HP Z400 Workstation

Maintenance and Service Guide

About this guide

This guide provides service and maintenance information for the HP Z400 Workstation. It includes these topics:

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1 Product overview

This chapter presents an overview of the hardware components of the workstation. It includes these topics:

Topics

Product features

The following sections describe the workstation system board architecture and components, and includes these topics:

Topics

System board architecture

This section describes the workstation system architecture.

The following figures show the typical system board block diagram for 4–DIMM and 6–DIMM Z400 workstations.

Figure 1-1 4–DIMM system board block diagram
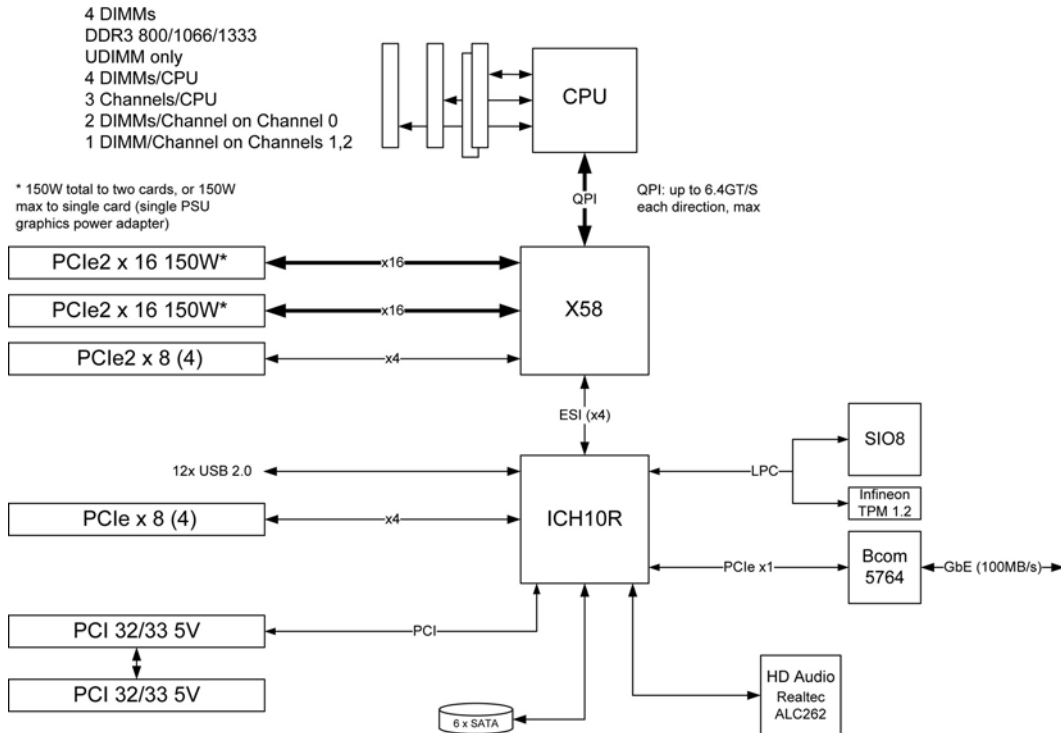
> **NOTE:** The x1, x4, x8, and x16 designators describe the mechanical length of the slot. The number in parentheses lists the number of electrical PCIe lanes routed to the expansion slot. For example, x16 (8) means that the expansion slot is mechanically a x16 length connector, with eight PCIe lanes connected.

Figure 1-2 6–DIMM system board block diagram
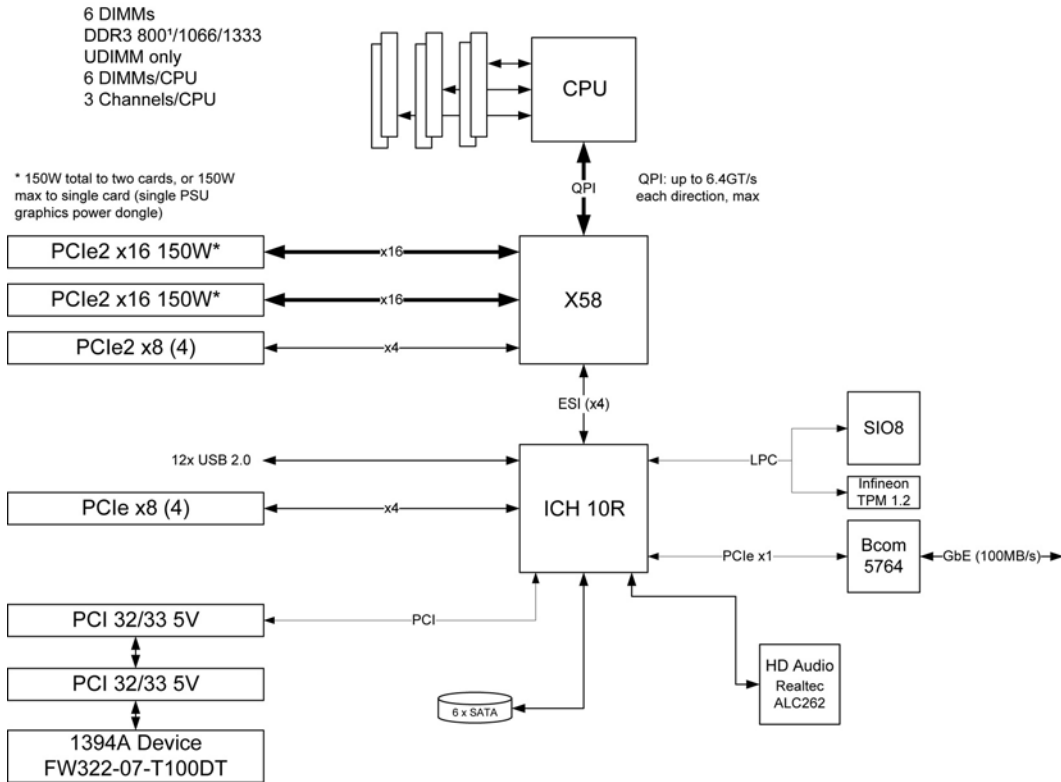
Processor technology

This workstation uses the Intel® X58 Express chipset to support the latest Quad Core Intel® Xeon™ processor W3500 Series, including processors up to 130W. These processors incorporate an integrated 3-channel memory controller, microarchitecture improvements and large L3 cache to provide superior performance. In addition, the workstation uses Intel QuickPath Interconnect (QPI) to connect the processor and I/O controller with speeds up to 6.4 GT/s.

Memory technology

The workstation dual in-line memory modules (DIMMs) are based on DDR3 1333MHz technology, and are error checking and correcting (ECC)-protected. Three direct attach memory channels permit low latency accesses and fast data transfer for improved performance. The workstation supports system memory sizes of up to 16GB (in the 4-DIMM Z400s, using 4-GB DIMMs) and 24 GB (in the 6-DIMM Z400s, using 4-GB DIMMs).

NOTE: DIMMs should be distributed across all three memory channels for optimal performance.

Graphics

The workstation supports PCIe Gen2 (PCIe2) bus speeds and can support dual PCIe Gen2 graphics cards in PCIe2 x16 slots. It supports graphics cards up to 150W in the primary graphics slot. If the primary graphics card consumes less than 150W, a second graphics card may be supported in the second PCIe2 x16 slot, subject to the overall 150W power system limitations.

Expansion card slots

The workstation implements one Intel X58 I/O chip to provide a total of six high-performance graphics and I/O slots. In addition to the two full x16 PCIe Gen2 slots, two additional PCIe x8 (4) slots (x8

mechanically, x4 electrically) provide extra I/O bandwidth for high speed I/O cards. Open ended PCIe x8 connectors let the user install x16 physical size cards in the x8 (4) slots.

Additional features

Redundant array of independent disks (RAID) configurations for SATA support modes 0, 1, 5 and 10. eSATA (3.0 Gbps) is supported using an optional adapter. The workstation provides 8 external and 4 internal USB 2.0 ports. The 475W power supply is 85% efficient and enables Energy Star Version 5.0 system configurations. HP WattSaver technology enables support of the European Union EuP power limit of 1W in off mode. HP Quiet Fan Technology enables quiet system operation. A plug-in card supports Serial Attached SCSI (SAS) drives.

Workstation components

This section describes workstation components, including front and rear panel components.

For complete and current information on supported accessories and components for the workstation, see http://partsurfer.hp.com.

Chassis components

The following image shows the components of a typical workstation configuration. Drive configurations can vary.

Figure 1-3 Workstation components

Table 1-1 Workstation component descriptions

Item	Description	Item	Description
1	Power supply	9	Memory module (DIMM)
2	Side access panel	10	System board
3	Rear system fan	11	PCIe card
4	SFF Hard drive	12	PCI card
5	Hard disk drive	13	Airflow guide (for 6-DIMM Z400 product)
6	Optical drive	14	Speaker
7	Processor (CPU) heatsink	15	Front bezel
8	Processor	16	Chassis

Front panel components

The following figure shows the front panel of a typical workstation configuration.

Figure 1-4 Front panel
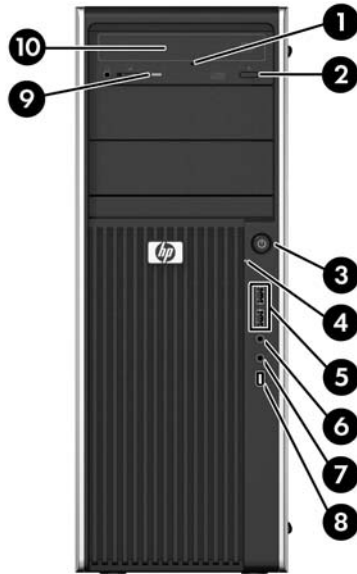
Table 1-2 Front panel connectors

Item	Symbol	Description	Item	Symbol	Description
1		Optical drive manual eject	6	🎧	Headphone connector
2		Optical drive eject button	7	🎤	Microphone connector
3	⏻	Power button	8		1394a connector (optional and plugged unless configured)
4		Hard drive activity light	9		Optical drive activity light
5		USB 2.0 ports (2)	10		Optical drive

Rear panel components

The following figure shows the rear panel of a typical workstation configuration.

Figure 1-5 Rear panel
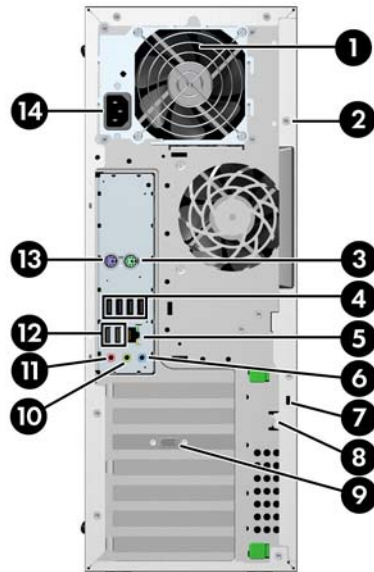
📝 **NOTE:** The rear panel connectors are labeled with industry-standard icons and colors to assist in connecting peripheral devices.

Table 1-3 Rear panel connectors

Item	Symbol	Description	Item	Symbol	Description
1		Power supply Built-In Self Test (BIST) LED	8		Padlock loop
2		Universal chassis clamp opening	9		Graphics card connector
3	🖱	PS/2 mouse connector (green)	10	((•⟫	Audio line-out connector (green)
4	⟵⟶	USB 2.0 ports (4)	11	🎤	Microphone connector (pink)
5	⊞	RJ-45 network connector	12	⟵⟶	USB 2.0 ports (2)
6	((•⟫	Audio line-in connector (blue)	13	⌨	PS/2 keyboard connector (purple)
7		Cable lock slot	14		Power cord connector

Workstation specifications

This section provides workstation chassis, power supply, and environmental specifications.

Physical characteristics

The following table lists the workstation physical characteristics.

Weight (Typical configuration)	13.5-19.6 kg (29.8-43.2 lb.)
Chassis Dimensions	**Height**: 45.0 cm (17.7 in.)
	Width: 17.0 cm (6.7 in.)
	Depth: 44.5 cm (17.5 in.)

Power supply description

The workstation includes a 475-W 85% efficient power supply to provide power for the workstation. The power supply is compatible with ENERGY STAR requirements.

Power supply voltages

Table 1-4 Power supply source voltages

Source voltage	Description
+3.3V	PCI, PCIe, audio, clocks, chipset, super I/O, BIOS ROM, and onboard logic
+5.1V	Storage (hard disk drive, optical disk drive, diskette drive), PCI, PCIe, chipset, audio, keyboard/mouse, and USB
+12 V-CPU	Input to onboard regulator that supplies power to CPU and CPU fan
+12 V-B	PCI, PCIe, and system fans
+12 V-D	Storage (hard disk drive, optical disk drive, diskette drive), graphics adapter, and input to onboard regulator that supplies power to memory
V12N	PCI and serial ports
+5 V-SB	Sleep circuitry

Power supply currents

Table 1-5 Maximum current per rail

Voltage rail	475W maximum continuous current
+12 V-CPU	17.5A
+12 V-B	17.5A
+12 V-D	18.0A
V12N	0.30A
+5 V-SB	2.25A
3.3V	15.0A
5.1V	21.0A

△ **CAUTION:** Do not exceed 475 watts of total continuous output power.

Maximum combined power on 3.3V and 5.1V is 110W.

Maximum combined current on +12V(CPU,B,D) is 38A.

Power supply specifications

Table 1-6 Power supply specifications

Item	Description	
Power supply	**475W Wide Ranging, Active PFC and 85% efficient**	
Operating voltage range	90 – 269 VAC	
Rated voltage range	**100–240 VAC**	**118 VAC**
Rated line frequency	50–60 Hz	400 Hz
Operating line frequency range	47–66 Hz	393–407 Hz
Rated input current	10A @ 100-127 VAC 6A @ 200–240 VAC	10A @ 118 VAC
Heat dissipation (Configuration and software dependent)	Typical 954 Btu/hr = (240.3 kg-cal/hr) Maximum 1977 Btu/hr = (498.2 kg-cal/hr)	
Power supply fan	One fan, 92mm x 25mm, variable speed	
FEMP Standby Power compliant @115V (<2W in S5 – Power Off)	Yes	
EuP Compliant @230V (<1w in S5 – Power Off)	Yes	
Built-in Self Test LED	Yes	
Surge tolerant full ranging power supply (withstands power surges up to 2000V)	Yes	
Power Consumption in sleep mode (as defined by ENERGY STAR) - Suspend to RAM (S3) (Instantly Available PC)	<6 watts	

Power consumption and heat dissipation

Power consumption and heat dissipation specifications are available for multiple configurations. To review available specifications, see 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.

System fans

This workstation includes:

- One rear system fan
- One CPU heatsink fan
- One power supply fan

In addition, an optional front system fan is available for special environments, and some graphics cards include onboard fans.

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 137.

3. Reconnect the power cord and restart the workstation.

When you power off the workstation through the operating system, power consumption falls below what is considered low power consumption but does not reach zero. This low power consumption feature extends the life of the power supply.

Environmental specifications

The following table lists the environmental specifications of HP Workstations.

Table 1-7 **HP Workstation environmental specifications**

Temperature	**Operating**: 5 to 35°C (40 to 95°F) **Non-operating**: -40 to 60°C (-40 to 140°F) **NOTE:** Derate by one degree C (1.8 degrees F) for every 305m (1,000 ft.) altitude over 1,524m (5,000 ft.).
Humidity	**Operating**: 8 to 85% Relative Humidity (RH), non-condensing **Non-operating**: 8 to 90% Relative Humidity, non-condensing
Altitude	**Operating:** 0 to 3,048m (10,000 ft.) **Non-operating**: 0 to 9,144m (30,000 ft.)
Shock	**Operating**: ½-sine: 40*g*, 2-3ms **Non-operating**: ● ½-sine: 160 cm/s, 2-3ms (~100*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 **Non-Operating**: random: 2.0*g* (rms), 10-500 Hz **NOTE:** Values do not indicate continuous vibration.

ENERGY STAR Qualification

HP computers marked with the ENERGY STAR logo are compliant with the applicable U.S. Environmental Protection Agency (EPA) ENERGY STAR specifications for computers. The EPA ENERGY STAR logo does not imply endorsement by the EPA. As an ENERGY STAR Partner, Hewlett-Packard Company has determined the products marked with the ENERGY STAR logo are ENERGY STAR qualified per the applicable ENERGY STAR guidelines for energy efficiency. The following logo appears on all ENERGY STAR qualified computers.

The ENERGY STAR Computers Program was created by the EPA to promote energy efficiency and reduce air pollution through more energy-efficient equipment in homes, offices, and factories. One way products achieve this energy efficiency is by reducing power consumption when not being used through the Microsoft Windows Power Management feature.

The Power Management feature enables the workstation to enter a low-power (or "sleep") mode after a period of inactivity. When used with an external monitor that is ENERGY STAR qualified, this feature also supports the similar power management features of the external monitor.

To take advantage of this energy savings:

- The Power Management feature has been preset to suspend the workstation to a sleep state after 30 minutes of inactivity.

- The Power Management feature has been preset to suspend the monitor to a sleep state after 15 minutes of inactivity.

Both the computer and monitor can be woken from sleep mode through user interaction with any of the computer input devices (mouse, keyboard, and so on). when configured with Wake On LAN (WOL) enabled, the workstation can also be woken by a network signal.

See the EPA ENERGY STAR Power Management Web site for more information about the energy and financial savings potential of the Power Management Feature: http://www.energystar.gov/powermanagement.

See the EPA ENERGY STAR Web site for more information about the ENERGY STAR program and its environmental benefits: http://www.energystar.gov.

△ **CAUTION:** Using the Energy Save Monitor feature with monitors that are not ENERGY STAR qualified can cause video distortion when an Energy Save timeout occurs.

📝 **NOTE:** ENERGY STAR is not supported on Linux workstations.

If it is necessary to restore the operating system, you must also reset the ENERGY STAR settings (if applicable) after the restore.

To verify the factory default power settings for your workstation, select **Start>Control Panel**, and then double-click **Power Options**.

EUP compliance mode

This workstation provides EUP compliance mode capability.

When enabled, this feature lets the workstation shut down to the lowest possible power state by removing all power to the system board.

When disabled, the workstation powers down conventionally.

When the workstation is shut down in EUP compliance mode, you must use the workstation power button to restore power.

Enabling EUP compliance mode

To enable EUP compliance mode:

1. Press F10 during start up.

2. Using the arrow keys, select the **Power>Hardware Power Management>EuP Compliance Mode**, and then select **Enable**.

3. Press F10 to accept the change.

4. Select **File>Save Change and Exit**, and then press F10 to accept the change.

Disabling EUP compliance mode

To disable the EUP compliance mode:

1. Press F10 during start up.

2. Select **Power>Hardware Power Management>EuP Compliance Mode**, and then select **Disable**.

3. Press F10 to accept the change.

4. Select **File>Save Change and Exit**, and then press F10 to accept the change.

Accessibility

HP is committed to developing products, services, and information that is easier to access for all customers, including customers with disabilities and age-related limitations. HP products with Windows Vista® Business and Microsoft® Windows® XP Professional preinstalled are designed for accessibility, and these products are tested with industry-leading Assistive Technology products. For more information see http://www.hp.com/accessibility.

Hyper-threading

This HP workstation supports Hyper-threading.

Hyper-Threading Technology (HTT), is an Intel-proprietary technology used to provide process parallelization. The operating system treats a processor with Hyper-Threading enabled as two processors instead of one. This improves performance under certain workloads by getting useful work from parts of the processor that would otherwise remain idle. Hyper-threading relies on support from the operating system as well as the CPU.

To implement hyper-threading, see The Computer Setup (F10) Utility on page 30.

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.

When the workload does not require all CPU cores, this feature diverts power from inactive cores to active cores, increasing their performance. This lets the CPU run at a higher than normal rate.

Use the workstation BIOS to enable, enhance, or disable Turbo Boost. For instructions on setting BIOS features, see The Computer Setup (F10) Utility on page 30.

HP Cool Tools

An HP workstation with Windows 7 or Windows Vista includes additional software not installed when you first start the workstation. To access or learn more about these additional preinstalled tools on the workstation that can enhance the workstation experience:

1. Open the HP Cool Tools folder by selecting **Start>All Programs>HP Cool Tools**.

2. Select the **HP Cool Tools** icon on the desktop.

3. To learn more about these applications, select **HP Cool Tools—Learn More**.

4. To install or launch the applications, select the appropriate application.

NOTE: A preinstalled Windows Vista Business operating system does not contain a Cool Tools icon, shortcut or folder, but several of the tool programs are included, such as Performance Tuning Framework.

Ensuring proper ventilation

Proper ventilation for the system is important for workstation operation. Follow these guidelines to ensure adequate ventilation:

- Operate the workstation on a sturdy, level surface.

- Place the workstation in an area with adequate ventilation. Provide at least 15.24 CM (6 inches) of clearance at the front and back of the workstation as shown in the following figure.

  Your workstation might look different than the one shown.

  Figure 1-6 Proper workstation ventilation

- Ensure that the ambient air temperature surrounding the workstation falls within the published limit.

  > **NOTE:**   The ambient upper limit of 35 C is only good up to 1524 M (5000 FT) elevation. There is a 1 C per 304.8 M (1000 FT) derating above 1524 M (5000 FT). So, at 3,048 M (10,000 FT), the upper ambient air temperature limit is 30 C.

- For cabinet installation, ensure adequate cabinet ventilation and ensure that the ambient temperature within the cabinet does not exceed published limits.

- Never restrict the incoming or outgoing airflow of the workstation by blocking any vents or air intakes as shown in the following figure.

  Figure 1-7 Proper workstation placement
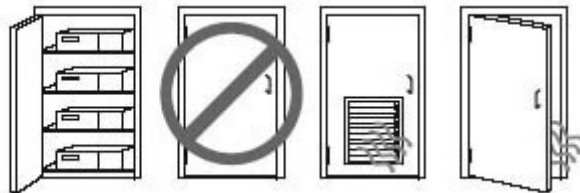
2 Setting up the operating system

This chapter provides setup and update information for the workstation operating system. It includes these topics:

Topics

This chapter also includes information on how to determine that you have the latest BIOS, drivers, and software updates installed on the workstation.

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

Setting up the Microsoft operating system

📝 **NOTE:** If you ordered a downgrade from Windows 7 or Windows Vista to Windows XP Professional operating system, your system will be preinstalled with Windows XP Professional operating system. With this configuration, you will receive recovery media for the Windows 7 or Windows Vista operating system only. In case you need to restore or recover the Windows XP Professional operating system in the future, it is important that you create recovery media disks for Windows XP Professional operating system after first boot.

When you first apply power to the workstation, the operating system is installed. This process takes approximately 5 to 10 minutes. Carefully follow the instructions on the screen to complete the installation.

△ **CAUTION:** After installation has started, do *not* turn off the workstation until the process is complete. Turning off the workstation during installation can damage the installation and operation of the software.

For complete operating system installation and configuration instructions, see the operating system documentation that was provided with the workstation. Additional information is available in the online help tool after you successfully install the operating system.

Installing or upgrading device drivers

To install hardware devices after the operating system is installed, you must install the appropriate device drivers before you install the devices. Follow the installation instructions that came with the device. In addition, for optimum performance, your operating system must have the most recent updates, patches, and software fixes. For additional driver and software update information, refer to Upgrading device drivers on page 22.

Transferring files and settings to your Windows workstation

The Microsoft Windows operating system offers data migration tools that helps you choose and transfer files and data from a Windows computer to your Windows 7, Windows Vista, or Windows XP Professional operating system workstation.

For instructions on how to use these tools, see the documents at http://www.microsoft.com.

Setting up Red Hat Enterprise Linux

HP offers an HP Installer Kit for Linux (HPIKL) to supplement Red Hat box sets and help HP Linux customers customize their system image. The HPIKL contains the HP driver CD and device drivers to successfully setup up the Red Hat Enterprise Linux (RHEL) operating system, The HP Installer Kit for Linux CDs are currently available for download at http://www.hp.com/support/workstation_swdrivers.

Installing with the HP driver CD

To install the HP driver CD, see "Installing with the HP Installer Kit for Linux" in the *HP Workstations for Linux* manual at http://www.hp.com/support/workstation_manuals.

Installing and customizing Red Hat-enabled workstations

Linux-enabled workstations require the HP Installer Kit and the purchase of a Red Hat Enterprise Linux box set. The Installer kit includes the HP CDs necessary to complete the installation of all versions of the Red Hat Enterprise Linux box set that have been qualified to work on an HP workstation.

To use the drivers in the HP Installer kit for Linux other than RHEL, you must manually extract the drivers from the HP Driver CD and install them. HP does not test the installation of these drivers on other Linux distributions nor does HP support this operation.

Verifying hardware compatibility

To see which Linux versions have been qualified to work on HP Workstations visit http://www.hp.com/support/linux_hardware_matrix.

Setting up Novell SLED

To set up the SUSE Linux Enterprise Desktop (SLED) on systems preloaded with the operating system:

1. Boot the workstation.

2. Start the Installation Settings and enter the password, network, graphics, time, keyboard settings, and Novell Customer Center Configuration for the workstation.

   NOTE: During Installation Settings after the first time after booting the system the Novell subscription can be activated from the Novell Customer Center Configuration screen. Visit the full Novell Customer Center documentation at http://www.novell.com/documentation/ncc/.

Updating the workstation

HP is constantly working on improving your total workstation experience. To ensure that the workstation leverages the latest enhancements, HP recommends that you install the latest BIOS, driver, and software updates on a regular basis.

Updating the workstation after first boot

After successfully booting the workstation for the first time, you should follow these guidelines to ensure that the workstation is up-to-date:

- Ensure that you have the latest system BIOS loaded. See Upgrading the BIOS on page 20 for instructions.

- Ensure that you have the latest drivers for your system. See Upgrading device drivers on page 22 for instructions.

- Become familiar with your available HP resources.

- Consider a subscription to Driver Alerts at http://www.hp.com/go/subscriberschoice.

Upgrading the BIOS

For optimum performance, determine the BIOS revision on the workstation, and upgrade it if necessary.

Determining current BIOS

To determine the current BIOS of the workstation during system power up:

1. Wait for F10=setup to appear on the lower right corner of the screen.

2. Press F10 to enter the F10 Setup utility.

   The F10 Setup utility displays the workstation BIOS version under **File > System Information**.

3. Note the workstation BIOS version so that you can compare it with the BIOS versions that appear on the HP website.

Upgrading BIOS

To find and download the latest available BIOS, which includes the latest enhancements:

1. Go to http://www.hp.com/go/workstationsupport.

2. Select **Download Drivers and Software** from the left menu column under Tasks.

3. Follow the instructions to locate the latest BIOS available for the workstation.

4. If the BIOS on the Web site is the same as the version on your system, no further action is required.

5. If the BIOS on the Web site is a version later than the one on your system, download the appropriate version for the workstation. Follow the instructions in the release notes to complete the installation.

Upgrading device drivers

If you install a peripheral device (such as a printer, display adapter, or network adapter), confirm you have the latest device drivers loaded. If you purchased your device through HP, visit the HP Web site to download the latest drivers for your device. These drivers have been tested to ensure the best compatibility between your device and your HP workstation.

If you did not purchase your device from HP, HP recommends visiting the HP Web site first to see if your device and its drivers have been tested for HP workstation compatibility. If no driver is available, visit the device manufacturer's Web site to download the latest drivers.

To upgrade device drivers:

1. Go to http://www.hp.com/go/workstationsupport.

2. Select **Download Drivers and Software** from the left menu column under Tasks.

3. Follow the instructions to find the latest drivers available for the workstation.

If a needed driver is not found, see the Web site of the manufacturer of the peripheral device.

3 Restoring the operating system

This chapter describes how to restore the Windows or Linux operating system. It includes these topics:

Restore methods

The Windows 7 or Windows Business Vista operating system can be reinstalled using the HP RestorePlus! process. The Windows XP Professional operating system can be reinstalled using the RestorePlus! process or the HP Backup and Recovery Manager.

● RestorePlus!

The RestorePlus! process reinstalls the Windows operating system and device drivers (for devices included with the system) to a near-factory state. The process does not back up or recover data on the hard drive. Some application software might not be restored using this process and must be installed from the appropriate application CD.

● HP Backup and Recovery Manager (HPBR) Recovery Point

The HP Backup and Recovery Manager application can be used to capture and restore the contents of the system partition. It captures a snapshot of the system partition and stores it in a Recovery Point. Everything on the system partition at the time the recovery point was made is saved.

NOTE: HP Backup and Restore is only supported on the HP xw6600 and xw8600 Workstations.

The Recovery Point is saved to the hard drive and can be burned to media for safekeeping.

CAUTION: These methods restore the operating system, but not data. Data must be backed up regularly to avoid loss.

Ordering backup software

If you cannot create system recovery CDs or DVDs, you can order a recovery disk set from the HP support center. To obtain the support center telephone number for your region see http://www.hp.com/support/contactHP.

Restoring Windows 7 or Windows Vista

This section describes how to restore Windows 7 or Windows Vista.

Ordering the RestorePlus! media

If you ordered restore media with your workstation, the media is included with your workstation components.

If you did not order restore media, call HP Support and request a RestorePlus! media kit. For worldwide technical support phone numbers, see http://www.hp.com/support.

Restoring the operating system

NOTE: Windows 7 and Windows Vista provide a backup and restore application as well. To learn more about this application, see the Microsoft Web site.

CAUTION: Before you restore the operating system, back up your data.

When you run RestorePlus! from media, the process deletes all information on the primary hard drive, including all partitions.

To restore Windows 7 or Windows Vista:

1. Boot from the RestorePlus! DVD to start the RestorePlus! process. You must start from the RestorePlus! DVD to install device drivers and settings.

2. Follow the prompts to restore your operating system.

Some application software might not be restored using this process. If software is not restored, install it from the appropriate application DVD.

Restoring Windows XP Professional

This section describes how to restore the Windows XP Professional operating system.

NOTE: The workstation must have a CD or DVD writer installed to create the media set.

Creating RestorePlus! media

The RestorePlus! kit can be created using the files contained on the hard drive. To create the restore media:

1. Boot the workstation.

2. During boot up, an HP Backup and Recovery Manager screen is displayed prompting you to create Recovery CDs or DVDs. Select **Now**.

3. An Initial Recovery Point (IRP) of the system is captured. This is a snapshot of the system hard drive. The capture can take more than 10 minutes.

4. After the IRP is created, you can create a set of backup CDs or DVDs.

   To create a RestorePlus! media set including the Windows XP operating system CD, select **RestorePlus! > Microsoft Windows XP operating system > Supplemental media**.

   NOTE: Depending on the options, there might be additional DVDs you can create.

5. Follow the prompts to create RestorePlus!, operating system, and HPBR media.

If you are unable to create CD/DVDs on your workstation, call HP Support and request a RestorePlus! media kit. For worldwide technical support phone numbers, see http://www.hp.com/support.

Creating HP Backup and Recovery (HPBR) media

NOTE: HPBR is only supported on Windows XP systems. For details, refer to the documentation on the Supplemental Software - *HP Backup and Recovery* CD included with the workstation. The documentation can be accessed during installation.

The Initial Recovery Point can be burned to optical media and used to recover a system. This section describes making the media.

NOTE: The workstation must have a CD or DVD writer to create the media set.

To create HPBR recovery media:

1. The Initial Recovery Point was captured when the RestorePlus! media set was created previously.

   If the IRP was not created, start the HP Backup and Recovery Manager and create recovery points using the Expert mode. Follow the HPBR online documentation for instructions.

2. Burn the IRP to media from HPBR.

   Select **HPBR Start > All Programs > HP Backup & Recovery > HP Backup and Recovery Manager**.

3. Select **Next** at the first screen.

   Select **Create recovery CDs or DVDs to recover the system**, and then select **Next**.

4. Choose **Next** to display a list of available CD image and the recovery points.

5. Check the box next to Initial Recovery Point, and then select **Next**.

6. Follow the instructions to create the media.

Restoring the operating system

> △ **CAUTION:** Before you restore the operating system, back up your data.
>
> When you run RestorePlus! from media, the process deletes all information on the primary hard drive, including all partitions. If you run RestorePlus! from the recovery partition, only the root (C:) partition is affected.

Using RestorePlus!

To restore with RestorePlus!:

1. Boot the workstation from the RestorePlus! DVD. You must start from the RestorePlus! DVD for device drivers and settings to be installed.

2. Follow the prompts to restore the operating system.

Some application software might not be restored using this process. If software is not restored, install it from the appropriate application DVD.

Using HPBR

To restore with the HPBR Initial Recovery Point media:

1. Boot the workstation from the Initial Recovery Point media.

2. Follow the prompts to restore the system to the state when the IRP was created.

Using the recovery partition

A system that shipped with Windows XP includes a recovery partition. You can boot the system from that recovery partition.

From the recovery partition you can perform a system restore using the HPBR Initial Recovery Point, if it was created. If it was not, you can use a RestorePlus! install.

To restore using the recovery partition:

1. Boot the workstation.

2. When prompted on the boot screen to enter the Recovery Manager, press F11.

> ☆ **TIP:** The opportunity to press F11 during the boot process is small. It comes about the time the F10 prompt appears.

> ▣ **NOTE:** To ensure that the recovery processes reinstall on the correct hard drive, do not disconnect the target drive during the recovery process.

3. Follow the prompts to restore the system to factory-like condition.

Restoring Novell SLED

The SLED restore media is required to restore the Linux operating system.

Creating restore media

THE SUSE Linux Enterprise Desktop preload includes a SUSE ISO icon on the desktop. You can click this icon to go to the /iso directory. The /iso directory contains all iso images used to preload your workstation. To recover or restore the original image, follow the instructions in the readme file in the /iso directory to copy the ISO image file onto CDs.

NOTE: Make copies of the ISO recovery images on CD as backup files in case your workstation experiences a hard drive failure.

4 System management

This section describes the tools and utilities that provide system management for the workstation. It includes these topics:

Topics

BIOS ROM

The BIOS ROM is a collection of machine language applications stored as firmware in ROM. It includes functions such as POST, PCI device initialization, Plug and Play support, power management, and the Computer Setup (F10) Utility. The BIOS ROM is a 1-MB Serial Peripheral Interface (SPI) port.

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

The Computer Setup (F10) Utility

This section contains these topics:

Topics
Computer Setup (F10) functionality on page 30
Accessing the Computer Setup (F10) Utility on page 32
The Computer Setup (F10) Utility menu on page 33

Computer Setup (F10) functionality

The Computer Setup (F10) Utility lets you:

- Change factory default settings and set or change the workstation configuration, which might be necessary when you add or remove hardware.

- Determine if all devices installed on the workstation are recognized by the system and functioning.

- Determine information about the operating environment of the workstation.

- Solve system configuration errors that are detected but not fixed during the Power-On Self-Test (POST).

- Establish and manage passwords and other security features.

- Establish and manage energy-saving time-outs (not supported on Linux platforms).

- Modify or restore factory default settings.

- Set the workstation date and time.

- 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, SAS, diskette drives, optical disk drives, network drives, LS-120 drives and USB boot devices.

- Configure the boot priority of SATA and SAS hard-drive controllers.

- Enable or disable Network Server Mode, which lets the workstation start the operating system when the power-on password is enabled with or without a keyboard or mouse attached. When attached to the workstation, the keyboard and mouse remain locked until the power-on password is entered.

- Enable or disable POST Messages to change the display status of POST messages. POST Messages disabled suppresses most POST messages, such as memory count, product name, and other nonerror 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 appears when the workstation is powered on or restarted.

- Specify the Asset Tag or property identification number assigned by the company to this workstation.

- Enable power-on password prompts during system restarts (warm-starts) and power on.

- 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 on CD or diskette and restoring it on workstations.

- Execute self-tests on specified SATA and SAS hard disk drives (if supported by the drive).

Accessing the Computer Setup (F10) Utility

To access the Computer Setup (F10) Utility menu:

1. Power on or restart the workstation.

2. When the display is active and **F10=Setup** appears in the lower right corner of the screen, press F10.

   If you do not press F10 at the appropriate time, try again. Turn the workstation off, then on, and press F10 again to access the utility. You can also press the Ctrl + Alt + Delete keys before starting if you miss the opportunity to press F10.

3. Select the 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.

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**>**Save Changes**, and then select **F10=YES.**

   ● To remove changes you have made, select **Ignore Changes** and then select **F10=YES**.

   ● To reset to factory settings, select **File>Default Setup>Restore Factory Settings as Default**. Press F10 to accept the changes, and then select **Apply Defaults and Exit**. This restores the original factory system defaults.

△ **CAUTION:**   Do not power off the workstation while the ROM is saving the Computer Setup (F10) Utility changes, because the Complementary Metal-Oxide Semiconductor (CMOS) could become corrupted. After you exit the F10 Setup screen, you can disconnect power from the workstation.

The 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.

Table 4-1 Computer Setup (F10) Utility menu descriptions

Heading	Option	Description
File	System Information	Displays the following system characteristics: ● Product Name ● QPI Link Speed ● Memory Size ● Integrated MAC ● System BIOS ● Boot Block Date ● Chassis serial number ● Asset Tracking Number ● Management Module ● Processor Type ● Processor Speed ● Processor Stepping ● Cache Size ● DIMMs
	About	Displays copyright information.
	System Temperatures	Displays system temperatures and fan speeds.
	Set Time and Date	Lets you set system time and date.
	Flash System ROM	Lets you upgrade the BIOS from a ROM image on diskette, CD, or USB.
	Replicated Setup	Provides these options: ● Save to Removable Media—Saves the workstation configuration, including CMOS, in the *qsetup.txt* file. This file can be saved to a formatted, blank 1.44-MB diskette, or to a USB device. ● Restore from Removable Media—Restores the workstation configuration from a diskette or a USB 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.

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

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 non-SCSI storage devices (except SATA devices) and provides options for obtaining specific information about each device: ● Hard Disk—Provides information about the hard disk drives in the workstation. It is available in IDE Mode only. ● CD-ROM—Provides information about the optical disk drives in the workstation. (IDE mode only.) ● Diskette Type (for legacy diskette drives only)—Identifies the highest capacity media type accepted by the diskette drive. Options are 3.5" (1.44 MB), 5.25" (1.2 MB), and Not Installed. ● Default Values—Resets devices to their default configuration (SATA is the default). ◦ Multisector Transfers—Defines the transfer of data per interrupt. Options are 8, 16, and Disable (16 is the default). ◦ Transfer Mode—Specifies the active data transfer mode. Options (subject to device capabilities) are Max UDMA, PIO 0, Max PIO, Enhanced DMA, and Ultra DMA0. (Max UDMA is the default). ◦ Translation Mode—Lets the BIOS determine the translation mode used to configure a formatted SATA or USB mass storage device. This prevents you from needing to know how the mass storage device was formatted. Options are Automatic, Bit Shift, LBA Assisted, Use (Cylinders, Heads, Sectors), and Off. Automatic is the default. Ordinarily, you should not change the translation mode selected by the BIOS. If the selected translation mode is not compatible with the translation mode that was active when the drive was partitioned and formatted, the data on the disk is inaccessible.
	Storage Options	Provides these options: ● Removable Media Boot—Enables and disables the ability to start the workstation from removable media. ● Legacy Diskette Write—Enables and disables the ability to write data to removable media. ● SATA Emulation—Sets the SATA emulation mode with the following options: ◦ RAID + AHCI—both the RAID and AHCI OPROMs execute. This emulation mode is the default and offers the best performance and most functionality. ◦ IDE —offers standard SATA supports (four ports only). ● SATA PORT 0-*n*—enables and disables the SATA ports. Offers these configurations: ◦ GEN 2/3.0 Gbps (Internal Only/eSATA Only) ◦ GEN 1/1.5 Gbps (eSATA Only)
	DPS Self-test	Select a drive—Lets you select a drive to test. (Available in SATA IDE emulation mode only.) The DPS self-test function directs an IDE hard disk to run an internal self-test and report the results. If the SATA controller is not in IDE emulation mode, the DPS self-test option is not displayed in the setup menu. This selection appears only when at least one drive capable of performing the IDE DPS self-test is attached to the workstation. By default, the SATA controller is in RAID+AHCI mode, so this option is not displayed

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Boot Order	Lets you configure the boot order of diskette drive and hard disk drive by physically reordering the menu entries. The menu presents the following default boot order:
		● Optical Drive
		● Diskette Drive
		● USB Device
		● Hard Drive
		● Embedded Ethernet controller
		● Embedded Ethernet controller (ASF) Second embedded LAN. (Not available in some configurations.)
		Press Enter to drag a device to a preferred place.
		Press F5 to remove the device from consideration 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 with File>Save Changes and 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 press Enter. The workstation then starts from the selected nondefault 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:
		● Lock Legacy Resources—Prevents the operating system from changing resources to serial, parallel, or diskette controller.
		● Network Server Mode—Enables network server mode.
		● Password Prompt on Warm Boot—Enables a password prompt on a warm boot.
		● Setup Browse Mode—Enables read-only functionality for password info.
	Smart Cover	Lets you enable and disable the cover removal sensor, or notify you if the sensor is activated.

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Device Security	Makes the following devices available or hidden to the workstation: ● Serial Port ● Front USB Ports ● Rear USB Ports ● Internal USB Ports ● System Audio ● IEEE 1394 Controller (Not available on some models.) ● Ethernet Controller ● Ethernet Controller (ASF) (Not available on some models.) ● SAS Controller (Not available on some models) ● Legacy Diskette ● Embedded Security Device ● SATA 0-*n* For each device, Device Available is the default setting, which lets the operating system 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 appears in the setup menu if the workstation has a DriveLock-compatible hard disk drive.
	Embedded Security Device	This option becomes available if Embedded Device is set to Available. 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: ● Power-On Authentication Support—Enables and disables an authentication feature that requires you to enter a TPM user key password to start the workstation. This feature uses the TPM to generate and store the authentication password. ● Reset Authentication Credential—Resets the authentication functionality and clears authentication credentials. 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.
	Network Service Boot	Enables or disables the ability to boot to the network using the F12 key or the boot order.
	System IDs	Provides these options: ● Asset Tag—A 16-byte string identifying the workstation. ● Ownership Tag—An 80-byte string identifying ownership of the workstation. This tag appears on the screen during POST. ● Universal Unique Identifier (UUID)—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—Lets you set the keyboard locale for System ID entry.

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	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.
		● Virtualization Technology for Directed I/O (VT–d2)—Enables a virtual machine to gain exclusive control of a hardware device, such as a graphics card.
		● Embedded Security Device—This option becomes available if Embedded Device is set to Available.
		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:
		○ Power-On Authentication Support—Enables and disables an authentication feature that requires you to enter a TPM user key password to start the workstation. This feature uses the TPM to generate and store the authentication password.
		○ Reset Authentication Credential—Resets the authentication functionality and clears authentication credentials.
		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 lets the operating system access the device. Hidden makes the device unavailable. It is disabled by the BIOS and cannot be enabled by the operating system.
		● Intel IO Virtualization—Enables or disables Virtualization Technology to increase workstation I/O performance.
		● Embedded Security Device Support—Lets the workstation leverage the trusted platform mechanism device.
		● OS Management of Embedded Security Device—Enables or disables operating system control of the TPM device, including turning it on and off, initializing it, and resetting it.
		● Reset of Embedded Security Device through OS—Enables or disables operating system ability to reset the TPM.
	Setup Security Level	Lets the administrator set the security level of each setup feature.
Power	OS Power Management	Enables or disables:
		● Runtime Power Management
		● MWAITE-AWARE OS
		● Idle Power Savings
		● ACPI S3 Hard Disk Reset
		● ACPI S3 PS/2 Mouse Wakeup
		● USB Wake on Device Insertion
		● Unique Sleep State Blink Rates

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Hardware Power Management	Enables or disables: ● SATA Power Management ● Intel Turbo Boost Technology ● Enhanced Intel Turbo Boost Technology ● Eup Compliance Mode
	Thermal	Lets you set the rate of the system fan when the CPU is in idle.

Advanced[2]	Power-On Options	Lets you set the following:
		● POST Messages—Enables or disables the splash screen during POST.
		● F9 Prompt (Displayed or Hidden)—Selecting **Displayed** displays the **F9=Boot Menu** during POST. Selecting **Hidden** prevents the text from being displayed. However, pressing F9 still accesses the boot menu.
		● F10 Prompt (Displayed or Hidden)—Selecting **Displayed** displays **F10=Setup** during POST. Selecting **Hidden** prevents the text from being displayed, but pressing F10 still accesses the Setup screen.
		● F12 Prompt (Displayed or Hidden)—Selecting **Displayed** displays **F12=Network Service Boot** during POST. Selecting **Hidden** prevents the text from being displayed but pressing F12 still forces the workstation to attempt booting from the network.
		● Option ROM[1] prompt (Enable or Disable)—Enabling this feature causes the workstation to display a message before loading options ROMs.
		● Remote Wakeup Boot Source—Enables you to set the remote wakeup boot source as:
		   ○ Local Hard Drive
		   ○ Remote Server
		● After Power Loss (On, Off, Previous State)—Enabling this option directs the previous state to be the default.
		● POST Delay (in seconds) (5, 10, 15, 20, None)—Adds a specified delay to the POST process. This delay is sometimes needed for hard disk 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 the Computer Setup (F10) Utility.

	BIOS Power-On	Lets you disable or specify a weekday and time for BIOS power-on.
	Processors	Enables/disables these options: ● Hyper-Threading—Provides processor parallelization such that the operating system treats one processor as two. ● Active Cores (1,2, or All Cores)—Selects a single core, or multiple cores per socket. (Not available on some configurations.) ● Limit CPUID Maximum Value to 3 (Enable or Disable)—Sets the number of allowable CPU IDs.
	Onboard Devices	Lets you set resources (IRQ, DMA, I/O Rate) or disable onboard system devices such as serial port and diskette controller. Operating system parameters generally override Onboard Devices settings.
	PCI VGA Configuration	Configures which expansion slots are used for graphics cards. In multi-graphics card configurations, this option designates one graphics card as primary and the other card as secondary.

Table 4-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Chipset/Memory	Enable/disable these options: ● PCI SERR# Generation (Enable or Disable)—Controls PCI SERR# generation for ill-behaved PCI add-in cards (that can generate SERR# spuriously). ● PCI VGA Palette Snooping (Enable or Disable)—Controls PCI VGA Palette Snooping for compatibility purposes. ● Memory Mode Interleave—Sets interleave mode for dual socket workstations.
	Device Options	Lets you set the following device options: ● Num Lock State at Power-On (On or Off) ● S5 Wake-on-LAN (Enable or Disable) ● Multiprocessor (Activates a single core.) ● Unique Sleep State Blink Rates (Enable or Disable) ● Internal speaker ● Monitor Tracking (Enable or Disable) ● NIC PXE Option ROM[1] Download (Enable or Disable) ● SAS Option ROM[1] Download (Enable or Disable) (Not available on some workstations.) ● SATA RAID Option ROM[1] Download (Enable or Disable)

[1]   Available on selected models

[2]   These options should be used by advanced users only

Workstation management

This section summarizes capabilities, features, and key components of workstation management, including:

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

Initial workstation configuration and deployment

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

If you prefer to replace the preinstalled software image with a customized set of system and application software, several methods are available for deploying a customized software image, including:

● Installing additional software applications after unbundling the preinstalled software image

● Using a disk cloning process to copy the contents from one hard disk drive to another

The Restore Plus! CD, ROM-based setup, and 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

Remote system installation enables starting and setting up the workstation using software and configuration information on a network server. This feature provides a useful system setup and configuration tool for the following tasks:

● Deploying a software image on new PCs

● Formatting a hard disk drive

● Installing application software or drivers

● Updating 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 is a BIOS configuration setting that can be changed to always attempt a PXE boot.

Replicating the setup

This section provides information about replicating the workstation setup.

Copying a setup configuration to a single workstation

△ **CAUTION:** A setup configuration is model-specific. File system corruption can result if source and target workstations are not the same model.

To copy a setup configuration:

1. Select a setup configuration to copy, and then restart the workstation.

2. As soon as the workstation powers on, press and hold F10 until you enter the 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 workstation, and then press and hold F10 again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

3. Select **File>Replicated Setup>Save to Removable Media**. Follow the instructions on the screen to create the configuration diskette or USB media device.

4. Power off the workstation you are configuring and insert the configuration diskette into the diskette drive or USB media device.

5. Power on the workstation you are configuring.

6. Press and hold the F10 key until you enter the Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.

7. Select **File>Replicated Setup>Restore from Removable Media**, and then follow the instructions on the screen.

8. Restart the workstation when the configuration is complete.

Copying a setup configuration to multiple workstations

△ **CAUTION:** A setup configuration is model-specific. If source and target workstations are not the same model, file system corruption can result. For example, do not copy the setup configuration from an HP xw8600 Workstation to an HP Z400 Workstation.

This method takes longer to prepare the configuration diskette, but copying the configuration to target workstations is fast.

A bootable diskette is required for this procedure. If Windows XP is not available to create a bootable diskette, use the method for copying to a single workstation instead (see).

1. Create a bootable diskette or USB media device.

2. Select a setup configuration to copy.

3. If you are using a diskette or USB storage device, insert it now.

4. Restart the workstation.

5. As soon as the workstation powers on, press and hold F10 until you enter the Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.

   📝 **NOTE:** If you do not press the F10 key at the appropriate time, you must restart the workstation, and then press and hold the F10 key again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

6. Select **File>Replicated Setup>Save to Removable Media**, and follow the instructions on the screen to create the configuration diskette or USB media device.

7. Download a BIOS utility for replicating setup (*repset.exe*), and copy it to the configuration diskette or USB media device. To obtain this utility, see http://www.hp.com/support/files.

8. Enter the model number of the workstation.

9. On the configuration diskette, create an *autoexec.bat* file containing *repset.exe* and *cpqsetup.txt*.

10. Power off the workstation you are configuring, insert the configuration diskette or USB device, and then power on the workstation. The configuration utility runs automatically.

11. When the configuration is complete, restart the workstation.

Updating and managing software

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

- HP Client Manager Software
- System Software Manager
- Altiris Client Management Solutions
- Proactive Change Notification
- Subscriber's Choice

HP Client Manager Software

The HP Client Manager Software offers these services:

- Detailed views of hardware inventory for asset management
- PC health-check monitoring and diagnostics
- Proactive notification of changes in the hardware environment
- Web-accessible reporting of business-critical details such as thermal warnings and memory alerts
- Remote updating of system software such as device drivers and ROM BIOS
- Remote changing of boot order
- Configuration of system BIOS settings

The HP Client Management Solutions (CMS), available for download from http://www.hp.com/go/easydeploy, are standards-based solutions for managing and controlling workstations in a networked environment.

For more information about the HP Client Manager, see http://www.hp.com/go/ssm.

Altiris Client Management Solutions

Altiris and HP have partnered to provide comprehensive, tightly integrated systems management solutions to reduce the cost of owning HP client PCs.

The HP CMS is the foundation for additional Altiris Client Management Solutions that address the following topics.

- Inventory and asset management
- Deployment and migration
- Help desk and problem resolution
- Software and operations management

For more information about the following topics, go to http://www.hp.com/go/ssm.

- How HP CMS works
- Which solutions are compatible with the operating system
- How to download a fully functional, 30-day evaluation version of Altiris solutions

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. To download HP SoftPaq Download Manager, visit http://h20331.www2.hp.com/Hpsub/cache/509658-0-0-225-121.html.

System Software Manager

System Software Manager (SSM) is a utility available on Windows workstations that lets you 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 on the software, the driver download Web site, and on the Support Software CD.

To download the utility or to obtain more information about SSM, see http://www.hp.com/go/ssm.

Proactive Change Notification

The Proactive Change Notification application uses the Subscriber's Choice Web site to:

●   Send Proactive Change Notification (PCN) e-mail informing you up to 60 days in advance of hardware and software changes to most commercial workstations and servers

●   Send you e-mail containing customer bulletins, customer advisories, customer notes, and driver alerts for most commercial workstations and servers

You can create a profile to ensure you receive only the information relevant to the specific IT environment.

To learn more about the PCN application and to create a custom profile, see Subscriber's Choice on page 46.

Subscriber's Choice

Subscriber's Choice is a client-based service from HP that supplies you with personalized product tips, feature articles, and driver and support alerts and notifications based on the profile.

Subscriber's Choice Driver and Support Alerts and Notifications delivers e-mail notifying you that the information you subscribed to in the profile is available for review and retrieval.

To learn more about Subscriber's Choice and create a custom profile, see:

http://www.hp.com/go/subscriberschoice

ROM Flash

HP workstations include a programmable flash ROM. By establishing a setup password in the Computer Setup (F10) Utility, you can protect the ROM from being inadvertently updated or overwritten. This function is important to ensure the operating integrity of the workstation.

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

For maximum ROM protection, establish a setup password. The setup password prevents unauthorized ROM upgrades. SSM lets you create the setup password on several workstations simultaneously.

Remote ROM Flash

Remote ROM Flash lets system administrators safely upgrade the ROM on remote HP workstations from a centralized network management console. This permits consistent deployment and greater control of HP PC ROM images over the network.

To use Remote ROM Flash, the workstation must be powered 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 locally updates or restores the system ROM on PCs using a Windows operating system. For more information about HPQFlash, see http://www.hp.com/go/ssm, and enter the name of the workstation.

FailSafe Boot Block ROM

The FailSafe Boot Block ROM enables system recovery in the unlikely event of a ROM flash failure. For example, if a power failure occurs during a ROM upgrade, the Boot Block uses a flash-protected section of the ROM to verify a valid system ROM flash when power is restored to the workstation.

If the system ROM is valid, the workstation starts normally.

If the system ROM fails the validation check, the FailSafe Boot Block ROM provides enough support to start the workstation from a BIOS image CD 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 workstation power LED blinks red eight times and the workstation beeps eight times; then the workstation 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.

Recovering the workstation from Boot Block Recovery mode

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

1. If there is media in the diskette or optical disk drives, remove it.

2. Insert a BIOS image CD into the CD drive.

    You can also use USB media such as an HP DriveKey.

3. Power off, then power on the workstation.

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

    If a setup password has been established, the Caps Lock light illuminates and you are prompted for the password.

4. Enter the setup password.

    If the workstation starts from the CD or USB media and successfully reprograms the ROM, three keyboard lights illuminate. A rising-tone series of beeps also signals successful recovery.

5. Remove the CD or USB media and power off the workstation.

6. Restart the workstation.

Workstation security

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

Asset tracking

Asset tracking features incorporated into the workstation provide asset tracking data that can be managed using HP Systems Insight Manager (HP SIM), HP CMS, or other systems-management applications.

Seamless, automatic integration between asset tracking features and these products lets you choose the management tool 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:

● HP ProtectTools Embedded Security prevents unauthorized access to data, checks system integrity, and authenticates third-party users attempting system access.

● Security features such as ProtectTools and the Side access panel sensor (Smart Cover Sensor) help prevent unauthorized access to the data and to the internal components of the workstation.

● By disabling parallel, serial, or USB ports, or by disabling removable-media boot capability, you can protect valuable data assets.

● Memory Change and Side access panel sensor (Smart Cover Sensor) alerts can be forwarded to system management applications to deliver proactive notification of tampering with a workstation's internal components.

ProtectTools, the Side access panel sensor (Smart Cover Sensor), and the Side access panel solenoid lock (Hood Lock) are available as options on select systems.

Use the following utilities to manage security settings on the HP workstation:

● (Local) Use the Computer Setup (F10) Utility.

● (Remote) Use HP CMS or System SSM, which let you use a simple command-line utility to control security settings and permit the secure and consistent deployment.

For more information about the Computer Setup (F10) Utility, see .

The following table and sections refer to the management of workstation security through the Computer Setup (F10) Utility

Table 4-2 Security features overview

Feature	Purpose	How it is established
Removable Media Boot Control	Prevents booting from removable media drives	From the Computer Setup (F10) Utility menu
Serial, Parallel, USB, or Infrared Interface Control	Prevents transfer of data through the integrated serial, parallel, USB, or infrared interface	From the Computer Setup (F10) Utility menu
Power-On Password	Prevents use of the workstation until the password is entered (applies to initial system startup and restarts)	From the Computer Setup (F10) Utility menu

Table 4-2 Security features overview (continued)

Feature	Purpose	How it is established
Setup Password	Prevents reconfiguration of the workstation (use of the Setup utility) until the password is entered	From the Computer Setup (F10) Utility menu
Network Server Mode	Provides unique security features for workstations used as servers	From the Computer Setup (F10) Utility menu

SATA hard disk drive security

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

⚠ **WARNING!** Enabling DriveLock can render a SATA hard disk 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) functions. It is only available when hard disk drives that support the ATA security command set are detected. On HP workstations, it is not available when the SATA emulation mode is RAID+AHCI or RAID.

DriveLock is for HP customers for whom data security is a paramount concern. For such customers, the cost of a hard disk 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 disk drive is replicated on a corporate information system or is regularly backed up.

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

DriveLock applications

The most practical use of DriveLock is in a corporate environment. The system administrator would be responsible for configuring the hard disk drive, which involves setting the DriveLock master password and a temporary user password. If you forget 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 regain access to the hard disk drive.

HP recommends that corporate system administrators who enable DriveLock also establish a corporate policy for setting and maintaining master passwords. This prevents situation in which an employee sets both DriveLock passwords before leaving the company. This scenario leaves the hard disk drive unusable and forces its replacement. Likewise, system administrators who do not set a master password might find themselves locked out of a hard disk 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 disk drives as a common practice. For these users, the potential loss of a hard disk drive resulting from forgetting both passwords is much greater than the value of the data DriveLock protects.

Create an administrator-only setup password to restrict access to Computer Setup (F10) and DriveLock. This keeps users from enabling DriveLock.

Using DriveLock

When DriveLock detects hard disk drives that support the ATA security command, a DriveLock menu item appears under the Security menu in the Computer Setup (F10) menu. This presents you with options to set the master password and to enable DriveLock. You must provide a user password to enable DriveLock. Because a system administrator typically performs the initial configuration of DriveLock, set a master password first.

HP recommends that system administrators set a master password whether they plan to enable DriveLock or not. This lets administrators 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 disk 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. Power on or restart the workstation.

2. As soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation, and then press and hold F10 again to access the utility.

   If you are using a PS2 keyboard, you might see a keyboard error message. Disregard it.

3. Select **Security>DriveLock Security**.

4. For each DriveLock-capable drive, select a drive by pressing F10 to accept.

5. Under Enable/Disable DriveLock options, select **Enable**, and then press F10 to enable DriveLock for a specific drive.

   △ **CAUTION:** Forgetting the DriveLock password renders the drive unusable.

6. Enter a new user password, and then press F10 to accept. This password may be 1 to 32 characters long.

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

8. Select **File>Save Changes and Exit**, and then press F10. After you press F10, the workstation performs a cold start before invoking the DriveLock function.

   You can also use this process to set the DriveLock master password by selecting **Master** in Step 5.

   When the workstation 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 workstation attempts to start anyway. However, the boot process most likely fails because data from a locked drive cannot be accessed.

   In a single drive workstation, if the drive has DriveLock enabled, the workstation 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 drive-locked drive remains inaccessible without the DriveLock password.

   In a two-drive workstation that has a boot drive and a data drive, you can apply the DriveLock feature to the data drive only. In this case, the workstation 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 workstation completes the next start cycle. This warm-start behavior is consistent with the DriveLock feature.

Password security

The power-on password prevents unauthorized use of the workstation by requiring entry of a password to access applications or data when the workstation is powered on or restarted. The setup password specifically prevents unauthorized access to the Computer Setup (F10) Utility and can also override the power-on password. When prompted for the power-on password, entering the setup password instead enables access to the workstation.

You can establish a network-wide setup password, which lets the system administrator log in to all network systems to perform maintenance without having 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 workstation (through the use of the Computer Setup (F10) Utility) until the password is entered.

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

1. Power on or restart the workstation.

2. As soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation, and then press and hold F10 again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

3. Select **Security>Setup Password** and then follow the onscreen instructions.

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

Establishing a power-on password using workstation setup

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

When Network Server Mode is disabled, you must enter the password when the workstation is powered on, when 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 workstation is restarted. When Network Server Mode is enabled, the password prompt is not presented during POST, but an attached PS/2 keyboard remains locked until you enter the power-on password.

To enable Network Server Mode, you must set a power-on password under **Advanced>Password Options**. This option lets the workstation start without requiring the power-on password, although the keyboard and mouse remain locked until you enter the password. The keyboard LEDs flash in a rotating pattern when the workstation is in locked mode.

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

1. Power on or restart the workstation.

2. As soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation and then press and hold F10 again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

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 workstation.

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 workstation, you will be prompted to enter it each time you run the Computer Setup (F10) Utility.

To enter a setup password:

1. Restart the workstation.

2. As soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation and press and hold F10 again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

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 workstation before you can continue.

Changing a power-on or setup password

To change a power-on or setup password:

1. Restart the workstation.

2. To change the power-on password, go to step 4.

3. To change the setup password, as soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation, and then press and hold the F10 key again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

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 56.

   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 power on the workstation.

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

Deleting a power-on or setup password

To delete a power-on or setup password:

1. Power on or restart the workstation.

2. Choose from the following:

   ● To delete the power-on password, go to step 4.

   ● To delete the setup password, as soon as the workstation is powered on, press and hold F10 until you enter the 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 workstation 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 National keyboard delimiter characters on page 56.

4. Press Enter.

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 workstation.

Table 4-3 National keyboard delimiter characters

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 workstation.

For instructions about clearing passwords, see Configuring password security and resetting CMOS on page 184.

Chassis security

Side access panel sensor (Smart Cover Sensor) (optional)

The optional Side access panel sensor is a combination of hardware and software technology that can alert you when the workstation side access panel has been removed (if the sensor has been configured in the Computer Setup (F10) Utility).

The three levels of Side access panel sensor protection are shown in the following table:

Table 4-4 Side access panel sensor protection levels

Level	Setting	Description
Level 0	Disabled	Side access panel sensor * is disabled (default).
Level 1	Notify User	When the workstation restarts, a message appears indicating that the workstation side access panel has been removed.
Level 2	Setup Password	When the workstation is restarted, a message appears indicating that the workstation side access panel has been removed. You must enter the setup password to continue.

*   Side access panel sensor settings can be changed using the Computer Setup (F10) Utility.

Setting the side access panel sensor protection level

To set the side access panel sensor protection level:

1. Power on or restart the workstation.

2. As soon as the workstation is powered on, press and hold the F10 key until you enter the 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 workstation, and then press and hold the F10 key again to access the 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**.

Side access panel solenoid lock

The side access panel solenoid locks the side access panel to the chassis. The solenoid is controlled by a local or remote signal.

To lock the solenoid, set a password for the solenoid lock in the Computer Setup (F10) Utility. To unlock the solenoid, remove the solenoid lock password in the Computer Setup (F10) Utility.

The solenoid lock FailSafe Key–available from HP–is is a device for manually disabling the solenoid lock. You will need the FailSafe Key in case of forgotten password, power loss, or workstation malfunction.

Cable lock (optional)

To prevent theft, the rear chassis panel of the workstation accommodates a keyed cable lock. 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 workstation is connected to a network that is managed by HP CMS, the workstation 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.

Drive Protection System

The Drive Protection System (DPS) is a diagnostic tool built into hard disk drives and is installed in select HP workstations. The DPS helps diagnose problems that might result in unwarranted hard disk drive replacement.

When HP workstations are built, each installed hard disk drive is tested using the DPS, and a permanent record of key information is written onto each drive. Every time the DPS is run, test results are written to the hard disk drive. The service provider can use this information to help diagnose conditions that required you to run the DPS software.

ECC fault prediction

When the workstation 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 workstation.

Thermal sensors

Several thermal sensors in the HP Workstation regulate workstation 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 workstation to enter a low-power standby state. This lets you go to standby without closing applications or return to the same operational state without any data loss.

Changing the power button configuration

To change the power button configuration:

1. Select **Start**, and then select **Control Panel>Power Options**.

2. In Power Options Properties, select the **Advanced** tab.

3. In the Power Button section, select **Hibernate**.

   NOTE: Hibernate must be enabled in the Hibernate tab.

After configuring the power button to function as a button, you can press the power button to put the workstation in a very low power state. Press the button again to bring the workstation out of this low power state to full power state. To completely turn off power to the workstation, press and hold the power button for four seconds.

△ **CAUTION:** Do not use the power button to power off the workstation unless the system is not responding; turning off the power without operating system interaction can cause data loss.

5 Replacing components

This chapter presents removal and installation procedures for most internal workstation components. It includes these topics:

Warnings and cautions

WARNING! Any surface or area of the equipment marked with this symbol indicates the 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.

WARNING! Any surface or area of the equipment marked with this symbol indicates the 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.

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 workstation 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! If a product is shipped in packaging marked with this symbol, the product must always be lifted by two persons to avoid personal injury due to product weight.

CAUTION: Static electricity can damage the electronic components of the workstation. Before beginning these procedures, be sure you discharge static electricity by briefly touching a grounded metal object.

CAUTION: Observe the following cautions when removing or replacing a processor:

— Installing a processor incorrectly can damage the system board. Contact an HP authorized reseller or service provider to install the processor. If you plan to install the processor yourself, read all of the instructions carefully before you begin.

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

— Processor socket pins are delicate and bend easily. Use extreme care when placing the processor in the socket.

CAUTION: To prevent damage to the workstation, observe the following Electrostatic Discharge (ESD) precautions while performing the system parts removal and replacement procedures:

— 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 Workstation products. They have been extensively tested for reliability and are manufactured to high quality standards.

Service considerations

Review the following sections, which describe service considerations, before removing and replacing system components.

> ⚠ **WARNING!** Do not use the front bezel as a handle or lifting point when lifting or moving the workstation. Lifting the workstation from the front bezel, or lifting it incorrectly, could cause the workstation to fall, causing possible injury to you and damage to the workstation. To properly and safely lift the workstation, use the handles. If the workstation is not equipped with handles, lift from the bottom of the workstation.

Cautions, warnings and safety precautions

For safety, review the cautions, warnings, and safety precautions before accessing the workstation components. Also, review the *Safety and Regulatory Guide* that came with the workstation for more information.

ESD information

Generating static

The following table shows that different activities generate different amounts of static electricity. Static electricity increases as humidity decreases.

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

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

Preventing ESD equipment damage

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

● 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.

● When 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 workstation.

● **Heel straps, toe straps, and boot straps**—These can be used at standing workstations 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.

The following table shows protection levels available from static shielding materials.

Table 5-1 Static shielding protection levels

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

This section provides guidelines to prevent ESD damage to equipment.

Grounding the work area

To prevent static damage in the work area:

- 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

The recommended materials and equipment are:

- Antistatic tape

- Antistatic smocks, aprons, and sleeve protectors

- Conductive bins and other assembly or soldering aids

- Conductive foam

- Conductive tabletop workstations with a ground cord of one megohm ± 10% resistance

- Static-dissipative table or floor mats with a hard-tie to ground

- Field service kits

- Static awareness labels

- Wrist straps and footwear straps providing one megohm ± 10% resistance

- Material-handling packages

- Conductive plastic bags

- Conductive plastic tubes

- Conductive tote boxes

- Opaque shielding bags

- Transparent metallized shielding bags

- Transparent shielding tubes

Tools and software requirements

The tools necessary for workstation component removal and installation are:

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

Special handling of components

The components included in this section require special handling when servicing the workstation.

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

Cables and connectors

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. In all cases, avoid bending or twisting the cables, and be sure that the cables are routed in such a way that they cannot be caught or snagged by parts being removed or replaced.

When servicing the workstation, be sure that cables are placed in their proper location during the reassembly process. Improper cable placement can damage the workstation.

Hard disk drives

Hard disk drives are fragile, precision components. Avoid subjecting them to physical shock and vibration. The following guidelines apply to all drives, including failed drives, replacement drives, and spares.

● Do not remove hard disk drives from the shipping package for storage. Keep hard disk drives in their protective packaging until they are mounted in the workstation.

● Avoid dropping hard disk drives from any height.

● If you are inserting or removing a hard disk drive, power off the workstation. Do not remove a hard disk drive while the workstation is powered on or in standby mode.

● Before handling a drive, be sure that you discharge static electricity. While handling a drive, avoid touching the connector. For more information about preventing electrostatic damage, see ESD information on page 62.

To prevent possible ESD damage when the drive is installed, connect the drive power cable before connecting the data cable. This discharges accumulated static electricity through the drive power cable to the workstation chassis.

● When inserting a drive, do not use excessive force.

● Avoid exposing a hard disk drive to liquids, temperature extremes, or products with magnetic fields such as monitors or speakers.

Lithium coin cell battery

The battery included with the workstation provides power to the real-time clock and has a lifetime of about three years.

For instructions on battery removal and replacement, see Battery on page 108.

⚠ **WARNING!** This workstation contains a lithium battery. There is a risk of fire and chemical burn if the battery is handled improperly. Do not disassemble, crush, puncture, short the external contacts, dispose of in water or fire, or expose the battery to temperatures higher than 60° Centigrade (140° Fahrenheit).

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

Customer self-repair

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

📝 **NOTE:** Some components, like the liquid cooling system, 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 this system.

Removing and installing components

Component locations

The following illustration and table identify workstation system board components.

Figure 5-1 4-DIMM configuration system board components
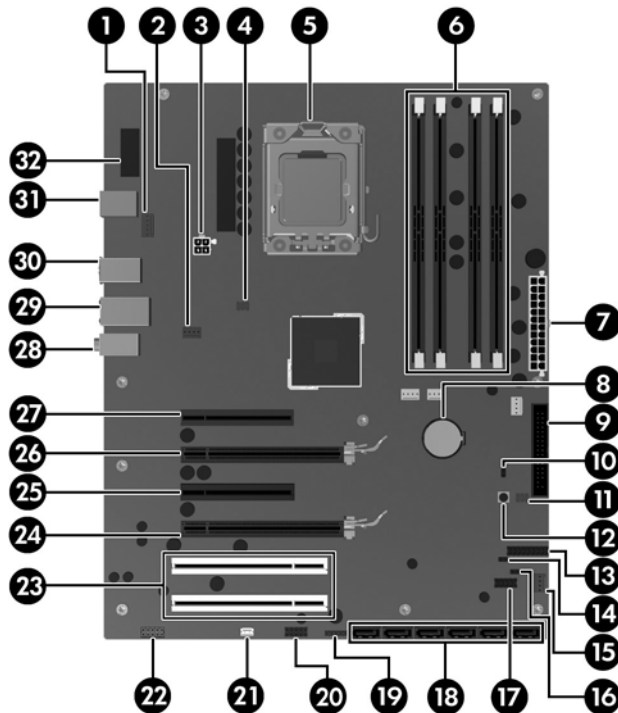
Table 5-2 4-DIMM system board components ID

Item	Component	Item	Component	Item	Component
1	CPU fan	12	Clear CMOS button	23	PCI 32/33
2	Rear chassis fan	13	Front power button/LED	24	PCIe2 x16
3	CPU power	14	Crisis recovery jumper	25	PCIe x8(4)
4	Solenoid hood lock	15	Front chassis fan	26	PCIe2 x16
5	CPU socket	16	HDD LED	27	PCIe2 x8(4)
6	Memory sockets	17	Internal USB 1/DASH	28	Audio
7	Main power	18	SATA ports	29	Network/USB
8	Battery	19	Internal USB 2	30	USB
9	Floppy disk drive	20	Front USB	31	Keyboard/mouse
10	Password jumper	21	Speaker	32	Serial
11	Chassis intrusion switch	22	Front audio		

Figure 5-2 6-DIMM configuration system board components
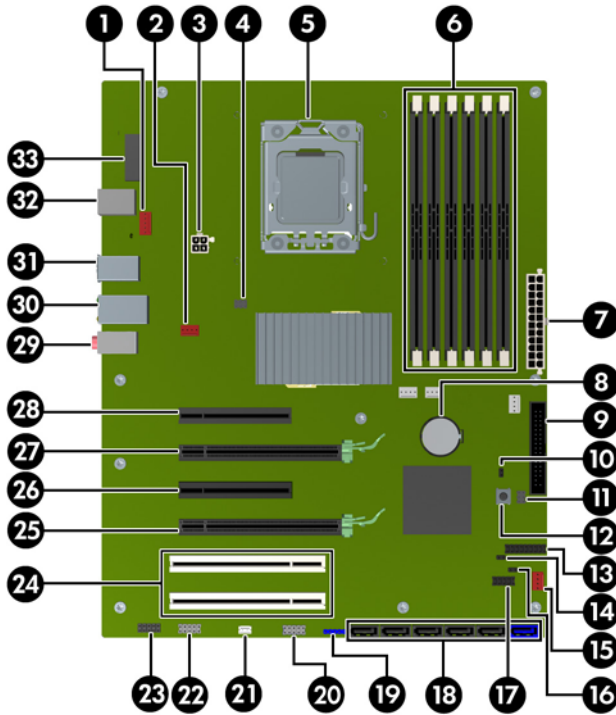
Table 5-3 6-DIMM system board components ID

Item	Component	Item	Component	Item	Component
1	CPU fan	12	Clear CMOS button	23	Front audio
2	Rear chassis fan	13	Front power button/LED	24	PCI 32/33
3	CPU power	14	Crisis recovery jumper	25	PCIe2 x16
4	Solenoid hood lock	15	Front chassis fan	26	PCIe x8(4)
5	CPU socket	16	HDD LED	27	PCIe2 x16
6	Memory sockets	17	Internal USB 1/DASH	28	PCIe2 x8(4)
7	Main power	18	SATA ports	29	Audio
8	Battery	19	Internal USB 2	30	Network/USB
9	Floppy disk drive	20	Front USB	31	USB
10	Password jumper	21	Speaker	32	Keyboard/mouse
11	Chassis intrusion switch	22	Front 1394a	33	Serial

For related system architecture information, see .

Predisassembly procedures

Perform the following steps before servicing a workstation:

1.

2. Locate and clear a suitable work area.

3. Close all open software applications.

4. Remove all diskettes, CDs, and DVDs from the workstation.

5. Shut down the operating system.

6. Power off the workstation and all peripheral devices connected to it.

7. Remove or disengage security devices that prevent you from opening the workstation.

8. Disconnect the power cord from the electrical outlet and then from the workstation.

9. Disconnect peripheral device cables from the workstation.

10. Gather the tools.

11. Service the workstation.

12. Restore power to the workstation when servicing is done.

Disassembly order

For convenience, disassembly procedures should be followed in a particular order. Use the following table to determine the sequence in which to access major workstation components.

Table 5-4 Workstation component installation

To install/replace...	Remove...	Then remove...	Then remove...	Then remove...	Then remove...	Then remove...	Then remove...
Hard drive, battery, front bezel, rear system fan, side access panel sensor, or solenoid lock	Chassis lock	Side access panel					
Memory, liquid cooling system, heatsink, or power supply	Chassis lock	Side access panel	Airflow guide				
Processor	Chassis lock	Side access panel	Airflow guide	Heatsink			
Expansion card (PCI/PCIe)	Chassis lock	Side access panel	Expansion card support	Expansion card hold down clamp or support			
Front panel I/O assembly, power button assembly, or system speaker	Chassis lock	Side access panel	Front bezel				
Optical bay filler or optical drive	Chassis lock	Side access panel	Airflow guide	Front bezel			
System board	Chassis lock	Side access panel	Airflow guide	Expansion card hold down clamp or support	Expansion cards or DIMMs	Liquid cooling system (If any)	Heatsink (optional)

NOTE: Z400s with 4 DIMM slots do not have an airflow guide.

Cable lock (optional)

If a cable lock is installed on the workstation, remove it before servicing the workstation.

Unlock it and pull it out of the cable lock slot as shown in the following figure.

Figure 5-3 Removing the cable lock

Side access panel

Before accessing the internal components of the workstation, you must remove the side access panel.

This section describes how to remove and install the side access panel.

Removing the side access panel

To remove the side access panel:

⚠ **WARNING!** Before removing the workstation side access panel, be sure that the workstation is powered off and that the power cord is disconnected from the electrical outlet.

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove locks that are present such as a cable lock.

4. Pull up on the handle ❶, slide the cover 1/2-inch towards the rear of the system ❷, then rotate the cover off the chassis ❸ as shown in the following figure.

    Figure 5-4 Removing the side access panel

Installing the side access panel

To install the side access panel:

1. Align the bottom groove of the side panel with the bottom edge of the chassis.

2. Rotate the side panel toward the chassis, slide the panel forward to engage the fingers on the top cover as well as the latch, then press firmly until the latch engages.

Side access panel sensor (optional)

The side access panel sensor is a remote solenoid that detects when the side access panel is opened.

This section describes how to remove and install the sensor.

Removing the side access panel sensor

To remove the side access panel sensor:

1. Power down the workstation (see).

2. Disconnect power from the workstation (see).

3. Remove the side access panel (see).

4. Disconnect the sensor cable from the inline chassis cable as shown below ❶.

Figure 5-5 Removing the side access panel sensor
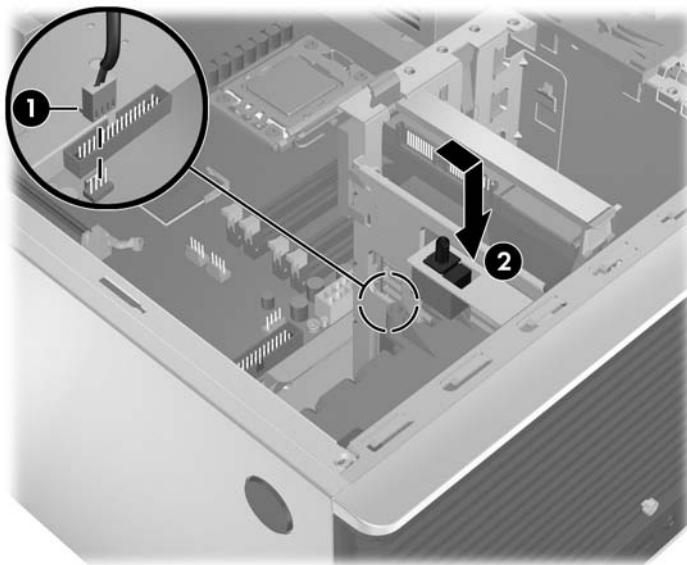
5. Slide the sensor back in its slot, push the sensor down, and then remove it from the chassis ❷.

Installing the side access panel sensor

To replace the side access panel sensor, reverse the previous steps.

NOTE: The metal bracket where the sensor resides is part of the sensor kit and must be installed when installing a sensor for the first time.

Side access panel solenoid lock

The side access panel solenoid lock provides a method to lock the side access panel by means of a local or remote signal-controlled solenoid.

This section describes how to remove and install the side access panel solenoid lock.

Removing the side access panel solenoid lock

To remove the side access panel solenoid lock:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Disconnect the side access panel solenoid lock cable from the system board ❶.

5. Remove the two screws that fasten the solenoid lock to the chassis ❷ as shown in the following figure.

6. Pull the solenoid lock assembly inward and then up ❸ to remove the assembly from the chassis.

Figure 5-6 Removing the side access panel solenoid lock
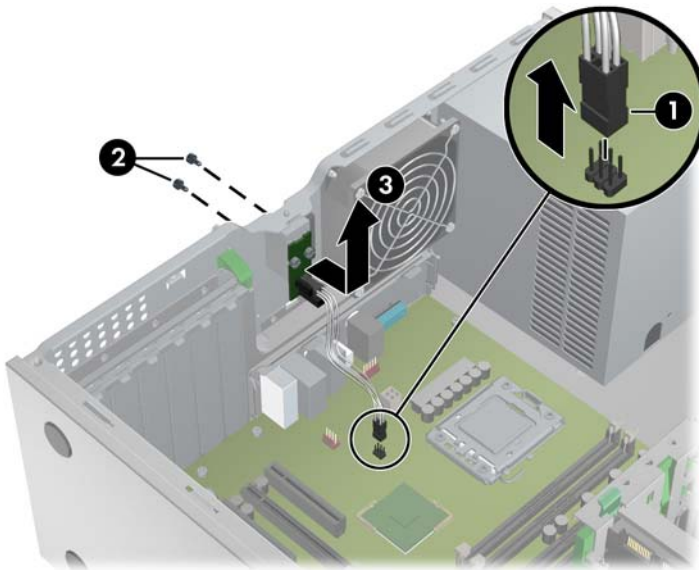
Installing the side access panel solenoid lock

Reverse the above steps to install the side access panel solenoid lock. This involves connecting the solenoid lock cable to the system board and fastening the solenoid lock to the chassis.

Bezel

This section describes how to remove and install the front chassis bezel.

Removing the front bezel

To remove the front bezel:

1. Remove the side access panel (see Removing the side access panel on page 72).

2. Lift the release tabs ❶, and then rotate the front bezel off the chassis ❷.

   Figure 5-7 Removing the front bezel
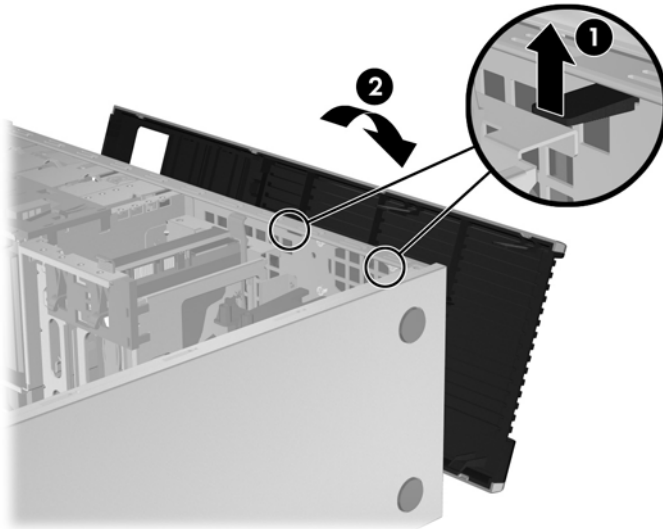
Installing the front bezel

To install the front bezel, align the tabs discussed in the previous section and rotate the bezel until it snaps in place.

Front panel I/O device assembly

This section describes how to remove and install a front panel I/O device assembly.

Removing the front panel I/O device assembly

To remove the front panel I/O device assembly:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the front bezel (see Removing the front bezel on page 75).

5. Remove the fastening screws from the I/O device assembly and remove it from the chassis as shown in the following figure.

Figure 5-8 Removing the front panel I/O device assembly
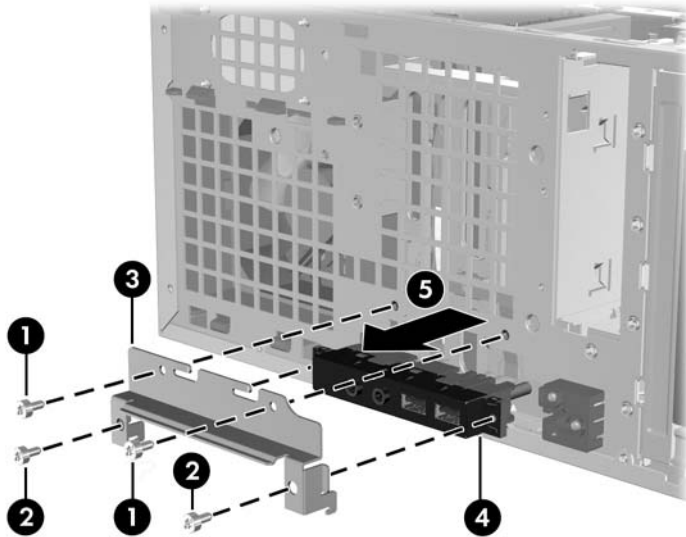
6. Disconnect the front panel I/O device assembly cables from the system board as shown below.

📝 **NOTE:** Z400s with 6 DIMM slots have an additional cable from the front panel to the 1394a card that you must also disconnect.

Figure 5-9 Disconnecting the front panel I/O cables
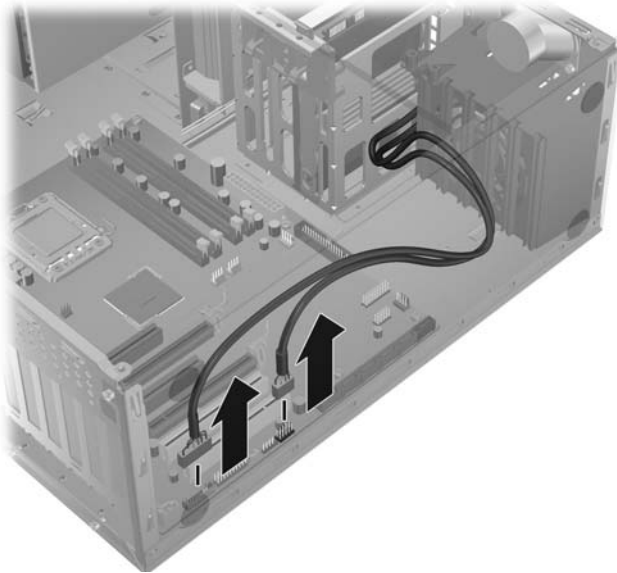
7. Carefully guide the front panel I/O device assembly from the chassis.

Installing the front panel I/O device assembly

To install the front panel I/O device assembly:

1. Guide the front panel I/O device assembly cables through the chassis openings from which they were removed.

2. Place the front panel I/O device assembly in the chassis.

3. Install the fastening screws in the reverse order from which they were removed.

4. Connect the front panel I/O cables directly to the system board. Connect the audio cable to the connector at ❶ and the USB cable to the connector at ❸, as shown in the following diagram.

    ● For 6 DIMM Z400s, connect the front 1394a cable directly to the system board at location ❷, as shown in the following diagram.

    ● For 4 DIMM Z400s, connect the front 1394a cable directly to the optional 1394a expansion card. (If the 1394a cable is not used, use the plastic clip at the bottom of the chassis to secure the cable.)

Figure 5-10 Connecting the front panel I/O device cables
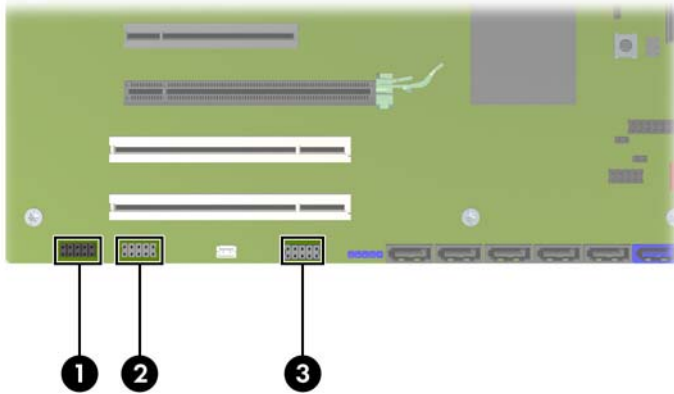
Power button assembly

This section describes how to remove and install the power button assembly.

Removing the power button assembly

To remove the power button assembly:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the front bezel (see Removing the front bezel on page 75).

5. Disconnect the power button cable from the system board as shown next.

    Figure 5-11 Disconnecting the power button cable
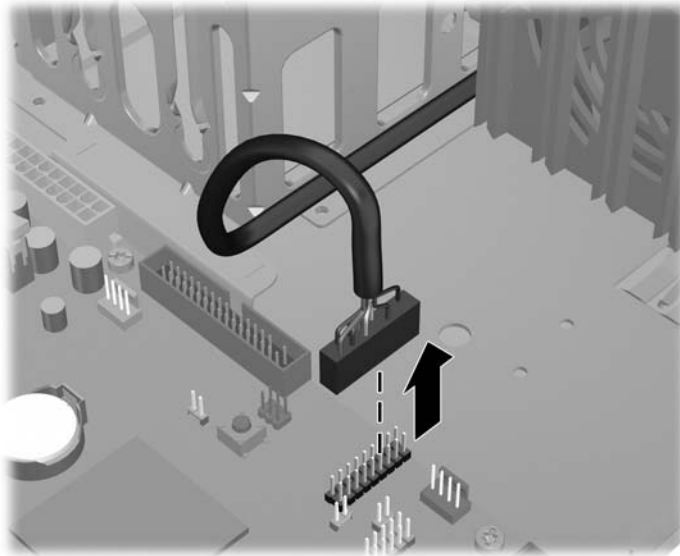
6. From inside of the chassis, push the tabs ❶ in from the chassis sides.

7. Pull the power button assembly ❷ from the chassis.

Figure 5-12 Removing the power button assembly
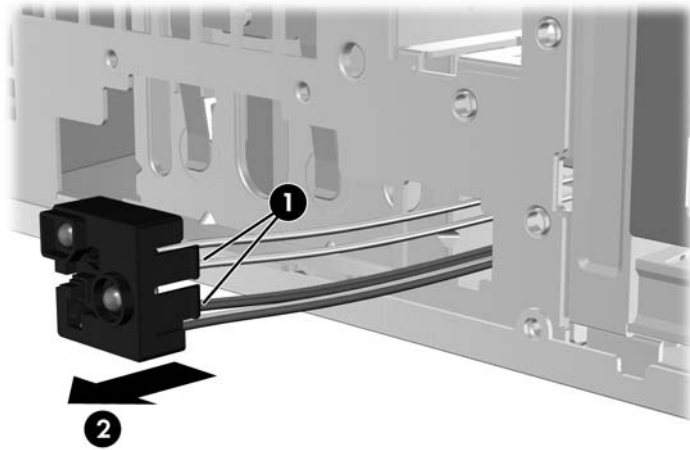
Installing the power button assembly

To replace the power button assembly, reverse the previous steps.

Optical disk drive (mini-tower configuration)

This section describes how to remove and install an optical disk drive in the workstation mini-tower configuration.

Removing an optical disk drive from the optical bay (mini-tower configuration)

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the airflow guide (see Removing the airflow guide on page 92).

5. Remove the front bezel (see Removing the front bezel on page 75).

6. Disconnect the data ❶ and power ❷ cables from the optical disk drive as shown in the following figure.

   Figure 5-13 Disconnecting optical disk drive cables
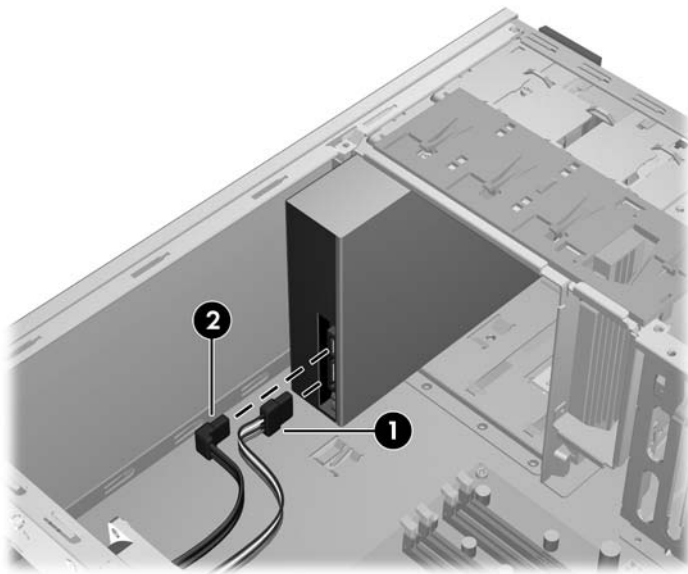
7. Lift the green drive-lock release lever ❶ and gently slide the drive out of the chassis ❷ as shown in the following figure.

Figure 5-14 Removing the optical disk drive
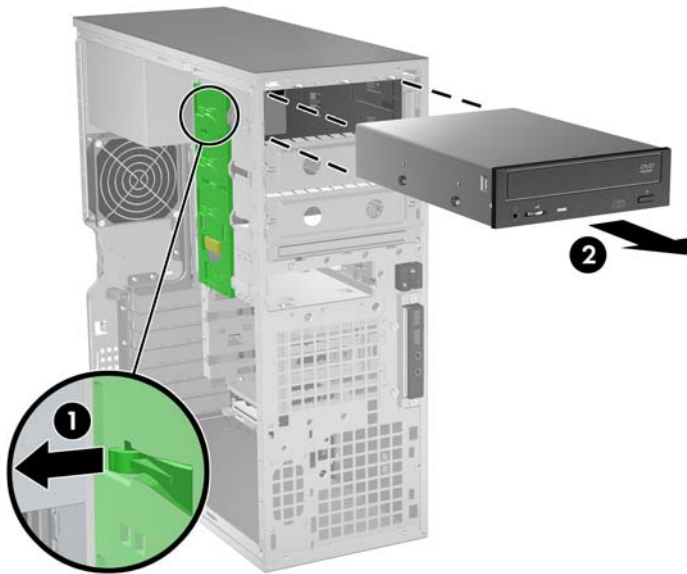
Installing an optical disk drive in the optical bay (mini-tower configuration)

To install an optical disk drive:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the airflow guide (see Removing the airflow guide on page 92).

5. Remove the front bezel (see Removing the front bezel on page 75).

6. Remove the bezel blank where you want to add the drive.

7. Install the four black metric M3 guide screws into the sides of the drive.

8. Lift the green release lever ❶ and slide the optical disk drive into the bay until it is stopped by the release latch as shown in the figure below.

Figure 5-15 Installing the optical disk drive
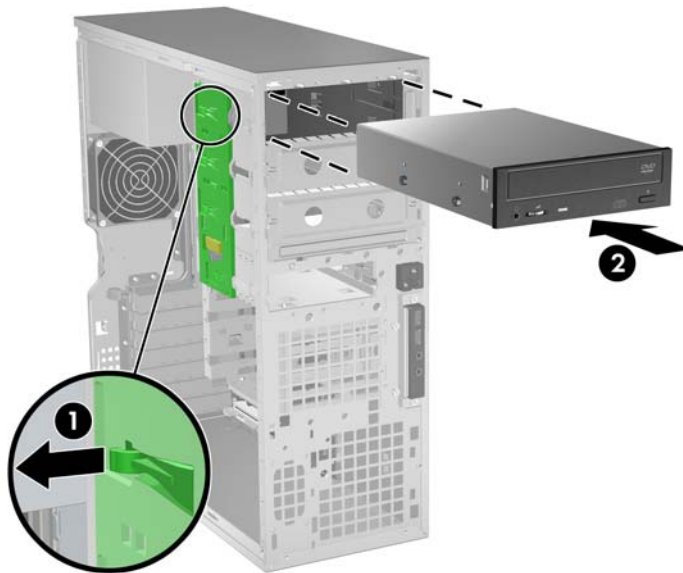
9. Release the latch and continue sliding the drive until the latch closes and engages the drive ❷.

   ☼ **TIP:** During installation, the adjacent drive or filler may move slightly. You may have to slide and align both devices to get the release latch to close and engage both devices.

10. Connect the power and data cables to the drive as shown in the following figure. (See the service label on the side access panel for component locations in your model of Z400.)

11. Connect the optical disk drive data cable to the appropriate SATA port on the system board as shown in the following figure.

Figure 5-16 Connecting power and data cables
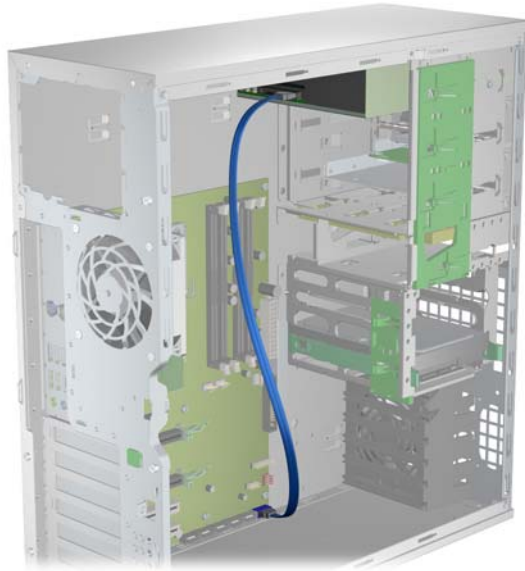
Optical disk drive (desktop configuration)

This section describes how to remove and install an optical disk drive in the workstation desktop configuration.

Removing an optical drive (desktop configuration)

1. Disconnect power from the system (Predisassembly procedures on page 69),

2. Remove the side access panel (Removing the side access panel on page 72).

3. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

4. Remove the front bezel (Removing the front bezel on page 75).

5. Disconnect the data ❶ and power ❷ cables from the optical disk drive as shown in the following figure. (The connector colors might be different than shown in the figure.)

   Figure 5-17 Disconnecting the optical drive cables
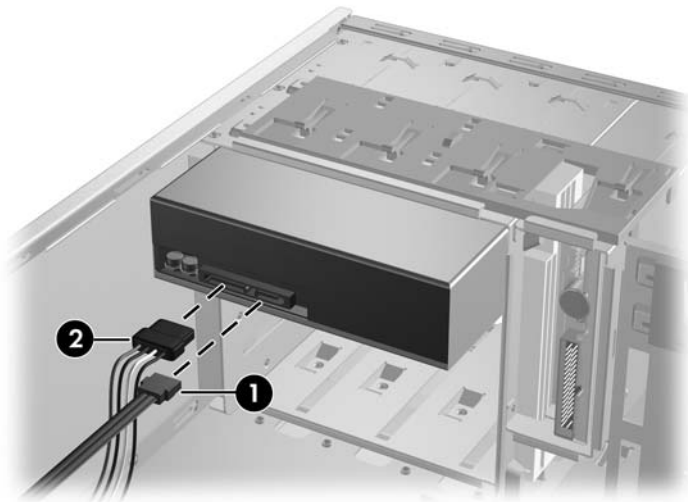
6. Press down on the yellow drive-lock release lever (1) and gently slide the drive out of the chassis (2).

Figure 5-18 Removing the optical drive from chassis

7. After removing the drive (1), remove the four guide screws from the drive (2) if you plan to install another drive.

Figure 5-19 Removing the optical drive screws

Installing an optical drive (desktop configuration)

1. Disconnect power from the system (Predisassembly procedures on page 69),

2. Remove the side access panel (Removing the side access panel on page 72),

3. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

4. Remove the front bezel (see Removing the front bezel on page 75),

5. Remove the bezel blank where the drive is being added.

6. Install the four black metric M3 guide screws into the drive (1).

   Figure 5-20 Installing the optical drive

7. Align the screws with the grooves in the drive bay and gently slide the drive into the bay until it snaps into place (2).

   △ **CAUTION:** Ensure that the optical drive is secure in the workstation chassis by pulling on the drive to see if it can be disengaged. Failure to properly secure the drive can cause damage to the drive when moving the workstation.

8. Connect the data ❶ and power ❷ cables from the system board to the optical disk drive as shown in the following figure. (The connector colors might be different than shown in the figure.)

Figure 5-21 Connecting the optical drive cables
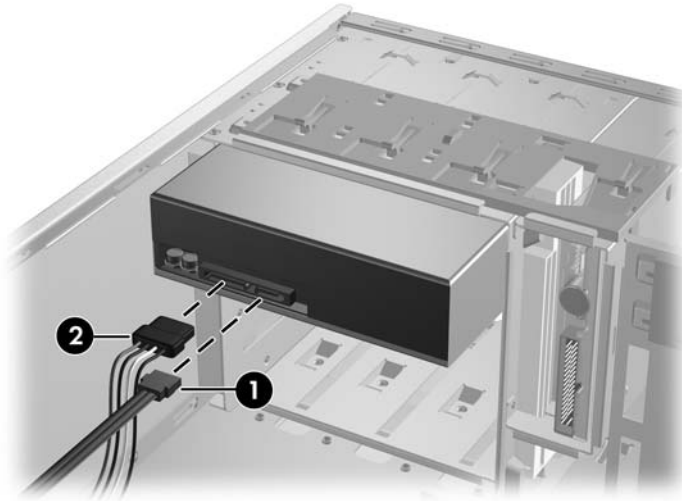
9. Reverse steps 1–5 to replace the components you removed during installation.

Workstation speaker

This section describes how to remove and install the workstation speaker.

Removing the workstation speaker

To remove the workstation speaker:

1. Power down the workstation (see Predisassembly procedures on page 69).
2. Disconnect power from the workstation (see Predisassembly procedures on page 69).
3. Remove the side access panel (see Removing the side access panel on page 72).
4. Remove the front bezel (see Removing the front bezel on page 75).
5. Disconnect the speaker cable from the system board ❶ as shown in the figure below.
6. Remove the two screws as shown ❷.
7. Slide the speaker away from the chassis and remove it from the chassis ❸.

Figure 5-22 Removing the workstation speaker
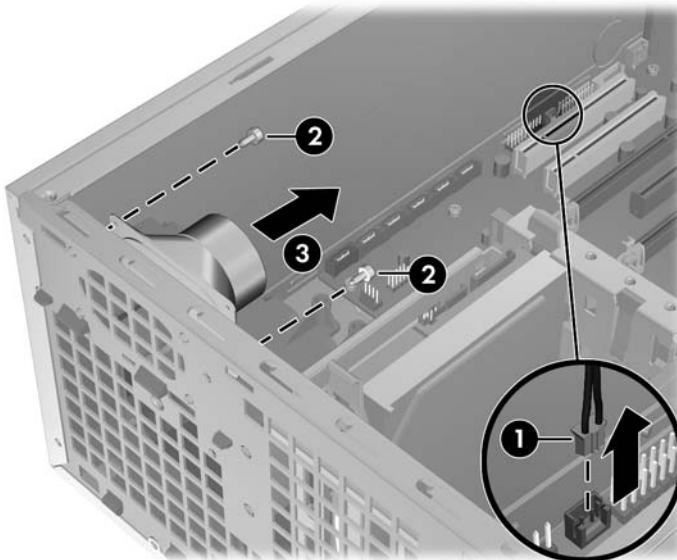
Installing the workstation speaker

To install the speaker, reverse the previous steps.

Power supply

This section describes how to remove and install a power supply.

Removing the power supply

To remove the power supply:

1. Power down the workstation (see Predisassembly procedures on page 69).
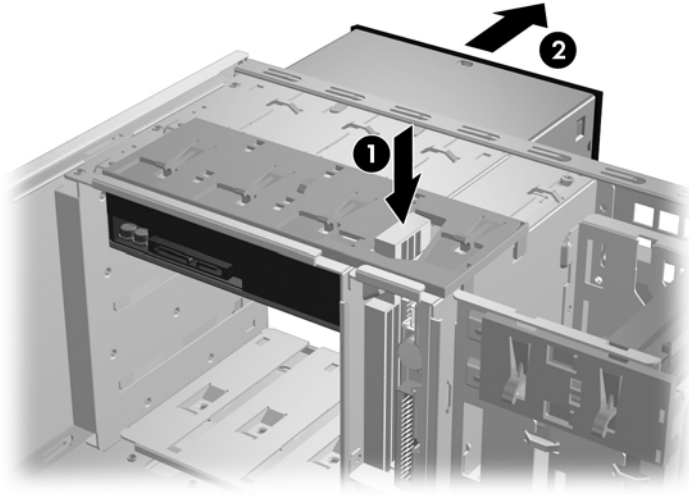2. Disconnect power from the workstation (see Predisassembly procedures on page 69).
3. Remove the side access panel (see Removing the side access panel on page 72).
4. Remove the airflow guide (see Removing the airflow guide on page 92).
5. Disconnect all of the power supply cables from the system board and all peripheral devices (hard drives, optical drives, and others as needed).
6. Remove the four screws from the rear of the chassis ❶.
7. Slide the power supply inward then up to remove it from the chassis ❷.

Figure 5-23 Removing power supply
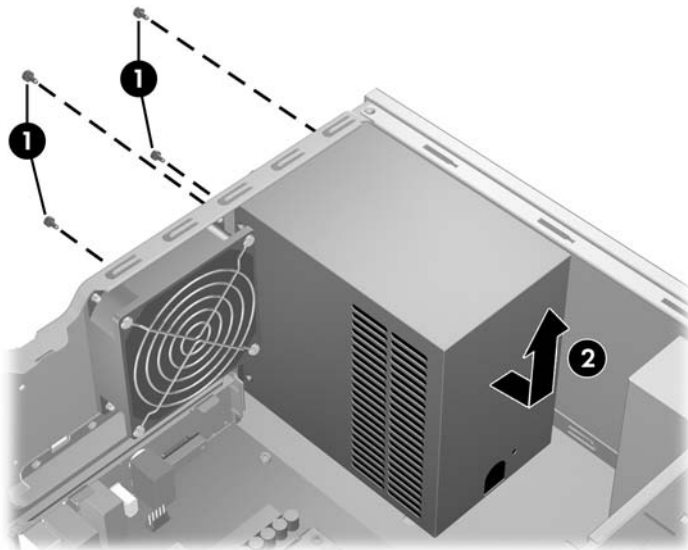
Installing the power supply

To install the power supply, reverse the previous steps.

Power connections

For help with identifying power cables, see the following figure and table. Make sure that you route or tie all cables so they cannot interfere with the processor heatsink fans.

Figure 5-24 Power connector identification for a typical configuration
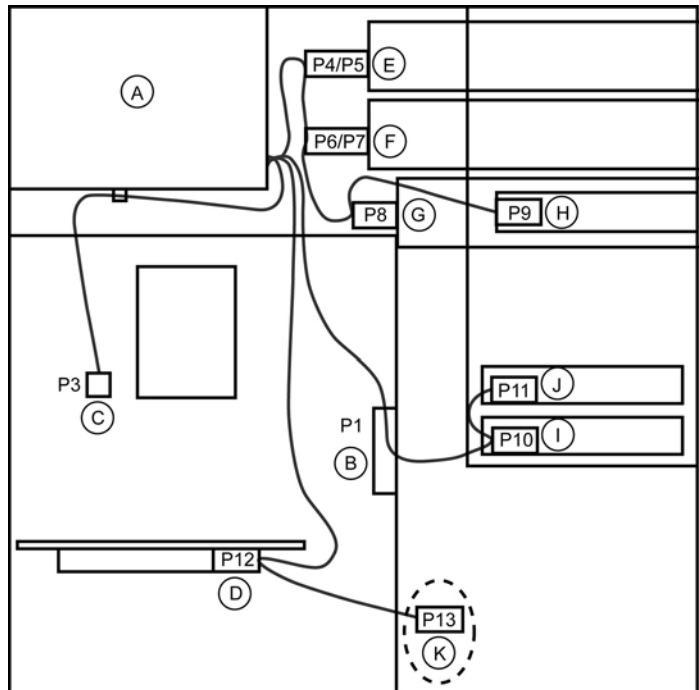
Table 5-5 Power connector description

Item	Description	Item	Description
A	Power supply	G	(P8) Optical drive
B	(P1) Main power	H	(P9) Floppy diskette drive
C	(P3) CPU power	I	(P10) Hard drive
D	(P12) PCIe auxiliary power	J	(P11) Hard drive
E	(P4/P5) Optical drive	K	(P13) Auxiliary/diskette drive
F	(P6/P7) Optical drive		

Rear system fan assembly

This section describes how to remove and install the rear system fan assembly.

Removing the rear system fan assembly

To remove the rear system fan assembly:

1. Power down the workstation (see Predisassembly procedures on page 69).
2. Disconnect power from the workstation (see Predisassembly procedures on page 69).
3. Remove the side access panel (see Removing the side access panel on page 72).
4. Disconnect the rear system fan assembly cable ❶ from the system board as shown in the following figure.

    Figure 5-25 Disconnecting fan wires
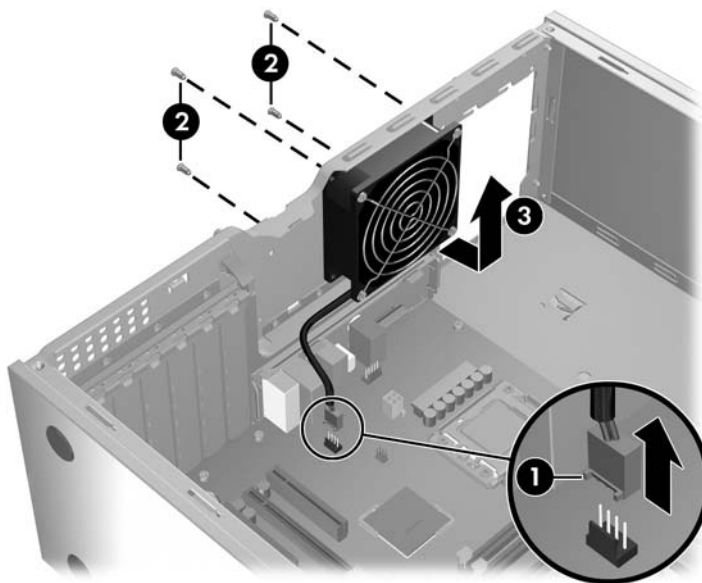
5. Remove the four screws from the rear of the chassis ❷, and then pull the fan assembly inward and then up ❸ out of the chassis.

Installing the rear system fan assembly

To install the rear system fan assembly, reverse these steps.

Airflow guide

This section describes how to remove and install the airflow guide used in the 6–DIMM versions of the workstation.

Removing the airflow guide

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Press the airflow guide release latches as shown in the following figure, and guide the airflow guide out of the chassis.

Figure 5-26 Removing the airflow guide

Installing the airflow guide

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Press the power cables, including P1, down toward the system board between the DIMM slots and the internal bay, as shown in the following figure.

Figure 5-27 Positioning the chassis cables
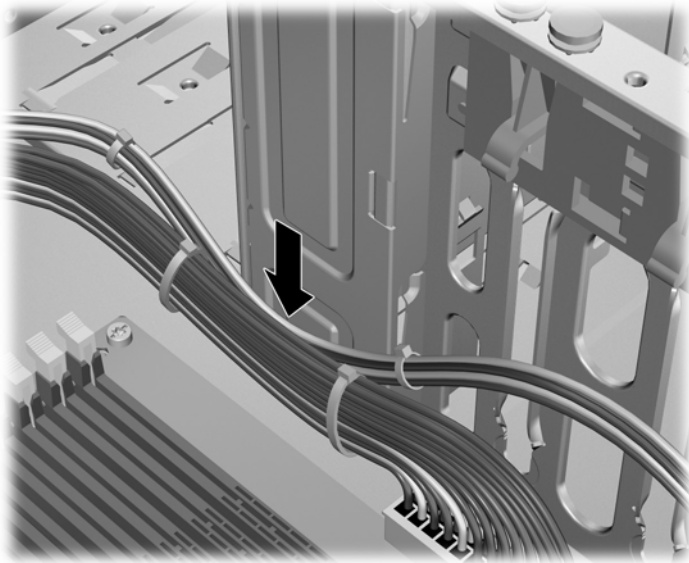
5. Set the airflow guide into the chassis.

   a. Place the edge of the airflow guide ❶ between DIMM socket #6 and the CPU heatsink.

   Figure 5-28 Installing the airflow guide
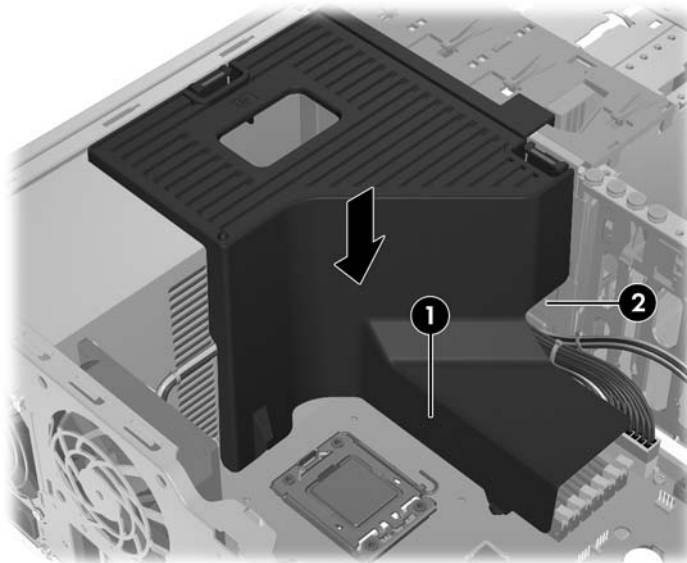
   b. Route the power and data cables through the opening next to the internal bay ❷.

6. Route the CPU power cable (P3) through the opening next to the power supply as shown in the following figure.

Figure 5-29 Routing the CPU power cable
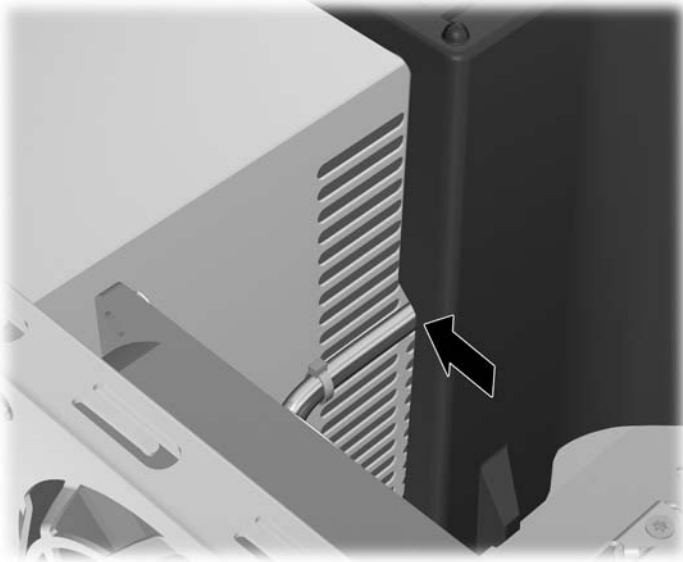
7. Secure the airflow guide in the chassis.

   a. Insert the tab on the airflow guide into the slot next to the yellow ODD release lever ❶, and then press down as shown in the following figure.

   Figure 5-30 Securing the airflow guide
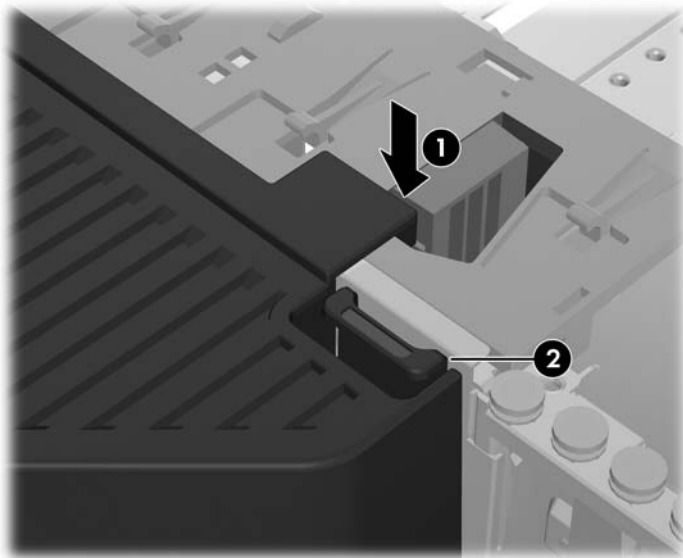
   b. Ensure that the airflow guide secures even with the end of the FDD bay, and that the latch ❷ engages with the slot in the internal bay cover.

c. Ensure that the latch on the top of the airflow guide snaps under the edge of the chassis frame as shown in the following figure.

Figure 5-31 Securing the airflow guide latch
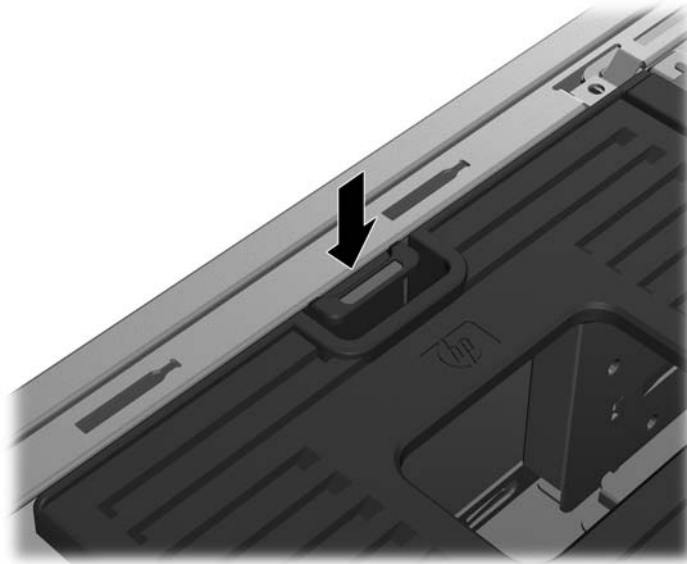
8. Replace all components that were removed in preparation for component installation.

Memory

This section presents memory module (DIMM) configuration information and removal/installation procedures.

DIMM installation guidelines

- Install only HP-approved unbuffered DDR3 DIMMs. See http://www.hp.com/go/quickspecs to find which DIMMs are compatible with the workstation

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

DIMM installation order

Review the following figures to determine the correct installation order for DIMMs.

Figure 5-32 4–DIMM load order
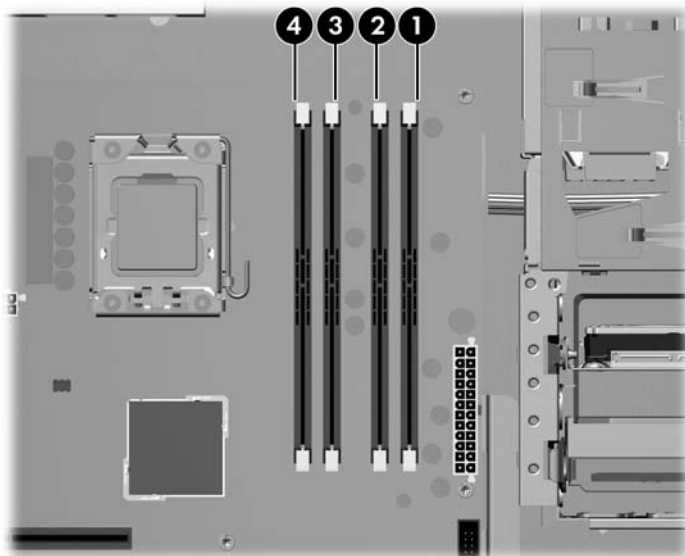
Figure 5-33 6–DIMM load order
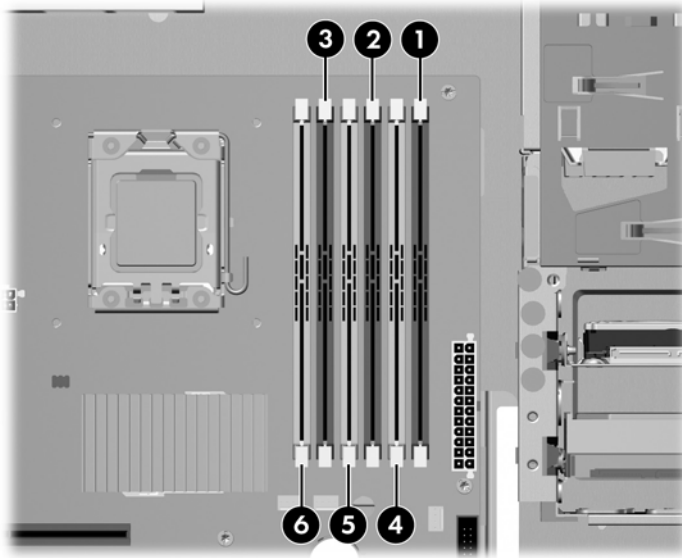
Supported DIMM configurations

The workstation supports these DIMM arrangements, depending on which Z400 product you order:

- Up to six DIMM slots
- Memory range from 1 GB to 16GB for the 4-DIMM product
- Memory range from 1 GB to 24GB for the 6-DIMM product
- No support for mirroring
- No support for DIMM sparing

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 or memory riser.
- 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).

## Removing a DIMM

To remove a DIMM:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

   △ **CAUTION:** To prevent electrical damage to the DIMMs during removal or installation, power off the workstation and unplug the power cord from the AC power outlet. Otherwise, the workstation may not recognize the memory changes.

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Push gently outward on the DIMM socket levers ❶ as shown in the following figure.

   Figure 5-34 Removing a DIMM
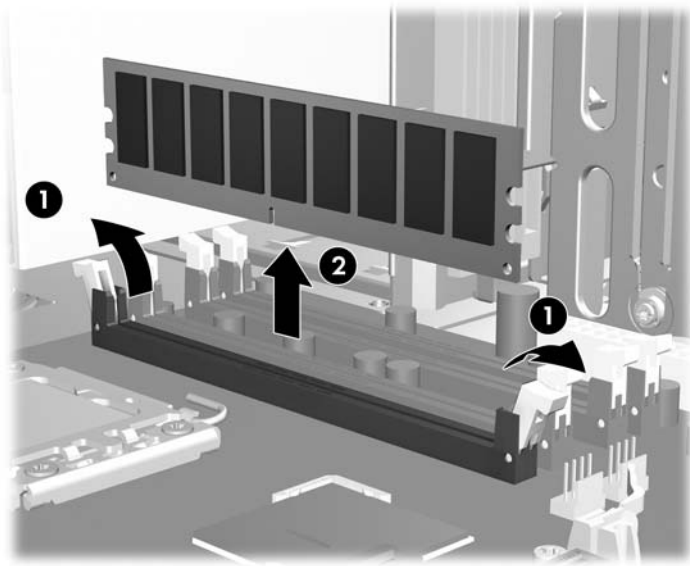
6. Lift the DIMM straight up ❷ and out of the socket, then store the DIMM in an antistatic bag.

Installing a DIMM

To install the DIMM:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

    △ **CAUTION:**   To prevent electrical damage to the DIMMs during removal or installation, power off the workstation and unplug the power cord from the AC power outlet. Otherwise, the workstation may not recognize the memory changes.

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Push gently outward on the DIMM socket levers as shown in the following figure.

    Figure 5-35 Opening DIMM socket levers
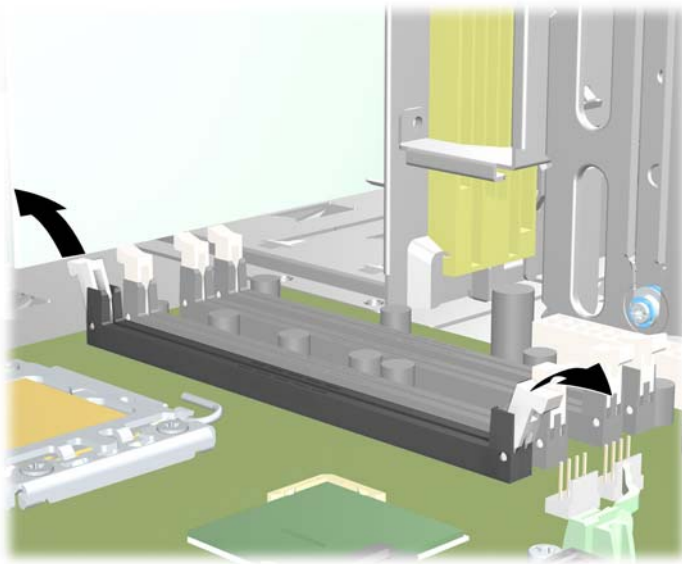
6. Align the DIMM connector key with the DIMM socket key, and then seat the DIMM firmly in the socket ❶ as shown in the following figure.

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

Figure 5-36 Seating the DIMM
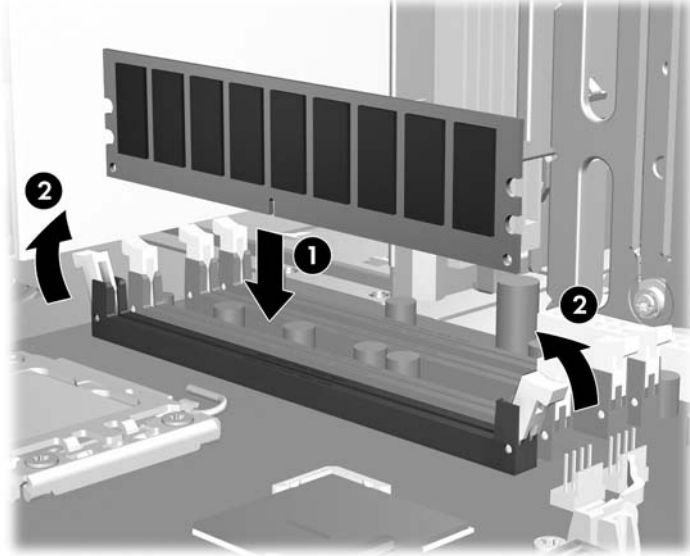
7. Secure the socket levers ❷.

8. For a 6-DIMM workstation configuration, replace the airflow guide (see Installing the airflow guide on page 93).

9. Replace all components that you removed in preparation for component installation.

Expansion card slot identification

This section identifies and describes workstation expansion card slots, and presents card configuration information.

Slot identification and description

The following figure identifies workstation expansion card slots.

Figure 5-37 Identifying expansion card slots
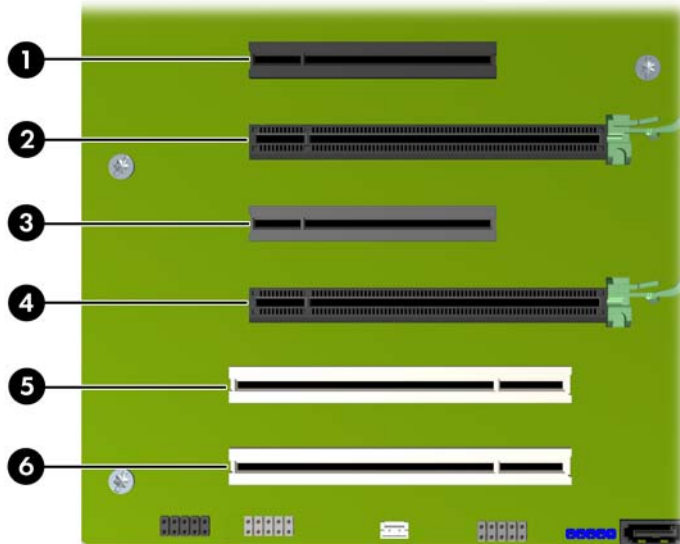
The following table describes the workstation PCIe card slots.

Table 5-6 PCI slots

Slot	Type	Slot power (Maximum)
1	PCIe2 - x8(4)	25W
2	PCIe2 - x16	75W
3	PCIe - x8(4)	25W
4	PCIe2 - x16	75W
5	PCI 32/33	25W
6	PCI 32/33	25W

NOTE: The x1, x4, x8, and x16 designators describe the mechanical length of the slot. The number in parentheses shows how many electrical PCIe lanes are routed to the expansion slot. For example, x16(8) means that the expansion slot is mechanically a x16 length connector, with eight PCIe lanes connected. A x16 graphics card runs at the bandwidth of the slot it is plugged into.

Slots one and three use open-ended PCIe connectors, so a PCIe x16 card can be inserted. Graphics cards greater than 75 watts require the use of an auxiliary power cable adapter.

Card configuration restrictions for power supplies

△ **CAUTION:** To prevent damage, the overall power consumption of the workstation (including I/O cards, CPU, and memory) must not exceed the maximum rating of the workstation power supply. For power supply information, see Power supply specificationson page 10.

The maximum graphics configuration with an 475W power supply can include two 75-watt cards (one in slot two, one in slot four), or one 150-watt card in slot two or slot four.

If you use a graphics card with greater than 75 watts of power, leave the adjacent slot empty. The maximum graphics power depends on CPU and memory selections. Follow any additional workstation configuration restrictions.

Choosing an expansion card slot

Whenever possible, use the following tips to help you select the proper slot for an expansion card:

● Insert the primary graphics card in a PCIe x16 slot intended for graphics.

● Insert a second graphics card in a second PCIe x16 slot intended for a secondary graphics card.

● Install full-length cards in slots that support full-length cards.

● For optimal cooling and acoustics do not insert a card next to a graphics card to avoid blocking the graphics card heatsink and fan. This is especially important for a card that requires an auxiliary power cable. For best results, choose a lower profile card to place next to the heatsink and fan.

● Install a card in a slot that most closely matches its interface technology:

   ◦ Install a PCIe Gen2 x8 card in a PCIe Gen2 x8 slot.

   ◦ Install a PCIe Gen1 x8 card in a PCIe Gen1 x8 slot.

   ◦ Install a PCIe Gen1 x4 card in a PCIe Gen1 x4 slot.

   ◦ Install a PCIe Gen1 x1 card in a PCIe Gen1 x1 slot.

   ◦ Install a PCI card in a PCI slot.

   ◦ Whenever possible, install a PCIe x1 card in an x1 slot.

● Leave as much space as possible between cards.

● For best operational efficiency, select a slot that:

   ◦ Electrically matches the number of PCIe card lanes (e.g., x4 in a x4 slot).

   ◦ Has more lanes electrically.

   ◦ Has fewer lanes, but is closer to your needs. For example, place an x16 card in an x8 slot, and an x8 card in a an x4 slot.

● An x1 connector supports an x1 card only. Although, an x1 card can be inserted into any slot, this may waste the potential for future card placement.

● Install cards that require internal cable connections so that the cables are organized and have the least amount of strain on them. Some cables may be routed under, rather than over the other expansion cards.

● To prevent electromagnetic interference, avoid installing a card with external cable connections next to a graphics card.

Expansion card

PCIe I/O slots can support other PCIe cards with less bus bandwidth than what is physically defined for the slot.

Expansion card slot description

NOTE: The x1, x4, x8, and x16 designators describe the mechanical length of the slot. The number in parentheses shows how many electrical PCIe lanes are routed to the expansion slot. For example, x16(8) means that the expansion slot is mechanically a x16 length connector, with eight PCIe lanes connected. A x16 graphics card runs at the bandwidth of the slot it is plugged into.

Use the following table to determine PCIe card compatibility.

Table 5-7 Workstation PCIe compatibility matrix

Slot	Mechanical compatibility	Electrical compatibility
1	x8 connector, open-ended*	PCIe2 (x1, x4)
2	x16 connector	PCIe2 (x1, x4, x8, x16)
3	x8 connector, open-ended*	PCIe (x1, x4)
4	x16 connector	PCIe2 (x1, x4, x8, x16)

* This slot is open-ended so a PCIe x16 card can be inserted.

- Slots one, two, and four are PCIe GEN2 slots.

- Graphics cards greater than 75 watts require the use of an auxiliary power cable adapter.

Removing an expansion card

To remove an expansion card:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the expansion card support, if installed. Some workstation models use a bar support; remove the two screws ❶ and lift up on the support ❷.

Figure 5-38 Removing expansion card support
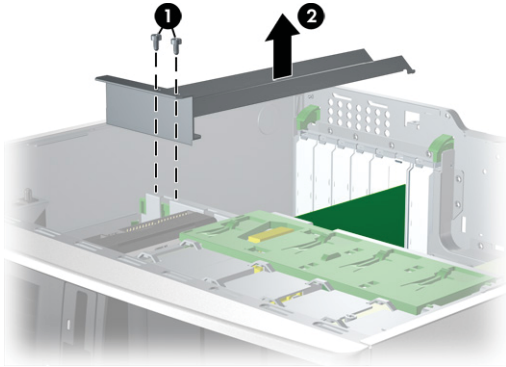
Other workstation models use a hold down clamp; grasp the top of the clamp ❶, squeeze the release handles until the bottom of the clamp releases from the clamp rail ❷ (it should click when it releases), and swing the clamp out from the back panel ❸.

Figure 5-39 Removing expansion card clamp
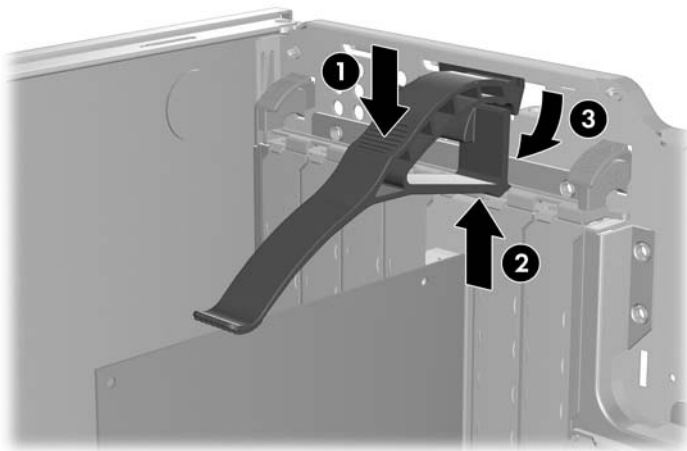
5. Remove all cables connected to the expansion card.

6. Push down on the expansion card retention clamp levers on the inside of the chassis to open the retention clamp ❶ as shown below.

Figure 5-40 Removing the expansion card
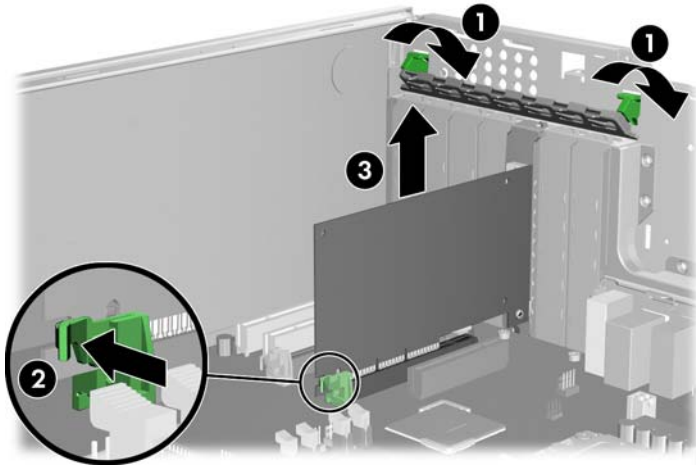
Release the expansion card slot latch ❷, and then carefully lift the card from the chassis ❸.

7. Install a expansion slot cover and close the expansion card retention clamp.

If the expansion card retention clamp does not close, ensure that all cards are properly seated, and then try again.

Installing an expansion card

Visit http://www.hp.com/go/quickspecs to learn which graphics cards are supported in the workstation, how much memory each graphics card includes, and graphics card power requirements.

To install an expansion card:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. Remove the expansion card support (if installed) by removing the two screws and lifting up on the support (see Removing an expansion card on page 104).

5. Push the expansion card retention clamp levers down on the outside of the chassis to release the retention clamp ❶ as shown in the figure below.

Figure 5-41 Removing the slot cover
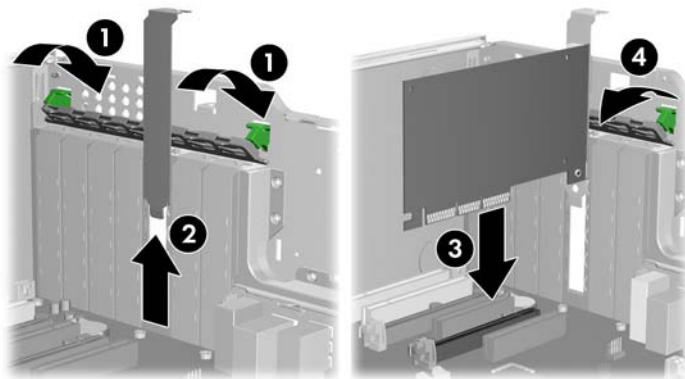
6. Remove the expansion card slot cover by pulling it up, out of the chassis ❷.

☆ **TIP:** Grasp the slot cover between two fingers—one from the inside of the chassis, and one from the outside.

7. Angle the card into the expansion card guide.

8. Align the PCIe card keyway with the slot key, and then firmly seat the card in the slot as shown next ❸.

9. Close the expansion card retention clamp by rotating it downward ❹.

   If the PCI retention clamp does not close, ensure that all cards are properly seated, and then try again.

   If required by the card, connect the auxiliary power cable to the card (not illustrated).

Battery

This section describes how to remove and install the battery.

The battery that comes with the workstation provides power to the real-time clock and has a minimum lifetime of about three years.

⚠ **WARNING!** This workstation includes a lithium battery. There is a risk of fire and chemical burn if the battery is handled improperly. Do not disassemble, crush, puncture, short external contacts, dispose in water or fire, or expose it to temperatures higher than 60°C (140°F).

⚠ **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 Diskette** option in the Computer Setup (F10) Utility.

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

Removing the battery

To remove the battery:

1. Power down the workstation (see Predisassembly procedures on page 69).
2. Disconnect power from the workstation (see Predisassembly procedures on page 69).
3. Remove the side access panel (see Removing the side access panel on page 72).
4. On the system board, press the release tab of the battery holder.
5. Pull the tab ❶ on the battery holder, and then lift it straight up ❷ as shown in the following figure.

   Figure 5-42 Removing the battery
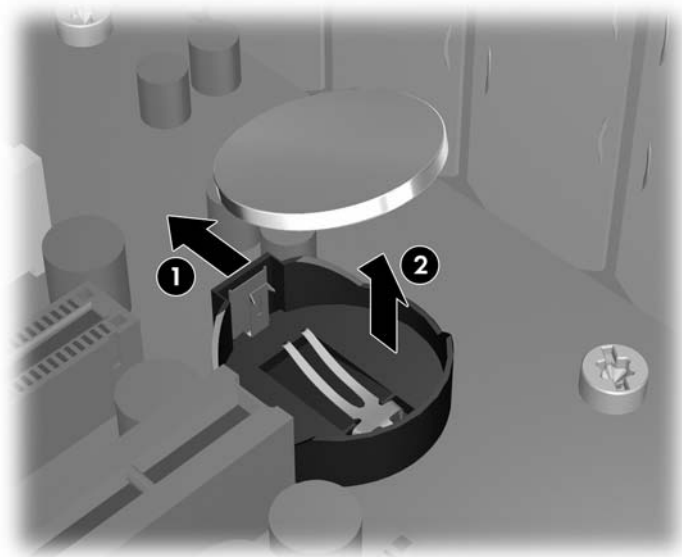
Installing the battery

To install the battery:

1. Confirm the polarity (positive or negative) of the battery to position it correctly in the battery holder.
2. Place the battery edge under the plastic housing tab and press gently until it snaps into place.

Hard disk drive

This section provides information to successfully remove and install a hard disk drive.

Removing the hard disk drive

To remove a hard disk drive:

1. Power down the workstation (see).

2. Disconnect power from the workstation (see).

3. Remove the side access panel (see).

4. Disconnect the power and data cables from the drive.

5. Press the green hard disk drive release tab ❶, then slide the hard disk drive ❷ from the chassis as shown.

   Figure 5-43 Removing the drive from the chassis
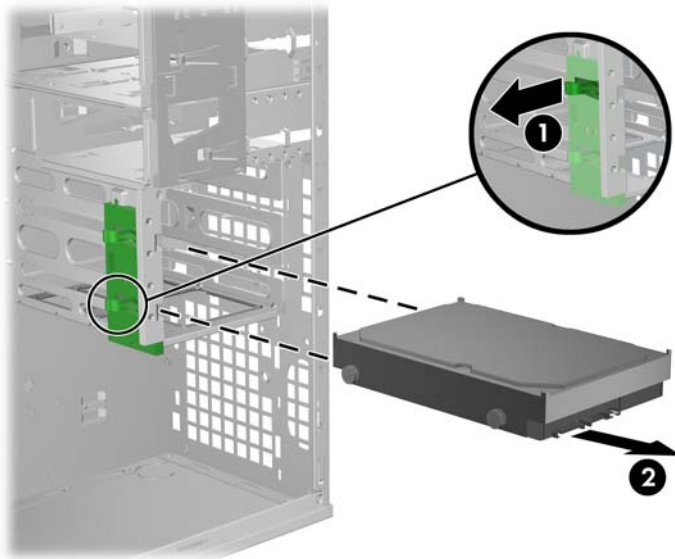
6. Replace the side access cover when finished.

Installing the hard disk drive

Installation guidelines

The workstation typically ships with an HDD, but additional drives can be added to expand data storage:

● Refer to the service label on the side access panel of your workstation to determine the location of the SAS and SATA ports.

● Additional HDDs must be added in a specific sequence, depending on the type of workstation.

● Once installed, the HDDs are assigned drive letters, with C:\ being the typical boot disk. Drive letters are assigned using the Computer Setup (F10) Utility.

- With additional HDDs installed, the workstation boot sequence can be modified so that the workstation boots from one of the additional drives. Boot sequence is specified using the Computer Setup (F10) Utility.

- With additional HDDs installed, you have hard disk space for additional programs, data files, and backup.

The HDD bays are not labeled on the chassis.

The cables plug into the system board connectors in the following manner:

- SATA HDD cables are plugged into SATA ports, starting at SATA port zero.

- SAS HDD cables do not plug into system board connectors, but into a separate SAS controller card.

Installation

To install an HDD:

1. Select a drive bay in which to install the hard disk drive.

2. Locate the four isolation grommet screws on the chassis.

   Figure 5-44 Locating the grommet screws
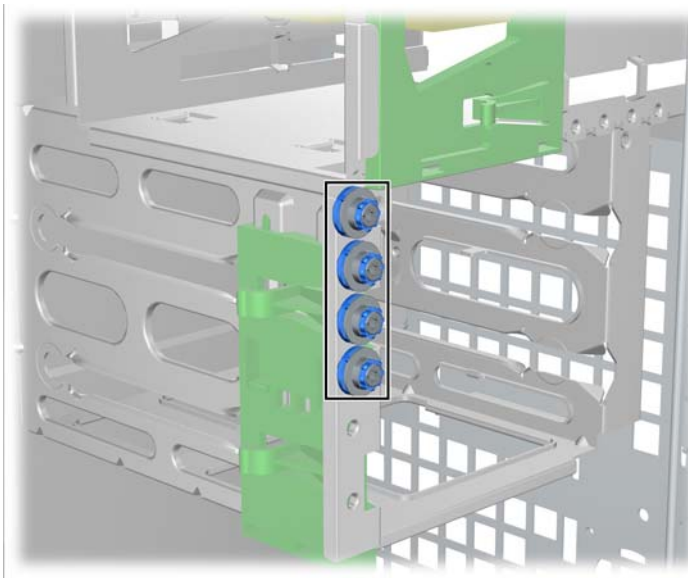
3. Install the four isolation grommet screws as shown in the following figure.

   Figure 5-45 Installing the grommet screws
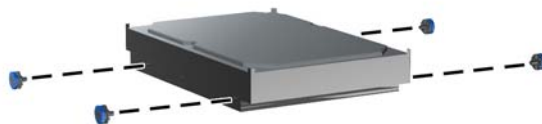
4. If installing a SAS drive, attach a SAS-to-SATA cable adapter to the connector on the SAS hard drive as shown in the following figure.

📝 **NOTE:** SAS Drives require a separate SAS Controller plug-in card.

Figure 5-46 Attaching the cable adapter
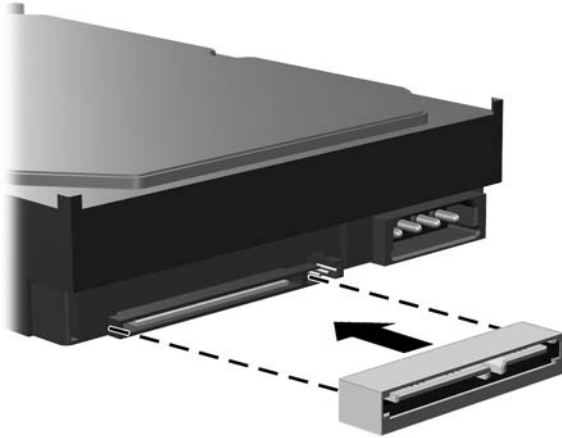
5. Push the hard disk drive into the selected bay until it snaps into place ❶ as shown in the following figure.

Figure 5-47 Installing the HDD drive
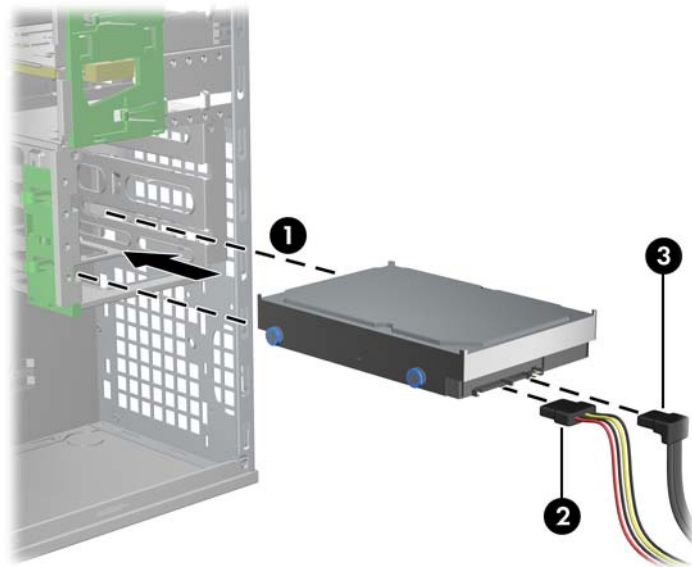
6. Attach a power cable ❷ to the drive, and attach a data cable ❸ from the SATA port or SAS controller to the hard disk drive.

📝 **NOTE:** For SATA and SAS HDDs, connect data cables to lower-numbered drive connectors first on the system board (for SATA HDDs) or SAS controller card (for SAS HDDs). To identify hard disk drive connectors, refer to the workstation service label on the side access panel.

7. Replace all components that were removed in preparation for component installation.

Liquid cooling solution

This section describes how to remove and install a processor liquid cooling solution (LCS).

NOTE: The LCS is not eligible for Customer Self-Repair. Call HP Support for further instructions before attempting to remove or repair this system.

Removing the liquid cooling solution

1. Disconnect power from the system (Predisassembly procedures on page 69).

2. Remove the side access panel (see Removing the side access panel on page 72).

3. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

4. Remove the LCS VR fan.

   a. Disconnect the LCS VR fan cable from the system board as shown in the following figure.

   Figure 5-48 Disconnecting the LCS VR fan cable
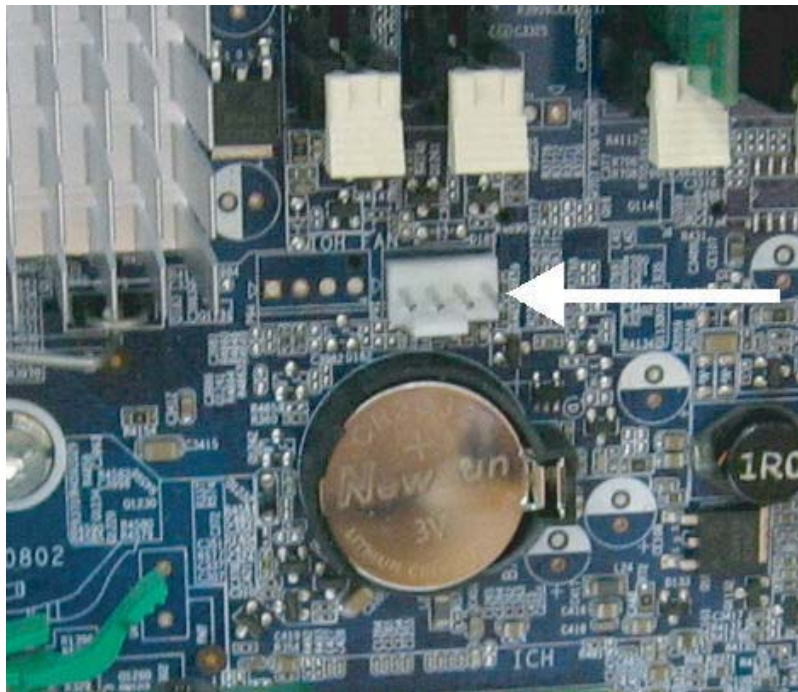
b. Disconnect the two LCS VR fan assembly bracket screws and remove the assembly from the chassis as shown in the following figure.

Figure 5-49 Removing the LCS VR fan assembly
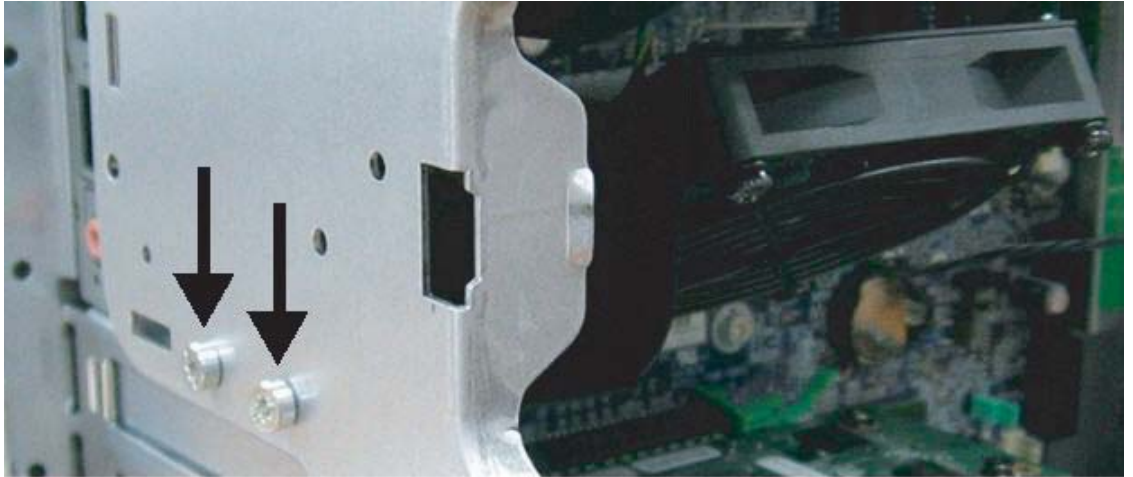
5. Disconnect the rear system fan cable from the system board as shown in the following figure.

Figure 5-50 Disconnecting the rear system fan cable
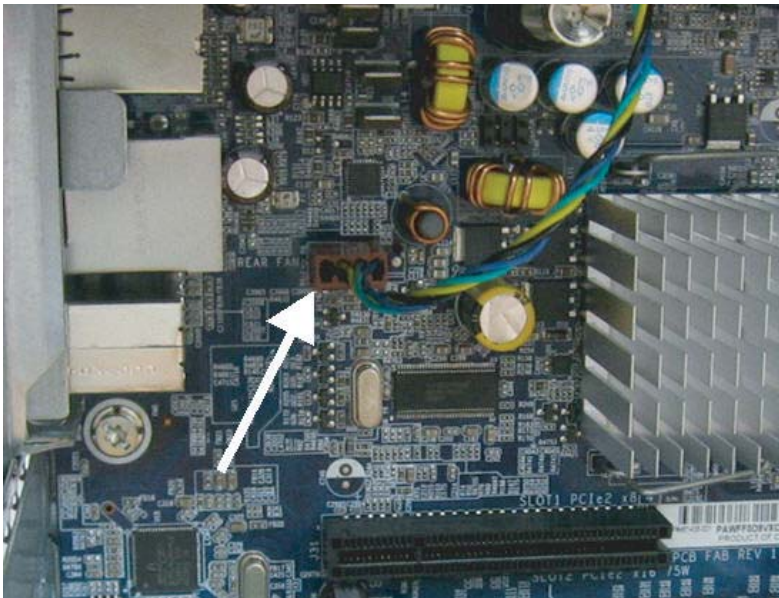
6. Remove the screws and the LCS radiator assembly from the chassis as shown in the following figure.

Figure 5-51 Removing the LCS radiator assembly

7. Disconnect the LCS pump cable from the system board as shown in the following figure.

Figure 5-52 Disconnecting the LCS pump cable

8. Remove the cold plate assembly.

    a. Remove the four heatsink mounting screws shown in the following figure from the LCS cold plate assembly, and then lift the assembly from the CPU.

        Figure 5-53 Disconnecting the LCS cold plate from the CPU
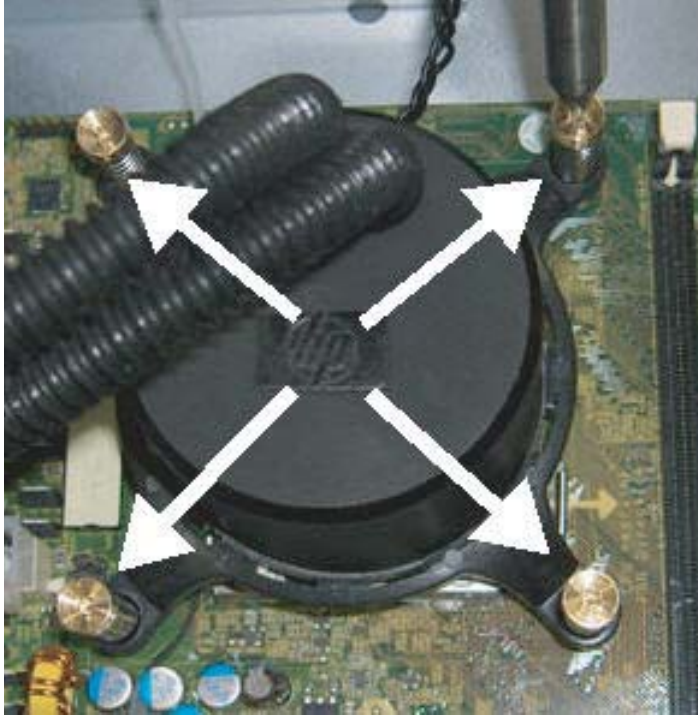
b. With the cold plate assembly removed, gently twist the cold plate ❶ and remove it from the retention ring ❷ as shown in the following figure.

Figure 5-54 Removing the cold plate assembly from the retention ring
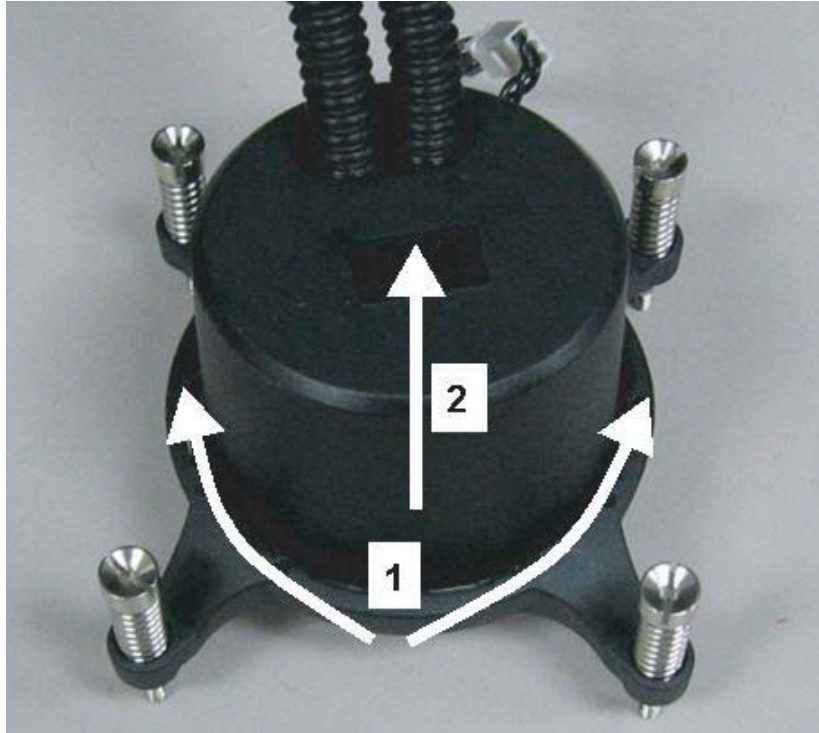
9. Remove the rear system fan from the LCS radiator fan holder.

   Press the fan holder tabs outward ❶, and rotate the fan out of the holder ❷ as shown in the following figure. Release the tabs when the fan is removed.

   Figure 5-55 Removing the rear system fan from the radiator fan holder

10. Reinstall the rear system fan (see).

11. Reinstall the CPU heatsink (see).

12. Reinstall all removed components and reconnect any cables that have been disconnected.

Installing a liquid cooling solution

1. Disconnect power from the system (Predisassembly procedures on page 69),

2. Remove the side access panel (see Removing the side access panel on page 72).

3. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

4. Remove the rear system fan assembly from the chassis (see Removing the rear system fan assembly on page 91).

5. Install the rear system fan in the LCS radiator fan holder. Place the edge of the fan in the holder, and then rotate it into the holder until it snaps into place as shown in the following figure.

☀ **TIP:** Ensure that the fan cable is positioned in the slot in the lower-right corner of the LCS radiator fan holder.

Figure 5-56 Installing the system fan in the LCS radiator fan holder

6. Remove the CPU heatsink (see Removing the CPU heatsink on page 127).

7. Set the cold plate retention ring on the CPU heatsink mounting base, and then slightly tighten a single retention screw (see Installing the CPU heatsink on page 128) as shown in the following figure.

   ☼ **TIP:** Tighten the retention ring screw only one or two turns to keep its corner in place while allowing the rest of the ring to move.

   Figure 5-57 The retention screw
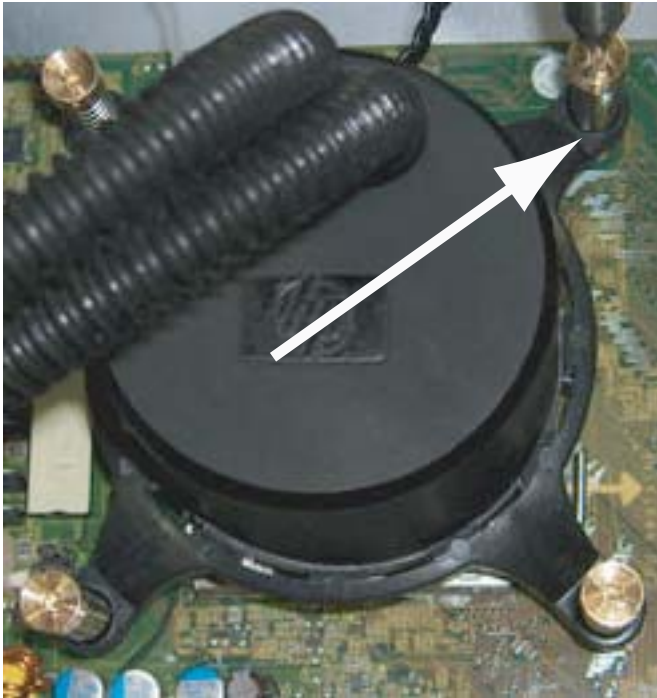
8. Install the LCS cold plate.

   a. Remove the plastic cover from the bottom of the cold plate as shown in the following figure.

      Figure 5-58 Removing the protective cap

   b. Apply thermal compound to the top CPU surface (see Installing the CPU heatsink on page 128).

c. Lift the edge of the LCS cold plate retention ring, align the tabs on the retention ring with the slots in the cold plate, and then set the cold plate into the retention ring on the CPU as shown in the following figure.

☼ **TIP:** Ensure that the HP logo is positioned horizontally as shown in the figure.

Figure 5-59 Positioning the LCS cold plate

d. Gently twist the cold plate body until it locks into place in the retention ring as shown in the previous figure.

e. Lower the retention ring with the attached cold plate onto the CPU.

△ **CAUTION:** Do not scratch the system board while maneuvering the cold plate assembly or you might damage components.

f. Tighten the four cold plate retention screws (see).

Figure 5-60 Tightening the cold plate screws
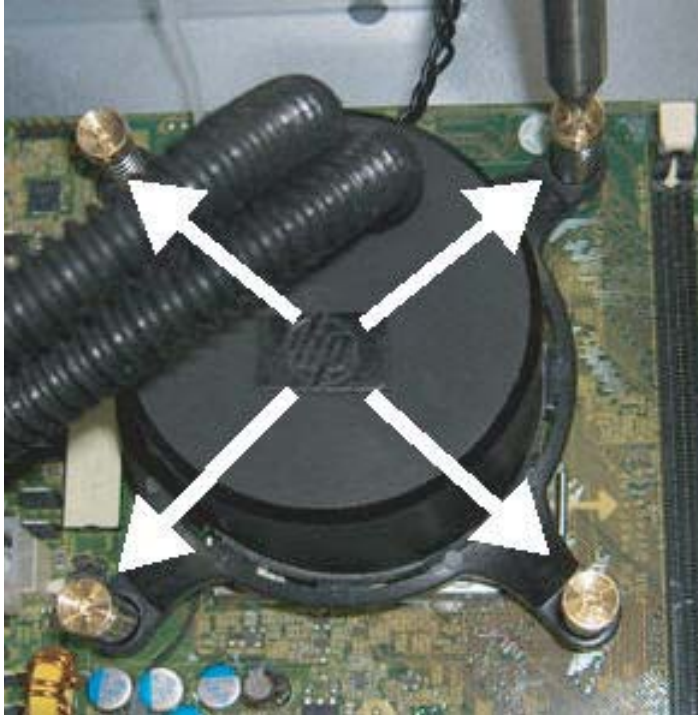
9. Connect the LCS pump cable to the system board as shown in the following figure.

Figure 5-61 Connecting the LCS pump cable

10. Install the LCS radiator with attached rear system fan in the chassis. as shown in the following figure.

    a. Align the LCS radiator assembly in the chassis as shown in the following figure.

      ☆ **TIP:** Align the radiator assembly with the rear system fan screw holes in the chassis.

      Figure 5-62 Aligning the LCS radiator assembly
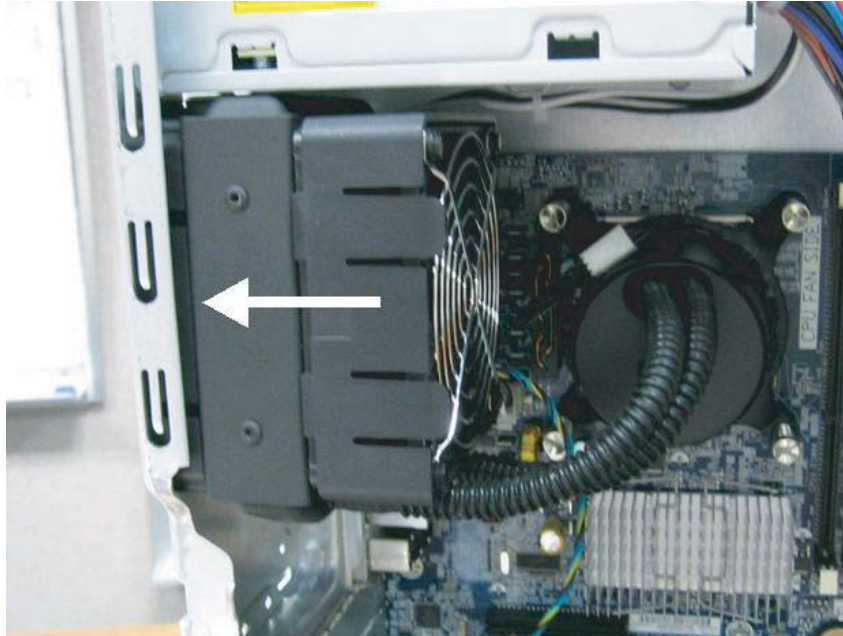
b. Fasten the LCS radiator assembly to the chassis as shown in the following figure.

Figure 5-63 Fastening the LCS radiator assembly
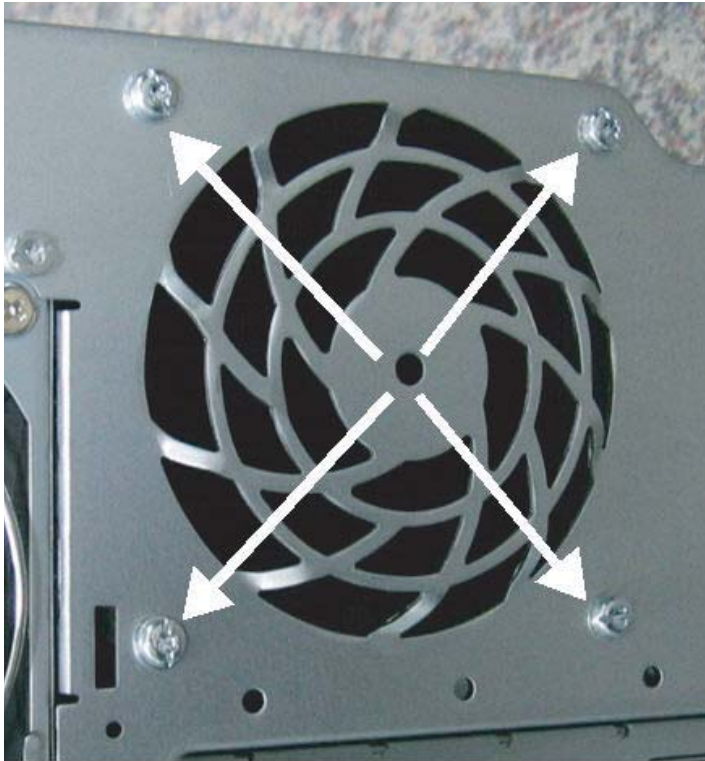
11. Connect the rear system fan cable to the system board as shown in the following figure.

Figure 5-64 Connecting the rear system fan cable
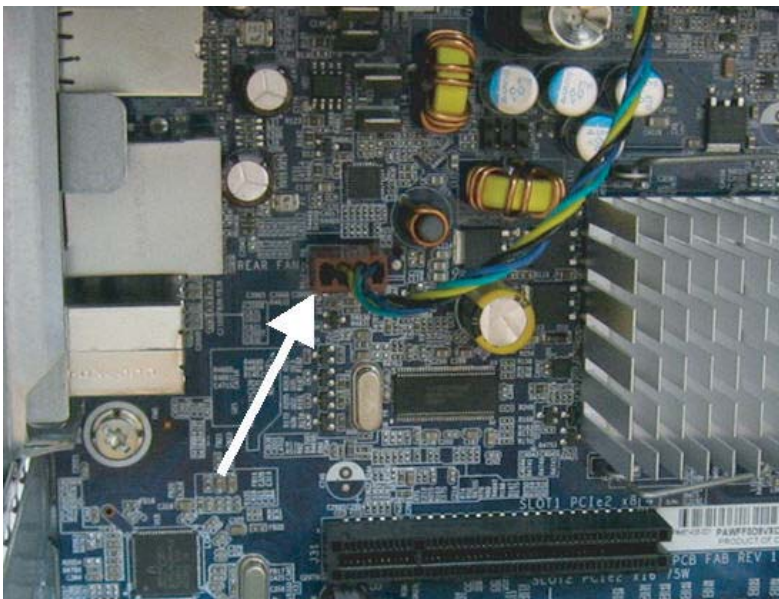
12. Install the LCS VR fan in the chassis.

    a. Place the LCS VR fan in the chassis so that the fan bracket holes align with the holes in the chassis as shown in the following figure.

       Figure 5-65 Aligning the LCS VR fan bracket
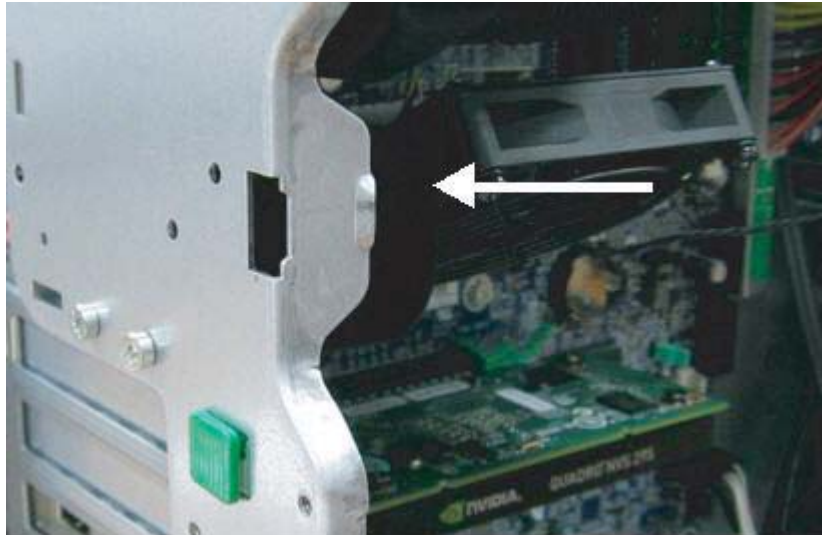
    b. Fasten the LCS VR fan assembly to the chassis as shown in the following figure.

       Figure 5-66 Fastening the LCS VR fan

c. Connect the LCS VR fan cable to the system board as shown in the following figure.

Figure 5-67 Connecting the LCS VR fan cable
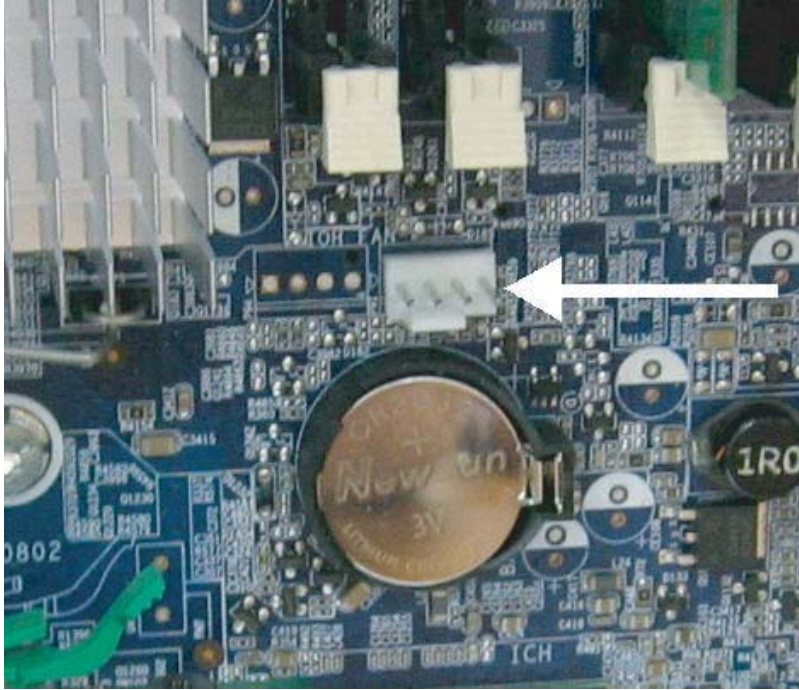
13. Reinstall all removed components and reconnect any cables that have been disconnected.

CPU heatsink

This section describes how to remove and install a CPU heatsink.

Removing the CPU heatsink

To remove a heatsink:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Slowly and evenly loosen one pair of diagonally opposite screws ❶ from the CPU until the screw shanks disengage from the system board, and then loosen the remaining pair ❷ as shown below.

△ **CAUTION:** Do *not* fully loosen one screw, and then move on to the next. Instead, loosen all screws a little at a time, ensuring that the CPU heatsink remains level.

Figure 5-68 Loosening heatsink screws in sequence
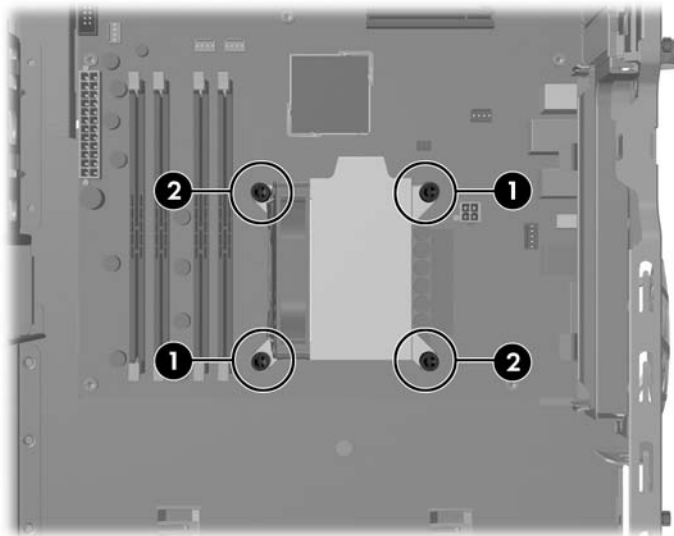
6. Disconnect the CPU heatsink fan cable from the system board ❶ as shown in the following figure.

Figure 5-69 Disconnecting the heatsink fan cable
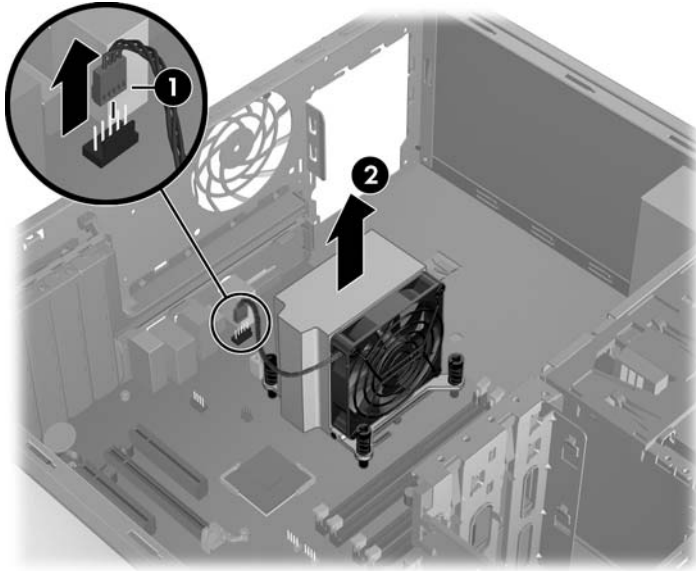
7. Before lifting the heatsink, gently twist the heatsink to break the thermal compound between the CPU and the heatsink.

8. Lift the CPU heatsink out of the chassis ❷.

9. Use alcohol and a soft cloth to clean the thermal interface residue from the CPU and the heatsink, allowing the alcohol on the CPU and CPU heatsink to dry completely.

Installing the CPU heatsink

To install a heatsink:

1. Disconnect power from the system (Predisassembly procedures on page 69).

2. Remove the side access panel (see Removing the side access panel on page 72).

3. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

4. Remove the CPU heatsink (see Removing the CPU heatsink on page 127).

5. Perform one of the following tasks:

● If you are reusing the original heatsink, apply thermal compound to the center of the CPU top surface.

● If you are using a new CPU heatsink, do not apply thermal compound to the CPU because the new heatsink already has thermal compound applied to the heatsink surface. Instead, remove the thermal compound protective liner from the bottom of the new heatsink.

6. Align the four mounting screws with the mounting holes in the system board and carefully place the heatsink on the CPU.

Ensure that the heatsink is placed properly with the fan positioned toward the front, facing the memory DIMMs.

△ **CAUTION:** Do not overtighten the heatsink screws. If you overtighten them, you might strip the threads in the system board tray.

Do *not* fully tighten one screw and then move on to the next. Instead, tighten all screws a little at a time, ensuring that the CPU remains level.

7. Tighten all screws partially so the CPU heatsink remains level.

8. Tighten each set of diagonally opposed screws a little at a time to 6 in.-lbs. of torque.

9. Connect the CPU heatsink fan connector to the system board.

Figure 5-70 Connecting the heatsink fan cable
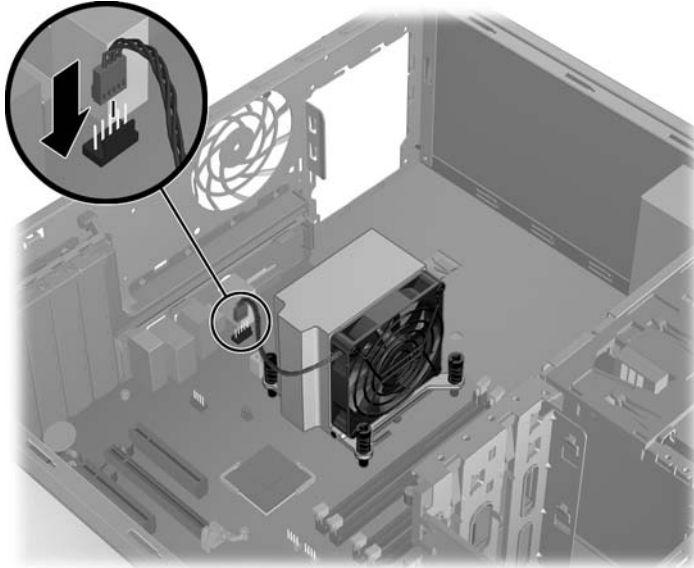
CPU

This section describes how to remove and install a CPU.

Removing a CPU

To remove a CPU:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Remove the CPU heatsink (see Removing the CPU heatsink on page 127).

6. Raise the CPU socket lever ❶ and open the cover ❷ as shown in the following figure.

   Figure 5-71 Removing a CPU
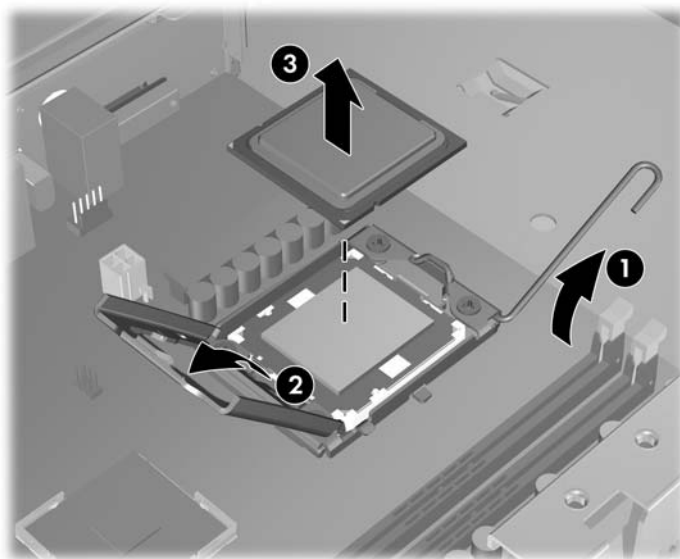
   △ **CAUTION:** Do not touch the CPU socket contacts or the gold pads underneath the CPU. Use extreme care and handle the CPU only by the edges.

7. Pull the CPU straight out of the socket ❸, and store the CPU in a static free container in a safe place where it cannot be damaged

Installing a CPU

NOTE: HP recommends that you do not swap processors (CPUs) from one system board to another.

To install a CPU:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Remove the CPU heatsink (see Removing the CPU heatsink on page 127).

6. Remove the CPU (see Removing a CPU on page 130).

7. Using extreme care, fully raise the CPU socket lever and cover.

CAUTION: The CPU socket contacts are delicate. To avoid bending the contacts, use extreme care when installing the CPU in the socket.

8. Align the notches in the CPU base with the tabs on the socket as shown in the figure below.

   Seat the CPU into the socket. Ensure that the underside of the CPU is level with the top of the CPU socket.

   Figure 5-72 Seating the CPU
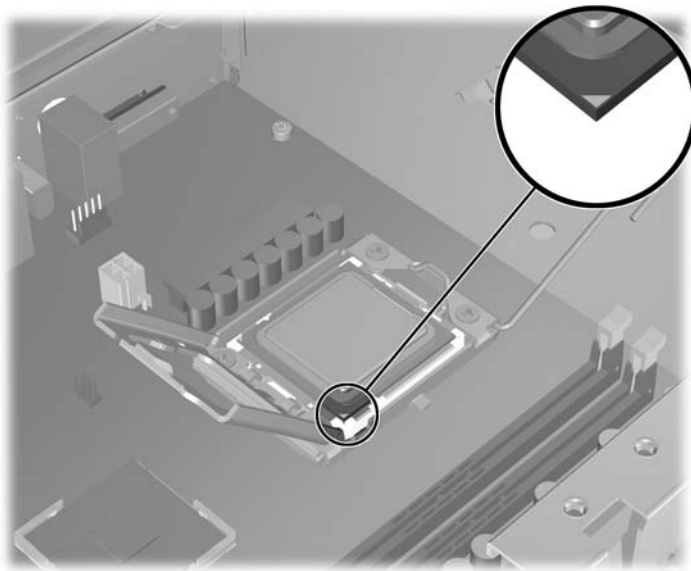
9. Close the CPU cover plate by lightly pressing down on the CPU cover plate while closing the socket lever.

10. Replace the CPU heatsink (see Installing the CPU heatsink on page 128).

System board

This section describes replacing the system board.

Removing the system board

To remove the system board:

1. Power down the workstation (see Predisassembly procedures on page 69).

2. Disconnect power from the workstation (see Predisassembly procedures on page 69).

3. Remove the side access panel (see Removing the side access panel on page 72).

4. If your system has an airflow guide, remove it (see Removing the airflow guide on page 92).

5. Remove expansion boards and graphics cards (see Removing an expansion card on page 104).

6. (Optional) Remove the CPU heatsink (see Removing the CPU heatsink on page 127).

7. Disconnect all cabling from the system board.

   ☼ **TIP:** Make a note of the cable connections before disconnecting them from the system board. For more information, refer to Power connectionson page 90.

8. Gently squeeze the release mechanism ❶ as shown in the following figure.

   Figure 5-73 Removing the system board
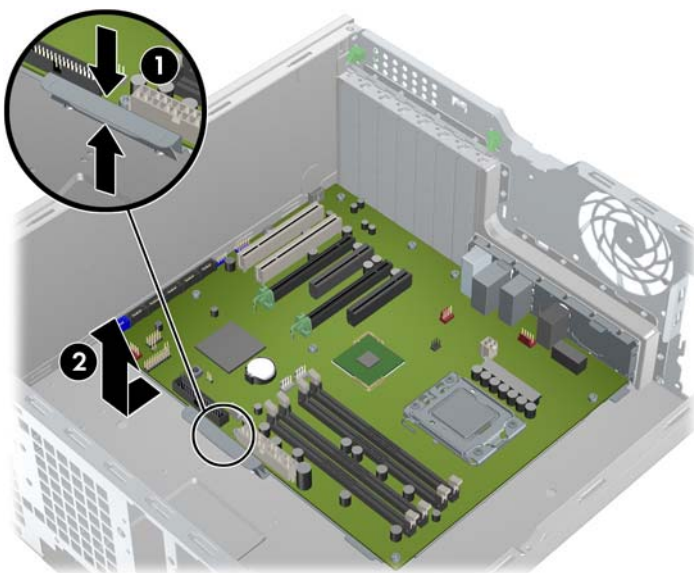
9. Lift the system board slightly to clear the release mechanism and then pull the board away from the rear of the chassis and then lift the system board upward ❷ out of the chassis.

   ☼ **TIP:** If you leave the heatsink installed, you can grasp it and use it to guide the system board out of the chassis.

Installing the system board

To install the system board:

1. Insert the system board with the rear chassis side of the board tilted slightly downward.

2. Push back on the board while maintaining downward pressure on the board to clear the release mechanism. The latch should click into place.

3. Reinstall all removed components and cables. (Refer to Power connections on page 90 to identify power cables.)

Converting to desktop configuration

This workstation can be operated in the mini-tower or the desktop configuration. Follow these steps to convert to desktop configuration operation:

1. With power removed from the workstation, remove the side access panel (see Removing the side access panel on page 72).

2. Remove the front bezel from the workstation (see Removing the front bezel on page 75).

3. Press gently on the edges of the optical drive bay filler panel, and remove it from the front bezel as shown in the following figure.

Figure 5-74 Removing the ODD bay filler panel
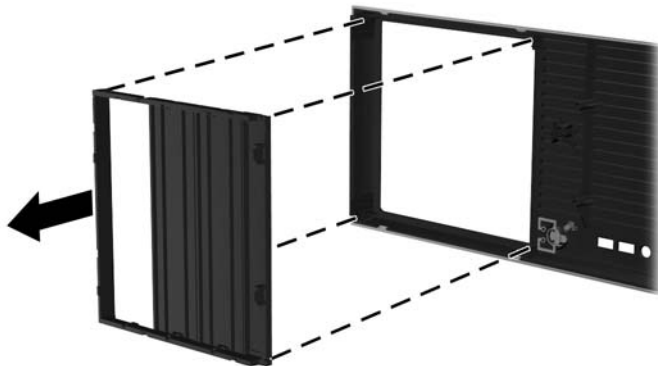
4. Rotate the filler panel 90 degrees to a horizontal position.

5. Align the slots in the filler panel frame with the tabs in the front bezel. Press the optical drive filler panel back into the front bezel until it snaps into place as shown in the following figure.

Figure 5-75 Installing the ODD bay filler panel
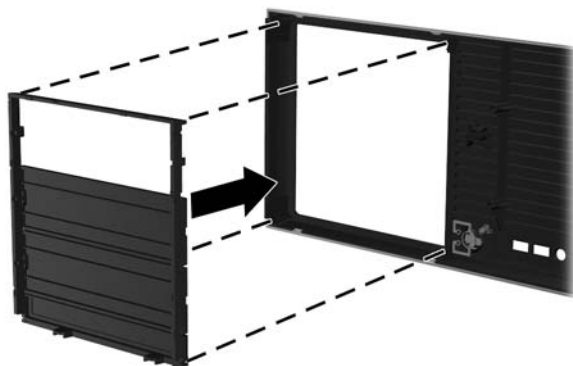
6. On the back of the front bezel, squeeze the HP logo mounting tabs ❶ and press the logo outward ❷ as shown in the following figure.

Figure 5-76 Rotating the HP logo
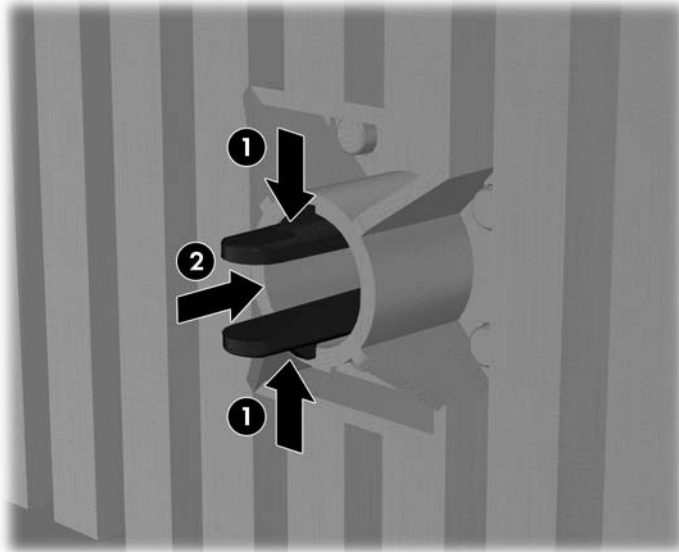
Rotate the HP logo 90 degrees counterclockwise, and then release the logo and press it back into place in the front bezel.

7. Remove the EMI filler panels and remove the optical disk drive from the chassis (see Removing an optical disk drive from the optical bay (mini-tower configuration) on page 80.

8. Rotate the EMI filler panels and the optical drive 90 degrees as shown in the figure below, and then reinstall them (see Installing an optical drive (desktop configuration) on page 86.

Figure 5-77 Reinstalling the optical drive

9. Replace the front bezel (see Installing the front bezel on page 75) and the side access panel (see Installing the side access panel on page 72) when finished.

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, see http://www.hp.com/go/recycle.

6 Diagnostics and troubleshooting

This chapter describes the tools available for diagnosing and troubleshooting system issues, and includes these topics:

Calling technical support

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

- Have the workstation readily accessible.

- Write down the workstation 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 workstation.

- Note the applications you were using when you encountered the problem.

- Note the power supply BIST status, if applicable.

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

NOTE: On most models, the serial number and product number labels can be found on the top panel or side of the workstation and at the rear of the workstation.

For a listing of all worldwide technical support phone numbers, visit http://www.hp.com/support, select your region, and click **Contact HP** in the upper-left corner.

Locating ID labels

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

Each HP Workstation has two unique serial number labels ❶ and a Certificate of Authentication (COA) label ❷ as shown in the figure below.

Figure 6-1 Workstation label locations

In general, the serial number labels can be found on the top panel or on the side of the workstation and at the rear of the workstation (your workstation may look different). Keep this number available when contacting customer service for assistance.

A product number is generally located next to the serial number.

The COA is used for Windows-preinstalled systems only and is generally located on the top panel or side of the workstation near the serial number label. On some workstations, it is located on the bottom of the workstation.

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.

Diagnosis guidelines

If you encounter a problem with the workstation, monitor, or software, the following sections 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 workstation and monitor are plugged into a working electrical outlet.

- Remove all diskettes, CDs, or USB drive keys from your system before turning it on.

- Verify that the workstation is turned on and the green 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 by visiting http://www.hp.com/go/quickspecs.

- Verify that the monitor is turned on and the green monitor light is on. Note that not all monitors are equipped with LED lights to indicate their functionality.

- 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 primary display 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).

Diagnosis during operation

- Look for blinking LEDs on the front of the workstation. The blinking lights are error codes that will help you diagnose the problem. Refer to the Diagnostic LED and audible (beep) codes on page 165 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.

- 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 screen is blank, plug the monitor into a different video port on the workstation if one is available. Alternatively, replace the monitor with a monitor that you know is working properly.

- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.

- For more detailed information, see the troubleshooting chapter in the *Maintenance and Service Guide* at http://www.hp.com/support/workstation_manuals.

Troubleshooting checklist

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

- Is the workstation and monitor connected to a working electrical outlet?
- Is the workstation powered on?
- Is the green power light illuminated?
- Is the monitor on?
- Is the green monitor light illuminated?
- If the monitor is dim, adjust the monitor brightness and contrast controls.
- Press and hold any key. If the system beeps, the keyboard is operating correctly.
- Check cables for loose or improper connections.
- After installing a non-plug and play (PnP) expansion board or other option (such as a diskette drive), reconfigure the workstation.
- Are all necessary device drivers installed?
- Have all printer drivers been installed for each application?
- Have you removed diskettes, optical disks, and USB drive keys from the drives before powering on the workstation?
- Are you running the latest version of BIOS, drivers, and software?

HP troubleshooting resources and tools

This section provides information on the HP Help and Support Center, E-support, and Helpful Hints for troubleshooting.

HP Support Assistant

The HP Support Assistant is a customized HP user interface that enhances the Windows Vista and Win 7 Help and Support Center functions. This customized utility allows you to access specific information about an HP Workstation such as configuration information by clicking **Start** > **Help and Support.** The interface also provides customized help and support links to the HP Web site related to the HP Workstation.

NOTE: The customized HP Support Assistant is not available on Windows XP Professional x32 or x64 Editions, or on Linux.

HP Help and Support Center

The HP Help and Support Center is a customized HP user interface that enhances the Windows XP Help and Support Center Help feature. This customized utility allows you to access specific information about your HP Workstation such as configuration information by clicking **Start** > **Help and Support.** The interface also provides customized help and support links to the HP Web site related to your HP Workstation.

NOTE: The customized HP Help and Support Center is not available on Windows XP Professional x64 Edition or on Linux.

NOTE: Currently, HP Help and Support Center does not work on Windows Vista.

E-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 Web sites 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 Web site, 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.

Troubleshooting a problem

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

1. Visit http://www.hp.com/go/workstationsupport.

2. Under the **Business Support Center** menu on the left, select **Troubleshoot a problem**.

3. Under **Select your product** (center window), select **Workstations** (under **personal computing**).

4. Under **Select your product**, continue with selections as appropriate to the workstation series and model, and to the problem you are troubleshooting.

Instant Support and Active Chat

HP Instant Support is a set of Web-based support tools that automate and speed up the resolution of desktop computing, tape storage, and printing problems.

Active Chat enables you to electronically submit a support ticket to HP over the Web. When you submit a support ticket, Active Chat collects information about the computer and pass it to an online support specialist. The collection of information might take up to 30 seconds depending on the computer configuration. When you submit a support ticket, you receive a confirmation message containing your case ID, the support hours for your location, and the estimated time of response.

For more information about HP Instant Support and Active Chat and how to use them, visit http://www.hp.com/hps/hardware/hw_professional.html.

📝 **NOTE:** This feature is not available on Windows XP Professional x64 Edition or on Linux.

Customer Advisories, Customer and Security Bulletins, and Customer Notices

To find advisories, bulletins, and notices:

1. Visit http://www.hp.com/go/workstationsupport.

2. Select the desired product.

3. Under **Resources for <your selected product>**, select **See more…**.

4. Under **Self-Help resources:** in the center of the window, choose the desired action and appropriate information in the scroll list to view the index.

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 provides a list of general suggestions that 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 diskettes, optical disks, and USB drive keys from the drives before powering on the workstation.

- Verify that the workstation is turned on and the green 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 by visiting http://www.hp.com/go/quickspecs.

- Verify that the monitor is turned on and the green monitor 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).

During operation

- Look for blinking LEDs on the front of 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 screen is blank, plug the monitor into a different video port on the workstation if one is available. Alternatively, replace the monitor with a monitor that you know is working properly.

- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.

- For more detailed information, see the troubleshooting chapter in the *Maintenance and Troubleshooting Guide* at http://www.hp.com/support/workstation_manuals.

Customizing the monitor display

You can manually select or change the monitor model, refresh rates, screen resolution, color settings, font sizes, and power management settings. To do so, right-click the desktop, then click **Properties** to change display settings. For more information, see the online documentation provided with the graphics controller utility or the documentation that came with your monitor.

Troubleshooting scenarios and solutions

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

NOTE: For Linux troubleshooting information, refer to the *HP Workstations for Linux User Manual* at http://www.hp.com/support/linux_user_manual.

Solving minor problems

Table 6-1 **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 workstation shuts down. 2. Disconnect the electrical plug from the outlet. 3. Restart the workstation.
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 workstation 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 the Computer Setup (F10) Utility or the Microsoft 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 the Computer Setup (F10) Utility.
Poor performance is experienced.	Processor is hot.	1. Verify that airflow to the workstation 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.

Table 6-1 Minor problems (continued)

Problem	Cause	Possible Solution
Workstation powered off automatically and the Power LED flashes red 2 times (once every second), followed by a 2-second pause, and then two simultaneous beeps sounded.	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 workstation air vents are not blocked. 2. Open the access panel and press the workstation 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 power on, and the LEDs on the front of the workstation are not flashing.	System cannot power on.	Press and hold the power button for less than four seconds. If the hard drive LED turns green, then perform the following procedures:
		
		1. To find a faulty device, remove all devices one at a time:
		  a. Disconnect AC power to the workstation.
		  b. Remove a device.
		  c. Reconnect AC power and power on the workstation.
		
		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 illuminate, then perform the following tasks:
		  a. Verify that the workstation 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 functionality:
		  a. Disconnect the AC power.
		  b. Remove the internal power supply cables from the system board. (You do not need to remove the power supply from the chassis.)
		  c. Reconnect the AC power.
		    ● If the power supply fan spins and the BIST LED illuminates (see Testing power supply on page 148), the power supply is good. Replace the system board.
		    ● If the power supply fan does not spin or the LED does not illuminate (see Testing power supply on page 148), replace the power supply.

Solving power supply problems

This section presents power supply troubleshooting scenarios.

Testing power supply

Before replacing the power supply, use the Built-In Self-Test (BIST) feature to learn if the power supply still works.

To test the power supply:

1. Disconnect the AC power.

2. Remove the internal power supply cables from the system board. (You do not need to remove the power supply from the chassis.)

3. If necessary, disconnect the PCIe power cable from the graphics card.

4. Plug in AC power and verify the following:

    ●   If the green BIST LED on the rear of the workstation is illuminated *and* the fan is spinning, the power supply is functional.

    ●   If the green BIST LED is not illuminated *or* the fan is not spinning, replace the power supply.

See the *Rear panel components* section of this service guide to locate the BIST LED on this workstation.

Table 6-2 **Power supply problems**

Problem	Cause	Solution
Power supply shuts down intermittently.	Power supply fault.	Replace the power supply.
Workstation powers off and the Power LED flashes red 2 times (once every second), followed by a 2-second pause.	Processor thermal protection is activated. A fan might be blocked or not turning. OR The processor heatsink fan assembly is not properly attached to the processor.	1. Ensure that the workstation air vents are not blocked. 2. Open the access panel and press the workstation power button. 3. Verify that the system fan is running. 4. Verify that the processor heatsink fan spins. If the heatsink fan is not spinning, verify that the fan cable is plugged into the system board connector. Verify that the fan is properly seated. 5. Replace the processor heatsink.

Power LED flashes red (once every 2 seconds).	Power failure (power supply is overloaded).	1. Determine whether a device is causing the problem by performing the following:
		
		  a. Disconnect AC power.
		  b. Remove all attached devices.
		  c. If necessary, disconnect the PCIe power cable from the graphics card.
		  d. Power on the workstation.
		
		If the system enters the POST, perform the following:
		
		  a. Power off the workstation.
		  b. Replace one device at a time and repeat this procedure until a failure occurs.

Table 6-2 Power supply problems (continued)

Problem	Cause	Solution
		c. Replace the device causing the failure
		d. Continue adding devices one at a time to verify that all devices are functioning.
		2. Verify power supply functionality.
		a. Disconnect AC power.
		b. Remove the internal power supply cables from the system board. (You do not need to remove the power supply from the chassis.)
		c. If necessary, disconnect the PCIe power cable from the graphics card.
		d. Plug in AC power.
		• If the power supply fan spins and the LED illuminates (see Testing power supply on page 148), the power supply is good. Replace the system board.
		• If the power supply fan does not spin or the LED does not illuminate (see Testing power supply on page 148), replace the power supply.

Solving diskette problems

Table 6-3 Diskette problems

Problem	Cause	Solution
Diskette drive light stays on.	Diskette is damaged.	1. Right-click **Start**, select **Explore**, and then select a drive. 2. Select **File>Properties>Tools**. 3. Under Error-checking, select **Check Now.**
	Diskette is incorrectly inserted.	Remove and reinsert diskette.
	Files on the diskette are damaged.	Verify the program diskettes.
	Drive cable is not properly connected.	Reconnect the power cable and verify that all four pins are connected.
Drive not found.	Cable is loose.	Reseat the diskette drive data and power cables.
	Removable drive is not seated properly.	Reseat the drive.

Table 6-3 Diskette problems (continued)

Problem	Cause	Solution
Diskette drive cannot write to a diskette.	Diskette is not formatted.	Format the diskette.
	Diskette is write-protected.	Use another diskette or remove the write protection.
	Writing to the wrong drive.	Verify the drive letter in the path statement.
	There is not enough space on the diskette.	Use another diskette.
	Diskette write-control is enabled.	Use the Computer Setup (F10) Utility to verify the storage security feature disabled settings.
	Diskette is damaged.	Replace the damaged disk.
Cannot format diskette.	Invalid media reported.	When formatting a disk in MS-DOS, you might need to specify diskette capacity.
		For example, to format a 1.44-MB diskette, enter the following command at the MS-DOS prompt: **FORMAT A: /F:1440**
A problem has occurred with a disk transaction.	The directory structure is bad, or there is a problem with a file.	1. Right-click **Start**, select **Explore**, and then select a drive.
		2. Select **File>Properties>Tools**.
		3. Under Error-checking, select **Check Now**.
Diskette drive cannot read a diskette.	Diskette is not formatted.	Format the diskette.
	You are using the wrong diskette type for the drive type.	Verify the type of drive that you are using and use the correct diskette type.
	You are reading the wrong drive.	Verify the drive letter in the path statement.
	Diskette is damaged.	Replace the diskette with a new one.
Invalid system disk is displayed.	A diskette that does not contain the system files needed to start the workstation has been inserted into the drive.	When drive activity stops, remove the diskette and press the Spacebar. The workstation attempts to boot from the next device in the boot order.
	Diskette error has occurred.	Restart the workstation by pressing the power button.
Cannot boot to diskette	Diskette is not bootable.	Replace with a bootable diskette.
	Diskette boot has been disabled in Computer Setup.	Run the Computer Setup (F10) Utility and enable diskette boot in **Storage>Boot Order**.
	Removable media boot has been disabled in Computer Setup.	Run the Computer Setup (F10) Utility and enable Removable Media Boot in **Storage>Storage Options**.
	Diskette MBR validation is enabled.	Run the Computer Setup (F10) Utility and disable Diskette MBR Validation in **Storage>Storage Options**.

Solving hard drive problems

Table 6-4 Hard drive problems

Problem	Cause	Solution
Hard drive error occurs.	Hard disk has bad sectors or has failed.	Locate and block the usage of bad sectors. If necessary, reformat the hard disk. If the drive is detected by the BIOS, run DPS Self-test.
Disk transaction problem.	The directory structure is bad, or there is a problem with a file.	1. Right-click **Start**, select **Explore**, and select a drive. 2. Select **File>Properties>Tools**. 3. Under Error-checking, select **Check Now**.
Drive not found (identified).	Improper cable connection	On workstations with discreet data and power cables, ensure 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, check for connector damage on the drive and in the chassis. Reseat the hard drive and its carrier in the chassis to ensure a proper connection. (See the *Hard drive* section of this guide for connection details.)
	The system might not have automatically recognized a newly installed device.	1. Run the Computer Setup (F10) Utility. 2. If the system does not recognize the new device, verify that the device is listed in the Computer Setup (F10) Utility. If it is listed, the probable cause is a driver problem. If it is not listed, the probable cause is a hardware problem. 3. If this drive is newly installed, enter **Setup** and try adding a POST delay under Advanced>Power-On.
	Drive responds slowly immediately after power-up.	Run the Computer Setup (F10) utility, and increase the POST Delay in Advanced>Power-On Options.
Nonsystem disk or NTLDR missing message.	System is trying to start from a nonbootable diskette.	Remove the diskette from the drive.
	System is trying to start from a damaged hard drive.	1. Insert a bootable diskette into the drive and restart the workstation. 2. If the hard drive is still inaccessible and MBR Security is enabled, try restoring the previously saved MBR image by entering Setup and selecting **Security>Restore Master Boot Record**.
	System files missing or not properly installed.	1. Insert a bootable system diskette and restart. 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.
Workstation will not start.	Hard drive is damaged.	Replace the hard drive.

Solving display problems

Table 6-5 Display problems

Problem	Cause	Solution
Blank screen (no video).	The cable connections are not correct.	Verify the cable connections from the monitor to the workstation and to a working electrical 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.
	Fixed-sync monitor does not sync at the resolution specified.	Verify that the monitor can accept the same horizontal scan rate as the resolution specified.
	Computer is in Hibernate mode.	Press the power button to resume from Hibernate mode.
	Workstation monitor settings are not compatible with the monitor.	1. When you see **Press F8** in the bottom-right corner of the screen, restart the workstation and press F8 during startup. 2. Using the keyboard arrow keys, select **Enable VGA Mode** and then press Enter. 3. For Windows, double-click the **Display** icon in the Control Panel and then select the **Settings** tab. 4. Use the sliding control to reset the resolution.
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 workstation in VGA mode. 2. After the operating system starts, change the display settings to match those supported by your graphics card and monitor. 3. Refer to your operating system and graphics card documentation for information about changing display settings.
Power LED flashes red 6 times (once every second), followed by a 2–second pause, and then the workstation beeps 6 times.	Prevideo graphics error.	For systems with a graphics card: 1. Reseat the graphics card. 2. Replace the graphics card. 3. Replace the system board.
Monitor does not function when used with Energy Saver features.	Monitor without Energy Saver capabilities is being used with Energy Saver features enabled.	Disable the monitor Energy Saver feature.
Dim characters	The brightness and contrast controls are not set properly.	Adjust the monitor brightness and contrast controls.
	Cables are not properly connected.	Verify that the graphics cable is connected to the graphics card and the monitor.

Table 6-5 Display problems (continued)

Problem	Cause	Solution
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 requested resolution.
The picture is broken up, rolls, jitters, or flashes.	The monitor connections might be faulty, or the monitor might be incorrectly adjusted.	1. Be sure the monitor cable is securely connected to the workstation. 2. In a multiple CRT monitor system, ensure that the monitors' electromagnetic fields are not interfering with each other . Move them apart if necessary. 3. Move fluorescent lights or fans that are too close to the CRT monitor.
	Monitor must be degaussed.	Degauss the monitor.
Vibrating or rattling noise coming from inside a CRT monitor when powered on.	Monitor degaussing coil has been activated.	None. It is normal for the degaussing coil to be activated when the monitor is powered on.
Clicking noise coming from inside a CRT monitor.	Electronic relays have been activated inside the monitor.	None. It is normal for some monitors to make a clicking noise when turned on and off, when going in and out of Standby mode, and when changing resolutions.
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; or 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. 3. Download SoftPaq SP22333 to assist with the synchronization).
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.

Solving audio problems

Table 6-6 Audio problems

Problem	Cause	Solution
Sound does not come out of the speaker or headphones.	Software volume control is turned down.	Double-click the **Speaker** icon on the taskbar and use the volume slider to adjust the volume.
	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 **System.** 2. On the Hardware tab, select the **Device Manager** button. 3. Right-click the **CD/DVD** device and select **Properties**. 4. On the Properties tab, select **Enable digital CD audio for this CD-ROM device**.
	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.	1. From the Control Panel, select **Sound, Speech and Audio Devices**, and then select **Sounds and Audio Devices**. 2. Deselect the **Mute** checkbox.
	Computer is in Standby mode.	Press the power button to resume from Standby mode.
Noise or no sound comes out of the speakers or headphones.		1. If you are using digital speakers that have a stereo jack and you want the system to autoswitch to digital, use a stereo-to-mono adapter to engage the auto sense feature, or use multimedia device properties to switch the audio signal from analog to digital. 2. If the headphones have a mono jack, use the multimedia device properties to switch the system to analog out. **NOTE:** If you set digital as the Output Mode, the internal speaker and external analog speakers no longer output audio until you switch back to an auto sense or analog mode. If you set analog as the Output Mode, external digital speakers do not function until you change the output mode back to an auto-sense or digital mode.
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 disk might be full.	1. Before recording, be sure there is enough free space on the hard disk. 2. Try recording the audio file in a compressed format.

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.	

Self-troubleshooting with HP Vision Diagnostics

Hewlett-Packard Vision Field Diagnostics let you view information about the hardware configuration and perform hardware troubleshooting for HP Desktop and Workstation systems. These tools let you isolate potential issues and determine if problems relate to the operating system or the hardware. These diagnostics run outside the operating system by DVD, CD, or USB flash drive, making them easy to access and use.

HP Vision Diagnostics offer these benefits:

- Ability to capture complete system configuration information that can be shared as an HTML file, including:
  - System serial number
  - System product number
  - System BIOS revision
  - Memory size and configuration
  - Processor information
  - Storage device information and configuration
  - Graphics / audio / communications information and configuration
  - And more...
- Comprehensive list of diagnostic test available with new added features:
  - Highly configurable testing options: quick / complete / custom / interactive / non-interactive
  - Specific failing memory DIMM identification
  - Tests video card memory

- ◦ Launches DST Smart tests for both SATA and SAS drives
- ◦ Many other tests and diagnostics
- Diagnostic Failure Code Output – A unique warranty code is generated for each failure which can be used to validate diagnostic use for a specific system
- Easy to use - uses similar user interface as previous field diagnostics, HP Insight Diagnostics
- True End2End diagnostics – same diagnostics modules used in factory
- Easy to obtain:
  - ◦ Download from Web
  - ◦ Bootable via USB flash drive, DVD, or CD
  - ◦ Included with restore media

Please run Vision diagnostics on supported products when attempting to troubleshoot system issues.

Overview

The HP Vision Diagnostics utility lets you view information about the hardware configuration of the workstation and perform hardware diagnostic tests on subsystems. The utility simplifies the process of effectively identifying, diagnosing, and isolating hardware issues.

Invoke HP Vision Diagnostics to display the Survey tab. This tab shows the current configuration of the workstation. From the Survey tab, you can access several categories of information about the workstation. Other tabs provide additional information, including diagnostic test options and test results.

Use HP Vision Diagnostics to determine if the system recognizes all the devices installed on the workstation and if the devices function properly. HP recommends that you run these tests after you install or connect new devices.

You can save the information from each diagnostic screen to an HTML file. You should run tests, save the test results, and print them so that you have a report available before placing a call to the Customer Support Center.

NOTE: HP Vision Diagnostics may not detect third-party devices..

Downloading and accessing HP Vision Diagnostics

Follow these steps to download the HP Vision Diagnostics utility from the HP Web site to a CD, DVD, or USB flash drive. Then use the disk or drive to perform diagnostics on the workstation:

1. Go to http://www.hp.com.

2. Select the **Support & Drivers** link.

3. Select the **Download driver and software** radio button.

4. Enter your product number in the text box, and then press Enter.

5. Select your operating system.

6. Select the **Diagnostic** link.

7. Locate **HP Vision Diagnostics** and select **Download.**

8. After the *.iso* file is downloaded, save the file to a USB flash drive (recommended for faster performance) or use CD-ROM burning software to copy the *.iso* file to an optical medium.

9. Insert the disk or USB drive into the workstation while it is turned on.

10. Shut down the workstation.

11. Turn on the workstation. The system boots into HP Vision Diagnostics.

   NOTE: If the system does not boot to the CD in the optical drive or the USB flash drive, you may need to change the boot order. You may use the Computer Setup (F10) utility to change the boot order, or press F9 to select the appropriate boot device.

12. At the boot menu, select either the **HP Vision Diagnostics** utility to test the various hardware components in the computer or the **HP Memory Test** utility to test memory only.

   NOTE: The HP Memory Test, a comprehensive memory diagnostic utility, runs as a stand-alone application, outside of HP Vision Diagnostics.

   If the workstation boots from a CD, you must use a separate boot CD to run the memory diagnostic. Hence, HP recommends that you use a USB key to boot the diagnostic utilities. It is faster than using a CD or DVD, and it accommodates both Memory and Vision diagnostics.

13. If you run HP Vision Diagnostics, select the appropriate language and click **Continue**.

14. In the End User License Agreement page, select **Agree** if you agree with the terms. The HP Vision Diagnostics utility launches and displays the Survey tab.

Accessing HP Vision Diagnostics on the workstation

The following procedures describe how to access the HP Vision Diagnostics utilities included in the workstation software.

Creating and using a bootable USB key

This section describes how to use a USB key to access the HP Vision Diagnostics.

NOTE: Using a USB key is the most convenient method to access the HP Vision Diagnostics.

1. In the C:\VisionDiagnostics\ directory, double-click on VisionDiagUSB.exe. A setup menu appears.

2. Follow the setup prompts to create a bootable ISO image of the diagnostic utilities on a USB key.

3. Use the operating system to turn off the workstation.

4. Restart the workstation with the USB key installed. The workstation boots to the USB key and initiates HP Vision Diagnostics.

5. Follow the prompts to troubleshoot the workstation.

Creating and using a bootable DVD

This section describes how to use a DVD to access the HP Vision Diagnostics.

1. In the C:\VisionDiagnostics\ directory, double-click on the VisionDiagISO.exe file. A setup menu appears.

2. Follow the setup prompts to create a bootable ISO image of the diagnostic utilities on a DVD.

3. Enable a workstation boot from DVD.

4. Use the operating system to turn off the workstation.

5. Restart the workstation with the with the DVD installed in the optical drive. The workstation boots to the DVD and initiates HP Vision Diagnostics.

6. Follow the HP Vision Field Diagnostic prompts to troubleshoot the workstation.

Using the HP Memory Test utility

This section describes how to access the HP Memory Test utility.

NOTE: The HP Memory Test is a comprehensive memory diagnostic utility that is run as a stand-alone application, outside of HP Vision Diagnostics.

If the workstation is booted from a CD, a separate boot CD will be required to use the memory diagnostic. Hence, HP recommends that a USB key be used to boot the diagnostic utilities. It is faster than using a CD, and it accommodates both Memory and Vision diagnostics.

1. In the C:\VisionDiagnostics\ directory, double-click on the MemoryDiagISO.exe file. A setup menu appears.

2. Follow the setup prompts to create a bootable ISO image of the memory diagnostic utility on a DVD.

3. Use the operating system to turn off the workstation.

4. Restart the workstation with the with the DVD installed in the optical drive. The workstation boots to the DVD and initiates the memory diagnostic utility.

5. Follow the diagnostic prompts to troubleshoot workstation memory.

User interface

The HP Vision Diagnostics application provides six major functions, accessible through Tabs. These functions are:

- **Survey** — Your current system hardware information.
- **Test** — List all diagnostics available for your system. Tests are started there.
- **Status** — This screen shows progress and status of currently running diagnostics.
- **History** — All past diagnostics runs and status are listed there.
- **Errors** — All past diagnostics failures are listed there.
- **Help** — User help about HP Vision Diagnostics.

There are also some common operations that are part of the utility. They include:

- **Exit Diagnostics** button — This button will close HP Vision Diagnostic application and reboot your system. Any running test will be aborted.
- **Reload** button — If available, this button will rescan your system hardware and reload the diagnostics without the need to restart your entire system.
- **Save** button — If available, save your system survey, test history or error data as an HTML file to a floppy disk or a USB key drive.

Survey tab

The Survey tab shows your system hardware information, organized into eleven Categories (for example "Processors") and device instances (for example "Processor 1").

The amount of information displayed can be controlled by selecting a combination of View Level and Category.

The **View Levels** include:

- **Overview** — shows high level summary of the system hardware. This is the default view level.
- **Summary** — gives limited configuration data for each specific Category.
- **Advanced** — offers more technical and low-level data for the computer-savvy user.

The **Categories Levels** include:

- **All** — Shows all Categories.
- **Architecture** — Shows system architecture information such as high level PCI devices, low level SMBIOS, CMOS and PCI configuration space data.
- **Audio** — Shows all embedded and add-on audio devices.
- **Asset Control** — Shows asset control related information such as product name, serial number, asset tag, and universal unique ID information.
- **Communication** — Shows communication devices such as serial, parallel, USB, network, Firewire, modem, and Bluetooth ports and devices.
- **Graphics** — Shows all embedded and add-on video cards.
- **Input Devices** — Shows user input devices such as all connected mice and keyboards.
- **Memory** — Shows system memory information.

- **Miscellaneous** — List any devices or data that don't belong to any other Category.

- **Processors** - Shows system processors.

- **Storage** — Shows mass storage devices such as floppy drives, optical drives, SATA, SAS hard disk drives and controllers, as well as any RAID arrays.

- **System** — Shows information about system board devices such as fans and cables.

Test tab

The Test tab lists all available diagnostics. The lists have been tailored according to your system configuration. You can select or unselect different Test Modes:

- **Quick** — Performs quick-performance tests that cover your entire hardware. You cannot change test parameters.

- **Complete** — Performs all available tests but may take a long time to complete. You cannot change test parameters.

- **Custom** — Offers all available tests, and you can change test parameters to fit your specific needs. For advanced users only!

By default, the three test modes do not display prompts and require no interaction. Errors are displayed when testing is complete.

To add interactive tests,

To add interactive tests, click the **Include interactive tests** box under Test Mode. Interactive tests give you maximum control over the testing process. The diagnostic software prompts you for input during tests.

📝 **NOTE:** Memory can not be tested from within the HP Vision Diagnostics application. To test the memory in your workstation, exit HP Vision Field Diagnostic, boot to either the CD or USB flash drive and select **HP Memory Test** from the boot menu.

The **Duration of Test** options control the duration of the test sequence. The following options are available:

- **Number of loops** — A test selection will run once by default. Enter a positive number to make a test selection run many times.

- **Total test time (hours:minutes)** — Alternatively, the test selection can be set to run for a specified amount of time. This does not guarantee that all tests will run if the entered time is less than the necessary time to run all the tests

- **Stop at first error** — Check this option to stop test execution as soon as one error is encountered.

The following **Test Controls** exist:

- **Select All, Unselect All** button — This button toggles to select or unselect all the tests from the test selection tree.

- **Expand, Collapse** button — This button toggles to expand or collapse the test selection tree.

- **Start Test** button — Click this button to start executing all selected tests. HP Vision Diagnostics will automatically switch to the Status tab in order to keep track of the test execution and status.

⚠ **WARNING!** Once started, do not reboot or power off your computer until all the tests have been completed.

To begin testing:

1. Select the Test tab.

2. Select the type of tests you want to run: **Quick**, **Complete**, or **Custom**.

3. Include optional interactive tests by selecting **Include interactive tests**.

4. Choose how you want the test to be executed, either **Number of Loops** or **Total Test Time**. When choosing to run the test over a specified number of loops, enter the number of loops to perform. If you want the diagnostic test for a specified time period, enter the amount of time in minutes.

5. Click the **Start Test** button to begin the testing. This displays the Status tab, which lets you monitor the progress of the tests. When the tests finish, the Status tab shows whether the devices passed or failed.

6. If errors are found, go to the Errors tab to display detailed information and recommended actions.

Status tab

The Status tab shows the overall progress and status of the test scenario as well as the progress and status of each test. The color coded status are black, blue, green, red, and orange.

The Status tab colors are:

- **Waiting** (black) — when no test is running
- **Running** (blue) — when at least one test is currently running
- **Passed** (green) — when all tests have run successfully, meaning that no hardware error or defect has been detected
- **Failed** (red) — when thee tests have detected at least one error with your system
- **Canceled** (orange) — when the test scenario has been explicitly canceled, in which case no pass or fail conclusion can be drawn

The available data is:

- **Current Loop** — Shows the current execution loop out of total number of loops specified in the Test panel.
- **Test Time** — Shows the total time elapsed since the beginning of the test execution.
- **Test Complete** — Shows the number of tests successfully completed out of the total number of test to execute.
- **Cancel** button — Push the Cancel button to immediately terminate all currently running tests.

History tab

The History tab shows the history of the past test executions.

The History Log displays all tests that have been executed, the number of times of execution, the number of times failed, the date each test was executed, and the time it took to complete each test. The **Clear History** button will clear the contents of the History Log.

The contents of the History Log may be saved as a HTML file to either floppy or USB flash drive by clicking the **Save** button.

Errors tab

The Errors tab displays detailed information about any errors found, as well as any recommended actions.

The Error Log displays the tests for devices that have failed during the diagnostic testing and includes the following columns of information.

- The Device section displays the device tested.
- The Test section displays the type of test run.
- The Times Failed is the number of times the device has failed a test.
- The Defect Code provides a numerical code for the failure. The error codes are defined in the Help tab.
- The Description section describes the error that the diagnostic test found.
- The Reason section describes the likely cause of the error.

- The Recommended Repair will give a recommended action that should be performed to resolve the failed hardware.

- The Warranty ID is a unique error code associated with the specific error on your computer. When contacting the HP Support Center for assistance with a hardware failure, please be prepared to provide the Warranty ID.

- The Clear Errors button will clear the contents of the Error Log.

The contents of the Error Log may be saved as a HTML file to either floppy or USB flash drive by clicking the **Save** button.

Help tab

The Help tab contains a Vision Help section, and a Test Components section. This tab includes search and index features. You may also review the HP End User License Agreement (EULA), as well as the HP Vision Field Diagnostic application version information on this tab.

The various sections located here are:

- The Vision Help section contains information on the major functions of HP Vision Diagnostics.

- The Test components section provides a description of each test, as well as the parameters that may be adjusted when running in Custom test mode.

- The Defect codes section contains information on the numerical error code that may appear in the Errors tab.

- The Memory test tab section provides information on the HP Memory Test application that may be launched from the boot menu.

- The HP Support section provides information on obtaining technical support from HP.

Saving and printing information in HP Vision Diagnostics

You can save the information displayed in the HP Vision Diagnostics Survey, History and Errors tabs to a diskette or a USB flash drive. You can not save to the hard drive. The system will automatically create an html file that has the same appearance as the information displayed on the screen.

1. Insert a diskette or USB flash drive if running HP Vision Diagnostics from CD.

2. Click **Save** in the bottom on any of the Survey, History or Errors tabs. All three log files will be saved regardless of from which tab the Save button was clicked.

3. Select the drive onto which you will save the log files and click the **Save** button. Three html files will be saved to the inserted diskette or USB flash drive.

    NOTE: Do not remove the diskette or USB key until you see a message indicating that the html files have been written to the media.

4. Print the desired information from the storage device used to save it.

    NOTE: To exit HP Vision Diagnostics, click the **Exit Diagnostics** button at the bottom of the screen. Be sure to remove the USB flash drive or CD from the optical drive.

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.

Table 6-8 Diagnostic lights and audible codes

Activity	Possible cause	Recommended action
Blue Power LED* on. No beeps.	Workstation on.	
Blue Power LED* blinks every two seconds.* No beeps.	Workstation in Sleep mode (S3-Suspend to RAM). Select models only.	
Blue Power LED* is off.* No beeps.	Workstation in Hibernate mode (S4-Suspend to disk) or off state (S5).	N/A
Blue Power LED* blinks three times*, once per second.* No beeps.	Workstation in Sleep mode (S3-Suspend to RAM). Select models only.	
Blue Power LED* blinks four times*, once per second.* No beeps.	Workstation in Hibernate mode (S4-Suspend to disk).	

*User-selectable. See The Computer Setup (F10) Utility menu on page 33 for details.

For the following LED activity and beeps, the beeps are heard through the chassis speaker. Blinks and beeps repeat for 5 cycles, after which, only the blinks continue to repeat.

Table 6-8 Diagnostic lights and audible codes (continued)

Activity	Possible cause	Recommended action
Red Power LED blinks 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 workstation is off. To prevent damage, disconnect the workstation power cord before you remove a component. 1. Ensure that the workstation 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, make sure the fan cable is plugged into the workstation board header. Ensure 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.
Red Power LED blinks three times, once every second, followed by a two-second pause. Three beeps.	CPU not installed (not an indicator of bad CPU).	1. Verify that the CPU is present. 2. Reseat the CPU.
Red Power LED blinks 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 workstation is off. To prevent damage, disconnect the workstation power cord before you remove a component. 1. Open the access panel and ensure that all power connections (24-pin Main, 4-pin CPU) are secure on the system board. 2. Check if a device is causing the problem by removing **all** attached devices (such as hard, diskette, or optical disk drives, and expansion cards.) Power on the workstation. If the system enters the POST, power off 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 ensure all devices are functioning properly. 3. Check the power supply functionality. a. Disconnect the AC power. b. Disconnect ALL internal power supply cables. c. Plug in the AC power. If the power supply fan spins and the BIST** LED lights, the power supply is functional. The problem might be on the system board. Contact HP for assistance. If the power supply fan does not spin or the BIST** LED does not light, the problem might be in the power supply. Contact HP for assistance.
Red Power LED blinks 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 workstation is off. To prevent damage, disconnect the workstation 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.

Table 6-8 Diagnostic lights and audible codes (continued)

Activity	Possible cause	Recommended action
Red Power LED blinks 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 workstation is off. To prevent damage, disconnect the workstation power cord before you remove a component. 1. Reseat the graphics card. 2. Verify the graphics auxiliary power cable is connected (if applicable). 3. The problem might be on the graphics card. Contact HP for assistance.
Red Power LED blinks 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:** Refer to the *Maintenance and Service Guide* for the workstation model for detailed information on clearing CMOS. 2. The problem might be on the system board. Contact HP for assistance.
Red Power LED blinks 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 workstation is off. To prevent damage, disconnect the workstation power cord before you remove a component. 1. Clear CMOS. **NOTE:** Refer to the *Maintenance and Service Guide* for the workstation model for detailed information on clearing CMOS. 2. Upgrade the ROM using SoftPaq from the hard disk drive, CD, diskette, or USB removable device (for example, HP Drive Key). See the ROM Flash section of the *Maintenance and Service Guide* at http://www.hp.com/support/workstation_manuals. SoftPaq is a self-extracting executable that lets you upgrade the ROM. The executable contains contains use instructions, To download Softpaq, visit http://www.hp.com/go/workstationsupport. 3. The system board might have a problem. Contact HP for assistance.
Red Power LED blinks nine times, once every second, followed by a two-second pause. Nine beeps.	System powers on but does not start.	1. The system board might have a problem. Contact HP for assistance. 2. The CPU might have a problem. Contact HP for assistance.

Table 6-8 Diagnostic lights and audible codes (continued)

Activity	Possible cause	Recommended action
System does not power-on and LEDs are not blinking. No beeps.	System unable to power on.	**CAUTION:** Internal components might be powered even when the workstation is off. To prevent damage, disconnect the workstation power cord before you remove a component.
		To resolve the problem, choose one of the following options:
		Press and hold the power button for less than 4 seconds. If the hard disk drive LED turns green, then:
		1. Remove the expansion cards one at a time and try holding the power button again for less than 4 seconds.
		2. The problem might be on the system board. Contact HP for assistance.
		Press and hold the power button for less than 4 seconds. If the hard disk drive LED does not turn on green then:
		1. Check that unit is plugged into a working AC outlet.
		2. Open the access panel and check that the power button harness is properly connected to the system board.
		3. Check that **all** power supply cables are properly connected to the system board.
		4. Check the power supply functionality
		a. Disconnect the AC power.
		b. Disconnect **all** internal power supply cables.
		c. Plug in the AC power.
		If the power supply fan spins and the BIST[**] LED lights, the power supply is functional. The problem might be on the system board. Contact HP for assistance.
		If the power supply fan does not spin or the BIST[**] LED does not light, the problem might be in the power supply. Contact HP for assistance.

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

[**]   Some workstation models do not have BIST LED functionality.

LED color definitions

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

Table 6-9 LED color definitions

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 169.)
None	No light	System is in Hibernate, or is off.

POST error messages

The Power-On Self Text (POST) is a series of diagnostic tests that runs automatically when the workstation is powered on.

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

● Keyboard

● DIMMs

● Diskette drives

● All mass storage devices

● CPUs

● Controllers

● Fans

● Temperature sensors

● Cables (front/rear panels, audio, and USB ports)

The table shown next describes the POST error messages.

Table 6-10 POST error messages

Screen message	Probable cause	Recommended action
101—Option ROM Checksum Error	System ROM checksum.	Verify the 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.
110—Out of memory space for option ROMs	Option ROM for a device could not run because of memory constraints.	1. Run the Computer Setup (F10) Utility to disable unneeded option ROMs, and to enable ACPI/USB Buffers at Top of Memory.
162—Systems Options Error		
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.

Table 6-10 POST error messages (continued)

Screen message	Probable cause	Recommended action
164—Memory Size Error	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 workstation requirements. 2. Insert the DIMM in the proper memory socket. 3. Replace the DIMM if the problem persists.
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 workstation 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.

Table 6-10 POST error messages (continued)

Screen message	Probable cause	Recommended action
214—DIMM Configuration Warning	DIMMs are not installed correctly (not paired correctly).	See the service label on the workstation access panel for the correct memory configurations, and reseat the DIMMs accordingly.
215—DIMM Configuration Error		
216—Memory Size Exceeds Maximum Supported	The amount of memory installed exceeds that supported by the hardware.	1. Verify how much memory the workstation supports. 2. Remove the excess memory.
301—Keyboard Error	Keyboard failure.	1. Reconnect the keyboard with the workstation powered off. 2. Check the connector for bent or missing pins. 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 workstation powered off. 2. Connect a keyboard directly to the workstation (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 workstation powered off. 2. Connect a keyboard directly to the workstation (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 BIOS.
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.
512—Rear Chassis fan not detected	Rear fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
513—Front Chassis fan not detected	Front fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
514—Memory fan not detected	Memory fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.

Table 6-10 POST error messages (continued)

Screen message	Probable cause	Recommended action
515—CPU Overtemp occurred	Insufficient processor cooling or processor defect.	1. If necessary, add a heatsink to the processor and ensure proper operation. 2. Replace the processor.
516—Chipset fan not detected	Chipset fan missing, disconnected, or defective.	1. Ensure that the fan is installed and connected properly. 2. Replace the fan.
517—Low power CPU heatsink(s) detected for high power CPUs	Inadequate heatsink is installed.	Replace the low power heatsink with a high power heatsink.
518—Power supply wattage insufficient for hardware configuration	Workstation configuration requires more power than the power supply can provide.	1. Reduce the workstation power consumption. 2. Replace the power supply with a high output power supply.
601—Diskette Controller Error	Diskette controller circuitry or diskette drive circuitry incorrect.	1. Run the Computer Setup (F10) utility. 2. Verify cabling and replace defective cables if necessary. 3. Clear CMOS. 4. Replace the diskette drive. 5. Replace the system board.
605—Diskette Drive Type Error	Mismatch in drive type.	1. Run the Computer Setup (F10) Utility. 2. Disconnect any other diskette controller devices (tape drives). 3. Clear the CMOS.
610—External Storage Device Failure	External storage device is not detected, is improperly connected, or is defective.	1. Verify that the external device is present and connected properly. 2. Replace the external device.
611—Primary Floppy Port Address Assignment Conflict	The flexible disk drive is configured at a previously assigned address.	Select a new address for the flexible disk drive.
912—Computer Cover Has Been Removed Since Last System Start Up	N/A	No action required.
914— Hood Lock Coil is not Connected	Mechanism is missing or is not connected.	1. Reconnect or replace the missing mechanism. 2. Reseat or replace the missing mechanism cable.
916—Power Button Not Connected	Power button cable is disconnected from the system board.	Reconnect the cable and restart.
917—Front Audio Not Connected	Front Audio mechanism is missing or is not connected.	1. Replace or reconnect the missing front audio mechanism to the system board. 2. Reseat or replace the missing mechanism cable.
918—Front USB Not Connected	Front USB mechanism is missing or is not connected.	1. Replace or reconnect the missing Front USB mechanism to the system board.. 2. Reseat or replace the missing mechanism cable.

Table 6-10 POST error messages (continued)

Screen message	Probable cause	Recommended action
919—Multi-Bay Riser Not Connected	Multi-Bay riser mechanism is missing or is not connected.	1. Replace or reconnect the missing Multi-Bay mechanism to the system board. 2. Reseat or replace the missing mechanism cable.
920—Fatal error on QPI link X	Fatal error detected on QPI link x, where x is 0 or 1. This type of error is identified on the line following the error message.	Potential system board problem; contact HP Support.
921—Fatal error on QPI Protocol link X	Fatal error detected in QPI link x protocol, where x is 0 or 1. This type of error is identified on the line following the error message.	Potential system board problem; contact HP Support.
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.
923—Fatal error on ESI port 0	A fatal error occurred on ESI port 0. slot.	Verify that the ESI port device is connected and working properly.
924—Fatal error on IOH core X	Fatal error detected on IOH core x, where x is 0 or 1. This type of error is identified on the line following.	Potential system board problem; contact HP Support.
925—Fatal error on IOH miscellaneous	Fatal miscellaneous error detected on IOH core x, where x is 0 or 1.	Potential system board problem; contact HP Support.
926—Fatal error on IOH Vtd	Fatal error detected in the Intel Virtualization Technology.	Potential system board problem; contact HP Support.
927—Fatal error on DIMM in slot CPU X DIMM Y	Fatal multibit ECC error detected on the DIMM in the slot labeled CPU x DIMM y (where x is 0 or 1 and y is 1 - 6), as labeled on the system board.	Replace the DIMM in the identified slot.
928—Fatal machine check detected on CPU X		Contact HP support.
1720—SMART Hard Drive Detects Imminent Failure	Hard drive is about to fail. (Some hard disk drives have a firmware patch that fixes erroneous error messages.)	1. Determine if the hard disk drive is giving a correct error message. 2. Run the Drive Protection System test (if applicable). 3. Apply firmware patch (if applicable). See http://www.hp.com/support. 4. Back up contents and replace the hard disk drive.
1783—Fixed Disk 0/1 locked	Hard disk drive failure.	Diagnose the hard disk 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. Check the processor stepping to ensure 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.

Table 6-10 POST error messages (continued)

Screen message	Probable cause	Recommended action
1803—Processor feature set is insufficient for current system settings	Processor feature set is insufficient for current system settings. The BIOS settings do not match the support provided by the processor	Change the BIOS settings or upgrade the processors.
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 1394 GUID (Invalid electronic serial number)	No electronic serial number is stored with the system.	To assign a serial number , select **Security >System IDs** in the Computer Setup (F10) Utility.
ERROR: Invalid electronic serial number (no number)	No electronic serial number is stored with the system	To assign a serial number , select **Security >System IDs** in the Computer Setup (F10) Utility.
ERROR: An unsupported processor is installed. System halted	Unsupported processor detected.	Replace the processor.
ERROR: A processor requiring too much power is installed. System halted	Unsupported processor detected.	Replace the processor.
Invalid electronic serial number	Incorrect serial number registered in the system.	Use the Computer Setup (F10) Utility to reset the serial number.
Network Server Mode Active and No Keyboard Attached	Keyboard not detected.	Verify that a functioning keyboard is attached to the workstation.
Processor initialization fails!!!	Processor defective.	Replace the processor.

7   Configuring RAID devices

This chapter describes how to configure SAS and SATA RAID devices, and includes these topics:

Topics

For additional information about configuring RAIDs, see http://www.hp.com/support/RAID_FAQs. For information about preparing the workstation for RAID configuration, see http://www.hp.com/support/workstation_manuals.

Maximum hard drive configurations

This section lists the maximum number of hard drives supported on HP workstations for RAID configurations.

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

TIP: Use the table values to determine workstation-specific maximum number of hard drives as discussed the sections below.

Table 7-1 Maximum hard drives

Workstation	SATA hard drive	SATA SFF[*] hard drive	SAS hard drive
Z800	5	6	5
Z600	3	4	3
Z400	4	4	4

[*]   Small form factor hard drive

Configuring SATA RAID devices

This section describes how to use the Intel Matrix Storage Manager option ROM Configuration utility to set up and manage SATA RAID volumes.

The following SATA RAID configurations are supported on this workstation:

- Up to the workstation-specific maximum number of internal SATA hard disk drives and eSATA drives (if you use an optional eSATA bulkhead cable)

- Intel Matrix Storage Manager (IMSM) for Windows

If only a single HDD is attached, the Intel Matrix Storage Manager option ROM does not execute. Associated messages are not displayed.

The Intel SATA AHCI BIOS executes when you select **RAID+AHCI** for the SATA emulation mode. This BIOS is only used to support serial-attached optical drives.

This section does not apply to configuring SATA RAID in the Linux environment. For Linux SATA RAID, refer to the Software RAID in Linux Workstations section in the *HP Workstations for Linux User Guide* at http://bizsupport1.austin.hp.com/bc/docs/support/SupportManual/c00063015/c00063015.pdf.

Attaching SATA HDDs

Attach the required minimum number of SATA hard drives for the desired RAID level:

- RAID 0: two or more hard drives

- RAID 1: only two hard drives

- RAID 5: three or more hard drives

- RAID 10: only four hard drives

Configuring system BIOS

Configure the system BIOS to enable embedded SATA RAID functionality.

1. To enter the system BIOS setup, press F10.

2. Use the arrow keys to highlight the desired language, and then press Enter.

3. Use the arrows to highlight **Storage>Storage Options**, and then press Enter.

4. Use the up or down arrow key to highlight **SATA Emulation**.

5. Use the left or right arrow key to select **RAID+AHCI**.

6. To accept the new setting, press F10.

7. Use the arrows to highlight **Advanced>Power-On Options**, and then press Enter.

8. Use the up or down arrow key to highlight **POST Messages**.

9. Use the left or right arrow key to select **Enable**.

10. To accept the new setting, press F10.

11. Use the arrow keys to highlight **Advanced>Device Options**, and then press Enter.

12. Use the up or down arrow key to highlight **SATA RAID Option ROM Download**, and then press Enter.

13. Use the left or right arrow key to select **Enable**.

14. To accept the new setting, press F10.

15. Use the arrows to highlight **File>Save Changes and Exit**, and then press Enter.

16. Press F10 when prompted.

Creating RAID volumes

To create RAID volumes, use the Intel Matrix Storage Manager option ROM Configuration utility.

1. To enter the Intel Matrix Storage Manager option ROM Configuration utility, press Ctrl+I when prompted

2. If required, refer the workstation *Maintenance and Service Guide* to make available enough physical drives to create the RAID volume.

3. Use the up or down arrow key to highlight **1. Create RAID Volume**, and then press Enter.

4. Type the desired RAID volume name in the Name: field, and then press Tab.

5. Use the up or down arrow key to select the RAID level in the RAID Level: field, and then press Tab.

6. To display the Select dialog, press Enter.

7. Use the up and down arrow keys and Space to mark individual physical as members of the volume.

8. To exit the Select dialog and return to the Create Volume Menu dialog, press Enter.

9. If appropriate, use the up or down arrow key to select the Strip Size in the Strip Size: field, and then press Tab.

10. Enter the desired volume size in the Capacity: field, and then press Tab.

11. Press Enter to initiate volume creation.

12. When prompted, press Y to acknowledge the warning message and create the volume.

13. Return to step 3 to create additional RAID volumes, or use the up or down arrow key to highlight **4. Exit**, and then press Enter.

14. Press Y when prompted to confirm the exit.

Configuring SAS RAID devices

Supported configurations

The following RAID configurations are supported on this workstation:

📝 **NOTE:** This section does not apply to configuring SAS RAID in the Linux environment. For Linux SAS RAID information, including supported configurations, refer to *Installing and Configuring SAS Hardware RAID on HP Linux Workstations* at http://www.hp.com/support/xw8600_manuals.

- Up to the workstation-specific maximum number of internal SAS hard disk drives
- LSI MegaRAID Storage Manager (MSM) for Windows

The following RAID configurations are supported on this workstation:

- RAID 0 – Striped disk array (IS)
  - Two drive minimum
  - Improved I/O performance
  - No fault tolerance
- RAID 1 — Mirrored disk array (IM)
  - Two drives
  - 100% redundancy
  - Can recover from single drive failure
  - Improved read performance
- RAID 1E (IME)
  - Three drives minimum
  - Can be an odd number of drives
  - Can always recover from a single drive failure and, in some cases, can recover from two drive failures

SAS RAID 0 configuration

Use the following procedure to configure an Integrated Striped (IS) volume with the BIOS-based configuration utility. The procedure assumes that the system has the required disk and disk controllers.

1. Start the LSI Corporation Configuration Utility. During BIOS start up, you are prompted to **Press Ctrl-C to start LSI Corp. Configuration Utility**.

2. On the Main menu of the BIOS-based configuration utility, use the arrow keys to select an adapter.

3. Press Enter to go to the Adapter Properties screen.

4. On the Adapter Properties screen, use the arrow keys to select **RAID Properties**, and press Enter to go to the New Array Type screen.

5. In the Select New Array Type screen, use the arrow keys to select **Create IS Volume**. Press Enter to go to the Create New Array screen.

6. In the Create New Array screen, use the arrow keys to select the first disk for the IS volume. Then use the arrow keys to move to the RAID Disk column for this disk, and press Space and + or - to select **Yes** as the value for this column.

   If partitions are defined on the selected disk, a message appears warning you that data on the disk will be lost when the striped volume is created.

7. Press M to migrate, or D to delete the data on the drive.

8. To select additional drives for the striped volume, up to the workstation-specific maximum number, repeat the previous steps.

9. When all drives are selected, press C to create the array once. Use the arrow keys to move to **Save changes then exit this menu** and press Enter.

10. When the new array is created, the Adapter Properties screen appears. Press Esc twice and select **Exit**.

SAS RAID 1 configuration

Use the following procedure to configure an Integrated Mirroring (IM) volume with the BIOS-based configuration utility. The procedure assumes that the system has the required drives and drive controllers.

1. Start the LSI Corporation Configuration Utility. During BIOS start up, you are prompted to **Press Ctrl-C to start LSI Corp. Configuration Utility**.

2. On the Main menu of the BIOS-based configuration utility, use the arrow keys to select an adapter.

3. Press Enter to go to the Adapter Properties screen.

4. On the Adapter Properties screen, use the arrow keys to select **RAID Properties**, and press Enter to go to the New Array Type screen.

5. In the Select New Array Type screen, use the arrow keys to select **Create IM Volume**. Press Enter.

6. To configure a two-disk mirrored volume with an optional hot spare disk:

   a. In the Create New Array screen, use the arrow keys to select the primary disk for the IM volume (the disk with the data you want to mirror.)

   b. Use the arrow keys to move to the RAID Disk column for this disk and press Space to select **Yes** as the value.

   If partitions are defined on the selected disk, a message appears warning you that data on the disk will be lost when the mirrored volume is created.

   c. Press M to migrate or D to delete the data on the drive.

   d. The value in the Array Disk column changes to Primary.

   Use the arrow keys to select the secondary (mirrored) disk for the IM volume, and then select **Yes** as the value for the Array Disk column.

   If partitions are defined on this disk, a message warns that data on the disk will be lost when the mirrored volume is created.

   e. Press Delete to confirm erasing data from the disk, or press any other key to deselect the disk.

7. When all drives are selected, press C to create the array once. Use the arrow keys to move to **Save changes then exit this menu** and press Enter.

8. When the new array is created, the Adapter Properties screen appears. Press Esc twice and select **Exit**.

SAS RAID 1E configuration

Use the following procedure to configure an Integrated Mirroring Extended (IME) volume with the BIOS-based configuration utility. The procedure assumes that the system has the required disk and disk controllers.

1. Start the LSI Corporation Configuration Utility. During BIOS start up, you are prompted to **Press Ctrl-C to start LSI Corp. Configuration Utility**.

2. On the Main menu of the BIOS-based configuration utility, use the arrow keys to select an adapter.

3. Press Enter to go to the Adapter Properties screen.

4. On the Adapter Properties screen, use the arrow keys to select **RAID Properties**, and press Enter to go to the New Array Type screen.

5. In the Select New Array Type screen, use the arrow keys to select **Create IME Volume**. Press Enter.

6. To configure a mirrored volume or an optional hot spare drive with up to the workstation-specific maximum number of drives:

   a. In the Create New Array screen, use the arrow keys to select the first disk for the IME volume.

   b. Use the arrow keys to move to the RAID Disk column for this disk, and then use the + or - keys to select **Yes** as the value.

      If partitions are defined on the selected disk, a message appears warning that the data on the disk will be lost when the mirrored volume is created.

   c. Press M to migrate, or D to delete the data on the drive.

   d. Use the arrow keys to select the next disk for the IME volume, and then select **Yes** as the value for the Array Disk column.

      If partitions are defined on this disk, a message warns you that data on the disk will be lost when the mirrored volume is created.

   e. Press **Delete** to confirm erasing data from the disk, or press any other key to deselect the disk.

   f. Repeat the previous steps to select up to the workstation-specific maximum number of drives for the IME volume, including configuration of a hot spare.

7. When all drives are selected, press C to create the array once. Use the arrow keys to move to **Save changes then exit this menu** and press Enter.

8. When the new array is created, the Adapter Properties screen appears. Press Esc twice and select **Exit**.

Deleting RAID volumes

Use the LSI Logic Corporation Configuration Utility to delete SAS RAID volumes.

1. Start the LSI Corporation Configuration Utility. During BIOS start up, you are prompted to **Press Ctrl-C to start LSI Corp. Configuration Utility**.

2. On the Main menu of the BIOS-based configuration utility, use the arrow keys to select an adapter.

3. Press Enter to go to the Adapter Properties screen.

4. In the Select New Array Type screen, use the arrow keys to select **New Existing Array**.

5. In the View Array screen, use the arrow keys to select **Manage Array**. Press Enter.

6. In the Manage Array screen, use the arrow keys to select **Delete Array**. Press Enter.

   Press Y to delete the array and exit to the adapter properties screen.

8 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

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

There are three possibilities for setting passwords:

● Define a setup password only

● Define a power-on password only

● Define both

When defining a setup password only, you cannot enter the setup utility without the password.

No password is needed to start from power-on.

When defining a power-on password only, the power-on password is needed to enter F10 Setup or to start from power-on.

When defining both, the setup password is needed to enter F10 setup and can be used to start from power-on.

The power-on password cannot be used to enter the F10 Setup Utility, but it can be used to start from power-on.

One of the passwords will be required to start from power on.

After you create both passwords, you can use the setup password in place of the power-on password as an override to log into the workstation (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 the workstation 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 **Save to Diskette** from the File menu.

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, disconnect the power cord from the wall outlet and let the internal system components cool before touching.

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

⚠ **CAUTION:** Static electricity can damage the electronic components of the workstation or optional equipment. Before beginning these procedures, be sure that you are discharged of static electricity by briefly touching a grounded metal object.

1. Shut down the operating system, power off the workstation and external devices, and disconnect the workstation power cord and external devices from power outlets.

2. Disconnect the keyboard, monitor, and other external devices that are connected to the workstation.

3. Remove the access panel.

4. Locate the password header and jumper.

   The password header is E49. The password jumper is green so it can be easily identified.

5. Verify that the AC power cord is disconnected from the power outlet.

6. Remove the jumper from pins 1 and 2.

7. Replace the access panel.

8. Reconnect the external equipment.

9. Reconnect AC power to the workstation.

10. Power on the workstation.

11. Wait for the workstation to display the HP splash screen.

12. Repeat steps 1 through 5.

13. Replace the jumper from pins 1 and 2.

14. Repeat steps 7 through 10.

15. Wait for the workstation to boot to the F10 (Setup) Utility.

16. Use the F10 (Setup) Utility to create the new passwords.

Clearing and Resetting the CMOS

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

Using the CMOS Button

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 let the internal system components cool before you touch them.

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

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

1. Shut down the operating system, power off the workstation and any external devices, and then disconnect the workstation power cord and external devices from power outlets.

2. Disconnect the keyboard, monitor, and other external devices that are connected to the workstation.

3. Remove the access panel.

   CAUTION: Before pressing the Clear CMOS button, back up the workstation 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 **Save to Diskette** from the File menu.

4. Locate, press, and hold the CMOS button for five seconds.

   NOTE: Verify that the AC power cord is disconnected from the power outlet.

   The CMOS button does not clear CMOS if the power cord is connected.

   For assistance locating the CMOS button and other components, see Clearing and Resetting the CMOS on page 186.

5. Replace the access panel.

6. Reconnect external devices.

7. Plug in and power on the workstation. The system boots to a 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 powers back on.

9. Use the F10 (Setup) Utility to reset the date and time.

Using the Computer Setup (F10) Utility to Reset CMOS

To reset CMOS using the Computer Setup (F10) Utility:

1. Access the 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 workstation must be restarted to access this utility.

3. From the Computer Setup (F10) Utility menu, select **File>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 the press F10 to accept.

5. Select **File->Apply Defaults and Exit**, and then press F10 to accept.

6. Reset the workstation passwords and configuration information, such as the system date and time.
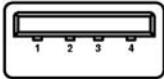
NOTE: This step does not clear the passwords.

A Connector pins

Workstation keyboard	Pin	Signal
	1	Data
	2	Unused
	3	Ground
	4	+5 VDC
	5	Clock
	6	Unused
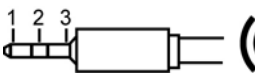
Workstation mouse	Pin	Signal
	1	Data
	2	Unused
	3	Ground
	4	+5 VDC
	5	Clock
	6	Unused
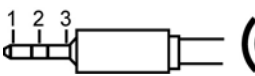
Workstation Ethernet	Pin	10/100–MbSignal	1000–Mb signal		
	1	(+) Transmit Data	TX/RX	0	+
	2	(-) Transmit Data	TX/RX	0	–
	3	(+) Receive Data	TX/RX	1	+
	4	Unused	TX/RX	2	+
	5	Unused	RX/RX	2	–
	6	(-) Receive Data	TX/RX	1	–
	7	Unused	TX/RX	3	+
	8	Unused	TX/RX	3	–

Workstation USB		Pin	Signal
		1	+5 VDC
		2	- Data
		3	+ Data
		4	Ground
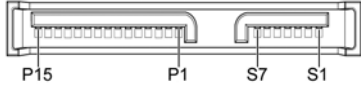
Microphone cable (1/8 inch)		Pin	Signal
		1 (Tip)	Audio
		2 (Ring)	Power
		3 (Shield)	Ground

Headphone cable (1/8 inch)		Pin	Signal
		1 (Tip)	Audio_Left
		2 (Ring)	Audio_Right
		3 (Shield)	Ground

Audio line-in cable (1/8 inch)		Pin	Signal
		1 (Tip)	Audio_In_Left
		2 (Ring)	Audio_In_Right
		3 (Shield)	Ground

Line-out audio cable (1/8 inch)		Pin	Signal
		1 (Tip)	Audio_Out_Left
		2 (Ring)	Audio_Out_Right
		3 (Shield)	Ground

SATA drive

Pin	Signal	Pin	Signal	Pin	Signal
Data Cable		**Power Cable**		**Power Cable**	
S1	Ground	P1	3.3V power	P8	5V power
S2*	A+	P2	3.3V power	P9	5V power

SATA drive
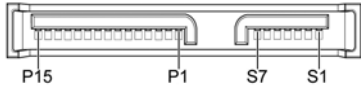
Pin	Signal	Pin	Signal	Pin	Signal
	Data Cable		Power Cable		Power Cable
S3*	A-	P3	3.3V power	P10	Ground
S4	Ground	P4	Ground	P11	Reserved
S5**	B-	P5	Ground	P12	Ground
S6**	B+	P6	Ground	P13	12V power
S7	Ground	P7	5V power	P14	12V power
* S2 and S3 differential signal pair				P15	12V power
**S5 and S6 differential signal pair					

SAS drive
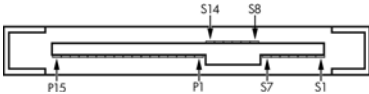
Segment	Pin	Backplane receptacle	Plug and cable receptacles
Primary signal segment	S1	SIGNAL GROUND	
	S2	TP+	RP+
	S3	TP-	RP-
	S4	SIGNAL GROUND	
	S5	RP-	TP-
	S6	RP+	TP+
	S7	SIGNAL GROUND	
Secondary signal segment	S8	SIGNAL GROUND	
	S9	TS+	RS+
	S10	TS-	RS-
	S11	SIGNAL GROUND	
	S12	RS-	TS-
	S13	RS+	TS+
	S14	SIGNAL GROUND	

SAS drive
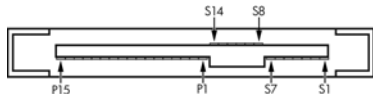
Segment	Pin	Backplane receptacle	Plug and cable receptacles
Power segment	P1	V_{33}^c	
	P2	V_{33}^c	
	P3	V_{33}^c precharge [c]	
	P4	GROUND	
	P5	GROUND	
	P6	GROUND	
	P7	V_5^c precharge [c]	
	P8	V_5^c	
	P9	V_5^c	
	P10	GROUND	
	P11	READY LED [d]	
	P12	GROUND	
	P13	V_{12} precharge [c]	
	P14	V_{12}^c	
	P15	V_{12}^c	

VGA
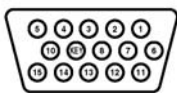
Pin	Signal	Pin	Signal	Pin	Signal
1	Red Analog	6	GND	11	Monitor ID
2	Green Analog	7	GND	12	DDC Serial Data
3	Blue Analog	8	GND	13	Horizontal Sync
4	Monitor ID	9	+5 VDC	14	Vertical Sync
5	GND	10	GND	15	DDC Serial Clock

DVI-I cable
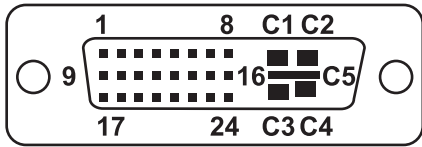
Pin	Signal	Pin	Signal
1	T.M.D.S DATA 2-	16	HOT PLUG DETECT
2	T.M.D.S DATA 2+	17	T.M.D.S DATA 0-
3	T.M.D.S DATA 2/4 SHIELD	18	T.M.D.S DATA 0+
4	T.M.D.S DATA 4-	19	T.M.D.S DATA 0/5 SHIELD
5	T.M.D.S DATA 4+ 2	0	T.M.D.S DATA 5-
6	DDC CLOCK	21	T.M.D.S DATA 5+
7	DDC DATA	22	T.M.D.S CLOCK SHIELD
8	ANALOG VERT. SYNC	23	T.M.D.S CLOCK+
9	T.M.D.S DATA 1-	24	T.M.D.S CLOCK-
10	T.M.D.S DATA 1+		
11	T.M.D.S DATA 1/3 SHIELD	C1	ANALOG RED
12	T.M.D.S DATA 3-	C2	ANALOG GREEN
13	T.M.D.S DATA 3+	C3	ANALOG BLUE
14	+5V POWER	C4	ANALOG HORZ SYNC
15	GND	C5	ANALOG GROUND

Display port
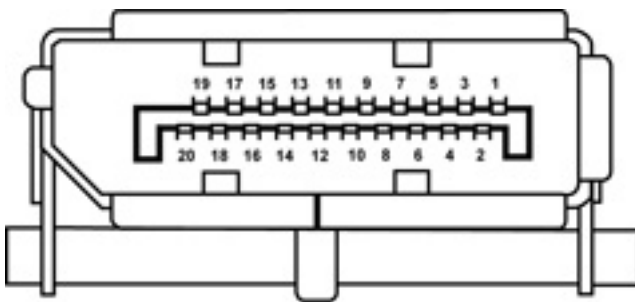
Pin	Signal	Pin	Signal
1	ML_Lane 0(p)	11	GND
2	GND	12	ML_Lane 3(n)
3	ML_Lane 0(n)	13	GND
4	ML_Lane 1(p)	14	GND

Display port

5	GND	15	AUX CH(p)
6	ML_Lane 1(n)	16	GND
7	ML_Lane 2(p)	17	AUX CH(n)
8	GND	18	Hot Plug Detect
9	ML_Lane 2(n)	19	DP_PWR Return
10	ML_Lane 3(p)	20	DP_PWR

Main power cable, P1
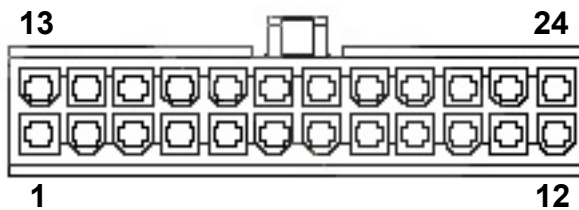
Pin	Signal	Pin	Signal	Pin	Signal
1	+3.3V	9	+5 Vaux	17	GND
2	+3.3V	10	+12 V-B	18	GND
3	GND	11	+12 V-B	19	GND
4	+5V	12	12 V-D	20	GND
5	GND	13	+3.3V	21	+5V
6	+5V	14	−12V	22	+5V
7	GND	15	GND	23	12 V-D
8	POK	16	PS_ON_L	24	GND

CPU power cable, P3	Pin	Color	Signal
	1	BLK	GND
	2	BLK	GND
	3	WHT	12V CPU
	4	WHT	12V CPU
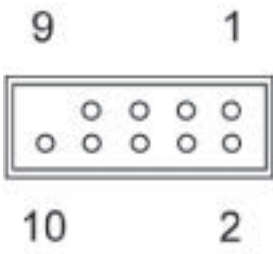
CAUTION: Ensure that you can differentiate between which power cable connects to the PCIe x16 graphics card and which power cable connects to the system board. These two cables have different pin counts and different colors. The PCIe power cable has a 6-pin black connector, and the CPU power cable has an 4-pin white connector. When power is present, you must never connect the PCIe power cable to the system board. If you do so, the system board can be damaged and the warranty voided. To see a picture of the PCIe cable and where it must be connected, see Expansion cardon page 104.

NOTE: The 6-pin power (auxiliary PCIe) is only required with high-powered graphics cards.

Graphics aux. power cables, P12	Pin	Signal	Color
	1	V12-D	YEL
	2	V12-D	YEL
	3	V12-D	YEL
	4	GND	BLK
	5	GND	BLK
	6	GND	BLK

Internal USB 1 2x5	Pin	Signal
	1	+5V
	2	+5V
	3	USB6#
	4	USB9#
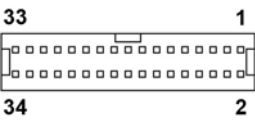
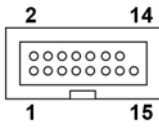| Internal USB 1 2x5	Pin	Signal
CAUTION: Possible equipment damage.	5	USB6
The 2x5 connector can be mated to either a wide 2x5 option cable connector or a narrow 1x5 option cable connector.	6	USB9
	7	GND
To prevent damage to the connectors, always connect a narrow 1x5 option cable connector to pins 1,3,5, and 7 only of the 2x5 connector (pin 9 is not keyed on the connector).	8	GND
	9	(not keyed)
	10	DETECT

Internal USB 2 2x5	Pin	Signal
	1	+5V
	2	+5V
	3	USB7#
	4	USB8#
CAUTION: Possible equipment damage.	5	USB7
The 2x5 connector can be mated to either a wide 2x5 option cable connector or a narrow 1x5 option cable connector.	6	USB8
	7	GND
To prevent damage to the connectors, always connect a narrow 1x5 option cable connector to pins 1,3,5, and 7 only of the 2x5 connector (pin 9 is not keyed on the connector).	8	GND
	9	(not keyed)
	10	DETECT

Rear system fan	Pin	Signal
	1	GND
	2	+12V
	3	Tach
	4	PWM

CPU fan	Pin	Signal
	1	GND
	2	+12V
	3	TACH1
	4	PWM
	5	TACH2

FDD	Pin	Signal	Pin	Signal
	1	Ground	18	FLP_DIR#
	2	FLP_LOWDEN#	19	Ground
	3	Tach	20	FLP_STEP#
	4	FLP_WDO	21	Ground
	5	MT	22	FLP_STEP#
	6	Unused	23	Ground
	7	Ground	24	FLP_WRTEN#
	8	FLP_INDEX#	25	Ground
	9	Ground	26	FLP_TRACK#
	10	FLP_MOTOR#	27	Ground
	11	Ground	28	FLP_WP#
	12	Unused	29	Ground
	13	Ground	30	FLP_RD_D#
	14	FLP_SEL_A#	31	Ground
	15	Ground	32	FLP_HD_SEL#
	16	Unused	33	Ground
	17	Ground	34	FLP_DSKCHG#

Internal serial	Pin	Signal	Pin	Signal
	1	DTR1#	9	+5V
	2	RXD1	10	+3.3V AUX
	3	CTS1#	11	RTS1#
	4	DSR1#	12	COM DETECT
	5	TXD1	13	DCD21#
	6	RI#	14	-12V
	7	Ground	15	+12V
	8	Ground		

B System board designators

This appendix describes the system board designators for this workstation.

Designator	Silk screen	Component
MTG1-MTG10	N/A	Mounting holes
E15	E15	Crisis recovery header/jumper
E49	E49 PSWD	Clear password header/jumper
J9	J9 RJ/USB	LAN/DUAL USB
J10	J10 QUAD USB	Quad rear USB
J20	J20 SLOT6 PCI	PCI slot
J21	J21 SLOT5 PCI	PCI slot
J31	J31 SLOT1 PCIe2 x8(4)	PCIe2 x8(4) slot
J32	J32 SLOT3 PCIe x8(4)	PCIe x8(4) slot
J41	J41 SLOT2 PCIe2 x16 75W	PCIe2 x16 slot
J42	J42 SLOT4 PCIe2 x16 75W	PCIe2 x16 slot
J68	J68 PS2 KBD_MSE	Stacked keyboard/mouse connector
J83	J83 AUD	Triple stacked audio jacks
J86	J86	Slot2 PCIe x16 retention clip
J87	J87	Slot4 PCIe x16 retention clip
SW50	SW50 CMOS	Clear CMOS switch/push button
P1	P1PWR	Power supply connector (24-pin)
P3	P3 PWR CPU	CPU power connector (4-pin)
P5	P5 PB/LED	Power button/HDD LED/Power LED switch/ Side access panel sensor/Temperature header
P8	P8 REAR FAN	Rear system fan
P10	P10 FLPY	Floppy diskette drive connector
P24	P24 FRONT USB	Front panel USB header
P25	P25 USB2	Single USB header
P26	P26 DASH/USB1	DASH/Dual internal USB
P29	P29 HDD LED	Hard disk drive LED connector
P60-P63	P60 - P63 SATA0 - SATA3	SATA Connectors

Designator	Silk screen	Component
P66 - P67	P66 - P67 SATA4 - SATA5	SATA Connectors
P70	P70 CPU0 FAN	Primary CPU fan header
P93	P93 FRNTFAN	Front fan header
P94	P94 IOH FAN	IOH fan header
P124	P124 HLCK	Side access panel solenoid lock header
XBT1	XBT1 BAT	Battery holder
XMM1 - XMM6	4-DIMM: XMM1-XMM4, DIMM1-DIMM4 6-DIMM: XMM1-XMM6, DIMM1-DIMM6	Memory slots
XU1	XU1 CPU0	Primary CPU socket

C   Routine Care

General cleaning safety precautions

- Never use solvents or flammable solutions to clean the workstation.
- Never immerse any component in water or cleaning solutions; apply any liquids to a clean cloth and then use the cloth on the component.
- Always unplug the workstation before cleaning the keyboard, mouse, or air vents.
- Always disconnect the keyboard before cleaning it.
- Wear safety glasses equipped with side shields when cleaning the keyboard.

Cleaning the workstation case

- Follow the safety precautions presented (Service considerations on page 62) before cleaning the workstation.
- To remove light stains or dirt, use plain water with a clean, lint-free cloth or swab.
- For stronger stains, use a mild dish washing liquid diluted with water. Rinse well by wiping it with a cloth or swab dampened with clear water.
- For stubborn stains, use isopropyl (rubbing) alcohol. No rinsing is required because the alcohol evaporates quickly and does not leave a residue.
- After cleaning, always wipe the workstation with a clean, lint-free cloth.
- Occasionally, clean the air vents on the workstation. Lint and other foreign matter can block the vents and limit the airflow.

Cleaning the keyboard

△ **CAUTION:**   Use safety glasses equipped with side shields before attempting to clean debris from under the keys.

- Follow the safety precautions presented (Service considerations on page 62) before cleaning the workstation.
- Visible debris underneath or between the keys can be removed by vacuuming or shaking.
- Canned, pressurized air can be used to clean debris from under the keys. Use caution because too much air pressure can dislodge lubricants applied under the wide keys.
- If you remove a key, use a specially designed key remover to prevent damage to the keys. This tool is available from many electronic supply outlets.

△ **CAUTION:**   Never remove a wide key (like the space bar key) from the keyboard. If these keys are improperly removed or installed, the keyboard might not function properly.

- Clean under a key with a swab moistened with isopropyl alcohol and squeezed out. Be careful not to wipe away lubricants necessary for proper key functions. Allow the parts to air dry before reassembly.

- Use tweezers to remove any fibers or dirt in confined areas.

Cleaning the monitor

- Follow the safety precautions presented (Service considerations on page 62) before cleaning the workstation.

- To clean the monitor, wipe the monitor screen with a towelette designed for cleaning monitors or a clean cloth moistened with water.

  △ **CAUTION:**   Do not use sprays or aerosols directly on the screen—the liquid might seep into the housing and damage a component.

  Never use solvents or flammable liquids on the monitor because display or housing damage may result.

Cleaning the mouse

1. Follow the safety precautions presented (Service considerations on page 62) before cleaning the workstation.

2. Remove the mouse ball from the housing by removing the retaining plate.

3. Clean the mouse ball.

4. Pull out any debris from the ball socket, and wipe the ball with a clean, dry cloth.

5. Reassemble the mouse.

D   Locating HP resources

This section provides information on the following HP resources for your workstation:

Topics

- HP Cool Tools
- Regulatory information
- Accessories
- System board
- Serial number and Certificate of Authenticity labels
- Linux

- Additional information
- Technical support
- Business Support Center
- IT Resource Center
- HP Service Center
- HP Business and IT Services
- Warranty information

- User and third-party documentation, and white papers
- Product notifications
- QuickSpecs
- Customer Advisories, Security Bulletins, Notices

- Diagnostics tools
- Audible beeps and LED code definitions
- Web-based support tools

- Software, BIOS, and driver updates
- Operating system reinstallation
- Operating system

Product information

Table D-1 Product information

Topic	Location
HP Cool Tools	Most HP Microsoft Windows workstations are preloaded with additional software that is not automatically installed during first boot. Additionally, a number of valuable tools on your workstation are preinstalled that may enhance system performance. To access or learn more about these applications, choose one of the following options: ● Click the **HP Cool Tools** icon on the desktop, or ● Open the **HP Cool Tools** folder by selecting **Start** > **All Programs** > **HP Cool Tools**. To learn more about these applications, click **HP Cool Tools—Learn More**. To install or launch the applications, click the appropriate application icon.
Regulatory information	Refer to the *Safety & Regulatory Information* guide for product Class information. You can also refer to the label on the workstation chassis.
Accessories	For complete and current information on supported accessories and components, see http://www.hp.com/go/workstations.
System board	A diagram of the system board is located on the inside of the side access panel. Also, additional information is located in the *Maintenance and Service Guide* on the Web at http://www.hp.com/support/workstation_manuals/
Serial number and Certificate of Authenticity (COA) labels (if applicable)	Serial number labels are on the top panel, or on the side of the unit at the rear, depending on the workstation model. The COA label is generally located on the top or side panel near the serial number label. Some workstations have this label on the bottom of the unit.
Linux	For information on running Linux on HP workstations, see http://www.hp.com/linux/.

Product support

Table D-2 Product support

Topic	Location
Additional information	For online access to technical support information and tools, see http://www.hp.com/go/workstationsupport.
	Support resources include Web-based troubleshooting tools, technical knowledge databases, driver and patch downloads, online communities, and proactive notification services.
	The following communication and diagnostic tools are also available:
	• Instant Chat
	• Instant Support
	• Diagnose Problem
	Refer to the workstation *Maintenance and Service Guide* for more information on how to receive support.
Technical support	Before you call technical support, refer to the workstation *Maintenance and Service Guide* for a listing of information you need to have available before you call.
	For a listing of all worldwide technical support phone numbers, see http://www.hp.com/support/, select your region, and click **Contact HP** in the upper-left corner.
Business Support Center (BSC)	For software/driver downloads, warranty information, single-topic documents, user manuals, or service manuals, see http://www.hp.com/go/bizsupport.
IT Resource Center (ITRC)	See http://www.itrc.hp.com/ for a searchable knowledge base for IT professionals.
HP Business and IT Services.	For business and IT information, see http://www.hp.com/hps/.
HP Hardware Support Services	For hardware service information, see http://www.hp.com/hps/hardware/.
Warranty information	To locate base warranty information, see _.
	To locate an existing Care Pack, see http://www.hp.com/go/lookuptool.
	To extend a standard product warranty, see http://www.hp.com/hps/carepack. HP Care Pack Services offer upgraded service levels to extend and expand a standard product warranty.

Product documentation

Table D-3 Product documentation

Topic	Location
HP user documentation, white papers, and third-party documentation	For the latest online documentation, see http://www.hp.com/support/workstation_manuals. These include this User Guide and the *Maintenance and Service Guide*.
Product notifications	Subscriber's Choice is an HP program that lets you sign up to receive driver and software alerts, proactive change notifications (PCNs), the HP newsletter, customer advisories, and more. Sign up at http://www.hp.com/go/subscriberschoice/. Customer advisories and product change notifications are also available on http://www.hp.com/go/bizsupport/.
Workstation QuickSpecs	The Product Bulletin contains QuickSpecs for HP Workstations. QuickSpecs provide an overall specification review of your product. It includes information about its features including the operating system, power supply, memory, CPU, and many other components of the system. To access the QuickSpecs, see http://www.hp.com/go/productbulletin/.
Customer Advisories, Security Bulletins, and Notices	To find advisories, bulletins, and notices: 1. See http://www.hp.com/go/workstationsupport. 2. Select the desired product. 3. From the **Resources** section, select **See more…** 4. Use the scroll bar to select **Customer Advisories, Customer Bulletins, or Customer Notices**.

Product diagnostics

Table D-4 Product diagnostics

Topic	Location
Diagnostics tools	Download the HP Vision Field Diagnostics utility from the HP Web site. To use this utility, refer to the appropriate section of the workstation *Maintenance and Service Guide*.
Audible beep and LED code definitions	Refer to the appropriate section of the workstation *Maintenance and Service Guide* for detailed information about beep and Light Emitting Diode (LED) codes applicable to the workstation.

Product updates

Table D-5 Product updates

Topic	Location
Software, BIOS, and driver updates	See http://www.hp.com/go/workstationsupport to verify that you have the latest drivers for the workstation. To locate the current workstation BIOS on your Microsoft Windows workstation, select **Start>Help and Support>Pick a Task>Use Tools to view...>Tools>My Computer Information>View general system information...**.
Operating system	For information on operating systems supported on HP workstations, see http://www.hp.com/go/wsos.

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