



IBM Mobile Systems  
ThinkPad Computer  
Hardware Maintenance Manual

February 2001

**This manual supports:**  
**ThinkPad T20/T21/T22 (MT 2647/2648)**

**Note**

Before using this information and the product it supports, be sure to read the general information under "Notices" on page 126.

**First Edition (February 2001)**

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# Introduction

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## Important service information

### Important

Diskette fixes are customer-installable. The diskette fixes are posted on the IBM support site (<http://www.pc.ibm.com/support/>).

Advise customers to contact the PC Company HelpCenter at 800-772-2227 if they need assistance in obtaining or installing any diskette fixes.

Customers in Canada should call IBM HelpPC at 800-565-3344 for assistance or download information.

## Strategy for replacing FRUs

### Before replacing parts

Make sure that all diskette fixes are installed before replacing any FRUs listed in this manual.

Use the following strategy to prevent unnecessary FRU replacement and service expense:

- **If you are instructed to replace a FRU but the replacement does not correct the problem, reinstall the original FRU before you continue.**
- Some computers have both a processor board and a system board. If you are instructed to replace either the processor board or the system board, and replacing one of them does not correct the problem, reinstall that board, and then replace the other one.
- If an adapter or device consists of more than one FRU, any of the FRUs may be the cause of the error. Before replacing the adapter or device, remove the FRUs, one by one, to see if the symptoms change. Replace only the FRU that changed the symptoms.

**Attention**

The setup configuration on the computer you are servicing may have been customized. Running Automatic Configuration may alter the settings. Note the current configuration settings (using the View Configuration option); then, when service has been completed, verify that those settings remain in effect.

**Strategy for replacing a hard-disk drive**

Always try to run a low-level format before replacing a hard-disk drive.

**Attention**

The drive startup sequence in the computer you are servicing may have been changed. Be extremely careful during write operations such as copying, saving, or formatting. If you select an incorrect drive, data or programs can be overwritten.

**How to use error messages**

Use the error codes displayed on the screen to diagnose failures. If more than one error code is displayed, begin the diagnosis with the first error code. Whatever causes the first error code may also cause false error codes. If no error code is displayed, see if the error symptom is listed in the Symptom-to-FRU Index for the computer you are servicing.

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**Diskette compatibility matrix**

The compatibility of each of the drives with the diskettes for it is as follows:

Diskette drive	Diskette capacity	Compatibility
3.5-inch	1.0 MB	Read and write
	2.0 MB	Read and write
	4.0 MB	Not compatible

## Safety notices: multilingual translations

In this manual, safety notices appear in English with a page number reference to the appropriate translation in this section.

The safety notices are provided in English, French, German, Italian, and Spanish, as follows:

### Safety notice 1

Before the computer is powered-on after FRU replacement, make sure all screws, springs, and other small parts are in place and are not left loose inside the computer. Verify this by shaking the computer and listening for rattling sounds. Metallic parts or metal flakes can cause electrical shorts.

Avant de remettre l'ordinateur sous tension après remplacement d'une unité en clientèle, vérifiez que tous les ressorts, vis et autres pièces sont bien en place et bien fixées. Pour ce faire, secouez l'unité et assurez-vous qu'aucun bruit suspect ne se produit. Des pièces métalliques ou des copeaux de métal pourraient causer un court-circuit.

Bevor nach einem FRU-Austausch der Computer wieder angeschlossen wird, muß sichergestellt werden, daß keine Schrauben, Federn oder andere Kleinteile fehlen oder im Gehäuse vergessen wurden. Der Computer muß geschüttelt und auf Klappergeräusche geprüft werden. Metallteile oder-splitter können Kurzschlüsse erzeugen.

Prima di accendere l'elaboratore dopo che é stata effettuata la sostituzione di una FRU, accertarsi che tutte le viti, le molle e tutte le altri parti di piccole dimensioni siano nella corretta posizione e non siano sparse all'interno dell'elaboratore. Verificare ci ÚÚ scuotendo l'elaboratore e prestando attenzione ad eventuali rumori; eventuali parti o pezzetti metallici possono provocare cortocircuiti pericolosi.

Antes de encender el sistema despues de sustituir una FRU, compruebe que todos los tornillos, muelles y demás piezas pequeñas se encuentran en su sitio y no se encuentran sueltas dentro del sistema. Compruébelo agitando el sistema y escuchando los posibles ruidos que provocarían. Las piezas metálicas pueden causar cortocircuitos eléctricos.

**Safety notice 2** **DANGER:**

Some standby batteries contain a small amount of nickel and cadmium. Do not disassemble a standby battery, recharge it, throw it into fire or water, or short-circuit it. Dispose of the battery as required by local ordinances or regulations. Use only the battery in the appropriate parts listing. Use of an incorrect battery can result in ignition or explosion of the battery.

Certaines batteries de secours contiennent du nickel et du cadmium. Ne les démontez pas, ne les rechargez pas, ne les exposez ni au feu ni à l'eau. Ne les mettez pas en court-circuit. Pour les mettre au rebut, conformez-vous à la réglementation en vigueur. Lorsque vous remplacez la pile de sauvegarde ou celle de l'horloge temps réel, veillez à n'utiliser que les modèles cités dans la liste de pièces détachées adéquate. Une batterie ou une pile inappropriée risque de prendre feu ou d'exploser.

Die Bereitschaftsbatterie, die sich unter dem Diskettenlaufwerk befindet, kann geringe Mengen Nickel und Cadmium enthalten. Sie darf nur durch die Verkaufsstelle oder den IBM Kundendienst ausgetauscht werden. Sie darf nicht zerlegt, wiederaufgeladen, kurzgeschlossen, oder Feuer oder Wasser ausgesetzt werden. Die Batterie kann schwere Verbrennungen oder Verätzungen verursachen. Bei der Entsorgung die örtlichen Bestimmungen für Sondermüll beachten. Beim Ersetzen der Bereitschafts- oder Systembatterie nur Batterien des Typs verwenden, der in der Ersatzteilliste aufgeführt ist. Der Einsatz falscher Batterien kann zu Entzündung oder Explosion führen.

(continued)

**Continuation of Safety notice 2** **DANGER:**

Alcune batterie di riserva contengono una piccola quantità di nichel e cadmio. Non smontarle, ricaricarle, gettarle nel fuoco o nell'acqua né cortocircuitarle. Smaltirle secondo la normativa in vigore (DPR 915/82, successive disposizioni e disposizioni locali). Quando si sostituisce la batteria dell'RTC (real time clock) o la batteria di supporto, utilizzare soltanto i tipi inseriti nell'appropriato Catalogo parti. L'impiego di una batteria non adatta potrebbe determinare l'incendio o l'esplosione della batteria stessa.

Algunas baterías de reserva contienen una pequeña cantidad de níquel y cadmio. No las desmonte, ni recargue, ni las eche al fuego o al agua ni las cortocircuite. Deséchelas tal como dispone la normativa local. Utilice sólo baterías que se encuentren en la lista de piezas. La utilización de una batería no apropiada puede provocar la ignición o explosión de la misma.

**Safety notice 3** **DANGER:**

The battery pack contains small amounts of nickel. Do not disassemble it, throw it into fire or water, or short-circuit it. Dispose of the battery pack as required by local ordinances or regulations. Use only the battery in the appropriate parts listing when replacing the battery pack. Use of an incorrect battery can result in ignition or explosion of the battery.

La batterie contient du nickel. Ne la démontez pas, ne l'exposez ni au feu ni à l'eau. Ne la mettez pas en court-circuit. Pour la mettre au rebut, conformez-vous à la réglementation en vigueur. Lorsque vous remplacez la batterie, veillez à n'utiliser que les modèles cités dans la liste de pièces détachées adéquate. En effet, une batterie inappropriée risque de prendre feu ou d'exploser.

Akkus enthalten geringe Mengen von Nickel. Sie dürfen nicht zerlegt, wiederaufgeladen, kurzgeschlossen, oder Feuer oder Wasser ausgesetzt werden. Bei der Entsorgung die örtlichen Bestimmungen für Sondermüll beachten. Beim Ersetzen der Batterie nur Batterien des Typs verwenden, der in der Ersatzteilliste aufgeführt ist. Der Einsatz falscher Batterien kann zu Entzündung oder Explosion führen.

La batteria contiene piccole quantità di nichel. Non smontarla, gettarla nel fuoco o nell'acqua né cortocircuitarla. Smaltirla secondo la normativa in vigore (DPR 915/82, successive disposizioni e disposizioni locali). Quando si sostituisce la batteria, utilizzare soltanto i tipi inseriti nell'appropriato Catalogo parti. L'impiego di una batteria non adatta potrebbe determinare l'incendio o l'esplosione della batteria stessa.

Las baterías contienen pequeñas cantidades de níquel. No las desmonte, ni recargue, ni las eche al fuego o al agua ni las cortocircuite. Deséchelas tal como dispone la normativa local. Utilice sólo baterías que se encuentren en la lista de piezas al sustituir la batería. La utilización de una batería no apropiada puede provocar la ignición o explosión de la misma.



**Safety notice 4**** DANGER:**

The lithium battery can cause a fire, an explosion, or a severe burn. Do not recharge it, remove its polarized connector, disassemble it, heat it above 100°C (212°F), incinerate it, or expose its cell contents to water. Dispose of the battery as required by local ordinances or regulations. Use only the battery in the appropriate parts listing. Use of an incorrect battery can result in ignition or explosion of the battery.

La pile de sauvegarde contient du lithium. Elle présente des risques d'incendie, d'explosion ou de brûlures graves. Ne la rechargez pas, ne retirez pas son connecteur polarisé et ne la démontez pas. Ne l'exposez pas à une température supérieure à 100°C, ne la faites pas brûler et n'en exposez pas le contenu à l'eau. Mettez la pile au rebut conformément à la réglementation en vigueur. Une pile inappropriée risque de prendre feu ou d'exploser.

Die Systematterie ist eine Lithiumatterie. Sie kann sich entzünden, explodieren oder schwere Verbrennungen hervorrufen. Batterien dieses Typs dürfen nicht aufgeladen, zerlegt, über 100 C erhitzt oder verbrannt werden. Auch darf ihr Inhalt nicht mit Wasser in Verbindung gebracht oder der zur richtigen Polung angebrachte Verbindungsstecker entfernt werden. Bei der Entsorgung die örtlichen Bestimmungen für Sondermüll beachten. Beim Ersetzen der Batterie nur Batterien des Typs verwenden, der in der Ersatzteilliste aufgeführt ist. Der Einsatz falscher Batterien kann zu Entzündung oder Explosion führen.

La batteria di supporto è una batteria al litio e può incendiarsi, esplodere o procurare gravi ustioni. Evitare di ricaricarla, smontarne il connettore polarizzato, smontarla, riscaldarla ad una temperatura superiore ai 100 gradi centigradi, incendiarla o gettarla in acqua. Smaltirla secondo la normativa in vigore (DPR 915/82, successive disposizioni e disposizioni locali). L'impiego di una batteria non adatta potrebbe determinare l'incendio o l'esplosione della batteria stessa.

(continued)

**Continuation of Safety notice 4**

 **DANGER:**

La batería de repuesto es una batería de litio y puede provocar incendios, explosiones o quemaduras graves. No la recargue, ni quite el conector polarizado, ni la desmonte, ni caliente por encima de los 100°C (212°F), ni la incinere ni exponga el contenido de sus celdas al agua. Deséchela tal como dispone la normativa local.

**Safety notice 5**

If the LCD breaks and the fluid from inside the LCD gets into your eyes or on your hands, immediately wash the affected areas with water for at least 15 minutes. Seek medical care if any symptoms from the fluid are present after washing.

Si le panneau d'affichage à cristaux liquides se brise et que vous recevez dans les yeux ou sur les mains une partie du fluide, rincez-les abondamment pendant au moins quinze minutes. Consultez un médecin si des symptômes persistent après le lavage.

Die Leuchtstoffröhre im LCD-Bildschirm enthält Quecksilber. Bei der Entsorgung die örtlichen Bestimmungen für Sondermüll beachten. Der LCD-Bildschirm besteht aus Glas und kann zerbrechen, wenn er unsachgemäß behandelt wird oder der Computer auf den Boden fällt. Wenn der Bildschirm beschädigt ist und die darin befindliche Flüssigkeit in Kontakt mit Haut und Augen gerät, sollten die betroffenen Stellen mindestens 15 Minuten mit Wasser abgespült und bei Beschwerden anschließend ein Arzt aufgesucht werden.

Nel caso che caso l'LCD si dovesse rompere ed il liquido in esso contenuto entrasse in contatto con gli occhi o le mani, lavare immediatamente le parti interessate con acqua corrente per almeno 15 minuti; poi consultare un medico se i sintomi dovessero permanere.

Si la LCD se rompe y el fluido de su interior entra en contacto con sus ojos o sus manos, lave inmediatamente las áreas afectadas con agua durante 15 minutos como mínimo. Obtenga atención medica si se presenta algún síntoma del fluido despues de lavarse.

**Safety notice 6**

To avoid shock, do not remove the plastic cover that protects the lower part of the inverter card.

Afin d'éviter tout risque de choc électrique, ne retirez pas le cache en plastique protégeant la partie inférieure de la carte d'alimentation.

Aus Sicherheitsgründen die Kunststoffabdeckung, die den unteren Teil der Spannungswandlerplatine umgibt, nicht entfernen.

Per evitare scosse elettriche, non rimuovere la copertura in plastica che avvolge la parte inferiore della scheda invertitore.

Para evitar descargas, no quite la cubierta de plástico que rodea la parte baja de la tarjeta invertida.

**Safety notice 7**

Though the main batteries have low voltage, a shorted or grounded battery can produce enough current to burn personnel or combustible materials.

Bien que le voltage des batteries principales soit peu élevé, le court-circuit ou la mise à la masse d'une batterie peut produire suffisamment de courant pour brûler des matériaux combustibles ou causer des brûlures corporelles graves.

Obwohl Hauptbatterien eine niedrige Spannung haben, können sie doch bei Kurzschluß oder Erdung genug Strom abgeben, um brennbare Materialien zu entzünden oder Verletzungen bei Personen hervorzurufen.

Sebbene le batterie di alimentazione siano a basso voltaggio, una batteria in corto circuito o a massa può fornire corrente sufficiente da bruciare materiali combustibili o provocare ustioni ai tecnici di manutenzione.

Aunque las baterías principales tienen un voltaje bajo, una batería cortocircuitada o con contacto a tierra puede producir la corriente suficiente como para quemar material combustible o provocar quemaduras en el personal.

**Safety notice 8**

Before removing any FRU, power off the computer, unplug all power cords from electrical outlets, remove the battery pack, and then disconnect any interconnecting cables.

Avant de retirer une unité remplaçable en clientèle, mettez le système hors tension, débranchez tous les cordons d'alimentation des socles de prise de courant, retirez la batterie et déconnectez tous les cordons d'interface.

Die Stromzufuhr muß abgeschaltet, alle Stromkabel aus der Steckdose gezogen, der Akku entfernt und alle Verbindungskabel abgenommen sein, bevor eine FRU entfernt wird.

Prima di rimuovere qualsiasi FRU, spegnere il sistema, scollegare dalle prese elettriche tutti i cavi di alimentazione, rimuovere la batteria e poi scollegare i cavi di interconnessione.

Antes de quitar una FRU, apague el sistema, desenchufe todos los cables de las tomas de corriente eléctrica, quite la batería y, a continuación, desconecte cualquier cable de conexión entre dispositivos.

## Safety information

The following section contains the safety information that you need to be familiar with before servicing an IBM mobile computer.

### General safety

Follow these rules to ensure general safety:

- Observe good housekeeping in the area of the machines during and after maintenance.
  - When lifting any heavy object:
    1. Ensure you can stand safely without slipping.
    2. Distribute the weight of the object equally between your feet.
    3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
    4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that weigh more than 16 kg (35 lb) or objects that you think are too heavy for you.*
  - Do not perform any action that causes hazards to the customer, or that makes the equipment unsafe.
  - Before you start the machine, ensure that other service representatives and the customer's personnel are not in a hazardous position.
  - Place removed covers and other parts in a safe place, away from all personnel, while you are servicing the machine.
  - Keep your toolbox away from walk areas so that other people will not trip over it.
  - Do not wear loose clothing that can be trapped in the moving parts of a machine. Make sure that your sleeves are fastened or rolled up above your elbows. If your hair is long, fasten it.
  - Insert the ends of your necktie or scarf inside clothing or fasten it with a nonconductive clip, approximately 8 centimeters (3 inches) from the end.
  - Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing.
- Attention:** Metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
  - After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
  - Reinstall all covers correctly before returning the machine to the customer.

## Electrical safety

Observe the following rules when working on electrical equipment.

### Important

Use only approved tools and test equipment. Some hand tools have handles covered with a soft material that does not insulate you when working with live electrical currents.

Many customers have, near their equipment, rubber floor mats that contain small conductive fibers to decrease electrostatic discharges. Do not use this type of mat to protect yourself from electrical shock.

- Find the room emergency power-off (EPO) switch, disconnecting switch, or electrical outlet. If an electrical accident occurs, you can then operate the switch or unplug the power cord quickly.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages.
- Disconnect all power before:
  - Performing a mechanical inspection
  - Working near power supplies
  - Removing or installing main units
- Before you start to work on the machine, unplug the power cord. If you cannot unplug it, ask the customer to power-off the wall box that supplies power to the machine and to lock the wall box in the off position.
- If you need to work on a machine that has *exposed* electrical circuits, observe the following precautions:
  - Ensure that another person, familiar with the power-off controls, is near you.

**Attention:** Another person must be there to switch off the power, if necessary.

- Use only one hand when working with powered-on electrical equipment; keep the other hand in your pocket or behind your back.

**Attention:** An electrical shock can occur only when there is a complete circuit. By observing the above rule, you may prevent a current from passing through your body.

- When using testers, set the controls correctly and use the approved probe leads and accessories for that tester.
- Stand on suitable rubber mats (obtained locally, if necessary) to insulate you from grounds such as metal floor strips and machine frames.

Observe the special safety precautions when you work with very high voltages; these instructions are in the

safety sections of maintenance information. Use extreme care when measuring high voltages.

- Regularly inspect and maintain your electrical hand tools for safe operational condition.
- Do not use worn or broken tools and testers.
- *Never assume* that power has been disconnected from a circuit. First, *check* that it has been powered off.
- Always look carefully for possible hazards in your work area. Examples of these hazards are moist floors, nongrounded power extension cables, power surges, and missing safety grounds.
- Do not touch live electrical circuits with the reflective surface of a plastic dental mirror. The surface is conductive; such touching can cause personal injury and machine damage.
- Do not service the following parts *with the power on* when they are removed from their normal operating places in a machine:
  - Power supply units
  - Pumps
  - Blowers and fans
  - Motor generators

and similar units. (This practice ensures correct grounding of the units.)

- If an electrical accident occurs:
  - Use caution; do not become a victim yourself.
  - Switch off power.
  - Send another person to get medical aid.

## Safety inspection guide

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

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

Consider these conditions and the safety hazards they present:

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



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

Checklist:

1. Check exterior covers for damage (loose, broken, or sharp edges).
2. Power-off the computer. Disconnect the power cord.
3. Check the power cord for:
  - a. A third-wire ground connector in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and frame ground.
  - b. The power cord should be the type specified in the parts list.
  - c. Insulation must not be frayed or worn.
4. Remove the cover.
5. Check for any obvious non-IBM alterations. Use good judgment as to the safety of any non-IBM alterations.
6. Check inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
7. Check for worn, frayed, or pinched cables.
8. Check that the power-supply cover fasteners (screws or rivets) have not been removed or tampered with.

## Handling electrostatic discharge-sensitive devices

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

### Notes

1. Use product-specific ESD procedures when they exceed the requirements noted here.
2. Make sure that the ESD protective devices you use have been certified (ISO 9000) as fully effective.

When handling ESD-sensitive parts:

- Keep the parts in protective packages until they are inserted into the product.
- Avoid contact with other people.
- Wear a grounded wrist strap against your skin to eliminate static on your body.

- Prevent the part from touching your clothing. Most clothing is insulative and retains a charge even when you are wearing a wrist strap.
- Use the black side of a grounded work mat to provide a static-free work surface. The mat is especially useful when handling ESD-sensitive devices.
- Select a grounding system, such as those listed below, to provide protection that meets the specific service requirement.

**Note**

The use of a grounding system is desirable but not required to protect against ESD damage.

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

## Grounding requirements

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

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## Laser compliance statement

Some IBM Personal Computer models are equipped from the factory with a CD-ROM drive or DVD drive. CD-ROM drives or DVD drives are also sold separately as options. The CD-ROM drive or DVD drive is a laser product. The CD-ROM drive or DVD 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 1 laser products. Elsewhere, the drive is certified to conform to the requirements of the International Electrotechnical Commission (IEC) 825 and CENELEC EN 60 825 for Class 1 laser products.

When a CD-ROM drive or DVD drive is installed, note the following:

**⚠ CAUTION:**

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

**O uso de controles, ajustes ou desempenho de procedimentos diferentes daqueles aqui especificados pode resultar em perigosa exposição à radiação.**

凡未在这里指明的任何控制用法、调整、行为，都会导致严重后果。

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

**Werden Steuer- und Einstellelemente anders als hier festgesetzt verwendet, kann gefährliche Laserstrahlung auftreten.**

Az itt előírt eljárásoktól, beállításoktól és vezérlésektől eltérni a lézersugárzás veszélye miatt kockázatos !

**L'utilizzo di controlli, regolazioni o l'esecuzione di procedure diverse da quelle specificate possono provocare l'esposizione a.**

Использование элементов настройки и выполнение процедур иных, чем указано здесь, может привести к опасному радиационному облучению.

Použitie kontrol, úprav alebo iných vykonaní od iných výrobcov, ako je v tomto špecifikované, mohlo by mať za následok nebezpečenstvo vystavenia sa vyžiarovaniu.

**El uso de controles o ajustes o la ejecución de procedimientos distintos de los aquí especificados puede provocar la exposición a radiaciones peligrosas.**

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

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

**⚠ DANGER:**

**Emits visible and invisible laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.**

**Radiação por raio laser ao abrir. Não olhe fixo no feixe de luz, não olhe diretamente por meio de instrumentos óticos e evite exposição direta com o feixe de luz.**

**开启时会有激光发射时，请勿盯视激光光束，请勿直接查看视觉仪器，并且避免直接接触在激光光束之中。**

**Rayonnement laser si carter ouvert. Évitez de fixer le faisceau, de le regarder directement avec des instruments optiques, ou de vous exposer au rayon.**

**Laserstrahlung bei geöffnetem Gerät. Nicht direkt oder über optische Instrumente in den Laserstrahl sehen und den Strahlungsbereich meiden.**

**Kinyitáskor lézersugár ! Ne nézzen bele se szabad szemmel, se optikai eszközökkel. Kerülje a sugárnyalábbal való érintkezést !**

**Aprenendo l'unità vengono emesse radiazioni laser. Non fissare il fascio, non guardarlo direttamente con strumenti ottici e evitare l'esposizione diretta al fascio.**

**Открывая, берегитесь лазерного излучения. Не смотрите на луч, не разглядывайте его с помощью оптических инструментов, а также избегайте прямого воздействия лазерного луча.**

**Keď je laserová jednotka otvorená. Vyhnite sa priamemu pohľadu a nehládte priamo s optickými nástrojmi do lúča a vyhnite sa priamemu vystaveniu lúčov.**

**Radiación láser al abrir. No mire fijamente ni examine con instrumental óptico el haz de luz. Evite la exposición directa al haz.**

---

## General descriptions

This chapter includes descriptions for any ThinkPad model that has the PC-Doctor DOS diagnostics program. Some descriptions might not apply to your particular computer.

---

### Read this first

Before you go to the checkout guide, be sure to read this section.

#### Important notes

- **Only certified trained personnel should service the computer.**
- **Read the entire FRU removal and replacement page before replacing any FRU.**
- **Use new nylon-coated screws when you replace FRUs.**
- **Be extremely careful during such write operations as copying, saving, or formatting.** Drives in the computer that you are servicing sequence might have been altered. If you select an incorrect drive, data or programs might be overwritten.
- **Replace FRUs only for the correct model.** When you replace a FRU, make sure the model of the machine and the FRU part number are correct by referring to the FRU parts list.
- **A FRU should not be replaced because of a single, unreproducible failure.** Single failures can occur for a variety of reasons that have nothing to do with a hardware defect, such as cosmic radiation, electrostatic discharge, or software errors. Consider replacing a FRU only when a problem recurs. If you suspect that a FRU is defective, clear the error log and run the test again. If the error does not recur, do not replace the FRU.
- **Be careful not to replace a nondefective FRU.**

### What to do first:

When you do return a FRU, you must include the following information in the parts exchange form or parts return form that you attach to it:

- \_\_\_ 1. Name and phone number of servicer
- \_\_\_ 2. Date of service
- \_\_\_ 3. Date on which the machine failed
- \_\_\_ 4. Date of purchase
- \_\_\_ 5. Failure symptoms, error codes appearing on the display, and beep symptoms

- \_\_\_ 6. Procedure index and page number in which the failing FRU was detected
- \_\_\_ 7. Failing FRU name and part number
- \_\_\_ 8. Machine type, model number, and serial number
- \_\_\_ 9. Customer's name and address

**Note for warranty:** During the warranty period, the customer may be responsible for repair costs if the computer damage was caused by misuse, accident, modification, unsuitable physical or operating environment, or improper maintenance by the customer. The following list provides some common items that are not covered under warranty and some symptoms that might indicate that the system was subjected to stress beyond normal use.

Before checking problems with the computer, determine whether the damage is covered under the warranty by referring to the following:

**The following are not covered under warranty:**

- LCD panel cracked from the application of excessive force or from being dropped
- Scratched (cosmetic) parts
- Distortion, deformation or discoloration of the cosmetic parts
- Cracked or broken plastic parts, broken latches, broken pins, or broken connectors caused by excessive force
- Damage caused by liquid spilled into the system
- Damage caused by the improper insertion of a PC Card or the installation of an incompatible card
- Damage caused by foreign material in the diskette drive
- Diskette drive damage caused by pressure on the diskette drive cover or by the insertion of a diskette with multiple labels
- Damaged or bent diskette eject button
- Fuses blown by attachment of a nonsupported device
- Forgotten computer password (making the computer unusable)
- Sticky keys caused by spilling a liquid onto the keyboard

**The following symptoms might indicate damage caused by nonwarranted activities:**

- Missing parts might be a symptom of unauthorized service or modification.
- If the spindle of a hard-disk drive becomes noisy, it may have been subjected to excessive force, or dropped.

## Related service information

This section provides information about the following:

- “Service Web site”
- “Using Recovery CD”
- “Passwords” on page 22
- “Power management” on page 24

### Service Web site

When the latest maintenance diskette and the system program service diskette are available, a notice will be posted on <http://www.pc.ibm.com/partner/infotips/>

### Using Recovery CD

To create Service Partition and install the preloaded system from Recovery CD, do the following;

#### To create Service Partition [SP]:

1. Erase all partitions on the hard-disk drive using FDISK or similar application.
2. Boot with Recovery CD (and boot diskette if required).
3. A menu will appear stating **“Your computer originally included a Product Recovery program ... Reinstall the Product Recovery Program? (Y/N) [ ]”**.

**Note:** If the hard-disk drive contains any partitions, you will not receive this menu — go to step 1.

4. Enter **“Y”** and Service Partition will be created and loaded with D2D files.

**Note:** If you do not want to create Service Partition, press **“N”**, and then go to step 8.

5. Press **“ENTER”** at next window to continue.
  - Service Partition will be created. System will automatically reboot during this process.
  - Recovery process will copy some files to the Service Partition, PKUNZIP others.
  - Follow prompts — you may be prompted to change CDs.
  - System will reboot when complete, continue to step 6 to install preloaded system.

#### Install preloaded system from CD:

6. Boot with Recovery CD (and boot diskette if required)
7. If the hard-disk drive is blank, a menu will appear stating **“Your computer originally included a Product Recovery program ... Reinstall the Product Recovery Program? (Y/N) [ ]”**.
  - To install Service Partition, go to step 4.
  - To preload hard-disk drive without installing Service Partition, press **“N”**.

8. If a menu appears asking which operating system to install, highlight proper operating system and press “**ENTER**”.
9. A menu will appear stating “**Full Recovery:**”. Press “**ENTER**” to select.
10. Enter “**Y**” at the three windows which follow.
11. Follow prompts to complete Recovery.

## Passwords

As many as three passwords may be needed for any ThinkPad computer: the power-on password (POP), the hard-disk password (HDP), and the supervisor password (SVP).

**Exception:** If only SVP is installed, the password prompt does not appear when the operating system is booted.

When any of these passwords is used, a password prompt appears on the screen whenever the computer is turned on. The computer does not start until the password is entered.

### Power-on password:

A power-on password (POP) protects the system from being powered on by an unauthorized person. The password must be entered before an operating system can be booted.

### Hard-disk password:

There are two hard-disk passwords (HDPs):

- User HDP—for the user
- Master HDP—for the system administrator, who can use it to get access to the hard disk even if the user has changed the user HDP

**Note:** There are two modes for the HDP: **User only** and **Master + User**. The **Master + User** mode requires two HDPs and is designed for the system administrator to input both in the same operation. The system administrator then provides the user HDP to the system user.



**Attention**

If the user HDP is forgotten, check to see if a master HDP was set. If a master HDP was set and can be recalled, this will allow access to the hard-disk drive. If no master HDP is available, IBM does not provide any services to reset either the user or the master HDP nor recover data from the hard-disk drive. The hard-disk drive can be replaced for a scheduled fee.

**Supervisor password:**

A supervisor password (SVP) protects the system information stored in the IBM BIOS Setup Utility. The SVP must be entered in order to access the IBM BIOS Setup Utility and make changes to system configuration settings.

**Attention**

If the SVP has been forgotten and cannot be made available to the servicer, there is no service procedure to reset the password. The systemboard must be replaced for a scheduled fee.

**How to remove the power-on password**

To remove a POP that you have forgotten, do the following:

(A) If SVP is not installed:

1. Turn off the computer.
2. Remove the battery pack.

For how to remove the battery pack, see "1010 Battery pack" on page 55.

3. Remove the backup battery.

For how to remove the backup battery, see "1020 Backup battery" on page 56.

4. Turn on the computer and wait until the POST ends.

After the POST ends, the password prompt does not appear. The POP has been removed.

5. Reinstall the backup battery and the battery pack.

(B) If SVP is installed and known by the servicer:

1. Turn on the computer by pressing and holding **F1**.
2. Enter the SVP. The IBM BIOS Setup Utility menu appears.
3. Select **Password**, using the cursor keys to move down the menu.
4. Select **Power-On Password**.
5. Enter the SVP, at the Enter Current Password field.

6. When the Enter New Password field opens, leave it blank and press **Enter** twice.
7. Press **Enter** in the Changes have been saved window.
8. Press **F10**; then select **Yes** in the Setup confirmation window.

## How to remove the hard-disk password

### Attention

If **User only** mode is selected and the user HDP is forgotten and cannot be made available to the servicer, IBM does not provide any services to reset the user HDPs nor recover data from the hard-disk drive. The hard-disk drive can be replaced for a scheduled fee.

To remove the user HDP that has been forgotten, when the SVP and master HDP is known, do the following:

1. Power on the computer by pressing and holding **F1**.
2. Enter the SVP. The IBM BIOS Setup Utility menu appears.
3. Select **Password**, using the cursor keys to move down the menu.
4. Select **Hard-disk x password**, where *x* is the letter of the hard-disk drive. A pop-up window opens.
5. Select either **User HDP** or **Master HDP**.
6. Enter the master HDP; then leave the New Password field blank and press **Enter** twice.
7. Press **F10**.
8. Select **Yes** in the Setup Configuration window.

Both user HDP and master HDP will have been removed.

## Power management

To reduce power consumption, the computer has three power management modes: screen blank, standby, and hibernation.

### Notes

- Screen blank mode is called *standby mode* in Windows 95 and Windows NT.
- Standby mode is called *suspend mode* in Windows 95 and Windows NT.

## Screen blank mode

Screen blank mode has three variants, as follows:

1. If you press **Fn + F3**, or the time set on the "LCD off timer" in IBM BIOS Setup Utility expires,
  - The LCD backlight turns off.

- The hard-disk drive motor stops.
  - The speaker is muted.
2. If you are using the ACPI operating system and you press **Fn + F3**,
    - The LCD backlight turns off.
    - The hard-disk drive motor stops.
  3. If the time set on the "Turn off monitor" timer in the operating system expires,
    - The LCD backlight turns off.

To end screen blank mode and resume normal operation, press any key.

## Standby mode

When the computer enters standby mode, the following events occur in addition to what occurs in screen blank mode:

- The LCD is powered off.
- The hard-disk drive is powered off.
- The CPU stops.

To enter standby mode, press **Fn + F4**.

**Note:** You can change the action of **Fn + F4**, if you are using the ACPI operating system.

In certain circumstances, the computer goes into standby mode automatically:

- If a "suspend time" has been set on the timer, and the user does not do any operation with the keyboard, the TrackPoint, the hard disk, the parallel connector, or the diskette drive within that time.
- If the battery indicator blinks orange, indicating that the battery power is low. (Alternatively, if **Hibernate when battery becomes low** has been selected in the "Power Management Properties" window, the computer goes into hibernation mode.)

### Note for the APM operating system:

Even if you don't set the low-battery alarm, the charge indicator notifies you when the battery is low, and then the computer enters the power-saving mode automatically. This default low-battery behavior is independent of the operating system; so if you have set the low-battery alarm, the computer may not do what you specified. It chooses either your setting or the default setting, whichever is appropriate.

If you are using the ACPI operating system, only the low-battery alarm is available.

To cause the computer to return from standby mode and resume operation, do one of the following:

- Press the **Fn** key.

- Open the LCD cover (only if you are using Windows Me and you entered standby mode by closing the LCD cover).
- Turn on the power switch.

Also, the computer automatically returns from standby mode and resumes operation in either of the following events:

- The ring indicator (RI) is signaled by a serial device or a PC Card device (Windows 2000 does not support ring indicator (RI) resume by PC Card device.)
- The time set on the resume timer elapses. In Windows 98, the **Scheduled Tasks** setting takes priority over the **Resume on timer** selection in the "Power Management Properties" window.

**Note:** The computer does not accept any input immediately after it enters standby mode. Wait a few seconds before taking any action to reenter operation mode.

## Hibernation mode

### Note for Windows NT

If you are using Windows NT in the default format, NTFS, you cannot create a hibernation file. If you want to use hibernation mode, you will need to reinstall Windows NT with FAT format.

### Note for OS/2

If you are using OS/2 in the default format, HPFS, you cannot create a hibernation file. If you want to use hibernation mode, you will need to reinstall OS/2 with FAT format.

In hibernation mode, the following occurs:

- The system status, RAM, VRAM, and setup data are stored on the hard disk.
- The system is powered off.

### Notes:

1. If you are using the APM operating system ,
  - In the ThinkPad Configuration program, the computer can be set to **Suspend/hibernate while docked**.
  - If you are running the computer on ac power and using a communication PC Card, the computer cannot enter hibernation mode.
2. If the computer enters the hibernation mode while it is docked to the docking station, do not undock it from the docking station before resuming normal operation.

If you do undock it and then try to resume normal operation, you will get an error message, and you will have to restart the system.

To cause the computer to enter hibernation mode, do any of the following:

- Press the **Fn + F12** keys.
- If you are using the APM operating system and have set the mode to **Power switch mode [Hibernation]**, turn off the power switch.

Also, the computer automatically goes into hibernation mode in either of the following conditions:

- If you are using an operating system other than Windows 98 and the timer conditions are satisfied in suspend mode.
- If you are using the APM operating system and have set the mode to **Hibernate when battery becomes low**, and the battery charge becomes critically low.

**Note:** If you are using the ACPI operating system, you can define closing the lid, pressing the Power button and pressing **Fn + F4** as events that cause the system to go into hibernation mode.

When the power is turned on, the computer returns from hibernation mode and resumes operation. The hibernation file in the boot record on the hard-disk drive is read, and system status is restored from the hard-disk drive.

## Checkout guide

Use the following procedures as a guide in identifying and correcting problems with the ThinkPad computer.

**Note:** The diagnostic tests are intended to test only IBM products. The use of non-IBM products, prototype cards, or modified options can lead to false indications of errors and invalid system responses.

1. Identify the failing symptoms in as much detail as possible.
2. Verify the symptoms. Try to re-create the failure by running the diagnostic test or by repeating the operation.

## Testing the computer

The ThinkPad computer has a test program called PC-Doctor<sup>®</sup> DOS (hereafter called *PC-Doctor*). You can detect errors by running the diagnostics test included in PC-Doctor. This section is an overview of the procedure. For details that depend on model-unique functions, refer to “Product overview” on page 37.

For some possible configurations of the computer, PC-Doctor might not run correctly. To avoid this problem, you need to initialize the computer setup by use of the IBM BIOS Setup Utility before you run PC-Doctor. On the IBM BIOS Setup Utility screen, press **F9**, **Enter**, **F10**, and then **Enter**.

**Note:** When you initialize the computer configuration, some devices are disabled, such as the serial port. If you test one of these devices, you will need to enable it by using PS2.EXE.

PC-Doctor cannot be used to test a device that is in the docking station, even if the computer supports the docking station. To test a USB device, connect it to the USB connector of the computer. To test the Ultrabay 2000 device, install it in the Ultrabay 2000 slot of the computer.

To run the test, do as follows:

**Note:** In the following procedure, you can select an item not only with the arrow keys, but also with the TrackPoint. Instead of pressing **Enter**, click the left button.

1. Insert the PC-Doctor disk into the diskette drive; then power on the computer.

If the computer cannot be powered on, go to “Power system checkout” on page 30, and check the power sources.

If an error code appears, go to “Symptom-to-FRU index” on page 44.

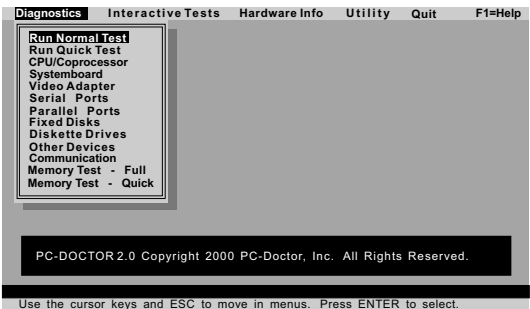
On the first screen, select the model and press **Enter**. Follow the instructions on the screen.

2. The main panel of PC-Doctor appears.
3. Select **Diagnostics** with the arrow keys, and press **Enter**.

A pull-down menu appears. (Its exact form depends on the model.)

The options on the test menu are as follows:

Diagnostics	Interactive Tests
<ul style="list-style-type: none"> <li>• Run Normal Test</li> <li>• Run Quick Test</li> <li>• CPU/Coprocessor</li> <li>• Systemboard</li> <li>• Video Adapter</li> <li>• Serial Ports</li> <li>• Parallel Ports</li> <li>• Fixed Disks</li> <li>• Diskette Drives</li> <li>• Other Devices</li> <li>• Communication</li> <li>• Memory Test – Full</li> <li>• Memory Test – Quick</li> </ul>	<ul style="list-style-type: none"> <li>• Keyboard</li> <li>• Video</li> <li>• Internal Speaker</li> <li>• Mouse</li> <li>• Joystick Test</li> <li>• Diskette</li> <li>• System Load</li> <li>• CD-ROM/DVD Test</li> <li>• Stereo Speaker</li> </ul>
<p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• In the <b>Keyboard</b> test in <b>Interactive Tests</b>, the <b>Fn</b> key is scanned only once. Each key should be held down for at least 2 seconds; otherwise, it cannot be sensed.</li> <li>• The sound card is not recognized in the <b>Stereo Speaker</b> in the <b>Interactive Tests</b>. To test it, use the audio device test in the <b>Other Devices (Diagnostics)</b>.</li> <li>• <b>Video Adapter</b> test supports only the LCD display on ThinkPad. Before running PC-Doctor DOS, detach the external Monitor.</li> </ul>	



4. Run the applicable function test.

5. Follow the instructions on the screen. If there is a problem, PC-Doctor shows messages describing it.
6. To exit the test, select **Quit — Exit Diag**.

To cancel the test, press **Esc**.

**Note:** After executing PC-Doctor, check the system time/date and reset them if needed.

## Detecting system information with PC-Doctor

PC-Doctor can detect the following system information:

### Hardware Info

- System Configuration
- Memory Contents
- Physical Disk Drives
- Logical Disk Drives
- VGA Information
- IDE Drive Info
- PCI Information
- PNPISA Info
- SMBIOS Info
- VESA LCD Info

### Utility

- Run External Tests
- Surface Scan Hard Disk
- Benchmark System
- DOS Shell
- Tech Support Form
- Battery Rundown
- View Test Log
- Print Log
- Save Log
- Full Erase Hard Drive
- Quick Erase Hard Drive

## Power system checkout

To verify a symptom, do the following:

1. Power off the computer.
2. Remove the battery pack.
3. Connect the ac adapter.
4. Check that power is supplied when you power on the computer.
5. Power off the computer.
6. Disconnect the ac adapter and install the charged battery pack.
7. Check that the battery pack supplies power when you power on the computer.

If you suspect a power problem, see the appropriate one of the following power supply checkouts:



- “Checking the ac adapter”
- “Checking operational charging”
- “Checking the battery pack” on page 32
- “Checking the backup battery” on page 32

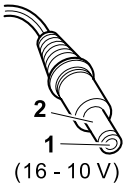
## Checking the ac adapter

You are here because the computer fails only when the ac adapter is used:

- If the power problem occurs only when the port replicator is used, replace the port replicator.
- If the power-on indicator does not turn on, check the power cord of the ac adapter for correct continuity and installation.
- If the computer does not charge during operation, go to “Checking operational charging.”

To check the ac adapter, do the following:

1. Unplug the ac adapter cable from the computer.
2. Measure the output voltage at the plug of the ac adapter cable. See the following figure:



Pin	Voltage (V dc)
1	+15.5 to +17.0
2	Ground

3. If the voltage is not correct, replace the ac adapter.
4. If the voltage is acceptable, do the following:
  - Replace the system board.
  - If the problem persists, go to “Product overview” on page 37.

**Note:** Noise from the ac adapter does not always indicate a defect.

## Checking operational charging

To check whether the battery charges properly during operation, use a discharged battery pack or a battery pack that has less than 50% of the total power remaining when installed in the computer.

Perform operational charging. If the battery status indicator or icon does not turn on, remove the battery pack and let it return to room temperature. Reinstall the battery pack. If the charge indicator or icon still does not turn on, replace the battery pack.

If the charge indicator still does not turn on, replace the system board. Then reinstall the battery pack. If it is still not charged, go to the next section.

## Checking the battery pack

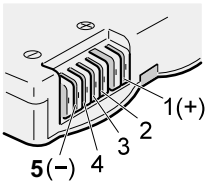
Battery charging does not start until the Power Meter shows that less than 95% of the total power remains; under this condition the battery pack can charge to 100% of its capacity. This protects the battery pack from being overcharged or from having a shortened life.

To check the status of your battery, move your cursor to the Power Meter icon in the icon tray of the Windows taskbar and wait for a moment (but do not click), and the percentage of battery power remaining is displayed. To get detailed information about the battery, double-click the Power Meter icon.

**Note:** If the battery pack becomes hot, it may not be able to charge. Remove it from the computer and leave it at room temperature for a while. After it cools down, reinstall and recharge it.

To check the battery pack, do the following:

1. Power off the computer.
2. Remove the battery pack and measure the voltage between battery terminals 1 (+) and 5 (-). See the following figure:



Terminal	Voltage (V dc)
1	+ 0 to + 12.6
5	Ground (-)

3. If the voltage is less than +11.0 V dc, the battery pack has been discharged.

**Note:** Recharging will take at least 3 hours, even if the indicator does not turn on.

If the voltage is still less than +11.0 V dc after recharging, replace the battery.

4. If the voltage is more than +11.0 V dc, measure the resistance between battery terminals 4 and 5. The resistance must be 4 to 30 K  $\Omega$ .

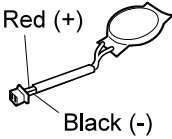
If the resistance is not correct, replace the battery pack. If the resistance is correct, replace the system board.

## Checking the backup battery

Do the following:

1. Power off the computer, and unplug the ac adapter from it.
2. Turn the computer upside down.

3. Remove the battery pack (see “1010 Battery pack” on page 55 ).
4. Remove the backup battery (see “Checking the battery pack” on page 32).
5. Measure the voltage of the backup battery. See the following figure.



Wire	Voltage (V dc)
Red	+2.5 to +3.2
Black	Ground

- If the voltage is correct, replace the system board.
- If the voltage is not correct, replace the backup battery.
- If the backup battery discharges quickly after replacement, replace the system board.



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# ThinkPad T20/T21/T22

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## Product overview

This section presents the following product-unique information:

- “Specifications”
- “Status indicators” on page 39
- “FRU Tests” on page 41
- “Fn key combinations” on page 43

## Specifications

The following table lists the specifications of the ThinkPad T20, T21 and T22 series :

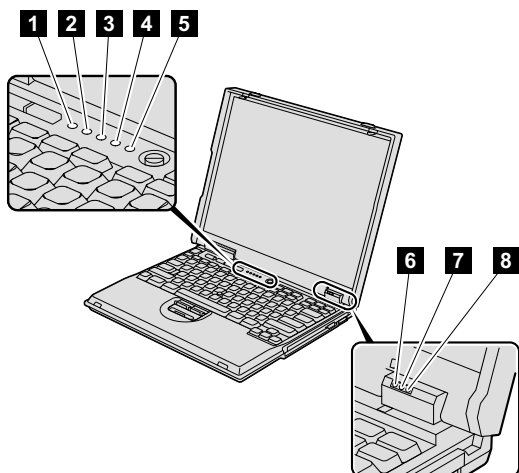
Feature	Description
Processor	<p><b>T20</b></p> <ul style="list-style-type: none"> <li>• Intel® mobile Pentium® III processor 650 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 700 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 750 MHz featuring Intel® SpeedStep™ technology</li> </ul> <p><b>T21</b></p> <ul style="list-style-type: none"> <li>• Intel® mobile Pentium® III processor 750 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 800 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 850 MHz featuring Intel® SpeedStep™ technology</li> </ul> <p><b>T22</b></p> <ul style="list-style-type: none"> <li>• Intel® mobile Pentium® III processor 800 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 900 MHz featuring Intel® SpeedStep™ technology</li> <li>• Intel® mobile Pentium® III processor 1 GHz featuring Intel® SpeedStep™ technology</li> </ul>
Bus architecture	PCI Bus
Memory (standard)	128 MB (on the system board)
Memory (optional)	64 MB, 128 MB or 256 MB DIMM card (maximum of 512 MB)
CMOS RAM	242 bytes

Feature	Description
Display	<p><b>T20</b></p> <ul style="list-style-type: none"> <li>• 13.3-inch, 16M colors, XGA (1024 × 768 resolution) TFT color LCD</li> <li>• 14.1-inch, 16M colors, XGA (1024 × 768 resolution) TFT color LCD</li> </ul> <p><b>T21, T22</b></p> <ul style="list-style-type: none"> <li>• 13.3-inch, 16M colors, XGA (1024 × 768 resolution) TFT color LCD</li> <li>• 14.1-inch, 16M colors, XGA (1024 × 768 resolution) TFT color LCD</li> <li>• 14.1-inch, 16M colors, SXGA+ (1400 × 1050 resolution) TFT color LCD</li> </ul>
Diskette drive (Ultrabay 2000)	1.44 MB (3-mode), 3.5-inch
Hard-disk drive	<p><b>T20</b></p> <ul style="list-style-type: none"> <li>• 6.0 GB, 2.5-inch, IDE interface</li> <li>• 12.0 GB, 2.5-inch, IDE interface</li> <li>• 18.0 GB, 2.5-inch, IDE interface</li> <li>• 20.0 GB, 2.5-inch, IDE interface</li> </ul> <p><b>T21, T22</b></p> <ul style="list-style-type: none"> <li>• 10.0 GB, 2.5-inch, IDE interface</li> <li>• 20.0 GB, 2.5-inch, IDE interface</li> <li>• 32.0 GB, 2.5-inch, IDE interface</li> </ul>
I/O port	<ul style="list-style-type: none"> <li>• External monitor</li> <li>• Line-in</li> <li>• Headphone</li> <li>• Microphone</li> <li>• Mouse or keyboard</li> <li>• Parallel or diskette drive</li> <li>• Port replicator connector</li> <li>• Serial</li> <li>• Universal serial bus (USB) connector</li> <li>• RJ11</li> <li>• RJ45</li> <li>• TV-out</li> </ul>
Internal modem	56.6 Kbps
Audio	<ul style="list-style-type: none"> <li>• Internal microphone</li> <li>• Internal speaker</li> <li>• Software control volume</li> </ul>
Infrared transfer	IrDA 1.1
PC Card	One Type-III or two Type-II
AC adapter	72-watt type
Bay device	<p><b>T20</b></p> <ul style="list-style-type: none"> <li>• 10-24x CD-ROM drive</li> <li>• 6x DVD-ROM drive</li> </ul> <p><b>T21, T22</b></p> <ul style="list-style-type: none"> <li>• 10-24x CD-ROM drive</li> <li>• 8x DVD-ROM drive</li> </ul>



## Status indicators

The system status indicators show the status of the computer, as follows:



Indicator	Meaning
<b>1</b> Drive in use	<p><b>Green:</b> Data is being read from or written to the hard-disk drive, the diskette drive, or the drive in the Ultrabay 2000. When this indicator is on, do not put the computer into standby mode or turn off the computer.</p> <p><b>Note:</b> Do not move the system while the Green drive in use light is on. Sudden physical shock could cause drive errors.</p>
<b>2</b> Num lock	<p><b>Green:</b> The numeric keypad on the keyboard is enabled. To enable or disable the keypad, press and hold the <b>Fn</b> key while pressing the <b>NumLk</b> key.</p>
<b>3</b> Caps lock	<p><b>Green:</b> Caps Lock mode is enabled. To enable or disable Caps Lock mode, press <b>Fn + Caps Lock</b> key.</p>
<b>4</b> Scroll lock	<p><b>Green:</b> Scroll Lock mode is enabled. Arrow keys can be used as screen-scroll function keys, but not to move the cursor. To enable or disable Scroll Lock mode, press <b>Fn + ScrLk</b> key. Not all application programs support this function.</p>

Indicator	Meaning
<p><b>5</b> Power on</p>	<p><b>Green:</b> This indicator stays lighted whenever the computer is on. If the power-on indicator is on and the standby indicator is off, the system is ready to use. If both the power-on indicator and the standby indicator are on, you can use the computer after it returns from the standby mode and the standby indicator goes off.</p>
<p><b>6</b> Battery</p>	<p><b>Green:</b> The battery is fully charged.</p> <p><b>Blinking green:</b> The battery has enough power to operate, but is being charged.</p> <p><b>Orange:</b> The battery power is low. The battery needs to be charged.</p> <p><b>Blinking orange:</b> The battery needs to be charged when the indicator starts blinking orange, the computer beeps three times.</p>
<p><b>7</b> Standby status</p>	<p><b>Green:</b> The computer is in standby mode.</p> <p><b>Blinking green:</b> The computer is entering standby mode or hibernation mode, or is resuming normal operation. This indicator does not blink in Windows 2000 and Windows Me.</p>
<p><b>8</b> UltraBay status</p>	<p><b>Green:</b> An Ultrabay 2000 device is installed and in use.</p> <p><b>Blinking green:</b> An Ultrabay 2000 device is in the process of being detached.</p> <p><b>Turn off:</b> An Ultrabay 2000 device is ready to be attached or detached.</p> <p><b>Note:</b> If you are using Windows 2000, the UltraBay status indicator does not blink while an Ultrabay 2000 device is being detached. Instead, a message box pops up when the process is completed; then the indicator turns off.</p>

## FRU Tests

The following table shows the test for each FRU.

FRU	Applicable test
System board	<ol style="list-style-type: none"> <li>1. <b>Diagnostics --&gt; CPU/Coprocessor</b></li> <li>2. <b>Diagnostics --&gt; Systemboard</b></li> </ol>
Power	<b>Diagnostics --&gt; Other Devices --&gt; IBM AC Adapter, IBM Battery 1 (IBM Battery 2)</b>
LCD unit	<ol style="list-style-type: none"> <li>1. <b>Diagnostics --&gt; Video Adapter</b></li> <li>2. <b>Interactive Tests --&gt; Video</b></li> </ol>
Modem	<ol style="list-style-type: none"> <li>1. Make sure the modem is set up correctly.</li> <li>2. Replace the modem jack and the modem card in turn, and run the following test in <b>Diagnostics --&gt; Communication</b>: <ol style="list-style-type: none"> <li>a. Lucent Modem (M2) Loopback</li> <li>b. Lucent Modem (M2) Dialtone/DTM</li> <li>c. Intel Modem Register</li> <li>d. Intel Modem Loopback/DTMF</li> <li>e. Intel SP Modem Register</li> <li>f. Intel SP Modem Loopback/DTMF</li> <li>g. 3Com MiniPCI Modem Test</li> <li>h. 3Com MiniPCI Dialtone Test</li> </ol> </li> </ol>
Audio	<ol style="list-style-type: none"> <li>1. <b>Interactive Tests --&gt; Internal Speaker</b></li> <li>2. <b>Diagnostics --&gt; Other Devices --&gt; Crystal SoundFusion™ Test</b></li> </ol>
Speaker	<b>Interactive Tests --&gt; Internal Speaker</b>
PC Card slots	<b>Diagnostics --&gt; Systemboard --&gt; PCMCIA, PCMCIA External Loop</b>
Keyboard	<ol style="list-style-type: none"> <li>1. <b>Diagnostics --&gt; Systemboard --&gt; Keyboard</b></li> <li>2. <b>Interactive Tests --&gt; Keyboard</b></li> </ol>
TrackPoint or pointing device	<p>If the TrackPoint does not work, check the configuration in the ThinkPad Configuration program. If the TrackPoint is disabled, select <b>Enable</b> to enable it.</p> <p>After you use the TrackPoint, the pointer may drift on the screen for a short time. This drift can occur when a slight, steady pressure is applied to the TrackPoint pointer. This symptom is not a hardware problem. If the pointer stops after a short time, no service action is necessary.</p> <p>If enabling the TrackPoint does not correct the problem, continue with the following:</p> <ul style="list-style-type: none"> <li>• <b>Interactive Tests --&gt; Mouse</b></li> </ul>
Hard-disk drive	<b>Diagnostics --&gt; Fixed Disks</b>
Diskette drive	<ol style="list-style-type: none"> <li>1. <b>Diagnostics --&gt; Diskette Drives</b></li> <li>2. <b>Interactive Tests --&gt; Diskette</b></li> </ol>
CD-ROM or DVD drive	<ol style="list-style-type: none"> <li>1. <b>Diagnostics --&gt; Other Devices --&gt; CD-ROM/DVD</b></li> <li>2. <b>Interactive Tests --&gt; CD-ROM/DVD Test</b></li> </ol>

FRU	Applicable test
Memory	<ol style="list-style-type: none"><li data-bbox="314 228 888 332">1. If two DIMMs are installed, remove one of them and run <b>Diagnostics --&gt; Memory Test - Quick</b>.</li><li data-bbox="314 332 888 435">2. If the problem does not recur, return the DIMM to its place, remove the other one, and run the test again.</li><li data-bbox="314 435 888 508">3. If the test does not detect the error, run <b>Diagnostics --&gt; Memory Test - Full</b>.</li></ol>
Fan	<ol style="list-style-type: none"><li data-bbox="314 524 888 628">1. Turn on the computer and check the air turbulence at the louver near the power switch.</li><li data-bbox="314 628 888 693">2. Run <b>Diagnostics --&gt; Other Devices --&gt; IBM Fan</b>.</li></ol>

## Fn key combinations

The following table shows the function of each combination of **Fn** with a function key.

The **Fn** key works independently from the operating system.

Key combination	Description
<b>Fn + F1</b>	Reserved.
<b>Fn + F2</b>	Reserved.
<b>Fn + F3</b>	Turn off the LCD display, leaving the screen blank. To turn the LCD display on again, press any key or the TrackPoint stick.
<b>Fn + F4</b>	Turn standby mode on. To return to normal operation, press the Fn key.
<b>Fn + F5</b>	Reserved.
<b>Fn + F6</b>	Reserved.
<b>Fn + F7</b>	Switch between the LCD and an external monitor.
<b>Fn + F8</b>	Turn screen expansion on or off. (There is no symbol on the key.)
<b>Fn + F9</b>	Reserved.
<b>Fn + F10</b>	Reserved.
<b>Fn + F11</b>	Reserved.
<b>Fn + F12</b>	Turn hibernation mode on.
<b>Fn + PgUp</b>	Turn the ThinkLight on or off.
<b>Fn + Home</b>	The LCD becomes brighter.
<b>Fn + End</b>	The LCD becomes less bright.

## Symptom-to-FRU index

The symptom-to-FRU index in this section lists symptoms and errors and their possible causes. The most likely cause is listed first, in boldface type.

**Note:** Do the FRU replacement or other actions in the sequence shown in the column headed “FRU or action, in sequence.” If replacing a FRU does not solve the problem, put the original part back in the computer. Do not replace a nondefective FRU.

This index can also help you determine, during regular servicing, what FRUs are likely to need to be replaced next.

A numeric error is displayed for each error detected in POST or system operation. In the displays, **n** can be any number.

If no numeric code is displayed, check the narrative descriptions of symptoms. If the symptom is not described there, go to “Intermittent problems” on page 49.

### Note

For an IBM device not supported by diagnostic codes in the ThinkPad notebook computers, see the manual for that device.

## Numeric error codes

Symptom or error	FRU or action, in sequence
<b>0175</b> Bad CRC1, stop POST task — The EEPROM checksum is not correct.	<b>System board.</b>
<b>0187</b> EAIA data access error — The access to EEPROM has failed.	<b>System board.</b>
<b>0188</b> Invalid RFID serialization information area or bad CRC2 — The EEPROM checksum is not correct.	<b>System board.</b>
<b>0189</b> Invalid RFID configuration information area — The EEPROM checksum is not correct.	<b>System board.</b>

(continued)

Symptom or error	FRU or action, in sequence
<b>0190</b> Critical low battery error.	<ol style="list-style-type: none"> <li>1. Charge the battery pack.</li> <li>2. Battery pack.</li> </ol>
<b>0193</b> RF antenna has been removed.	<b>Enter the supervisor password.</b>
<b>0194</b> The computer has been carried through a security gate.	<b>Enter the supervisor password.</b>
<b>0200</b> Hard disk error — The hard disk is not working.	<ol style="list-style-type: none"> <li>1. Reseat the hard-disk drive.</li> <li>2. Load Setup Defaults in IBM BIOS Setup Utility.</li> <li>3. Hard-disk drive.</li> <li>4. System board.</li> </ol>
<b>021x</b> Stuck key — Keyboard error.	<b>Run interactive tests of the keyboard and the auxiliary input device.</b>
<b>0220</b> Monitor type error — Monitor type does not match the one specified in CMOS.	<b>Load Setup Defaults in IBM BIOS Setup Utility.</b>
<b>0230</b> Shadow RAM error — The shadow RAM failure at offset nnnn.	<b>System board.</b>
<b>0231</b> System RAM error — System RAM failure at offset nnnn.	<ol style="list-style-type: none"> <li>1. DIMM.</li> <li>2. System board.</li> </ol>
<b>0232</b> Extended RAM error — Extended RAM failure at offset nnnn.	<ol style="list-style-type: none"> <li>1. DIMM.</li> <li>2. System board.</li> </ol>
<b>0250</b> System battery error — System battery is dead.	<b>Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date.</b>
<b>0251</b> System CMOS checksum bad—Default configuration used.	<b>Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date.</b>
<b>0252</b> Password checksum bad — The password is cleared.	<b>Reset the password by running IBM BIOS Setup Utility.</b>
<b>0260</b> System timer error.	<ol style="list-style-type: none"> <li>1. Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date.</li> <li>2. System board.</li> </ol>

(continued)

Symptom or error	FRU or action, in sequence
<b>0270</b> Real-time clock error.	1. <b>Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date.</b> 2. System board.
<b>0271</b> Date and time error — Neither the date nor the time is set in the computer.	<b>Run IBM BIOS Setup Utility to reset the time and date.</b>
<b>02B2</b> Incorrect drive A type.	1. <b>Diskette drive.</b> 2. External FDD cable. 3. I/O card.
<b>02F4</b> EISA CMOS not writable.	1. <b>Load Setup Defaults in IBM BIOS Setup Utility.</b> 2. Replace the backup battery. 3. System board.
<b>02F5</b> DIMM test failure.	1. <b>DIMM.</b> 2. System board.
<b>02F6</b> Software NMI failure.	1. <b>DIMM.</b> 2. System board.
<b>02F7</b> Fail-safe timer NMI failure.	1. <b>DIMM.</b> 2. System board.



## Error messages

Symptom or error	FRU or action, in sequence
Device address conflict.	<ol style="list-style-type: none"> <li>1. <b>Load Setup Defaults in IBM BIOS Setup Utility.</b></li> <li>2. Backup battery.</li> <li>3. System board.</li> </ol>
Allocation error for device.	<ol style="list-style-type: none"> <li>1. <b>Load Setup Defaults in IBM BIOS Setup Utility.</b></li> <li>2. Backup battery.</li> <li>3. System board.</li> </ol>
Failing bits: nnnn.	<ol style="list-style-type: none"> <li>1. <b>DIMM.</b></li> <li>2. System board.</li> </ol>
Invalid system configuration data.	<ol style="list-style-type: none"> <li>1. <b>DIMM.</b></li> <li>2. System board.</li> </ol>
I/O device IRQ conflict.	<ol style="list-style-type: none"> <li>1. <b>Load Setup Defaults in IBM BIOS Setup Utility.</b></li> <li>2. Backup battery.</li> <li>3. System board.</li> </ol>
Operating system not found.	<ol style="list-style-type: none"> <li>1. Check that the operating system has no failure and is installed correctly.</li> <li>2. <b>Enter IBM BIOS Setup Utility and see whether the hard-disk drive and the diskette drive are properly identified.</b></li> <li>3. Reseat the hard-disk drive.</li> <li>4. Reinstall the operating system.</li> <li>5. Diskette drive.</li> <li>6. Hard-disk drive.</li> <li>7. System board.</li> </ol>
Hibernation error.	<ol style="list-style-type: none"> <li>1. <b>Restore the system configuration to what it was before the computer entered hibernation mode.</b></li> <li>2. If memory size has been changed, re-create the hibernation file.</li> </ol>
Fan error.	<b>Fan.</b>

## Beep symptoms

Symptom or error	FRU or action, in sequence
One beep and a blank, unreadable, or flashing LCD.	<ol style="list-style-type: none"> <li>1. <b>Reseat the LCD connector.</b></li> <li>2. LCD assembly.</li> <li>3. External CRT.</li> <li>4. System board.</li> </ol>
One long and two short beeps, and a blank or unreadable LCD.	<ol style="list-style-type: none"> <li>1. <b>System board.</b></li> <li>2. LCD assembly.</li> <li>3. DIMM.</li> </ol>
Two short beeps with error codes.	<b>POST error. See “Numeric error codes” on page 44.</b>
Two short beeps with blank screen.	<ol style="list-style-type: none"> <li>1. <b>System board.</b></li> <li>2. DIMM.</li> </ol>
Two or more beeps, or a continuous beep. Operating System starts successfully.	If a Mini PCI Ethernet card is installed, confirm that <b>Alert On LAN 2</b> in IBM BIOS Setup Utility is <b>disabled</b> .
Three short beeps, pause, three more short beeps, and one short beep.	<ol style="list-style-type: none"> <li>1. <b>DIMM.</b></li> <li>2. System board</li> </ol>
Only cursor appears.	<b>Reinstall operating system.</b>

## No beep symptoms

Symptom or error	FRU or action, in sequence
No beep, power-on indicator on, LCD blank, and no POST.	<ol style="list-style-type: none"> <li>1. <b>Make sure that every connector is connected tightly and correctly.</b></li> <li>2. DIMM.</li> <li>3. System board.</li> </ol>
No beep, power-on indicator on, and LCD blank during POST.	<ol style="list-style-type: none"> <li>1. <b>Reseat DIMM.</b></li> <li>2. System board.</li> </ol>
The power-on password prompt.	A power-on password or a supervisor password is set. Type the password and press <b>Enter</b> .
The hard-disk password prompt.	A hard-disk password is set. Type the password and press <b>Enter</b> .
The DOS full screen looks smaller.	Start the ThinkPad Configuration program and set the <b>Screen expansion</b> function.

## LCD-related symptoms

### Important

The TFT LCD for the notebook computer contains many thin-film transistors (TFTs). A small number of dots that are missing, discolored, or always lighted is characteristic of TFT LCD technology, but excessive pixel problems can cause viewing concerns. The LCD should be replaced if the number of missing, discolored, or lighted dots in any background is:

- **XGA:** 8 or more bright dots, 8 or more dark dots, or a total of 9 or more bright and dark dots.
- **SXGA+:** 11 or more bright dots, 13 or more dark dots, or a total of 16 or more bright and dark dots.

**Note:** A bright dot is a white or colored pixel that is always on. A dark dot is a pixel that is always off and shows as black.

Symptom or error	FRU or action, in sequence
No beep, power-on indicator on, and a blank LCD during POST.	<b>System board.</b>
<ul style="list-style-type: none"> <li>• LCD backlight not working.</li> <li>• LCD too dark.</li> <li>• LCD brightness cannot be adjusted.</li> <li>• LCD contrast cannot be adjusted.</li> </ul>	<ol style="list-style-type: none"> <li>1. <b>Reseat the LCD connectors.</b></li> <li>2. LCD assembly.</li> <li>3. System board.</li> </ol>
<ul style="list-style-type: none"> <li>• LCD screen unreadable.</li> <li>• Characters missing pixels.</li> <li>• Screen abnormal.</li> <li>• Wrong color displayed.</li> </ul>	<ol style="list-style-type: none"> <li>1. <b>See important note for “LCD-related symptoms”.</b></li> <li>2. Reseat all LCD connectors.</li> <li>3. LCD assembly.</li> <li>4. System board.</li> </ol>
Horizontal or vertical lines displayed on LCD.	<b>LCD assembly.</b>

## Intermittent problems

Intermittent system hang problems can be due to a variety of causes that have nothing to do with a hardware defect, such as cosmic radiation, electrostatic discharge, or software errors. FRU replacement should be considered only when a problem recurs.

When analyzing an intermittent problem, do the following:

1. Run the diagnostic test for the system board in loop mode **at least 10 times**.
2. If no error is detected, do **not** replace any FRUs.

3. If any error is detected, replace the FRU shown by the FRU code. Rerun the test to verify that no more errors exist.

## **Undetermined problems**

You are here because the diagnostic tests did not identify which adapter or device failed, wrong devices are installed, a short circuit is suspected, or the system is inoperative. Follow these procedures to isolate the failing FRU (do not isolate FRUs that have no defects).

Verify that all attached devices are supported by the computer.

Verify that the power supply being used at the time of the failure is operating correctly. (See "Power system checkout" on page 30.)

1. Power off the computer.
2. Visually check each FRU for damage. Replace any damaged FRU.
3. Remove or disconnect all of the following devices:
  - a. Non-IBM devices
  - b. Devices attached to the port replicator
  - c. Printer, mouse, and other external devices
  - d. Battery pack
  - e. Hard-disk drive
  - f. External diskette drive
  - g. DIMM
  - h. CD-ROM and diskette drive in the UltralimBay
  - i. PC Cards
4. Power on the computer.
5. Determine whether the problem has changed.
6. If the problem does not recur, reconnect the removed devices one at a time until you find the failing FRU.
7. If the problem remains, replace the following FRUs one at a time (do not replace a nondefective FRU):
  - a. System board
  - b. LCD assembly

## FRU replacement notices

This section contains notices related to removing and replacing parts. Read this section carefully before replacing any FRU.

### Screw notices

Loose screws can cause a reliability problem. In IBM ThinkPad computer, this problem is addressed with special nylon-coated screws that have the following characteristics:

- They maintain tight connections.
- They do not easily come loose, even with shock or vibration.
- They are harder to tighten.
- They should be used only once.

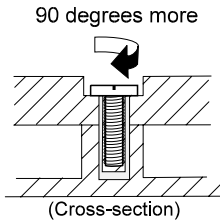
Do the following when you service this machine:

- Keep the screw kit (for the P/N, see “Miscellaneous parts” on page 119) in your tool bag.
- Always use new screws.
- Use a torque screwdriver if you have one.

Tighten screws as follows:

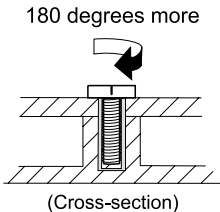
- **Plastic to plastic**

Turn an additional **90 degrees** after the screw head touches the surface of the plastic part:



- **Logic card to plastic**

Turn an additional **180 degrees** after the screw head touches the surface of the logic card:



- **Torque driver**

If you have a torque driver, refer to the “Torque” column for each step.

- Make sure you use the correct screw. If you have a torque screwdriver, tighten all screws firmly to the torque shown in the table. **Never use a screw that you removed. Use a new one. Make sure the screws are tightened firmly.**

## Retaining serial numbers

This section includes the following descriptions:

- “Restoring the serial number of the system unit”
- “Retaining the UUID”

### Restoring the serial number of the system unit

When the computer was manufactured, the EEPROM on the system board was loaded with the serial numbers of the system and all major components. These numbers need to remain the same throughout the life of the computer.

If you replace the system board, you must restore the serial number of the system unit to its original value.

Before replacing the system board, save the original serial number by doing the following:

1. Install the ThinkPad hardware maintenance diskette version 1.61, and restart the computer.
2. From the main menu, select **1. Set System Identification**.
3. Select **2. Read S/N data from EEPROM**.

The serial number for each device is displayed. Write down the serial number of the system unit, designated as follows:

20: System unit serial number

After you have replaced the system board, restore the serial number by doing the following:

1. Install the ThinkPad hardware maintenance diskette version 1.61 and restart the computer.
2. From the main menu, select **1. Set System Identification**.
3. Select **1. Add S/N data from EEPROM**.

Follow the instructions on the screen.

**Note:** The serial number of the system unit is written on the label attached on the bottom of the computer.

### Retaining the UUID

The Universally Unique Identifier (UUID) is a 128-bit number uniquely assigned to your computer at production and stored in the EEPROM of your system board. The algorithm that generates the number is designed to provide

unique IDs until the year A.D. 3400. No two computers in the world have the same number.

When you replace the system board, you must set the UUID on the new system board as follows:

1. Install the ThinkPad hardware maintenance diskette version 1.61, and restart the computer.
2. From the main menu, select **4. Assign UUID**.

A new UUID is created and written. If a valid UUID already exists, it is not overwritten.

## Removing and replacing a FRU

This section presents information and drawings for use in removing and replacing a FRU. Be sure to observe the following general rules:

1. Do not try to service the computer unless you have been trained and certified. An untrained person runs the risk of damaging parts.
2. Before replacing any FRU, review “FRU replacement notices” on page 51.
3. Begin by removing any FRUs that have to be removed before the failing FRU. Any such FRUs are listed at the top of the page. Remove them in the order in which they are listed.
4. Follow the correct sequence in the steps for removing the FRU, as indicated in the drawings by the numbers in square callouts.
5. When turning a screw to replace a FRU, turn it in the direction indicated by the arrow in the drawing.
6. When removing the FRU, move it in the direction indicated by the arrow in the drawing.
7. To put the new FRU in place, reverse the removal procedure and follow any notes that pertain to replacement. For information about connecting and arranging internal cables, see “Locations” on page 107.
8. When replacing a FRU, use the correct screw as shown in the procedures.

### **CAUTION:**

**Before removing any FRU, power off the computer, unplug all power cords from electrical outlets, remove the battery pack, and then disconnect any interconnecting cables.**

### **CAUTION:**

**Do not disassemble the battery pack, throw it into fire or water, or short-circuit it. Dispose of the battery pack as required by local ordinances or regulations.**

**Attention:** Before the computer is powered on after FRU replacement, make sure all screws, springs, and other small parts are in place and are not loose inside the computer. Verify this by shaking the computer gently and listening for rattling sounds. Metallic parts or metal flakes can cause electrical short circuits.

**Attention:** The system board is sensitive to, and can be damaged by, electrostatic discharge. Establish personal grounding by touching a ground point with one hand before touching these units.

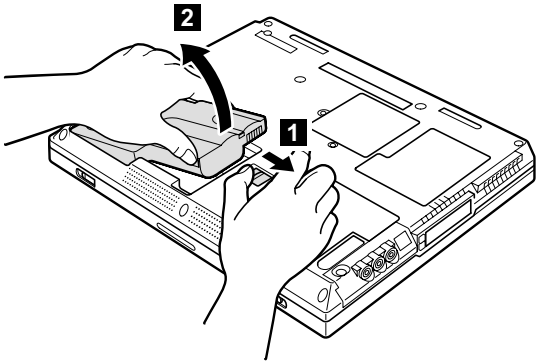
You must use an electrostatic discharge (ESD) strap (P/N 6405959) to establish personal grounding.



## 1010 Battery pack

### CAUTION:

If the rechargeable battery pack is incorrectly replaced, there is a danger of an explosion. The battery pack contains a small amount of harmful substances. To avoid possible injury: (1) replace only with a battery of the type recommended by IBM, or an equivalent, (2) keep the battery pack away from fire, (3) do not expose it to water or rain, (4) do not attempt to disassemble it, (5) do not short-circuit it. 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.

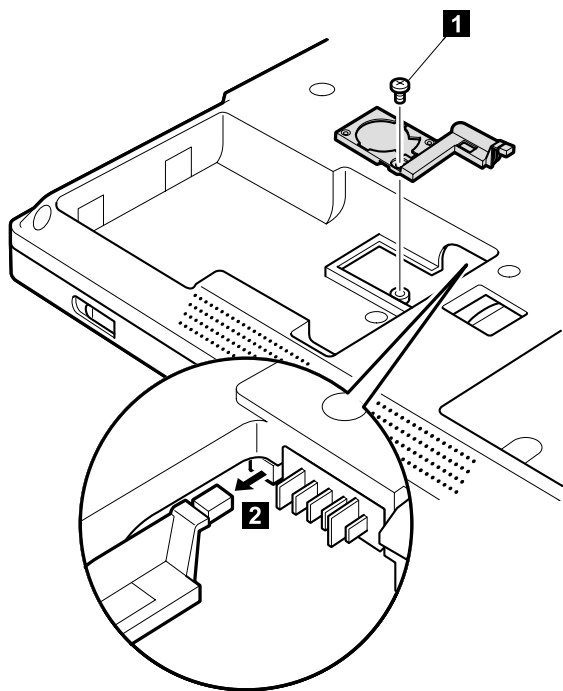


## 1020 Backup battery

### CAUTION:

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.

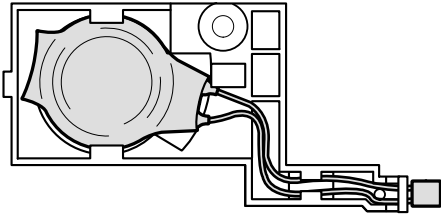
- Battery pack (1010)



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 × 3.5 mm, (1)	39.2 Ncm (4 kgfcm)

(continued)

**Cable routing:** When attaching the backup battery to the holder, route the battery cable as in the following figure.



## 1030 Hard-disk drive

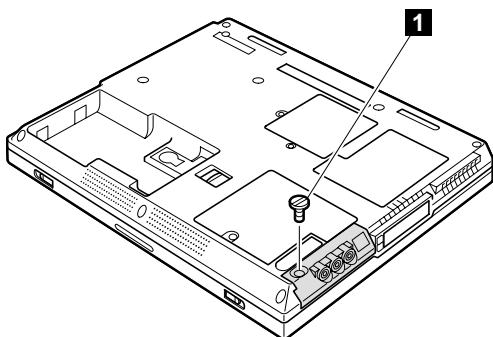
### Attention

**Do not drop or apply any shock to the hard-disk drive.** The hard-disk drive is sensitive to physical shock. Incorrect handling can cause damage and permanent loss of data.

Before removing the drive, have the user make a backup copy of all the information on the drive if possible.

Never remove the drive while the system is operating or is in suspend mode.

- Battery pack (1010)

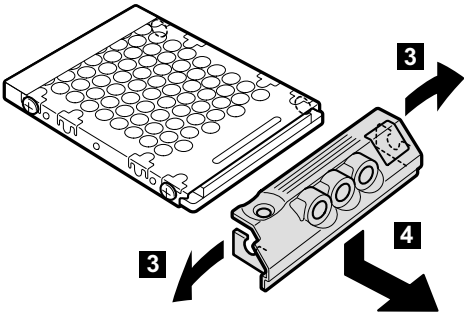
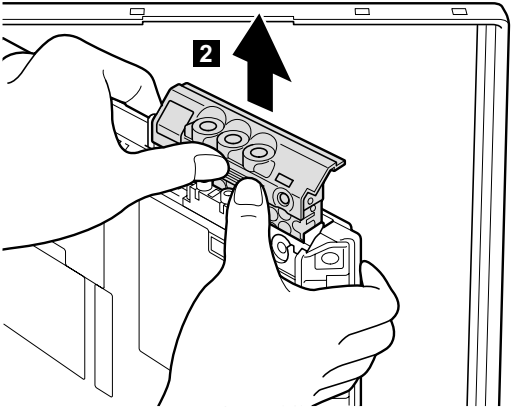


**Note:** The hard disk is attached to the cover.

Step	Screw (quantity)
<b>1</b>	Coin screw (1) or security screw (1)
<b>Note:</b> Use a 2.5-mm allen wrench to remove the security screw.	

(continued)

When removing the hard-disk drive, open the LCD a little as shown in the figure.

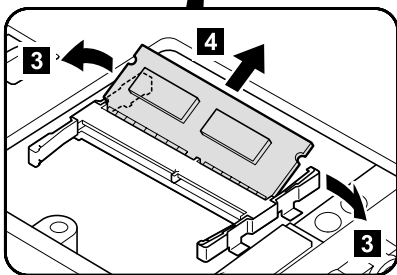
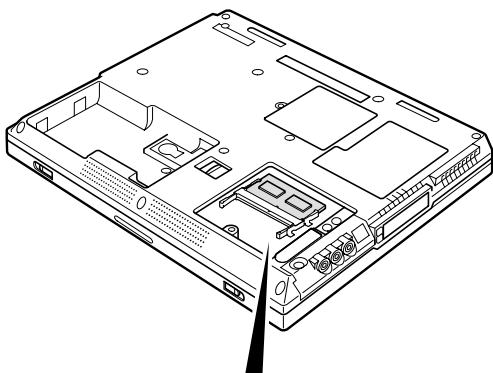
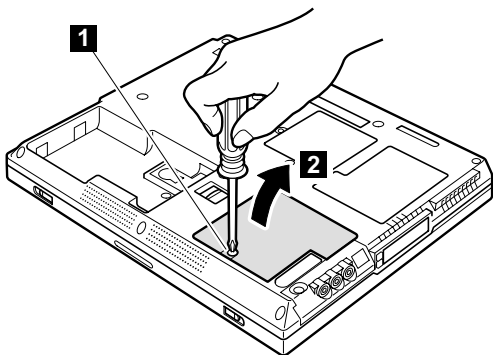


**When installing:** Make sure that the HDD connector is firmly connected.

## 1040 DIMM

- Battery pack (1010)

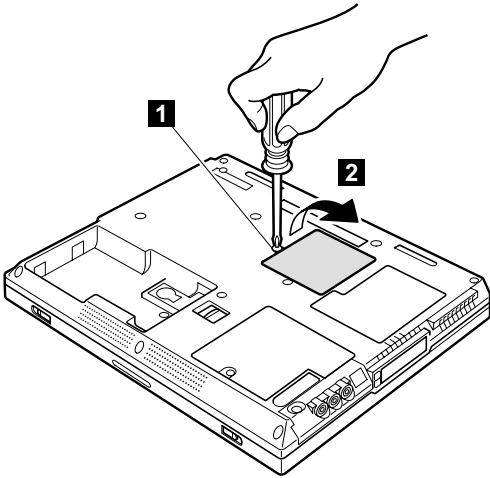
**Note:** Loosen the screw **1**, but do not remove it.



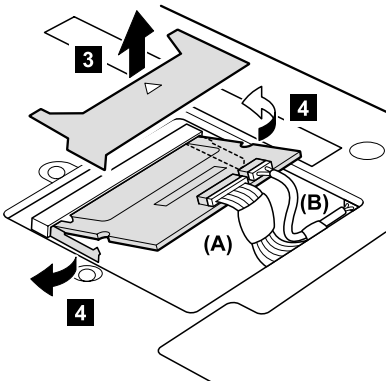
## 1050 Mini PCI adapter

- Battery pack (1010)

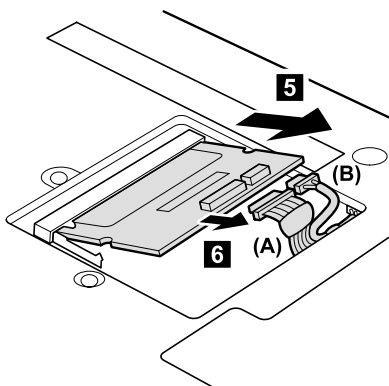
**Note:** Loosen the screw **1**, but do not remove it.



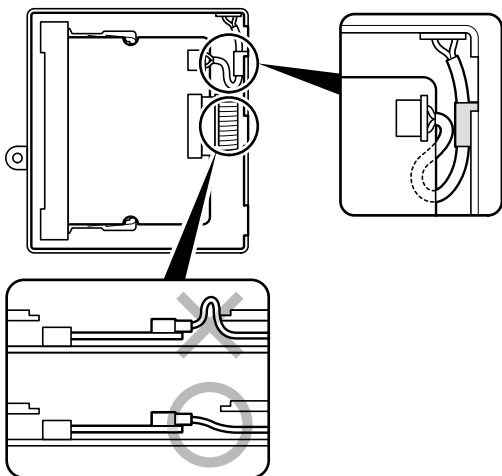
**Note:** The following illustration shows the combo card. Connector **(A)** is for the LAN feature and **(B)** is for the modem feature. Disconnect either **(A)** or **(B)** in step **4**. This slot also supports a Mini PCI modem card or Mini PCI network card.



(continued)



**When installing:** Make sure not to pinch the connector cable when re-installing the Mini PCI adapter.

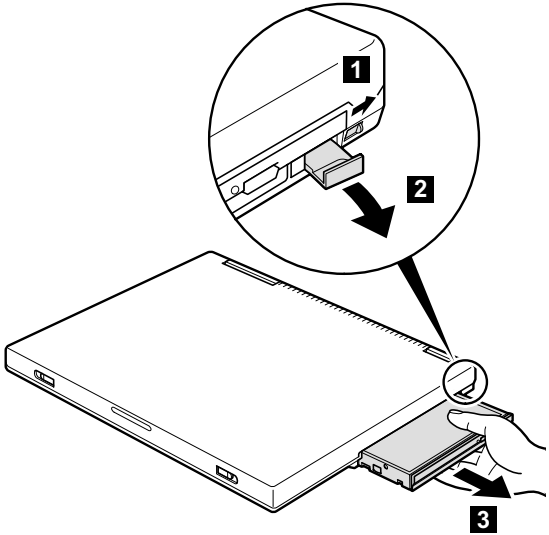




## 1060 Ultrabay 2000 device

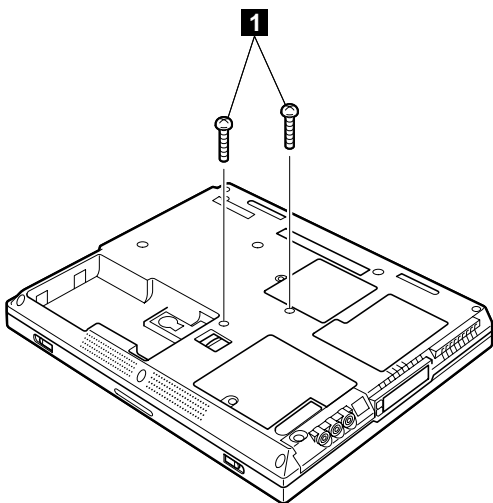
Any of several devices can be inserted into the Ultrabay 2000. The procedure for installing and removing is the same for every device.

**Note:** When you release the switch in step **1** the lever pops out. Pull the lever a little in step **2** to release the device from the bay.

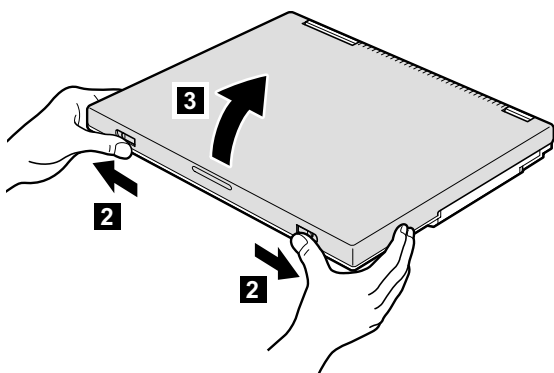


## 1070 Keyboard

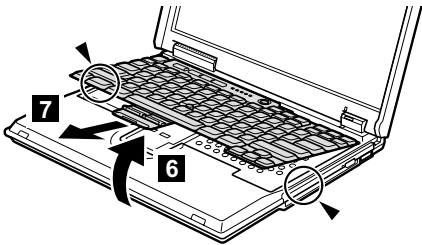
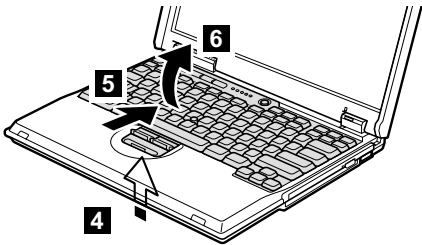
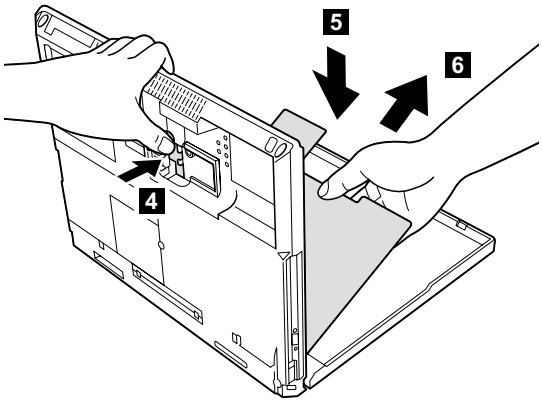
- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 x 14 mm, nylon-coated (2)	39.2 Ncm (4 kgfcm)



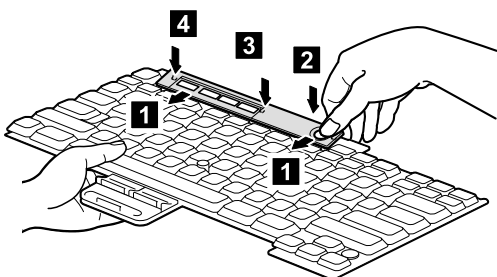
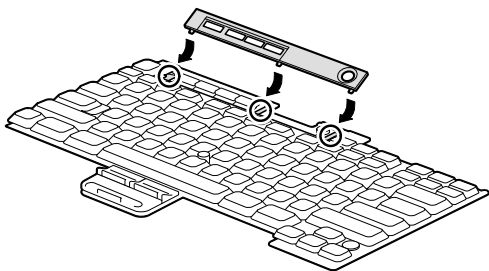
(continued)



(continued)

*Removing and replacing a FRU*

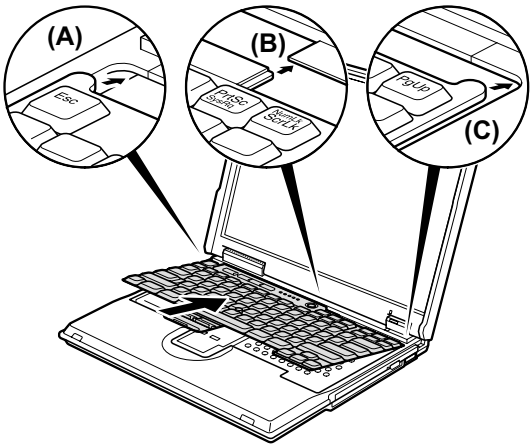
When installing the easy-button cover, do as follows:



(continued)

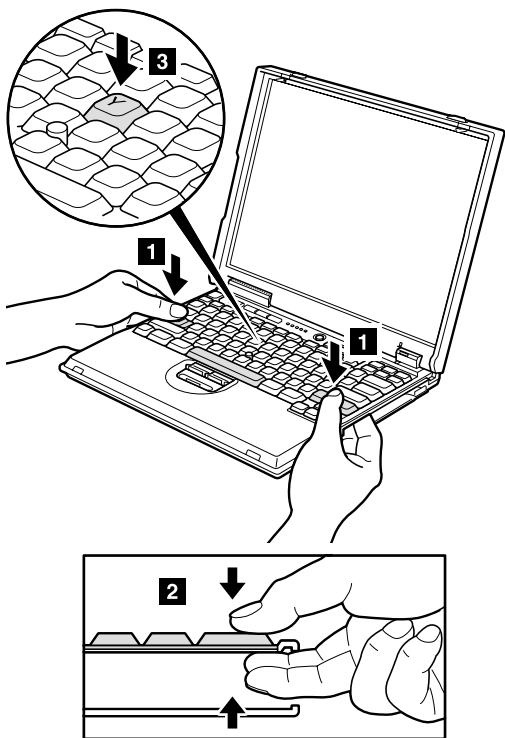
When installing the keyboard, do as follows:

1. Install the new keyboard, following the directions in the figure. Make sure that the keyboard edges, shown in the figure as **(A)**, **(B)**, and **(C)**, are under the frame.



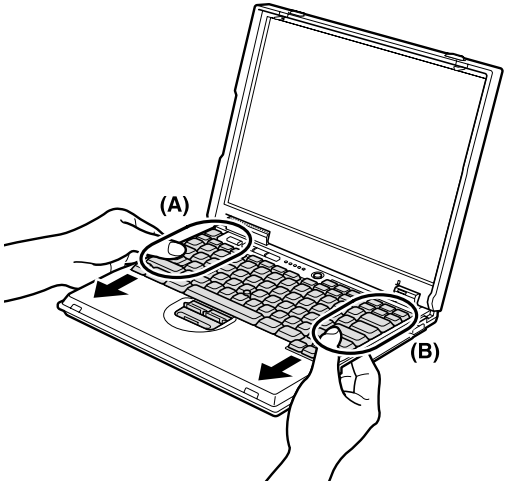
(continued)

2. Insert your fingers into the PC Card slot on the left of the computer and the Ultrabay 2000 slot on the right of the computer as shown in **1** . Then, with your fingers in those slots as in **2** , latch the keyboard in place by using your thumbs to press firmly on the shift keys. Press the **Y** key to connect the keyboard to the connector on the underside of the key **3** .



(continued)

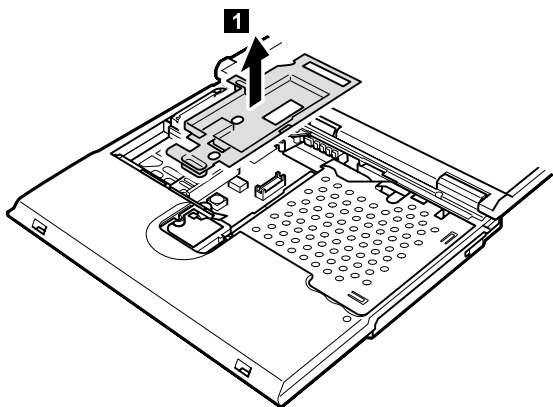
3. To make sure that the front side of the keyboard is housed firmly, gently press the shift keys with your thumbs and try to slide the keyboard towards you. Do not push parts **(A)** and **(B)** on the keyboard strongly; to do so might cause distortion of the Ultrabay 2000 slot and the PC Card slot.



4. Replace the screws, using the new screws provided with the keyboard. **Then press the Y key again, hard, to make sure that the keyboard is firmly connected.**

## 1080 Keyboard CRU insulator

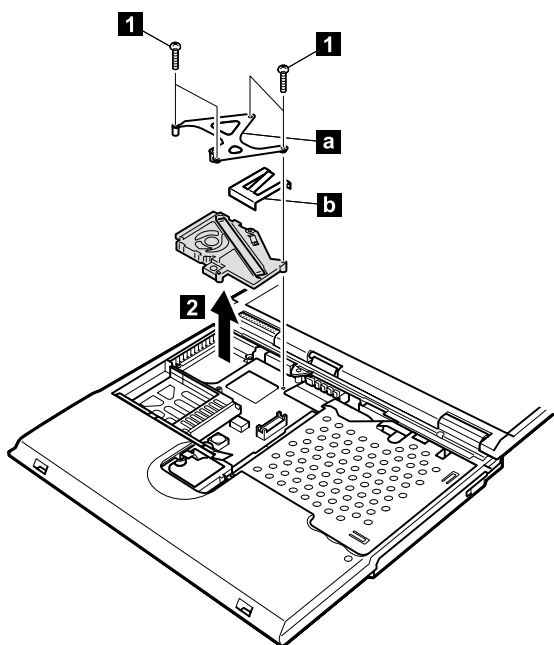
- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)





## 1090 Fan assembly

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)



### Notes:

1. **a** -part is for T21, T22 series only. Other models do not have this bracket.
2. **b** -part is for T21 series and MT2647-3Cx, -3Ex, -7Cx, -7Ex (T22 series) only. Other models do not have this bracket.

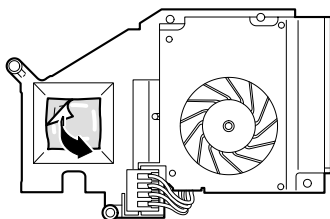
Step	Screw (quantity)	Torque
<b>1</b>	M2.0 × 13.5 mm, nylon-coated (4)	24.5 Ncm (2.5 kgfcm)

(continued)

**When installing the fan assembly:**

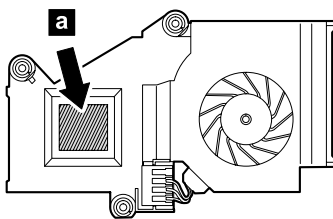
**For T20**

Remove the protective sheet from the thermal rubber on the fan assembly.



**For T21, T22**

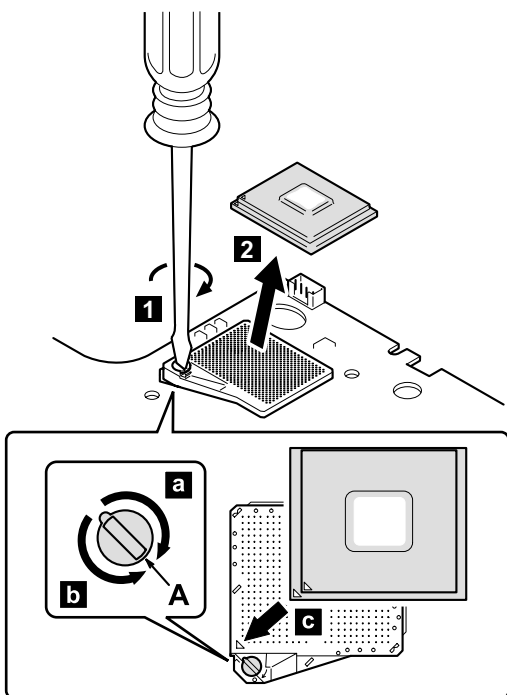
Apply the thermal grease (05K5751) on the **a**-part of the fan as shown in the following figure.



## 1100 CPU

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)

Rotate the **A** to the direction of the arrow **a** to release the lock and then remove the CPU.

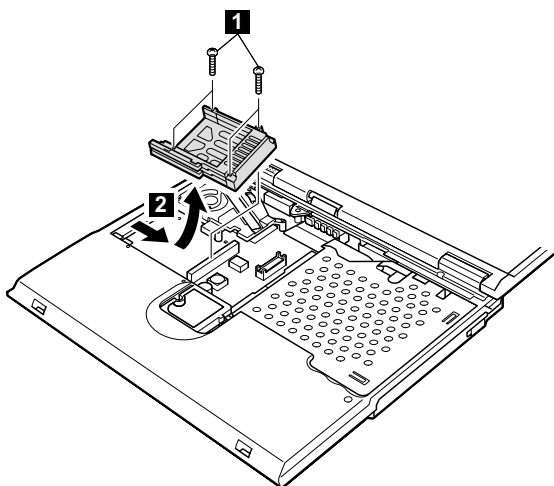


**When installing:** Do as as shown in the figure; see figure xxx.

- When attaching the CPU to the socket, do as shown in the procedure **c**
- Rotate the **A** to the direction of the arrow **b** to lock the CPU.

## 1110 PC Card slot assembly

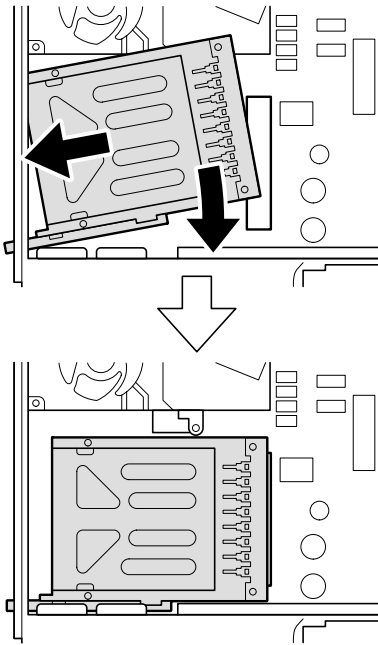
- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)



Step	Screw (quantity)	Torque
<b>1</b>	M2.0 × 13.5 mm, nylon-coated (4)	24.5 Ncm (2.5 kgfcm)

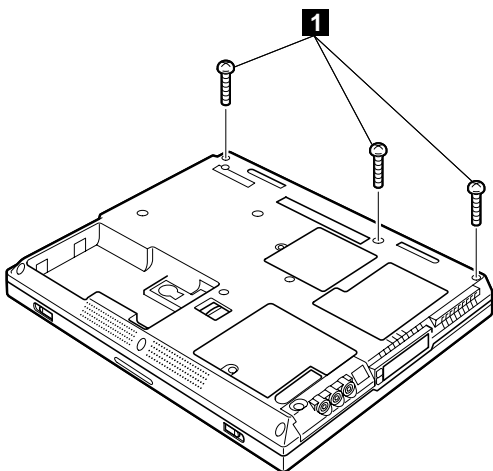
(continued)

When installing the PC card slot assembly, do as shown in the figure.



## 1120 Hinge cover

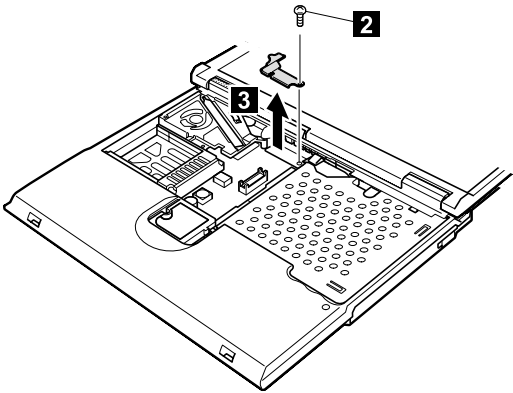
- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 x 14 mm, nylon-coated (3)	39.2 Ncm (4 kgfcm)

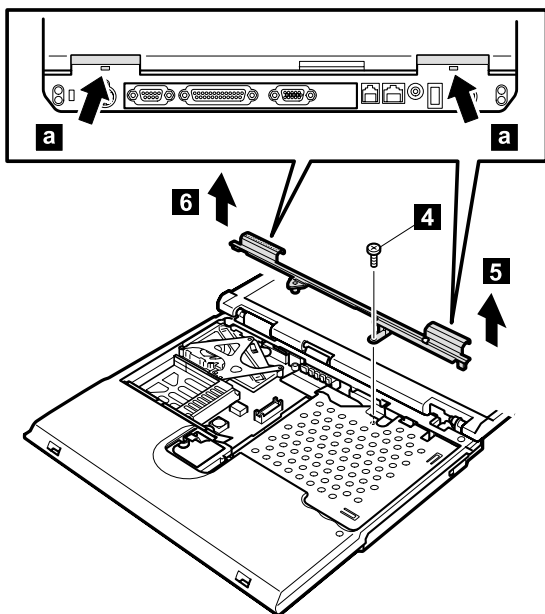
(continued)

Removing and replacing a FRU



Step	Screw (quantity)	Torque
<b>2</b>	M2.5 × 14 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)

(continued)



Step	Screw (quantity)	Torque
4	M2.5 x 4.8 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)

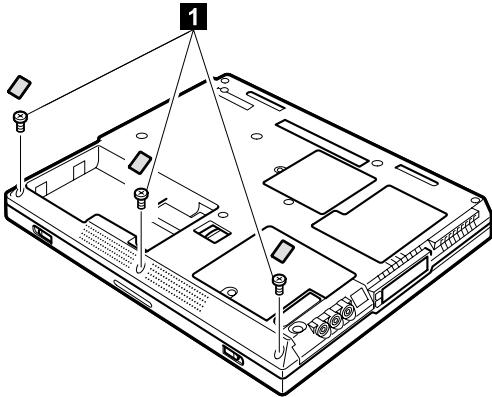
**When installing, do as follows:**

- Install the hinge cover according to the procedure 5, 6 and then tighten the screw 4. In procedure 5, take care not to damage the lens.
- Make sure that both latches a are firmly attached and snap into place.



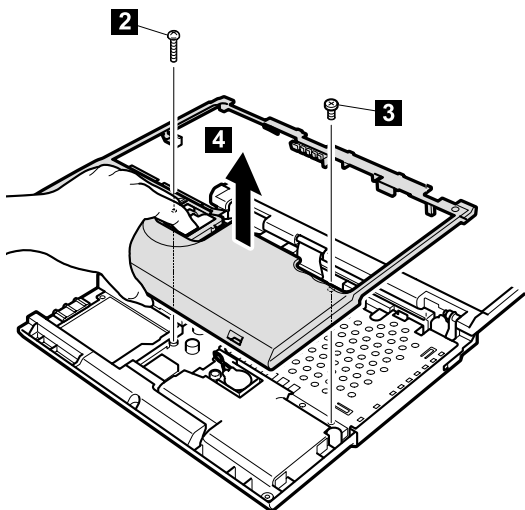
## 1130 Keyboard bezel

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Hinge cover (1120)



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 × 3.5 mm, nylon-coated (3)	39.2 Ncm (4 kgfcm)

(continued)

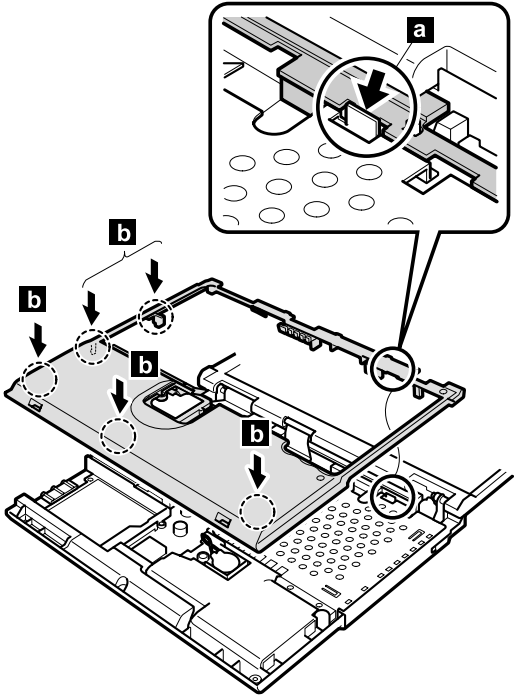


Step	Screw (quantity)	Torque
<b>2</b>	M2.5 × 14 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)
<b>3</b>	M2.5 × 4.8 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)

(continued)

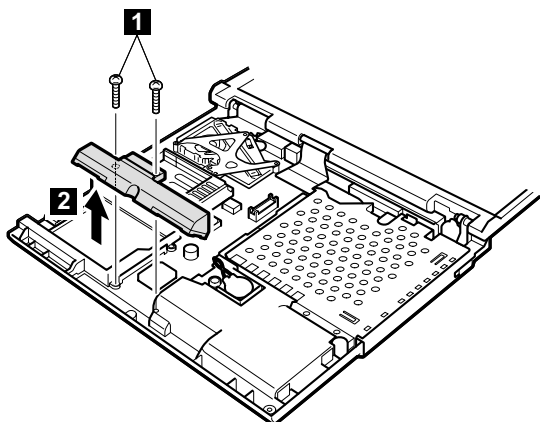
**When installing, do as follows:**

- Make sure that the **a** -part is firmly attached as shown in the figure.
- Make sure that all of the latches of the keyboard bezel **b** are firmly attached.



## 1140 Speaker

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Hinge cover (1120)
- Keyboard bezel (1130)

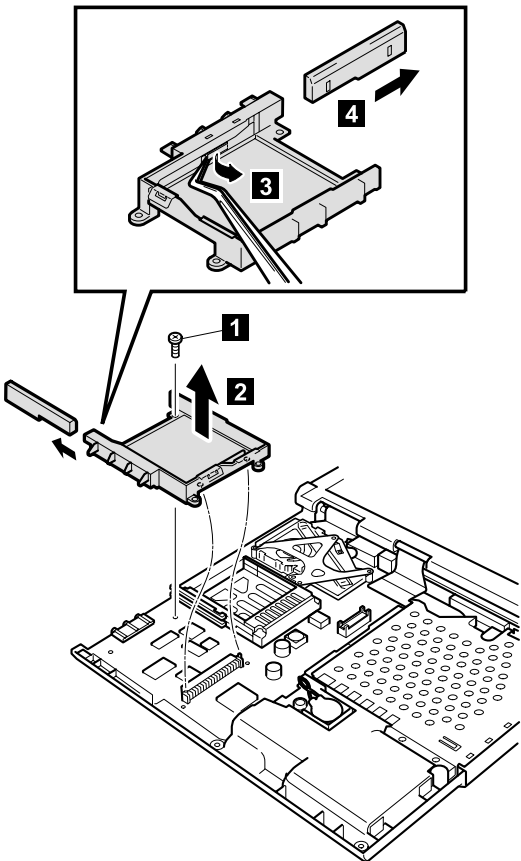


Step	Screw (quantity)	Torque
<b>2</b>	M2.5 x 14 mm, nylon-coated (2)	39.2 Ncm (4 kgfcm)

## 1150 Hard-disk bay and RF ID adapter

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Hinge cover (1120)
- Keyboard bezel (1130)
- Speaker (1140)

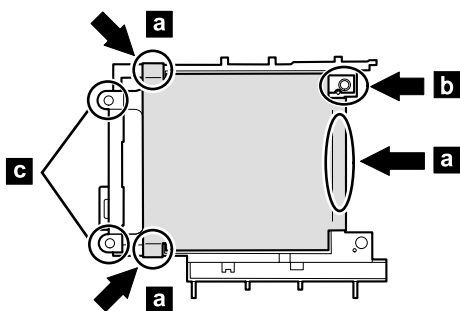
Procedures **3** and **4** are only for the case when RF ID adapter has been attached into the hard-disk bay.



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 × 4.8 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)

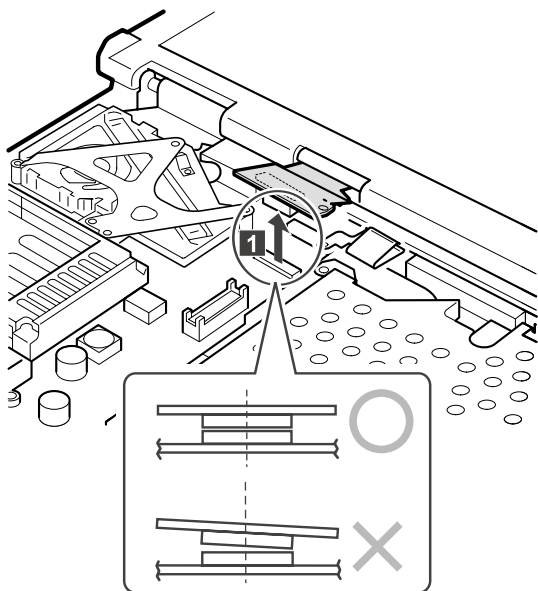
**When installing:**

1. Make sure that the **a** -parts of the insulation do not come off.
2. Make sure that the **b** -part is not turned over.
3. Make sure that the holes in the guide rail and in the aluminium sheet are aligned, and the aluminium sheet does not protrude in the **c** -parts. The protruding parts of the sheet can cause electrical short.



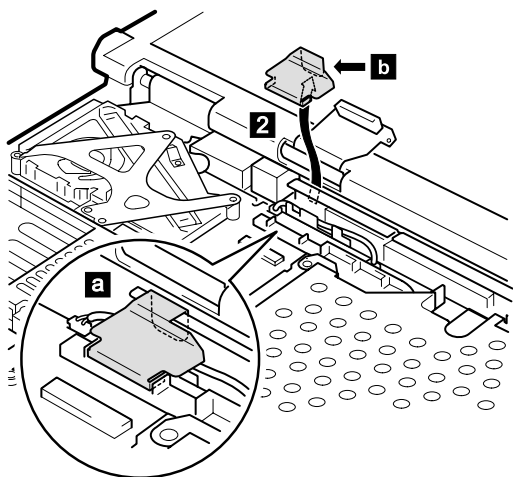
## 1160 Ultrabay 2000 slot

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Hinge cover (1120)
- Keyboard bezel (1130)



**When installing:** Make sure that the FPC connector is firmly attached.

(continued)



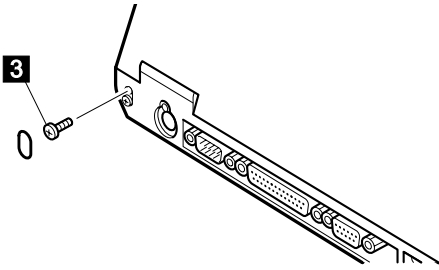
**When installing:** Make sure that the FPC bracket is firmly attached as shown in the figure **a**.

**Note:** **b**-part is for the following models only:

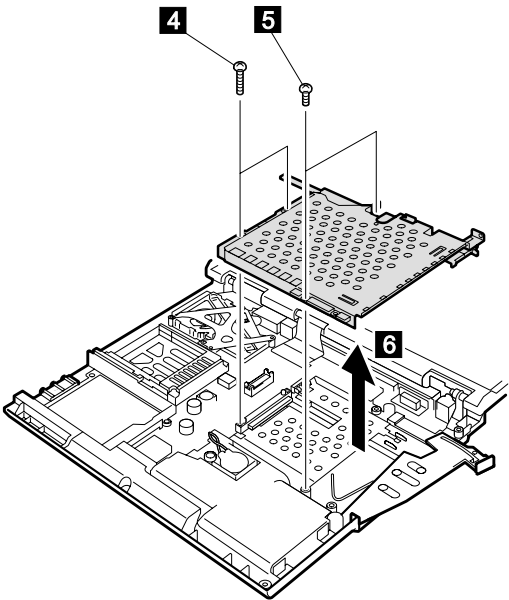
T21	MT2647	-57x, -5Bx, -97x, -9Bx
T22	MT2647	-4Cx, -4Ex, -4Gx, -8Gx, -8Cx, -8Ex, -LCx, -5Cx, -5Ex, -9Cx, -9Ex
	MT2648	-4Cx, -4Ex, -4Gx, -8Cx, -8Ex, -8Gx

(continued)





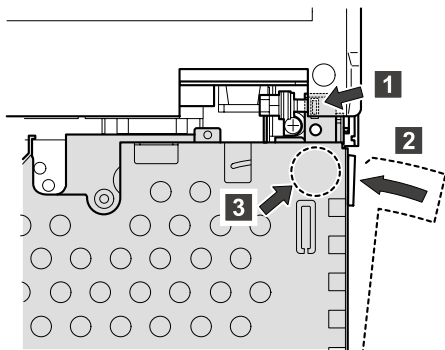
Step	Screw (quantity)	Torque
<b>3</b>	M2.5 × 4.8 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)



Step	Screw (quantity)	Torque
<b>4</b>	M2 × 13.5 mm, nylon-coated (2)	24.5 Ncm (2.5 kgfcm)
<b>5</b>	M2.5 × 4.8 mm, nylon-coated (2)	39.2 Ncm (4 kgfcm)

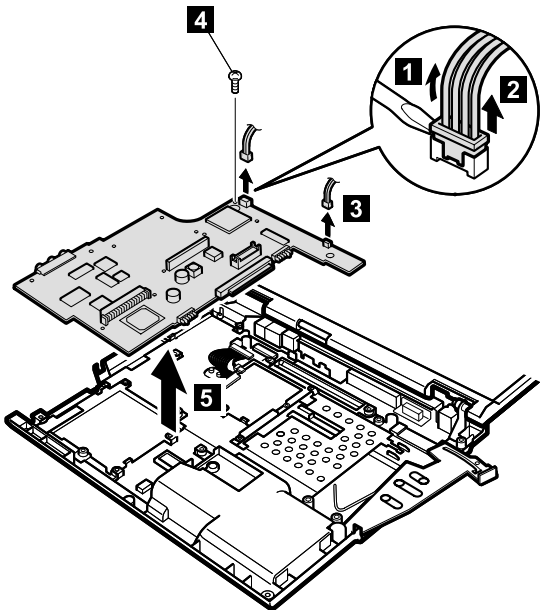
(continued)

**When installing:** Make sure that the guide of the slot is firmly attached **1** and if the eject lever has been popped out, push it back in the direction of arrow **2** until it snaps, and then push the upper-right corner of the slot **3** to fix it firmly.



## 1170 System board

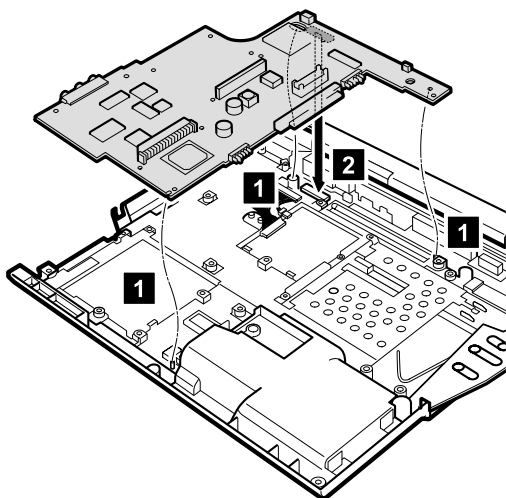
- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- DIMM (1040)
- Mini PCI adapter (1050)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- PC card slot assembly (1110)
- Hinge cover (1120)
- Keyboard bezel (1130)
- Speaker (1140)
- Hard-disk bay and RF ID adapter (1140)
- Ultrabay 2000 slot (1150)



Step	Screw (quantity)	Torque
4	M2.5 x 4.8 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)

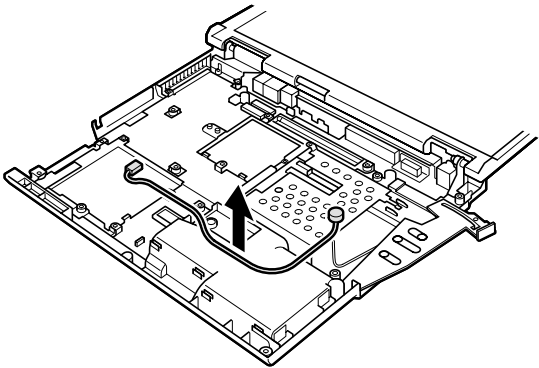
(continued)

**When installing:** Make sure that all of the guides are firmly attached **1** and you have fastened the connector firmly to the underside of the system board **2**.

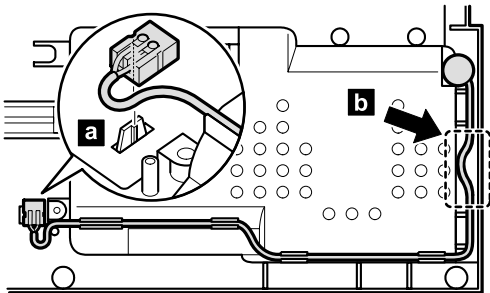


## 1180 Microphone cable

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- DIMM (1040)
- Mini PCI adapter (1050)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- PC card slot assembly (1110)
- Hinge cover (1120)
- Keyboard bezel (1130)
- Speaker (1140)
- Hard-disk bay and RF ID adapter (1150)
- Ultrabay 2000 slot (1160)
- System board (1170)

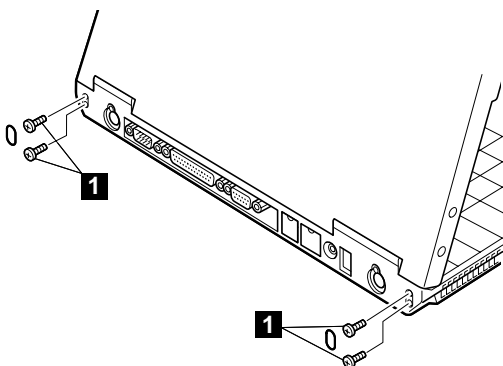


**Cable routing:** When replacing the cable, make sure the connector is firmly attached into place **a**. Cable slacking is only allowed at the **b**-part of the frame.



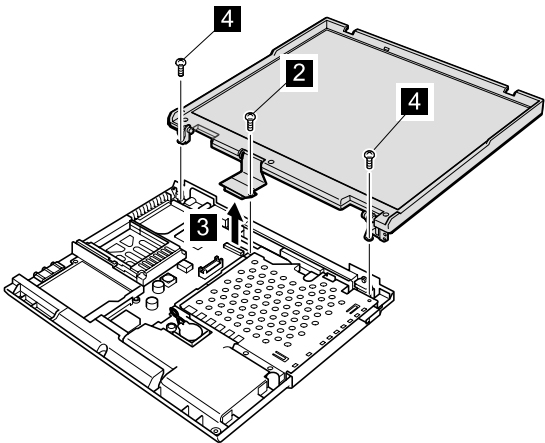
## 2010 LCD assembly

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- Hinge cover (1120)
- Keyboard bezel (1130)



Step	Screw (quantity)	Torque
<b>1</b>	M2.5 × 4.8 mm, nylon-coated (4)	39.2 Ncm (4 kgfcm)

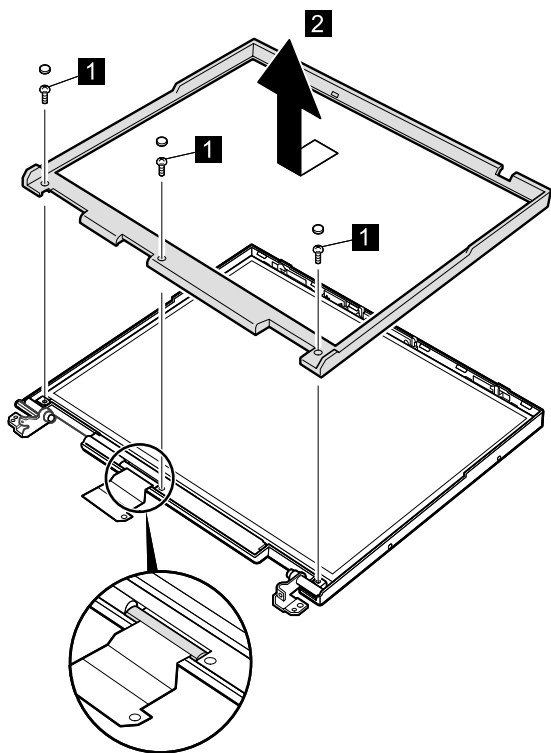
(continued)



Step	Screw (quantity)	Torque
<b>2</b>	M2.5 × 14 mm, nylon-coated (1)	39.2 Ncm (4 kgfcm)
<b>4</b>	M2.5 × 4.8 mm, nylon-coated (2)	39.2 Ncm (4 kgfcm)

## 2020 Front bezel

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- Hinge cover (1120)
- Keyboard bezel (1130)
- LCD assembly (2010)

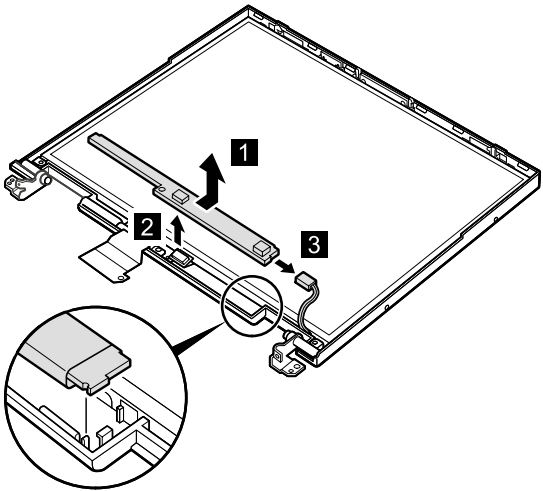


Step	Screw (quantity)	Torque
<b>1</b>	M2.5 x 4.8 mm, nylon-coated (3)	39.2 Ncm (4 kgfcm)

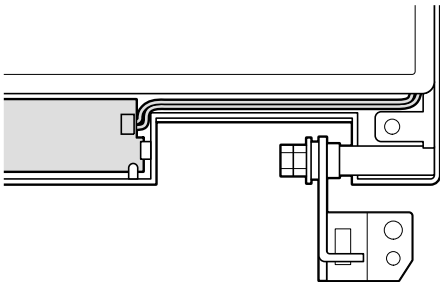


## 2030 Inverter card

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- Hinge cover (1120)
- Keyboard bezel (1130)
- LCD assembly (2010)
- Front bezel (2020)



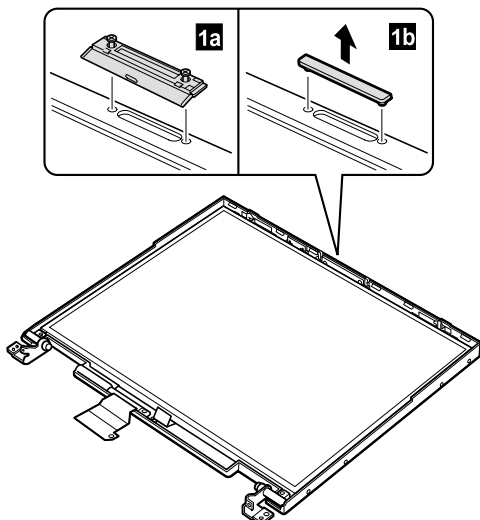
**Cable routing:** When replacing the inverter card, route the connector cable as in the following figure:



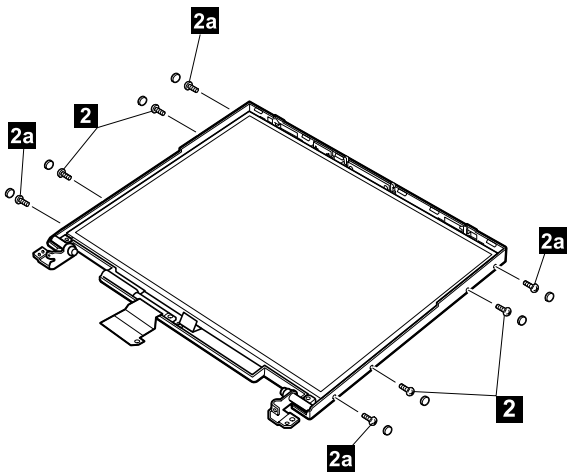
## 2040 LCD panel

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- Hinge cover (1120)
- Keyboard bezel (1130)
- LCD assembly (2010)
- Front bezel (2020)

Remove the UltraPort adapter if it has been screwed onto the LCD. To do this, remove the screw from both side of the adapter as shown in the figure **1a**. Remove the connector cover for the others as shown in the figure **1**.

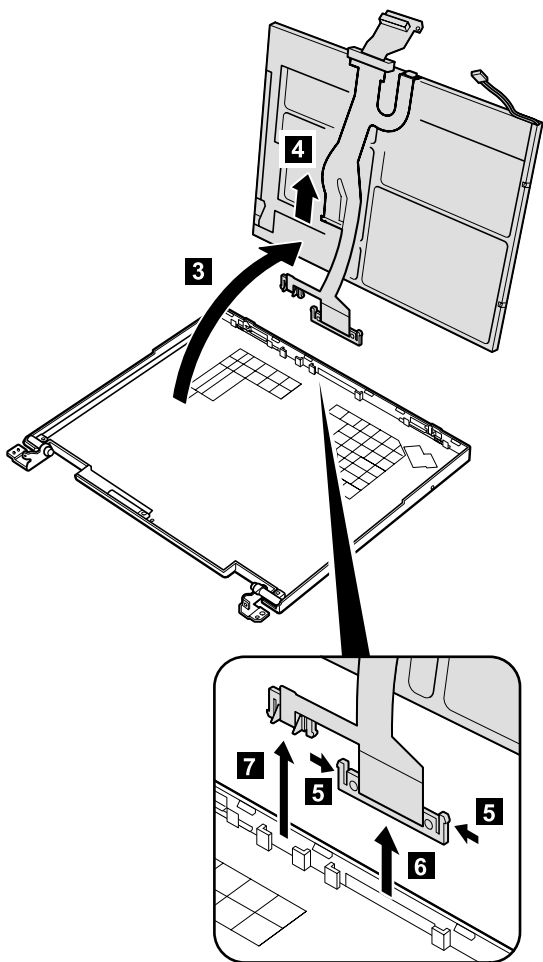


(continued)



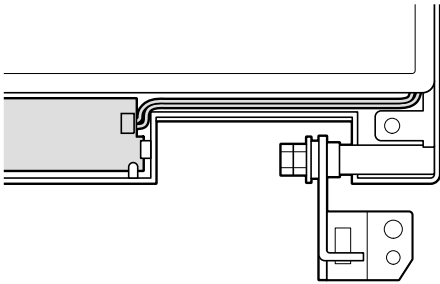
Step	Screw (quantity)	Torque
<b>2</b>	For 13.3-in. LCD, LG (05K9636), 14.1-in. XGA LCD, Hitachi (05K9568) and 14.1-in. SXGA+ LCD, Hitachi (46L2493) M2 x 4 mm, nylon-coated (4)	24.5 Ncm (2.5 kgfcm)
<b>2a</b>	For 14.1-in. LCD, LG (05K9567), SAMSUNG (05K9678) and 14.1-in. SXGA+ LCD, LG (05K9567), LG (46L2495) M2 x 4 mm, nylon-coated (4)	24.5 Ncm (2.5 kgfcm)

(continued)



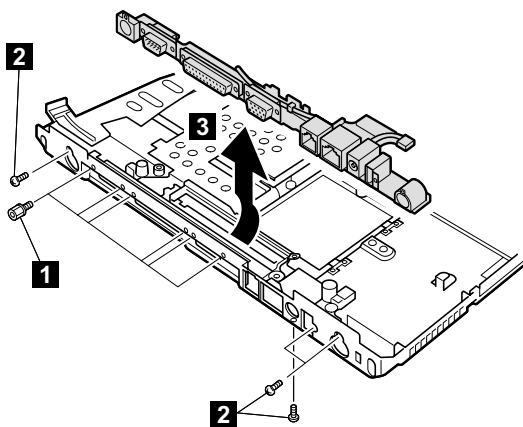
(continued)

**Cable routing:** When installing the LCD, route the connector cable as in the following figure:



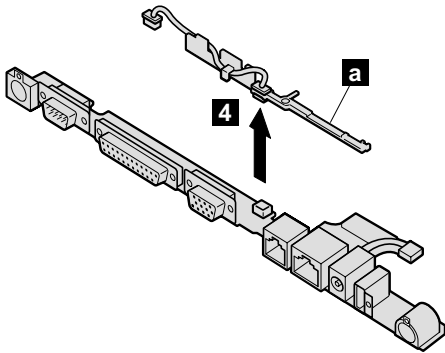
## 2050 Sub card

- Battery pack (1010)
- Backup battery (1020)
- Hard-disk drive (1030)
- DIMM (1040)
- Mini PCI adapter (1050)
- Ultrabay 2000 device (1060)
- Keyboard (1070)
- Keyboard CRU insulator (1080)
- Fan assembly (1090)
- PC card slot assembly (1110)
- Hinge cover (1120)
- Keyboard bezel (1130)
- Speaker (1140)
- Hard-disk bay and RF ID adapter (1150)
- Ultrabay 2000 slot (1160)
- System board (1170)
- LCD assembly (2010)



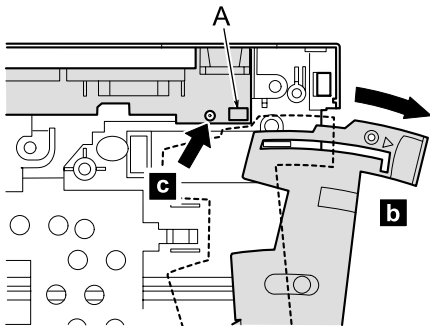
Step	Screw (quantity)	Torque
<b>1</b>	Hex stud (6)	39.2 Ncm (4 kgfcm)
<b>2</b>	M2.5 x 4.8 mm, nylon-coated (4)	39.2 Ncm (4 kgfcm)

(continued)

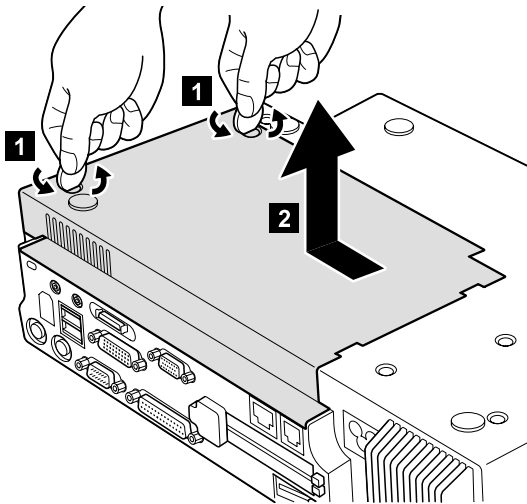


**When installing, do the following:**

- Attach the I/O card spacer ( **a** ) onto the new sub card and make sure that the connector is firmly attached.
- Make sure that the eject lever is popped out **b** and then install the sub card.
- Take care not to damage the switch on the sub card (**A**).
- Make sure that the guide of the card is firmly attached **c** as shown in the figure.

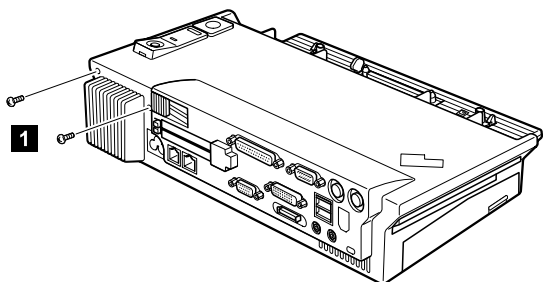


## 3010 ThinkPad Dock PCI cover



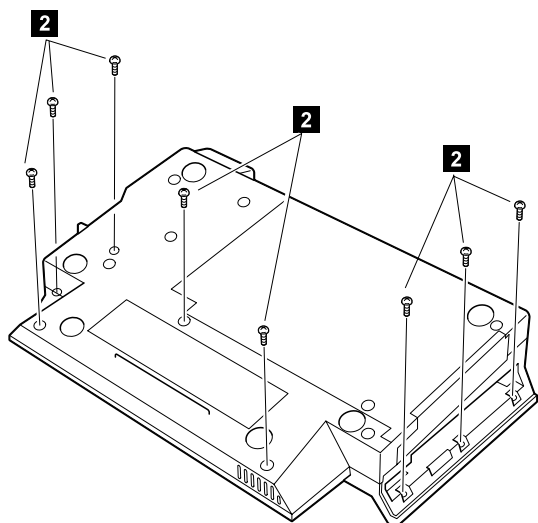


## 3020 ThinkPad Dock top cover



(Rear view)

Step	Screw (quantity)	Torque
<b>1</b>	M2.5 × 4.8 mm (2)	39.2 Ncm (4 kgfcm)



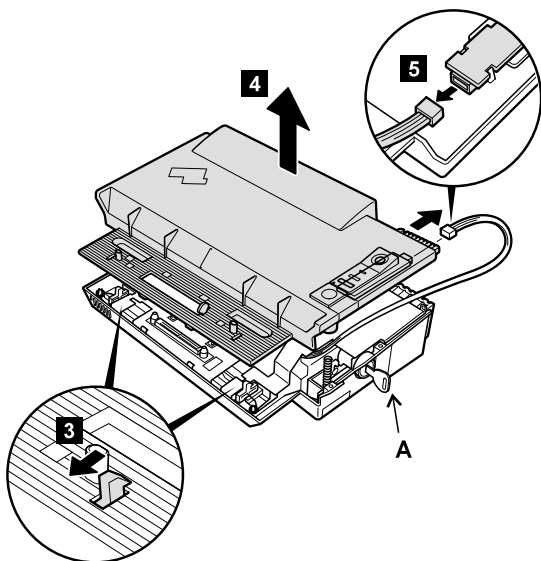
(Bottom view)

Step	Screw (quantity)	Torque
<b>2</b>	M2.5 × 4.8 mm (8)	39.2 Ncm (4 kgfcm)

(continued)

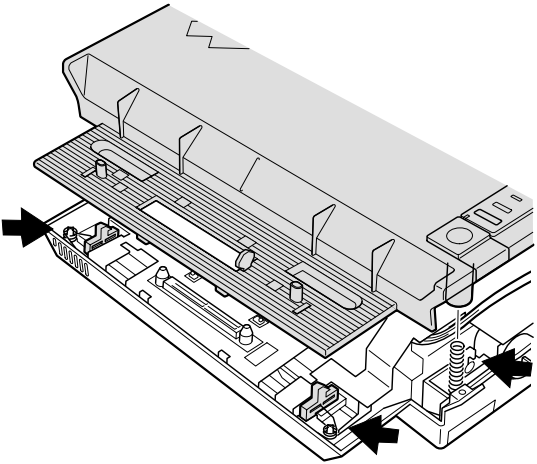
*Removing and replacing a FRU*

Make sure that the system lock key **A** is set to the Unlock position. Release the front latches in step **3**, and then remove the top cover **4**. For step **5**, see the inside view, shown in the circle.

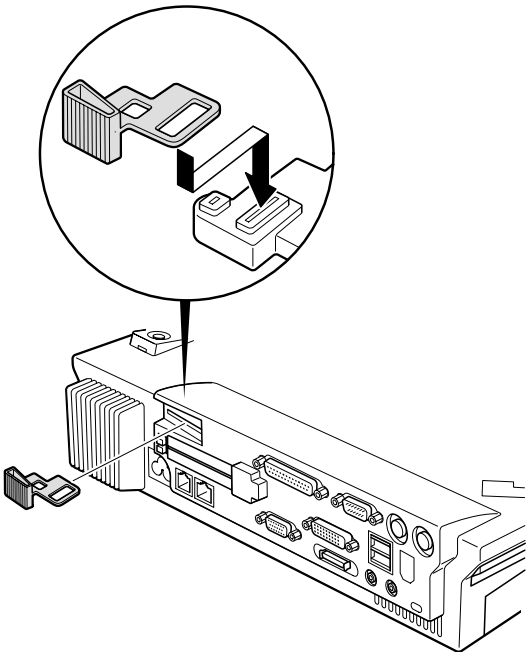


When replacing the top cover, do the following:

- Make sure that the springs are placed correctly.



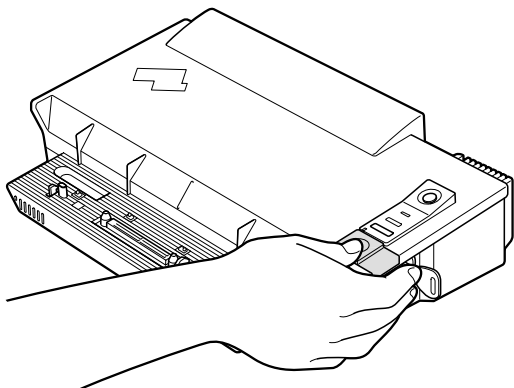
- Make sure that the device release lever is seated correctly.



(continued)

*Removing and replacing a FRU*

- Make sure that the release button works correctly.



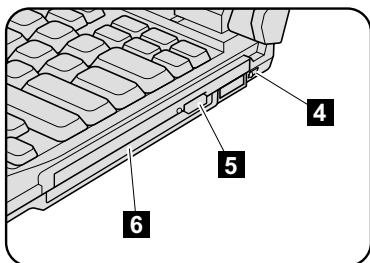
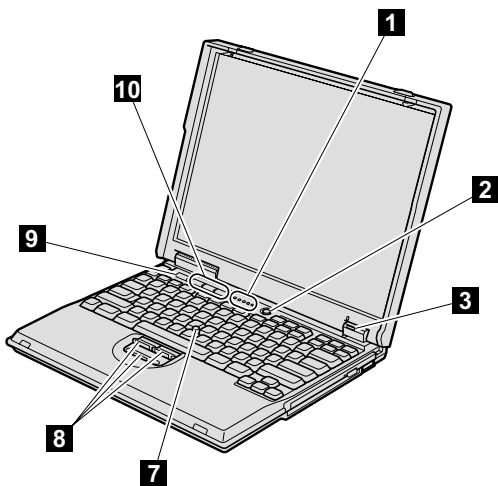
## Locations

### Front view

- 1** System status indicators
- 2** Power switch
- 3** Battery, standby mode, and UltraBay status indicators
- 4** Bay latch
- 5** Eject button
- 6** Ultrabay 2000 device

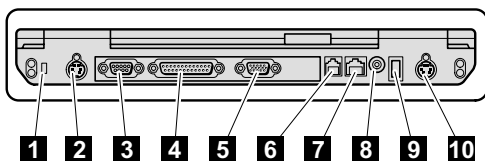
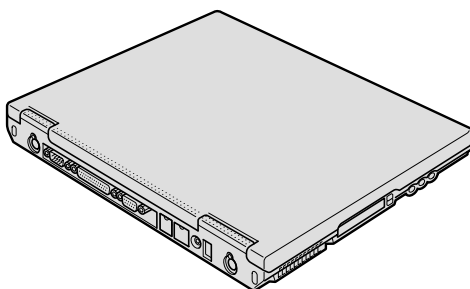
**Note:** The Ultrabay 2000 accepts storage devices, such as a DVD drive or a CD-ROM drive.

- 7** TrackPoint pointing stick
- 8** TrackPoint buttons
- 9** ThinkPad button
- 10** Volume and mute buttons



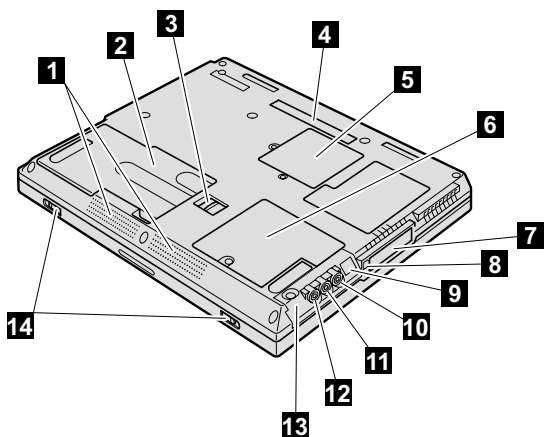
## Rear view

- 1** Security keyhole
- 2** TV-out connector
- 3** Serial connector
- 4** Parallel connector
- 5** External-monitor connector
- 6** Modem connector
- 7** Ethernet connector
- 8** Power jack
- 9** Universal serial bus (USB) connector
- 10** External-input-device connector



**Bottom view**

- 1** Built-in stereo speakers
- 2** Battery pack
- 3** Battery pack latches
- 4** Docking connector
- 5** Mini PCI card slot
- 6** DIMM
- 7** PC card slots
- 8** PC card eject button
- 9** Infrared port
- 10** Stereo headphone jack
- 11** Stereo line-in jack
- 12** Microphone jack
- 13** Hard-disk drive
- 14** LCD latches



## Parts list

### T20, T21 and T22 series model matrix

The T20, T21 and T22 series includes two models, MT2647 and MT2648. The following table summarizes the characteristics of each model, to help you determine which FRU in the part list meets your need. The table contains an entry for each of the eight types of MT2647, labeled A through F and three types of MT2648 G through I.

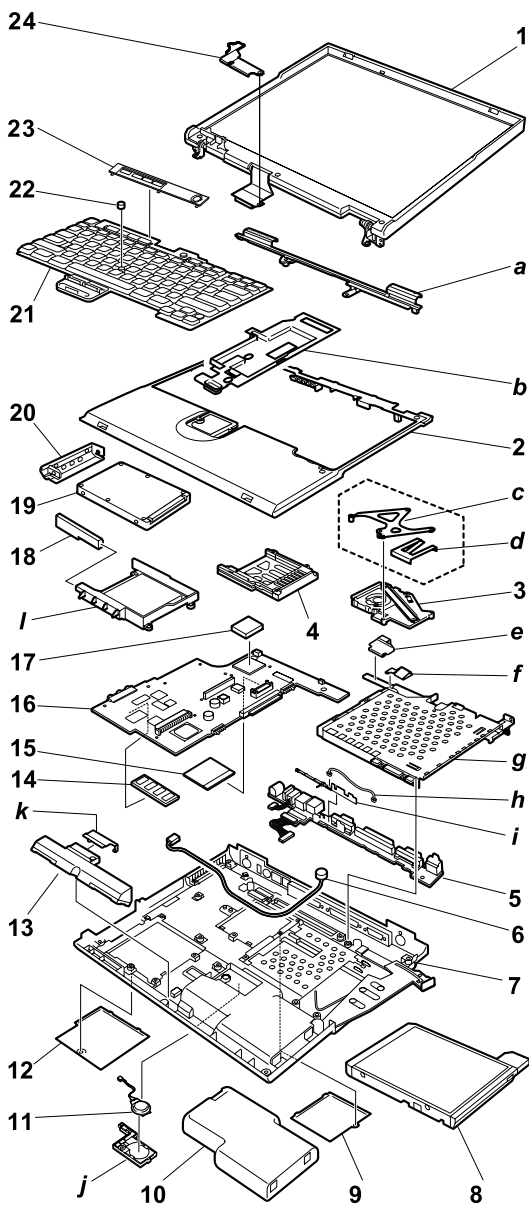
Suffix no.	HDD	CPU	Bay device	LCD
<b>T20 MT2647 (A)</b>				
-21x, 24x, 61x, 64x	6 GB	CMG650	CD-ROM	13.3-in. XGA
-31x			DVD-ROM	14.1-in. XGA
-32x, 72x	12 GB	CMG700	CD-ROM	13.3-in. XGA
-41x, 42x, 43x, 44x, 45x, 81x, 82x, 84x			DVD-ROM	14.1-in. XGA
<b>T20 MT2647 (B)</b>				
-52x, 55x, 92x, 95x	20 GB	CMG750	DVD-ROM	14.1-in. XGA
-L1x, L2x			CD-ROM	
<b>T21 MT2647 (C)</b>				
-27x, 2Bx, 67x, 6Bx	10 GB	CMG750	CD-ROM	13.3-in. XGA
-47x, 4Ax, 4Bx, 87x, 8Ax, 8Bx, L7x	20 GB	CMG800	DVD-ROM	14.1-in. XGA
<b>T21 MT2647 (D)</b>				
-57x, 5Bx, 97x, 9Bx	32 GB	CMG850	DVD-ROM	14.1-in. SXGA+
<b>T22 MT2647 (E)</b>				
-3Cx, 3Ex, 7Cx, 7Ex	10 GB	CMG800	CD-ROM	13.3-in. XGA
<b>T22 MT2647 (F)</b>				
-4Cx, 4Ex, 4Gx, 8Gx, 8Cx, 8Ex, LCx	20 GB	CMG900	DVD-ROM	14.1-in. XGA
-5Cx, 5Ex, 9Cx, 9Ex	32 GB	CMG 1G		14.1-in. SXGA+

(continued)



Suffix no.	HDD	CPU	Bay device	LCD
<b>T20</b> MT2648; (G)				
-41x, 42x, 81x, 82x	12 GB	CMG700	DVD-ROM	14.1-in. XGA
<b>T21</b> MT2648; (H)				
-47x, 4Ax, 4Bx, 87x, 8Ax, 8Bx	20 GB	CMG800	DVD-ROM	14.1-in. XGA
<b>T22</b> MT2648; (I)				
-4Cx, 4Ex, 4Gx, 8Cx, 8Ex, 8Gx	20 GB	CMG900	DVD-ROM	14.1-in. XGA

**CMGxxx:** Intel® mobile Pentium® III processor xxx MHz featuring Intel® SpeedStep™ technology



- Each FRU is available for all types/models, unless specific types or models are given.
- The FRUs marked with asterisk are CRU (customer replaceable unit).

No.	FRU	P/N
<i>a - l</i>	See "Miscellaneous parts" on page 119.	
1	LCD unit (see "LCD FRU" on page 116)	
2	Keyboard bezel	
	for T20	08K6088
	for Korea	08K6765
	for T21	04P3451
	for Korea	04P3694
	for T22	26P9265
	for Korea	26P9311
3	Fan assembly	
	for T20	08K6396
	for T21	04P3448
	for T22	
	MT2647 (E)	08K7268
	MT2647 (F), MT2648 (I)	08K7316
4	PC Card slots	
	for T20	08K6083
	for T21, T22	08K7064
5	I/O card	26P8023
6	Microphone cable assembly	27L0520
7	Base cover	
	for 2647 (A, B)	08K6079
	for T-China	08K6346
	for Korea	08K6350
	for 2648 (G)	08K6369
	for T-China	08K6370
	for Korea	08K6372
	for 2647 (C, D)	04P3444
	for Korea	04P3446
	for 2648 (H)	04P3445
	for Korea	04P3447
	for 2647 (E)	26P9291
	for Korea	26P9309

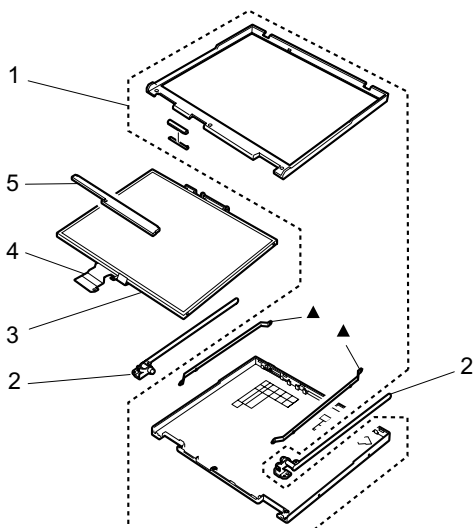
(continued)

No.	FRU	P/N
7	Base cover	
	for 2647 ( F )	08K7362
	for Korea	26P9174
	for 2648 ( I )	26P9173
	for Korea	26P9175
8	Diskette drive* (TEAC)	05K9206
	Diskette drive* (Sony)	08K9578
	Ultrabay 2000 CD-ROM drive* (see "Optional FRUs" on page 121)	
	Ultrabay 2000 DVD drive* (see "Optional FRUs" on page 121)	
	for optional Ultrabay 2000 devices, see "Optional FRUs" on page 121.	
9	Cover, DIMM slot*	08K6090
10	Battery pack* (see "Optional FRUs" on page 121)	
11	Backup battery	02K6572
12	Cover, Mini PCI adapter slot*	08K6091
13	Speaker assembly	08K6089
14	DIMM* (see "Optional FRUs" on page 121)	
15	Mini PCI modem card* (see "Optional FRUs" on page 121)	
	Mini PCI Ethernet* (see "Optional FRUs" on page 121)	
	Mini PCI combo card* (see "Optional FRUs" on page 121)	
16	System board	
	for 2647 (A), 2648 (G)	10L1339
	for 2647 (B)	08K3216
	for 2647 (C), 2648 (H)	08K3385
	for 2647 (D)	08K3387
	for 2647 (E)	08K3344
	for 2647 (F), 2648 (I)	08K3381

(continued)

No.	FRU	P/N
17	CPU, Pentium III 650 MHz with SpeedStep technology	10L1405
	CPU, Pentium III 700 MHz with SpeedStep technology	10L1417
	CPU, Pentium III 750 MHz with SpeedStep technology	08K3191
	CPU, Pentium III 800 MHz with SpeedStep technology	08K3246
	CPU, Pentium III 850 MHz with SpeedStep technology	08K3248
	CPU, Pentium III 900 MHz with SpeedStep technology	08K3346
	CPU, Pentium III 1 GHz with SpeedStep technology	08K3392
18	Asset ID RF adapter (see "Optional FRUs" on page 121)	
19	Hard-disk drive* (see "Optional FRUs" on page 121)	
20	Cover, hard-disk drive* for T20	08K6092
	Cover, hard-disk drive* for T21, T22	04P3496
21	Keyboard* (see "Keyboard" on page 118)	
22	Pointing stick cap*	84G6536
23	Easy button cover for T22 <b>Note:</b> This part is included in system miscellaneous parts in T20 and T21 series (see "System miscellaneous parts for T20" on page 120).	26P9183
24	Bracket, LCD FPC	26P9178

## LCD FRU



**Note:** The parts marked with ▲ are only for 13.3-in. LCD cover kit.

## 13.3-in. XGA TFT

No.	FRU	P/N
1	LCD cover kit (13.3-in.) XGA	08K6685
	for Korea	08K6764
2	Hinges	08K6087
3	LCD panel, 13.3 XGA (LG)	05K9636
4	LCD cable assembly 13.3	27L0562
5	Inverter Card	10L1402

(continued)

**14.1-in. XGA TFT**

No.	FRU	P/N
1	LCD cover kit (14.1-in.) XGA	08K6086
	for Korea	08K6763
2	Hinges	08K6087
3	LCD panel, 14.1 XGA (LG)	05K9567
	LCD panel, 14.1 XGA (Hitachi) for T20, T21	05K9568
	LCD panel, 14.1 XGA (SAMSUNG) for T20, T21	05K9678
	LCD panel, 14.1 XGA (SAMSUNG) Light Weight for T22	05K9851
	LCD panel, 14.1 XGA (DBU) Light Weight for T22	05K9888
4	LCD cable assembly 14.1	
	For T20, T21	27L0519
	For T22	27L0640
5	Inverter Card	10L1402

**14.1-in. SVGA+ TFT**

No.	FRU	P/N
1	LCD cover kit (14.1-in.) SXGA+	04P3552
	for Korea	04P3693
2	Hinges	08K6087
3	LCD panel, 14.1 SXGA+ (Hitachi)	46L2493
	LCD panel, 14.1 SXGA+ (LG)	46L2495
4	LCD cable assembly 14.1 SXGA+	27L0590
5	Inverter Card	10L1402

## Keyboard

Language	P/N (NMB)	P/N (ALPS)
Arabic	02K5750	02K5721
Belgian	02K5745	02K5716
Canadian French	02K5732	02K5703
Chinese, traditional	02K5747	02K5718
Czech	02K5751	02K5722
Danish	02K5738	02K5709
Dutch	02K5735	02K5706
European Spanish	02K5740	02K5711
European French	02K5734	02K5705
German	02K5733	02K5704
Greek	02K5753	02K5724
Hungarian	02K5752	02K5723
Hebrew	02K5749	02K5720
Italian	02K5739	02K5710
Japanese	02K5730	02K5701
Korean	02K5744	02K5715
Latin American Spanish	02K5743	02K5714
Norwegian	02K5737	02K5708
Polish	02K5755	02K5726
Portuguese	02K5742	02K5713
Russian	02K5748	02K5719
Slovakian	02K5754	02K5725
Slovenian	02K5756	02K5727
Swedish or Finnish	02K5736	02K5707
Swiss	02K5741	02K5712
Thai	02K5757	02K5728
Turkish	02K5746	02K5717
U.K. English	02K5731	02K5702
U.S. English	02K5729	02K5700



## Miscellaneous parts

FRU	P/N
Screw kit (including nylon-coated screws): <ul style="list-style-type: none"> <li>• M2.5 x 14 mm, bind head (15)</li> <li>• M2.5 x 4.8 mm, flat head (20)</li> <li>• M2.5 x 3.5 mm, flat head (10)</li> <li>• M2.0 x 13.5 mm, pan head (15)</li> <li>• M2..0 x 4.0 mm, small head (10)</li> <li>• Hex stud D-sub (10)</li> <li>• Coin screw (1)</li> <li>• Security screw (1)</li> <li>• Blank cap, enhanced port (5)</li> <li>• Screw caps, rear (5)</li> <li>• Screw caps (5)</li> <li>• Screw caps (painted) (10)</li> <li>• Screw caps (not painted) (5)</li> </ul>	08K6093
Base miscellaneous parts for T20, T21: <ul style="list-style-type: none"> <li>• I/O plate</li> <li>• Cover, RF ID</li> <li>• Spring, battery lock</li> <li>• Lid, docking FR</li> <li>• Lid, docking RR</li> <li>• Spring, lid docking</li> <li>• Spring, lid PC card</li> <li>• Lid, PC card</li> <li>• ESD plate, audio</li> <li>• Insulator for base cover</li> <li>• Eject lever</li> <li>• Spring lever</li> <li>• Puller bay</li> <li>• Label danger, backup battery</li> <li>• Rubber foot</li> <li>• Sponge</li> <li>• Knob, battery lock</li> <li>• Latch, battery lock</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	08K6081

FRU	P/N
Base miscellaneous parts for T22: <ul style="list-style-type: none"> <li>• Cover, RF ID</li> <li>• Spring, battery lock</li> <li>• Lid, docking FR</li> <li>• Lid, docking RR</li> <li>• Spring, lid docking</li> <li>• Spring, lid PC card</li> <li>• Lid, PC card</li> <li>• ESD plate, audio</li> <li>• Insulator for base cover</li> <li>• Eject lever</li> <li>• Spring lever</li> <li>• Puller bay</li> <li>• Label danger, backup battery</li> <li>• Rubber foot, low height (2)</li> <li>• Rubber foot, high (1)</li> <li>• Sponge</li> <li>• Knob, battery lock</li> <li>• Latch, battery lock</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	26P9285
System miscellaneous parts for T20: <ul style="list-style-type: none"> <li>• (a) Hinge cover assembly</li> <li>• Easy button cover</li> <li>• (i)I/O card spacer</li> <li>• (h) Cable RJ11 to system board docking</li> <li>• (j) Holder, backup battery</li> <li>• (g) Ultrabay 2000 guide rail</li> <li>• (i) Hard-disk bay guide rail</li> <li>• (b) Insulator, keyboard CRU</li> <li>• Mini PCI guide</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	08K6085
System miscellaneous parts for T21: <ul style="list-style-type: none"> <li>• (a) Hinge cover assembly</li> <li>• Easy button cover T21</li> <li>• (i)I/O card spacer</li> <li>• (h)Cable RJ11 to system board docking</li> <li>• (j)Holder, backup battery</li> <li>• (g) Ultrabay 2000 guide rail</li> <li>• Hard-disk bay guide rail</li> <li>• (b) Insulator, keyboard CRU</li> <li>• Mini PCI guide</li> <li>• (c)Keyboard support</li> <li>• (f) ESD plate spring CSB</li> <li>• (d) ESD fan cover</li> <li>• (e) Bracket EMI, FPC</li> <li>• Grease</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	04P3449

FRU	P/N
System miscellaneous parts for T22: <ul style="list-style-type: none"> <li>• (a) Hinge cover assembly</li> <li>• Easy button cover T21</li> <li>• (j)I/O card spacer</li> <li>• (h)Cable RJ11 to system board docking</li> <li>• (j)Holder, backup battery</li> <li>• (g) Ultrabay 2000 guide rail</li> <li>• (f) Hard-disk bay guide rail</li> <li>• (b) Insulator, keyboard CRU</li> <li>• Mini PCI guide</li> <li>• (c)Keyboard support</li> <li>• (f) ESD plate spring CSB</li> <li>• (d)ESD fan cover</li> <li>• (e) Bracket EMI, FPC</li> <li>• (k) Bracket RF, speaker</li> <li>• Grease</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	04P3980
Miscellaneous parts, for system board: <ul style="list-style-type: none"> <li>• Planar stud</li> <li>• Insulator, PC card</li> <li>• Insulator, battery latch</li> <li>• KDB connector guide</li> <li>• Shock rubber</li> <li>• Insulator, docking connector</li> <li>• Insulator, fan connector</li> <li>• Insulator, Ultrabay 2000 connector</li> <li>• Insulator, I/O connector</li> <li>• Shield, mini PCI</li> <li>• Insulator, hard-disk drive</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	08K7099
Miscellaneous parts, for I/O card <ul style="list-style-type: none"> <li>• DC jack connector</li> <li>• Cable RJ11/45 to mini PCI</li> <li>• Insulator, modular jack</li> <li>• Insulation tape</li> <li>• Screw caps</li> <li>• Screw caps, rear</li> </ul>	08K6683

## Optional FRUs

UltraPort camera	02K5153
IBM tripod	08K6449
UltraPort adapter and connector cover	08K6105
USB cable attachment	08K6108
USB cable	27L0542
ThinkPad Dock	08N1546
PCI cover	05K6246
ThinkPad Dock with extension plate	08N1537
PCI cover	08N7317

Top cover and screw kit for ThinkPad Dock	12P4143
Battery pack, Panasonic	02aK6626
Battery pack, SANYO	02K6627
Multiple battery charger	02K6642
Ultrabay 2000 battery	02K6645
AC adapter (72W), 3-pin (ASTEC)	02K6666
AC adapter (72W), 2-pin (ASTEC)	02K6669
AC adapter (72W), 3-pin (DELTA)	02K6670
AC adapter (72W), 2-pin (DELTA)	02K6673
AC adapter (72W), 2-pin (SANKEN)	02K6677
ThinkPad Port Replicator	08N1536
Telephone cable	05K2707
Telephone cable (San Tai)	27L0603
Ultrabay 2000 CD-ROM drive (TEAC)	27L3436
Ultrabay 2000 CD-ROM drive (LG)	05K9159
Ultrabay 2000 CD-ROM drive (LG) (low power)	08K9545
Ultrabay 2000 DVD drive 8x (MKE)	27L3447
Ultrabay 2000 DVD drive 8x (Hitachi)	08K9513
Ultrabay 2000 DVD drive 8x (TOSHIBA)	08K9547
Ultrabay 2000 SuperDisk drive	05K9235
Ultrabay 2000 2nd HDD adapter	08K6067
Conversion adapter	08K6360
Hard-disk drive (6.0 GB), SSD	05K9227
Hard-disk drive (6.0 GB), Hitachi	05K9228
Hard-disk drive (10.0 GB), SSD	08K9508
Hard-disk drive (10.0 GB), Hitachi	08K9531
Hard-disk drive (12.0 GB), SSD	05K9229
Hard-disk drive (12.0 GB), Hitachi	05K9230
Hard-disk drive (18.0 GB), SSD	05K9231
Hard-disk drive (20.0 GB), SSD	27L3427
Hard-disk drive (20.0 GB), Hitachi	08K9533
Hard-disk drive (32.0 GB), SSD	08K9509
Asset ID RF adapter	08K6065
Mini PCI modem card (Ambit)	08K3383
Mini PCI modem card (Ambit)	08K3252
Mini PCI modem card	08K3338
Mini PCI combo card (Intel)	06P3809
Mini PCI combo card (Intel)	19K5888
Mini PCI combo card (Intel)	08K3125
Mini PCI combo card (3Com)	06P3829
Mini PCI combo card (3Com)	00N8117

64-MB SDRAM SO DIMM	20L0264
128-MB SDRAM SO DIMM	20L0265
256-MB SDRAM SO DIMM	33L3070
Diskette drive cable	27L0525
Video cable	27L0531

## Common parts list

### Tools

Triconnector wrap plug	72X8546
PC test card	35G4703
Audio wrap cable	66G5180
USB parallel test cable	05K2580
Screwdriver kit	95F3598
Torque screwdriver	05K4695
5 mm socket wrench	05K4694
Screwdriver	27L8126
ThinkPad hardware maintenance diskette version 1.61 <b>Note:</b> Download the file from the Web site.	–

### Power cords (system)

IBM power cords for a specific country are usually available only in that region:

#### *For 2-pin power cords:*

Region	P/N
Canada, United States of America	13H5264
Japan	13H5273
Argentina	36L8870

#### *For 3-pin power cords:*

Region	P/N
Australia, New Zealand	76H3514
Taiwan, Thailand	76H3516
Italy	76H3530
Denmark	76H3520
UK, Hong Kong	76H3524
European countries	76H3518
India, South Africa	76H3522
Israel	76H3532
Korea	76H3535
People's Republic of China (other than Hong Kong)	02K0539
Switzerland	76H3528

**Power cords (docking station)**

IBM power cords for a specific country are usually available only in that region: 3-pin -->

**For 3-pin power cords:**

<b>Region</b>	<b>P/N</b>
Argentina	36L8868
Australia, New Zealand	75H8988
Canada, Thailand, United States of America	75H8989
Denmark	75H8992
European countries	75H8990
India, South Africa	75H8993
Israel	75H8999
Italy	75H8998
Japan	75H8996
Korea	76H3536
People's Republic of China (other than Hong Kong)	02K0540
Switzerland	75H8997
United Kingdom	75H8994

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