HP Z1 G2 Workstation

Maintenance and Service Guide

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About this guide

This guide provides service and maintenance information.

IMPORTANT: **Removal and replacement procedures are now available in videos on the HP website.**

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml.

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NOTE: View the *HP Z1 G2 Workstation User Guide* at http://www.hp.com/support/workstation_manuals.

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1 Hardware overview

The HP Z1 G2 Workstation is offered in both a touch and a non-touch model. The touch model has a glossy glass front, and the non-touch model has a matte surface, surrounded by a plastic bezel.

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.

This chapter presents an overview of workstation hardware components.

Topics
Front and bottom components on page 2
Side components on page 3
Rear components on page 4
Chassis components on page 5
System board components on page 6
System board architecture on page 7
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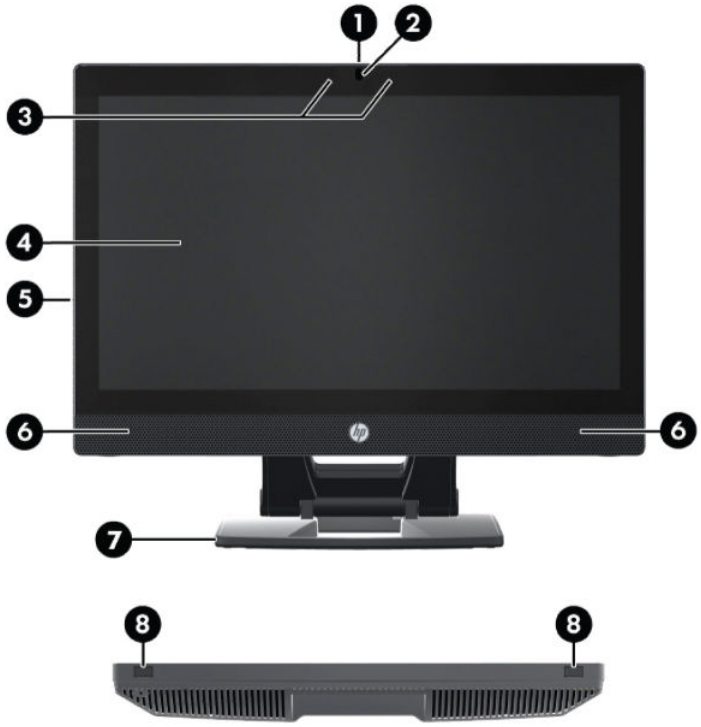
Front and bottom components



1	Camera angle adjustment dial	**5**	Serial number pull-out card
2	Camera	**6**	Speakers
3	Left and right digital microphones	**7**	Stand
4	Display panel	**8**	Chassis latches (bottom view)

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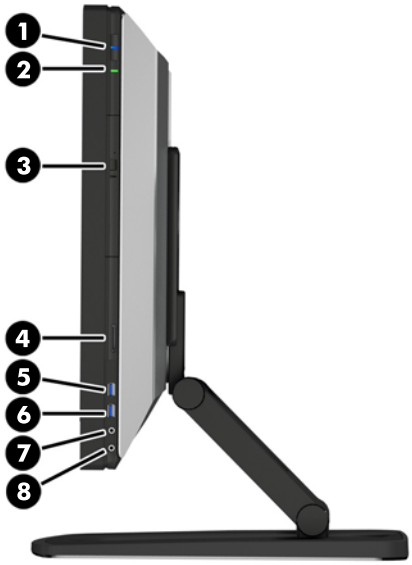
Side components



1		Power button	5	SS	USB 3.0 port
2		Hard drive activity light	6	SS	USB 3.0 with battery charging port
3		Slimline slot-load optical drive (or optional Thunderbolt™ 2 module)	7		Headset jack
4		Memory card reader	8		Microphone jack

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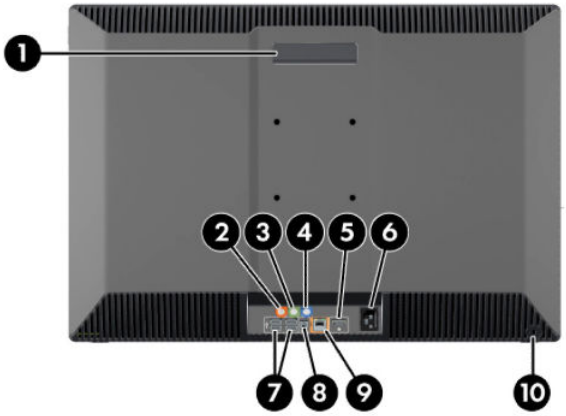
Rear components



1		Handle	**6**		Power cord connector
2	Sub	Subwoofer jack(orange)	**7**		USB 2.0 connectors (4)
3		Audio line-out jack (green)	**8**	S/PDIF	Optical S/PDIF audio output
4		Audio line-in jack (blue)	**9**		RJ-45 network connector
5		DisplayPort 1.1a connector	**10**		Security cable slot

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Chassis components

1	Chassis and display assembly	**7**	Memory modules (DIMMs)	**13**	Graphics filler block (installed if graphics card assembly is not ordered)
2	Stand	**8**	Slot-load optical drive	**14**	Rear I/O board
3	Power supply	**9**	3.5” hard drive carrier	**15**	Wireless keyboard/mouse USB receiver
4	Graphics card assembly	**10**	System board	**16**	Memory fan
5	Mini-PCIe or mSATA card	**11**	Side I/O board	**17**	Optional Thunderbolt 2 module (installed in slot-load optical drive bay)
6	Processor (CPU) heatsink	**12**	Speakers	**18**	Optional 2.5” hard drive carrier

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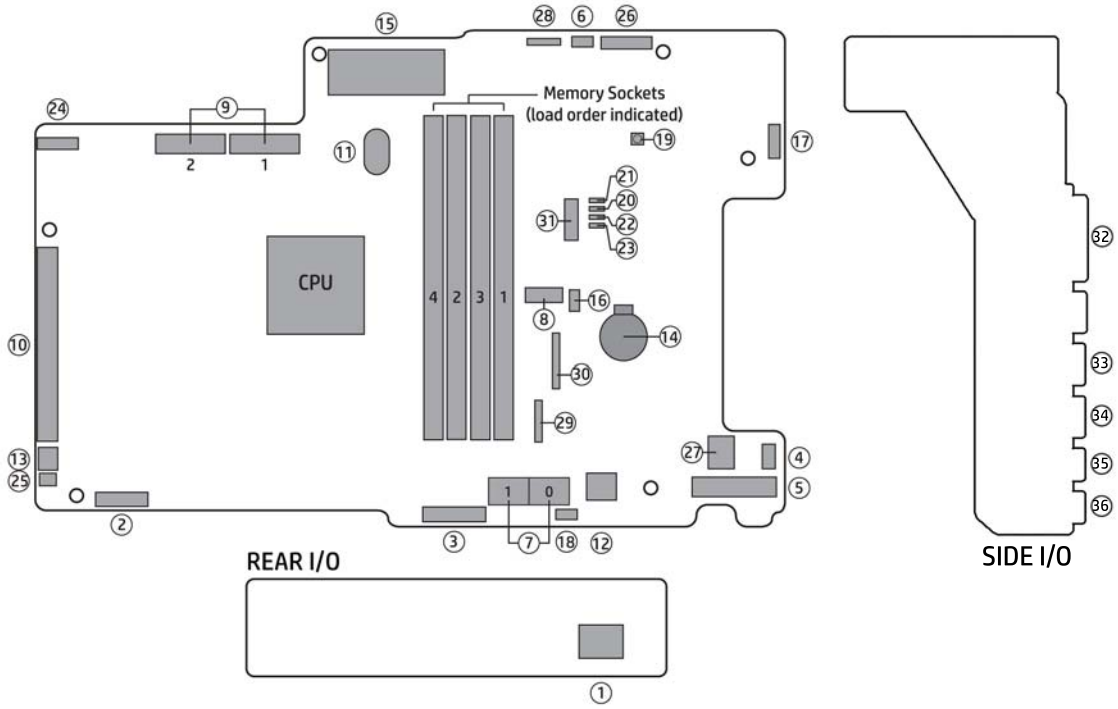
System board components

The following figure and table describe the system board component layout.



I/O		Cooling		Misc	
1	Internal USB	**11**	CPU fan	**24**	Display
2	Rear DP/LAN	**12**	Memory fan	**25**	Hood sensor
3	Rear USB	**13**	MXM fan	**26**	LED backlight
4	Rear audio		**Power**	**27**	Speakers
5	Side I/O	**14**	Battery	**28**	Webcam/Mic
6	Touch controller header	**15**	Main power	**29**	Thunderbolt 2 module PCIe
	SATA	**16**	Optical drive power	**30**	Thunderbolt 2 module DisplayPort
7	Hard drive SATA (6 Gb/s)	**17**	User panel I/O header	**31**	Thunderbolt 2 module power
8	Optical drive SATA (6 Gb/s)	**18**	HDD power connector	**32**	Side I/O memory card reader
	PCI/PCIe		**Service**	**33**	Side I/O USB 3.0
9	Mini PCIe/mSATA (2)	**19**	Clear CMOS	**34**	Side I/O USB 3.0 battery charging
10	MXM graphics	**20**	Crisis Recovery jumper	**35**	Side I/O audio (headset)
		21	ME/AMT flash override jumper	**36**	Side I/O audio (mic)
		22	Boot block enable		
		23	Password jumper		

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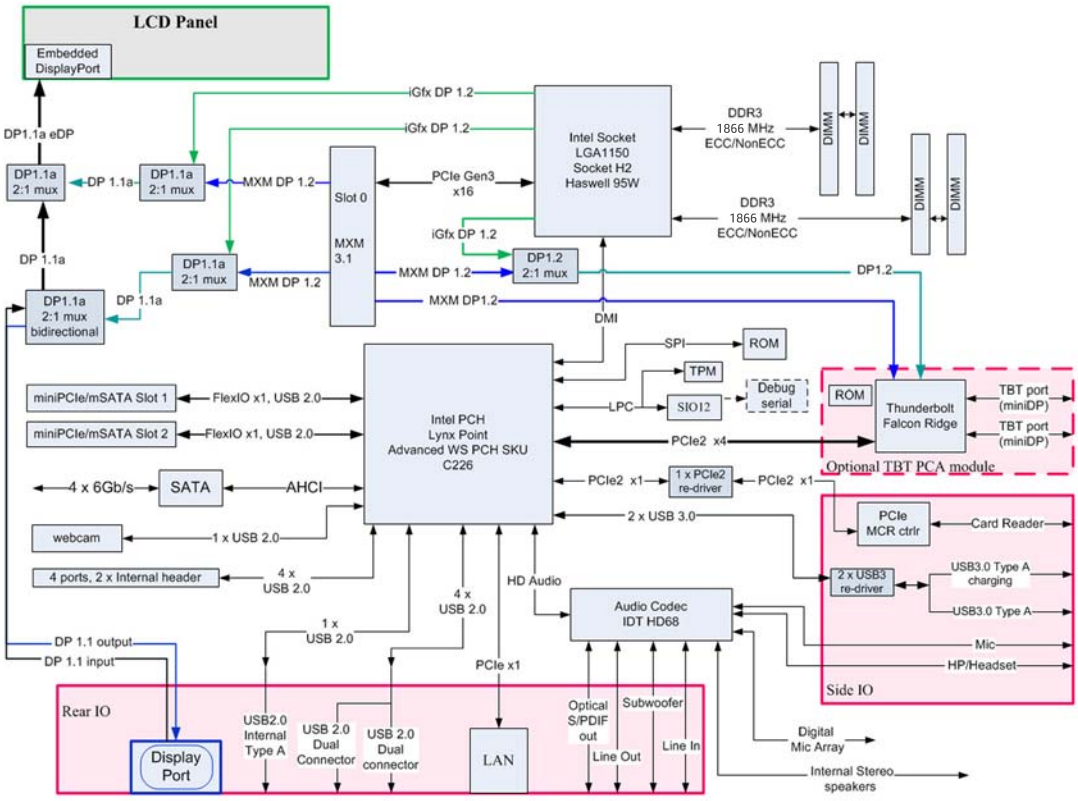
System board architecture

The following figure shows the system board block diagram.



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Workstation specifications

Physical characteristics and technical specifications

	HP Z1 G2 Workstation	
Weight	With stand (non touch)	19.2 kg (42.3 lbs)
	With stand (touch)	21.0 kg (46.3 lbs)
	Without stand (non touch)	13.3 kg (29.3 lbs)
	Without stand (touch)	15.1 kg (33.3 lbs)
	Stand only	5.9 kg (13.0 lbs)
Dimensions	Upright, including stand	**Height**: 533.4 mm (21.0 in) **Width**: 660.4 mm (26.0 in) **Depth**: 419.1 mm (16.5 in)
	Unit only	**Height**: 457.2 mm (18.0 in) **Width**: 660.4 mm (26.0 in) **Depth**: 81.3 mm (3.2 in)
Processor technology	Intel® Series C226 chipset with: • Support for the Intel® Xeon® Processor E3 v3 Family or 4th generation Intel® Core™ processors up to 95W • Integrated 2-channel memory controller • Microarchitecture improvements • Integrated graphics (some models) • Advanced Vector Extensions (AVX) to increase floating point performance • Intel DMI2 interface connecting the processor to the I/O controller	
Power supply	• 400 W, 90% efficient, compatible with ENERGY STAR® Version 6.0 requirements • Supports European Union ERP Lot 6 tier 2 power limit of less than 0.5 W in off mode	
Memory technology	• Dual inline memory modules (DIMMs) based on DDR3 1866 MHz technology • Supports error checking and correcting (ECC) and non-ECC DIMMs • Two direct-attach memory channels that enable low-latency access and fast data transfer for improved performance • Up to 32 GB system memory (8 GB DIMMs) • 1866 MHz, 2 GB, 4 GB, or 8 GB ECC unbuffered DIMM • 1866 MHz, 4 GB non-ECC unbuffered DIMM **NOTE:** The processor controls the speed of the memory. If the processor supports only 1600 MHz memory, the memory will run at 1600 MHz regardless of the speed capability of the DIMMs.	
Graphics	• One MXM graphics card assembly (optional) that has PCIe x16 Gen3 link **NOTE:** MXM graphics can simultaneously drive up to 4 displays. For example it can drive the internal display and a monitor connected to the external DisplayPort and a monitor connected to each port on the optional Thunderbolt 2 module, if installed. Or it can drive 4 multistream monitors connected to a port on the optional Thunderbolt 2 module, if installed; in this case the internal panel will not be active.	

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	HP Z1 G2 Workstation
	NOTE: The speed of the PCIe x16 link is determined by the processor and the graphics card. If the processor or the graphics card only supports PCIe Gen2 speeds, the MXM PCIe x16 link will run at Gen2 speeds. • Supports Intel HD Graphics 4400, 4600, or P4600 (depends on processor type) **NOTE:** If an MXM graphics card is installed, Intel HD Graphics is disabled. **NOTE:** Intel Core processors provide Intel HD Graphics 4400 or 4600; Intel Xeon processors with model designations that end in "---5" provide Intel HD Graphics P4600. **NOTE:** Intel HD graphics can drive up to 3 displays simultaneously. For example, it can drive the internal display and a monitor attached to the external DisplayPort and a monitor attached to the port on the optional Thunderbolt 2 module, if installed. Or it can drive 3 multistream displays off the optional Thunderbolt 2 module, if installed; in this case the internal display will not be active.
I/O technology	• RAID configurations for SATA RAID levels 0, 1 • External and internal USB 2.0 ports • External USB 3.0 ports; the lower port supplies USB battery charging • HP Low Power State technology enabled • Supports European Union ERP Lot 6 tier2 power limit of less than 0.5W in off mode • RJ-45 for LAN • DisplayPort (output/input) • Webcam • Digital microphone array • Headset and microphone • Line in and line out • Subwoofer • Optical S/PDIF output • SD 4.0 card reader • Thunderbolt 2 port(s) if optional Thunderbolt module installed **NOTE:** MXM graphics supports 2 Thunderbolt 2 ports; Intel HD graphics supports 1 Thunderbolt 2 port.

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Environmental specifications

Temperature	**Operating**: 5°C to 35°C (40°F to 95°F) **Nonoperating**: -40°C to 60°C (-40°F to 140°F) **NOTE:** The ambient upper limit of 35°C is good up to 1524 m (5000 ft) elevation. Derate by 1°C for every 305 m (1000 ft) above 1524 m (5000 ft). For example, at 3,048 m (10,000 ft), the upper ambient air temperature limit is 30°C.
Humidity	**Operating**: 8% to 85% relative humidity, non-condensing **Nonoperating**: 8% to 90% relative humidity, non-condensing
Altitude	**Operating:** 0 to 3,048 m (10,000 ft) **Nonoperating**: 0 to 9,144 m (30,000 ft)
Shock	**Operating**: ½-sine: 40*g*, 2–3 ms (~62 cm/sec) **Nonoperating**: • ½-sine: 160 cm/s, 2–3 ms (~105*g*) • square: 422 cm/s, 20*g* **NOTE:** Values represent individual shock events and do not indicate repetitive shock events.
Vibration	**Operating random**: 0.5*g* (rms), 5–300 Hz, up to 0.0025 g^2/Hz **Non-operating random**: 2.0*g* (rms), 5–500 Hz, up to 0.0150 g^2/Hz **NOTE:** Values do not indicate continuous vibration.

Location and ventilation

Proper ventilation for the system is important for workstation operation. To be sure that ventilation is adequate, do the following:

- Operate the workstation on a sturdy, level surface.
- Provide at least:
  - 12 cm (4.7 in) clearance at the front, back, top, and bottom of the workstation
  - 16 cm (6.3 in) clearance on the right side for the optical drive
- Confirm that the ambient air temperature surrounding the workstation falls within the specified limits (see Environmental specifications on page 10).
- Never restrict the incoming or outgoing airflow of the workstation by blocking any vents or air intakes.

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2 System management

This section describes the tools and utilities that provide system management for the workstation.

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BIOS ROM on page 12
Computer Setup (F10) Utility on page 13
Desktop management on page 23

Power management features

ERP compliance mode

This computer provides ERP compliance mode capability.

When this feature is enabled, the computer shuts down to the lowest possible power state. The computer must then be turned on with the power button. One of the effects is that "wake on LAN" is disabled.

When this feature is disabled, the computer shuts down conventionally.

Enabling ERP compliance mode	1. Power on or restart the workstation and press F10 during startup to launch the Computer Setup (F10) utility. 2. Using the arrow keys, select **Power**, then **Hardware Power Management**, and then **S5 Maximum Power Savings**. 3. Select **Enable**, and then press Enter to accept the change. 4. Select **File**, and then select **Save Change and Exit**. Press Enter to accept the change. 5. If using Windows 8 or Windows 8.1, boot to Windows and search in the Start Menu for the setting **Change what the power buttons do**. Uncheck **Turn on fast startup (recommended)**. If the checkbox is not available, select **Change settings that are currently unavailable** at the top of the window. If using Windows 10, use the taskbar search field to search for Power Options. Select **Choose what the power button does**, then select **Turn on fast startup (recommended)**.
Disabling ERP compliance mode	1. Power on or restart the workstation and press F10 during startup to launch the Computer Setup (F10) utility. 2. Using the arrow keys, select **Power**, then **Hardware Power Management**, and then **S5 Maximum Power Savings**. 3. Select **Disable**, and then press Enter to accept the change. 4. Select **File**, and then select **Save Change and Exit**. Press Enter to accept the change. 5. If using Windows 8 or Windows 8.1, boot to Windows and search in the Start Menu for the setting **Change what the power buttons do**. Check **Turn on fast startup (recommended)**. If the check box is not available, select **Change settings that are currently unavailable** at the top of the window. If using Windows 10, use the taskbar search field to search for Power Options. Select **Choose what the power button does**, then select **Turn on fast startup (recommended)**.

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Hyper-Threading Technology (HTT)

This computer supports HTT, an Intel-proprietary technology that improves processor performance through parallelization of computations (doing multiple tasks at once).

The operating system treats an HTT-enabled processor as two virtual processors and shares the workload between them when possible. This feature requires that the operating system support multiple processors and be specifically optimized for HTT.

Use the Computer Setup (F10) Utility to enable HTT.

Go to http://www.hp.com/go/quickspecs to determine if your CPU supports HTT.

SATA Power Management

SATA Power Management enables or disables SATA bus and/or device power management.

Intel Turbo Boost Technology

The HP Z Workstation series supports Intel® Turbo Boost Technology.

This feature enables the CPU to run at frequencies above the normal frequency. When all CPU cores are not necessary for the workload, inactive cores are turned off and power is diverted to the active cores to increase their performance.

Turbo Boost is enabled and disabled with the Computer Setup (F10) Utility.

Go to http://www.hp.com/go/quickspecs to determine if your CPU supports Turbo Boost.

BIOS ROM

The BIOS ROM is a collection of machine language applications stored as firmware in ROM. It includes functions such as Power-On Self-Test (POST), PCI device initialization, Plug and Play support, power management, and Computer Setup (F10) Utility.

Go to http://www.hp.com/go/quickspecs to review the latest BIOS ROM specifications.

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Computer Setup (F10) Utility

Topics
Computer Setup (F10) Utility functions on page 13
Accessing Computer Setup (F10) Utility on page 14
Computer Setup (F10) Utility menu on page 15

Computer Setup (F10) Utility functions

This section presents the Computer Setup (F10) Utility functions. In most cases, OS-specific information is described for a Windows-based computer, however much of this information applies to all operating systems. Occasional notes about non-Windows operating systems are included.

Computer Setup (F10) Utility enables you to perform the following tasks:

- Update BIOS using a USB device.
- Change factory default settings and set or change the workstation configuration, which might be necessary when you add or remove hardware.
- Determine whether all devices installed on the workstation are recognized by the system and are functioning.
- Determine information about the operating environment of the workstation.
- Solve system configuration errors that are detected but not resolved during the Power-On Self-Test (POST).
- Establish and manage passwords and other security features.
- Establish and manage energy-saving time-outs.
- Set the workstation date and time, and modify or restore factory default settings.
- Set, view, change, or verify the workstation configuration, including settings for CPU, graphics, memory, audio, storage, communications, and input devices.
- Modify the boot order of installed mass storage devices such as SATA drives, optical drives, and network drives.
- Enable or disable Network Server Mode. This mode enables the workstation to start the operating system when the power-on password is enabled, with or without a keyboard or mouse attached. When the keyboard and mouse are attached to the workstation, they remain locked until the power-on password is entered.
- Select Post Messages Enabled or Disabled to change the display status of Power-On Self-Test (POST) messages. Post Messages Disabled suppresses most POST messages, such as memory count, product name, and other non-error text messages. If a POST error occurs, the error is displayed regardless of the mode selected. To manually switch to Post Messages Enabled during POST, press any key (except F1 through F12).
- Specify an Ownership Tag, which is displayed on the screen when the workstation is started or restarted.
- Specify the Asset Tag or property identification number assigned to this workstation.
- Enable power-on password prompts during system restarts (warm-starts) and when the computer is started.

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- Hide or show the integrated I/O functionality, including serial, USB, or parallel ports, audio, or embedded NIC. Hidden devices are inaccessible, which increases system security.
- Enable or disable removable media boot ability.
- Enable or disable removable media write ability (if supported by hardware).
- Replicate the workstation setup by saving system configuration information to removable storage or restoring it.

Accessing Computer Setup (F10) Utility

Accessing Computer Setup (F10) Utility requires a keyboard. To access Computer Setup (F10) Utility:

1. Turn on or restart the workstation.
2. When the display is active and **Press the Esc key for Startup Menu** appears at the bottom of the screen, press F10 or Esc.

   If you do not press F10 or Esc at the appropriate time, try again. Turn the workstation off, then on, and press F10 again to access the utility. You can also press Ctrl + Alt + Delete before starting if you do not press F10 before the message disappears.
3. Select a language from the list, and press the Enter key.

   In the Computer Setup (F10) Utility menu, five headings are displayed: File, Storage, Security, Power, and Advanced.

NOTE: The option for selecting the language is available on first boot only. To reset the selection, press Esc during POST and from the Startup menu, select **Change Language** to switch between languages.

4. Use the left and right arrow keys to select the appropriate heading, use the up and down arrow keys to select an option, and then press Enter.
5. Choose from the following:
   - To apply and save changes, select **File** and then select **Save Changes and Exit**. Press Enter to accept the changes.
   - To remove changes you have made, select **Ignore Changes and Exit**, and then press Enter to acknowledge the cancellation.
   - To restore factory settings, select **File**, select **Default Setup**, and then select **Restore Factory Settings as Default**. Press Enter to accept the changes, and then select **Apply Defaults and Exit**.

CAUTION: Do not turn off the workstation while saving Computer Setup (F10) Utility changes, because the Complementary Metal-Oxide Semiconductor (CMOS) nonvolatile storage could become corrupted. Turn off after you exit the F10 Setup screen.

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Computer Setup (F10) Utility menu

The following table describes the functions available in the Computer Setup (F10) Utility menu.

NOTE: With new BIOS releases, the following content is subject to change, so the menu might be different than shown.

Heading	Option	Description

File	System Information	Displays the following information:
		• Product Name
		• Manufacturer
		• SKU Number
		• Processor Type
		• Processor Speed
		• Processor Stepping
		• Memory Size
		  ◦ Channel A
		  ◦ Channel B
		• Integrated MAC
		• Chassis serial number
		• Asset Tracking Number
		• System Board ID
		• System Board CT Number
		• BIOS Version & Date
		• ME Firmware Version

	About	Displays system BIOS copyright information.
	Set Time and Date	Enables you to set system time and date.
	Flash System ROM	Enables you to upgrade the BIOS from a ROM image on a CD or USB or hard drive or network.
	Replicated Setup	Provides these options: • Save to Removable Storage Device—Saves the workstation configuration, including CMOS, in the cpqsetup.txt file. This file can be saved to a USB removable storage device. • Restore from Removable Storage Device—Restores the workstation configuration from a USB removable storage device.
	Default Setup	Provides these options: • Save Current Settings as Default—Saves the current settings as default settings for the next operation. • Restore Factory Settings as Default—Restores the factory settings as the default settings for the next operation.
	Apply Defaults and Exit	Restores the default settings defined in Default Setup.

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Heading	Option	Description
	Ignore Changes and Exit	Exits workstation setup without applying or saving changes.
	Save Changes and Exit	Saves changes to system configuration and exits the workstation setup.
Storage	Device Configuration	Lists installed storage devices and provides options for obtaining specific information about each device: To see additional information about a device, use the Up and Down arrow keys to see a device and press Enter to show additional details about the device if available. Hard Disk • SATA0 <DRIVE CAPACITY>, <DRIVE MFG and/or MODEL> (If installed) • SATA1 <DRIVE CAPACITY>, <DRIVE MFG and/or MODEL> (If installed) • SATA5 <DRIVE CAPACITY>, <mSATA DRIVE MFG and/or MODEL> (If mSATA installed in SLOT2) CD-ROM • SATA2 <MFG MODEL> (If installed)
	Storage Options	Provides these options: • SATA Emulation—Sets the SATA emulation mode with the following options: ◦ RAID —RAID OPROM executes. This emulation mode is the default and offers the best performance and most functionality. ◦ IDE—Legacy emulation mode ◦ AHCI—Advanced host controller interface emulation • Removable Media Boot—Enables and disables the ability to start the workstation from removable media.
	Boot Order	Enables you to configure the boot order by physically reordering the menu entries. The following is the default boot order presented in the menu: • UEFI Boot Sources ◦ OS-specific Boot Manager ◦ ATAPI CD/DVD Drive ◦ USB Floppy/CD ◦ USB Hard Drive ◦ Hard Drive (may only appear if the device has an EFI boot file on it) • Legacy Boot Sources ◦ ATAPI CD/DVD Drive ◦ USB Floppy/CD ◦ Hard Drive — USB Hard Drive — *Hard Drive Name* ◦ Network Controller (This option is available only if the workstation is connected to a network.) Use the arrow keys to move the cursor to a listed device, and then perform one of the following actions: • Press Enter to select or deselect the device.

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Heading	Option	Description
		• Use the arrow keys to move a selected device up or down in the boot order. Press F10 to accept the new boot order. • For a selected device, press F5 to enable or disable it as a bootable device. MS-DOS drive lettering assignments might not apply after an operating system other than MS-DOS has started. Boot devices can be disabled in the boot order process. These order changes are stored in the physical ROM when the F10 Setup changes are confirmed. Select **File**, select **Save Changes**, and then select **Exit**. You can temporarily override the boot order. To start one time from a device other than the default device specified in Boot Order, restart the workstation and press F9 when the F9=Boot Menu message appears on the screen. After POST completes, a list of bootable devices is displayed. Use the arrow keys to select the preferred bootable device, and then press Enter. The workstation then starts from the selected non-default device for this one time.
Security	Setup Password	Enables you to set and enable a setup password for the administrator. If you create a setup password, you must use it to change workstation setup options, to flash the ROM, and to make changes to certain Plug and Play settings under Windows.
	Power-On Password	Enables you to set and enable the power-on password.
	Password Options	This option becomes available when you create a setup and/or power-on password. It provides these options: • Setup Browse Mode—Enables read-only functionality for password info. • Password Prompt on F9, F11 & F12—Enables a password prompt on a warm boot. • Network Server Mode—Enables network server mode. • Stringent Password—(Disable/Enable) Creates a password that cannot be reset by the password jumper.
	Device Security	Makes the following devices available or hidden to the workstation: • Embedded Security Device • Card Reader Controller • Internal Webcam Device • Touch Controller • System Audio • Network Controller • SATA0 • SATA1 • SATA2 • Thunderbolt Security Level (These options are available only when the Thunderbolt 2 module is in the system.) ◦ Legacy Mode (This option allows all devices to connect without user intervention.) ◦ Unique ID (default) (Device connection is managed by the Thunderbolt Service running on the host system. The Thunderbolt Service is currently available only on Windows. Upon first device connection, the Thunderbolt Service prompts you to connect, and you can choose from **Do Not Connect**, **One Time Connect**, or **Always Connect**. Choosing **Always Connect** for one device allows any device of the same type to connect to the system. For example, selecting **Always Connect** for one LaCie Little Big Disk allows any LaCie Little Big Disk to connect to the system.)

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Heading	Option	Description
		◦ One time saved Key (Applies to Falcon Ridge devices only, allows Thunderbolt host controller to differentiate between many of the same type of device.) ◦ DP++ only (This option allows only monitor connections and does not allow data traffic.) For each device (except Embedded Security Device), **Device Available** is the default setting and allows the operating system to access the device. **Device Hidden** makes the device unavailable; it is disabled by the BIOS and cannot be enabled by the operating system. **NOTE:** An entry for enabling DriveLock will only appear in the setup menu if the workstation has at least one enabled hard drive that supports it.
	USB Security	Set workstation USB ports to Enabled/Disabled: • Side USB Ports ◦ USB3 Port 1 ◦ USB3 Port 2 • Rear USB Ports ◦ USB Port 1 ◦ USB Port 2 ◦ USB Port 3 ◦ USB Port 4
	Slot Security	Lets you enable or disable any mini PCIe/mSATA slot.
	Network Boot	Enables or disables the ability to boot to the network using the F12 key or the boot order.
	System IDs	Provides these options: • Enter Asset Tag—A 16-byte string identifying the workstation. • Enter Ownership Tag—An 80-byte string identifying ownership of the workstation. This tag appears on the screen during POST. • Enter UUID (Universal Unique Identifier)—Can only be updated if the current chassis serial number is invalid. (These ID numbers are normally set in the factory and are used to uniquely identify the workstation.) • Keyboard Layout—Enables you to set the keyboard locale for System ID entry.
	Master Boot Record Security	Enable or Disable—This option is for advanced users. When Master Boot Record (MBR) Security is enabled, the BIOS prevents any changes being made to the MBR of the current bootable disk while in MS-DOS or Windows Safe Mode. **NOTE:** Most operating systems control access to the MBR of the current bootable disk; the BIOS cannot prevent changes that may occur while the operating system is running.
	System Security	Provides these options: • Data Execution Prevention—Enables or disables Data Execution Prevention mode in the CPUs. This mode prohibits code from running in pages that were set up as data pages, and prevents attacks such as buffer overflows. Operating system support is required for this feature. • Virtualization Technology (VTx)—Enables or disables Intel Virtualization Technology to increase workstation performance. (Only visible on supported CPUs) • Virtualization Technology Directed I/O (VTd)—(Enabled or Disabled) Controls the underlying processor and chipset features needed to support a virtual appliance. • Trusted Execution Technology—(Disabled/Enabled) Turns Intel TXT feature on or off. • Embedded Security Device—This option becomes available if Embedded Device is set to Available under Device Security.

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Heading	Option	Description
		NOTE: Embedded Security Device must be set to Device Available in the Device Security menu, and you must create a Setup Password, in order to configure the Embedded Security Device. Embedded Security Device—(Hidden or Available) turns the Trusted Platform Mechanism (TPM) on and off. Device Hidden is the default. If this option is made available, the following options become available: ◦ Reset to factory settings ◦ Measure boot variables/devices to PCR1 For more information on TPM go to http://technet.microsoft.com/en-us/library/cc749022(v=ws.10).aspx. To enable the Embedded Security Device and to access any security features associated with the device, you must enter a setup password. Setting a device to Available enables the operating system to access the device. Hidden makes the device unavailable. It is disabled by the BIOS and cannot be enabled by the operating system. **CAUTION:** Choosing Reset to Factory Settings may result in significant data loss. The embedded security device is a critical component of many security schemes. Erasing the security keys prevents access to data protected by the Embedded Security Device. • OS Management of Embedded Security Device—Enables or disables the ability of the operating system to control the TPM device, including turning it on and off, initializing it, and resetting it. ◦ Reset of Embedded Security Device through OS—Enables or disables the ability of the operating system to reset the TPM. Available only when OS Management of Embedded Security Device is enabled. ◦ No PPI provisioning ◦ Allow PPI policy to be changed by OS
	DriveLock Security	Lets you assign or modify a master password or user password for hard drives. When enabled, this feature prompts the user to provide one of the DriveLock passwords during POST. If the user does not successfully enter one of the passwords, the hard drive remains inaccessible until one of the passwords is successfully entered during a subsequent cold-boot sequence. **NOTE:** This selection appears only when the system includes at least one drive that supports the DriveLock feature.
	Secure Boot Configuration	• Legacy Support—(Enable/Disable) • Secure Boot—(Enable/Disable) • Key Management ◦ Clear Secure Boot Keys—(Clear/Don't Clear) ◦ Key Ownership—(HP Keys/Custom Keys) • Fast Boot—(Enable/Disable) For more information on secure boot management go to http://h10025.www1.hp.com/ewfrf/wc/document?docname=c03653226&cc=us&dlc=en&lc=en.
Power	OS Power Management	Enables or disables: • Runtime Power Management—(Enable or Disable) • Idle Power Savings—Extended (default) or Normal; extended mode reduces processor power consumption when the CPU is idle • Unique Sleep State Blink Rates—(Enable or Disable)
	Hardware Power Management	Enables or disables: • SATA Power Management

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Heading	Option	Description
		• S5 Maximum Power Savings
	Thermal	Enables you to set the rate of the system fan when the CPU is in idle (Fan Idle Mode).
Advanced	Power-On Options	Enables you to set the following: • POST Messages—Enables or disables the splash screen during POST. • Press the Esc key for Startup Menu • Option ROM Prompt—(Enable or Disable) Enabling this feature causes the workstation to display a message before loading options ROMs. • After Power Loss (On, Off, Previous State)—"On" means the system will power on again after power is restored. "Off" means it will remain shut down after power is restored. "Previous State" directs the previous state to be the default after power is restored. • POST Delay (in seconds)—Adds a specified delay (5, 10, 15, 20, None) to the POST process. This delay is sometimes needed for hard drives on some expansion cards that spin up slowly (so slowly that they are not ready to start by the time POST is finished). The POST delay also gives you time to select F10 to enter Computer Setup (F10) Utility or other startup functions (e.g., F9 Boot Menu or F2 Diagnostics).. • Remote Wakeup Boot Source—Enables you to set the remote wakeup boot source as: ◦ Local Hard Drive ◦ Remote Server • Factory Recovery Boot Support—(Disabled/Enabled) • Bypass F1 Prompt on Configuration Changes • POST Memory Manager Runtime Allocation—(Disabled/Enabled) Enabling this forces legacy POST Memory Manager (PMM) to use runtime memory for allocation. This prevents Hibernation (S4) issues with some UEFI Windows installations.
	BIOS Power-On	Enables you to disable or specify a weekday and time for BIOS power-on. If this feature is enabled, the system will self-boot at the appointed day and time.
	Onboard Devices	Enables you to select the Legacy Device's IRQ, DMA, and I/O Range. The settings may not take effect for all operating systems. To hide a device from the OS, see Security/Device Security.
	Bus Options	Configures graphics cards per workstation slots. • PCI SERR# Generation—(Enabled/Disabled) Controls PCI SERR# generation for ill-behaved PCI add-in cards (that can generate SERR# spuriously)
	Device Options	Enables you to set the following device options: • Turbo Mode—(Enabled/Disabled) Allows Intel Processors to run at frequencies above the normal frequency. (Only visible on supported CPUs) • S5 Wake on LAN—(Enabled/Disabled) Allows unit to be turned on over the network. • Num Lock State at Power-On—(On or Off) • IGD (Integrated Graphic Device) Memory—Displayed when Integrated Video is Enabled. Sets the maximum amount of system memory that can be allowed as graphics memory (32M, 64M (default), 128M, 256M, 512M, 1024M). • Internal speaker—(Enable or Disable) • USB EHCI Port Debug—(Enable or Disable) • Multi-Processor (Activates a single core.)—(Enable or Disable) • Hyperthreading—(Enable or Disable) (Only visible on supported CPUs)
	Slot Settings	Enables you to set the following options for the Mini PCIe/mSATA slots:

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Heading	Option	Description
		• Slot 1 Option ROM Download—(Enabled/Disabled) • Slot 2 Option ROM Download—(Enabled/Disabled)
	Management Operations	Lets you set the following AMT (Intel Active Management Technology) configuration options: • AMT—(Enabled/Disabled) Allows for remote discovery, repair and protection of networked workstations. Enabling the AMT function also enables the Network Controller (required for AMT to function correctly). • Unconfigure AMT/ME—(Disabled/Enabled) Restores AMT/ME defaults. When you save and exit after enabling this option, you will be prompted to complete the process upon restart. A Setup Password (even if one is set) does not need to be entered to complete the process. **NOTE:** Information about Intel AMT can be found at www.intel.com. • Hide Un-Configure ME Confirmation Prompt—(Disabled/Enabled) • WatchDog Timer—(Enabled/Disabled) OS and BIOS WatchDog Timers can be set independently (in minutes): ◦ OS WatchDog Timer—Sets the OS WatchDog Timer ◦ BIOS WatchDog Timer—Sets the BIOS WatchDog Timer
	Option ROM Launch Policy	• PXE Option ROMS—(Legacy, UEFI Only, Do Not Launch) • Storage Option ROMS—(Legacy, UEFI Only, Do Not Launch) • Video Option ROMS—(Legacy, UEFI Only)
	Connected BIOS	• Connected BIOS—(Enable/Disable) • Use Proxy—(Enable/Disable) For more information about Connected BIOS, go to http://h20565.www2.hp.com/portal/site/hpsc/template.PAGE/action.process/public/psi/mostViewedDisplay/?sp4ts.oid=5403903&javax.portlet.action=true&spf_p.tpst=psiContentDisplay&javax.portlet.begCacheTok=com.vignette.cachetoken&spf_p.prp_psiContentDisplay=wsrp-interactionState%3DdocId%253Demr_na-c04119260%257CdocLocale%253Den_US&javax.portlet.endCacheTok=com.vignette.cachetoken.
	Update BIOS via Network	• Update BIOS via Network—(Enable/Disable) • Update Source—(HP, Custom) • Update Address (Only appears if Custom is selected in Update Source) • Automatic BIOS Update Setting—(Enable/Disable) For more information about Updae BIOS via Network, go to http://h20565.www2.hp.com/portal/site/hpsc/template.PAGE/action.process/public/psi/mostViewedDisplay/?sp4ts.oid=5403903&javax.portlet.action=true&spf_p.tpst=psiContentDisplay&javax.portlet.begCacheTok=com.vignette.cachetoken&spf_p.prp_psiContentDisplay=wsrp-interactionState%3DdocId%253Demr_na-c04119260%257CdocLocale%253Den_US&javax.portlet.endCacheTok=com.vignette.cachetoken.
	Intel (R) Ethernet Connection I217–LM — [MAC address]	• PORT CONFIGURATION MENU ◦ NIC Configuration • Link Speed—(Auto Negotiated, 10 Mbps Half, 10 Mbps Full, 100 Mbps Half, 100 Mbps Full)) • Wake On LAN—(Enable/Disable) ◦ Blink LEDs • PORT CONFIGURATION INFORMATION

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Heading	Option	Description
		◦ UEFI Driver ◦ Adapter PBA ◦ Chip Type ◦ PCI Device ID ◦ Bus:Device:Function ◦ Link Status ◦ MAC Address

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Desktop management

This section summarizes capabilities, features, and key components of computer management.

Topics
Initial computer configuration and deployment on page 24
Installing a remote system on page 24
Copying a setup configuration to another computer on page 24
Updating and managing software on page 25
LANDesk Software on page 25
HP Driver Pack on page 25
HP SoftPaq Download Manager on page 25
HP System Software Manager on page 26
ROM Flash on page 26
FailSafe Boot Block on page 26
Workstation security on page 27
Fault notification and recovery on page 34
Dual-state power button on page 34

NOTE: Support for specific features described in this guide can vary by model and software version.

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Initial computer configuration and deployment

The computer includes a preinstalled system software image. After a brief software unbundling process, the computer is ready to use.

If you prefer to replace the preinstalled software image with a customized set of system and application software, you can deploy a customized software image using either of the following methods:

- Installing additional software applications after unbundling the preinstalled software image
- Using a disk-cloning process to copy the contents from one hard drive to another

The HP Recovery Manager DVDs, ROM-based setup, and Advanced Configuration and Power Interface (ACPI) hardware provide further assistance with recovery of system software, configuration management and troubleshooting, and power management.

Support for specific features described in this guide can vary by model and software version.

The best deployment method depends on the information technology environment and processes.

Installing a remote system

When the computer has been configured as a remote system, you can start it and set it up by using software and configuration information on a network server. This feature is usually used for system setup and configuration and can be used to perform the following functions:

- Deploy a software image on new PCs
- Format a hard drive
- Install application software or drivers
- Update the operating system, application software, or drivers

To initiate a remote system installation, press F12 when **F12=Network Service Boot** appears in the lower right corner of the HP logo screen. Follow the onscreen instructions to continue the installation process. The default boot order can be changed in the BIOS so that the system always attempts to boot from the network.

Copying a setup configuration to another computer

This section provides information about replicating the computer setup.

CAUTION: Setup configuration is model specific. File system corruption can result if source and target computers are not the same model.

To copy a setup configuration:

1. Select a computer to use as the source of the setup configuration.
2. Connect a removable storage device to the computer, and then restart the computer.
3. As soon as the computer turns on, press and hold F10 until you enter Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.

   NOTE: If you do not press F10 at the appropriate time, you must restart the computer, and then press and hold F10 to access the utility.

4. Select **File**, select **Replicated Setup**, and then select **Save to Removable Storage Device**. Follow the instructions on the screen to create the configuration file `cpqsetup.txt` and write it to a USB storage device.

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5. Turn off the computer you want to configure (the target computer), and connect the removable storage device that contains the configuration.
6. Turn on the target computer.
7. Press and hold the F10 key until you enter Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.
8. Select **File**, select **Replicated Setup**, and then select **Restore from Removable Storage Device**. Follow the instructions on the screen.
9. Restart the computer when the configuration is complete.

Updating and managing software

HP provides several tools for managing and updating software on desktops and computers:

- LANDesk Software
- HP Driver Pack
- HP SoftPaq Download Manager
- System Software Manager

LANDesk Software

LANDesk and HP have partnered to help HP customers increase control over IT resources, reduce risks associated with owning them, and boost productivity within the IT environment.

Centrally leverage and manage the power of HP Professional Innovation tools with these features:

- Deployment and migration
- Remote assistance
- Mobile user and device management
- Energy conservation and power management
- HP hardware management

Go to http://www.landesk.com/partners/hp/client-management/ for more information about LANDesk Client Management Solutions for HP.

HP Driver Pack

The HP Driver Pack contains the Microsoft Windows drivers in an .INF-based installation format. This .INF installation method can be used alone or with bare-metal operating system deployment tools that require .INF based drivers. Select 32bit or 64bit to see a list of platforms (notebooks and tablets, workstations, and desktops) and the respective driver packs under the operating system. For more information, go to http://www8.hp.com/us/en/ads/clientmanagement/drivers-pack.html.

HP SoftPaq Download Manager

HP SoftPaq Download Manager is a free, easy-to-use interface for locating and downloading software updates for the HP client PC models in your environment. By specifying your models, operating system, and language, you can quickly locate, sort, and select the SoftPaqs you need. For more information, go to http://www8.hp.com/us/en/ads/clientmanagement/drivers-bios.html#softpaq-download-mng.

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HP System Software Manager

HP System Software Manager (SSM) is a utility that is available on Windows computers. It enables you to update system-level software on multiple systems simultaneously. When executed on a PC client system, SSM detects hardware and software versions and then updates the software from a central repository, known as a *file store*. Driver versions supported by SSM are noted with a special icon in the software, on the driver download website, and on the Support Software CD.

To download the utility or to obtain more information about SSM, go to http://www8.hp.com/us/en/ads/clientmanagement/drivers-bios.html#system-sw-mng.

ROM Flash

BIOS settings are stored on a programmable flash ROM. By establishing a setup password in Computer Setup (F10) Utility, you can protect unauthorized users from modifying the BIOS settings. This function is important to be sure that the operating integrity of the computer.

To upgrade the BIOS, download the latest SoftPaq images from http://www.hp.com/support/workstation_swdrivers.

Remote ROM Flash

Remote ROM Flash allows system administrators to safely upgrade the ROM on remote HP computers from a centralized network management console, resulting in a consistent deployment of, and greater control over, HP PC ROM images over the network.

To use Remote ROM Flash, the computer must be turned on, or turned on using Remote Wakeup.

For more information about Remote ROM Flash and HPQFlash, see the HP Client Manager Software or System Software Manager sections at http://www.hp.com/go/ssm.

HPQFlash

The HPQFlash utility is used to locally update or restore the system ROM on PCs using a Windows operating system. For more information about HPQFlash, go to http://www.hp.com/go/ssm, and enter the name of the computer.

FailSafe Boot Block

FailSafe Boot Block enables BIOS recovery in the unlikely event of a ROM flash failure.

For example, if a power failure occurs during a ROM upgrade, Boot Block uses a flash-protected section of the ROM to verify a valid system ROM flash when power is restored to the computer.

If the system ROM is valid, the computer starts normally. If the system ROM fails the validation check, FailSafe Boot Block provides enough support to start the computer from a BIOS image CD that has been created from a SoftPaq. The BIOS image CD programs the system ROM with a valid image.

When Boot Block detects an invalid system ROM, the computer power LED blinks red eight times and the computer beeps eight times; then the computer pauses for two seconds. On some models, a Boot Block recovery mode message appears.

In preparation for system recovery, use the BIOS CD media file in the SoftPaq to create a BIOS image CD or USB flash drive.

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Recovering the computer from Boot Block Recovery mode

To recover the computer after it enters Boot Block recovery mode:

1. Remove any media such as USB flash drives or discs in the optical drives.
2. Insert a BIOS image CD into the DVD drive. You can also use USB media such as an HP DriveKey.
3. Turn the computer off, and then turn it on.

   If no BIOS image CD or USB media is found, you are prompted to insert one and restart the computer.

   If a setup password has been established, the Caps Lock light turns on and you are prompted for the password.
4. Enter the setup password.

   If the computer starts from the boot media and successfully reprograms the ROM, three keyboard lights turn on and a rising-tone series of beeps signals successful recovery.
5. Remove the boot media and turn off the computer.
6. Restart the computer.

Workstation security

This section provides information about providing system security through asset tracking, password security, hard drive locking, and chassis locks.

Asset tracking

Asset tracking features provide data that can be managed using HP Systems Insight Manager (HP SIM), HP Console Management Controller (CMC), or other systems-management applications.

Seamless, automatic integration between asset tracking features and these products enables you to choose the management tool that is best suited to the environment and to leverage investments in existing tools.

HP also offers several solutions for controlling access to valuable components and information:

- Security features such as the Smart Cover Sensor (side access panel sensor) help prevent unauthorized access to the data and to the internal components of the computer
- Capability for protecting valuable data assets by disabling parallel, serial, or USB ports, or by disabling removable-media boot capability
- Memory Change and Side access panel sensor (Smart Cover Sensor) alerts, which can be forwarded to system management applications to deliver proactive notification of tampering with a computer's internal components

The Smart Cover Sensor and cable lock are available as options on select systems.

You can manage security settings as follows:

- Locally, with Computer Setup (F10) Utility
- Remotely, with HP CMS or HP System Software Manager (SSM), which enable the secure, consistent deployment and control of security settings from a simple command line utility

For more information about Computer Setup (F10) Utility, see Computer Setup (F10) Utility menu on page 15.

The following Computer Setup (F10) Utility features let you manage computer security.

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Feature	Purpose
Removable Media Boot Control	Prevents booting from removable media drives
USB Interface Control	Prevents transfer of data through the integrated USB interface
Power-On Password	Prevents use of the computer until the password is entered (applies to initial system startup and restarts)
Setup Password	Prevents reconfiguration of the computer (through Computer Setup (F10) Utility) until the password is entered
Network Server Mode	Provides unique security features for computers used as servers

SATA hard drive security

HP computers include the HP DriveLock facility for SATA hard drives to prevent unauthorized access to data.

⚠ **WARNING!** Enabling DriveLock can render a SATA hard drive permanently inaccessible if the master password is lost or forgotten. No method exists to recover the password or access the data.

DriveLock has been implemented as an extension to Computer Setup (F10) Utility functions. It is only available when hard drives that support the ATA security command set are detected. On HP computers, it is not available when the SATA emulation mode is RAID.

DriveLock is for HP customers for whom data security is the paramount concern. For such customers, the cost of a hard drive and the loss of the data stored on it is inconsequential when compared to the damage that could result from unauthorized access to its contents.

To balance this level of security with the need to address the issue of a forgotten password, the HP implementation of DriveLock employs a two-password security scheme. One password is intended to be set and used by a system administrator, while the other is typically set and used by the user.

No "back door" can be used to unlock the drive if both passwords are lost. Therefore, DriveLock is most safely used when the data contained on the hard drive is replicated on a corporate information system or is regularly backed up.

If both DriveLock passwords are lost, the hard drive is inaccessible. For users who do not fit the previously defined customer profile, this outcome might not be acceptable. For users who fit this profile, the outcome might be a tolerable risk, given the nature of the data stored on the hard drive.

DriveLock applications

The most practical use of DriveLock is in a corporate environment. The system administrator would be responsible for configuring the hard drive, which involves setting the DriveLock master password and a temporary user password. If the system administrator forgets the user password or if the equipment is passed on to another employee, the master password can be used to reset the user password and restore access to the hard drive.

HP recommends that corporate system administrators who enable DriveLock also establish a corporate policy for setting and maintaining master passwords. This precaution will prevent loss of information if an employee sets both DriveLock passwords before leaving the company. In such a scenario, the hard drive is inaccessible and must be replaced. Likewise, by not setting a master password, system administrators might find themselves locked out of a hard drive and unable to perform routine checks for unauthorized software, other asset control functions, and support.

For users with less stringent security requirements, HP does not recommend enabling DriveLock. Users in this category include personal users, or users who do not maintain sensitive data on their hard drives as a

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common practice. For these users, the potential loss of a hard drive resulting from forgetting both passwords is much greater than the value of the data DriveLock protects.

Access to Computer Setup (F10) Utility and DriveLock can be restricted through the setup password. By specifying a setup password and not giving it to users, system administrators can restrict users from enabling DriveLock.

Using DriveLock

When hard drives that support the ATA security command set are detected, DriveLock appears under the Security menu in the Computer Setup (F10) Utility menu. You are presented with options to set the master password and to enable DriveLock. You must provide a user password to enable DriveLock. Because the initial configuration of DriveLock is typically performed by a system administrator, a master password should be set first.

HP encourages system administrators to set a master password whether they plan to enable DriveLock or not. This gives the administrator the ability to modify DriveLock settings if the drive is locked in the future. After the master password is set, the system administrator can enable DriveLock or leave it disabled.

If a locked hard drive is present, POST requires a password to unlock the device. If a power-on password is set and it matches the device's user password, POST does not prompt the user to re-enter the password. Otherwise, the user is prompted to enter a DriveLock password.

For a cold start, use the master or user password. For a warm start, enter the same password used to unlock the drive during the preceding cold start.

Users have two attempts to enter a correct password. During cold start, if neither attempt succeeds, POST continues but the drive remains inaccessible. During a warm-start or restart from Windows, if neither attempt succeeds, POST halts and the user is instructed to cycle power.

Enabling DriveLock

To enable and set the DriveLock user password:

1. Turn on or restart the computer.
2. As soon as the computer is turned on, repeatedly press the F10 key until Computer Setup (F10) Utility starts.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 to access the utility.
3. Select **Security** and then select **DriveLock Security**.
4. For each DriveLock-capable drive, select the drive by pressing Enter.
5. Under Enable/Disable DriveLock options, select **Enable**, and then press Enter to enable DriveLock for that drive.

NOTE: To set the DriveLock master password, select **Master**.

CAUTION: If you forget the DriveLock password, the drive is inaccessible.

6. Enter a new user password (1 to 32 characters long), and then press Enter to accept.

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7. Enter the password again in the **Enter New Password Again** field. If you forget this password, the drive is permanently disabled.

8. Select **File** and then select **Save Changes and Exit**. Press Enter to accept the changes. After you press Enter, the computer performs a cold start before invoking the DriveLock function.

   When the computer starts, you are prompted to enter the DriveLock password for each DriveLock-capable drive for which you have set a password. You have two attempts to enter the password correctly. If the password is not entered correctly, the computer attempts to start anyway. However, the boot process most likely fails because data from a locked drive cannot be accessed.

   In a single-drive computer, when DriveLock is enabled, the computer might not be able to boot to the operating system, and might try to boot from the network or from another storage device (depending on the boot ordering options). Regardless of the outcome of the start attempts, the locked drive remains inaccessible without the DriveLock password.

   In a two-drive computer that has a boot drive and a data drive, you can apply the DriveLock feature to the data drive only. In this case, the computer can always start, but the data drive is accessible only when the DriveLock password is entered.

   Cold starts require that you enter DriveLock passwords. However, DriveLock passwords are also required for warm starts. For example, if you boot to DOS and press Ctrl+Alt+Del, you must enter the DriveLock password before the computer completes the next start cycle. This warm-start behavior is consistent with the DriveLock feature.

Password security

The power-on password prevents unauthorized access to applications or data when the computer is turned on or restarted. The setup password specifically prevents unauthorized access to the Computer Setup (F10) Utility and can also be used as an override to the power-on password. An administrator can enter the setup password at the prompt for the power-on password and gain access to the computer.

You can establish a network-wide setup password to enable the system administrator to log in to all network systems to perform maintenance without needing to know the power-on password.

Establishing a setup password using Computer Setup (F10) Utility

Establishing a setup password through the Computer Setup (F10) Utility prevents reconfiguration of the computer (through the use of Computer Setup (F10) Utility) until the password is entered.

To establish a setup password using the Computer Setup (F10) Utility menu:

1. Turn on or restart the computer.

2. As soon as the computer is turned on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 to access the utility.

3. Select **Security** and then select **Setup Password**. Follow the onscreen instructions.

4. Before exiting, select **File** and then select **Save Changes and Exit**.

Establishing a power-on password using computer setup

Establishing a power-on password through Computer Setup (F10) Utility prevents access to the computer when power is connected, unless you specify the password. When a power-on password is set, Computer Setup (F10) Utility presents Password Options in the Security menu. The password options include Network Server Mode and Password Prompt on Warm Boot.

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When Network Server Mode is disabled, you must enter the password when the computer is turned on and the key icon appears on the monitor. When Password Prompt on Warm Boot is enabled, you must enter the password. The password must also be entered each time the computer is restarted. When Network Server Mode is enabled, the password prompt is not presented during POST.

To enable Network Server Mode, you must set a power-on password under **Advanced > Password Options**. This option enables the computer to start without requiring the power-on password, but the keyboard and mouse are locked until you enter the password.

To establish a power-on password through the Computer (F10) menu:

1. Turn on or restart the computer.
2. As soon as the computer is turned on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 to access the utility.
3. Select **Security > Power-On Password**, and then follow the onscreen instructions.
4. Before exiting, select **File > Save Changes and Exit**.

Entering a power-on password

To enter a power-on password:

1. Restart the computer.
2. When the key icon appears on the monitor, enter the current password, and then press Enter.

Type carefully. For security reasons, the characters you enter do not appear on the screen.

If you enter the password incorrectly, a broken key icon appears. Try again. After three unsuccessful tries, you will enter the F10 setup screen with read-only permission. (See the Setup Browse Mode option under the Power-On options.)

Entering a setup password

If a setup password has been established on the computer, you will be prompted to enter it each time you run Computer Setup (F10) Utility.

To enter a setup password:

1. Restart the computer.
2. As soon as the computer is turned on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 to access the utility.
3. When the key icon appears on the monitor, enter the setup password, and press Enter.

Type carefully. For security reasons, the characters you enter do not appear on the screen.

If you enter the password incorrectly, a broken key icon appears. Try again. After three unsuccessful tries, you must restart the computer before you can continue.

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Changing a power-on or setup password

To change a power-on or setup password:

1. Restart the computer.
2. To change the power-on password, go to step 4.
3. To change the setup password, as soon as the computer is turned on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 to access the utility.
4. When the key icon appears, enter the current password, a slash (/) or alternative delimiter character, the new password, another slash (/) or alternative delimiter character, and the new password again as shown:

   current password/new password/new password

   For information about the alternative delimiter characters, see National keyboard delimiter characters on page 33.

   Type carefully. For security reasons, the characters you enter do not appear on the screen.
5. Press Enter.

The new password takes effect the next time you turn on the computer.

The power-on and setup passwords can also be changed using the Security options in Computer Setup (F10) Utility.

Deleting a power-on or setup password

To delete a power-on or setup password:

1. Turn on or restart the computer.
2. Choose from the following:
   - To delete the power-on password, go to step 4.
   - To delete the setup password, as soon as the computer is turned on, press and hold F10 until you enter Computer Setup (F10) Utility. Press Enter to bypass the title screen, if necessary.

     If you do not press F10 at the appropriate time, you must restart the computer and then press and hold F10 again to access the utility.

     Use the appropriate operating system shutdown process.
3. When the key icon appears, enter the current password followed by a slash (/) or alternative delimiter character: *current password/*

   For information about the alternative delimiter characters see the following section.
4. Press Enter.

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National keyboard delimiter characters

Each keyboard meets country-specific requirements. The syntax and keys you use for changing or deleting passwords depend on the keyboard included with the computer.

Language	Delimiter	Language	Delimiter	Language	Delimiter
Arabic	/	Greek	-	Russian	/
Belgian	=	Hebrew	.	Slovakian	-
BHCSY*	-	Hungarian	-	Spanish	-
Brazilian	/	Italian	-	Swedish/Finnish	/
Chinese	/	Japanese	/	Swiss	-
Czech	-	Korean	/	Taiwanese	/
Danish	-	Latin American	-	Thai	/
French	!	Norwegian	-	Turkish	.
French Canadian	é	Polish	-	U.K. English	/
German	-	Portuguese	-	U.S. English	/

* Bosnia-Herzegovina, Croatia, Slovenia, and Yugoslavia

Clearing passwords

If you forget the password, you cannot access the computer.

For instructions about clearing passwords, see Configuring password security and resetting CMOS on page 71.

Chassis security

Smart Cover Sensor

The Smart Cover Sensor, an optional feature, is a combination of hardware and software technology that alerts you if the interior or the computer is accessed (provided the sensor has been configured in Computer Setup (F10) Utility). The sensor alerts you when the side panel is removed (desktop and tower models) or when the computer is opened (all-in-one models). When the Smart Cover Sensor is installed, Smart Cover appears under the Security menu in the Computer Setup (F10) Utility menu.

Three levels of protection are available:

Level	Setting	Description
Level 0	Disabled	Sensor* is disabled (default).
Level 1	Notify User	When the computer restarts, a message indicates that the computer has been opened or the access panel has been removed.
Level 2	Setup Password	When the computer restarts, a message indicates that the computer has been opened or the access panel has been removed. You must enter the setup password to continue.

* Smart Cover Sensor settings can be changed using Computer Setup (F10) Utility.

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Setting the protection level

To set the Smart Cover Sensor protection level:

1. Turn on or restart the computer.
2. During startup, press and hold the F10 key until you enter Computer Setup (F10) Utility. Press Enter to bypass the title screen, if necessary.

   NOTE: If you do not press the F10 key at the appropriate time, you must restart the computer, and then press and hold the F10 key again to access Computer Setup (F10) Utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.
3. Select **Security > Smart Cover > Cover Removal Sensor**, and follow the onscreen instructions.
4. Before exiting, select **File > Save Changes and Exit**.

Cable lock (optional)

To prevent theft, you can attach a keyed cable lock to the bottom-left corner of the chassis. This cable lock attaches to the chassis and secures it to the work area.

Fault notification and recovery

Fault notification and recovery features combine innovative hardware and software technology to prevent the loss of critical data and minimize unplanned downtime.

If the computer is connected to a network that is managed by HP CMS, the computer sends a fault notice to the network management application. With HP CMS, you can also remotely schedule diagnostics to run on managed PCs and create a summary report of failed tests.

ECC fault prediction

When the computer encounters an excessive number of error checking and correcting (ECC) memory errors, it displays a local alert message. This message contains information about the errant DIMM, enabling you to take action before you experience noncorrectable memory errors. ECC DIMMs are standard on this computer.

Thermal sensors

Several thermal sensors in the HP Workstation regulate computer fans to maintain an acceptable, efficient chassis temperature.

Dual-state power button

With ACPI enabled, the power button can function as an on/off switch or as a button. This feature does not completely turn off power, but instead causes the computer to enter a low-power standby state. This enables you to go to standby without closing applications, and to return to the same operational state without any data loss.

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Changing the power button configuration (Windows only)

CAUTION: To reduce the risk of data loss, do not use the power button to turn off the computer unless the system is unresponsive.

NOTE: If the computer is unresponsive, press and hold the power button for four seconds to completely turn off power to the computer.

Windows 7 or Windows 10

1. Select **Start**, and then select **Control Panel > System and Security > Power Options**.
2. In the left pane, click **Choose what the power buttons do**.
3. Select the desired options.

If you choose Sleep or Hibernate, you can press the power button to initiate standby, and then press it again to exit standby and return to your work. To completely turn off the workstation, select **Start > Shut Down**.

Windows 8

1. Point to the upper-right or lower-right corner of the Start screen to display the charms.
2. Select **Search**.
3. In the **Search** field, type `control`.
4. Select **Control Panel**, and then select **System and Security > Power Options**.
5. Select **Choose What the Power Button Does**.
6. Select the desired options.

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3 Component replacement information and guidelines

This chapter provides warnings, cautions, information, and guidelines for removal and replacement procedures. It does not document the step-by-step procedures.

IMPORTANT: Removal and replacement procedures are now available in videos on the HP website.

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml.

This chapter includes these topics:

Topics
Warnings and cautions on page 36
Service considerations on page 37
Product recycling on page 39
Component replacement guidelines on page 39
• Battery on page 39
• Cable management on page 40
• CPU (processor) and CPU heatsink on page 41
• Expansion slots on page 41
• Hard drives on page 42
• Memory on page 42
• Power supply on page 44
• Thermal sensors on page 45

Warnings and cautions

WARNING! These symbols on any surface or area of the equipment indicate the following:

Presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists. To reduce the risk of injury from a hot component, let the surface cool before touching.

Presence of an electrical shock hazard. To reduce the risk of injury from electrical shock, do not open any enclosed area marked with this symbol.

Product must always be lifted by two persons to avoid personal injury due to product weight.

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

— Do not disable the power cord grounding plug. The grounding plug is an important safety feature.

— Plug the power cord in a grounded (earthed) outlet that is easily accessible at all times.

— Disconnect power from the equipment by unplugging the power cord from the electrical outlet.

WARNING! To reduce the risk of serious injury, read the *Safety & Comfort Guide*. It describes proper computer setup, posture, health, and work habits for computer users, and provides important electrical and mechanical safety information. This guide is located at http://www.hp.com/ergo.

WARNING! Do not use the front bezel as a handle or lifting point when lifting or moving the computer. Lifting the computer from the front bezel, or lifting it incorrectly, could cause the computer to fall, causing possible injury to you and damage to the computer. To properly and safely lift the computer, lift from the bottom of the computer.

CAUTION: Static electricity can damage the electronic components of the computer. To prevent damage to the computer, observe the following Electrostatic Discharge (ESD) precautions while servicing the computer:

— 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.

NOTE: HP accessories are for use in HP products. They have been extensively tested for reliability and are manufactured to high quality standards.

Service considerations

Tools and software requirements

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

- Torx T-15 driver
- Flat-blade and cross-tip screwdrivers
- Diagnostics software

Electrostatic discharge (ESD) information

Generating static

Different activities generate different amounts of static electricity through electrostatic discharge (ESD). Static electricity increases as humidity decreases.

CAUTION: Static electricity in the amount of 700 volts might degrade a product.

Event	Relative humidity		
	55%	40%	10%
Walking across carpet	7,500V	15,000V	35,000V
Walking across vinyl floor	3,000V	5,000V	12,000V
Motions of bench worker	400V	800V	6,000V

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	Removing bubble pack from PCB	7,000V	20,000V	26,500V
	Packing PCBs in foam-lined box	5,000V	11,000V	21,000V

Preventing ESD equipment damage

Many electronic components are sensitive to ESD. Circuitry design and structure determine the degree of sensitivity. To prevent damage to electronic components and accessories, observe the following packaging and grounding precautions:

- Transport products in static-safe containers such as tubes, bags, or boxes, to avoid hand contact.
- Protect electrostatic parts and assemblies with nonconductive or approved containers or packaging.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free stations.
- Place items on a grounded surface before removing them from containers.
- Before handling or touching a sensitive component or assembly, ground yourself by touching the chassis.
- Avoid contact with pins, leads, or circuitry.
- Place reusable electrostatic-sensitive parts from assemblies in protective packaging or nonconductive foam.

Personal grounding methods and equipment

Use the following items to help prevent ESD damage:

- **Wrist straps** — These are flexible straps with a maximum of one megohm ± 10% resistance in the ground cords. To provide a proper ground, wear the strap against bare skin. The ground cord must be connected and fit snugly into the banana plug connector on the grounding mat or computer.
- **Heel straps, toe straps, and boot straps** — These can be used at standing computers and are compatible with most types of shoes or boots. On conductive floors or dissipative floor mats, use them on both feet with a maximum of one megohm ± 10% resistance between the operator and ground.

Static shielding materials

Static shielding materials provide the following levels of protection.

Method	Voltage
Antistatic plastic	1,500V
Carbon-loaded plastic	7,500V
Metalized laminate	15,000V

Grounding the work area to prevent static damage

- Cover the work surface with approved static-dissipative material. Use a wrist strap connected to the work surface, and properly grounded tools and equipment.
- Use static-dissipative mats, foot straps, or air ionizers to give added protection.
- Handle electrostatic-sensitive components, parts, and assemblies by the case or PCB laminate. Handle them only in static-free work areas.
- Disconnect power and input signals before inserting and removing connectors or test equipment.
- Use fixtures made of static-safe materials when fixtures must directly contact dissipative surfaces.
- Keep work area free of nonconductive materials, such as plastic assembly aids and Styrofoam.
- Use field service tools (such as cutters, screwdrivers, and vacuums) that are conductive.

Recommended ESD prevention materials and equipment

- Antistatic tape
- Antistatic smocks, aprons, and sleeve protectors
- Conductive bins and other assembly or soldering aids
- Conductive foam
- Static awareness labels
- Wrist straps and footwear straps providing one megohm ± 10% resistance
- Material-handling packages
- Conductive plastic bags

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• Conductive tabletop computers with a ground cord of one megohm ± 10% resistance • Static-dissipative table or floor mats with a hard-tie to ground • Field service kits	• Conductive plastic tubes • Conductive tote boxes • Opaque shielding bags • Transparent metallized shielding bags • Transparent shielding tubes

Product recycling

HP encourages customers to recycle used electronic hardware, HP original print cartridges, and rechargeable batteries.

For information about recycling HP components or products, go to http://www.hp.com/go/recycle.

Component replacement guidelines

This section provides information and guidelines for removal and replacement procedures. It does not document the step-by-step procedures.

IMPORTANT: Removal and replacement procedures are now available in videos on the HP website.

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml. In Media Selection, choose **Desktops & Workstations** for product category and **Personal Workstations** for the product family, and then choose your platform.

This chapter provides guidelines for removal and replacement procedures.

Topics
Battery on page 39
Cable management on page 40
CPU (processor) and CPU heatsink on page 41
Expansion slots on page 41
Hard drives on page 42
Memory on page 42
Power supply on page 44
Thermal sensors on page 45

Battery

The battery that comes with the computer provides power to the real-time clock and has a minimum lifetime of about three years. Observe the following warning and caution when replacing the battery.

CAUTION: Before removing the battery, back up the CMOS settings in case they are lost when the battery is removed. To back up the CMOS settings, select the **Save to Removable Storage** option in Computer Setup (F10) Utility.

NOTE: Do not dispose of batteries, battery packs, and accumulators with general household waste.

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Cable management

Proper routing of the internal cables is critical to the operation of the workstation. 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 heatsink. (Some air flow guides have a cable guide that lets you route cables safely around the heatsink.)
- Do not jam cables on top of expansion cards or DIMMs. Circuit cards and DIMMs are not designed to take excessive pressure.
- Keep cables clear of movable or rotating parts (such as the power supply and drive cage) to prevent them from being cut or crimped when the component is lowered into its normal position.
- When folding a flat ribbon cable, never fold to a sharp crease. Sharp creases may damage the wires.
- In all cases, avoid bending or twisting the cables. Do not bend any cable sharply. A sharp bend can break the internal wires.
- Never bend a SATA data cable tighter than a 30 mm (1.18 in) radius.
- Never crease a SATA data cable.
- Do not rely on components like the drive cage, power supply, or computer cover to push cables down into the chassis. Always position the cables to lay properly by themselves or in the cable guides and chassis areas designed for cable routing.

When removing the power supply power cable from the connector on the system board, always follow these steps:

1. Press down the top of the retaining latch attached to the cable end of the connector.
2. Grasp the cable end of the connector and pull it straight out.

⚠ **CAUTION:** Always pull on the connector — NEVER pull on the cable. Pulling on the cable could damage the cable and result in a failed power supply.

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CPU (processor) and CPU heatsink

⚠ **CAUTION:** Observe the following cautions when removing or replacing the heatsink:

— When removing the heatsink, loosen all screws a little at a time to be sure that the CPU remains level. Do *not* fully loosen one screw, and then move on to the next.

— Do not overtighten the heatsink screws. Overtightening can strip the threads in the chassis.

⚠ **CAUTION:** Observe the following cautions when removing or replacing the CPU.

— Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove or install a component.

— Do not touch the CPU socket contacts or the gold pads underneath the CPU. Use extreme care and handle the CPU only by the edges.

— The CPU socket contacts are delicate and bend easily. To avoid bending the contacts, use extreme care when installing the CPU in the socket.

— Installing a processor incorrectly can damage the system board. Contact an authorized service provider to install the processor. If you plan to install the processor yourself, view the entire remove-and-replace video before you begin.

— Failure to follow the computer preparation instructions can result in an improperly installed processor, causing extensive computer damage.

Expansion slots

The workstation has the following expansion slots:

- One MXM slot that supports Type A and Type B cards (dedicated for graphics)
- Two Mini PCIe/mSATA slots that support mSATA devices or full-length Mini PCIe cards. Half-length cards require an extender plate.

Go to http://www.hp.com/go/quickspecs to learn which cards are supported in the workstation.

⚠ **CAUTION:** To prevent damage, the overall power consumption of the computer (including I/O cards, CPU, and memory) must not exceed the maximum rating of the computer power supply. For power supply information, see Power supply specifications on page 44.

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Hard drives

- To verify the type, size, and capacity of the storage devices installed in the computer, run **Computer Setup (F10) Utility**.
- The workstation supports SATA hard drives or mSATA devices.
- The workstation requires one of the following supported carriers:
  - 671193-001 supports one 3.5-in hard drive
  - 671192-001 supports one or two 2.5-in hard drives or solid-state drives
- Combining a 2.5-in hard drive and 3.5-in hard drive is not possible.
- No cable adapters are required for any hard drives. The cables necessary for all hard drive configurations are included in the base system and automatically “blind mate” or “direct connect” to the drive(s) when installed.
- The workstation supports mSATA devices in the Mini PCIe/mSATA slots.

Handling hard drives

CAUTION: Take proper precautions when handling hard drives to prevent loss of work and damage to the computer or drive.

- Do not remove hard drives from the shipping package for storage. Keep hard drives in their protective packaging until they are mounted in the computer.
- Always shut down the operating system, turn off the power, and unplug the power cord. Never remove a drive while the computer is on or in standby mode.
- Before handling a drive, be sure that you discharge static electricity. While handling a drive, avoid touching the connector.
- Handle a drive carefully. Do not drop it from any height.
- Do not use excessive force when inserting a drive.
- Avoid exposing a hard drive to liquids, temperature extremes, or products that have magnetic fields such as monitors or speakers.
- If you must mail a drive, use a bubble-pack mailer or other protective packaging and label the package “Fragile: Handle With Care.”

Memory

Supported DIMM configurations

The HP Z1 G2 Workstation has 4 DIMM slots and supports up to 32 GB ECC or 16 GB non-ECC unbuffered DDR3 1866 MHz memory.

NOTE: Mirroring and DIMM sparing are not supported.

- Four DIMM slots
- Maximum capacity: 32 GB
- Error checking and correcting (ECC) and non-ECC DIMMs only.

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BIOS errors and warnings

The BIOS generates warnings/errors on invalid memory configurations:

- If the BIOS can find a valid memory configuration by disabling plugged-in memory, it does so and reports a warning during POST. The workstation can still be started. The warning will indicate the location of the failed DIMM on the system board.
- If there is no way for the BIOS to obtain a valid memory configuration by disabling plugged-in memory, the BIOS halts with a diagnostics 2006 code for memory error (five beeps and blinks).

DIMM installation guidelines

- Install only HP-approved DDR3 DIMMs

CAUTION: HP ships only DIMMs that are electrically and thermally compatible with this computer. Because third-party DIMMs might not be electrically or thermally compatible, they are not supported by HP.

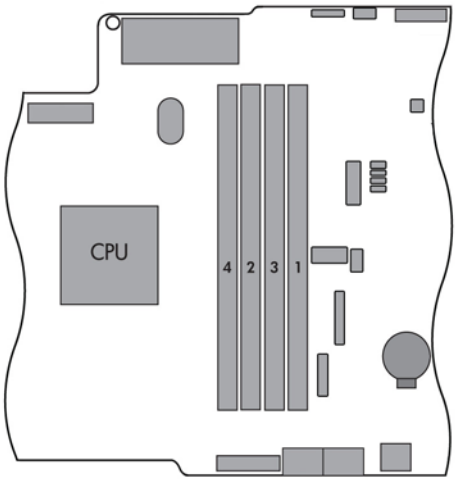
- For ECC DIMMs, use only industry-standard ECC unbuffered DIMMs. Go to http://www.hp.com/go/quickspecs to find which DIMMs are compatible with the computer.
- Do not intermix non-ECC memory DIMMs with ECC memory DIMMs.

CAUTION: DIMMs and their sockets are keyed for proper installation. To prevent socket or DIMM damage, align these guides properly when installing DIMMs.

DIMM installation order

Install DIMMs in this order.

CAUTION: Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove or install a component.



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Power supply

The workstation includes a 400W 90% efficient power supply that is compatible with ENERGY STAR requirements.

Power supply specifications

Power supply	400 W wide-ranging, active Power Factor Correction, 90% efficient
Operating voltage range	90–264 V ac
Rated voltage range	100–240 V ac
Rated line frequency	50–60 Hz
Operating line frequency range	47–63 Hz
Rated input current	5A @ 100–240 V
Heat dissipation, typical (configuration and software dependent)	253 btu/hr (64 kg-cal/hr)
Heat dissipation, maximum (configuration and software dependent)	1569 btu/hr (395 kg-cal/hr)
Power supply fan *All fans are variable speed*	Two variable speed fans, 40 mm x 20 mm
Built-in Self Test LED	Yes
Power Consumption in sleep mode (as defined by ENERGY STAR) - Suspend to RAM (S3)	< 4 W
ENERGY STAR® Version 6.0 qualified (Config Dependent)	Yes
FEMP Standby Power Compliant	Yes, < 1 W in S5-Power Off @ 115 V ac
Surge tolerant, full-ranging (withstands power surges up to 2000 V)	Yes
ErP Lot 6-Tier 1 compliance @ 230 V (<1 W in S5-Power Off)	Yes
ErP Lot 6-Tier 2 compliance @ 230 V (<0. W in S5-Power Off)	Yes

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Power consumption and heat dissipation

Power consumption and heat dissipation specifications are available for multiple configurations. To review available specifications, go to http://www.hp.com/go/quickspecs.

To reach zero power consumption, unplug the workstation from the power outlet or use a power strip with an on/off switch. For additional information about power-saving features, see the operating system installation instructions.

This product is in compliance with U.S. Executive Order 13221 (FEMP).

Resetting the power supply

If an overload triggers the power supply overload protection, power is immediately disconnected.

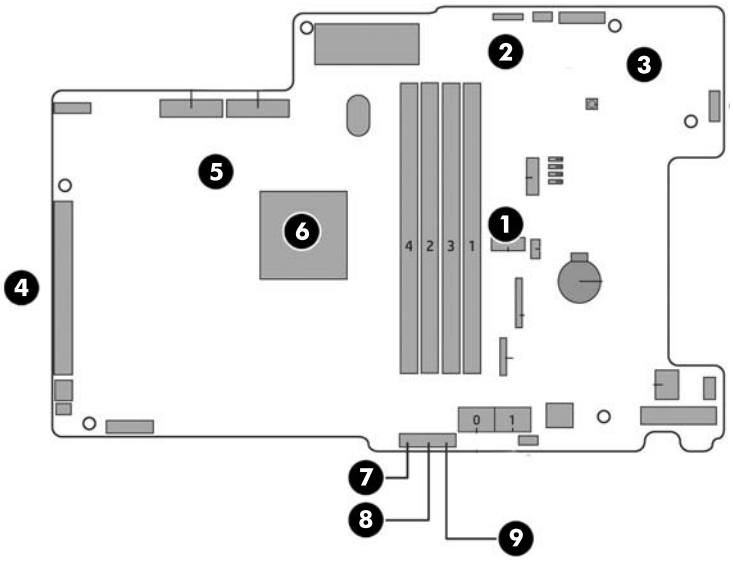
To reset the power supply:

1. Disconnect the power cord from the workstation.
2. Determine what caused the overload, and fix the problem. For troubleshooting information, see Diagnostics and troubleshooting on page 46.
3. Reconnect the power cord, and restart the workstation.

When you turn off the workstation through the operating system, power consumption falls below what is considered low power consumption but does not reach zero. Power consumption only reaches zero when you unplug the workstation from the power outlet.

Thermal sensors

The following illustration shows the locations of the thermal sensors. Sensors that attach with a harness can be replaced.



1	Memory VR sensor	**4**	MXM GPU sensor	**7**	Drive 1 sensor
2	12 V–3.3 V VR sensor	**5**	CPU0 VR sensor	**8**	Drive 2 sensor
3	Backlight VR sensor	**6**	CPU0 DTS sensor (inside processor)	**9**	Inlet air sensor

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4 Diagnostics and troubleshooting

This chapter describes the tools available for diagnosing and troubleshooting system issues.

Topics
Calling support on page 47
Locating ID labels on page 48
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Calling support

At times you might encounter an issue that requires support. When you call support:

- Have the computer readily accessible.
- Write down the computer serial numbers, product numbers, model names, and model numbers and have them in front of you.
- Note any applicable error messages.
- Note any add-on options.
- Note the operating system.
- Note any third-party hardware or software.
- Note the details of any blinking LEDs on the front of the computer (tower and desktop configurations) or on the side of the computer (all-in-one configurations).
- Note the applications you were using when you encountered the problem.

NOTE: When calling in for service or support, you might be asked for the product number (example: PS988AV) of the computer. If the computer has a product number, it is generally located next to the 10- or 12-digit serial number of the computer.

NOTE: On most models, the serial number and product number labels can be found on the top or side panel and at the rear of the computer (tower and desktop configurations) or on a pull-out card on the side of the display (all-in-one configurations).

For a listing of all worldwide support phone numbers, go to http://www.hp.com/support, select your region, and click **Connect with HP** in the upper-right corner.

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Locating ID labels

To assist in troubleshooting, product, serial, and authentication numbers are available on each computer.

- All workstations have a serial number (unique for each workstation) and product number. Have these numbers available when you contact support.
- The Certificate of Authentication (COA) is used only for systems with Windows 7 preinstalled.
- The Genuine Microsoft Label (GML) is used only for systems with Windows 8 preinstalled.
- A service label shows the build ID and Feature Byte strings, which are needed for system board replacement.

The all-in-one service label can be found in the location shown in the figure below (pull-out card).

Locating warranty information

To locate base warranty information, see http://www.hp.com/support/warranty-lookuptool.

To locate an existing Care Pack, see http://www.hp.com/go/lookuptool.

To extend a standard product warranty, visit http://www.hp.com/hps/carepack. HP Care Pack Services offer upgraded service levels to extend and expand a standard product warranty.

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Diagnosis guidelines

If you encounter a problem with the computer or software, consult the following sections. They provide a list of general suggestions that help you isolate and focus on the problem before taking further action.

Diagnosis at startup

- Verify that the computer and external monitor (if connected) are plugged into a functional AC power outlet.
- Remove all CDs or USB flash drives from your system before turning it on.
- Verify that the computer is turned on and the power light is blue (normal operation) and not red (error state).
- If you have installed an operating system other than the factory-installed operating system, go to http://www.hp.com/go/quickspecs to verify that it is supported on your system.

Diagnosis during operation

- Look for blinking LEDs on the side of the computer. The blinking lights are error codes that will help you diagnose the problem. See Diagnostic LED and audible (beep) codes on page 63 for information on interpreting diagnostic lights and audible codes.
- Verify that all cables are not loosely or incorrectly connected.
- Wake the computer by pressing any key on the keyboard or the power button. If the system remains in suspend mode, shut down the system by pressing and holding the power button for at least four seconds, and then press the power button again to restart the system. If the system does not shut down, unplug the power cord, wait a few seconds, and then plug it in again. If it does not restart, press the power button to start the computer.
- Restart the computer after installing a non–Plug and Play (PnP) expansion board or other option.
- Be sure that all required device drivers have been installed. For example, if you have connected a printer, you must install a printer driver.
- If you are working on a network, plug another computer with a different cable into the network connection. There might be a problem with the network plug or cable.
- If you recently added new hardware, remove it and see if the computer functions properly.
- If you recently installed new software, uninstall it and see if the computer functions properly.
- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.
- Press the Caps Lock key. If the Caps Lock LED toggles on or off, the keyboard is operating correctly.

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Troubleshooting checklist

Before running diagnostic utilities, use the following checklist to find possible solutions for computer or software problems.

- Is the computer connected to a functional AC power outlet?
- Is the computer turned on?
- Is the blue power light on?
- If the internal display is dim, adjust the internal display brightness and contrast controls.
- Press the Caps Lock key several times. If the Caps Lock LED toggles on and off, the keyboard is operating correctly.
- Verify that all cables are not loosely or incorrectly connected.
- After installing a non-PnP expansion board or other option (such as a diskette drive), restart the computer.
- Are all necessary device drivers installed?
- Have all printer drivers been installed for each application?
- Have you removed CDs and USB flash drives before powering on the computer?
- Are you running the latest version of BIOS, drivers, and software?

HP troubleshooting resources and tools

This section provides information on the HP Support Center (HPSC), Online support, and Helpful Hints for troubleshooting.

Online support

Online access and support resources include web-based troubleshooting tools, technical knowledge databases, driver and patch downloads, online communities, and product change notification services.

The following websites are also available to you:

- http://www.hp.com—Provides useful product information.
- http://www.hp.com/support/workstation_manuals—Provides the latest online documentation.
- http://www.hp.com/go/workstationsupport—Provides technical support information for workstations.
- http://www.hp.com/support—Provides a listing of the worldwide technical support phone numbers. Access the telephone numbers by visiting the website, then select your region, and click **Contact HP** in the upper-left corner.
- http://www.hp.com/support/workstation_swdrivers—Provides access to software and drivers for workstations.

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Troubleshooting a problem

To help you troubleshoot problems with your system, HP provides the HPSC. The HPSC is a portal to an extensive selection of online tools. To access HPSC and troubleshoot a problem with the workstation, complete the following:

1. Go to http://www.hp.com/go/workstationsupport.
2. Specify your product.
3. Under the **Support Options** menu on the left, select **Troubleshoot a problem** and then select the appropriate category in the resulting menu on the right.

Customer Advisories, Bulletins, Notices, and Product Change Notifications

To find advisories, bulletins, and notices:

1. Go to http://www.hp.com/go/workstationsupport.
2. Select the desired product.
3. Under **Knowledge Base**, select **Advisories, Bulletins & Notices**.

Product Change Notifications

Product Change Notifications (PCNs) are proactive notifications for product changes occurring within a 30-60 day window of the effective date of the change in the manufacturing process. PCNs give customers advanced notice of changes to their product, such as an updated BIOS version that they may need to qualify prior to the change taking place. The latest PCNs are located at: http://www.hp.com/go/workstationsupport.

Helpful hints

If you encounter a problem with the workstation, monitor, or software, the following general suggestions might help you isolate and focus on the problem before taking further action.

At startup

- Verify that the workstation and monitor are plugged into a working electrical outlet.
- Remove all optical discs and USB drive keys from the drives before powering on the workstation.
- Verify that the workstation is turned on and the power light is on.
- If you have installed an operating system other than the factory-installed operating system, check to be sure that it is supported on your system, go to http://www.hp.com/go/quickspecs.
- Verify that the monitor is turned on and the power light is on.
- Turn up the brightness and contrast controls of the monitor if the monitor is dim.
- If the workstation has multiple video sources and only a single monitor, the monitor must be connected to the source selected as the primary VGA adapter. During startup, the other monitor connectors are disabled; if the monitor is connected to one of these ports, it will not function after Power-on Self Test (POST). You can select the default VGA source in Computer Setup (f10) Utility.

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During operation

- Look for blinking LEDs on the workstation. The blinking lights are error codes that will help you diagnose the problem. Refer to the *Diagnostic lights and audible (beep) codes* section of this document for information on interpreting diagnostic lights and audible codes.
- Press and hold any key. If the system beeps, then your keyboard is operating correctly.
- Check all cables for loose or incorrect connections.
- Wake the workstation by pressing any key on the keyboard or the power button. If the system remains in suspend mode, shut down the system by pressing and holding the power button for at least four seconds, then press the power button again to restart the system. If the system does not shut down, unplug the power cord, wait a few seconds, then plug it in again. If it does not restart, press the power button to start the workstation.
- Reconfigure the workstation after installing a non–plug and play expansion board or other option. Refer to the *Hardware installation problems* section of this document for instructions.
- Be sure that all required device drivers have been installed. For example, if you have connected a printer, you must install a printer driver.
- If you are working on a network, plug another workstation with a different cable into the network connection. There might be a problem with the network plug or cable.
- If you recently added new hardware, remove the hardware and verify if the workstation functions properly.
- If you recently installed new software, uninstall the software and verify if the workstation functions properly.
- If the monitor connected to a tower, desktop or all-in-one computer is blank:
  - Plug the monitor into a different video port on the computer if one is available. Alternatively, replace the monitor with a monitor that you know is working properly.
  - Verify that the computer *and monitor* are plugged into a working electrical outlet.
  - Verify that the monitor is turned on and the power light is on.
  - Turn up the brightness and contrast controls of the monitor if the monitor is dim.
- If the internal display on an all-in-one computer is blank, open the computer and make sure the graphics card is properly installed.
- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.

Customer Self-Repair program

Under the Customer Self-Repair program, you can order a replacement part and install the part without onsite HP technical assistance. Customer self-repair may be required for some components. See http://www.hp.com/go/selfrepair for information on the program.

NOTE: Some components are not eligible for customer self-repair and must be returned to HP for service. Call HP Support for further instructions before attempting to remove or repair these components.

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Troubleshooting scenarios and solutions

This section presents an extensive overview of various troubleshooting scenarios and possible solutions for a Windows-based computer.

Solving minor problems

Problem	Cause	Possible Solution
Workstation appears frozen and does not shut down when the power button is pressed.	Software control of the power switch is not functional.	1. Press and hold the power button for at least four seconds until the computer shuts down. 2. Disconnect the electrical plug from the outlet.
Workstation seems to be frozen.	Program in use has stopped responding to commands.	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.
Workstation date and time display is incorrect.	Real-time clock (RTC) battery might need replacement.	1. Reset the date and time in the Control Panel. 2. Replace the RTC battery.
Workstation appears to pause periodically.	Network driver is loaded and no network connection is established.	Establish a network connection, or use Computer Setup (F10) Utility or the Windows Device Manager to disable the network controller.
Cursor does not move using the arrow keys on the keypad.	The Num Lock key might be on.	Press Num Lock. The Num Lock key can be disabled or enabled in Computer Setup (F10) Utility.
Poor performance is experienced.	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 heatsink is installed properly.
	Hard drive is full.	Transfer data from the hard drive to create more space on the hard drive.
Workstation turned off automatically and the power LED flashes red two times (once per second), followed by a two second pause, and then two consecutive beeps.	Processor thermal protection is activated. A fan might be blocked or not turning. OR The processor heatsink is not properly attached to the processor.	1. Verify that the computer air vents are not blocked. 2. Open the access panel and press the computer power button. 3. Verify that the system fan is running. 4. Verify that the processor heatsink fan spins. If the fan is not spinning, verify that the heatsink fan cable is plugged into the system board connector and that the heatsink is properly seated. 5. Replace the processor heatsink.
System does not turn on, and the LEDs on the side of the computer are not flashing.	System cannot turn on.	Press and hold the power button for less than four seconds. If the hard drive LED turns green, then perform the following steps. 1. To find a faulty device, remove all devices one at a time: a. Disconnect AC power to the computer. b. Remove a device. c. Reconnect AC power and turn on the computer.

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Problem	Cause	Possible Solution
		2. Repeat this process until the faulty device is identified. Remove the graphics card last. Replace the faulty device. 3. If no faulty device is found, replace the system board. OR 1. Press and hold the power button for *less than* four seconds. If the hard drive LED does not turn on, then perform the following tasks: a. Verify that the computer is plugged into a working AC outlet. b. Verify that the power button harness is connected to the inline front panel I/O device assembly connector. 2. Verify that the power supply cables are connected to the system board. 3. Verify power supply with PSU functionality. a. Disconnect the AC power. b. Unplug the DC cables from the PSU. c. Reconnect AC power. • If the PSU fan spins and the BIST LED illuminates, the PSU is good; replace the system board. • If the PSU does not spin or the LED does not illuminate, replace the PSU.
Workstation will not start.	Hard drive is damaged.	Replace the hard drive.

Solving hard drive problems

Problem	Cause	Solution
Hard drive error occurs.	Hard drive has bad sectors or has failed.	Locate and block the usage of bad sectors. If necessary, reformat the hard drive. If the drive is detected by the UEFI, run F2 Diagnostics Drive Test.
Hard drive transaction problem.	The directory structure is bad, or there is a problem with a file.	1. In Windows Explorer, select the drive. 2. Enable the context menu and select **Properties**. 3. In the Properties dialog, select the **Tools** tab and select **Check Now**.
Drive not found (identified).	Improper cable connection	On computers with discrete data and power cables, verify that the data and power cables are securely connected to the hard drive. (See the *Hard drive* section of this guide for connection details.)
	Improperly seated hard drive	On systems with blind-mate drive connections, verify that there is no connector damage on the drive or in the chassis. Reseat the hard drive and its carrier in the chassis to be sure that there is a proper connection. (See the *Hard drive* section of this guide for connection details.)
	The system might not have automatically	Perform one or both of the following:

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Problem	Cause	Solution
	recognized a newly installed device.	• Verify that the drive is listed in the Computer Setup (F10) Utility (Storage>Device Configuration). If it is listed, the probable cause is a driver problem. If it is not listed, the probable cause is a hardware problem. • If this drive is newly installed, run the Computer Setup (F10) Utility and increase the POST Delay in Advanced > Power-On Options.
	Drive responds slowly immediately after power-up.	Run the Computer Setup (F10) Utility, and increase the POST Delay in Power-On Options in the Advanced menu.
Nonsystem disk or NTLDR missing message.	System is trying to start from non-bootable media.	Remove the media device.
	System is trying to start from a damaged hard drive.	1. Insert bootable media and restart the computer. 2. If the hard drive is still inaccessible and MBR Security is enabled, try restoring the previously saved MBR image by entering the Computer Setup (F10) Utility and selecting **Security > Restore Master Boot Record**.
	System files missing or not properly installed.	1. Insert bootable media and restart the computer. 2. Verify that the hard drive is partitioned and formatted. 3. Install the system files for the appropriate operating system, if necessary.
	Hard drive boot disabled in Computer Setup.	Run the Computer Setup (F10) Utility and enable the hard drive entry in the Storage>Boot Order list.
	Boot Order Incorrect	Run Computer Setup (F10) Utility and set the correct order in Storage >Boot Order. Of special note, an mSATA drive will have a higher SATA port number than drives in the regular HDD bays. If drives are removed and the system rebooted, the boot order may be changed by the BIOS and would need to be reset to the desired order. The F9 Boot Order menu can be used to check and choose the right drive for boot.

Solving internal display problems

Problem	Cause	Solution
Blank screen (no video).	Cable connections are not correct.	1. Verify the LCD display cable connection to J65 on the system board and to the internal LCD panel connector. 2. Verify the LED backlight cable connection to P2 on the system board and to the LED power connector on the internal LCD panel.
	Screen blanking utility installed or energy saver features enabled.	Press a key or the mouse button and, if set, enter your password.
	System ROM is bad; system is running in FailSafe Boot Block mode (indicated by 8 beeps).	Reflash the ROM using a SoftPaq.
	Computer is in Hibernate mode.	Press the power button to resume from Hibernate mode.

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Problem	Cause	Solution
	Backlight circuit on motherboard is damaged.	Replace the motherboard.
	The key sequence that switches the DisplayPort connector from internal graphics source to external graphics source was pressed, but there is no external source (such as a laptop) for graphics.	On the workstation keyboard: 1. Simultaneously press Ctrl + Shift + S+D (*switch display*). This reverts the workstation to internal graphics source and places the workstation display in standby mode. 2. Press the space bar (or move the mouse) to wake up the display.
The display works properly during the POST but goes blank when the operating system starts.	The display settings in the operating system are incompatible with the internal LCD panel.	For Windows: 1. Restart your computer in Windows Safe Mode. 2. Uninstall the graphics driver for the graphics controller (Intel HD Graphics or NVIDIA Graphics). 3. Reboot in normal Windows mode. 4. Install the latest graphics driver for the graphics controller you are using (Intel HD Graphics or NVIDIA Graphics).
Backlight level is turned all the way down in software environment settings		This can happen if a utility has been used to set it to a very low level. Resetting to a usable value requires actions typically using the same utility that was originally used. Some OSes and environments may have other means for resetting.
Power LED flashes red 6 times (once every second), followed by a 2-second pause, and then the computer beeps 6 times.	Prevideo graphics error.	Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Try either solution: • Install a processor with Intel HD Graphics. • Install a supported graphics card.
Dim characters	Brightness and contrast controls are not set properly.	In Windows, go to **Control Panel**, select **Power Options**, and then adjust the internal LCD panel brightness and contrast controls using the **Screen Brightness** slider bar at the bottom of the window.
	Cables are not properly connected.	1. Open the computer. 2. Verify that the LCD Display Cable connects J65 on the system board to the internal LCD panel connector. 3. Verify that the LED Backlight Cable connects P2 on the system board to the LED power connector on the internal LCD panel.
Blurry video or requested resolution cannot be set.	Correct video drivers were not loaded after graphics controller upgrade.	Install the video drivers included in the upgrade kit, or download and install the latest drivers for your graphics card from http://welcome.hp.com/country/us/en/support.html.

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Problem	Cause	Solution
	The internal LCD panel cannot display requested resolution.	1. Change the resolution to either 2560 x 1440 or 1280 x 720. 2. Update the graphics driver to the latest version available for your graphics controller.
	The graphics driver is not working properly.	1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.
The picture is broken up, rolls, jitters, or flashes.	The internal LCD panel connections to the motherboard might be faulty or the panel might be incorrectly adjusted.	1. Open the computer. 2. Verify the LCD display cable connects J65 on the system board to the display connector on the internal LCD panel. 3. Verify that the LED backlight cable connects P2 on the system board to the LED power connector on the internal LCD panel.
	The graphics driver is not working properly.	1. Boot into the OS and uninstall the graphics driver. 2. Reboot. 3. Install the latest graphics driver for your graphics controller.
Some typed symbols do not appear correctly.	The font you are using does not support that symbol.	Use the Character Map to locate and select the appropriate symbol. (Windows 7) Select **Start > All Programs > Accessories > System Tools > Character Map**. (Windows 8) Display the charms and select **Search**. In the **Search** field, type `character`, then select **Character Map**. Copy the symbol from the Character Map into a document. (Windows 10) Type `character` in the taskbar search box, and then select **Character Map**.
	The LCD panel resolution is not properly set.	Use one of the following: • Change the panel resolution in the Windows Control Panel by navigating to **Appearance and Personalization > Display**. Click **Change display settings** then adjust the resolution. • Use the control panel for the graphics controller (Intel or nVidia).
	The graphics driver does is not working properly or does not support the symbol set with that resolution.	Try either solution: • Change the panel resolution using either of the following: 1) Change the panel resolution in the Windows Control Panel by navigating to **Appearance and Personalization > Display**. Click **Change display settings** then adjust the resolution. or 2) Use the control panel for the graphics controller (Intel or nVidia). • Install the latest graphics driver: 1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.
Integrated Graphics comes up in OS when using an MXM	MXM is inserted incorrectly	1. Open the system and locate the MXM graphics module. 2. Carefully remove the MXM graphics module by squeezing on the retention tab and gently pulling the card from the MXM slot. 3. Take the module and align the card's connector parallel to the motherboard MXM slot. 4. Gently insert the card at a 45 degree angle from the bottom of the motherboard into the slot.

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Problem	Cause	Solution
		NOTE: Maintain the card parallel with the motherboard slot when inserting the card!

Solving externally connected display problems

Problem	Cause	Solution
Blank screen (no video).	The cable connections are not correct.	Verify the cable connections from the monitor to the computer and to a working AC outlet.
	The monitor is off.	Turn the monitor on (LED is on). You might need to refer to the monitor manual for an explanation of LED signals.
	Screen blanking utility installed or energy saver features enabled.	Press a key or the mouse button and, if set, enter your password.
	System ROM is bad; system is running in FailSafe Boot Block mode (indicated by 8 beeps).	Reflash the ROM using a SoftPaq.
	Processor does not support graphics output and no discrete graphics card is installed **NOTE:** Power LED flashes red 6 times (once every second), followed by a 2-second pause, followed by 6 beeps.	Either: • Install a processor with graphics support. • Install a supported MXM graphics card.
	Computer is in Hibernate mode.	Press the power button to resume from Hibernate mode.
	Multiple displays are not enabled in the graphics control panel.	Go to the graphics control panel and enable multi-display by selecting either clone mode or extended mode.
	The graphics driver is not loaded.	Install the latest graphics driver.
	The graphics driver is not working properly.	1. When you see **Press F8** in the bottom-right corner of the screen, restart the computer and press F8 during startup. 2. Using the keyboard arrow keys, select **Windows Safe Mode**, and then press Enter. 3. In Windows, uninstall the graphics driver. 4. Reboot the computer into the normal Windows mode. 5. Install the latest graphics driver.
The display works properly during the POST but goes blank when the operating system starts.	The display settings in the operating system are incompatible with your graphics card and monitor.	1. For Windows, restart your computer in Windows Safe Mode. 2. After the operating system starts, change the display settings to match those supported by your graphics card and monitor. 3. See your operating system and graphics card documentation for information about changing display settings.
	Multiple displays are not enabled in the graphics control panel.	Go to the graphics control panel and enable multi-display by selecting either clone mode or extended mode.
	The graphics driver is not loaded.	Install the latest graphics driver.

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Problem	Cause	Solution
Power LED flashes red 6 times (once every second), followed by a 2-second pause, followed by 6 beeps.	Prevideo graphics error.	Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Either: • Install a processor with Intel HD Graphics. • Install a supported graphics card.
Dim characters	The brightness and contrast controls are not set properly.	Adjust the monitor brightness and contrast controls.
	Cables are not properly connected.	1. Verify that the monitor cable is securely connected to the computer and the monitor. 2. Verify that internal Rear IO DP/LAN cable is connected to the system board and the Rear I/O board: a. Open the computer. b. Verify the Rear IO DP/LAN Cable is connected to CON6701 on the system board and J16 on the Rear I/O board (on the left bottom side).
Blurry video or requested resolution cannot be set.	If the graphics controller was upgraded, the correct video drivers might not be loaded.	Install the video drivers included in the upgrade kit, or download and install the latest drivers for your graphics card from http://welcome.hp.com/country/us/en/support.html.
	Monitor cannot display requested resolution.	Change the resolution.
The picture is broken up, rolls, jitters, or flashes.	The monitor connections might be faulty, or the monitor might be incorrectly adjusted.	1. Verify that the monitor cable is securely connected to the computer and the monitor. 2. Verify that internal rear IO DP/LAN cable is connected to the system board and the rear I/O board: a. Open the computer. b. Verify the rear IO DP/LAN cable is connected to CON6701 on the system board and J16 on the rear I/O board (on the left bottom side).
	Monitor must be degaussed.	Degauss the monitor.
High pitched noise coming from inside a flat-panel monitor.	Brightness and contrast settings are too high.	Lower brightness and contrast settings.
Fuzzy focus; streaking, ghosting, or shadowing effects; horizontal scrolling lines; faint vertical bars; unable to center the picture on the screen (flat-panel monitors using an analog VGA input connection only.)	Flat-panel monitor's internal digital conversion circuits might be unable to correctly interpret the output synchronization of the graphics card.	1. Select the monitor's **Auto-Adjustment** option in the monitor's onscreen display menu. 2. Manually synchronize the Clock and Clock Phase onscreen display functions.

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Problem	Cause	Solution
Some typed symbols do not appear correctly.	The font you are using does not support that symbol.	Use the Character Map to locate and select the appropriate symbol. Select **Start > All Programs > Accessories > System Tools > Character Map**. You can copy the symbol from the Character Map into a document.
	The graphics driver does is not working properly or does not support the symbol set with that resolution.	Try either solution: • Change the panel resolution in the Windows **Control Panel > Screen Resolution** menu or through the control panel for the graphics controller (Intel or nVidia). • Install the latest graphics driver: 1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.

Solving audio problems

Problem	Cause	Solution
Sound does not come out of the speaker or headphones.	Software volume control is turned down.	Click the **Speaker** icon on the taskbar and use the volume slider to adjust the volume, and/or adjust the volume control in the audio player.
	The external speakers are not turned on.	Turn on the external speakers.
	External speakers plugged into the wrong audio jack.	See your sound card documentation for proper speaker connection.
	Digital CD audio is not enabled.	Enable digital CD audio: 1. From the Control Panel, select **Device Manager.** 2. Right-click the **DVD/CD-ROM** device and select **Properties**. 3. On the **Driver Properties** tab, select **Enable**.
	Headphones or devices connected to the line-out connector have muted the internal speaker.	Turn on and use headphones or external speakers, if connected, or disconnect headphones or external speakers.
	Volume is muted.	Click the **Speaker** icon on the taskbar and confirm that the mute button below the volume slider is not selected.
	Computer is in Standby mode.	Press the power button to resume from Standby mode.
Sound quality (such as tone, focus, space, equalization, treble or bass) from the internal speakers is not acceptable.	The graphic equalizer (EQ) and/or DTS audio enhancement settings have been changed and are not appropriate for the audio content being played.	1. Open the DTS user interface (found either in the Control Panel or the taskbar). 2. Go to the Advanced Settings tab. 3. Click the Reset button under Default Settings. This restores the DTS audio enhancement settings, graphic equalizer, and volume to the default settings, which are optimized for most audio content.

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Problem	Cause	Solution
Sound occurs intermittently.	Processor resources are being used by other open applications.	Shut down all open processor-intensive applications.
Workstation appears to be locked up while recording audio.	The hard drive might be full.	1. Before recording, be sure there is enough free space on the hard drive. 2. Try recording the audio file in a compressed format.
The optical S/PDIF output does not work.	S/PDIF is not the default audio output device.	1. Go to **Control Panel > Sound**. 2. On the **Playback** tab, select **Digital Output (S/PDIF)**. 3. Click **Set Default**.
Audio over DisplayPort is not working.	Either the monitor does not support audio, or DisplayPort is not the default audio output.	1. Go to **Control Panel > Sound**. 2. On the **Playback** tab, select the DisplayPort monitor. (If there is no monitor audio device listed, the monitor does not support audio). 3. Click **Set Default**.
Audio input does not work.	The wrong device is set as the default audio input.	1. Go to **Control Panel > Sound**. 2. On the **Recording** tab, select the appropriate input. 3. Click **Set Default**.

Solving printer problems

Problem	Cause	Solution
Printer does not print.	Printer is not turned on and online.	Turn the printer on and be sure it is online.
	The correct printer driver for the application is not installed.	1. Install the correct printer driver for the application. 2. Try printing using the MS-DOS command: **DIR C:\> [printer port]** Replace *printer port* with the address of the printer used. If the printer works, reload the printer driver.
	If you are on a network, you might not have made a connection to the printer.	Make the proper network connection to the printer.
	Printer might have failed.	Run printer self-test.
Printer does not turn on.	The cables might not be connected properly.	

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Using 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 tool runs outside of the operating system so that it can isolate hardware failures from issues that may be caused by the operating system or other software components.

To start HP PC Hardware Diagnostics UEFI:

1. Turn on or restart the computer, quickly press Esc, and then press F2.

   The BIOS searches three places for the HP PC Hardware Diagnostics (UEFI) tools in the following order:

   a. Connected USB drive

   NOTE: To download the HP PC Hardware Diagnostics UEFI tool to a USB drive, see the following section.

   b. Hard drive

   c. BIOS

2. Click 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 while it is running, press Esc.

Downloading HP PC Hardware Diagnostics (UEFI) to a USB device

NOTE: The HP PC Hardware Diagnostics (UEFI) download instructions are provided in English only.

There are two options to download HP PC Hardware Diagnostics to a USB device:

Option 1: HP PC Diagnostics Homepage—Provides access to the latest UEFI version.

1. Go to http://hp.com/go/techcenter/pcdiags.
2. Click the **UEFI Download** link, and then select **Run**.

Option 2: Support and Drivers pages—Provides downloads for a specific product for earlier and later versions.

1. Go to http://www.hp.com.
2. Point to **Support**, located at the top of the page, and then click **Download Drivers**.
3. In the text box, enter the product name, and then click **Go**.

   – or –

   Click **Find Now** to let HP automatically detect your product.
4. Select your computer model, and then select your operating system.
5. In the Diagnostic section, click **HP UEFI Support Environment**.

   – or –

   Click **Download**, and then select **Run**.

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Diagnostic codes and errors

This section presents information about diagnostic LED codes, LED color definitions, and POST error messages to help you troubleshoot problems.

Diagnostic LED and audible (beep) codes

This section describes the front panel LED error and operation codes as well as the audible codes that might occur before or during the POST.

Activity	Possible cause	Recommended action
Power LED is blue. No beeps.	Computer on.	N/A
Power LED flashed blue every two seconds. No beeps.	Computer in Sleep mode (S3-Suspend to RAM). Select models only.	
Power LED is off. No beeps.	Computer in Hibernate mode (S4-Suspend to disk) or system is off (S5).	
Power LED flashes blue three times*, once per second. No beeps.	Computer in Sleep mode (S3-Suspend to RAM). Select models only.	
Power LED flashes blue four times*, once per second. No beeps.	Computer in Hibernate mode (S4-Suspend to disk).	
*User-selectable. See Computer Setup (F10) Utility menu on page 15 for details.		
For the following LED activity and beeps, the beeps are heard through the chassis speaker. Flashes and beeps repeat for five cycles. Then, only the flashes repeat.		
Power LED flashes red two times, once every second, followed by a two-second pause. Two beeps.	CPU thermal protection activated by either of the following methods: • A fan might be blocked or not turning. • The heatsink and fan assembly is not properly attached to the CPU.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Verify that the computer air vents are not blocked and the cooling fan is running. 2. Open the access panel, press power button, and verify that the CPU fan is spinning. If the CPU fan is not spinning, verify that the fan cable is plugged into the computer board header. Verify that the fan is fully and properly seated or installed. 3. If fan is plugged in and seated properly, but is not spinning, the problem might be in the CPU fan. Contact HP for assistance. 4. Verify that the fan assembly is properly attached. If problems persist, there might be a problem with the CPU heatsink. Contact HP for assistance.
Power LED flashes red three times, once every second, followed by a two-second pause. Three beeps.	CPU not installed (not an indicator of bad CPU).	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Verify that the CPU is present. 2. Reseat the CPU.

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Activity	Possible cause	Recommended action
Power LED flashes red four times, once every second, followed by a two-second pause. Four beeps.	Power failure (power supply is overloaded).	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Open the access panel and verify that all power connections are secure on the system board. 2. To verify if a device is causing the problem, remove **all** attached devices (such as hard drives, optical drives, and expansion cards.) Turn on the computer. If the system enters the POST, turn off the computer and replace one device at a time; repeat this procedure until failure occurs. Replace the device that is causing the failure. Continue adding devices one at a time to confirm that all devices are functioning properly.
Power LED flashes red five times, once every second, followed by a two-second pause. Five beeps.	Pre-video memory error.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Reseat DIMMs. 2. Replace DIMMs one at a time to isolate faulty module. 3. Replace third-party memory with HP memory. 4. The problem might be on the system board. Contact HP for assistance.
Power LED flashes red six times, once every second, followed by a two-second pause. Six beeps.	Pre-video graphics error.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Either install a processor with Intel HD Graphics, or install a supported graphics card.
Power LED flashes red seven times, once every second, followed by a two-second pause. Seven beeps.	System board failure (ROM detected failure prior to video).	1. Clear CMOS. **NOTE:** See Clearing and resetting the CMOS on page 73 for details. 2. The problem might be on the system board. Contact HP for assistance.
Power LED flashes red eight times, once every second, followed by a two-second pause. Eight beeps.	Invalid ROM based on bad checksum.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Clear CMOS. **NOTE:** See Clearing and resetting the CMOS on page 73 for details. 2. Upgrade the ROM using SoftPaq, either from the hard drive, CD, diskette, or USB flash drive (for example, HP Drive Key). The ROM can be flashed by through the F10 Setup Menu by going to **File>Flash System ROM**. SoftPaq is a self-extracting executable,

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Activity	Possible cause	Recommended action
		which contains instructions for its use, that enables you to upgrade the ROM. To download the Softpaq executable, go to http://www.hp.com/go/workstationsupport. 3. The problem might be on the system board. Contact HP for assistance.
Power LED flashes red nine times, once every second, followed by a two-second pause. Nine beeps.	System turns on but does not start.	1. The problem might be on the system board. Contact HP for assistance. 2. The problem might be in the CPU. Contact HP for assistance.
System does not power-on and LEDs are not blinking. No beeps.	System unable to turn on. PSU doesn't pass self test	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. The user should perform the Built-In-Self-Test (BIST) To resolve the problem, press and hold the power button for less than four seconds. Then, choose the appropriate option below. If the hard drive LED turns green, try the following procedures in the sequence provided: 1. Remove the expansion cards one at a time and try holding the power button again for less than four seconds. 2. Contact HP for assistance. The problem might be on the system board. – or – If the hard drive LED does not turn green, try the following procedure: 1. Confirm that unit is plugged into a working AC outlet. 2. Open the access panel and confirm that the power button harness is properly connected to the system board. 3. Confirm that all power supply cables are properly connected to the system board.

* The BIOS option you select controls the blue LED function during these suspend modes.

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LED color definitions

The following table describes what each LED light on the computer front panel signifies.

LED state	LED color	System status
Solid	Blue	System is on.
Flashing	Blue	System is in Standby.
Solid or flashing	Red	System has experienced an error. (See POST error messages on page 66.)
None	No light	System is in Hibernate mode, or is off.

POST error messages

The Power-On Self Test (POST) is a series of diagnostic tests that runs automatically when the computer is turned on.

Audible and visual messages occur before the operating system starts if the POST encounters a problem. POST verifies the following items to confirm that the computer system is functioning properly:

- Keyboard
- DIMMs
- CD or DVD drives
- All mass storage devices
- CPUs
- Controllers
- Fans
- Temperature sensors
- Cables (front/rear panels, audio, and USB ports)

The following table describes the POST error messages.

Screen message	Probable cause	Recommended action
101—Option ROM Checksum Error	System ROM checksum.	Verify that you have the latest ROM: 1. Flash the ROM, if needed. 2. If an expansion card was recently added, remove it to find out if the problem remains. 3. Clear CMOS. If the message disappears, there might be a problem with the expansion card. 4. Replace the system board.
102—System Board Failure	DMA, timers, and so forth, might be set improperly or might be defective.	1. Clear the CMOS. 2. Remove the expansion boards. 3. Replace the system board.

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Screen message	Probable cause	Recommended action
110—Out of memory space for option ROMs	Option ROM for a device could not run because of memory constraints.	Run the Computer Setup (F10) Utility to disable unneeded option ROMs, and to enable ACP1/USB Buffers at Top of Memory.
162—Systems Options Error	RTC power (CMOS battery) is lost	1. Run Computer Setup (F10) Utility and set default settings. 2. Replace the CMOS battery. 3. Replace the system board.
163—Time and Date Not Set	• Invalid time or date in configuration memory. • RTC battery might need replacement. • CMOS jumper might not be properly installed.	1. Set the date and time from the Control Panel or in the Computer Setup (F10) Utility (depending on the operating system). 2. If the problem persists, replace the RTC battery.
164—Memory Size changed	Memory configuration is incorrect.	1. Run the Computer Setup (F10) Utility or the Windows utilities. 2. Verify that the memory modules are installed properly. 3. If third-party memory has been added, test the memory configuration using HP memory. 4. Verify the memory module type.
201—Memory Error	RAM failure.	1. Run the Computer Setup (F10) Utility or the Windows utilities. 2. Be sure that memory modules are installed correctly. 3. Verify the memory module type. 4. Remove and replace memory modules one at a time to isolate faulty modules. 5. Replace faulty memory modules. 6. If the error persists after replacing memory modules, replace the system board.
202—Memory Type Mismatch	Memory modules do not match.	Replace the memory modules with matched sets.
203—Memory module failed self-test and failing rank was disabled	Defective memory module.	Replace the memory module.
204—Memory module failed and user rank was disabled	Improper module load.	Reseat the memory module correctly.
205—Memory high temperature detected	Insufficient memory module cooling.	Verify that a memory module cooling fan is installed and operating.
206—Memory setup invalid	Memory configured incorrectly.	Reconfigure the memory modules in the proper slots.
207—Incompatible DIMMs detected	DIMMs are installed that do not fulfill system requirements.	1. Verify that the memory module type matches computer requirements. 2. Insert the DIMM in the proper memory socket. 3. Replace the DIMM if the problem persists.

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Screen message	Probable cause	Recommended action
208—Mismatched DIMMs detected	Installed DIMMs are improperly matched.	Verify that matching DIMMs are installed.
209—Memory warning condition detected	Incorrect memory module type in use.	Verify that the memory modules are compatible with computer requirements.
212—Failed Processor 0	Processor has failed to initialize.	1. Reseat the processor in its socket. 2. If the processor does not respond, replace it. 3. Replace the system board.
213—Incompatible Memory Modules	A memory module in the memory socket identified in the error message is missing critical SPD information, or is incompatible with the chipset.	1. Verify the memory module type. 2. Insert the DIMM in another memory socket. 3. Replace the module with a DIMM conforming to the SPD standard.
214—DIMM Configuration Warning	DIMMs are not installed correctly (not paired correctly).	See the service label on the computer access panel for the correct memory configurations, and reseat the DIMMs accordingly.
216—Memory Size Exceeds Maximum Supported	The amount of memory installed exceeds that supported by the hardware.	1. Verify how much memory the computer supports. 2. Remove the excess memory.
301—Keyboard Error	Keyboard failure.	1. Reconnect the keyboard with the computer powered off. 2. Connect a keyboard directly to the computer (instead of through a switch box). 3. Be sure that none of the keys are pressed. 4. Replace the keyboard.
303—Keyboard Controller Error	I/O board keyboard controller is defective or is not set properly.	1. Reconnect the keyboard with the computer powered off. 2. Connect a keyboard directly to the computer (instead of through a switch box). 3. Replace the system board.
304—Keyboard or System Unit Error	Keyboard failure.	1. Reconnect the keyboard with the computer turned off. 2. Connect a keyboard directly to the computer (instead of through a switch box). 3. Be sure that none of the keys are pressed. 4. Replace keyboard. 5. Replace system board.
510—Splash Screen image corrupted	Splash Screen image has errors.	Update system UEFI.
511—CPU Fan not detected	Fan is not connected or is defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
515—CPU Overtemp occurred	Insufficient processor cooling or processor defect.	1. If necessary, add a heatsink to the processor and verify proper operation.

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Screen message	Probable cause	Recommended action
		2. Replace the processor.
516—MXM fan not detected	MXM fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
517—Memory fan not detected	Memory fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
530—Left DMIC cable not connected.	Left Dmic cable is not connected to the system board or to the left Dmic.	1. Reseat the cable. 2. Replace the cable.
531—Right DMIC cable not connected.	Right Dmic cable is not connected to the system board or to the right Dmic.	1. Reseat the cable. 2. Replace the cable.
532—Side I/O board not connected.	Side I/O board is missing or is not connected.	1. Reseat the Side I/O board. 2. Replace the Side I/O board. 3. Replace the system board.
533—Rear I/O USB/Audio cable not connected.	The Rear I/O USB/Audio cable between the system board and Rear I/O board is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
534—Rear I/O DP/LAN cable not connected.	The Rear I/O DP/LAN cable between the system board and Rear I/O board is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
535—LED Backlight cable not connected.	The LED backlight cable between the system board and the LCD panel is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
536—LCD DP cable not connected.	The LCD DP cable between the system board and the LCD panel is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
539—Unable to read GPU temperature. The graphics card may overheat.		1. Power cycle the system. 2. If the problem persists, contact HP support.
550—Thunderbolt power cable not connected.	The Thunderbolt power cable is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
551—Thunderbolt DP cable not connected.	The Thunderbolt DP cable is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
552—Thunderbolt PCIE cable not connected.	The Thunderbolt PCIE cable is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
538—Panel I/O cable not connected.	The Panel I/O cable is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
912—Computer Cover Has Been Removed Since Last System Start Up	N/A	No action required.

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Screen message	Probable cause	Recommended action
917—Front Audio cable not connected.	The Front Audio cable (speakers cable) is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
922—Fatal error on PCIe slot X	Fatal error occurred in the designated slot.	Move the card to a different slot. If the problem persists, replace the card.
925—Fatal Misc error	A fatal miscellaneous chipset error was detected.	Contact HP Support.
928—Fatal machine check detected on CPU X		Contact HP support.
929—Fatal MCA error	An MCA condition was detected on the system.	Contact HP Support.
942—Memory Training error	A DIMM or DIMMs did not train correctly	Contact HP Support.
1720—SMART Hard Drive Detects Imminent Failure	Hard drive is about to fail. (Some hard drives have a firmware patch that fixes erroneous error messages.)	1. Determine if the hard drive is giving a correct error message. 2. Run the UEFI F2 Diagnostics Drive Test (if applicable). 3. Apply firmware patch (if applicable). Go to http://www.hp.com/support. 4. Back up contents and replace the hard drive.
1783—Fixed Disk 0/1 locked	Hard drive failure.	Diagnose the hard drive, and replace it if necessary.
1796—SATA Cabling Error	Missing or improperly attached cable.	Verify that a cable is attached. Reattach the cable.
1797—SATA Drivelock is not supported in RAID mode	SATA Drivelock is not supported in RAID mode.	Disable RAID mode, or disable SATA drivelock.
1801—Microcode Update Error	Unknown or unsupported processor stepping.	The microcode update failed. Verify the processor stepping to confirm that it is a supported stepping. If it is contact, HP Support.
1802—Processor Not Supported	The system board does not support the processor.	Replace the processor with a compatible one.
1803—Processor feature set is insufficient for current system settings	Processor feature set is insufficient for current system settings. The UEFI settings do not match the support provided by the processor	Change the UEFI settings or upgrade the processor.
1804—A processor feature and the memory configuration are incompatible	A processor feature is incompatible with the memory configuration.	Restore the previous memory configuration.
ERROR: Invalid electronic serial number (no number)	No electronic serial number is stored with the system	To assign a serial number, open Computer Select (F10) Utility, and then select **Security > System IDs**.
ERROR: An unsupported processor is installed. System halted	Unsupported processor detected.	Replace the processor.
Invalid electronic serial number	Incorrect serial number registered in the system.	To assign a serial number, open Computer Select (F10) Utility, and then select **Security > System IDs**.
Processor initialization fails	Processor defective.	Replace the processor.

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5 Configuring password security and resetting CMOS

This chapter describes how to configure password security and to reset CMOS, and includes these topics:

- Preparing to configure passwords on page 71
- Resetting the password jumper on page 71
- Clearing and resetting the CMOS on page 73

Preparing to configure passwords

The Computer Setup (F10) Utility enables you to create setup and power-on passwords.

There are three possibilities for setting passwords:

- Define a setup password only. You will need the password to enter Computer Setup (F10) Utility, but you will not need a password to start the workstation.
- Define a power-on password only. This password lets you start the workstation or enter the setup utility.
- Define both. In this case, the setup password lets you start the workstation and enter the setup utility. The power-on password starts the workstation but does not let you enter the setup utility,

After you create both passwords, you can use the setup password in place of the power-on password as an override to log in to the computer (a useful feature for a network administrator).

NOTE: You can only clear the passwords with the password jumper. Clearing CMOS does not clear the passwords.

CAUTION: Before pressing the Clear CMOS button, back up your computer CMOS settings.

Pressing the Clear CMOS button resets CMOS values to factory defaults and erases customized information, including asset numbers and special settings.

To back up the CMOS settings, run the Computer Setup (F10) Utility and select **File>Replicated Setup>Save to Removable Storage Device**.

Resetting the password jumper

Use the following procedure to disable the power-on or setup password features and clear the power-on and setup passwords.

WARNING! To reduce the risk of personal injury from electrical shock and hot surfaces, be sure to disconnect the power cord from the wall outlet and allow the internal system components to cool before touching them.

CAUTION: When the computer is plugged in, the power supply has voltage applied to the system board, even when the computer is turned off. Failure to disconnect the power cord can result in damage to the system.

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CAUTION: Static electricity can damage the electronic components of the computer or optional equipment. Before beginning these procedures, briefly touch a grounded metal object to be sure that you are discharged of static electricity.

1. Access the jumper:
   a. Shut down the operating system, turn off the computer and external devices, and then disconnect the power cords from the computer and external devices.
   b. Disconnect any external devices.
   c. Open the workstation.
   d. Locate the password header and jumper.

      The password header is E49. The password jumper is blue so it can be easily identified.
2. Remove the jumper from pins 1 and 2. Do not lose the jumper.
3. Restart the computer:
   a. Close the workstation.
   b. Reconnect the AC power cord to the computer.
   c. Turn on the computer and wait for the workstation to display the HP splash screen.
4. Repeat step 1.
5. Replace the jumper on pins 1 and 2.
6. Repeat step 3, except press the F10 key during startup to access Computer Setup (F10) Utility.
7. Use the setup utility to create new passwords.

NOTE: The BIOS option “Stringent Password” creates a password that cannot be reset by the password jumper.

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Clearing and resetting the CMOS

This section describes the steps necessary to successfully clear and reset the CMOS. The CMOS of the computer stores password information and information about the computer configuration.

Using the CMOS button to reset CMOS

To clear CMOS using the Clear CMOS button, use the following procedure:

WARNING! To reduce the risk of personal injury from electrical shock and hot surfaces, disconnect the power cord from the wall outlet and allow the internal system components to cool before touching them.

CAUTION: When the computer is plugged in, the power supply has voltage applied to the system board, even when the computer is turned off. Failure to disconnect the power cord can result in damage to the system.

Static electricity can damage the electronic components of the computer or optional equipment. Before beginning these procedures, briefly touch a grounded metal object to be sure that you are discharged of static electricity.

1. Back up your computer CMOS settings with Computer Setup (F10) Utility, and select **File>Replicated Setup>Save to Removable Storage Device**.

   CAUTION: Pressing the Clear CMOS button resets CMOS values to factory defaults and erases customized information, including asset numbers and special settings.

2. Shut down the operating system, turn off the computer and external devices, and disconnect any external devices.
3. Disconnect the AC power cord from the computer and wait 30 seconds for the power to dissipate.

   NOTE: The Clear CMOS button does not clear CMOS if the AC power cord is connected to the computer.

4. Open the workstation.
5. Locate and press the CMOS button.

   For assistance locating the CMOS button and other system board components, see the system board layout in System board components on page 6.

6. Close the workstation, reconnect external devices, connect the power cord to the workstation, and then turn on the workstation.
7. The system boots to an F1 prompt and displays a message that the date/time has changed and that system options have changed.
8. Press F1. The system shuts down for three seconds and then restarts.
9. Use Computer Setup (F10) Utility to reset the date and time.

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Using Computer Setup (F10) Utility to reset CMOS

1. Access Computer Setup (F10) Utility menu.
2. When the computer setup message appears in the lower-right corner of the screen, press F10, and then press Enter to bypass the title screen, if necessary.

   If you do not press F10 while the message is displayed, the computer must be rebooted to access this utility.
3. From Computer Setup (F10) Utility menu, select **File**, and then select **Default Setup**.

   This restores the settings that include boot sequence order and other factory settings. However, it does not force hardware rediscovery.
4. Choose **Restore Factory Settings as Default**, and then press Enter to accept.
5. Select **File > Apply Defaults and Exit**, and then press Enter to accept.
6. Reset the computer passwords and configuration information, such as the system date and time.

NOTE: This step does not clear the passwords.

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A Linux technical notes

HP offers a variety of Linux solutions for HP workstation customers.

- HP certifies and supports Red Hat® Enterprise Linux (RHEL) on HP workstations.
- HP certifies SUSE Linux Enterprise Desktop (SLED) on HP workstations.
- HP offers a SLED 11 preload on some Z Series workstations.

For Linux setup and restore procedures, go to http://www.hp.com/support/workstation_manuals to find the user guide for your workstation.

Topics
System RAM on page 75
Audio on page 75
Network cards on page 76
Hyper-Threading Technology on page 76
NVIDIA Graphics Workstations on page 77

NOTE: After you set up the operating system, verify that the latest BIOS, drivers, and software updates are installed.

CAUTION: Do not add optional hardware or third-party devices to the workstation until the operating system is successfully installed. Adding hardware might cause errors and prevent the operating system from installing correctly.

System RAM

HP supports different amounts of total RAM in various HP workstations, based on the number of hardware DIMM slots and the capabilities of the system. The total memory supported for each configuration is listed in the *Hardware Support Matrix for HP Linux Workstations* at http://www.hp.com/support/linux_hardware_matrix.

Audio

All HP workstations come with built-in audio hardware. The audio hardware is supported by the *Advanced Linux Sound Architecture* (ALSA) drivers included with all modern Linux distributions.

The audio hardware provides basic playback and recording features. The ability to simultaneously play audio from multiple sources, such as applications and CDs, is provided by software mixing functionality in the ALSA driver. The performance of software audio mixing and playback functionality is greatly improved in ALSA drivers version 1.0.13 and later.

After the NVIDIA proprietary driver is installed, the optional NVIDIA graphics devices supported in the HP Z1 G2 Workstation also provide audio functionality over HDMI, which can be passed through the external DisplayPort connector to a monitor with audio capabilities. Such a configuration may present two audio

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hardware choices. If you do not hear sound through the speakers, one possible reason is that the NVIDIA audio device has been chosen by default. Verify the audio settings (for example, **Sound** in GNOME Control Center).

In some systems, embedded Intel HD graphics may also present a similar HDMI audio device that can be used through the DisplayPort interface. No proprietary driver is needed for this device, just a sufficiently recent kernel.

Network cards

All HP workstations include one or two integrated network interface controllers. The HP Z1 G2 Workstation includes a PCI Express Mini Card that implements both wireless LAN and Bluetooth. The iwlagn driver supports the wireless LAN; in most distributions, the Network Manager automatically senses that wireless networks are available. Bluetooth support is also available in many Linux distributions.

Hyper-Threading Technology

The Z Series workstations support Hyper-Threading Technology (HTT), an Intel-proprietary technology that improves processor performance through parallelization of computations (doing multiple tasks at once). The operating system treats an HTT-enabled processor as two virtual processors and shares the workload between them when possible. This feature requires that the operating system support multiple processors and be specifically optimized for HTT.

To enable HTT:

1. During startup, press F10 to enter Computer Setup (F10) Utility. Use the arrow keys to navigate and select options.
2. Select **Advanced > Device Options**.
3. Set **Hyper-Threading** to **Enable**, and then press F10 to exit the menu.
4. Select **File > Save Changes and Exit**.
5. Restart the system to enable HTT.

NOTE: On most recent Linux distributions, the kernel automatically detects that HTT is enabled and works correctly.

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NVIDIA Graphics Workstations

Some HP Z1 G2 workstation configurations come with NVIDIA Quadro graphics hardware. HP recommends the use of NVIDIA proprietary graphics drivers for best results on Linux and Windows based systems. Go to the Support page on http://www.hp.com or http://www.nvidia.com for the latest available drivers.

HP also provides recommended versions of the drivers with RPM-compatible installers for RHEL and SLED distributions. These are available from the HP Installer Kit for Linux and from workstation driver repositories on hp.com. When HP installers are used, their contents and documentation links are installed in the `/opt/hp/nvidia` folder.

When installing Linux on an HP Z1 G2 workstation that contains an NVIDIA card, administrators should select a VESA-compatible driver to avoid the instability that is experienced with some open-source versions of the Nouveau and DRM drivers.

Open source versions of Nouveau drivers and NVIDIA proprietary graphics drivers cannot coexist in the same runtime environment because they use the same hardware resources. If administrators create their own Linux environments using NVIDIA proprietary graphics drivers but choose not to use versions packaged by HP, HP recommends that they manually append the following boot loader parameters to properly suppress the Nouveau driver at runtime (grub example below):

```
kernel /vmlinuz ... rdblacklist=nouveau nouveau.modeset=0
```

This action is applied by HP installers but must be applied/restored under other circumstances.

To customize the display characteristics and resolutions of an NVIDIA proprietary graphics driver environment, execute the following command:

```
/usr/bin/nvidia-settings
```

To create and manipulate the /etc/X11/xorg.conf file, execute the following command:

```
/usr/bin/nvidia-xconfig
```


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B Configuring RAID devices

This appendix explains how to configure RAID arrays on your workstation.

Topics
RAID hard drive maximum and associated storage controller options on page 79
Supported RAID configurations on page 79
Configuring Intel SATA RAID on page 80
Configuring SATA RAID in Windows on page 81
Software RAID solution on page 81

For additional information about RAID configuration, go to http://www.hp.com/support/RAID_FAQs.

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RAID hard drive maximum and associated storage controller options

This section lists the maximum number of hard drives supported on HP workstations according to RAID configuration and storage controller options.

NOTE: This section applies to internal workstation configurations that do not use add-in cards and external enclosures.

- Max of 2 drives:
  - 2 x 2.5” (SFF HDD or SSD)

    OR
  - One 3.5” HDD (Using 3.5” HDD Carrier) plus one mSATA drive
- Max of 3 drives:
  - 2 x 2.5” SFF HDD or SSD (Using 2.5” HDD carrier) plus one mSATA drive

Supported RAID configurations

The following RAID configurations are supported:

RAID configuration details		
Configuration	**Description**	**Controllers**
RAID 0 Integrated striped disk array	• Requires a minimum of two drives. • Provides improved I/O performance. • Provides no fault tolerance. • Loses all data if any disk in the array fails. • Increases disk performance.	Intel with RST
RAID 1 Mirrored disk array	• Supports a minimum of two drives. • Provides 100% redundancy: all data from one drive is duplicated on a second drive. • Recovers from a single-drive failure. • Serves as a good entry-level redundant system.	Intel with RST

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Configuring Intel SATA RAID

This section describes how to use Intel® Rapid Storage Technology (RST) to set up and manage SATA RAID volumes.

NOTE: These instructions apply to Windows-based systems.

You can create a SATA RAID array that contains up to the maximum number of internal SATA hard drives and eSATA drives (if you use an optional eSATA bulkhead cable) supported on your workstation.

The Intel SATA option ROM configuration utilities run when you select **RAID** for the SATA emulation mode.

Two or more hard drives must be attached to the controller for the option ROM to run.

Configuring the system BIOS to enable embedded SATA RAID functionality

The Z1 G2 Workstation defaults to RAID emulation mode. RAID emulation mode includes the benefits of AHCI with the added benefit of supporting RAID configurations. If the mode has been changed to IDE or AHCI, follow the steps below to change it back.

CAUTION: Changing SATA emulation modes after the OS has been installed will prevent the system from booting and require reinstallation of the OS. Back up your data before changing SATA emulation mode.

1. During startup, press F10 to enter Computer Setup (F10) Utility. Use the arrow keys to navigate and select options.
2. Select **Storage** > **Storage Options**, then press Enter.
3. Select **SATA Emulation**.
4. If not already set to RAID, use right/left arrow keys to select RAID
   a. Read the warning and press Enter to dismiss the warning. If your OS was installed in a SATA emulation mode other than RAID, you will need to reinstall your OS.
   b. Press F10 to accept the settings.
5. Navigate to **Security** > **Secure Boot Configuration**.
6. Verify that **Legacy Support** is set to **Enabled**. If not enabled, use the arrow keys to change **Legacy Support** to **Enabled**.
   a. Read the **Legacy Support** message and press Enter to dismiss the message.
   b. Press F10 to accept the settings.
7. Navigate to **Advanced** > **Option ROM Launch Policy** > **Storage Option ROMs**.
   - Verify that **Storage Option ROMs** are set to **Legacy Only**. If not set to **Legacy Only** use the arrow keys to change to **Legacy Only**.
   - Press F10 to accept the settings.
8. Navigate to **Save Changes and Exit** and press Enter.

   Hint: Pressing F10 several times will also take you back to the **File** menu. **Yes** should already be selected in the **Save Changes and Exit**. Press Enter to confirm.
9. The system will reboot.

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Configuring RAID volumes in Option ROM

Follow these steps to create RAID volumes.

1. Press ctrl+I, when prompted, to enter the Intel Rapid Storage Technology Option ROM. Use the arrow keys to navigate and select options.

   NOTE: If only a single hard drive is attached, the utility does not execute. No message is displayed.

2. Select **1. Create RAID Volume**,and then press Enter.
3. Enter the desired RAID volume name in the name field, and then press Tab.
4. Select a level in the RAID Level field by using Up and Down arrows, and then press Tab.
5. If appropriate, press Enter to select disks. Use Up and Down arrows to highlight the disks, and Space to select each disk and press Enter when done.
6. If appropriate use Up and Down arrows to select a size in the **Strip Size** field, and then press Tab.
7. Enter the desired size in the **Capacity** field, and then press Tab
8. Press Enter to initiate volume creation.

Configuring SATA RAID in Windows

This section explains how to use the Intel Rapid Storage Technology Utility to set up and manage SATA RAID volumes in Windows.

1. Press the Windows key and start typing `Intel`. “Intel ®Rapid Storage Technology should appear in **Programs**. Click on **Intel Rapid Storage Technology** to start the Graphical User Interface (GUI). Alternatively, in Windows 7, you can click the Start button at the lower left corner of the screen and navigate to the **Intel Rapid Storage Technology**.
2. Click **Yes** if prompted, to allow the application to make changes to your system.
3. Click the **Create** button at the top of the window.
4. Select the desired volume type and click the **Next** button. (Only valid configurations will be available. All other options will be grayed out and not selectable.)
5. A default name will be shown. You can change the name to something more descriptive if desired.
6. Click on the checkbox to select each disk that you want included in the RAID volume.
7. Adjust the volume size if desired.
8. Click **Next**.
9. Review the proposed configuration and click **Create Volume**.
10. You will receive a “Volume Creation Complete” message. Click **OK** to dismiss the message.
11. Close the Intel ®Rapid Storage Technology GUI.
12. Remember to open the Disk Management snap-in to initialize and format the newly created array. The new array will not be visible until it is initialized and formatted.

Software RAID solution

This section summarizes software RAID considerations that are specific to the Linux environment, and provides links to additional configuration resources.

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Software RAID considerations

The Linux kernel software RAID driver (called *md*, for *multiple device*) offers integrated software RAID without the need for additional hardware disk controllers or kernel patches. Unlike most hardware RAID solutions, software RAID can be used with all types of disk technologies, including SATA, SCSI, and solid-state drives. This software solution requires only minimal setup of the disks themselves.

However, when compared to hardware-based RAID, software RAID has disadvantages in managing the disks, breaking up data as necessary, and managing parity data. The CPU must assume some extra loading: disk-intensive workloads result in roughly double the CPU overhead (for example, from 15% to 30%). For most applications, this overhead is easily handled by excess headroom in the processors. But for some applications where disk and CPU performance are very well balanced and already near bottleneck levels, this additional CPU overhead can become troublesome.

Hardware RAID offers advantages because of its large hardware cache and the capability for better scheduling of operations in parallel. However, software RAID offers more flexibility for disk and disk controller setup. Additionally, hardware RAID requires that a failed RAID controller must be replaced with an identical model to avoid data loss, whereas software RAID imposes no such requirements.

Some software RAID schemes offer data protection through mirroring (copying the data to multiple disks in case one disk fails) or parity data (checksums that allow error detection and limited rebuilding of data in case of a failure). For all software RAID solutions on HP workstations, redundancy can be restored only after the system is shut down so that the failed drive can be replaced. This replacement requires only a minimum amount of work.

Performance considerations

Disk I/O bandwidth is typically limited by the system bus speeds, the disk controller, and the disks themselves. The balance of these hardware limitations, as affected by the software configuration, determines the location of the any bottleneck is in the system.

Several RAID levels offer improved performance relative to stand-alone disk performance. If disk throughput is restricted because of a single disk controller, RAID can probably do little to improve performance until another controller is added. Conversely, if raw disk performance is the bottleneck, a tuned software RAID solution can dramatically improve the throughput. The slower disk performance is, relative to the rest of the system, the better RAID performance will scale, because the slowest piece of the performance pipeline is being directly addressed by moving to RAID.

Configuring software RAID

See the following sites for additional information about configuring software RAID on Red Hat Enterprise Linux (RHEL) or SUSE Linux Enterprise Desktop (SLED):

- Red Hat Enterprise Linux 6—See the *Storage Administration Guide* at https://access.redhat.com/site/documentation
- SLED 11—See the *Deployment Guide* at http://www.suse.com/documentation/sled11/book_sle_deployment/?page=/documentation/sled11/book_sle_deployment/data/book_sle_deployment.html.

For more information about Open Source and Linux at HP, go to http://www.hp.com/go/opensource.

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C System board designators

This appendix describes the system board designators for this computer.

Main system board

Designator	Name on board	Component
E1	FDO	Flash Descriptor Override header/jumper
E14	BB	Boot Block header/jumper
E15	BBR	Crisis recovery header/jumper
E49	PSWD	Clear password header/jumper
P66	WEBCAM	Webcam/Digital Mic connector
CON6701	DP/LAN	Rear DP/LAN connector (white)
J7	J7	Side I/O connector (black)
J17	Rear IO	Rear USB connector (white)
J18	Rear Audio	Rear audio connector (white)
J65	eDP	eDP (embedded DisplayPort) connector (white)
J41	MXM	MXM (PCIe x16) graphics connector (black)
J31	mPCIe/mSATA1 SLOT1	Mini-PCIe/mSATA connector (black)
J32	mPCIe/mSATA2 SLOT2	Mini-PCIe/mSATA connector (black)
J12	TBT_PCIE	Thunderbolt 2 module PCIex4 connector (black)
J11	TBT_DP	Thunderbolt 2 module DP connector (black)
J8	TBT PWR	Thunderbolt 2 module power connector (white)
SW50	CMOS	Clear CMOS button
P1	PWR	Power Supply, 20-pin (white)
P2	PWR LED	LED Sync and Power, 19-pin (black)
P5	PB/LED	Side power button/LED (black)
P10	MXM FAN	MXM blower (white)
P9	MEM FAN	Memory blower (black)
P24	TOUCH USB	Touch USB 2x5 header (blue)
P60	SATA0	SATA 6.0 Gbps hard drive port (black)
P61	SATA1	SATA 6.0 Gbps hard drive port (black)

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Designator	Name on board	Component
P62	SATA2	SATA 6.0 Gbps optical drive port (black)
P8	CPU FAN	CPU cooler (black)
P125	HSENSE	Hood sensor (white)
P160	SATA PWR	SATA hard drive power (white)
P161	ODD PWR	SATA optical drive power/eject (white)
P6	SPKR	Internal speakers (white)
XBT1	BATT	Battery holder
BZ1	BZ1	Internal buzzer for beep codes (black)
XMM1 - XMM4	DIMM1 — DIMM4	Memory slots
XU1	PROCESSOR	CPU socket

Rear I/O board

All connectors on the rear I/O board, except for J90, are on the bottom of board.

Designator	Name on board	Component
J90	USB2	Internal USB 2.0 Type A
J9	RJ45	LAN
J64	DISPLAYPORT	DisplayPort
J15	Rear IO	Rear USB/Audio connector (white)
J16	DP/LAN	Rear DP/LAN connector (white)
J81	USB2	Dual-USB 2.0
J82	USB2	Dual-USB 2.0
J76	S/PDIF	Optical S/PDIF
J79	SUB	Subwoofer jack
J73	IN	Audio line-in jack
J74	OUT	Audio line-out jack

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Side I/O board

Designator	Name on board	Component
J72	MIC	Microphone jack
J75	HDSET	Headset jack
J71	USB3	USB 3.0 & battery charging port
J70	USB3	USB 3.0
J166	CARD READER	SD 4.0 card reader
J7	J7	Side I/O connector (bottom side)

Thunderbolt 2 module board

Designator	Name on board	Component
J8	TBT-PWR	Thunderbolt 2 module power connector (black)
J11	TBT_DP	Thunderbolt 2 module DP connector (black)
J12	TBT_PCIE	Thunderbolt 2 module PCIe connector (black)
CON1	TBT1	Thunderbolt 2 module port 1 (top port in system)
CON2	TBT2	Thunderbolt 2 module port 2 (bottom port in system)

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