

ThinkStation®

P320 Tiny User Guide and Hardware Maintenance Manual

Think



Machine Types (MTs): 30C1 (Energy Star), 30C2 (Energy Star), and
30C3 (Energy Star)

Note: Before using this information and the product it supports, be sure to read and understand the *Important Product Information Guide*.

Third Edition (July 2018)

© Copyright Lenovo 2017, 2018.

LIMITED AND RESTRICTED RIGHTS NOTICE: If data or software is delivered pursuant to a General Services Administration "GSA" contract, use, reproduction, or disclosure is subject to restrictions set forth in Contract No. GS-35F-05925.

Contents

Chapter 1. Product overview 1

Front view	1
Rear view	2
System board	3
Machine type and model label	4

Chapter 2. I/O box 5

Overview	5
Using the I/O box	5

Chapter 3. Connecting to other devices 7

Attaching a Kensington-style cable lock	7
Connecting to a Tiny-In-One monitor	7

Chapter 4. Features 9

Chapter 5. Replacing hardware 11

Before replacing hardware	11
Handling static-sensitive devices	11
Knowing replaceable parts	11
Replacing CRUs	14
Replacing the keyboard or wireless keyboard	15
Replacing the mouse or wireless mouse	16
Replacing the power adapter	19
Replacing the vertical stand	22
Replacing the VESA mount bracket	23

Replacing the external optical drive	24
Replacing the external I/O box	26
Replacing the power adapter bracket	28
Removing the computer cover	29
Replacing the storage drive	29
Replacing the internal speaker	31
Replacing the bottom cover	33
Replacing the memory module	34
Replacing the M.2 storage drive	36
Completing the parts replacement.	38
Replacing FRUs.	40
Replacing the system fan	40
Replacing the illuminated red dot cable.	41
Replacing the advanced speaker	42
Replacing the Wi-Fi antennas	44
Replacing the storage drive cable	49
Replacing the PCI Express card and PCI Express card adapter.	50
Replacing the Wi-Fi card	52
Replacing the heat sink	60
Replacing the microprocessor	62
Replacing the coin-cell battery	66
Replacing the system board and chassis	68
Replacing the system board and chassis	69

Appendix A. Notices 73

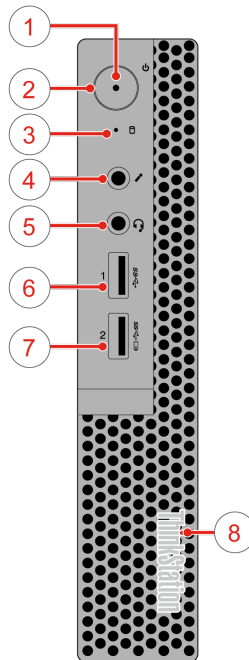
Trademarks	74
----------------------	----

Chapter 1. Product overview

This chapter provides basic information to help you get familiar with your computer.

Front view

Note: Your computer model might look slightly different from the illustration.



1 Power indicator	2 Power button
3 Storage drive activity indicator	4 Microphone connector
5 Headset connector	6 USB 3.0 connector
7 Always On USB 3.0 connector	8 Illuminated red dot

- **Always On USB 3.0 connector**

Used to connect a device that requires a USB 2.0 or USB 3.0 connection, such as a keyboard, a mouse, a scanner, a printer, or a personal digital assistant (PDA). With the power adapter connected, you can charge the automatically detected device even when the computer is in hibernation mode or turned off.

- **Headset connector**

Used to connect a headset or headphones to your computer.

- **Illuminated red dot**

This indicator is on when the computer is powered on.

- **Microphone connector**

Used to connect a microphone to your computer. You can use the microphone to record sounds or interact with the computer using speech-recognition software.

- **Power button**

Used to turn on your computer. When you cannot shut down the computer from the operating system, press and hold the power button for four or more seconds to turn off the computer.

- **Power indicator**

This indicator is on when the computer is on.

- **Storage drive activity indicator**

This indicator is on when the storage drive is in use.

- **USB 3.0 connector**

Used to connect a USB-compatible device, such as a USB keyboard, mouse, scanner, printer, or personal digital assistant (PDA). For optimal data transfer, connect a USB 3.0 device to a USB 3.0 connector instead of a USB 2.0 connector.

Rear view

Note: Your computer model might look slightly different from the illustration.

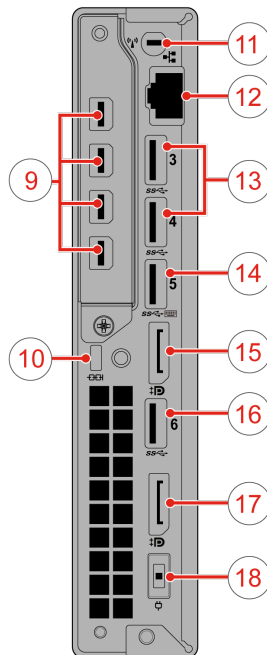


Figure 1. Rear view

9 Mini DisplayPort® connectors (4) (optional)	10 Security-lock slot
11 Wi-Fi antenna slot	12 Ethernet connector
13 USB 3.0 connectors (2)	14 USB 3.0 connector
15 DisplayPort connector	16 USB 3.0 connector
17 DisplayPort connector	18 Power adapter connector

- **DisplayPort connector**

Used to send or receive audio and video signals. You can attach a compatible audio or video device to this connector, such as a high-performance monitor.

- **Ethernet connector**

Used to connect an Ethernet cable for network access.

- **Mini DisplayPort connector**

Used to send or receive audio and video signals. You can attach a compatible audio or video device to this connector, such as a high-performance monitor. Depending on the computer model, the connector might vary.

- **Power adapter connector**

Used to connect the power adapter to your computer for power supply.

- **Security-lock slot**

Used to secure a Kensington-style cable lock.

- **USB 3.0 connector**

Used to connect a device that requires a USB 2.0 or USB 3.0 connection.

- **Wi-Fi antenna slot**

Used to install the rear Wi-Fi antenna cable connector that is available only on some models. The rear Wi-Fi antenna is installed on the rear Wi-Fi antenna cable connector.

System board

Note: See “Front view” on page 1 or “Rear view” on page 2 for additional component descriptions.

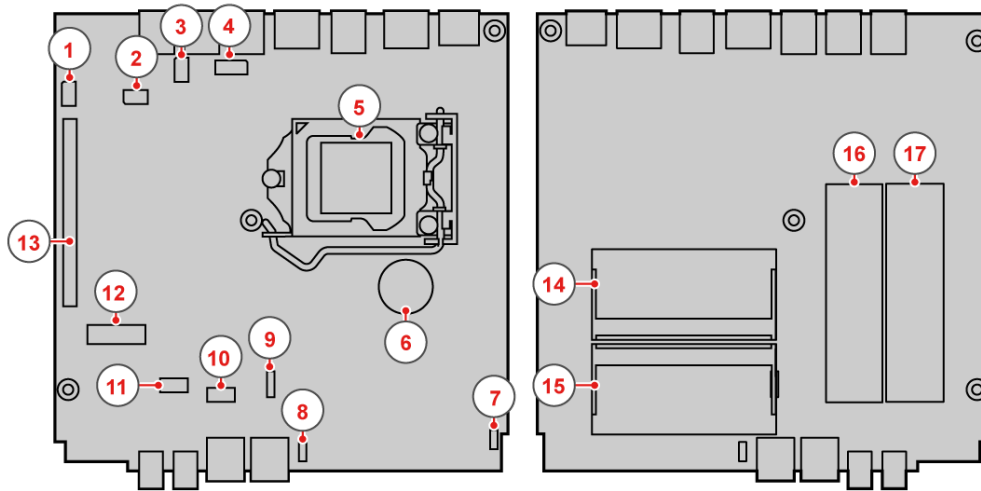


Figure 2. Parts on the system board

1 Serial connector 1	2 Serial connector 2
3 USB 3.0 connector	4 Storage drive fan connector
5 Microprocessor socket	6 Coin-cell battery
7 Illuminated red dot connector	8 Internal speaker connector
9 System fan connector	10 Advanced speaker connector
11 SATA storage drive connector	12 M.2 Wi-Fi card slot
13 PCI Express graphics card slot	14 Memory slot (DIMM1)

15 Memory slot (DIMM2)	16 M.2 storage drive slot 2
17 M.2 storage drive slot 1	

Machine type and model label

The machine type and model label identifies your computer. When you contact Lenovo for help, the machine type and model information helps support technicians to identify your computer and provide faster service.

The machine type and model label is attached on the side of your computer as shown.

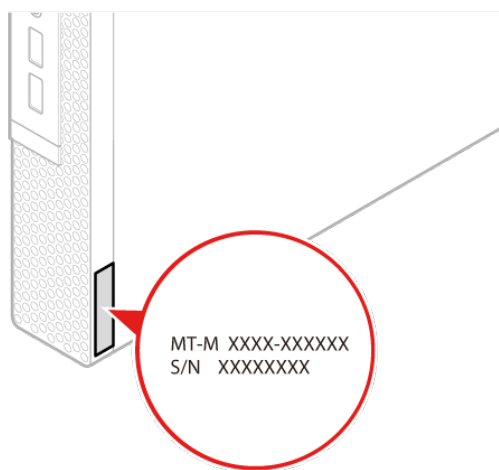


Figure 3. Machine type and model label

Chapter 2. I/O box

Overview

Note: Depending on your computer model, the I/O box might be optional.

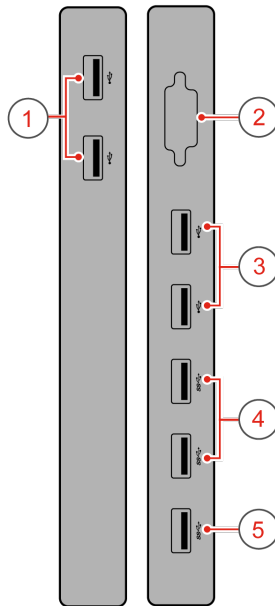


Figure 4. I/O box overview

1 USB 2.0 connectors (2)	2 Serial connector (optional)
3 USB 2.0 connectors (2)	4 USB 3.0 connectors (2)
5 USB 3.0 connector (for connecting to the computer)	

Using the I/O box

When you use the I/O box with the ThinkStation® tiny computer, note the following:

- The I/O box supports a maximum current rating of 5 A. It is recommended that you connect low-current devices to the I/O box and connect high-current devices directly to the ThinkStation tiny computer to ensure the best performance of the devices.
- The USB 2.0 connectors and USB 3.0 connectors on the I/O box provide a current of 500 mA and 900 mA current, respectively. When you connect a high-current storage drive to only one USB connector, the system might not recognize the device. You can connect the storage drive to two USB connectors on the I/O box.
- The serial connector does not support hot swapping. Do not connect a device to the connector or remove a device from the connector while the system is running.
- The connectors on the I/O box cannot be enabled or disabled individually. To enable or disable any of the connectors on the I/O box, enable or disable the USB connectors on the rear of the computer.

- The I/O box enables you to wake up the computer from standby mode through operations on devices connected to the I/O box connectors.

Chapter 3. Connecting to other devices

Attaching a Kensington-style cable lock

You can use a Kensington-style cable lock to secure your computer to a desk, table, or other non-permanent fixture. The cable lock connects to the security-lock slot at the rear of your computer. Depending on the type selected, the cable lock can be operated with a key or combination. The cable lock also locks the buttons used to open the computer cover. This is the same type of lock used with many notebook computers. You can order such a cable lock directly from Lenovo by searching for *Kensington* at: <https://support.lenovo.com>

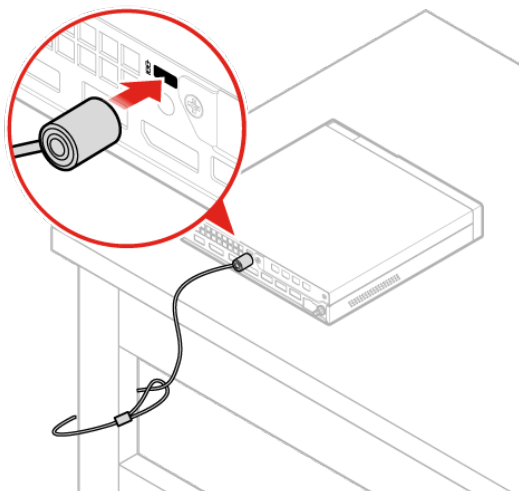


Figure 5. Kensington-style cable lock

Connecting to a Tiny-In-One monitor

Note: When installing the P320 Tiny computer to the Tiny-In-One (TIO) monitor, ensure that you use the 135W ac power adapter that comes with the computer.

The P320 Tiny computer works with its integrated graphics card by default when it is installed to the TIO monitor. You can turn on or turn off the computer by pressing the power button on the TIO monitor. Any other devices connected to TIO monitor function the same as they are connected to the computer.

To switch the primary video display output from the integrated graphics card to the discrete graphics card, do the following:

1. Turn on or restart your computer.
2. Before Windows starts up, repeatedly press and release F1 or Fn+F1 (depending on the keyboard settings) until the Setup Utility program opens. If a BIOS password has been set, enter the correct password when prompted.
3. Locate the **Select Active Video** submenu and select **PEG**. Then press F10 to save changes and exit.
4. Connect the discrete-graphics-card connector on the computer with the DisplayPort or HDMI connector of the TIO monitor using an applicable dongle.

5. Press the mode-switching button on the TIO monitor to change from the TIO mode to the DP mode or HDMI mode.

When the computer works with the discrete graphics card, pressing the power button on the TIO monitor only turns on or turns off the TIO monitor. Devices connected to the TIO monitor do not function the same as they are connected to the computer.

Supported TIO monitor models:

- Tiny-in-One 23 (MT: 10DQ)
- Tiny-in-One 22 (MT: 10LK)
- Tiny-in-One 24 (MT: 10LL)
- TIO22Gen3 (MT: 10R1)
- TIO22Gen3Touch (MT: 10R0)
- TIO24Gen3 (MT: 10QY)
- TIO24Gen3Touch (MT: 10QX)

Chapter 4. Features

Power supply

- 135 watt automatic voltage-sensing power supply

Storage drives

- Up to three storage drives

Note: If your computer comes with a discrete graphics card, the computer can support up to two storage drives only.

Video features

The integrated graphics card supports the following:

- DisplayPort connectors

The optional discrete graphics card supports the following and provides enhanced display capability and experience:

- Mini DisplayPort connectors

Audio features

The integrated audio card supports the following:

- Advanced speaker (optional)
- Headset connector
- Internal speaker
- Microphone connector

Input/Output (I/O) features

- Audio connectors (headset and microphone)
- DisplayPort connectors
- Ethernet connector
- Serial connectors (optional)
- USB connectors

Expansion

- External I/O box (optional)
- External optical drive box (optional)
- Memory slots
- M.2 storage drive slots
- PCI Express graphics card slot

Network features

- Ethernet LAN
- Wireless LAN (optional)
- Bluetooth (optional)

Physical dimensions

- Width: 35 mm (1.4 inches)
- Height: 183 mm (7.2 inches)
- Depth: 179 mm (7.1 inches)

Weight (without the package)

- Maximum configuration as shipped: 1.3 kg (2.9 lb)

Chapter 5. Replacing hardware

This chapter provides instructions on how to replace hardware for your computer.

Before replacing hardware

Attention: Do not open your computer or attempt any repairs before reading the <i>Important Product Information Guide</i> .
--

Read these notes before replacing hardware:

- Some of the hardware components explained in this manual are optional.
- Use computer components provided only by Lenovo.
- When installing or replacing an option, use the appropriate instructions explained in this manual along with the instructions that come with the option.
- In most areas of the world, Lenovo requires the return of defective CRUs (Customer Replaceable Units). Information about this will come with the CRU or will come a few days after the CRU arrives.

Handling static-sensitive devices

Do not open the static-protective package containing the new component until the defective component has been removed and you are ready to install the new component. Static electricity, although harmless to you, can seriously damage computer components.

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

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

Knowing replaceable parts

Customer-Replaceable Units (CRUs)

CRUs are computer parts that a user can upgrade or replace. There are two types of CRUs: self-service and optional-service.

- **Self-service CRUs:**

You can install self-service CRUs easily. These CRUs might be standalone, latched, or secured by up to two screws.

Examples of self-service CRUs include the keyboard, mouse, any USB device, and the power cord. Other self-service CRUs might include memory modules, adapter cards, hard disk drives, and optical drives.

Note: Users are responsible for replacing all self-service CRUs.

- **Optional-service CRUs:**

Handling optional-service CRUs requires some technical skills and simple tools (such as a screwdriver).

These CRUs are isolated parts within the computer. They are usually concealed by an access panel that is secured by more than two screws. You must remove the screws and panel to access the specific CRU.

Optional-service CRUs can be removed and installed by users or, during the warranty period, by a Lenovo service technician.

Field-Replaceable Units (FRUs)

FRUs are computer parts that a trained technician can upgrade or replace. For detailed FRU information, such as the FRU part numbers and supported computer models, go to:

<https://support.lenovo.com/partslookup>

CRUs and FRUs locations

Refer to the following illustrations to check the locations of CRUs and FRUs within the computer.

Notes:

- Some of the following parts might look different from the one illustrated.
- Some of the following parts are optional on some models.

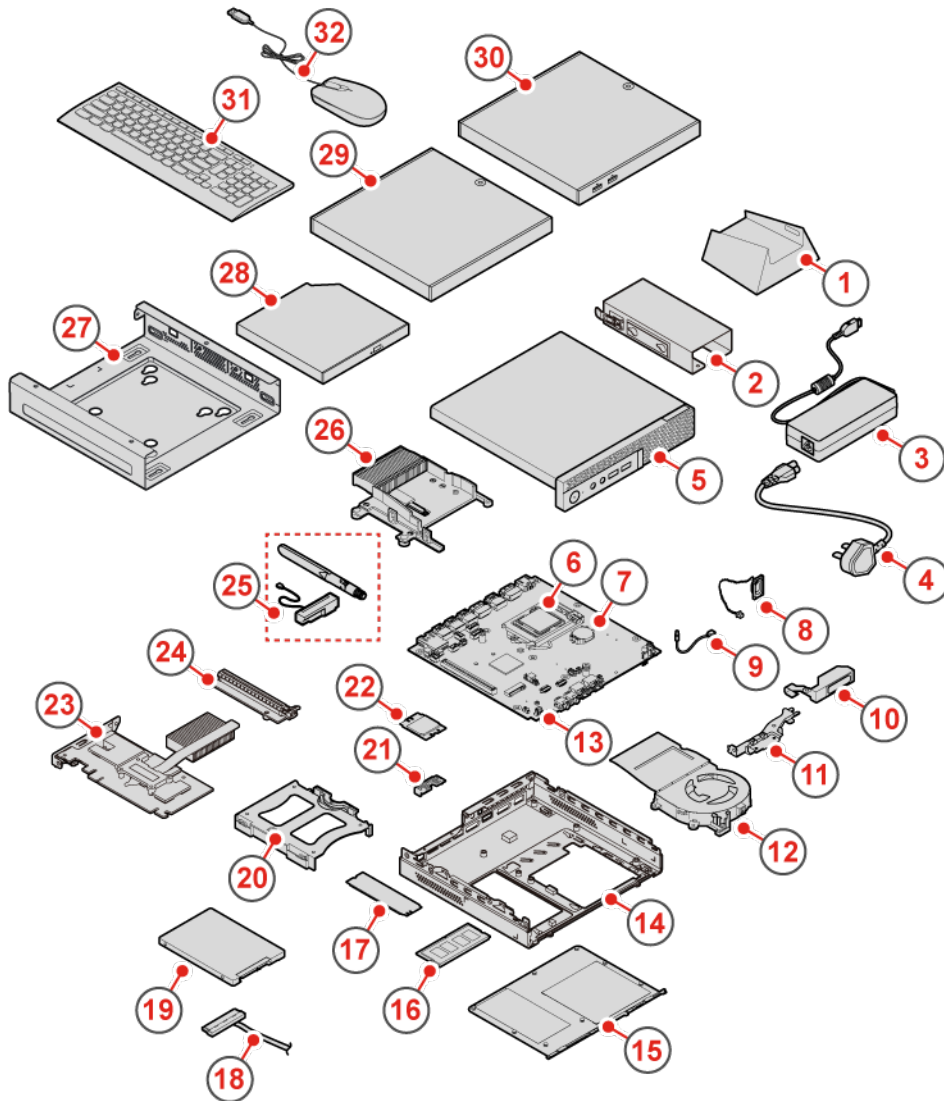


Figure 6. CRUs and FRUs

Number	FRU description	Self-service CRU	Optional-service CRU
1	Vertical stand	Yes	No
2	Power adapter bracket	Yes	No
3	Power adapter	Yes	No
4	Power cord	Yes	No
5	Computer cover	Yes	No
6	Microprocessor	No	No

Number	FRU description	Self-service CRU	Optional-service CRU
7	Coin-cell battery	No	No
8	Internal speaker	No	Yes
9	Illuminated red dot cable	No	No
10	Advanced speaker	No	No
11	Antenna bracket	No	No
12	System fan	No	No
13	System board	No	No
14	Chassis	No	No
15	Bottom cover	Yes	No
16	Memory module	Yes	No
17	M.2 storage drive	Yes	No
18	Storage drive cable	No	No
19	Storage drive	No	Yes
20	Storage drive bracket	No	Yes
21	Wi-Fi card shield	No	No
22	Wi-Fi card	No	No
23	PCI Express card	No	No
24	PCI Express card adapter	No	No
25	Wi-Fi antennas	No	No
26	Heat sink	No	No
27	VESA® mount bracket	Yes	No
28	External optical drive	Yes	No
29	External optical drive box	Yes	No
30	External I/O box	Yes	No
31	Keyboard or wireless keyboard	Yes	No
32	Mouse or wireless mouse	Yes	No

Replacing CRUs

Before replacing CRUs

Customer Replaceable Units (CRUs) are computer parts that a user can upgrade or replace. There are two types of CRUs: self-service and optional-service.

To check the locations of CRUs, see “Knowing replaceable parts” on page 11.

Note: To replace other parts except the CRUs mentioned in the following sections, contact a Lenovo service technician. The support phone numbers are available at <https://pcsupport.lenovo.com/supportphonenumberlist>.

Replacing the keyboard or wireless keyboard

Note: The wireless keyboard is available only on some models.

Replacing the keyboard

1. Turn off the computer and disconnect all power cords from electrical outlets.
2. Disconnect the old keyboard cable from the computer.
3. Connect a new keyboard to the appropriate connector on the computer.

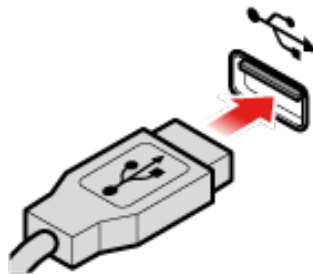


Figure 7. Replacing the keyboard

Replacing the wireless keyboard

1. Remove your old wireless keyboard.
2. Take out the new wireless keyboard from the package.
3. Open the battery compartment cover, and install two AAA batteries according to the polarity indicators.

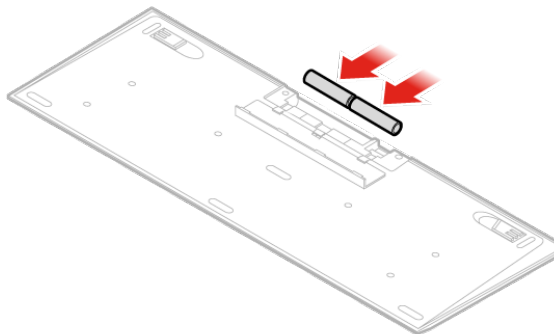


Figure 8. Replacing the wireless keyboard

4. Remove the USB dongle from the keyboard compartment or from the wireless mouse compartment and connect it to an available USB connector on the computer.
5. Close the compartment cover. The keyboard is ready for use.

Replacing the mouse or wireless mouse

Note: The wireless mouse is available only on some models.

Replacing the mouse

1. Turn off the computer and disconnect all power cords from electrical outlets.
2. Disconnect the old mouse cable from the computer.
3. Connect a new mouse to the appropriate connector on the computer.

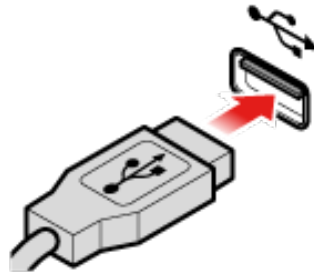


Figure 9. Replacing the mouse

Replacing the wireless mouse

1. Disconnect the USB dongle from your computer. Then, remove your old wireless mouse.
2. Remove the new wireless mouse from the package.
3. Open the battery compartment cover, and install two AAA batteries according to the polarity indicators.
 - a. Open the battery compartment.

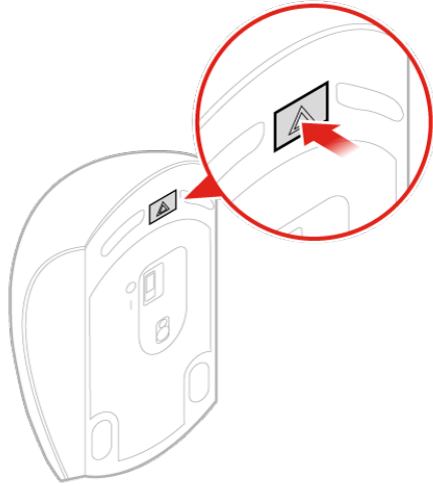


Figure 10. Opening the battery compartment

- b. Take out the USB dongle.



Figure 11. Taking out the USB dongle

- c. Connect the USB dongle to a USB connector.

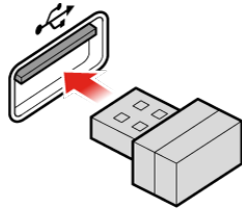


Figure 12. Connecting the USB dongle to a USB connector

- d. Install the mouse batteries.

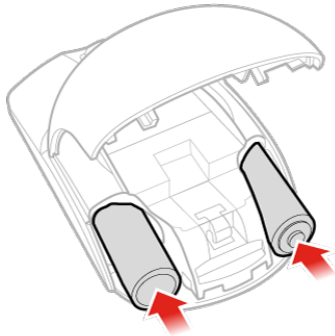


Figure 13. Installing the mouse batteries

- e. Close the battery compartment cover.

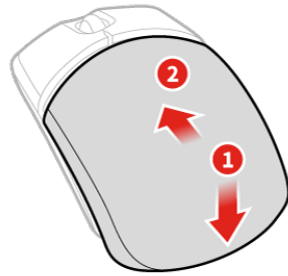


Figure 14. Closing the battery compartment cover

- f. Push the power switch to the on position.

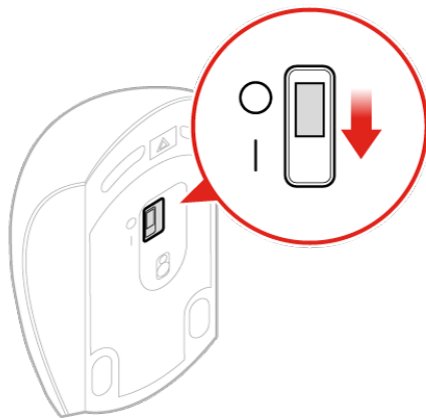


Figure 15. Pushing the power switch to the on position

Notes:

- The green LED indicates that the mouse is ready for use.
- The flashing amber LED indicates a low battery level.
- Push the power switch to the off position when you are not using the mouse to extend the battery life.
- After disconnecting the USB dongle from your computer, store it in the wireless mouse compartment or in the wireless keyboard compartment.

Replacing the power adapter

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

Note: The P320 Tiny computer supports the following Tiny-in-one (TIO) monitor models: Tiny-in-One 23-Monitor (MT: 10DQ), Tiny-in-One 22-Monitor (MT: 10LK), Tiny-in-One 24-Monitor (MT: 10LL), TIO22Gen3-Monitor (MT: 10R1), TIO22Gen3Touch-Monitor (MT: 10R0), TIO24Gen3-Monitor (MT: 10QY), and TIO24Gen3Touch-Monitor (MT: 10QX). When using the P320 Tiny computer with the TIO monitor, ensure that you use the 135W power adapter that comes with the P320 Tiny computer.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Replace the power adapter.

Note: Your power cord might look different from the one illustrated.

- a. Remove the power adapter.

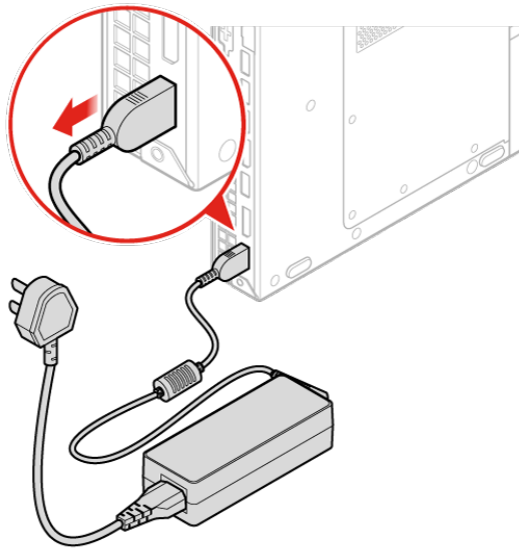


Figure 16. Removing the power adapter

- b. Remove the power cord.

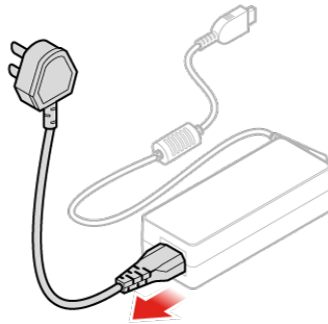


Figure 17. Removing the power cord

- c. Install the power cord.

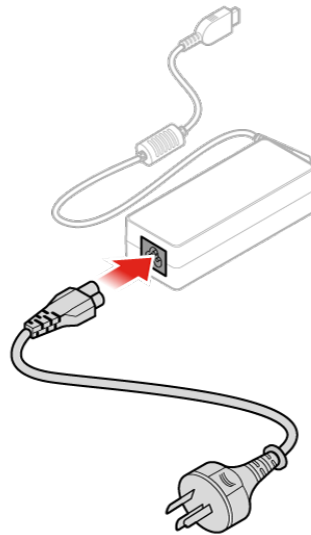


Figure 18. Installing the power cord

- d. Install the power adapter.

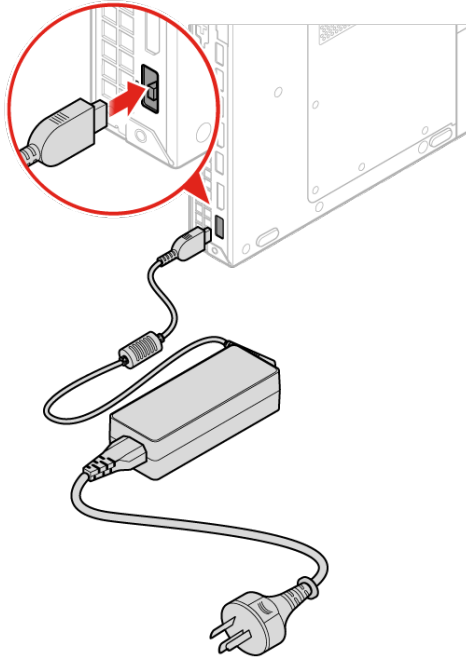


Figure 19. Installing the power adapter

Replacing the vertical stand

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Replace the vertical stand.
 - a. Remove the vertical stand.

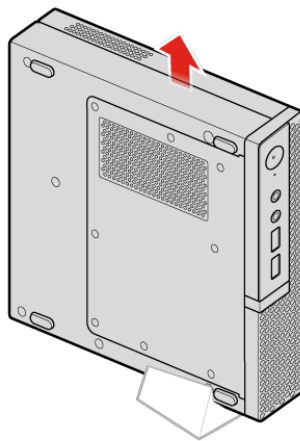


Figure 20. Removing the vertical stand

- b. Install the vertical stand.

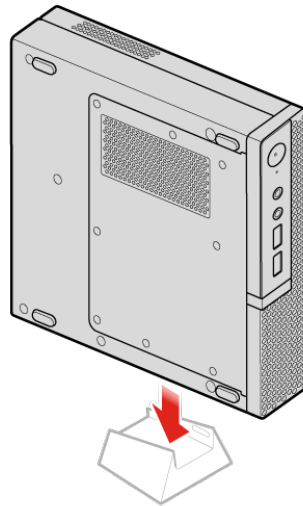


Figure 21. Installing the vertical stand

Replacing the VESA mount bracket

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Replace the VESA mount bracket.
 - a. Remove the VESA mount bracket.

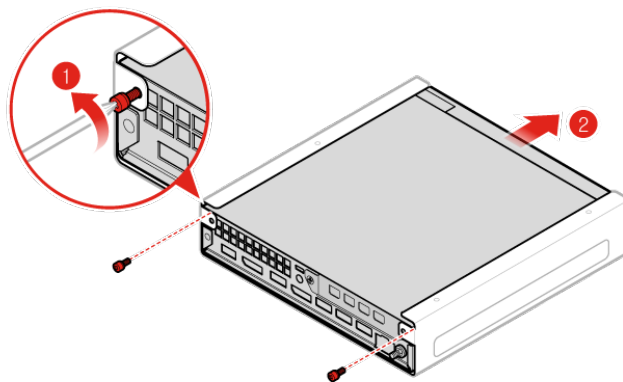


Figure 22. Removing the VESA mount bracket

- b. Install the VESA mount bracket.

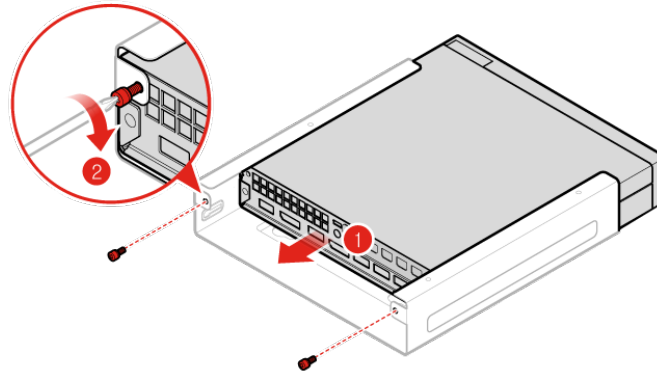


Figure 23. Installing the VESA mount bracket

Replacing the external optical drive

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Replace the external optical drive.
 - a. Remove the external optical drive box.

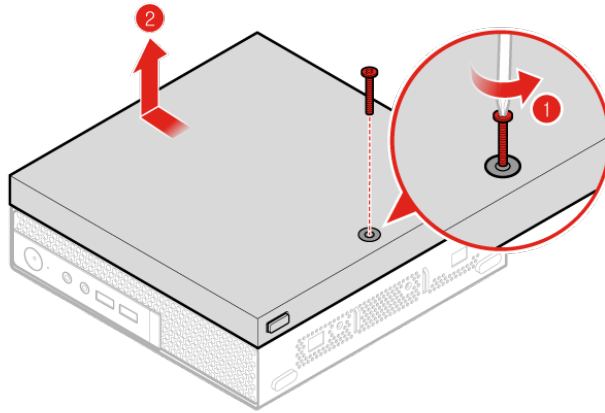


Figure 24. Removing the external optical drive box

- b. Remove the external optical drive.

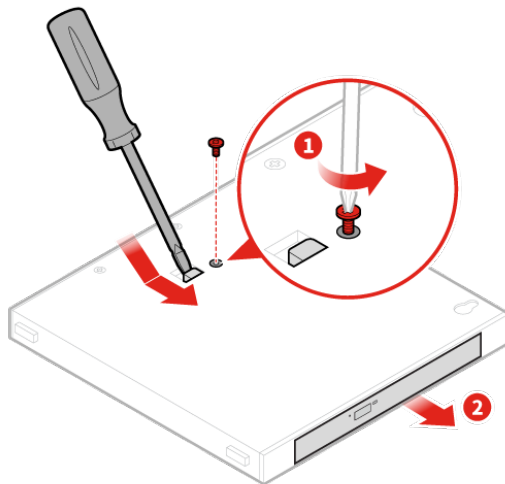


Figure 25. Removing the external optical drive

- c. Install the external optical drive.

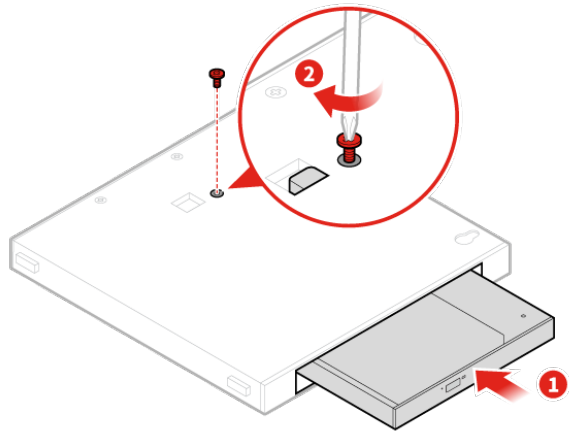


Figure 26. Installing the external optical drive

- d. Install the external optical drive box.

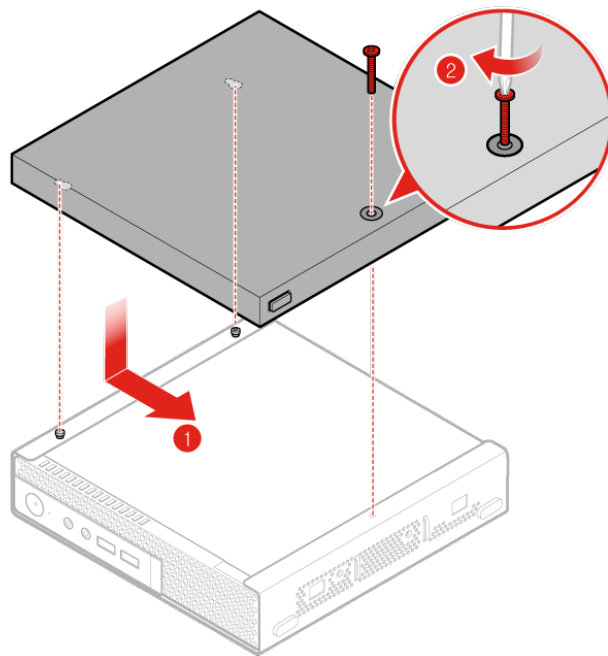


Figure 27. Installing the external optical drive box

Replacing the external I/O box

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer and the external I/O box.
3. Replace the external I/O box.
 - a. Remove the external I/O box.

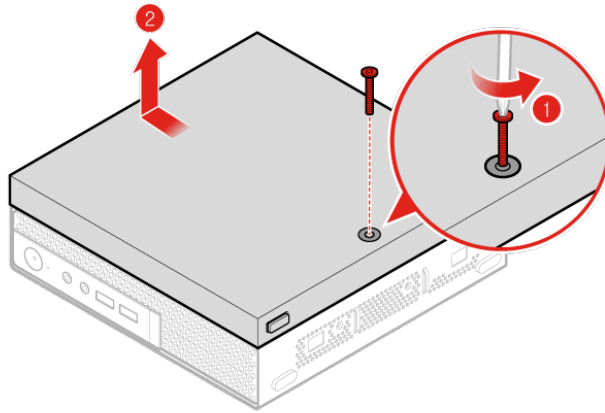


Figure 28. Removing the external I/O box

- b. Install the external I/O box.

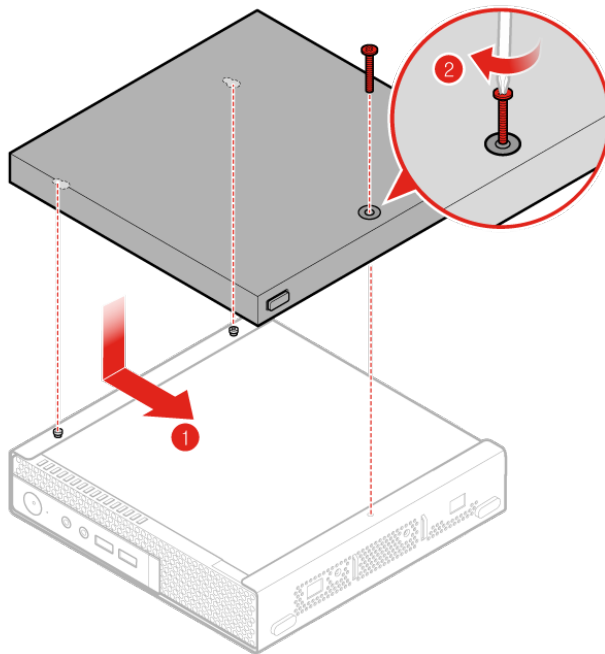


Figure 29. Installing the external I/O box

Replacing the power adapter bracket

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Replace the power adapter bracket.
 - a. Remove the power adapter bracket.

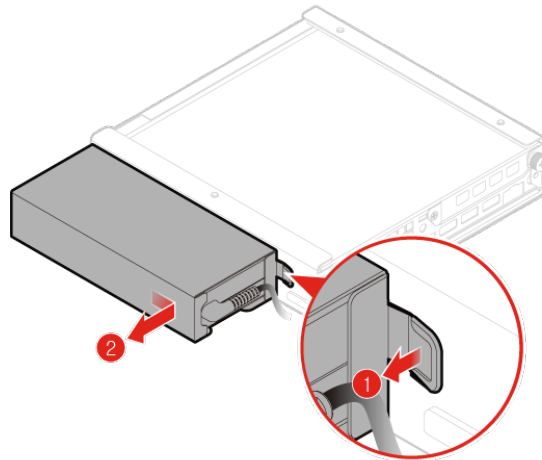


Figure 30. Removing the power adapter bracket

- b. Install the power adapter bracket.

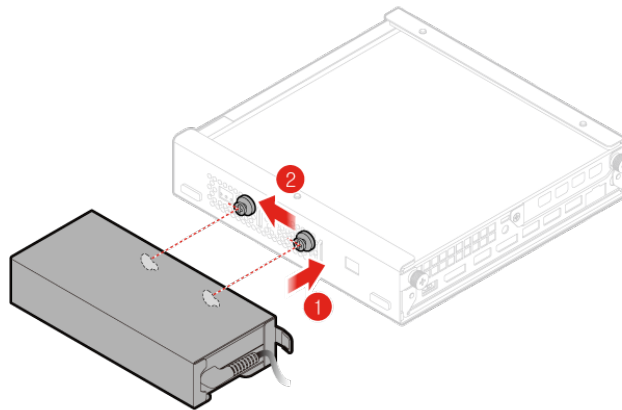


Figure 31. Installing the power adapter bracket

Removing the computer cover

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover.

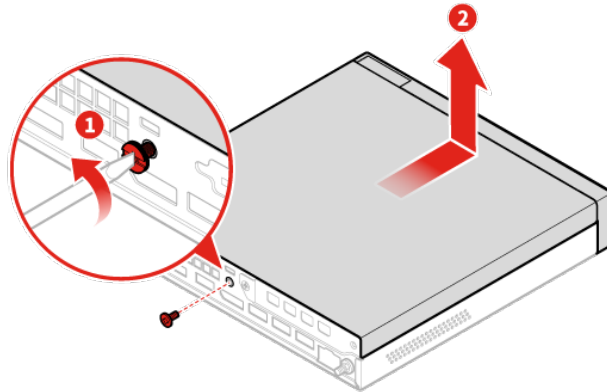


Figure 32. Removing the computer cover

Replacing the storage drive

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Disconnect the storage drive cables from the system board. See “System board” on page 3.
5. Replace the storage drive.
 - a. Remove the storage drive.

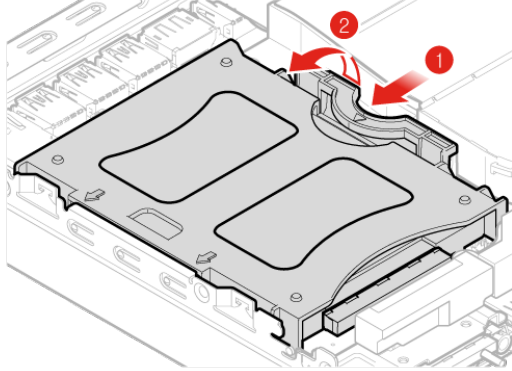


Figure 33. Removing the storage drive

- b. Remove the storage drive bracket.

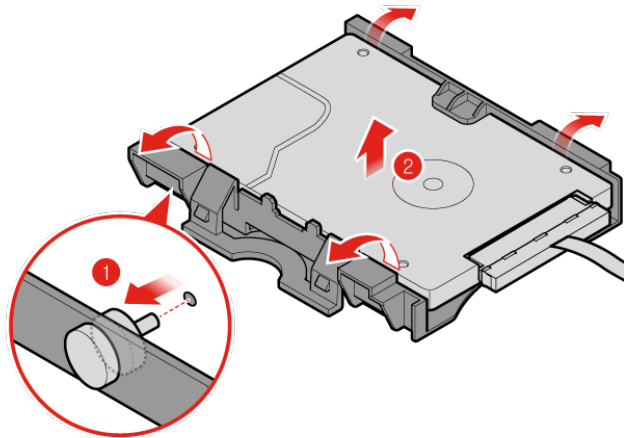


Figure 34. Removing the storage drive bracket

- c. Install the storage drive bracket.

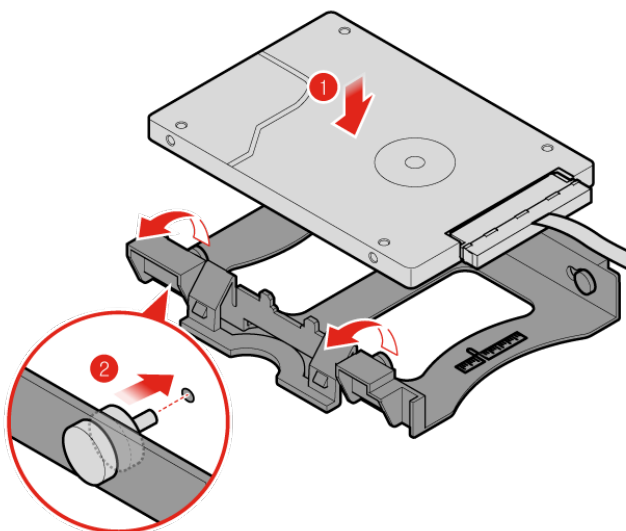


Figure 35. Installing the storage drive bracket

- d. Install the storage drive.

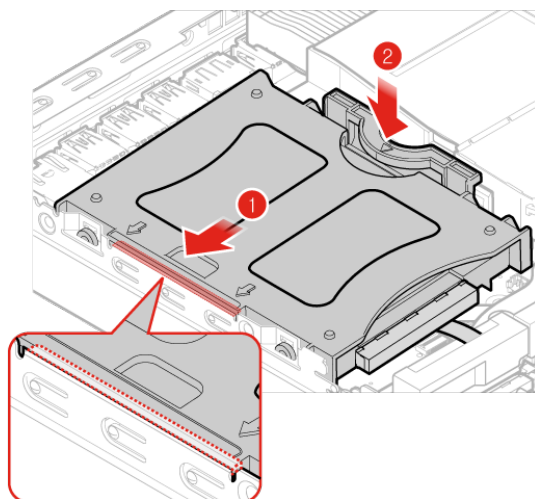


Figure 36. Installing the storage drive

6. Connect the storage drive cables to the system board. See “System board” on page 3.
7. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the internal speaker

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.

3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Disconnect the internal speaker cable from the internal speaker connector on the system board. See “System board” on page 3.
5. Replace the internal speaker.
 - a. Remove the internal speaker.

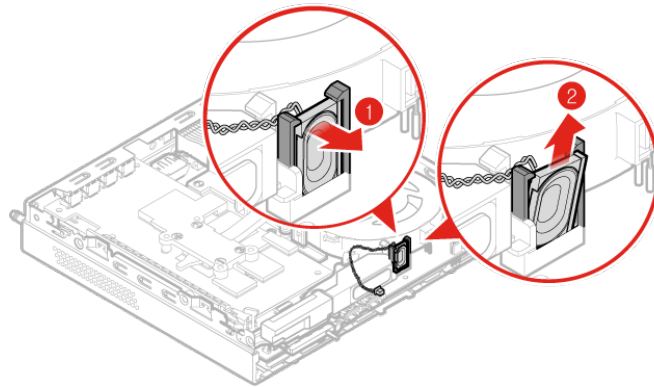


Figure 37. Removing the internal speaker

- b. Install the internal speaker.

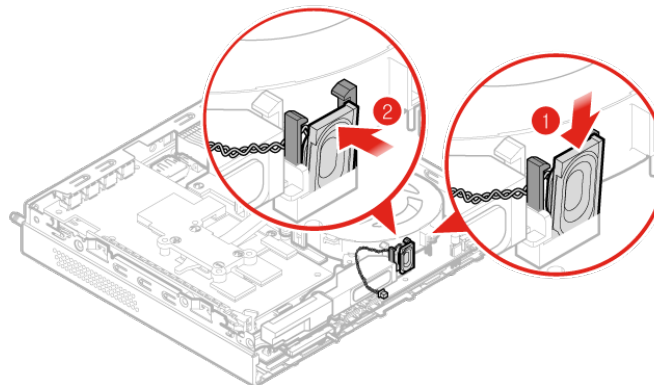


Figure 38. Installing the internal speaker

6. Connect the internal speaker cable to the internal speaker connector on the system board. See “System board” on page 3.
7. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the bottom cover

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Replace the bottom cover.
 - a. Remove the bottom cover.

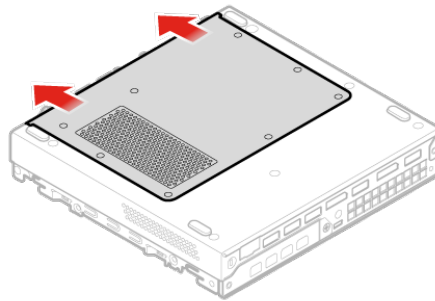


Figure 39. Removing the bottom cover

- b. Install the bottom cover.

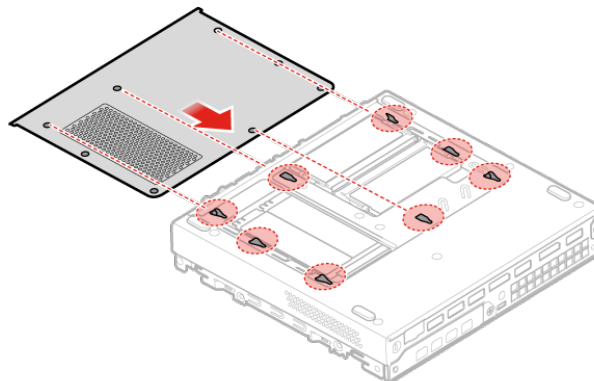


Figure 40. Installing the bottom cover

5. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the memory module

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

If your computer supports one memory module, install the module into the DIMM 1 slot. If your computer supports two memory modules, install one memory module into the DIMM 1 slot first and then install the other into the DIMM 2 slot. See “System board” on page 3 for the locations of the slots.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Remove the bottom cover. For details, see “Replacing the bottom cover” on page 33.
5. Replace the memory module.
 - a. Open the memory module retainer.

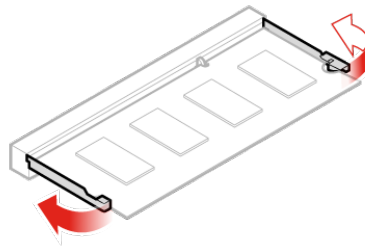


Figure 41. Opening the memory module retainer

- b. Remove the memory module.

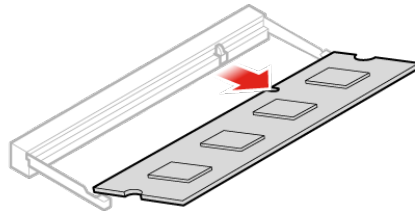


Figure 42. Removing the memory module

- c. Install the memory module.

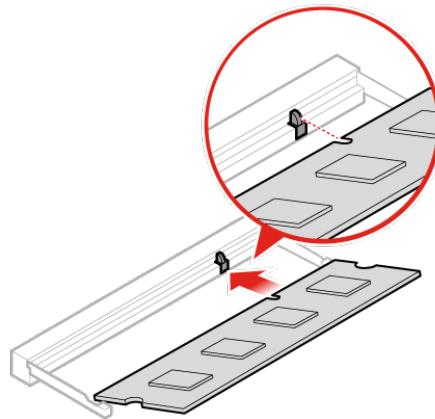


Figure 43. Installing the memory module

- d. Close the memory module retainer.

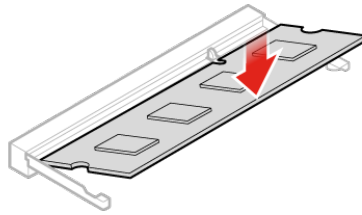


Figure 44. Closing the memory module retainer

6. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the M.2 storage drive

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

The instructions on how to install or replace a M.2 solid-state drive also apply to the Intel Optane memory. Before replacing the Intel Optane memory, ensure that you disable the Intel Optane memory from the Intel Rapid Storage Technology (Intel RST) Console. Otherwise, all data on the storage drive will be lost.

Note: The instructions on how to replace an M.2 storage drive also apply to the Intel® Optane™ memory.

If your computer supports one M.2 storage drive, install the drive into the M.2 storage drive slot 1. If your computer supports two M.2 storage drives, install one drive into the M.2 storage drive slot 1 first and then install the other into the slot 2. See “System board” on page 3 for the locations of the slots.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Remove the bottom cover. For details, see “Replacing the bottom cover” on page 33.
5. Replace the M.2 storage drive.
 - a. Unlock the M.2 storage drive clip.

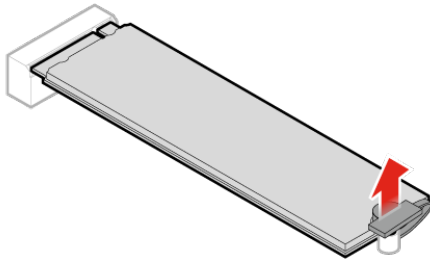


Figure 45. Unlocking the M.2 storage drive clip

- b. Remove the M.2 storage drive.

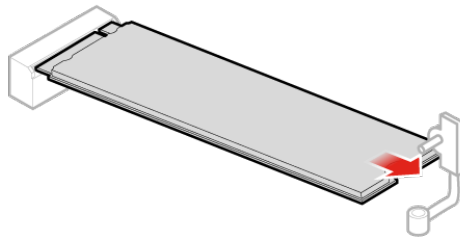


Figure 46. Removing the M.2 storage drive

- c. Install the M.2 storage drive.

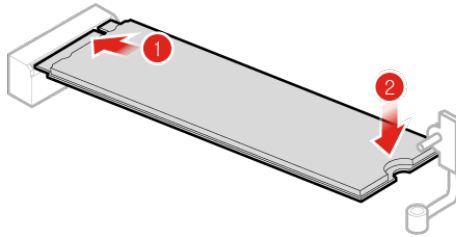


Figure 47. Installing the M.2 storage drive

- d. Lock the M.2 storage drive clip.

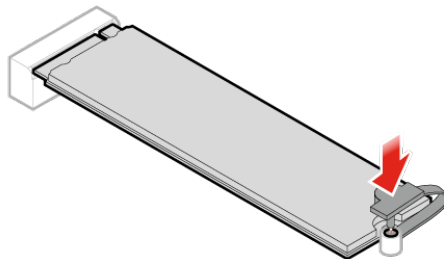


Figure 48. Locking the M.2 storage drive clip

6. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Completing the parts replacement

After completing the installation or replacement for all parts, reinstall the computer cover and reconnect the cables.

To reinstall the computer cover and reconnect the cables to your computer, do the following:

1. Ensure that all components have been reassembled correctly and that no tools or loose screws are left inside your computer. See “System board” on page 3 for the locations of various components in your computer.

2. Ensure that the cables are routed correctly before reinstalling the computer cover. Keep cables clear of the hinges and sides of the computer chassis to avoid interference when reinstalling the computer cover.
3. Install the computer cover.

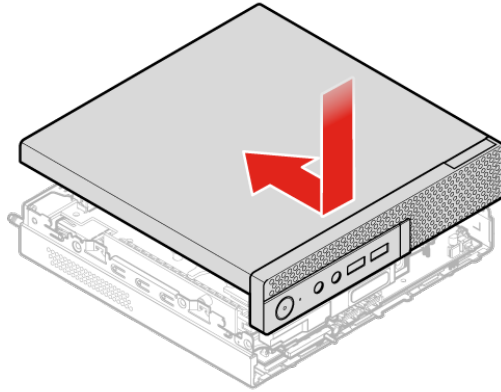


Figure 49. Installing the computer cover

4. Install the screw to secure the computer cover.
5. Place the computer in an upright position.
6. If a locking device is available, use it to lock the computer. See Chapter 3 “Connecting to other devices” on page 7.
7. Reconnect the external cables and power cords to the corresponding connectors on the computer. See “Front view” on page 1 or “Rear view” on page 2 for the locations of various components in your computer.

Replacing FRUs

Before replacing FRUs

Before replacing any Field Replaceable Units (FRUs), read the following:

- **Only certified and trained personnel can service the computer.**
- **Before replacing an FRU, read the entire section about replacing the part.**
- **Be extremely careful during writing operations such 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 an FRU only with another FRU of the correct model.**

When you replace an FRU, ensure that the model of the machine and the FRU part number are correct by referring to the website <https://support.lenovo.com/partslookup>.

- **An 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 an FRU only when a problem recurs. If you suspect that an FRU is defective, clear the error log and run the test again. If the error does not recur, do not replace the FRU.

- **Only replace a defective FRU.**

To check the locations of FRUs, see “Knowing replaceable parts” on page 11.

Attention: Do not open your computer or attempt any repair before reading the *Important Product Information Guide*.

Replacing the system fan

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.
3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
5. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
6. Release the illuminated red dot cable from the system fan.
7. Disconnect the system fan cable from the system fan connector on the system board. See “System board” on page 3.
8. Replace the system fan.
 - a. Remove the system fan.

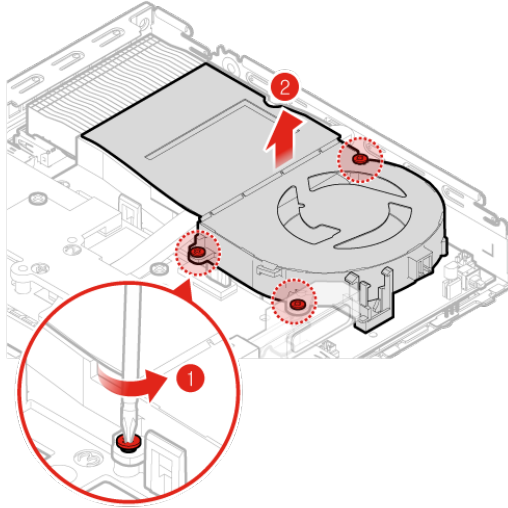


Figure 50. Removing the system fan

- b. Install the system fan.

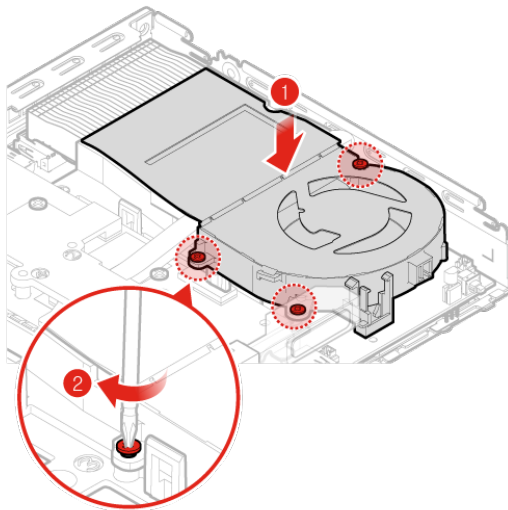


Figure 51. Installing the system fan

9. Connect the system fan cable to the system fan connector on the system board. See “System board” on page 3.
10. Install the illuminated red dot cable to the new system fan.
11. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the illuminated red dot cable

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.

2. Disconnect the illuminated red dot cable from the system board. See “System board” on page 3.
3. Replace the illuminated red dot cable.
 - a. Remove the illuminated red dot cable.

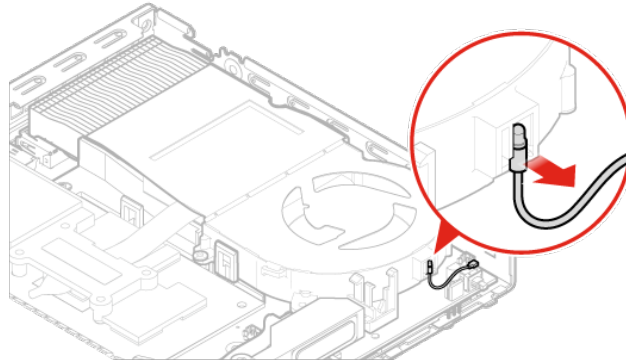


Figure 52. Removing the illuminated red dot cable

- b. Install the illuminated red dot cable.

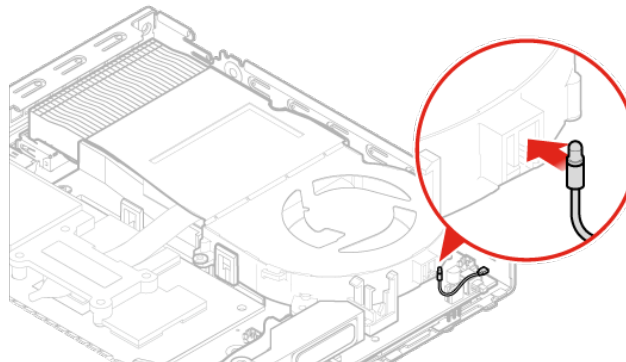


Figure 53. Installing the illuminated red dot cable

4. Connect the illuminated red dot cable to the system board. See “System board” on page 3.
5. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the advanced speaker

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the system fan. For details, see “Replacing the system fan” on page 40.
4. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
5. Disconnect the advanced speaker cable from the advanced speaker connector on the system board. See “System board” on page 3.
6. Replace the advanced speaker.
 - a. Remove the advanced speaker.

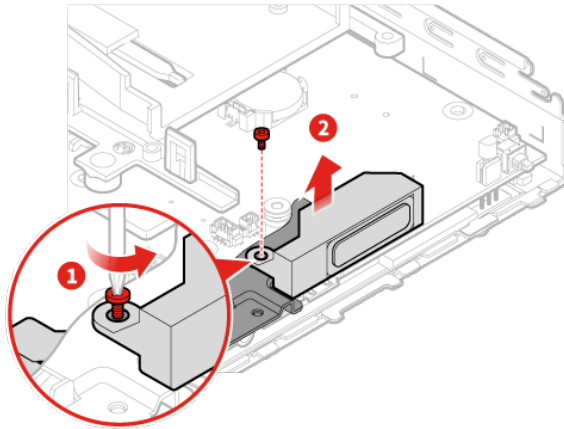


Figure 54. Removing the advanced speaker

- b. Install the advanced speaker.

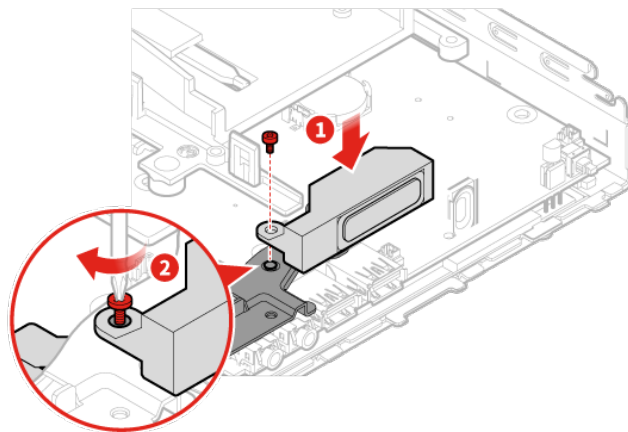


Figure 55. Installing the advanced speaker

7. Connect the advanced speaker cable to the advanced speaker connector on the system board. See “System board” on page 3.
8. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the Wi-Fi antennas

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

Replacing the front Wi-Fi antenna

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the system fan. For details, see “Replacing the system fan” on page 40.
4. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
5. Replace the front Wi-Fi antenna.
 - a. Disconnect the front Wi-Fi antenna cable.

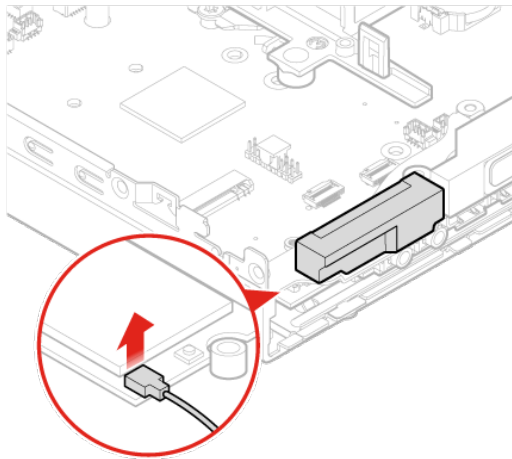


Figure 56. Disconnecting the front Wi-Fi antenna cable

- b. Remove the front Wi-Fi antenna.

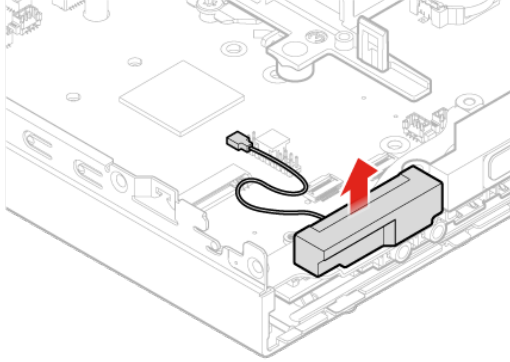


Figure 57. Removing the front Wi-Fi antenna

- c. Install the front Wi-Fi antenna.

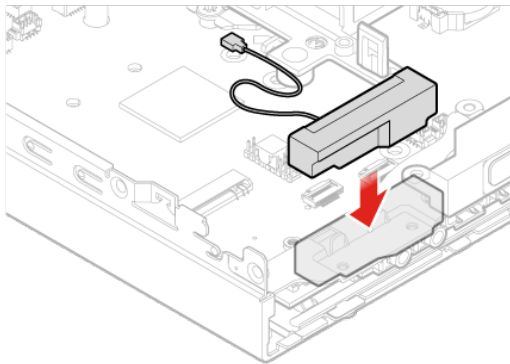


Figure 58. Installing the front Wi-Fi antenna

- d. Connect the front Wi-Fi antenna cable to the Wi-Fi card.

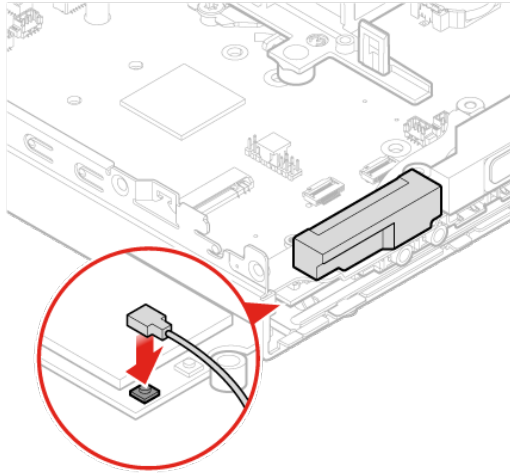


Figure 59. Connecting the front Wi-Fi antenna cable to the Wi-Fi card

6. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the rear Wi-Fi antenna

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the system fan. For details, see “Replacing the system fan” on page 40.
4. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Disconnect the rear Wi-Fi antenna cable from the Wi-Fi card.
7. Replace the rear Wi-Fi antenna.

Note: Record the cable routing before removing the rear Wi-Fi antenna cable.

- a. Remove the rear Wi-Fi antenna.

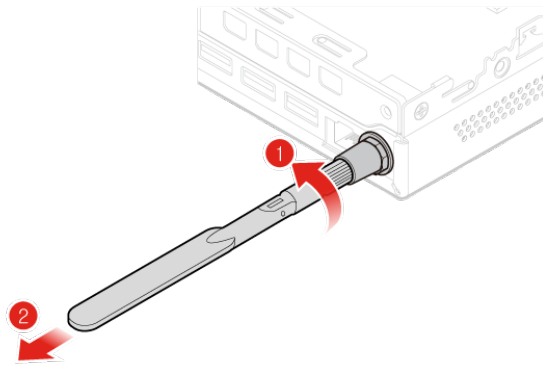


Figure 60. Removing the rear Wi-Fi antenna

- b. Remove the screw cover that secures the rear Wi-Fi antenna cable.

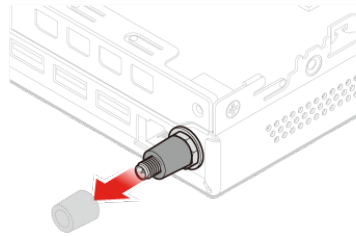


Figure 61. Removing the screw cover that secures the rear Wi-Fi antenna cable

- c. Remove the rear Wi-Fi antenna cable.

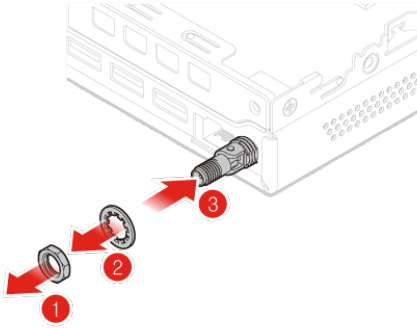


Figure 62. Removing the rear Wi-Fi antenna cable

- d. Install the rear Wi-Fi antenna cable.

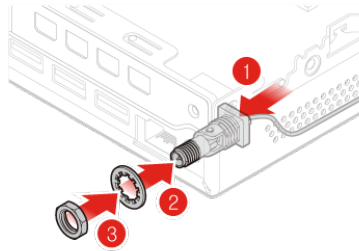


Figure 63. Installing the rear Wi-Fi antenna cable

- e. Install the screw cover to secure the rear Wi-Fi antenna cable.

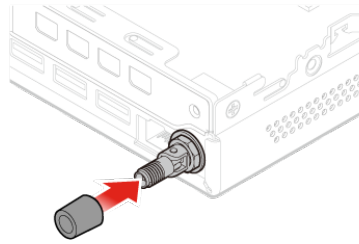


Figure 64. Installing the screw cover to secure the rear Wi-Fi antenna cable

- f. Install the rear Wi-Fi antenna.

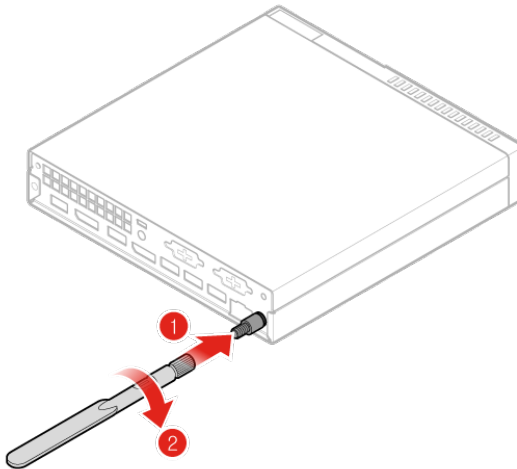


Figure 65. Installing the rear Wi-Fi antenna

8. Connect the rear Wi-Fi antenna cable to the Wi-Fi card.
9. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the storage drive cable

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Replace the storage drive cable.

- a. Remove the storage drive cable.

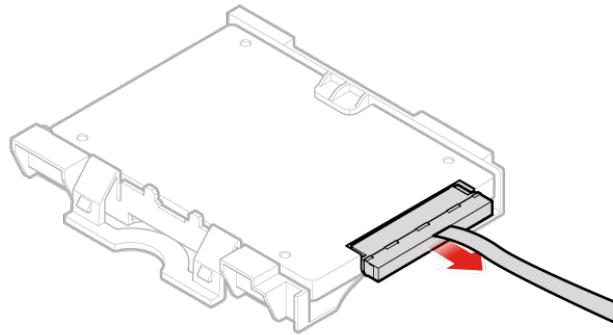


Figure 66. Removing the storage drive cable

- b. Install the storage drive cable.

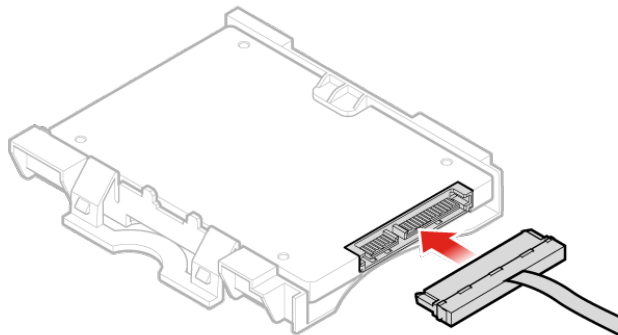


Figure 67. Installing the storage drive cable

4. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the PCI Express card and PCI Express card adapter

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove any media from the drives and turn off all connected devices and the computer.
2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.

3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
5. Remove the system fan. For details, see “Replacing the system fan” on page 40.
6. Replace the PCI Express card and PCI Express card adapter.
 - a. Remove the PCI Express card.

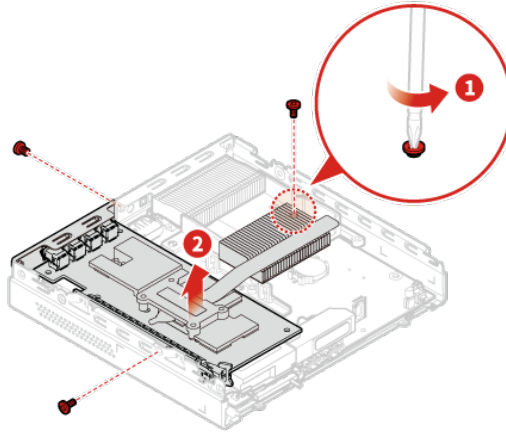


Figure 68. Removing the PCI Express card

- b. Remove the PCI Express card adapter.

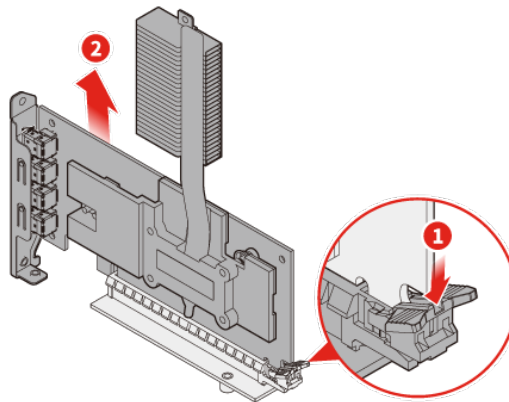


Figure 69. Removing the PCI Express card adapter

- c. Install the PCI Express card adapter.

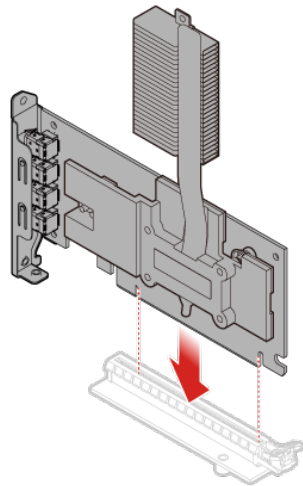


Figure 70. Installing the PCI Express card adapter

- d. Install the PCI Express card.

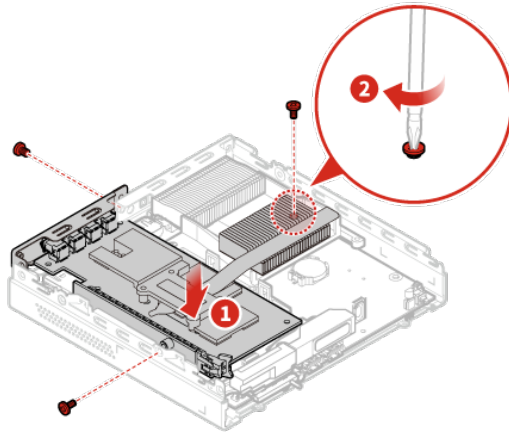


Figure 71. Installing the PCI Express card

- 7. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the Wi-Fi card

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

- 1. Remove any media from the drives and turn off all connected devices and the computer.
- 2. Disconnect all power cords from electrical outlets and disconnect all cables that are connected to the computer.

3. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
4. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
5. Remove the system fan. For details, see “Replacing the system fan” on page 40.
6. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
7. Depending on your computer model, refer to one of the following to replace the Wi-Fi card.
 - Type 1
Remove the Wi-Fi card shield.

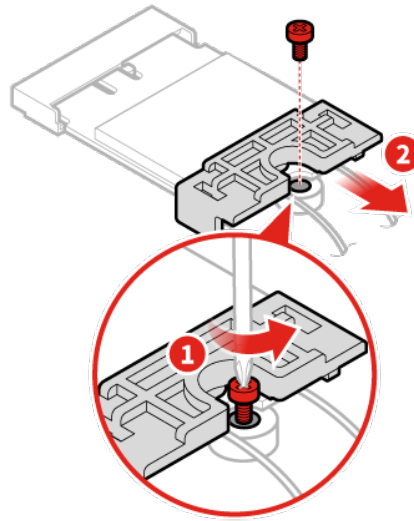


Figure 72. Removing the Wi-Fi card shield

Disconnect the Wi-Fi antenna cables.

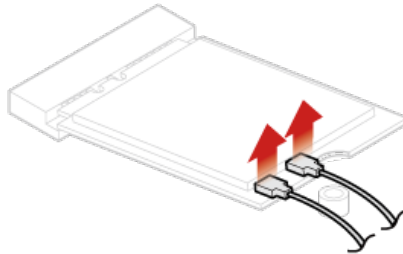


Figure 73. Disconnecting the Wi-Fi antenna cables

Remove the Wi-Fi card.

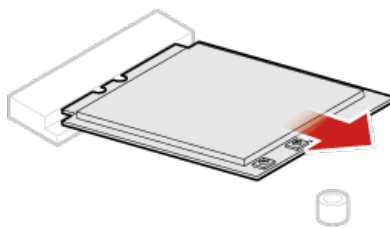


Figure 74. Removing the Wi-Fi card

Install the Wi-Fi card.

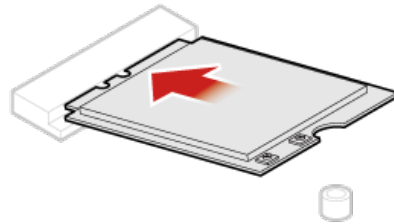


Figure 75. Installing the Wi-Fi card

Connect the Wi-Fi antenna cables.

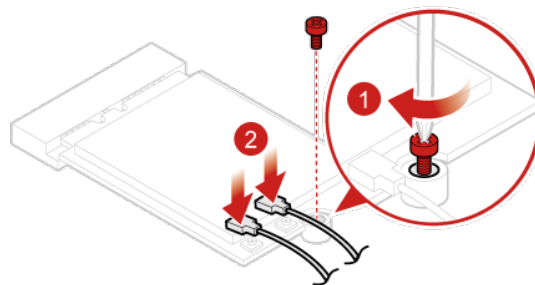


Figure 76. Connecting the Wi-Fi antenna cables

Install the Wi-Fi card shield.

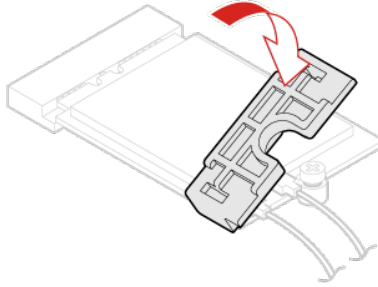


Figure 77. Installing the Wi-Fi card shield

- Type 2
Remove the Wi-Fi card shield.

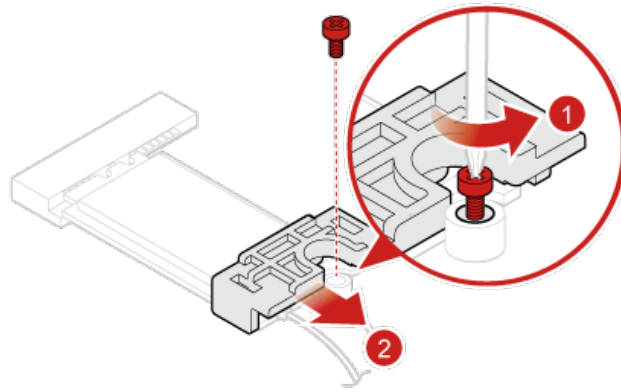


Figure 78. Removing the Wi-Fi card shield

Disconnect the Wi-Fi antenna cables.

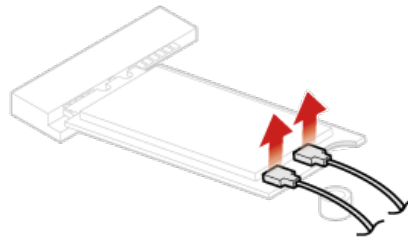


Figure 79. Disconnecting the Wi-Fi antenna cables

Remove the Wi-Fi card.

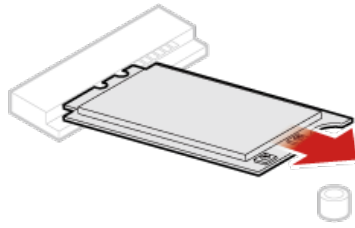


Figure 80. Removing the Wi-Fi card

Install the Wi-Fi card.

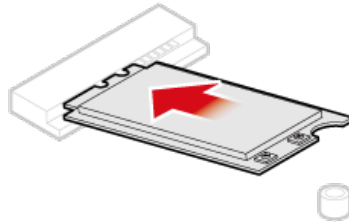


Figure 81. Installing the Wi-Fi card

Connect the Wi-Fi antenna cables.

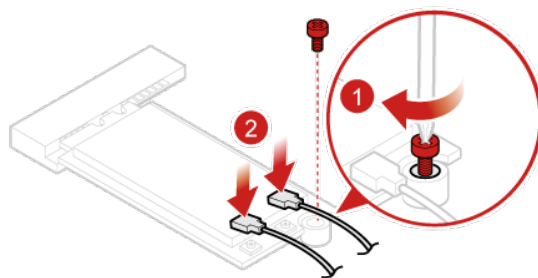


Figure 82. Connecting the Wi-Fi antenna cables

Install the Wi-Fi card shield.

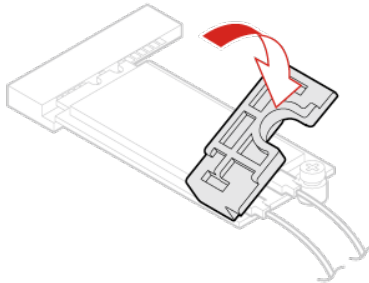


Figure 83. Installing the Wi-Fi card shield

8. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the heat sink

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
4. Remove the system fan. For details, see “Replacing the system fan” on page 40.
5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Replace the heat sink.
 - a. Loosen the screws that secure the heat sink.

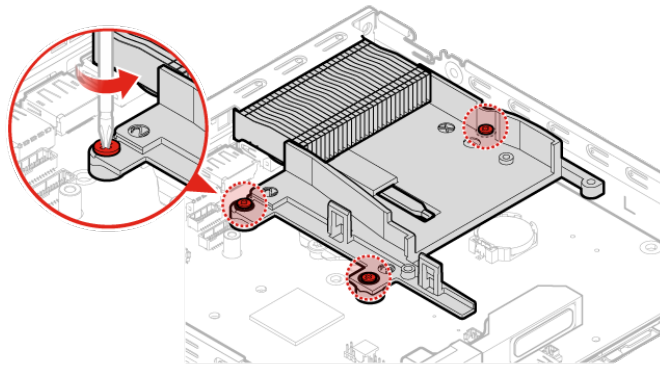


Figure 84. Loosening the screws that secure the heat sink

- b. Remove the heat sink.

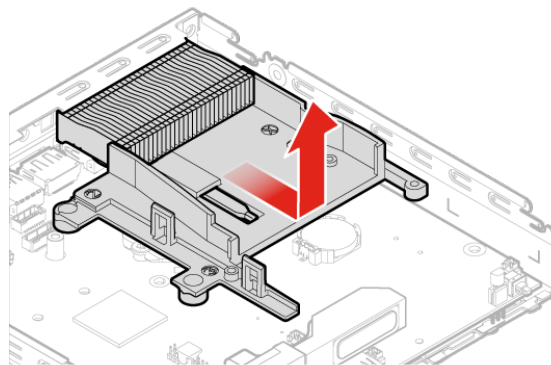


Figure 85. Removing the heat sink

- c. Install the heat sink.

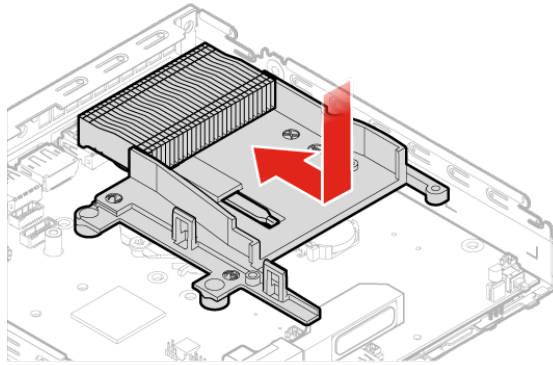


Figure 86. Installing the heat sink

- d. Tighten the screws to secure the heat sink.

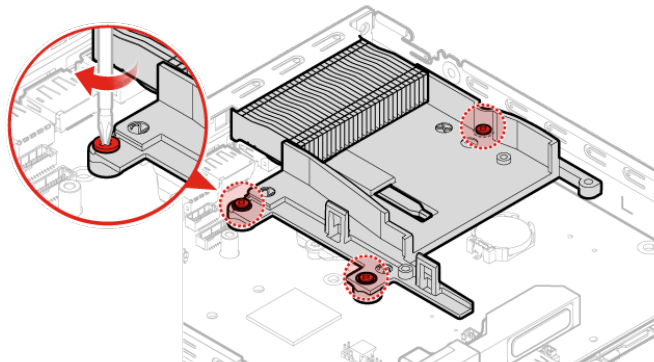


Figure 87. Tightening the screws to secure the heat sink

7. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the microprocessor

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

CAUTION:



The heat sink and microprocessor might be very hot. Before you open the computer cover, turn off the computer and wait several minutes until the computer is cool.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
4. Remove the system fan. For details, see “Replacing the system fan” on page 40.
5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Remove the heat sink. For details, see “Replacing the heat sink” on page 60.
7. Replace the microprocessor.

Notes:

- Your microprocessor and socket might look different from the one illustrated.
- Touch only the edges of the microprocessor. Do not touch the gold contacts on the bottom.
- Do not drop anything onto the microprocessor socket while it is exposed. The socket pins must be kept as clean as possible.

- a. Unlock the microprocessor socket retainer.

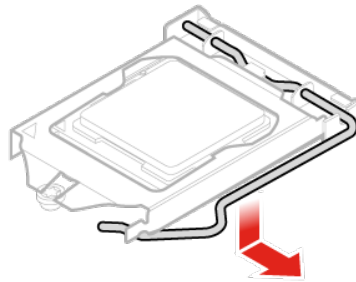


Figure 88. Unlocking the microprocessor socket retainer

- b. Pivot the microprocessor socket upward.

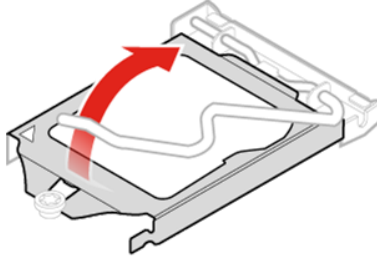


Figure 89. Pivoting the microprocessor socket upward

- c. Remove the microprocessor.

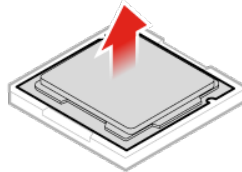


Figure 90. Removing the microprocessor

- d. Install the microprocessor.

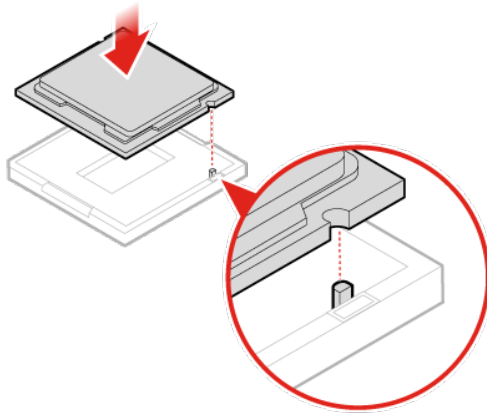


Figure 91. Installing the microprocessor

- e. Pivot the microprocessor socket downward.

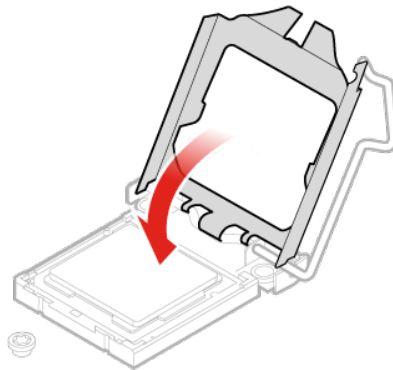


Figure 92. Pivoting the microprocessor socket downward

- f. Lock the microprocessor socket retainer.

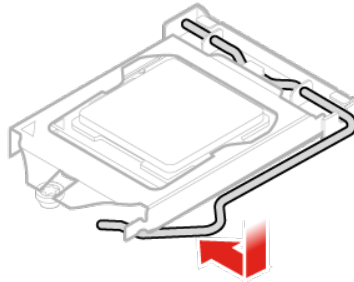


Figure 93. Locking the microprocessor socket retainer

8. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the coin-cell battery

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

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

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

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
4. Remove the system fan. For details, see “Replacing the system fan” on page 40.
5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Remove the heat sink. For details, see “Replacing the heat sink” on page 60.
7. Replace the coin-cell battery.
 - a. Release the coin-cell battery.

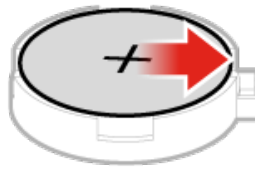


Figure 94. Releasing the coin-cell battery

- b. Remove the coin-cell battery.



Figure 95. Removing the coin-cell battery

- c. Install the coin-cell battery.

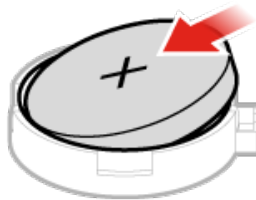


Figure 96. Installing the coin-cell battery

- d. Press the coin-cell battery downward until it snaps into position.

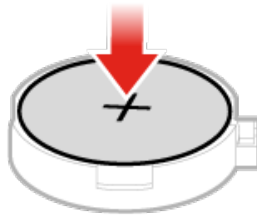


Figure 97. Pressing the coin-cell battery downward until it snaps into position

8. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

To dispose of the coin-cell battery, refer to the “Lithium coin-cell battery notice” topic in the *Safety, Warranty, and Setup Guide*.

Replacing the system board and chassis

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
4. Remove the system fan. For details, see “Replacing the system fan” on page 40.
5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Remove the heat sink. For details, see “Replacing the heat sink” on page 60.
7. Remove the Wi-Fi card. For details, see “Replacing the Wi-Fi card” on page 52.
8. Remove the Wi-Fi antennas. For details, see “Replacing the Wi-Fi antennas” on page 44.
9. Remove the microprocessor. For details, see “Replacing the microprocessor” on page 62.
10. Remove the bottom cover. For details, see “Replacing the bottom cover” on page 33.
11. Remove the memory module. For details, see “Replacing the memory module” on page 34.
12. Remove the M.2 storage drive. For details, see “Replacing the M.2 storage drive” on page 36.
13. Remove the antenna bracket. For details, see “” on page .
14. Record the cable routing and cable connections, and then disconnect all cables from the system board. See “System board” on page 3.
15. Replace the antenna bracket.
 - a. Remove the antenna bracket.

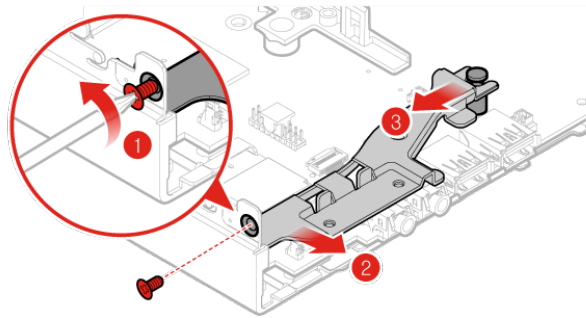


Figure 98. Removing the antenna bracket

- b. Install the antenna bracket.

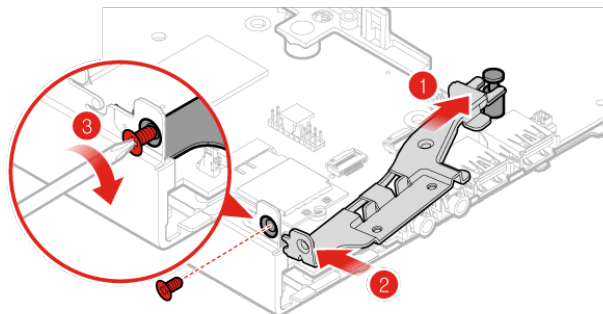


Figure 99. Installing the antenna bracket

16. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Replacing the system board and chassis

Attention: Do not open your computer or attempt any repairs before reading the *Important Product Information Guide*.

1. Remove the computer cover. For details, see “Removing the computer cover” on page 29.
2. Remove the storage drive. For details, see “Replacing the storage drive” on page 29.
3. Remove the internal speaker. For details, see “Replacing the internal speaker” on page 31.
4. Remove the system fan. For details, see “Replacing the system fan” on page 40.

5. Remove the PCI Express card. For details, see “Replacing the PCI Express card and PCI Express card adapter” on page 50.
6. Remove the heat sink. For details, see “Replacing the heat sink” on page 60.
7. Remove the Wi-Fi card. For details, see “Replacing the Wi-Fi card” on page 52.
8. Remove the Wi-Fi antennas. For details, see “Replacing the Wi-Fi antennas” on page 44.
9. Remove the microprocessor. For details, see “Replacing the microprocessor” on page 62.
10. Remove the bottom cover. For details, see “Replacing the bottom cover” on page 33.
11. Remove the memory module. For details, see “Replacing the memory module” on page 34.
12. Remove the M.2 storage drive. For details, see “Replacing the M.2 storage drive” on page 36.
13. Remove the antenna bracket. For details, see “Replacing the system board and chassis” on page 68.
14. Record the cable routing and cable connections, and then disconnect all cables from the system board. See “System board” on page 3.
15. Replace the system board and chassis.

Note: Carefully handle the system board by its edges.

- a. Remove the screws that secure the system board.

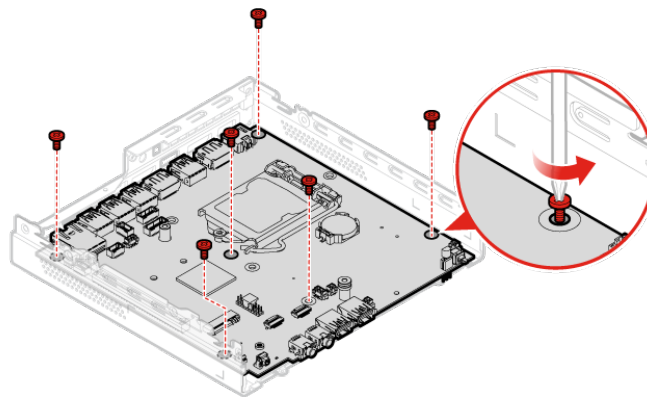


Figure 100. Removing the screws that secure the system board

- b. Remove the system board.

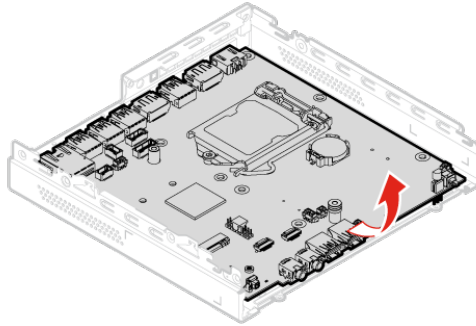


Figure 101. Removing the system board

- c. Install the system board.

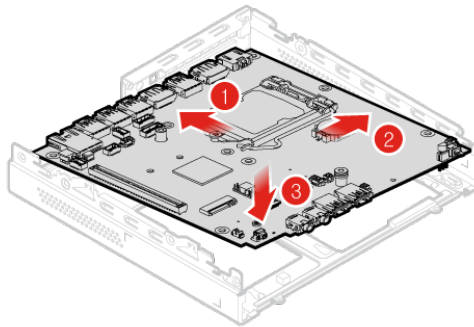


Figure 102. Installing the system board

- d. Install the screws to secure the system board.

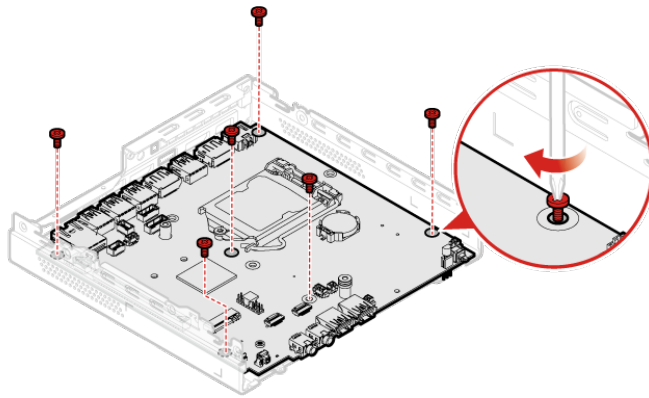


Figure 103. Installing the screws to secure the system board

16. Route all the cables that you disconnected from the failing system board, and then reconnect the cables to the new system board. See “System board” on page 3.
17. Reinstall the computer cover and reconnect the cables. For details, see “Completing the parts replacement” on page 38.

Appendix A. Notices

Lenovo may not offer the products, services, or features discussed in this document in all countries. Consult your local Lenovo representative for information on the products and services currently available in your area. Any reference to a Lenovo product, program, or service is not intended to state or imply that only that Lenovo product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any Lenovo intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any other product, program, or service.

Lenovo may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*Lenovo (United States), Inc.
1009 Think Place - Building One
Morrisville, NC 27560
U.S.A.
Attention: Lenovo Director of Licensing*

LENOVO PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. Lenovo may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

The products described in this document are not intended for use in implantation or other life support applications where malfunction may result in injury or death to persons. The information contained in this document does not affect or change Lenovo product specifications or warranties. Nothing in this document shall operate as an express or implied license or indemnity under the intellectual property rights of Lenovo or third parties. All information contained in this document was obtained in specific environments and is presented as an illustration. The result obtained in other operating environments may vary.

Lenovo may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any references in this publication to non-Lenovo Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this Lenovo product, and use of those Web sites is at your own risk.

Any performance data contained herein was determined in a controlled environment. Therefore, the result obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Trademarks

The following terms are trademarks of Lenovo in the United States, other countries, or both:

- Lenovo
- The Lenovo logo
- ThinkStation
- The ThinkStation logo

Intel and Optane are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries.

DisplayPort and VESA are trademarks of the Video Electronics Standards Association.

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

Lenovo