redundant power supplies, the server can withstand a power loss from either power supply. This helps you avoid significant interruption to the operation of the server when a power supply fails. You can replace the failing hot-swap redundant power supply without turning off the server.

Some server models come with only one power supply. You can purchase a hot-swap redundant power supply from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

CAUTION:

Hazardous moving parts. Keep fingers and other body parts away.



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.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- To maintain the EMI integrity and cooling of the server, install a new hot-swap redundant power supply as soon as you remove the failing one or cover the other bay with a protective shield if you just use one power supply to provide power.
- Your hot-swap redundant power supply might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the new hot-swap redundant power supply and follow those instructions in addition to the instructions in this topic.

To install or replace a hot-swap redundant power supply, do the following:

1. Do one of the following:
 - If you are installing a hot-swap redundant power supply, locate the bay for the power supply in the rear of your server. Insert two fingers into the two holes in the protective shield that covers the bay, and then pull the shield out of the chassis. Store the shield in case that you later remove the power supply and need the shield to cover the bay.

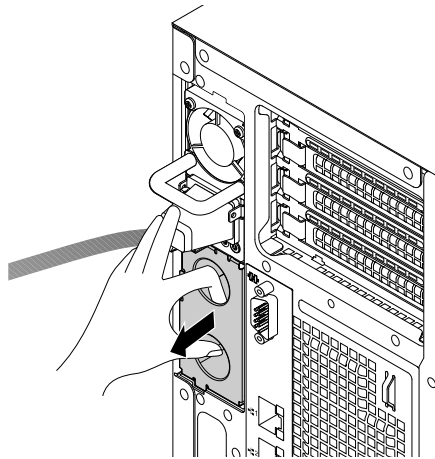


Figure 94. Removing the protective shield for the power supply bay

- If you are replacing a hot-swap redundant power supply, do the following:
 - a. Locate the failing power supply in the rear of your server.

Note: On each power supply, there are three status LEDs near the power cord connector. For information about the status LEDs, see “Power supply status LEDs” on page 31.

- b. Disconnect the power cord from the failing hot-swap redundant power supply. Then, press the release tab **1** and pull the handle **2** at the same time to slide the failing hot-swap redundant power supply out of the chassis.

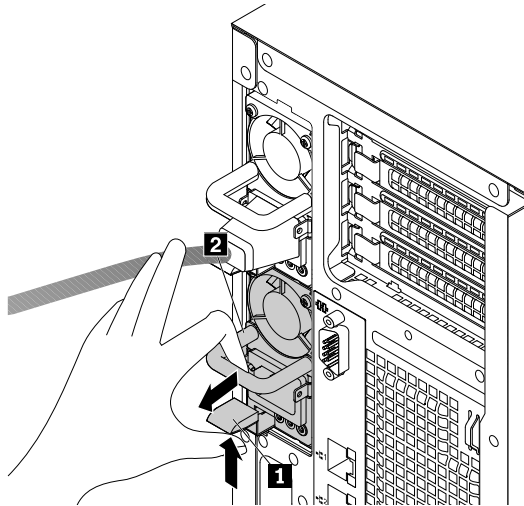


Figure 95. Removing a hot-swap redundant power supply

2. Touch the static-protective package that contains the new hot-swap redundant power supply to any unpainted surface on the outside of the server. Then, remove the new hot-swap redundant power supply from the package.
3. Note the orientation of the new hot-swap redundant power supply, and then slide it into the chassis until it snaps into position.

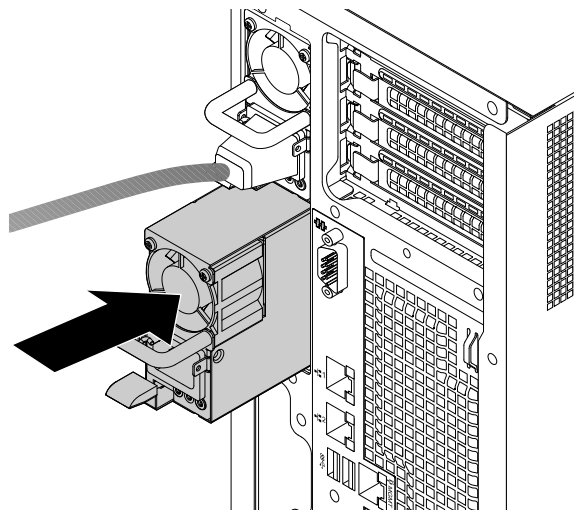


Figure 96. Installing a hot-swap redundant power supply

4. Connect the power cord to the power cord connector on the new power supply. Then, check the status LEDs near the power cord connector. For information about the status LEDs, see “Power supply status LEDs” on page 31.

5. If you are instructed to return the old hot-swap redundant power supply, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

Installing a 2.5-inch drive into a 3.5-inch-drive bay

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Ensure that you have a 3.5-inch to 2.5-inch drive adapter and a 3.5-inch drive bracket available before the installation.
- Only on server models with fifteen 3.5-inch-drive bays can you install both 2.5-inch drives and 3.5-inch drives into the same server.

To install a 2.5-inch drive into a 3.5-inch-drive bay, do the following:

1. Locate the appropriate storage-drive bay. See “Front view of the server” on page 17.
2. Press the release button **1** to open the handle of the dummy tray.

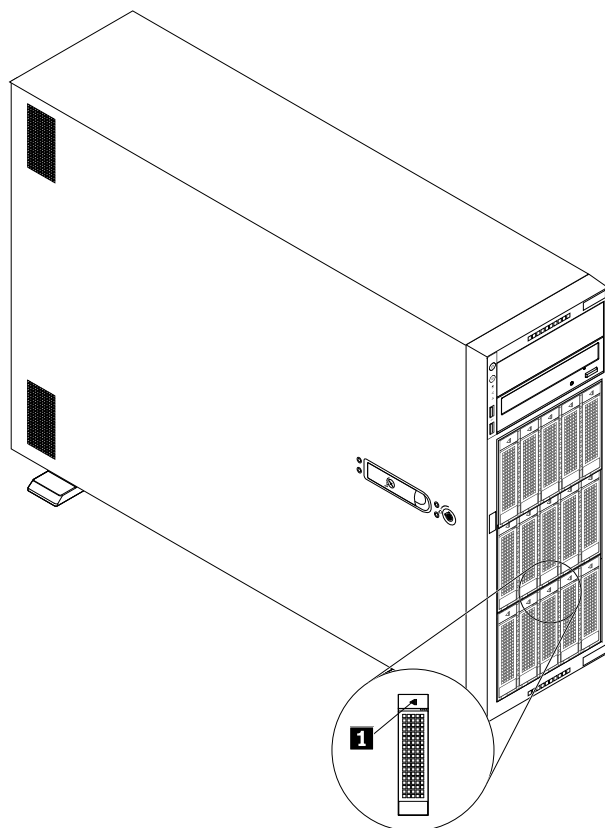


Figure 97. Opening the handle of the dummy tray

3. Pull the handle and carefully slide the dummy tray out of the front of the chassis.

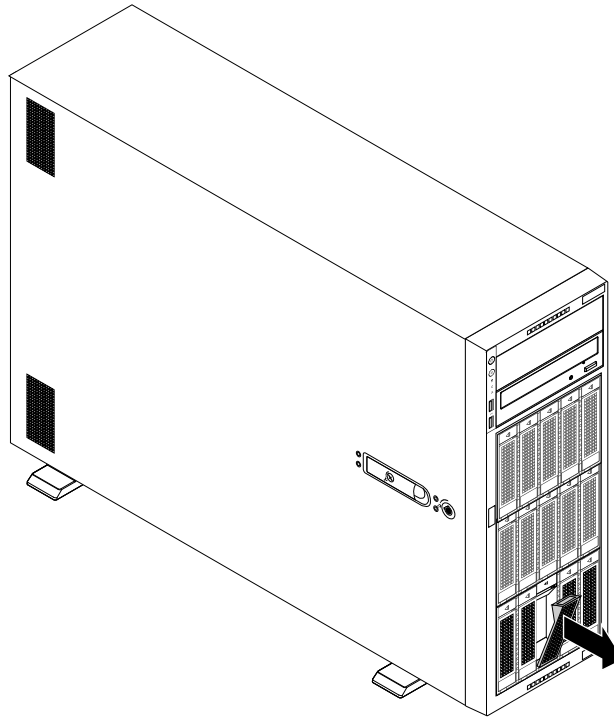


Figure 98. Removing the dummy tray

4. Touch the static-protective package that contains the 2.5-inch drive to any unpainted surface on the outside of the server. Then, take the 2.5-inch drive out of the package.

5. Position the 2.5-inch drive into the 3.5-inch to 2.5-inch drive adapter as shown in the following illustration.

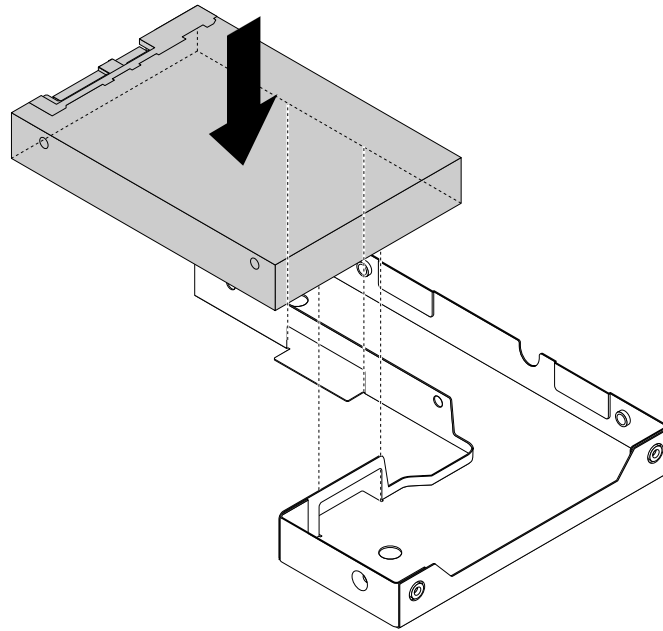


Figure 99. Positioning the 2.5-inch drive into the drive adapter

6. Align the two screw holes in the 2.5-inch drive with the corresponding holes in the drive adapter. Then, install the two screws to secure the 2.5-inch drive to the drive adapter.

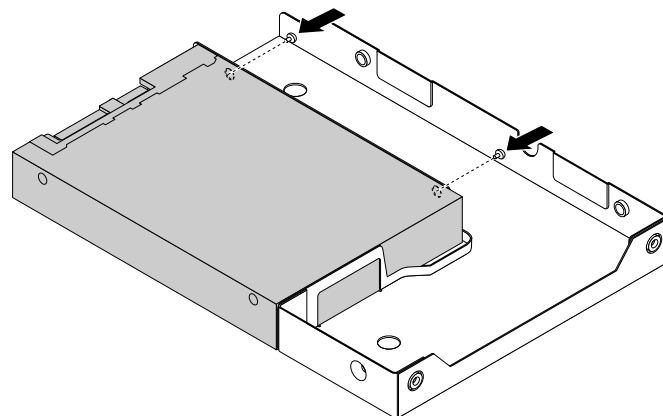


Figure 100. Installing the screws to secure the 2.5-inch drive to the drive adapter

7. Position the drive adapter and the 2.5-inch drive into the 3.5-inch drive bracket. Align the screw holes in the drive adapter and the 2.5-inch drive with the corresponding holes in the bracket. Then, install the five screws to secure the drive adapter and the 2.5-inch drive into the bracket.

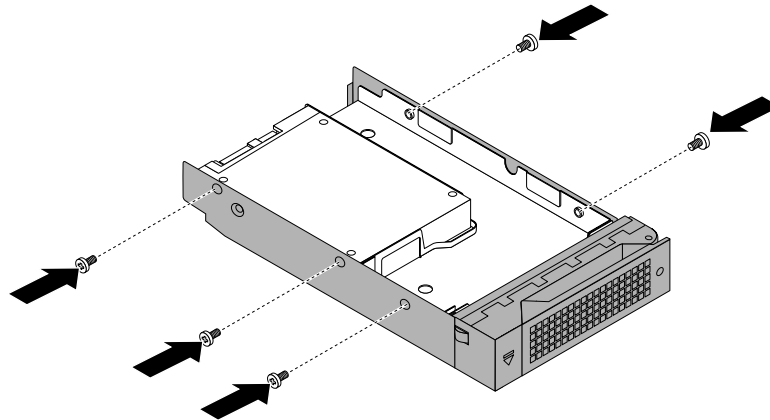


Figure 101. Installing the screws to secure the drive adapter and the 2.5-inch drive to the bracket

8. Slide the 2.5-inch drive into the drive bay from the front until it snaps into position, and then completely close the handle.

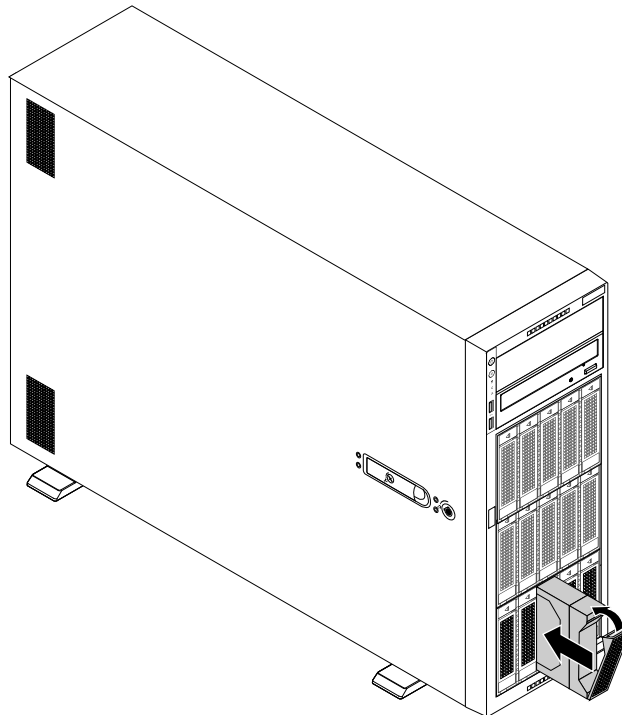


Figure 102. Installing the 2.5-inch drive

9. Check the hot-swap-drive status LEDs to ensure that the 2.5-inch drive is operating correctly. You might have to restart the server for the newly installed 2.5-inch drive to be recognized. See “Hot-swap-drive LEDs” on page 30. If the 2.5-inch drive is faulty, reinstall or replace it until it is operating correctly.
10. Close the front door (if available).

11. Save the removed dummy storage-drive tray in the event that you later remove the 2.5-inch drive and need a dummy tray to cover the drive bay.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To configure RAID, go to “Configuring RAID” on page 58.

Replacing the front-panel board

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the new front-panel board and follow those instructions in addition to the instructions in this topic.
- The front-panel board is sensitive to ESD. Ensure that you read and understand “Handling static-sensitive devices” on page 64 first and carefully perform the operation.

To replace the front-panel board, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the front bezel. See “Removing and reinstalling the front bezel” on page 70.
5. Locate the front panel. See “Front panel” on page 20.
6. Disconnect the front-panel cable from the rear of the front-panel board and from the front panel connector on the system board. See “System board components” on page 41.
7. If necessary, remove any parts and disconnect any cables that might impede your access to the front panel cable. Record the cable routing, and then release the front panel cable from any cable clips or ties in the chassis.

8. Press the release tab **1** on the bottom of the front-panel board and pull it in the direction as shown at the same time. Then, remove the front-panel board out of the chassis.

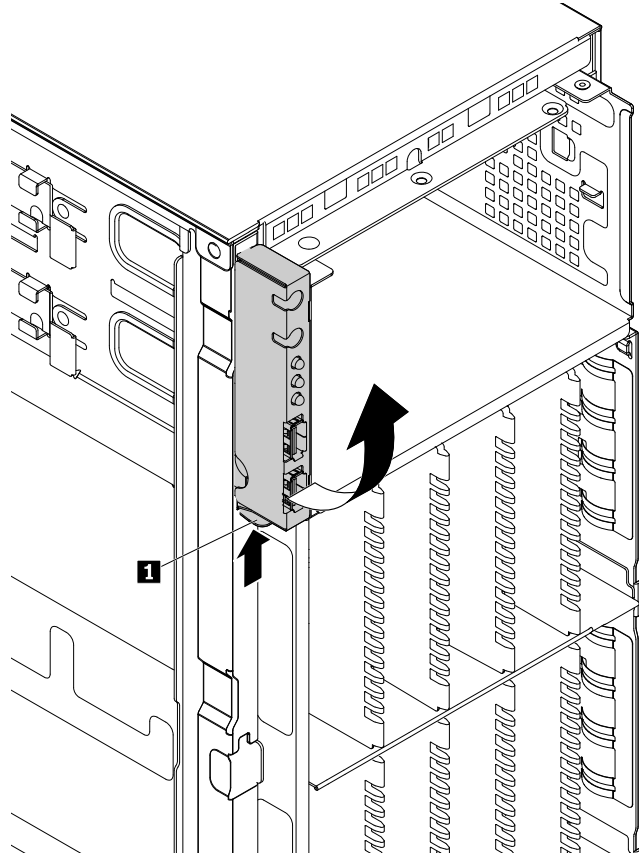


Figure 103. Removing the front-panel board

9. Touch the static-protective package that contains the new front-panel board to any unpainted surface on the outside of the server. Then, take the new front-panel board out of the package.

10. Insert the metal tab on the top of the new front-panel board into the corresponding hole **1** in the chassis. Then, press the release tab and pivot the front-panel board inward until it snaps into position.

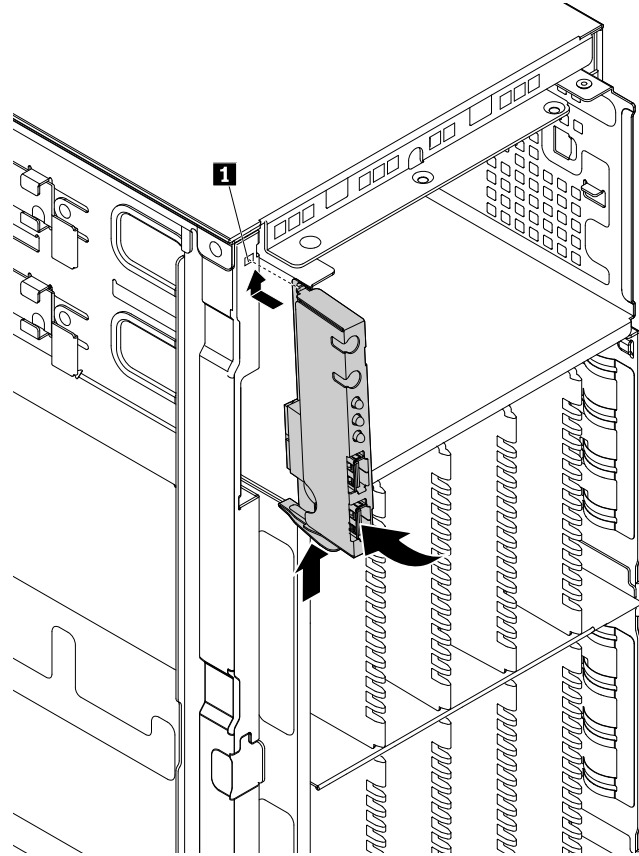


Figure 104. Installing the front-panel board

11. Route the new front panel cable through the corresponding hole in the chassis. Connect the front panel cable to the rear of the new front-panel board and to the front panel connector on the system board. See “System board components” on page 41.
12. Refer to your note to properly route the signal cable of the new front-panel board. If necessary, secure the signal cable with cable clips or ties in the chassis.
13. Reinstall the front bezel. See “Removing and reinstalling the front bezel” on page 70.
14. If you are instructed to return the old front-panel board, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Replacing the ThinkServer RAID Super Capacitor Module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have a ThinkServer RAID Super Capacitor Module installed. Depending on the model, the server might come with up to three ThinkServer RAID Super Capacitor Modules.

The ThinkServer RAID Super Capacitor Module protects the cache memory on the installed RAID card or AnyRAID adapter. You can purchase a ThinkServer RAID Super Capacitor Module from the Lenovo Web site at:

<http://lenovoquickpick.com/usa/home/thinkserver/rack-and-tower-server>

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might come with up to three ThinkServer RAID Super Capacitor Modules.
- Use any documentation that comes with the ThinkServer RAID Super Capacitor Module and follow those instructions in addition to the instructions in this topic.

To replace the ThinkServer RAID Super Capacitor Module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Disconnect the cable from the ThinkServer RAID Super Capacitor Module. Remove the screw that secures the ThinkServer RAID Super Capacitor Module and then disengage it from the chassis.

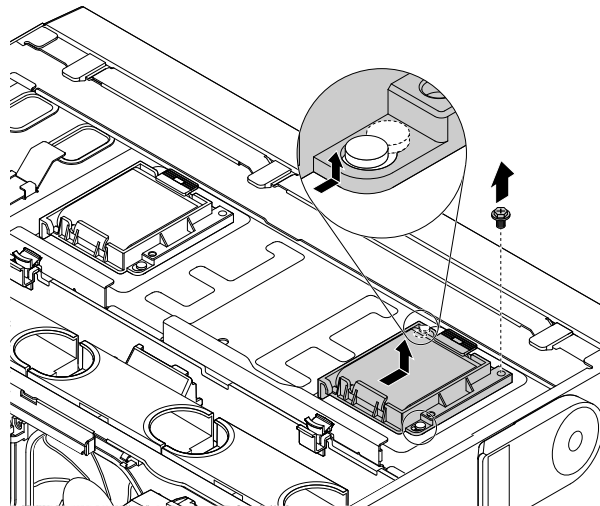


Figure 105. Removing the ThinkServer RAID Super Capacitor Module with the bracket from the chassis

5. Gently press the tab **1** on the bracket and remove the ThinkServer RAID Super Capacitor Module from the bracket at the same time.

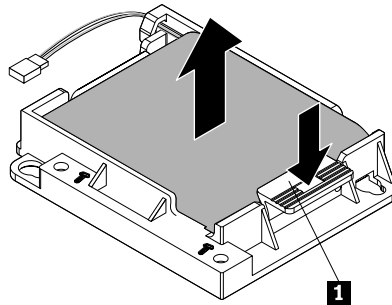


Figure 106. Removing the ThinkServer RAID Super Capacitor Module from the bracket

6. Touch the static-protective package that contains the new ThinkServer RAID Super Capacitor Module to any unpainted surface on the outside of the server. Then, take the new ThinkServer RAID Super Capacitor Module out of the package.
7. Note the orientation of the new ThinkServer RAID Super Capacitor Module. Then, gently press the tab **1** on the bracket and install the new ThinkServer RAID Super Capacitor Module into the bracket at the same time.

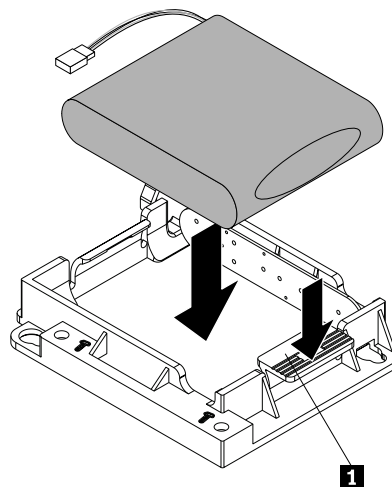


Figure 107. Installing the ThinkServer RAID Super Capacitor Module into the bracket

8. Ensure that the screw holes in the new ThinkServer RAID Super Capacitor Module with the bracket are aligned with the corresponding stubs in the chassis. Then, install the screw to secure the new ThinkServer RAID Super Capacitor Module with the bracket in place.

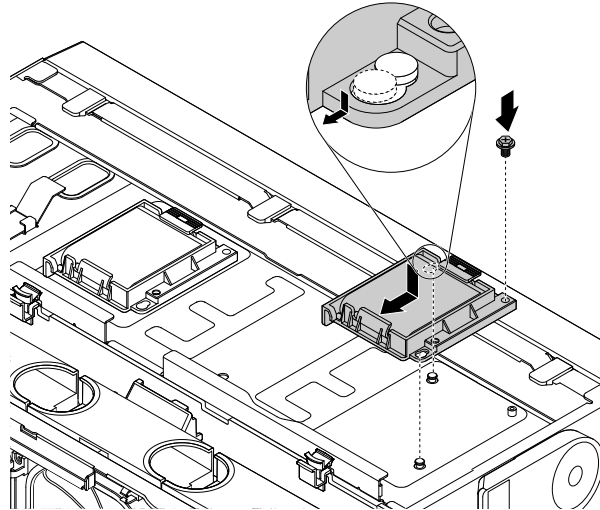


Figure 108. Installing the ThinkServer RAID Super Capacitor Module with the bracket on the chassis

9. Connect the cable to the new ThinkServer RAID Super Capacitor Module.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement procedure, go to “Completing the parts replacement” on page 164.

Replacing the AnyRAID adapter or the pass-through board

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have an AnyRAID adapter or a pass-through board installed.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server, AnyRAID adapter, or pass-through board might look different from the illustrations in this topic.
- Use any documentation that comes with the AnyRAID adapter or pass-through board and follow those instructions in addition to the instructions in this topic.

To replace the AnyRAID adapter or the pass-through board, do the following:

Attention: Replacing the AnyRAID adapter or the pass-through board might impact your RAID configurations. Back up your data before you begin to avoid any data loss due to a RAID configuration change.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.

2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove any parts and disconnect any cables that might impede your operation.
5. Locate the AnyRAID adapter or the pass-through board. See “Server components” on page 25.
6. Disconnect all cables from the AnyRAID adapter or the pass-through board.
7. Do one of the following:
 - For the pass-through board or the AnyRAID adapter without an air duct, go to step 8.
 - For 3.5-inch-drive server models that have an AnyRAID adapter installed with an air duct
Open the small handle **1** by gently pressing down the handle slightly and pulling the handle outward to release it from the secured position. Then, lift the AnyRAID-adapter air duct straight up and out of the chassis.

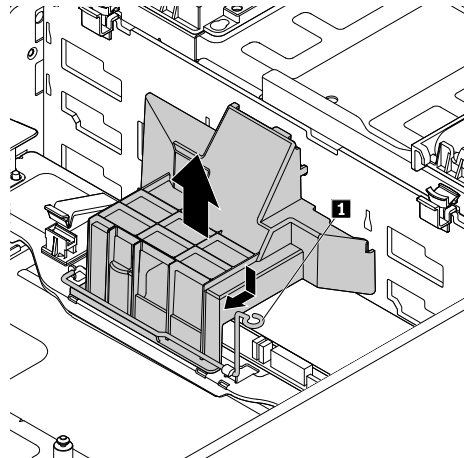


Figure 109. Removing the AnyRAID-adapter air duct for server models with 3.5-inch drives

- For 2.5-inch-drive server models that have an AnyRAID adapter installed with an air duct
Loosen the screw that secures the AnyRAID-adapter air duct. Then, lift it in the direction as shown until you can completely remove it.

Note: The screw is an integrated part of the AnyRAID-adapter air duct. Do not try to remove the screw from the AnyRAID-adapter air duct.

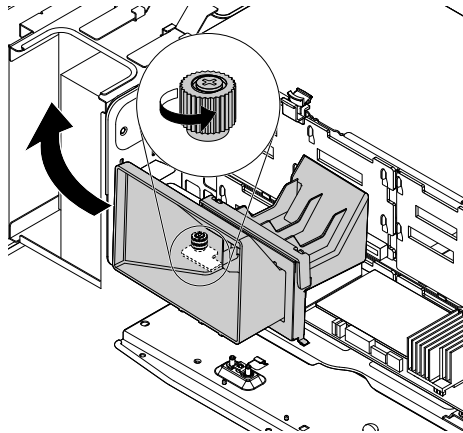


Figure 110. Removing the AnyRAID-adapter air duct for server models with 2.5-inch drives

- Loosen the two screws that secure the AnyRAID adapter or the pass-through board. Then, grasp the AnyRAID adapter or the pass-through board by its edges and carefully pull it out of the AnyRAID-adapter slots on the backplane.

Notes:

- The AnyRAID adapter or the pass-through board fits tightly into the AnyRAID-adapter slots. If necessary, alternate moving each side of the AnyRAID adapter or the pass-through board a small and equal amount until it is removed from the connectors.
- The two screws are integrated parts of the AnyRAID adapter or the pass-through board. Do not try to remove the two screws from the AnyRAID adapter or the pass-through board.

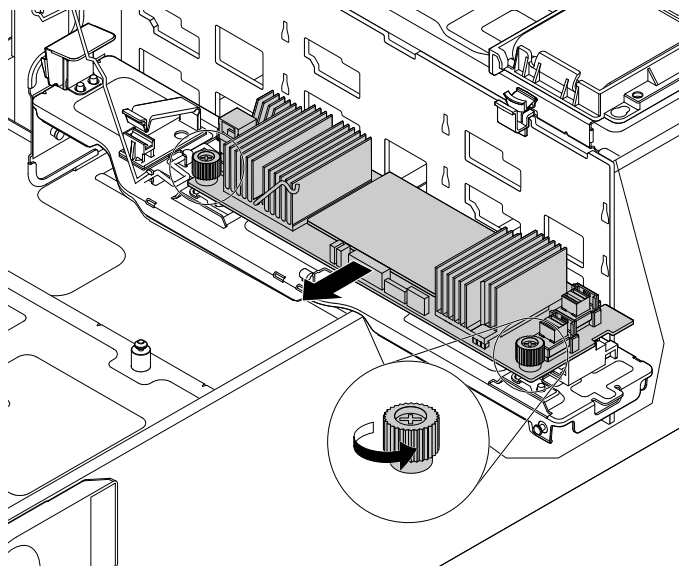


Figure 111. Removing the AnyRAID adapter or the pass-through board

- Under the AnyRAID adapter or the pass-through board, there is an AnyRAID-adapter tray used to help secure the AnyRAID adapter or the pass-through board in place. If necessary, remove and reinstall the tray by doing the following:

Note: Depending on the model, the AnyRAID-adapter tray that comes with your server might look slightly different with the following illustrations. However, the removal and installation procedures are the same.

- To remove the AnyRAID-adapter tray, press the release tab **1**. Then, grasp the tray and carefully pull it out of the chassis.

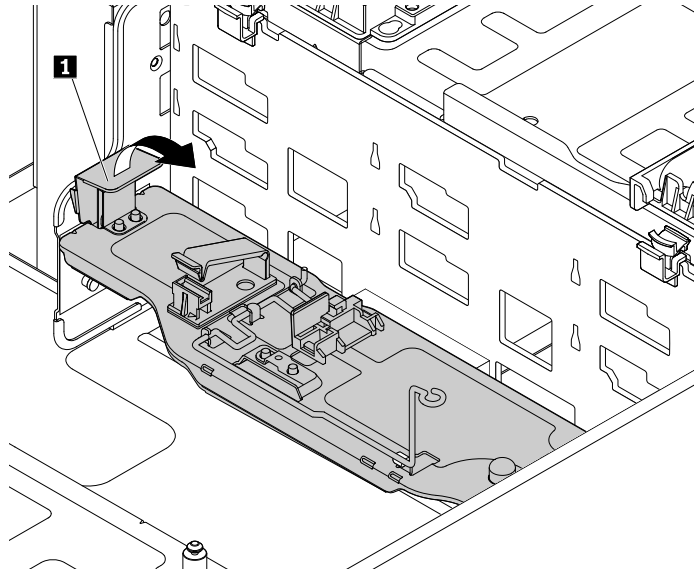


Figure 112. Removing the AnyRAID-adapter tray

- To reinstall the AnyRAID-adapter tray, locate the mounting area on one side of the chassis. Insert the tab into the hole **1** and align the two pins on the tray with the two gaps **2** in the mounting area. Then, pivot the AnyRAID-adapter tray downward until it snaps into position.

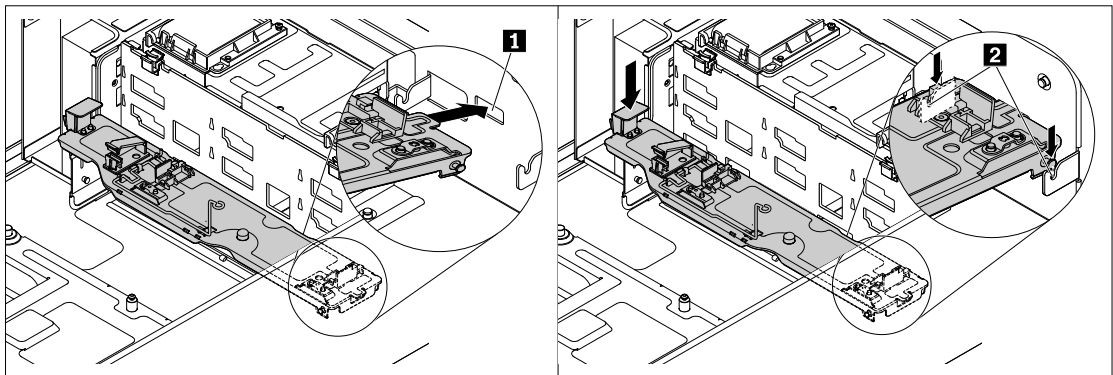


Figure 113. Installing the AnyRAID-adapter tray

10. Touch the static-protective package that contains the new AnyRAID adapter or the pass-through board to any unpainted surface on the outside of the server. Then, take the new AnyRAID adapter or the pass-through board out of the package.

11. Position the new AnyRAID adapter or the pass-through board near the backplane. Then, carefully press the new AnyRAID adapter or the pass-through board straight into the AnyRAID-adapter slots until it is securely seated. Tighten the two screws to secure the new AnyRAID adapter or the pass-through board in place.

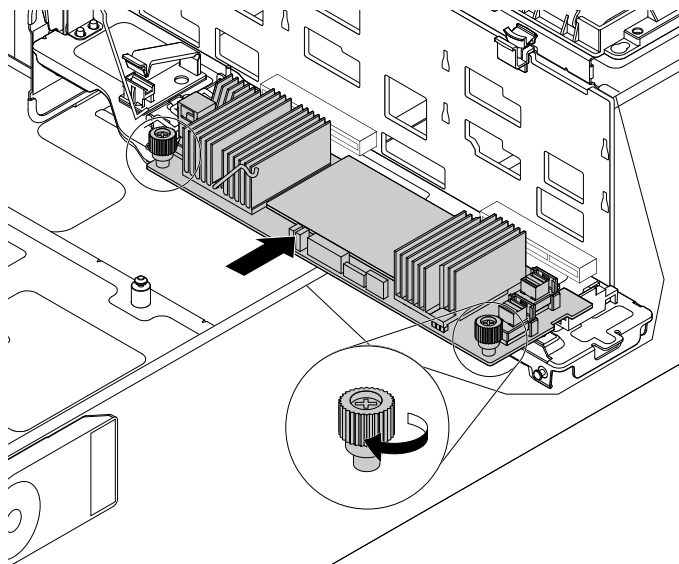


Figure 114. Installing the AnyRAID adapter or the pass-through board

12. Reinstall the AnyRAID-adapter air duct (if available).
13. Reconnect the cables. See “Connecting cables” on page 39.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement procedure, go to “Completing the parts replacement” on page 164.

Replacing the hot-swap-drive backplane

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have hot-swap internal storage drives installed.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- The hot-swap-drive backplane is sensitive to ESD. Ensure that you read and understand “Handling static-sensitive devices” on page 64 first and carefully perform the operation.
- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the new hot-swap-drive backplane and follow those instructions in addition to the instructions in this topic.

To replace the hot-swap-drive backplane, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the backplanes. See “Hot-swap-drive backplane” on page 37.
5. Remove the AnyRAID adapter or the pass-through board. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.
6. Remove all the installed hot-swap storage drives and dummy trays (if any) from the storage-drive bays. See “Installing or replacing a hot-swap internal storage drive” on page 112.
7. Record the cable connections on the backplane, and then disconnect all the cables from the backplane.
8. Depending on the server model, do one of the following:
 - For the server models with 3.5-inch-drive backplane, press the two release tabs **1** and gently lift the 3.5-inch-drive backplane a little bit upward so that it is released from the hooks on the chassis. Then, carefully remove the 3.5-inch-drive backplane out of the chassis.

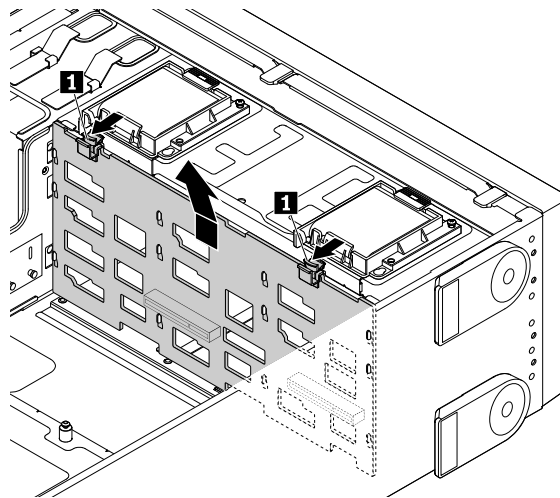


Figure 115. Removing the 3.5-inch-drive backplane

- For the server models with 2.5-inch-drive backplane, press the release tab **1** and gently lift the 2.5-inch-drive backplane a little bit upward so that it is released from the hooks on the chassis. Then, carefully remove the 2.5-inch-drive backplane out of the chassis.

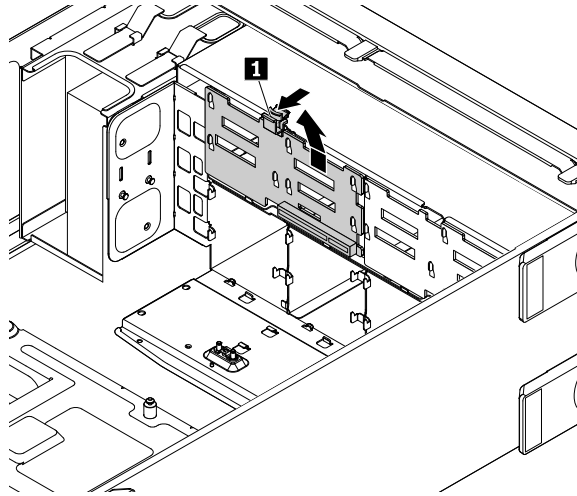


Figure 116. Removing the 2.5-inch-drive backplane

9. Touch the static-protective package that contains the new backplane to any unpainted surface on the outside of the server. Then, remove the new backplane from the package.

Note: Carefully handle the backplane by its edges.

10. Position the new backplane on the drive cage so that the holes in the new backplane are aligned with the corresponding hooks on the chassis. Then, slightly press the new backplane until it snaps into position.
11. Reinstall all the hot-swap storage drives and dummy trays. See “Installing or replacing a hot-swap internal storage drive” on page 112.
12. Reinstall the AnyRAID adapter or the pass-through board. See “Replacing the AnyRAID adapter or the pass-through board” on page 143.
13. Refer to your note to reconnect the cables to the backplane.
14. If you are instructed to return the old backplane, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Replacing the easy-swap-drive module

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

This topic applies only to server models that have easy-swap internal storage drives installed.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: The easy-swap-drive module is sensitive to ESD. Ensure that you read and understand “Handling static-sensitive devices” on page 64 first and carefully perform the operation.

To replace the easy-swap-drive module, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Locate the easy-swap-drive module. See “Server components” on page 25.
5. Remove all the installed easy-swap hard disk drives and dummy trays (if any) from the storage-drive bays. See “Installing or replacing an easy-swap drive” on page 115.
6. Disconnect the signal cable and power cable from the system board.
7. Press the release tab **1** and gently lift the easy-swap-drive module slightly upward so that it is released from the hooks on the chassis. Then, move the easy-swap-drive module to the rear of the chassis to remove the module.

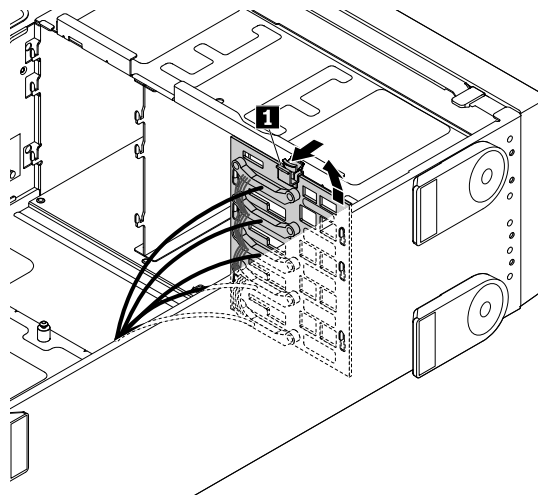


Figure 117. Removing the easy-swap-drive module

8. Touch the static-protective package that contains the new module to any unpainted surface on the outside of the server. Then, remove the new module from the package.

Note: Carefully handle the module by its edges.

9. Position the new module on the hard-disk-drive cage so that the holes in the new module are aligned with the corresponding hooks on the chassis. Then, slightly press the new module until it snaps into position.
10. Reinstall all the easy-swap storage drives and dummy trays. See “Installing or replacing an easy-swap drive” on page 115.
11. Reconnect the signal cable and power cable to the system board. See “Connecting the easy-swap-drive module to the system board” on page 40.
12. If you are instructed to return the old module, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement procedure, go to “Completing the parts replacement” on page 164.

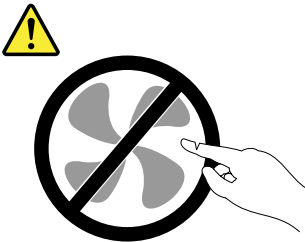
Replacing the system fan

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Your server has four system fans. You can view the system-fan status LEDs on the chassis to identify which system fan might have problems and need to be replaced. See “System-fan status LEDs” on page 30.

CAUTION:

Hazardous moving parts. Keep fingers and other body parts away.



Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To replace a system fan, do the following:

1. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server.
2. Remove the server cover.

3. Pinch the U-shaped sides on the top of the system fan and slide the system fan out of the chassis.

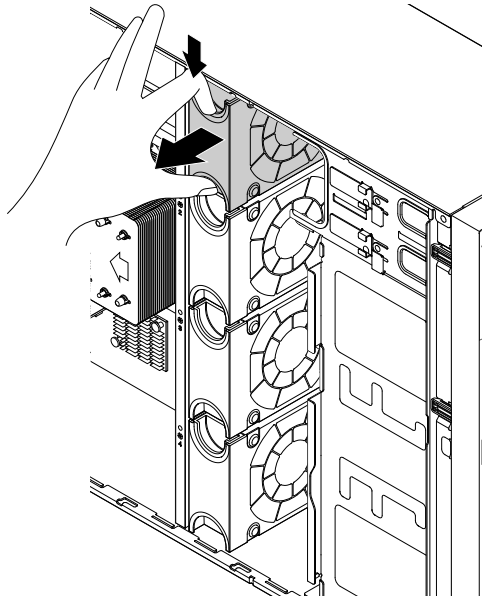


Figure 118. Removing the system fan

4. Touch the static-protective package that contains the new system fan to any unpainted surface on the outside of the server. Then, remove the new system fan from the package.
5. Hold the new system fan so that the connector on the fan is aligned with the corresponding connector on the chassis. Then slide the new system fan into the chassis until it snaps into position.

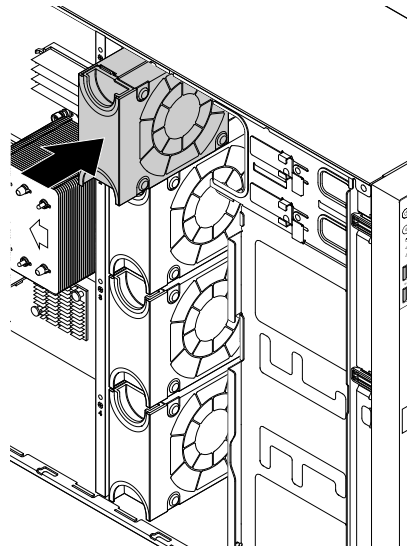


Figure 119. Installing the system fan

6. If you are instructed to return the old system fan, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Replacing the heat sink

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

CAUTION:



The heat sink might be very hot. Turn off the server and wait several minutes to let the server cool before removing the server cover.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Notes:

- Depending on the model, your server might look slightly different from the illustrations in this topic.
- Use any documentation that comes with the new heat sink and follow those instructions in addition to the instructions in this topic.

To replace the heat sink, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.

5. Remove the four screws that secure the heat sink to the system board. It is recommended that you carefully remove the four screws using the following method to avoid any possible damage to the system board.
 - a. Partially remove screw **1**, then completely remove screw **3**, and then return to screw **1** and completely remove it.
 - b. Partially remove screw **2**, then completely remove screw **4**, and then return to screw **2** and completely remove it.

Note: The four screws are integrated parts of the heat sink. Do not try to remove the four screws from the heat sink.

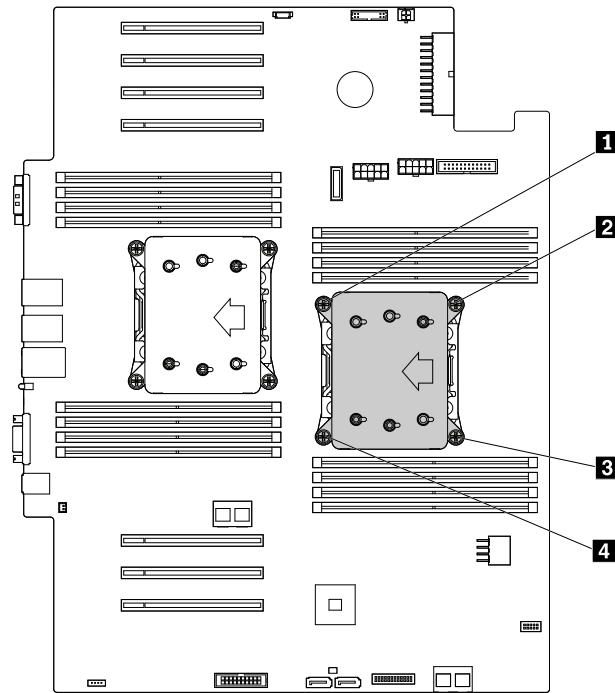


Figure 120. Removing the screws that secure the heat sink

6. Gently twist the heat sink to free it from the microprocessor and then lift the heat sink off the system board.
7. Lay aside the old heat sink. Touch the static-protective package that contains the new heat sink to any unpainted surface on the outside of the server. Then, remove the new heat sink from the package and remove the protective cover from the heat sink.

Notes:

- When handling the heat sink, do not touch the thermal grease on the bottom of it.
 - Before installing the new heat sink, use the cleaning pad that comes with the new heat sink to wipe the thermal grease from the top of the microprocessor. Dispose of the cleaning pad after all of the thermal grease is removed from the microprocessor.
8. Place the new heat sink on the system board so that the four screws on the new heat sink are aligned with the corresponding mounting studs on the system board. Note the orientation of the new heat sink. Ensure that the arrow on the new heat sink points to the rear of the server. See “Server components” on page 25.

9. Install the four screws to secure the new heat sink on the system board. It is recommended that you carefully install the four screws using the following method to avoid any possible damage to the system board.
 - a. Partially tighten screw **1**, then firmly tighten screw **3**, and then return to screw **1** and firmly tighten it. Do not over-tighten the screws.
 - b. Partially tighten screw **2**, then firmly tighten screw **4**, and then return to screw **2** and firmly tighten it. Do not over-tighten the screws.

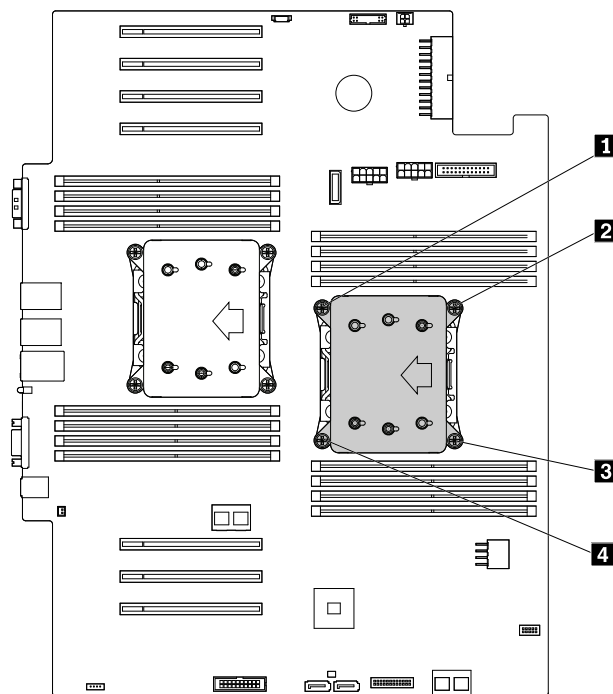


Figure 121. Installing the screws to secure the heat sink

10. If you are instructed to return the old heat sink, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Replacing the coin-cell battery

Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Your server has a special type of memory that maintains the date, time, and configuration information for built-in features. The coin-cell battery keeps the information active when you turn off the server. The coin-cell battery normally requires no charging nor maintenance throughout its life; however, no battery lasts forever. If the coin-cell battery fails, the date, time, and configuration information, including passwords, are lost and an error message is displayed when you turn on the server.



Danger of explosion if battery is incorrectly replaced.

When replacing the lithium coin-cell battery, use only the same or an equivalent type that is recommended by the 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.

The following statement applies to users in the state of California, U.S.A.

California Perchlorate Information:

Products containing manganese dioxide lithium coin cell batteries may contain perchlorate.

Perchlorate Material - special handling may apply, See <http://www.dtsc.ca.gov/hazardouswaste/perchlorate>

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

To replace the coin-cell battery, do the following:

Note: After you replace the coin-cell battery, you must reset passwords, reset system date and time, and reconfigure the server.

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Locate the coin-cell battery. See “Server components” on page 25.
6. Remove any installed PCIe card (such as the Ethernet card) that impedes your access to the coin-cell battery. See “Removing a PCIe card” on page 87.

7. Remove the old coin-cell battery.

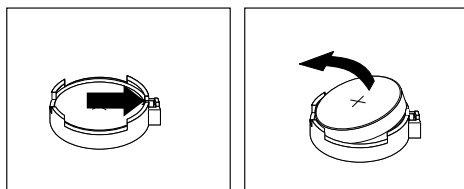


Figure 122. Removing the coin-cell battery

8. Install a new coin-cell battery.

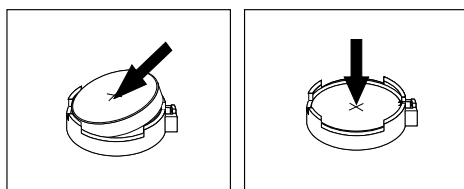


Figure 123. Installing the coin-cell battery

9. Reinstall the PCIe card (such as the Ethernet card) that has been removed. See “Installing a PCIe card” on page 84.

10. Dispose of the old coin-cell battery as required by local ordinances or regulations.

What to do next:

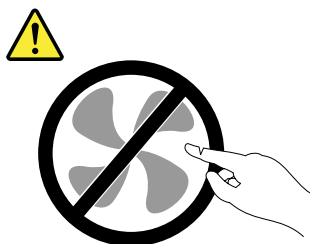
- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164. After you replace the coin-cell battery, you must reset passwords, reset system date and time, and reconfigure the server. See Chapter 5 “Configuring the server” on page 51.

For service technician only: replacing the system board

Attention: This procedure must be performed by trained service personnel of Lenovo. Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

CAUTION:

Hazardous moving parts. Keep fingers and other body parts away.



CAUTION:



The heat sinks and microprocessors might be very hot. Turn off the server and wait several minutes to let the server cool before removing the server cover.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To replace the system board, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.
5. Record the component locations, cable connections, and cable routing in the server.
6. Remove all memory modules. See “Removing a memory module” on page 83.
7. Remove all PCIe cards, including the Ethernet card and RAID card. See “Removing a PCIe card” on page 87.
8. Remove the TPM if one is installed. See “Removing the TPM” on page 104.
9. Remove the TSM Premium if one is installed. See “Removing the TSM Premium” on page 101.
10. Remove the SD module if one is installed. See “Installing or removing the SD module” on page 89.
11. Remove the coin-cell battery. See “Replacing the coin-cell battery” on page 156.
12. Remove the heat sinks. See “Replacing the heat sink” on page 154.
13. Remove the PCIe card holders. See “Removing and reinstalling the PCIe card holder” on page 74.
14. Remove any installed system fan that impedes your access to cables and then disconnect all cables from the system board.

15. Loosen the two screws that secure the system board. Gently lift each edge of the system board slightly upward so that the system board is disengaged from the mounting stubs on the chassis. Then, carefully remove the system board out of the chassis.

Note: Carefully handle the system board by its edges.

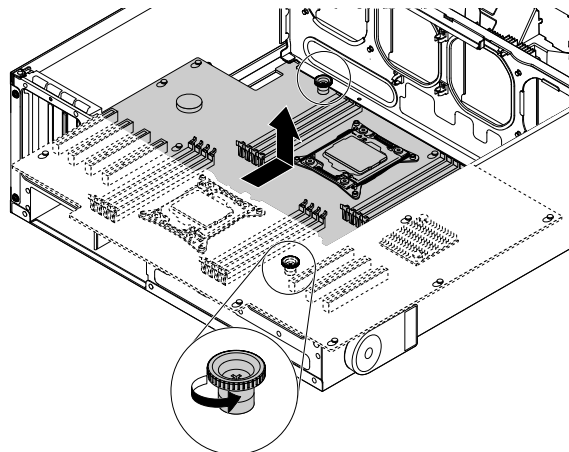


Figure 124. Removing the system board

16. Place the old system board on a clean, flat, and static-protective surface. Touch the static-protective package that contains the new system board to any unpainted surface on the outside of the server. Then, take the new system board out of the package.
17. Install the new system board into the chassis. Align the holes in the new system board with the corresponding mounting studs on the chassis. Then, move the system board towards the rear of the server. Ensure that the rear connectors on the new system board are inserted into the corresponding holes in the rear panel. Tighten the two screws to secure the system board in place

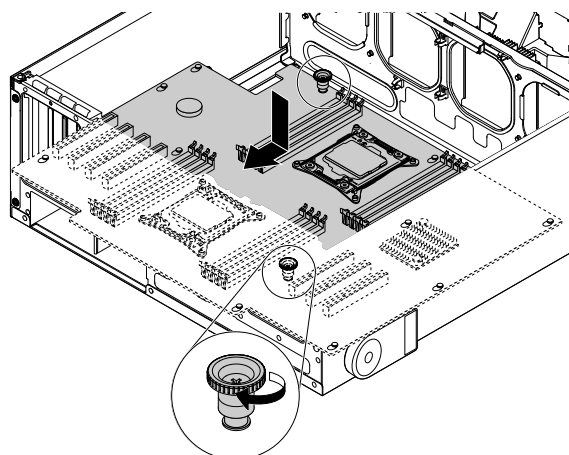


Figure 125. Installing the system board

18. Remove the microprocessors from the old system board and install them on the new system board. See “Installing or replacing the microprocessor” on page 122.

19. Use a cleaning pad to wipe the thermal grease from the heat sinks and the top of the microprocessors. Dispose of the cleaning pad after all of the thermal grease is removed.
20. Use one of the following methods to apply appropriate amount of thermal grease to the top of the microprocessors in the shape of a cross or a circle as shown. Using too much or too little thermal grease can cause a thermal problem due to imperfect contact with the components.

Notes:

- Do not touch the thermal grease.
- Keep the thermal grease off the system board.



Figure 126. Applying the thermal grease to the top of the microprocessor

21. Install the heat sinks on the new system board. See “Replacing the heat sink” on page 154.
22. The old system board must be returned with two microprocessor socket covers to protect the pins on the microprocessor sockets during shipping and handling. Use the microprocessor socket covers removed from the new system board.

To install a microprocessor socket cover on the old system board, do the following:

- a. Close the microprocessor retainer. Press down the small handle **1** first and then push the handle inward to secure it. Then, press down the small handle **2** and then push the handle inward to lock the microprocessor retainer into position.

Note: There are two marks on the microprocessor retainer. Ensure that you close the small handle marked with **1** first and then close the other small handle marked with **2**. Always follow the correct sequence when you close the small handles.

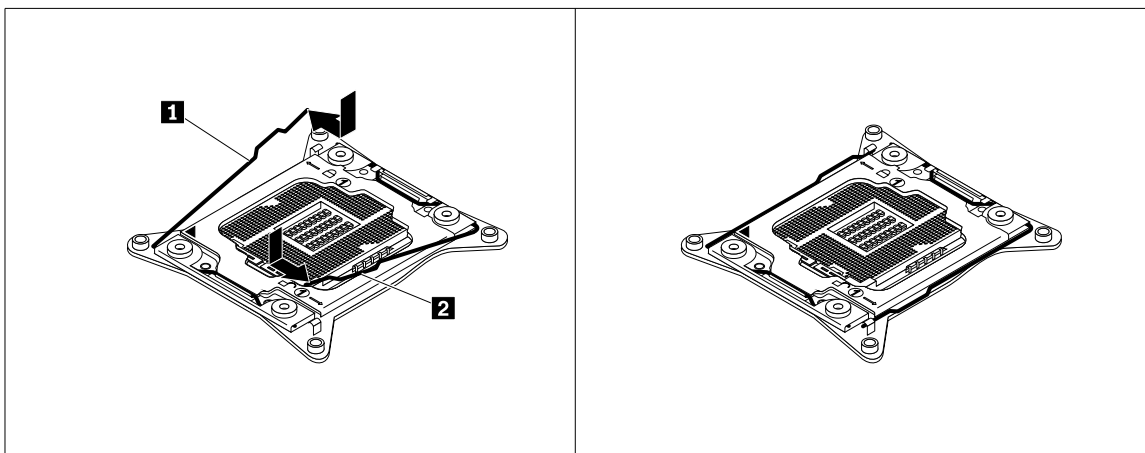


Figure 127. Securing the microprocessor retainer

- b. Position the microprocessor socket cover above the microprocessor socket so that the small triangle **1** on the socket cover faces the small triangle **2** on the microprocessor retainer. Then, carefully press the socket cover straight down into the socket until it snaps into position.

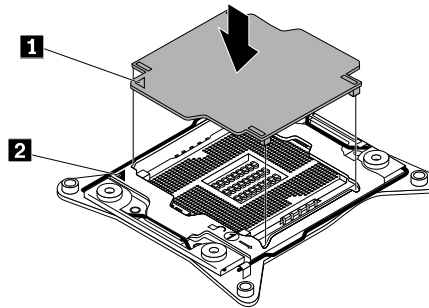


Figure 128. Installing the microprocessor socket cover

23. Install all parts that you have removed and connect all cables to the new system board. Refer to the information that you have recorded and the related topics in Chapter 6 “Replacing hardware” on page 63.
24. If you are instructed to return the old system board, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.
- After a system board is replaced, do the following:
 1. Start the Setup Utility program by pressing the F1 key, and then check the BIOS and BMC version.
 2. Go to <http://www.lenovo.com/drivers> and follow the instructions on the Web page to download the latest version of firmware. Then, install the firmware to your server.
 3. Update the machine type, model number, and serial number of the system board. Either you will be prompted to do this while upgrading the BIOS, or you can locate the files for updating the VPD within the DOS BIOS package. For some servers, the VPD utility is available for download at: <http://www.lenovo.com/drivers>.

For service technician only: replacing the power interface board

Attention: This procedure must be performed only by trained service personnel of Lenovo. Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

To replace the power interface board, do the following:

1. Remove all media from the drives and turn off all attached devices and the server. Then, disconnect all power cords from electrical outlets and disconnect all cables that are connected to the server.
2. If the server is installed in a rack cabinet, remove the server from the rack cabinet and place it on a flat, clean, and static-protective surface. See the *Rack Installation Instructions* that comes with the server. If the server is in tower form factor, lay the server on its side for easier operation.
3. Remove the server cover. See “Removing the server cover” on page 66.
4. Remove the cooling shroud. See “Removing the cooling shroud” on page 69.

5. Remove all hot-swap redundant power supplies. See “Installing or replacing a hot-swap redundant power supply” on page 131.
6. Record the component locations, cable connections, and cable routing in the server.
7. Remove the system board. “For service technician only: replacing the system board” on page 158.
8. Lift the release button **1** and then disengaged the power interface board from the chassis.

Note: Carefully handle the power interface board by its edges.

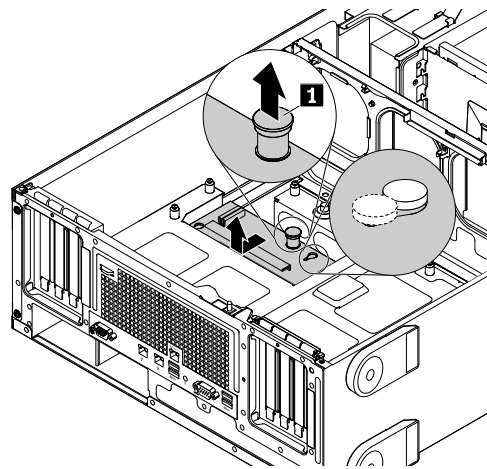


Figure 129. Removing the power interface board

9. Place the old power interface board on a clean, flat, and static-protective surface. Touch the static-protective package that contains the new power interface board to any unpainted surface on the outside of the server. Then, take the new power interface board out of the package.
10. Install the new power interface board into the chassis. Align the two holes in the new power interface board with the corresponding mounting stubs on the chassis. Then, move the power interface board towards the front of the server until the power interface board snaps into position.

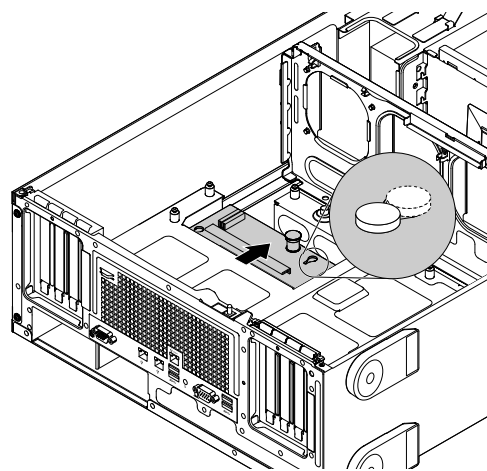


Figure 130. Installing the power interface board

11. Install all parts that you have removed and reconnect all cables. Refer to the information that you have recorded and the related topics in Chapter 6 “Replacing hardware” on page 63.

12. If you are instructed to return the old power interface board, follow all packaging instructions and use any packaging materials that are supplied to you for shipping.

What to do next:

- To work with another piece of hardware, go to the appropriate section.
- To complete the replacement, go to “Completing the parts replacement” on page 164.

Completing the parts replacement

This topic provides instructions to help you complete the parts replacement and turn on your server.

To complete the parts replacement, properly route the cables inside the server, reinstall the server cover, reconnect all the external cables. For some devices, update the firmware and run the Setup Utility program to do further setup.

Reinstalling the server cover and reconnecting cables

<p>Attention: Do not open your server or attempt any repair before reading and understanding “Safety information” on page iii and “Guidelines” on page 63.</p>

This topic provides instructions on how to reinstall the server cover and reconnect cables to your server.

Attention: For proper cooling and airflow, reinstall the server cover before turning on the server. Operating the server for extended periods of time (more than 30 minutes) with the server cover removed might damage server components.

Before you begin, print all the related instructions or ensure that you can view the PDF version on another computer for reference.

Note: Depending on the model, your server might look slightly different from the illustrations in this topic.

To reinstall the server cover and reconnect cables to your server, do the following:

1. Ensure that all components have been reassembled correctly and that no tools or loose screws are left inside your server.
2. Ensure that all internal cables are routed correctly and secured by any cable clips or ties in the server. Keep cables clear of the hinges and sides of the server chassis to avoid interference with reinstalling the server cover.
3. If you have removed the front bezel, reinstall it. See “Removing and reinstalling the front bezel” on page 70.

4. Position the server cover on the chassis so that the tabs on the server cover are aligned with the corresponding gaps in the chassis. Pivot the server cover to close it.

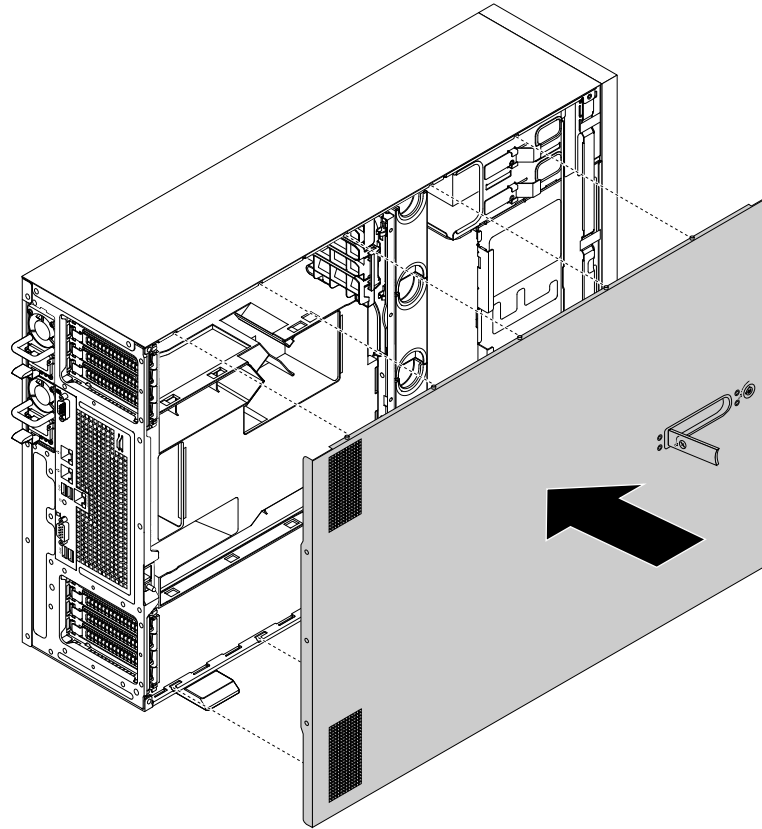


Figure 131. Closing the server cover

5. Lock the cover lock **2** and cover-handle lock **1**.

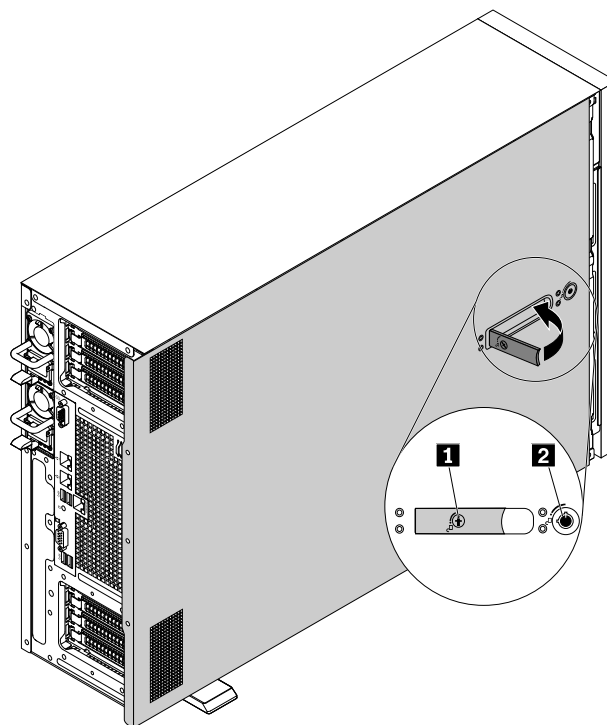


Figure 132. Locking the cover lock and the cover-handle lock

6. Reconnect external cables and power cords to the server. See “Rear view of the server” on page 22 to identify the connectors on the rear panel of the server.

Attention: To avoid component damage, connect the power cords last.

Note: In most areas of the world, Lenovo requires the return of the defective CRU. Information about this will come with the CRU or will come a few days after the CRU arrives.

Updating the server configuration

When you turn on the server for the first time after you install, remove, or replace a device, you might need to update the server configuration.

Some optional devices have device drivers that you must install. For information about installing device drivers, use the documentation that comes with each optional device. To obtain the supported device drivers for your server from the Lenovo Support Web site, go to <http://www.lenovo.com/support>. Then, follow the instructions on the Web page to find and download the device drivers you need.

Refer to the following information resources to update the server configuration:

- To update the BIOS configuration, see “Using the Setup Utility program” on page 51.
- To update the RAID configuration, see “Configuring RAID” on page 58.
- To use the Lenovo ThinkServer Deployment Manager program, see “Lenovo ThinkServer Deployment Manager” on page 14.
- To update your system firmware, see “Updating the firmware” on page 61.

Chapter 7. Troubleshooting and diagnostics

This chapter provides information about basic troubleshooting and diagnostic methods to help you solve problems that might occur in the server.

If you cannot diagnose and correct a problem by using the information in this chapter, see Chapter 8 “Getting information, help, and service” on page 173 for additional troubleshooting resources.

Troubleshooting procedure

Use the following information as a general procedure for diagnosing and troubleshooting problems you experience with your server:

1. Verify that the power cords and the cables for all attached devices are connected correctly and securely.
2. Verify that the server and all attached devices that require ac power are connected to properly grounded, functioning electrical outlets.
3. Verify that all installed hardware and attached devices are enabled in the BIOS settings of your server. For more information about accessing and changing the BIOS settings, see “Using the Setup Utility program” on page 51.
4. View the status and diagnostic LEDs to identify the system and device status and diagnose problems. See “Viewing the status and diagnostic LEDs” on page 167.
5. If the server is not working after you have added new software, installed a new optional device, or replaced a piece of hardware, remove or reinstall the software or device to see if the problem could be solved.
6. View the SEL to diagnose problems. See “Viewing the system event log” on page 167.
7. Turn on the server and press Esc as soon as you see the logo screen to view any diagnostic messages.
8. Refer to “Basic troubleshooting tables” on page 168 and follow the instructions for the type of problem you are experiencing. If the basic troubleshooting information does not help you resolve a problem, continue with the next step.
9. Try using a previous server configuration to see if a recent change to hardware or software settings has caused a problem. Before restoring your previous configuration, capture your current configuration in case the older configuration settings do not solve the problem or have adverse effect.
10. Use an antivirus program to see if your server has been infected by a virus. If the program detects a virus, remove the virus.
11. If none of these actions solve the problem, seek technical assistance. See Chapter 8 “Getting information, help, and service” on page 173.

Viewing the status and diagnostic LEDs

Your server has status and diagnostic LEDs on the front panel, the DIT panel (varies by model), the rear panel (Ethernet status LEDs), the system board, the hot-swap internal storage drives (if supported), and the optical drives. The various LEDs help you easily identify the system and device status and diagnose problems. For information about the LEDs, refer to the related topics in “Locations” on page 16.

Viewing the system event log

The system event log (SEL) contains information about all the POST and system management interrupt (SMI) events. You can view the SEL to diagnose system problems.

The TSM implements the SEL as specified in the IPMI 2.0 specification. The SEL is accessible regardless of the system power state through the TSM in-band and out-of-band interfaces.

For more information about viewing the SEL, refer to the *ThinkServer Management Module User Guide* on the documentation DVD that comes with your server.

Basic troubleshooting tables

Use the basic troubleshooting information to find solutions to problems that have definite symptoms.

Lenovo ThinkServer Deployment Manager program problems

Follow the suggested actions for the corresponding symptom in the order in which they are listed until the problem is solved. If none of these actions solve the problem, see “Troubleshooting procedure” on page 167 for the subsequent steps you should check after using the information in this topic. If the problem still cannot be solved, seek technical assistance. See Chapter 8 “Getting information, help, and service” on page 173.

Note: If you are instructed to remove, install, or replace any CRUs, refer to the related procedure in Chapter 6 “Replacing hardware” on page 63.

Symptom	Action
The operating system installation program continuously loops.	Make more space available on the hard disk drive.
The Lenovo ThinkServer Deployment Manager program cannot start the operating system medium.	Ensure that the operating system medium is supported by the Lenovo ThinkServer Deployment Manager program version you are using. For a list of the supported operating systems, refer to the user guide and compatibility notes for the Lenovo ThinkServer Deployment Manager program through the program main interface. See “Lenovo ThinkServer Deployment Manager” on page 14.

Optical drive problems

Follow the suggested actions for the corresponding symptom in the order in which they are listed until the problem is solved. If none of these actions solve the problem, see “Troubleshooting procedure” on page 167 for the subsequent steps you should check after using the information in this topic. If the problem still cannot be solved, seek technical assistance. See Chapter 8 “Getting information, help, and service” on page 173.

Notes:

1. If you are instructed to remove, install, or replace any CRUs, refer to the related procedure in Chapter 6 “Replacing hardware” on page 63.
2. If an action step is preceded by “(Trained service technician only),” this action step is reserved for a trained service technician and must be performed only by a trained service technician.

Symptom	Action
The optical drive is not recognized.	<ol style="list-style-type: none"> 1. Ensure that: <ul style="list-style-type: none"> • The signal cable and connector are not damaged and the connector pins are not bent. • The optical drive is securely connected to the correct SATA connector on the system board and the SATA connector is enabled in the Setup Utility program. See “Using the Setup Utility program” on page 51. • All cables and jumpers (if any) are installed correctly. • The correct device driver is installed for the optical drive. 2. Run any optical drive diagnostic programs if you have. 3. Reinstall the optical drive and reconnect cables. 4. Replace the signal cable for the optical drive. 5. Replace the optical drive. 6. (Trained service technician only) Replace the system board.
A disc is not working correctly.	<ol style="list-style-type: none"> 1. Ensure that the disc is in the optical drive with the shiny side facing down. 2. Ensure that the disc surface is clean and not scratched. 3. Check the disc or package for regional coding. You might need to purchase a disc with coding for the region where you are using the product. 4. Restart the disc player program. 5. Restart the server. 6. Run any optical drive diagnostic programs if you have. 7. Reinstall the optical drive and reconnect cables. 8. Replace the signal cable for the optical drive. 9. Replace the optical drive.

Internal storage drive problems

Follow the suggested actions for the corresponding symptom in the order in which they are listed until the problem is solved. If none of these actions solve the problem, see “Troubleshooting procedure” on page 167 for the subsequent steps you should check after using the information in this topic. If the problem still cannot be solved, seek technical assistance. See Chapter 8 “Getting information, help, and service” on page 173.

Notes:

1. If you are instructed to remove, install, or replace any CRUs, refer to the related procedure in Chapter 6 “Replacing hardware” on page 63.
2. If the server model comes with hot-swap storage drives, the status LEDs on each hot-swap storage drive help you easily identify a problem. See “Hot-swap-drive LEDs” on page 30.

Symptom	Action
A newly-installed easy-swap drive is not recognized.	<ol style="list-style-type: none"> 1. Ensure that: <ul style="list-style-type: none"> • The signal cable and connector are not damaged. • The easy-swap-drive module is securely connected to the correct SATA connectors on the system board and the SATA connectors are enabled in the Setup Utility program. See “Using the Setup Utility program” on page 51. • All cables and jumpers (if any) are installed correctly. 2. If you have any diagnostic programs, run the diagnostic programs to test the storage drive. 3. Reinstall the easy-swap drive and reconnect cables. 4. Replace the easy-swap drive. 5. Replace the easy-swap-drive module.
A newly installed hot-swap storage drive is not recognized.	<ol style="list-style-type: none"> 1. Ensure that the drive is installed into the correct drive bay. 2. Restart the server. 3. Remove the drive from the bay, wait 45 seconds, and reinsert the drive into the bay, making sure that the drive connects to the hot-swap-drive backplane. 4. If you have any diagnostic programs, run the diagnostic programs to test the storage drive. 5. Ensure that the backplane is correctly seated. When it is correctly seated, the drive assemblies correctly connect to the backplane without bowing or causing movement of the backplane. 6. Ensure that the cable connection is correct. See “Connecting cables” on page 39. 7. Reconnect the backplane power cable and repeat step 1 through step 4. 8. Reconnect the signal cable and repeat step 1 through step 4. 9. Reconnect the AnyRAID adapter and repeat step 1 through step 4. 10. If you suspect a problem with the signal cable, AnyRAID adapter, or the backplane: <ol style="list-style-type: none"> a. Replace the affected signal cable. b. Replace the affected AnyRAID adapter. c. Replace the affected backplane.
Multiple storage drives fail.	<ol style="list-style-type: none"> 1. If you have any diagnostic programs, run the diagnostic programs to test the storage drives. 2. Ensure that the cable connection is correct. See “Connecting cables” on page 39. 3. Reconnect the power cable. 4. Reconnect the signal cable. 5. Replace the affected signal cable. 6. Replace the AnyRAID adapter. 7. For hot-swap storage drives, if you suspect a problem with the backplane, replace the affected backplane.

Memory module problems

Follow the suggested actions for the corresponding symptom in the order in which they are listed until the problem is solved. If none of these actions solve the problem, see “Troubleshooting procedure” on page 167 for the subsequent steps you should check after using the information in this topic. If the problem still cannot be solved, seek technical assistance. See Chapter 8 “Getting information, help, and service” on page 173.

Notes:

1. If you are instructed to remove, install, or replace any CRUs, refer to the related procedure in Chapter 6 “Replacing hardware” on page 63.
2. If an action step is preceded by “(Trained service technician only),” this action step is reserved for a trained service technician and must be performed only by a trained service technician.

Symptom	Action
The amount of system memory that is displayed is less than the total capacity of the installed physical memory modules and you suspect a memory module problem.	<ol style="list-style-type: none">1. Ensure that:<ul style="list-style-type: none">• All memory modules are the correct type supported by the server. See “Features” on page 8.• You follow the memory module installation rules. See “Memory module installation rules” on page 76.• All memory modules are seated correctly and securely.• The system firmware is up-to-date.2. If you have any diagnostic programs, run the diagnostic programs to test the memory modules.3. Reinstall the memory modules.4. Replace the suspect memory modules.5. (Trained service technician only) Replace the system board.

Keyboard, mouse, or USB device problems

Follow the suggested actions for the corresponding symptom in the order in which they are listed until the problem is solved. If none of these actions solve the problem, see “Troubleshooting procedure” on page 167 for the subsequent steps you should check after using the information in this topic.

Symptom	Action
All or some keys on the keyboard do not work.	<ol style="list-style-type: none">1. Ensure that:<ul style="list-style-type: none">• The USB keyboard cable is securely connected to a USB connector on the server. If the USB keyboard is connected to a USB hub, disconnect the keyboard from the hub and connect it directly to the server.• No keys are stuck.• The USB controller is enabled in the Setup Utility program. See “Using the Setup Utility program” on page 51.2. Restart the server.

Symptom	Action
	3. Replace the keyboard.
The mouse or pointing device does not work.	<ol style="list-style-type: none"> 1. Ensure that: <ul style="list-style-type: none"> • The mouse or pointing device cable is securely connected to the server. If the USB mouse or pointing device is connected to a USB hub, disconnect the mouse or pointing device from the hub and connect it directly to the server. • The mouse or pointing device is clean and no dust accumulates. • The device drivers are installed correctly. • The USB controller is enabled in the Setup Utility program. See “Using the Setup Utility program” on page 51. 2. Restart the server. 3. Replace the mouse or pointing device.
A USB device does not work.	<ol style="list-style-type: none"> 1. Ensure that: <ul style="list-style-type: none"> • The USB cable is securely connected to the server. If the USB device is connected to a USB hub, disconnect the device from the hub and connect it directly to the server. • The device drivers are installed correctly. • The USB controller is enabled in the Setup Utility program. See “Using the Setup Utility program” on page 51. 2. Restart the server. 3. Replace the USB device.

Chapter 8. Getting information, help, and service

This chapter contains information about help, service, and technical assistance for products manufactured by Lenovo and where to go for additional information about Lenovo and Lenovo products.

Information resources

You can use the information in this topic to access useful resources relating to your needs when using the product.

Using the documentation

Information about your Lenovo system and installed software, if any, or optional devices is available in the documentation that comes with the product. The documentation can include printed documents, online documents, readme files, and help files. Most of the documentation for your server is on the documentation DVD provided with your server. Refer to the troubleshooting information in your server *User Guide and Hardware Maintenance Manual* for instructions on how to diagnose problems and do basic troubleshooting. The troubleshooting and diagnostics information might tell you that you need additional or updated device drivers or other software. Lenovo maintains pages on the World Wide Web where you can get the latest technical information and download documentation or device drivers and updates. To access the Lenovo Support Web site, go to:

<http://www.lenovo.com/support>

For more information about your server documentation, see “Server documentation” on page 2.

If you suspect a software problem, refer to the documentation, including readme files and online help, that comes with the operating system or software program.

ThinkServer Web site

The ThinkServer Web site provides up-to-date information and services to help you buy, use, upgrade, and maintain your server. You also can do the following by visiting the ThinkServer Web site at:

<http://www.lenovo.com/thinkserver>

- Shop for servers as well as upgrades and accessories for your server.
- Purchase additional services and software.
- Purchase upgrades and extended hardware repair services.
- Access the Lenovo Limited Warranty (LLW).
- Access the online manuals for your products.
- Access troubleshooting and support information for your server model and other supported products.
- Download the latest device drivers and software updates for your server model.
- Find the service and support phone numbers for your country or region.
- Find a Service Provider located near you.

Lenovo Support Web site

Technical support information is available on the Lenovo Support Web site at:

<http://www.lenovo.com/support>

This Web site is updated with the latest support information such as the following:

- Drivers and software
 - Diagnostic solutions
 - Product and service warranty
 - Product and parts details
 - User guides and manuals
 - Knowledge base and frequently asked questions
-

Help and service

This topic contains information about obtaining help and service.

Before you call

Before you call, do the following to try to solve the problem by yourself:

- Check all cables to ensure that they are connected.
- Check the power buttons to ensure that the system and optional devices are turned on.
- Use the troubleshooting information in your system documentation on the documentation DVD that comes with your product.
- Check for the updated information, new device drivers, and hints and tips on the Lenovo Support Web site at:
<http://www.lenovo.com/support>

If possible, be at your product when you call. Have the following information available:

- Machine type and model
- Serial numbers of your Lenovo hardware products
- Description of the problem
- Exact wording of any error messages
- Hardware and software configuration information

Calling for service

During the warranty period, you can get help and information by telephone through the Customer Support Center.

The following services are available during the warranty period:

- **Problem determination** - Trained service personnel are available to assist you with determining a hardware problem and deciding what action is necessary to fix the problem.
- **Hardware repair** - If the problem is caused by hardware under warranty, trained service personnel are available to provide the applicable level of service.
- **Engineering Change management** - There might be changes that are required after a product has been sold. Lenovo or your reseller will make selected Engineering Changes (ECs) that apply to your hardware available.

The warranty does not cover the following:

- Replacement or use of parts not manufactured for or by Lenovo or non-warranted Lenovo parts
- Identification of software problem sources
- Configuration of the UEFI BIOS as part of an installation or upgrade
- Changes, modifications, or upgrades to device drivers
- Installation and maintenance of network operating systems (NOS)
- Installation and maintenance of application programs

For the warranty type and duration for your product, refer to the *Safety, Warranty, and Support Information* on the documentation DVD that comes with your server. You must retain your proof of purchase to obtain warranty service.

For warranty service, consult the worldwide Lenovo Support telephone list. Telephone numbers are subject to change without notice. The most up-to-date telephone list for Lenovo Support is always available on the Web site at <http://www.lenovo.com/support/phone>. If the telephone number for your country or region is not listed, contact your Lenovo reseller or Lenovo marketing representative.

Using other services

If you travel with a Lenovo notebook computer or relocate your computer to a country where your desktop, notebook, or server machine type is sold, your computer might be eligible for International Warranty Service, which automatically entitles you to obtain warranty service throughout the warranty period. Service will be performed by service providers authorized to perform warranty service.

Service methods and procedures vary by country, and some services might not be available in all countries. International Warranty Service is delivered through the method of service (such as depot, carry-in, or on-site service) that is provided in the servicing country. Service centers in certain countries might not be able to service all models of a particular machine type. In some countries, fees and restrictions might apply at the time of service.

To determine whether your computer is eligible for International Warranty Service and to view a list of countries where service is available, go to <http://www.lenovo.com/support>, click **Warranty**, and follow the instructions on the screen.

For technical assistance with the installation of or questions related to Service Packs for your installed Windows product, refer to the Microsoft Product Support Services Web site at <http://support.microsoft.com/directory> or you can contact the Customer Support Center. Some fees might apply.

Purchasing additional services

During and after the warranty period, you can purchase additional services, such as support for hardware, operating systems, and application programs; network setup and configuration services; upgraded or extended hardware repair services; and custom installation services. Service availability and service names might vary by country or region. For more information about these services, go to the Lenovo Web site at: <http://www.lenovo.com>

Appendix A. Notices

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Attention: Lenovo Director of Licensing*

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Any performance data contained herein was determined in a controlled environment. Therefore, the result obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Trademarks

The following terms are trademarks of Lenovo in the United States, other countries, or both:

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- The Lenovo logo
- The ThinkServer logo
- ThinkServer

Intel and Intel Xeon are trademarks of Intel Corporation in the United States, other countries, or both.

Linux is a registered trademark of Linus Torvalds.

Microsoft and Windows are trademarks of the Microsoft group of companies.

Other company, product, or service names may be trademarks or service marks of others.

Important notes

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

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

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1 024 bytes, MB stands for 1 048 576 bytes, and GB stands for 1 073 741 824 bytes.

When referring to internal storage 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 storage drive capacities assume the replacement of any standard storage drives and population of all storage drive bays with the largest currently supported drives that are available from Lenovo.

Maximum memory might require replacement of the standard memory with an optional memory module.

Lenovo makes no representations or warranties with respect to non-Lenovo products. Support (if any) for the non-Lenovo products is provided by the third party, not Lenovo.

Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

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 server 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 server 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 Lenovo determines that the levels of particulates or gases in your environment have caused damage to the server, Lenovo may condition provision of repair or replacement of servers or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 12. Limits for particulates and gases

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

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

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

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

Polyvinyl Chloride (PVC) cable and cord notice

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

Recycling information

Lenovo encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. Lenovo offers a variety of programs and services to assist equipment owners in recycling their IT products. For information on recycling Lenovo products, go to: <http://www.lenovo.com/recycling>

Recycling information for Brazil

Declarações de Reciclagem no Brasil

Descarte de um Produto Lenovo Fora de Uso

Equipamentos elétricos e eletrônicos não devem ser descartados em lixo comum, mas enviados à pontos de coleta, autorizados pelo fabricante do produto para que sejam encaminhados e processados por empresas especializadas no manuseio de resíduos industriais, devidamente certificadas pelos órgãos ambientais, de acordo com a legislação local.

A Lenovo possui um canal específico para auxiliá-lo no descarte desses produtos. Caso você possua um produto Lenovo em situação de descarte, ligue para o nosso SAC ou encaminhe um e-mail para: reciclar@lenovo.com, informando o modelo, número de série e cidade, a fim de enviarmos as instruções para o correto descarte do seu produto Lenovo.

Battery return program

This product may contain a lithium or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal or batteries outside the United States, go to <http://www.lenovo.com/recycling> or contact your local waste disposal facility.

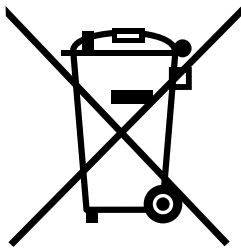
Battery recycling information for the United States and Canada



US & Canada Only

Battery recycling information for the European Union

EU



Notice: This mark applies only to countries within the European Union (EU).

Batteries or packaging for batteries are labeled in accordance with European Directive 2006/66/EC concerning batteries and accumulators and waste batteries and accumulators. The Directive determines the framework for the return and recycling of used batteries and accumulators as applicable throughout the European Union. This label is applied to various batteries to indicate that the battery is not to be thrown away, but rather reclaimed upon end of life per this Directive.

Les batteries ou emballages pour batteries sont étiquetés conformément aux directives européennes 2006/66/EC, norme relative aux batteries et accumulateurs en usage et aux batteries et accumulateurs usés. Les directives déterminent la marche à suivre en vigueur dans l'Union Européenne pour le retour et le recyclage des batteries et accumulateurs usés. Cette étiquette est appliquée sur diverses batteries pour indiquer que la batterie ne doit pas être mise au rebut mais plutôt récupérée en fin de cycle de vie selon cette norme.

In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury, and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling, and treatment of batteries and accumulators. Customer participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances. For proper collection and treatment, go to: <http://www.lenovo.com/recycling>

Requirements for Batteries Containing Perchlorate

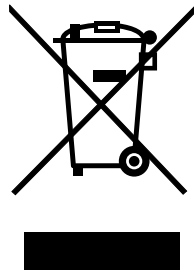
The following statement applies to users in the state of California, U.S.A.

California Perchlorate Information:

Products containing CR (manganese dioxide) lithium coin cell batteries may contain perchlorate.

Perchlorate Material - special handling may apply, See
<http://www.dtsc.ca.gov/hazardouswaste/perchlorate>

Important WEEE information



The WEEE marking on Lenovo products applies to countries with WEEE and e-waste regulations (for example, European Directive 2002/96/EC, India E-Waste Management & Handling Rules, 2011). Appliances are labeled in accordance with local regulations concerning waste electrical and electronic equipment (WEEE). These regulations determine the framework for the return and recycling of used appliances as applicable within each geography. This label is applied to various products to indicate that the product is not to be thrown away, but rather put in the established collection systems for reclaiming these end of life products.

Users of electrical and electronic equipment (EEE) with the WEEE marking must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to them for the return, recycle, and recovery of WEEE and to minimize any potential effects of EEE on the environment and human health due to the presence of hazardous substances. For additional WEEE information go to:
<http://www.lenovo.com/recycling>

Restriction of Hazardous Substances Directive (RoHS)

This topic provides statements about the Restriction of Hazardous Substances Directive (RoHS).

European Union RoHS

Lenovo products sold in the European Union, on or after 3 January 2013 meet the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("RoHS recast" or "RoHS 2").

For more information about Lenovo progress on RoHS, go to:
http://www.lenovo.com/social_responsibility/us/en/RoHS_Communication.pdf

German Ordinance for Work gloss statement

The product is not suitable for use with visual display work place devices according to clause 2 of the German Ordinance for Work with Visual Display Units.

Das Produkt ist nicht für den Einsatz an Bildschirmarbeitsplätzen im Sinne § 2 der Bildschirmarbeitsverordnung geeignet.

Export classification notice

This product is subject to the United States Export Administration Regulations (EAR) and has an Export Classification Control Number (ECCN) of 4A994.b. It can be re-exported except to any of the embargoed countries in the EAR E1 country list.

Electronic emission notices

The following information refers to the Lenovo ThinkServer machine types 70DG, 70DH, 70DJ, 70DK, 70DL, 70DM, 70DN, and 70DQ.

Federal Communications Commission (FCC) Statement

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.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Lenovo is not responsible for any radio or television interference caused by using other than specified or recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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 may cause undesired operation.

Industry Canada Compliance Statement

CAN ICES-3(A)/NMB-3(A)

United Kingdom telecommunications safety requirement

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.

European Union - Compliance to the Electromagnetic Compatibility Directive

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. Lenovo cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the installation of option cards from other manufacturers.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to European Standard EN 55022. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Lenovo, Einsteinova 21, 851 01 Bratislava, Slovakia



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

German Class A compliance statement

Deutschsprachiger EU Hinweis:

Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG (früher 89/336/EWG) zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der Lenovo empfohlene Kabel angeschlossen werden. Lenovo übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der Lenovo verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der Lenovo gesteckt/eingebaut werden.

Deutschland:

Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Betriebsmitteln

Dieses Produkt entspricht dem „Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln“ EMVG (früher „Gesetz über die elektromagnetische Verträglichkeit von Geräten“). Dies ist die Umsetzung der EU-Richtlinie 2004/108/EG (früher 89/336/EWG) in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln, EMVG vom 20. Juli 2007 (früher Gesetz über die elektromagnetische Verträglichkeit von Geräten), bzw. der EMV EG Richtlinie 2004/108/EC (früher 89/336/EWG), für Geräte der Klasse A.

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen. Verantwortlich für die Konformitätserklärung nach Paragraf 5 des EMVG ist die Lenovo (Deutschland) GmbH, Gropiusplatz 10, D-70563 Stuttgart.

Informationen in Hinsicht EMVG Paragraf 4 Abs. (1) 4:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

Nach der EN 55022: „Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen und dafür aufzukommen.“

Nach dem EMVG: „Geräte dürfen an Orten, für die sie nicht ausreichend entstört sind, nur mit besonderer Genehmigung des Bundesministers für Post und Telekommunikation oder des Bundesamtes für Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Störungen zu erwarten sind.“ (Auszug aus dem EMVG, Paragraph 3, Abs. 4). Dieses Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Anmerkung: Um die Einhaltung des EMVG sicherzustellen sind die Geräte, wie in den Handbüchern angegeben, zu installieren und zu betreiben.

Eurasian compliance mark



ENERGY STAR model information



ENERGY STAR® is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy aimed at saving money and protecting the environment through energy efficient products and practices.

Lenovo is proud to offer our customers products with an ENERGY STAR compliant designation. Some models of the following machine types have been designed and tested to conform to the ENERGY STAR program requirement for computer servers at the time of manufacture: 70B6 and 70B7.

For more information about ENERGY STAR ratings for Lenovo servers, go to <http://www.lenovo.com>.

By using ENERGY STAR compliant products and taking advantage of the power-management features of your server, you reduce the consumption of electricity. Reduced electrical consumption contributes to potential financial savings, a cleaner environment, and the reduction of greenhouse gas emissions.

For more information about ENERGY STAR, go to:
<http://www.energystar.gov>

Lenovo encourages you to make efficient use of energy an integral part of your day-to-day operations. To help in this endeavor, set the following power-management features to take effect when your servers have been used:

- Processor- or core-reduced power states
- Variable speed fan control based on power or thermal readings
- Low power memory states

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