IBM

IBM Mobile Systems
ThinkPad Computer
Hardware Maintenance Manual

April 2002

This manual supports:
> **ThinkPad T20, T21, T22, T23**
> > **(MT 2647/2648)**
> **ThinkPad Dock (MT 2631)**

First Edition (April 2002)

About this manual

This manual contains service and reference information for
IBM ThinkPad T20, T21, T22, T23 (MT2647, 2648), and
ThinkPad Dock (MT2631) products. Use this manual along
with the advanced diagnostic tests to troubleshoot
problems.

The manual is divided into sections as follows:
- The common sections provide general information,
  guidelines, and safety information required in servicing
  computers.
- The product-specific section includes service, reference,
  and product-specific parts information.

Important

This manual is intended for trained service
personnel who are familiar with ThinkPad products.
Use this manual along with the advanced diagnostic
tests to troubleshoot problems effectively.

Before servicing an IBM ThinkPad product, be sure
to review the safety information under "Safety
notices: multilingual translations" on page 3, "Safety
information" on page 13, and "Laser compliance
statement" on page 18.

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Introduction

Important service information

Important

BIOS and device driver fixes are customer-installable. The BIOS and device drivers are posted on the IBM support site http://www.ibm.com/pc/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 expense for replacing and servicing FRUs:

- **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.

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 multilingual, translated safety notice found in this section.

The following safety notices are provided in English, French, German, Italian, and Spanish.

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 ciò 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.

⚠ **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)

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.

⚠ **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.

(continued)

(continuation of safety notice 3)

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 temperature 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.

(continued)

(continuation of safety notice 4)

Die Systembatterie ist eine Lithiumbatterie. 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 e una batteria al litio e puo 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.

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.

⚠ **DANGER**

> **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

⚠ **DANGER**

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.

⚠ **DANGER**

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 presents 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 object that weighs 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 toolcase 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.

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- 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 devices that are sensitive to electorostatic discharge

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.

Laser compliance statement

Some IBM Personal Computer models are equipped from the factory with an optical storage device such as a CD-ROM drive or a DVD-ROM drive. They are also sold separately as options. The drive is certified in the U.S. to conform to the requirements of the Department of Health and Human Services 21 Code of Federal Regulations (DHHS 21 CFR) Subchapter J for Class 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, DVD drive or the other laser product 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 kontrôl, 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, DVD-ROM drive or the other optical storage device could result in exposure to hazardous laser radiation. There are no serviceable parts inside those drives. **Do not open.**

Some CD-ROM drives, DVD-ROM drives, or other optical storage devices 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 !.

Aprendo 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 nehľadte 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"
• "Restoring the preloaded system"
• "Passwords" on page 26
• "Power management" on page 28

Service web site

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

Restoring the preloaded system

If the data on a hard-disk drive is damaged or accidentally
erased, you can restore the software that was shipped with
the computer. This software includes the pre-installed
operating system, applications, and device drivers.

To restore the pre-installed software, you can use either
the Product Recovery program or a recovery CD.

Ordering the recovery CD

When the hard-disk drive is replaced because of a
failure, no Product Recovery program is on the new
hard disk. In this case, you must use the Product
Recovery CD for the computer. Order the recovery
CD and the hard-disk drive at the same time so that
you can recover the new hard-disk drive with the
pre-installed software when they arrive. For
information on which CD to order, see "Recovery
CDs" on page 161

The Product Recovery program is in the service partition, a
section of the hard-disk drive that is not displayed by
Windows Explorer.

Attention: All of the files on the primary hard-disk
partition (usually drive C) will be lost in the recovery
process. Be sure to back up copies of the files you have
saved on your drive C before you begin.

Creating a Recovery Repair diskette
If the operating system cannot boot normally, or if you
cannot get access to the Product Recovery program, you
can use the Recovery Repair diskette to boot the
computer. Make a Recovery Repair diskette and save it for
future use. To make a Recovery Repair diskette, do the
following:

1. Shut down and restart the computer.

2. At the prompt, press F11. (The option to press F11 appears for only a few seconds. You must press F11 quickly.) The Product Recovery program main menu opens.

   Note: If you are prompted to select the operating system, select one you want to recover. Then the Product Recovery program main menu opens.

3. Select **System Utilities** from the main menu. Press Enter.

4. Select **Create a Recovery Repair diskette**. Press Enter.

5. Follow the on-screen instructions.

6. When the process is completed, label the diskette "Recovery Repair diskette" and save it for future use.

Product Recovery program

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

To use the Product Recovery program to restore the pre-installed software, do the following:

1. Save all files and shut down the desktop.

2. Turn off the computer.

3. Turn on the computer. If you are using Windows XP, three messages (F1, F11, and F12) appear on the screen for a few seconds. One of them is "**Press F11 to invoke the IBM Product Recovery program**". While the message is displayed, quickly press F11.

   If you are using Windows 2000 or another operating system, the startup screen is displayed first, and then the message "**To start the Product Recovery program, press F11**" at the top of the screen. Here again it appears very briefly; watch for it, and press F11 before it disappears.

   Note: If this message is not displayed, you can use a Recovery Repair diskette to get access to the Product Recovery program. (For using a Recovery Repair diskette, see "To use the Recovery Repair diskette:" on page 26.)

4. From the list displayed on the screen, select the operating system you want to recover.

5. Select the recovery options you want, and follow the instructions on the screen.

6. When the Product Recovery program finishes running, the computer will restart with the pre-installed operating system, drivers, and software.

Note: Network drivers are not automatically restored
with Windows NT 4.0; you will need to reinstall
them.

Note: If you use Windows 2000 or Windows 98,
restart the system by pressing Ctrl+Alt+Del or
by turning the computer off and then on again.
The computer will restart with the pre-installed
operating system, drivers, and software.

Using the recovery CD

To create the service partition and install the preloaded
system from the recovery CD, do the following:

To create the service partition:

1. Erase all partitions on the hard-disk drive, using FDISK
   or a similar application.

2. Boot with the recovery CD (and the boot diskette if
   required.)

3. Following message is displayed: "**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
   do not receive this message; go to step 1.

4. Press Y key. The service partition is created and
   loaded with the Product Recovery program files.

   Note: If you do not want to create the service partition,
   press N key, and then go to step 8.

5. At next window, press Enter to continue.

   • The service partition is created. The system
     automatically reboots during this process.

   • The recovery process copies some files to the
     service partition, and PKUNZIPs others.

   • Follow the prompts. You may be prompted to
     change CDs.

   • When the process is complete, the system reboots.
     Continue to step 6 to install preloaded system.

Install preloaded system from CD:

6. Boot with the recovery CD (and the boot diskette if
   required.)

7. If the hard-disk drive is blank, the following message
   is displayed: "**Your computer originally included a
   Product Recovery program ... Reinstall the
   Product Recovery program? (Y/N) [ ]**".

   • To install the service partition, go to step 4.

- To preload the hard-disk drive without installing the service partition, press N key.

8. If you get a message asking which operating system to install, select the proper operating system and press Enter.

9. A message is displayed: "**Full Recovery:**". Press Enter to select.

10. On each of the next three windows, press the Y key.

11. Follow the prompts to complete the recovery.

To use the Recovery Repair diskette:

1. Shut down and turn off the computer.

2. Insert the Recovery Repair diskette into the drive, and then turn on the computer.

3. Follow the on-screen instructions.

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).

If any of these passwords has been set, a prompt for it appears on the screen whenever the computer is turned on. The computer does not start until the password is entered.

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

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; the system administrator enters both in the same operation. The system administrator then provides the user HDP to the system user.

Attention: If the user HDP has been forgotten, check whether a master HDP has been set. If it has, it can be used for 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, or to 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 get access to 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 system board 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 no SVP has been set:

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

   For how to remove the battery pack, see "1010 Battery pack" on page 60.
3. Remove the backup battery.

   For how to remove the backup battery, see "1020 Backup battery" on page 61.
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 an SVP has been set and is 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. At the Enter Current Password field, enter the SVP.
6. When the Enter New Password field opens, leave it blank and press Enter twice.
7. In the Changes have been saved window, press Enter.

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8. Press F10; then, in the Setup confirmation window, select **Yes** .

How to remove the hard-disk password

Attention: If **User only** mode is selected and the user HDP has been forgotten and cannot be made available to the servicer, IBM does not provide any services to reset the user HDPs or to recover data from the hard-disk drive. The hard-disk drive can be replaced for a scheduled fee.

To remove a user HDP that has been forgotten, when the SVP and the master HDP are 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 **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 do not 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 the 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.

Note: 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.

- If you are using the ACPI operating system and have defined one of the following actions as the event that causes the system to go into hibernation mode, perform that action.
  - Closing the lid.
  - Pressing the power button.
  - Pressing Fn+F4 keys.

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

- If a "hibernation time" has been set on the timer, and the user does not do any operation with the keyboard, the TrackPoint, the hard-disk drive, the parallel connector, or the diskette drive within that time.
- If 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.

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® 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 41.

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 35, and check the power sources.

If an error code appears, go to "Symptom-to-FRU index" on page 49.

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
• Run Normal Test • Run Quick Test • CPU/Coprocessor • Systemboard • Video Adapter • Serial Ports • Parallel Ports • Fixed Disks • Diskette Drives • Other Devices • ZIP Drive • LS-120/240 Drive • Communication • Wireless LAN(*) • Memory Test – Full • Memory Test – Quick	• Keyboard • Video • Internal Speaker • Mouse • Joystick Test • Diskette • System Load • CD-ROM/DVD Test • Stereo Speaker • 802.11 Wireless Radio Test(*)

Notes:
- In the **Keyboard** test in **Interactive Tests**, the Fn key is scanned only once. Each key should be held down for at least 2 seconds; otherwise, it cannot be sensed.
- The sound card is not recognized in the **Stereo Speaker** in the **Interactive Tests**. To test it, use the audio device test in the **Other Devices** in **Diagnostics**.
- **Video Adapter** test supports only the LCD display on ThinkPad. Before running PC-Doctor DOS, detach the external Monitor.
- To test **ZIP Drive** or **LS-120/240 Drive**, each media is needed to be inserted before start testing.
- **Wireless LAN** test and **802.11 Wireless Radio Test** is only for some models. Some models do not have them.
- To test **Digital Signature Chip**, the chip must be enabled and initialized.
- When **Legacy Floppy Drives** is Enabled in the IBM BIOS Setup Utility, **Diskette Drives** test is activated even if no legacy diskette drive is attached to the ThinkPad.

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```
Diagnostics   Interactive Tests   Hardware Info   Utility   Quit   F1=Help
 Run Normal Test
 Run Quick Test
 CPU/Coprocessor
 Systemboard
 Video Adapter
 Serial  Ports
 Parallel  Ports
 Fixed Disks
 Diskette Drives
 Other Devices
 ZIP Drive
 LS-120/240 Drive
 Communication
 Wireless LAN
 Memory Test - Full
 Memory Test - Quick

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Use the cursor keys and ESC to move in menus.  Press ENTER to select.
```

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" on page 36
- "Checking the battery pack" on page 36
- "Checking the backup battery" on page 37

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:

(16 - 10 V)
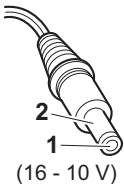
Pin	Voltage (V dc)
1	+15.5 to +17.0
2	Ground

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 41.

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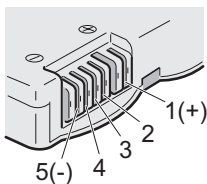
Terminal	Voltage (V dc)
1	+0 to +12.6
5	Ground (–)

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 Ω.

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 60.)
4. Remove the backup battery (see "Checking the battery pack" on page 36.)
5. Measure the voltage of the backup battery. See the following figure.

Red (+)
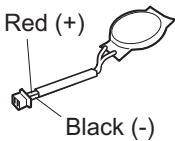
Black (-)

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.

ThinkPad T20, T21, T22 and T23 series

Product overview

This section presents the following product-unique information:
- "Specifications"

Specifications

The following table lists the specifications of the ThinkPad T20, T21, T22 and T23 series :

Feature	Description
Processor	**T20** • Mobile Intel® Pentium® III processor 650 MHz • Mobile Intel® Pentium® III processor 700 MHz • Mobile Intel® Pentium® III processor 750 MHz **T21** • Mobile Intel® Pentium® III processor 750 MHz • Mobile Intel® Pentium® III processor 800 MHz • Mobile Intel® Pentium® III processor 850 MHz **T22** • Mobile Intel® Pentium® III processor 800 MHz • Mobile Intel® Pentium® III processor 900 MHz • Mobile Intel® Pentium® III processor 1 GHz **T23** • Mobile Intel® Pentium® III processor 866 MHz-M • Mobile Intel® Pentium® III processor 1.0 GHz-M • Mobile Intel® Pentium® III processor 1.13 GHz-M • Mobile Intel® Pentium® III processor 1.2 GHz-M
Bus architecture	PCI Bus
Memory (standard)	**T20, T21, T22** • 128 MB (PC100) (on the system board) **T23** • 128 MB (PC133) (on the system board) • 256 MB (PC133) (on the system board)

(continued)

Product overview

Feature	Description
Memory (optional)	**T20, T21, T22** • 64 MB, 128 MB, or 256 MB DIMM card (maximum of 512 MB) **T23** • 64 MB, 128 MB, 256 MB, or 512 MB DIMM card (maximum of 1024 MB)
CMOS RAM	242 bytes
Display	**T20** • 13.3-inch, 16M colors, XGA (1024×768 resolution) TFT color LCD • 14.1-inch, 16M colors, XGA (1024×768 resolution) TFT color LCD **T21, T22, T23** • 13.3-inch, 16M colors, XGA (1024×768 resolution) TFT color LCD • 14.1-inch, 16M colors, XGA (1024×768 resolution) TFT color LCD • 14.1-inch, 16M colors, SXGA+ (1400×1050 resolution) TFT color LCD
Hard-disk drive	**T20** • 6.0 GB, 2.5-inch, IDE interface • 12.0 GB, 2.5-inch, IDE interface • 18.0 GB, 2.5-inch, IDE interface • 20.0 GB, 2.5-inch, IDE interface **T21, T22** • 10.0 GB, 2.5-inch, IDE interface • 20.0 GB, 2.5-inch, IDE interface • 32.0 GB, 2.5-inch, IDE interface **T23** • 15.0 GB, 2.5-inch, IDE interface • 20.0 GB, 2.5-inch, IDE interface • 30.0 GB, 2.5-inch, IDE interface • 40.0 GB, 2.5-inch, IDE interface • 48.0 GB, 2.5-inch, IDE interface • 60.0 GB, 2.5-inch, IDE interface
I/O port	• External monitor • Line-in • Headphone • Microphone • Mouse or keyboard • Parallel or diskette drive • Port replicator connector • Serial • One universal serial bus (USB) connector for T20, T21, and T22 series • Two USB connectors for T23 • RJ11 • RJ45 (covered) • TV-out

(continued)

Feature	Description
Internal modem	56.6 Kbps
Audio	• Internal microphone • Internal speaker • Software control volume
Infrared transfer	IrDA 1.1
802.11b (only for T23 series)	Mini PCI Type-IIIa IEEE 802.11b wireless LAN card
PC Card	One Type-III or two Type-II
AC adapter	72-watt type
Bay device	**T20** • 1.44 MB (3-mode), 3.5-inch diskette drive • 10-24x CD-ROM drive • 6x DVD-ROM drive **T21, T22, T23** • 1.44 MB (3-mode), 3.5-inch diskette drive • 10-24x CD-ROM drive • 8x DVD-ROM drive • CD-RW drive • DVD/CD-RW combo drive

Status indicators

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

Indicator	Meaning	
1 Drive in use	**Green:**	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.
	Note: Do not move the system while the Green drive in use light is on. Sudden physical shock could cause drive errors.	
2 Num lock	**Green:**	The numeric keypad on the keyboard is enabled. To enable or disable the keypad, press and hold the Fn key while pressing the NumLk key.
3 Caps lock	**Green:**	Caps Lock mode is enabled. To enable or disable Caps Lock mode, press Fn + Caps Lock key.

(continued)

Indicator	Meaning	
4 Scroll lock	**Green:**	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 Fn + ScrLk key. Not all application programs support this function.
5 Power on	**Green:**	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.
6 Battery	**Green:**	The battery is fully charged.
	Blinking green:	The battery has enough power to operate, but is being charged.
	Orange:	The battery power is low. The battery needs to be charged.
	Blinking orange:	The battery needs to be charged when the indicator starts blinking orange, the computer beeps three times.
7 Standby status	**Green:**	The computer is in standby mode.
	Blinking green:	The computer is entering standby mode or hibernation mode, or is resuming normal operation. This indicator does not blink in Windows 2000, Windows Me, and Windows XP.
8 Ultrabay status	**Green:**	An Ultrabay 2000 device is installed and in use.
	Blinking green:	An Ultrabay 2000 device is in the process of being detached.
	Turn off:	An Ultrabay 2000 device is ready to be attached or detached.
	Note: If you are using Windows 2000 or Windows XP, 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.	

FRU Tests

The following table shows the test for each FRU.

FRU	Applicable test
System board	1. **Diagnostics --> CPU/Coprocessor** 2. **Diagnostics --> Systemboard**
Power	**Diagnostics --> Other Devices --> IBM AC Adapter, IBM Battery 1 (IBM Battery 2)**
LCD unit	1. **Diagnostics --> Video Adapter** 2. **Interactive Tests --> Video**

Modem	1. Make sure the modem is set up correctly.
	2. Replace the modem jack and the modem card in turn, and run the following test in **Diagnostics --> Communication**:
	  a. Lucent Modem (M2) Loopback
	  b. Lucent Modem (M2) Dialtone/DTM
	  c. Lucent Soft Modem Loopback (T23 only)
	  d. Lucent Soft Modem Dialtone (T23 only)
	  e. Intel Modem Register
	  f. Intel Modem Loopback/DTMF
	  g. Intel SP Modem Register
	  h. Intel SP Modem Loopback/DTMF
	  i. 3Com MiniPCI Modem Test
	  j. 3Com MiniPCI Dialtone Test

Audio	1. **Interactive Tests --> Internal Speaker** 2. **Diagnostics --> Other Devices --> Crystal SoundFusion™ Test**
Speaker	**Interactive Tests --> Internal Speaker**
PC Card slots	**Diagnostics --> Systemboard --> PCMCIA, PCMCIA External Loop**
Keyboard	1. **Diagnostics --> Systemboard --> Keyboard** 2. **Interactive Tests --> Keyboard**
TrackPoint or pointing device	If the TrackPoint does not work, check the configuration in the ThinkPad Configuration program. If the TrackPoint is disabled, select **Enable** to enable it. 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. If enabling the TrackPoint does not correct the problem, continue with the following: • **Interactive Tests --> Mouse**
Hard-disk drive	**Diagnostics --> Fixed Disks**

(continued)

FRU	Applicable test
Diskette drive	1. **Diagnostics --> Diskette Drives** 2. **Interactive Tests --> Diskette**
CD-ROM, DVD, CD-RW or CD-RW/DVD combo drive	1. **Diagnostics --> Other Devices --> CD-ROM/DVD** 2. **Interactive Tests --> CD-ROM/DVD Test**
Memory	1. If two DIMMs are installed, remove one of them and run **Diagnostics --> Memory Test - Quick**. 2. If the problem does not recur, return the DIMM to its place, remove the other one, and run the test again. 3. If the test does not detect the error, run **Diagnostics --> Memory Test - Full**.
Fan	1. Turn on the computer and check the air turbulence at the louver near the power switch. 2. Run **Diagnostics --> Other Devices --> IBM Fan**.

Fn key combinations

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

Key combination	Description
Fn+F1	Reserved.
Fn+F2	Reserved.
Fn+F3	Turn off the LCD display, leaving the screen blank. To turn the LCD display on again, press any key or the TrackPoint stick. **Note:** To use Fn+F3 for screen blank in Windows 2000 and Windows XP, you must have IBM PM device driver installed on your computer.
Fn+F4	Turn standby mode on. To return to normal operation, press the Fn key independently, without pressing a function key.
Fn+F5	Reserved.
Fn+F6	Reserved.
Fn+F7	Switch between the LCD and an external monitor (CRT). If an external monitor is attached, computer output is displayed in the following three patterns by turns: • CRT display • LCD+CRT display • LCD
Fn+F8	Turn screen expansion on or off. (There is no symbol on the key.) **Note:** This function is not supported in Windows 2000 and Windows XP.
Fn+F9	Reserved.
Fn+F10	Reserved.
Fn+F11	Reserved.
Fn+F12	Turn hibernation mode on. To return to normal operation, press the power button for less than four seconds. **Note:** To use Fn+F12 for hibernation in Windows 2000 and Windows XP, you must have IBM PM device driver installed on your computer.
Fn+PgUp	Turn the ThinkLight on or off.
Fn+Home	The LCD becomes brighter.
Fn+End	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 55.

- **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
0175 Bad CRC1, stop POST task—The EEPROM checksum is not correct.	**System board**.
0187 EAIA data access error—The access to EEPROM is failed.	**System board**.
0188 Invalid RFID serialization information area or bad CRC2—The EEPROM checksum is not correct.	**System board**.
0189 Invalid RFID configuration information area—The EEPROM checksum is not correct.	**System board**.
0190 Critical low-battery error	1. **Charge the battery pack**. 2. Battery pack.

Symptom or error	FRU or action, in sequence
0193 RF antenna has been removed	**Enter the supervisor password**.
0194 The computer has been carried through a security gate	**Enter the supervisor password**.
0195 Security hardware tamper detected	1. **Enter IBM BIOS Setup Utility by entering supervisor password, and select "Password" --> "IBM Security Chip" --> "Clear IBM Security Chip" to clear this error**. 2. Security chip. 3. System board.
0196 Security hardware removed	1. **Enter IBM BIOS Setup Utility by entering supervisor password, and select "Password" --> "IBM Security Chip" --> "Clear IBM Security Chip" to clear this error**. 2. Security chip. 3. System board.
0197 Invalid remote change requested	**The remote configuration for the security chip has failed. Confirm the operation and try again.**
01C9 More than one Ethernet devices are found. Remove one of them. Press <Esc> to continue.	1. **Remove the Ethernet device that you installed; or press Esc to ignore the warning message**. 2. System board.
0200 Hard disk error—The hard disk is not working.	1. **Reseat the hard-disk drive**. 2. Load Setup Defaults in IBM BIOS Setup Utility. 3. Hard-disk drive. 4. System board.
021x Keyboard error	**Run interactive tests of the keyboard and the auxiliary input device**.
0220 Monitor type error—Monitor type does not match the one specified in CMOS.	**Load Setup Defaults in IBM BIOS Setup Utility.**
0230 Shadow RAM error—Shadow RAM fails at offset nnnn.	**System board**.
0231 System RAM error—System RAM fails at offset nnnn.	1. **DIMM**. 2. System board.

Symptom or error	FRU or action, in sequence
0232 Extended RAM error—Extended RAM fails at offset nnnn.	1. **DIMM**. 2. System board.
0250 System battery error—System battery is dead.	**Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date**.
0251 System CMOS checksum bad—Default configuration used.	**Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date**.
0252 Password checksum bad—The password is cleared.	**Reset the password by running IBM BIOS Setup Utility.**
0260 System timer error	1. **Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date**. 2. System board.
0270 Real time clock error	1. **Replace the backup battery and run IBM BIOS Setup Utility to reset the time and date**. 2. System board.
0271 Date and time error—Neither the date nor the time is set in the computer.	**Run IBM BIOS Setup Utility to reset the time and date**.
02B2 Incorrect drive A type	1. **Diskette drive**. 2. External FDD cable. 3. I/O card.
02F4 EISA CMOS not writable	1. **Load Setup Defaults in IBM BIOS Setup Utility**. 2. Replace the backup battery. 3. System board.
02F5 DMA test failed	1. **DIMM**. 2. System board.
02F6 Software NMI failed	1. **DIMM**. 2. System board.
02F7 Fail-safe timer NMI failed	1. **DIMM**. 2. System board.

Error messages

Symptom or error	FRU or action, in sequence
Device address conflict.	1. **Load "Setup Defaults" in IBM BIOS Setup Utility**. 2. Backup battery. 3. System board.
Allocation error for device.	1. **Load "Setup Defaults" in IBM BIOS Setup Utility**. 2. Backup battery. 3. System board.
Failing bits: nnnn.	1. **DIMM**. 2. System board.
Invalid system configuration data.	1. **DIMM**. 2. System board.
I/O device IRQ conflict.	1. **Load "Setup Defaults" in IBM BIOS Setup Utility**. 2. Backup battery. 3. System board.
Operating system not found.	1. Check that the operating system has no failure and is installed correctly. 2. **Enter IBM BIOS Setup Utility and see whether the hard-disk drive and the diskette drive are properly identified**. 3. Reseat the hard-disk drive. 4. Reinstall the operating system. 5. Diskette drive. 6. Hard-disk drive. 7. System board.
Hibernation error.	1. **Restore the system configuration to what it was before the computer entered hibernation mode**. 2. If memory size has been changed, re-create the hibernation file.
Fan error.	**Fan**.
Thermal sensing error.	**System board**.

Beep symptoms

Symptom or error	FRU or action, in sequence
One beep and a blank, unreadable, or flashing LCD.	1. **Reseat the LCD connector**. 2. LCD assembly. 3. External CRT. 4. System board.
One long and two short beeps, and a blank or unreadable LCD.	1. **System board**. 2. LCD assembly. 3. DIMM.
Two short beeps with error codes.	**POST error. See "Numeric error codes" on page 49.**
Two short beeps and a blank screen.	1. **System board**. 2. DIMM.
Two or more beeps, or a continuous beep. Operating system starts successfully.	If a mini-PCI Ethernet card is installed, confirm that **Alert On LAN 2** in IBM BIOS Setup Utility is **disabled**.
Three short beeps, pause, three more short beeps, and one short beep.	1. **DIMM**. 2. System board
One short beep, pause, three short beeps, pause, three more short beeps, and one short beep.	
Only cursor appears.	**Reinstall operating system**.

No-beep symptoms

Symptom or error	FRU or action, in sequence
No beep, power-on indicator on, LCD blank, and no POST.	1. **Make sure that every connector is connected tightly and correctly**. 2. DIMM. 3. System board.
No beep, power-on indicator on, and LCD blank during POST.	1. **Reseat DIMM**. 2. System board.
The power-on password prompt appears.	A power-on password or a supervisor password is set. Type the password and press **Enter**.
The hard-disk password prompt appears.	A hard-disk password is set. Type the password and press **Enter**.
The DOS full screen looks smaller.	Start the ThinkPad Configuration program and set the **Screen expansion** 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 means a pixel is always on
>   (white or color.) A dark dot means a pixel is
>   always off (black color.)

Symptom or error	FRU or action, in sequence
No beep, power-on indicator on, and a blank LCD during POST.	**System board**.
• LCD backlight not working. • LCD too dark. • LCD brightness cannot be adjusted. • LCD contrast cannot be adjusted.	1. **Reseat the LCD connectors**. 2. LCD assembly. 3. System board.
• LCD screen unreadable. • Characters missing pixels. • Screen abnormal. • Wrong color displayed.	1. **See important note for "LCD-related symptoms."** 2. Reseat all LCD connectors. 3. LCD assembly. 4. System board.
Horizontal or vertical lines displayed on LCD.	**LCD assembly**.

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 35.)
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 Ultrabay
    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 167) 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:

  90 degrees more

  (Cross-section)
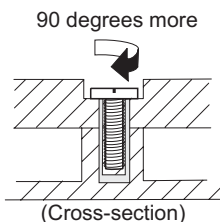
- **Logic card to plastic**

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

  180 degrees more

  (Cross-section)
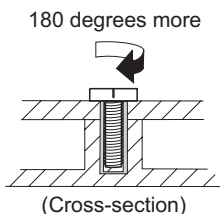
- **Torque driver**

  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 1.62, 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 1.62 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 1.62, 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 directions and drawings for use in removing and replacing a FRU. Be sure to observe the following general rules:

1. Do not try to service any 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 56.

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 140.

8. When replacing a FRU, use the correct screw as shown in the procedures.

⚠ DANGER

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.

Attention: Before the computer is powered on after FRU replacement, make sure that 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. Before touching it, establish personal grounding by touching a ground point with one hand or by using an electrostatic discharge (ESD) strap (P/N 6405959).

ThinkPad T20, T21, T22 and T23 series **59**

1010 Battery pack

⚠ DANGER

> **Use only the battery in the parts listing for your computer. Use of an incorrect battery can result in ignition or explosion of the battery.**
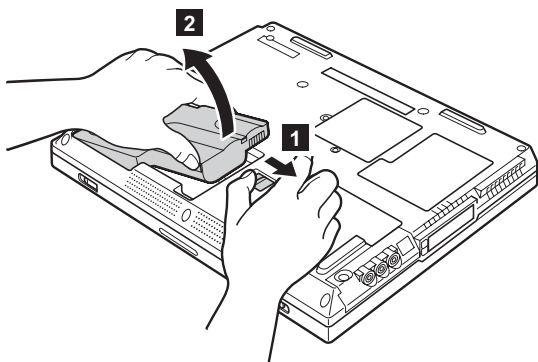
1020 Backup battery

⚠ DANGER

Use only the battery in the parts listing for your computer. Use of an incorrect battery can result in ignition or explosion of the battery.

For access, remove this FRU:
- "1010 Battery pack" on page 60
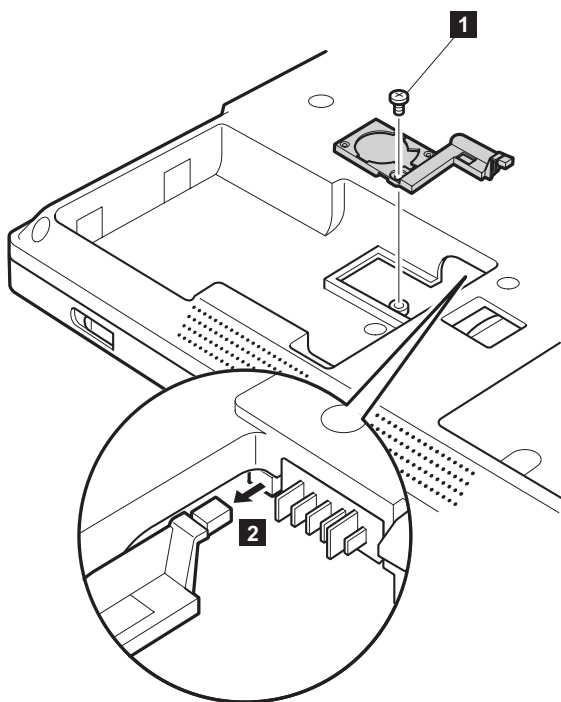
Step	Screw (quantity)	Torque
1	M2.5 × 3.5 mm, (1)	0.392 Nm (4 kgfcm)

(continued)

Cable routing: When attaching the backup battery to the holder, route the battery cable as in the following figure.
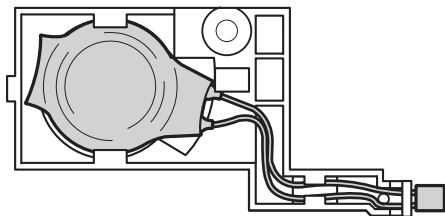
1030 Hard-disk drive

> **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.

For access, remove this FRU:

- "1010 Battery pack" on page 60
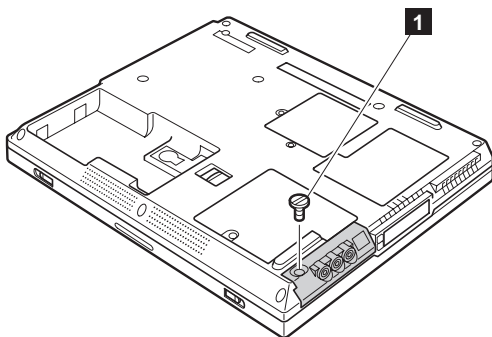
Note: The hard disk is attached to the cover.

Step	Screw (quantity)
1	Coin screw (1) or security screw (1)
Note: 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.
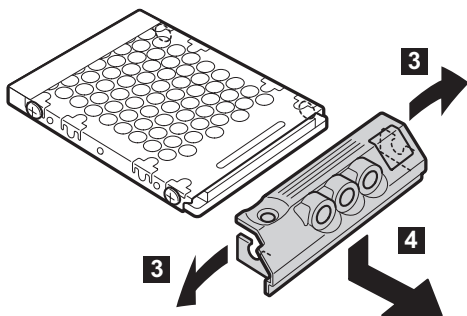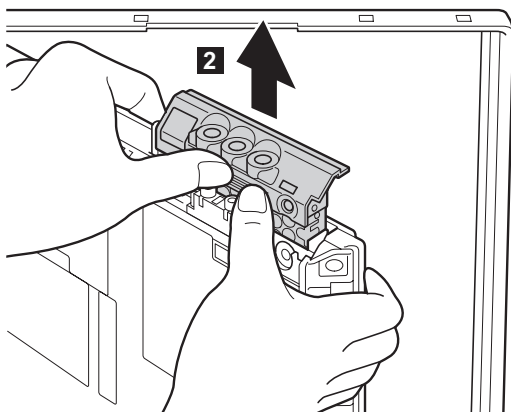
When installing: Make sure that the HDD connector is firmly connected.

1040 DIMM

For access, remove this FRU:
- "1010 Battery pack" on page 60

Note: Loosen the screw **1**, but do not remove it.
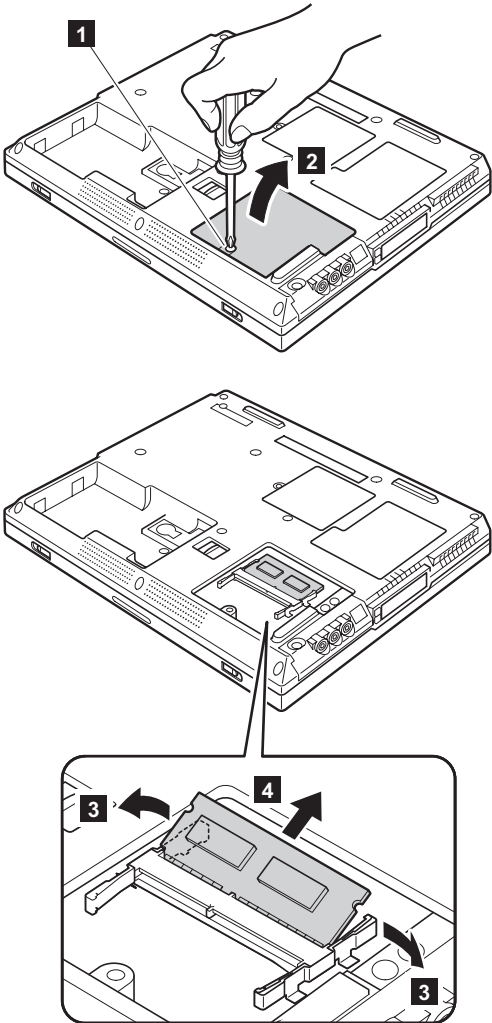
When installing: With the notched end of the DIMM
toward the socket, insert the DIMM into
the socket, and then press it firmly. Pivot
the DIMM until it snaps into place. Make
sure that the card is firmly fixed in the
slot and does not move easily.

1050 Mini PCI adapter

For access, remove this FRU:
• "1010 Battery pack" on page 60

For T20, T21 and T22 series

Note: Loosen the screw 1 , but do not remove it.
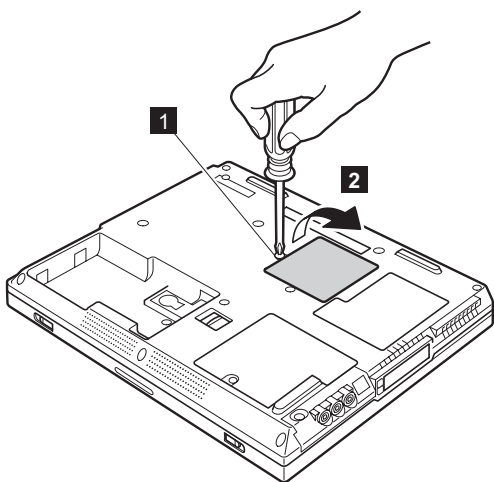
(continued)

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 **6** . This slot also supports a Mini PCI modem card or Mini PCI network card.
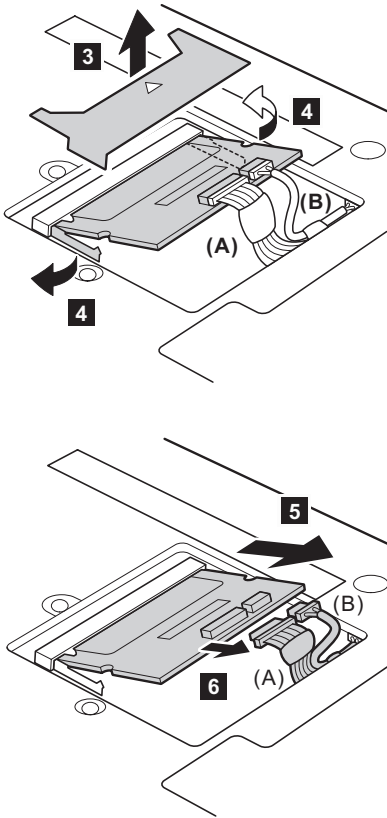
(continued)

When installing: Make sure not to pinch the connector cable when re-installing the Mini PCI adapter.
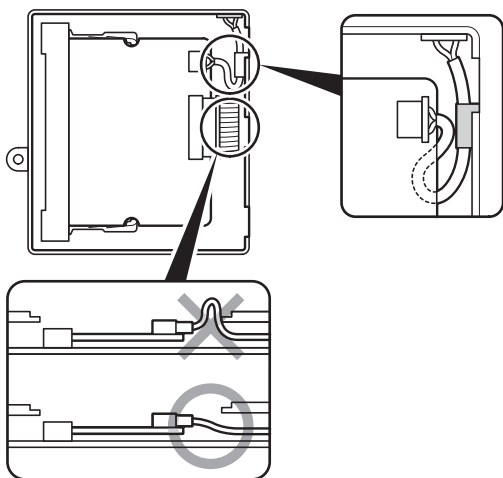
For T23 series

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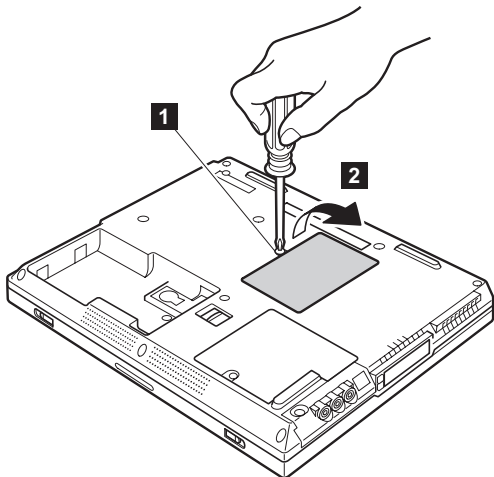
(continued)

In step **3a** and **3b** , pull the tab of the each antenna cables to unplug the cables.
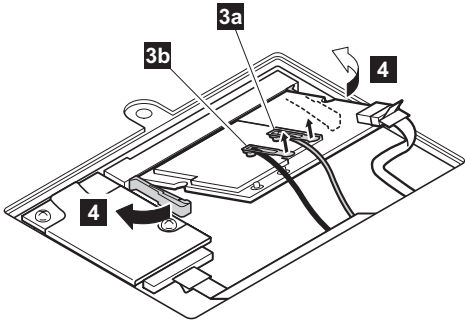
When installing: Plug the gray antenna cable **3a** into jack *J1* (MAIN), and the black antenna cable **3b** into jack *J2* (AUX).
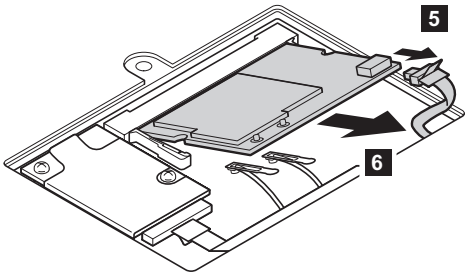
When installing: With the notched end of the card toward the socket, insert the card into the socket, and then press it firmly. Pivot the card until it snaps into place. Make sure that the card is firmly fixed in the slot and does not move easily.

1060 Ethernet daughter card

> **Note**
>
> This section is only for the following models of T23 series;
> - All models of MT2647 excepting xQx, L4x
> - All models of MT2648
>
> Other models do not have the Ethernet daughter card (EDC).

For access, remove this FRU:
- "1010 Battery pack" on page 60

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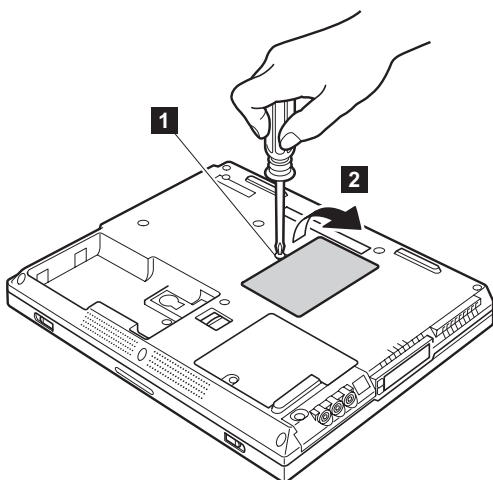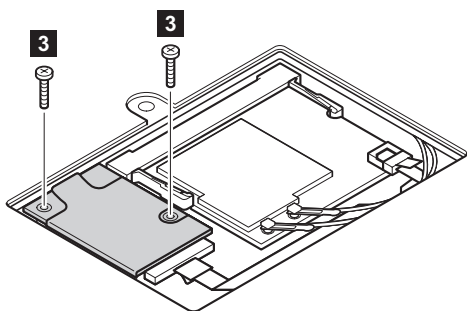
(continued)

Step	Screw (quantity)	Torque
3	M2.5 × 11.5 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

(continued)
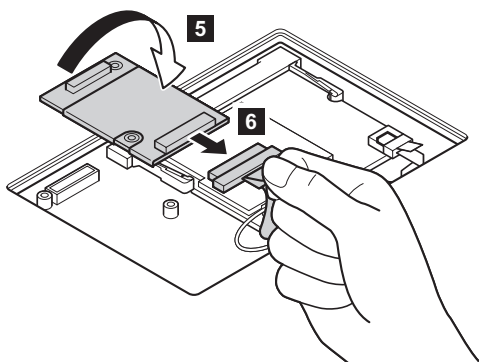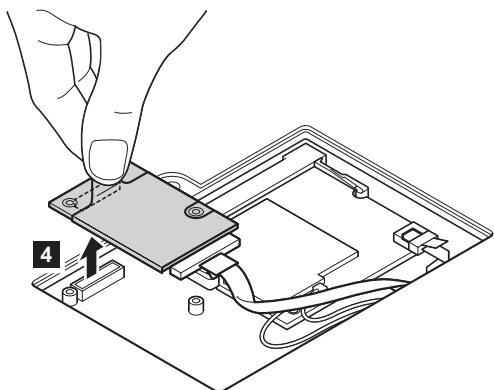
When installing: Make sure that both of the connectors
4 and 6 are firmly attached.

1070 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.

Ultrabay 2000 also supports Ultrabay Plus device, such as Ultrabay Plus carrier.

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.
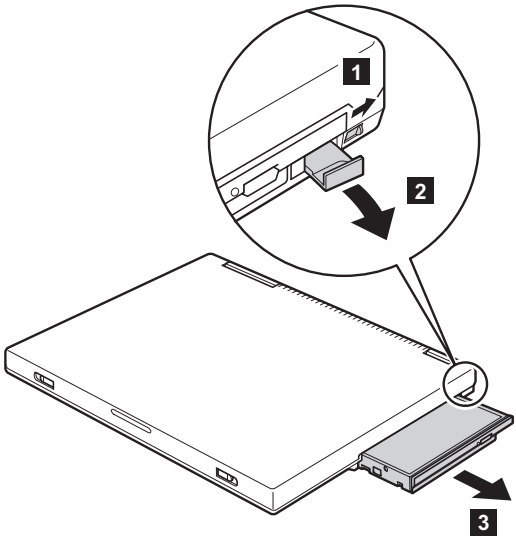
1080 Keyboard

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73

For T20, T21 and T22 series
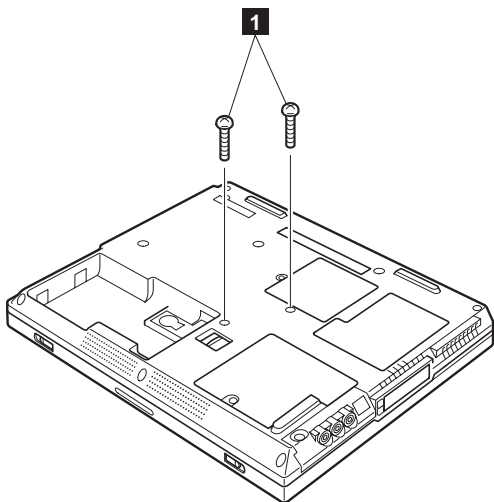
Step	Screw (quantity)	Torque
1	M2.5 × 14 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

Note: T20, T21 and T22 series do not have the removal procedures 2 to 4 . After step 1 , go to step 5 .

(continued)

For T23 series

Note: Loosen the screw `2`, but do not remove it.
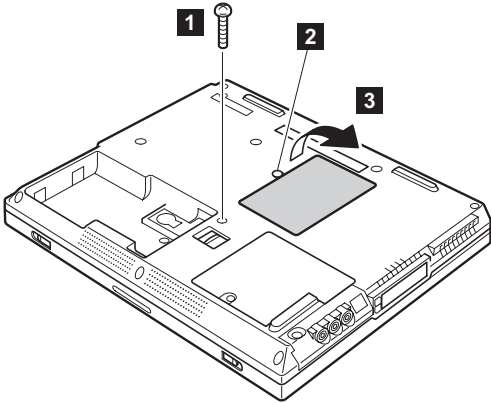
Step	Screw (quantity)	Torque
`1`	M2.5 × 14 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)
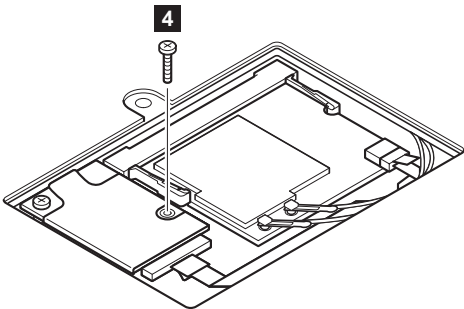
Step	Screw (quantity)	Torque
`4`	M2.5 × 11.5 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

(continued)

Note: Step 5 to 10 are common for all models.
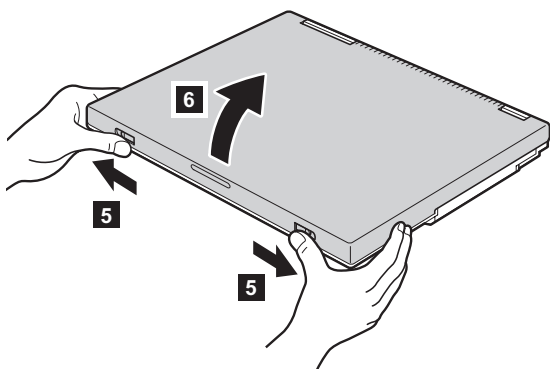
(continued)
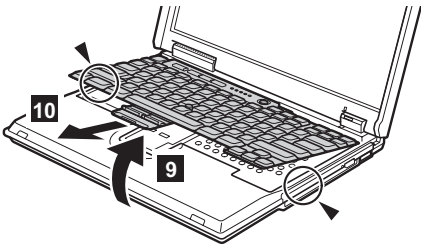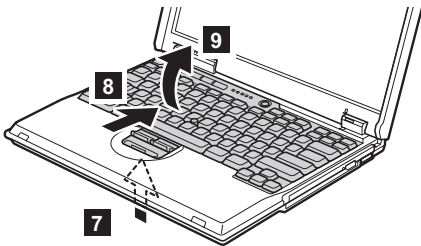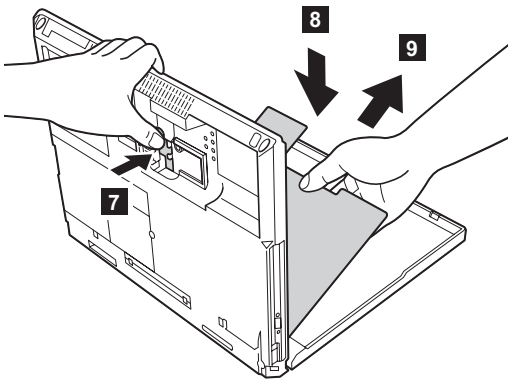
(continued)

Note: Before installing a new keyboard, attach the easy-button cover as follows:
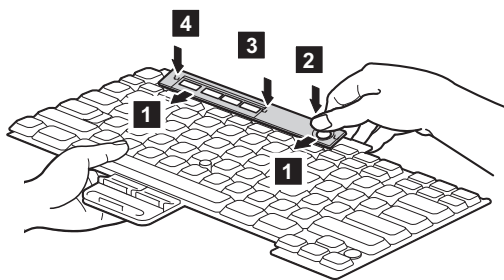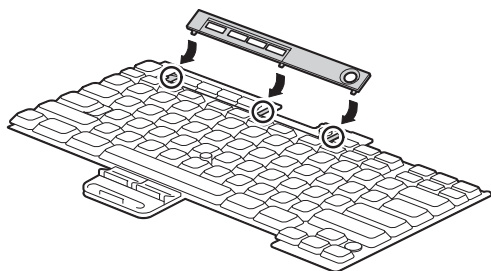
(continued)

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.
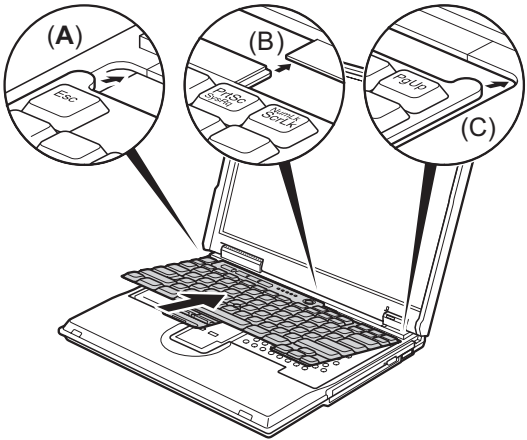
(continued)

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** .
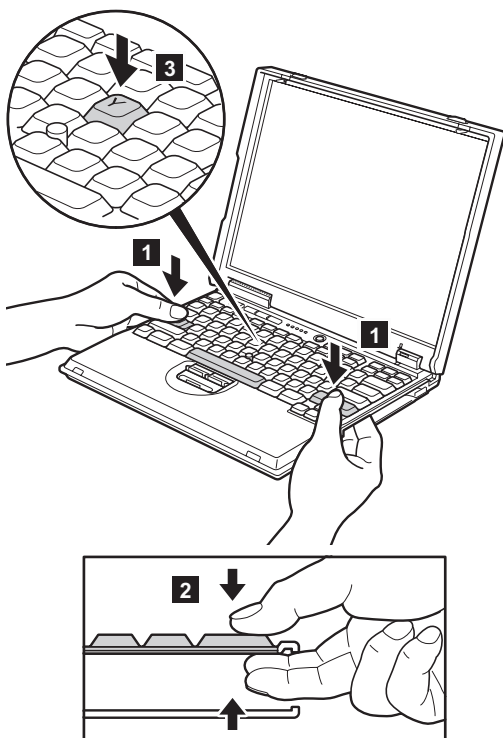
(continued)

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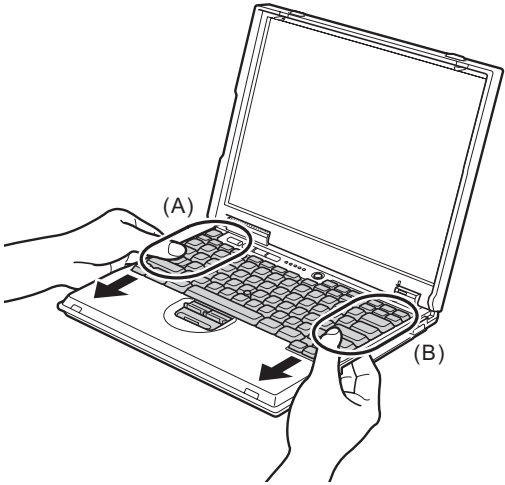
4. Replace the screws, using the new screws provided with the keyboard. **Then press the Y key again, hard, to make sure that the keyboard is firmly connected.**

1090 Keyboard CRU insulator

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74

Note: The shape of the keyboard CRU insulator varies from model to model. In some models, the shape might be slightly different from the insulator in this figure.
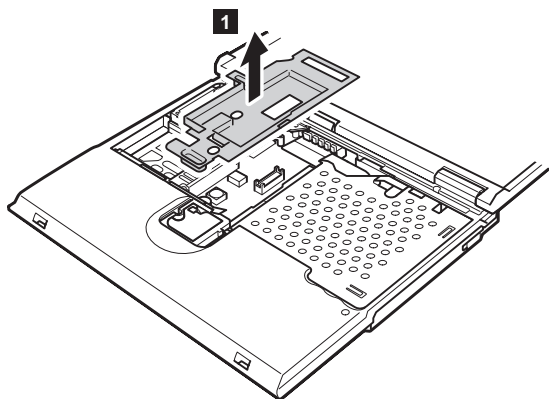
1100 Hinge cover

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82

Note: Step **1** is common for all models.
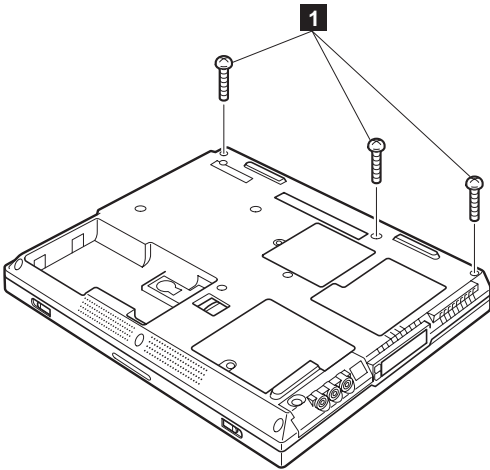
Step	Screw (quantity)	Torque
1	M2.5 × 14 mm, nylon-coated (3)	0.392 Nm (4 kgfcm)

(continued)

For T20 and T21 series
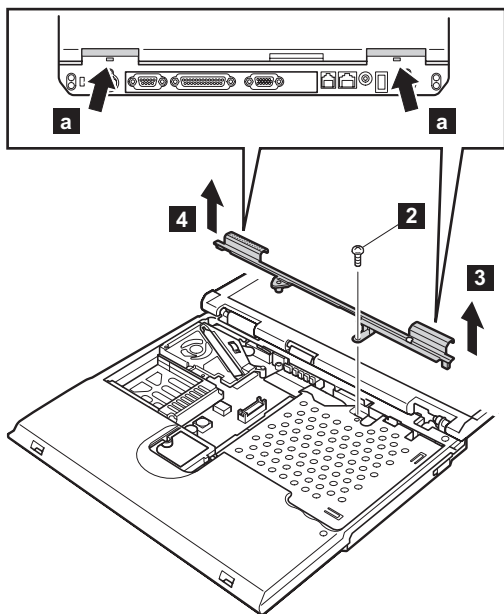
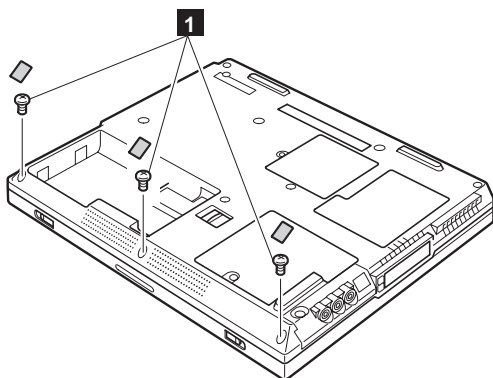| Step	Screw (quantity)	Torque
2	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

When installing:
1. Install the hinge cover according to the step 3 , 4 and then tighten the screw 2 . In step 3 , take care not to damage the lens.
2. Make sure that both latches a are firmly attached and snap into place.

For T22 series
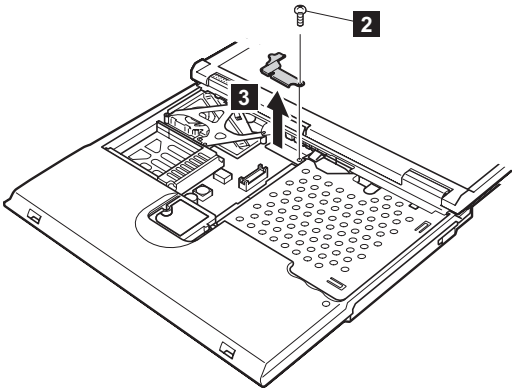
Step	Screw (quantity)	Torque
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
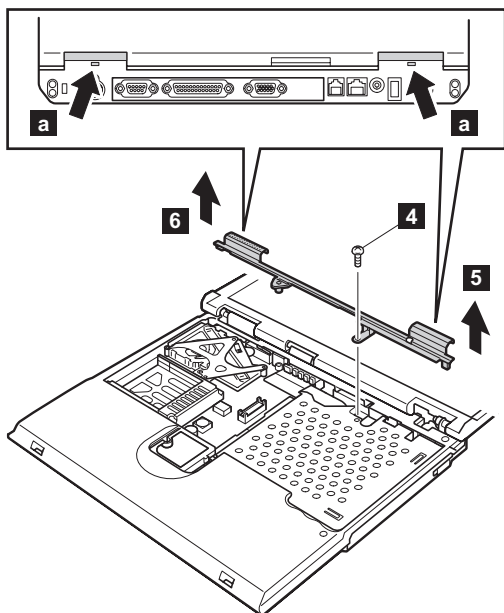
(continued)

Step	Screw (quantity)	Torque
4	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

When installing:

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

For T23 series
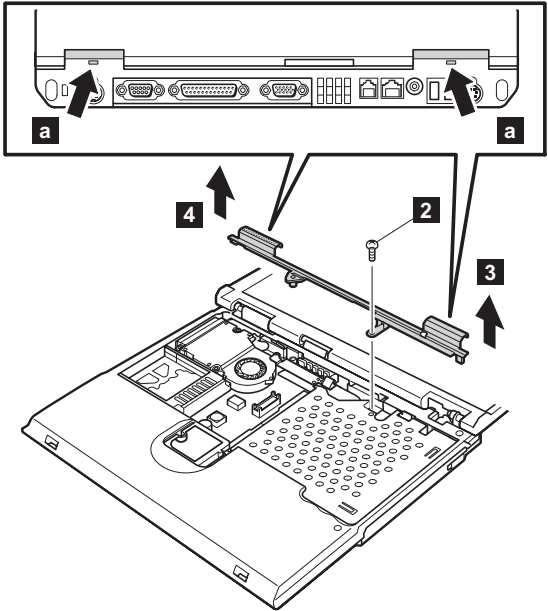
Step	Screw (quantity)	Torque
2	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

When installing:
1. Install the hinge cover according to the step 3 , 4 and then tighten the screw 2 . In step 3 , take care not to damage the lens.
2. Make sure that both latches a are firmly attached and snap into place.

1110 Keyboard bezel

For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83

For T20, T21 and T22 series

Step	Screw (quantity)	Torque
1	M2.5 × 3.5 mm, nylon-coated (3)	0.392 Nm (4 kgfcm)

(continued)

Step	Screw (quantity)	Torque
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
3	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

(continued)

For T23 series
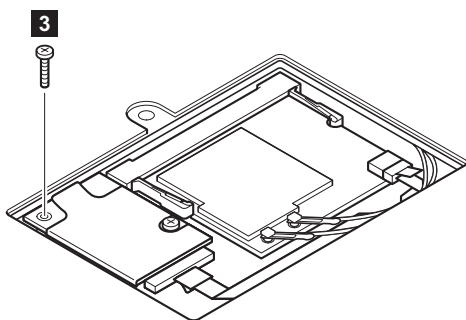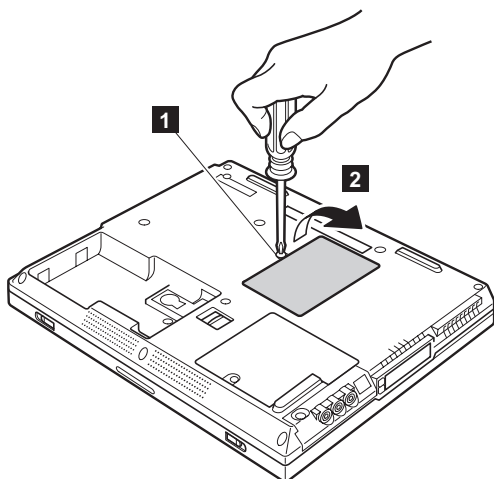
Note: Loosen the screw ∎1∎ , but do not remove it.

Step	Screw (quantity)	Torque
∎3∎	M2.5 × 11.5 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
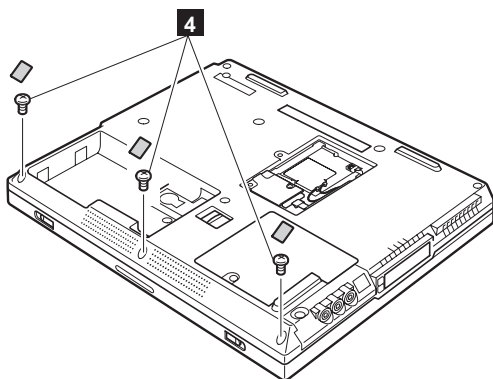
(continued)

Step	Screw (quantity)	Torque
4	M2.5 × 3.5 mm, nylon-coated (3)	0.392 Nm (4 kgfcm)

(continued)
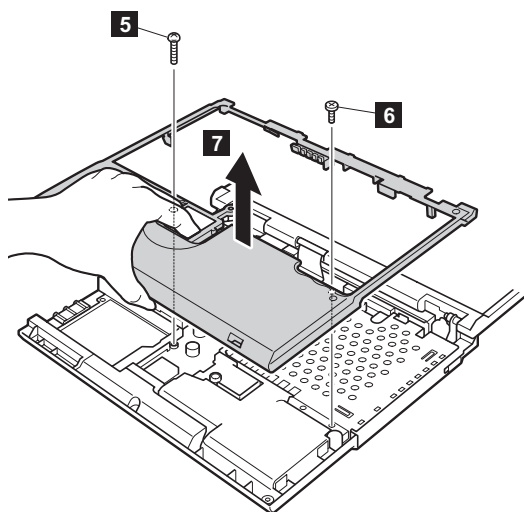
Step	Screw (quantity)	Torque
5	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
6	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

When installing, do as follows:

- Make sure that the **a** -part is firmly attached as shown in the figure.
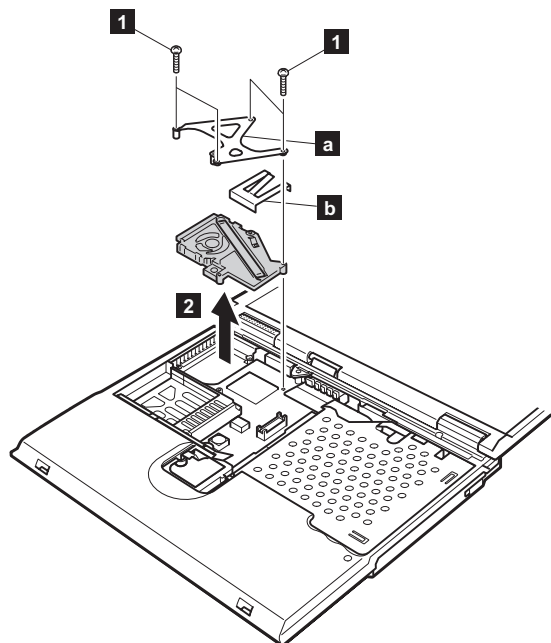- Make sure that all of the latches of the keyboard bezel **b** are firmly attached.
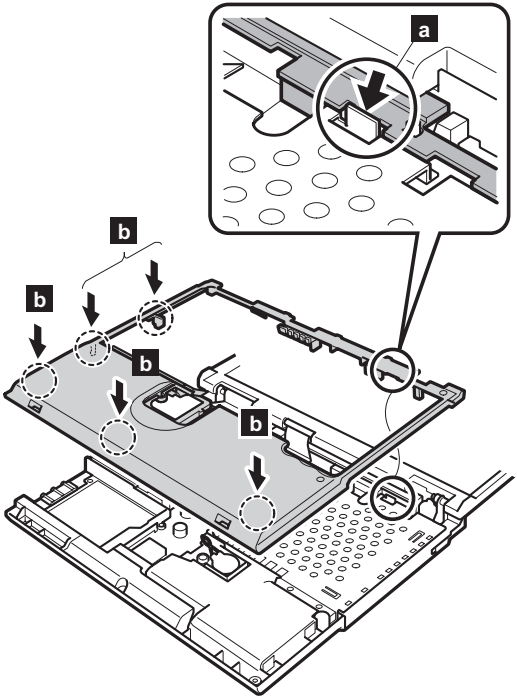
1120 Fan assembly

For T20, T21, T22 series
For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82

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.
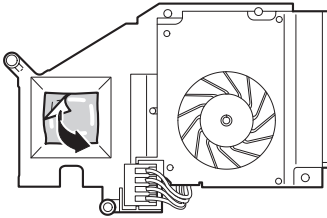
Step	Screw (quantity)	Torque
1	M2 × 13.5 mm, nylon-coated (4)	0.245 Nm (2.5 kgfcm)

(continued)
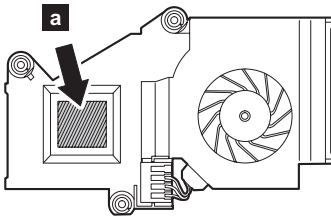
When installing the fan assembly:

For T20

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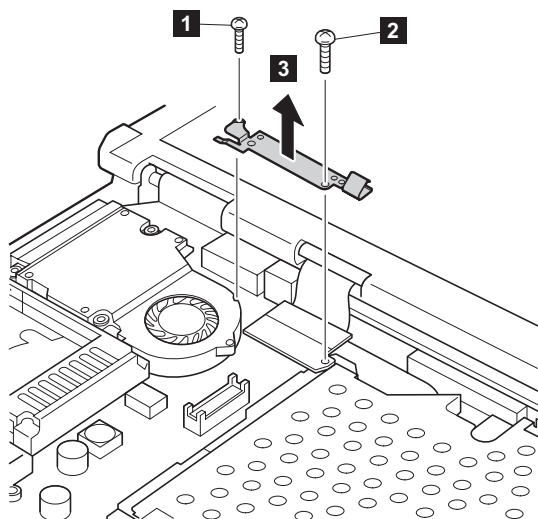

For T21, T22

Apply the thermal grease (05K5751) on the **a** -part of the fan as shown in the following figure.
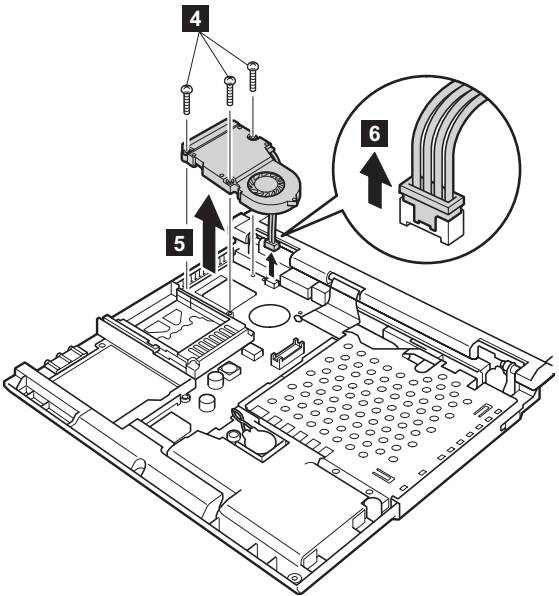
For T23 series

For access, remove these FRUs, in order:

Step	Screw (quantity)	Torque
1	M2 × 13.5 mm, nylon-coated (1)	0.245 Nm (2.5 kgfcm)
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

(continued)

Step	Screw (quantity)	Torque
4	M2.0 × 13.5 mm, nylon-coated (3)	0.245 Nm (2.5 kgfcm)

When installing: Apply the thermal grease (05K5751) on the **a** -part of the fan as shown in the following figure.
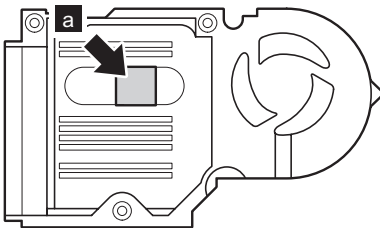
1130 CPU

For access, remove these FRUs, in order:

For T20, T21 and T22 series

Rotate the the head of the screw (**A**) to the direction of the arrow **a** to release the lock and then remove the CPU.
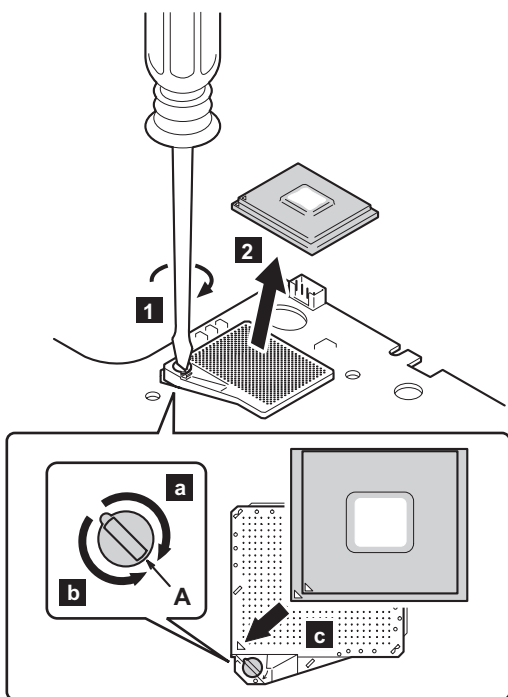
When installing:

1. When attaching the CPU to the socket, do as shown in the step **c** .
2. Rotate the head of the screw (**A**) to the direction of the arrow **b** to lock the CPU.

For T23 series

Note: The shape of the CPU socket vary from model to model. When removing or installing the CPU, confirm the shape of the CPU socket and do either steps `1`, `2` and `a` or steps `1'`, `2` and `a'`.

Rotate the head of the screw to the direction of the arrow `1` or `1'` to release the lock and then remove the CPU.
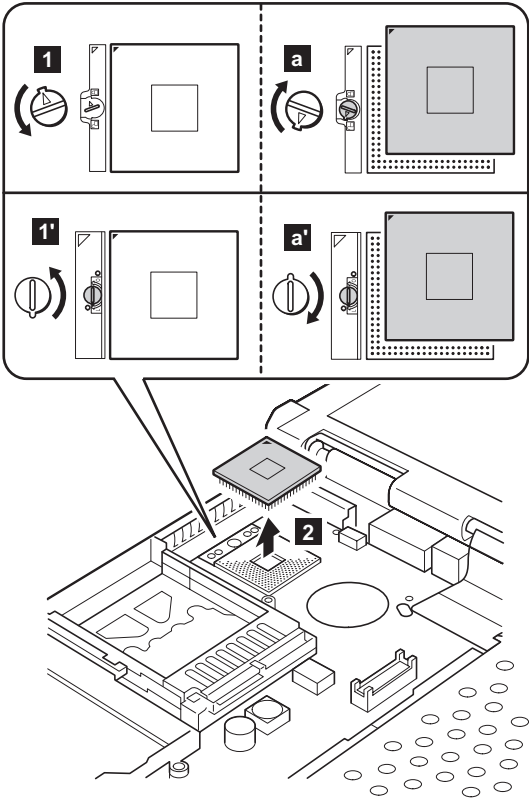
When installing: Rotate the head of the screw to the direction of the arrow `a` or `a'` to lock the CPU.

1140 PC Card slot assembly

For T20, T21, T22 series
For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
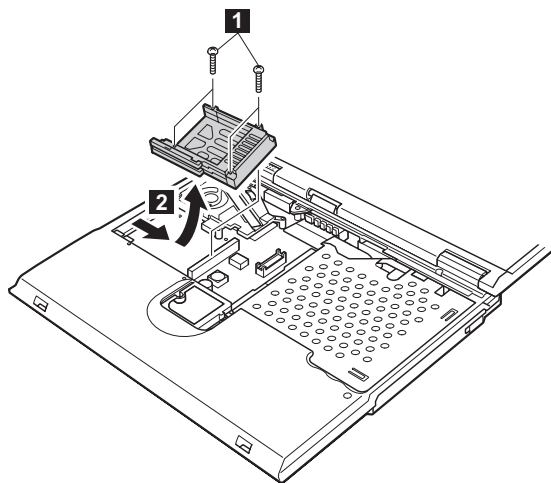
Step	Screw (quantity)	Torque
1	M2 x 13.5 mm, nylon-coated (4)	0.245 Nm (2.5 kgfcm)

(continued)

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

For T23 series

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
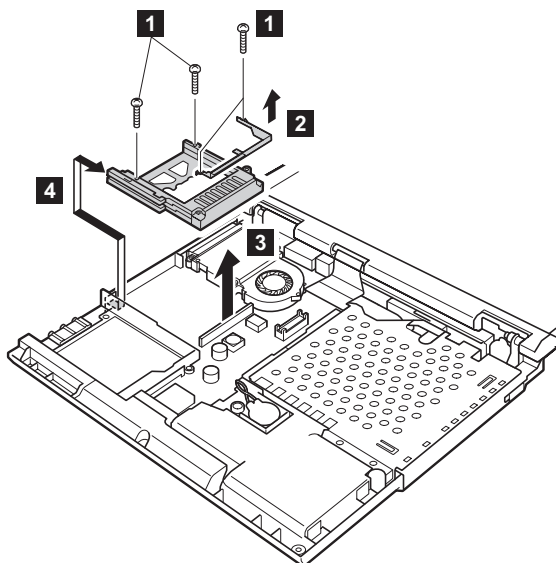
Step	Screw (quantity)	Torque
1	M2 × 13.5 mm, nylon-coated (4)	0.245 Nm (2.5 kgfcm)

1150 Speaker

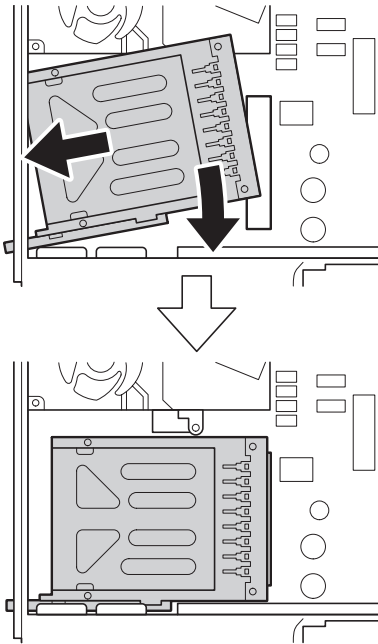For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
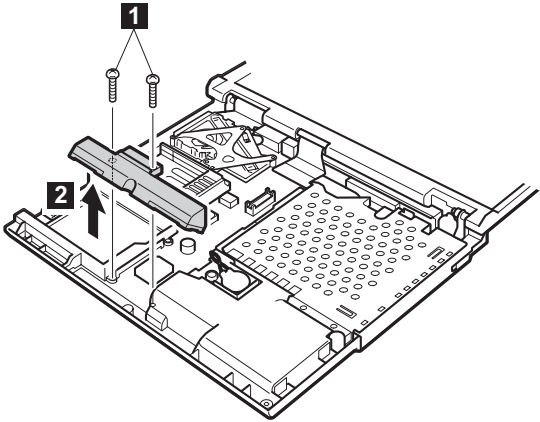
Step	Screw (quantity)	Torque
1	M2.5 × 14 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

Before installing new speaker for T22 and T23 series:
Secure speaker RF bracket (a) to the new speaker with
an adhesive tape inside of the bracket.

For T22 series
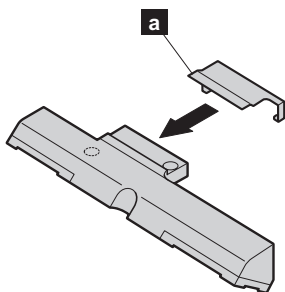
For T23 series
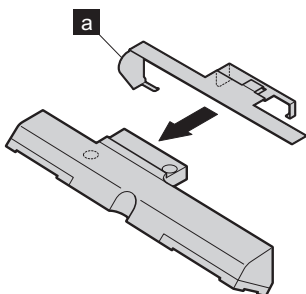
1160 Hard-disk bay

For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
- "1150 Speaker" on page 103

Note: Step **3** and **4** are only for the case when Asset ID RF adapter has been attached into the hard-disk bay.
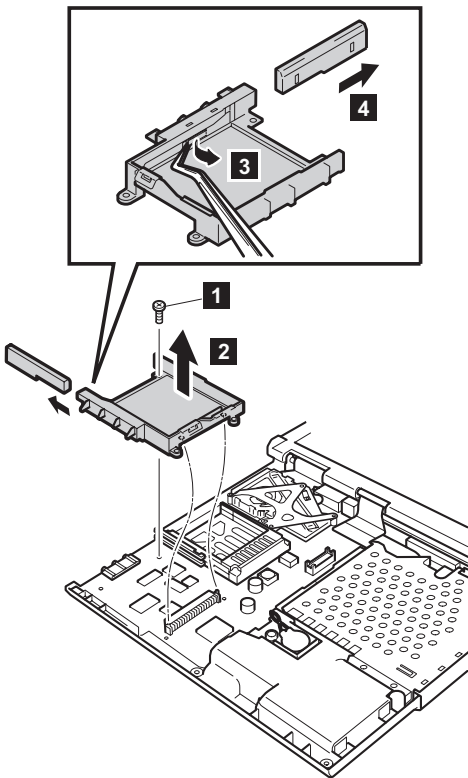
Step	Screw (quantity)	Torque
1	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

When installing: Make sure the followings:

- **a** -parts of the insulation do not come off.
- **b** -part (**b'** s are only for T23 series) is not turned over.
- 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.
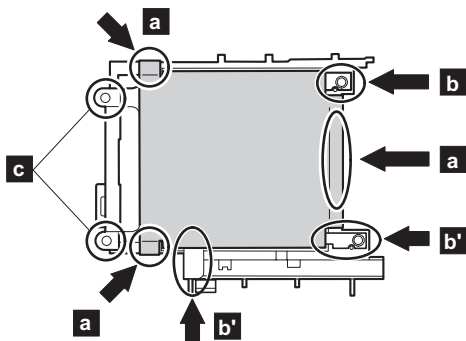
1170 Ultrabay 2000 slot

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88

For T20 series
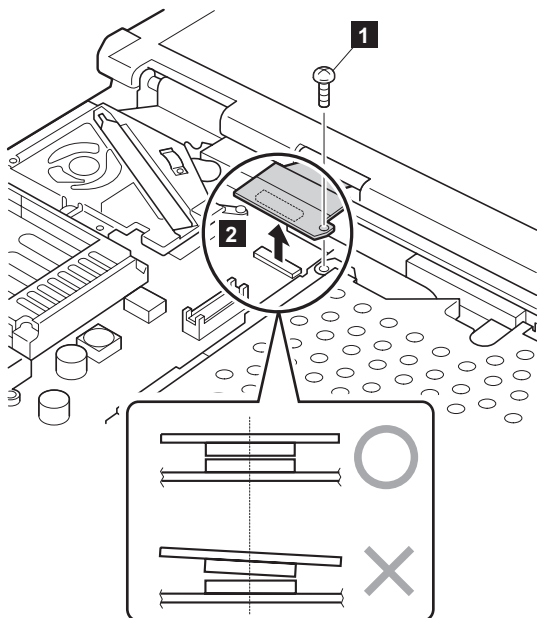
Step	Screw (quantity)	Torque
1	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

Note: T20 series do not have the removal procedure 3 and 4. After step 2, go to step 5.

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

(continued)

For T21 and T22 series
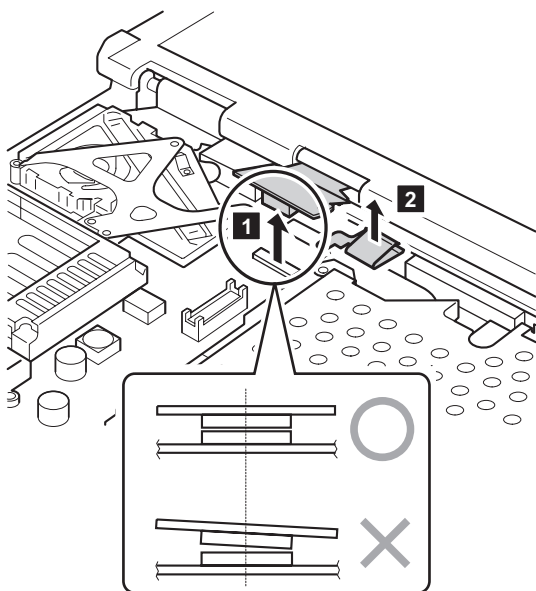
Note: T21 series do not have the removal procedure `3` and `4`. After step `2`, go to step `5`.

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

(continued)

For T23 series
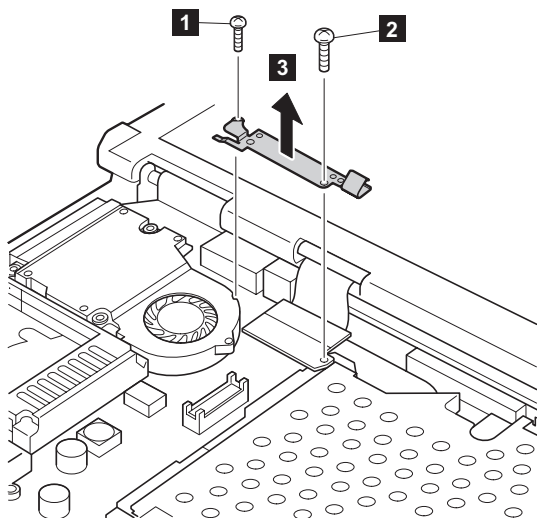
Step	Screw (quantity)	Torque
1	M2 × 13.5 mm, nylon-coated (1)	0.245 Nm (2.5 kgfcm)
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
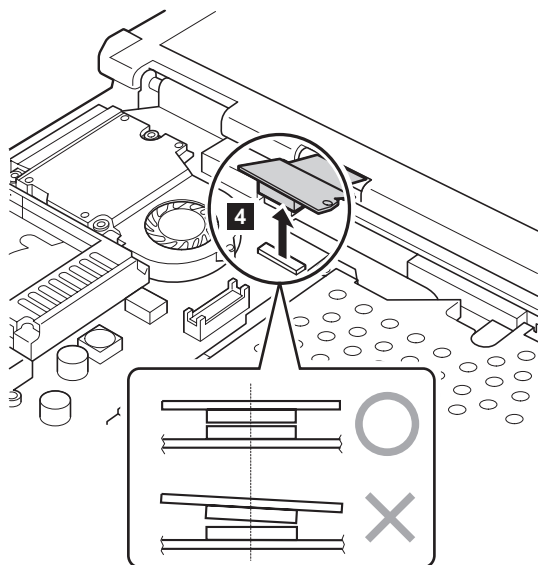
(continued)

Note: The models with 13.3-in. XGA LCD in T20 series
and in T21 series do not have FPC bracket (**5**).
For those models, skip step **5** .
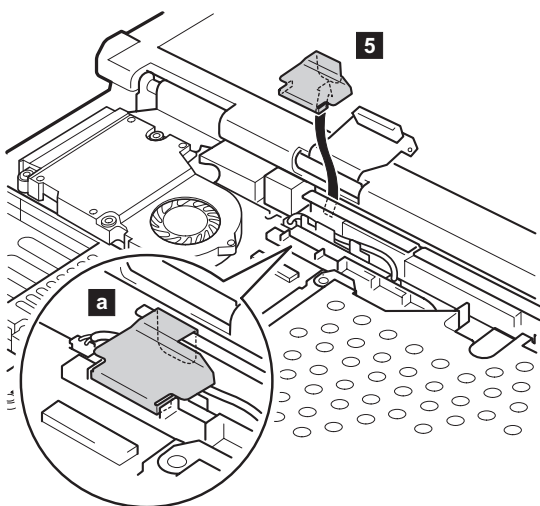
When installing: Make sure that the FPC bracket is firmly
attached as shown in the figure **a** .

(continued)

Note: Step 6 to step 9 are common for T20, T21, T22 and T23 series.
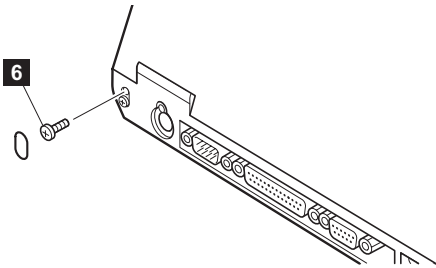
Step	Screw (quantity)	Torque
6	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
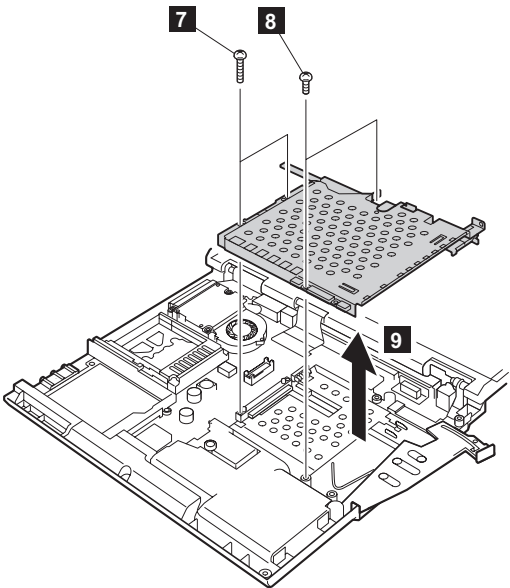
Step	Screw (quantity)	Torque
7	M2 × 13.5 mm, nylon-coated (2)	0.245 Nm (2.5 kgfcm)
8	M2.5 × 4.8 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

When installing: Make sure that the guide of the slot is firmly attached **1** and if the eject lever has been poped 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.
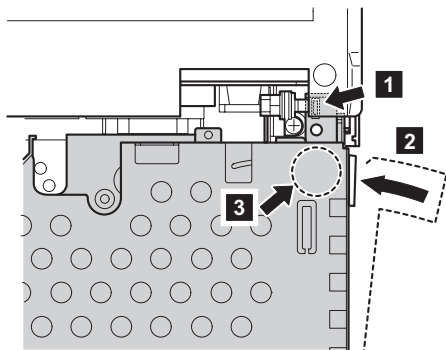
1180 System board

For access, remove these FRUs, in order:

For T20, T21, T22 series

Step	Screw (quantity)	Torque
4	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (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** .
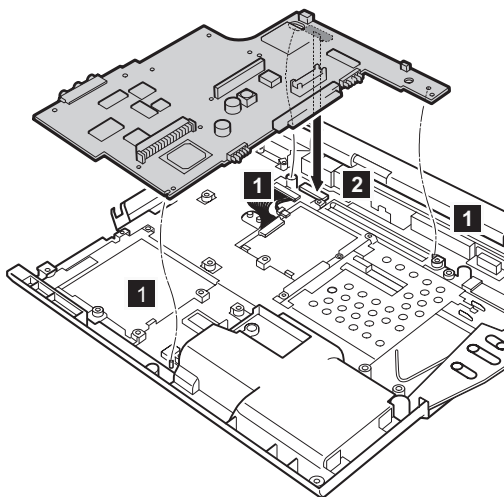
For T23 series
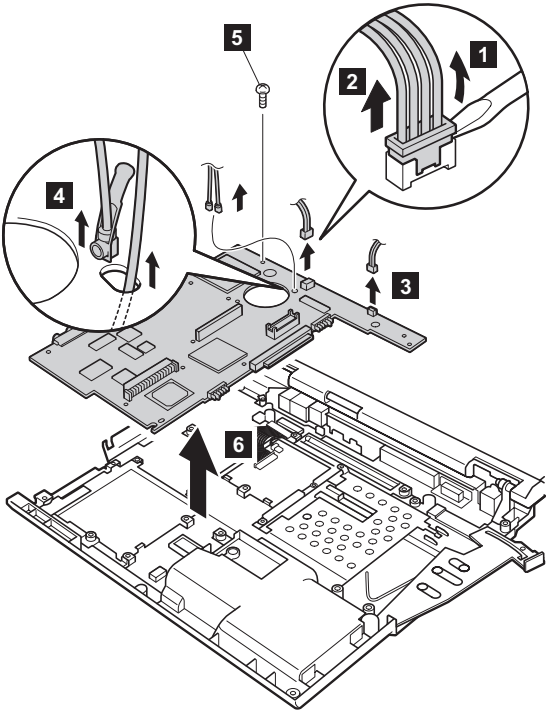
Step	Screw (quantity)	Torque
5	M2.5 × 4.8 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)

(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** .
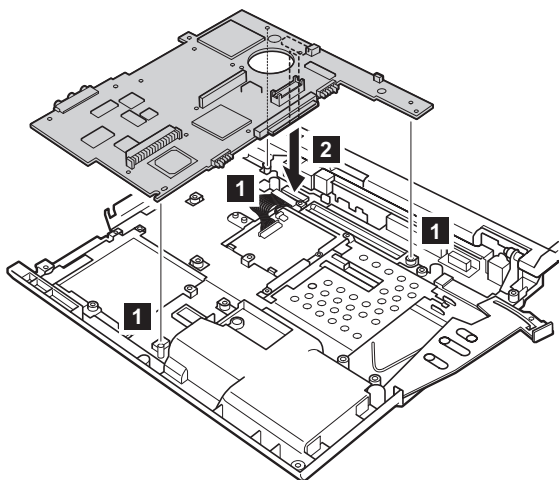
1190 Secure chip

Note

This section is only for the following models;
- MT2647-5Lx, 9Lx, DLT, HLU
- MT2647-5Dx, 5Fx, 5Hx, 5Jx, 5Nx, 5Mx, 9Dx, 9Fx, 9Hx, 9Jx, 9Nx, 9Mx, DFx, HNx, NNx
- MT2647-5Rx, 5Sx, 5Ux, 9Rx, 9Sx, 9Ux, HSU

Other models do not have the secure chip.

For access, remove these FRUs, in order:

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

1200 Microphone cable

For access, remove these FRUs, in order:

- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1040 DIMM" on page 65
- "1050 Mini PCI adapter" on page 66
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
- "1120 Fan assembly" on page 94
- "1140 PC Card slot assembly" on page 100
- "1150 Speaker" on page 103
- "1160 Hard-disk bay" on page 105
- "1170 Ultrabay 2000 slot" on page 107
- "1180 System board" on page 113
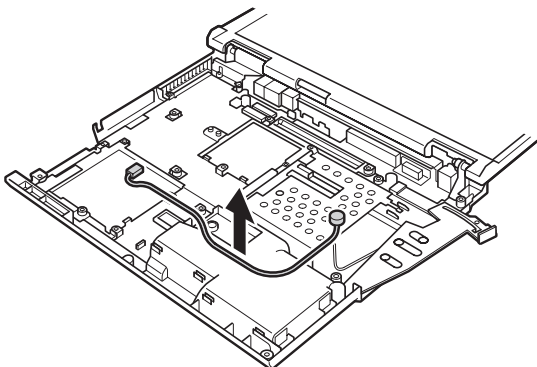
Cable routing: When replacing the cable, make sure the connector is firmly attached into place **a**. Cable slacking is only allowed at the **b**-part of the frame.
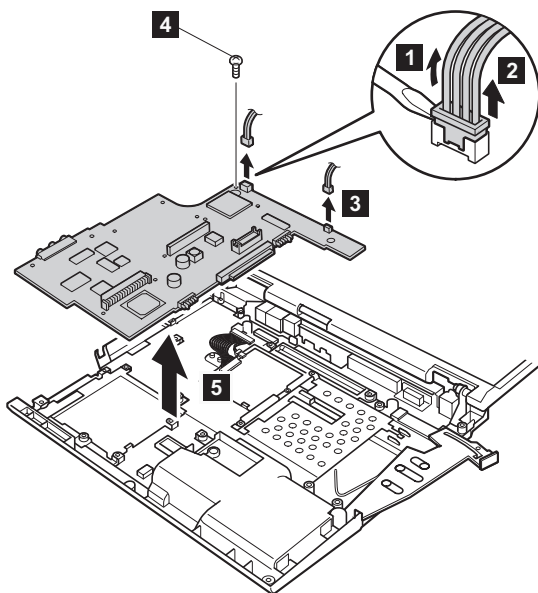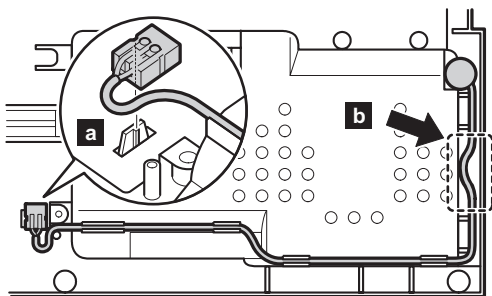
2010 LCD assembly

For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1050 Mini PCI adapter" on page 66
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
- "1120 Fan assembly" on page 94
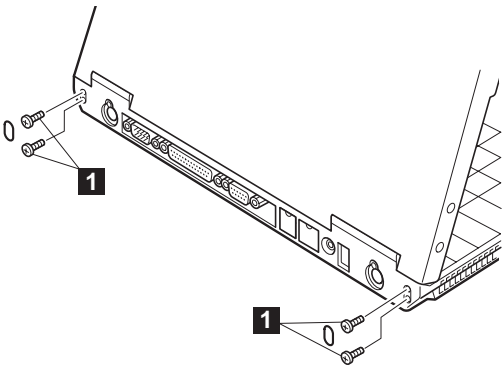
Step	Screw (quantity)	Torque
1	M2.5 × 4.8 mm, nylon-coated (4)	0.392 Nm (4 kgfcm)

(continued)

For models excepting MT2647-xLx, xNx
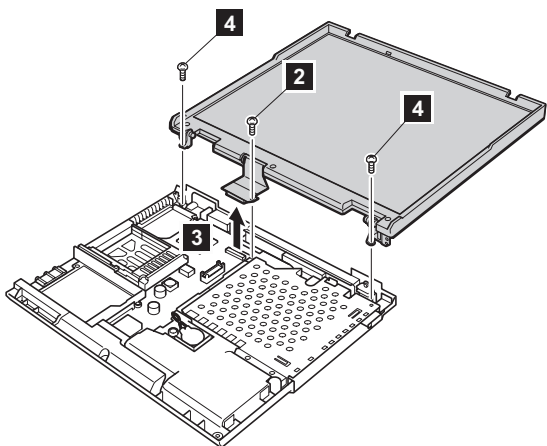
Step	Screw (quantity)	Torque
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
4	M2.5 × 4.8 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

For MT2647-xLx, xNx
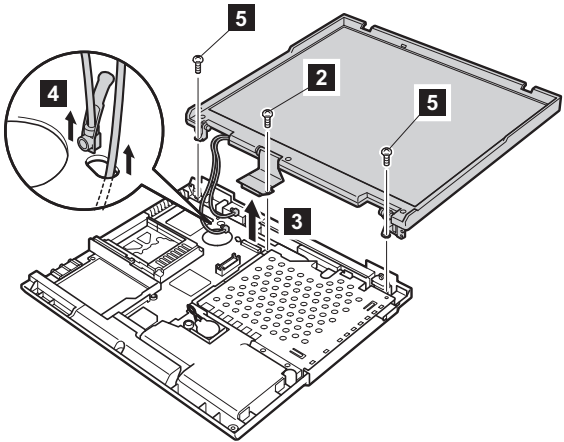
Step	Screw (quantity)	Torque
2	M2.5 × 14 mm, nylon-coated (1)	0.392 Nm (4 kgfcm)
5	M2.5 × 4.8 mm, nylon-coated (2)	0.392 Nm (4 kgfcm)

2020 Front bezel

For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
- "1120 Fan assembly" on page 94
- "2010 LCD assembly" on page 119
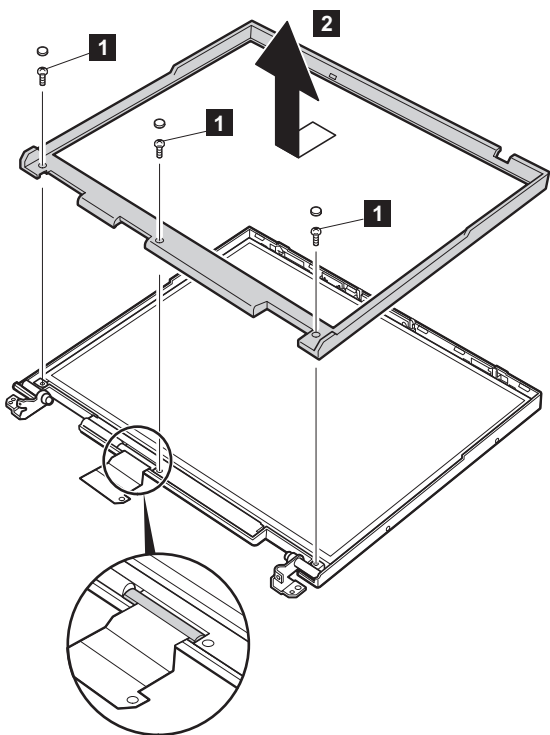
Step	Screw (quantity)	Torque
1	M2.5 × 4.8 mm, nylon-coated (3)	0.392 Nm (4 kgfcm)

2030 Inverter card

For access, remove these FRUs, in order:

Cable routing: When replacing the inverter card, route the connector cable as in the following figure:
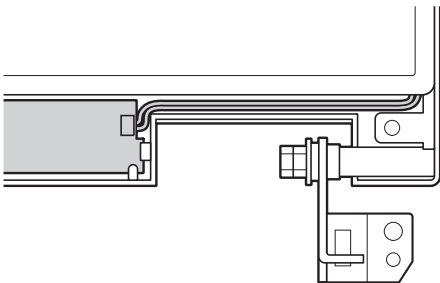
2040 LCD panel

For access, remove these FRUs, in order:

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 **1b** .
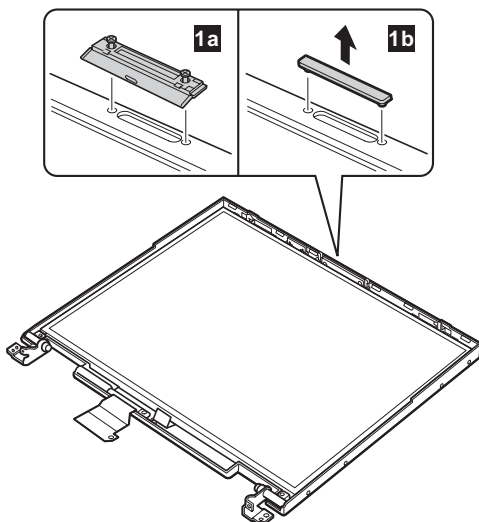
(continued)
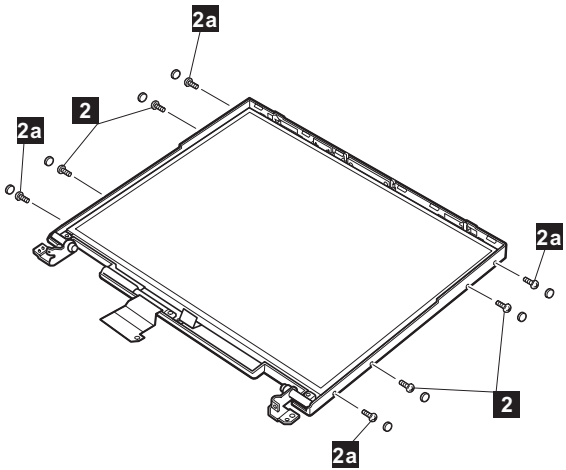
Step	Screw (quantity)	Torque
For 13.3-in. XGA LCD LG (05K9636), 14.1-in. XGA LCD Hitachi (05K9568), 14.1-in. SXGA+ LCD Hitachi (46L2493)		
2	M2 × 4 mm, nylon-coated (4)	0.245 Nm (2.5 kgfcm)
For 14.1-in. XGA LCD LG (05K9567), SAMSUNG (05K9678), Hyundai (05K9940), DBU (05K9888), 14.1-in. SXGA+ LCD LG (46L2495)		
2a	M2 × 4 mm, nylon-coated (4)	0.245 Nm (2.5 kgfcm)
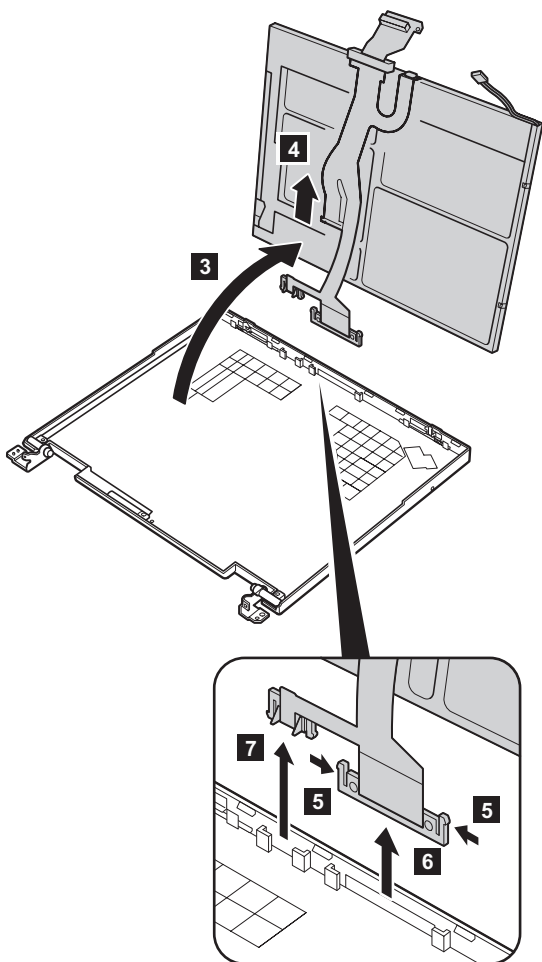
(continued)

(continued)

Cable routing: When installing the LCD, route the connector cable as in the following figure:
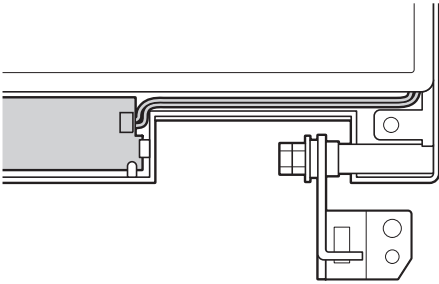
2050 Antenna assembly

Note

This section is only for MT2647-xFx, xJx, xLx, xNx, xSx. Other models do not have the antenna assembly.

For access, remove these FRUs, in order:
- "1010 Battery pack" on page 60
- "1020 Backup battery" on page 61
- "1030 Hard-disk drive" on page 63
- "1070 Ultrabay 2000 device" on page 73
- "1080 Keyboard" on page 74
- "1090 Keyboard CRU insulator" on page 82
- "1100 Hinge cover" on page 83
- "1110 Keyboard bezel" on page 88
- "1120 Fan assembly" on page 94
- "2010 LCD assembly" on page 119
- "2020 Front bezel" on page 122
- "2030 Inverter card" on page 123
- "2040 LCD panel" on page 124
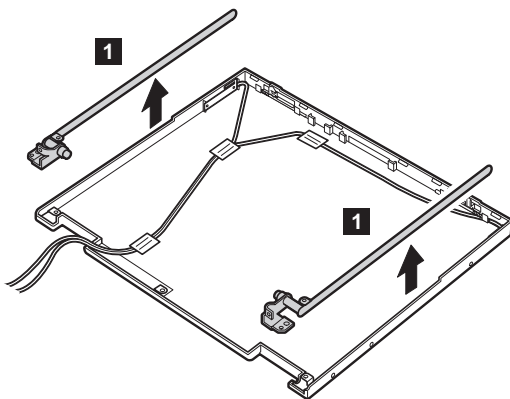
Strip off the insulation tapes `2` securing the antenna cables.
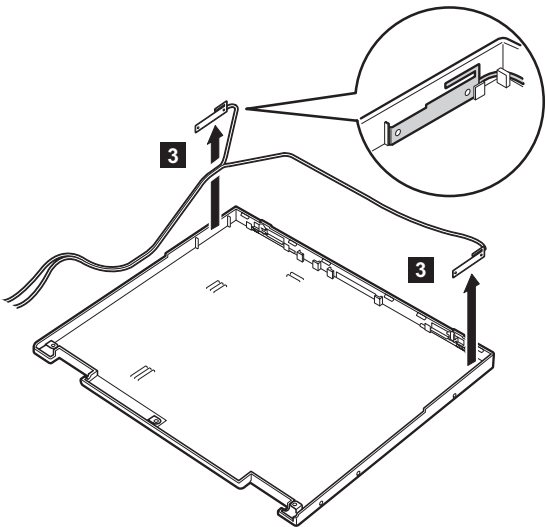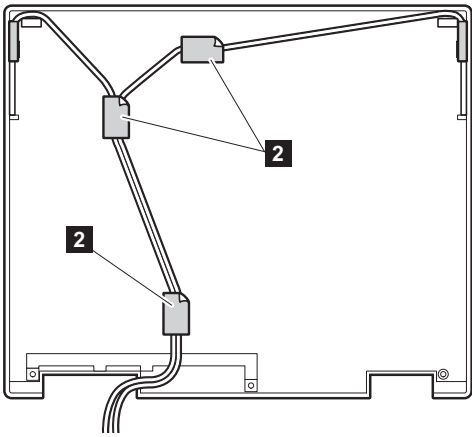
Cable routing: Route the antenna cables as follows;

1. Hook the black antenna cable to projection (**1**) on the right corner of the rear cover.
2. Route the black antenna cable to go through cable guides **2** and **3** .
3. Hook the gray antenna cable to projection (**4**) on the left corner of the rear cover.
4. Route the gray antenna cable to go through cable guides **5** .
5. Make sure that both of the cables are not twisted.
6. Stick insulation tapes **6** , **7** and **8** .

2060 Sub card

For access, remove these FRUs, in order:

Step	Screw (quantity)	Torque
1	Hex stud (6)	0.392 Nm (4 kgfcm)
2	M2.5 × 4.8 mm, nylon-coated (4)	0.392 Nm (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 poped 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.
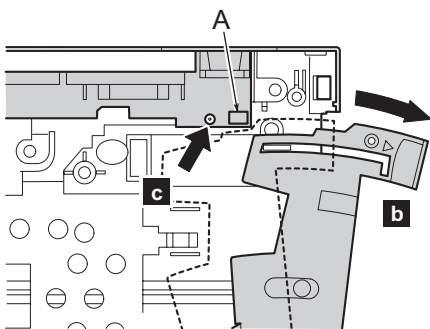
3010 ThinkPad Dock PCI cover

Before replacing the PCI cover:

There are two types of ThinkPad Dock, as follows:

• ThinkPad Dock: FRU no. 08N1546 (PCI cover: FRU no. 05K6246)
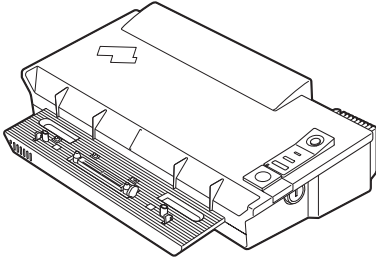
• ThinkPad Dock with extension plate: FRU no. 08N1537 (PCI cover: FRU no. 08N7317)
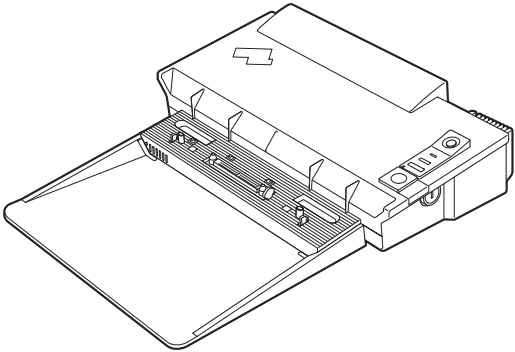
Confirm the FRU no. of the ThinkPad Dock first and choose the proper PCI cover FRU for the ThinkPad Dock you are servicing.

Note: The following illustration shows how to remove the PCI cover of ThinkPad Dock (FRU no. 08N1546). Do the same to remove the PCI cover of ThinkPad Dock with extension plate (FRU no. 08N1537).
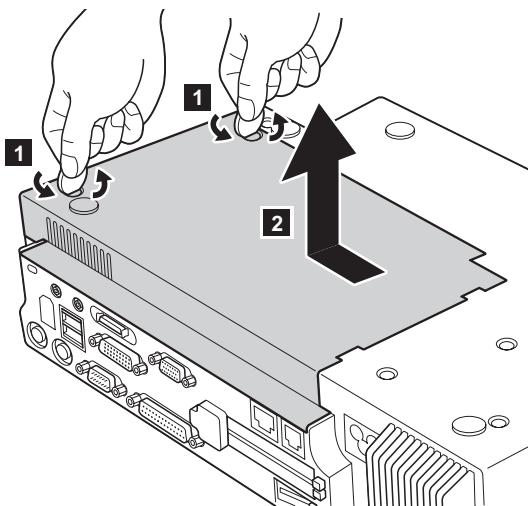
(Bottom view)

3020 ThinkPad Dock top cover

> **Note**
>
> This section is only for the ThinkPad Dock (FRU no. 08N1546). The top cover and screw kit for ThinkPad Dock (FRU no. 12P4143) is not available for the ThinkPad Dock with extension plate (FRU no. 08N1537) .
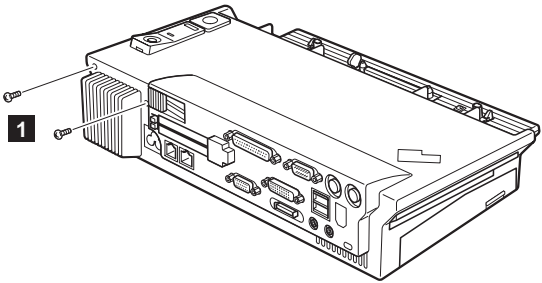
(Rear view)

Step	Screw (quantity)	Torque
1	M2.5 × 4.8 mm (2)	0.392 Nm (4 kgfcm)

(continued)
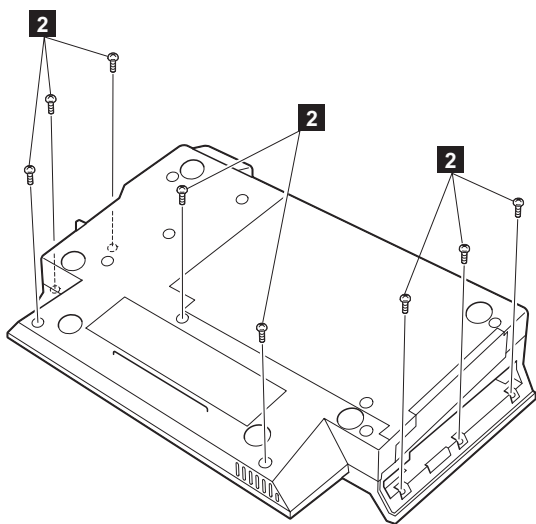
(Bottom view)

Step	Screw (quantity)	Torque
2	M2.5 × 4.8 mm (8)	0.392 Nm (4 kgfcm)

(continued)

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.
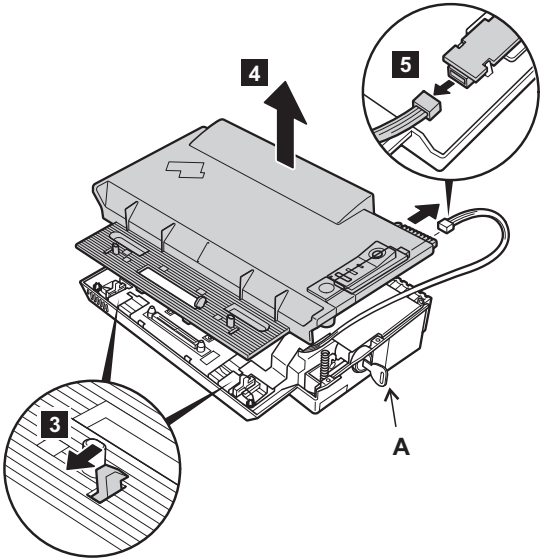
When replacing the top cover, do the following:

- Make sure that the springs are placed correctly.
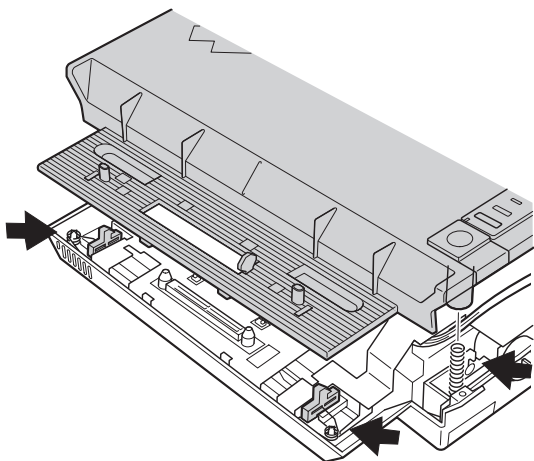
- Make sure that the device release lever is seated correctly.
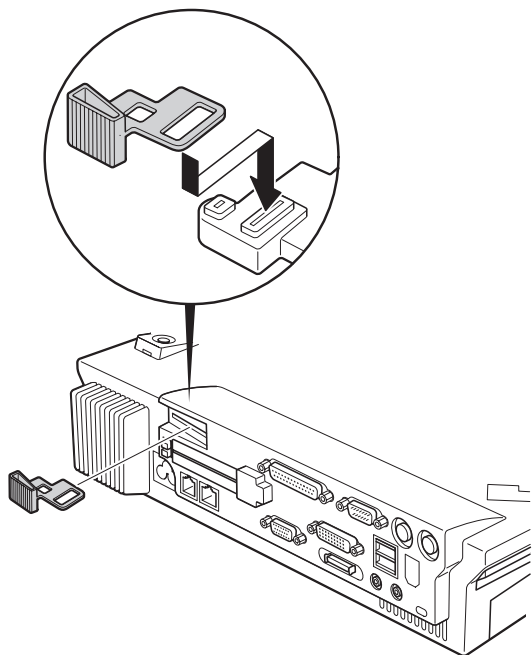
(continued)

- Make sure that the release button works correctly.
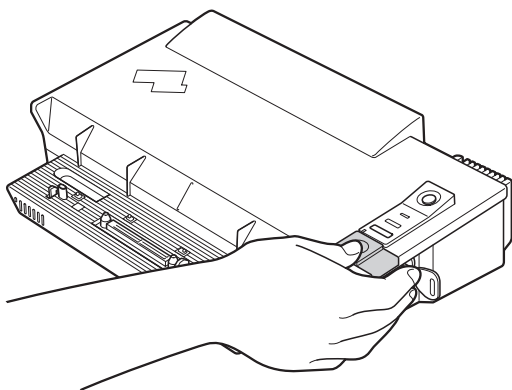
Locations

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
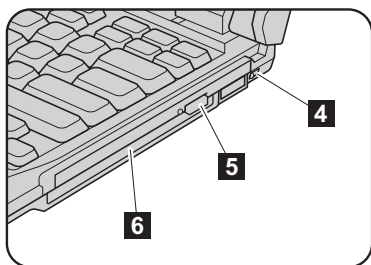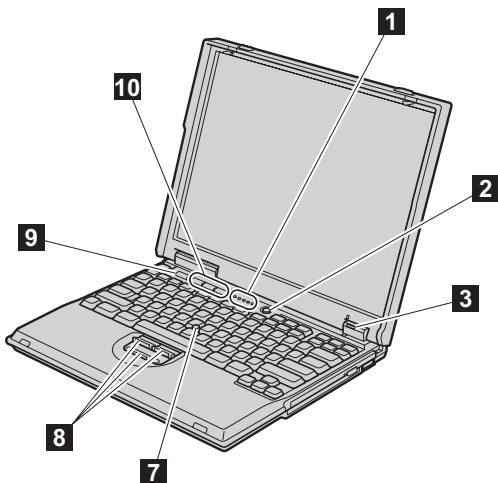
Rear view

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

　　Note: T23 series have two USB connectors.
10　External-input-device connector
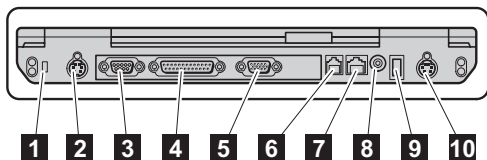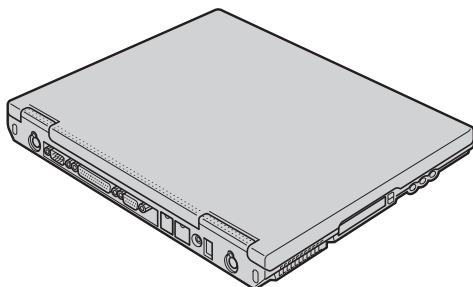
Bottom view

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
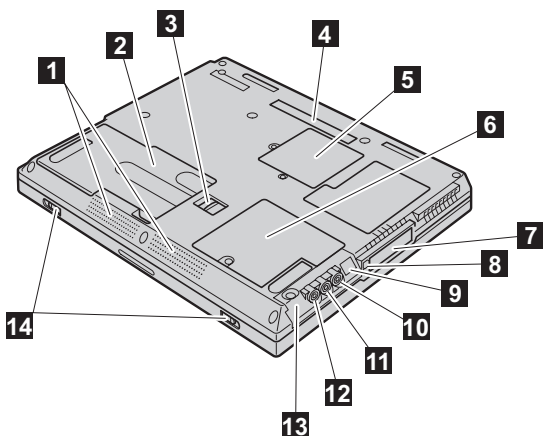
Parts list

T20, T21, T22 and T23 series model matrix

The T20, T21, T22 and T23 series includes several models. The following table summarizes the characteristics of each model, to help you determine which FRU in the part list meets your need.

Model	CPU	Bay device	Mini PCI adapter	LCD	HDD
T20 (Memory: 128 MB)			(*): Memory 64 MB (**): Memory 256 MB		
2647-21x, 61x	CMG 650	CD-ROM	Modem	13.3-in. XGA	6 GB
2647-24x, 64x			Combo (Intel)		
2647-A1x		—	—		—
2647-31x		DVD-ROM (6x)	Modem	14.1-in. XGA	6 GB
2647-2EY		CD-ROM	Combo (3Com)	13.3-in. XGA	12 GB
2647-32x, 72x (*)	CMG 700		Modem		
2647-T1x (**)				14.1-in. XGA	
2647-41x, 81x, 43x		DVD-ROM (6x)	Modem		
2648-41x, 81x					
2647-42x, 82x			—		
2648-42x, 82x					
2647-44x, 84x			Combo (Intel)		
2648-44x, 84x					
2647-46x, 86x			Combo (3Com)		
2648-46x, 86x					
2647-45x		FDD	Ethernet		
2647-B1x		—	—		—
2647-L1x, L2x	CMG 750	CD-ROM	Modem	14.1-in. XGA	20 GB
2647-52x, 92x		DVD-ROM (6x)			
2647-55x, 95x			Combo (Intel)		
2647-C1x		—	—		—

(continued)

Parts list

Model	CPU	Bay device	Mini PCI adapter	LCD	HDD
T21 (Memory: 128 MB)					
2647-27x, 67x	CMG 750	CD-ROM	Modem	13.3-in. XGA	10 GB
2647-2Ax, 6Ax			Combo (Xircom)		
2647-4Bx, 8Bx			Combo (3Com)		
2647-47x, 49x, 87x, L7x	CMG 800	DVD-ROM (8x)	Modem	14.1-in. XGA	20 GB
2648-47x, 87x					
2647-4Ax, 8Ax			Combo (Xircom)		
2648-4Ax, 8Ax			Combo (Intel)		
2647-4Bx, 8Bx			Combo (3Com)		
2648-4Bx, 8Bx					
2647-57x, 97x	CMG 850		Modem	14.1-in. SXGA+	32 GB
2647-5Ax, 9Ax			Combo (Xircom)		
2647-5Bx, 9Bx			Combo (3Com)		
T22 (Memory: 128 MB)					
2647-3Cx, 7Cx	CMG 800	CD-ROM	Modem	13.3-in. XGA	10 GB
2647-3Ex, 7Ex, B2x, B3x, B4x, B5x			Combo (Intel)		
2647-4Cx,4Gx, 8Gx, 8Cx,M2x, M3x, LCx	CMG 900	DVD-ROM (8x)	Modem	14.1-in. XGA	20 GB
2648-4Cx, 8Cx					
2647-4Ex, 8Ex, M4x, M5x			Combo (Intel)		
2648-4Ex, 8Ex					
2647-4Gx, 8Gx			Combo (3Com)		
2648-4Gx, 8Gx					
2647-T2x		FDD	Combo (Intel)		
2647-5Cx, 9Cx	CMG 1G	DVD-ROM (8x)	Modem	14.1-in. SXGA+	32 GB
2647-5Ex, 9Ex, M6x			Combo (Intel)		

(continued)

Model	CPU	Bay device	Mini PCI adapter	LCD	HDD
T23 (Memory: 128 MB)			(**): Memory 256 MB		
2647-2Kx except 2KC 2647-6Kx except xxC 2647-AKx, BAx, BJx, EKx	Tual 866	CD-ROM	Modem	13.3-in. XGA	15 GB
2647-2KC, 6KC		DVD-ROM (8x)			
2647-2Rx, 6Rx	Tual 1.0	CD-ROM		14.1-in. XGA	20 GB
2647-2Tx, 2UC, 6UC, 3RG, 7RG		DVD-ROM (8x)			
2648-2Tx					
2647-3TK, 7TK		CD-ROM			30 GB
2647-T4x (**)	Tual 1.13			14.1-in. XGA	
2647-4Mx, 8Mx, MMx		DVD-ROM (8x)			
2648-4Mx, 8Mx					
2647-4Qx, 8Qx *1					
2647-4Nx, 8Nx, GNU, KNG, MNx			802.11/ v.90	14.1-in. XGA with antenna	
2648-4Nx, 8Nx					
2647-4Rx, 8Rx	Tual 1.2		Modem	14.1-in. XGA	40 GB
2648-4Rx, 8Rx					
2647-4Sx, 8Sx, BSx			802.11/ v.90	14.1-in. XGA with antenna	
2648-4Sx, 8Sx					
2647-5Kx, 9Kx	Tual 1.13		Modem	14.1-in. SXGA+	48 GB
2647-5Lx, 9Lx, DLT, HLU *2			802.11/ v.90	14.1-in. SXGA+ with antenna	

(continued)

Parts list

Model	CPU	Bay device	Mini PCI adapter	LCD	HDD
T23 (Memory: 128 MB)			(**): Memory 256 MB		
2647-5Mx, 9Mx	Tual 1.2	CD-RW	Modem	14.1-in. SXGA+	48 GB
2647-5Nx, 9Nx, HNx, NNx *2			802.11/ v.90	14.1-in. SXGA+ with antenna	
2647-5Fx, 9Fx, DFx *2		DVD-ROM (8x)			
2647-5Dx, 9Dx *2			Modem	14.1-in. SXGA+	
2647-5Hx, 9Hx *2		DVD/ CD-RW combo			
2647-5Jx, 9Jx *2			802.11/ v.90	14.1-in. SXGA+ with antenna	
2647-5Ux, 9Ux *2	Tual 1.2	DVD-ROM (8x)	Modem	14.1-in. SXGA+	60 GB
2647-5Rx, 9Rx *2 (**)		DVD/ CD-RW combo			
2647-5Sx, 9Sx, HSx *2 (**)			802.11/ v.90	14.1-in. SXGA+ with antenna	
• CMG xxx: Mobile Intel® Pentium® III processor xxx GHz (MHz) • Tual xxx: Mobile Intel® Pentium® III processor xxx GHz (MHz)-M • *1: no EDC feature, *2: featuring Secure chip					

Overall

For T20, T21 and T22
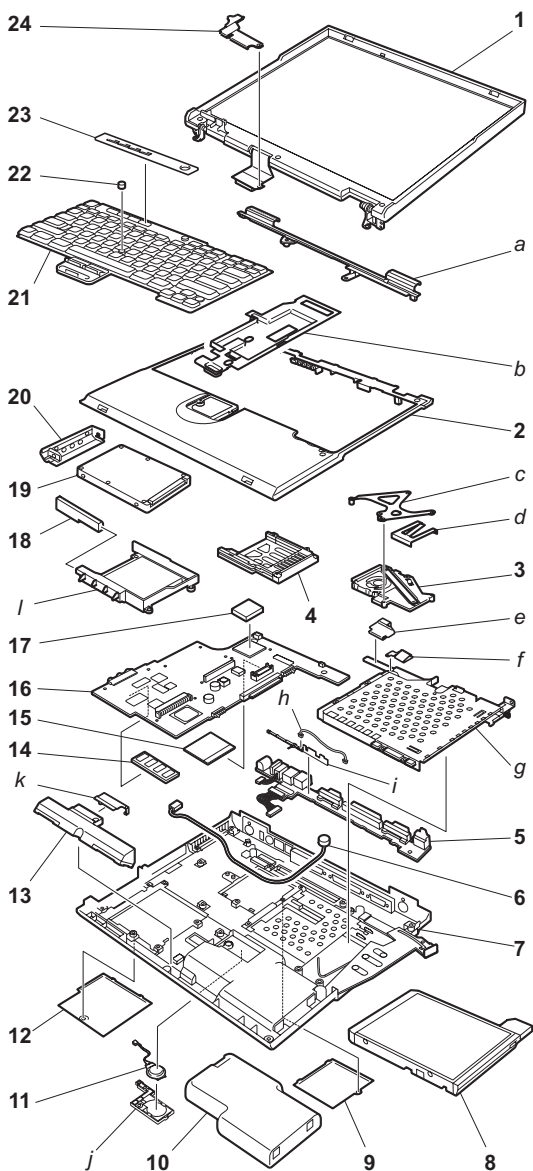
- Each FRU is available for all types or models, unless specific types or models are given.
- The FRUs marked with asterisk are CRUs (customer replaceable units.)
- The FRUs marked with **OP** are also available as optional FRUs.

No.	FRU	P/N
a - l	See "Miscellaneous parts" on page 167.	
1	LCD unit (see "LCD FRUs" on page 157)	
2	Keyboard bezel for T20	
	for all models except xxK	46P2615
	for models xxK	46P2616
	Keyboard bezel for T21 and T22	
	for all models except xxK	46P2613
	for models xxK	46P2614
3	Fan assembly for T20	08K7066
	Fan assembly for T21	04P3448
	Fan assembly for T22	
	for 2647-3xx, 7xx, BxG	08K7268
	for 2648-all for 2647-all except models 3xx, 7xx, BxG	26P9317
4	PC Card slots	08K7064
5	I/O card	26P8023
	I/O card with conformal coating	08K3373
6	Microphone cable assembly	27L0520
7	Base cover for T20	
	for 2647-all except models xxK, xxT	08K6079
	for 2647-xxK	08K6350
	for 2647-xxT	08K6346
	for 2648-all except models xxK, xxT	08K6369
	for 2648-xxK	08K6372
	for 2648-xxT	08K6370
	Base cover for T21	
	for 2647-all except models xxK	26P9291
	for 2647-xxK	04P3446
	for 2648-all except models xxK	04P3445
	for 2648-xxK	04P3447

(continued)

No.	FRU	P/N
7	Base cover for T22	
	for 2647-3xx, 7xx, Bxx except models xxK	26P9291
	for 2647-3xK, 7xK, BxK	26P9309
	for 2647-4xx, 5xx, 8xx, 9xx, Mxx, Lxx except models xxK	08K7362
	for 2647-4xK, 5xK, 8xK, 9xK, MxK, LxK	26P9174
	for 2648-all except models xxK	26P9173
	for 2648-xxK	26P9175
8	Ultrabay 2000 diskette drive (TEAC)	08K9606*
	Ultrabay 2000 diskette drive (SONY)	08K9607*
	Ultrabay 2000 CD-ROM drive (TOSHIBA) OP	27L3973*
	Ultrabay 2000 CD-ROM drive (TEAC), low power OP	27L3436*
	Ultrabay 2000 CD-ROM drive (LG) OP	27L4141*
	Ultrabay 2000 CD-ROM drive (LG), low power OP	27L4301*
	Ultrabay 2000 DVD drive 6x (MKE) OP	05K9188*
	Ultrabay 2000 DVD drive 6x (TOSHIBA) OP	05K9160*
	Ultrabay 2000 DVD drive 8x (MKE) OP	27L4241*
	Ultrabay 2000 DVD drive 8x (HITACHI) OP	27L4236*
	for other optional Ultrabay 2000 devices, see "Optional FRUs" on page 170.	
9	Cover, DIMM slot	08K6090*
10	Battery pack, Panasonic OP	
	for all models except xxE, xxJ	02K6626*
	for models xxE, xxJ	02K6857*
	Battery pack, SANYO OP	
	for all models except xxE, xxJ	02K6627*
	for models xxE, xxJ	02K6859*
11	Backup battery	02K6572
12	Cover, Mini PCI adapter slot	08K6091*
13	Speaker assembly	08K6089
14	64-MB SDRAM SO DIMM (PC100) OP	20L0264*
	128-MB SDRAM SO DIMM (PC100) OP	20L0265*
	for other optional DIMM, see "Optional FRUs" on page 170.	

(continued)

Parts list

No.	FRU	P/N
15	Mini PCI modem card `OP` for T20 (models x1x except T1U, x2x, x3x, BxG)	08K3429*
	Mini PCI modem card (Ambit) for T20, T21 (models x1x, x2x, x3x, xxG)	08K4855*
	Mini PCI modem card (Hoshi CR) for T21 (models x7x except x7G)	08K3338*
	Mini PCI modem card (Ambit), V.92 ready for T22 (models xCx)	08K4853*
	Mini PCI combo card (Intel) `OP` for T20 (models x4x, x5x), T21 (models xAJ, xAK)	08K3125*
	Mini PCI combo card (3Com) `OP` for T20 (models x6x), T21 (models xBx)	00N8117*
	Mini PCI combo card (Intel) `OP` for T21 (models xBx)	06P3829*
	Mini PCI combo card (Intel CR) `OP` for T21 (models xAx except xAJ, xAK)	19K5888*
	Mini PCI combo card (Intel), V.92 ready `OP` for T22 (models xEx, BxG, 6xx, PM5, T2x)	06P3809*
	Mini PCI combo card (3Com) `OP` for T22 (2647-4Gx, 8Gx, MxU)	22P6753*
	Mini PCI Ethernet card `OP` for T20 (2647-45G, 45U)	10L1423*
	for other optional Mini PCI adapter, see "Optional FRUs" on page 170.	
16	System board	
	for T20 (all models except 2647-5xx, 9xx, Lxx)	12P3360
	for T20 (2647-5xx, 9xx, Lxx)	12P3363
	for T21 (all models except 2647-5xx, 9xx Cxx)	12P3366
	for T21 (2647-5xx, 9xx Cxx)	12P3369
	for T22 (2647-3xx, 7xx Bxx)	26P8096
	for T22 (all models except 2647-3xx, 7xx Bxx)	26P8098
17	CPU, Pentium III 650 MHz	10L1405
	CPU, Pentium III 700 MHz	10L1417
	CPU, Pentium III 750 MHz	08K3191
	CPU, Pentium III 800 MHz	08K3246
	CPU, Pentium III 850 MHz	08K3248
	CPU, Pentium III 900 MHz	08K3346
	CPU, Pentium III 1 GHz	08K3392

(continued)

No.	FRU	P/N
18	Asset ID RF adapter (see "Optional FRUs" on page 170)	
19	Hard-disk drive (6.0 GB), STD `OP`	05K9227*
	Hard-disk drive (6.0 GB), HITACHI `OP`	05K9228*
	Hard-disk drive (10.0 GB), STD `OP`	08K9508*
	Hard-disk drive (10.0 GB), HITACHI `OP`	08K9531*
	Hard-disk drive (12.0 GB), STD `OP`	05K9229*
	Hard-disk drive (12.0 GB), HITACHI `OP`	05K9230*
	Hard-disk drive (20.0 GB), STD `OP`	27L4286*
	Hard-disk drive (20.0 GB), HITACHI `OP`	08K9533*
	Hard-disk drive (30.0 GB), STD `OP`	08K9564*
	Hard-disk drive (32.0 GB), STD `OP`	08K9509*
	for other optional hard-disk drive, see "Optional FRUs" on page 170.	
20	Cover, hard-disk drive for T20	08K6092*
	Cover, hard-disk drive for T21, T22	04P3496*
21	Keyboard* (see "Keyboard" on page 160)	
22	Pointing stick cap	84G6536*
23	Easy button cover for T22	26P9183
24	Bracket, LCD FPC	26P9178
—	Shield, Mini PCI	
—	Blank cap for RJ45 (for T20)	04P3975
—	Telephone cable (San Tai)	27L0603
—	Recovery CD (see "Recovery CDs" on page 161.)	
—	AC adapter* (see "AC adapters" on page 156.)	
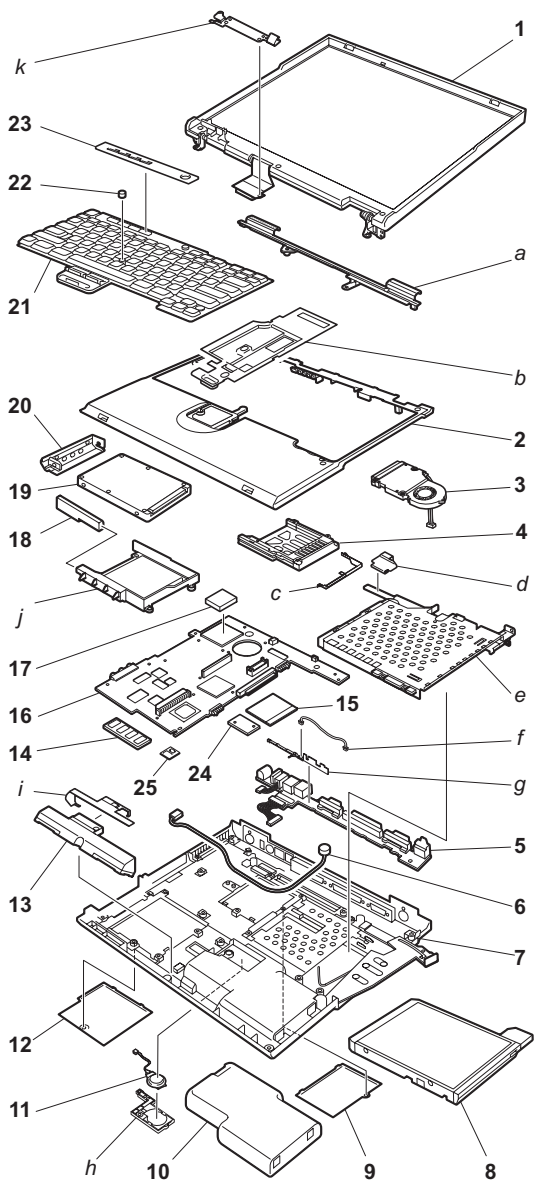
For T23

- Each FRU is available for all types or models, unless specific types or models are given.
- The FRUs marked with one asterisk are CRUs (customer replaceable units.)
- The FRUs marked with **OP** are also available as optional FRUs.

No.	FRU	P/N
a - k	See "Miscellaneous parts" on page 167.	
1	LCD unit (see "LCD FRUs" on page 157)	
2	Keyboard bezel for T23 (all models except xxK)	46P2611
	for models xxK	46P2612
3	Fan assembly for T23	26P9166
4	PC Card slots for T23	26P9165
5	I/O card assembly for T23	26P8006
6	Microphone cable assembly	27L0520
7	Base cover for 2647 (T23)	
	for models except xJx, xFx, xLx, xNx, xSx, xxC, xxK, xxT	26P9158
	for models xDC, xKC, xMC, xPC, xUC, 2TC, xRC	26P9162
	for models xHK, xKK, xMK, xPK, xRK, 2TK, 3TK, 7TK	26P9160
	for models xHT, xKT, xMT, xPT, xRT, 2TT	46L4922
	Base cover for 2647 wireless (T23)	
	for models xJx except xJK, xJT for models xFx except xFC for models xLx except xLK, xLT for models xNx except xNC, xNK, xNT for models xSx except xSC, xSK, xST	46L4972
	for models xNC, xFC, xSC, x5TC, 9TC	46L4934
	for models xJK, xLK, xNK, xSK	26P9611
	for models xJT, xLT, xNT, xST	46L4923
	Base cover for 2648 (T23)	
	for models except 4Nx, 8Nx, xxC, xxK, xSx, xxT	26P9159
	for models 4MC, 4PC, 8MC, 8PC, 2TC, xRC	26P9163
	for models 4MK, 4PK, 8MK, 8PK, 2TK, xRK	26P9161
	for models 4MT, 4PT, 8MT, 8PT, 2TT, xRT	46L4924

(continued)

Parts list

No.	FRU	P/N
7	Base cover for 2648 wireless (T23)	
	for models xNx, xSx, except xNC, xNK, xNT, xSC, xSK, xST	46L4921
	for models 4NC, 8NC, xSC	46L4935
	for models 4NK, 8NK, xSK	46L4933
	for models 4NT, 8NT, xST	46L4925
8	Ultrabay 2000 CD-ROM drive (LG), low power **OP**	27L4301*
	Ultrabay 2000 CD-ROM drive (TEAC), low power **OP**	27L3436*
	Ultrabay 2000 DVD-ROM drive 8x (MKE) **OP**	27L4241*
	Ultrabay 2000 DVD-ROM drive 8x (MKE), light weight **OP**	08K9648*
	Ultrabay 2000 DVD-ROM drive 8x (HITACHI) **OP**	27L4236*
	Ultrabay 2000 DVD-ROM drive 8x (HLDS), light weight **OP**	08K9646*
	Ultrabay 2000 DVD-ROM drive 8x (TOSHIBA) **OP**	27L4213*
	Ultrabay 2000 CD-RW drive (SONY) **OP**	27L4231*
	Ultrabay 2000 CD-RW drive (TEAC) **OP**	27L4297*
	Ultrabay 2000 DVD/CD-RW combo drive (TOSHIBA) **OP**	27L4249*
	Ultrabay 2000 DVD/CD-RW combo drive (KME) **OP**	27L4359*
	for other optional Ultrabay 2000 devices, see "Optional FRUs" on page 170.	
9	Cover, DIMM slot for T23	26P9421*
10	Battery pack, PANASONIC **OP**	
	for models xKx, xQx, L4x except xxE, xxJ	02K6626*
	for models xKE, xKJ	02K6857*
	Battery pack, SANYO **OP**	
	for models xKx, xQx, L4x except xxE, xxJ	02K6627*
	for models xKE, xKJ	02K6859*
	Battery pack, PANASONIC 2.0 Ah **OP**	
	for all models except xKx, xQx, L4x	02K7026*
	for models xxE, xxJ except xKE, xKJ	02K7030*
	Battery pack, SANYO 2.0 Ah **OP**	
	for all models except xKx, xQx, L4x	02K7028*
	for models xxE, xxJ except xKE, xKJ	02K7032*
11	Backup battery	02K6572

(continued)

No.	FRU	P/N
12	Cover, Mini PCI adapter slot	08K7416*
13	Speaker assembly	08K6089
14	128-MB SDRAM SO DIMM (PC133) `OP`	19K4653*
	256-MB SDRAM SO DIMM (PC133) `OP`	19K4655*
	for other optional DIMMs, see "Optional FRUs" on page 170.	
15	Mini PCI modem card (Ambit) `OP` for all models except 2647-xFx, xJx, xLx, xNx, xSx, 5TC, 9TC, and 2648-xNx, xSx	08K4853*
	Mini PCI 802.11b/v.92 modem card (ACTIONTEC) 2647-xFx, xJx, xLx, xNx, xSx, 5TC, 9TC, and 2648-xNx, xSx	12P3657
16	System board for models except 2647-4Rx, 8Rx, BSx, 4Sx, 8Sx, DRx, DSx, and 2648-4Rx, 8Rx, 4Sx, 8Sx **Note:** Use a new system board with the same FRU no. as the original FRU.	26P8218
		12P3770
	System board 2647-4Rx, 8Rx, BSx, 4Sx, 8Sx, DRx, DSx 2648-4Rx, 8Rx, 4Sx, 8Sx	12P3770
17	CPU assembly, mobile Intel® Pentium® III processor 866 MHz-M	26P7999
	CPU assembly, mobile Intel® Pentium® III processor 1.0 GHz-M	26P8122
	CPU assembly, mobile Intel® Pentium® III processor 1.13 GHz-M	26P8082
	CPU assembly, mobile Intel® Pentium® III processor 1.2 GHz-M	26P8005
18	Asset ID RF adapter (see "Optional FRUs" on page 170)	
19	Hard-disk drive (15.0 GB), HITACHI `OP`	08K9587*
	Hard-disk drive (15.0 GB), STD `OP`	08K9585*
	Hard-disk drive (20.0 GB), HITACHI `OP`	08K9533*
	Hard-disk drive (20.0 GB), STD `OP`	27L4286*
	Hard-disk drive (30.0 GB), HITACHI `OP`	08K9592*
	Hard-disk drive (30.0 GB), STD `OP`	27L4291*
	Hard-disk drive (40.0 GB), STD `OP`	08K9683*
	Hard-disk drive (40.0 GB), HITACHI `OP`	08K9767*
	Hard-disk drive (48.0 GB), STD `OP`	08K9599*
	Hard-disk drive (60.0 GB), STD `OP`	08K9700*
20	Cover, hard-disk drive for T23	26P9543*
21	Keyboard* (see "Keyboard" on page 160.)	
22	Pointing stick cap	84G6536*
23	Easy button cover	26P9536

(continued)

Parts list

No.	FRU	P/N
24	Ethernet daughter card (Ambit) **OP** for all models except 2647-xQx	26P8181
25	Secure chip **OP** for 2647-5xx except 5Kx, 9xx except 9Kx for 2647-HNx, xLx	26P8084
—	Telephone cable (SAN TAI)	27L0603
—	Recovery CD (see "Recovery CDs" on page 161.)	
—	AC adapter* (see "AC adapters".)	

AC adapters

FRU	P/N
AC adapter (72 W), 2-pin (ASTEC) **OP** for models xxE, xxF, xxJ, xxP, xxS, xxU, xxX	02K6753*
AC adapter (72 W), 2-pin (DELTA) **OP** for models xxE, xxF, xxJ, xxP, xxS, xxU, xxX	02K6756*
AC adapter (72 W), 2-pin (SANKEN) for models xxE, xxF, xxJ, xxP, xxS, xxU, xxX	02K6757*
AC adapter (72 W), 3-pin (ASTEC) **OP** for models xxA, xxB, xxC, xxG, xxH, xxK, xxM, xxT, xxY	02K6751*
AC adapter (72 W), 3-pin (DELTA) **OP** for models xxA, xxB, xxC, xxG, xxH, xxK, xxM, xxT, xxY	02K6754*

LCD FRUs
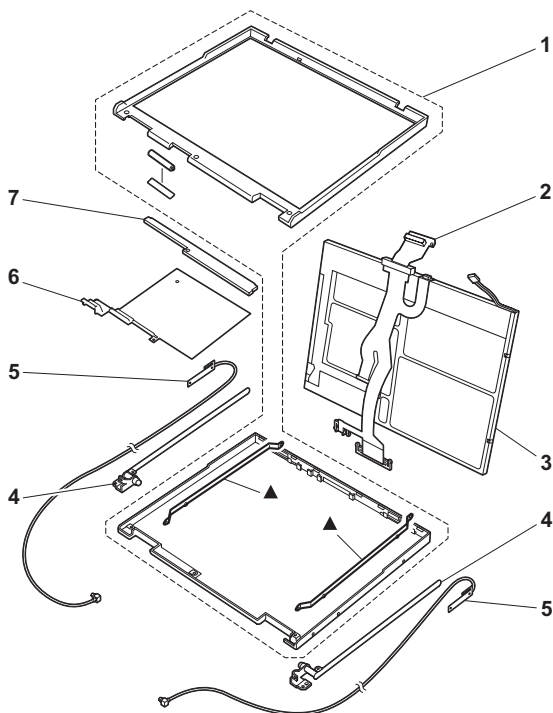
Notes:
1. The parts marked with ▲ are only for 13.3-in. LCD cover kit.
2. **5** is for the models with 14.1-in. XGA TFT with antenna and for the models with 14.1-in. SXGA+ TFT with antenna.
3. **6** is only for 2647-52x, 92x, C2x, L1x.

13.3-in. XGA TFT

No.	FRU	P/N
1	LCD cover kit (13.3-in.) XGA (except models xxK)	08K6685
	models xxK	08K6764
2	LCD cable assembly 13.3	27L0562
3	LCD panel, 13.3 XGA (LG)	05K9636
4	Hinges	08K6087
5	not available for this model	—
6	not available for this model	—
7	Inverter card	10L1402

14.1-in. XGA TFT

No.	FRU	P/N
1	LCD cover kit (14.1-in.) XGA	
	for T20, T21 (except models xxK)	26P9566
	for T20, T21 (models xxK)	26P9567
	for T22, T23 (except models xxK)	46L4843
	for T22, T23 (models xxK)	46L4844
	LCD cover antenna kit (except models xxK)	46L4910
	models xxK	46L4911
2	LCD cable assembly 14.1 XGA for T20, T21	27L0519
	LCD cable assembly 14.1 XGA (CR) for T22, T23	27L0640
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	05K9944
	LCD panel, 14.1 XGA (HYUNDAI) for T20, T21	05K9940
	LCD panel, 14.1 XGA (LG) X10 Light Weight	11P8241
	LCD panel, 14.1 XGA (HITACHI) Light Weight for T22, T23	11P8258
	LCD panel, 14.1 XGA (SAMSUNG) Light Weight for T22, T23	46L2292
	LCD panel, 14.1 XGA (DBU) Light Weight for T22, T23	05K9888
4	Hinges	08K6087
	Hinges for antenna	26P9196
5	Antenna assembly	26P9197
6	Thermal hinge (only for 2647-52x, 92x, C2x, L1x)	08K6353
7	Inverter card	10L1402

14.1-in. SXGA+ TFT

No.	FRU	P/N
1	LCD cover kit (14.1-in.) SXGA+ (except models xxK)	26P9383
	models xxK	26P9385
	LCD cover antenna kit (except models xxK)	46L4910
	models xxK	46L4911
2	LCD cable assembly 14.1 SXGA+	27L0590
3	LCD panel, 14.1 SXGA+ (HITACHI)	46L2493
	LCD panel, 14.1 SXGA+ (LG)	46L2495
4	Hinges	08K6087
	Hinges for antenna	26P9196
5	Antenna assembly	26P9197
6	not available for this model	—
7	Inverter card	10L1402

Keyboard

Language	P/N (NMB)	P/N (ALPS)
Arabic	02K5750*	—
Belgian	02K5745*	—
Chinese, traditional	02K5747*	02K5718*
Czech	02K5751*	—
Danish	02K5738*	—
Dutch	02K5735*	—
English, U.K.	02K5731*	—
English, U.S.	02K5729*	—
French, Canadian	02K5732*	—
French, European	02K5734*	—
German	02K5733*	—
Greek	02K5753*	—
Hungarian	02K5752*	—
Hebrew	02K5749*	—
Italian	02K5739*	—
Japanese	02K5730*	02K5701*
Korean	02K5744*	02K5715*
Norwegian	02K5737*	—
Polish	02K5755*	—
Portuguese	02K5742*	—
Russian	02K5748*	—
Slovak	02K5754*	—
Slovenian	02K5756*	—
Spanish, European	02K5740*	—
Spanish, Latin American	02K5743*	—
Swedish or Finnish	02K5736*	—
Swiss	02K5741*	—
Thai	02K5757*	02K5728*
Turkish	02K5746*	—

Recovery CDs

For Windows 98 (T22 series)

Language	P/N
Arabic	14P9515*
Chinese, Simplified	27P2112*
Chinese, Traditional	27P2110*
Czech	14P9516*
Danish	23P9240*
Dutch	23P9247*
English, U.K.	23P9236*
English, U.S.	23P9235*
Finnish	23P9246*
French, Canadian	23P9237*
French, European	23P9241*
German	23P9242*
Greek	23P9266*
Hebrew	14P9517*
Hungarian	23P9267*
Italian	23P9245*
Japanese	46P4398*
Norwegian	23P9248*
Polish	23P9264*
Portuguese	23P9239*
Russian	23P9268*
Slovak	23P9270*
Slovenian	23P9269*
Spanish, European	23P9243*
Spanish, Latin American	23P9238*
Swedish	23P9244*
Thai	14P9519*
Turkish	14P9518*

For Windows 2000 (T22 series)

Language	P/N
Arabic	14P9525*
Czech	14P9526*
Greek	23P9218*
Hebrew	14P9527*
Hungarian	23P9219*
Polish	14P9528*
Russian	23P9220*
Slovak	23P9222*
Slovenian	23P9221*
Turkish	14P9529*

For Windows 2000/Windows NT (T22 series)

Language	P/N
Chinese, Simplified	27P2117*
Chinese, Traditional	27P2114*
Danish	23P9180*
Dutch	23P9187*
English, U.K.	23P9176*
English, U.S.	23P9175*
French, Canadian	23P9177*
French, European	23P9181*
Finnish	23P9186*
German	23P9182*
Italian	23P9185*
Japanese	27P1659*
Norwegian	23P9188*
Portuguese	23P9179*
Spanish, European	23P9183*
Spanish, Latin American	23P9178*
Swedish	23P9184*

For Windows 98 (T23 series)

Language	P/N
Arabic	14P9202*
Arabic (modem enabled)	14P9201*
Chinese, Simplified	46P4518*
Chinese, Traditional	46P4514*
Chinese, Traditional (Hong Kong S.A.R.)	46P6327*
Czech	14P9203*
Danish	14P9192*
Dutch	14P9199*
English, U.K.	14P9188*
English, U.S.	32P5573*
Finnish	14P9198*
French, Canadian	14P9189*
French, European	14P9193*
German	14P9194*
Greek	32P5653*
Hebrew	14P9204*
Hungarian	14P9208*
Italian	14P9197*
Japanese	46P4419*
Norwegian	14P9200*
Polish	14P9205*
Portuguese	14P9191*
Russian	14P9209*
Slovak	14P9211*
Slovenian	14P9210*
Spanish, European	14P9195*
Spanish, Latin American	14P9190*
Swedish	14P9196*
Thai	14P9212*
Turkish	14P9206*

For Windows 2000 (T23 series)

Language	P/N
Arabic	32P6633*
Chinese, Simplified	46P4520*
Chinese, Traditional	46P4516*
Chinese, Traditional (Hong Kong S.A.R.)	46P6329*
Czech	32P6634*
Danish	32P6624*
Dutch	32P6631*
English, U.K.	32P6620*
English, U.S.	32P6619*
Finnish	32P6630*
French, Canadian	32P6621*
French, European	32P6625*
German	32P6626*
Greek	32P6638*
Hebrew	32P6635*
Hungarian	32P6639*
Italian	32P6629*
Norwegian	32P6632*
Polish	32P6636*
Portuguese	32P6623*
Russian	32P6640*
Spanish, European	32P6627*
Spanish, Latin American	32P6622*
Swedish	32P6628*
Turkish	32P6637*

For Windows 2000/Windows NT (T23 series)

Language	P/N
Danish	14P9291*
Dutch	14P9298*
English, U.K.	32P5645*
English, U.S.	32P5576*
French, Canadian	14P9288*
French, European	14P9292*
Finnish	14P9297*
German	14P9293*
Italian	14P9296*
Japanese	46P4421*
Norwegian	32P5742*
Portuguese	14P9290*
Spanish, European	14P9294*
Spanish, Latin American	14P9289*
Swedish	14P9295*

For Windows XP (T23 series)

Language	P/N
Arabic	32P6736*
Chinese, Simplified	46L6288*
Chinese, Traditional	46L6287*
Chinese, Traditional (Hong Kong S.A.R.)	46P6362*
Czech	32P6737*
Danish	32P6727*
Dutch	32P6734*
English, U.K.	32P6723*
English, U.S.	32P6722*
Finnish	32P6733*
French, Canadian	32P6724*
French, European	32P6728*
German	32P6729*
Greek	32P6741*
Hebrew	32P6738*
Hungarian	32P6742*
Italian	32P3732*
Japanese	46P4457*
Norwegian	32P6735*
Polish	32P6739*
Portuguese	32P6726*
Russian	32P6743*
Spanish, European	32P6730*
Spanish, Latin American	32P6725*
Swedish	32P6731*
Turkish	32P6740*

Miscellaneous parts

Italicized letters in parentheses are reference to the exploded view on page 147 and 152.

FRU	P/N
Screw kit (including nylon-coated screws) for T20, T21, T22 and T23 series: • M2.5 x 14 mm, bind head (15) • M2.5 x 11.5 mm, flat head (5) • M2.5 x 4.8 mm, flat head (20) • M2.5 x 3.5 mm, flat head (10) • M2.0 x 13.5 mm, pan head (15) • M2..0 x 4.0 mm, small head (10) • Hex stud D-sub (10) • Coin screw (1) • Security screw (1) • Blank cap, enhanced port (5) • Screw caps, rear (5) • Screw caps (5) • Screw caps (painted) (10) • Screw caps (not painted, thin) (10) • Screw caps (not painted) (5)	26P9654
Base miscellaneous parts for T20, T21, T22 and T23 series: • Cover, RF ID • Spring, battery lock • Lid, docking FR • Lid, docking RR • Spring, lid docking • Spring, lid PC card • Lid, PC card • ESD plate, audio • Insulator for base cover • Eject lever • Spring lever • Puller bay • Label danger, backup battery • Rubber foot, low height (2) • Rubber foot, high (1) • Sponge • Knob, battery lock • Latch, battery lock • Screw caps • Screw caps, rear	26P9285

(continued)

FRU	P/N
System miscellaneous parts for T20 series: • (*a*) Hinge cover assembly • (23) Easy button cover • (*i*) I/O card spacer • (*h*) Cable RJ11 to system board docking • (*j*) Holder, backup battery • (*g*) Ultrabay 2000 guide rail • (*l*) Hard-disk bay guide rail • (*b*) Insulator, keyboard CRU • Mini PCI guide • Screw caps • Screw caps, rear **Note:** 12P4226 does not contain *c*, *d*, *e*, *f* and *k*.	12P4226
System miscellaneous parts for T21 series: • (*a*) Hinge cover assembly • (23) Easy button cover • (*i*) I/O card spacer • (*h*) Cable RJ11 to system board docking • (*j*) Holder, backup battery • (*g*) Ultrabay 2000 guide rail • (*l*) Hard-disk bay guide rail • (*b*) Insulator, keyboard CRU • (*c*) ESD fan cover • (*d*) ESD plate spring CSB • (*e*) ESD bracket, FPC • (*f*) Keyboard support • (24) Bracket, LCD FRC • Mini PCI guide • Grease • Screw caps • Screw caps, rear **Note:** 12P4227 does not contain *k*.	12P4227
System miscellaneous parts for T22 series: • (*a*) Hinge cover assembly • (23) Easy button cover • (*i*) I/O card spacer • (*h*) Cable RJ11 to system board docking • (*j*) Holder, backup battery • (*g*) Ultrabay 2000 guide rail • (*l*) Hard-disk bay guide rail • (*b*) Insulator, keyboard CRU • (*c*)ESD fan cover • (*d*) ESD plate spring CSB • (*e*) ESD bracket, FPC • (*f*) Keyboard support • (24) ESD bracket, LCD FPC • (*k*) Speaker RF bracket • Mini PCI guide • Grease • Screw caps • Screw caps, rear	12P4228

(continued)

FRU	P/N
System miscellaneous parts for T23 series: • (*a*) Hinge cover assembly • (23) Easy button cover T23 • (*g*) I/O card spacer • (*f*) Cable RJ11 to system board docking • (*h*) Holder, backup battery • (*e*) Ultrabay 2000 guide rail • (*j*) Hard-disk bay guide rail • (*b*) Insulator, keyboard CRU • (*k*) ESD bracket, FPC • (*d*) ESD bracket, LCD FPC • (*c*) EMI finger PCMCIA • (*i*) Bracket EMI speaker • Mini PCI guide • Thermal grease • Screw caps • Screw caps, rear	12P4229
I/O card miscellaneous parts for for T20, T21 and T22 series: • DC jack connector • Cable RJ11/45 to mini PCI • Insulator, modular jack • Insulation tape • Screw caps • Screw caps, rear	08K6683
I/O card miscellaneous part for T23 series: • DC jack connector • Cable RJ11/45 to Mini PCI/EDC • Insulator, modular jack • Insulator for system board • Insulation tape • Screw caps • Screw caps, rear	26P9789
System board miscellaneous parts for T20, T21 and T22 series: • System board stud • Insulator, PC card • Insulator, battery latch • Keyboard connector guide • Shock rubber • Insulator, docking connector • Insulator, fan connector • Insulator, Ultrabay 2000 connector • Insulator, I/O connector • Shield, Mini PCI • Insulator, hard-disk drive • Thermal grease • Screw caps • Screw caps, rear	08K7099

(continued)

Parts list

FRU	P/N
System board miscellaneous parts for T23 series: • System board stud • System board stud (long) • System board stud (back) • Insulator, PC card • Insulator, battery latch • Keyboard connector guide • Shock rubber • Insulator, docking connector • Insulator, Ultrabay 2000 bay connector • Insulator, I/O connector • Insulator, hard-disk drive • Shield, Mini PCI • Insulator, guide rail • Thermal grease • Screw caps • Screw caps, rear	26P9164

Optional FRUs

FRU	P/N
256-MB SDRAM SO DIMM (PC100)	33L3070*
64-MB SDRAM SO DIMM (PC133)	19K4651*
512-MB SDRAM SO DIMM (PC133)	19K4657*
Ultrabay 2000 diskette drive (TEAC)	08K9606*
Ultrabay 2000 diskette drive (SONY)	08K9607*
Ultrabay 2000 CD-ROM drive (24x) (LG)	27L4141*
Ultrabay 2000 CD-ROM drive (24x) (TOSHIBA)	27L3973*
Ultrabay 2000 DVD-ROM drive (6x) (MKE)	05K9188*
Ultrabay 2000 DVD-ROM drive (6x) (TOSHIBA)	05K9160*
Ultrabay 2000 DVD-ROM drive (8x) (MKE)	27L4241*
Ultrabay 2000 DVD-ROM drive (8x) (HITACHI)	27L4236*
Ultrabay Plus device carrier	26P9388*
Ultrabay Plus numeric keypad	19K2056*
Ultrabay Plus cradle for WorkPad c500 series	26P9389*

(continued)

FRU	P/N
Ultrabay 2000 SuperDisk drive (LS120)	05K9235*
Ultrabay 2000 SuperDisk drive (LS120 2x)	27L3450*
Ultrabay 2000 SuperDisk drive (LS240)	08K9615*
Ultrabay 2000 ZIP-250 drive	00N8254*
Ultrabay 2000 battery	02K6645*
Ultrabay 2000 2nd HDD adapter	08K6067*
Hard-disk drive (6.0 GB), STD	05K9227*
Hard-disk drive (6.0 GB), HITACHI	05K9228*
Hard-disk drive (10.0 GB), STD	08K9508*
Hard-disk drive (12.0 GB), STD	05K9229*
Hard-disk drive (12.0 GB), HITACHI	05K9230*
Hard-disk drive (18.0 GB), STD	27L4073*
Hard-disk drive (20.0 GB), STD	27L4286*
Hard-disk drive (32.0 GB), STD	08K9509*
Hard-disk drive (40.0 GB), STD	08K9683*
Hard-disk drive (48.0 GB), STD	08K9599*
Hard-disk drive (60.0 GB), STD	08K9700*
Mini PCI combo card (Intel)	08K9509*
Battery pack (Li-Ion) 9 cell, Panasonic	02K6615*
Battery pack (Li-Ion) 9 cell, SANYO	02K6619*
Multiple battery charger	02K6642*
Multiple battery charger (Ni-HM)	02K6718*
AC adapter (72 W), 3-pin (ASTEC)	02K6666*
AC adapter (72 W), 2-pin (ASTEC)	02K6669*
Asset ID RF adapter	08K6065*
ThinkPad Dock	08N1546*
PCI cover	05K6246*
ThinkPad Dock with extension plate	08N1537*
PCI cover with foot	08K7317*
Top cover and screw kit for ThinkPad Dock	12P4143*
ThinkPad Port Replicator	08N1536*
Diskette drive cable	27L0525*
Conversion adapter for diskette drive cable	08K6360*
Video cable	27L0531*
Telephone cable	05K2707*

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 1.62 **Note:** Download the file from the following Web site: `http://www.ibm.com/pc/partner/infotips`	—

Power cords (system)
IBM power cords for a specific country or region are usually available only in that country or region:

For 2-pin power cords:

Region	P/N
Canada, U.S.	13H5264*
Japan	13H5273*
Argentina	36L8870*

For 3-pin power cords:

Region	P/N
Australia, New Zealand	76H3514*
Taiwan, Thailand	76H3516*
Italy	76H3530*
Denmark	76H3520*
U.K., China (Hong Kong S.A.R.)	76H3524*
European countries	76H3518*
India, South Africa	76H3522*
Israel	76H3532*
Korea	76H3535*
China (P.R.C.) (other than Hong Kong S.A.R.)	02K0539*
Switzerland	76H3528*

Power cords (docking station)

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

For 3-pin power cords:

Region	P/N
Argentina	36L8868*
Australia, New Zealand	75H8988*
Canada, Thailand, U.S.	75H8989*
Denmark	75H8992*
European countries	75H8990*
India, South Africa	75H8993*
Israel	75H8999*
Italy	75H8998*
Japan	75H8996*
Korea	76H3536*
China (P.R.C.) (other than Hong Kong S.A.R)	02K0540*
Switzerland	75H8997*
U.K.	75H8994*

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