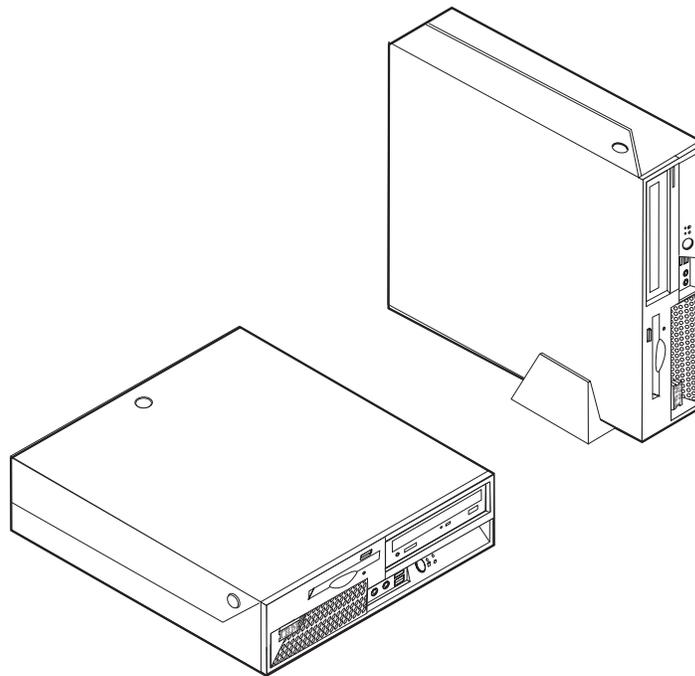ThinkCentre™

IBM

User Guide
Types 8424, 8425, 8428
Types 8171, 8172, 8173

ThinkCentre™

User Guide
Types 8424, 8425, 8428
Types 8171, 8172, 8173

IBM

Note

Before using this information and the product it supports, be sure to read the "Important safety information" on page v and Appendix D, "Notices," on page 41.

Contents

Important safety information

This information can help you safely use your IBM® personal computer. Follow and retain all information included with your IBM computer. The information in this document does not alter the terms of your purchase agreement or the IBM Statement of Limited Warranty.

Customer safety is important to IBM. Our products are developed to be safe and effective. However, personal computers are electronic devices. Power cords, power adapters, and other features can create potential safety risks that can result in physical injury or property damage, especially if misused. To reduce these risks, follow the instructions included with your product, observe all warnings on the product and in the operating instructions, and review the information included in this document carefully. By carefully following the information contained in this document and provided with your product, you can help protect yourself from hazards and create a safer computer work environment.

Note: This information includes references to power adapters and batteries. In addition to mobile personal computers, IBM ships some products (such as speakers or monitors) with external power adapters. If you have such a product, this information applies to your product. In addition, your computer product may contain a coin-sized internal battery that provides power to your system clock even when the machine is unplugged, so the battery safety information applies to all computers.

Conditions that require immediate action

Products can become damaged due to misuse or neglect. Some product damage is serious enough that the product should not be used again until it has been inspected and, if necessary, repaired by an authorized servicer.

As with any electronic device, pay close attention to the product when it is turned on. On very rare occasions, you might notice an odor or see a puff of smoke or sparks vent from your machine. Or you might hear sounds like popping, cracking or hissing. These conditions might merely mean that an internal electronic component has failed in a safe and controlled manner. Or, they might indicate a potential safety issue. However, do not take risks or attempt to diagnose the situation yourself.

Frequently inspect your computer and its components for damage or wear or signs of danger. If you have any question about the condition of a component, do not use the product. Contact the IBM Support Center® or the product manufacturer for instructions on how to inspect the product and have it repaired, if necessary.

In the unlikely event that you notice any of the conditions listed below, or if you have any safety concerns with your product, stop using the product and unplug it from the power source and telecommunication lines until you can speak to the IBM Support Center for further guidance.
- Power cords, plugs, power adapters, extension cords, surge protectors, or power supplies that are cracked, broken or damaged.
- Signs of overheating, smoke, sparks or fire.

- Damage to a battery (such as cracks, dents, creases), discharge from a battery, or a buildup of foreign substances on the battery.
- A cracking, hissing or popping sound, or strong odor that comes from the product.
- Signs that liquid has been spilled or an object has fallen onto the computer product, the power cord or power adapter.
- The computer product, the power cord or power adapter has been exposed to water.
- The product has been dropped or damaged in any way.
- The product does not operate normally when you follow the operating instructions.

Note: If you notice these conditions with a non-IBM product (such as an extension cord), stop using that product until you can contact the product manufacturer for further instructions, or until you get a suitable replacement.

General safety guidelines

Always observe the following precautions to reduce the risk of injury and property damage.

Service

Do not attempt to service a product yourself unless instructed to do so by the IBM Support Center. Use only an IBM authorized service provider who is approved to repair your particular product.

Note: Some parts can be upgraded or replaced by the customer. These parts are referred to as Customer Replaceable Units, or CRUs. IBM expressly identifies CRUs as such, and provides documentation with instructions when it is appropriate for customers to replace those parts. You must closely follow all instructions when performing such replacements. Always make sure that the power is turned off and that the product is unplugged from any power source before you attempt the replacement. If you have any questions or concerns, contact the IBM Support Center.

Power cords and power adapters

Use only the power cords and power adapters supplied by the product manufacturer.

Never wrap a power cord around the power adapter or other object. Doing so can stress the cord in ways that can cause the cord to fray, crack or crimp. This can present a safety hazard.

Always route power cords so that they will not be walked on, tripped over, or pinched by objects.

Protect the cord and power adapters from liquids. For instance, do not leave your cord or power adapter near sinks, tubs, toilets, or on floors that are cleaned with liquid cleansers. Liquids can cause a short circuit, particularly if the cord or power adapter has been stressed by misuse. Liquids can also cause gradual corrosion of the power cord terminals and/or the connector terminals on the adapter which can eventually result in overheating.

Always connect power cords and signal cables in the correct order and ensure that all power cord connectors are securely and completely plugged into receptacles.

Do not use any power adapter that shows corrosion at the ac input pins and/or shows signs of overheating (such as deformed plastic) at the ac input or anywhere on the power adapter.

Do not use any power cords where the electrical contacts on either end show signs of corrosion or overheating or where the power cord appears to have been damaged in any way.

Extension cords and related devices

Ensure that extension cords, surge protectors, uninterruptible power supplies, and power strips that you use are rated to handle the electrical requirements of the product. Never overload these devices. If power strips are used, the load should not exceed the power strip input rating. Consult an electrician for more information if you have questions about power loads, power requirements, and input ratings.

Plugs and outlets

If a receptacle (power outlet) that you intend to use with your computer equipment appears to be damaged or corroded, do not use the outlet until it is replaced by a qualified electrician.

Do not bend or modify the plug. If the plug is damaged, contact the manufacturer to obtain a replacement.

Some products are equipped with a three-pronged plug. This plug fits only into a grounded electrical outlet. This is a safety feature. Do not defeat this safety feature by trying to insert it into a non-grounded outlet. If you cannot insert the plug into the outlet, contact an electrician for an approved outlet adapter or to replace the outlet with one that enables this safety feature. Never overload an electrical outlet. The overall system load should not exceed 80 percent of the branch circuit rating. Consult an electrician for more information if you have questions about power loads and branch circuit ratings.

Be sure that the power outlet you are using is properly wired, easily accessible, and located close to the equipment. Do not fully extend power cords in a way that will stress the cords.

Connect and disconnect the equipment from the electrical outlet carefully

Batteries

All IBM personal computers contain a non-rechargeable coin cell battery to provide power to the system clock. In addition many mobile products such as Thinkpad notebook PCs utilize a rechargeable battery pack to provide system power when in portable mode. Batteries supplied by IBM for use with your product have been tested for compatibility and should only be replaced with IBM approved parts.

Never attempt to open or service any battery. Do not crush, puncture, or incinerate batteries or short circuit the metal contacts. Do not expose the battery to water or other liquids. Only recharge the battery pack strictly according to instructions included in the product documentation.

Battery abuse or mishandling can cause the battery to overheat, which can cause gasses or flame to "vent" from the battery pack or coin cell. If your battery is damaged, or if you notice any discharge from your battery or the buildup of foreign materials on the battery leads, stop using the battery and obtain a replacement from the battery manufacturer.

Batteries can degrade when they are left unused for long periods of time. For some rechargeable batteries (particularly Lithium Ion batteries), leaving a battery unused in a discharged state could increase the risk of a battery short circuit, which could shorten the life of the battery and can also pose a safety hazard. Do not let rechargeable Lithium-Ion batteries completely discharge or store these batteries in a discharged state.

Heat and product ventilation

Computers generate heat when turned on and when batteries are charging. Notebook PCs can generate a significant amount of heat due to their compact size. Always follow these basic precautions:

* Do not leave the base of your computer in contact with your lap or any part of your body for an extended period when the computer is functioning or when the battery is charging. Your computer produces some heat during normal operation. Extended contact with the body could cause discomfort or, potentially, a skin burn.
* Do not operate your computer or charge the battery near flammable materials or in explosive environments.
* Ventilation slots, fans and/or heat sinks are provided with the product for safety, comfort, and reliable operation. These features might inadvertently become blocked by placing the product on a bed, sofa, carpet, or other flexible surface. Never block, cover or disable these features.

CD and DVD drive safety

CD and DVD drives spin discs at a high speed. If a CD or DVD is cracked or otherwise physically damaged, it is possible for the disc to break apart or even shatter when the CD drive is in use. To protect against possible injury due to this situation, and to reduce the risk of damage to your machine, do the following:

* Always store CD/DVD discs in their original packaging
* Always store CD/DVD discs out of direct sunlight and away from direct heat sources
* Remove CD/DVD discs from the computer when not in use
* Do not bend or flex CD/DVD discs, or force them into the computer or their packaging
* Check CD/DVD discs for cracks before each use. Do not use cracked or damaged discs

Additional safety information

DANGER

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

To avoid a shock hazard:
* **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**

- Connect all power cords to a properly wired and grounded electrical outlet.
- Connect to properly wired outlets any equipment that will be attached to this product.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.
- Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.

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

DANGER

Le courant électrique provenant de l'alimentation, du téléphone et des câbles de transmission peut présenter un danger.

Pour éviter tout risque de choc électrique :
- Ne manipulez aucun câble et n'effectuez aucune opération d'installation, d'entretien ou de reconfiguration de ce produit au cours d'un orage.
- Branchez tous les cordons d'alimentation sur un socle de prise de courant correctement câblé et mis à la terre.
- Branchez sur des socles de prise de courant correctement câblés tout équipement connecté à ce produit.
- Lorsque cela est possible, n'utilisez qu'une seule main pour connecter ou déconnecter les câbles d'interface.;
- Ne mettez jamais un équipement sous tension en cas d'incendie ou d'inondation, ou en présence de dommages matériels.
- Avant de retirer les carters de l'unité, mettez celle-ci hors tension et déconnectez ses cordons d'alimentation, ainsi que les câbles qui la relient aux réseaux, aux systèmes de té lécommunication et aux modems (sauf instruction contraire mentionnée dans les procédures d'installation et de configuration).
- Lorsque vous installez, que vous déplacez, ou que vous manipulez le présent produit ou des périphériques qui lui sont raccordés, reportez-vous aux instructions ci-dessous pour connecter et déconnecter les différents cordons.

Connexion:	Déconnexion:
1. Mettez les unités hors tension.	1. Mettez les unités hors tension.
2. Commencez par brancher tous les cordons sur les unités.	2. Débranchez les cordons d'alimentation des prises.
3. Branchez les câbles d'interface sur des connecteurs.	3. Débranchez les câbles d'interface des connecteurs.
4. Branchez les cordons d'alimentation sur des prises.	4. Débranchez tous les câbles des unités.
5. Mettez les unités sous tension.	

Lithium battery notice

CAUTION:
Danger of explosion if battery is incorrectly replaced.

When replacing the battery, use only IBM Part Number 33F8354 or an equivalent type battery 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.

ATTENTION

Danger d'explosion en cas de remplacement incorrect de la batterie.

Remplacer uniquement par une batterie IBM de type ou d'un type équivalent recommandé par le fabricant. La batterie contient du lithium et peut exploser en cas de mauvaise utilisation, de mauvaise manipulation ou de mise au rebut inappropriée.

Ne pas :
- Lancer ou plonger dans l'eau
- Chauffer à plus de 100°C (212°F)
- Réparer ou désassembler

Mettre au rebut les batteries usagées conformément aux règlements locaux.

Modem safety information

To reduce the risk of fire, electrical shock, or injury when using telephone equipment, always follow basic safety precautions, such as:
- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

- Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.
- Do not use the telephone to report a gas leak in the vicinity of the leak.

Consignes de sécurité relatives au modem

Lors de l'utilisation de votre matériel téléphonique, il est important de respecter les consignes ci-après afin de réduire les risques d'incendie, d'électrocution et d'autres blessures :
- N'installez jamais de cordons téléphoniques durant un orage.
- Les prises téléphoniques ne doivent pas être installées dans des endroits humides, excepté si le modèle a été conçu à cet effet.
- Ne touchez jamais un cordon téléphonique ou un terminal non isolé avant que la ligne ait été déconnectée du réseau téléphonique.
- Soyez toujours prudent lorsque vous procédez à l'installation ou à la modification de lignes téléphoniques.
- Si vous devez téléphoner pendant un orage, pour éviter tout risque de choc électrique, utilisez toujours un téléphone sans fil.
- En cas de fuite de gaz, n'utilisez jamais un téléphone situé à proximité de la fuite.

Laser compliance statement

Some IBM Personal Computer models are equipped from the factory with a CD-ROM drive or a DVD-ROM drive. CD-ROM drives and DVD-ROM drives are also sold separately as options. CD-ROM drives and DVD-ROM drives are laser products. These drives are certified in the U.S. to conform to the requirements of the Department of Health and Human Services 21 Code of Federal Regulations (DHHS 21 CFR) Subchapter J for Class 1 laser products. Elsewhere, these drives are certified to conform to the requirements of the International Electrotechnical Commission (IEC) 825 and CENELEC EN 60 825 for Class 1 laser products.

When a CD-ROM drive or a DVD-ROM drive is installed, note the following handling instructions.

CAUTION:
Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.

Removing the covers of the CD-ROM drive or DVD-ROM drive could result in exposure to hazardous laser radiation. There are no serviceable parts inside the CD-ROM drive or DVD-ROM drive. **Do not remove the drive covers.**

Some CD-ROM drives and DVD-ROM drives contain an embedded Class 3A or Class 3B laser diode. Note the following statement.

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

DANGER:

Certains modèles d'ordinateurs personnels sont équipés d'origine d'une unité de CD-ROM ou de DVD-ROM. Mais ces unités sont également vendues séparément en tant qu'options. L'unité de CD-ROM/DVD-ROM est un appareil à laser. Aux État-Unis, l'unité de CD-ROM/DVD-ROM est certifiée conforme aux normes indiquées dans le sous-chapitre J du DHHS 21 CFR relatif aux produits à laser de classe 1. Dans les autres pays, elle est certifiée être un produit à laser de classe 1 conforme aux normes CEI 825 et CENELEC EN 60 825.

Lorsqu'une unité de CD-ROM/DVD-ROM est installée, tenez compte des remarques suivantes:

ATTENTION: Pour éviter tout risque d'exposition au rayon laser, respectez les consignes de réglage et d'utilisation des commandes, ainsi que les procédures décrites.

L'ouverture de l'unité de CD-ROM/DVD-ROM peut entraîner un risque d'exposition au rayon laser. Pour toute intervention, faites appel à du personnel qualifié.

Certaines unités de CD-ROM/DVD-ROM peuvent contenir une diode à laser de classe 3A ou 3B. Tenez compte de la consigne qui suit:

DANGER

Rayonnement laser lorsque le carter est ouvert. Évitez toute exposition directe des yeux au rayon laser. Évitez de regarder fixement le faisceau ou de l'observer à l'aide d'instruments optiques.

Chapter 1. Overview

Thank you for selecting an IBM® computer. Your computer incorporates many of the latest advances in computer technology and can be upgraded as your needs change.
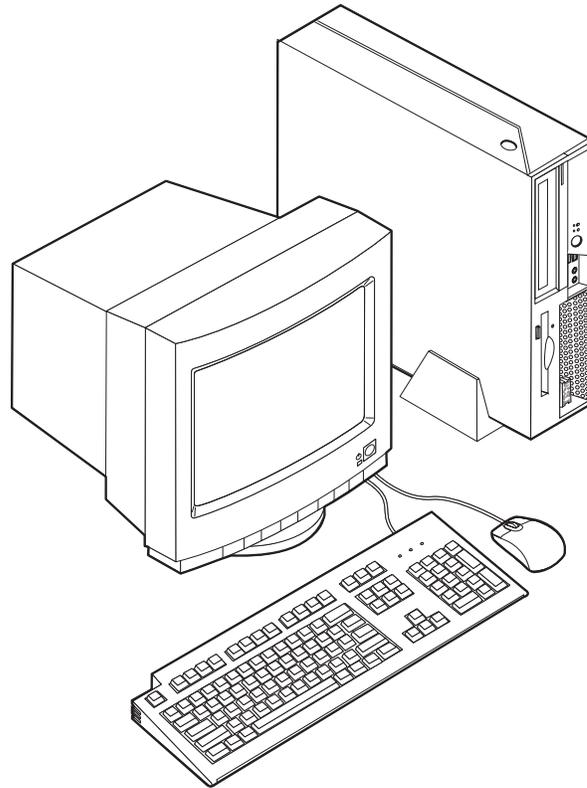
Instructions for installing external and internal options are included in this publication. When adding an option, use these instructions along with the instructions that come along with the option.

Information resources

The *Quick Reference* that comes with your computer provides information for setting up your computer, starting the operating system, troubleshooting, and notices.

Access IBM provides a link to more information about your computer. Click **Start** → **Access IBM**.

If you have Internet access, the most up-to-date manuals for your computer are available from the World Wide Web. To access this information, point your browser to:

http://www.ibm.com/pc/support

Type your machine type and model number in the **Quick Path** field, and click **Go**.

Features

This section provides an overview of the computer features and preinstalled software.

System summary

The following information covers a variety of models. For a listing of features for your specific model, go to Chapter 3, "Using the IBM Setup Utility," on page 25.

Microprocessor
- Intel Pentium® 4 processor with HyperThreading Technology
- Intel Pentium 4 processor
- Intel® Celeron™ processor
- Internal cache (size varies by model type)

Memory
Support for two 184-pin dual inline memory modules (DIMMs). Each DIMM socket can support up to 1 GB of PC2700 double data rate (DDR) synchronous dynamic random access memory (SDRAM) for a system maximum of 2 GB.

Internal drives
- 3.5-inch, half-inch (slim) diskette drive
- Hard disk drive
- CD-ROM, DVD-ROM, DVD-ROM/CD-RW Combo, CD-RW, or Rambo III, IV DVD-RAM Multi-Burner optical drive (some models)

Video subsystem
Intel Graphics Media Accelerator 900 with dual display support

Audio subsystem
The integrated AC'97 audio controller provides four audio connectors.
- Microphone and headphone connectors on the front panel
- Line-in and line-out connectors on the rear panel
- Mono internal speaker

Connectivity
- 10/100/1000 Mbps integrated Intel Ethernet controller that supports the Wake on LAN feature (some models)
- Peripheral Component Interconnect (PCI) V.90 Data/Fax modem (some models)

System management features
- Remote Program Load (RPL) and Dynamic Host Configuration Protocol (DHCP)
- Wake on LAN
- Wake on Serial port (RS232) from ACPI S1, S3, and S5
- Wake on USB from ACPI S1 and S3
- Wake on PS/2 Keyboard/Mouse from ACPI S1 and S3
- Remote Administration
- Automatic power-on startup

- System Management (SM) BIOS and SM software
- Ability to store POST hardware test results

Input/output features
- 1 PCI Slot
- 1 PCI Express x1 slot with support for PCI-e DVI-D Connection Adapter
- 25-pin Parallel Port
- Two 9-pin serial connectors
- Eight USB 2.0 connectors (two on front panel and six on rear panel)
- PS/2® mouse connector
- PS/2 keyboard connector
- Ethernet connector
- VGA monitor connector
- Two audio connectors (line-in and line-out) on rear panel
- Two audio connectors (microphone and headphone) on front panel

Expansion
- One 132-bit PCI slot
- One PCI Express x1 slot with support for PCI-e DVI-D Connection Adapter
- Two DIMM memory connectors

Power
- 225 Watt power supply with manual voltage selection switch
- Automatic 50/60 Hz input frequency switching
- Advanced Power Management support
- Advanced Configuration and Power Interface (ACPI) support

Security features

The IBM Embedded Security Subsystem (ESS) is a security subsystem included on IBM ThinkCentre PCs. It consists of a dedicated Hardware Security Module built on to the motherboard and Client Security Software, a free, web-downloaded application. ESS provides the following security values by enhancing the security of:
- data stored on the PC by providing an encryption application (File and Folder Encryption) or encryption products from ISVs (such as products from Utimaco Safeware)
- digital certificates and other digital identity information stored on a PC
- VPN products from Cisco, Check Point and 3Com by increasing the protection around login credentials these products use
- customer network by providing unique machine identifiers for PCs in the network (by associating certificates with the built-in Hardware Security Module)

Other security features include:
- User and administrator passwords
- Support for the addition of a cable lock such as a Kensington lock
- Knockout holes for installing a rope clip (U-bolt)
- Optional keylock on top cover
- Startup sequence control

- Startup without diskette drive, keyboard, or mouse
- Diskette and hard disk I/O control
- Serial and parallel port I/O control
- Security profile by device

IBM preinstalled software
Your computer comes with preinstalled software. An operating system, device drivers to support built-in features, and other support programs are included.

Operating systems (preinstalled) (varies by model)

Note: Not all countries or regions will have these operating systems.
- Microsoft® Windows® XP Home
- Microsoft Windows XP Professional

Available options

The following are some available options:
- External options
  - Parallel port devices, such as printers and external drives
  - Serial port devices, such as external modems and digital cameras
  - Audio devices, such as external speakers for the sound system
  - USB devices, such as printers, joysticks, and scanners
  - Security devices, such as a cable lock
  - Monitors
- Internal options
  - System memory, called dual inline memory modules (DIMMs)
  - Peripheral component interconnect (PCI) adapters
  - PCI Express x1 adaptors
  - CD-ROM, DVD-ROM, or CD-RW drive, hard disk drive, diskette drive, and other removable media drives

For the latest information about available options, see the following World Wide Web pages:
- http://www.ibm.com/pc/us/options/
- http://www.ibm.com/pc/support/

You can also obtain information by calling the following telephone numbers:
- Within the United States, call 1-800-IBM SERV (1-800-426-7378), your IBM reseller, or IBM marketing representative.
- Within Canada, call 1-800-565-3344 or 1-800-IBM-4YOU.
- Outside the United States and Canada, contact your IBM reseller or IBM marketing representative.

Specifications

This section lists certain specifications for your computer. For the latest specification information, see the *User Guide* for your computer model and type at:

http://www.ibm.com/pc/support/

Dimensions	**Airflow**
Width: 12.2 inches (310 mm)	Approximately 14 cubic feet (0.45 cubic meters) per minute
Height: 3.35 inches (85 mm)	
Depth: 14.1 inches (358 mm)	**Acoustical noise-emission values**
Weight	**Note:** In this computer, fan speed is controlled by temperature, configuration, and software. Actual noise-emission values might be different from the stated values depending on the number of fans and the speed of the fans.
Minimum configuration as shipped: 7.3 kg (16 lbs)	
Maximum configuration: 8.5 kg (18.7 lbs)	
Environment	Average sound-pressure levels for computers with a microprocessor that runs at or below 2.8 GHz:
Air temperature:	At operator position - 0.5 meters:
Operating at 0 - 3000 ft (914.4 m): 10° to 35°C (50° to 95°F)	Idle: 30 dBA
	Operating: 34 dBA
Operating at 3000 ft - 7000 ft (2134 m): 10° to 32°C (50° to 89.6°F)	At bystander position - 1 meter (3.3 ft):
	Idle: 26 dBA
Non-operating: 10° to 43°C (50° to 110°F)	Operating: 29 dBA
Humidity:	Declared (upper limit) sound-power levels:
Operating: 8% to 80%	Idle: 4.0 bels
Non-operating: 8% to 80%	Operating: 4.3 bels
Transit: 8% to 90%	Average sound-pressure levels for computers with a microprocessor that runs at greater than 2.8 GHz:
Maximum altitude: 7000 ft (2133.6 m)	
Electrical input	At operator position - 0.5 meters:
Input voltage:	Idle: 31 dBA
Low range:	Operating: 34 dBA
Minimum: 100 V ac	At bystander position - 1 meter (3.3 ft):
Maximum: 127 V ac	Idle: 26 dBA
Input frequency range: 50–60 Hz	Operating: 29 dBA
Voltage switch setting: 115 V ac	Declared (upper limit) sound-power levels:
High range:	Idle: 4.0 bels
Minimum: 200 V ac	Operating: 4.3 bels
Maximum: 240V ac	
Input frequency range: 50–60 Hz	**Note:** These levels were measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779 and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average values stated because of room reflections and other nearby noise sources. The declared sound-power levels indicate an upper limit, below which a large number of computers will operate.
Voltage switch setting: 230 V ac	
Input kilovolt-amperes (kVA) (approximate):	
Minimum configuration as shipped: 0.09 kVA	
Maximum configuration: 0.23 kVA	
Heat output (approximate) in British thermal units (Btu) per hour:	
Minimum configuration: 205.8 Btu/hr (60 watts)	
Maximum configuration: 548.8 Btu/hr (160 watts)	

Supported operating positions

To provide proper air flow to internal components, you must position your computer in one of the positions as illustrated below.
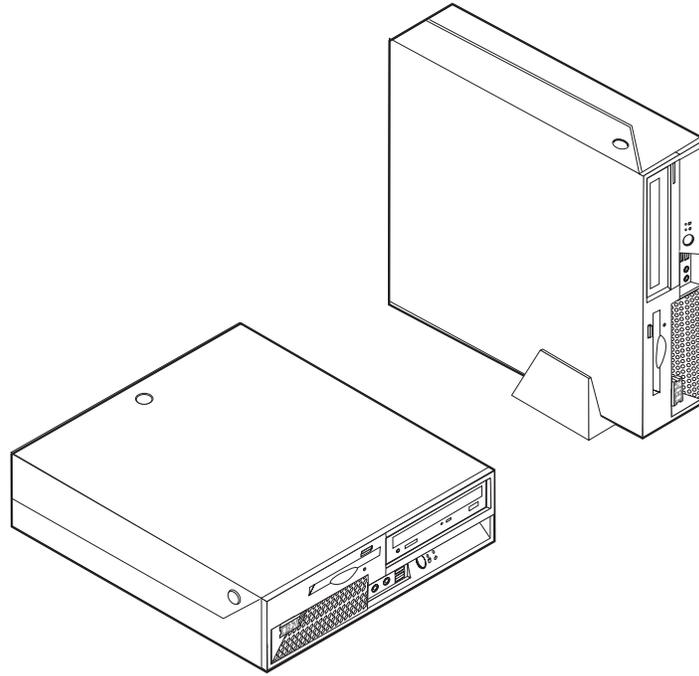
Chapter 2. Installing options

This chapter provides instructions for installing optional memory, PCI adapters, drives, and security features. When installing an option, use these instructions along with the instructions that come with the option.

> **Important**
>
> Before you install or remove any option, read "Important safety information" on page v. These precautions and guidelines will help you work safely.

Handling static-sensitive devices

Static electricity, although harmless to you, can seriously damage computer components and options.

When you add an option, do *not* open the static-protective package containing the option until you are instructed to do so.

When you handle options and other computer components, take these precautions to avoid static electricity damage:

- Limit your movement. Movement can cause static electricity to build up around you.
- Always handle components carefully. Handle adapters and memory modules by the edges. Never touch any exposed circuitry.
- Prevent others from touching components.
- When you install a new option, touch the static-protective package containing the option to a metal expansion-slot cover or other unpainted metal surface on the computer for at least two seconds. This reduces static electricity in the package and your body.
- When possible, remove the option and install it directly in the computer without setting the option down. When this is not possible, place the static-protective package that the option came in on a smooth, level surface and place the option on it.
- Do not place the option on the computer cover or other metal surface.

Installing external options

This section shows the various external connectors on your computer to which you can attach external options, such as external speakers, a printer, or a scanner. For some external options, you must install additional software in addition to making the physical connection. When adding an external option, use the information in this section to identify the required connector, and then use the instructions that come with the option to help you make the connection and install any software or device drivers that are required for the option.

Locating controls and connectors on the front of your computer

The following illustration shows locations of the controls and connectors on the front of your computer.
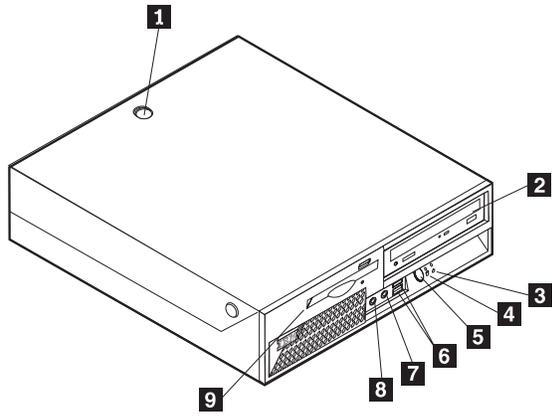
1	Cover keylock (some models)	6	USB connectors (2)
2	CD or DVD drive	7	Microphone connector (line in)
3	Hard disk drive activity indicator	8	Headphone connector (line out)
4	Power-on indicator	9	Diskette drive
5	Power button		

Locating connectors on the rear of your computer

The following illustration shows locations of connectors on the rear of your computer.
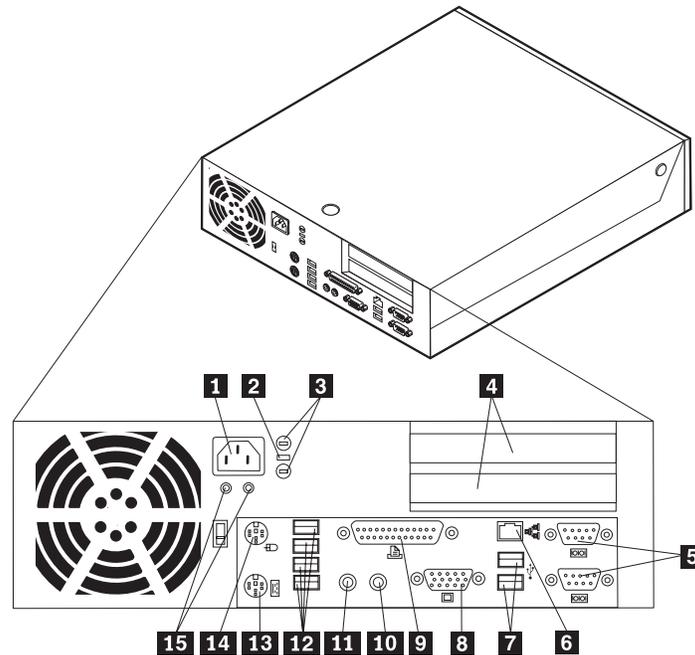
1	Power cord connector	**9**	Parallel connector
2	Cable lock latch	**10**	Audio line-in connector
3	Rope clip (U-bolt) holes	**11**	Audio line-out connector
4	PCI and PCI express adapter slots	**12**	USB connectors (4)
5	Serial connectors (2)	**13**	PS/2 keyboard connector
6	Ethernet connector	**14**	PS/2 mouse connector
7	USB connectors (2)	**15**	LEDs
8	VGA monitor connector		

Note: Some connectors on the rear of your computer are color-coded to help determine where to connect the cables.

Obtaining device drivers

You can obtain device drivers for operating systems that are not preinstalled at http://www.ibm.com/pc/support/ on the World Wide Web. Installation instructions are provided in README files with the device-driver files.

Opening the cover

To open the cover:

1. Shut down your operating system, remove any media (diskettes, CDs, or tapes) from the drives, and turn off all attached devices and the computer.

2. Unplug all power cords from electrical outlets.

3. Disconnect all cables attached to the computer. This includes power cords, input/output (I/O) cables, and any other cables that are connected to the computer.

4. Remove the floor stand, if attached.

5. If a cover lock is installed, unlock the cover.

6. Press inward on the two buttons and rotate the top cover upward as illustrated.
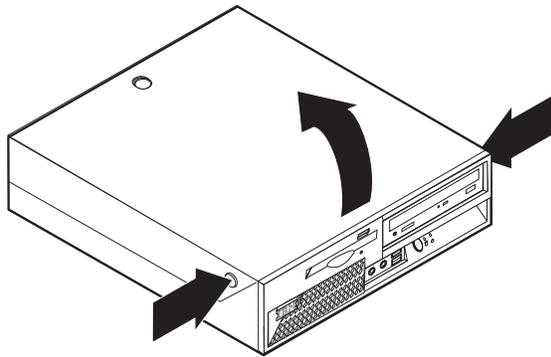
Locating components

The following illustration will help you locate the various components in your computer.
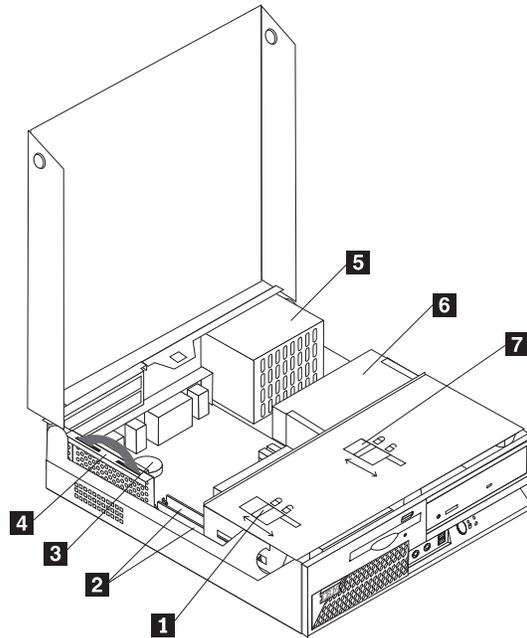
1	Diskette drive lock	**5**	Power supply assembly
2	DIMM (memory) connectors (2)	**6**	CD or DVD drive (hard disk drive is under the CD drive)
3	Battery	**7**	CD or DVD drive lock
4	PCI riser		

Accessing system board components and drives

You might need to rotate the drive bay assembly upward and remove the PCI riser and adapters to access system board components such as memory, the battery, the Clear CMOS/BIOS recovery jumper and to access the drives.

To access system board components and the drives:

1. Turn off the computer.
2. Open the cover. See "Opening the cover" on page 12.
3. Rotate the drive bay assembly upward as illustrated.

   Note: Make sure you note the location of any cables that you disconnect from the drives or the system board.
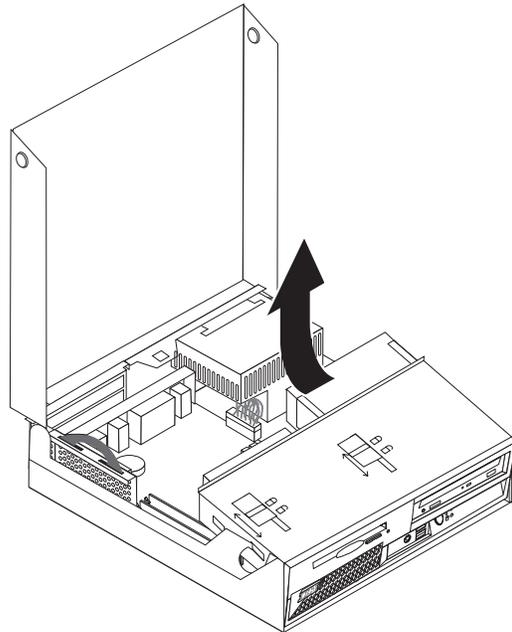
4. If any PCI adapters are installed, remove the PCI riser and adapter cards. Do not remove any adapters from the riser card. See "Installing PCI adapters" on page 17.

Identifying parts on the system board

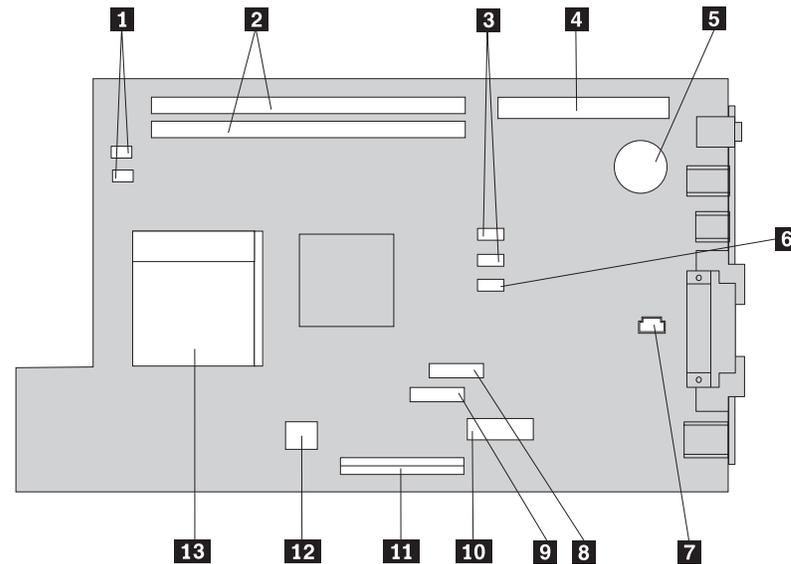The system board (sometimes called the *planar* or *motherboard*) is the main circuit board in your computer. It provides basic computer functions and supports a variety of devices that are IBM-installed or that you can install later.

The following illustration shows the locations of parts on the system board.

1	Fan connectors (2)	8	Diskette drive connector
2	Memory DIMM connectors (2)	9	Power button and front LED assembly connector
3	SATA IDE hard disk drive connectors (2)	10	Power supply connector
4	Riser connector	11	PATA Primary IDE connector (hard disk drive and CD-ROM drive)
5	CMOS Battery	12	Power supply connector
6	Clear CMOS/BIOS recovery jumper	13	Microprocessor
7	Internal speaker connector		

Installing memory

Your computer has two connectors for installing dual inline memory modules (DIMMs) that provide up to a maximum of 2 GB of system memory.

When installing memory, the following rules apply:
- Use 2.5 V, 184-pin, double data rate synchronous dynamic random access memory (DDR SDRAM), non-ECC DIMMs.
- Use 128 MB, 256 MB, 512 MB, or 1 GB DIMMs (when available) in any combination.

Note: Only DDR SDRAM DIMMs can be used.

To install DIMMs:
1. Access the system board. See "Accessing system board components and drives" on page 14.
2. Locate the DIMM connectors. See "Identifying parts on the system board" on page 15.
3. Open the retaining clips.
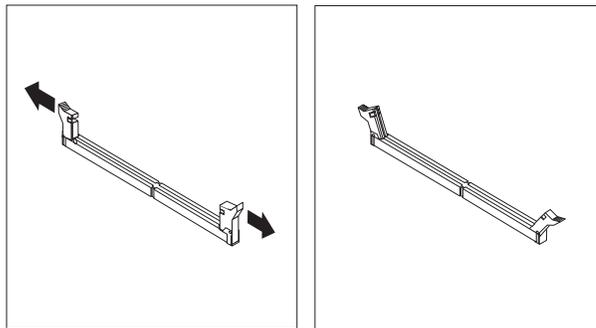
4. Make sure the notch in the DIMM aligns with the tab on the connector. Push or insert the memory module straight down into the connector until the retaining clips close.
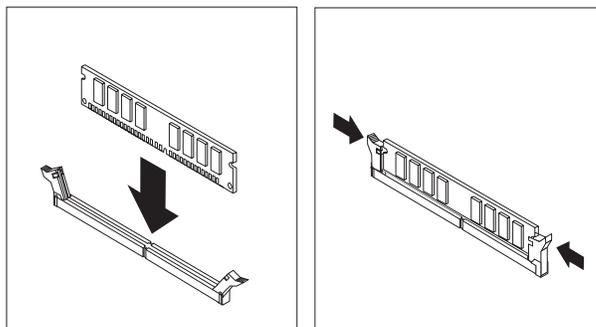
5. Replace the PCI riser and adapters if it was removed.
6. Place the drives back to the original position.
7. Replace the cover. See "Closing the cover and connecting the cables" on page 24.

Installing PCI adapters

This section provides information and instructions for installing and removing PCI adapters. Your computer has a riser card with one PCI expansion slot and one PCI Express x1 expansion slot.

To install a PCI adapter:

1. Open the cover. See "Opening the cover" on page 12.
2. While holding the left rear of the computer chassis down, pull upward on the handle provided, to remove the PCI riser and any adapters that are currently installed.
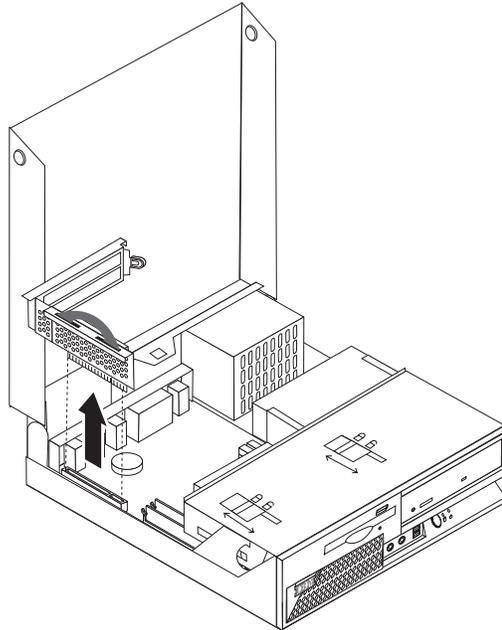
3. Release the slot cover latch and remove the slot cover for the appropriate expansion slot.
4. Remove the adapter from its static-protective package.
5. Install the adapter into the appropriate slot in the PCI riser.
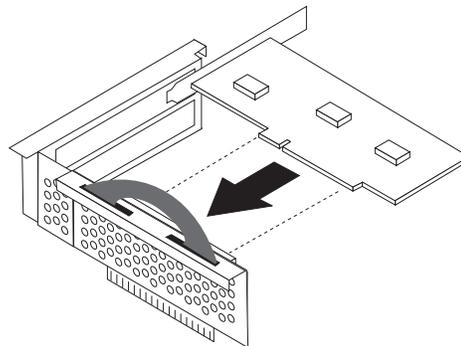
Note: The top slot is for the PCI adaptor and the bottom slot is for the PCI express adaptor.

6. Position the adapter-slot-cover latch to retain the adapters.
7. Reinstall the PCI riser and adapters.
8. Close the cover. See "Closing the cover and connecting the cables" on page 24.

What to do next:
- To work with another option, go to the appropriate section.
- To complete the installation, go to "Closing the cover and connecting the cables" on page 24.

Removing and replacing the battery

Your computer has a special type of memory that maintains the date, time, and settings for built-in features, such as parallel-port assignments (configuration). A battery, sometimes called the CMOS battery, keeps this information active when you turn off the computer.

The battery normally requires no charging or maintenance throughout its life; however, no battery lasts forever. If the battery fails, the date, time, and configuration information (including passwords) are lost. An error message is displayed when you turn on the computer.

Refer to "Lithium battery notice" on page x for information about replacing and disposing of the battery.

Important
Before you install or remove any component, read "Important safety information" on page v. These precautions and guidelines will help you work safely.

To change the battery:
1. Turn off the computer and disconnect the power cord from the electrical outlet and from the computer.
2. Open the cover. See "Opening the cover" on page 12.
3. Refer to "Identifying parts on the system board" on page 15 and locate the battery.
4. Remove the PCI riser and PCI adapters that impede access to the battery.
5. Remove the old battery.
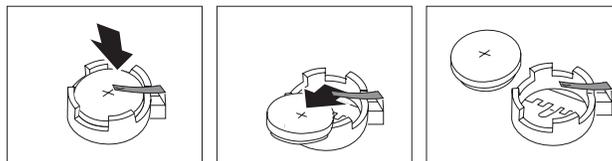
6. Install the new battery.
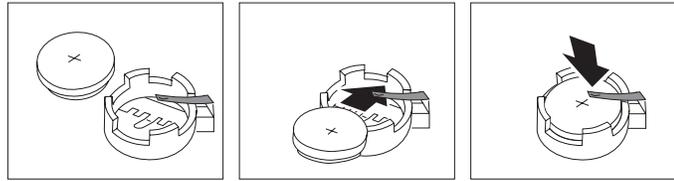
7. Install the PCI riser and adapters if removed.
8. Replace the cover, and connect the cables. See "Closing the cover and connecting the cables" on page 24.

   Note: When the computer is turned on for the first time after battery replacement, an error message might be displayed. This is normal after replacing the battery.

9. Turn on the computer and all attached devices.
10. Use the IBM Setup Utility program to set the date and time and any passwords.

Removing and replacing an optical drive

1. Open the cover. See "Opening the cover" on page 12.
2. Rotate the drive bay assembly upward to gain access to the cable connections. See "Accessing system board components and drives" on page 14 and "Locating components" on page 13.
3. Disconnect the signal and power cables from the drive.
4. Slide the lock **1** to the unlocked position.
5. Open the door at the front of the drive and slide it out the front of the computer.
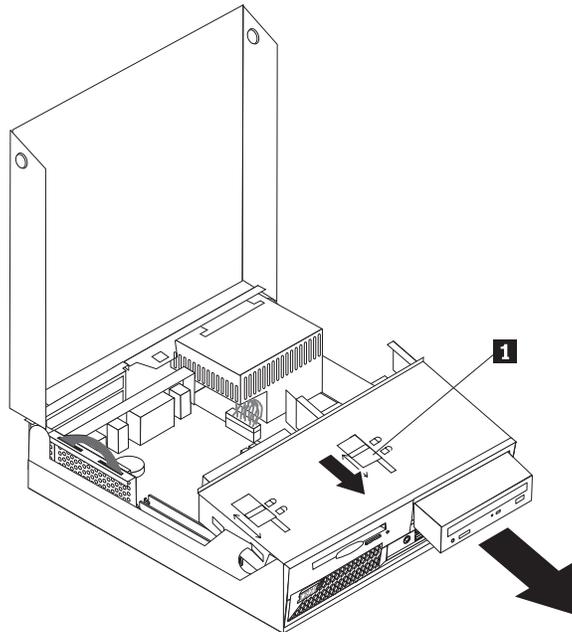
6. Install the new drive into the bay from the front.
7. Slide the lock **1** to the locked position and close the door at the front of the drive.

8. If you are replacing an existing drive, place the master/slave jumper on the drive in the same position as on the drive being replaced. Also refer to any instructions that come with the drive.

9. Connect the signal cable and power cable to the drive.

10. See "Closing the cover and connecting the cables" on page 24 to finish the procedure.

Removing and replacing a diskette drive

1. Open the cover. See "Opening the cover" on page 12.
2. Slide the lock **1** to the unlocked position.
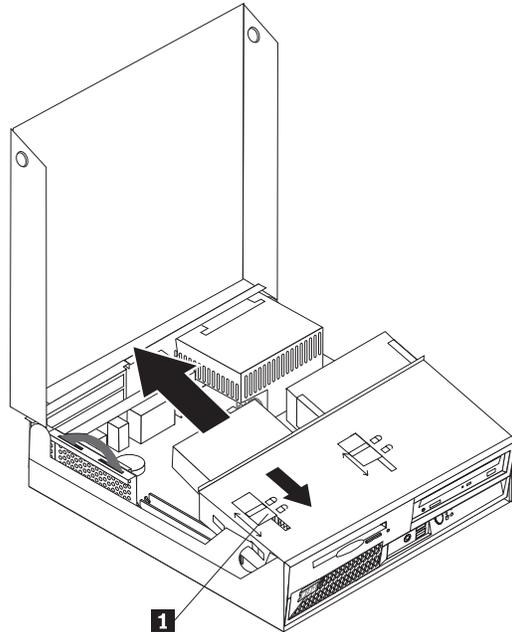
3. Slide the drive towards the rear of the computer far enough to gain access to the flat cable connector on the drive and disconnect the flat cable from the drive.

4. Rotate the drive bay assembly upward and remove the diskette drive.

To install a new diskette drive:

1. Slide the new drive partially into the bay from the rear.
2. Connect the flat cable to the new drive.
3. Slide the new drive completely into the bay and slide the lock **1** to the locked position.
4. See "Closing the cover and connecting the cables" on page 24 to finish the procedure.

Installing security features

To help prevent hardware theft and unauthorized access to your computer, several security lock options are available. The following sections help you identify and install the various types of locks that might be available for your computer. In addition to physical locks, unauthorized use of your computer can be prevented by a software lock that locks the keyboard until a correct password is typed in.

Make sure that any security cables you install do not interfere with other computer cables.

Identifying security locks

The following illustration will help you to identify the various types of security locks that your computer might have.
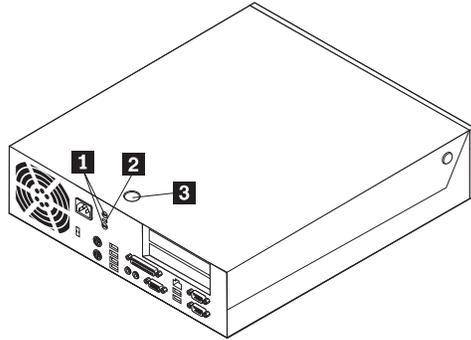
1	Holes for Rope clip (U-bolt)
2	Slot for integrated cable lock (Kensington lock)
3	Cover lock

Integrated security cable

With an integrated cable lock (sometimes referred to as the Kensington lock), you can secure your computer to a desk, table, or other non-permanent fixture. The cable lock attaches to a security slot at the rear of your computer and is operated with a key. This is the same type of lock used with many laptop computers. You can order a security cable directly from IBM. Go to http://www.pc.ibm.com/support and search on *Kensington*.
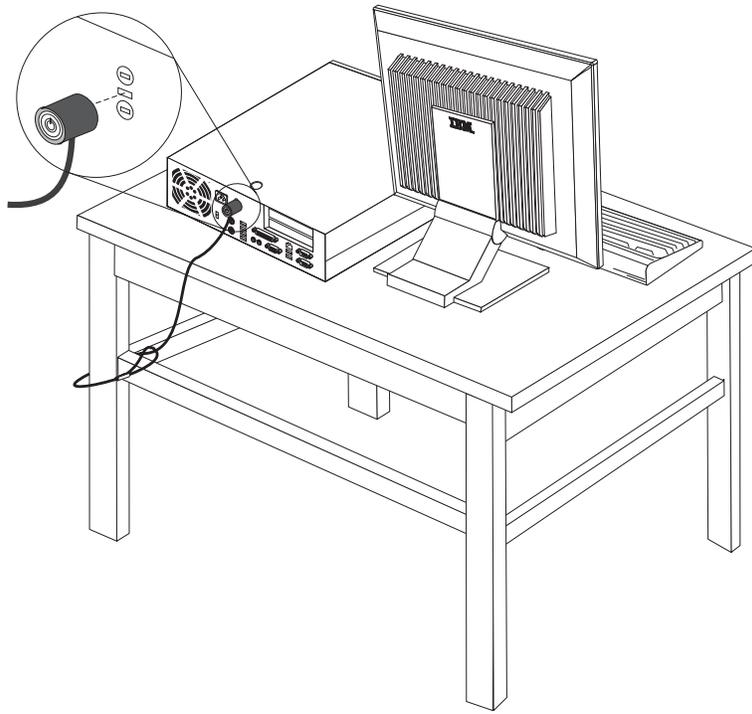
Rope clip

Using a 3/16 in (5 mm) security rope clip (sometimes referred to as a U-bolt), a steel security cable, and a padlock you can secure your computer to a desk, table, or other non-permanent fixture. For computers designed to accommodate the rope clip, knockouts at the rear of the chassis are provided.

To install a rope clip:

1. Remove the cover. See "Opening the cover" on page 12.
2. Use a tool, such as a screwdriver, to remove the two metal knockouts.
3. Insert the rope clip through the rear of the chassis and install the nuts using either an adjustable or an appropriate sized wrench.
4. Replace the cover.
5. Thread the security cable through the rope clip and around an object that is not part of or permanently attached to the building structure or foundation, and from which it cannot be removed; then fasten the cable together with a lock.
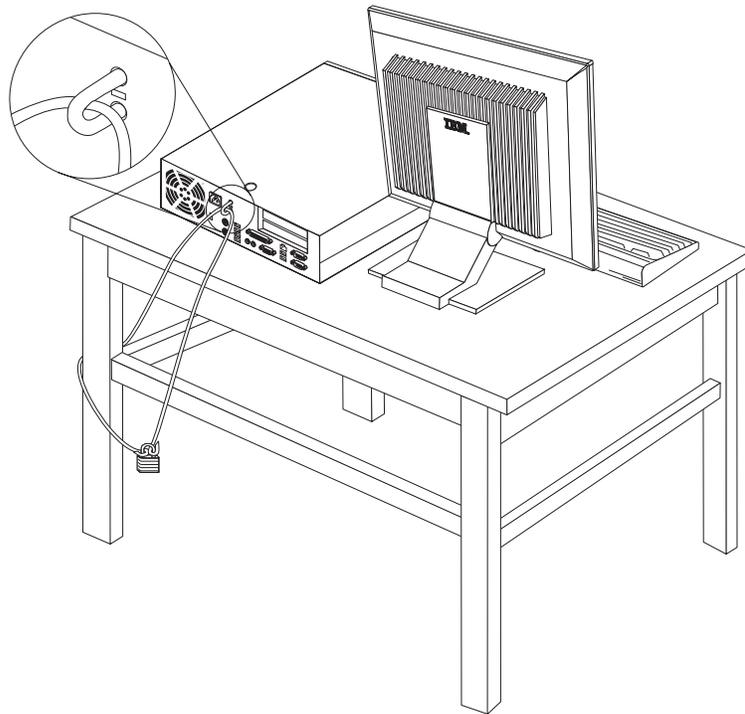
Cover lock

Your computer comes with a built-in key lock or a provision to install a key lock such as those provided by the Illinois Lock Company. The mailing address is:
Illinois Lock Company
301 W. Hintz Road
Wheeling, IL 60090-5754 USA

Password protection

To deter unauthorized use of your computer, you can use the IBM Setup Utility program to set a password. When you turn on your computer you are prompted to type the password to unlock the keyboard for normal use.

Erasing a lost or forgotten password (clearing CMOS)

This section applies to lost or forgotten passwords. For more information about lost or forgotten passwords, go to Access IBM.

To erase a forgotten password:

1. Refer to "Accessing system board components and drives" on page 14.
2. Locate the Clear CMOS/BIOS recovery jumper on the system board. See "Identifying parts on the system board" on page 15.
3. Move the jumper from the standard position (pins 1 and 2) to the maintenance or configure position (pins 2 and 3).
4. Install the PCI riser and adapters if removed.
5. Lower the drive bay assembly and reconnect any cables that were disconnected.
6. Close the cover and connect the power cable. See "Closing the cover and connecting the cables."
7. Restart the computer, leave it on for approximately 10 seconds, and then turn off the computer.
8. Repeat step 1.
9. Move the CMOS/BIOS recovery jumper back to the standard position (pins 1 and 2).
10. Reassemble the computer and close the cover. See "Closing the cover and connecting the cables."

Closing the cover and connecting the cables

After working with options, you need to install any removed parts, close the cover, and reconnect cables, including telephone lines and power cords. Also, depending on the option that is installed, you might need to confirm the updated information in the IBM Setup Utility program.

To close the cover and connect cables to your computer:

1. Ensure that all components have been reassembled correctly and that no tools or loose screws are left inside your computer.
2. Clear any cables that might impede the replacement of the cover.
3. Make sure the drive bay assembly is lowered and that the drive locks are both in the **locked position**. Otherwise, you cannot close the cover.
4. Close the cover.
5. If a cover lock is installed, lock the cover.
6. If your computer is being placed in the vertical position, attach the floor stand.

   Attention: To prevent overheating and possible component damage, always attach the floor stand when placing the computer in the vertical position.
7. Reconnect the external cables and power cords to the computer. See "Locating connectors on the rear of your computer" on page 11.
8. To update the configuration, see Chapter 3, "Using the IBM Setup Utility," on page 25.

Chapter 3. Using the IBM Setup Utility

The IBM Setup Utility program is stored in the electrically erasable programmable read-only memory (EEPROM) of your computer. The IBM Setup Utility program is used to view and change the configuration settings of your computer, regardless of which operating system you are using. However, the operating-system settings might override any similar settings in the IBM Setup Utility program.

Starting the IBM Setup Utility program

To start the IBM Setup Utility program, do the following:

1. If your computer is already on when you start this procedure, shut down the operating system and turn off the computer.
2. Turn on the computer and look for the following prompt on the logo screen:

   (To interrupt normal startup, press Enter)

   Press Enter when you see the prompt.
3. When the Startup Interrupt Menu displays, press F1.

   Note: If a user password or an administrator password has been set, the IBM Setup Utility program menu is not displayed until you type your password. See "Using passwords" for more information.

The IBM Setup Utility might start automatically when POST detects that hardware has been removed or new hardware has been installed in your computer.

Viewing and changing settings

The IBM Setup Utility program menu lists items that identify system configuration topics.

When working with the IBM Setup Utility program menu, you must use the keyboard. The keys used to perform various tasks are displayed at the bottom of each screen.

Exiting from the IBM Setup Utility program

When you finish viewing or changing settings, press Esc to return to the IBM Setup Utility program menu (you might have to press Esc several times). If you want to save the new settings, select **Save Settings** or **Save and exit the Setup Utility**. Otherwise, your changes will not be saved.

Using passwords

By using the IBM Setup Utility program, you can set passwords to prevent unauthorized persons from gaining access to your computer and data. The following types of passwords are available:

- User Password
- Administrator Password
- IDE Drive User Password
- IDE Drive Master Password

You do not have to set any passwords to use your computer. However, if you decide to set any passwords, read the following sections.

Password considerations

If you are setting any of the various types of passwords on your computer, you should read and understand the following information:

- If you type an incorrect password, you will see an error message. If you type an incorrect password three consecutive times, you must turn the computer off and start again.
- If you set both a User Password and an IDE Drive User Password to the same string, you will be prompted for the password only once when you turn on your computer.
- Do not move an IDE hard disk drive to another computer if an IDE Drive User Password has been set unless that computer also supports the IDE Drive User password.
- If your computer is connected to a local area network (LAN), Wake on LAN will not work unless both a User Password and an IDE Drive User Password are set using the same password.

User Password

When a User Password is set, the user is prompted to type a valid password each time the computer is turned on. The computer cannot be used until a valid password is typed from the keyboard.

Administrator Password

Setting an Administrator Password deters unauthorized persons from changing configuration settings. If you are responsible for maintaining the settings of several computers, you might want to set an Administrator Password.

After you set an Administrator Password, a password prompt is displayed each time you try to access the IBM Setup Utility program.

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

IDE Drive User Password

The IDE Drive User Password is used to protect the data on the IDE hard disk drive(s). When this password is set, you are prompted to type a valid password before any hard disk drive can be used. This prompt is displayed each time you turn on your computer. If your computer has multiple hard disk drives, they all must use the same password.

Attention

If an IDE Drive User Password is set but no IDE Drive Master Password is set, there is no recovery in the event that the IDE Drive User Password is lost or forgotten. The hard disk drive must be replaced. See "IDE Drive Master Password" on page 27.

IDE Drive Master Password

The IDE Drive Master Password is used to recover use of the hard disk drive in the event that the IDE Drive User Password is lost or forgotten. Only the person who knows the IDE Drive Master password can reset the IDE Drive User Password.

Attention

Make sure that the IDE Drive Master password is stored in a safe place. If both the IDE Drive User password and the IDE Drive Master password are lost or forgotten, the IDE hard disk drive must be replaced.

If both the IDE Drive User Password and the IDE Drive Master Password are to be set, the IDE Drive Master Password must be set before setting the IDE Drive User Password.

Setting, changing, and deleting a password

To set, change, or delete a password, do the following:

Note: A password can be any combination of up to seven characters (A- Z, a-z, and 0-9).

1. Start the IBM Setup Utility program (see "Starting the IBM Setup Utility program" on page 25).
2. From the IBM Setup Utility program menu, select **Security**.
3. Select **Set Passwords**. Read the information displayed on the right side of the screen.

Using Security Profile by Device

Security Profile by Device is used to enable or disable user access to the following devices:

IDE controller	When this feature is set to **Disable**, all devices connected to the IDE controller (such as hard disk drives or the CD-ROM drive) are disabled and will not be displayed in the system configuration.
Diskette Drive Access	When this feature is set to **Disable**, the diskette drive cannot be accessed.
Diskette Write Protect	When this feature is set to **Enable**, all diskettes are treated as if they are write-protected.

To set Security Profile by Device, do the following:

1. Start the IBM Setup Utility program (see "Starting the IBM Setup Utility program" on page 25).
2. From the IBM Setup Utility program menu, select **Security**.
3. Select **Security Profile by Device**.
4. Select the desired devices and settings and press Enter.
5. Return to the IBM Setup Utility program menu and select **Exit** and then **Save Settings** or **Save and exit the Setup Utility**.

   Note: If you do not want to save the settings, select **Exit the Setup Utility without saving**.

Selecting a startup device

If your computer does not start up (boot) from a device such as the CD-ROM, diskette, or hard disk as expected, use one of the following procedures to select a startup device.

Selecting a temporary startup device

Use this procedure to startup from any boot device.

Note: Not all CDs, hard disks, and diskettes are startable (bootable).

1. Turn off your computer.
2. Turn on your computer and look for the following prompt on the logo screen:

    (To interrupt normal startup, press Enter)

    Press Enter when you see the prompt.
3. When the Startup Interrupt Menu displays, press F12.
4. Select the desired startup device from the Startup Device menu and press Enter to begin.

Note: Selecting a startup device from the Startup Device menu does not permanently change the startup sequence.

Changing the startup device sequence

To view or permanently change the configured startup device sequence, do the following:

1. Start the IBM Setup Utility program (see "Starting the IBM Setup Utility program" on page 25).
2. Select **Startup**.
3. Select **Startup Sequence**. See the information displayed on the right side of the screen.
4. Select the devices for the Primary Startup Sequence, the Automatic Startup Sequence, and the Error Startup Sequence.
5. Select **Exit** from the IBM Setup Utility menu and then **Save Settings** or **Save and exit the Setup Utility**.

If you have changed these settings and want to return to the default settings, select **Load Default Settings** on the Exit menu.

Advanced settings

On some computer models the Advanced settings menu includes a setting to Enable/Disable HyperThreading. This feature works only with HyperThreading-aware operating systems such as Microsoft Windows XP. The default setting for HyperThreading is Enabled. However, if you select **Set Defaults** and are using an operating system other than Windows XP, your computer performance might be degraded. Therefore, you should always set HyperThreading to Disabled unless you are sure your operating system supports HyperThreading.

Appendix A. Updating POST/BIOS

This appendix contains information about updating POST/BIOS and how to recover from a POST/BIOS update failure.

POST/BIOS

POST and *BIOS* are the basic layer of software that is built into your computer. They include the power-on self-test (POST), the basic input/output system (BIOS) code, and the IBM Setup Utility program. POST is a set of tests and procedures that is performed each time you turn on your computer. BIOS is a layer of software that translates instructions from other layers of software into electrical signals that the computer hardware can understand. You can use the IBM Setup Utility program to view and change the configuration and setup of your computer.

Your computer system board has a module called *electrically erasable programmable read-only memory* (EEPROM, also referred to as *flash memory*). You can easily update POST, BIOS, and the IBM Setup Utility program by starting your computer using a flash update diskette or by running a special update program from your operating system.

IBM might make changes and enhancements to the POST/BIOS. When updates are released, they are available as downloadable files on the World Wide Web (see the *Quick Reference*). Instructions for using the POST/BIOS updates are available in a .txt file that is included with the update files. For most models, you can download either an update program to create a system-program-update (flash) diskette or an update program that can be run from the operating system.

Note: You can download a self starting bootable CD image (known as an .iso image) of the diagnostics program from http://www.ibm.com/pc/support to support systems without a diskette drive.

Updating (flashing) BIOS from a diskette

1. Insert a POST/BIOS update (flash) diskette into the diskette drive (drive A) in your computer. POST/BIOS updates are available at http://www.ibm.com/pc/support/ on the World Wide Web.
2. Turn on the computer. If it is on already, you must turn it off and back on again. The update begins.

Updating (flashing) BIOS from your operating system

Note: Due to constant improvements being made to the IBM Web site, Web page content (including the links referenced in the following procedure) is subject to change.
1. From your browser, type http://www.pc.ibm.com/support in the address field and press Enter.
2. Locate Downloadable files for your type of computer.
3. Under Select your product, choose your machine type and click **Go**.
4. In Downloadable file by category, click **BIOS**.
5. Under Download files - BIOS by date, click your machine type.

6. Scroll down and look for a .txt file that has instructions for Flash BIOS update from the operating system. Click the .txt file.

7. Print these instructions. This is very important since they are not on the screen after the download begins.

8. From your browser, Click **Back** to return to the list of files. Carefully follow the printed instructions to download, extract, and install the update.

Recovering from a POST/BIOS update failure

If power to your computer is interrupted while POST/BIOS is being updated (flash update), your computer might not restart correctly. If this happens, perform the following procedure commonly called Boot-block Recovery.

1. Turn off the computer and any attached devices, such as printers, monitors, and external drives.

2. Unplug all power cords from electrical outlets, and open the cover. See "Opening the cover" on page 12.

3. Locate the Clear CMOS/BIOS Recovery jumper on the system board. See "Identifying parts on the system board" on page 15.

4. If necessary, refer to "Accessing system board components and drives" on page 14 to gain access to the Clear CMOS/BIOS Recovery jumper.

5. Remove any cables or adapters that impede access to the Clear CMOS/BIOS Recovery jumper.

6. Move the jumper from the standard position (pins 1 and 2) to pins 2 and 3.

7. Replace any cables or adapters that were removed.

8. Close the cover. See "Closing the cover and connecting the cables" on page 24.

9. Reconnect the power cords for the computer and monitor to electrical outlets.

10. Insert the POST/BIOS update (flash) diskette into drive A, and turn on the computer and the monitor.

11. During the update session there will be no video. You will hear a long beep when recovery is completed. Remove the diskette from the diskette drive, and turn off the computer and monitor.

12. Unplug the power cords from electrical outlets.

13. Open the cover. See "Opening the cover" on page 12.

14. Remove any cables or adapters that impede access to the Clear CMOS/BIOS Recovery jumper.

15. Replace the Clear CMOS/BIOS Recovery jumper to its original position.

16. Replace any cables or adapters that were removed.

17. Close the cover and reconnect any cables that were disconnected.

18. Turn on the computer to restart the operating system.

Appendix B. Cleaning the mouse

This appendix provides instructions on how to clean your mouse. The procedure will be different depending on which type of mouse you have.

Cleaning an optical mouse

If you experience some problems with your optical mouse, check the following:

1. Turn the mouse over and look carefully at the lens area.
   a. If there is a smudge on the lens, gently clean the area with a plain cotton swab or plain q-tip.
   b. If there is some debris in the lens, gently blow the debris away from the area.
2. Check the surface you are using the mouse on. If you have a very intricate picture or pattern beneath the mouse it is difficult for the digital signal processor (DSP) to determine changes in the mouse position.

Cleaning a mouse with a ball

If the pointer on the screen does not move smoothly with the mouse, you might need to clean the mouse.

Note: The following illustration might be slightly different from your mouse.
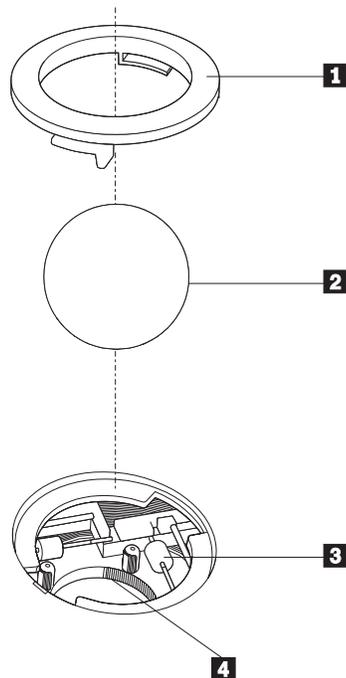
1 Retainer ring
2 Ball
3 Plastic rollers
4 Ball cage

To clean a mouse with a ball:

1. Turn off your computer.
2. Turn the mouse over, with the top side down, and look carefully at the bottom. Twist the retainer ring **1** to the unlocked position to remove the ball.
3. Place your hand over the retainer ring and ball **2** , and then turn the mouse over, top side up, so that the retainer ring and ball fall out into your hand.
4. Wash the ball in warm, soapy water then dry it with a clean cloth. Blow air carefully into the ball cage **4** to dislodge dust and lint.
5. Look for a build up of dirt on the plastic rollers **3** inside the ball cage. This build up usually appears as a stripe running across the middle of the rollers.
6. If the rollers are dirty, clean them by using a cotton swab soaked in isopropyl (rubbing) alcohol. Turn the rollers with your finger and continue swabbing them until all the dirt is removed. Be sure the rollers are still centered in their channels after you clean them.
7. Remove any fibers from the swab that might be remaining on the rollers.
8. Replace the ball and the retainer ring.
9. Turn your computer back on.

Appendix C. Manual modem commands

The following section lists commands for manually programming your modem.

Commands are accepted by the modem while it is in Command Mode. Your modem is automatically in Command Mode until you dial a number and establish a connection. Commands may be sent to your modem from a PC running communication software or any other terminal devices.

All commands sent to the modem must begin with **AT** and end with **ENTER**. All commands may be typed in either upper or lower case, but not mixed. To make the command line more readable, spaces may be inserted between commands. If you omit a parameter from a command that requires one, it is just like specifying a parameter of **0**.

Example:

ATH [ENTER]

Basic AT commands

In the following listings, all default settings are printed in **bold text**.

Command		Function
A		Manually answer incoming call.
A/		Repeat last command executed. **Do not** precede **A/** with AT or follow with ENTER.
D_		**0 - 9, A-D, # and ***
	L	last number redial
	P	pulse dialing
		Note: Pulse dialing is not supported for Australia, New Zealand, Norway, and South Africa.
	T	**touch-tone dialing**
	W	wait for second dial tone
	,	pause
	@	wait for five seconds of silence
	!	flash
	;	return to Command Mode after dialing
DS=n		Dial one of the four telephone numbers (n=0-3) stored in the modem non-volatile memory.
E_	E0	Commands are not echoed
	E1	**Commands are echoed**
+++		Escape Characters - Switch from Data Mode to Command Mode (T.I.E.S. Command)
H_	H0	Force modem on-hook (hang up)

Command		Function
	H1	Force modem off-hook (make busy)
		Note: H1 command is not supported for Italy
I_	I0	Display product-identification code
	I1	Factory ROM checksum test
	I2	Internal memory test
	I3	Firmware ID
	I4	Reserved ID
L_	L0	Low speaker volume
	L1	**Low speaker volume**
	L2	Medium speaker volume
	L3	High speaker volume
M_	M0	Internal speaker off
	M1	**Internal speaker on until carrier detected**
	M2	Internal speaker always on
	M3	Internal speaker on until carrier detected and off while dialing
N_		Included for compatibility only, provides no effect
O_	O0	Return to Data Mode
	O1	Return to Data Mode and initiate an equalizer retrain
P		**Set Pulse dial as default**
Q_	Q0	Modem sends responses
Sr?		Read and display value in register r.
Sr=n		Set register r to value n (n = 0-255).
T		**Set Tone Dial as default**
V_	**V0**	**Numeric responses**
	V1	**Word responses**
W_	**W0**	**Report DTE speed only**
	W1	Report line speed, error correction protocol, and DTE speed.
	W2	Report DCE speed only
X_	X0	Hayes Smartmodem 300 compatible responses/blind dialing.
	X1	Same as X0 plus all CONNECT responses/blind dialing
	X2	Same as X1 plus dial tone detection
	X3	Same as X1 plus busy detection/blind dialing
	X4	All responses and dial tone and busy **signal detection**
Z_	Z0	Reset and retrieve active profile 0
	Z1	Reset and retrieve active profile 1

Extended AT commands

Command		Function
&C_	&C0	Force Carrier Detect Signal High (ON)
	&C1	**Turn on CD when remote carrier is present**
&D_	&D0	**Modem ignores the DTR signal**
	&D1	Modem returns to Command Mode after DTR toggle
	&D2	**Modem hangs up, returns to the Command Mode after DTR toggle**
	&D3	Resets modem after DTR toggle
&F_	&F	Recall factory default configuration
&G_	**&G0**	**Guard tone disabled**
	&G1	Guard tone disabled
	&G2	1800 Hz guard tone
&K_	&K0	Disable flow control
	&K3	**Enable RTS/CTS hardware flow control**
	&K4	Enable XON/XOFF software flow control
	&K5	Enable transparent XON/XOFF flow control
	&K6	Enable both RTS/CTS and XON/XOFF flow control
&M_	**&M0**	Asynchronous operation
&P_	**&P0**	**US setting for off-hook-to-on-hook ratio**
	&P1	UK and Hong Kong off-hook-to-on-hook ratio
	&P2	Same as &P0 setting but at 20 pulses per minute
	&P3	Same as &P1 setting but at 20 pulses per minute
&R_	&R0	Reserved
	&R1	**CTS operates per flow control requirements**
&S_	**&S0**	**Force DSR Signal High (ON)**
	&S1	DSR off in command mode, on in on-line mode
&T_	&T0	Ends test in progress
	&T1	Perform Local Analog Loopback Test
	&T3	Perform Local Digital Loopback Test
	&T4	**Grant Remote Digital Loopback Test request by remote modem**
	&T5	Deny Remote Digital Loopback Test request
	&T6	Perform a Remote Digital Loopback Test
	&T7	Perform a Remote Digital Loopback Test and Self-Test
	&T8	Perform Local Analog Loopback Test and Self-Test
&V	&V0	Displays Active and Stored Profiles

Command		Function
	&V1	Display Last Connection Statistics
&W_	&W0	Stores the active profile as Profile 0
	&W1	Stores the active profile as Profile 1
%E_	**%E0**	**Disable auto-retrain**
	%E1	Enable auto-retrain
+MS?		Displays the current Select Modulation settings
+MS=?		Displays a list of supported Select Modulation options
+MS=a,b,c,e,f		Select modulation where: **a**=0, 1, 2, 3, 9, 10, 11, 12, 56, 64, 69; **b**=0-1; **c**=300-56000; **d**=300-56000; **e**=0-1; and **f**=0-1. **A, b, c, d, e, f** default=**12, 1, 300, 56000, 0, 0.** Parameter **"a"** specifies the modulation protocol desired where: 0=V.21, 1=V.22, 2=V.22bis, 3=V.23, 9=V.32, 10=V.32bis, 11=V.34, 12=V.90,K56Flex,V.34......,56=K 56Flex, V.90,V.34......, 64=Bell 103, and 69=Bell 212. Parameter "b" specifies automode operations where: 0=automode disabled, 1= automode enabled with V.8/V.32 Annex A. Parameter **"c"** specifies the minimum connection data rate (300- 56000). Parameter **"d"** specifies the maximum connection rate (300-56000); Parameter **"e"** specifies the codec type (0= Law, and 1=A-Law). Parameter **"f"** specifies "robbed bit" signaling detection (0=detection disabled 1=detection enabled)

MNP/V.42/V.42bis/V.44 commands

Command		Function
%C_	%C0	Disable MNP Class 5 and V.42bis data compression
	%C1	Enable MNP Class 5 data compression only
	%C2	Enable V.42bis data compression only
	%C3	**Enable MNP Class 5 and V.42bis data compression**
&Q_	&Q0	Direct data link only (same as \N1)
	&Q5	**V.42 data link with fallback options**
	&Q6	Normal data link only (same as \N0)
+DS44=0, 0		Disable V.44
+DS44=3, 0		Enable V.44
+DS44?		Current values
+DS44=?		List of support values

Fax Class 1 commands

+FAE=n	Data/Fax Auto Answer
+FCLASS=n	Service Class
+FRH=n	Receive data with HDLC framing
+FRM=n	Receive data
+FRS=n	Receive silence
+FTH=n	Transmit data with HDLC framing
+FTM=n	Transmit data
+FTS=n	Stop transmission and wait

Fax Class 2 commands

+FCLASS=n	Services class.
+FAA=n	Adaptive answer.
+FAXERR	Fax error value.
+FBOR	Phase C data bit order.
+FBUF?	Buffer size (read only).
+FCFR	Indicate confirmation to receive.
+FCLASS=	Service class.
+FCON	Facsimile connection response.
+FCIG	Set the polled station identification.
+FCIG:	Report the polled station identification.
+FCR	Capability to receive.
+FCR=	Capability to receive.
+FCSI:	Report the called station ID.
+FDCC=	DCE capabilities parameters.
+FDCS:	Report current session.
+FDCS=	Current session results.
+FDIS:	Report remote capabilities.
+FDIS=	Current sessions parameters.
+FDR	Begin or continue phase C receive data.
+FDT=	Data transmission.
+FDTC:	Report the polled station capabilities.
+FET:	Post page message response.
+FET=N	Transmit page punctuation.
+FHNG	Call termination with status.
+FK	Session termination.
+FLID=	Local ID string.
+FLPL	Document for polling.
+FMDL?	Identify model.
+FMFR?	Identify manufacturer.

+FPHCTO	Phase C time out.
+FPOLL	Indicates polling request.
+FPTS:	Page transfer status.
+FPTS=	Page transfer status.
+FREV?	Identify revision.
+FSPT	Enable polling.
+FTSI:	Report the transmit station ID.

Voice commands

#BDR	Select Baud Rate
#CID	Enable Caller ID detection and reporting format
#CLS	Select Data, Fax or Voice/Audio
#MDL?	Identify Model
#MFR?	Identify Manufacturer
#REV?	Identify Revision Level
#TL	Audio output transmit level
#VBQ?	Query Buffer Size
#VBS	Bits per sample (ADPCM or PCM)
#VBT	Beep Tone Timer
#VCI?	Identify Compression Method
#VLS	Voice line select
#VRA	Ringback goes away timer
#VRN	Ringback never came timer
#VRX	Voice Receive Mode
#VSDB	Silence deletion tuner
#VSK	Buffer skid setting
#VSP	Silence detection period
#VSR	Sampling rate selection
#VSS	Silence deletion tuner
#VTD	DTMF tone reporting capability
#VTM	Enable timing mark placement
#VTS	Generate tone signals
#VTX	Voice transmit mode

> **Attention Switzerland User:**
>
> If your Swisscom phone line does not have Taxsignal switched OFF, modem function may be impaired. The impairment may be resolved by a filter with the following specifications:
>
> Telekom PTT SCR-BE
> Taximpulssperrfilter-12kHz
> PTT Art. 444.112.7
> Bakom 93.0291.Z.N

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