



**Note**

Before using this information and the product it supports, be sure to read the general information under “Important safety instructions” on page v and “Notices” on page 47.

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# Contents

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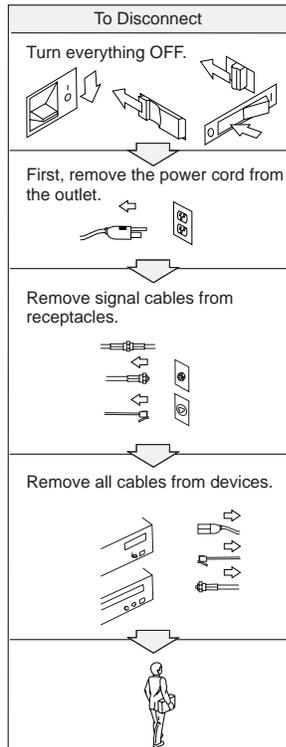
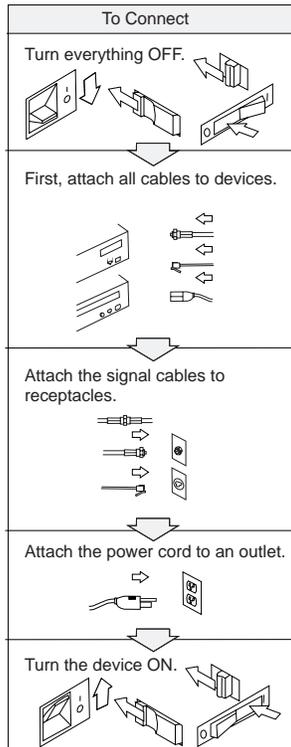
<b>Important safety instructions</b> . . . . .	v
Laser compliance statement . . . . .	ix
<b>Handling the ThinkPad computer</b> . . . . .	xi
ThinkPad don'ts . . . . .	xi
ThinkPad do's . . . . .	xiii
Cleaning your computer . . . . .	xiii
Carrying your computer . . . . .	xiv
Extending the life of your computer's battery . . . . .	xiv
<b>Chapter 1. System overview</b> . . . . .	1
Features . . . . .	2
Specifications . . . . .	5
Using your online user's guide . . . . .	7
Starting BIOS Setup Utility . . . . .	8
<b>Chapter 2. Protecting your computer</b> . . . . .	11
Using passwords . . . . .	12
Power-on password . . . . .	12
Screen saver password . . . . .	12
Hard-disk passwords . . . . .	13
Windows password . . . . .	13
Supervisor password . . . . .	14
Network password . . . . .	14
Passwords and standby mode . . . . .	14
Using the locks and the security screw . . . . .	15
Attaching the mechanical lock . . . . .	15
Using the security screw . . . . .	15
Using the Asset RF ID feature . . . . .	16
<b>Chapter 3. Solving computer problems</b> . . . . .	17
Troubleshooting . . . . .	18
Error codes or messages . . . . .	18
No error codes or messages . . . . .	22
Power switch problem . . . . .	22
Input problems . . . . .	23
Standby or hibernation problems . . . . .	25
LCD problems . . . . .	28
Battery problems . . . . .	30
Hard-disk-drive problems . . . . .	31
Software problems . . . . .	32

Other problems . . . . .	34
Testing your computer . . . . .	35
Backing up your system . . . . .	35
Backing up your system configuration . . . . .	35
Backing up your data . . . . .	36
Recovering lost or damaged software . . . . .	37
Getting service . . . . .	40
ThinkPad Web site . . . . .	41
Recording sheets . . . . .	42
<b>Appendix A. Product warranty and notices . . . . .</b>	<b>45</b>
Notices . . . . .	47
Year 2000 readiness and instructions . . . . .	47
Trademarks . . . . .	48
Electronic emission notices . . . . .	49
Telecommunication notices . . . . .	51
Product notice requirements . . . . .	54
Notice for Australia . . . . .	54
Notice for New Zealand . . . . .	54
Notice for European Union countries . . . . .	55

# Important safety instructions



**Electric current from power, telephone, and communication cables is hazardous. To avoid shock hazard, connect and disconnect cables as shown below when installing, moving, or opening the covers of this product or attached devices. If the 3-pin power cord is provided with this product, it must be used with a properly grounded outlet.**





Reduce the risk of fire and electric shock by always following basic safety precautions, including the following:

- Do not use your computer in or near water.
- During electrical storms:
  - Do not use your computer with the telephone cable connection.
  - Do not connect the cable to or disconnect it from the telephone outlet on the wall.



If the rechargeable battery pack is incorrectly replaced, there is danger of an explosion. The battery pack contains a small amount of harmful substances. To avoid possible injury:

- Replace only with a battery of the type recommended by IBM, or an equivalent.
- Keep the battery pack away from fire.
- Do not expose it to water or rain.
- Do not attempt to disassemble it.
- Do not short-circuit it.
- Keep it away from children.

Do not put the battery pack in trash that is disposed of in landfills. When disposing of the battery, comply with local ordinances or regulations and your company's safety standards. In the United States, call IBM at 1-800-IBM-4333 for information on disposal.

**DANGER**

There is a danger of an explosion if the backup battery is incorrectly replaced.

The lithium battery (IBM P/N 02K6572 UL-recognized component [file no. MH12210]) contains lithium and can explode if it is not properly handled or disposed of.

Replace only with a battery of the same type.

To avoid possible injury or death, do not: (1) throw or immerse the battery into water, (2) allow it to heat to more than 100 °C (212 °F), or (3) attempt to repair or disassemble it. Dispose of it as required by local ordinances or regulations and your company's safety standards.

**DANGER**

Follow the instructions below when installing or reconfiguring the Mini PCI option.

To avoid shock hazard, disconnect all the cables and the ac adapter when you install the Mini PCI option or open the covers of the system or attached devices. Electrical current from power, telephone, and communication cables is hazardous.

**CAUTION:**

When you have added or upgraded a Mini PCI Card or a memory card, do not use your computer until you have closed the cover. Never use the computer when the cover is open.

Remove the main battery pack of the computer also. The certain circuit of the system still exists even if the power seems to be off. Do not forget to remove the ac adapter and the battery pack.

**CAUTION:**

The fluorescent lamp in the liquid crystal display (LCD) contains mercury. Do not put it in trash that is disposed of in landfills. Dispose of it as required by local ordinances or regulations.

The LCD is made of glass, and rough handling or dropping the computer can cause the LCD to break. If the LCD breaks and the internal fluid gets into your eyes or on your hands, immediately wash the affected areas with water for at least 15 minutes; if any symptoms are present after washing, get medical care.

**CAUTION:**

To reduce the risk of fire, use only No. 26 AWG or larger (thicker) telephone cable.

## Laser compliance statement

The CD-ROM or DVD drive, which can be installed in the IBM ThinkPad T20, is a laser product. The drive's classification label (shown below) is on the surface of the drive.

CLASS 1 LASER PRODUCT  
LASER KLASSE 1  
LUOKAN 1 LASERLAITE  
APPAREIL A LASER DE CLASSE 1  
KLASS 1 LASER APPARAT

The drive is 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 I laser products.

In other countries, the drive is certified to conform to the requirements of EN60825.



**Do not open the CD-ROM or DVD drive unit; no user adjustments or serviceable parts are inside.**

**Use of controls, adjustments, or the performance of procedures other than those specified might result in hazardous radiation exposure.**

Class 1 laser products are not considered hazardous. The design of the laser system and the CD-ROM or DVD-ROM drive ensures that there is no exposure to laser radiation above a Class 1 level during normal operation, user maintenance, or servicing.

Some drives contain an embedded Class 3A laser diode. Note this warning:



**Emits visible and invisible laser radiation when open.  
Avoid direct eye exposure. Do not stare into the beam  
or view it directly with optical instruments.**

Save these instructions.

## Handling the ThinkPad computer

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Notebook computers are precision machines that require careful handling. Though your computer is designed and tested to be durable and to function reliably in normal work environments, you need to use some common sense in handling it.

This section provides tips for handling notebook computers in general. Some descriptions might not suit your situation.

Check your shipping checklist to confirm the items you get with your computer.

By following these handling tips, you will get the most use and enjoyment out of your computer for a long time to come.

### ThinkPad don'ts

- Do not subject your computer to physical punishment, such as dropping or bumping.
- Do not place heavy objects on your computer.
- Do not spill or allow liquids into your computer.
- Do not use your computer in or near water (to avoid the danger of electrical shock).
- Do not pack your computer in a tightly packed suitcase or bag. Your LCD might be damaged.

A scratchlike marking on your LCD might be a stain transferred from the keyboard or from the TrackPoint stick when the cover was pressed from the outside. Wipe such a stain gently with a dry soft cloth. If the stain remains, moisten the cloth with LCD cleaner and wipe the stain again. Be sure to dry the LCD before closing it.

- Do not disassemble your computer. Only an authorized IBM ThinkPad repair technician should disassemble and repair your computer.
- Do not scratch, twist, hit, or push the surface of your computer display.
- Do not place any objects between the display and the keyboard or under the keyboard.
- Do not pick up or hold your computer by the display. When picking up your open computer, hold it by the bottom (keyboard) half.

- Do not modify or tape the latches to keep the display open or closed.
- Do not turn your computer over while the ac adapter is plugged in. This could break the adapter plug.
- Do not move the computer when the hard disk drive is accessing data (when the indicator is blinking).
- Do not use or store your computer where the temperature is below 5° C or above 35° C (41° F and 95° F).
- Do not place your computer closer than 13 cm (5 in.) to any electrical appliance that generates a strong magnetic field, such as a motor, a magnet, a TV, a refrigerator, or large audio speakers.
- Do not put an operating cellular phone on the computer. The phone might cause malfunction in the computer system.
- Do not hard-mount your computer in a vehicle or anywhere that it is subject to strong vibration.
- Do not crush, drop, or physically punish the external or removable hard disk, diskette, or CD-ROM drive when it is outside your computer.
- Do not press on the middle part of the diskette drive or the CD-ROM drive.
- Do not insert a diskette at an angle. Not inserting the diskette straight into the drive can damage the drive.
- Do not attach more than one label to a diskette, and do not allow the label to be loose. Multiple or loose labels can detach or tear and then lodge in the drive.
- Do not touch the lens on the CD-ROM tray.
- Do not close the CD-ROM tray until you hear the CD-ROM click into the center pivot of the CD-ROM drive.
- Do not touch the surface of a compact disc; handle the compact disc only by its edges.
- Do not connect the modem to a PBX (private branch exchange) or other digital telephone extension line. **Your computer can use only a public-switched telephone network (PSTN).** The use of a phone line other than PSTN can damage your modem. If you are not sure which kind of phone line you are using, contact your telephone company. Many hotels or office buildings use digital telephone extension lines, so check before connecting the telephone cable in such places.
- 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 dissipates some heat during normal operation. This heat is a function of the level of system activity and battery charge level. Extended contact with your body, even through clothing, could cause discomfort or, eventually, a skin burn.

## ThinkPad do's

Treat your computer like precision electronic machinery.

- When installing your hard disk, diskette, or CD-ROM drive, follow the instructions in the online book and apply pressure only where needed on the device.
- When installing the CD-ROM or diskette drive into the UltralimBay, make sure the ac adapter is disconnected from your computer.
- If you exchange drives in your computer, reinstall the plastic bezel faces (if supplied).
- Store your external and removable hard disk, diskette, and CD-ROM drives in the appropriate container or packaging when they are not being used.
- Choose a quality carrying case that will protect your computer.
- Store packing materials safely out of reach of children to prevent the risk of suffocation from plastic bags.
- Register your ThinkPad products with IBM (refer to the Web page: <http://www.pc.ibm.com/register>). This can help authorities return your computer to you if it is lost or stolen. Registering your computer also enables IBM to notify you about possible upgrades.
- Check the IBM Web page (<http://www.ibm.com/thinkpad>) periodically to get current information about your computer.

## Cleaning your computer

Occasionally clean your computer as follows:

- Use a soft cloth moistened with nonalkaline detergent to wipe the exterior of the computer.
- Don't spray cleaner directly on the display or keyboard.
- Gently wipe the LCD with a dry, soft cloth.

## Carrying your computer

When carrying your computer, follow these instructions to prevent possible damage to it and your data:

1. Remove any media from the CD-ROM drive or diskette drive.
2. Turn off all attached devices.
3. Power off the computer, or enter suspend or hibernation mode; then close the LCD. Make sure the suspend indicator is on when the computer is in suspend mode, or the power indicator is off when it is powered off or in hibernation mode.
4. Unplug all external cables and cords connected to your computer.
5. Make sure all computer doors and covers are closed.
6. Use a quality carrying case that provides adequate cushion and protection.

Do not move the computer when the hard disk drive is accessing data—that is, when the indicator is blinking. Make sure the indicator is off before you carry the computer.

## Extending the life of your computer's battery

The amount of battery power consumed by your computer depends on such conditions as the frequency of use, the operating temperature, and the period in storage (if unused). The following tips can help you to extend the life of your battery:

- Do not recharge the battery pack until all of its power is used. Recharging a battery pack that is not completely discharged can shorten battery life.
- Once you start charging the battery pack, do not use it until it is fully charged.
- Whenever possible, use the ThinkPad battery power-saving modes:
  - **Screen blank**
  - **Standby**
  - **Hibernation**For more information, refer to the online user's guide.
- Decrease the brightness of the LCD.
- Use power management. Each operating system comes with its own power management system.

- Whenever the internal serial devices—the modem, the serial port, and the infrared port—are not in use, stop the supply of power to them.
- If you will not be using the computer for a long period, remove the battery pack and keep it in a cool place.



## Chapter 1. System overview

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Features . . . . .	2
Specifications . . . . .	5
Using your online user's guide . . . . .	7
Starting BIOS Setup Utility . . . . .	8

## *Features and specifications*

# Features

### **Processor**

- Intel® Mobile Pentium® III processor

### **Memory**

- Built-in: 128 MB
- Maximum: 512 MB

### **Storage device**

- 2.5-inch hard disk drive

### **Display**

The color display uses TFT technology:

- Resolution:
  - LCD: Up to 1024-by-768, depending on the model
  - External monitor: Up to 1600-by-1200
- Brightness control

### **Keyboard**

- 84-key, 85-key, or 89-key
- TrackPoint
- Fn key function
- ThinkPad Button
- Volume Buttons
- ThinkLight

## ***Features and specifications***

### **Diskette drive**

To get the best performance from your diskette drives, use high-quality diskettes (such as IBM diskettes) that meet or exceed the following standards:

- **1-MB, 2DD, 3.5-inch diskette:**
  - ANSI (American National Standards Institute) X3.137
  - ISO (International Standards Organization) 8860
  - ECMA (European Computer Manufacturers Association) 100
- **2-MB, 2HD, 3.5-inch diskette:**
  - ANSI X3.171
  - ISO 9529
  - ECMA 125

## ***Features and specifications***

### **External interface**

- Serial connector (EIA-RS232D)
- Parallel connector (IEEE 1284A—supports an external-diskette-drive interface with attached cable and adapter)
- External input-device connector
- External-monitor connector
- Expansion connector
- PC Card slots (two Type I or Type II PC Cards, or one Type III PC Card)
- Headphone jack
- Line-in jack
- Microphone jack
- Infrared port
- Universal serial bus (USB) connector
- Telephone connector (available if the modem Mini-PCI Card or the Combo Mini-PCI Card is installed)
- Ethernet connector (available if the Ethernet Mini-PCI Card or the Combo Mini-PCI Card is installed)
- UltraPort connector to support an optional IBM digital camera
- Video-out connector
- Ultrabay 2000

## Specifications

### Size

- Width: 304.8 mm (12.0 in.)
- Depth: 248.9 mm (9.8 in.)
- Height: 33.0 mm (1.3 in.)

### Environment

- Maximum altitude without pressurization: 3048 m (10,000 ft)
- Temperature
  - At altitudes up to 2438 m (8000 ft)
    - Operating with no diskette: 5° to 35°C (41° to 95°F)
    - Operating with a diskette: 10° to 35°C (50° to 95°F)
    - Not operating: 5° to 43°C (41° to 109°F)
  - At altitudes above 2438 m (8000 ft)
    - Maximum operating temperature, 31.3°C (88° F)

**Note:** When you charge the battery pack, its temperature must be at least 10°C (50°F).

- Relative humidity:
  - Operating with no diskette in the drive: 8% to 95%
  - Operating with a diskette in the drive: 8% to 80%

### Heat output

- 56 W (191 Btu/hr) maximum

## ***Specifications***

### **Electrical (ac adapter)**

- Sine-wave input at 50 to 60 Hz
- Input rating of the ac adapter: 100 to 240 V ac, 50 to 60 Hz

### **Lithium-ion battery pack**

- Nominal voltage: 10.8 V dc
- Capacity: 3.6 AH

## Using your online user's guide

Your computer offers full information and documentation online. There is no need to carry heavy manuals or other reference books.

Online help is provided by ThinkPad Assistant. One way you can get access to it is to press the computer's unique ThinkPad Button to open the Access ThinkPad. There, you can do a Quick Search or search the full text of the help system. Alternatively, you can go to ThinkPad Assistant by clicking **Start** → **Programs** → **ThinkPad Information**.

ThinkPad Assistant has the following sections:

- About your ThinkPad
- Everyday use
- Communicate
- Home and travel
- Enhancements
- Maintenance and upgrades
- Security
- Problem-solving
- How to reach IBM

If you are logged on to the Internet, click one of the Internet portal buttons in Access ThinkPad.

- Get help and user support.
- Update software.
- Find business solutions.
- Learn about accessories that can help make you even more productive.

## *Starting BIOS Setup Utility*

# Starting BIOS Setup Utility

Your computer provides a program, called IBM BIOS Setup Utility, that enables you to select various setup parameters. The panels in this utility are as follows:

- **Config:** Set the configuration of your computer.
- **Date/Time:** Set the date and time.
- **Password:** Set a password.
- **Startup:** Set the startup device.
- **Restart:** Restart the system.

**Note:** You can set parameters more easily by using the ThinkPad Configuration Program. For more information on this program, refer to the online user's guide.

To start IBM BIOS Setup Utility, do as follows:

1. To protect yourself against accidental loss of data, use ConfigSafe (see "Backing up your system configuration" on page 35) to save your computer's current configuration.
2. Remove any diskette from the diskette drive, and then turn off the computer.
3. Turn on the computer; then, while the "Press F1 for IBM BIOS Setup Utility" message is displayed at the lower-left area of the screen, press F1.

If you have set a supervisor password, the "IBM BIOS Setup Utility" menu appears after you enter the password. You can start the utility by pressing Enter instead of entering the supervisor password; then, however, you cannot change the parameters that are protected by the supervisor password. For more information, refer to the online user's guide.

4. Using the cursor keys, move to an item you want to change. When the item you want is highlighted, press Enter. A submenu is displayed.
5. Change the items you wish to change. To change the value of an item, use the F5 or F6 key. If the item has a submenu, you can display it by pressing Enter.

### ***Starting BIOS Setup Utility***

6. Press F3 or Esc to exit from the submenu. If you are in a nested submenu, press Esc repeatedly until you reach the IBM BIOS Setup Utility menu.

**Note:** If you need to restore the settings to their original state as of the time of purchase, press the F9 key to load the default settings. Also, the Restart submenu offers you such options as loading the default settings or discarding the changes.

7. Select **Restart**; then press Enter. Change the option you want; then press Enter. Your computer restarts.

***Starting BIOS Setup Utility***

# Chapter 2. Protecting your computer

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- Using passwords . . . . . 12
  - Power-on password . . . . . 12
  - Screen saver password . . . . . 12
  - Hard-disk passwords . . . . . 13
  - Windows password . . . . . 13
  - Supervisor password . . . . . 14
  - Network password . . . . . 14
  - Passwords and standby mode . . . . . 14
- Using the locks and the security screw . . . . . 15
  - Attaching the mechanical lock . . . . . 15
  - Using the security screw . . . . . 15
- Using the Asset RF ID feature . . . . . 16

## *Using passwords*

# Using passwords

To make sure only authorized persons may work on your computer, you can set different kinds of passwords. Then prospective users will have to know the proper passwords in order to access your computer or data.

You can set the following passwords in your computer:

- Power-on password
- Screen saver password
- Hard-disk passwords
- Windows password
- Supervisor password
- Network password

## Power-on password

You can set a power-on password to help prevent unauthorized users from starting up your ThinkPad computer.

If you set a power-on password, the password prompt appears on the screen whenever you turn on the computer. You must enter the correct password to start using the computer.

**Note:** If you forget your power-on password, you cannot reset it. You must take the computer to an IBM reseller or IBM marketing representative to have the password canceled.

To set a power-on password, refer to the online user's guide.

## Screen saver password

You can set a screen saver password. Once the screen saver has started, only those who know the password can close the screen saver and resume operating the computer.

**Note:** The screen saver password does not thoroughly protect your computer against unauthorized users. By turning your computer off and then on again, an unauthorized user could restart Windows without knowing your screen saver password—unless you have also set a power-on password.

To set a screen saver password, refer to the online user's guide.

## Hard-disk passwords

Two types of hard-disk password help protect the information on your hard disk.

When either type of hard-disk password has been set, the information on your hard disk cannot be accessed without one of the passwords.

These are the two types of hard-disk password:

- User hard-disk password
- Master hard-disk password—which requires a user password

When a user hard-disk password is set, no one can access files and applications on the hard disk without first typing the password.

The system administrator sets the master hard-disk password; no one else knows or uses it. Then the system administrator sets a user password and tells it to the user. The user can change the user password.

The master password, like a master key, enables the administrator to access the hard disk even if the user has changed the user password.

### **Attention**

If you forget your hard-disk password, there is no way to reset your password or recover data from the hard disk. You must take your computer to an IBM reseller or marketing representative to replace the hard-disk drive. A fee will be charged for parts and service.

To set a hard-disk password, refer to the online user's guide.

## Windows password

When you start your ThinkPad computer and the Windows operating system opens, Windows will require you to enter a user ID and a password.

To set a Windows password, refer to the online user's guide.

## *Using passwords*

### **Supervisor password**

The supervisor password protects the system information stored in the IBM BIOS Setup Utility so that, without knowing the password, no one can change the configuration of the computer.

#### **Attention**

If you forget your supervisor password, there is no way to reset it. You must take your computer to an IBM reseller or marketing representative to replace the system board. A fee will be charged for parts and service.

To establish a supervisor password, refer to the online user's guide.

### **Network password**

If you work on a local area network (LAN) with your ThinkPad computer, your LAN administrator might have set passwords to restrict access to certain parts of the network. If you are authorized to access restricted areas of your LAN, you will need to establish a logon password in Windows.

To establish your network password in Windows, refer to the online user's guide.

### **Passwords and standby mode**

If you have set passwords and you put your computer into standby mode by pressing Fn+F4, you can resume operating the computer by pressing Fn.

You will be prompted to type your password. To unlock your computer, you must enter a power-on password or a supervisor password (if one is set).

Any hard disk for which you have set a hard-disk password is then unlocked automatically.

For information on hard-disk passwords for a hard disk in a docking station, refer to the online user's guide.

## Using the locks and the security screw

### Attaching the mechanical lock

You can attach a mechanical lock to your computer, to help prevent it from being removed without your permission.

Attach a mechanical lock to the keyhole of the computer; then secure the chain on the lock to a stationary object. Refer to the instructions provided with the mechanical lock.

**Note:** You are responsible for evaluating, selecting, and implementing locking devices and security features. IBM makes no comments, judgments, or warranties on the function, quality, or performance of locking devices and security features.

### Using the security screw

The security screw shipped with your computer can help prevent the hard-disk drive from being removed.

To replace the coin screw with the security screw, do as follows:

1. Turn off the computer; then disconnect the ac adapter and all cables from the computer.
2. Remove the screw with a coin; then install the security screw, and tighten it with a 2.5-mm allen wrench.
3. Connect the ac adapter; then turn on the computer.

## *Using the Asset RF ID feature*

# Using the Asset RF ID feature

The Asset ID RF feature, available as an option, applies Asset ID technology, which you can think of as the next generation of bar code technology. This option enables communication between the ThinkPad computer and an industry-standard radio-frequency hand-held device, called a reader hereafter in this manual. The option provides better management, deployment, and security of your ThinkPad computer inventory. After this option is installed in your computer, the reader can recognize the following information:

Serial numbers:

- System board
- System unit

Configuration information:

- UUID
- MAC address
- CPU data
- DIMM data
- Diskette drive data
- IDE device data
- PCI device data
- ISA Plug and Play device data
- LCD panel data
- Docking station data

A reader can also recognize the following user information after it has been set in your computer:

- User name
- Telephone number
- Machine lease data

The Asset ID RF feature can also be used to prevent your computer from being stolen. It is effective only when the supervisor password is set.

If you use this option for security, you need to enable RFID security after installing it into your computer. For more information, refer to the online user's guide.

## Chapter 3. Solving computer problems

---

Troubleshooting . . . . .	18
Error codes or messages . . . . .	18
No error codes or messages . . . . .	22
Power switch problem . . . . .	22
Input problems . . . . .	23
Standby or hibernation problems . . . . .	25
LCD problems . . . . .	28
Battery problems . . . . .	30
Hard-disk-drive problems . . . . .	31
Software problems . . . . .	32
Other problems . . . . .	34
Testing your computer . . . . .	35
Backing up your system . . . . .	35
Backing up your system configuration . . . . .	35
Backing up your data . . . . .	36
Recovering lost or damaged software . . . . .	37
Using the Recovery CD . . . . .	37
Using the Software Selections CD . . . . .	38
Getting service . . . . .	40
ThinkPad Web site . . . . .	41
Recording sheets . . . . .	42

## Troubleshooting

### Error codes or messages

**Notes:**

1. In the charts, x can represent any character.
2. The version of PC-Doctor referred to here is PC-Doctor for Windows.

Message	Cause and action
0175: Bad CRC1, stop POST task	The EEPROM checksum is not correct (block # 6). Have the computer serviced.
0187: EAIA data access error	The access to EEPROM has failed. Have the computer serviced.
0188: Invalid RFID serialization information area or bad CRC2	The EEPROM checksum is not correct (blocks # 0 and 1, or block # 6). The system board should be replaced, and the box serial number needs to be reinstalled. Have the computer serviced.
0189: Invalid RFID configuration information area	The EEPROM checksum is not correct (blocks # 4 and 5). The system board should be replaced, and the UUID needs to be reinstalled. Have the computer serviced.
0190: Critical low-battery error	The computer turned off, because the battery is low. Connect the ac adapter to the computer and charge the battery pack, or replace the battery pack with a fully charged one.
0193: RF antenna has been removed	The RFID antenna that you installed has been removed. Enter the supervisor password to return your computer to normal operation.
0194: The computer has been carried through the security gate	The computer has been carried through a security portal gate. Enter the supervisor password to return your computer to the normal operation.
0200: Hard disk error	The hard disk is not working. Make sure that the hard-disk drive is attached firmly. Run the BIOS Setup Utility (refer to "Starting BIOS Setup Utility" on page 8); then make sure that the hard-disk drive is not disabled in the Startup menu.

## Hardware troubleshooting

Message	Cause and action
021x: Keyboard error	<p>Make sure that no object is placed on the keyboard or on the external keyboard, if one is attached. Turn off the computer, and turn off all attached devices. Turn on the computer first; then turn on the attached devices. If you still see the same error code, do the following:</p> <ul style="list-style-type: none"> <li>• Make sure that the right connector is being used between the external keyboard and the computer.</li> <li>• Turn off the computer, disconnect the external keyboard, and turn the computer on again. If your built-in keyboard operates correctly, have the external keyboard serviced.</li> </ul> <p>Test the computer by using PC-Doctor (refer to “Testing your computer” on page 35).</p> <ul style="list-style-type: none"> <li>• If the computer stops during the test, have it serviced.</li> </ul>
0220: Monitor type error	<p>The monitor type does not match the type specified in CMOS. Run the IBM BIOS Setup Utility (refer to “Starting BIOS Setup Utility” on page 8) to make sure that your monitor type matches the type specified in the utility.</p>
0230: Shadow RAM error	<p>The shadow RAM failed. Test your computer's memory with PC-Doctor (refer to “Testing your computer” on page 35). If you added a memory module just before turning the computer on, reinstall it. Then test the memory with PC-Doctor.</p>
0231: System RAM error	<p>The system RAM failed. Test your computer's memory with PC-Doctor (refer to “Testing your computer” on page 35). If you added a memory module just before turning the computer on, reinstall it. Then test the memory with PC-Doctor.</p>
0232: Extended RAM error	<p>The extended RAM failed. Test your computer's memory with PC-Doctor (refer to “Testing your computer” on page 35). If you added a memory module just before turning the computer on, reinstall it. Then test the memory with PC-Doctor.</p>
0250: System battery error	<p>The system battery is dead. Replace the battery and run the BIOS Setup Utility (refer to “Starting BIOS Setup Utility” on page 8) to verify the configuration. If you still have a problem, have the computer serviced.</p>
0251: System CMOS checksum bad	<p>The system CMOS may have been corrupted by an application program. Run the BIOS Setup Utility (refer to “Starting BIOS Setup Utility” on page 8) to reconfigure the settings. If the same error code appears, have the computer serviced.</p>
0252: Password checksum bad	<p>The password you have set has been cleared. Run the BIOS Setup Utility (refer to “Starting BIOS Setup Utility” on page 8) to set the password.</p>
0260: System timer error	<p>Have the computer serviced.</p>

## Hardware troubleshooting

Message	Cause and action
0270: Real time clock error	Have the computer serviced.
0271: Date and time error	Neither the date nor the time is set in the computer. Set the date and time, using the IBM BIOS Setup Utility (refer to "Starting BIOS Setup Utility" on page 8).
0280: Previous boot incomplete	Your computer was unable to complete the boot process. Turn the computer off; then turn it on to start the IBM BIOS Setup Utility (refer to "Starting BIOS Setup Utility" on page 8). Verify the configuration and then restart the computer, either by choosing the Exit Saving Changes option under the Restart item or by pressing F10. If the same error code appears, have the computer serviced.
02D0: System cache error	The cache is disabled. Have the computer serviced.
02F4: EISA CMOS not writable	Have the computer serviced.
02F5: DMA test failed	Have the computer serviced.
02F6: Software NMI failed	Have the computer serviced.
02F7: Fail-safe timer NMI failed	Have the computer serviced.
The power-on password prompt appears.	A power-on password or a supervisor password has been set. Type the password and press Enter to use the computer. If the power-on password is not accepted, a supervisor password may have been set. Type the supervisor password and press Enter. If you still see the same error message, have the computer serviced.
The hard-disk password prompt appears.	A hard-disk password has been set. Type the password and press Enter. If you still see the same error message, have the computer serviced.
The DOS full-screen looks smaller.	If you use a DOS application that supports only 640×480 resolution (VGA mode), the screen image may look slightly distorted or may appear smaller than the display size. This is to maintain compatibility with other DOS applications. To expand the screen image to the same size as the actual screen, start the ThinkPad Configuration Program (refer to the online user's guide) and click LCD; then select the Screen expansion function. (The image may still look slightly distorted.)  <b>Note:</b> If your computer has screen expansion function, you can use the Fn+F8 keys to expand the screen image.

## Hardware troubleshooting

Message	Cause and action
Hibernation error	<p>The system configuration changed while your computer was in hibernation mode, and your computer cannot resume normal operation.</p> <ul style="list-style-type: none"><li>• Restore the system configuration to what it was before your computer entered hibernation mode.</li><li>• If the memory size has been changed, re-create the hibernation file.</li></ul>
Operating system not found	<p>Verify the following:</p> <ul style="list-style-type: none"><li>• The hard-disk drive is correctly installed.</li><li>• A startable diskette is in the diskette drive.</li></ul> <p>If the same error message appears, check the boot sequence, using the BIOS Setup Utility (refer to “Starting BIOS Setup Utility” on page 8).</p>
Fan error	<p>The cooling fan is failing. Have the computer serviced.</p>
EMM386 Not Installed—Unable to Set Page Frame Base Address	<p>Edit C:\CONFIG.SYS and change a line from device=C:\WINDOWS\EMM386.EXE RAM to device=C:\WINDOWS\EMM386.EXE NOEMS and save this file.</p>
CardBus Configuration Error—Device Disabled	<p>Press F1 to go to IBM BIOS Setup Utility. Press F9 and then Enter to load the default setting.</p> <p>Press F10 and then Enter to restart the system.</p>

## Hardware troubleshooting

### No error codes or messages

Problem	Cause and action
<p>The screen is blank and you do not hear any beeps.</p> <p><b>Note:</b> If you are not sure whether you heard any beeps, turn off the computer; then turn it on again, and listen again. If you are using an external monitor, refer to “External monitor problems” in the online user’s guide.</p>	<p>If a power-on password is set, press any key to display the power-on password prompt, and then type the correct password and press Enter.</p> <p>If the power-on password prompt does not appear, the brightness may be set to minimum brightness. Adjust the brightness level by pressing Fn+Home.</p> <p>If the screen still remains blank, make sure of the following:</p> <ul style="list-style-type: none"><li>• The battery pack is installed correctly.</li><li>• The ac adapter is connected to the computer and the power cord is plugged into a working electrical outlet.</li><li>• The computer power is on. (Turn on the power switch again for confirmation.)</li></ul> <p>If the screen remains blank, have the computer serviced.</p>
<p>The screen is blank and you hear two or more beeps, or a continuous beep.</p>	<p>If you are using Ethernet, check the following:</p> <ul style="list-style-type: none"><li>• Make sure that the Ethernet cable is connected firmly.</li><li>• Contact your network administrator.</li></ul> <p>If the screen is still blank, and beeps do not stop, have the computer serviced.</p>
<p>Only the cursor appears.</p>	<p>Reinstall your operating system, and turn on the computer. If you still see only the cursor on the screen, have the computer serviced.</p>

### Power switch problem

Problem	Cause and action
<p>The system freezes, and you cannot turn off the computer.</p>	<p>Turn off the computer by pressing and holding the power switch for 4 seconds or more. If the system is still not reset, remove the ac adapter and the battery pack.</p>

## Input problems

Problem	Cause and action
The cursor drifts when the computer is turned on or after it resumes normal operation.	<p>The cursor may drift when you are not using the TrackPoint during normal operation. This is a normal characteristic of the TrackPoint and is not a defect. The cursor may drift for several seconds under the following conditions:</p> <ul style="list-style-type: none"> <li>• When the computer is turned on.</li> <li>• When the computer resumes normal operation.</li> <li>• When the TrackPoint is pressed for a long time.</li> <li>• When the temperature changes.</li> </ul>
The cursor does not work for a while after the settings in the Mouse Properties window have been changed.	<p>This is a normal characteristic of the cursor. Wait several seconds until the cursor returns to the normal state.</p>
The mouse or pointing device does not work.	<p>Make sure that the cable for the mouse or pointing device cable is in the ThinkPad Configuration Program.</p> <p>Make sure that the cable for the mouse or pointing device is securely connected to the computer. Try using the TrackPoint. If the TrackPoint works, the error may be due to the mouse.</p> <p>If your mouse is incompatible with the IBM PS/2 mouse, disable the TrackPoint, using the ThinkPad Configuration Program.</p> <p><b>Note:</b> For more information, see the manual supplied with the mouse.</p>
The mouse buttons do not work.	<p>Change the mouse driver to <b>Standard PS/2 Port Mouse</b>, and then reinstall <b>IBM PS/2 TrackPoint</b> driver. Refer to the Software Selections CD for installing the driver.</p>
The scrolling or magnifying glass function does not work.	<p>See the mouse driver in Device Manager, and make sure that the <b>IBM PS/2 TrackPoint</b> driver is installed.</p>
The cursor does not move after the computer returns from one of the power management modes.	<p>Make sure you followed the instructions correctly when you installed Windows with the power management option.</p>

## Hardware troubleshooting

Problem	Cause and action
Some or all keys on the keyboard do not work.	<p>If the problem occurred immediately after the computer returned from standby mode, enter the power-on password if one has been set.</p> <p>If an external keyboard is connected, the numeric keypad on your computer does not work. Use the numeric keypad on the external keyboard.</p> <p>If an external numeric keypad or a mouse is connected, do the following:</p> <ol style="list-style-type: none"><li>1. Turn off the computer.</li><li>2. Remove the external numeric keypad or the mouse.</li><li>3. Turn on the computer and try using the keyboard again.</li></ol> <p>If the keyboard problem is resolved, carefully reconnect the external numeric keypad, external keyboard, or mouse, making sure that you have seated the connectors properly.</p> <p>If keys on the keyboard still do not work, have the computer serviced.</p>
A number appears when you type a letter.	The numeric lock function is on. To disable it, press and hold Shift; then press NumLk.
Some or all keys on the external numeric keypad do not work.	Make sure that the external numeric keypad is correctly connected to the computer.
Some or all keys on the external keyboard do not work.	<p>To use an external keyboard, you need to attach the keyboard/mouse cable to the computer.</p> <ul style="list-style-type: none"><li>• Make sure that the keyboard/mouse cable is correctly connected to the computer.</li><li>• Make sure that the keyboard cable is connected to the correct side of the keyboard/mouse cable.</li></ul> <p>If these connections are correct, disconnect the keyboard/mouse cable from the computer and make sure that the keyboard operates properly. If the built-in keyboard works, there is a problem with either the cable or with the keyboard. Try using a different keyboard/mouse cable or an external keyboard.</p>

## Standby or hibernation problems

Problem	Cause and action
The computer enters standby mode automatically.	If the processor reaches a temperature that is too high, the computer will automatically enter standby mode to allow the computer to cool and to protect the processor and other internal components.
The computer enters standby mode immediately after POST (the standby indicator turns on).	<p>Make sure of the following:</p> <ul style="list-style-type: none"> <li>• The battery pack is charged.</li> <li>• The operating temperature is within the acceptable range. Refer to "Specifications" on page 5.</li> </ul> <p>If the battery charge and the temperature are acceptable, have the computer serviced.</p>
The critical low-battery error appears, and the computer immediately turns off.	The battery power is getting low. Connect the ac adapter to the computer, or replace the battery pack with a fully charged one.
The LCD remains blank after you take action to return from standby or hibernation mode.	Check whether the external monitor was disconnected while the computer was in standby mode. <b>Do not disconnect the external monitor while the computer is in standby mode or hibernation mode. If no external monitor is attached when the computer resumes, the LCD remains blank and output is not displayed. This restriction does not depend on the resolution value.</b>
The computer does not return from standby mode, or the standby indicator stays on and the computer does not work.	The computer automatically enters standby or hibernation mode when the battery is depleted. Connect the ac adapter to the computer, and press Fn.

## Hardware troubleshooting

Problem	Cause and action
When you are using the port replicator, resuming normal operation from hibernation or standby mode takes a long time.	<p>If the Ethernet port is enabled, but the port replicator is not connected to a network, resuming operation can take a long time. The computer queries the Ethernet until the timeout timer stops the query. If you want to access the Ethernet, connect the network cable. If you are not using the network, disable the Ethernet connector as follows:</p> <p><b>For Windows 98:</b></p> <ol style="list-style-type: none"><li>1. Double-click the <b>System</b> icon in the Control Panel.</li><li>2. Click the <b>Device Manager</b> tab.</li><li>3. Double-click <b>Network Adapter</b>.</li><li>4. Double-click <b>Intel EtherExpress PRO PCI Adapter</b>.</li><li>5. Mark the check box for <b>Disable in this hardware profile</b>.</li><li>6. Click <b>OK</b>.</li><li>7. Close all windows.</li><li>8. Restart the computer.</li></ol> <p><b>For Windows NT:</b></p> <ol style="list-style-type: none"><li>1. Double-click the <b>System</b> icon in the Control Panel.</li><li>2. Select <b>Intel EtherExpress PRO Adapter</b>, and click <b>Startup...</b></li><li>3. Select <b>Disabled</b>.</li><li>4. Click <b>OK</b>.</li><li>5. Click <b>Close</b>.</li><li>6. Close all windows.</li><li>7. Restart the computer by turning it off and on again.</li></ol>
Your computer does not enter standby or hibernation mode.	Check whether any option has been selected to disable your computer from entering standby or hibernation mode.

## Hardware troubleshooting

Problem	Cause and action
<p>The computer does not enter standby mode after the interval set on the timer under Windows 98 or Windows NT.</p>	<p><b>For Windows 98:</b></p> <p>The generic CD-ROM or DVD-ROM driver for Windows 98 accesses the internal CD-ROM drive or DVD-ROM drive every 3 seconds to see whether a CD-ROM is inserted in the CD-ROM drive or the DVD-ROM drive. This prevents your computer from entering standby mode even after a timeout. To prevent this from occurring, do the following:</p> <ol style="list-style-type: none"><li>1. Click <b>Start</b>.</li><li>2. Move the cursor to <b>Settings</b> and <b>Control Panel</b>.</li><li>3. Click <b>Control Panel</b>, and then double-click <b>System</b>.</li><li>4. Click the <b>Device Manager</b> tab.</li><li>5. Click the + mark for <b>CD-ROM</b>.</li><li>6. Double-click the name of the CD-ROM or DVD-ROM.</li><li>7. Click the <b>Settings</b> tab.</li><li>8. Clear the <b>Auto insert notification</b> check box.</li></ol> <p>Windows 98 no longer detects a CD-ROM or a DVD-ROM automatically.</p> <p><b>For Windows NT:</b></p> <p>If you enable the CD-ROM AutoRun feature, the timer does not send the computer into standby mode. To enable the timer in this situation, edit the configuration information in the registry as follows:</p> <pre>HKEY_LOCAL_MACHINE\SYSTEM\   CurrentControlSet\Services\Cdrom\   Autorun: 0x1 &gt; Autorun: 0</pre>

## Hardware troubleshooting

Problem	Cause and action
The Fn+F12 key combination does not make the computer enter hibernation mode.	<p>Enable hibernation mode as follows:</p> <p><b>For Windows 98:</b></p> <ol style="list-style-type: none"><li>1. Start the ThinkPad Configuration Program</li><li>2. Click <b>Power Management</b>.</li><li>3. Click the <b>Hibernation</b> tab.</li><li>4. Click the <b>Enable hibernation...</b> button.</li><li>5. Click the <b>Create Now</b> button.</li></ol> <p>The computer cannot enter hibernation mode if you are using one of the IBM communication PC Cards. To enter hibernation mode, stop the communication program, and then remove the PC Card or disable the PC Card slot, using the Control Panel.</p> <p><b>For Windows NT:</b></p> <p><b>Note:</b> In Windows NT, you can use hibernation mode only if your hard disk has been formatted in the FAT format. If you format your hard disk with NTFS, the default format in Windows NT, you cannot use hibernation mode.</p> <ol style="list-style-type: none"><li>1. Start the ThinkPad Configuration Program.</li><li>2. Click <b>Power Management</b>.</li><li>3. Click <b>Suspend/Resume Options</b>.</li><li>4. Click <b>Enable Hibernation</b>.</li><li>5. Click <b>OK</b>.</li></ol> <p>The computer cannot enter hibernation mode when you are using one of the IBM communication PC Cards. To enter hibernation mode, stop the communication program, and then remove the PC Card or disable the PC Card slot, using the Control Panel.</p>

## LCD problems

Problem	Cause and action
The screen is blank.	Press Fn+Home to make the screen brighter. If the problem persists, do the "Cause and action" for the next problem in this list.

## Hardware troubleshooting

Problem	Cause and action
<p>The screen is unreadable or distorted.</p>	<p>Make sure of the following:</p> <ul style="list-style-type: none"> <li>• The device driver for the display is installed correctly.</li> <li>• The resolution and color depth are set correctly on the display.</li> <li>• The monitor type is correct.</li> </ul> <p>To check these settings, do as follows:</p> <p>Open the Display Properties window as follows:</p> <ol style="list-style-type: none"> <li>1. Click <b>Start</b>.</li> <li>2. Move the cursor to <b>Settings</b> and <b>Control Panel</b>.</li> <li>3. Click <b>Control Panel</b>, and then double-click <b>Display</b>.</li> </ol> <p><b>For Windows 98:</b></p> <ol style="list-style-type: none"> <li>1. Click the <b>Settings</b> tab.</li> <li>2. Check whether the color depth and resolution are correctly set.</li> <li>3. Click <b>Advanced...</b></li> <li>4. Click the <b>Adapter</b> tab.</li> <li>5. Make sure "S3_Inc. Savage/IX w/MV" is shown in the Adapter Information window.</li> <li>6. Click the <b>Monitor</b> tab.</li> <li>7. Make sure the information is correct.</li> </ol> <p><b>For Windows NT:</b></p> <ol style="list-style-type: none"> <li>1. Click the <b>Settings</b> tab.</li> <li>2. Check whether the color depth and resolution are correctly set.</li> <li>3. Click <b>Display Type....</b></li> <li>4. Make sure "S3_Inc. Savage/IX Display Driver" is shown in the Display Type window.</li> <li>5. Click <b>OK</b>.</li> <li>6. Click the <b>Test</b> button in the Settings window.</li> <li>7. Make sure the output is displayed correctly.</li> </ol>
<p>Incorrect characters appear on the screen.</p>	<p>Make sure that the operating system and the application program are installed and configured correctly. If they are, have the computer serviced.</p>
<p>The screen stays on even after you turn off your computer.</p>	<p>Press and hold the power switch for 4 seconds or more to turn off your computer; then turn it on again.</p>
<p>Missing, discolored, or bright dots appear on the screen every time you turn on your computer.</p>	<p>This is an intrinsic characteristic of the TFT technology. Your computer's display contains multiple thin-film transistors (TFTs). A small number of missing, discolored, or bright dots on the screen might exist all the time.</p>

## Hardware troubleshooting

Problem	Cause and action
When you try to start DVD playback, a message appears: "Unable to create overlay window." <i>or</i> While running video playback, DVD playback, or game applications, you may get poor playback or none at all.	Do either of the following: <ul style="list-style-type: none"><li>• If you are using LCD and external monitor simultaneously in 32-bit color mode, change the color depth to 16-bit mode.</li><li>• If you are using TV with 32-bit color, change the color depth to 16-bit mode.</li><li>• If you are using a desktop size of 1280x1024 or larger, reduce the desktop size and the color depth.</li></ul>

## Battery problems

Problem	Cause and action
The battery pack cannot be fully charged by the power-off charging method in the standard charge time for your computer.	The battery pack might be over-discharged. Do the following: <ol style="list-style-type: none"><li>1. Turn off the computer.</li><li>2. Make sure that the over-discharged battery pack is in the computer.</li><li>3. Connect the ac adapter to the computer and let it charge.</li></ol> If the battery pack cannot be fully charged in 24 hours, use a new battery pack. If you have an optional Quick Charger, use it to charge the over-discharged battery pack.
Your computer shuts down before the battery status indicator shows empty, <b>-or-</b> Your computer operates after the battery status indicator shows empty.	Discharge and recharge the battery pack.
The operating time for a fully charged battery pack is short.	Discharge and recharge the battery pack. If your battery's operating time is still short, use a new battery pack.
The computer does not operate with a fully charged battery pack.	The surge protector in the battery pack might be active. Turn off the computer for one minute to reset the protector; then turn on the computer again.

## Hardware troubleshooting

Problem	Cause and action
The battery pack cannot be charged.	You cannot charge the battery when it is too hot. If the battery feels hot, remove it from the computer and allow it to cool to room temperature. After it cools, reinstall it and recharge the battery. If it still cannot be charged, have it serviced.

## Hard-disk-drive problems

Problem	Cause and action
The hard-disk drive makes a rattling noise intermittently.	<p>The rattling noise might be heard when:</p> <ul style="list-style-type: none"><li>• The hard-disk drive starts accessing the data or when it stops.</li><li>• You carry the hard-disk drive.</li><li>• You carry your computer.</li></ul> <p>This is a normal characteristic of a hard-disk drive and is not a defect.</p>
The hard-disk drive does not work.	In the Startup menu in the IBM BIOS Setup Utility, make sure that there is no exclamation point ! to the left of the hard-disk drive. If there is such a mark, the hard-disk drive is disabled. Clear the mark to enable the drive.

## Hardware troubleshooting

### Software problems

Problem	Cause and action
An application does not run correctly.	<p>Make sure that the problem is not being caused by the application.</p> <p>Check that your computer has the minimum memory required for the application. Refer to the manuals supplied with the application.</p> <p>Check that the application is designed to operate with your operating system.</p> <p>Check that other applications run correctly on your computer.</p> <p>Check that the necessary device drivers are installed.</p> <p>Check that the application works when it is run on some other computer.</p> <p>If an error message appears when you are using the application program, refer to the manuals supplied with the application.</p> <p>If the application still does not run correctly, contact your place of purchase or a service representative for help.</p>
The main window bitmap in the ThinkPad Configuration Program is distorted (Windows NT only).	<p>Installing the <b>Active Desktop</b>, bundled with Internet Explorer Version 4.0 on Windows NT, might cause this problem. Do one of the following:</p> <ul style="list-style-type: none"><li>• Uninstall the <b>Active Desktop</b>. (Merely disabling the <b>Active Desktop</b> does not solve the problem.)</li><li>• Close the ThinkPad Configuration Program, and start it again. (This is a temporary recovery.)</li></ul>

## Hardware troubleshooting

Problem	Cause and action
<p>While you are installing Windows 95, the system automatically reboot, showing a message, "Getting ready to run Windows 95 for the first time..."; then screen color becomes abnormal and the system halts.</p>	<p>If you install the Windows 95 as Typical (default) in Setup Option, you may encounter this problem. To recover, do as follows:</p> <ol style="list-style-type: none"> <li>1. Reboot the system by pressing Ctrl+Alt+Del.</li> <li>2. The startup screen appears with "Safe mode" selected. Press Enter.</li> <li>3. When you see the screen message "Windows is running in Safe mode," press <b>OK</b>.</li> <li>4. On the desktop, click the right mouse button to show the Display Properties window.</li> <li>5. Click <b>Property</b>.</li> <li>6. Click the <b>Settings</b> tab.</li> <li>7. Click the <b>Change Display Type...</b> button.</li> <li>8. Under Adapter Type, click the <b>Change</b> button.</li> <li>9. In the Select Device list, click <b>Show All devices</b>.</li> <li>10. Click <b>Standard Display Types</b> and <b>Standard Display Adapter (VGA)</b>.</li> <li>11. Click <b>Close</b>.</li> <li>12. At the System Setting change window, click <b>Yes</b>.</li> <li>13. Reboot the system.</li> </ol> <p>If you are installing Windows 95 OSR 2.0, 2.1, or 2.5, do as follows:</p> <ol style="list-style-type: none"> <li>1. Reboot the system by pressing Ctrl+Alt+Del.</li> <li>2. The Startup screen appears with "Safe mode" selected. Press Enter.</li> <li>3. When you see the screen message "Cannot detect devices in Safe Mode," click <b>OK</b>.</li> <li>4. When you see the screen message "Windows is running in Safe mode," press <b>OK</b>.</li> <li>5. On the desktop, click the right mouse button to show the Display Properties window.</li> <li>6. Click <b>Advanced Properties</b>.</li> <li>7. Click the <b>Adapter</b> tab.</li> <li>8. Click the <b>Change</b> button.</li> <li>9. In the Select Device list, click <b>Show All devices</b>.</li> <li>10. Click <b>Standard Display Types</b> and <b>Standard Display Adapter (VGA)</b>.</li> <li>11. Click <b>OK</b>.</li> <li>12. Click <b>Close</b>.</li> <li>13. In the System Settings change window, click <b>Yes</b>.</li> <li>14. Reboot the system.</li> </ol>

## Hardware troubleshooting

### Other problems

Problem	Cause and action
The computer locks or does not accept any input.	<p>If your computer enters standby mode during a communication operation, it might lock. Disable the standby timer when you are working on the network.</p> <p>To turn off the computer, press and hold the power switch for 4 seconds or more.</p>
The computer does not turn off with the power switch.	<p>If the standby indicator is on and you are working under battery power, replace the battery with a fully charged one or change your power source to ac power.</p> <p>If the problem persists, press and hold the power switch for 4 seconds or more; this forces the computer to turn off.</p>
The computer does not start from the device you choose, such as a diskette drive.	<p>Refer to the Startup menu of the IBM BIOS Setup Utility (refer to "Starting BIOS Setup Utility" on page 8). Make sure that the startup sequence in the BIOS Setup Utility is set so that the computer starts from the device you choose.</p> <p>Make sure that the device from which the computer starts is enabled, by checking that there is no ! mark preceding the device name.</p>
The computer does not respond.	<p>The IRQs for the PCI are all set at 11. The computer does not respond because it cannot share the IRQ with other devices. For details, refer to "ThinkPad Configuration Program" in the online user's manual.</p>

## Testing your computer

If you have a problem with your computer, you can test it by using PC-Doctor.

To run PC-Doctor, do as follows:

1. Click **Start**.
2. Move the cursor to **Programs** and then to **PC-Doctor for Windows**.
3. Click **PC-Doctor for Windows**.
4. Choose either the Quick Test or the standard test.

### **Attention**

Running the Quick Test set can take 10 minutes or longer. Make sure you have time to run the entire test; do not interrupt the test while it is running.

The Quick Test set runs many test of critical hardware components, but it does not run all of the diagnostic test in PC-Doctor. If PC-Doctor reports that all of the tests in the Quick Test set have been run and that it has found no problems, consider running additional tests in PC-Doctor.

If you are preparing to contact IBM for support, be sure to print the test log so that you can rapidly provide information to the help technician.

## Backing up your system

### **Backing up your system configuration**

When you add software applications or devices to your computer, the installation process can change the computer registry and configuration.

If your computer does not work properly after you add applications or devices, you need to restore the previous configuration.

## **Backing up your system**

Use ConfigSafe to save the configuration before you make changes. Then if something goes wrong, Use ConfigSafe to restore the system registry and configuration files.

To capture a snapshot of your system configuration with ConfigSafe:

1. Click **Start**.
2. Move the cursor to **Programs, ConfigSafe**, and then **ConfigSafe**.
3. Double-click **ConfigSafe**.
4. Click the **camera** icon.
5. Type a name for the snapshot. For example, before installing a word processor, you might type, "Before installing word processor."
6. Click **OK**.
7. After a few moments, the main ConfigSafe window will return. The snapshot is complete.

If you need to restore a configuration snapshot, open ConfigSafe and follow the on-screen instructions.

## **Backing up your data**

Hard disks are reliable data storage devices. Even so, it is wise to protect yourself against accidental data loss or the unlikely event of a hard-disk malfunction by backing up your important files regularly.

To back up data, start the backup application as follows:

1. Click **Start**.
2. Move the cursor to **Programs, Accessories, System Tools**, and **Backup**.
3. Click **Backup**.

Make sure that the **Create a new backup job** button is marked in the Microsoft Backup window.

Click **OK**. The Backup Wizard will guide you through backing up some or all of the files on your hard disk.

## Recovering lost or damaged software

### *Using the Recovery CD*

A Recovery CD and a Recovery Boot Diskette are provided with your computer. If the preinstalled operating system becomes damaged or is accidentally erased, you can recover it by using the Recovery CD.

#### **Attention**

The recovery programs restore your hard disk to its factory-shipped condition. In the process, they erase the entire hard disk, including personal files and software programs you have installed. Be sure to back up all your personal files before you use a Recovery CD.

**Note:** The recovery process might take up to 2 hours.

To start the recovery process:

1. Turn off the computer.
2. Make sure that the CD-ROM or DVD-ROM drive is connected to your computer.
3. Make sure that the diskette drive is connected to your computer.
4. Insert the Recovery CD Boot Diskette into the diskette drive.
5. Turn on the computer.
6. Follow the on-screen instructions. You will be prompted to insert the Recovery CD into the CD-ROM or DVD-ROM drive.
7. When you receive a message saying that the recovery process is complete, remove the Recovery CD Boot Diskette from the diskette drive.
8. Select **Restart**. Your computer will restart with the original preloaded operating system.

## ***Backing up your system***

### ***Using the Software Selections CD***

The Software Selections CD contains all the software applications and device drivers for your computer. You can customize your computer with this CD.

If you need to reinstall software, or install a driver for a hardware device, put the Software Selections CD in your CD-ROM or DVD-ROM drive. The Features menu appears automatically.

The Software Selections CD offers the following functions:

- **Welcome**

This page displays the model and serial number of your computer, and a menu from which you can select an item by clicking it.

- **Install Software**

Use this page for doing the following:

- Reinstalling a software application
- Installing a hardware device driver
- Installing software that was not preinstalled on your computer

- **Uninstall Software**

You can uninstall any application program or device driver that was installed from the Software Selections CD and that has an uninstall entry in the **Add/Remove Program** list.

- **Advanced Functions**

- **Change Settings**

You can select options such as where to access the Software Selections CD and how to display information about software.

## ***Backing up your system***

- Install Device Drivers  
Go to this page to view a list of the device drivers on the system and install the ones you want. The page may also contain a readme for the driver you are installing; if so, be sure to read it before starting installation.
- Create a Diskette Image  
Some applications or devices require a diskette for installation. With this function, you create a diskette image.
- Create a Software Selections CD image  
You can copy the entire Software Selections CD and program onto your hard disk, and then install software and drivers without the CD.
- Read the License Agreement  
This page presents the license agreements for the software programs on the Software Selections CD.
- Help  
This page introduces the Software Selections CD and explains each item.

## Getting service

# Getting service

With the original purchase of an IBM hardware product, you have access to extensive support under warranty. Be sure to retain your proof of purchase to obtain warranty service.

For hardware product assistance covered under the terms of the IBM Statement of Limited Warranty, you may call the IBM Personal Computer HelpCenter (1-800-772-2227 in the U.S.)

The following services are available during the warranty period:

- **Problem determination:** Trained personnel are available to assist you in determining whether you have a hardware problem and deciding what action is necessary to fix the problem.
- **IBM hardware repair:** If the problem is determined to be caused by IBM hardware under warranty, trained service personnel are available to provide service.
- **Engineering change management:** Occasionally, changes may be required after a product has been sold. IBM or, if authorized by IBM, your reseller will make Engineering Changes (ECs) available that apply to your hardware.

To prepare for your call, fill in the blanks of the recording sheets (refer to “Recording sheets” on page 42) with information about your computer. If possible, be at your computer when you call.

The following items are not covered:

- Replacement or use of non-IBM parts or nonwarranted IBM parts
- Configuration of BIOS as part of an installation to device drivers
- Installation and maintenance of network operating systems (NOS)
- Installation and maintenance of application programs

## **ThinkPad Web site**

On the World Wide Web, the IBM Personal Computing Web site has up-to-date information about IBM products and support:

**<http://www.ibm.com/pc>**

You can find support information for your IBM products, including supported options, on the IBM Personal Computing Support page:

**<http://www.ibm.com/pc/support>**

If you click **profile** on the support page, you can create a customized support page that is specific to your hardware, complete with Frequently Asked Questions, Parts Information, Technical Hints and Tips, and Downloadable Files.

You will have the information you need, all in one place.

In addition, you can choose to receive e-mail notifications whenever new information about your registered products becomes available.

You can also go directly to the ThinkPad page:

**<http://www.ibm.com/thinkpad>**

IBM might make improvements or changes to this Web site at any time without any notice.

## Getting service

### Recording sheets

#### Option list

To prepare for your call to IBM, make a copy of this page and the next one and, on the copy, fill in the blanks with information about your computer.

- |  |   |
|--|---|
| <input type="checkbox"/> DIMM _____MB            | <input type="checkbox"/> Battery pack               |
| <input type="checkbox"/> Hard disk drive _____GB | <input type="checkbox"/> Docking station _____model |
| <input type="checkbox"/> PC Cards _____MB        | <input type="checkbox"/> Port replicator            |
| <input type="checkbox"/> PC Card                 | <input type="checkbox"/> Other                      |
| <input type="checkbox"/> PC Card                 |   |

#### Identification numbers

The serial number label is on the bottom of your computer. Write the machine **Type** and the serial number (**S/N**) below:

IBM product name	_____
Machine type	_____
Serial number	_____

**Problem recording sheet**

Collect this needed information before you call for help. Then you will be able to get help as quickly as possible.

- Type of problem:

Continuous                       Intermittent

- Error code:

\_\_\_\_\_

- Operating system and version, if available:

Windows Version\_\_\_\_\_

- Application programs running at the time of the problem:

\_\_\_\_\_  
\_\_\_\_\_

- Problem symptom (describe in detail):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Can the problem be reproduced?

Yes     No

If yes, describe how it can be reproduced:

\_\_\_\_\_  
\_\_\_\_\_

## ***Getting service***

## Appendix A. Product warranty and notices

International Business Machines Corporation

Armonk, New York 10504

### Statement of limited warranty

*The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you originally purchase for your use, and not for resale, from IBM or an IBM authorized reseller. The term "Machine" means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. Machines are subject to these terms only if purchased in the United States or Puerto Rico, or Canada, and located in the country of purchase. If you have any questions, contact IBM or your reseller.*

**Machine:** IBM ThinkPad T20 and the Battery Pack

**Warranty period\*:**

Model 2647 and 2648: Three Years except in some countries

Model 2649: One Year

Battery Pack: One Year

*\*Elements and accessories are warranted for three months. Contact your place of purchase for warranty service information.*

### Production status

Each Machine is manufactured from new parts, or new and serviceable used parts (which perform like new parts). In some cases, the Machine may not be new and may have been previously installed. Regardless of the Machine's production status, IBM's warranty terms apply.

### The IBM warranty

IBM warrants that each Machine 1) is free from defects in materials and workmanship and 2) conforms to IBM's Official Published Specifications. IBM calculates the expiration of the warranty period from the Machine's Date of Installation. The date on your receipt is the Date of Installation, unless IBM or your reseller informs you otherwise.

During the warranty period, IBM or your reseller will provide warranty service under the type of service designated for the Machine and will manage and install engineering changes that apply to the Machine. IBM or your reseller will specify the type of service.

For a feature, conversion, or upgrade, IBM or your reseller may require that the Machine on which it is installed be 1) the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Some of these transactions (called "Net-Priced" transactions) may include additional parts and associated replacement parts that are provided on an exchange basis. All removed parts become the property of IBM and must be returned to IBM.

Replacement parts assume the remaining warranty of the parts they replace.

If a Machine does not function as warranted during the warranty period, IBM or your reseller will repair or replace it (with a Machine that is at least functionally equivalent) without charge. If IBM or your reseller is unable to do so, you may return it to your place of purchase and your money will be refunded.

If you transfer a Machine to another user, warranty service is available to that user for the remainder of the warranty period. You should give your proof of purchase and this Statement to that user.

### Warranty service

To obtain warranty service for the Machine, you should contact your reseller or call IBM. In the United States, call IBM at **1-800-772-2227**. In Canada, call IBM at **1-800-565-3344**. You may be required to present proof of purchase.

Depending on the Machine, the service may be 1) a "Repair" service at your location (called "On-site") or at one of IBM's or a reseller's service locations (called "Carry-in") or 2) an "Exchange" service, either On-site or Carry-in.

When a type of service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced.

## Product warranty

It is your responsibility to:

1. obtain authorization from the owner (for example, your lessor) to have IBM or your reseller service a Machine that you do not own;
2. where applicable, before service is provided —
  - a) follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provide,
  - b) secure all programs, data, and funds contained in a Machine,
  - c) inform IBM or your reseller of changes in a Machine's location, and
  - d) for a Machine with exchange service, remove all features, parts, options, alterations, and attachments not under warranty service. Also, the Machine must be free of any legal obligations or restrictions that prevent its exchange; and
3. be responsible for loss of, or damage to, a Machine in transit when you are responsible for the transportation charges.

### Extent of warranty

IBM does not warrant uninterrupted or error-free operation of a Machine.

Unless IBM specifies otherwise, IBM provides non-IBM machines on an "AS IS" basis. However, non-IBM manufacturers may provide their own warranties to you.

Misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, removal of product labels or parts identification labels, or failure caused by a product for which IBM is not responsible may void the warranties.

THESE WARRANTIES REPLACE ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HOWEVER, SOME LAWS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES. IF THESE LAWS APPLY, THEN ALL EXPRESS AND IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.

In Canada, warranties include both warranties and conditions.

Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

### Limitation of liability

Circumstances may arise where, because of a default on IBM's part (including fundamental breach) or other liability (including negligence and misrepresentation), you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages, IBM is liable only for:

1. bodily injury (including death), and damage to real property and tangible personal property; and
2. the amount of any other actual loss or damage, up to the greater of \$100,000 or the charge for the Machine that is the subject of the claim.

Under no circumstances is IBM liable for any of the following:

1. third-party claims against you for losses or damages (other than those under the first item listed above);
2. loss of, or damage to, your records or data; or
3. economic consequential damages (including lost profits or savings) or incidental damages, even if IBM is informed of their possibility.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

## Notices

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any of the intellectual property rights of IBM may be used instead of the IBM product, program, or service. The evaluation and verification of operation in conjunction with other products, except those expressly designated by IBM, are the responsibility of the user.

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to the IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1784, U.S.A.

## Year 2000 readiness and instructions

This is a Year 2000 Readiness Disclosure.

A product is Year 2000 Ready if the product, when used in accordance with its associated documentation, is capable of correctly processing, providing and/or receiving date data within and between the 20th and 21st centuries, provided all other products (for example, software, hardware, and firmware) used with the product properly exchange date data with it.

This IBM PC hardware product has been designed to process four-digit date information correctly within and between the 20th and 21st centuries. If your IBM computer is on when the century changes, you should turn it off and then back on again once, or restart the operating system, to ensure that the internal clock resets itself for the new century.

This IBM PC product cannot prevent errors that might occur if software you use or exchange data with is not ready for the Year 2000. IBM software that comes with this product is Year 2000 Ready. However, software from other companies might come with this IBM PC product. IBM cannot take responsibility for the

## Notices

readiness of that software. You should contact the software developers directly if you wish to verify readiness, understand limitations, or look for any software updates.

To learn more about IBM PC products and the Year 2000, visit our Web site at <http://www.pc.ibm.com/year2000>. The information and tools there can help you with your Year 2000 transition plan, especially if you have multiple IBM PCs. IBM encourages you to check periodically for updated information.

## Trademarks

The following terms are trademarks of the IBM Corporation in the United States or other countries or both:

IBM	ThinkPad
HelpCenter	TrackPoint
PS/2	

Microsoft, Windows, and Windows NT are trademarks of Microsoft Corporation in the United States and/or other countries.

Pentium is a trademark of Intel Corporation in the United States and/or other countries. (For a complete list of Intel trademarks, see <http://www.intel.com/tradmarx.htm>)

Other company, product, or service names may be the trademarks or service marks of others.

## Electronic emission notices

### *Federal Communications Commission (FCC) Statement*

ThinkPad T20, model number 2647, 2648, and 2649

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an IBM authorized dealer or service representative for help.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from IBM authorized dealers. IBM is not responsible for any radio or television interference caused 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.

Responsible Party:

International Business Machines Corporation  
New Orchard Road  
Armonk, NY 10504  
Telephone 1-919-543-2193

## Notices

### *Industry Canada Class B Emission Compliance Statement*

This Class B digital apparatus complies with Canadian ICES-003.

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

Cet appareil numérique de la classe B est conform à la norme NMB-003 du Canada.

### *European Community Directive Conformance Statement*

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electro-magnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

A declaration of Conformity with the requirements of the Directive has been signed by IBM United Kingdom Limited, PO BOX 30 Spango Valley Greenock Scotland PA160AH.

This product satisfies the Class B limits of EN 55022.

## Telecommunication notices

### *Federal Communications Commission (FCC) and telephone company requirements*

1. This device complies with Part 68 of the FCC rules. A label is affixed to the device that contains, among other things, the FCC registration number, USOC, and Ringer Equivalency Number (REN) for this equipment. If these numbers are requested, provide this information to your telephone company.

**Note:** If the device is an internal modem, a second FCC registration label is also provided. You may attach the label to the exterior of the computer in which you install the IBM modem, or you may attach the label to the external DAA, if you have one. Place the label in a location that is easily accessible, should you need to provide the label information to the telephone company.

2. The REN is useful to determine the quantity of devices you may connect to your telephone line and still have those devices ring when your number is called. In most, but not all areas, the sum of the RENs of all devices should not exceed five (5). To be certain of the number of devices you may connect to your line, as determined by the REN, you should call your local telephone company to determine the maximum REN for your calling area.
3. If the device causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance; if advance notice is not practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC.
4. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be given advance notice to give you an opportunity to maintain uninterrupted service.
5. If you experience trouble with this product, contact your authorized reseller, or call IBM. In the United States, call IBM at **1-800-772-2227**. In Canada, call IBM at **1-800-565-3344**. You may be required to present proof of purchase.

The telephone company may ask you to disconnect the device from the network until the problem has been corrected, or until you are sure the device is not malfunctioning.

6. No customer repairs are possible to the device. If you experience trouble with the device, contact your Authorized Reseller or see the Diagnostics section of this manual for information.
7. This device may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs. Contact your state public utility commission or corporation commission for information.
8. When ordering network interface (NI) service from the local Exchange Carrier, specify service arrangement USOC RJ11C.

## Notices

### *Canadian Department of Communications certification label*

**NOTICE:** The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements documents. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations. Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

**Caution:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

**NOTICE:** The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

### *Étiquette d'homologation du ministère des Communications du Canada*

**AVIS** : L'étiquette d'Industrie Canada identifie le matériel homologué. Cette étiquette certifie que le matériel est conforme aux normes de protection, d'exploitation et de sécurité des réseaux de télécommunications, comme le prescrivent les documents concernant les exigences techniques relatives au matériel terminal. Le ministère n'assure toutefois pas que le matériel fonctionnera à la satisfaction de l'utilisateur.

Avant d'installer ce matériel, l'utilisateur doit s'assurer qu'il est permis de le raccorder aux installations de l'entreprise locale de télécommunications. Le matériel doit également être installé en suivant une méthode acceptée de raccordement. L'abonné ne doit pas oublier qu'il est possible que la conformité aux conditions énoncées ci-dessus n'empêche pas la dégradation du service dans certaines situations.

Les réparations de matériel homologué doivent être coordonnées par un représentant désigné par le fournisseur. L'entreprise de télécommunications peut demander à l'utilisateur de débrancher un appareil à la suite de réparations ou de modifications effectuées par l'utilisateur ou à cause de mauvais fonctionnement.

Pour sa propre protection, l'utilisateur doit s'assurer que tous les fils de mise à la terre de la source d'énergie électrique, des lignes téléphoniques et des canalisations d'eau métalliques, s'il y en a, sont raccordés ensemble. Cette précaution est particulièrement importante dans les régions rurales.

**Avertissement** : L'utilisateur ne doit pas tenter de faire ces raccordements lui-même; il doit avoir recours à un service d'inspection des installations électriques ou à un électricien, selon le cas.

**AVIS** : L'indice d'équivalence de la sonnerie (IES) assigné à chaque dispositif terminal indique le nombre maximal de terminaux qui peuvent être raccordés à une interface. La terminaison d'une interface téléphonique peut consister en une combinaison de quelques dispositifs, à la seule condition que la somme d'indices d'équivalence de la sonnerie de tous les dispositifs n'excède pas 5.

## Notices

### Product notice requirements

The following notice applies to machines equipped with both a DVD function and a TV-out function:

This product incorporates copyright protection technology that is protected by method claims of U.S. patent numbers 4631603, 4577216, 4819098, 4907093, and other intellectual property rights owned by Macrovision Corporation and other rights owners. Use of this copyright protection technology must be authorized by Macrovision Corporation and is intended for home and other limited viewing use only, unless otherwise authorized by Macrovision Corporation. Reverse engineering or disassembly is prohibited.

### Notice for Australia

The following notice applies when using the telephony functions:

**WARNING:**  
FOR SAFETY REASONS, ONLY CONNECT EQUIPMENT WITH A TELECOMMUNICATIONS COMPLIANCE LABEL. THIS INCLUDES CUSTOMER EQUIPMENT PREVIOUSLY LABELLED PERMITTED OR CERTIFIED.

### Notice for New Zealand

The modem in this ThinkPad is set up for Tone Dialing. Users should only select Pulse Dialing if they are connecting to the Telecom NZ network via a PBX or other systems which requires Pulse Dialing. Pulse Dialing is required only for a small number of obsolescent PBX or similar systems.

The grant of a Telepermit for any item of terminal equipment indicates only that Telecom has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all of Telecom's network services.

This equipment is not capable, under all operating conditions, of correct operation at the higher speeds for which it is designed. Telecom will accept no responsibility should difficulties arise in such circumstances.

This device is equipped with pulse dialling while the Telecom standard is DTMF tone dialling. There is no guarantee that Telecom lines will always continue to support pulse dialling.

Use of pulse dialling, when this equipment is connected to the same line as other equipment, may give rise to bell tinkle or noise and may also cause a false answer

## Notices

condition. Should such problems occur, the user should NOT contact the Telecom Faults Service.

This equipment shall not be set to make automatic calls to the Telecom '111' Emergency Service.

This equipment should not be used under any circumstances which may constitute a nuisance to other Telecom customers.

### Notice for European Union countries

The equipment described here has been approved in accordance with Council Decision 98/482/EC for pan-European single-terminal connection to the Public Switched Telephone Network (PSTN). However, because of differences between the individual PSTNs provided in different countries, the approval does not, of itself, give an unconditional assurance that the equipment will operate successfully on every PSTN network termination point. In the event of problems, you should contact your equipment supplier first. The modem integrated in this equipment is designed to work on the following country or regional networks: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Republic of Ireland, United Kingdom. Operation in pulse dialing mode is supported only for PBXs. To operate with the networks listed above, the modem should be set as explained in the chapter headed "Use the built-in modem" in the online user's guide.

For Spain: A change in the polarity of the dc voltage can cause the connection to be broken.

