ThinkPad

Hardware Maintenance Manual

ThinkPad X131e Chromebook

Note: Before using this information and the product it supports, be sure to read the general information under Appendix A "Notices" on page 61.

Contents

About this manual

This manual contains service and reference information for the following ThinkPad® products.

ThinkPad X131e Chromebook™

Machine type (MT) 6283

Use this manual along with the advanced diagnostic tests to troubleshoot problems.

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

Before servicing a ThinkPad product, be sure to read all the information under and Chapter 3 "Important service information" on page 11.

Chapter 1. Safety information

This chapter presents following safety information that you need to be familiar with before you service a ThinkPad notebook 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 that 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 that you think is 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 technicians 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. Ensure 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, about 8 centimeters (3 inches) from the end.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing, because metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
- Reinstall all covers correctly before returning the machine to the customer.
- Fan louvers on the machine help to prevent overheating of internal components. Do not obstruct fan louvers or cover them with labels or stickers.

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. That 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.

    CAUTION:
    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. Instructions for these precautions 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:
  - Power supply units
  - Pumps
  - Blowers and thermal fan assembly
  - Motor generators
  - Units similar to those listed above

  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 technicians from injury. This guide addresses only those items. You should use good judgment to identify potential safety hazards due to attachment of non-ThinkPad 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. Turn 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 the frame ground.
   b. The power cord should be the authorized type specified for your computer on the Web page http://www.lenovo.com/serviceparts-lookup.
   c. Insulation must not be frayed or worn.
4. Check for cracked or bulging batteries.
5. Remove the cover.
6. Check for any obvious non-ThinkPad alterations. Use good judgment as to the safety of any non-ThinkPad alterations.
7. Check inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
8. Check for worn, frayed, or pinched cables.
9. Check that the power-supply cover fasteners (screws or rivets) have not been removed or tampered with.

Handling devices that are sensitive to electrostatic 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. Ensure 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 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 to guard against ESD damage is desirable but not necessary.

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

Safety notices

DANGER

> 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 left loose inside the computer. Verify this by shaking the computer and listening for rattling sounds. Metallic parts or metal flakes can cause electrical short circuits.

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.

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.

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.

DANGER

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.

DANGER

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

DANGER

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

DANGER

Unless hot swap is allowed for the FRU being replaced, do as follows before removing it: power off the computer, unplug all power cords from electrical outlets, remove the battery pack, and disconnect any interconnecting cables.

Chapter 2. General checkout

This chapter presents following information:

Be sure to read the following important notes.

Important:

- **Only certified trained personnel should service the computer. Personnel repairing the Lenovo Chromebook computer must have completed the certification course number RTPW1170 or CTPi217.**

- **Before replacing any Field Replaceable Unit (FRU), read the entire page on removing and replacing FRUs.**

- **When you replace FRUs, it is recommended to use new nylon-coated screws.**

- **Be extremely careful during such write operations as copying, saving, or formatting.** The sequence of the drives in the computer that you are servicing might have been altered. If you select an incorrect drive, data or programs might be overwritten.

- **Replace a FRU only with another FRU of the correct model.** When you replace a FRU, ensure that the model of the machine and the FRU part number are correct by referring to the FRU parts list on the Web page http://www.lenovo.com/serviceparts-lookup.

- **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 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 service technician
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: 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. Following is a list of some common items that are not covered under warranty and some symptoms that might indicate that the system was subject 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 list:

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
- Plastic parts, latches, pins, or connectors that have been cracked or broken 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
- 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
- Use of an incorrect ac power adapter on laptop products

The following symptom might indicate damage caused by nonwarranted activities:
- Missing parts might be a symptom of unauthorized service or modification.
- Check for obvious damage to a hard disk drive. If the spindle of a hard disk drive becomes noisy, the hard disk drive might have been dropped or subject to excessive force.

Power system checkout

To verify a symptom, do the following:
1. Turn off the computer.
2. Remove the battery pack.
3. Connect the ac adapter.
4. Check that power is supplied when you turn on the computer.
5. Turn off the computer.
6. Disconnect the ac adapter and install the charged battery pack.
7. Check that the battery pack supplies power when you turn on the computer.

If you suspect a power problem, see the appropriate one of the following power supply checkouts:
- "Checking the ac power adapter" on page 8
- "Checking operational charging" on page 9
- "Checking the battery pack" on page 9

Checking the ac power adapter

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

- If the power-on indicator does not turn on, check the power cord of the ac power adapter for correct continuity and installation.

- If the computer does not charge during operation, go to "Checking operational charging" on page 9

To check the ac adapter, do the following:
1. Unplug the ac adapter cable from the computer.
2. Measure the output voltage at the plug of the ac adapter cable. See the following figure:
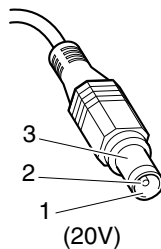
Pin	Voltage (V dc)
1	+20
2	0
3	Ground

Note: Output voltage across pin 2 of the ac power adapter might differ from the one you are servicing.
3. If the voltage is not correct, replace the ac adapter.
4. If the voltage is acceptable, replace the system board.

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

Checking operational charging

To check whether the battery pack charges properly during operation, do the following:

Note: Before you begin, install a discharged battery pack or a battery pack that has less than 50% of the total power remaining in the computer.

1. If the battery status indicator or icon does not turn on, remove the battery pack and let it return to room temperature.
2. Reinstall the battery pack.
3. If the battery status indicator still does not turn on, replace the battery pack.
4. If the battery indicator still does not turn on, replace the system board. Otherwise, refer to "Checking the battery pack" on page 9 to check the original battery pack.

Checking the battery pack

The battery status indicator is located in the lower-right corner of the screen. To view the percentage of battery power remaining, click the battery status 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. Turn off the computer and disconnect the ac power adapter.
2. Remove the battery pack and measure the voltage between battery terminals 1 (+) and 7 (-). See the following table:
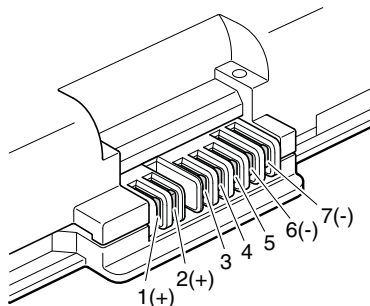
Terminal	Voltage (V dc)
1	+ 0 to + 12.6
7	Ground (-)

3. Measure the resistance between battery terminals 5 and 7. The resistance should be 4 to 30 KΩ. If the resistance is not correct, replace the battery pack.
4. Depending on the voltage that you measure, do one of the following:

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

   - If the voltage is more than +11.0 V dc, discharge the battery pack until the voltage becomes less than +11.0 V dc, and then recharge the battery pack. If the voltage still is less than +11 V dc after recharging, replace the battery pack.

   Note: Recharging will take at least three hours, even if the battery status indicator does not turn on.
5. Replace the system board if the new battery pack is not charged.

Chapter 3. Important service information

This chapter presents the following important service:
- "Power management" on page 11
- "Symptom-to-FRU index" on page 11
- "Overview of the Chromebook USB repair shim" on page 13
- "Strategy for replacing FRUs for GAV" on page 17
- "Strategies for replacing FRUs" on page 17

Important:
- Advise customers to contact the Lenovo® Customer Support Center if they need any assistance. Telephone numbers for Lenovo Support are available at:
  http://www.lenovo.com/support/phone
- System disassembly and reassembly videos that show the FRU removal or replacement procedures for the Lenovo authorized service technicians are available at:
  http://www.lenovoservicetraining.com/ion/

Power management

To reduce power consumption, put the computer into sleep mode if you do not use it.

When the computer enters sleep mode, the following events occur:
- The LCD is powered off.
- The microprocessor stops.

To enter sleep mode, close the lid if you are logged in. To resume from sleep mode, open the computer lid and press any key.

Note: If you are not logged in, closing the lid will shut down the computer.

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

- After a period of inactivity

- When the battery indicator blinks orange, indicating that the battery power is low

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

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

Symptom-to-FRU index

This section contains following information:
- "LCD-related symptoms" on page 12
- "Intermittent problems" on page 12
- "Undetermined problems" on page 12

The symptom-to-FRU index in this section lists some symptoms 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 what FRUs need to be replaced next during regular servicing.

LCD-related symptoms

Important: The TFT LCD for the notebook computer contains many thin-film transistors (TFTs). The presence of 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. If the LCD you are servicing has two or less visible defective pixels, it should not be considered faulty. However, if the LCD has three or more visible defective pixels, it will be deemed as defective by Lenovo and it should be replaced.

Notes:

- This policy applies to all ThinkPad notebook computers purchased on 1 January, 2008 or later.
- Lenovo will not provide warranty replacement if the LCD is within specifications because we cannot guarantee that any replacement LCD will have zero pixel defects
- One pixel consists of R, G, B sub-pixels.

Table 1. LCD-related symptoms

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.

Undetermined problems

If wrong devices are installed, or if the system simply is not operating, 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 8)

1. Turn 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-ThinkPad devices
b. Printer, mouse, and other external devices
c. Battery pack
d. Hard disk drive or solid-state drive
e. External drive
f. Memory module installed in slot **b** ("1030 Memory modules" on page 35)
g. PC Cards
4. Turn on the computer.
5. Determine whether the problem has been solved.
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

Overview of the Chromebook USB repair shim

This section provides information about the recovery solution on the Chrome OS™ operating system by using the Chromebook USB repair shim (hereafter referred to as the repair shim).

The repair shim is a bootable device that is required to service the Chromebook computer. The repair shim is used for the following purposes:

• Diagnose problems and restore the system to the factory default settings

• Refresh the system with the latest firmware and software

The repair shim is not necessary when a Customer Replaceable Unit (CRU) is replaced. If a non-CRU is broken, or there is a strong suspicion that a particular non-CRU is defective, it can be replaced before using the repair shim. Otherwise, the repair shim must be used before any non-CRU is replaced.

The following is the list of CRUs for a Chromebook computer:

• ac power adapter

• Battery pack

• Bottom slot cover

• Keyboard

• Memory module

• Trackpoint cap

For CRU definition, see "Locating FRUs and CRUs" on page 24.

Creating the repair shim

Lenovo service technicians need to download the repair shim image from the Lenovo Support Web site to create a repair shim. A Lenovo service credential is required to download the image.

Notes:

• To create the repair shim, a USB device with at least 4 gigabyte (GB) of storage is required. The required USB storage capacity depends on the size of the recovery image.

• You might also need a recovery tool to create the repair shim. To prevent potential performance risks or unexpected failure, it is recommended that you use the Win32 Disk Imager to create the repair shim.

• Ensure that you create the repair shim using the latest version of the repair shim image. If you use an earlier version, it might cause the repair process to fail.

To create the repair shim, do the following:

Attention: Creating the repair shim will delete all data stored on the USB device. To avoid data loss, make a backup copy of all the data that you want to keep.

1. Download the latest version of the repair shim image from the Lenovo Support Web site at: http://www.lenovo.com/support
2. Extract the downloaded file that contains the repair shim image.
3. Download the recovery tool. The Win32 Disk Imager recovery tool is available at: http://sourceforge.net/projects/win32diskimager/
4. Run the recovery tool and follow the instructions on the screen to create the recovery shim.
5. After you recover the Chromebook computer, format the USB device. If you do not format the USB device, you will not be able to use the storage space. Also, the USB device might not be recognizable by the Windows operating system.

Setting the write-protect switch

By default, the on-board Read-Only Memories (ROMs) are set as write-protected. Before refreshing the Chromebook firmware, set the ROMs as unprotected by flipping the write-protect switch on the system board.

To flip the write-protect switch, do the following:
1. Disconnect the ac power adapter and all cables from the computer, and then remove the battery pack. See "1010 Battery pack" on page 33.
2. Remove the bottom slot cover. See "1020 Bottom slot cover" on page 34.
3. Depending on the model type, do the following:
   - For models with a hard disk drive or solid-state drive installed, remove the hard disk drive or solid-state drive. See "1070 Hard disk drive or solid-state drive assembly" on page 39.
   - For models with an empty hard disk drive bracket installed, remove the hard disk drive bracket. See "1080 Hard disk drive bracket" on page 40.
4. Remove the keyboard. See "1090 Keyboard" on page 41.
5. Remove the keyboard bezel assembly. See "1110 Keyboard bezel assembly" on page 44.
6. Locate the write-protect switch on the system board as shown in the following illustration. To turn off the write-protect function, flip the write-protect switch to the left as shown by the arrow **a**. To turn on the write-protect function, flip the write-protect switch to the right as shown by the arrow **b**.
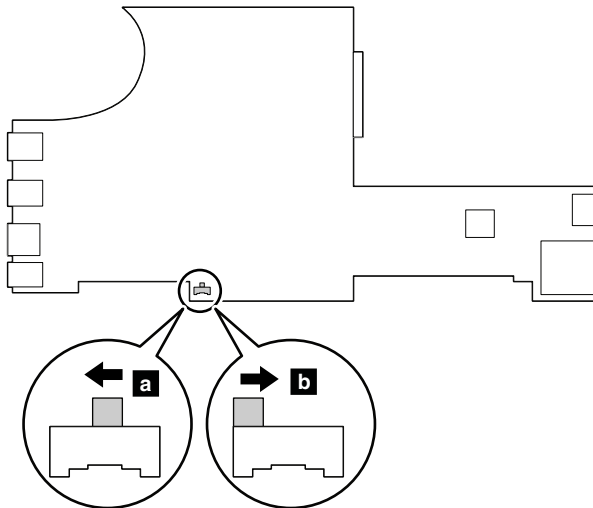
7. After you have flipped the write-protect switch, reassemble the computer. Reinstall the battery back and reconnect the ac power adapter and all cables.

Using the repair shim

This section provides instructions on how to use the repair shim you have created.

To use the repair shim, do the following:

1. Turn off the write-protect function. See "Setting the write-protect switch" on page 14.
2. Disconnect the ac power adapter, and then remove the battery pack. Wait for about five seconds. Then reinstall the battery pack, and reattach the ac power adapter.
3. Wait for about five seconds. Press and hold Esc and the refresh key (c), and then press the power button to start the computer and enter recovery mode.
4. When the recovery screen is displayed, press and hold Ctrl+D, and then press Enter. The system automatically restarts and enters developer mode.
5. Turn off the computer. Then repeat step 2 and step 3 to start the computer and enter recovery mode.
6. When the recovery screen is displayed, connect the repair shim to the USB connector on the right-side of the computer. The repair shim will update the firmware and image automatically. When the update process finishes, the computer will restart and enter the factory-test-image environment.

   Notes:
   - Do not connect the repair shim to the USB connectors on the left-side of the computer.
   - The update process is automatic, and takes less than 10 minutes. Status information will be displayed on the computer screen during the process.
7. Remove the repair shim and put it in a safe place. Follow the instructions on the screen to start the factory text items. For information about the factory test items, see "Factory test items" on page 16.
8. If the factory test items revealed a defective component, turn off the computer, disconnect the ac power adapter, and then replace the defective component. For more information about the replacement procedure, see Chapter 7 "Removing or replacing a FRU" on page 31.
9. Turn on the write-protect function. See "Setting the write-protect switch" on page 14.
10. Turn on the computer, and it will enter the factory-test-image environment again. It is recommended that you run Stress Test and FactoryFlow Test to ensure that new components function correctly.

Note: It is not necessary to turn off the write-protect function again if additional components need to be replaced.

11. Run the Google Required Test (GRT) and the Hardware Identity (HWID) Test. If the tests finish successfully, the system will automatically restart and enter the Chrome OS operating system.

   Notes:

   - If the system board is replaced, you are required to enter the 16-character machine type and model (MTM) and serial number (SN) string. The string consists of the 4-digit machine type, 3-digit model number, 7-digit SN, and is preceded by the characters "1S". You can find the MTM and SN label attached in the battery compartment. For the location of the MTM and SN label, see "Applying labels to the base cover" on page 53.

     If the MTM and SN are already displayed, and match the numbers shown on the label in the battery compartment, press Esc to leave the values as they are.

   - If any test is marked as failed, the final process will not complete. The final process can be forced to complete by pressing F. Do not force the final process to complete when a component fails the test. Force the final process to complete only when the test has to be bypassed, because it cannot be performed.

   - After the repair process finishes, the system is in a clean out-of-box state. If applicable, customers need to reenroll the system for enterprise enrollment.

   - If the GRT test fails, refer to the common mistakes that lead to GRT failure in "Factory test items" on page 16.

Factory test items

After the system enters the factory-test-image environment, factory test items will run. The factory test process contains the following three types of tests:

- **Stress Test**: The Stress Test is designed to test how the system functions under stress by running the maximum workload applications. The Stress Test includes the test of the memory module, microprocessor, and graphics card. The test takes about 15 minutes to finish and can be cancelled during the process. If the test is cancelled, it will be marked as failed.

- **FactoryFlow Test**: The FactoryFlow Test is designed to test the individual component to verify its function, such as the TPM, display, audio, camera, keyboard, and so on. It is recommended to run all the FactoryFlow Test items. Some test items might require an HDMI monitor or a SD card. If the HDMI monitor or SD card is not available, the tests can be bypassed, but with the overall test marked as failed.

- **GRT**: GRT test checks the system status and helps reset the system back to the factory default settings. If anything is wrong, the test cannot be finalized. The following items are some common mistakes that lead to GRT test failure:

  - **HWID mismatch**: Each Chromebook computer has a known hardware configuration. Each configuration is assigned a HWID. HWID mismatch can be caused by using unauthorized parts, or missing parts. For more information about HWID, see "Hardware identity" on page 32.

    If the write-protect function is not turned off before using the repair shim, it will also cause HWID mismatch. For instructions on how to turn off the write-protect function, see "Setting the write-protect switch" on page 14.

  - **VPD (Vital Product Data) incorrect**: Confirm that the 16-character MTM and serial number string is entered correctly. For example, if the MTM is 6283-ABC, and the serial number is LR12345, the correct string should be "1S6283ABCLR12345".

  - **Write-protect switch is off**: System cannot be finalized until the write-protect switch is turned back on.

Strategies for replacing FRUs

Use the following strategies 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 a device consists of more than one FRU, any of the FRUs might 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.

Strategy for replacing FRUs for GAV

General Announce Variant (GAV)

This is a standard model (fixed configuration). GAVs are announced and offered to all customers. The MTM portion of the machine label is a 4-digit MT and 3-digit model, where model = a "fixed part number", for example: 1829-F1U. Also, eSupport will list these products under the same fixed model number.

FRU identification for GAV products

Use Lenovo eSupport to identify major FRUs, FRU part numbers, and FRU descriptions for GAV products at an MT - serial number level. Examples of major FRUs are hard disk drive, system board, liquid crystal display (LCD), and memory module.

To identify the major FRUs for a product, do the following:
1. Go to:
   http://www.lenovo.com/support
2. Click **Warranty & Services**.
3. Click **Check Warranty Status**.
4. On the Warranty Status Lookup page, click **Parts Lookup**.
5. Type your machine type and serial number, and then click **Submit**.

eSupport also can be used to view the general FRU list for a product.

To get the general FRU list for a product, do the following:
1. Go to:
   http://www.lenovo.com/support
2. Click **Parts & Accessories**.
3. Follow the instructions on the screen to select product.
4. Click **Products and Parts Detail**.
5. On the PRODUCT AND PARTS DETAIL page, click the **Parts Detail** tab to view the FRU list.

   Note: The FRU list is a general list of components and does not contain specific model information.

Chapter 4. Status indicators

This chapter presents the system status indicators that show the status of the computer.
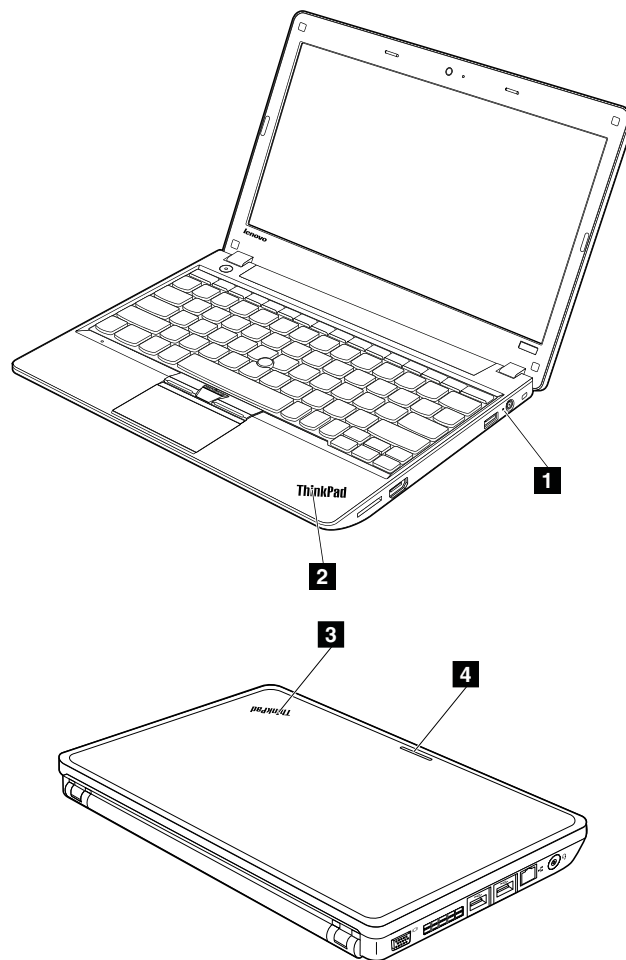
Table 2. Status indicators

Indicator	Meaning
1 ac power status indicator	• **Green:** The ac power adapter is connected. • **Off:** The ac power adapter is not connected.
2 3 System status indicator	The illuminated dot in the ThinkPad logo on the outer lid of the computer and on the palm rest works as a system status indicator: it shows whether the computer is in sleep, or normal mode. • **Red:** The computer is on . • **Fast blinking red:** The computer is entering sleep mode. • **Slow blinking red:** The computer is in sleep mode. • **Off:** The computer is off.
4 Wireless status indicator	• **Green:** The wireless features, such as wireless LAN, Bluetooth, and wireless WAN, are enabled. • **Off:** The wireless features are disabled.

Chapter 5. Special keys

The following table describes the functions of some special keys to help you use the keyboard more effectively.

| Special keys	Function
←	Goes back to the previous page.
→	Goes forward to the next page.
C	Refreshes the current page.
▱	Opens the current page in full-screen mode.
▭⫿	Switches to the next window.
☀	Adjusts the screen brightness to a lower level.
☀	Adjusts the screen brightness to a higher level.
🔇	Mutes the speaker.
🔈	Decreases the volume.
🔊	Increases the volume.
🔒	Locks the computer.
🔍	Searches applications and the Web. You also can use the Search key to enable Caps Lock function by customizing it. After you have enabled the Caps Lock function, you can type all alphabetic characters (A-Z) in uppercase. To customize the Search key, click the status area in the lower-right corner of the screen, then go to **Settings → Device → Keyboard settings**. Customize the Search key as desired.
◇	By default, this key is set to provide the function of a Ctrl key. However, you can customize it as desired. To customize this key, click the status area in the lower-right corner of the screen, and then go to **Settings → Device → Keyboard settings**.
⌨	Opens help information for the keyboard.

Chapter 6. Locations

This chapter introduces the locations of the computer hardware components.

Locating computer controls, connectors, and indicators

This topic introduces the locations of the computer controls, connectors, and indicators.

Front view
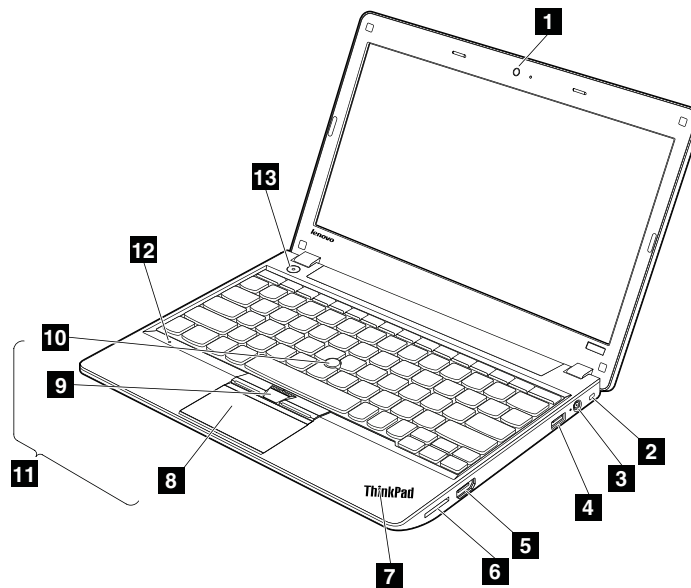
1 Camera   **8** Touch pad

2 Security keyhole   **9** TrackPoint buttons

3 ac power connector   **10** TrackPoint pointing stick

4 USB 2.0 connector   **11** UltraNav® pointing device

5 HDMI connector   **12** Microphone

6 Media card reader slot   **13** Power button

7 System status indicator

7: For more information, see Chapter 4 "Status indicators" on page 19.

Rear view
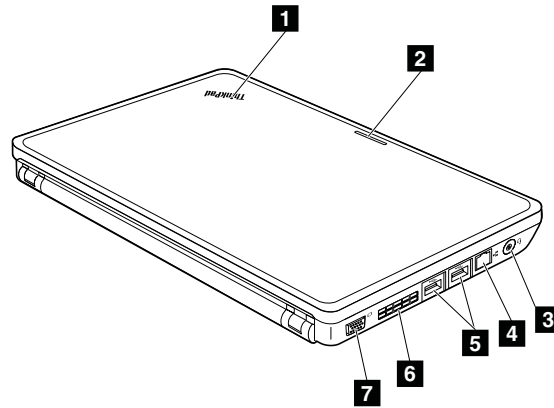
1 System status indicator   **5** USB 3.0 connectors

2 Wireless status indicator   **6** Fan louver

3 Combo audio connector   **7** Video graphics array (VGA) connector

4 RJ45 Ethernet connector

1 2: For more information, see Chapter 4 "Status indicators" on page 19.

Bottom view
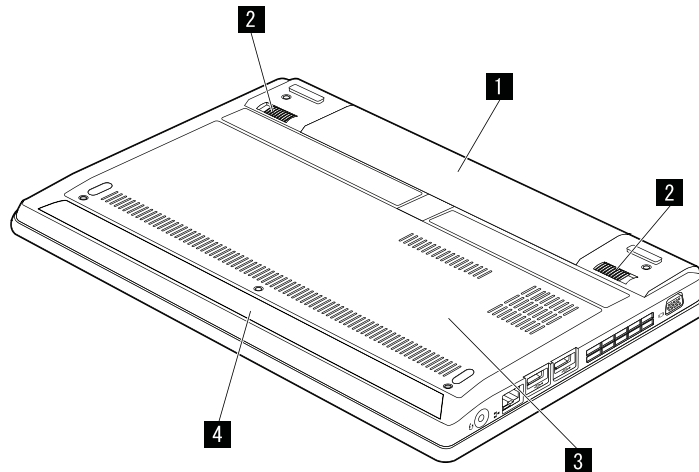
1 Battery pack   **3** Bottom slot cover

2 Battery pack latches   **4** Speaker

Locating FRUs and CRUs

This topic introduces the following service parts:
- "Major FRUs and CRUs" on page 26
- "LCD FRUs and CRUs" on page 28

Notes:

- Each FRU is available for all types or models, unless otherwise specified.

- **CRU statement for customers:**

  You can resolve some problems with your product with a replacement part you can install yourself, called a "Customer Replaceable Unit" or "CRU." Some CRUs are designated as self-service CRUs and others are designated as optional-service CRUs. *Installation of self-service CRUs is your responsibility. For optional-service CRUs, you can either install the CRU yourself or you can request that a Service Provider installs the CRU according to the warranty service for your product.* If you intend on installing the CRU, Lenovo will ship the CRU to you. CRU information and replacement instructions are shipped with your product and are available from Lenovo at any time upon request. You can find a list of CRUs for your product in this *Hardware Maintenance Manual*. An electronic version of this manual can be found at http://www.lenovo.com/support. Click **User Guides & Manuals** and then follow the on-screen instructions to find the manual for your product. You might be required to return the defective part that is replaced by the CRU. When return is required: (1) return instructions, a prepaid shipping label, and a container will be included with the replacement CRU; and (2) you might be charged for the replacement CRU if Lenovo does not receive the defective CRU within thirty (30) days of your receipt of the replacement CRU. See your Lenovo Limited Warranty documentation for full details.

  ThinkPad computers contain the following types of CRUs:

  – **Self-service CRUs:** These CRUs unplug or are held by no more than two screws. Examples of these types of CRUs include the ac power adapter, power cord, and battery. Other self-service CRUs depending on product design might include the memory module, wireless card, keyboard, and palm rest with finger print reader and touchpad.

  – **Optional-service CRUs:** These CRUs are isolated parts within the computer that are concealed by an access panel that is typically secured by more than two screws. Once the access panel is removed, the specific CRU is visible.
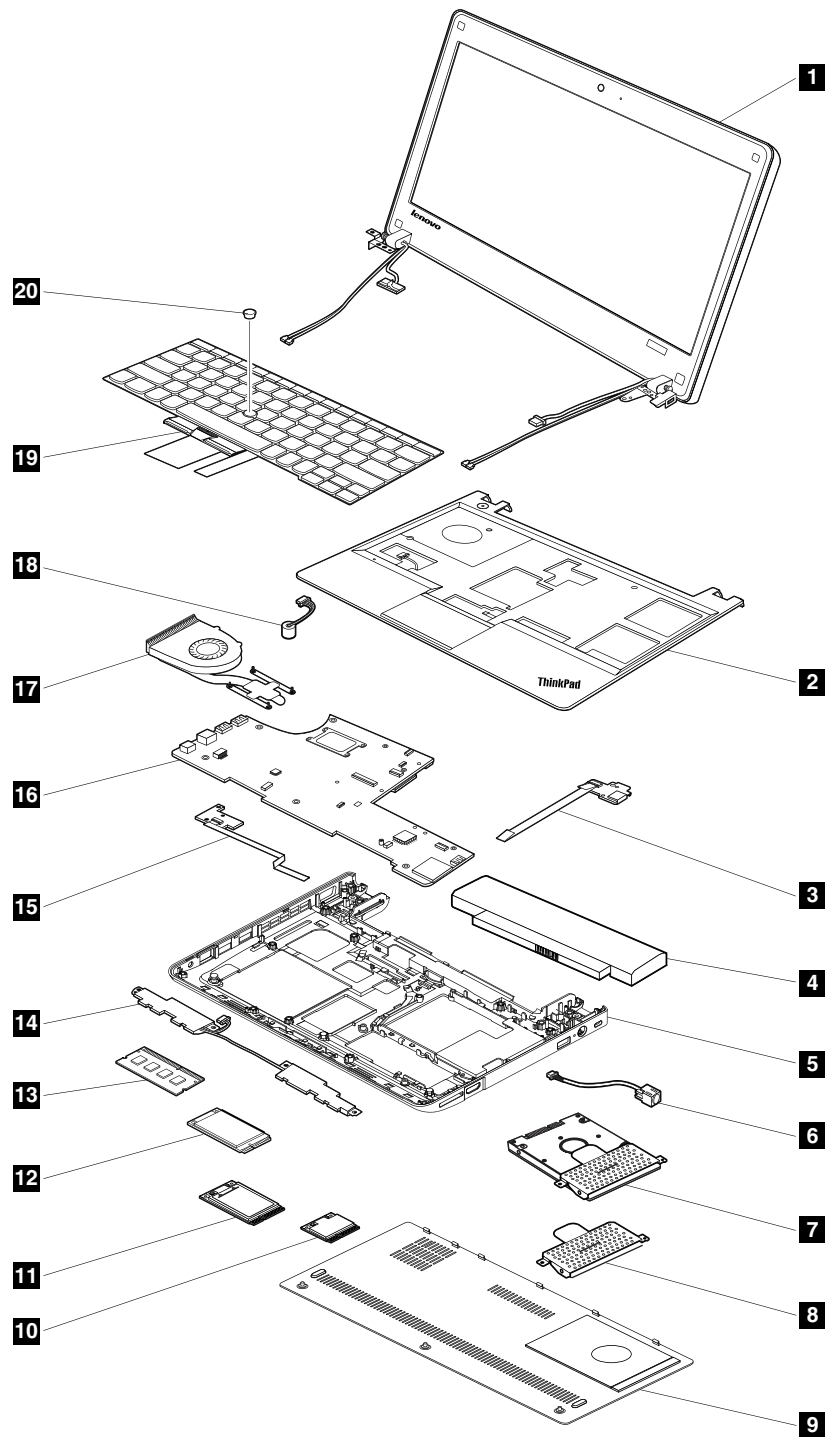
Major FRUs and CRUs

Table 3. Major FRUs and CRUs

No.	FRU description	Self-service CRU	Optional-service CRU
1	LCD unit (See "LCD FRUs and CRUs" on page 28.)	No	No
2	Keyboard bezel assembly	No	No

Table 3. Major FRUs and CRUs (continued)

No.	FRU description	Self-service CRU	Optional-service CRU
3	I/O board	No	No
4	Battery	Yes	No
5	Base cover assembly	No	No
6	DC-in cable assembly	No	No
7	Hard disk drive or solid state drive (on some models)	No	No
8	Hard disk drive bracket (on some models)	No	No
9	Bottom slot cover	Yes	No
10	PCI Express Mini Card for wireless LAN	No	No
11	PCI Express Mini Card for wireless WAN (on some models)	No	No
12	mSATA solid-state drive (on some models)	No	No
13	Memory module	Yes	No
14	Speaker assembly	No	No
15	CRT board assembly	No	No
16	System board	No	No
17	Thermal fan assembly	No	No
18	Microphone	No	No
19	Keyboard	Yes	No
20	TrackPoint cap	Yes	No

LCD FRUs and CRUs
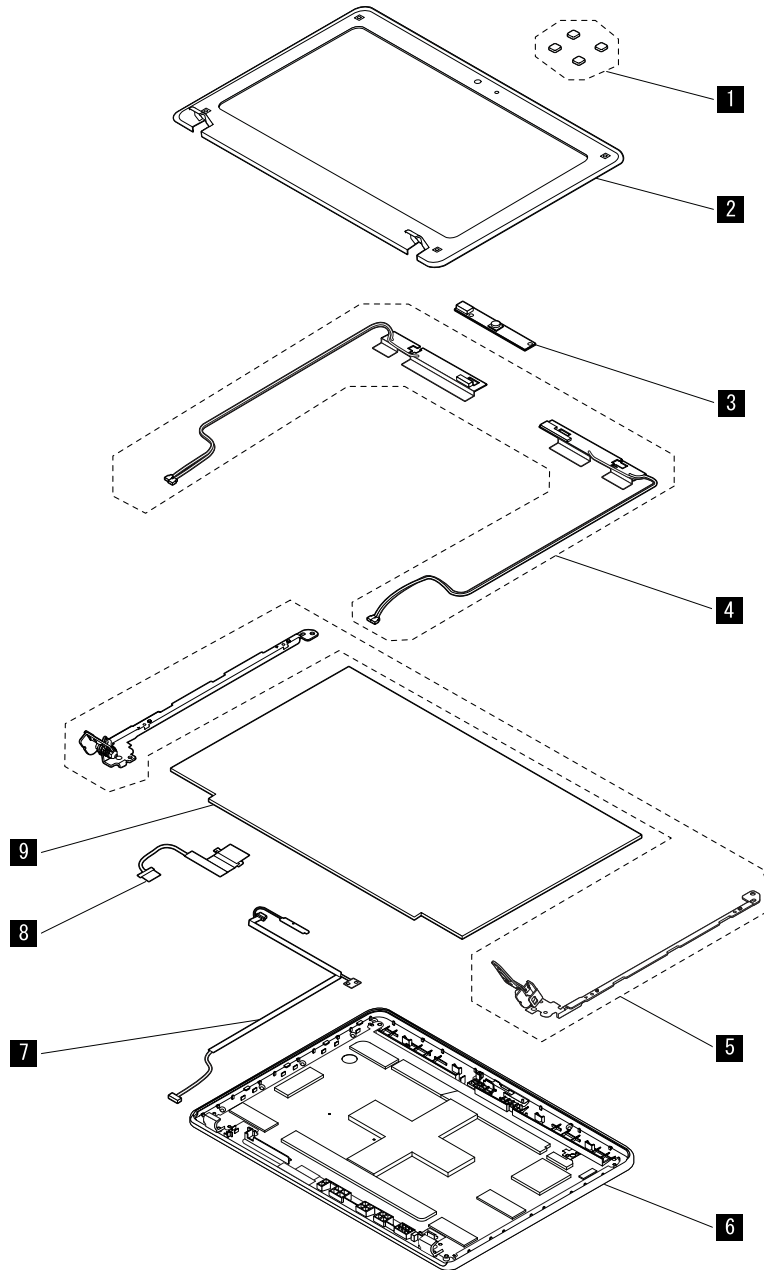
Table 4. LCD FRUs and CRUs

No.	FRU description	Self-service CRU	Optional-service CRU
1	LCD screw caps	No	No
2	LCD bezel assembly	No	No
3	Camera	No	No
4	Antenna kit	No	No
5	Hinges	No	No
6	LCD rear cover assembly	No	No

Table 4. LCD FRUs and CRUs (continued)

No.	FRU description	Self-service CRU	Optional-service CRU
7	Camera cable	No	No
8	LCD cable	No	No
9	LCD panel	No	No

Miscellaneous kits and other parts

Table 5. Miscellaneous kits

FRU descriptions	Self-service CRU	Optional service
LCD cover miscellaneous kit • LCD bracket • LCD gasket • LCD cover foil • LCD foil sheet • Screw M2 x L5 • Screw M1.7 x L3 • CCD lens mylar • Magnet • Bezel rubber • Antenna rubber	No	No
Base cover assembly miscellaneous kit • Base gasket • Base foil • Battery latch-Right • Battery latch-Left • Battery latch spring • Battery knob • Screw M2.5 x L6 • Screw M2.0 x L3 • Screw M2.0 x L5 • Screw M2.0 x L8	No	No
Bottom slot cover miscellaneous kit • Bottom slot cover sponge • Bottom slot cover gasket • Bottom slot cover acid tap • Foot rubber-left and right • Capture screw M2 x L4 • Mylar sheet • Thermal mesh	No	No
Bracket extender half mini card	No	No
Screw kit	No	No

Table 6. Other parts

Descriptions	Self-service CRU	Optional service
ac power adapter	Yes	No
Power cord	Yes	No

Chapter 7. Removing or replacing a FRU

This chapter provides instructions on how to remove or replace a FRU.

CRU statement for customers:
You can resolve some problems with your product with a replacement part you can install yourself, called a "Customer Replaceable Unit" or "CRU." Some CRUs are designated as self-service CRUs and others are designated as optional-service CRUs. *Installation of self-service CRUs is your responsibility. For optional-service CRUs, you can either install the CRU yourself or you can request that a Service Provider installs the CRU according to the warranty service for your product.* If you intend on installing the CRU, Lenovo will ship the CRU to you. CRU information and replacement instructions are shipped with your product and are available from Lenovo at any time upon request. You can find a list of CRUs for your product in this *Hardware Maintenance Manual*. An electronic version of this manual can be found at http://www.lenovo.com/support. Click **User Guides & Manuals** and then follow the on-screen instructions to find the manual for your product. You might be required to return the defective part that is replaced by the CRU. When return is required: (1) return instructions, a prepaid shipping label, and a container will be included with the replacement CRU; and (2) you might be charged for the replacement CRU if Lenovo does not receive the defective CRU within thirty (30) days of your receipt of the replacement CRU. See your Lenovo Limited Warranty documentation for full details.

General guidelines

When removing or replacing a FRU, be sure to observe the following general guidelines:

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. Begin by removing any FRUs that have to be removed before replacing the failing FRU. Any such FRUs are listed at the beginning of each FRU replacement procedure. Remove them in the order in which they are listed.

3. Follow the correct sequence in the steps for removing the FRU, as given in the drawings by the numbers in square callouts.

4. When turning a screw, turn it in the direction as given by the arrow in the drawing.

5. When removing the FRU, move it in the direction as given by the arrow in the drawing.

6. To put the new FRU in place, reverse the removal procedure and follow any notes that pertain to replacement.

7. When replacing a FRU, use the correct screw(s) as shown in the replacement procedure.

⚠️DANGER

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

Attention:

- After replacing a FRU, do not turn on the computer until you have made sure that all screws, springs, and other small parts are in place and none are 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.

- 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.

Screw notices

Loose screws can cause a reliability problem. In the ThinkPad notebook 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.

Do the following when you service this machine:
- Keep the screw kit in your tool bag. For the part number of the screw kit, go to http://www.lenovo.com/serviceparts-lookup.
- It is recommended to use new screws.
- It is recommended to use each screw only once.
- 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)
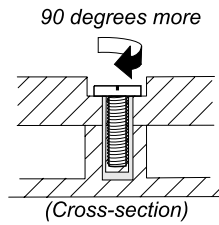
- **Logic card to plastic**
  Turn an additional **180 degrees** after the screw head touches the surface of the logic card:

180 degrees more

(Cross-section)
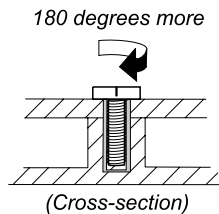
- **Torque driver**
  If you have a torque driver, refer to the **Torque** column in the screw information table for each step.
  – Ensure that you use the correct screw. It is recommended to use new screws for replacements.
  – If you have a torque screwdriver, tighten all screws firmly to the torque specified in the screw information table for each step.
  – Ensure that torque screw drivers are calibrated correctly following country specifications.

Hardware identity

A set of valid hardware identities (HWIDs) are provided by Google. Google logs the exact hardware combination into a Chromebook computer and creates a HWID. The HWID is used to ensure that all parts are valid during the repair of the Chromebook computer. The HWID is used for the following purposes:

- Auto-update new patches and software for the lifetime of the computer
- Recover the computer to the factory default settings

If unauthorized parts are installed, you might not get the correct auto-updates for your computer, or you might not recover your computer successfully to the factory default settings. For example, if you install a different model of the wireless LAN card, which is not the required configuration, the HWID will not match.

HWID is checked by using the repair shim. For information about the repair shim, see "Overview of the Chromebook USB repair shim" on page 13.

Prerequisite for replacing a FRU

Use the repair shim before replacing any non-CRUs. The following is the list of CRUs for a Chromebook computer:

- ac power adapter
- Battery pack
- Bottom slot cover
- Keyboard
- Memory module
- Trackpoint cap

For CRU definition, see "Locating FRUs and CRUs" on page 24.

For information about how to use the repair shim, see "Overview of the Chromebook USB repair shim" on page 13.

1010 Battery pack

Note: You can replace the battery pack only if it is physically damaged or a customer is reporting a possible safety issue.

Removal steps of battery pack

⚠️**DANGER**

Use only the authorized battery specified for your computer. Any other battery could ignite or explode.
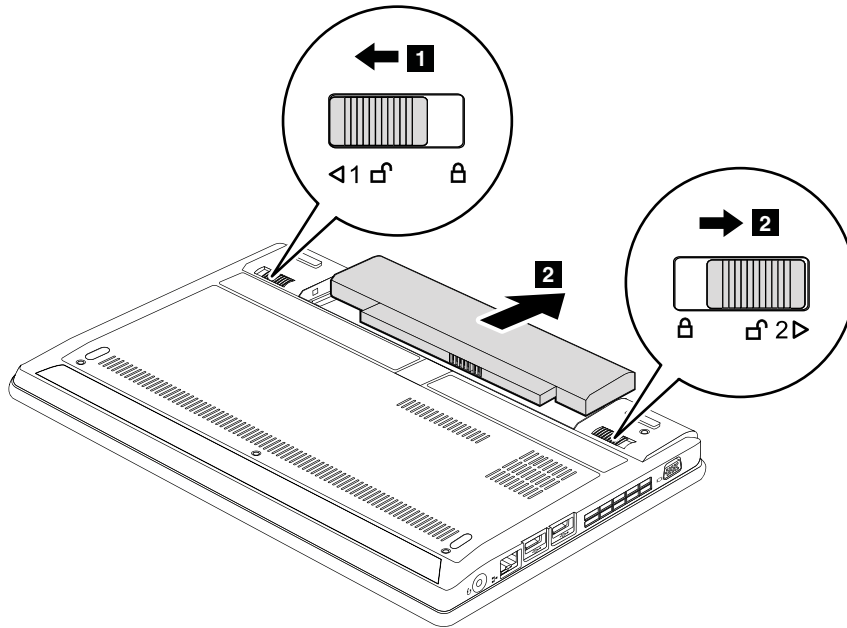
When installing: Ensure that the battery latch **2** is in the locked position.

1020 Bottom slot cover

For access, remove this FRU:
• "1010 Battery pack" on page 33

Removal steps of bottom slot cover

Note: Loosen the screws **1**, but do not remove them.
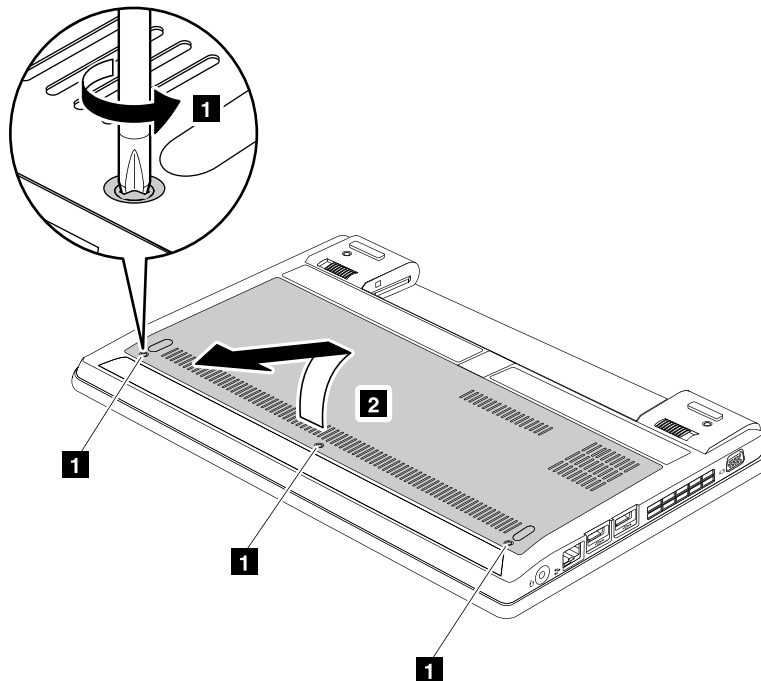
1030 Memory modules

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
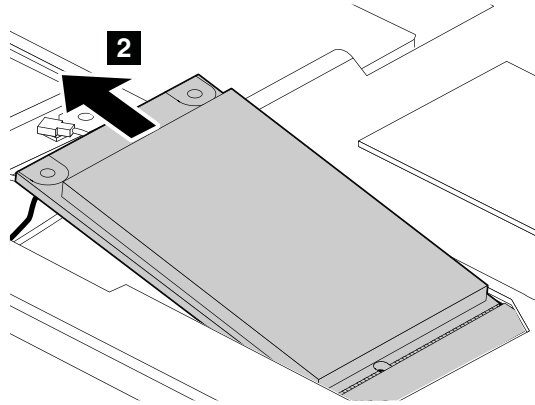- "1020 Bottom slot cover" on page 34

Removal steps of memory modules
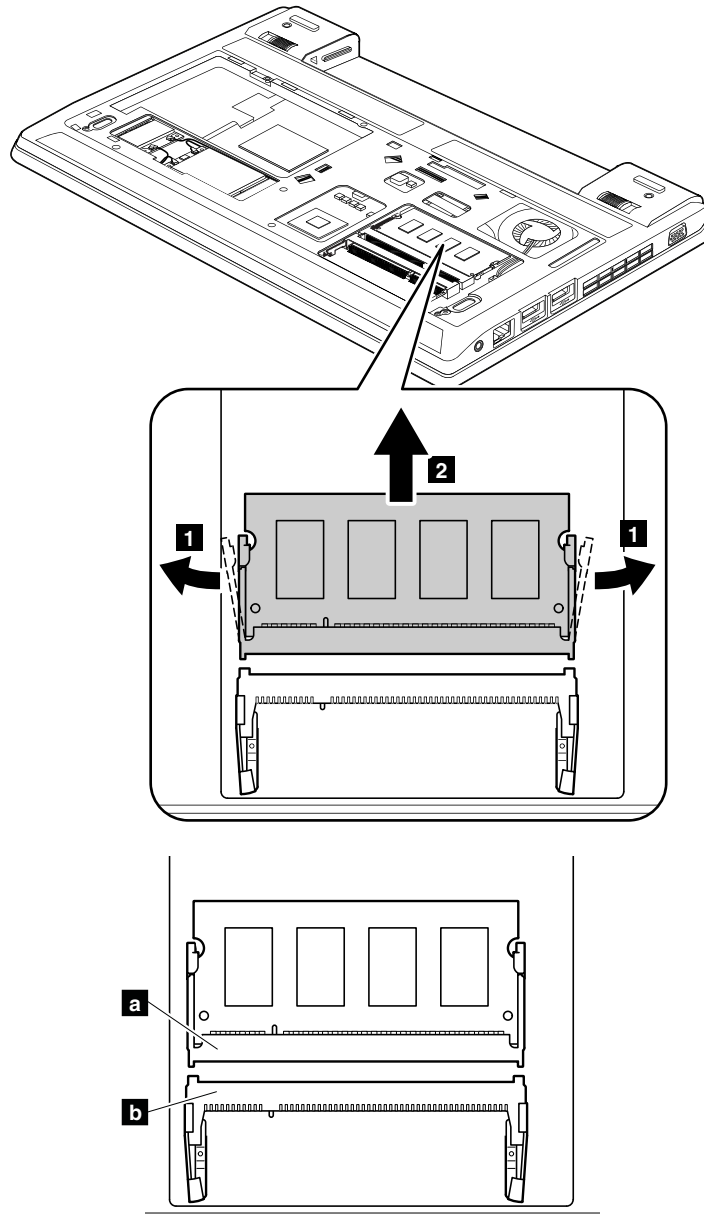
When installing:

Note: If only one memory module is to be installed on the computer you are servicing, installed it in SLOT **a**, not in SLOT **b**.

Insert the notched end of the memory module into the slot. Press the memory module firmly, and pivot it until it snaps into place. Ensure that it is firmly installed in the slot and does not move easily.
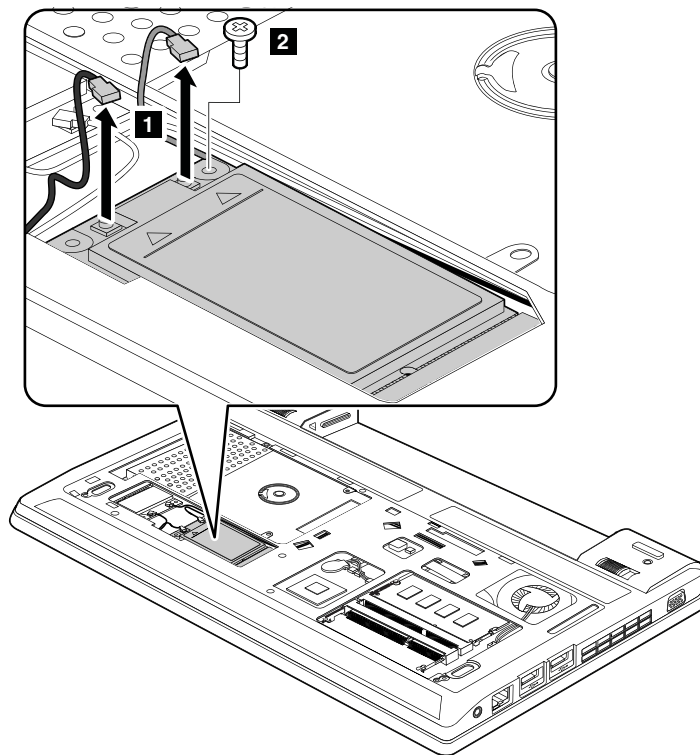
1040 PCI Express Mini Card for wireless LAN

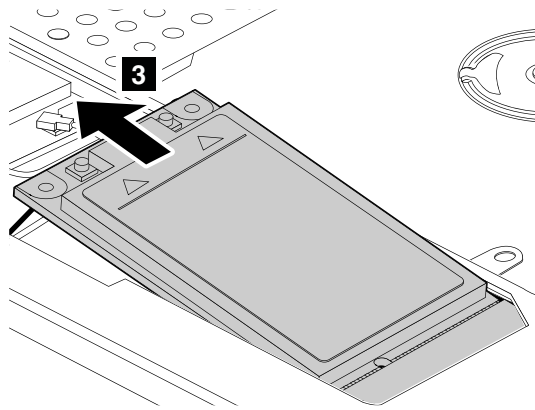For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Removal steps of PCI Express Mini Card for wireless LAN

In step **1**, unplug the connectors by using the removal tool antenna RF connector. If the removal tool is not available, pick the connectors with your fingers and gently unplug them.
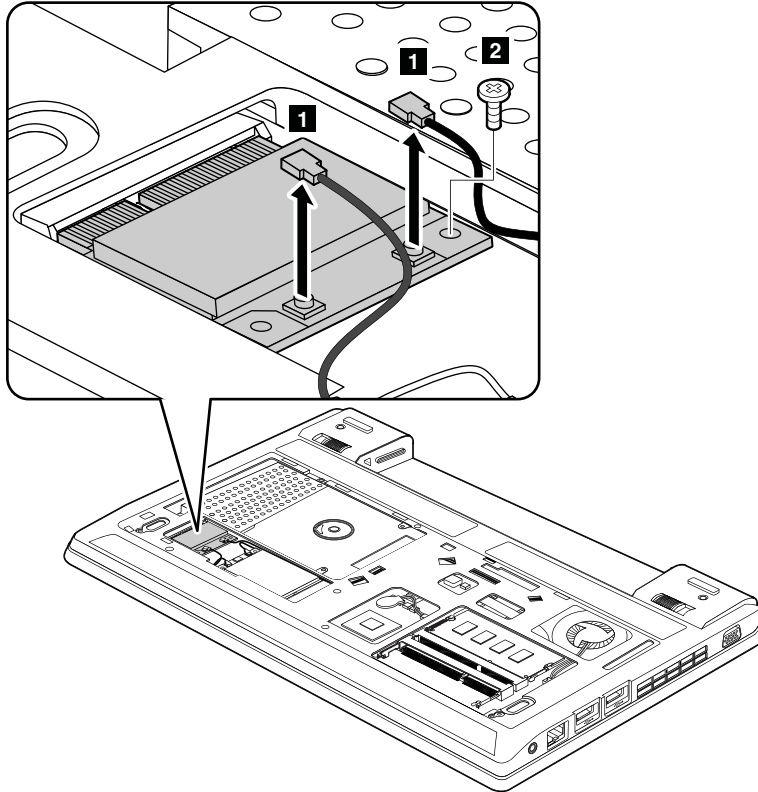
Step	Screw (quantity)	Color	Torque
2	M2 × 3 mm, wafer-head, nylon-coated (1)	Black	0.181 Nm (1.85 kgf-cm)
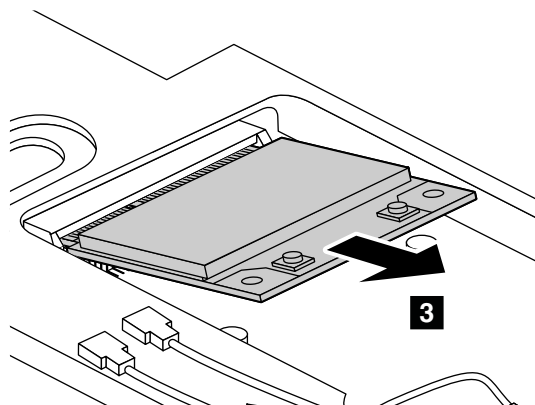
When installing: Plug the black cable into the main connector, and the gray cable into the auxiliary connector.

1050 mSATA solid-state drive

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Removal steps of mSATA solid-state drive

The computer comes with either a PCI Express Mini Card for wireless WAN or an mSATA solid-state drive. If the computer is equipped with an mSATA solid-state drive, it is installed in the wireless WAN card slot.

Attention:

- Do not drop the drive or apply any physical shock to it. The drive is sensitive to physical shock. Improper 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 it if possible.
- Never remove the drive while the system is operating or is in suspend mode.
- If the mSATA solid-state drive is replaced, a recovery image is required. Instructions on recovering a Chrome OS operating system are available at http://support.google.com/chromeos.
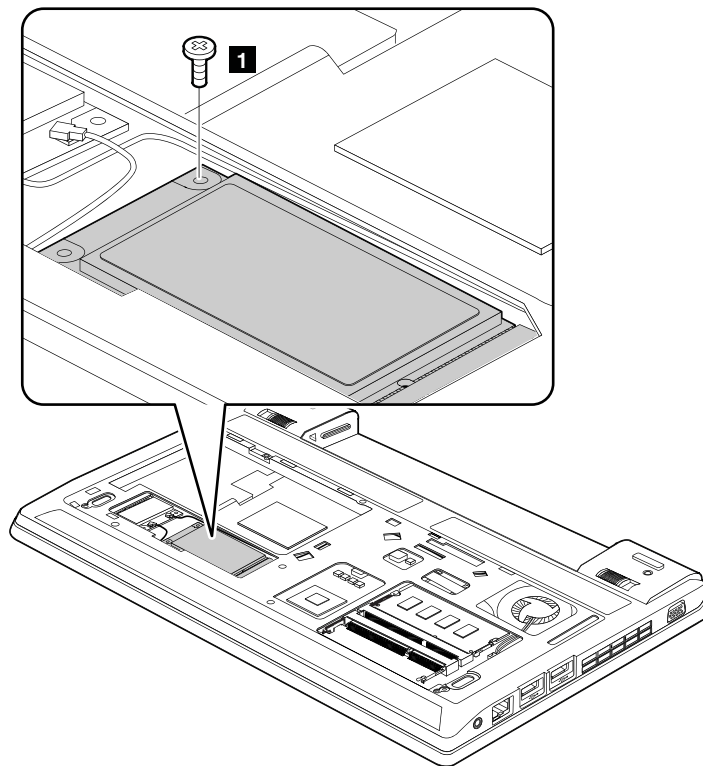
Step	Screw (quantity)	Color	Torque
1	M2 × 3 mm, wafer-head, nylon-coated (1)	Black	0.181 Nm (1.85 kgf-cm)

1060 PCI Express Mini Card for wireless WAN

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Removal steps of PCI Express Mini Card for wireless WAN

In step **1**, unplug the connectors by using the removal tool antenna RF connector or pick the connectors with your fingers and gently unplug them in the direction of the arrows.

Step	Screw (quantity)	Color	Torque
2	M2 × 3 mm, wafer-head, nylon-coated (1)	Black	0.181 Nm (1.85 kgf-cm)

When installing: Plug the red cable into the main connector, and the blue cable into the auxiliary connector.

1070 Hard disk drive or solid-state drive assembly

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Attention:

- Do not drop the drive or apply any physical shock to it. The drive is sensitive to physical shock. Improper 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 it if possible.

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

Removal steps of hard disk drive or solid-state drive
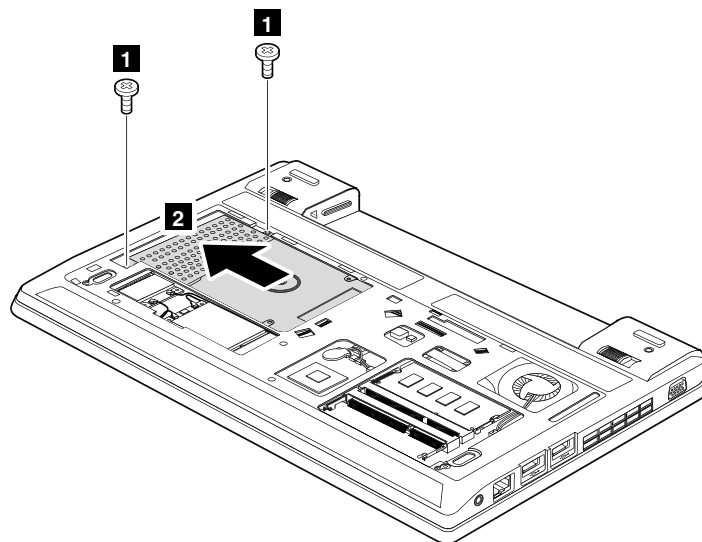
Step	Screw (quantity)	Color	Torque
1	M2 × 5 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)
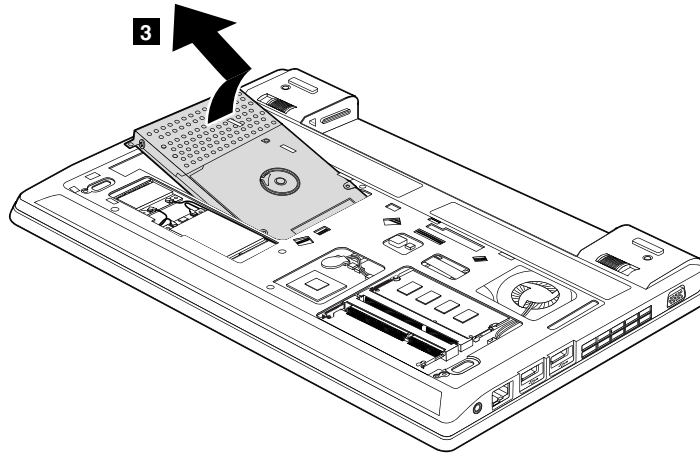
When installing: Ensure that the hard disk drive or solid-state drive assembly is attached firmly.

Removal steps of the hard disk drive or solid-state drive bracket
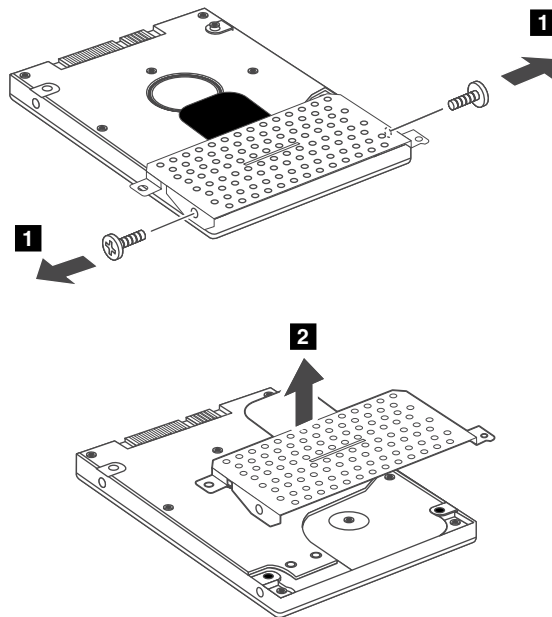
Step	Screw (quantity)	Color	Torque
1	M3 × 3.5 mm, wafer-head, nylon-coated (2)	Silver	0.392 Nm (4 kgf-cm)

1080 Hard disk drive bracket

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Depending on the model type, your computer might not have the hard disk drive or solid-state drive. Instead, it will have an empty hard disk drive bracket installed.

Removal steps of hard disk drive bracket
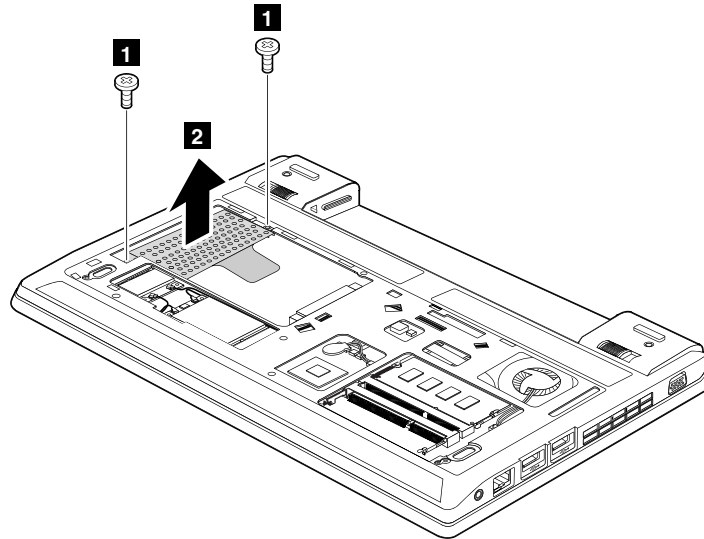
Step	Screw (quantity)	Color	Torque
1	M2 × 5 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)

When installing: Ensure that the hard disk drive bracket is attached firmly.

1090 Keyboard

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34

Removal steps of keyboard
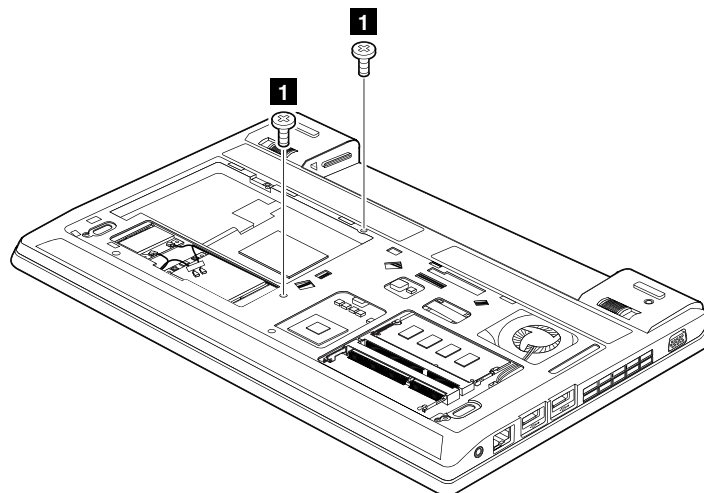
When installing: Ensure that the screws have been fastened to secure the keyboard.

Step	Screw (quantity)	Color	Torque
1	M2 × 8 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)
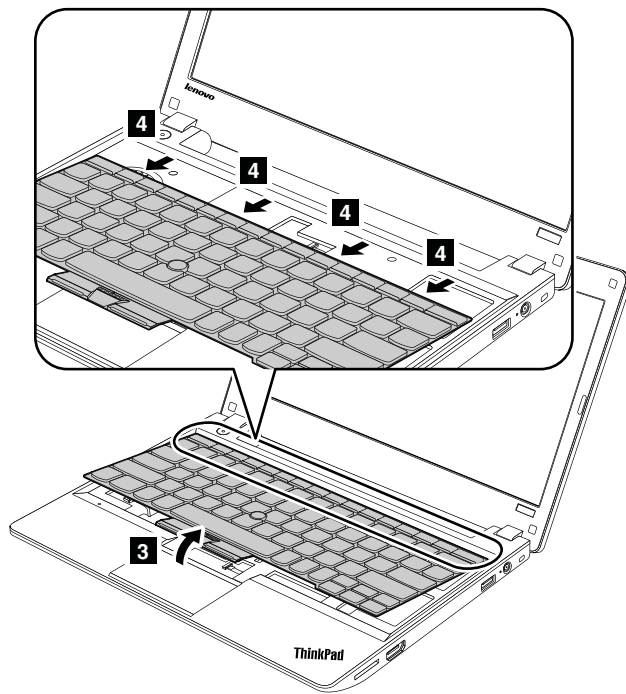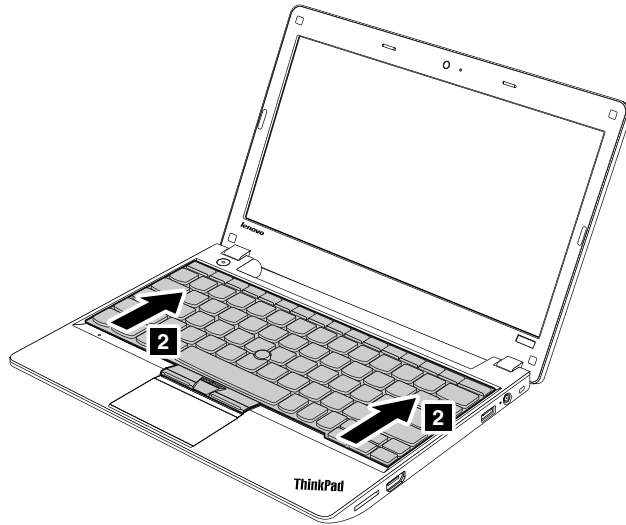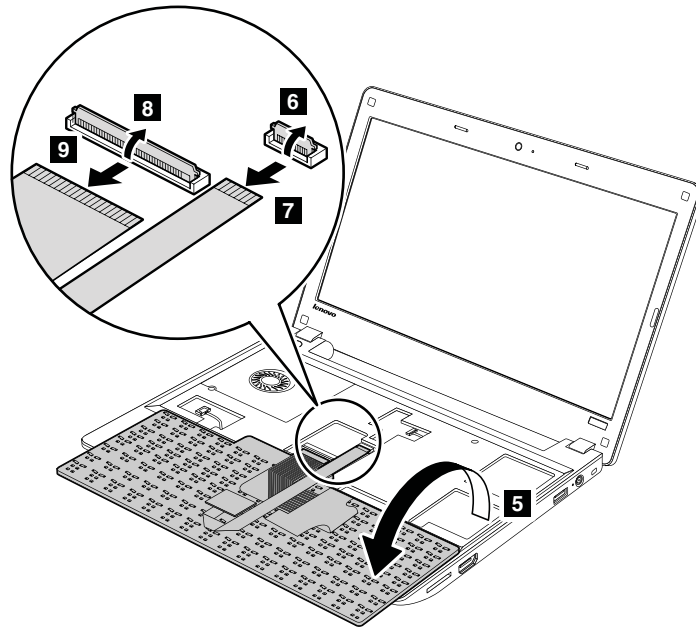
Installation steps of keyboard

To install the keyboard, do the following:

1. Attach the connectors.
2. Attach the keyboard and ensure that the hooks on the front edge of the keyboard are under the frame.
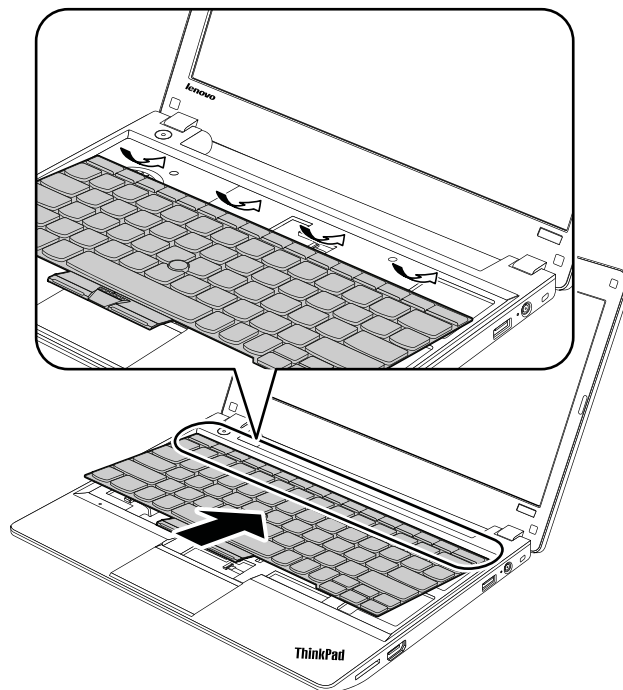
3. When the front edge of the keyboard is housed firmly, gently press the keys with your fingers and slide the keyboard toward you until the keyboard is in place.
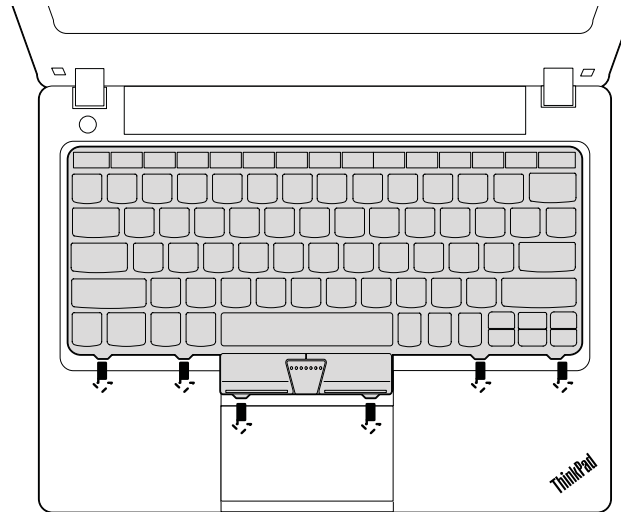
4. Secure the keyboard by tightening the screws from the bottom side of the computer.

1110 Keyboard bezel assembly

For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41

Removal steps of keyboard bezel assembly
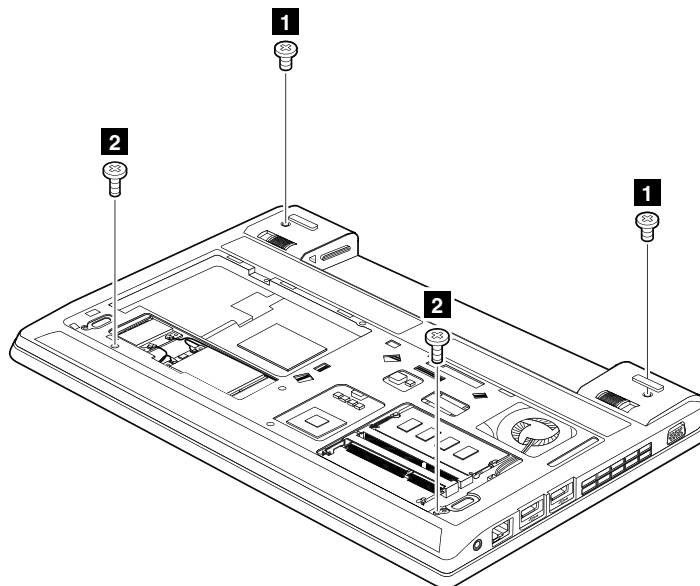
Step	Screw (quantity)	Color	Torque
1	M2.5 × 8 mm, wafer-head, nylon-coated (2)	Black	0.392 Nm (4 kgf-cm)
2	M2 × 8 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)
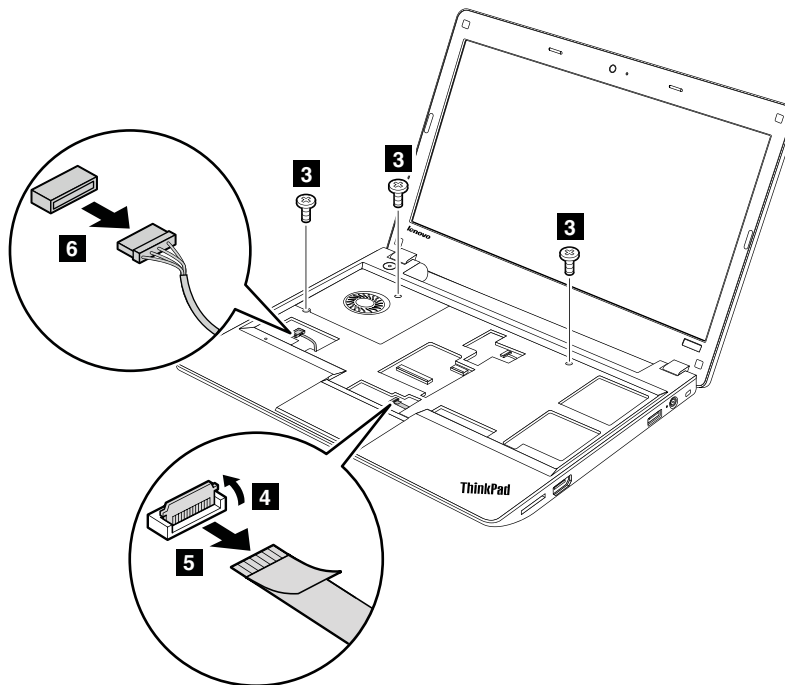
When installing: Ensure that the connectors are attached firmly.

Step	Screw (quantity)	Color	Torque
3	M2 × 5 mm, wafer-head, nylon-coated (3)	Black	0.181 Nm (1.85 kgf-cm)

In step **7**, release the keyboard bezel assembly from the frame as shown in the following illustration using a plastic pry tool, and remove the keyboard bezel assembly in the direction shown by the arrow **8**.
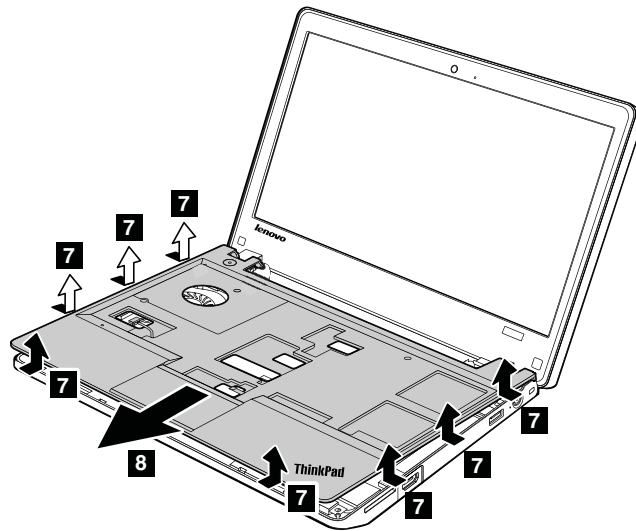
When installing: Ensure that all the projections of the keyboard bezel assembly are attached firmly to the guide holes of the base cover.
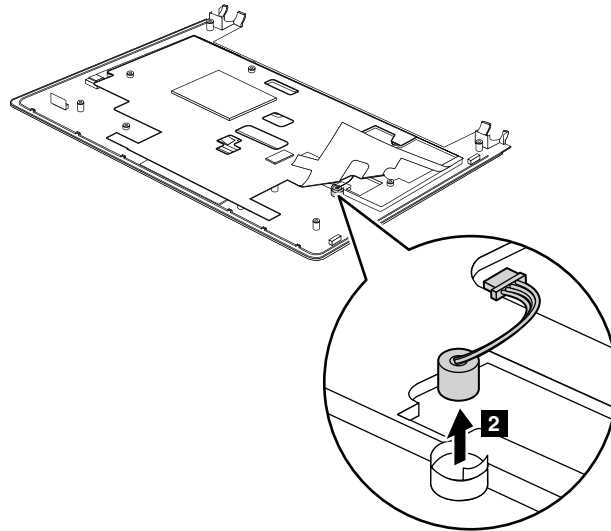
1120 Microphone

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44

Removal steps of microphone
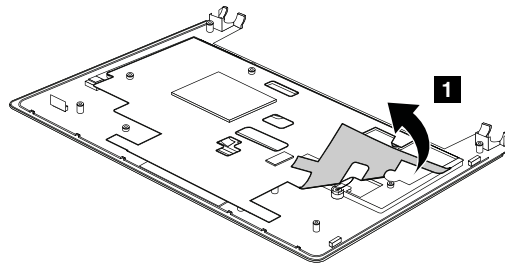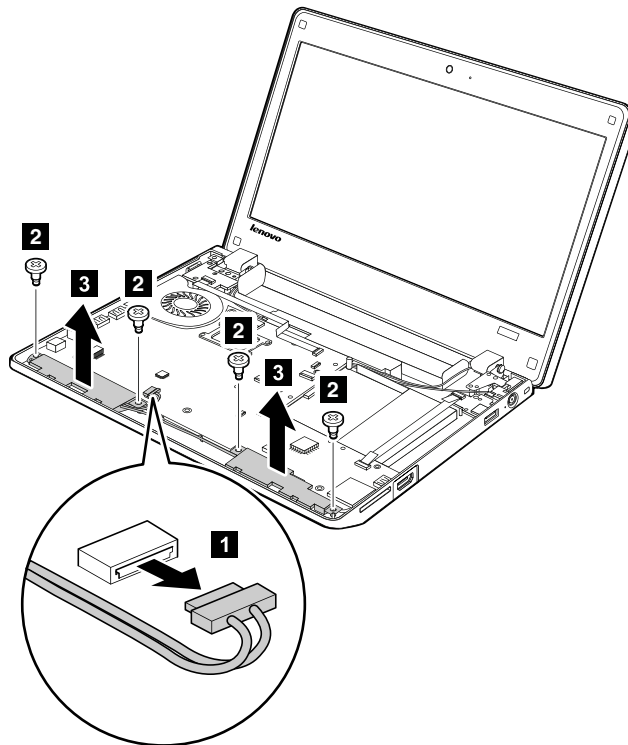
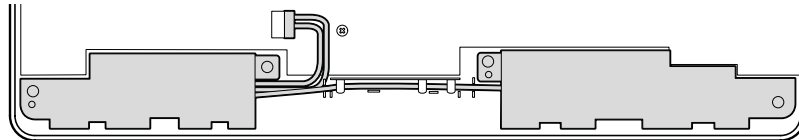## 1130 Speaker assembly

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44

Removal steps of speaker assembly

Step	Screw (quantity)	Color	Torque
2	M2 × 5.5 mm, shoulder screw, nylon-coated (4)	Black	0.181 Nm (1.85 kgf-cm)

When installing: Attach the speaker assembly and route the cable as shown in the following illustration, and ensure that the speaker connector is attached firmly.
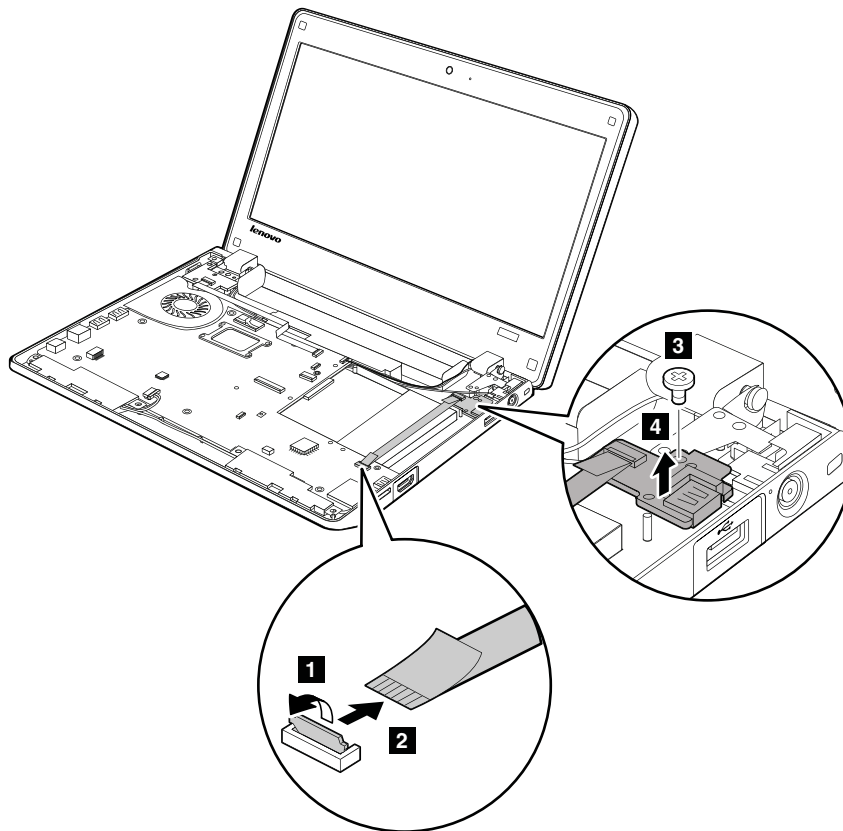

1140 I/O board

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44

Removal steps of I/O board

Step	Screw (quantity)	Color	Torque
3	M2 × 3 mm, wafer-head, nylon-coated (1)	Black	0.181 Nm (1.85 kgf-cm)

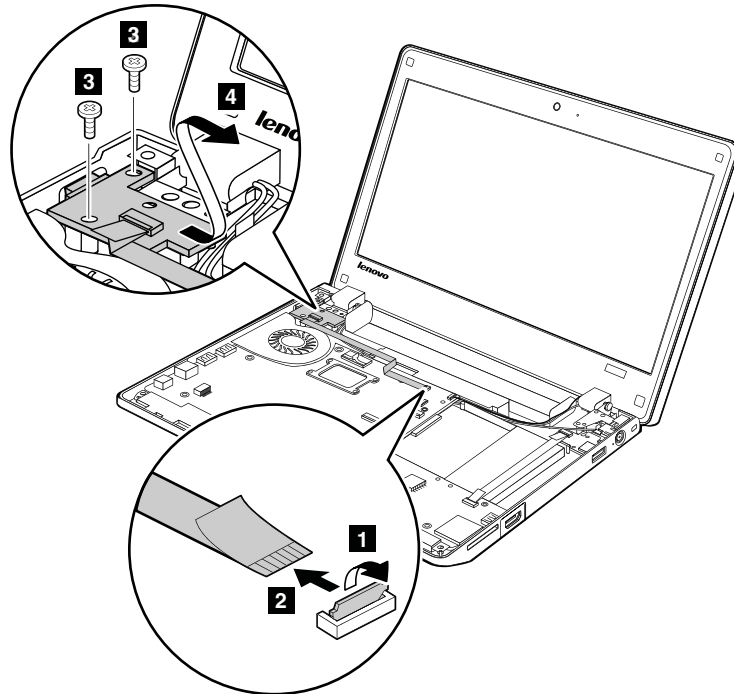**When installing:** Ensure that the connector is attached firmly.

1150 CRT board assembly (with cable)

For access, remove these FRUs in order:
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44

Removal steps of CRT board assembly

Step	Screw (quantity)	Color	Torque
3	M2 × 3 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)

When installing: Ensure that the connector is attached firmly to the system board.

1160 System board assembly and thermal fan assembly

Important notices for handling the system board:

Some components mounted on a system board are very sensitive. Improper handling of a system board can cause damage to those components, and might cause a system malfunction. When handling the system board, bear the following in mind:

- The system board has an accelerometer, which can be broken by applying several thousands of G-forces.

  Note: Dropping a system board from a height of as little as six inches so that it falls flat on a hard bench can subject the accelerometer to as much as 6,000 G's of shock.

- Be careful not drop a system board or apply any excessive force to it.

- If a system board is dropped, be sure to document the drop in any reject report, and replace the system board.

- Avoid rough handling of any kind.
- Avoid bending a system board and hard pushing to prevent cracking at each BGA (Ball Grid Array) chipset.
- At every point in the process, be sure not to drop or stack the system board.
- If you put a system board down, be sure to put it only on a padded surface such as an ESD mat or conductive corrugated material.

For access, remove these FRUs in order:

**Note:** Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
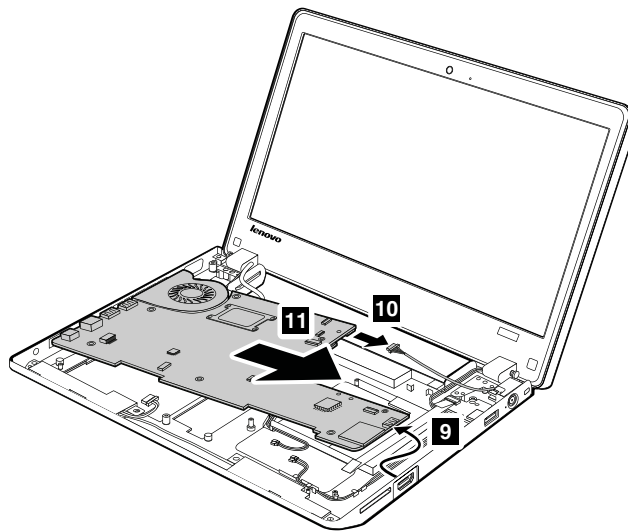- "1110 Keyboard bezel assembly" on page 44

Removal steps of system board
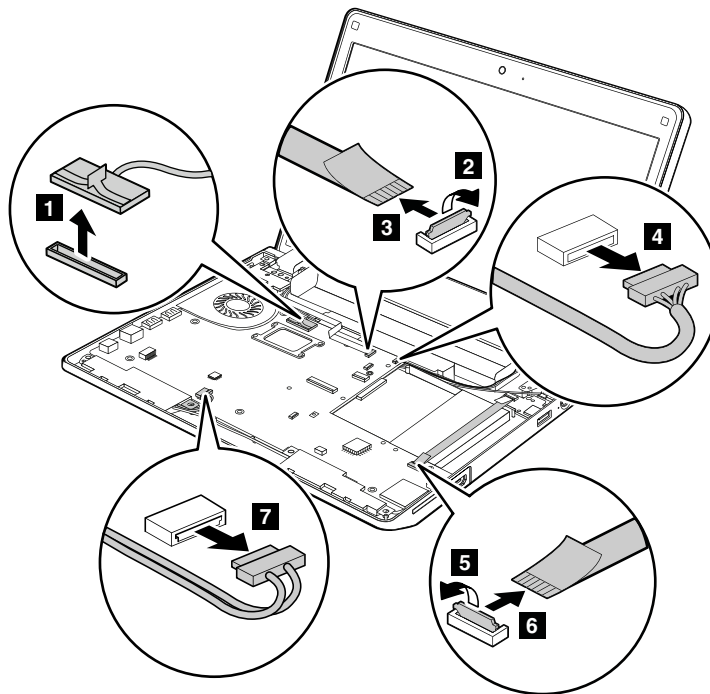
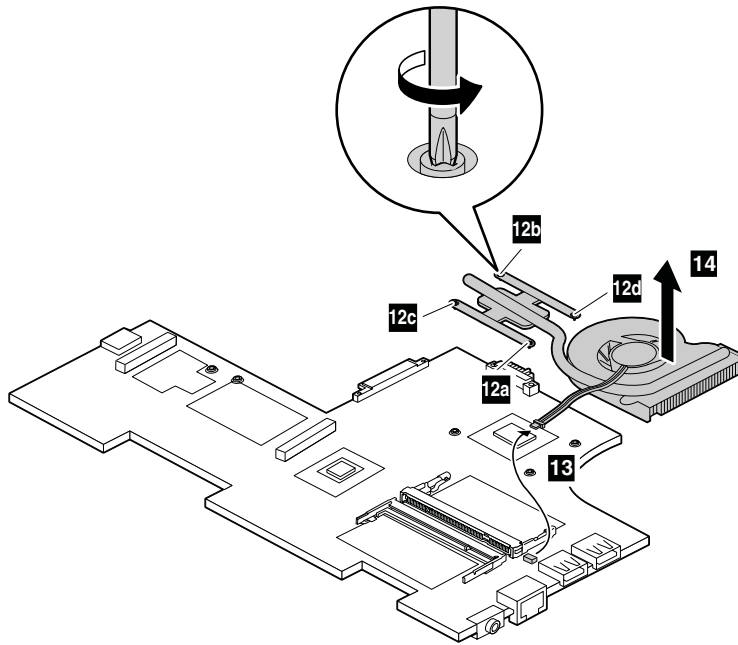**When installing:** Ensure that the connectors are attached firmly to the system board.
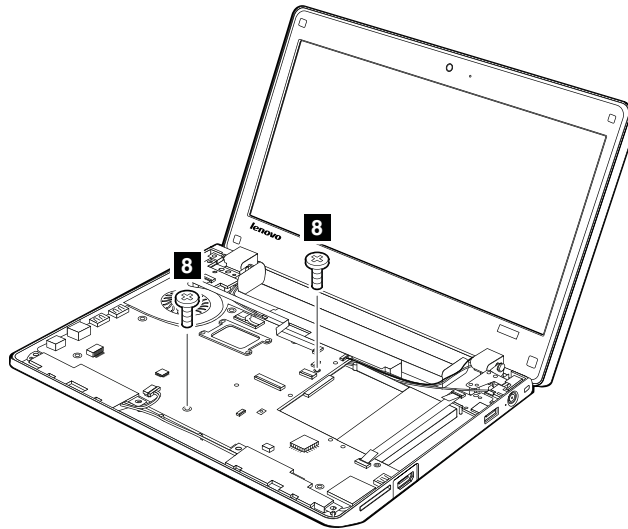
Step	Screw (quantity)	Color	Torque
8	M2 × 3 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)

When installing: Ensure that the connector is attached firmly.

Removal steps of thermal fan assembly

Loosen the screws 12 in ascending alphabetic order as illustrated, but do not remove them.

**When installing:** Ensure that the connectors are attached firmly.

1170 DC-in cable and base cover assembly

For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44
- "1160 System board assembly and thermal fan assembly" on page 49
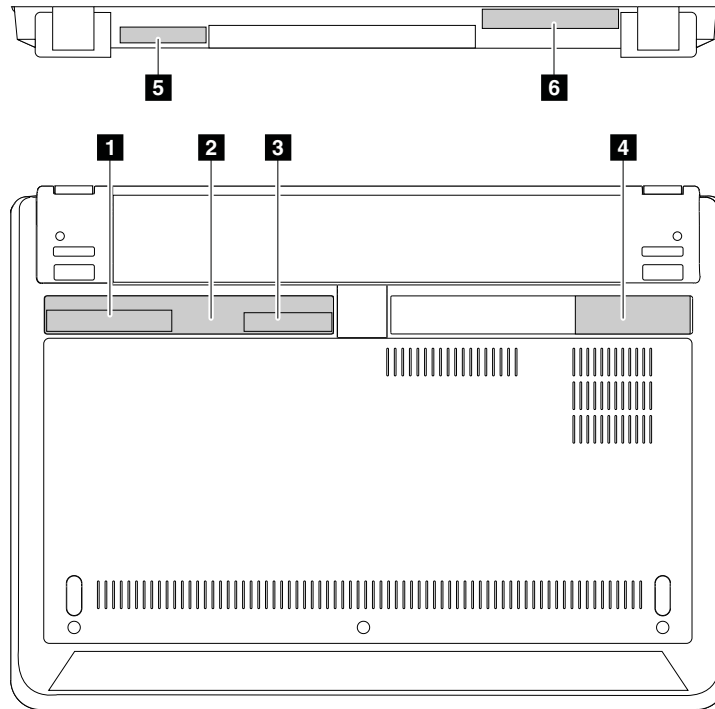- "2010 LCD unit" on page 53

Removal steps of DC-in cable
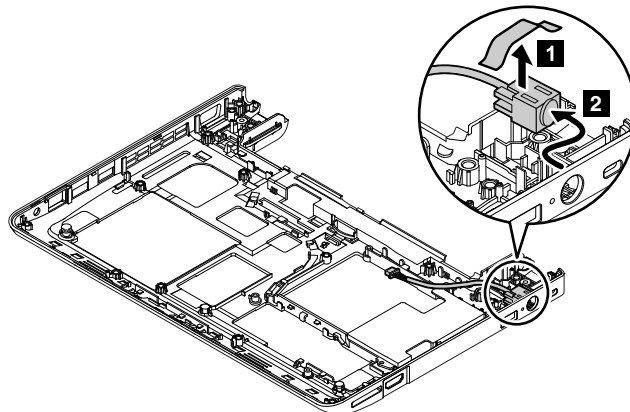
Applying labels to the base cover

The new base cover FRU is shipped with a kit containing labels of several kinds, including but not limited to those described in this topic.

The following illustration shows the correct location of each label.

When you replace the base cover, apply the following labels:

1 GEO label

2 Rating label

3 FCC label

4 Dummy label

5 S/N barcode label

6 Certified label

Note: If the base cover has two FCC labels, apply both to the new base cover.
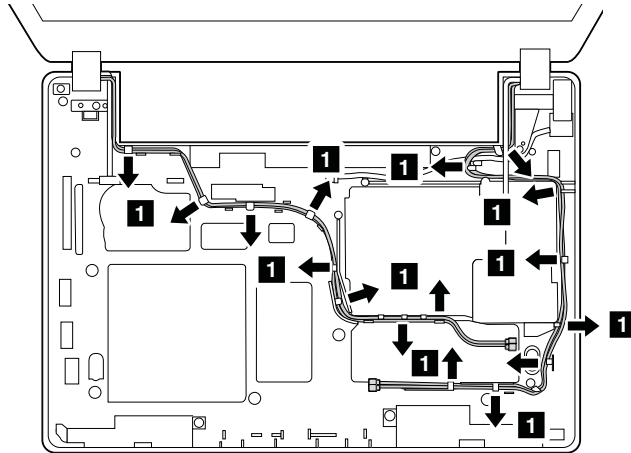
2010 LCD unit

For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44
- "1160 System board assembly and thermal fan assembly" on page 49

Removal steps of LCD unit

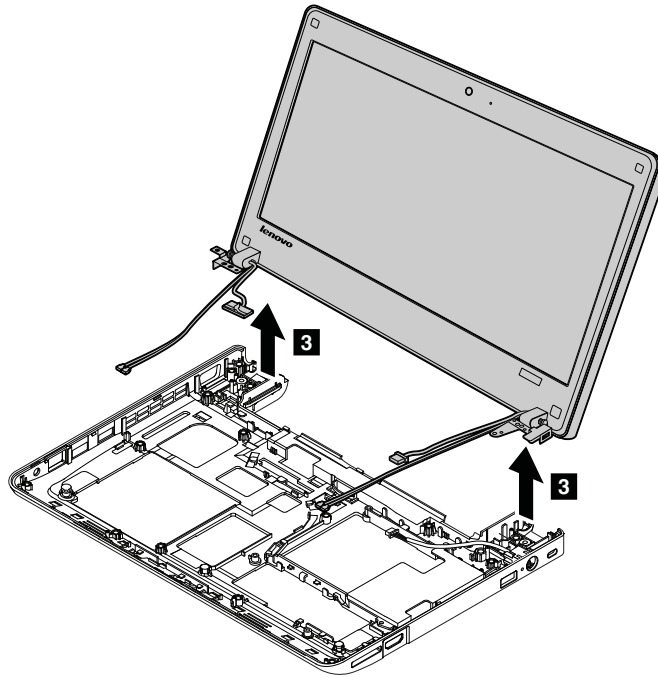In step **1**, release the antenna cables from the cable guides.

When installing:

- Ensure that the cables are attached to the cable guides firmly.
- When you route the cables, ensure that they are not subject to any tension. Tension could cause the cables to be damaged by the cable guides, or a wire to be broken.
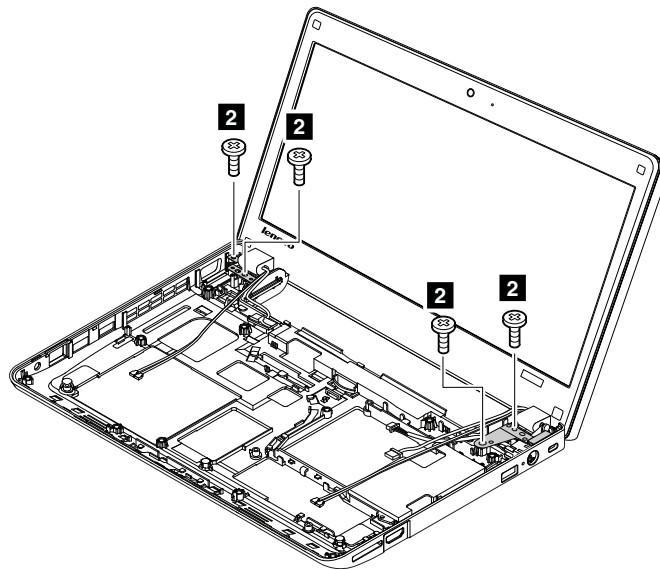
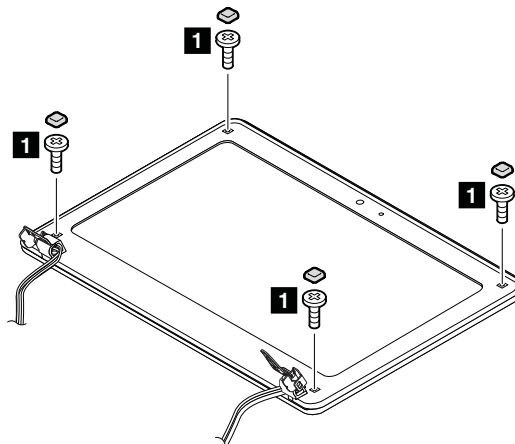| Step	Screw (quantity)	Color	Torque
2	M2.5 × 6 mm, wafer-head, nylon-coated (4)	Black	0.392 Nm (4 kgf-cm)

2020 LCD bezel assembly
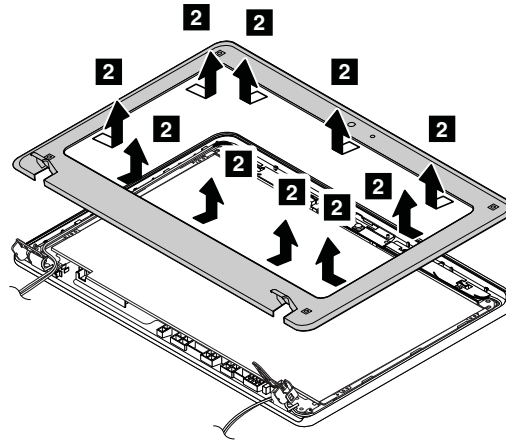
For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44
- "1160 System board assembly and thermal fan assembly" on page 49
- "2010 LCD unit" on page 53

Removal steps of LCD bezel assembly

Step	Screw cap	Screw (quantity)	Color	Torque
1	☐	M2 × 5 mm, wafer-head, nylon-coated (4)	Black	0.181 Nm (1.85 kgf-cm)

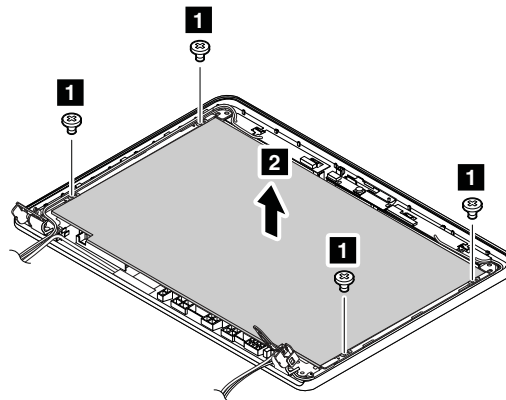**When installing:** Ensure that all the latches are attached firmly. Then secure the bezel with the screws.

2030 LCD panel, LCD cable, and hinges
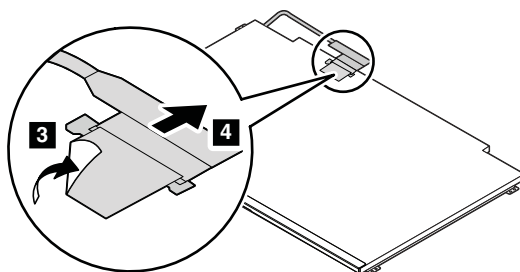
For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.

Removal steps of LCD panel and LCD cable

Step	Screw (quantity)	Color	Torque
1	M1.7 × 3 mm, wafer-head, nylon-coated (4)	Silver	0.181 Nm (1.85 kgf-cm)

When installing: Ensure that the connectors are attached firmly.

Removal steps of hinges

Step	Screw (quantity)	Color	Torque
1	M2 × 5 mm, wafer-head, nylon-coated (2)	Black	0.181 Nm (1.85 kgf-cm)

2040 Camera and camera cable

For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33
- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44
- "1160 System board assembly and thermal fan assembly" on page 49
- "2010 LCD unit" on page 53

- "2020 LCD bezel assembly" on page 55
- "2030 LCD panel, LCD cable, and hinges" on page 56
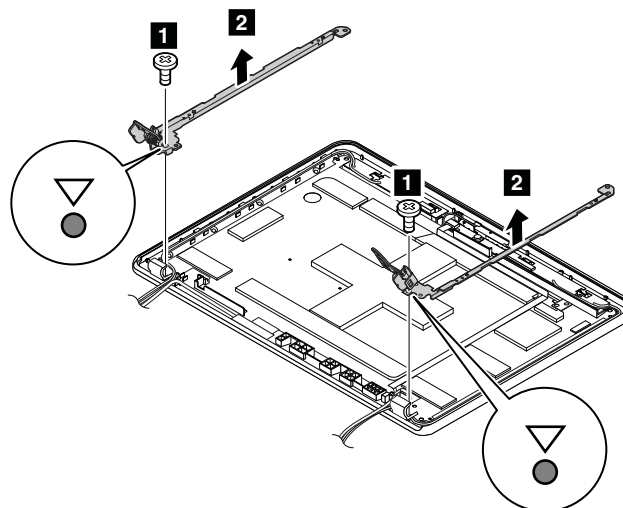
Removal steps of camera and camera cable

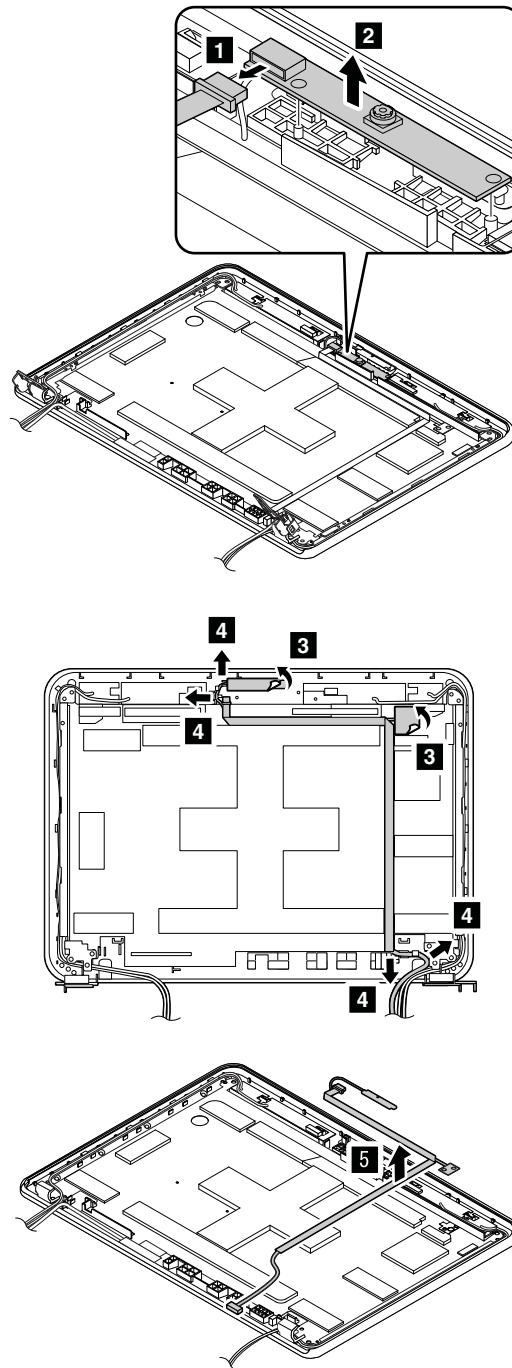

2050 Antenna kit and LCD rear cover assembly

For access, remove these FRUs in order:

Note: Depending on your model type, your computer might not have all the FRUs that are listed.
- "1010 Battery pack" on page 33

- "1020 Bottom slot cover" on page 34
- "1040 PCI Express Mini Card for wireless LAN" on page 36
- "1050 mSATA solid-state drive" on page 37
- "1060 PCI Express Mini Card for wireless WAN" on page 38
- "1070 Hard disk drive or solid-state drive assembly" on page 39
- "1080 Hard disk drive bracket" on page 40
- "1090 Keyboard" on page 41
- "1110 Keyboard bezel assembly" on page 44
- "1160 System board assembly and thermal fan assembly" on page 49
- "2010 LCD unit" on page 53
- "2020 LCD bezel assembly" on page 55
- "2030 LCD panel, LCD cable, and hinges" on page 56

Removal steps of antenna kit and LCD rear cover assembly

Release the antenna cables from the cable guides on the LCD rear cover assembly.
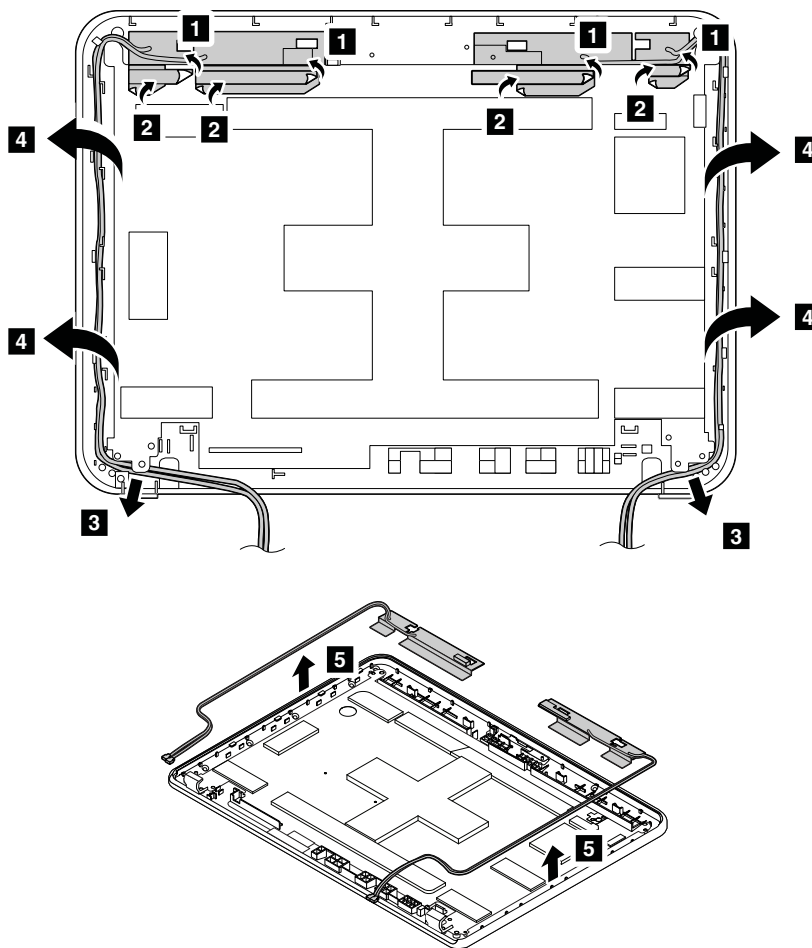
Cable routing: When you install the antenna kit, route the cables as shown in the following illustration. As you route the cables, ensure that they are not subject to any tension. Tension could cause the cables to be damaged by the cable guides, or a wire to be broken.
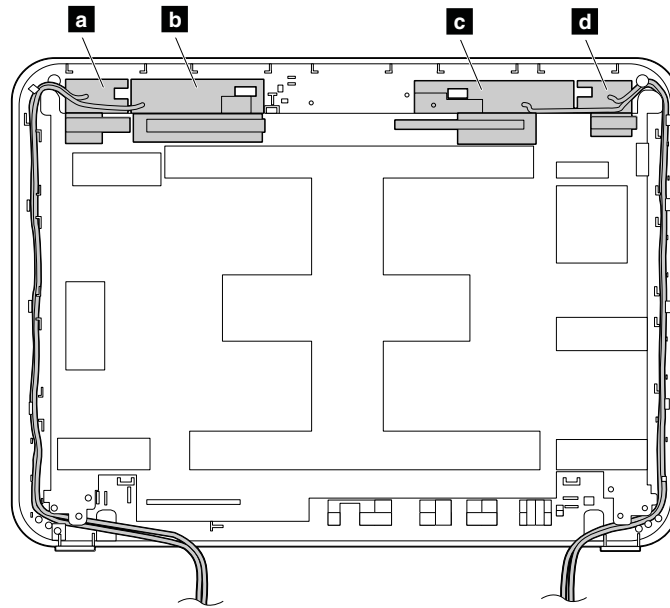
a Wireless LAN AUX antenna (black)
b Wireless WAN AUX antenna (blue, on some models)
c Wireless WAN MAIN antenna (red, on some models)
d Wireless LAN MAIN antenna (gray)

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Appendix B. Abbreviation table

The following table lists all abbreviations used in this manual.

Abbreviation	Term
BGA	Ball Grid Array
CMOS	Complementary Metal Oxide Semiconductor
CRC	Cyclic redundancy check
CRT	Cathode ray tube
CRU	Customer Replaceable Unit
EAIA	Enhanced Asset Information Area
EEPROM	Electrically Erasable Programmable Read-Only Memory
EFI	Extensible Firmware Interface
ESD	Electrostatic discharge
FPC	Flexible printed circuits
FRU	Field Replaceable Unit
GRT	Google Required Test
HWID	Hardware Identity
IC	Integrated circuits
LCD	Liquid Crystal Display
MTM	Machine type and model
POST	Power-on self-test
RFID	Radio-frequency identification
ROM	Read-Only Memory
VPD	Vital Product Data

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Part Number: 0C10473_02

Printed in

(1P) P/N: 0C10473_02