HP ZBook 15v G5 Mobile Workstation

Maintenance and Service Guide
IMPORTANT! This document is intended for
HP authorized service providers only.

Second Edition: February 2019

First Edition: May 2018

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Product notice

This guide describes features that are common to most models. Some features may not be available on your computer.

Not all features are available in all editions of Windows. This computer may require upgraded and/or separately purchased hardware, drivers, and/or software to take full advantage of Windows functionality. See http://www.microsoft.com for details.

Software terms

By installing, copying, downloading, or otherwise using any software product preinstalled on this computer, you agree to be bound by the terms of the HP End User License Agreement (EULA). If you do not accept these license terms, your sole remedy is to return the entire unused product (hardware and software) within 14 days for a refund subject to the refund policy of your place of purchase.

For any further information or to request a full refund of the computer, please contact your local point of sale (the seller).

Safety warning notice

⚠ **WARNING!** To reduce the possibility of heat-related injuries or of overheating the device, do not place the device directly on your lap or obstruct the device air vents. Use the device only on a hard, flat surface. Do not allow another hard surface, such as an adjoining optional printer, or a soft surface, such as pillows or rugs or clothing, to block airflow. Also, do not allow the AC adapter to contact the skin or a soft surface, such as pillows or rugs or clothing, during operation. The device and the AC adapter comply with the user-accessible surface temperature limits defined by the International Standard for Safety of Information Technology Equipment (IEC 60950-1).

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1 Product description

Table 1-1 Product components and their descriptions

Category	Description
Product name	HP ZBook 15v G5 Mobile Workstation
Processor	**8th generation Intel® Core™ processors**
	i7-8850H (2.6-GHz, turbo up to 4.3 GHz, 2400-MHz/9-MB L3 cache, six core, 45 W, Intel UHD Graphics 630 GPU)
	i7-8750H (2.2-GHz, turbo up to 4.1 GHz, 2400-MHz/9-MB L3 cache, six core, 45 W, Intel UHD Graphics 630 GPU)
	i5-8400H (2.5-GHz, turbo up to 4.2 GHz, 2400-MHz/8-MB L3 cache, quad core, 45 W, Intel UHD Graphics 630 GPU)
	i5-8300H (2.3-GHz, turbo up to 4.0 GHz, 2400-MHz/8-MB L3 cache, quad core, 45 W, Intel UHD Graphics 630 GPU)
	8th Generation Intel Xeon processor
	Xeon E-2176M (2.7-GHz, turbo up to 4.4 GHz, 2666-MHz/12-MB L3 cache, six core, 45 W)
Graphics	**Internal graphics**
	Intel UHD Graphics 630
	Discrete graphics
	NVIDIA® Quadro P620 with 4096 MB of dedicated video memory
	Supports DisplayPort 1.2 (supported through Thunderbolt 3)
	Supports Nvidia GC6 and GC off
	Supports hybrid (switchable) graphics
	Support HD Decode, DX12, and HDMI
	Supports Nvidia Optimus Technology
	Supports Open GL 4.5/Open CL 1.2/Vulkan 1.0
	Supports up to 4 total displays (through discrete card) (3 on UMA [through HP Elite 90W Thunderbolt 3 Dock or HP Thunderbolt Dock 230W G2])
	Supports Nvidia Mosaic Technology
Panel	**39.6-cm (15.6-in), white light-emitting diode (WLED), slim flat**
	Full high-definition (FHD), anti glare (1920×1080), UWVA, 220 nits, narrow bezel, with HD camera
	FHD, anti glare (1920×1080), UWVA, 220 nits, narrow bezel, with HD+ IR camera
	FHD, BrightView, Touch-on Panel (TOP)(1920×1080), UWVA, 250 nits, narrow bezel, with HD camera
	FHD, BrightView, Touch-on Panel (TOP)(1920×1080), UWVA, 250 nits, narrow bezel, with HD+IR camera
	Ultra high-definition (UHD), anti glare (3840×2160), UWVA, 340 nits, with HD camera
	UHD, anti glare (3840×2160), UWVA, 340 nits, with HD+IR camera

Table 1-1 Product components and their descriptions (continued)

Category	Description
Memory	Two non-customer-accessible/upgradable memory module slots
	DDR4-2666 dual channel support
	Supports up to 32 GB of non-ECC system RAM in the following configurations (Intel Core or Xeon processors):
	• 32768-MB total system memory (16384×2)
	• 16384-MB total system memory (8192×2 or 16384×1)
	• 8192-MB total system memory (8192×1) or (4096×2)
	Supports up to 32 GB of ECC system RAM in the following configurations (Intel Xeon processors only):
	• 32768-MB total system memory (16384×2)
	• 16384-MB total system memory (16384×1)
	• 8192-MB total system memory (8092×1)
Primary storage, 2.5 inch	Supports **6.35-cm** (2.5-in) SATA hard drives in **9.5-mm** (.37-in) and **7.0-mm** (.28-in) thicknesses
	Single hard drive configurations (2.5-in):
	2-TB, 5400 rpm
	2-TB, 5400 rpm, hybrid drive (8 GB cache)
	1-TB, 7200 rpm
	1-TB, 5400 rpm, hybrid drive (8 GB cache)
	500-GB, 7200 rpm
	500-GB, 7200 rpm, hybrid (8 GB cache)
	500-GB, 7200 rpm, self-encrypting drive (SED), Opal 2
	2.5-inch, solid-state drive, TLC:
	1 TB, SATA
	256 GB, SATA
Primary storage, M.2	**M.2 (NGFF), SS/DS, solid-state drive (2280)**
	SATA
	256 GB, SATA-3, self-encrypting drive, Opal 2, TLC
	PCIe (NVMe)
	2 TB, TLC
	1 TB, TLC
	1 TB, MLC
	512 GB, TLC
	512 GB, MLC
	512 GB, TLC, Opal 2
	256 GB, TLC

Table 1-1 Product components and their descriptions (continued)

Category	Description
	256 GB, MLC
	256 GB, TLC, Opal 2
Camera	HD camera, 720p
	IR/RGB FHD camera
Audio	HP Bang & Olufsen Audio
	HP Noise Cancellation Software
	Audio codec intergraded class-D AMP
	Skype for Business Certification
	Intel SST Audio
	Microphone (dual array)
	Dual speakers
Ethernet	Intel Ethernet Connection I219-LM 10/100/1000
	The following support S3/S4/S5 wake on LAN/HBMA (via out of band): embedded NIC, HP Elite USB-C Desk Dock, HP USB-C Universal Dock, HP Thunderbolt Dock 230W G2, and HP USB-C Mini Dock.
	The following support S3 wake on LAN/HBMA (via Windows operating system): Elite USB-C Dock, HP Executive Travel Hub, and HP Travel Hub.
Wireless Network	**WPAN Bluetooth:**
	Bluetooth 5.0 supported by combo card
	Integrated wireless options with dual antennas (M.2/PCIe) (select models only):
	Bluetooth Disabled IOPT
	Support for the following WLAN formats:
	• Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (non-vPro, MU-MIMO supported)
	• Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (vPro, MU-MIMO supported)
External media card	**HP Multi-Format Digital Media Reader**
	Support SD/SDHC/SDXC
Ports	HDMI 2.0
	RJ-45 (Ethernet)
	USB 3.0 Gen1 ports (2)
	USB 3.0 Gen1 Type-C port (supports USB 2.0 charging)
	USB Type-C Port Gen 2 with ThunderBolt3 PD out
	AC Smart Pin adapter plug
	Headphone/line out and microphone/line in combo jack
Docking	HP Thunderbolt Dock 230W G2

Table 1-1 Product components and their descriptions (continued)

Category	Description
	HP ZBook Dock with Thunderbolt 3 (150W)
	HP ZBook Dock with Thunderbolt 3 (200W)
	HP Elite USB-C Desk Dock
	HP USB-C Universal Dock
	HP USB-C Mini Dock
Keyboard/pointing devices	**Keyboard**
	Backlit, spill resistant, standard notebook keyboard
	TouchPad
	Gestures enabled by default
	Taps enabled as default
Power	**AC adapters** (Smart, PFC, 4.5 mm)
	150 W (models with discrete graphics)
	120 W (models with UMA graphics)
	Power cord
	1 meter, C5, 3-wire power cord
	Battery
	4-cell, 70-Whr, 4550 mAh, polymer battery, 1,000 cycle
	3-cell, 52.5-Whr, 4550 mAh, polymer battery, 1,000 cycle
	HP Fast Charge Technology
Security	TPM 2.0 (Infineon; soldered down)
	Kensington NanoSaver Security Lock support
	Fingerprint reader
	Preboot authentication (password)
Operating system	**Operating system version:**
	Windows 10, RS3
	Preinstalled:
	Windows 10 Home 64 Plus
	Windows 10 Home 64 Plus Single Language
	Windows 10 Home 64 High-End Chinese Market CPPP
	Windows 10 Pro 64
	Windows 10 Pro 64 Workstation Plus
	FreeDOS 2.0
	Restore media:

Table 1-1 Product components and their descriptions (continued)

Category	Description
	Windows 10 Workstation Edition USB
	Windows 10 USB
	Windows 10 Pro 64 USB
	Certified:
	Microsoft WHQL
	Web-only support:
	Windows 10 Enterprise 64
	Windows 10 Enterprise 64 LTSB 1607
Serviceability	**End-user replaceable parts**
	AC adapter

2 Getting to know your computer

Right side

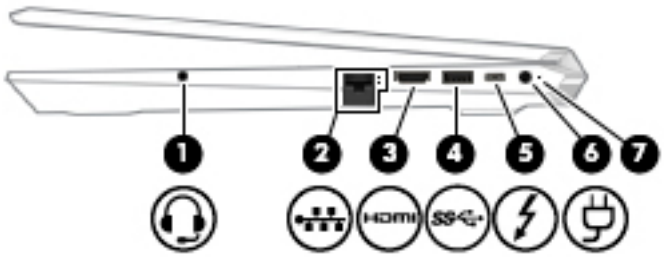


Table 2-1 Right-side components and their descriptions

Component			Description
(1)		Audio-out (headphone)/Audio-in (microphone) combo jack	Connects optional powered stereo speakers, headphones, earbuds, a headset, or a television audio cable. Also connects an optional headset microphone. This jack does not support optional standalone microphones. **WARNING!** To reduce the risk of personal injury, adjust the volume before putting on headphones, earbuds, or a headset. For additional safety information, see the *Regulatory, Safety, and Environmental Notices*. To access this guide: ▲ Select the **Start** button, select **HP Help and Support**, and then select **HP Documentation**. **NOTE:** When a device is connected to the jack, the computer speakers are disabled.
(2)		RJ-45 (network) jack/status lights	Connects a network cable. • White: The network is connected. • Amber: Activity is occurring on the network.
(3)		HDMI port	Connects an optional video or audio device, such as a high-definition television, any compatible digital or audio component, or a high-speed High-Definition Multimedia Interface (HDMI) device.
(4)		USB SuperSpeed port	Connects a USB device, such as a cell phone, camera, activity tracker, or smartwatch, and provides high-speed data transfer.
(5)		USB Type-C power connector and Thunderbolt™ port with HP Sleep and Charge	Connects an AC adapter that has a USB Type-C connector, supplying power to the computer and, if needed, charging the computer battery. – and – Connects and charges most USB devices that have a Type-C connector, such as a cell phone, camera, activity tracker, or smartwatch, and provides high-speed data transfer. – and – Connects a display device that has a USB Type-C connector, providing DisplayPort output.

Table 2-1 Right-side components and their descriptions (continued)

Component		Description
		NOTE: Your computer may also support a Thunderbolt docking station. **NOTE:** Cables and/or adapters (purchased separately) may be required.
(6)	Power connector	Connects an AC adapter.
(7)	Power light	• On: The computer is on. • Blinking: The computer is in the Sleep state, a power-saving state. The computer shuts off power to the display and other unneeded components. • Off: The computer is off or in Hibernation. Hibernation is a power-saving state that uses the least amount of power.

Left side

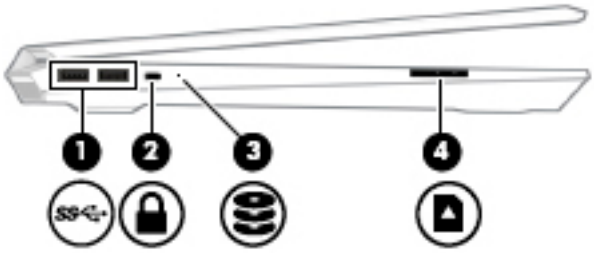


Table 2-2 Left-side components and their descriptions

Component		Description
(1)	USB SuperSpeed ports (2)	Connect a USB device, such as a cell phone, camera, activity tracker, or smartwatch, and provide high-speed data transfer.
(2)	Security cable slot	Attaches an optional security cable to the computer. **NOTE:** The security cable is designed to act as a deterrent, but it may not prevent the computer from being mishandled or stolen.
(3)	Drive light	• Blinking white: The hard drive is being accessed. • Amber: HP 3D DriveGuard has temporarily parked the hard drive.
(4)	Memory card reader	Reads optional memory cards that enable you to store, manage, share, or access information. To insert a card: 1. Hold the card label-side up, with connectors facing the computer. 2. Insert the card into the memory card reader, and then press in on the card until it is firmly seated. To remove a card: ▲ Press in on the card, and then remove it from the memory card reader.

Display

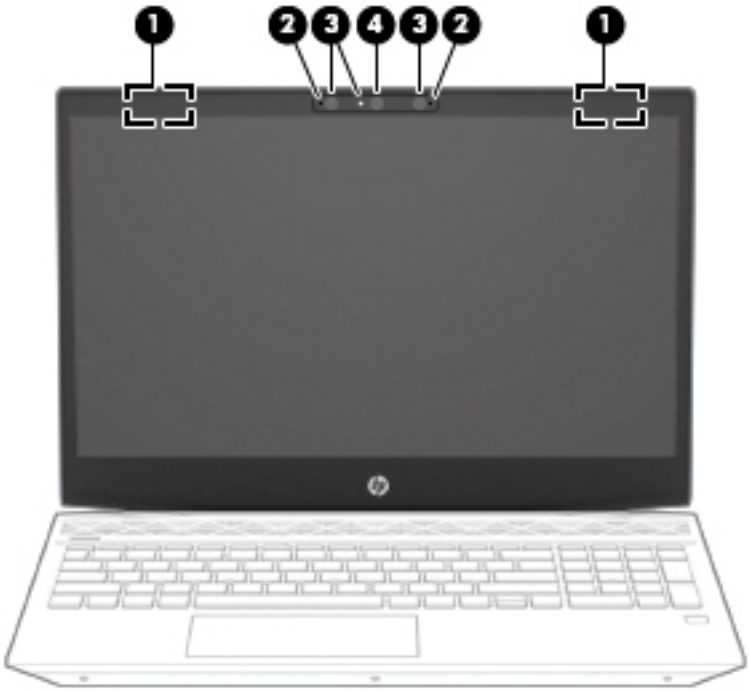


Table 2-3 Display components and their descriptions

Component		Description
(1)	Internal WLAN antennas (internal)*	Send and receive wireless signals to communicate with wireless local area networks (WLANs).
(2)	Internal microphones	Record sound.
(3)	Camera lights (select products only)	On: One or more cameras are in use.
(4)	Cameras (select products only)	Allow you to video chat, record video, and record still images. Some cameras also allow a facial recognition logon to Windows, instead of a password logon. **NOTE:** Camera functions vary depending on the camera hardware and software installed on your product.

*The antennas are not visible from the outside of the computer. For optimal transmission, keep the areas immediately around the antennas free from obstructions.

For wireless regulatory notices, see the section of the *Regulatory, Safety, and Environmental Notices* that applies to your country or region.

To access this guide:

1. Type `support` in the taskbar search bar, and then select the **HP Support Assistant** app.

   – or –

   Click the question mark icon in the taskbar.

2. Select **My PC**, select the **Specifications** tab, and then select **User Guides**.

Keyboard area

TouchPad

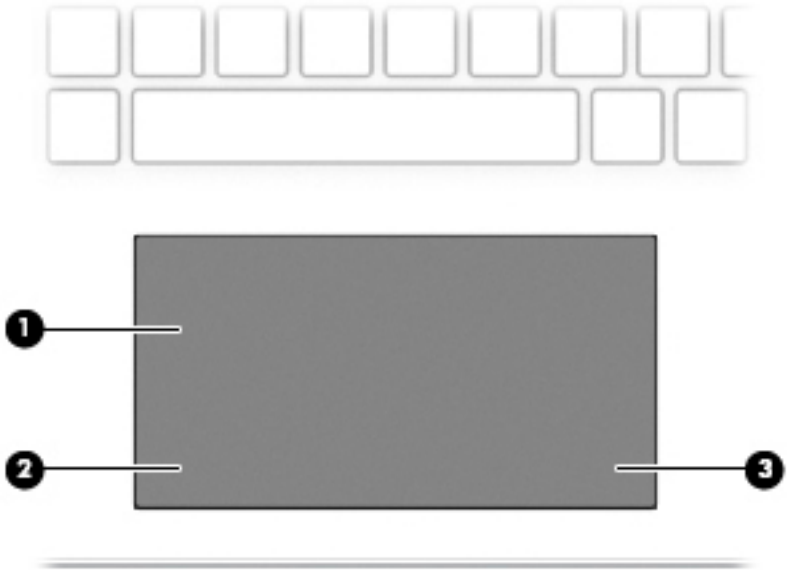


Table 2-4 TouchPad components and their descriptions

Component		Description
(1)	TouchPad zone	Reads your finger gestures to move the pointer or activate items on the screen.
(2)	Left TouchPad button	Functions like the left button on an external mouse.
(3)	Right TouchPad button	Functions like the right button on an external mouse.

Lights

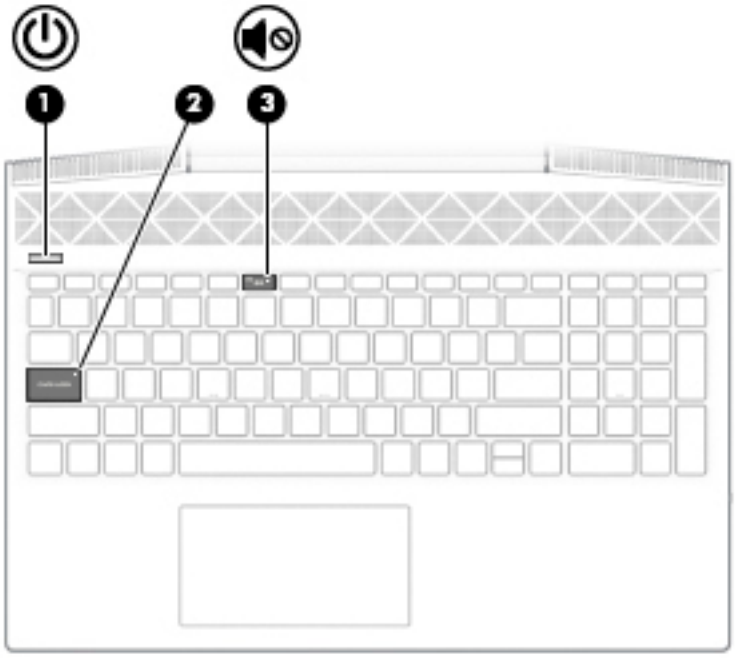


Table 2-5 Lights and their descriptions

Component		Description
(1)	Power light	• On: The computer is on. • Blinking: The computer is in the Sleep state, a power-saving state. The computer shuts off power to the display and other unneeded components. • Off: The computer is off or in Hibernation. Hibernation is a power-saving state that uses the least amount of power.
(2)	Caps lock light	On: Caps lock is on, which switches the key input to all capital letters.
(3)	Mute light	• On: Computer sound is off. • Off: Computer sound is on.

Button and speakers

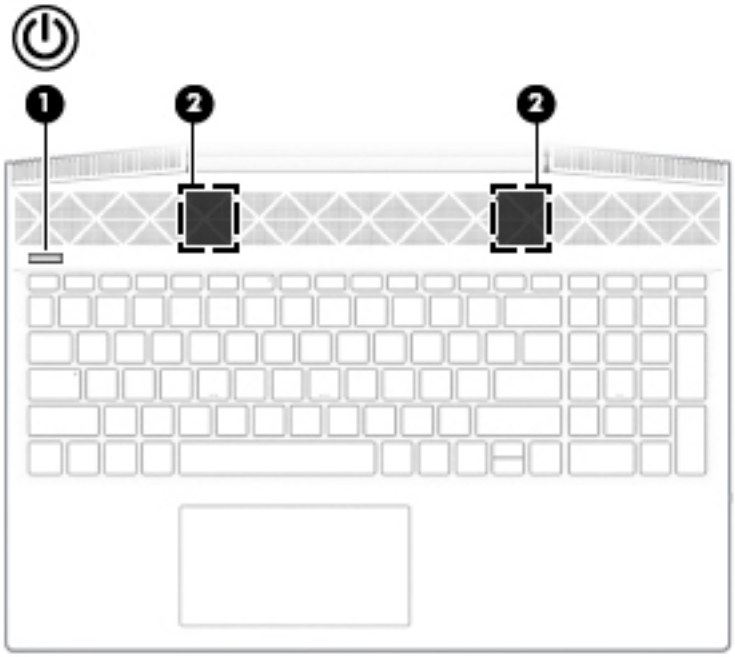


Table 2-6 Button and speakers and their descriptions

Component		Description
(1)	Power button	• When the computer is off, press the button to turn on the computer. • When the computer is on, press the button briefly to initiate Sleep. • When the computer is in the Sleep state, press the button briefly to exit Sleep. • When the computer is in Hibernation, press the button briefly to exit Hibernation. **CAUTION:** Pressing and holding down the power button results in the loss of unsaved information. If the computer has stopped responding and shutdown procedures are ineffective, press and hold the power button down for at least 5 seconds to turn off the computer. To learn more about your power settings, see your power options. ▲ Right-click the **Power** icon, and then select **Power Options**.
(2)	Speakers	Produce sound.

Special keys

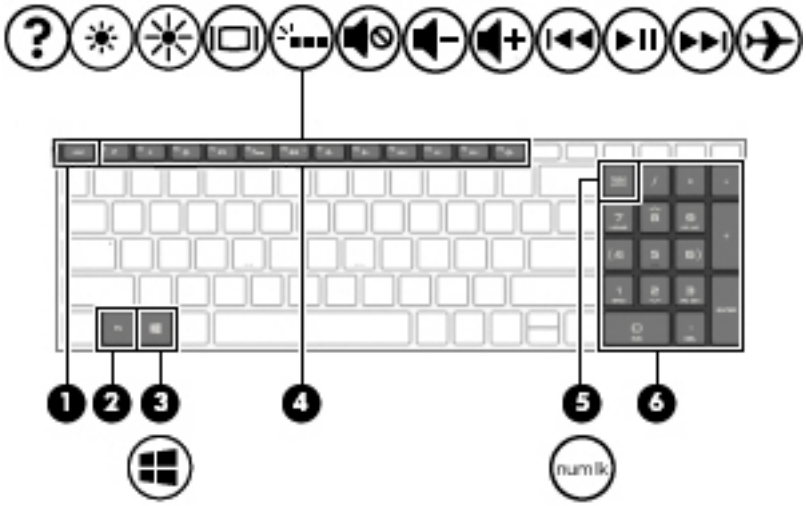


Table 2-7 Special keys and their descriptions

Component		Description
(1)	esc key	Displays system information when pressed in combination with the fn key.
(2)	fn key	Executes specific functions when pressed in combination with another key.
(3)	Windows key	Opens the **Start** menu. **NOTE:** Pressing the Windows key again will close the **Start** menu.
(4)	Action keys	Execute frequently used system functions. **NOTE:** On select products, the f5 action key turns the keyboard backlight feature off or on.
(5)	num lock key	Alternates between the navigational and numeric functions on the integrated numeric keyboard.
(6)	Integrated numeric keypad	A separate keypad to the right of the alphabet keyboard. When num lock is pressed, the keypad can be used like an external numeric keypad. **NOTE:** If the keypad function is active when the computer is turned off, that function is reinstated when the computer is turned back on.

Action keys

An action key performs the function indicated by the icon on the key. To determine which keys are on your product, see Special keys on page 13.

▲ To use an action key, press and hold the key.

Table 2-8 Action keys and their descriptions

Icon	Description
	Helps prevent side-angle viewing from onlookers. If needed, decrease or increase brightness for well-lit or darker environments. Press the key again to turn off the privacy screen. 
	Decreases the screen brightness incrementally as long as you hold down the key.
	Increases the screen brightness incrementally as long as you hold down the key.
	Opens the “How to get help in Windows 10” webpage.
	Switches the screen image between display devices connected to the system. For example, if a monitor is connected to the computer, repeatedly pressing this key alternates the screen image from the computer display to the monitor display to a simultaneous display on both the computer and the monitor.
	Turns the keyboard backlight off or on (select products only). **NOTE:** To conserve battery power, turn off this feature.
	Plays the previous track of an audio CD or the previous section of a DVD or a Blu-ray Disc (BD).
	Starts, pauses, or resumes playback of an audio CD, a DVD, or a BD.
	Plays the next track of an audio CD or the next section of a DVD or a BD.
	Stops audio or video playback of a CD, a DVD, or a BD.
	Decreases speaker volume incrementally while you hold down the key.
	Increases speaker volume incrementally while you hold down the key.
	Mutes or restores speaker sound.
	Turns the wireless feature on or off.

Table 2-8 Action keys and their descriptions (continued)

Icon	Description
	NOTE: A wireless network must be set up before a wireless connection is possible.
	Turns the airplane mode and wireless feature on or off. **NOTE:** The airplane mode key is also referred to as the wireless button. **NOTE:** A wireless network must be set up before a wireless connection is possible.

Bottom

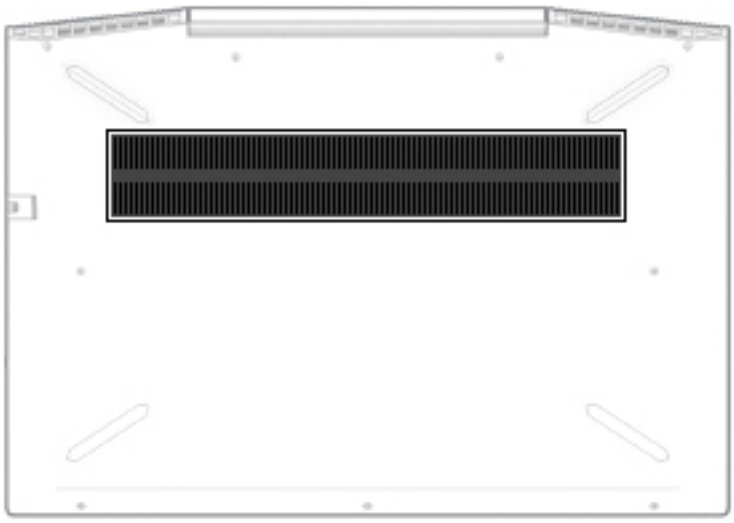


Table 2-9 Bottom components and their descriptions

Component	Description
Vent	Enables airflow to cool internal components. **NOTE:** The computer fan starts up automatically to cool internal components and prevent overheating. It is normal for the internal fan to cycle on and off during routine operation.

Labels

The labels affixed to the computer provide information you may need when you troubleshoot system problems or travel internationally with the computer. Labels may be in paper form or imprinted on the product.

IMPORTANT: Check the following locations for the labels described in this section: the bottom of the computer, inside the battery bay, under the service door, on the back of the display, or on the bottom of a tablet kickstand.

- Service label—Provides important information to identify your computer. When contacting support, you may be asked for the serial number, the product number, or the model number. Locate this information before you contact support.

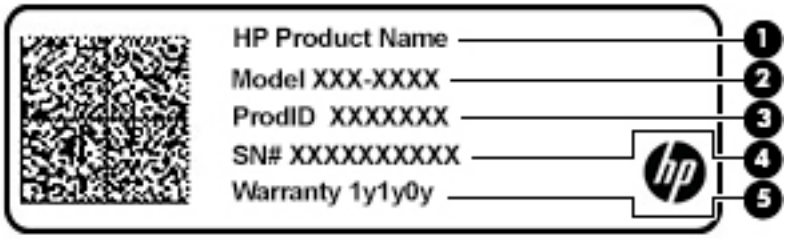


Table 2-10 Service label components

Component	
(1)	HP product name
(2)	Model number
(3)	Product ID
(4)	Serial number
(5)	Warranty period

- Regulatory label(s)—Provide(s) regulatory information about the computer.
- Wireless certification label(s)—Provide(s) information about optional wireless devices and the approval markings for the countries or regions in which the devices have been approved for use.

3 Illustrated parts catalog

Computer major components

NOTE: HP continually improves and changes product parts. For complete and current information on supported parts for your computer, go to http://partsurfer.hp.com, select your country or region, and then follow the on-screen instructions.

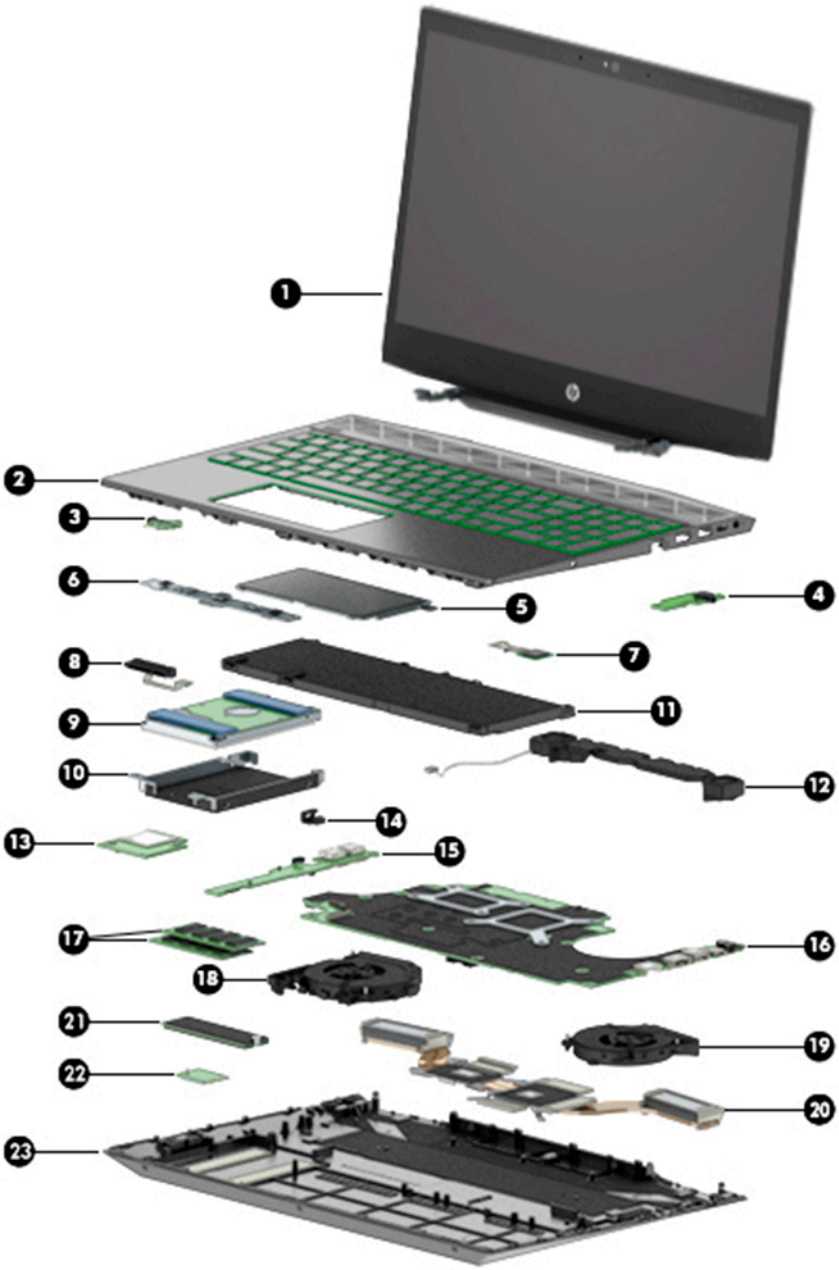


Table 3-1 Computer major components and their descriptions

Item	Component	Spare part number
(1)	**Display assembly** **NOTE:** For display assembly subcomponent spare part information, see Display assembly subcomponents on page 21.	not spared
(2)	**Top cover/keyboard** (includes thermal grease and keyboard connector Mylar) **NOTE:** For a detailed list of keyboard country codes, see Keyboard on page 117.	L25111-xxx
(3)	**Power button board** (includes rubber and thermal grease) **NOTE:** The power button board cable is available using spare part number L20352-001.	L30366-001
(4)	**Audio board** **NOTE:** The audio board cable is available using spare part number L20328-001.	L25087-001
(5)	**TouchPad board** **NOTE:** The TouchPad cable is available using spare part number L20332-001.	L29290-001
(6)	**TouchPad bracket** (not illustrated)	L20331-001
(7)	**Fingerprint reader module** **NOTE:** The fingerprint reader module cable is available using spare part number L25233-001.	L25098-001
(8)	**Hard drive connector/cable**	L20324-001
(9)	**Hard drive, 2.5-inch** (includes sponge; does not include brackets, connector board, or cable) **NOTE:** The hard drive cable is available using spare part number L20324-001.	
	2-TB, 5400-rpm	912487-857
	2-TB, 5400-rpm, hybrid drive	929167-856
	1-TB, 5400-rpm	766457-858
	1-TB, 5400-rpm, hybrid drive	924036-859
	500-GB, 7200-rpm	703236-856
	500-GB, 5400-rpm	731863-859
	500-GB, 7200-rpm, self-encrypting drive (SED)	820573-006
(10)	**Hard drive bracket**	L20325-001
(11)	**Battery** (includes Mylar and sponge)	
	4 cell	917724-856
	3 cell	L08855-856
(12)	**Speakers** (include thermal grease)	L25229-001
(13)	**Card reader board** **NOTE:** The card reader board cable is available using spare part number L20330-001.	L25225-001
(14)	**Security bracket**	L20353-001
(15)	**USB board** **NOTE:** The USB board cable is available using spare part number L30368-001.	L25088-001

Table 3-1 Computer major components and their descriptions (continued)

Item	Component	Spare part number
(16)	**System board** (includes thermal pad kit and thermal grease)	
	All system boards use the following part numbers:	
	xxxxxx-001: Non-Windows operating systems	
	xxxxxx-601: Windows 10 operating system	
	For use in models with discrete graphics memory:	
	• Intel Core i7-8850H processor	L25093-xx1
	• Intel Core i7-8750H processor	L25092-xx1
	• Intel Core i5-8400H processor	L25091-xx1
	• Intel Core i5-8300H processor	L25090-xx1
	• Intel Xeon E-2176M processor	L25096-xx1
	For use in models with UMA graphics memory:	
	• Intel Core i5-8400H processor	L25095-xx1
	• Intel Core i5-8300H processor	L25094-xx1
(17)	**Memory module**	
	DDR4-2666, ECC (for use in models with an Intel Xeon processor):	
	• 16-GB	L24981-005
	• 8-GB	L24983-005
	DDR4-2666, non-ECC (for use in models with an Intel Core processor):	
	• 16-GB	937438-855
	• 8-GB	937236-855
	• 4-GB	L10598-855
(18)	**Fan**, system processor (CPU)	L25224-001
(19)	**Fan**, graphics processor (VGA)	L25223-001
(20)	**Heat sink assembly** (includes replacement thermal materials)	
	For use in models with discrete graphics memory	L25086-001
	For use in models with UMA graphics memory	L25085-001
	Thermal pad kit	L25230-001
(21)	**Solid-state drive**, M.2	
	2 TB, PCIe, NVMe, TLC	L25103-001
	1 TB, PCIe, NVMe, TLC	L25099-001
	1 TB, Z Turbo Drive	L25106-001
	1 TB, SATA-3, TLC	L25109-001
	512 GB, PCIe, NVMe, TLC	L25105-001

Table 3-1 Computer major components and their descriptions (continued)

Item	Component	Spare part number
	512 GB, Z Turbo Drive	L25108-001
	512 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25104-001
	256 GB, Z Turbo Drive	L25107-001
	256 GB, PCIe, NVMe, TLC	L25101-001
	256 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25100-001
	256 GB, SATA-3, self-encrypting drive, Opal 2, TLC	L25102-001
	256 GB, SATA-3, TLC	L25110-001
(22)	**WLAN module**	
	Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (vPro)	L28418-005
	Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (non-vPro)	L22634-005
(23)	**Bottom cover**	
	For use in models with discrete graphics memory	L25083-001
	For use in models with UMA graphics memory	L29289-001

Display assembly subcomponents

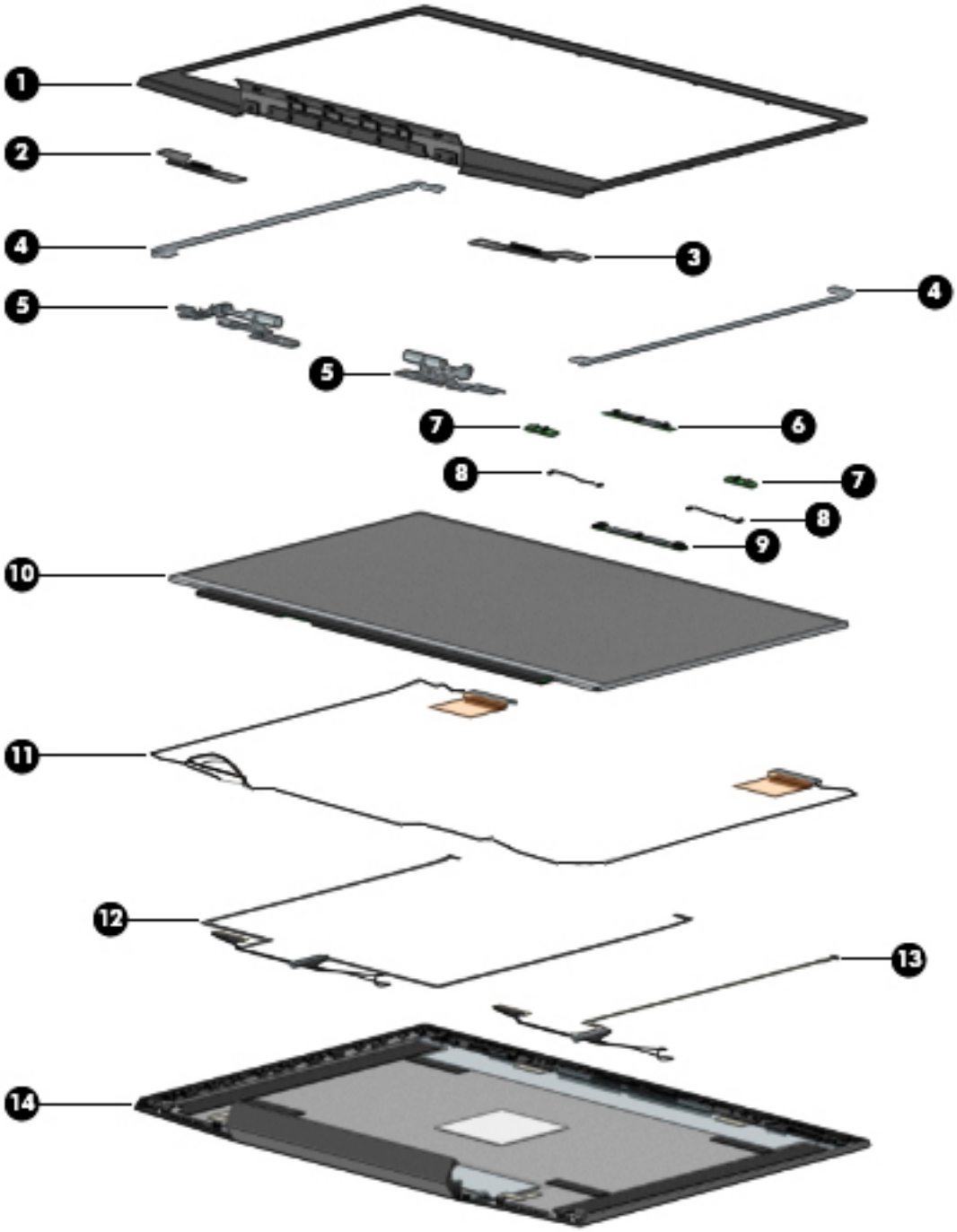


Table 3-2 Display components and their descriptions

Item	Component	Spare part number
(1)	**Display bezel**	
	For use in models with a standard HD camera	L25221-001
	For use in models with an IR camera	L25222-001

Table 3-2 Display components and their descriptions (continued)

Item	Component	Spare part number
	Display enclosure support brackets	
(2)	Left	L20312-001
(3)	Right	L20311-001
(4)	**Hinge brackets** (left and right)	L21053-001
(5)	**Hinges** (left and right; includes thermal pad kit and thermal grease)	L30367-001
(6)	**Camera module, HD** (includes microphone rubber)	L20771-001
(7)	**Camera boards**	
	HD camera board	L25226-001
	IR camera board	L25227-001
(8)	**Camera board cables** (for use with the HD camera board and the IR camera board)	L20347-001
(9)	**Camera module, IR FHD** (includes microphone rubber)	L20770-001
(10)	**Raw display panel** (includes display panel adhesive kit and display enclosure gaskets)	
	FHD, BrightView	L25097-001
	FHD, anti glare	L20361-001
	UHD	L20358-001
(11)	**Antennas**, dual (includes thermal pads and grease)	L30365-001
(12)	**Display cable** (for use in models with an FHD display and IR FHD camera; includes display panel adhesive)	L26665-001
	Display cable (for use in models with an UHD display and IR FHD camera; includes display panel adhesive)	L26667-001
	Display cable (for use in models with a FHD touch display and IR FHD camera; includes display panel adhesive)	L25235-001
(13)	**Display cable** (for use in models with an FHD display and HD camera; includes display panel adhesive)	L26664-001
	Display cable (for use in models with an UHD display and HD camera; includes display panel adhesive)	L26666-001
	Display cable (for use in models with a FHD touch display and HD camera; includes display panel adhesive)	L25234-001
(14)	**Display enclosure** (includes display panel adhesive)	L25084-001

Mass storage devices

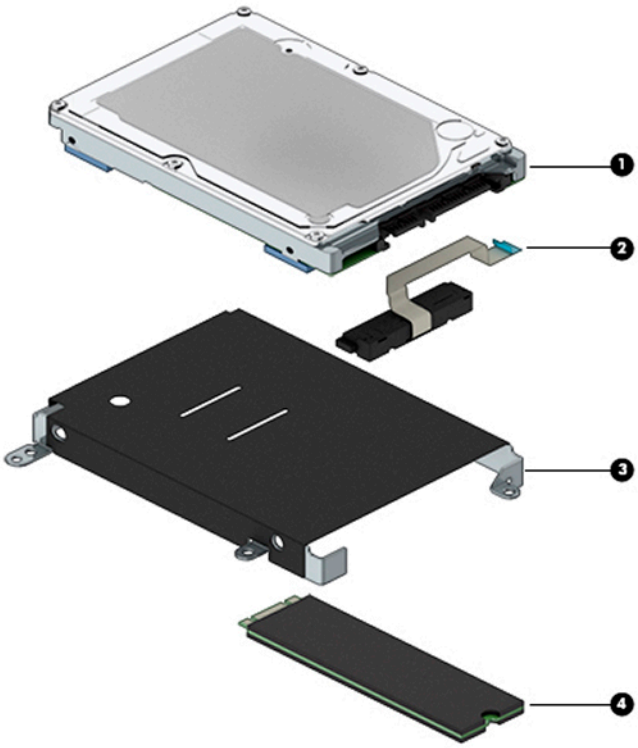


Table 3-3 Mass storage devices and their descriptions

Item	Component	Spare part number
(1)	**Hard drive** (includes sponge; does not include brackets, connector board, or cable):	
	2-TB, 5400-rpm	912487-857
	2-TB, 5400-rpm, hybrid drive	929167-856
	1-TB, 5400-rpm	766457-858
	1-TB, 5400-rpm, hybrid drive	924036-859
	500-GB, 7200-rpm	703236-856
	500-GB, 5400-rpm	731863-859
	500-GB, 7200-rpm, self-encrypting drive (SED)	820573-006
	Miscellaneous Kit (includes WLAN Mylar and hard drive cover Mylar; not illustrated)	L29469-001
(2)	**Hard drive connector/cable**	L20324-001
(3)	**Hard drive bracket**	L20325-001
(4)	**Solid-state drive**, M.2	
	2 TB, PCIe, NVMe, TLC	L25103-001
	1 TB, PCIe, NVMe, TLC	L25099-001
	1 TB, Z Turbo Drive	L25106-001
	1 TB, SATA-3, TLC	L25109-001

Table 3-3 Mass storage devices and their descriptions (continued)

Item	Component	Spare part number
	512 GB, PCIe, NVMe, TLC	L25105-001
	512 GB, Z Turbo Drive	L25108-001
	512 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25104-001
	256 GB, Z Turbo Drive	L25107-001
	256 GB, PCIe, NVMe, TLC	L25101-001
	256 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25100-001
	256 GB, SATA-3, self-encrypting drive, Opal 2, TLC	L25102-001
	256 GB, SATA-3, TLC	L25110-001

Miscellaneous parts

Table 3-4 Miscellaneous parts and their descriptions

Component	Spare part number
HP Smart AC adapter (PFC, slim, 4.5 mm)	
150 W	917649-850
120 W	710415-001
Power cord (C5), 1 meter:	
For use in Argentina	920689-003
For use in Australia	L30769-001
For use in Brazil	L30770-001
For use in Denmark	L30771-001
For use in Europe	L30772-001
For use in India	920689-016
For use in Israel	L30773-001
For use in Italy	L30774-001
For use in Japan	L30775-001
For use in North America	920689-001
For use in the People's Republic of China	920689-014
For use in South Africa	L30777-001
For use in South Korea	L30776-001
For use in Switzerland	L30778-001
For use in Taiwan	L30780-001
For use in Thailand	L30779-001
For use in the United Kingdom	L30781-001

Table 3-4 Miscellaneous parts and their descriptions (continued)

Component	Spare part number
Miscellaneous Kit (includes WLAN Mylar, hard drive cover Mylar, fingerprint reader Mylar, and fingerprint reader conductive tape)	L29469-001
Screw Kit	L25228-001
HP USB-C to VGA adapter	831751-001
HP USB-C to HDMI adapter	831752-001
HP USB-C to DisplayPort adapter	831753-001
HP Nano Dual Lock	918433-001
HP stereo USB headset	840340-001
HP USB laser mouse	674318-001
HP Comfort Grip Wireless Mouse	691922-001
HP USB External DVD+/-RW Drive	747080-001
HP ZBook Thunderbolt 3, 1 meter cable	914966-001
Top load case	679921-001

4 Removal and replacement procedures preliminary requirements

Tools required

You will need the following tools to complete the removal and replacement procedures:

- Non-marking, plastic pry tool
- Thin tool to disengage feet from bottom cover
- Phillips P0 and P1 magnetic screwdrivers

Service considerations

The following sections include some of the considerations that you must keep in mind during disassembly and assembly procedures.

NOTE: As you remove each subassembly from the computer, place the subassembly (and all accompanying screws) away from the work area to prevent damage.

Plastic parts

CAUTION: Using excessive force during disassembly and reassembly can damage plastic parts. Use care when handling the plastic parts. Apply pressure only at the points designated in the maintenance instructions.

Cables and connectors

CAUTION: When servicing the computer, be sure that cables are placed in their proper locations during the reassembly process. Improper cable placement can damage the computer.

Cables must be handled with extreme care to avoid damage. Apply only the tension required to unseat or seat the cables during removal and insertion. Handle cables by the connector whenever possible. In all cases, avoid bending, twisting, or tearing cables. Be sure that cables are routed in such a way that they cannot be caught or snagged by parts being removed or replaced. Handle flex cables with extreme care; these cables tear easily.

Drive handling

⚠ **CAUTION:** Drives are fragile components that must be handled with care. To prevent damage to the computer, damage to a drive, or loss of information, observe these precautions:

Before removing or inserting a hard drive, shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.

Before handling a drive, be sure that you are discharged of static electricity. While handling a drive, avoid touching the connector.

Handle drives on surfaces covered with at least one inch of shock-proof foam.

Avoid dropping drives from any height onto any surface.

After removing a hard drive, place it in a static-proof bag.

Avoid exposing an internal hard drive to products that have magnetic fields, such as monitors or speakers.

Avoid exposing a drive to temperature extremes or liquids.

If a drive must be mailed, place the drive in a bubble pack mailer or other suitable form of protective packaging and label the package “FRAGILE.”

Electrostatic discharge damage

Electronic components are sensitive to electrostatic discharge (ESD). Circuitry design and structure determine the degree of sensitivity. Networks built into many integrated circuits provide some protection, but in many cases, ESD contains enough power to alter device parameters or melt silicon junctions.

A discharge of static electricity from a finger or other conductor can destroy static-sensitive devices or microcircuitry. Even if the spark is neither felt nor heard, damage may have occurred.

An electronic device exposed to ESD may not be affected at all and can work perfectly throughout a normal cycle. Or the device may function normally for a while, then degrade in the internal layers, reducing its life expectancy.

⚠ **CAUTION:** To prevent damage to the tablet when you are removing or installing internal components, observe these precautions:

Keep components in their electrostatic-safe containers until you are ready to install them.

Before touching an electronic component, discharge static electricity by using the guidelines described in this section.

Avoid touching pins, leads, and circuitry. Handle electronic components as little as possible.

If you remove a component, place it in an electrostatic-safe container.

The following table shows how humidity affects the electrostatic voltage levels generated by different activities.

⚠ **CAUTION:** A product can be degraded by as little as 700 V.

Table 4-1 Static electricity occurrence based on activity and humidity

	Typical electrostatic voltage levels		
	Relative humidity		
Event	**10%**	**40%**	**55%**
Walking across carpet	35,000 V	15,000 V	7,500 V

Table 4-1 Static electricity occurrence based on activity and humidity (continued)

Typical electrostatic voltage levels			
	Relative humidity		
Event	**10%**	**40%**	**55%**
Walking across vinyl floor	12,000 V	5,000 V	3,000 V
Motions of bench worker	6,000 V	800 V	400 V
Removing DIPS from plastic tube	2,000 V	700 V	400 V
Removing DIPS from vinyl tray	11,500 V	4,000 V	2,000 V
Removing DIPS from Styrofoam	14,500 V	5,000 V	3,500 V
Removing bubble pack from PCB	26,500 V	20,000 V	7,000 V
Packing PCBs in foam-lined box	21,000 V	11,000 V	5,000 V

Packaging and transporting guidelines

Follow these grounding guidelines when packaging and transporting equipment:

- To avoid hand contact, transport products in static-safe tubes, bags, or boxes.
- Protect ESD-sensitive parts and assemblies with conductive or approved containers or packaging.
- Keep ESD-sensitive parts in their containers until the parts arrive at static-free workstations.
- Place items on a grounded surface before removing items from their containers.
- Always be properly grounded when touching a component or assembly.
- Store reusable ESD-sensitive parts from assemblies in protective packaging or nonconductive foam.
- Use transporters and conveyors made of antistatic belts and roller bushings. Be sure that mechanized equipment used for moving materials is wired to ground and that proper materials are selected to avoid static charging. When grounding is not possible, use an ionizer to dissipate electric charges.

Workstation guidelines

Follow these grounding workstation guidelines:

- Cover the workstation with approved static-shielding material.
- Use a wrist strap connected to a properly grounded work surface and use properly grounded tools and equipment.
- Use conductive field service tools, such as cutters, screw drivers, and vacuums.
- When fixtures must directly contact dissipative surfaces, use fixtures made only of static-safe materials.
- Keep the work area free of nonconductive materials, such as ordinary plastic assembly aids and Styrofoam.
- Handle ESD-sensitive components, parts, and assemblies by the case or PCM laminate. Handle these items only at static-free workstations.

- Avoid contact with pins, leads, or circuitry.
- Turn off power and input signals before inserting or removing connectors or test equipment.

Equipment guidelines

Grounding equipment must include either a wrist strap or a foot strap at a grounded workstation.

- When seated, wear a wrist strap connected to a grounded system. Wrist straps are flexible straps with a minimum of one megohm ±10% resistance in the ground cords. To provide proper ground, wear a strap snugly against the skin at all times. On grounded mats with banana-plug connectors, use alligator clips to connect a wrist strap.
- When standing, use foot straps and a grounded floor mat. Foot straps (heel, toe, or boot straps) can be used at standing workstations and are compatible with most types of shoes or boots. On conductive floors or dissipative floor mats, use foot straps on both feet with a minimum of one megohm resistance between the operator and ground. To be effective, the conductive must be worn in contact with the skin.

The following grounding equipment is recommended to prevent electrostatic damage:

- Antistatic tape
- Antistatic smocks, aprons, and sleeve protectors
- Conductive bins and other assembly or soldering aids
- Nonconductive foam
- Conductive tabletop workstations with ground cords of one megohm resistance
- Static-dissipative tables or floor mats with hard ties to the ground
- Field service kits
- Static awareness labels
- Material-handling packages
- Nonconductive plastic bags, tubes, or boxes
- Metal tote boxes
- Electrostatic voltage levels and protective materials

The following table lists the shielding protection provided by antistatic bags and floor mats.

Table 4-2 Static shielding protection levels

Material	Use	Voltage protection level
Antistatic plastics	Bags	1,500 V
Carbon-loaded plastic	Floor mats	7,500 V
Metallized laminate	Floor mats	5,000 V

5 Removal and replacement procedures for Authorized Service Provider parts

CAUTION: Components described in this chapter should only be accessed by an authorized service provider. Accessing these parts can damage the computer or void the warranty.

NOTE: HP continually improves and changes product parts. For complete and current information on supported parts for your computer, go to http://partsurfer.hp.com, select your country or region, and then follow the on-screen instructions.

Component replacement procedures

NOTE: Details about your computer, including model, serial number, product key, and length of warranty, are on the service tag at the bottom of your computer. See Labels on page 16 for details.

This chapter provides removal and replacement procedures for Authorized Service Provider only parts.

There are as many as 54 screws that must be removed, replaced, or loosened when servicing Authorized Service Provider only parts. Make special note of each screw size and location during removal and replacement.

Display subcomponents (bezel, panel, camera)

NOTE: Display assemblies are spared at the subcomponent level only.

This section illustrates how to remove the display bezel, display panel, and camera module without removing the display from the computer. Display assembly on page 67 illustrates removing display subcomponents that require that you remove the display assembly from the computer.

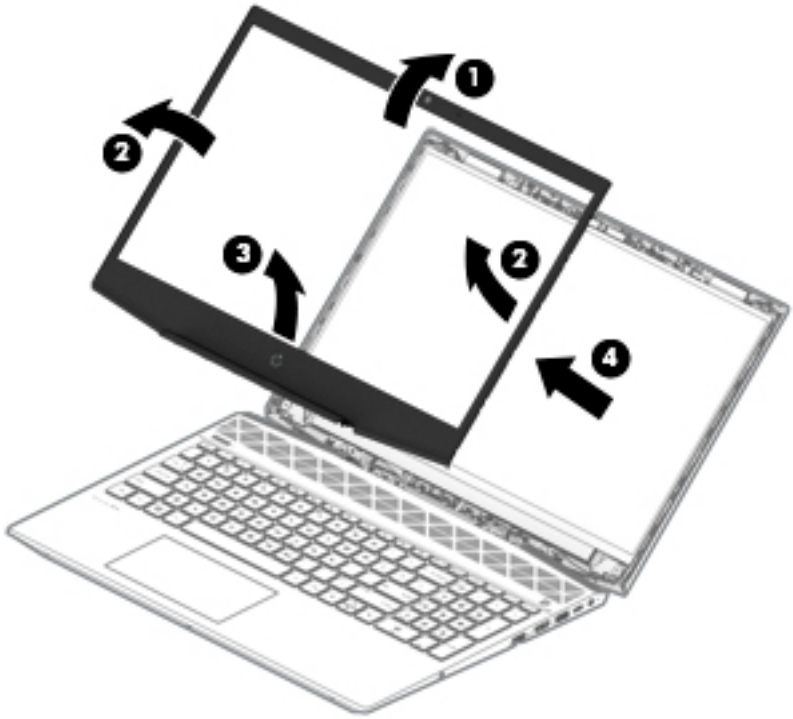
To remove display assembly subcomponents, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.

Remove the display assembly subcomponents:

1. Open the computer as far as it will open.
2. To remove the display bezel:
   a. Flex the inside of the top edge **(1)**, the left and right edges **(2)**, and the bottom edge **(3)** of the display bezel until the bezel disengages from the display enclosure.

b. Remove the display bezel **(4)**.

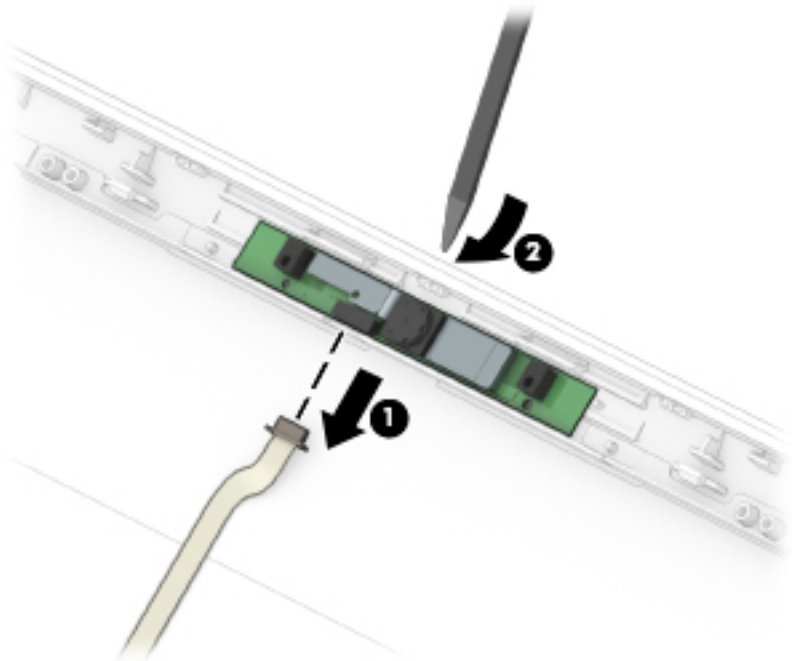


3. To remove the **HD camera module**:

   a. Position the display assembly with the top edge toward you.

   b. Disconnect the cable **(1)** from the camera module.

   c. Pry up to disengage the camera module from the adhesive that secures it to the display **(2)**.

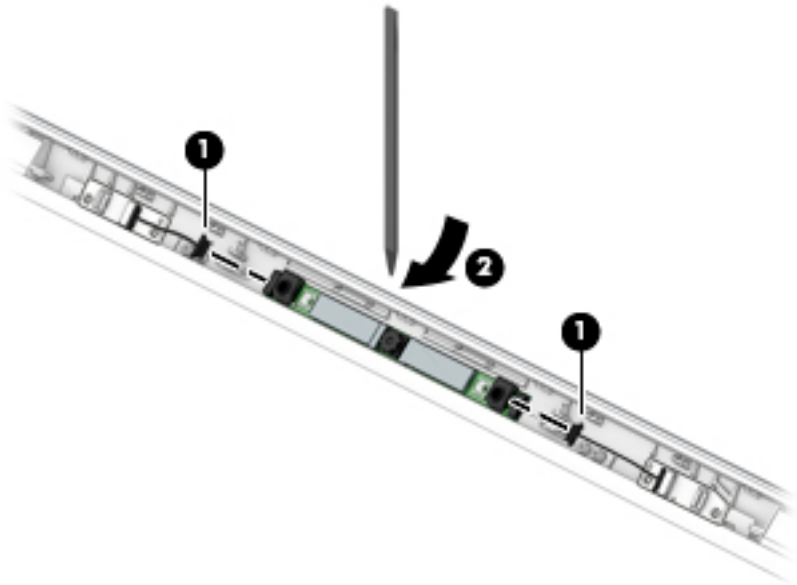


4. To remove the **infrared (IR) camera module**:

a. Position the display assembly with the top edge toward you.

b. Disconnect the cables from the sides of the camera module **(1)**.

c. Pry up to disengage the camera module from the adhesive that secures it to the display **(2)**.

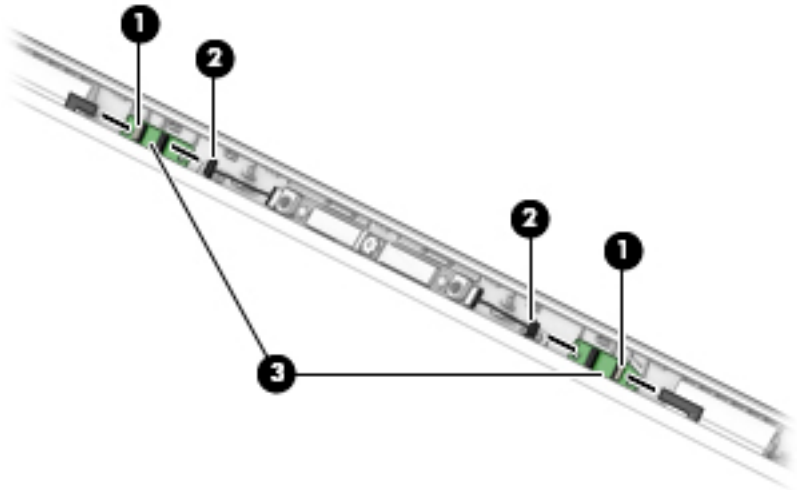


5. To remove the IR camera board and/or HD camera board:

a. Position the display assembly with the top edge toward you.

b. Disconnect the cable from the ZIF connector outside of the board **(1)** and disconnect the cable from the connector on the inside of the board **(2)**.

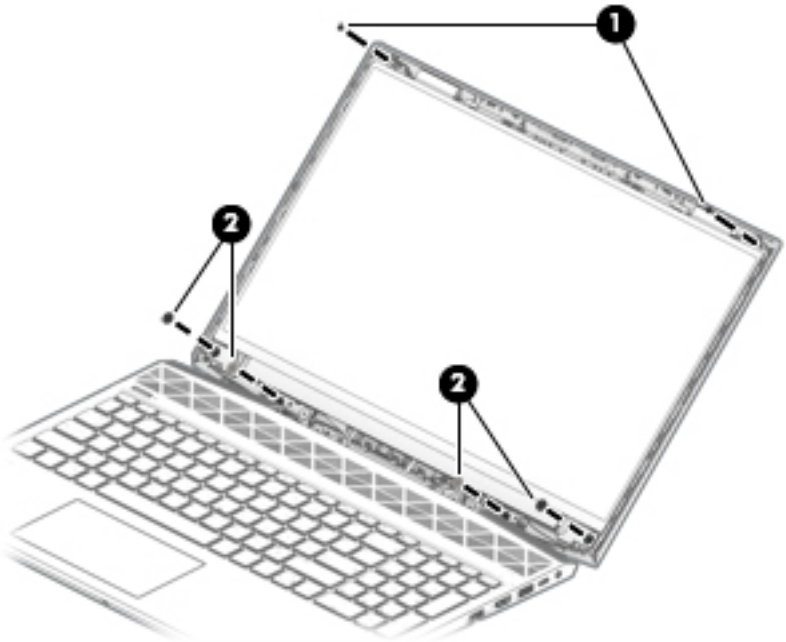
c. Pry up to disengage the board from the adhesive that secures it to the display **(3)**.



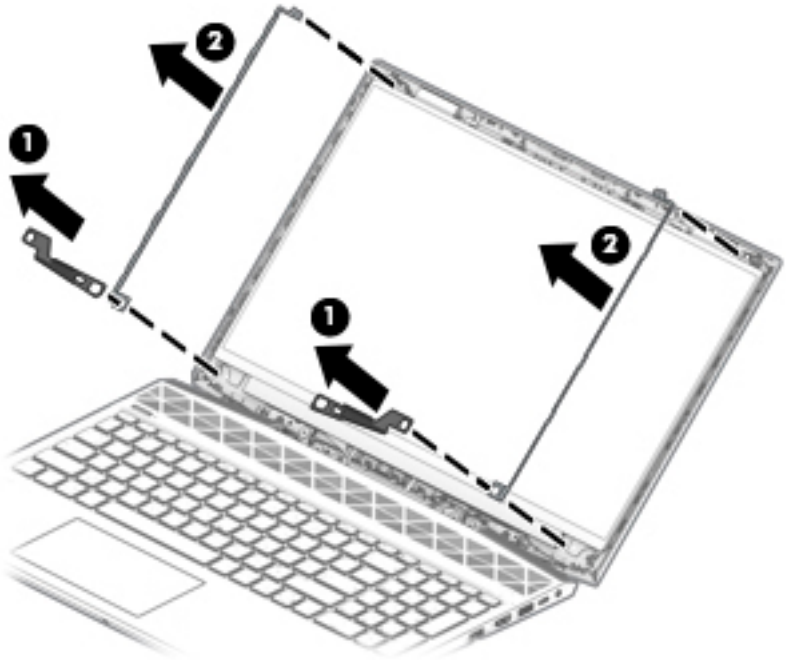
6. To remove the display panel:

a. Remove the two Phillips M2.0×3.0 screws **(1)** that secure the display panel to the top of the enclosure.

b. Remove the four broad head Phillips M2.5×3.0 screws **(2)** that secure the display panel to the bottom of the enclosure.



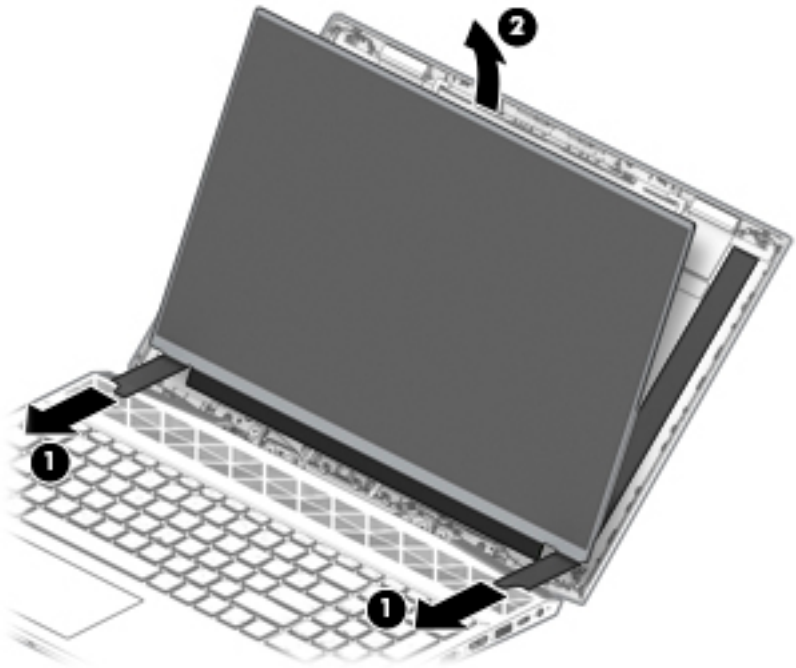
c. Remove the cover plates **(1)** and the display brackets **(2)**.



d. The panel is secured to the display enclosure with long strips of tape. Pull the tape out from under each side of the display panel **(1)**.

NOTE: You have to pull on the tape multiple times before it is completely removed.

e. Lift the top of the display panel off the display rear cover **(2)**.

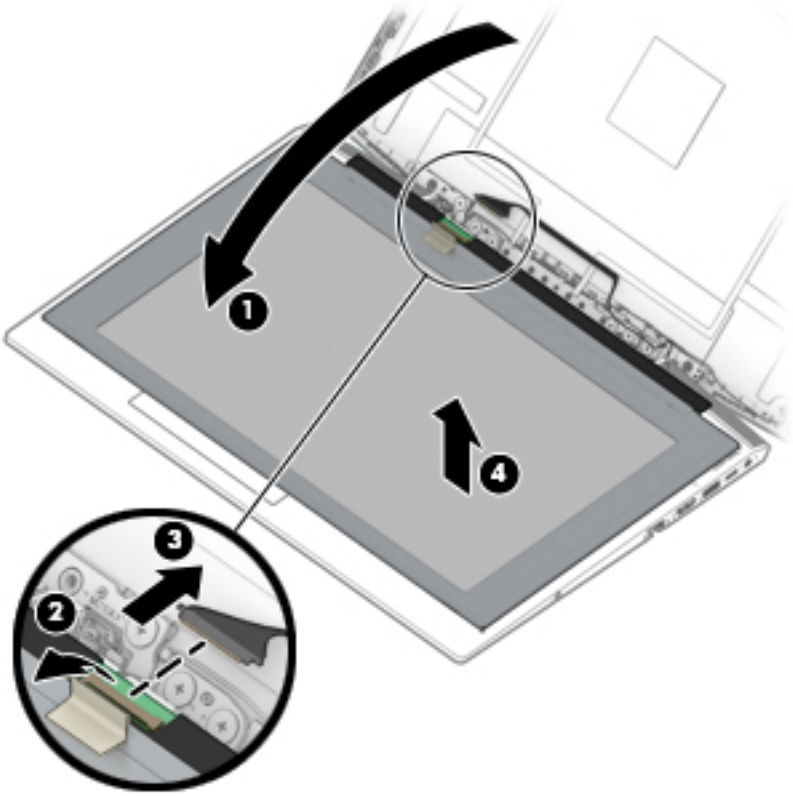


f. Use the following illustration to determine tape installation location when replacing the panel. Position the top of the adhesive at the right angle marks **(1)**, place the adhesive on the display enclosure **(2)**, and then remove the paper from the adhesive **(3)**.

g. Rotate the display panel onto the keyboard **(1)** to gain access to the display cable connection on the back of the panel.

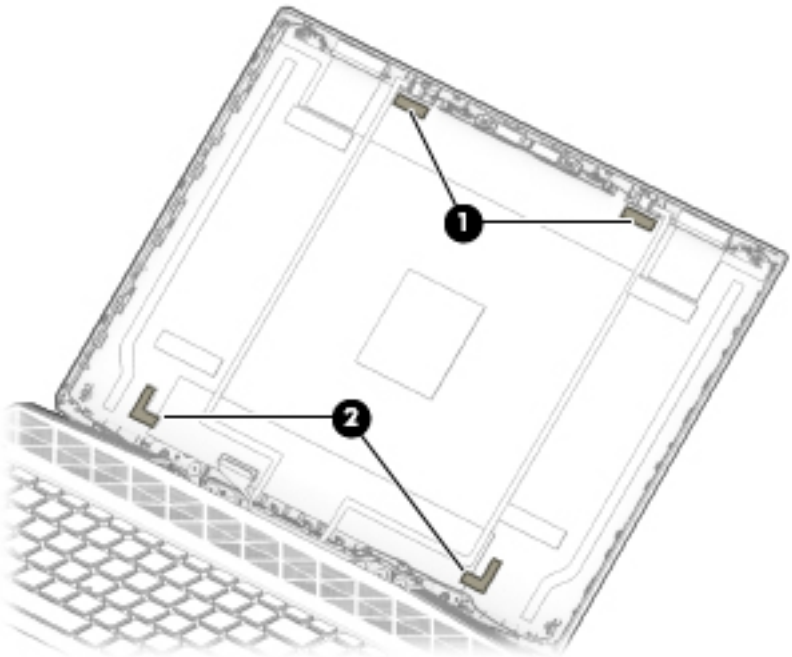
h. On the back of the display panel, release the adhesive strip that secures the display panel cable to the display panel **(2)**, and then disconnect the cable **(3)**.

i. Remove the display panel from the display enclosure **(4)**.



j. If replacing the raw display panel, install the EMI gaskets **(1)** and cover gaskets **(2)** as shown in the following image:

NOTE: The gaskets are included in the raw display panel spare parts kits.



Reverse this procedure to reassemble and install the display assembly components.

Bottom cover

Table 5-1 Bottom cover description and number

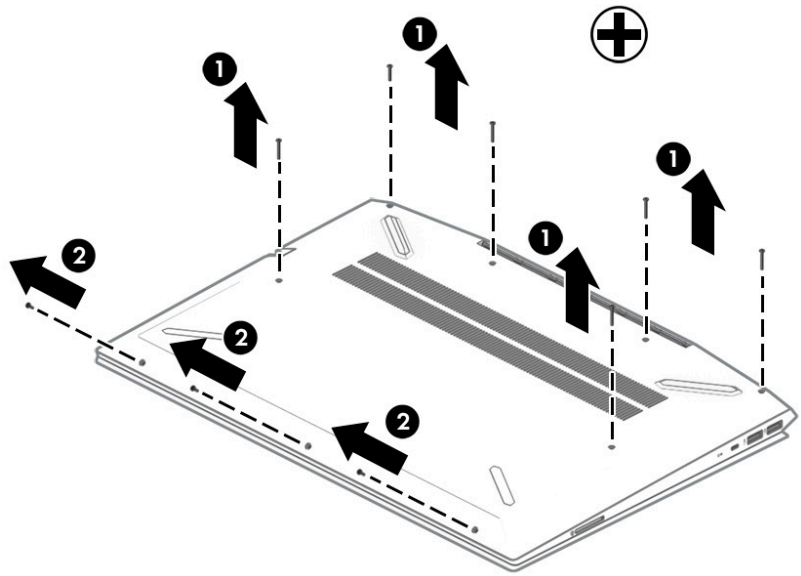
Description	Spare part number
Bottom cover for use in models with discrete graphics memory	L25083-001
Bottom cover for use in models with UMA graphics memory	L29289-001

Before removing the bottom cover, follow these steps:

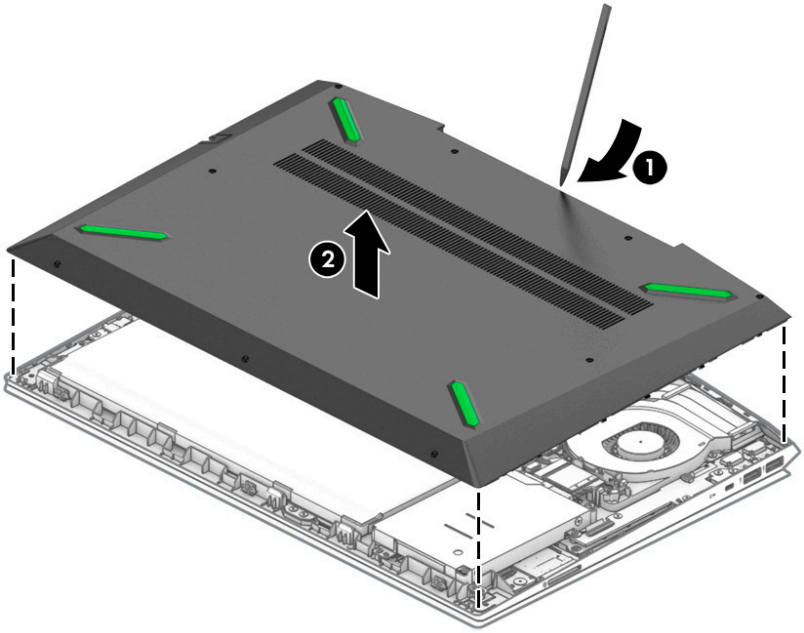
1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.

To remove the bottom cover:

1. Position the computer upside down with the front toward you.
2. Remove the six Phillips M2.0×13.0 screws **(1)** on the top half of the bottom cover.
3. Remove the three Phillips M2.0×5.0 screws **(2)** along the bottom of the bottom cover.



4. Using a non-marking tool, start prying near the middle of the computer near the display and work around to separate the bottom cover from computer **(1)**, and then remove the bottom cover **(2)**.



Reverse this procedure to install the bottom cover.

Battery

Table 5-2 Battery description and number

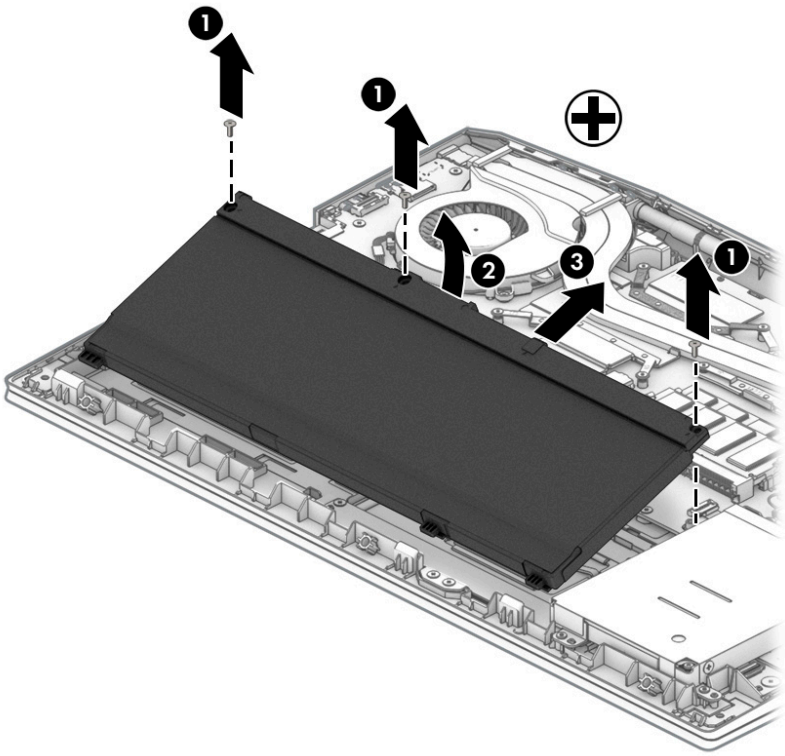
Description	Spare part number
Battery, 4 cell, 70 Wh, 4.55 Ah (includes Mylar and sponge)	917724-856
Battery, 4 cell, 52 Wh, 4.55 Ah (includes Mylar and sponge)	L08855-856

Before disassembling the computer, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).

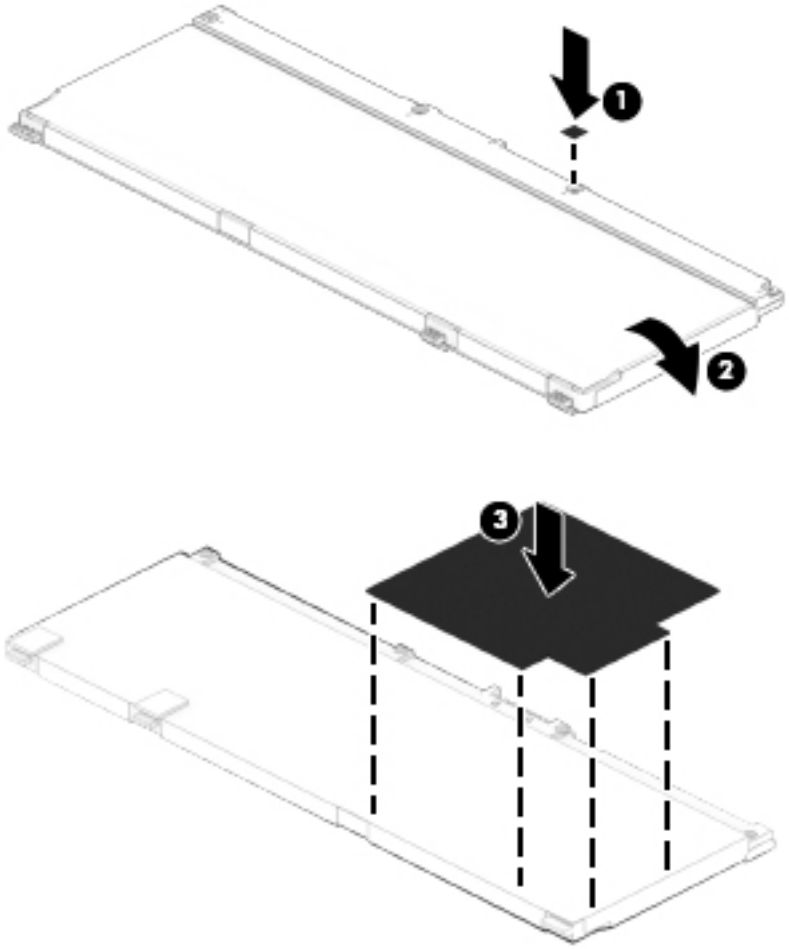
To remove the battery:

1. Remove the three Phillips PM2.0×5.0 screws **(1)** that secure the battery to the computer.
2. Lift the battery up near the connector **(2)**, and then remove the battery from the computer **(3)**.



Reverse this procedure to install the battery.

When installing a replacement battery, be sure to install the battery Mylar on the top of the battery **(1)**, turn the battery upside down **(2)**, and install the battery sponge on the bottom of the battery **(3)** as shown in the following image.


1
2
3

WLAN module

Table 5-3 WLAN module description and number

Description	Spare part number
Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (vPro)	L28418-005
Intel Dual Band Wireless-AC 9560 802.11 AC 2x2 WiFi + Bluetooth 5.0 Combo Adapter (non-vPro)	L22634-005
Miscellaneous Kit (includes WLAN Mylar, hard drive cover Mylar, fingerprint reader Mylar, and fingerprint reader conductive tape)	L29469-001

CAUTION: To prevent an unresponsive system, replace the wireless module only with a wireless module authorized for use in the computer by the governmental agency that regulates wireless devices in your country or region. If you replace the module and then receive a warning message, remove the module to restore device functionality, and then contact support.

Before removing the WLAN module, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

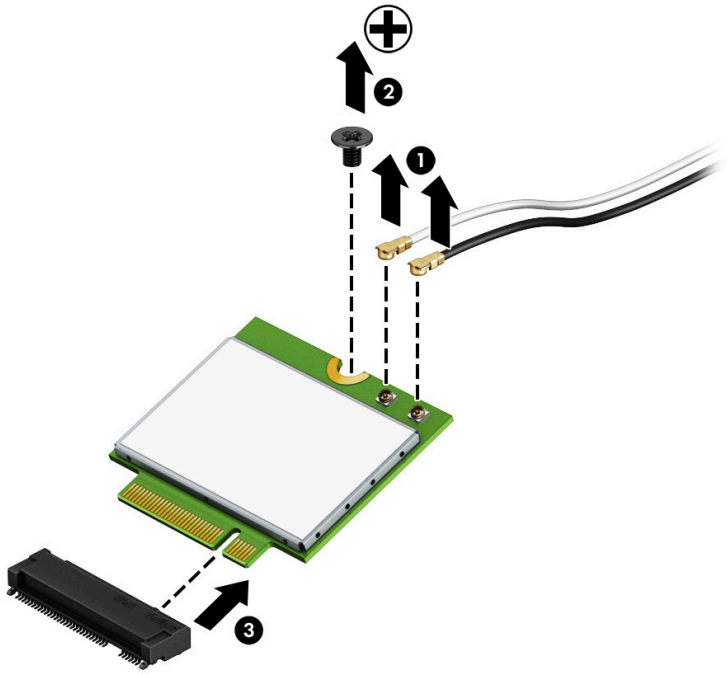
To remove the WLAN module:

1. If necessary, lift the Mylar from on top of the antenna connectors on the WLAN module.
2. Disconnect the WLAN antenna cables **(1)** from the terminals on the WLAN module.

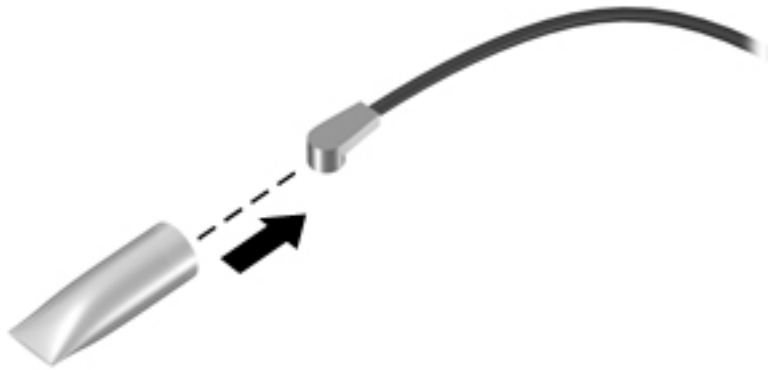
NOTE: The WLAN antenna cable labeled “1” connects to the WLAN module “Main” terminal labeled “1”. The WLAN antenna cable labeled “2” connects to the WLAN module “Aux” terminal labeled “2” (if applicable).

3. Remove the Phillips PM2.0×3.0 screw **(2)** that secures the WLAN module to the system board. (The WLAN module tilts up.)

4. Remove the WLAN module by pulling the module away from the slot at an angle **(3)**.



NOTE: If the WLAN antennas are not connected to the terminals on the WLAN module, the protective sleeves must be installed on the antenna connectors, as shown in the following illustration.



Reverse this procedure to install the WLAN module.

Memory module

Table 5-4 Memory module description and number

Description	Spare part number
Memory module, DDR4-2666, ECC (for use in models with an Intel Xeon processor):	
• 16-GB	L24981-005
• 8-GB	L24983-005
Memory module, DDR4-2666, non-ECC (for use in models with an Intel Core processor):	
• 16-GB	937438-855
• 8-GB	937236-855
• 4-GB	L10598-855

Before removing a memory module, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

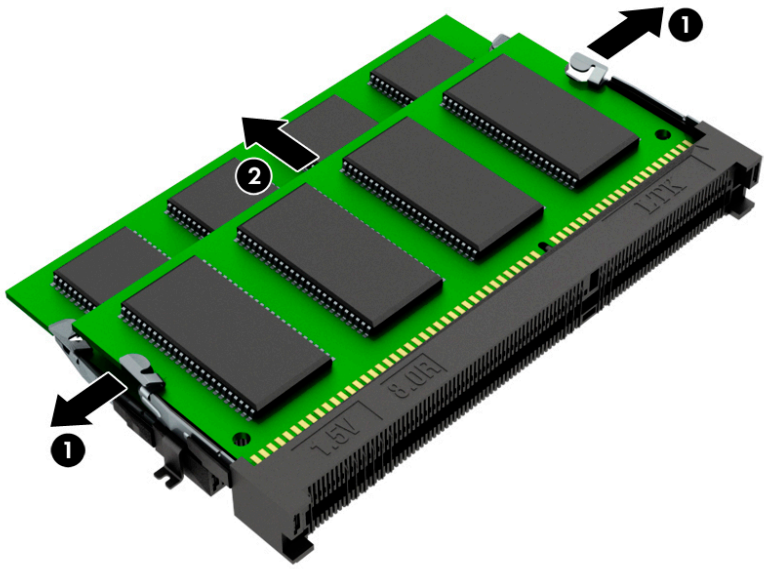
To remove a memory module:

1. Spread the retaining tabs **(1)** on each side of the memory module slot to release the memory module. (The memory module tilts up.)

2. Grasp the edge of the memory module **(2)**, and then gently pull the module out of the slot. Use the same procedure to remove both memory modules.

CAUTION: To prevent damage to the memory module, hold the memory module by the edges only. Do not touch the components on the memory module.

To protect a memory module after removal, place it in an electrostatic-safe container.



Reverse this procedure to install a memory module.

IMPORTANT: If only one memory module is installed, it must be installed in the bottom slot.

Solid-state drive (SSD)

Table 5-5 Solid-state drive (SSD) description and number

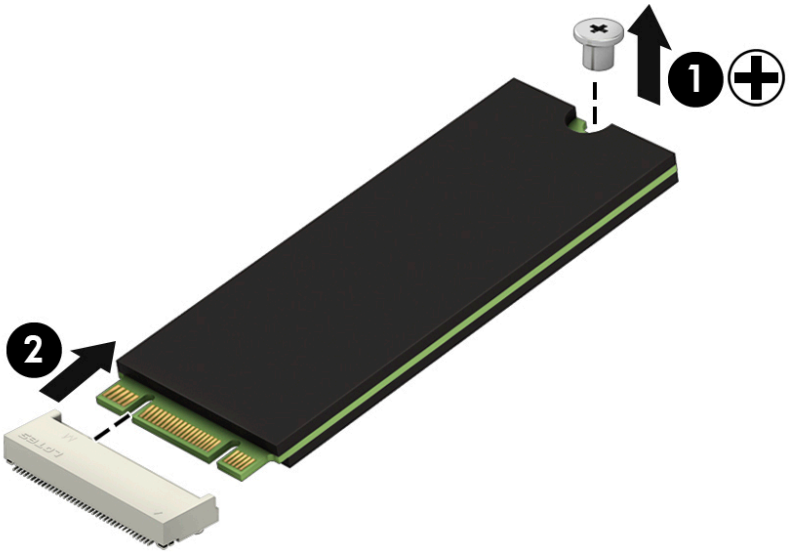
Description	Spare part number
2 TB, PCIe, NVMe, TLC	L25103-001
1 TB, PCIe, NVMe, TLC	L25099-001
1 TB, Z Turbo Drive	L25106-001
1 TB, SATA-3, TLC	L25109-001
512 GB, PCIe, NVMe, TLC	L25105-001
512 GB, Z Turbo Drive	L25108-001
512 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25104-001
256 GB, Z Turbo Drive	L25107-001
256 GB, PCIe, NVMe, TLC	L25101-001
256 GB, PCIe, NVMe, self-encrypting drive, Opal 2, TLC	L25100-001
256 GB, SATA-3, self-encrypting drive, Opal 2, TLC	L25102-001
256 GB, SATA-3, TLC	L25110-001

Before removing the solid-state drive, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

Remove the solid-state drive:

▲ Remove the Phillips M2.0×3.0 screw **(1)**, and then pull the drive from the socket **(2)**.



Reverse this procedure to reassemble and install the solid-state drive.

Hard drive

NOTE: The hard drive spare part kit does not include the hard drive bracket or cable.

Table 5-6 Hard dive description and number

Description	Spare part number
Hard drives:	
2-TB, 5400-rpm	912487-857
2-TB, 5400-rpm, hybrid drive	929167-856
1-TB, 5400-rpm	766457-858
1-TB, 5400-rpm, hybrid drive	924036-859
500-GB, 7200-rpm	703236-856
500-GB, 5400-rpm	731863-859
500-GB, 7200-rpm, self-encrypting drive (SED)	820573-006
Hard drive bracket	L20325-001
Hard drive cable	L20324-001
Miscellaneous Kit (includes WLAN Mylar, hard drive cover Mylar, fingerprint reader Mylar, and fingerprint reader conductive tape)	L29469-001

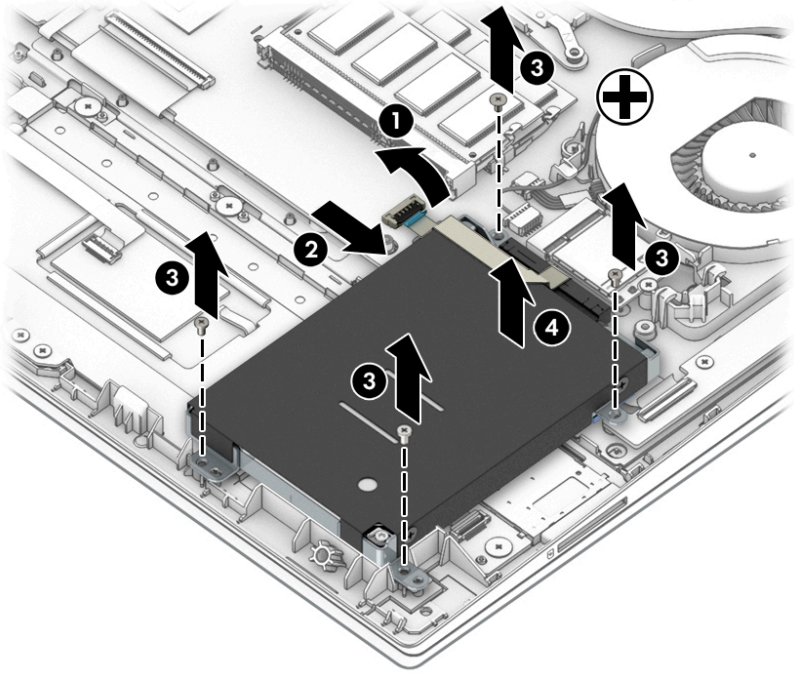
Before removing the hard drive, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

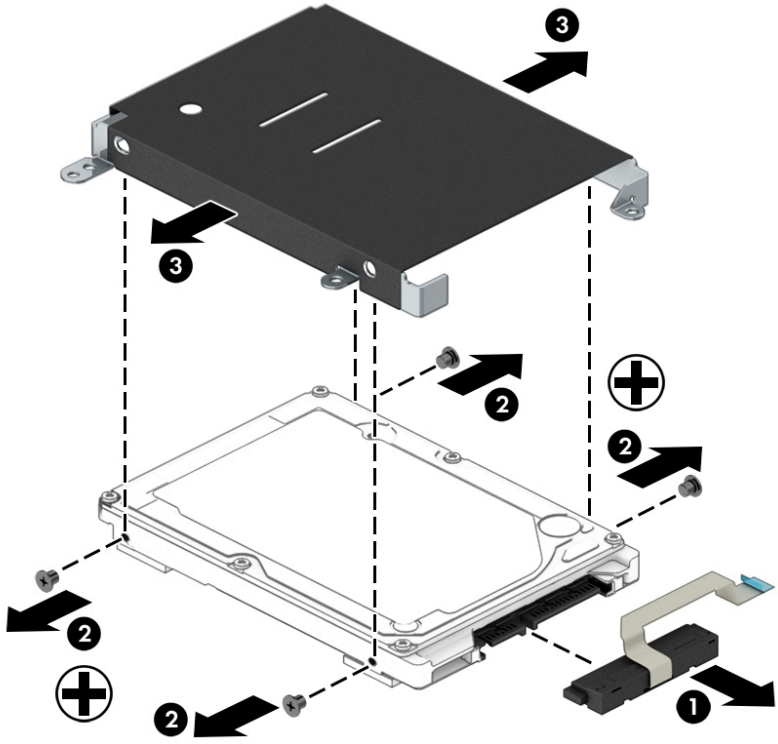
To remove the hard drive:

1. Lift the hard drive ZIF connector **(1)**, and then disconnect the hard drive cable from the system board **(2)**.
2. Remove the four Phillips M2.0×5.0 screws **(3)** that secure the hard drive to the computer.

3. Remove the hard drive from the computer **(4)**.



4. To remove the hard drive bracket and connector, pull the connector away from the hard drive **(1)**.
5. Remove the four Phillips M3.0×3.0 screws **(2)** that secure the bracket to the hard drive.
6. Pull the bracket away from the sides of the hard drive to remove it **(3)**.



Reverse this procedure to reassemble and install the hard drive.

Card reader board

Table 5-7 Card reader board description and number

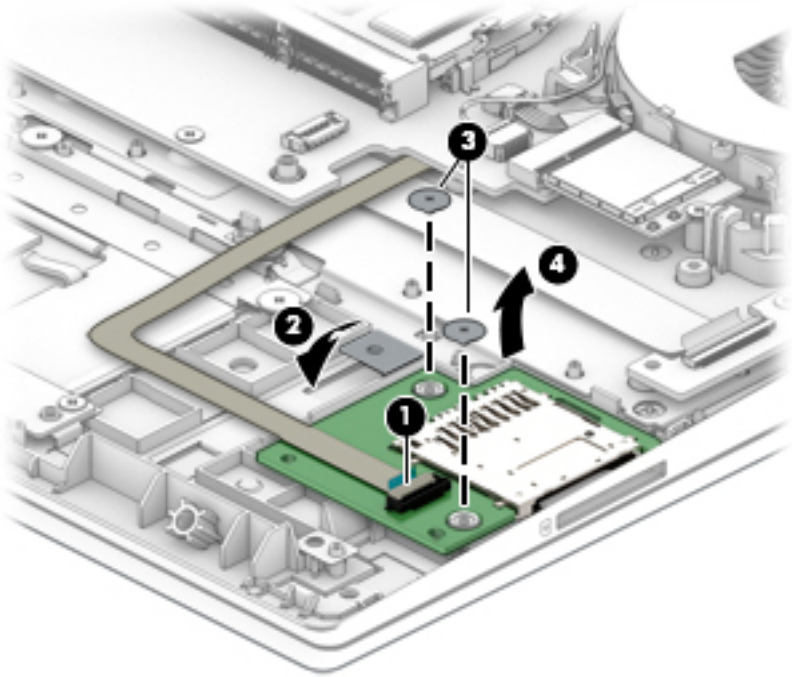
Description	Spare part number
Card reader board	L25225-001
Card reader board cable	L20330-001

Before removing the card reader board, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).

To remove the card reader board:

1. Disconnect the cable from the ZIF connector on the card reader board **(1)**.
2. Remove the tape from the board **(2)**.
3. Remove the two Phillips M2.0×2.0 screws **(3)** that secure the board to the computer.
4. Lift the rear of the board up, and then pull it away from the side of the computer to remove it **(4)**.



Reverse this procedure to install the card reader board.

Fans

Table 5-8 Fans description and number

Description	Spare part number
Fan for use over system processor (CPU)	L25224-001
Fan for use over graphics processor (VGA)	L25223-001

NOTE: To properly ventilate the computer, allow at least **7.6 cm** (3.0 in) of clearance on the left side of the computer. The computer uses an electric fan for ventilation. The fan is controlled by a temperature sensor and is designed to turn on automatically when high temperature conditions exist. These conditions are affected by high external temperatures, system power consumption, power management/battery conservation configurations, battery fast charging, and software requirements. Exhaust air is displaced through the ventilation grill located on the left side of the computer.

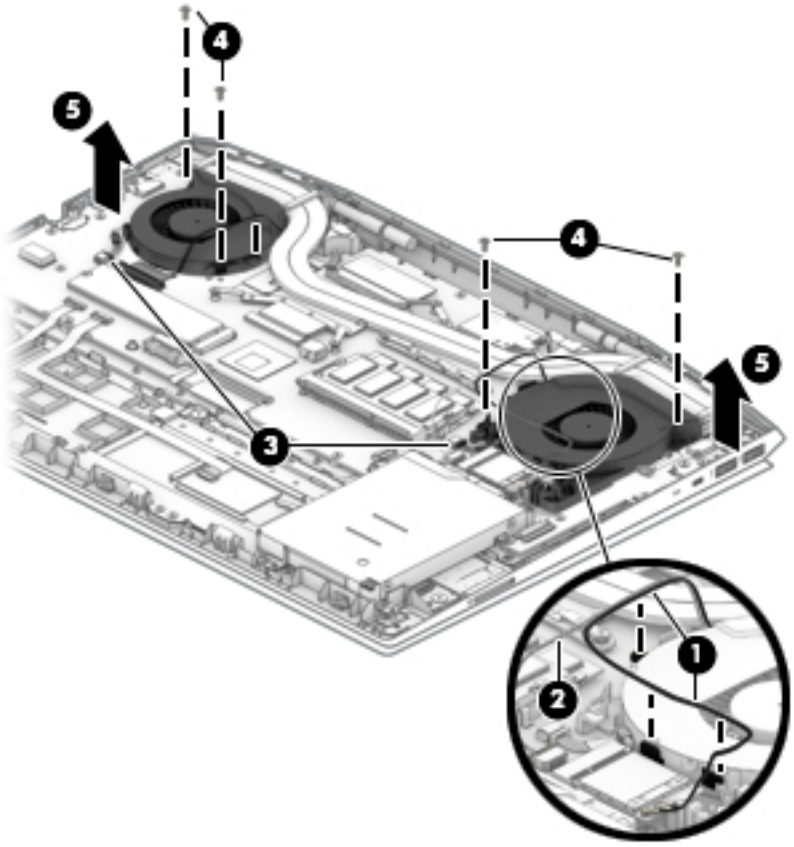
Before removing the fan assembly, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

To remove the fans:

1. Remove the antenna cables from the cable routing clips on the fans **(1)**.
2. Remove the speaker cable from the larger (CPU) fan **(2)**.
3. Disconnect the fan cables from the system board **(3)**.
4. Remove the two Phillips M2.0×5.0 screws **(4)** that secure each fan to the computer.

5. Remove the fans from the computer **(5)**.



Reverse this procedure to install the fans.

Heat sink

NOTE: The heat sink spare part kit includes replacement thermal materials.

Table 5-9 Heat sink description and number

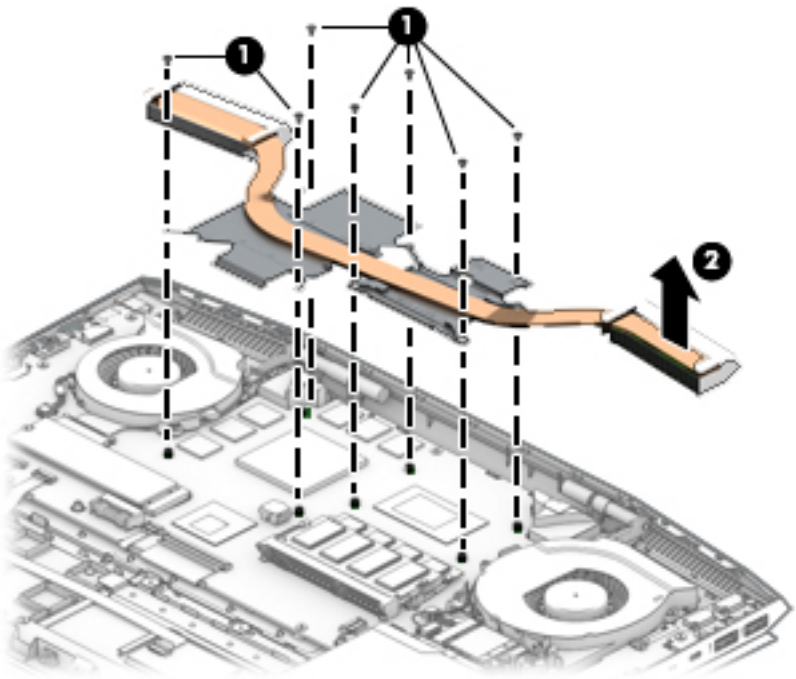
Description	Spare part number
Heat sink for use in models with discrete graphics memory	L25086-001
Heat sink for use in models with UMA graphics memory	L25085-001
Thermal pad kit	L25230-001

Before removing the heat sink, follow these steps:

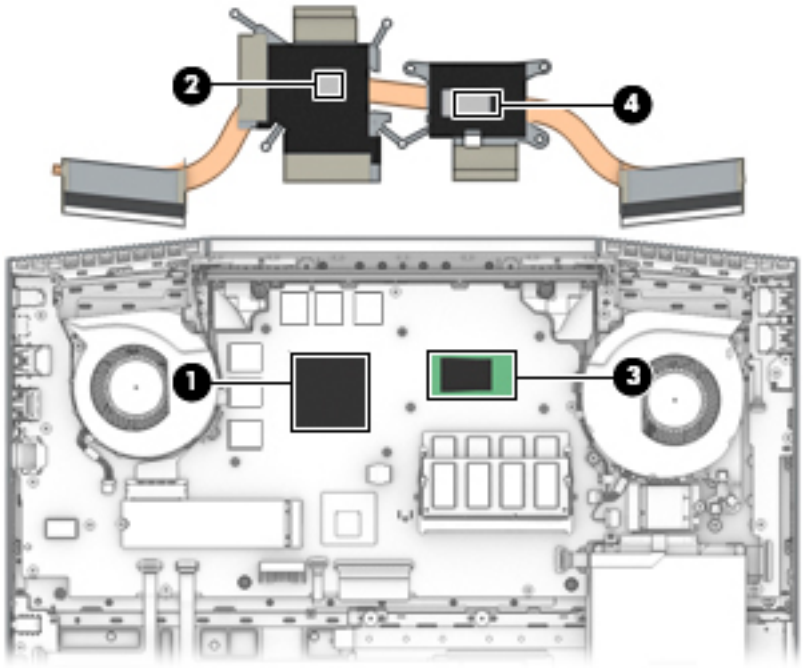
1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).

To remove the heat sink assembly:

1. In the order indicated on the heat sink assembly, remove the seven Phillips M2.0×3.0 screws **(1)** that secure the heat sink to the computer.
2. Lift the heat sink assembly from the computer **(2)**.



3. Each time the heat sink is removed, thoroughly clean the thermal material from the system board components **(1)(3)** and the associated surfaces of the heat sink **(2)(4)**. Replacement thermal material is included with the heat sink and system board spare part kits.



Reverse this procedure to install the heat sink.

TouchPad board

Table 5-10 TouchPad board description and number

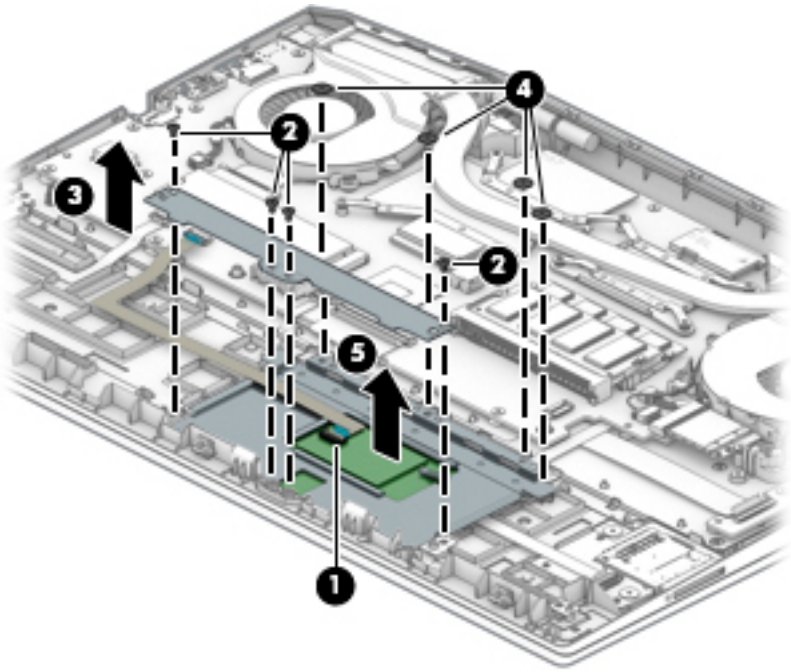
Description	Spare part number
TouchPad board	L29290-001
TouchPad bracket	L20331-001
TouchPad board cable (includes Mylar)	L20332-001

Before removing the TouchPad board, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).

To remove the TouchPad board:

1. Disconnect the cable from the ZIF connector on the TouchPad board **(1)**.
2. Remove the four Phillips M2.0×3.5 screws **(2)** that secure the bracket to the computer, and the lift the bracket off the TouchPad **(3)**.
3. Remove the four Phillips broad head M2.0×2.0 screws **(4)** that secure the TouchPad board to the computer, and the lift the board from the computer **(5)**.



Reverse this procedure to install the TouchPad board.

USB board and security bracket

Table 5-11 USB board and security bracket description and number

Description	Spare part number
USB board	L25088-001
USB board cable	L30368-001
Security bracket	L20353-001

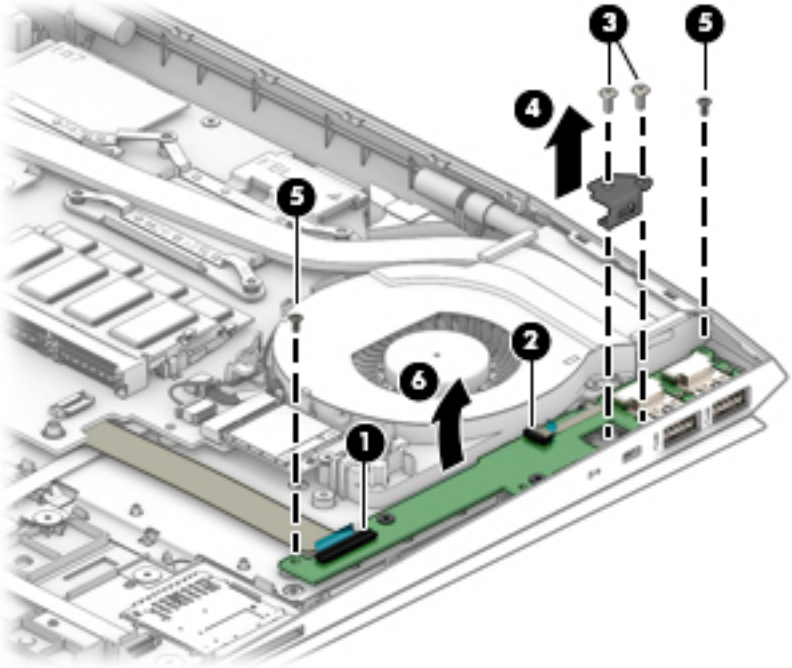
Before removing the USB board and security bracket, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).

To remove the USB board and security bracket:

1. Disconnect the larger (system board) **(1)** and smaller (power button board) **(2)** cables from the USB board ZIF connectors.
2. Remove the two Phillips M2.0×5.0 screws **(3)** that secure the security bracket to the computer.
3. Lift the bracket from on top of the board **(4)**.
4. Remove the two Phillips M2.0×3.0 screws **(5)** that secure the USB board to the computer.

5. Rotate the back of the board up and pull it away from the side of the computer to remove it **(6)**.



Reverse this procedure to install the USB board and security bracket.

Audio board

Table 5-12 Audio board description and number

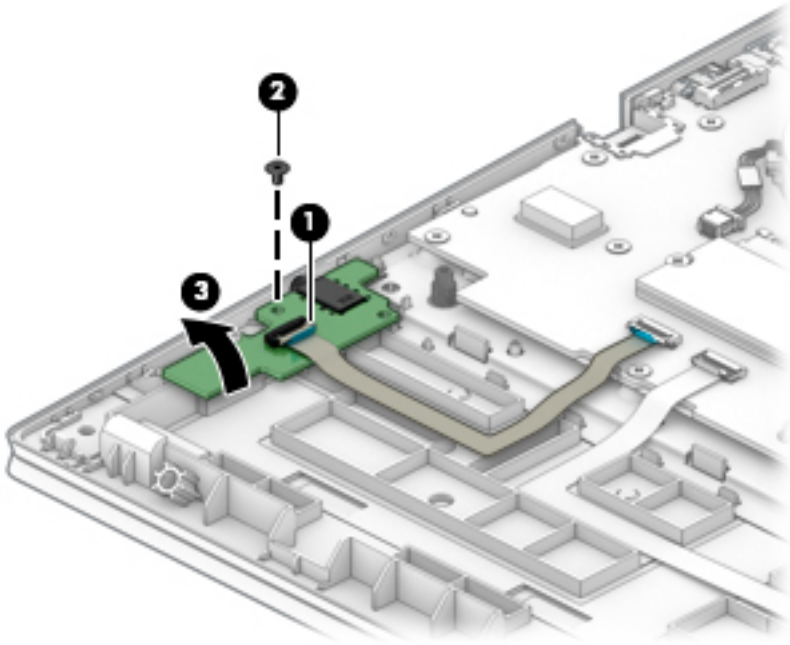
Description	Spare part number
Audio board	L25087-001
Audio board cable	L20328-001

Before removing the audio board and security bracket, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).

To remove the audio board:

1. Disconnect the cable from the audio board ZIF connector **(1)**.
2. Remove the Phillips M2.0×3.0 screw **(2)** that secures the board to the computer.
3. Rotate the back of the board up and pull it away from the side of the computer to remove it **(3)**.



Reverse this procedure to install the audio board.

Fingerprint reader module

Table 5-13 Fingerprint reader module description and number

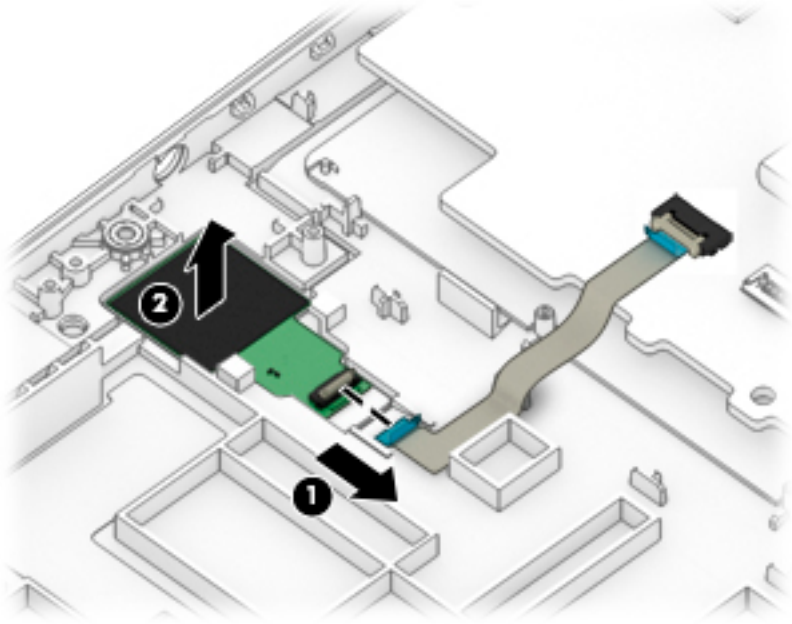
Description	Spare part number
Fingerprint reader module	L25098-001
Fingerprint reader module cable	L25233-001

Before removing the fingerprint reader module, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).
7. Remove the audio board (see Audio board on page 59).

To remove the fingerprint reader module:

1. Disconnect the cable from the fingerprint reader module ZIF connector **(1)**.
2. Remove the module from the computer **(2)**.



Reverse this procedure to install the fingerprint reader module.

Power button board

Table 5-14 Power button description and number

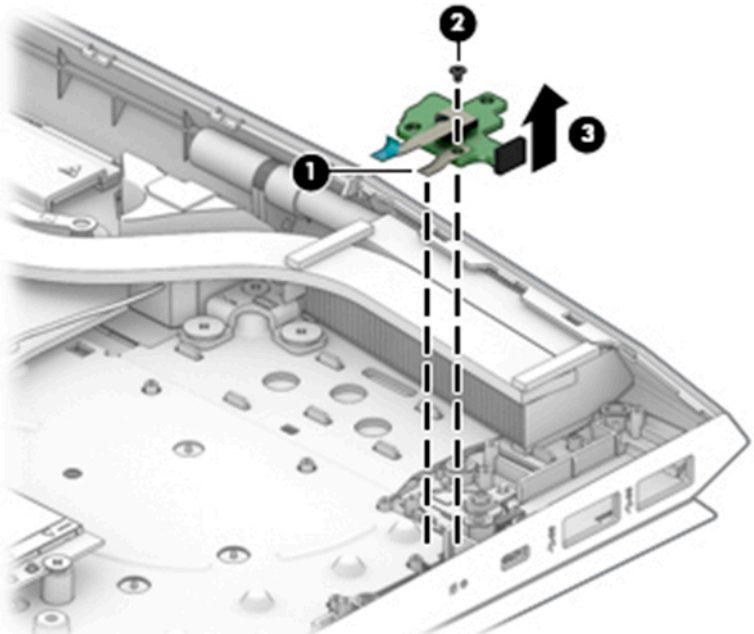
Description	Spare part number
Power button board (includes rubber and thermal grease)	L30366-001
Power button board cable (includes thermal pad kit and thermal grease)	L20352-001

Before removing the power button board, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).
7. Remove the USB board (see USB board and security bracket on page 57).
8. Remove the CPU fan (see Fans on page 51).

To remove the power button board:

1. Remove the tape from the board **(1)**.
2. Using a Phillips P0 screwdriver, remove the Phillips broad head PM1.6×1.8 screw **(2)** that secures the power button board to the computer.
3. Remove the power button board from the computer **(3)**.



Reverse this procedure to install the power button board and cable.

System board

NOTE: The system board spare part kit includes replacement thermal materials.

Table 5-15 System board description and number

Description	Spare part number
System board (includes thermal pad kit and thermal grease)	
All system boards use the following part numbers:	
xxxxxx-001: Non-Windows operating systems	
xxxxxx-601: Windows 10 operating system	
For use in models with discrete graphics memory:	
• Intel Core i7-8850H processor	L25093-xx1
• Intel Core i7-8750H processor	L25092-xx1
• Intel Core i5-8400H processor	L25091-xx1
• Intel Core i5-8300H processor	L25090-xx1
• Intel Xeon E-2176M processor	L25096-xx1
For use in models with UMA graphics memory:	
• Intel Core i5-8400H processor	L25095-xx1
• Intel Core i5-8300H processor	L25094-xx1

Before removing the system board, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the WLAN module (see WLAN module on page 42).
7. Remove the memory module (see Memory module on page 44).
8. Remove the hard drive (see Hard drive on page 48).
9. Remove the solid-state drive (see Solid-state drive (SSD) on page 46).
10. Remove the fans (see Fans on page 51).

IMPORTANT: You do not have to remove the heat sink to remove the system board.

To remove the system board:

1. Position the computer upright, and then disconnect the following cables from the system board:

   (1): Keyboard cable (ZIF)

(2): Keyboard backlight cable (ZIF)

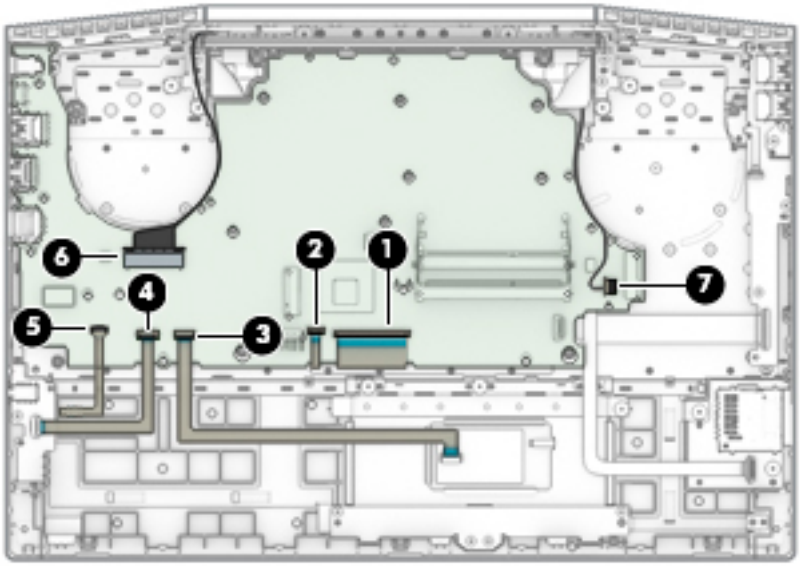
(3): TouchPad cable (ZIF)

(4): Audio board cable (ZIF)

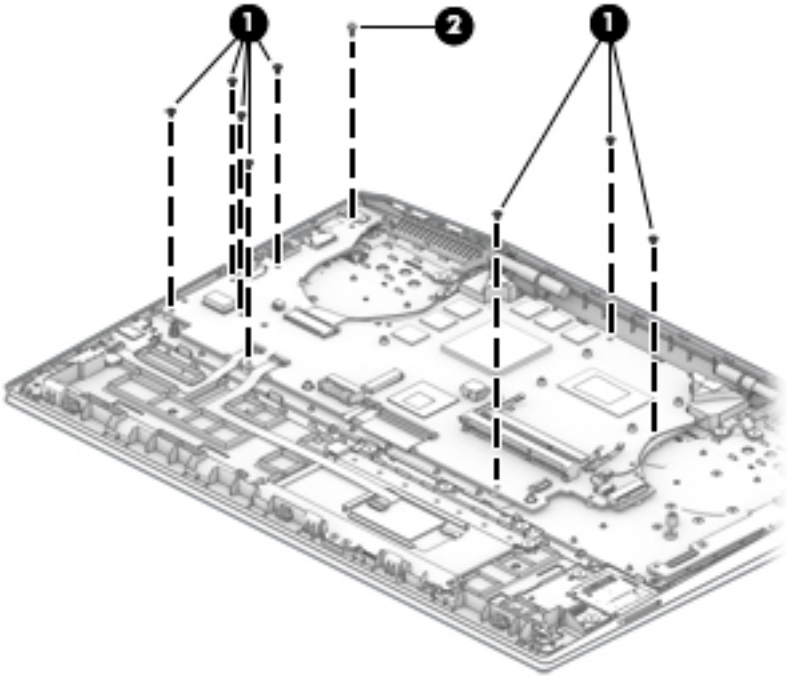
(5): Fingerprint reader cable (ZIF)

(6): Display cable (ZIF)

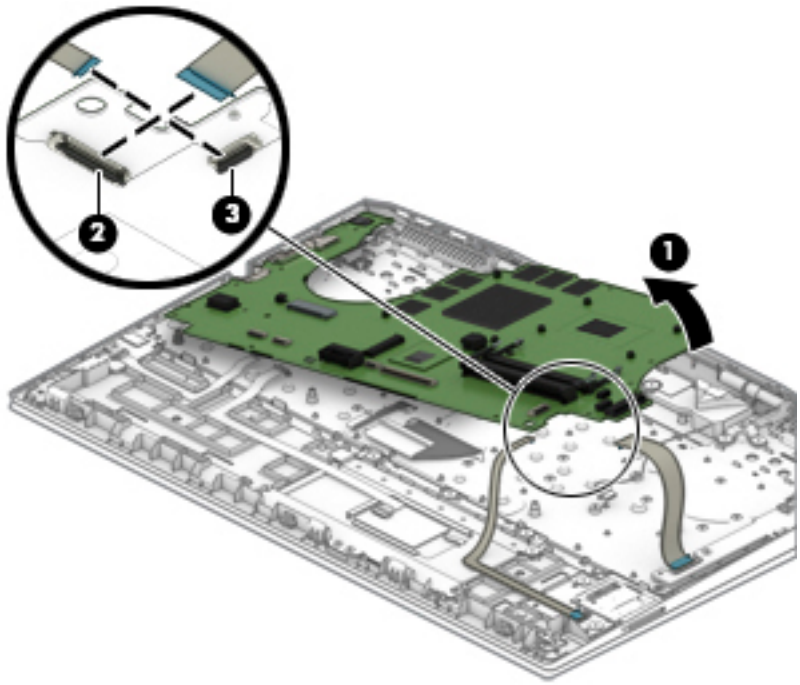
(7): Speaker cable



2. Remove the eight Phillips M2.0×3.0 screws **(1)** that secure the system board to the computer.
3. Remove the Phillips M2.0×5.0 screw **(2)** that secures the system board to the computer.



4. Rotate the interior side of the board upward **(1)**, and then disconnect the USB board cable **(2)** and the card reader board cable **(3)** from the ZIF connectors underneath the system board.



Reverse this procedure to install the system board.

Speakers

Table 5-16 Speakers description and number

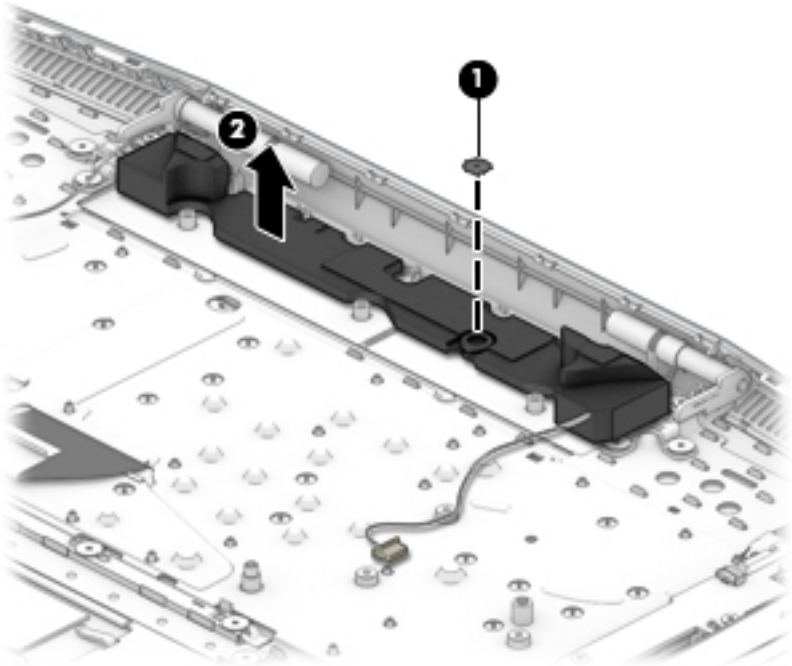
Description	Spare part number
Speakers (include thermal grease)	L25229-001

Before removing the speakers, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).
7. Remove the fans (see Fans on page 51).
8. Remove the system board (see System board on page 63).

To remove the speakers:

1. Remove the Phillips broad head M2.0×2.0 screw **(1)** that secures the speaker to the computer.
2. Remove the speakers from the computer **(2)**.



Reverse this procedure to install the speakers.

Display assembly

You can remove the display bezel, display panel, and camera module without removing the display assembly from the computer. For more information, see Display subcomponents (bezel, panel, camera) on page 31.You must remove the display assembly to remove the remaining subcomponents, as described in this section.

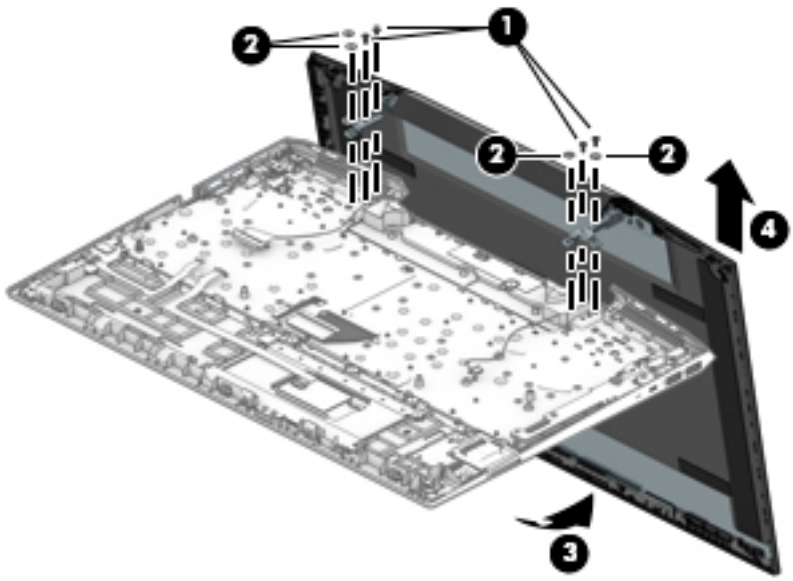
Display subcomponent spare parts are listed at Display assembly subcomponents on page 21.

Before removing the display assembly, follow these steps:

1. Shut down the computer. If you are unsure whether the computer is off or in Hibernation, turn the computer on, and then shut it down through the operating system.
2. Disconnect all external devices connected to the computer.
3. Disconnect the power from the computer by first unplugging the power cord from the AC outlet and then unplugging the AC adapter from the computer.
4. Remove the bottom cover (see Bottom cover on page 38).
5. Remove the battery (see Battery on page 40).
6. Remove the hard drive (see Hard drive on page 48).
7. Remove the fan assembly (see Fans on page 51).
8. Remove the system board (see System board on page 63).

To remove the display assembly:

1. Remove the four black Phillips M2.0×5.0 screws **(1)** and four broad head Phillips M2.0×2.0 screws **(2)** that secure the display assembly to the computer.
2. Lift the display to bend the hinges upward **(3)**.
3. Separate the display from the computer **(4)**.



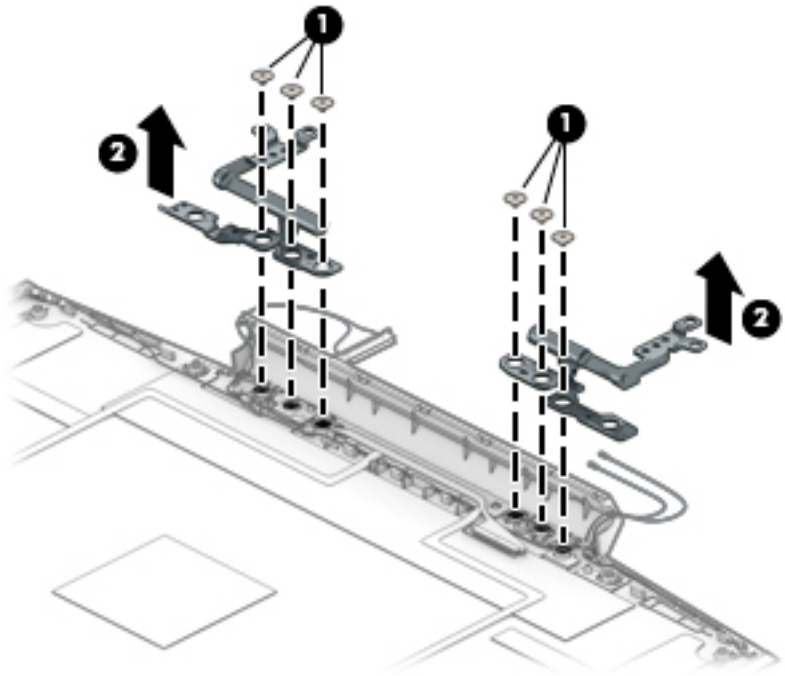
If it is necessary to replace display assembly subcomponents:

1. Remove the display bezel and display panel (see Display subcomponents (bezel, panel, camera) on page 31).

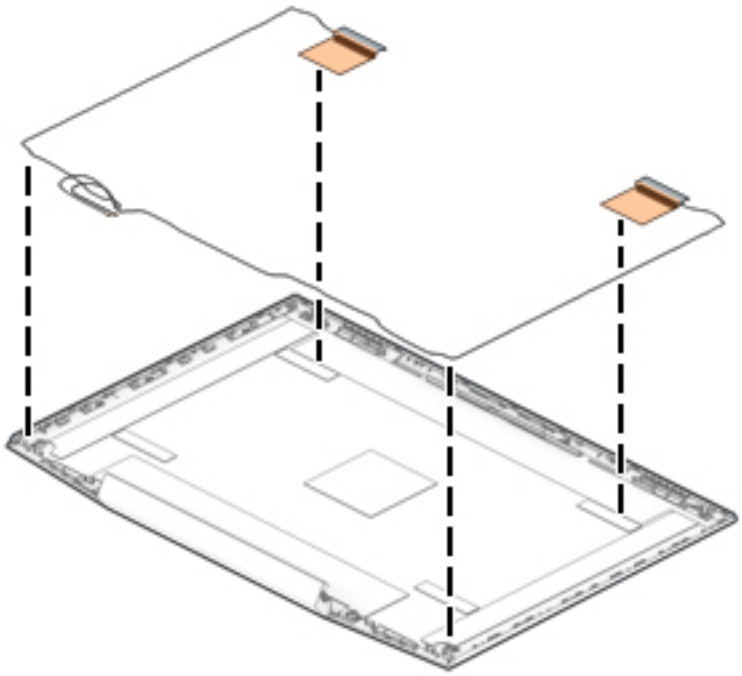
2. To remove the display hinges:

   a. Remove the three Phillips broad head M2.5×3.0 screws **(1)** that secure each hinge to the display enclosure.

   b. Remove the display hinges **(2)**.

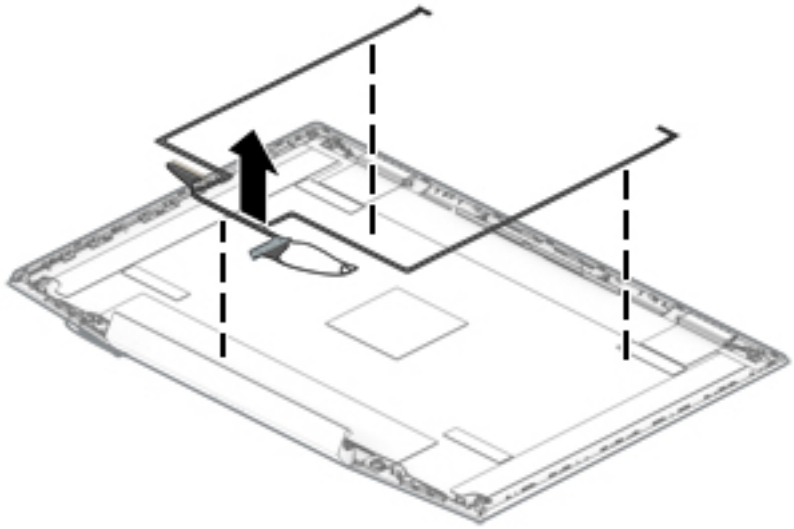


3. To remove the wireless antennas an cables, release the cables from the clips built into the side of the display enclosure, and then remove the antennas and cables.

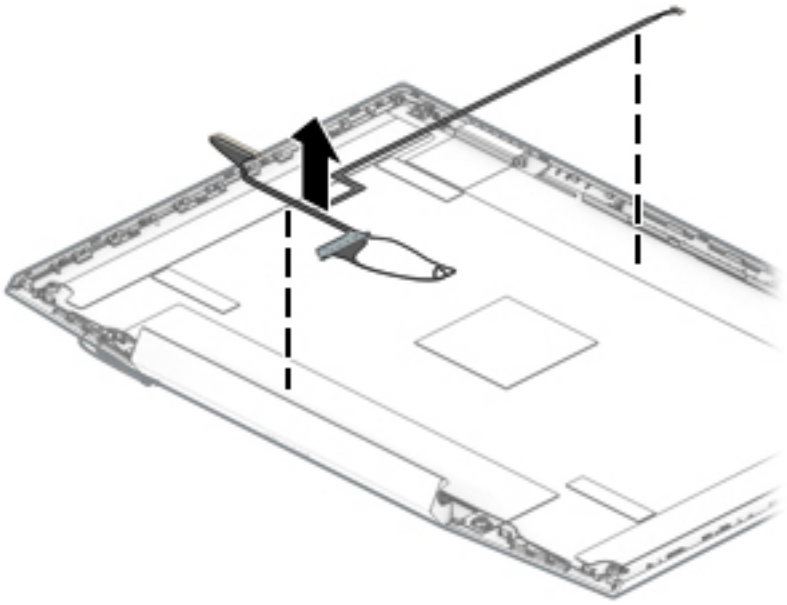


4. To remove the display/camera cable, remove the cable from the clips built into the side of the display enclosure, and then remove the cable from the display enclosure.

Models with an IR camera



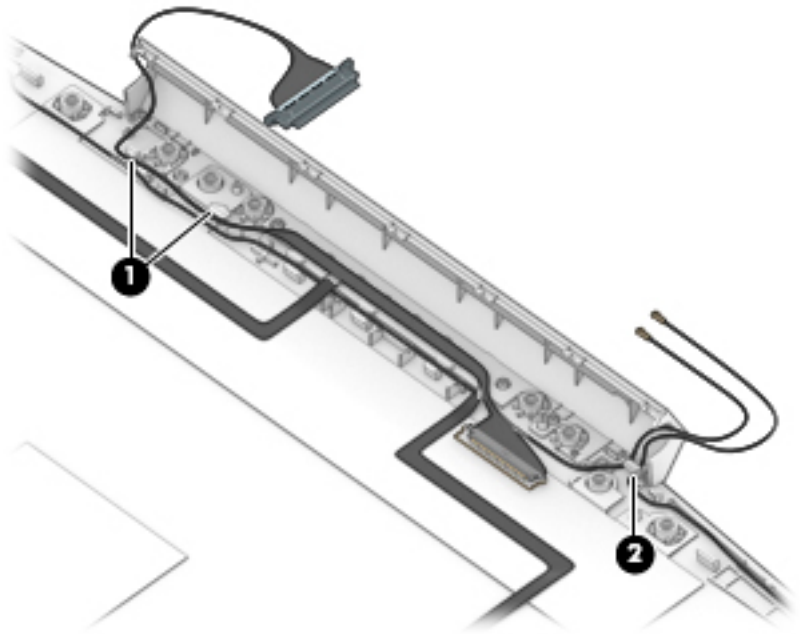
Models with an HD camera



5. Use the following image to determine proper cable routing around the left hinge for the camera/display cable and the wireless antenna cables.

   (1): Display/camera cable routing path

   (2): Antenna cable routing path



6. If replacing the display enclosure, be sure that the subcomponents (including the camera/microphone module, the antenna receivers, and all associated cables and hardware) are transferred to the new enclosure.

Reverse this procedure to reassemble and install the display assembly.

Top cover/keyboard

The top cover/keyboard spare part remains after all other spare parts have been removed.

The top cover/keyboard spare part kit includes the keyboard, keyboard cable and the keyboard backlight cable.

In this section, the first table provides the main spare part number for the keyboard. The second table provides the country codes.

NOTE: All top cover/keyboard spare part kits include thermal grease and keyboard connector Mylar.

Table 5-17 Top cover/keyboard description and number

Description	Spare part number
Top cover/keyboard	L25111-xxx

Table 5-18 Top cover/keyboard description and number

For use in country or region	Spare part number	For use in country or region	Spare part number	For use in country or region	Spare part number
Belgium	-A41	India	-D61	Saudi Arabia	-171
Brazil	-201	Israel	-BB1	Slovenia	-BA1
Bulgaria	-261	Italy	-061	South Korea	-AD1
Canada	-DB1	Japan	-291	Spain	-071
Czech Republic and Slovakia	-FL1	Latin America	-161	Sweden and Finland	-B71
Denmark	-081	The Netherlands	-B31	Switzerland	-BG1
Denmark, Finland, and Norway	-DH1	Northern Africa	-FP1	Taiwan	-AB1
France	-051	Norway	-091	Thailand	-281
Germany	-041	Portugal	-131	Turkey	-141
Greece	-151	Romania	-271	United Kingdom	-031
Hungary	-211	Russia	-251	United States	-001
Iceland	-DD1				

6 Interpreting system validation diagnostic front panel LEDs and audible codes

During the system validation phase that occurs at system startup, the BIOS validates the functionality of the following subsystems and conditions:

- AC adapter
- System board power
- Processor failure
- BIOS corruption
- Memory failure
- Graphics failure
- System board failure
- BIOS authentication failure

If an error is detected, specific patterns of long and short blinks, accompanied by long and short beeps (where applicable) are used to identify the error. These patterns will make up a two part code:

- Major – the category of the error
- Minor – the specific error within the category

NOTE: Single beep/blink codes are not used.

Table 6-1 Interpreting system validation diagnostic front panel LEDs and audible codes

Number of long beeps/blinks	Error category
1	Not used
2	BIOS
3	Hardware
4	Thermal
5	System board

Patterns of blink/beep codes are determined by using the following parameters:

- 1 second pause occurs after the last major blink.
- 2 second pause occurs after the last minor blink.
- Beep error code sequences occur for the first 5 iterations of the pattern and then stop.
- Blink error code sequences continue until the computer is unplugged or the power button is pressed.

NOTE: Not all diagnostic lights and audible codes are available on all models.

The red LED blinks to represent the major error category (long blinks). The white LED blinks to represent the minor error category (short blinks). For example, '3.5' indicates 3 long red blinks and 5 short white blinks to communicate the processor is not detected.

Table 6-2 Interpreting system validation diagnostic front panel LEDs and audible codes

Component tested	Major/ minor code	Error condition	Notebook Caps Lock/Num Lock LED	Desktop	Action
BIOS	2.2	The main area (DXE) of BIOS has become corrupted and there is no recovery binary image available	CAP/NUM Blink = 2	2.2 - Power LED (red.white)	Follow the Crisis Recovery instructions at http://support.hp.com/us-en/document/c02693833/.
	2.3	The embedded controller policy requires the user to enter a key sequence (SureStart 2.0)	CAP/NUM Blink = 8	2.3 - Power LED (red.white)	If analysis of the event that caused Sure Start recovery is desired, replace the board and send the bad board back. Otherwise, press this key combination to restore BIOS and boot: Up Arrow+ Down Arrow+ Esc.
	2.4	The embedded controller is recovering the boot block or DXE. Since it takes 10 sec. or so to load the DXE image and get video in the DXE case, this blink code is necessary. (SureStart)	Battery LED White and Amber blinking	2.4 - Power LED (red.white)	Wait for DXE recovery to complete.
Hardware	3.2	The embedded controller has timed out waiting for BIOS to return from memory initialization	CAP/NUM Blink = 3	3.2 - Power LED (red.white)	System board replacement.
	3.3	The embedded controller has timed out waiting for BIOS to return from graphics initialization (4/13- Graphics adaptor not found)	CAP/NUM Blink = 4	3.3 - Power LED (red.white)	If the system has an MXM module, try a different MXM module. Otherwise, the board most likely needs to be replaced.
	3.4	The system board displays a power failure (crowbar) *	CAP/NUM Blink = 5	3.4 - Power LED (red.white)	System board replacement.
System board	5.2	The embedded controller cannot find valid firmware	CAP/NUM Blink = 7 (2 BB failure) Battery LED Blinking = 1 Hz (3 B failure)	5.2 - Power LED (red.white)	System board replacement.
	5.3	The embedded controller has timed out waiting for the BIOS	CAP/NUM Blink = 1	Not implemented	System board replacement.

7 Troubleshooting guide

This chapter is primarily focused on troubleshooting HP Mobile Workstations and HP Notebooks. The information is provided so that you can solve problems yourself or at least narrow down what may be causing the problem. Based on some of the most common symptoms, this chapter helps to identify logical steps and available resources or tools for resolving an issue. HP recommends that you follow the instructions carefully, observe safety precautions, and note any observations or results. Capturing this information may help identify and resolve the problem faster.

⚠ **WARNING!** To reduce the risk of electric shock or damage to the equipment:

- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) outlet that is easily accessible at all times.
- Disconnect power from the equipment by unplugging the power cord from the AC outlet.
- Before disassembling notebooks, always disconnect power and remove the battery.

⚠ **CAUTION:** Static electricity can damage the electronic components of the computer. To prevent damage to the computer, carefully observe the electrostatic discharge precautions.

- Discharge static electricity by briefly touching a grounded metal object before you begin.
- Work on a static-free mat.
- Wear a static strap to ensure that any accumulated electrostatic charge is discharged from your body to the ground.
- Create a common ground for the equipment you are working on by connecting the static-free mat, static strap, and peripheral units to that piece of equipment.
- Refer to the Electrostatic Discharge Section of the Maintenance & Service Guide for more information.

CAUTION: The computer includes customer self-repair parts and parts that should only be accessed by an authorized service provider. See the chapter titled "Removal and replacement procedures for Customer Self-Repair parts," for details. Accessing parts described in the chapter titled "Removal and replacement procedures for authorized service provider only parts" can damage the computer or void the computer warranty.

Resources

Table 7-1 Troubleshooting resources and their descriptions

HP Resource Tool	Description	Link
HP Elite Support	Provides live HP Premium support (available 24/7) to Elite computers.	http://www8.hp.com/us/en/ads/elite-products/overview.html
HP Support Center	Provides important support, such as warranty, support cases, drivers, Customer Advisories, Customer and Security Bulletins, and Product Change Notices.	http://h20565.www2.hp.com/portal/site/hpsc
HP Troubleshooting Support page	Provides troubleshooting information for your specific HP computer.	http://www8.hp.com/us/en/troubleshooting.html
Subscribers Choice	Allows you to sign up for HP product updates.	http://www8.hp.com/us/en/subscribe/
HP Support Forums	Provide discussions about HP products and issues.	http://h30434.www3.hp.com/psg/
Service Access Workbench (SAW) (Available for technicians and Business Partners only)	Provides navigable content intended for use by internal and outsourced call center staff and can be a resource for support and product division professionals.	http://sawpro.atlanta.hp.com/km/saw/home.do
Vendors' web sites	Provide additional information for associated components such as Intel (processor, WLAN), Microsoft (Windows 7/8/10), AMD/NVidia (GPU), and so on.	http://www.intel.com/content/www/us/en/homepage.html http://www.microsoft.com http://www.amd.com http://www.nvidia.com

General troubleshooting steps

A basic logic should be used when troubleshooting computer issues. This section will help you become familiar with troubleshooting methodology and efficiently resolve problems. Proceed through the steps in the following table until the issue is resolved, and then move on to the next step that is relevant to the issue. For example, if you resolve a memory issue using the HP PC Diagnostics (UEFI) tool in step 6, you can then move on to step 10 to reseat the memory into its memory slot.

NOTE: General troubleshooting steps do not have to be followed in a specific order if an issue does not apply.

Table 7-2 Troubleshooting methodology and general troubleshooting steps

Identify issue	Analyze issue	Resolve issue	Verify solution
1. Understand the issue on page 77 2. Examine the environment on page 79 3. Perform a visual inspection of hardware on page 80 4. Update BIOS and drivers on page 80	5. Remove or uninstall recently added hardware, software on page 80 6. HP Hardware Diagnostics and Tools on page 81 7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85	8. Hard reset on page 87 9. Soft reset (Default Settings) on page 88 10. Reseat cables and connections on page 88 11. Test with minimum configuration on page 89 12. Test with verified working configuration (hardware and/or operating system) on page 90	Verify solution on page 91

Table 7-2 Troubleshooting methodology and general troubleshooting steps

Identify issue	Analyze issue	Resolve issue	Verify solution
		13. Replace the system board on page 90	

Identify the issue

1. Understand the issue

It is important to understand the issue that occurred, including related symptoms. It helps to understand the basic computer boot-up sequence as well as the failure itself. The boot-up sequence and associated failures are described below.

Boot up sequence

The computer performs several steps after you press the power button or restart the computer.

It is important to understand where in the boot-up sequence the symptoms occur. The following table lists the phases of the boot-up sequence and explains the symptoms that may occur in each phase. For example, a blue screen error (BSOD) often occurs during the performance phase.

Table 7-3 Boot-up sequence

Item	Procedure
Power-on	After power button is pressed, the computer boots after all internal power rails (i.e., 5V, 3.3V) are stable. Confirm that power lights are on fan is spinning. Common issues: all lights are off; troubleshooting lights are on; does not boot; video is absent.
POST (UEFI/BIOS)	Power-On Self-Test (POST) verifies that hardware components (processor, hard drive, memory, etc.) are functional. When POST is complete, the HP logo displays briefly and then disappears. If there are errors, the computer may exhibit blinking lights and POST error messages Common issues: lights blink, error message appears, hangs.
Performance (operating system)	System boots to operating system, and Windows logo screen appears. Common issues: hangs (lock up/freezes), blue screen, video distorted, driver conflict, slow performance, display issue (dead pixel), I/O issue (no speaker sound), wireless/audio unavailable, noise. See Analyze the issue on page 80 table below for detailed troubleshooting information).

Failure classification

Failure classification is a breakdown of different types of failures and symptoms that could occur during the boot-up sequence. Table 3 and table 4 represent the failure classification for common notebook failures.

Table 3 categorizes failures by the boot-up sequence.

1. Power-on: Common issues are No Power, Recycle/Reboot, etc.
2. POST: Common issues are No Boot (have power), Light Flash or Diagnostics Error.
3. Performance: Common issues are Intermittent Loss of Power, Blue Screen, Hang, etc. In many cases, issues may be identified and associated with a particular hardware (i.e., display, storage).

   Table 4 categorizes failures by hardware.

4. Display
5. I/O devices (Input/Output)
6. Storage
7. Mechanical

A single symptom can be listed under different groups. For example, No Video can belong to (1) Power-on or (4) Display; but Flickering when powered should be listed in (4) Display. Or, in another example, a blue screen can be caused by a driver conflict in Performance (4), but it can also be caused by a defective hard drive under (6) Storage. Therefore, failures that share similar symptoms are noted.

If possible, make a record of the failure symptom, the phase of the boot-up sequence where the failure occurs, and the most likely location in the failure tree (Table 7-4 Failure classification by boot-up sequence on page 78 and Table 7-5 Failure classification by hardware devices and mechanical on page 79). This will help isolate the issue and indicate the next steps. For example, when the computer is running the operating system, it may experience an issue with (4) Display, (5) I/O devices (keyboard, wireless, and so on), (6) Storage, or (7) Mechanical components (stuck buttons, thermal shutdown, and so on).

NOTE: "Uncategorized" is used if an issue found is not listed. For example, Bluetooth is offered on certain hardware configurations; therefore, a Bluetooth issue can be classified under "I/O Device" if needed.

Failure classification by boot-up sequence

Table 7-4 Failure classification by boot-up sequence

1. Power-on	2. POST	3. Performance
1. No Power on page 93	1. No video (with power) on page 99	1. Intermittent shutdown on page 103[a]
2. Intermittent power-on, shutdown, reboot on page 95[a]	2. Blinking lights on page 100	2. Blue screen (BSOD) error on page 127[b]
3. AC adapter issues on page 96	3. Diagnostics error messages on page 101	3. Freeze at Windows Logo (hang/lockup) on page 106
4. Battery not recognized, not charging on page 97	4. BIOS password on page 102	4. Electromagnetic Interference (EMI) on page 107
5. Battery discharges too fast on page 98		5. No wake up on page 108
6. Burnt smell on page 99		6. Unresponsive on page 109
		7. Slow performance on page 109[c]
		8. HP Smart Adapter warning message on page 110

[a,b,c] similar symptoms

Failure classification by hardware devices and mechanical

Table 7-5 Failure classification by hardware devices and mechanical

4. Display	5. I/O devices	6. Storage	7. Mechanical
1. Display anomalies on page 110	1. Keyboard on page 117	1. Hard drive/solid-state drive not recognized on page 126	1. Fan error message - 90B on page 129
2. Dead pixel on page 113	2. Keyboard pointing stick on page 118	2. No boot to operating system (no read/write error) on page 126	2. Noise (sound) on page 130
3. No video (internal) on page 113[d]	3. Keyboard backlight on page 118	3. Read-write error on page 127	3. Fan runs constantly on page 131
4. No video (external) on page 114[d]	4. TouchPad on page 119	4. Slow performance on page 109[c]	4. HP Thermal Monitor on page 84
5. DisplayPort/VGA on page 114	5. Network Connectivity Ethernet (RJ-45 jack) on page 119	5. Blue screen (BSOD) error on page 127[b]	5. Stuck power button on page 132
6. HDMI on page 114	6. Network connectivity wireless (WLAN) on page 120	6. Noisy hard drive on page 128	
7. No or bad external video via docking on page 115	7. USB on page 121		
8. Incorrect or missing color/ distorted image on page 115	8. Smart card reader on page 122		
9. Touch screen on page 116	9. Speaker and headphone audio issues on page 123		
	10. Thunderbolt (TB) on page 124		

[b,c,d] similar symptoms

2. Examine the environment

It is important to examine the computer's environment. If you can quickly identify the cause of the issue, fewer resolution steps may be needed. Perform the following environment inspections:

- Check all cables and connections to be sure that there are no loose connections.
- Confirm that power sources are good, such as wall power type/adapter (110V/220V ac), power strip. Test with a verified working AC outlet.
- Check for compatibility issues between the computer and third-party devices, peripherals, noncertified devices, incompatible hardware (i.e., Mac OS device). Incompatibility can result in blue screen errors, improper operation, and so on.
- Isolate the computer from sources of electromagnetic interference (EMI), such as cell phones, 2-way radios, floor mats, fans (and other electronic motors). EMI may contribute to a display freeze issue or lock-up.

3. Perform a visual inspection of hardware

It is important to do a visual inspection of the hardware itself. Perform physical inspection of the computer:

- Look for abnormalities such as a cracked display, dented battery, broken latches for battery bay, keyboard key caps popped out, dust over connectors, liquid spill over keyboard, etc.
- Look for signs of drop, movement, or vibration that may cause internal and external loose connections.

4. Update BIOS and drivers

IMPORTANT: Whenever possible, update to the latest BIOS, firmware, and drivers before troubleshooting.

Note that some customer company policies prohibit updates. Check your company policy before taking action.

The updates may include fixes for your computer issues, and they may also enhance system performance. HP continually improves the update process to make it easier. The BIOS update can be done locally through a manual process, through an automatic installation, or through a remote installation on multiple units.

Manually updating BIOS and drivers

- See the Computer Setup chapters to manually update BIOS and drivers.
- Refer to specific BIOS update installation instructions that accompany the download.

Remotely deploying BIOS and drivers

Instead of manually searching for and downloading each SoftPaq, users and IT personnel can use two tools to identify and download all appropriate SoftPaqs for the selected HP models.

- HP SoftPaq Download Manager (SDM) is a software tool designed to streamline the download, extraction, and installation process of SoftPaqs, including BIOS and drivers.
- HP System Software Manager (SSM) is a software tool designed to simplify the deployment of SoftPaqs to HP computers.

Analyze the issue

5. Remove or uninstall recently added hardware, software

HP has designed this computer and validated it using a full-range hardware and software qualification matrix. If an issue appears to have started recently, it may be related to the recent addition of hardware or software. A good method to determine the root cause is to remove recently added components or uninstall applications one at a time and restart the computer when necessary.

IMPORTANT: After you have completed the process of uninstalling hardware or software and are ready to reinstall, when installing a new device be sure that it is seated properly and all cables are correctly connected. After installing the device, restart the computer and make sure the new device is powered on. In addition, if the new device is a root cause of a problem, it could cause a conflict in drivers or incompatibility issues with other programs installed. For any new hardware you have added, be sure to install the latest drivers available from the device vendor website.

6. HP Hardware Diagnostics and Tools

HP offers different diagnostics and tools to diagnose hardware failure. This section describes how to use some of these tools. Make sure to check for the latest versions before use.

HP PC Hardware Diagnostics (UEFI)

HP PC Hardware Diagnostics is a Unified Extensible Firmware Interface (UEFI) that allows you to run diagnostic tests to determine whether the computer hardware is functioning properly. The HP PC Hardware Diagnostics (UEFI) tool is built within BIOS (basic memory and hard drive diagnostics only), or within new hard drives themselves. These drives contain more advanced versions of the diagnostic tool than the BIOS-based version.

In addition, for HP authorized service partners and IT professionals who need to support a mixed environment of older and newer HP/Compaq PCs, the http://www8.hp.com/us/en/campaigns/hpsupportassistant/pc-diags.html?jumpid=va_r602_us/en/any/pps/pl_ot_ob_ds_pd/HP_PC_Hardware_Diagnostics_cc/dt is a diagnostic tool that supports a wide range of HP Desktop and Notebook computers.

The tool runs outside the operating system so that it can isolate hardware failures from issues that are caused by the operating system or other software components. In reality, many problems can be determined using this tool if the issue is a defective part or a loose connection (i.e., reseating keyboard cable after the tool reports a keyboard error).

The tool has three major functions:

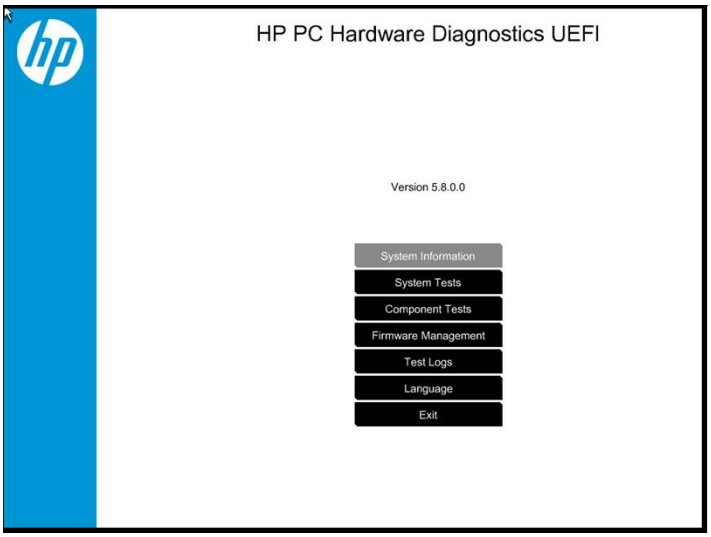
- System Tests - Check the computer's hardware to assure everything is functioning properly. If your system won't boot into Windows, try the Quick System Test. For more comprehensive testing, use the Extensive System Test option. If the System Test did not detect a hardware problem, continue with the Component Tests.
- Component Tests – Focus on selected hardware components in your computer.
- Firmware Management – Update your computer's BIOS to the latest version (available separately) or roll back to a previous version.

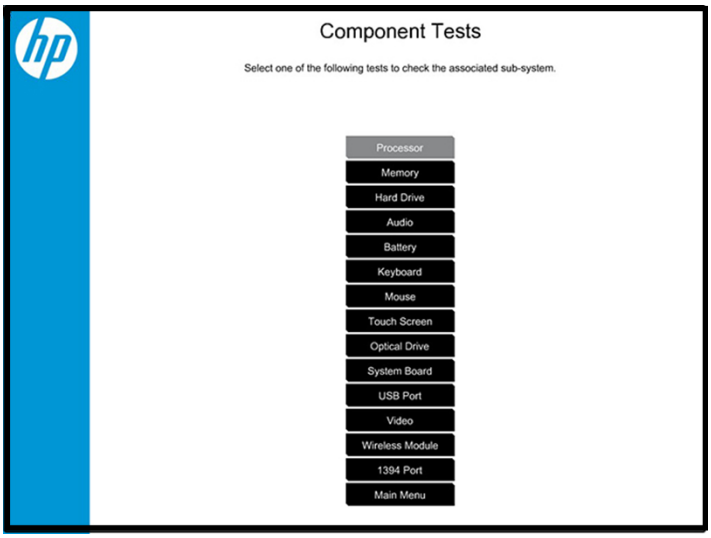
To start HP PC Hardware Diagnostics (UEFI):

1. Turn on or restart the computer, quickly press the esc button on the computer, and then press F2. The BIOS searches three places for the diagnostic tools, in the following order:
   a. Connected USB drive
   b. Hard drive
   c. BIOS

2. When the diagnostic tool opens, use the keyboard arrow keys to select the type of diagnostic test you want to run, and then follow the on-screen instructions.

   Screen shot appearance may vary.





NOTE: Users should utilize this tool, especially when the computer cannot boot to Windows.

NOTE: If a component fails a test, write down the information so it is available when contacting support. The information is also available in **Test Logs** on the Main Menu.

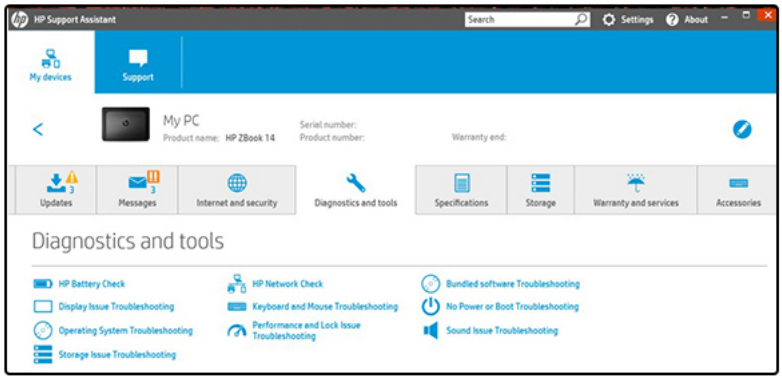
For more information, see the chapter titled “Using HP PC Hardware Diagnostics (UEFI).”

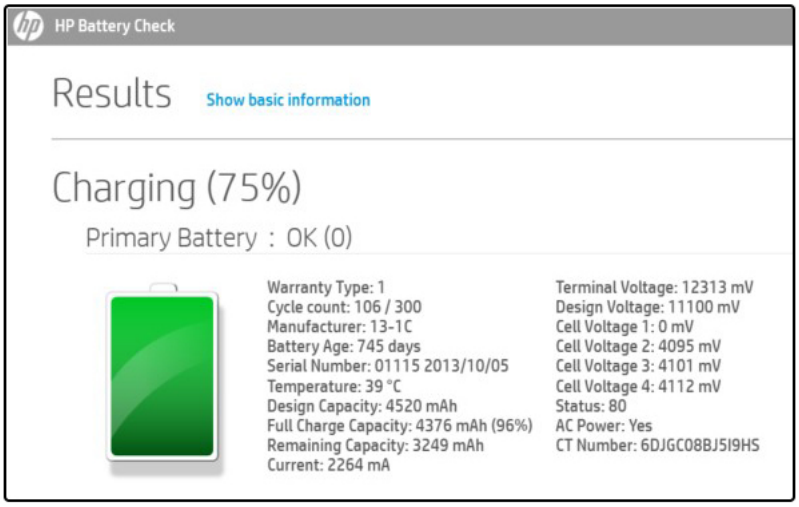
HP Support Assistant (HPSA)

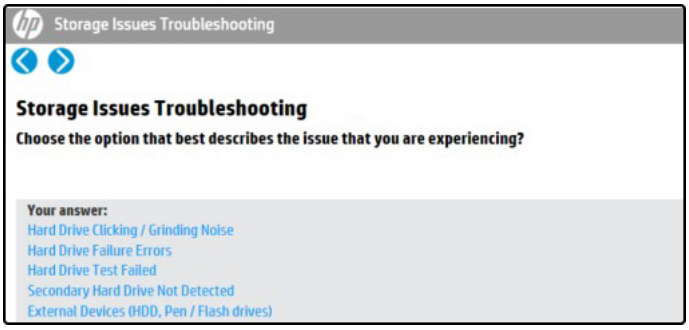
HP Support Assistant (HPSA) helps you maintain peak performance and resolve problems through automatic updates, built-in diagnostics, and a variety of assistance options. HPSA is preinstalled on every new HP PC with Windows 7, Windows 8, or Windows 10. HP is continually improving this tool. Please verify the latest version is installed to receive the most benefit. For more information, see http://www.hp.com/go/hpsupportassistant.

NOTE: HPSA can be used only if the computer boots into Windows. If the computer does not boot into Windows, use HP PC Hardware Diagnostics (UEFI) instead.

HPSA also integrates diagnostics and tools that help resolve issues. See example screen shots as follows.







HP BIOS Configuration Utility (BCU)

HP BCU is a free utility that captures the BIOS settings and their values. This tool provides a text file of the computer's BIOS configuration. This can help identify any settings that may be contributing to an issue.

In some cases, it may help to compare this BIOS text file to the default settings of the computer.

For more information, see the http://ftp.hp.com/pub/caps-softpaq/cmit/whitepapers/BIOS_Configuration_Utility_User_Guide.pdf.

NOTE: HP recommends that you reset BIOS before trying BCU. Resetting the BIOS is always available and relatively quick to try, whereas BCU takes extra time and effort.

HP Image Diagnostic Tool

Available to HP Authorized Support Partners (ASPs) and users from the ftp://ftp.hp.com/pub/idr/ImageDiags/, this tool collects information about the current state of the computer, including product serial number, platform and BIOS information, and information about user-installed software and hardware components. HP encourages you to review the report before sending it to support. The report may assist you with diagnostics and solutions to problems you encounter.

HP Thermal Monitor

NOTE: Available only to authorized service providers/technicians.

Available only for HP internal use, HP Thermal Monitor can be used to stress the processor and GPU and monitor the temperature values of various components in the system. The components that are currently monitored include the processor, GPU, ACPI thermal zones, hard drive, and battery. The tool reads the temperatures of the components, logs the data, and helps to determine whether the computer would overheat in the event of thermal shutdown, fan spinning loud, etc.

Non HP diagnostics tools

Windows-to-Go USB

Windows-To-Go USB is a Microsoft-based tool for Enterprise editions of Windows that can help in troubleshooting. You can find a process online about how to create a live Windows USB drive. For more information, see https://technet.microsoft.com/en-us/library/hh831833.aspx.

Intel Processor Diagnostic Tool

Determine what processor is in your computer and verify the processor operating frequency. The tool also tests specific processor features and performs a stress test on the processor. For more information, see http://www.intel.com/support/processors/sb/CS-031726.htm?iid=subhdr+tools_procdiagtool.

7. Status lights, blinking light codes, troubleshooting lights, and POST error messages

Carefully observe any behavior the computer may be exhibiting: status lights, blinking lights, and POST error messages during boot. It is important to understand what these indicators mean.

Status lights

See the chapter titled “External Component Identification” for light locations. The following table describes basic lights on the computer.

Table 7-6 Status lights

Component	Description
Power button	When the computer is off, press the button to turn on the computer. When the computer is on, press the button briefly to initiate Sleep (Windows) or Suspend (Linux). When the computer is in the Sleep state, press the button briefly to exit Sleep (Windows) or Suspend (Linux). When the computer is in Hibernation, press the button briefly to exit Hibernation. **CAUTION:** Pressing and holding down the power button results in the loss of unsaved information. If the computer has stopped responding and operating system shutdown procedures are ineffective, press and hold the power button.
Front power light	On: The computer is on. Blinking: The computer is in the Sleep state. Off: The computer is off.
Front AC adapter and battery light	White: The computer is connected to external power and the battery is charged from 90 to 99 percent. Amber: The computer is connected to external power and the battery is charged from 0 to 90 percent. Blinking amber: A battery that is the only available power source has reached a low battery level. When the battery reaches a critical battery level, the battery light begins blinking rapidly. By default, the critical battery level is defined in Power Options as 5%. Off: The battery is fully charged.
Front hard drive light	Blinking white: The hard drive is being accessed. Amber: HP 3D DriveGuard has temporarily parked the hard drive.
Rear AC adapter light	White: The computer is connected to external power. Off: The computer is not connected to external power.

Blinking light codes

During startup, the computer may not boot properly. If this occurs, blinking light codes that will help identify what is causing the issue. The computer uses the blinking lights below to identify a hardware component that reports an error during startup. For more information, see Blinking lights and boot error codes on page 134.

Table 7-7 Boot-error codes

Blink codes	Error
Amber battery light: blinks 1 Hz continuously	Embedded controller unable to load firmware
Caps/num lock lights = 1 blink	Processor not executing code
Caps/num lock lights = 2 blinks	BIOS recovery code unable to find valid BIOS recovery image
Caps/num lock lights = 3 blinks	Memory module error
Caps/num lock lights = 4 blinks	Graphics controller error
Caps/num lock lights = 5 blinks	System board error
Caps/num lock lights = 6 blinks	Intel Trusted Execution Technology (TXT) Error
Caps/num lock lights = 7 blinks	Sure Start unable to find valid BIOS Boot Block image
Caps/num lock lights = 8 blinks	Sure Start has identified a problem (Manual Recovery Policy Set)

POST error messages

The Power-On Self-Test (POST) is a series of diagnostic tests that runs automatically when the computer is powered on. If the POST encounters a problem, visual error messages are displayed before the operating system starts. POST checks the following items to ensure that the computer system is functioning properly:

- Memory
- Processors
- BIOS
- Mass storage devices
- Fans

The following table describes errors encountered during HP PC Hardware Diagnostics (UEFI).

Table 7-8 System diagnostics failure codes and user actions

Test description	Failure description	Error code	Suggested user actions
Startup Test	Memory module	200	Attempt to reseat the memory module and then repeat the test. For details on troubleshooting issues related to the memory module, search for support documentation at http://www.hp.com/support.
Startup Test	Hard Disk 1 SMART	301	Attempt to reseat the hard drive and repeat the test. The hard drive may have failed.
Boot Device Manager	Boot device not found	3F0	Reset BIOS. Then reseat the hard drive and repeat the test.
BIOS Recovery	BIOS Recovery Occurred	500	This message indicates that BIOS recovery was completed successfully. No further action is required.

Table 7-8 System diagnostics failure codes and user actions (continued)

Test description	Failure description	Error code	Suggested user actions
BIOS Application	BIOS Application Error	501	The BIOS installation may have become corrupted. Download the latest version of the BIOS and install it. If reinstalling the BIOS fails, contact support for further assistance.
CMOS Recovery	CMOS Recovery Occurred	502	This message indicates that CMOS recovery was completed successfully. No further action is required.
Battery Check	Primary Battery Replace	601	This message indicates that the primary battery has very low capacity. Search for support documentation at http://www.hp.com/support for details on using the HP Support Assistant to verify the battery capacity and, if necessary, order a replacement.
Wireless Modules	Not installed or responding	701	Reseat the wireless LAN adapter module and antennas. Because seating or reseating a wireless LAN adapter is unique to each computer model, see the WLAN module removal section in the removal and replacement chapter for further details. Contact support if third-party wireless adapters are installed in the computer.
Fan	Fan not operating correctly	90B	The system fan may be malfunctioning. Replace the fan.

Resolve the issue

8. Hard reset

A http://support.hp.com/us-en/document/c01684768 (or forced reset) erases all information in the computer's memory and may restore functionality. Resetting the computer forces the system to clear and reestablish the connections between the BIOS and the hardware.

Performing a hard reset might fix the following common conditions:

- Windows stops responding.
- Computer stops before Windows loads, indicated by incomplete boot-up, blinking cursor on a black background, and errors relating to operating system not found or a missing drive.
- Display suddenly goes blank and stays blank.
- Software freezes.
- Keyboard stops responding.
- The computer does not exit Sleep or Suspend state.
- An external device stops responding. Turn off the power to that device in addition to performing the steps in this document.

Before performing a hard reset, you must disconnect or remove all peripheral devices. You should start and test the computer by itself, and if the problem is not resolved, reconnect one peripheral device at a time. To resolve the startup or operational problem, run HP Support Assistant, or manually install all updated drivers from Microsoft and HP.

Before beginning, turn the computer over and look for a battery compartment door (service door). For 2015 platforms, the battery is considered removable but not accessible. See the battery section for how to remove/unplug the battery.

To perform a hard reset on a computer with a sealed or non removable battery, use the following steps:

1. Turn off the computer.
2. Remove the computer from any port replicator or docking station.
3. Disconnect all external connected peripheral devices such as USB storage devices, external displays, and printers.
4. Unplug the AC adapter from the computer.
5. Disconnect the battery.
6. Press and hold the power button for at least 15 seconds to drain residual power.
7. Reconnect the battery and plug the AC adapter back into the computer, but do not connect any of the peripheral devices.
8. Press the power button to turn on the computer.
9. If a startup menu appears, use the arrow keys to select **Start Windows Normally**, and then press the Enter key.
10. After reconnecting each of the peripheral devices, run Windows Update and HP Support Assistant to update all device drivers.

Clear CMOS

CMOS refers to the battery-powered, semiconductor chip located on computer's system board. Notebooks store low-level settings like the system time and hardware settings in CMOS. Sometimes it is necessary to clear CMOS, which requires removing the AC adapter and battery.

NOTE: Clearing the CMOS should only be performed for troubleshooting purposes. There is no reason to clear CMOS if the computer is working properly.

9. Soft reset (Default Settings)

NOTE: Some company policies prohibit updates or changes. Check whether the computer has custom BIOS settings before taking action.

If your computer is having issues booting, has errors during boot, is running into issues after adding hardware, or you are having other abnormal system behaviors that cannot be resolved through any other methods (i.e., hard reset), it may be necessary to reset the system BIOS to default settings.

To load BIOS to default settings: Reboot the computer, and then press **F10 > Main > Restore defaults**. For more information, see the BIOS F10 Setup technical white paper at http://support.hp.com, enter your computer model, and then go to **Manuals > White papers > HP PC BIOS F10 Setup Guide**.

10. Reseat cables and connections

NOTE: Before disassembling the computer to reseat cables and connections, always disconnect power and remove the battery or disconnect a non removable battery.

Many problems are caused by improper connections or loose connections due to abnormal movement and vibration. See Cable management on page 145 and Connector types on page 146 for suggested cable management practices when removing and installing components.

You can access and reseat connections for Customer Self-Repair (CSR) parts (see the “Removal and replacement procedures for Customer Self-Repair parts” chapter for details). Examples of reseating hardware include:

- Reseating the battery into the battery bay can resolve no-battery found and no-charging issues.
- Reseating memory modules can resolve memory error, no-boot, and blue screen issues.
- Reseating the hard drive can resolve a POST error 3F0 (no boot device) issue (see POST Error Messages and User Actions on page 136).
- Reseating the keyboard cable can resolve an unrecognized keys error.
- Reseating the wireless module and antenna cable can resolve a wireless connection issue.

For field replaceable units (FRUs), authorized service providers can try the following steps (for more information, see the ”Removal and replacement procedures for authorized service provider parts” chapter).

- Reseating the fan cable can fix POST error 90B (no fan detected) issue (see POST Error Messages and User Actions on page 136).
- Reseating the power cable can fix a no boot issue.
- Reseating the daughterboards (some models may have a power button board, VGA board, etc.) can resolve their functional issues.
- Reseating graphics cables and panel connectors can fix distorted/flickering video.
- Replacing thermal pads may resolve thermal power-down issue.

11. Test with minimum configuration

The factory-shipped computer (hardware configuration and preinstalled operating system image) is well tested and ready for use. Therefore, using the original factory hardware configuration and/or booting to operating system safe mode often resolves issues quickly.

- Disconnect any external USB storage, remove any discs in optical drives, remove the computer from a docking station, remove external video, etc.
- In addition to removing recently added components, the issue can be narrowed down further with a minimum configuration. For example, if HP PC Diagnostics reports a memory error, test one memory module at a time to isolate the defective module.
- If the computer does not successfully boot the operating system, booting to safe mode may help identify what may be causing the issue as described below.

Essential hardware configuration

NOTE: This step is to be used by authorized service providers only. HP will not honor the warranty for a system tested with the system board removed without the heat sink, fan, etc.

If none of the steps above resolve the issue, start the computer with essential hardware only. The purpose is to remove as much as hardware as possible while still maintaining the computer’s ability to turn on.

This essential configuration is often used to troubleshoot power-on related issues, such as no-boot, reboot, and freezing issues.

The essential hardware consists of the following:

- System board
- AC adapter (unplug nonremovable battery or remove battery)

- Processor (and heat sink/fan). (Processor may be integrated into the system board.)
- Memory (one verified working memory DIMM)
- Graphics card (if no VGA port is available on the system board). Platform may have both Intel integrated graphics and discrete graphics. Therefore, discrete graphics card may not be needed.
- External VGA monitor
- External USB keyboard
- External mouse

NOTE: After the service door is removed, disconnect all connections (internal keyboard, display, discrete GPU, hard drive/solid-state drive, daughterboards, etc.) to achieve the essential hardware configuration above. DO NOT disassemble the system board from its enclosure at this time.

Reverse the procedure above by reinstalling each piece of hardware removed, one piece at a time, and testing your computer after each installation. Since your computer works with only the essential hardware installed, those parts must be working properly. This means that one of the hardware components removed is causing the computer to not work properly. By installing each device back into the computer and testing each time, the failing hardware will eventually be identified.

Safe mode

A driver conflict often results in a blue screen error message. Therefore, booting in safe mode can resolve many issues in Windows because safe mode forces the computer to load a limited version of Windows which only contains essential files. Safe mode is useful for troubleshooting problems with programs and drivers that might not start correctly or that might prevent Windows from starting correctly.

If a problem does not reappear when you start in safe mode, eliminate the default settings and basic device drivers as possible causes. Refer to the links below for how to start your computer in safe mode:

- http://support.hp.com/us-en/document/c01835750
- http://support.hp.com/us-en/document/c03439317

12. Test with verified working configuration (hardware and/or operating system)

One troubleshooting technique that can quickly isolate an issue is using a verified working part while testing. A good example is to use an external keyboard, mouse, or VGA monitor when you have issues with an internal keyboard, TouchPad, or display. Testing with a verified working AC adapter can identify an error caused by a faulty one. Similarly, testing with a verified working operating system can determine bad behaviors of the current operating system. See Non HP diagnostics tools on page 84 for instructions about obtaining and using a Windows-To-Go USB.

NOTE: In some situations, more than one item may contribute to a problem.

13. Replace the system board

The system board may be replaced only by authorized service providers. This should not be considered an initial step taken to resolve an issue. Review and perform all steps discussed previously before replacing the system board. 4. Update BIOS and drivers on page 80, 7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85, 8. Hard reset on page 87, and 9. Soft reset (Default Settings) on page 88, and/or 10. Reseat cables and connections on page 88 can resolve many system board issues without requiring the effort of replacing unnecessary hardware.

Review Table 7-2 Troubleshooting methodology and general troubleshooting steps on page 76 for appropriate troubleshooting steps.

IMPORTANT: System board failure is not common. Do not replace the system board until you have tried all other troubleshooting options.

NOTE: Determine whether a previous service case might be related to the current problem. For example, a fan detection issue may be caused by a loose connection resulting from previous service.

NOTE: Most of the time, effective troubleshooting can prevent a system board replacement.

Items that may prevent resolution of the issue:

- The information provided about the issue omits key details, including any actions taken before the issue occurred.
- BIOS, software, and drivers have not been updated.
- Cables or connections are loose.
- Technician is unaware of information available from the HP Support website (i.e., CA - Customer Advisory).
- The issue is related to existing or known issues that may be identified in existing support articles.
- Technician may have omitted steps in the provided repair instructions (e.g., Spare Part Replacement Instructions).
- Skipping one of steps from Troubleshooting Methodology table results in No Defect Found (NDF)/No Fault Found (NFF)/No Issue Detected (NID) messages.

Verify solution

- Verify that the implemented solution works. Reboot the system or device and try to complete the task that produced the issue.
- If a part has been replaced, verify other basic functions. For example, GPU replacement requires keyboard removal. Therefore, it is good practice to verify all basic components to be sure that the solution is complete.
- Explain to the customer why the issue occurred and what was done to resolve it. If the solution you used was in an HP Public document, provide the document information to the customer, letting them know it can be located on www.hp.com. Also, tell them that there are other solutions available on the website. Advise the customer to check the website first when they have an issue. It may save them time calling in.
- Document the correct issue. Update the case with as many details as possible for other agents and engineering to analyze and study for lessons learned.

Helpful Hints

After you become familiar with the general troubleshooting steps above (General troubleshooting steps on page 76), follow the helpful hints below before running diagnostics and troubleshooting.

At startup

TIP: If you have installed an operating system other than the factory-installed operating system, go to http://www.hp.com/go/quickspecs and verify that it is supported on your system.

1. Be sure that the computer is plugged into a working AC outlet.
2. Be sure that power is connected to the docking station if a dock is used.
3. Be sure that the AC adapter light is on.

4. Be sure that the AC adapter is connected when you update BIOS to avoid BIOS corruption.
5. Be sure that the computer is turned on, the rear power light is solid white (connected to an external power source) and the front power light is solid white (normal operation).
6. Remove all optical and flash drives from your system before turning it on.
7. Be sure that the boot option is set to a working operating system drive.
8. Be sure that externally connected monitors are turned on and their power lights are on. Not all monitors are equipped with lights to indicate their functionality.
9. Turn up the brightness and contrast controls of a display or external display device if the screen is dim.

During operation

1. To wake the computer:
   a. Press the power button or any key on the keyboard.
   b. If the system remains in the Sleep (Windows), Suspend (Linux), or Hibernate state, shut down the system by pressing and holding the power button for at least four seconds.
   c. If the system does not shut down, unplug the power cord, wait a few seconds, and then plug it in again. Then press the power button again to restart the system. If it does not turn on, press the power button to start the computer.
2. Look for blinking lights on the computer. The blinking lights could be error codes that will help diagnose the problem.
3. Check all cables for loose or incorrect connections (external devices, power cords, dock, etc.).
4. After installing a non-Plug and Play expansion board or other option, reconfigure the computer. For example, if you upgrade to a solid-state drive, you may need to reconfigure the boot order.
5. Be sure that all required device drivers have been installed. For example, if you have connected a printer, you must install a printer driver.
6. If there is a network connection issue, plug another computer with a different cable into the network connection. There might be a problem with the network plug or cable.
7. If hardware has recently been installed, remove it and determine whether the computer functions properly.
8. If software has recently been installed, uninstall it and determine whether the computer functions properly.
9. If the screen is blank, confirm the display choice by pressing Windows logo + P and set to screen only. Or plug an external monitor into a different video port on the computer if one is available and close the computer lid.
10. Verify that the latest version of BIOS, drivers, and software are installed. A new release might support new features or fix the problem.
11. Press the caps lock and/or num lock key. If the caps lock and/or num lock light toggles on or off, the keyboard is likely operating correctly.
12. Press the TouchPad On/Off button light. If the light toggles on or off, the TouchPad is likely operating correctly.

Consulting with HP Service

If further HP support is required, a lot of the following information may be requested when you call, so it may be helpful to take notes.

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Product identification number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

Common issues and possible solutions

This section contains common issues, symptoms, and a series of tables that describe possible solutions to issues from *Failure classification* on page 77 tables. The following sections identify the issue with symptoms and solutions to resolve an issue.

Power-on issues

No Power

When a unit experiences no power there are several contributing factors to consider. Be sure to consider all symptoms related to this behavior in troubleshooting.

Table 7-9 Power-on issues

Items	Procedures
Symptoms	*Possible causes*
• Computer does not start	Failed power input to the computer (external power source, AC adapter, faulty battery).
• Display is black or blank	Bad connection to the computer (bad power button, power connector).
• No fan noise	Defective parts (memory, hard drive, graphics) or failed system board.
• No hard drive spinning	
• Lights do not glow	
	Troubleshooting steps
	Perform quick check
	Remove all external devices, including docking station.
	Verify external power source (2. Examine the environment on page 79).
	Perform a hard reset (8. Hard reset on page 87).

Table 7-9 Power-on issues (continued)

Items	Procedures
 	**Verify AC adapter** It is preferable to verify the battery before verifying the AC adapter. However, you can verify the AC adapter first, before opening the service door for a battery check. • Verify AC adapter is compatible with product. Verify that the part number is for this computer if possible. • Verify AC adapter and power cord are good (no physical damage, bent middle ID pin). • Verify AC adapter works on a verified working computer. • Plug in AC adapter and power on computer without battery. • Inspect power port on computer side for any damage, dust, or debris. • Check power light (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85). Rear power light indicates external power to the computer is good.
NOTE: Refer to battery replacement section for removing/replacing the battery	**Verify battery condition/status** 1. Check battery condition (overall result, cycle life, voltage, etc.) using HP PC Hardware Diagnostics (UEFI) or HPSA tools. 2. Verify that battery is installed properly in battery bay without a gap and that latch locks are tight (for models with removable batteries). 3. Check battery status light (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85). Be sure that battery is not fully discharged, preventing system from booting. 4. Determine whether the computer can turn on with battery only. 5. Remove service door and test with a verified working battery. If the computer boots, inspect original battery before replacement. 6. Test battery with a verified working computer to verify that it is OK. 7. If there is still no boot, remove battery and boot on AC power only.
The sections below are intended for authorized service providers/technicians.	
	Verify AC adapter – voltage 1. Measure DC voltage output that should be around 19.5 VDC and acceptable voltage range is from 18.5 – 20.5 VDC. 2. If the DC voltage is out of range, replace the AC adapter. **NOTE:** This action requires a digital voltmeter.
NOTE: 2015 mWS does not have the power cable between system board and power connector on chassis 	**Verify power button, power connector** 1. Be sure that power button is not stuck. 2. Reseat power connector cable (if applicable). 3. Replace new power connector cable (if the cable exists and is defective) 4. To isolate faulty power connector cable and power button, technicians can short power-on pads/pins to power up the computer. Contact HP Engineering for this information.
	Verify blinking lights (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85)

Table 7-9 Power-on issues (continued)

Items	Procedures
	At this point, there should be sufficient power from the AC adapter to the system board. Expect to hear the fan spinning and see blinking lights or error messages (i.e., faulty memory, HDD, etc)
	Verify system board 1. Test essential hardware configuration (11. Test with minimum configuration on page 89, 12. Test with verified working configuration (hardware and/or operating system) on page 90, 13. Replace the system board on page 90) by removing nonessential parts. 2. If there is still no boot, replace system board.
Tips and tricks	In essential hardware configuration, mWS G1 and G2 may require discrete GPU to boot. However, mWS G3 can boot with integrated graphics.

Intermittent power-on, shutdown, reboot

Table 7-10 Intermittent power-on, shutdown, reboot

Items	Procedures
Symptoms • Does not always turn on • Intermittently hangs • Intermittently shuts down • Spontaneously reboots	*Possible causes* Electrical short, fluctuating power source, unstable power rails, loose connections, bent pins, stray wires, dust, obvious damage, nearly faulty parts (bulging/leaking capacitor). Potentially will turn into a no power issue soon (No Power on page 93).
	Troubleshooting steps 1. Visually check power ports on both AC adapter and computer sides. 2. Inspect power sources: a. Verify AC adapter working correctly. Use a confirmed working adapter to test. b. Verify that battery is not depleted while system is in Sleep state. Test with a confirmed working battery.
The sections below are intended for authorized service providers/technicians.	
	1. Follow actions in No Power on page 93. a. Be sure that AC adapter has correct DC voltage. b. Verify battery - test with a confirmed working battery. c. Verify that power button is not stuck. d. Verify that power connector is not loose. e. Remedy loose connections and reseat major components (processor, memory, GPU, hard drive/solid-state drive, etc). 2. Perform visual check for loose connections, bent pins, stray wires, dust, nearly faulty parts (bulging/leaking capacitor). 3. Test **essential hardware configuration** (11. Test with minimum configuration on page 89) a. If system boots, reinstall nonessential hardware one component at a time to isolate issue.

Table 7-10 Intermittent power-on, shutdown, reboot (continued)

Items	Procedures
	b. If system does not boot, replace essential hardware with verified working parts, one component at a time. If system still does not boot, replace system board.

AC adapter issues

Table 7-11 AC adapter issues

	Solution
Symptoms • No sign of power • No boot • No rear power light • No front power light • Battery does not charge when AC adapter is connected	*Possible causes* AC adapter and others (i.e., external power source) *Troubleshooting steps* **Quick check** 1. Verify external power source (2. Examine the environment on page 79). 2. Remove all external devices, including docking station. 3. Perform a hard reset for the computer (8. Hard reset on page 87). 4. Disconnect and reassemble the power cord and adapter in case the adapter experienced short circuit, over current, over temperature events. 5. Use a verified working adapter. If the computer operates normally, there is a problem with the original adapter. 6. Verify that the AC adapter works on a verified working computer. If the computer operates normally, there is no problem with the adapter. See HP Smart Adapter warning message on page 110 for further information.
	Verify AC adapter 1. Remove working battery. 2. Verify that AC adapter is compatible with product. Verify that part number is for this computer if possible. 3. Inspect AC adapter and power cord for physical damage, bent middle ID pin. 4. Plug in AC adapter and power the computer without battery. 5. Inspect the power port on computer side for any damage, dust, debris. 6. Check power light (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85). Rear power light indicates that external power to the computer is good. 7. If there is still no rear power light or no boot, replace the AC adapter.
Tips and tricks	The HP Smart AC adapter has a special pin in the middle, called the ID pin, for power rating and throttling purpose. If this pin is broken, the rear power light will be on but the power button and front power lights will blink continuously and the computer will not turn on. Third party AC adapter will not work on the computer. Use the AC adapter that came with the computer for better performance.

Battery not recognized, not charging

Table 7-12 Battery not recognized, not charging

Items	Procedures
Symptoms	*Possible causes*
• No battery status light	Defective AC adapter and/or battery.
• Blinking amber (critically low battery level)	**NOTE:** Before proceeding, verify that the computer can boot to BIOS or Windows with a good AC adapter.
• No boot without AC adapter	
	Troubleshooting steps
	Visual inspections
	1. Inspect battery connectors for any signs of damage.
	2. Verify that battery is installed properly in battery bay without gap or obstructions and latch locks are tight. Reseat battery (for models with removable batteries).
	3. Determine whether battery gets hot (batteries heat up when charging, but not too hot to touch).
	Check battery warranty to see whether the battery is new or its warranty is expired. Battery capacity degrades over time.
	Verify front battery status light
	1. Battery status light is off: battery not recognized.
	2. Battery status light is blinking amber: critically low battery level.
	Reset
	1. Hard reset (8. Hard reset on page 87)
	2. Soft reset (9. Soft reset (Default Settings) on page 88)
	Verify AC adapter
	1. Determine whether the computer needs the AC adapter to boot and operate. Sometimes, intermittently bad AC adapter and loose connection between adapter and computer results in inability to charge battery which causes short run time.
	2. Inspect AC adapter to verify that it is functioning.
	3. Test with a working AC adapter and confirm whether battery is charging.
	4. Be sure that battery is fully charged (AC adapter plugged in at least 2.5 hours).
	Diagnostics: HP tools will report results such as passed, calibrate, weak, replace, no battery and unknown, and suggest corresponding actions.
	Use HP Hardware Diagnostics (UEFI) (6. HP Hardware Diagnostics and Tools on page 81)
	• HP PC Hardware Diagnostics (UEFI) is a good tool to use to isolate and determine faulty battery, especially for quickly discharging (short life) battery.
	Use HP Support Assistant tools in Windows (HP Support Assistant (HPSA) on page 83)
	1. Verify that battery is recognized and charging.
	2. Verify battery condition if battery cycle life is over specs (i.e., long life of 1000-cycle life and 3-year warranty). Battery may have premature capacity loss within its cycle life or warranty.
	3. If issue remains, test with a verified working battery and verify battery status lights and battery conditions.

Table 7-12 Battery not recognized, not charging (continued)

Items	Procedures
	4. If issue remains, replace system board. 5. Verify the new replacement.
Tips and tricks	See the computer user guide for instructions regarding battery maintenance and increasing battery life. Also reference http://support.hp.com/us-en/document/c01297640?jumpid=hpr_r1002_usen_link3.

Battery discharges too fast

Table 7-13 Battery discharges too fast

Items	Procedures
Symptoms Battery has good status light but discharges too fast	*Possible causes* AC adapter and/or battery.
	Troubleshooting steps **Verify AC adapter** Determine whether the computer needs the AC adapter to boot and operate. Sometimes, intermittently bad AC adapter and loose connection between adapter and computer results in inability to charge battery and causes short run time. 1. Inspect AC adapter to verify that it is working. 2. Test with AC adapter alone and with a verified working AC adapter.
	Verify battery: Battery capacity can degrade over time, so check the warranty coverage. Run a battery test to confirm if issue is hardware-related. 1. Review battery power plans in **Control Panel > Power Options** that may consume more energy and discharge battery faster. Resetting default to **Power Saver** option can conserve battery power. 2. Determine whether any graphics processing is running. 3. Verify battery maintenance and operations. Leaving the battery at a high level of charge in a high-temperature environment for extended periods accelerates the loss of capacity. 4. Test and calibrate battery using HP PC Hardware Diagnostics (UEFI). 5. Verify battery life cycle using HP Support Assistant tool. If battery cycle life is over specs (long life battery of 1000-cycle life and 3-year warranty), battery may have capacity loss beyond its lifecycle or warranty. 6. Compare discharge time with a verified working battery (remove AC adapter) using **Hardware Diagnostics (UEFI) > Hard Drive Tests > Extensive Test > Loop until error**.
Tips and tricks	To conserve battery power, turn off Wireless On-Off button and other peripherals/USB devices, applications, processes (in Task Manager) when not in use; also, reduce screen brightness. Follow HP instructions of how to maintain battery and increase battery life. Also reference http://support.hp.com/us-en/document/c01297640?jumpid=hpr_r1002_usen_link3.

Burnt smell

Table 7-14 Burnt smell

Items	Procedures
Symptoms	*Possible causes*
Emits smoke, burnt smell	Defective on-board components.
	Troubleshooting steps
	General visual inspection
	1. Disconnect the computer from power source (AC adapter and battery).
	2. Inspect for visual damage on AC adapter and battery. Test on a known working computer to isolate issue. If issue follows AC adapter or battery, replace it.
	3. Inspect any sign of liquid spill on the computer (back of keyboard).
The sections below are intended for authorized service providers/technicians.	
	Further inspection on components
	1. Inspect further sources internally after disassembling chassis, such as burnt or damaged components.
	2. If the issue persists, replace boards, AC adapter, and battery for safety concern and report issues to HP.

POST

No video (with power)

Table 7-15 No video (with power)

Items	Procedures
Symptoms • No video (black/blank image) but have power • Light activity • No error messages • Fan noise • Hard drive light blinking and hard drive noise	*Possible causes* Failed display Failed critical components (memory, hard drive, system board) Loose connection Recently added hardware **NOTE:** Assume the computer has not previously been set up for multiple displays.
	Troubleshooting steps
	Quick check
	1. Verify that system light activity is OK.
	2. Remove all external devices, including docking station. Recently added hardware and/or applications may cause graphics driver conflict and result in loss of video.
	3. Perform hardware reset (8. Hard reset on page 87) and verify that HP Logo is presented correctly on display screen when pressing F10.
	4. Test with external monitor via VGA port (or DisplayPort, HDMI, etc). Press power button and close the computer lid to force video output to external video. If unsuccessful, contact HP service.

Table 7-15 No video (with power) (continued)

Items	Procedures
	5. If external video is OK, update BIOS, software, and drivers (4. Update BIOS and drivers on page 80) and perform soft reset (9. Soft reset (Default Settings) on page 88) if needed. Go to next step to verify display.
	Verify display • When booting to Windows, determine whether image appears on display screen (via Windows Screen Solutions or Windows logo + P for display switcher). • If there is video on display, disconnect external display device, open the computer lid and restart.
The sections below are intended for authorized service providers/technicians.	
	1. Reseat display cable connection on system board. 2. Reseat display cable connection on display panel side. 3. Examine and reseat major components, such as hard drive, memory. 4. Test with minimum configuration (11. Test with minimum configuration on page 89) by removing hard drive to isolate operating system issues and testing video in F10 Setup. 5. If video is present, restart and retest the computer. 6. If video is present but bad, go to Display on page 110 section. 7. If issue persists (no video), test with external video. 8. If issue persists, test or replace a confirmed working display. 9. If issue persists, replace discrete graphics card. 10. If issue persists, replace system board due to defective video function.
Tips and tricks	Swipe a metal piece (screwdriver) over wireless/mute buttons to act as if closing lid to force video output to external display device. See the “External component identification – Display” section for location of the magnetic sensor.

Blinking lights

Table 7-16 Blinking lights

Items	Procedures
Symptoms	*Possible causes*
Lights blink on keyboard caps lock/num lock keys	Blinking lights on startup usually indicate a problem with basic functionality of a critical component (processor, BIOS, graphics cards, memory, etc.) due to loose connection, defective parts, or recently added parts.
	Troubleshooting steps 1. Check for any blink patterns. Count the number of blinks in a sequence, followed by a pause for a few seconds. 2. See Status, Blinking Lights, and Error Message (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85) for corrective actions.

Table 7-16 Blinking lights (continued)

Items	Procedures
	3. If internal hardware components (memory, hard drive, etc.) have been recently added, a component may not be connected properly. Remove and reseat new components (10. Reseat cables and connections on page 88) one at a time.
Note	Since the display may not be functional, lights are used to indicate an error.

Diagnostics error messages

Table 7-17 Diagnostics error messages

Items	Procedures
Symptoms • Computer has power • POST error message displays (Windows logo has not yet appeared)	*Possible causes* Diagnostic error messages indicate a problem. There may be a problem with the instruction being sent from the BIOS to a hardware component (e.g., keyboard failures), or incompatible hardware. Can usually be resolved by installing updated firmware for the component.
	Troubleshooting steps 1. See 7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85 for corrective actions. An example of a POST error message is shown below.  2. If there is power, you may be able to access BIOS. Reset BIOS to its default condition. (9. Soft reset (Default Settings) on page 88) 3. Restore hardware to its original condition (i.e., bootable solid-state drive instead of hard drive). 4. Reseat suspected components and verify connection. 5. Test suspected components using HP PC Hardware Diagnostics (UEFI) tool.
Note	An Error Message means the system has finished BIOS hardware validation and is ready to launch the **Startup Menu**. To access the **Startup Menu** for further options, press the Esc key while restarting the computer.

BIOS password

Table 7-18 BIOS password

Items	Procedures
Symptoms	*Possible causes*
Some sections are unavailable (grayed out)	BIOS administration password is required.
	Troubleshooting steps 1. Review F10 BIOS Setup Overview to determine which features must be enabled. 2. Your BIOS settings may be managed by a BIOS administrator password setup. 3. If you lost or forgot user password, contact your IT personnel. 4. If you lost or forgot administrator password, contact HP service to reset the password. This process requires a unique UUID.
Reference	**HP F10 Setup Overview** http://h10032.www1.hp.com/ctg/Manual/c04460979 http://h10032.www1.hp.com/ctg/Manual/c04685655 2015 Business PC models – see the BIOS F10 Setup technical white paper at http://support.hp.com, enter your computer model, and then go to **Manuals > White papers > HP PC BIOS F10 Setup Guide**.

Performance (OS)

NOTE: Most software problems occur as a result of the following:

- The application was not installed or configured correctly.
- There is insufficient memory available to run the application.
- There is a conflict between applications.

Make sure that all the needed device drivers are installed.

If an operating system other than the factory operating system is installed, check whether the operating system is supported and the application is certified for the version of the operating system.

HP ships and supports Windows 7 with BIOS Legacy boot mode and Windows 8, 10 with BIOS UEFI boot mode. Therefore, HP recommends that you switch BIOS boot mode from Legacy to UEFI Native for clean Windows 8, 10 installations, or to UEFI Hybrid (if available) for upgrading the option from Windows 7 to Windows 8, 10. UEFI Windows 8, 10 avoids many unexpected behaviors (i.e., blue screen error, graphics/video issues) in the BIOS Legacy setting.

Intermittent shutdown

Table 7-19 Intermittent shutdown

Items	Procedures
Symptoms • Shutdown during startup • Shutdown during operation	*Possible causes* It is often difficult to troubleshoot an intermittent issue. Possible causes include the following: Power-related issue: defective or insufficient power sources, poor connection. OS Custom Setting: Energy Saver (Power Management). Thermal-related issue: thermal sensors reach limits. Hardware related issue: voltage, out-of-range current; electrical short.
	Troubleshooting steps 1. Update BIOS and drivers. (4. Update BIOS and drivers on page 80) 2. Perform hard reset (8. Hard reset on page 87) 3. Perform soft reset (9. Soft reset (Default Settings) on page 88)
	Power related issue 1. Verify functionality of AC adapter alone. If no functionality, test with a verified working adapter. 2. Verify battery alone. Verify that battery is not depleted. Test battery using HP PC Hardware Diagnostics (UEFI) tool. 3. Verify connection of power button, power cable.
	OS custom settings 1. Advise users to reset power options and close all applications that are not in use, including applications in the background. 2. Test with a confirmed working operating system to isolate custom settings by users or any conflicting applications that cause shutdown.
The sections below are intended for authorized service providers/technicians.	
	Thermal-related issue 1. Verify thermal condition: a. Test fan using HP PC Hardware Diagnostics (UEFI) tool (6. HP Hardware Diagnostics and Tools on page 81) b. Check fan and connection. Reseat fan cable. c. Be sure that no obstructions or dust are in heat sink fan, fin, or vent. d. Test with a verified working fan. e. Remove old thermal compound and pads and replace with new compound and pads. 2. Verify thermal solution: ○ Use Thermal Monitor tool (available only to authorized service providers/technicians) to perform stress test (processor and GPU) (6. HP Hardware Diagnostics and Tools on page 81) and verify that thermal sensors are within limits after thermal condition is serviced.
	Hardware related issue

Table 7-19 Intermittent shutdown (continued)

Items	Procedures
	1. Check for any signs of loose connections, bent pins, stray wires, dust, nearly faulty parts (bulging/leaking capacitor). 2. Verify that lights are solid. 3. If shutdown is reproducible, test essential hardware configuration: a. If no issue with hardware configuration, reinstall one non essential component at a time to determine faulty hardware. b. If issue persists, replace essential hardware with a confirmed working part, one at a time. If no boot, replace system board.
Tips and tricks	Intermittent issue is difficult to reproduce and troubleshoot. It is important to record details on shutdown frequencies, system configuration (3D video application) and operating conditions.

Blue screen

Table 7-20 Blue screen

Items	Procedures
Symptoms • Have power, light activity, fan spinning • HP Logo displays briefly • Fails to boot into Windows operating system, displays blue screen, and then crashes, restarts, or stops responding	*Possible causes* Recent changes: conflict of instructions from multiple programs or just added hardware. Incompatible hardware and driver. Poor connection (hard drive, memory). Hardware malfunctioning due to overheating (GPU, processor). Defective hardware (memory, hard drive).
Important Notes & Resources	*Troubleshooting steps* There are many different ways to troubleshoot a blue screen error. Therefore, you need to identify working configuration (Windows 7/8/10) and specific symptoms of the failure in order to narrow down the issue. Refer to Blue screen (BSOD) error on page 127.
	**Recommended resources** Microsoft knowledge base: http://windows.microsoft.com/en-us/windows-8/resolve-windows-blue-screen-errors For more information search for HP Troubleshooting Error Messages on a blue screen at http://www.hp.com.

Overview of General Troubleshooting Steps for a blue screen error

1. Note the blue screen error message and what activity was performed at the time.
2. Perform a hard reset (8. Hard reset on page 87) after disconnecting all external peripherals.

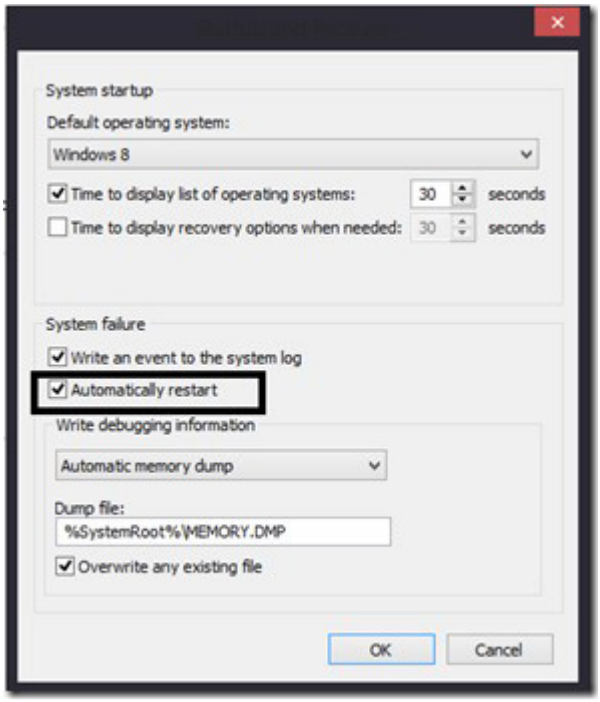
3. Reset BIOS to default (9. Soft reset (Default Settings) on page 88) to prevent booting to another device.
4. Run HP Hardware Diagnostics (6. HP Hardware Diagnostics and Tools on page 81) to isolate major faulty hardware issues.
    - HP PC Hardware Diagnostics (UEFI) tool to test hard drive, memory and system.
    - Thermal Monitor (available only to authorized service providers/technicians) tool to monitor temperature limits of processor and GPU. See “HP Thermal Monitor” in 6. HP Hardware Diagnostics and Tools on page 81.
5. Remove or undo recently added hardware (5. Remove or uninstall recently added hardware, software on page 80). For example, incompatible memory or new solid-state drive storage.
6. Reseat cables and connections (10. Reseat cables and connections on page 88). Pay attention to proper installation of memory and hard drive.
7. Verify that a minimum of at least 100 MB of free space is available on your Windows partition.
8. If you can start Windows:
    a. Update BIOS and drivers (4. Update BIOS and drivers on page 80) to support updates for incompatibilities.
    b. Get all the latest updates, using Windows Update.
    c. Undo recent changes:
        – Startup using Last Known Good Configuration.
        – Use System Restore.
        – Roll back device driver in Device Manager.
    d. Check for specific Error Message. See Common Blue Screen Error Messages on page 138.
    e. Boot to safe mode (11. Test with minimum configuration on page 89) to troubleshoot issues.
9. If you cannot start Windows:
    a. Boot to safe mode. (11. Test with minimum configuration on page 89)
    b. Use Startup Repair to fix Windows startup files.
    c. Undo recent changes using System Restore to revert to a previous “working” state.
    d. Check for specific STOP error by analyzing Crash Dump (retrieved via a bootable USB). See Use Windows Debugging Tool on page 139.
    e. Restore computer using System Recovery or image backup to factory settings.
10. Lastly, test with essential hardware configuration (11. Test with minimum configuration on page 89) along with a verified working operating system (i.e., USB Windows-To-Go), if available, to isolate the software issue.

Tips & tricks

In some cases, the computer may reboot automatically before you have time to read the blue screen.

To identify the error message itself, disable the automatic restart using one of the following methods:

Right-click on **My Computer**, and then select **Properties** > **Advanced**. Under **Startup and Recovery**, select **Settings**. Clear the **Automatically Restart** check box.



Windows Advanced Boot Option

Windows 7:

1. Press F8 to open the Windows Advanced Boot Option screen.
2. Select **Disable automatic restart on system failure** to view error messages.

Windows 8:

1. Press F11 (System Recovery) to open the Windows Advanced Boot Option screen.
2. Select **Startup Settings** to view error messages.

Freeze at Windows Logo (hang/lockup)

Table 7-21 Freeze at Windows Logo (hang/lockup)

Items	Procedures
Symptoms • Has power, light activity, fan spinning • HP Logo displays briefly • Attempt to boot to operating system and freeze/hang at Windows logo • No response to pressing num lock or caps lock key	*Possible causes* Conflict of instructions from multiple programs or drivers; installing a new hardware or program that is not compatible (may also cause a blue screen error—see blue screen issue).

Table 7-21 Freeze at Windows Logo (hang/lockup) (continued)

Items	Procedures
	
	Troubleshooting steps Follow suggested steps below one at a time to verify normal boot process: 1. Disconnect all external peripherals, and perform a hard reset (8. Hard reset on page 87). 2. Perform soft reset (9. Soft reset (Default Settings) on page 88). 3. Update BIOS and drivers (4. Update BIOS and drivers on page 80). a. Roll back to previous version may be necessary. b. Go to safe mode to install drivers. 4. Run Hardware Diagnostics (6. HP Hardware Diagnostics and Tools on page 81) to isolate hardware issue. 5. Undo recent changes in Windows (5. Remove or uninstall recently added hardware, software on page 80). 6. Reseat cables and connections (10. Reseat cables and connections on page 88). 7. Start Windows in safe mode (11. Test with minimum configuration on page 89). 8. Use Startup Repair Windows to fix Windows damaged files. 9. Test with essential hardware configuration (11. Test with minimum configuration on page 89) along with a verified working operating system (i.e., USB Windows-To-Go) if available to isolate the software issue.
Tips and tricks	For more information, see http://support.hp.com/us-en/document/c03671001.

Electromagnetic Interference (EMI)

Table 7-22 Electromagnetic Interference (EMI)

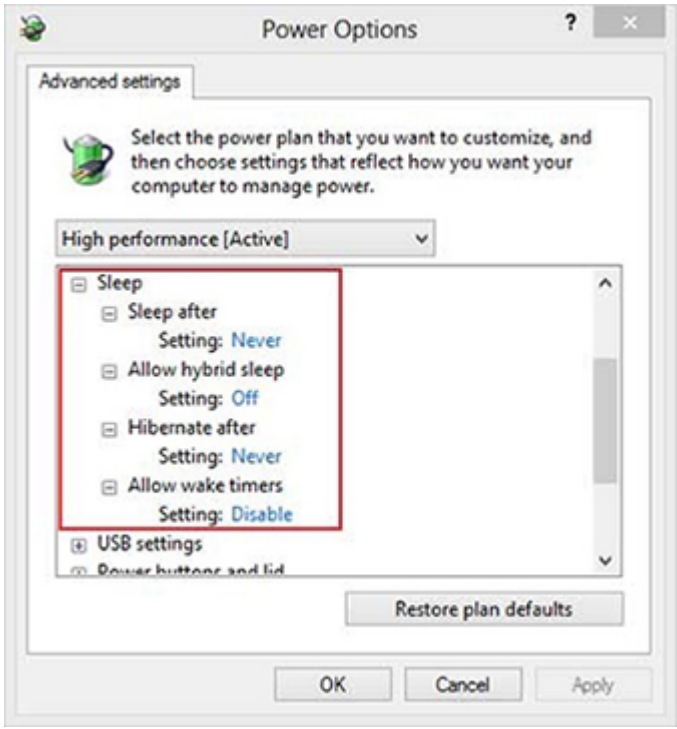
Items	Procedures
Symptoms System locks up, freezes in certain physical area or location	*Possible causes* Electromagnetic interference (EMI). *Troubleshooting steps* 1. See (2. Examine the environment on page 79). Pay attention to external power source, high-frequency signals such as cell phones, microwave ovens. 2. Move the computer to different locations nearby to determine where it fails and where it does not fail. 3. Test with a verified working computer in original factory configuration.

Table 7-22 Electromagnetic Interference (EMI) (continued)

Items	Procedures
	4. Consult with support.

No wake up

Table 7-23 No wake up

Items	Procedures
Symptoms When resuming from a power management state the computer may display: • Blank screen • Some light activity	*Possible causes* Power-saving mode; multiple-display setting. *Troubleshooting steps* 1. Verify that front power light (7. Status lights, blinking light codes, troubleshooting lights, and POST error messages on page 85) is blinking (indicating Sleep state). Press power button to exit Sleep. 2. Reset BIOS to default (associated with **OS Power Management** in **Power Menu**) (4. Update BIOS and drivers on page 80) 3. Verify power management settings in Windows **Power Options**. Disable Sleep options if the issue is resolved.  4. Screen saver is set. Press any key or touch TouchPad to resume. 5. Verify that Display Choice is set to external video only. Toggle screen control key combination Fn + F4 or Windows logo +P.
Tips and tricks	If you are using a docking station, set your notebook display as a primary display. When the computer is undocked, you may think it is in a power-saving state, but the screen image may actually display on an external display device in the docking configuration.

Unresponsive

Table 7-24 Unresponsive

Items	Procedures
Symptom	*Possible causes*
Unresponsive	Program in use has stopped responding to commands.
	Troubleshooting steps
	1. If possible, use the Windows Task Manager to isolate and terminate the offending process.
	2. Attempt the normal Windows shutdown procedure.
	3. Restart the computer using the power button.

Slow performance

Table 7-25 Slow performance

Items	Procedures
Symptom	*Possible causes*
Slow performance when performing small tasks, or even in idle mode	Processor is hot or hard drive is full.
	Troubleshooting steps
	Processor is hot
	1. Verify that airflow to the computer is not blocked.
	2. Verify that chassis fans are connected and working properly. Some fans operate only when needed.
	3. Verify that the processor heat sink is installed properly.
	Hard drive is full
	1. Transfer data from the hard drive to create more space on the hard drive. Microsoft recommends at least 200 MB to sync system files.
	2. Perform disk defragmentation to consolidate fragmented data on the hard drive so it will work more efficiently.
	Also see Slow performance on page 127.
Tips and tricks	See Routine Maintenance for Performance Improvement on page 138).
	See http://windows.microsoft.com/en-us/windows-8/free-up-disk-space.
	See http://windows.microsoft.com/en-us/windows/optimize-windows-better-performance#optimize-windows-better-performance=windows-vista.

HP Smart Adapter warning message

Table 7-26 HP Smart Adapter warning message

Items	Procedures
Symptom	*Possible causes*
Warning message displayed in Window	Less powerful AC adapter, BIOS out of date.
	
	Troubleshooting steps 1. Update BIOS that may contain a table that assigns an appropriate adapter for a certain configuration. 2. Update the latest **HP Hotkey Support** software from Drivers website. 3. Verify sufficient power source (where adapter is connected). 4. Use appropriate AC adapter (often supplied with system) for optimum system performance. 5. Test with a verified working AC adapter. 6. Test the adapter on a verified working computer. 7. Contact HP for configuration details.
Note	**HP Smart AC adapter warning message:** informs you that as power demands increase, the notebook may not perform at full capacity, which may result in longer battery-charging time. In cases of extreme power demands, the system may also throttle back the processor, or with systems that have a discrete video sub-system, a video balance mode may occur to further balance the power needs of the system. System processor functions always have priority over battery charging, so charging delays will occur first.

Display

Display anomalies

The display panel is a field replaceable unit (FRU) and must be replaced by only authorized technicians. However, HP highly recommends that users and technicians observe specific symptom vs. generic symptoms and utilize the HP PC Hardware Diagnostics (UEFI) tool before any replacement.

Symptom

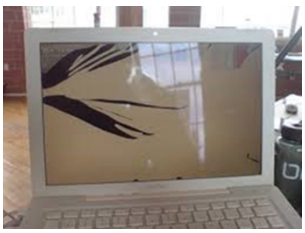
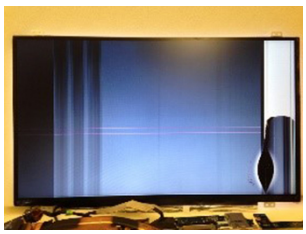
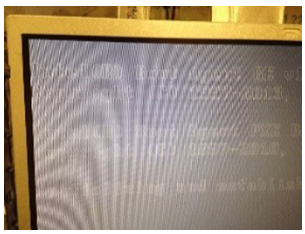
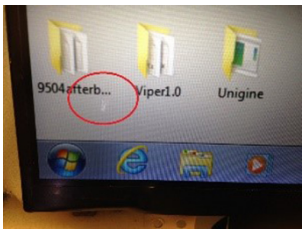
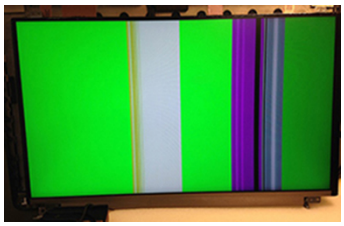
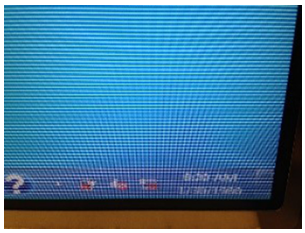
Common display issues with symptoms:

- Blank/black video
- Incorrect/missing color/distorted image
- Flickering image
- Vertical lines (due to LDVS, decreased signal integrity, and data loss)
- Dead pixel (due to display liquid, internal transistor, etc.)
- Horizontal lines (due to video memory)
- Distorted when hot (due to thermal issue)
- Cracked screen/image (physical damage)
- Light leakage/bleeding

  Contact support for assistance.
- Humming noise (due to frequency settings)

  Contact support for assistance.

Table 7-27 Display anomalies

Display anomalies		
		
Cracked screen	Cracked image	Blurred image
		
Dead pixel	Vertical lines	Horizontal lines

Quick check

- Visually examine the display for cracked screen, liquid crystal leak, dirty spots on glass, etc.
- Reset and update BIOS and docking firmware.
- Update operating system (OS), graphics/video drivers (Intel/AMD/NVidia, etc).

For custom images, HP highly recommends upgrading or installing Windows in UEFI mode (or Legacy disabled) to fully support hybrid graphics and avoid unexpected behaviors (i.e., blue screen error, graphics/video issues) in the BIOS Legacy setting.

- Configure Windows settings (Power options, Screen brightness, Personalization, Screen resolution, etc.).
- Test with a verified working external display.
- Boot to Windows in safe mode.
- Test with a verified working operating system (i.e., shipping image).

HP PC Hardware Diagnostics (UEFI) for video test

Use this tool to quickly determine if the display issue is related to a real hardware issue.

To start HP PC Hardware Diagnostics (UEFI) (6. HP Hardware Diagnostics and Tools on page 81), when the computer is at boot, press the F2 key, select **Component Tests**, and then select **Video**.

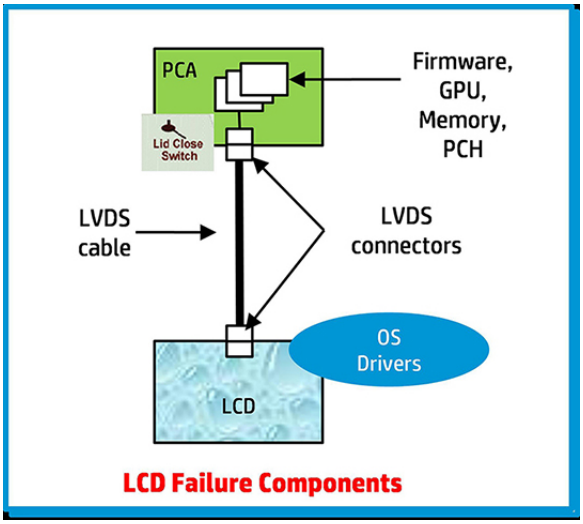
There are three options:

- **Video Memory Check**: to test video memory
- **Palette Check**: to test the three video color components (red, green, blue)
- **Dead Pixel Check:** to check dead pixels in eight different colors (Dead Pixel Check is available with the “HP PC Diagnostics 3-in-1 USB Key” tool)

Review the video troubleshooting in the Display section below for specific issues and possible solutions. For additional information about display problems, refer to documentation provided by the product manufacturer.

Display assembly diagram

The display assembly diagram shows basic video components: system board, graphics cards, display cables, display connectors, operating system (OS), graphics driver, and LCD display panel. Any component or a combination of these components can contribute to a video issue.



NOTE: The lid close switch is a Hall-effect sensor located in the top cover. When the display is closed, the sensor acts like a switch is closed. A notebook can force a video output to an external monitor, or go to hibernation or standby mode through power management. If the display screen does not light up when the display is open, the lid close switch (Hall-effect sensor) could be faulty.

Dead pixel

Display panel may show one or more pixels that are not properly lit when displaying a single color over the screen area. Use HP PC Hardware Diagnostics (UEFI) tool to determine those defective pixels. There is no solution for dead pixels. Refer to Display Issue: Pixel Anomalies on page 144 for the HP dead pixel policy.

No video (internal)

Table 7-28 No video (internal)

Items	Procedures
Symptoms	*Possible causes*
No internal video with certain programs (i.e., video-intensive games)	Display resolution, brightness, faulty lid switch, running a program requiring a higher resolution than the display screen can support. Faulty lid switch may put the system into Sleep or Hibernation mode.
	Troubleshooting steps
	Use an external monitor with higher resolution. Test with external monitor using HDMI or HP port. Press the power button and close the computer lid to force video output to external video. If there is still no video, contact support.
References	See section No video (with power) on page 99 for display information.

No video (external)

Table 7-29 No video (external)

Items	Procedures
Symptom	*Possible causes*
No image on external monitor	External monitor, resolution, display configuration, drivers.
	Troubleshooting steps 1. Be sure external monitor is compatible with the computer. 2. Be sure that external monitor is turned on. 3. Press any key to get out power saving mode. 4. Adjust the brightness of the monitor. 5. Test with a verified working monitor. 6. Test the monitor via internal ports (VGA, DP ports). 7. Install latest video driver. 8. Reset the screen resolution as described in the documentation. 9. Configure display choice, and then force output to external video by closing the notebook lid or pressing Fn + F4 to switch screen output.

DisplayPort/VGA

See No video (external) on page 114.

HDMI

Table 7-30 HDMI

Items	Procedures
Symptoms • Display issue • Sound issue	*Possible causes* Cable, connection, settings.
	Troubleshooting steps **Quick Check** 1. Verify HDMI device input source is set correctly (i.e., HDMI1). 2. Be sure you are using the correct HDMI cable. 3. Check connection and reconnect the HDMI cable. 4. Verify if sound output is configured correctly in **Control Panel > Sound Manager**.
	1. Perform hard reset (4. Update BIOS and drivers on page 80). 2. Update BIOS and drivers (4. Update BIOS and drivers on page 80) when sound is heard but no video on HDTV.
References	http://support.hp.com/us-en/document/c01186408

No or bad external video via docking

Table 7-31 No or bad external video via docking

Items	Procedures
Symptoms No or bad image on external monitor via ports of docking station (VGA, DP, TB, display port, etc.)	*Possible causes* Rooted from system board, software/drivers, dock connectors, docking station hardware/ firmware, dock video ports (DP, VGA, etc).
	Troubleshooting steps 1. Be sure that external monitor is powered on. 2. Be sure that external monitor is compatible with the computer. 3. If applicable, plug the dock in different Type-C ports. For more information, see the technical white paper titled "HP ZBook 65/150/200 W Thunderbolt 3 Dock User Guide." Go to http://support.hp.com/, enter your model number, and then click **Manuals > Technical white papers**. 4. If the screen image is distorted, try a DP-to-VGA adapter. Connect the adapter to each DisplayPort and VGA port of the dock. 5. Test the monitor via internal ports (VGA, DP, HDMI, etc.). 6. Verify that dock connectors of the notebook and the dock are clean, without dust, debris (e.g., using air duster). 7. Ideally, use a verified working operating system/system connected to the dock to isolate the issue of the current operating system. 8. Ideally, use a verified working docking station to isolate the faulty dock. 9. Update latest dock firmware. Be sure to follow the installation instructions carefully. You may want to try a DP-to-VGA adapter if you have a distorted screen image. Connect the adapter to each DisplayPort of the dock. If you still cannot update the dock, attempt to update it on a confirmed working notebook before having the dock replaced.
Note	See the technical white paper titled "Multiple displays on HP ZBook Mobile Workstations" from HP platform support website. Go to http://support.hp.com/, enter your model number, and then click **Manuals > Technical white papers**.

Incorrect or missing color/distorted image

Table 7-32 Incorrect or missing color/distorted image

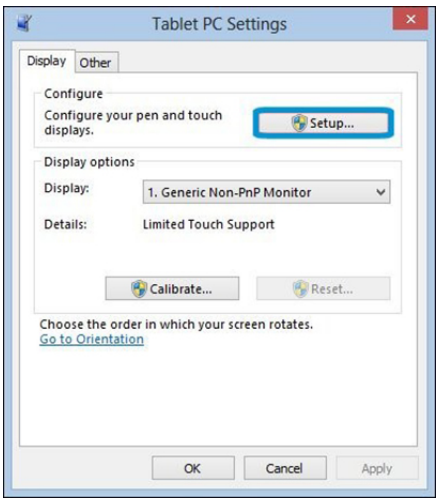
Items	Procedures
Symptoms System works normally but the display shows: • Missing or strange color • Image distortion	*Possible causes* Loose connection, display cable, display, graphics card.
	Troubleshooting steps **Verify with external monitor (i.e., VGA)** 1. Use combination Fn + F4 to enable output to external monitor. 2. Close the lid.

Table 7-32 Incorrect or missing color/distorted image (continued)

Items	Procedures
	If the external monitor also shows incorrect color, it is graphics card issue. Test with a verified working graphics card.
	Verify display cable and cable connection–Display disassembly is required. Be sure that external display cables are not pinched or damaged. Be sure that external display cables have good connection at both ends (system board and display panel). • If moving cables affects the image, it is display cable. Test with a confirmed working cable. • If moving cables does not affect the image, is display issue. Test with a confirmed working display

Touch screen

Table 7-33 Touch screen

Items	Procedures
Symptoms Unresponsive Inaccurate	*Possible causes* Dirt and smudge, driver, touch display configuration, power management. *Troubleshooting steps* **Quick check** Turn off the computer, spray glass cleaner onto a soft, damp cloth, and gently wipe the screen to remove dirt and smudge. **NOTE:** Do not spray cleaner directly onto the screen.
Configure the touch display in **Control Panel > Tablet PC Settings** 	1. Restart the computer. 2. Verify touch screen and graphics drivers. 3. Configure the touch display to identify the screen as a touch screen as shown in the image at left. 4. Calibrate the screen and reset if touch functionality is still not working correctly. 5. Perform diagnostic test in HP Hardware Diagnostics under **Component Tests > Touch Screen**. If the diagnostics tests pass but the touch screen still does not respond, continue following the steps. 6. Adjust the power management settings for your touch screen. If the touch screen stops working after waking from sleep, adjust the power management settings so that the touch screen device stays active while the computer is in sleep mode. 7. Perform Microsoft System Restore and restore to a time when the system was working. 8. Perform HP System Recovery if none of the above actions resolves the issue.
References	https://support.hp.com/us-en/document/c03488148

I/O devices

NOTE:

- Make sure external devices are supported and compliant (i.e., USB Type C, Thunderbolt 3, PCI Express, etc).
- If you have problems with external devices not provided by HP, contact device manufacturers for compatibility and latest drivers prior to troubleshooting (i.e., USB devices, Thunderbolt devices, PCI Express Card reader, VGA/Display/HDMI monitors, Speakers, etc).
- Be sure I/O devices are properly inserted into the I/O ports, and then be sure the I/O devices are recognized by Windows Device Manager.

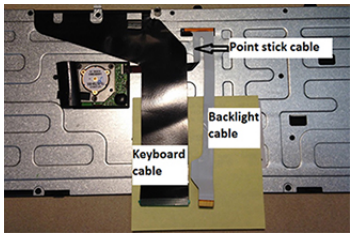
Keyboard

Table 7-34 Keyboard

Items	Procedures
Symptoms	*Possible causes*
Keystrokes not recognized Characters not matched	Dust trapped under keycap, loose keycap, loose keyboard connection, defective keyboard.
	Troubleshooting steps 1. Inspect the keyboard for any signs of dust, liquid, or debris trapped under sticky keys that might prevent keystroke recognition. 2. Check for incomplete connection between keyboard and system board by verifying that caps lock or num lock light turns on when key is pressed. 3. Verify whether the keyboard is recognized in Windows Device Manager and verify whether the keyboard driver is installed properly. 4. Test with a working external keyboard (i.e., USB keyboard). Also test in Windows for special keys (Caps Lock, Shift, Ctrl, Fn, Windows, Alt) if necessary. 5. Test with HP PC Hardware Diagnostics (UEFI) to isolate a hardware issue from a software issue. 6. Verify that BIOS is up to date. If so, resetting BIOS to default may help. 7. Test with verified working operating system or restore operating system to be sure that the issue is not caused by different language settings, sticky keys feature, etc. 8. Verify that keyboard flex cables are fully inserted and in good condition.
The sections below are intended for authorized service providers/technicians.	
	1. Verify if keyboard flex cable is in good condition (no delamination or torn cable end, no missing or cracked tracks, pads). 2. Verify keyboard flex cable ends are fully inserted and aligned with connectors on system board, and those connector tabs are properly closed. Reseat cables. 3. Replace new internal keyboard and retest.
Tips and tricks	A key only works when pressed with force. Inspect and remove debris trapped under keycap.

Keyboard pointing stick

Table 7-35 Keyboard pointing stick

Items	Procedures
Symptom	*Possible causes*
Point stick not working properly	Dust trapped under point stick, loose point stick cap.
	Troubleshooting steps 1. Inspect any signs of dust, liquid spill that prevent point stick from working. 2. Check whether point stick cap is loose and reseat it if necessary.
The sections below are intended for authorized service providers/technicians.	
 Example of back of keyboard, including keyboard, point stick, and backlight cables.	1. Verify whether keyboard flex cables are in good condition (no delamination or torn cable end, no missing or cracked tracks, pads). 2. Verify keyboard flex cable ends are fully inserted and aligned with connectors on system board and back of keyboard and that connector tabs are properly closed. 3. Reseat point stick cables.

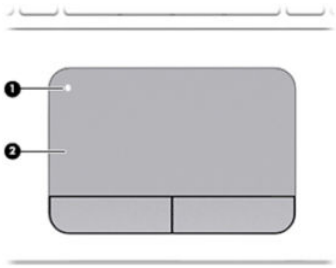
Keyboard backlight

Table 7-36 Keyboard backlight

Items	Procedures
Symptom	*Possible causes*
Backlight function not working properly	Backlight disabled, loose connection.
	Troubleshooting steps **NOTE:** Not all notebook computers have backlit keyboards. A keyboard function key lets you turn the light on and off. Verify if backlit feature is not disabled by pressing a combination of Fn + Backlit key.
The sections below are intended for authorized service providers/technicians.	
	1. Verify if backlight flex cables are in good condition (no delamination or torn cable end, no missing or cracked tracks, pads). 2. Verify backlight flex cable ends are fully inserted and aligned with connectors on system board and that connector tabs are properly closed. 3. Reseat backlight cable.

TouchPad

Table 7-37 TouchPad

Items	Procedures
Symptoms	*Possible causes*
Not working properly	On/Off enabled, driver, settings.
(1) – TouchPad on/off button **(2)** – TouchPad 	*Troubleshooting steps* 1. Ensure TouchPad On/Off light is not amber (disabled). Double touch to enable. 2. Verify if TouchPad device is listed in **Device Manager > Mice and other pointing devices**. 3. Install the latest TouchPad driver. 4. Adjust TouchPad settings (**Control Panel > Mouse**). 5. Test TouchPad controller using the HP PC Hardware Diagnostics (UEFI) tool (F2 > **Component Tests > Mouse Test > Pointer Test & Drag and Drop Test**).
The sections below are intended for authorized service providers/technicians.	
	1. Check the TouchPad cable for damage or a loose connection, and then reseat the TouchPad cable. 2. If issue persists, replace the TouchPad and verify the change.

Network Connectivity Ethernet (RJ-45 jack)

Table 7-38 RJ-45 ethernet jack

Items	Procedures
Symptoms • Unable to find networks (yellow bang) • Connection dropouts • Slow performance	*Possible causes* Network source, cable, connection, RJ-45 port, driver, settings.
	Troubleshooting steps **Quick Check:** verify the network status lights that supposed to flash when there is network activity.
HP Support Assistant tool - No network detected in HPSA	1. Turn off the computer's wireless feature (press wireless button). 2. Verify that networking source with recommended distance to the base is less than 300 feet. 3. Examine the Ethernet cable for damage. Test with a verified working cable. 4. Test with different networks and jacks and check with IT for hardware compatibility settings. 5. Connect a verified working RJ-45 cable directly to the computer to isolate other related issues (e.g., router, switch, docking station). 6. Verify Ethernet port lights (RJ-45): – Green (left): network is connected.

Table 7-38 RJ-45 ethernet jack (continued)

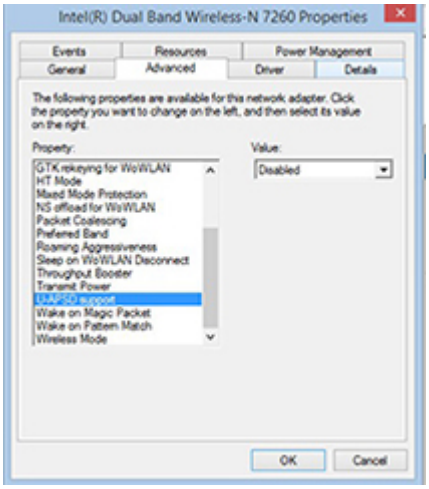
Items	Procedures
	– Amber (right): network is showing activity. 7. Test with HP Support Assistant in Windows. 8. Diagnose with HP PC Hardware Diagnostics (UEFI) to isolate a hardware issue from a software issue. 9. Examine Ethernet ports on the computer, docking station, and wall for damage, dust, obstructions. 10. **Update drivers:** Verify that Ethernet module is displayed in Device Manager and be sure that device driver is up to date. If updating drivers does not help, try rolling back to previous drivers. 11. **Reset BIOS to Default:** If other devices can connect to network, but computer cannot connect, a BIOS setting might be the cause of the problem. Restore BIOS to default. 12. Test with verified working operating system or perform operating system recovery to verify that the issue is not caused by customized settings. 13. Replace system board and verify that the issue is fixed.

Network connectivity wireless (WLAN)

Table 7-39 WLAN

Items	Procedures
Symptoms • Unable to find networks (yellow bang) • Connection dropouts • Slow performance	*Possible causes* Network source, cable, connection, wireless module, driver, settings.
HP Support Assistant tool - No network detected in HPSA  Wireless Adapter Properties - U-APSD support	*Troubleshooting steps* 1. Turn off the computer's wired network (remove RJ-45 cable). 2. Examine environment for interference, such as cell phone or microwave, that may emit high frequencies (above 1 GHz). 3. Verify wireless source by moving computer closer to the wireless base/ router. 4. Test with different wireless networks and check with your IT department for hardware compatibility, settings. 5. Verify that the wireless light is on. If the light is amber, press the wireless button to enable the wireless device. 6. Test with HP Support Assistant in Windows. 7. Diagnose with HP PC Hardware Diagnostics (UEFI) to isolate a hardware issue from a software issue. 8. **Update drivers:** Verify that wireless module is displayed in Device Manager and be sure that wireless drivers are up to date using www.hp.com or HP Support Assistant. If updating drivers does not help, try rolling back to previous drivers.

Table 7-39 WLAN (continued)

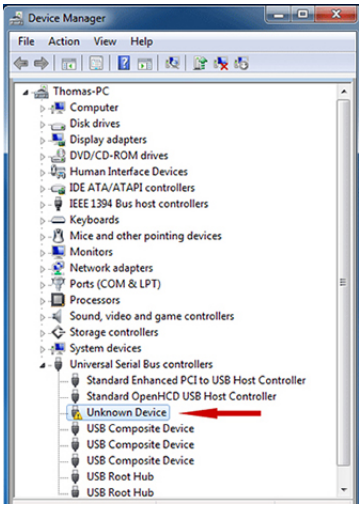
Items	Procedures
	9. **Reset BIOS to Default:** If other devices can connect to your wireless network, but your computer cannot connect, a BIOS setting might be the cause of the problem. Restore BIOS to default. 10. Configure power management advanced settings as necessary. In the example to the left, **U-APSD support** (Unscheduled Automatic Power Save Delivery) is changed to **Disabled** to resolve an incompatible access point. If disabling U-APSD improves the throughput issue, check with the access point provider for updated firmware that resolves the issue. 11. Test with verified working operating system or perform operating system recovery to verify that the issue is not caused by customized settings. 12. Test with a verified working wireless module.
The sections below are intended for authorized service providers/technicians.	
	1. Verify that the wireless module and its antenna cables are fully inserted and in good condition (see WLAN module removal and replacement section). Reseat wireless module and antenna connection. 2. Verify module antenna cable connection are not loose. 3. Verify antenna cables are properly connected to the MAIN and AUX terminals (see WLAN module removal and replacement section).

USB

Table 7-40 USB

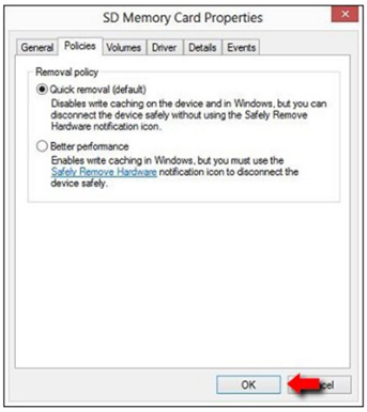
Items	Procedures
Symptoms • USB devices are not recognized • USB devices are not charging	*Possible causes* USB devices do not have the latest software drivers, port insufficient power, or not compliant. **NOTE:** USB Type-C uses a different connector entirely
Examples of USB device Not Recognized 	*Troubleshooting steps* 1. Unplug USB device and/or restart the computer (wait for 2-5 minutes) to reset USB port/hub in case of power surge. 2. Soft Reset (9. Soft reset (Default Settings) on page 88) and verify if USB device is recognized. 3. Verify if USB device is recognized in **Device Manager > Universal Serial Bus Controller**, or USB is recognized without Yellow bang. 4. Verify if the latest USB driver or/and USB chipset driver are installed. USB driver could be removed and reinstalled. 5. Make sure USB device is supported, for example, USB 3.0 device requires more power drawn (0.9A) from USB port than USB 2.0 device (0.5A). As a result, identify USB charging port to be used for charging a USB device, or an external AC power adapter may be required for an external USB storage to work properly.

Table 7-40 USB (continued)

Items	Procedures
	6. Test with verified working USB devices (keyboard, mouse, USB key) to make sure USB ports are functional. 7. Test USB device on a verified working computer to make sure USB device is not malfunctioning.

Smart card reader

Table 7-41 Smart card reader

Items	Procedures
Symptoms	*Possible causes*
• Not recognized	Physical damage, incorrect insertion, dirt, driver, malfunctioning card reader.
• Unable to write	**NOTE:** Some cards have a read/write security switch on the card. Make sure that switch is set to “write enabled” before attempting to write data to it.
Card Reader Removal Policy 	*Troubleshooting steps* 1. Verify card reader removal policy. 2. Make sure there is no physical damage to the card. 3. Inspect the ends of the memory cards for dirt or material closing a hole or spoiling a metal contact. Clean the contacts with a lint-free cloth and small amounts of isopropyl alcohol. Replace the memory card if necessary. 4. Reinstall and update the drivers for the card reader. 5. Make sure the smart card reader is compliant with ISO 7816 Class A, B, and C. 6. Reinsert the card reader with correct face as described in its documentation. 7. Check reader function with a verified working card.
	CAUTION: If the card reader has an in-use indicator light, do not insert or remove memory cards while the light is flashing. Doing so may cause loss of data on the card or may permanently damage the card reader.

Speaker and headphone audio issues

Table 7-42 Speaker and headphone audio issues

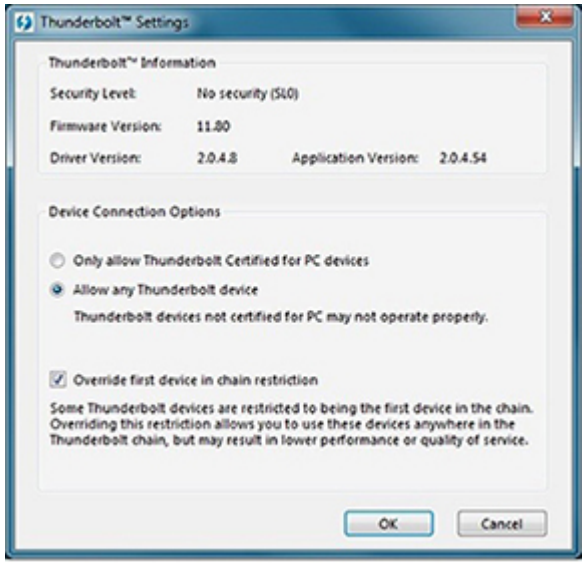
Items	Procedures
Symptoms • No sound from external or internal speakers • Distorted sound, too soft, too loud, intermittent	*Possible causes* Volume turned down, sound card not recognized, malfunctioning hardware, electronic interference.
	Troubleshooting steps 1. Remove any device connected to the Audio jack to enable the internal speaker. 2. Close all open programs. 3. Adjust volume by pressing Fn + F6/F7. Be sure that volume button light is not amber (mute). - or - Adjust Windows volume control by clicking the speaker icon on the Windows taskbar. Be sure that the sound is not muted. 4. Verify that sound card is detected in Windows Device Manager. 5. Reinstall the **latest audio driver**. 6. Test audio device using HP PC Hardware Diagnostics (UEFI) tool (F2 > **Component Tests > Audio**). 7. Test with a verified working operating system. If issue is resolved, restore full operating system. 8. Test with verified working external speakers or headset. 9. Reseat internal speaker connections. 10. Test with verified working internal speakers. 11. Replace internal speakers.
No sound from headphones	1. Adjust volume by pressing Fn + F6/F7. Be sure that volume button light is not amber (mute). Or adjust Windows volume control by clicking the speaker icon on the Windows taskbar. Be sure that the sound it not muted. 2. Check headphone cable connection. 3. Test with a verified working audio board. 4. Replace audio board and verify the change.
No sound from external speakers	1. Verify that external speakers are turned on. 2. Disconnect headphones from headphone jack. 3. Adjust volume by pressing Fn + F6/F7. Be sure that volume button light is not amber (mute). - or - Adjust Windows volume control by clicking the speaker icon on the Windows taskbar. Be sure that the sound is not muted. 4. Check for possible interference devices nearby that may impact the audio (cell phone or portable communications handset.)

Thunderbolt (TB)

Table 7-43 Thunderbolt

Items	Procedures
Symptom	*Possible causes*
Thunderbolt device not working	BIOS, drivers, and user settings.
	Troubleshooting steps

1. Update to the latest BIOS and choose appropriate TB Port settings.
2. Reset **User Account Settings** to default.
3. Update Intel Thunderbolt software that includes firmware version (for TB controller), driver version (operating system driver), and application version.



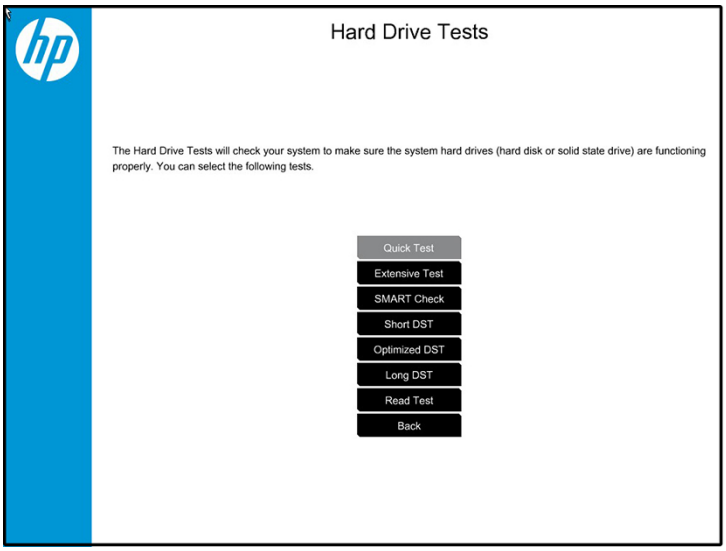
4. Verify that TB device is detected in Windows Device Manager.
5. Verify TB port, cable and connection.
6. Test with a verified working TB board, if possible.

NOTE: Thunderbolt is new technology. Thunderbolt cable and Thunderbolt device must be compatible with Windows. To determine whether your device is Thunderbolt Certified for Windows, see https://thunderbolttechnology.net/products.

Storage

NOTE:

- Back up all critical data prior to drive troubleshooting.
- Prior to contacting support, HP recommends that you run a drive (HDD, SSD, M.2 drive) test using the HP PC Hardware Diagnostics (UEFI) tool on the suspected failed drive.
- Diagnose the hard drive using BIOS, Diagnostics built in the shipping image, or an external USB (http://www8.hp.com/us/en/campaigns/hpsupportassistant/pc-diags.html?jumpid=va_r602_us/en/any/pps/pl_ot_ob_ds_pd/HP_PC_Hardware_Diagnostics_cc/dt).
- The drive quick test is recommended to quickly (less than 10 minutes) identify the malfunctioning drive. If the issue still exists, run Extensive Test (more than 2 hours, or loop mode, which will run until an error occurs).
- If any test fails, record failure code and contact support for instructions on how to order a replacement hard drive.
- If all of the tests pass, the hard drive is not damaged. As a rule, HP will not replace a hard drive under warranty that does not fail the HP Hard Drive Self-Test.
- If there is no physical problem with the hard drive (or memory), then try reinstalling the Windows operating system to troubleshoot the problem.



Hard drive/solid-state drive not recognized

Table 7-44 Hard drive/solid-state drive not recognized

Items	Procedures
Symptom Hard drive is not recognized during POST	*Possible causes* Loose connection, faulty hard drive, faulty drive configuration/BIOS setting. *Troubleshooting steps* 1. Perform a hard reset (8. Hard reset on page 87). 2. Reset BIOS to default. 3. Verify hard drive connection and flex cable. Reseat hard drive and cable connection. For multiple storage devices, keep the primary drive with the operating system and remove other devices. 4. Use the HP Hardware Diagnostics tool to verify the drive is recognized and test it. 5. If the hard drive fails diagnostics, record failure and have the drive replaced. 6. Identify when the issue is related to software. If the hard drive passes diagnostics, test the drive on a verified working computer. If the failure follows the drive, reinstall the operating system to make sure software is not an issue. 7. Test with a verified working hard drive. If it is still not recognized, the system board is faulty. **NOTE:** If the drive is seen in BIOS and Diagnostics, try a secure erase prior to replacing a drive as this may resolve related issues.

No boot to operating system (no read/write error)

Table 7-45 No boot to operating system (no read/write error)

Items	Procedures
Symptoms • Post error message: Boot Device not found (3F0) • Hang when booting to operating system	*Possible causes* Operating system, loose connection, faulty hard drive, BIOS configuration, Secure Boot. *Troubleshooting steps* 1. Verify if Secure Boot is enabled in BIOS. Secure Boot prevents legacy boot devices from starting the computer, including bootable CDs and DVDs. For more information, see http://support.hp.com/us-en/document/c03653226. 2. Reset BIOS to default. Be sure that BIOS **Boot Mode** in **Boot Option** is set up properly for bootable device and its operating system (i.e., UEFI Native for Windows 8). Another example, choosing **Legacy Boot Order** for an UEFI device will cause "Boot Device not found (3F0)" error. 3. Verify hard drive connection and flex cable. Reseat connection. For multiple storage devices, keep the primary drive with the operating system and remove other devices. 4. Use PC Hardware Diagnostics tool to test. Record failure code and have the hard drive replaced. 5. If there is no error, reinstall the operating system using HP Restore. 6. Test with a verified working operating system hard drive, if available.
Note	If there is a hard drive POST error message, see POST Error Messages and User Actions on page 136.

Read-write error

Table 7-46 Read-write error

Items	Procedures
Symptoms • Post error message (i.e., error code 301) • Hang when working on data, files, documents	*Possible causes* Loose connection, faulty hardware. *Troubleshooting steps* 1. Perform a hard reset (8. Hard reset on page 87). 2. Reset BIOS to default (9. Soft reset (Default Settings) on page 88). 3. Verify drive connection and flex cable. Reseat connection (10. Reseat cables and connections on page 88). 4. Use the HP Hardware Diagnostics tool to test. If failed, record failure code and have the hard drive replaced. 5. If no error with HP PC Hardware Diagnostics (UEFI) tool, try to repair the hard drive and its files in Windows (using command "`CHKDSK /f /r /x`"). Use HP Restore to reinstall the operating system, if needed. 6. Test with a verified working hard drive. If it is not recognized, the system board is faulty.
Note	If there is a hard drive POST error message, see POST Error Messages and User Actions on page 136.

Slow performance

Table 7-47 Slow performance

Items	Procedures
Symptoms Slow performance even when performing small read/write operations	*Possible causes* Operating system files, hard drive is full. *Troubleshooting steps* 1. Transfer data from the hard drive to create more space. Microsoft recommends at least 200 MB to sync system files. 2. Perform disk defragmentation to consolidate fragmented data on the hard drive so it will work more efficiently. **NOTE:** Do not defrag an SSD.
Tips & tricks	For optimal system performance, you need to place your operating system and all of your most commonly used applications and files in the fastest hard drive (solid-state drive) and fastest areas on the drive (primary partition of 200 GB max). See Routine Maintenance for Performance Improvement on page 138).

Blue screen (BSOD) error

Faulty hard drive may cause blue screen error. Perform the drive tests using the HP Diagnostics Tool to make sure the drive is functional. If all of the tests pass, see Common Blue Screen Error Messages on page 138 for detailed troubleshooting steps.

Noisy hard drive

IMPORTANT: An SSD has no moving parts, so it does not make loud or clicking noise.

Depending on type and rotational speed, some hard drives will make more noise then others.

Not all noises are related to the fan or hard drive.

Table 7-48 Noisy hard drive

Items	Procedures
Symptoms • Loud noise from hard drive • Clicking noise from hard drive • Still boots to operating system and operates normally	*Possible causes* BIOS, hard drive firmware, driver, faulty drive, power supply (AC adapter). *Troubleshooting steps* 1. Update BIOS and hard drive firmware. 2. Examine AC adapter to be sure that it is not faulty or overloaded. Disconnect all peripherals (USB storages, dock, etc.). 3. Remove hard drive to isolate the noise. 4. Test the hard drive on a verified working computer if the noise continues. If the hard drive makes the same noise or clicking sounds, the sounds are either normal sounds for the hard drive or a fault with the hard drive. 5. Verify original hard drive connection and flex cable. Reseat hard drive and connection. 6. Run HP PC Hardware Diagnostics (UEFI). If failed, record failure code and have the hard drive replaced. 7. If no error with HP PC Hardware Diagnostics (UEFI), perform disk defragmentation (some hard drives make a clicking noise when highly fragmented).
Tips & tricks	For optimal system performance, place your operating system and all of your most commonly used applications and files on the fastest hard drive or solid-state drive and on the fastest areas on the drive (primary partition of 200 GB max). See Routine Maintenance for Performance Improvement on page 138).

Mechanical

Fan error message - 90B

Table 7-49 Fan error message - 90B

Items	Procedures
Symptoms	*Possible causes*
Fan error 90B at boot **CAUTION:** May lead to system shutdown, data loss or possible system damage.	Defective fan; out-of-date BIOS. • The system fan is not spinning or not spinning properly (loose connection, fan is stuck or defective). • The temperature inside the case is too high, and the fan cannot spin fast enough to remove the heat due to an obstruction to air flow. 
	Troubleshooting steps **General actions** 1. Update BIOS and drivers (4. Update BIOS and drivers on page 80) or reset BIOS to default. BIOS may implement new fan characteristics and updates for other components. 2. Perform a hard reset (8. Hard reset on page 87). Performing a hard reset can reset recorded thermal values in memory.
	Thermal-related issue 1. Verify thermal condition: a. Check fan and connection. Reseat fan cable. b. Be sure that no obstructions or dust are in heat sink fan, fin, or vent. c. Test fan using HP PC Hardware Diagnostics (UEFI) tool (6. HP Hardware Diagnostics and Tools on page 81). Be sure that the fan is not producing loud noise and that fan blades spin correctly. d. Test with a verified working fan. e. Remove old thermal compound and pads, and replace properly with new pads. 2. Verify thermal solution ▲ Use Thermal Monitor tool (available only to authorized service providers/ technicians) to run stress test (processor and GPU) and verify that thermal sensors are within limits after thermal condition is serviced.
Note	BIOS currently omits fan presence detection to shorten boot time delay less than four seconds. Therefore, the fan error is generated based on previous boot to operating system that found system fan error.

Table 7-49 Fan error message - 90B (continued)

Items	Procedures
	Fan often is part of thermal solution, including heat sink, fin/ muffler, and thermal grease. Fan replacement requires reboot and fan function verification using HP PC Hardware Diagnostics (UEFI) tool. See https://support.hp.com/us-en/document/c01657439.

Noise (sound)

Table 7-50 Noise (sound)

Items	Procedures
Symptoms Computer emits abnormal noise	*Possible causes* Aside from basic components (power adapter/supply, fan, speaker, hard drive, optical drive, display panel, external devices), it is also common for electronic components to produce noise.
	Troubleshooting steps 1. Inspect external power source and change to verified working one. 2. Determine whether the noise comes from AC power adapter. Test with a verified working AC adapter.
	Disconnect external devices and all cables connected to the computer to isolate issue to computer only.
Noisy fan	Determine whether the noise comes from the fan. Disconnect the fan briefly to isolate whether noise originates from fan. If noise is absent with fan disconnected, refer to Fan runs constantly on page 131.
Noisy hard drive	Determine whether the noise comes from the hard drive. See Noisy hard drive on page 128.
Noisy optical drive	1. Determine whether the noise comes from an optical drive. 2. Remove CD/DVD from the optical drive.
Noisy speaker	1. Determine whether the noise comes from speaker. 2. Test with a verified working external headset/speaker.
Noisy display	Determine whether the noise comes from display panel (humming noise). Change display frequency settings. See Display on page 110.
The section below is intended for authorized service providers/technicians.	
	1. After disassembling the chassis, inspect components of the interior for excessive wear or damage. 2. If noise issues persist, proceed with process of elimination for battery, AC adapter, or boards.

Fan runs constantly

Table 7-51 Fan runs constantly

Items	Procedures
Symptoms • Fan never stops running • Generates heat • Decreased computer performance	*Possible causes* • BIOS not up to date. • Thermal condition (fan, air flow)--fan may not be defective but must run constantly to remove excess heat generated by electrical components. • Inappropriate configuration.
	Troubleshooting steps **General actions** 1. Verify whether BIOS is set to **Fan Always on while on AC Power** F10 Setup. When booting the computer, press F10 to open Setup, and then select **Advanced > Built-In Device Options Menu**. 2. Update BIOS and drivers (4. Update BIOS and drivers on page 80) and reset BIOS to default. BIOS may implement new fan characteristics and updates for other components. 3. Perform a hard reset (8. Hard reset on page 87). Performing a hard reset can reset recorded thermal values in memory.
	Thermal-related issue 1. Verify fan is spinning. Reseat fan cable before moving to next step. a. Check fan and connection. Reseat fan cable. b. Be sure that no obstructions or dust are in heat sink fan, heat sink fin, or vent. c. Test fan using HP PC Hardware Diagnostics (UEFI) tool (6. HP Hardware Diagnostics and Tools on page 81). Be sure that the fan is not producing loud noise and that fan blades spin correctly. d. Test with a verified working fan. e. Replace the fan. 2. Verify thermal solution Use Thermal Monitor tool (available only to authorized service providers/technicians) (HP Thermal Monitor on page 84) to run stress test (processor and GPU) and verify that thermal sensors are within limits after thermal condition is serviced.
	User configuration Change Power Options in Windows (i.e., choosing **Balanced mode** instead of **High performance**). High performance and extensive graphics may cause the fan run constantly to release the heat.
Notes	BIOS currently omits fan presence detection to shorten boot time delay less than four seconds. Therefore, the fan error is generated based on previous boot to operating system that found system fan error. Fan often is part of thermal solution, including heat sink, heat sink fin/muffler, and thermal grease. Fan replacement requires reboot and fan function verification using HP PC Hardware Diagnostics (UEFI) tool. For more information, see the following links: • http://support.hp.com/us-en/document/c01007591. • https://support.hp.com/us-en/document/c01657439.

Thermal shutdown (hot)

Table 7-52 Thermal shutdown (hot)

Items	Procedures
Symptoms Similar to fan runs constantly issue (Fan runs constantly on page 131) • System shutdown • Abnormal heat • Continually running fan • Decreased computer performance	*Possible causes* BIOS not up to date, thermal condition (fan, air flow) *Troubleshooting steps* 1. Update BIOS and drivers (4. Update BIOS and drivers on page 80) and reset BIOS to default. BIOS may implement new fan characteristics and updates for other component. 2. Perform a hard reset (8. Hard reset on page 87). Performing a hard reset can reset recorded thermal values in memory. 3. Determine whether you are using a correct AC adapter. 4. Be sure to turn power off completely when putting a notebook in a travel bag.
 	**Thermal-related issue** 1. Verify thermal condition: a. Check fan and connection. Reseat fan cable. b. Be sure that no obstructions or dust are in heat sink fan, fin, or vent. c. Be sure that the notebook is not sitting on a hot surface that blocks vent intakes. d. Test fan using HP PC Hardware Diagnostics (UEFI) tool (6. HP Hardware Diagnostics and Tools on page 81). Be sure that the fan is not producing a loud noise and that fan blades spin correctly. e. Test with a verified working fan. f. Remove old thermal compound and pads, and replace properly with new pads. 2. Verify thermal solution: ○ Use Thermal Monitor tool (available only to authorized service providers/technicians) to run stress test (processor and GPU) and verify that thermal sensors are within limits after thermal condition is serviced.
Note	See https://support.hp.com/us-en/document/c01657439.

Stuck power button

Table 7-53 Stuck power button

Items	Procedures
Symptoms • Rear power indicator light is on • Will not turn on when power button is pressed • Automatically powers on	*Possible causes* Sticky or defective power button. *Troubleshooting steps* **General actions** 1. Perform a hard reset (8. Hard reset on page 87). 2. Perform a soft reset if system can turn on.
The sections below are intended for authorized service providers/technicians.	
	1. Disassemble the unit.

Table 7-53 Stuck power button (continued)

Items	Procedures
	2. Inspect power button on the top cover and on the system board to make sure these buttons moves freely.

Additional information

The following sections provide additional information that can be used during the troubleshooting process.

Acronyms

The following acronyms are used in this chapter.

Blue screen (BSOD)—A Windows error screen that can occur if a problem causes your computer to shut down or restart unexpectedly. When you experience this type of error, you will not be able to see items such as the Start menu or the taskbar when your computer is turned on. Instead you might see a blue screen with a message that your computer ran into a problem and needs to restart.

CPU—Central processing unit

DIMM—Dual in-line memory module

Daughterboard—Type of circuit board that plugs into or is attached to the system board or similar expansion card to extend its features and services.

GPU–Graphics processor unit

GTS–General Troubleshooting Step

HDD–Hard drive

KB–Keyboard

LVDS–Low-Voltage Differential Signaling

MSG–Maintenance and Service Guide

mWS–Mobile Workstations

WS–Workstations

OS–Operating system

PC–Personal computer

POST–Power-On Self-Test

SSD–Solid-state drive

TSG–Troubleshooting Guide

UEFI–Unified Extensible Firmware Interface

WLAN–Wireless local area network

Blinking lights and boot error codes

The information below is from the white paper http://h10032.www1.hp.com/ctg/Manual/c04685655.

In some cases, when the host processor is not executing code or does not have the necessary code to drive the display, light blink codes inform you of a problem.

Table 7-54 Boot-error codes

Blink codes	Error
Amber battery light: blinks 1 Hz continuously	Embedded Controller unable to load firmware
Caps/num lock lights = 1 blink	Processor not executing code
Caps/num lock lights = 2 blinks	BIOS recovery code unable to find valid BIOS recovery image
Caps/num lock lights = 3 blinks	Memory module error
Caps/num lock lights = 4 blinks	Graphics controller error
Caps/num lock lights = 5 blinks	System board error
Caps/num lock lights = 6 blinks	Intel Trusted Execution Technology (TXT) Error
Caps/num lock lights = 7 blinks	Sure Start unable to find valid BIOS Boot Block image
Caps/num lock lights = 8 blinks	Sure Start has identified a problem (Manual Recovery Policy Set)

Processor not executing code

This computer has experienced a problem due to the failure of certain code to execute, resulting in a failed startup of the processor. The issue could be related to the processor or the system board in the computer. If the processor is socketed, be sure that the processor is seated correctly in the socket. If this error reoccurs, refer to General troubleshooting steps on page 76.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink once** followed by a pause, and then continue in a repeating pattern.

BIOS recovery code unable to find valid BIOS recovery image

This computer has experienced a problem in locating a valid BIOS image, resulting in a failed startup. This problem may be resolved by placing a clean copy of the system BIOS on a USB key or in the appropriate hard drive directory and performing a reboot. If this error reoccurs, refer to General troubleshooting steps on page 76.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink twice** followed by a pause, and then continue in a repeating pattern.

Memory module error

This computer has experienced a memory initialization problem resulting in a failed startup. This issue may be related to the memory modules in the computer. This problem may be resolved by ensuring that memory modules are correctly inserted and seated. If this error reoccurs, a service event is required to determine the source of the error (memory modules or system board) and take the appropriate corrective action.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink three times** followed by a pause, then continue in a repeating pattern.

Graphics Controller Error (No Controller)

This computer has experienced a graphics controller initialization problem resulting in a failed startup. This issue may be related to the graphics controller in your machine. This problem may be resolved by ensuring that the graphics controller module is seated correctly in machines with modular graphics. If this error reoccurs, a service event is required to identify the source of the error and take the appropriate corrective action.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink four times** followed by a pause, then continue in a repeating pattern.

Failure - System Board Error

This computer has experienced a system board initialization problem resulting in a failed startup. This issue may be related to the system board in the computer. A service event is required to identify the source of the error and take the appropriate corrective action.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink five times** followed by a pause, then continue in a repeating pattern.

Intel Trusted Execution Technology (TXT) Error

This computer has experienced a problem related to the Intel Trusted Execution Technology resulting in a failed startup. The error occurs when all of the following are true:

- The Intel Trusted Execution Technology (TXT) has been enabled on the computer.
- Policies have been set to prevent startup if the BIOS measurement has changed.
- The BIOS measurement has changed.

For more information about Intel TXT, go to http://www.intel.com/content/dam/www/public/us/en/documents/white-papers/trusted-execution-technology-security-paper.pdf.

A service event is required to resolve this issue.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink six times** followed by a pause, then continue in a repeating pattern.

Sure Start unable to find valid BIOS Boot Block image

This computer has experienced a problem in locating a valid BIOS image, resulting in a failed startup. A service event is required to identify the source of the error and take appropriate corrective action.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an “Off” or “Hibernated” state, lights associated with the caps lock and num lock keys will both **blink seven times** followed by a pause, then continue in a repeating pattern.

Sure Start has identified a problem (Manual Recovery Policy Set)

This computer has experienced a problem in locating a valid BIOS image, resulting in a failed startup. HP Sure Start will normally repair this type of issue; however, on this computer HP Sure Start has been configured to operate in manual mode key sequence. To proceed with the repair, press and hold the following keys: <ESC> +<UP arrow>+<DOWN arrow>. To avoid the need for this manual recovery step, set the HP Sure Start recovery policy to automatic. If this error reoccurs, a service event is required to identify the source of the error and take appropriate corrective action.

NOTE: The computer will attempt to notify you of this problem through a series of blinking lights. When you attempt to turn on the computer from an "Off" or "Hibernated" state, lights associated with the caps lock and num lock keys will both **blink eight times** followed by a pause, then continue in a repeating pattern.

POST Error Messages and User Actions

Table 7-55 POST Error Messages and User Actions

Test description	Failure descriptions	Error code	Possible user actions
Product information	Invalid value	00A	Contact support for assistance.
Startup test	Memory module	200	Attempt to reseat the memory module and then repeat the test. Search http://www.hp.com/support for details on troubleshooting issues related to the memory module. If the memory module still fails, contact support.
Startup test	Hard Disk 1 SMART	301	Attempt to reseat the hard drive and repeat the test. The hard disk drive may have failed. Contact support for assistance.
Startup test	Hard Disk 2 SMART	302	The hard drive may have failed. Contact support for assistance.
Startup test	Hard Disk 1 Quick	303	The hard drive may have failed. Contact support for assistance.
Startup test	Hard Disk 2 Quick	304	The hard drive may have failed. Contact support for assistance.
Run-in test	Memory module	200	Attempt to reseat the memory module and then repeat the test. Search http://www.hp.com/support for details on troubleshooting issues related to the memory module. If the memory module still fails, contact support.
Run-in test	Hard Disk 1 SMART	301	Attempt to reseat the hard drive and repeat the test. The hard drive may have failed. Contact support for assistance.
Run-in test	Hard Disk 2 SMART	302	The hard drive may have failed. Contact support for assistance.
Run-in test	Hard Disk 1 Quick	303	The hard drive may have failed. Contact support for assistance.
Run-in test	Hard Disk 2 Quick	304	The hard drive may have failed. Contact support for assistance.
Hard Disk Test	Hard Disk 1 SMART	301	Attempt to reseat the hard drive and repeat the test. The hard drive may have failed. Contact support for assistance.
Hard Disk Test	Hard Disk 2 SMART	302	The hard drive may have failed. Contact support for assistance.
Hard Disk Test	Hard Disk 1 Quick	303	The hard drive may have failed. Contact support for assistance.
Hard Disk Test	Hard Disk 2 Quick	304	The hard drive may have failed. Contact support for assistance.
Hard Disk Test	Hard Disk 1 Full	305	The hard drive may have failed. Contact support for assistance.

Table 7-55 POST Error Messages and User Actions (continued)

Test description	Failure descriptions	Error code	Possible user actions
Hard Disk Test	Hard Disk 2 Full	306	The hard drive may have failed. Contact support for assistance.
Boot Device Manager	Boot device not found	3F0	Indicates a potential problem with the hard drive. Please run the hard drive test. See https://support.hp.com/emea_africa-en/document/c01443371 for more information.
Boot Device Manager	Hard Disk 1 Error	3F1	Indicates a potential problem with the hard drive. Run the hard drive test. See https://support.hp.com/emea_africa-en/document/c01443371 for more information.
Boot Device Manager	Hard Disk 2 Error	3F2	Indicates a potential problem with the hard drive. Run the hard drive test. See https://support.hp.com/emea_africa-en/document/c01443371 for more information.
Boot Device Manager	Hard Disk 1 SMART	301	Indicates a potential problem with the hard drive. Run the hard drive test. See https://support.hp.com/emea_africa-en/document/c01443371 for more information.
Boot Device Manager	Hard Disk 2 SMART	302	Indicates a potential problem with the hard drive. Run the hard drive test. See https://support.hp.com/emea_africa-en/document/c01443371 for more information.
BIOS Recovery	BIOS Recovery Occurred	500	This message indicates that BIOS recovery was completed successfully. No further action is required.
BIOS Application	BIOS Application Error	501	The BIOS installation may have become corrupted. Download the latest version of the BIOS and install it. See 4. Update BIOS and drivers on page 80 for more information. If reinstalling the BIOS fails, contact support for further assistance.
CMOS Recovery	CMOS Recovery Occurred	502	This message indicates that CMOS recovery was completed successfully. No further action is required.
Battery Check	Primary Battery Replace	601	This indicates that the primary battery has very low capacity. Search http://www.hp.com/support for details on using the HP Support Assistant to verify the battery capacity and, if necessary, order a replacement.
Battery Check	Secondary Battery Replace	602	This indicates that the secondary battery has very low capacity. Search http://www.hp.com/support for details on using the HP Support Assistant to verify the battery capacity and, if necessary, order a replacement.
Wireless Module	Not installed or responding	701	Reseat the wireless LAN adapter module, if your notebook supports it. Because seating or reseating a wireless LAN adapter is unique to each computer model. For more information, see the chapter titled “Removal and replacement procedures for Customer Self-Repair parts.”
Fan	Fan not operating correctly	90B	The system fan may be malfunctioning. For information on troubleshooting heat-related issues, see http://support.hp.com/us-en/document/c01007591. A hard reset can sometimes restore the system fan to working order. See https://support.hp.com/us-en/document/c01684768 for details. If the system fan continues to malfunction, contact support.

Routine Maintenance for Performance Improvement

The following table presents a summary of the suggested times for performing the routine maintenance tasks described in this document.

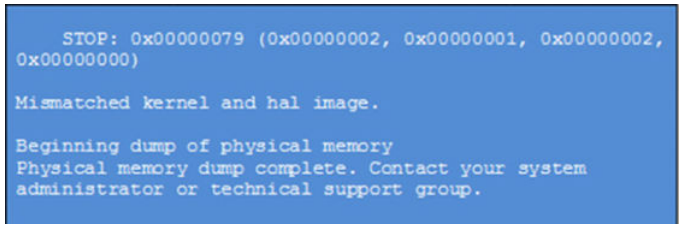
Table 7-56 Routine Maintenance for Performance Improvement

Tasks	Weekly	Monthly	Occasionally
Perform a system tune up.	X		
Run Windows Update.	X		
Scan for and remove viruses.	X		
Scan for and remove spyware and adware.	X		
Empty the Recycle Bin.	X		
Delete temporary Internet files.	X		
Back up user files.		X	
Create a restore point.		X	
Defragment the hard drive.		X	
Run Scan Disk.		X	
Clean the exterior of the computer.			X
Close programs that are not being used.			X
Prevent programs from loading at startup.			X

Common Blue Screen Error Messages

Error message list

The following image shows an example of one possible "https://msdn.microsoft.com/en-us/library/windows/hardware/hh994433(v=vs.85).aspx" from Microsoft:



The hexadecimal number following the word "STOP" is called the bug check code or Stop code. This is the most important item on the screen.

Bug check symbolic names

Each bug check code also has an associated symbolic name. In the example, the screen shows https://msdn.microsoft.com/en-us/library/windows/hardware/ff559209(v=vs.85).aspx (MISMATCHED_HAL).

Microsoft general troubleshooting of Windows bug check codes

- If you recently added hardware to the system, try removing or replacing it. Or check with the manufacturer to see if any patches are available.
- Try running HP PC Hardware Diagnostics (UEFI).
- Check with the manufacturer to see if an updated system BIOS or firmware is available.
- Be sure that any expansion board is properly seated and all cables are completely connected.
- Confirm that any new hardware that is installed is compatible with the installed version of Windows.
- If new device drivers or system services have been added recently, try removing or updating them.

NOTE: Use safe mode when removing or disabling components. Safe mode loads only the minimum required drivers and system services during the Windows startup. To enter safe mode, restart your computer and press F8 at the menu that displays the operating system choices. At the resulting **Windows Advanced Options** menu, choose **Safe Mode**.

- Run a virus detection program. Viruses can infect all types of hard drives formatted for Windows, and resulting drive corruption can generate system bug check codes. Be sure that the virus detection program checks the Master Boot Record for infections.
- Verify that the system has the latest service pack installed. To detect which service pack, if any, is installed on your system, click **Start**, click **Run**, type `winver`, and then press Enter. The **About Windows** dialog box displays the Windows version number and the version number of the service pack, if one has been installed.
- Disable BIOS memory options such as caching or shadowing.
- Check the System Log and Application Log in Event Viewer to see if any additional error messages have been logged recently. These might pinpoint the cause of the error.

Use Windows Debugging Tool

The https://msdn.microsoft.com/library/windows/hardware/ff551063%20(v=vs.85).aspx is one of the primary tools used by Microsoft software developers to analyze and resolve errors that result in memory dumps. Use the tool to determine the cause of the error. Follow general steps for downloading, setting up, and using the Windows 10 debugging tool. A similar process is used for Windows 7 or Windows 8.

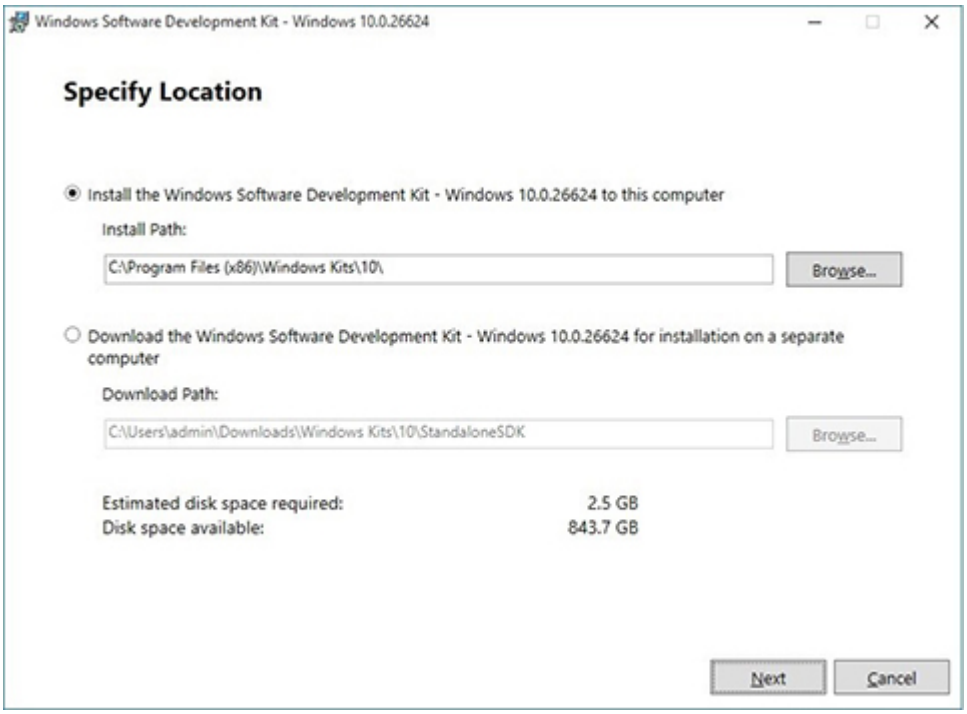
NOTE: The following screen shots provide only an example of the tool. Specifics shown are not representative of all applications of the debugging tool. This is a Microsoft tool supported by Microsoft.

Windows Software Development Kit (SDK)

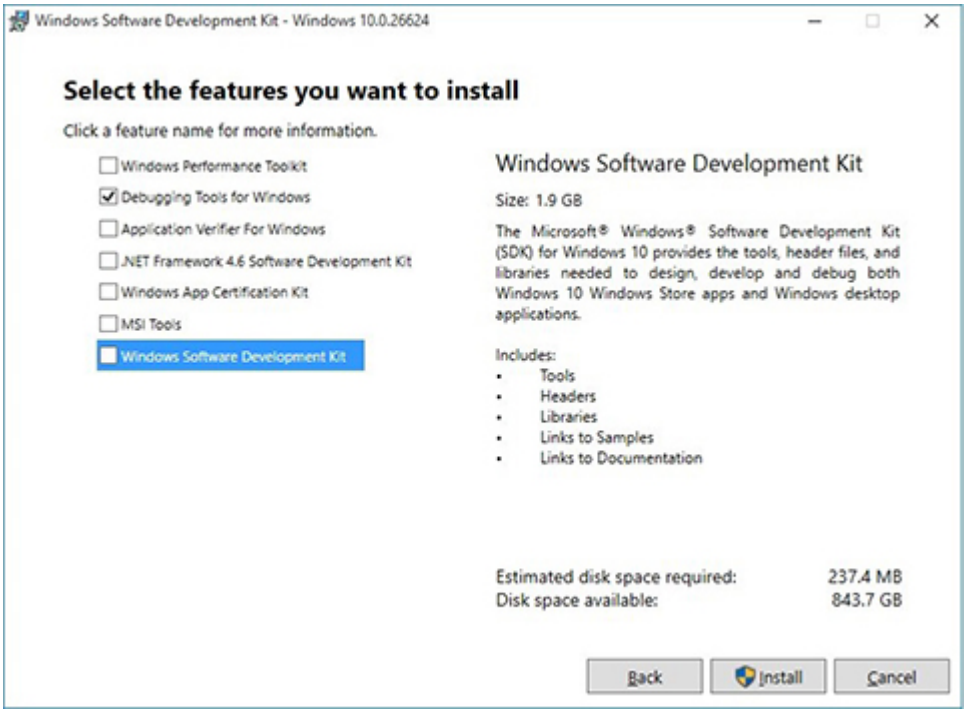
1. Download the SDK from the following link:

   https://dev.windows.com/en-US/downloads/windows-10-sdk

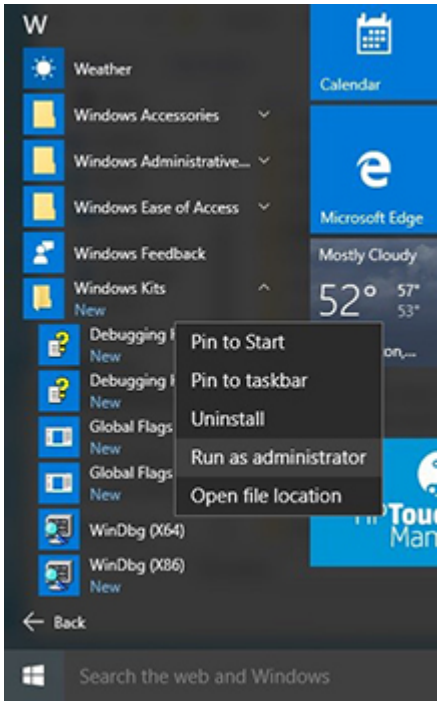
2. Set up the SDK in the configuration window (Windows 10 shown).



3. Select features to install.

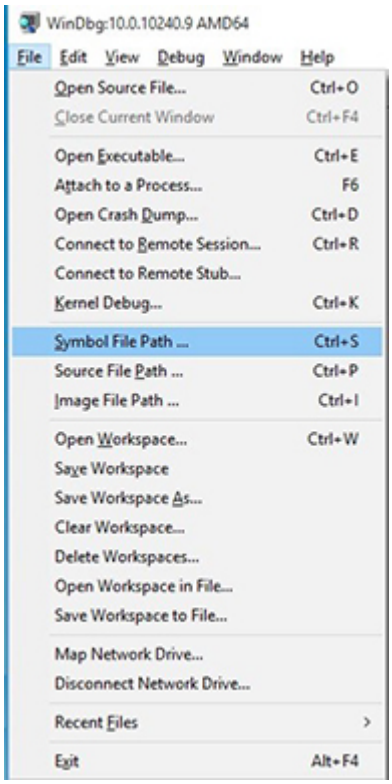


4. Run the SDK as an administrator.

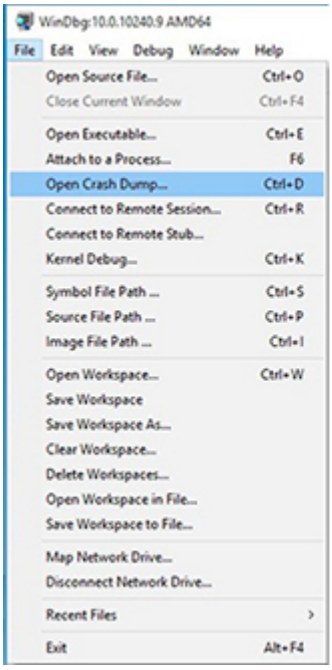


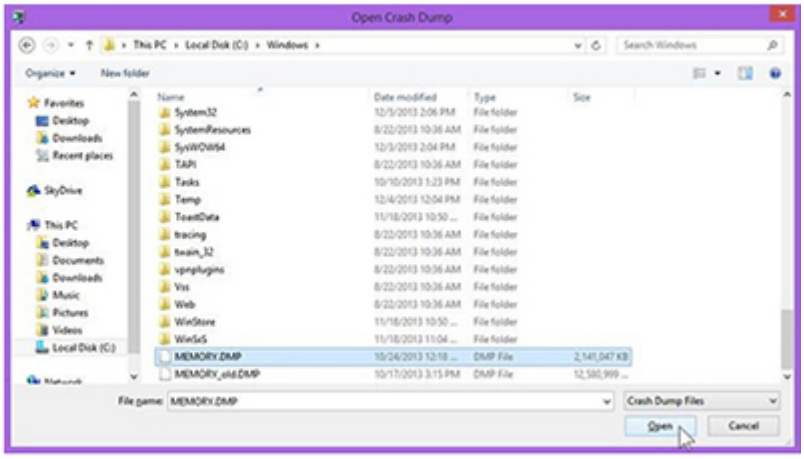
5. Set the symbol path. Select **File > Symbol File Path**.

   - In the **Symbol path** box, type `SRV*C:\Windows\symbol_cache*http://msdl.microsoft.com/download/symbols`.
   - Save the workspace.



6. Open the crash dump file.

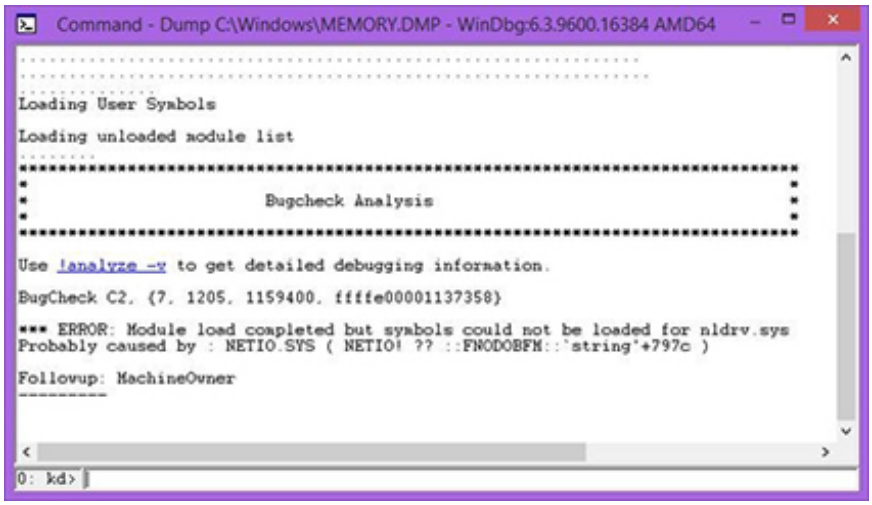




7. Analyze the file. In the following memory dump sample, look for Bug Check 0x3B. The ATIKMAG driver needs to be investigated for further root cause.

Lookup for Bug Check 0xC2.

```
1: kd> !analyze -v
*******************************************************************************
*                                                                             *
*                        Bugcheck Analysis                                    *
*                                                                             *
*******************************************************************************

SYSTEM_SERVICE_EXCEPTION (3b)
An exception happened while executing a system service routine.
Arguments:
Arg1: 00000000c0000005, Exception code that caused the bugcheck
Arg2: fffff8006d927acf, Address of the instruction which caused the bugcheck
Arg3: ffffd00020e4e500, Address of the context record for the exception that caused the bugcheck
Arg4: 0000000000000000, zero.

Debugging Details:
------------------
BUGCHECK_P1: c0000005
BUGCHECK_P2: fffff8006d927acf
BUGCHECK_P3: ffffd00020e4e500
BUGCHECK_P4: 0
EXCEPTION_CODE: (NTSTATUS) 0xc0000005 - The instruction at 0x%p referenced memory at 0x%p. The memory

FAULTING_IP:
atikmpag+2facf
fffff800`6d927acf 4539bc2434030000 cmp     dword ptr [r12+334h],r15d

...

SYMBOL_STACK_INDEX:  0
SYMBOL_NAME:  atikmpag+2facf
FOLLOWUP_NAME:  MachineOwner
MODULE_NAME: atikmpag
IMAGE_NAME:  atikmpag.sys
DEBUG_FLR_IMAGE_TIMESTAMP:  55479b42
STACK_COMMAND:  .cxr 0xffffd00020e4e500 ; kb
BUCKET_ID_FUNC_OFFSET:  2facf
FAILURE_BUCKET_ID:  0x3B_atikmpag!Unknown_Function
BUCKET_ID:  0x3B_atikmpag!Unknown_Function
PRIMARY_PROBLEM_CLASS:  0x3B_atikmpag!Unknown_Function
ANALYSIS_SOURCE:  KM
FAILURE_ID_HASH_STRING:  km:0x3b_atikmpag!unknown_function
FAILURE_ID_HASH:  {adb80875-801c-005a-68e8-645bb2f2c848}
```



Display Issue: Pixel Anomalies

All HP notebook displays adhere to strict quality and reliability specifications. A small percentage of display panels may have minor cosmetic manufacturing anomalies or irregularities such as bright or dark dots in the viewable area. These cosmetic imperfections are common to all display panel types and are not specific to any HP model or product line.

All display panel defects should be examined at the highest possible resolution using both the brightest and darkest possible backgrounds, because some sub-pixel failures may not be readily visible under certain conditions.

- Type 1: Bright dot on a dark background = Always On
- Type 2: Dark dot on a bright background = Always Off
- Combination = in any combination and any color that are always on or off

Use the HP PC Hardware Diagnostics (UEFI) tool to determine numbers of pixels and their distance. HP uses the following set of criteria when damaged displays are submitted for warranty coverage.

Source: http://support.hp.com/us-en/document/c00035844

Table 7-57 Electrical defect allowances

Panel resolution	Accept	Reject
Sub-pixel faults		
VGA, SVGA, SD, WSVGA, XGA, 720p, SD+, WXGA, HD	N ≤ 2 Type 1 N ≤ 2 Type 2	N ≥ 3 Type 1
WXGA+, SXGA+, HD+, SXGA+	N ≤ 3 Type 1 N ≤ 3 Type 2	N ≥ 4 Type 1
WSXGA+, UXGA, FHD, WUXGA	N ≤ 4 Type 1 N ≤ 4 Type 2	N ≥ 5 Type 1
QHD, QHD+, WQXGA, UD	N ≤ 5 Type 1 N ≤ 5 Type 2	N ≥ 6 Type 1
Electrical defect clusters (defects within a 5x5 pixel block)		
Minimum distance between ANY allowable defects (unless otherwise specified)	S ≥ 25 mm	S < 25 mm
Cluster with 2 or more sub-pixels with sub-pixel faults		Not allowed
Dim lines		Not allowed
Cross line(s) on/off		Not allowed
Horizontal line(s) on/off		Not allowed
Vertical line(s) on/off		Not allowed

NOTE: All LCD panel defects should be examined at the highest possible resolution using both the brightest and darkest possible backgrounds, as some sub-pixel failures may not be readily visible under certain conditions.

NOTE: Contact support for assistance if issues are not listed.

Cable management

Proper routing of the internal cables is critical to the operation of the computer. Follow good cable management practices when removing and installing components.

- Handle cables with care to avoid damage.
- Apply only the tension required to seat or unseat cables during insertion or removal from the connector.
- When possible, handle cables by the connector or pull-strap.
- Route cables in such a way that they cannot be caught or snagged by parts being removed or replaced.
- Keep cables away from direct contact with major heat sources, such as the heat sink. (Some air flow guides have a cable guide that lets you route cables safely around the heat sink.)
- Do not jam cables on top of daughterboards or memory modules (DIMMs). Circuit cards and DIMMs are not designed to take excessive pressure.
- Keep cables clear of any movable or rotating parts (such as a fan) to prevent them from being cut or crimped when the component is lowered into its normal position.
- In all cases, avoid bending or twisting the cables. Do not bend any cable sharply. A sharp bend can break the internal wires.
- Do not rely on components like the keyboard or service door to push cables down internally. Always position the cables to lay properly by themselves or in the cable guides and chassis areas designed for cable routing.

⚠ **CAUTION:** Always release connector latch before removing the cable. Otherwise, pulling the cable could damage the cable pins and result in a failed device.

Connector types

IMPORTANT: Connector pins and connector gold fingers should not be touched directly with bare hands.

There are several different types of connectors on the system board with different requirements for cable removal or insertion.

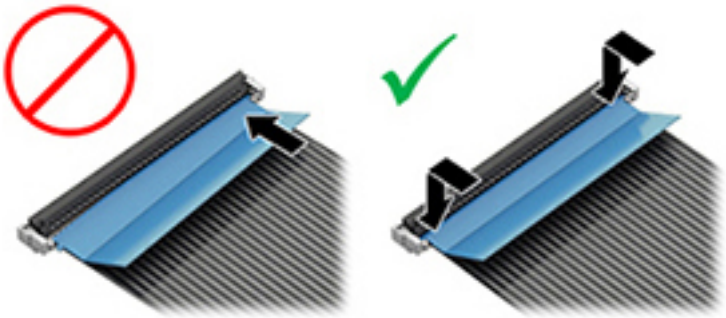
Flex cable

When connecting flex cables to a ZIF connector, rotate the latch to 90 degrees, push the cable completely, evenly into the connector, and then close the latch.

When removing flex cables from a ZIF connector on the system board, the latch must be released before the cable can be removed. Always follow these steps:

1. Flip the connector latch 90 degrees to release the cable.
2. Grasp the cable end of the connector and pull it straight out.

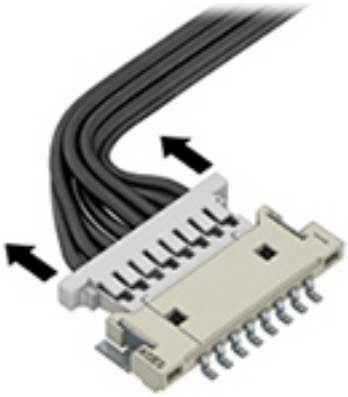
CAUTION: Always release connector latch before removing the cable. Otherwise, pulling the cable could damage the cable pins and result in a failed device.



Horizontal installation cable

Use flat tool to pull connector evenly. Do not pull on cable to remove.

Slide connector into receptacle on same horizontal plane as board and use flat tool to push evenly into receptacle.



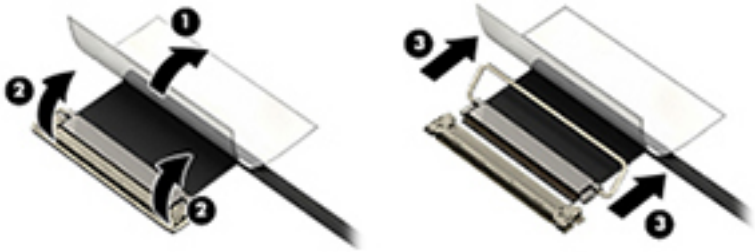
Multi-pin horizontal insert connector (LVDS cable to display panel)

Insert procedure:

1. Slide connector evenly into receptacle on same horizontal plane as PCB connector.
2. Pull lock bar to insert and push both side connector horizontally to firmly lock.
3. Tape down lock bar over the panel to hold in position.

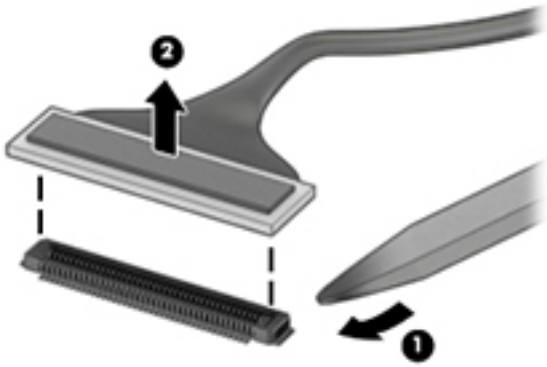
Reverse the procedure above to remove the connector:

1. Remove tape.
2. Pull up bar (pull tape) and release the lock with the PCB connector.
3. Pull to the direction in parallel with PCB to withdraw the connector.



Multi-pin vertical insert connector (LVDS cable to system board)

- Remove the connector gasket prior to removing the connector.
- If the connector has a plastic pull tab, use the tab to disconnect. Otherwise, use flat tool under the connector to remove evenly. Do not pull on the cable to remove.
- Press evenly when reseating/reconnecting/installing the connector.



For more information about cable management, see Cable management on page 145.

8 Computer Setup (BIOS), TPM, and HP Sure Start

Using Computer Setup

Computer Setup, or Basic Input/Output System (BIOS), controls communication between all the input and output devices on the system (such as disk drives, display, keyboard, mouse, and printer). Computer Setup includes settings for the types of devices installed, the startup sequence of the computer, and the amount of system and extended memory.

NOTE: Use extreme care when making changes in Computer Setup. Errors can prevent the computer from operating properly.

Starting Computer Setup

▲ Turn on or restart the computer, and when the HP logo appears, press f10 to enter Computer Setup.

Navigating and selecting in Computer Setup

- To select a menu or a menu item, use the tab key and the keyboard arrow keys and then press enter, or use a pointing device to select the item.
- To scroll up and down, select the up arrow or the down arrow in the upper-right corner of the screen, or use the up arrow key or the down arrow key on the keyboard.
- To close open dialog boxes and return to the main Computer Setup screen, press esc, and then follow the on-screen instructions.

To exit Computer Setup, choose one of the following methods:

- To exit Computer Setup menus without saving your changes, select **Main**, select **Ignore Changes and Exit**, and then select **Yes**.

NOTE: If you are using arrow keys to highlight your choice, you must then press enter.

- To save your changes and exit Computer Setup menus, select **Main**, select **Save Changes and Exit**, and then select **Yes**.

NOTE: If you are using arrow keys to highlight your choice, you must then press enter.

Your changes go into effect when the computer restarts.

Restoring factory settings in Computer Setup

NOTE: Restoring defaults will not change the hard drive mode.

To return all settings in Computer Setup to the values that were set at the factory, follow these steps:

1. Start Computer Setup. See Starting Computer Setup on page 149.
2. Select **Main**, select **Apply Factory Defaults and Exit**, and then select **Yes**.

NOTE: If you are using arrow keys to highlight your choice, you must then press enter.

NOTE: On select products, the selections may display **Restore Defaults** instead of **Apply Factory Defaults and Exit**.

Your changes go into effect when the computer restarts.

NOTE: Your password settings and security settings are not changed when you restore the factory settings.

Updating the BIOS

Updated versions of the BIOS may be available on the HP website.

Most BIOS updates on the HP website are packaged in compressed files called *SoftPaqs*.

Some download packages contain a file named Readme.txt, which contains information regarding installing and troubleshooting the file.

Determining the BIOS version

To decide whether you need to update Computer Setup (BIOS), first determine the BIOS version on your computer.

BIOS version information (also known as *ROM date* and *System BIOS*) can be accessed by pressing fn+esc (if you are already in Windows) or by using Computer Setup.

1. Start Computer Setup. See Starting Computer Setup on page 149.
2. Select **Main**, and then select **System Information**.
3. To exit Computer Setup menus without saving your changes, select **Main**, select **Ignore Changes and Exit**, and then select **Yes**.

NOTE: If you are using arrow keys to highlight your choice, you must then press enter.

To check for later BIOS versions, see Downloading a BIOS update on page 150.

Downloading a BIOS update

CAUTION: To reduce the risk of damage to the computer or an unsuccessful installation, download and install a BIOS update only when the computer is connected to reliable external power using the AC adapter. Do not download or install a BIOS update while the computer is running on battery power, docked in an optional docking device, or connected to an optional power source. During the download and installation, follow these instructions:

Do not disconnect power on the computer by unplugging the power cord from the AC outlet.

Do not shut down the computer or initiate Sleep.

Do not insert, remove, connect, or disconnect any device, cable, or cord.

1. Type `support` in the taskbar search box, and then select the HP Support Assistant app.

   – or –

   Select the question mark icon in the taskbar.
2. Select **Updates**, and then select **Check for updates and messages**.
3. Follow the on-screen instructions.
4. At the download area, follow these steps:

a. Identify the most recent BIOS update and compare it to the BIOS version currently installed on your computer. Make a note of the date, name, or other identifier. You may need this information to locate the update later, after it has been downloaded to your hard drive.

b. Follow the on-screen instructions to download your selection to the hard drive.

Make a note of the path to the location on your hard drive where the BIOS update is downloaded. You will need to access this path when you are ready to install the update.

NOTE: If you connect your computer to a network, consult the network administrator before installing any software updates, especially system BIOS updates.

BIOS installation procedures vary. Follow any instructions that are displayed on the screen after the download is complete. If no instructions are displayed, follow these steps:

1. Type `file` in the taskbar search box, and then select **File Explorer**.
2. Select your hard drive designation. The hard drive designation is typically Local Disk (C:).
3. Using the hard drive path you recorded earlier, open the folder that contains the update.
4. Double-click the file that has an .exe extension (for example, *filename*.exe).

   The BIOS installation begins.
5. Complete the installation by following the on-screen instructions.

NOTE: After a message on the screen reports a successful installation, you can delete the downloaded file from your hard drive.

Changing the boot order using the f9 prompt

To dynamically choose a boot device for the current startup sequence, follow these steps:

1. Access the Boot Device Options menu:
   - Turn on or restart the computer, and when the HP logo appears, press f9 to enter the Boot Device Options menu.
2. Select a boot device, press enter, and then follow the on-screen instructions.

TPM BIOS settings (select products only)

IMPORTANT: Before enabling Trusted Platform Module (TPM) functionality on this system, you must ensure that your intended use of TPM complies with relevant local laws, regulations and policies, and approvals or licenses must be obtained if applicable. For any compliance issues arising from your operation/usage of TPM which violates the above mentioned requirement, you shall bear all the liabilities wholly and solely. HP will not be responsible for any related liabilities.

TPM provides additional security for your computer. You can modify the TPM settings in Computer Setup (BIOS).

NOTE: If you change the TPM setting to Hidden, TPM is not visible in the operating system.

To access TPM settings in Computer Setup:

1. Start Computer Setup. See Starting Computer Setup on page 149.
2. Select **Security**, select **TPM Embedded Security**, and then follow the on-screen instructions.

Using HP Sure Start (select products only)

Select computer models are configured with HP Sure Start, a technology that monitors the computer's BIOS for attacks or corruption. If the BIOS becomes corrupted or is attacked, HP Sure Start automatically restores the BIOS to its previously safe state, without user intervention.

HP Sure Start is configured and already enabled so that most users can use the HP Sure Start default configuration. The default configuration can be customized by advanced users.

To access the latest documentation on HP Sure Start, go to http://www.hp.com/support. Select **Find your product**, and then follow the on-screen instructions.

9 Backing up, restoring, and recovering

This chapter provides information about the following processes, which are standard procedure for most products:

- **Backing up your personal information**—You can use Windows tools to back up your personal information (see Using Windows tools on page 153).
- **Creating a restore point**—You can use Windows tools to create a restore point (see Using Windows tools on page 153).
- **Creating recovery media** (select products only)—You can use the HP Cloud Recovery Download Tool (select products only) to create recovery media (see Using the HP Cloud Recovery Download Tool to create recovery media (select products only) on page 153).
- **Restoring and recovery**—Windows offers several options for restoring from backup, refreshing the computer, and resetting the computer to its original state (see Using Windows tools on page 153).

IMPORTANT: If you will be performing recovery procedures on a tablet, the tablet battery must be at least 70% charged before you start the recovery process.

IMPORTANT: For a tablet with a detachable keyboard, connect the tablet to the keyboard base before beginning any recovery process.

Backing up information and creating recovery media

Using Windows tools

IMPORTANT: Windows is the only option that allows you to back up your personal information. Schedule regular backups to avoid information loss.

You can use Windows tools to back up personal information and create system restore points and recovery media.

NOTE: If computer storage is 32 GB or less, Microsoft System Restore is disabled by default.

For more information and steps, see the Get Help app.

1. Select the **Start** button, and then select the **Get Help** app.
2. Enter the task you want to perform.

NOTE: You must be connected to the Internet to access the Get Help app.

Using the HP Cloud Recovery Download Tool to create recovery media (select products only)

You can use the HP Cloud Recovery Download Tool to create HP Recovery media on a bootable USB flash drive.

To download the tool:

▲ Go to the Microsoft Store and search for HP Cloud Recovery.

For details, go to http://www.hp.com/support, search for HP Cloud Recovery, and then select "HP PCs – Using the Cloud Recovery Tool (Windows 10, 7)."

NOTE: If you cannot create recovery media yourself, contact support to obtain recovery discs. Go to http://www.hp.com/support, select your country or region, and then follow the on-screen instructions.

Restoring and recovery

Restoring, resetting, and refreshing using Windows tools

Windows offers several options for restoring, resetting, and refreshing the computer. For details, see Using Windows tools on page 153.

Recovering using HP Recovery media

HP Recovery media is used to recover the original operating system and software programs that were installed at the factory. On select products, it can be created on a bootable USB flash drive using the HP Cloud Recovery Download Tool. For details, see Using the HP Cloud Recovery Download Tool to create recovery media (select products only) on page 153.

NOTE: If you cannot create recovery media yourself, contact support to obtain recovery discs. Go to http://www.hp.com/support, select your country or region, and then follow the on-screen instructions.

To recover your system:

- Insert the HP Recovery media, and then restart the computer.

Changing the computer boot order

If your computer does not restart using the HP Recovery media, you can change the computer boot order. This is the order of devices listed in BIOS where the computer looks for startup information. You can change the selection to an optical drive or a USB flash drive, depending on the location of your HP Recovery media.

To change the boot order:

IMPORTANT: For a tablet with a detachable keyboard, connect the tablet to the keyboard base before beginning these steps.

1. Insert the HP Recovery media.
2. Access the system **Startup** menu.

   For computers or tablets with keyboards attached:

   - Turn on or restart the computer or tablet, quickly press esc, and then press f9 for boot options.

   For tablets without keyboards:

   - Turn on or restart the tablet, quickly hold down the volume up button, and then select **f9**.

     – or –

     Turn on or restart the tablet, quickly hold down the volume down button, and then select **f9**.
3. Select the optical drive or USB flash drive from which you want to boot, and then follow the on-screen instructions.

10 Using HP PC Hardware Diagnostics

Using HP PC Hardware Diagnostics Windows (select products only)

NOTE: Depending on the operating system preinstalled on your computer, HP PC Hardware Diagnostics may not be supported.

HP PC Hardware Diagnostics Windows is a Windows-based utility that allows you to run diagnostic tests to determine whether the computer hardware is functioning properly. The tool runs within the Windows operating system in order to diagnose hardware failures.

If HP PC Hardware Diagnostics Windows is not installed on your computer, first you must download and install it. To download HP PC Hardware Diagnostics Windows, see Downloading HP PC Hardware Diagnostics Windows on page 155.

After HP PC Hardware Diagnostics Windows is installed, follow these steps to access it from HP Help and Support or HP Support Assistant.

1. To access HP PC Hardware Diagnostics Windows from HP Help and Support:

   a. Select the **Start** button, and then select **HP Help and Support**.

   b. Right-click **HP PC Hardware Diagnostics Windows**, select **More**, and then select **Run as administrator**.

   – or –

   To access HP PC Hardware Diagnostics Windows from HP Support Assistant:

   a. Type `support` in the taskbar search box, and then select the **HP Support Assistant** app.

      – or –

      Select the question mark icon in the taskbar.

   b. Select **Troubleshooting and fixes**.

   c. Select **Diagnostics**, and then select **HP PC Hardware Diagnostics Windows**.

2. When the tool opens, select the type of diagnostic test you want to run, and then follow the on-screen instructions.

   NOTE: If you need to stop a diagnostic test at any time, select **Cancel**.

3. When HP PC Hardware Diagnostics Windows detects a failure that requires hardware replacement, a 24-digit Failure ID code is generated. For assistance in correcting the problem, contact support, and then provide the Failure ID code.

Downloading HP PC Hardware Diagnostics Windows

- The HP PC Hardware Diagnostics Windows download instructions are provided in English only.
- You must use a Windows computer to download this tool because only .exe files are provided.

Downloading the latest HP PC Hardware Diagnostics Windows version

To download HP PC Hardware Diagnostics Windows, follow these steps:

1. Go to http://www.hp.com/go/techcenter/pcdiags. The HP PC Diagnostics home page is displayed.
2. In the **HP PC Hardware Diagnostics** section, select **Download**, and then select a location on your computer or a USB flash drive.

The tool is downloaded to the selected location.

Downloading HP Hardware Diagnostics Windows by product name or number (select products only)

NOTE: For some products, it may be necessary to download the software to a USB flash drive by using the product name or number.

To download HP PC Hardware Diagnostics Windows by product name or number, follow these steps:

1. Go to http://www.hp.com/support.
2. Select **Get software and drivers**, select your type of product, and then enter the product name or number in the search box that is displayed.
3. In the **HP PC Hardware Diagnostics** section, select **Download**, and then select a location on your computer or a USB flash drive.

The tool is downloaded to the selected location.

Installing HP PC Hardware Diagnostics Windows

To install HP PC Hardware Diagnostics Windows, follow these steps:

- Navigate to the folder on your computer or the flash drive where the .exe file was downloaded, double-click the .exe file, and then follow the on-screen instructions.

Using HP PC Hardware Diagnostics UEFI

NOTE: For Windows 10 S computers, you must use a Windows computer and a USB flash drive to download and create the HP UEFI support environment because only .exe files are provided. For more information, see Downloading HP PC Hardware Diagnostics UEFI to a USB flash drive on page 157.

HP PC Hardware Diagnostics UEFI (Unified Extensible Firmware Interface) allows you to run diagnostic tests to determine whether the computer hardware is functioning properly. The tool runs outside the operating system so that it can isolate hardware failures from issues that are caused by the operating system or other software components.

If your PC will not boot into Windows, you can use HP PC Hardware Diagnostics UEFI to diagnose hardware issues.

When HP PC Hardware Diagnostics UEFI detects a failure that requires hardware replacement, a 24-digit Failure ID code is generated. For assistance in correcting the problem, contact support, and provide the Failure ID code.

NOTE: To start diagnostics on a convertible computer, your computer must be in notebook mode, and you must use the attached keyboard.

NOTE: If you need to stop a diagnostic test, press esc.

Starting HP PC Hardware Diagnostics UEFI

NOTE: For Windows 10 S computers, see Downloading HP PC Hardware Diagnostics UEFI to a USB flash drive on page 157.

To start HP PC Hardware Diagnostics UEFI, follow these steps:

1. Turn on or restart the computer, and quickly press esc.
2. Press f2.

   The BIOS searches three places for the diagnostic tools, in the following order:

   a. Connected USB flash drive

      NOTE: To download the HP PC Hardware Diagnostics UEFI tool to a USB flash drive, see Downloading the latest HP PC Hardware Diagnostics UEFI version on page 157.

   b. Hard drive

   c. BIOS
3. When the diagnostic tool opens, select the type of diagnostic test you want to run, and then follow the on-screen instructions.

Downloading HP PC Hardware Diagnostics UEFI to a USB flash drive

Downloading HP PC Hardware Diagnostics UEFI to a USB flash drive can be useful in the following situations:

- HP PC Hardware Diagnostics UEFI is not included in the preinstall image.
- HP PC Hardware Diagnostics UEFI is not included in the HP Tool partition.
- The hard drive is damaged.

NOTE: The HP PC Hardware Diagnostics UEFI download instructions are provided in English only, and you must use a Windows computer to download and create the HP UEFI support environment because only .exe files are provided.

Downloading the latest HP PC Hardware Diagnostics UEFI version

To download the latest HP PC Hardware Diagnostics UEFI version to a USB flash drive:

1. Go to http://www.hp.com/go/techcenter/pcdiags. The HP PC Diagnostics home page is displayed.
2. In the **HP PC Hardware Diagnostics UEFI** section, select **Download UEFI Diagnostics**, and then select **Run**.

Downloading HP PC Hardware Diagnostics UEFI by product name or number (select products only)

NOTE: For some products, it may be necessary to download the software to a USB flash drive by using the product name or number.

To download HP PC Hardware Diagnostics UEFI by product name or number (select products only) to a USB flash drive:

1. Go to http://www.hp.com/support.
2. Enter the product name or number, select your computer, and then select your operating system.
3. In the **Diagnostics** section, follow the on-screen instructions to select and download the specific UEFI Diagnostics version for your computer.

Using Remote HP PC Hardware Diagnostics UEFI settings (select products only)

Remote HP PC Hardware Diagnostics UEFI is a firmware (BIOS) feature that downloads HP PC Hardware Diagnostics UEFI to your computer. It can then execute the diagnostics on your computer, and it may upload results to a preconfigured server. For more information on Remote HP PC Hardware Diagnostics UEFI, go to http://www.hp.com/go/techcenter/pcdiags, and then select **Find out more**.

Downloading Remote HP PC Hardware Diagnostics UEFI

NOTE: HP Remote PC Hardware Diagnostics UEFI is also available as a Softpaq that can be downloaded to a server.

Downloading the latest Remote HP PC Hardware Diagnostics UEFI version

To download the latest Remote HP PC Hardware Diagnostics UEFI version, follow these steps:

1. Go to http://www.hp.com/go/techcenter/pcdiags. The HP PC Diagnostics home page is displayed.
2. In the **HP PC Hardware Diagnostics UEFI** section, select **Download Remote Diagnostics**, and then select **Run**.

Downloading Remote HP PC Hardware Diagnostics UEFI by product name or number

NOTE: For some products, it may be necessary to download the software by using the product name or number.

To download HP Remote PC Hardware Diagnostics UEFI by product name or number, follow these steps:

1. Go to http://www.hp.com/support.
2. Select **Get software and drivers**, select your type of product, enter the product name or number in the search box that is displayed, select your computer, and then select your operating system.
3. In the **Diagnostics** section, follow the on-screen instructions to select and download the **Remote UEFI** version for the product.

Customizing Remote HP PC Hardware Diagnostics UEFI settings

Using the Remote HP PC Hardware Diagnostics setting in Computer Setup (BIOS), you can perform the following customizations:

- Set a schedule for running diagnostics unattended. You can also start diagnostics immediately in interactive mode by selecting **Execute Remote HP PC Hardware Diagnostics**.
- Set the location for downloading the diagnostic tools. This feature provides access to the tools from the HP website or from a server that has been preconfigured for use. Your computer does not require the traditional local storage (such as a disk drive or USB flash drive) to run remote diagnostics.

- Set a location for storing the test results. You can also set the user name and password settings used for uploads.
- Display status information about the diagnostics run previously.

To customize Remote HP PC Hardware Diagnostics UEFI settings, follow these steps:

1. Turn on or restart the computer, and when the HP logo appears, press f10 to enter Computer Setup.
2. Select **Advanced**, and then select **Settings**.
3. Make your customization selections.
4. Select **Main**, and then **Save Changes and Exit** to save your settings.

Your changes take effect when the computer restarts.

11 Specifications

Computer specifications

Table 11-1 Computer specifications

	Metric	U.S.
Dimensions		
Depth	**256.5 mm**	10.10 in
Width	**365.0 mm**	14.37 in
Height	**25.4 mm**	1.00 in
Weight		
52.5 WHr battery	**2142 g**	4.72 lb
70 WHr battery	**2180 g**	4.81 lb
Input power		
Operating voltage and current	19.5 V dc @ 3.33 A – 65 W 19.5 V dc @ 2.31 A – 45 W	
Temperature		
Operating	**5°C to 35°C**	41°F to 95°F
Nonoperating	**-20°C to 60°C**	-4°F to 140°F
Relative humidity (noncondensing)		
Operating	10% to 90%	
Nonoperating	5% to 95%	
Maximum altitude (unpressurized)		
Operating	**-15 m to 3,048 m**	-50 ft to 10,000 ft
Nonoperating	**-15 m to 12,192 m**	-50 ft to 40,000 ft

NOTE: Applicable product safety standards specify thermal limits for plastic surfaces. The device operates well within this range of temperatures.

39.6-cm (15.6-in) display specifications

Table 11-2 39.6-cm (15.6-in) display specifications

	Metric	U.S.
Active diagonal size	39.6-cm	15.6-in
Resolution	1920x1080 (FHD) 3840x2160 (UHD)	
Surface treatment	Anti glare BrightView	
Brightness	220 nits or 250 nits (FHD) 340 nits (UHD)	
Viewing angle	UWVA	
Backlight	WLED	
Graphics adapter	eDP (FHD) eDP+NVSR (UHD)	
Thickness	3.2 mm	

Hard drive specifications

Table 11-3 Hard drive specifications

	2-TB*	1-TB*	500-GB*
Dimensions			
Height	9.5 mm	9.5 mm	7.0 mm
Length	100.4 mm	100.4 mm	100.6 mm
Width	69.9 mm	69.9 mm	70.1 mm
Weight	130.0 g	107.0 g	92.0 g
Interface type	SATA	SATA	SATA
Transfer rate			
Synchronous (maximum)	300 MB/sec	300 MB/sec	300 MB/sec
Security	ATA security	ATA security	ATA security
Seek times (typical read, including setting)			
Single track	2.0 ms	2.0 ms	3 ms
Average (read/write)	12 ms	12 ms	13 ms
Maximum	22 ms	22 ms	24 ms
Logical blocks	3,907,029,168	1,953,525,168	1,048,576,000
Disk rotational speed	5400 rpm	5400 rpm	5400 rpm
Operating temperature	**0°C** to **60°C** (32°F to 140°F)		
*1 GB = 1 billion bytes when referring to hard drive storage capacity. Actual accessible capacity is less.			
NOTE: Certain restrictions and exclusions apply. Contact technical support for details.			

12 Power cord set requirements

The wide-range input feature of the computer permits it to operate from any line voltage from 100 to 120 volts ac, or from 220 to 240 volts ac.

The 3-conductor power cord set included with the computer meets the requirements for use in the country or region where the equipment is purchased.

Power cord sets for use in other countries and regions must meet the requirements of the country or region where the computer is used.

Requirements for all countries

The following requirements are applicable to all countries and regions:

- The length of the power cord set must be at least **1.5 m** (5.0 ft) and no more than **2.0 m** (6.5 ft).
- All power cord sets must be approved by an acceptable accredited agency responsible for evaluation in the country or region where the power cord set will be used.
- The power cord sets must have a minimum current capacity of 10 A and a nominal voltage rating of 125 or 250 V ac, as required by the power system of each country or region.
- The appliance coupler must meet the mechanical configuration of an EN 60 320/IEC 320 Standard Sheet C13 connector for mating with the appliance inlet on the back of the computer.

Requirements for specific countries and regions

Table 12-1 Power cord requirements for specific countries and regions

Country/region	Accredited agency	Applicable note number
Argentina	IRAM	1
Australia	SAA	1
Austria	OVE	1
Belgium	CEBEC	1
Brazil	ABNT	1
Canada	CSA	2
Chile	IMQ	1
Denmark	DEMKO	1
Finland	FIMKO	1
France	UTE	1
Germany	VDE	1
India	ISI	1
Israel	SII	1
Italy	IMQ	1
Japan	JIS	3
The Netherlands	KEMA	1
New Zealand	SANZ	1
Norway	NEMKO	1
The People's Republic of China	CCC	4
Saudi Arabia	SASO	7
Singapore	PSB	1
South Africa	SABS	1
South Korea	KTL	5
Sweden	SEMKO	1
Switzerland	SEV	1
Taiwan	BSMI	6
Thailand	TISI	1
The United Kingdom	ASTA	1
The United States	UL	2

1. The flexible cord must be Type HO5VV-F, 3-conductor, 0.75mm^2 conductor size. Power cord set fittings (appliance coupler and wall plug) must bear the certification mark of the agency responsible for evaluation in the country or region where it will be used.

Table 12-1 Power cord requirements for specific countries and regions (continued)

Country/region	Accredited agency	Applicable note number

2. The flexible cord must be Type SVT/SJT or equivalent, No. 18 AWG, 3-conductor. The wall plug must be a two-pole grounding type with a NEMA 5-15P (15 A, 125 V ac) or NEMA 6-15P (15 A, 250 V ac) configuration. CSA or C-UL mark. UL file number must be on each element.
3. The appliance coupler, flexible cord, and wall plug must bear a “T” mark and registration number in accordance with the Japanese Dentori Law. The flexible cord must be Type VCTF, 3-conductor, 0.75mm^2 or 1.25mm^2 conductor size. The wall plug must be a two-pole grounding type with a Japanese Industrial Standard C8303 (7 A, 125 V ac) configuration.
4. The flexible cord must be Type RVV, 3-conductor, 0.75mm^2 conductor size. Power cord set fittings (appliance coupler and wall plug) must bear the CCC certification mark.
5. The flexible cord must be Type H05VV-F 3X0.75mm^2 conductor size. KTL logo and individual approval number must be on each element. Corset approval number and logo must be printed on a flag label.
6. The flexible cord must be Type HVCTF 3X1.25mm^2 conductor size. Power cord set fittings (appliance coupler, cable, and wall plug) must bear the BSMI certification mark.
7. For 127 V ac, the flexible cord must be Type SVT or SJT 3 x 18 AWG, with plug NEMA 5-15P (15 A, 125 V ac), with UL and CSA or C-UL marks. For 240 V ac, the flexible cord must be Type H05VV-F 3X0.75/1.00mm^2 conductor size, with plug BS 1363/A with BSI or ASTA marks.

13 Statement of memory volatility

The purpose of this chapter is to provide general information regarding nonvolatile memory in HP Business computers. This chapter also provides general instructions for restoring nonvolatile memory that can contain personal data after the system has been powered off and the hard drive has been removed.

HP Business computer products that use Intel®-based or AMD®-based system boards contain volatile DDR memory. The amount of nonvolatile memory present in the system depends upon the system configuration. Intel-based and AMD-based system boards contain nonvolatile memory subcomponents as originally shipped from HP, assuming that no subsequent modifications have been made to the system and assuming that no applications, features, or functionality have been added to or installed on the system.

Following system shutdown and removal of all power sources from an HP Business computer system, personal data can remain on volatile system memory (DIMMs) for a finite period of time and will also remain in nonvolatile memory. Use the steps below to remove personal data from the computer, including the nonvolatile memory found in Intel-based and AMD-based system boards.

NOTE: If your tablet has a keyboard base, connect to the keyboard base before beginning steps in this chapter.

Current BIOS steps

1. Follow steps (a) through (l) below to restore the nonvolatile memory that can contain personal data. Restoring or reprogramming nonvolatile memory that does not store personal data is neither necessary nor recommended.

   a. Turn on or restart the computer, and then press esc while the "Press the ESC key for Startup Menu" message is displayed at the bottom of the screen.

   NOTE: If the system has a BIOS administrator password, enter the password at the prompt.

   b. Select **Main**, select **Apply Factory Defaults and Exit**, and then select **Yes** to load defaults.

   The computer will reboot.

   c. During the reboot, press esc while the “Press the ESC key for Startup Menu” message is displayed at the bottom of the screen.

   NOTE: If the system has a BIOS administrator password, enter the password at the prompt.

   d. Select the **Security** menu, select **Restore Security Settings to Factory Defaults**, and then select **Yes** to restore security level defaults.

   The computer will reboot.

   e. During the reboot, press esc while the “Press the ESC key for Startup Menu” message is displayed at the bottom of the screen.

   NOTE: If the system has a BIOS administrator password, enter the password at the prompt.

   f. If an asset or ownership tag is set, select the **Security** menu and scroll down to the **Utilities** menu. Select **System IDs**, and then select **Asset Tracking Number**. Clear the tag, and then make the selection to return to the prior menu.

g. If a DriveLock password is set, select the **Security** menu, and scroll down to **Hard Drive Utilities** under the **Utilities** menu. Select **Hard Drive Utilities**, select **DriveLock**, then uncheck the checkbox for **DriveLock password on restart**. Select **OK** to proceed.

h. Select the **Main** menu, and then select **Reset BIOS Security to factory default**. Click **Yes** at the warning message.

   The computer will reboot.

i. During the reboot, press esc while the “Press the ESC key for Startup Menu” message is displayed at the bottom of the screen.

NOTE: If the system has a BIOS administrator password, enter the password at the prompt.

j. Select the **Main** menu, select **Apply Factory Defaults and Exit**, select **Yes** to save changes and exit, and then select **Shutdown**.

k. Reboot the system. If the system has a Trusted Platform Module (TPM) and/or fingerprint reader, one or two prompts will appear—one to clear the TPM and the other to Reset Fingerprint Sensor; press or tap F1 to accept or F2 to reject.

l. Remove all power and system batteries for at least 24 hours.

2. Complete one of the following:

   - Remove and retain the storage drive.

   – or –

   - Clear the drive contents by using a third party utility designed to erase data from an SSD.

   – or –

   - Clear the contents of the drive by using the following BIOS Setup Secure Erase command option steps:

IMPORTANT: If you clear data using Secure Erase, it cannot be recovered.

a. Turn on or restart the computer, and then press esc while the "Press the ESC key for Startup Menu" message is displayed at the bottom of the screen.

b. Select the **Security** menu and scroll down to the **Utilities** menu.

c. Select **Hard Drive Utilities**.

d. Under **Utilities**, select **Secure Erase**, select the hard drive storing the data you want to clear, and then follow the on-screen instructions to continue.

Nonvolatile memory usage

Table 13-1 Nonvolatile memory usage

Nonvolatile Memory Type	Amount (Size)	Does this memory store customer data?	Does this memory retain data when power is removed?	What is the purpose of this memory?	How is data input into this memory?	How is this memory write-protected?
HP Sure Start flash (select models only)	8 MBytes	No	Yes	Provides protected backup of critical System BIOS code, EC firmware, and critical computer configuration data for select platforms that support HP Sure Start. For more information, see Using HP Sure Start (select models only) on page 174.	Data cannot be written to this device via the host processor. The content is managed solely by the HP Sure Start Embedded Controller.	This memory is protected by the HP Sure Start Embedded Controller.
Controller (NIC) EEPROM	64 KBytes (not customer accessible)	No	Yes	Stores NIC configuration and NIC firmware.	NIC EEPROM is programmed using a utility from the NIC vendor that can be run from DOS.	A utility is required to write data to this memory and is available from the NIC vendor. Writing data to this ROM in an inappropriate manner will render the NIC non-functional.
DIMM Serial Presence Detect (SPD) configuration data	256 Bytes per memory module, 128 Bytes programmable (not customer accessible)	No	Yes	Stores memory module information.	DIMM SPD is programmed by the memory vendor.	Data cannot be written to this memory when the module is installed in a computer. The specific write-protection method varies by memory vendor.
System BIOS	9 MBytes	Yes	Yes	Stores system BIOS code and computer configuration data.	System BIOS code is programmed at the factory. Code is updated when the system BIOS is updated. Configuration data and settings are input using the Computer Setup (BIOS) or a custom utility.	**NOTE:** Writing data to this ROM in an inappropriate manner can render the computer non-functional. A utility is required for writing data to this memory and is available on the HP website; go to http://www.hp.com/support. Select **Find your product**, and then follow the on-screen instructions.

Table 13-1 Nonvolatile memory usage (continued)

Nonvolatile Memory Type	Amount (Size)	Does this memory store customer data?	Does this memory retain data when power is removed?	What is the purpose of this memory?	How is data input into this memory?	How is this memory write-protected?
Intel Management Engine Firmware (present only in select Elite or Z models. For more information, go to http://www.hp.com/support. Select **Find your product**, and then follow the on-screen instructions.)	1.5 MBytes or 7 MBytes	Yes	Yes	Stores Management Engine Code, Settings, Provisioning Data and iAMT third-party data store.	Management Engine Code is programmed at the factory. Code is updated via Intel secure firmware update utility. Unique Provisioning Data can be entered at the factory or by an administrator using the Management Engine (MEBx) setup utility. The third party data store contents can be populated by a remote management console or local applications that have been registered by an administrator to have access to the space.	The Intel chipset is configured to enforce hardware protection to block all direct read/write access to this area. An Intel utility is required for updating the firmware. Only firmware updates digitally signed by Intel can be applied using this utility.
Bluetooth flash (select products only)	2 Mbit	No	Yes	Stores Bluetooth configuration and firmware.	Bluetooth flash is programmed at the factory. Tools for writing data to this memory are not publicly available but can be obtained from the silicon vendor.	A utility is required for writing data to this memory and is made available through newer versions of the driver whenever the flash requires an upgrade.
802.11 WLAN EEPROM	4 Kbit to 8 Kbit	No	Yes	Stores configuration and calibration data.	802.11 WLAN EEPROM is programmed at the factory. Tools for writing data to this memory are not made public.	A utility is required for writing data to this memory and is typically not made available to the public unless a firmware upgrade is necessary to address a unique issue.
Webcam (select products only)	64 Kbit	No	Yes	Stores webcam configuration and firmware.	Webcam memory is programmed using a utility from the device manufacturer that can be run from Windows.	A utility is required for writing data to this memory and is typically not made available to the public unless a firmware upgrade is necessary to address a unique issue.
Fingerprint reader (select products only)	512 KByte flash	Yes	Yes	Stores fingerprint templates.	Fingerprint reader memory is programmed by user enrollment in HP ProtectTools Security Manager.	Only a digitally signed application can make the call to write to the flash.

Questions and answers

1. **How can the BIOS settings be restored (returned to factory settings)?**

   IMPORTANT: Restore defaults does not securely erase any data on your hard drive. See question and answer 6 for steps to securely erase data.

   Restore defaults does not reset the Custom Secure Boot keys. See question and answer 7 for information about resetting the keys.

   a. Turn on or restart the computer, and then press esc while the "Press the ESC key for Startup Menu" message is displayed at the bottom of the screen.

   b. Select **Main**, and then select **Apply Factory Defaults and Exit**.

   c. Follow the on-screen instructions.

   d. Select **Main**, select **Save Changes and Exit**, and then follow the on-screen instructions.

2. **What is a UEFI BIOS, and how is it different from a legacy BIOS?**

   The Unified Extensible Firmware Interface (UEFI) BIOS is an industry-standard software interface between the platform firmware and an operating system (OS). It is a replacement for the older BIOS architecture, but supports much of the legacy BIOS functionality.

   Like the legacy BIOS, the UEFI BIOS provides an interface to display the system information and configuration settings and to change the configuration of your computer before an OS is loaded. BIOS provides a secure run-time environment that supports a Graphic User Interface (GUI). In this environment, you can use either a pointing device (Touchscreen, TouchPad, pointing stick, or USB mouse) or the keyboard to navigate and make menu and configuration selections. The UEFI BIOS also contains basic system diagnostics.

   The UEFI BIOS provides functionality beyond that of the legacy BIOS. In addition, the UEFI BIOS works to initialize the computer's hardware before loading and executing the OS; the run-time environment allows the loading and execution of software programs from storage devices to provide more functionality, such as advanced hardware diagnostics (with the ability to display more detailed system information) and advanced firmware management and recovery software.

   HP has provided options in Computer Setup (BIOS) to allow you to run in legacy BIOS, if required by the operating system. Examples of this requirement would be if you upgrade or downgrade the OS.

3. **Where does the UEFI BIOS reside?**

   The UEFI BIOS resides on a flash memory chip. A utility is required to write to the chip.

4. **What kind of configuration data is stored on the DIMM Serial Presence Detect (SPD) memory module? How would this data be written?**

   The DIMM SPD memory contains information about the memory module, such as size, serial number, data width, speed/timing, voltage, and thermal information. This information is written by the module manufacturer and stored on an EEPROM. This EEPROM cannot be written to when the memory module is installed in a computer. Third-party tools do exist that can write to the EEPROM when the memory module is not installed in a computer. Various third-party tools are available to read SPD memory.

5. **How can the BIOS security be reset to factory defaults and data erased?**

   IMPORTANT: Resetting will result in the loss of information.

   These steps will not reset Custom Secure Boot Keys. See question and answer 7 for information about resetting the keys.

a. Turn on or restart the computer, and then press esc while the "Press the ESC key for Startup Menu" message is displayed at the bottom of the screen.

b. Select **Main**, and then select **Reset Security to Factory Defaults**.

c. Follow the on-screen instructions.

d. Select **Main**, select **Save Changes and Exit**, and then follow the on-screen instructions.

6. **How can the Custom Secure Boot Keys be reset?**

   Secure Boot is a feature to ensure that only authenticated code can start on a platform. If you enabled Secure Boot and created Custom Secure Boot Keys, simply disabling Secure Boot will not clear the keys. You must also select to clear the Custom Secure Boot Keys. Use the same Secure Boot access procedure you used to create the Custom Secure Boot Keys, but make the selection to clear or delete all Secure Boot Keys.

   a. Turn on or restart the computer, and then press esc while the "Press the ESC key for Startup Menu" message is displayed at the bottom of the screen.

   b. Select the **Security** menu, select **Secure Boot Configuration**, and then follow the on-screen instructions.

   c. At the **Secure Boot Configuration** window, select **Secure Boot**, select **Clear Secure Boot Keys**, and then follow the on-screen instructions to continue.

Using HP Sure Start (select models only)

Select computer models are configured with HP Sure Start, a technology that continuously monitors your computer's BIOS for attacks or corruption. If the BIOS becomes corrupted or is attacked, HP Sure Start restores the BIOS to its previously safe state, without user intervention. Those select computer models ship with HP Sure Start configured and enabled. HP Sure Start is configured and already enabled so that most users can use the HP Sure Start default configuration. The default configuration can be customized by advanced users.

To access the latest documentation on HP Sure Start, go to http://www.hp.com/support. Select **Find your product**, and then follow the on-screen instructions.

14 Recycling

When a non-rechargeable or rechargeable battery has reached the end of its useful life, do not dispose of the battery in general household waste. Follow the local laws and regulations in your area for battery disposal.

HP encourages customers to recycle used electronic hardware, HP original print cartridges, and rechargeable batteries. For more information about recycling programs, see the HP Web site at http://www.hp.com/recycle.

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