

Technical Reference Manual

HP x4000 Workstation



E0601

Manufacturing Part Number: A6068-IE001

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1 **System Overview**

Overview

This manual provides detailed system specifications for the HP x4000 Workstation.

This chapter:

- Introduces the system's internal and external features
- Lists the system's specifications and characteristic data
- Provides a summary of the available documentation

HP x4000 Workstation Feature Set

The following table provides an overview of the x4000 Workstation feature set.

Feature	Description
<i>System Board</i>	<ul style="list-style-type: none"> • Eight-layer extended ATX form-factor • Single-sided • Four power/ground layers • Four signal layers
<i>Processor(s)</i>	<p>Intel dp Xeon processors:</p> <ul style="list-style-type: none"> • 1.5 GHz, 1.7 GHz, or higher with a quad-pumped 100MHz Front side bus • Netburst Microarchitecture with 20-stage instruction pipeline
<i>Chipset</i>	<p>Intel 860 chipset, including:</p> <ul style="list-style-type: none"> • Memory Controller Hub (MCH) • Interface Controller Hub (ICH2) • PCI 64-bit Hublink (P64H)
<i>Memory Controller Hub (MCH)</i>	<p>Provides the interface between the front side bus, memory, AGP, hublink A, and hublink B. It supports:</p> <ul style="list-style-type: none"> • One or two Intel Xeon processor(s) • Dual Rambus channels capable of supporting PC800 RIMMs • AGP Pro 110 4X graphics with 1.5 V signaling • 8-bit, 133 MB/s hublink A to ICH2, which bridges to the 33 MHz PCI bus • 16-bit, 266 MB/s hublink B to P64H, which bridges to the 66 MHz PCI bus

System Overview
HP x4000 Workstation Feature Set

Feature	Description
<i>Rambus Memory on Memory Expander Card (MEC)</i>	Plugs into the system board and supports: <ul style="list-style-type: none"> • 400 MHz operation delivering up to 3.2 GB/s memory bandwidth using two expansion channels operating in lock step • Up to 8 PC800 RIMMs (see “Upgrading Memory on the 8-RIMM MEC” on page 159 for memory loading instructions)
<i>P64H Hub to 64-bit PCI module</i>	Supports 64-bit, 66 MHz PCI bus containing: <ul style="list-style-type: none"> • Two 64-bit, Two PCI connectors 66 MHz PCI connectors • On-board SCSI controller
<i>Interface Controller Hub</i>	ICH2 Hublink to I/O controller modules supports: <ul style="list-style-type: none"> • Three 32-bit, 33 MHz PCI connectors • Two external USB ports • Two ATA 100 IDE controllers • One firmware hub interface • One AC97 audio interface
<i>BIOS</i>	Based on Phoenix core, including 4 MB flash.
<i>Accessory Card Slots</i>	<ul style="list-style-type: none"> • One AGP Pro 110 4X connector • Three 5V, 33 MHz, 32-bit Peripheral Component Interconnect (PCI) connectors • Two 3.3V, 66 MHz, 64-bit PCI connectors
<i>LAN Port</i>	The Intel 82550 10/100BaseT LAN port interfaces to the system via the 33 MHz, 32-bit PCI bus. Wake on LAN is supported.
<i>On-board SCSI Controller Chip</i>	The LSI SYM43C1010R has two Ultra 160 SCSI controllers to support two internal wide connectors: <ul style="list-style-type: none"> • Ribbon cable up to SCSI drives • Ribbon cable to external SCSI connector

Feature	Description
<i>Super I/O Chip</i>	<p>The Nation PC87366 chip supports:</p> <ul style="list-style-type: none"> • Two 9-pin, RS-232 serial ports • One ECP/EPP parallel port • One IDE floppy controller • PS2 Keyboard • PS2 Mouse
<i>IDE/ATA Controllers</i>	<p>Primary and secondary IDE controllers support DMA transfers for up to four devices.</p>
<i>Hardware Management Controller</i>	<p>Qlogic Zircon Lite micro-controller with Winbond W83782D auxiliary chip</p> <ul style="list-style-type: none"> • Monitors systems components via the SMBUS. • Reports errors to the Diag LED lights on the control panel.
<i>Operating System</i>	<p>All models come preloaded with Windows 2000 Professional, and include Windows 2000 and NT 4.0 recovery and installation CD-ROMs.</p>
<i>Mass Storage</i>	<p>Seven bays, supporting:</p> <ul style="list-style-type: none"> • Two front-access, 3.5-inch, 1 inch floppy drive bays (one factory installed drive) • Three front-access, 5.25 -inch half-height drive bays (up to 2 factory installed optical drives, not for use with hard disk drives) • Two internal 3.5-inch, 1-inch height hard disk drive bays (up to 2 factory installed drives).
<i>Optical Drives</i>	<p>Models include one or two of the following:</p> <ul style="list-style-type: none"> • IDE 48X CD-ROM • 12X CD-RW • 12X DVD

System Overview
HP x4000 Workstation Feature Set

Feature	Description
<i>Audio</i>	<p>On-board audio is provided by an Analog Devices AD1885 CODEC (AC97) and supports three rear panel jacks for:</p> <ul style="list-style-type: none">• Headphone/Line out (output) on the rear panel• Line-in (input) on the rear panel• Microphone (input) on the rear panel• CDROM (input) on the system board• Internal speaker (output) on the system board
<i>System Board Connectors (Internal)</i>	<ul style="list-style-type: none">• CD audio in• System speaker• Front panel• 2 CPU fans• 3 Chassis fans• Chassis intrusion• IDE floppy controller• 2 IDE controllers (primary and secondary)• 2 ATX Power• AGP Pro 110 4X (graphics)• 3 PCI 32-bit• 2 PCI 64-bit• 2 SCSI (both are internal wide connectors on the system board, but one has a ribbon cable attached to an external SCSI connector on the rear panel)

Feature	Description
<i>Rear Panel Connectors (External)</i>	<ul style="list-style-type: none">• SCSI Ultra Wide• PS2 Mouse• PS2 Keyboard• 25-pin parallel• 9-pin serial (two, buffered)• Dual USB connectors• LAN• Audio:<ul style="list-style-type: none">— Input Line jack (3.5 mm)— Output Line jack (3.5 mm)— Microphone jack (3.5 mm)

Internal and External Components

Figure 1-1, Figure 1-2, and Figure 1-3 and show the front, side, and rear views of the HP x4000 Workstation.

Figure 1-1 **Front View**

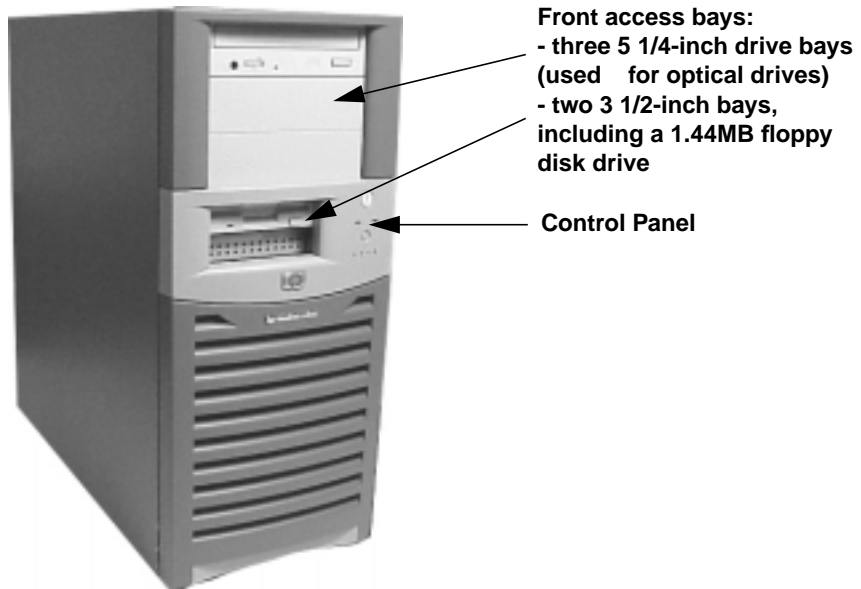


Figure 1-2 Side View with Cover Removed

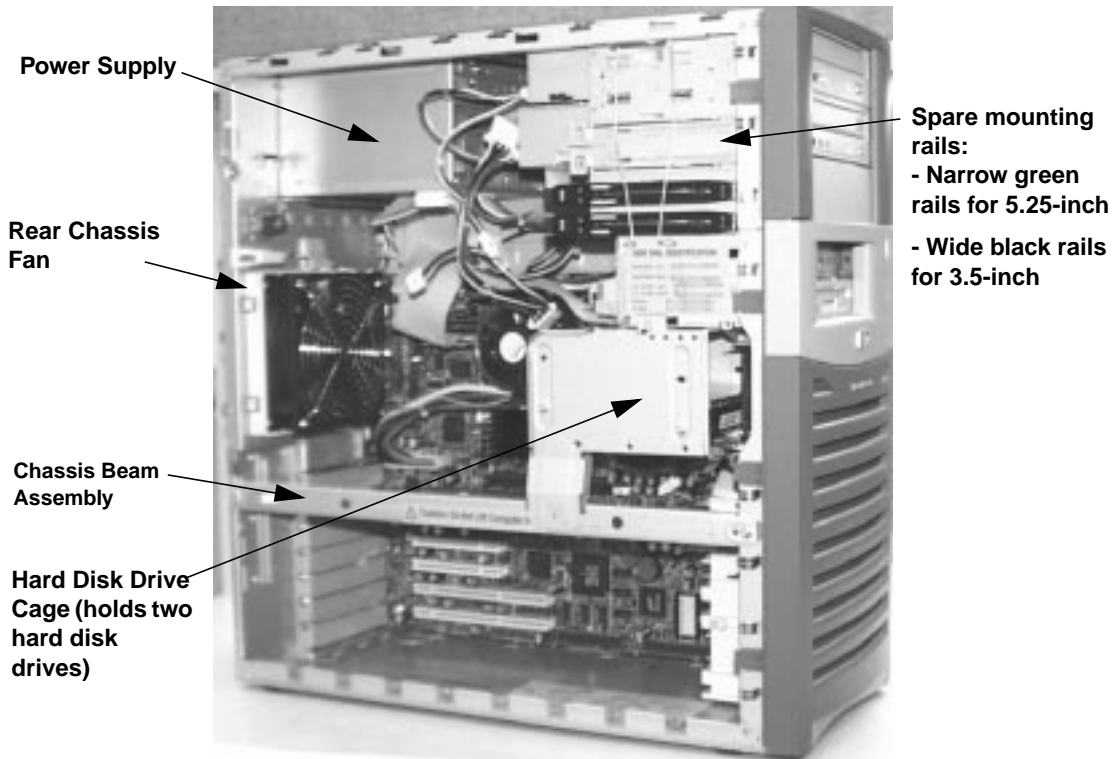
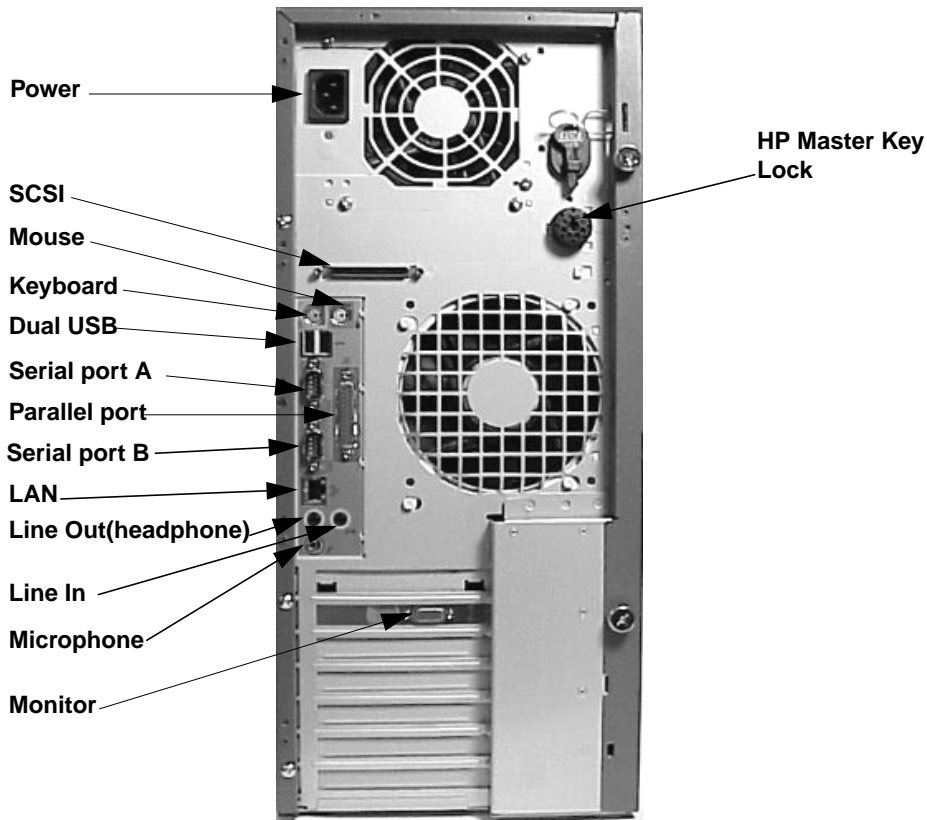


Figure 1-3 **Rear View**



HP x4000 Control Panel

The Workstation's control panel shown in Figure 1-4 has the following features:

- **Power On/Off button:** Press to start the Workstation. You can wake the Workstation from Hibernate or Stand By mode by pressing this button for less than four seconds. For more information about these modes, see "Using Power Management" on page 89.

CAUTION

Always power off through the operating system. Do not power off using the power button or reset button except during extreme circumstances when the system will not shut down through the operating system. Using the power button or reset button to power down may cause you to lose unsaved data from open applications.

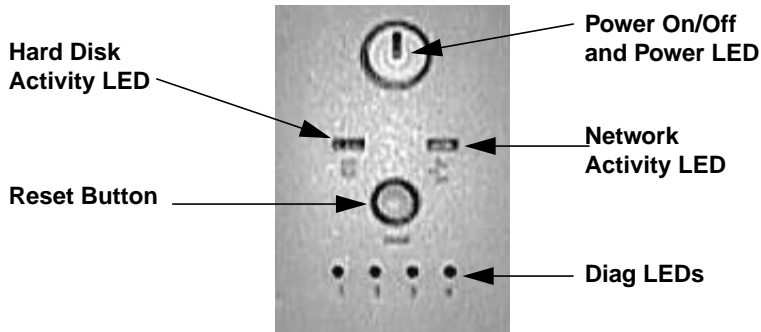
In the event that the operating system has hung and will not shut down, pressing the power button for five seconds is equivalent to pulling the power plug.

-
- **Power LED:**
 - Solid green indicates system on.
 - Solid yellow indicates the Workstation is in Stand By or Hibernate mode. See "Power Saving and Ergonomics" on page 89.
 - Flashing yellow, flashing red, or solid red indicates a system error. See "Understanding the Diag LEDs" on page 212.
 - **Reset button:** Press to reinitialize all the hardware without cycling power to the system. Avoid general use of this button because file damage may occur.
 - **Hard Disk Activity LED:** Flickers when your hard disk is being accessed.
 - **Network Activity LED:** Flickers when network activity is taking place. This occurs even when the Workstation is in a power-off state, provided Wake-on-LAN is not enabled and both the network and power cables are plugged in.

System Overview
HP x4000 Control Panel

- Diag LEDs: These four LEDs can be off, green, yellow, or red. The color pattern lets you diagnose problems with your Workstation. For more information, see “Understanding the Diag LEDs” on page 212.

Figure 1-4 **Control Panel**



Internal Features

The core architecture of the HP x4000 Workstation consists of:

- Intel 860 Memory Controller Hub (MCH)
- Input/Output Controller Hub (ICH2)
- PCI 64-bit Hub (P64H)
- 400 MHz (quad-pumped and 100MHz) front side bus and dp Xeon processors
- 400 MHz Rambus (PC800)
- AGP Pro 110 4X

For information about...	Refer to...
System board components	Chapter 2
Memory Expander Card (MEC)	Chapter 3
Hardware management (monitoring and reporting)	Chapter 5
Mechanical specifications	Chapter 8
Graphics cards	Chapter 9
Power supply and power requirements	Chapter 6
Mass storage devices	Chapter 9
System HP BIOS	Chapter 4
Tests and error messages	Chapter 11
Connector pin-outs and sockets	Chapter 7
Installing or replacing parts and accessories	Chapter 10
Troubleshooting	Chapter 11
Contacting support	Chapter 12

Documentation

The following table lists the documentation available for the HP x4000 Workstation. The printed documents were packaged with your Workstation. Some of the documents are available in PDF format at www.hp.com/workstations/support.

Title	Printed?	Part Numbers
<i>HP x4000 Workstation Installation Poster</i>	Yes and web	A6068-90001
<i>HP x4000 Workstation Getting Started Guide</i>	Yes and web	A6068-90000
<i>HP x4000 Workstation Technical Reference Manual</i>	No	web accessible only
<i>HP x4000 Workstation Service Handbook</i>	No	web accessible only

HP Web Site Contents

You can obtain additional online support documentation, BIOS upgrades, and drivers from www.hp.com/workstations/support.

2 **System Board**

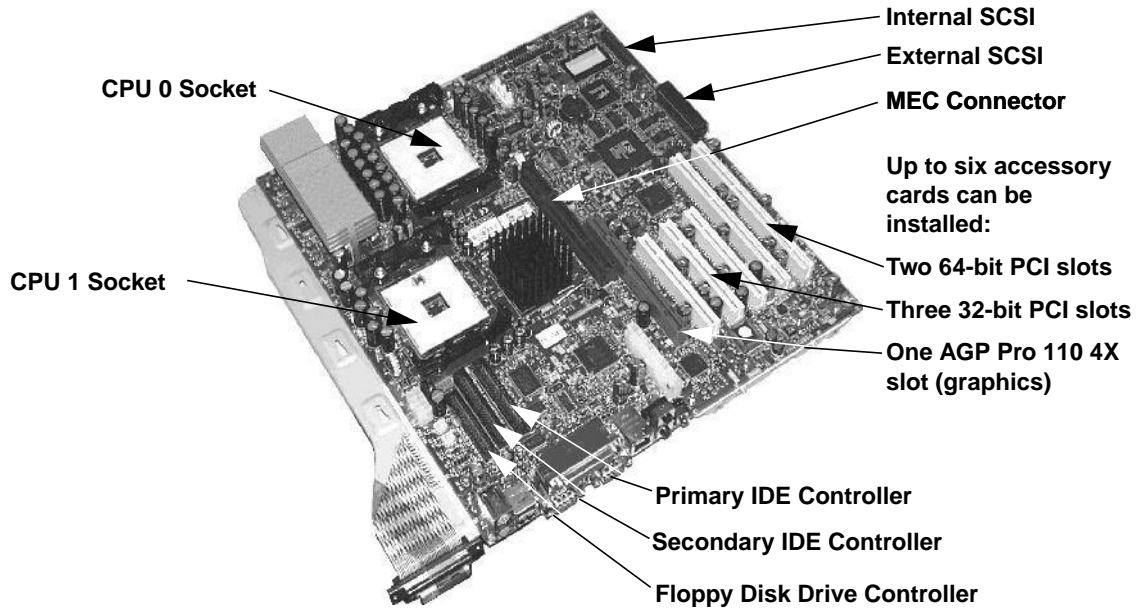
Overview

The following sections describe the system board:

- “System Board Component Layout” on page 27
- “System Chipset” on page 30
- “Expansion Card Slots” on page 35

Figure 2-1 shows the x4000 Workstation system board:

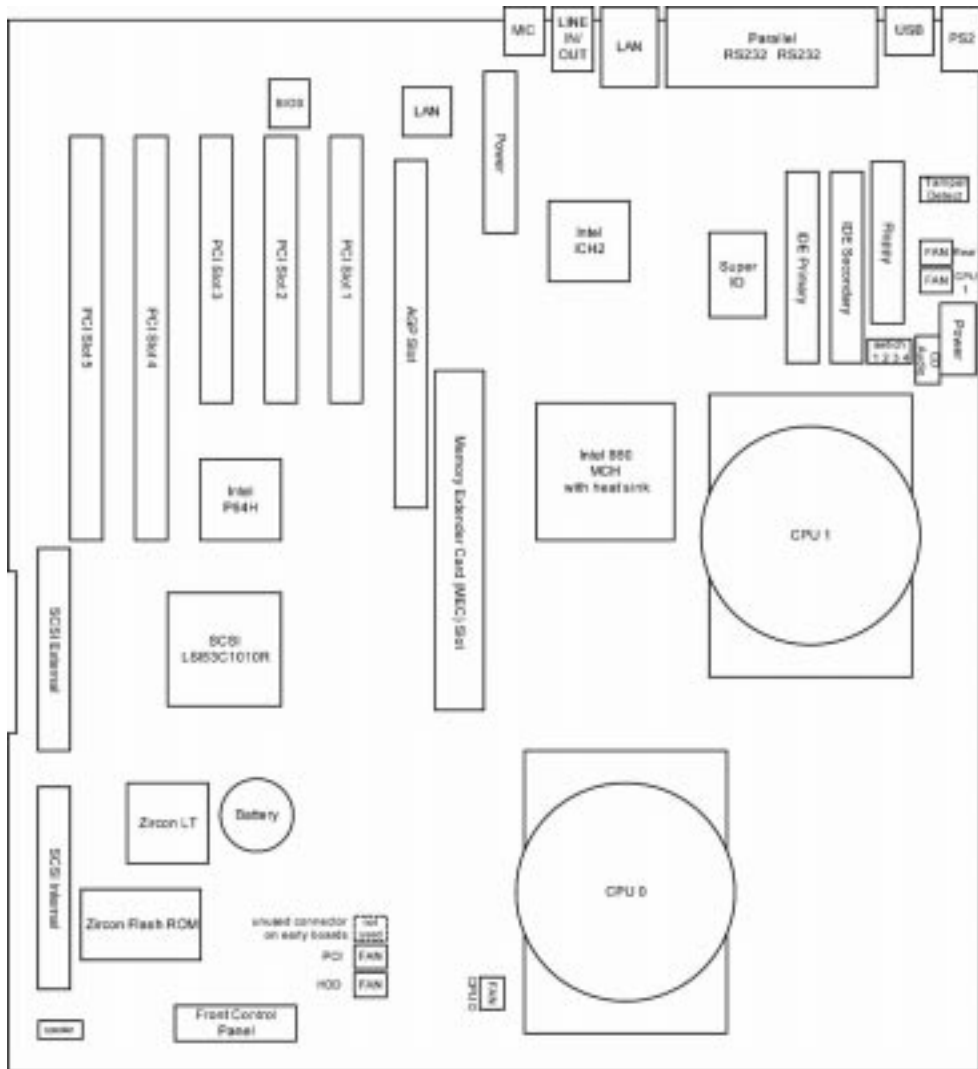
Figure 2-1 **x4000 Workstation System Board**



System Board Component Layout

Figure 2-2 shows where the chips and connectors reside on the system board.

Figure 2-2 System Board Diagram



System Board Switches

The system board includes a 4-pole DIP switch (shown in Figure 2-2), which lets you configure BIOS functions. Because the switches are read only at system start up, you must change the switch positions when the Workstation is shut down.

Switch	Function	Default	Comment
1	Clear BIOS password	Off	Clears both Administrator and User passwords, if they have been set.
2	Boot block recovery	Off	Forces a boot block recovery from a bootable BIOS flash disk in the floppy disk drive.
3	Clear CMOS	Off	Reset CMOS settings to BIOS defaults. You can also do this with the F9 key in the Setup program as described in "Clearing the CMOS" on page 46.
4	Enable safe mode	Off	Force processors to run at 800 MHz. This can be used as a troubleshooting tool or to correct a problem after adding a second processor. Before using this, flash the BIOS as described at www.hp.com/workstations/support . Use this switch as a last resort. If it gets the system running, replace the processors. If the problem persists, replace the system board.

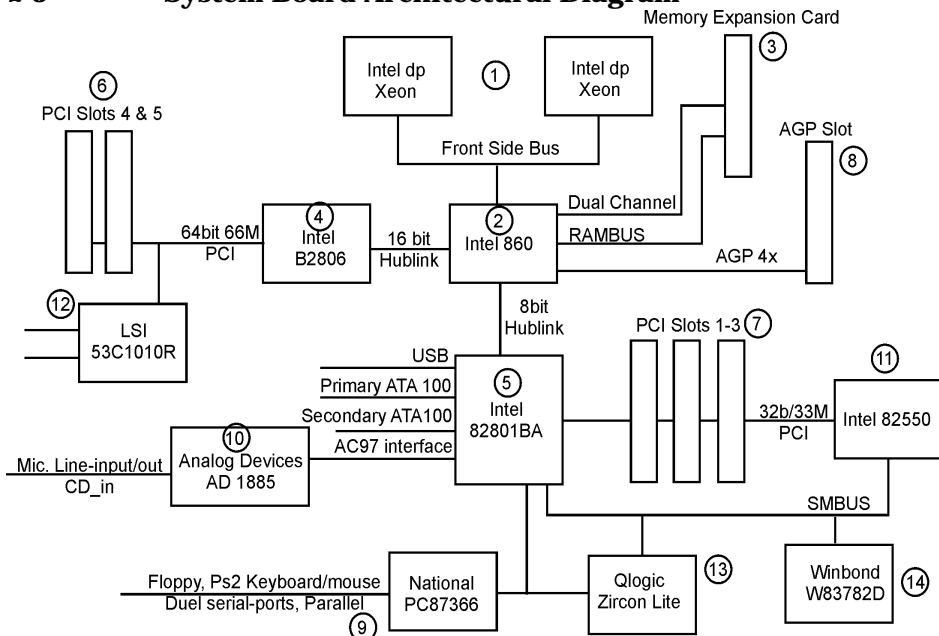
Architectural Diagram

Figure 2-3 enumerates the x4000 system board features:

1. One or two dp Xeon processors
2. Intel 860 memory controller hub (MCH)
3. Memory expansion card
4. Intel 82806 PCI 64-bit Hub (P64H) connected to 16-bit Hublink B
5. Intel 82801BA interface controller hub (ICH2) connected to 8-bit Hublink A

6. Two 3.3V, 66 MHz, 64-bit PCI slots
7. Three 5V, 33 MHz, 32-bit PCI slots
8. One 1.5 V signaling level AGP Pro 110 4X slot
9. National PC87366 Super I/P with connections to:
 - floppy device
 - two 9-pin RS232 connectors serial ports
 - 25-pin ECP/EPP parallel port
 - PS2 mouse
 - PS2 keyboard
10. Analog Devices AD1885 Codec (AC97) audio
11. Intel 82550 10/100 LAN port
12. LSI SYM53C1010R two Ultra160 SCSI controller
13. Zircon Lite hardware management controller
14. Winbond W83782D hardware monitoring ASIC

Figure 2-3 System Board Architectural Diagram



System Chipset

Memory Controller Hub (Intel 860)

The MCH supports:

- The 400 MHz (quad-pumped 100MHz) front side bus for up to two Intel dp Xeon processors
- Two Rambus channels with up to 8 PC800 ECC RIMMs total
- An Accelerated Graphics Port, AGP Pro 110 4x with 1.5V signaling only.
- Two source-synchronous, enhanced, Hublink buses:
 - Hublink A is an 8-bit, 133 MB/s connection to the ICH2
 - Hublink B is a 16-bit, 266 MB/s bus to the P64H

PCI 64-bit Hub (Intel 82086)

P64H provides the interface to the 64-bit, 66 MHz PCI bus with embedded SCSI controller chip and two 3.3 V PCI slots.

When 33 MHz cards are present, the P64H detects this condition and lowers the bus frequency to 33 MHz. Only 3.3 V cards can be used.

Interface Controller Hub (Intel 82801BA)

The ICH2 is the interface to:

- a 32-bit, 33 MHz PCI bus with embedded LAN and three 5 V PCI slots
- Two ATA100 IDE Controllers, which support DMA transfers rates for up to four devices

The IDE/ATA interface on the x4000 is provided primarily for use with optical devices

NOTE

The x4000 Workstation is optimized for use with SCSI hard disk drives. IDE hard disk drives are not tested or recommended in the x4000.

- Two external USB ports which are USB 1.1 compliant ports with over-current protection and support for wake up from S1 (sleep) state (USB mouse and keyboard are not supported).
- Audio
- Super I/O
- SMBUS

Super I/O Chip (National PC87366)

The Super I/O provides the interface to:

- Two serial ports (A and B). The serial port interface voltage levels are established by DS14185A communication port interface chips.
- One EPP parallel port
- Floppy disk drive
- PS2 Keyboard
- PS2 Mouse

LAN Chip (Intel 82550)

The LAN chip:

- Is 10/100 Base T
- Is IEEE 802.3 compliant
- Is on the 33 MHz, 32-bit PCI bus
- Supports Wake-on-LAN via the PME# signal
- Stores configuration information on attached EEPROM chip

SCSI Controller Chip (LSI SYM43C1010R)

The SCSI chip is a 64 bit/66 MHz PCI DMA bus master device. It includes 2 Ultra160 SCSI controllers, each with it's own independent channel. One channel is connected via ribbon cable to up to two internal SCSI devices. The other channel is routed to a back-panel connector to support external devices

SCSI features:

- **Double Transition (DT) clocking.** DT Clocking permits data transfer up to 160 MB/s on each channel, for a total of 320 MB/s
- **Cyclic Redundancy Check (CRC).** CRC improves the integrity of the SCSI data transmission through enhanced detection of communication errors. This is augmented with Asynchronous Information Protection to provide complete end-to-end protection of the SCSI I/O.
- **Domain Validation.** SureLink Domain Validation automatically tests and adjusts the SCSI transfer rate to ensure data integrity at the fastest speed.
- **LVD and Single-ended (SE) transfers.** If an SE device is connected, the channel it is connected to operates as an SE bus.
- **PCI 2.2 compliant**

Audio Chip (Analog Devices AD 1885)

The on-board audio is provided by an Analog Devices AD1885 CODEC (AC97). The audio connections are:

- headphone/lineout output (external)
- line-in input (external)
- microphone input (external)
- CD-ROM input (internal)
- internal speaker output (internal)

The output to the internal speaker is amplified via an LM4871 audio amplifier to provide the power level needed by the speaker.

A voltage regulator is used to provide a clean +5 volt supply for the CODEC's analog section, the internal speaker amplifier, and the microphone bias supply.

The **jacksense1** input of the CODEC is used to switch the audio output from the internal speaker to the headphone/lineout jack when a cable is plugged in the jack (this includes the keyboard's audio pass-through cable).

Voltage dividers are provided on the line-in and CD-ROM inputs to meet PC99 specification requirements.

Hardware Management Controller Chips

The x4000 Workstation is monitored and managed by two chips on the SMBUS;

- The Qlogic Zircon Lite micro-controller drives the Diag LEDs and the Power Button LED on the control panel.
- The Winbond WB782D ASIC monitors voltage levels and control fans.
- The SMBUS is a low frequency bus that communicates system state and error information among integrated circuits..

Clocks

Table 2-1 describes the clocks used in the x4000 Workstation.

Table 2-1 **Clocks**

Name	Description
System	A CK00-compliant clock synthesizer in a single CKx_SKS clock chip creates the main system clocks using a 14.318 MHz parallel mode crystal reference.
Memory	Two Direct Rambus Clock Generator (DRCG) chips provide the clocks for the expansion channels to the Memory Expansion Card (MEC). Using the 50 MHz reference clock provided by the system clock generator, each DRCG produces the 400 MHz differential clock needed by the memory expansion channel. The Memory Controller Hub (MCH) provides two pairs of feedback signals to the DRCGs to keep the Host and RDRAM clocks aligned.
Real Time Clock (RTC)	A 32.768 KHz parallel mode crystal is the reference for the ICH2 real-time clock circuitry.
Audio	A 24.576 MHz parallel mode crystal is the reference for the Audio Codec.
Local Area Network (LAN)	A 25 MHz parallel mode crystal provides a frequency reference for the 82550's internal oscillator.
SCSI	A 40 MHz oscillator provides the SCSI controller SCLK.
Zircon	A 10 MHz oscillator clocks the Zircon chip.

Expansion Card Slots

The x4000 expansion card slots are described in the following sections:

- “Peripheral Component Interconnect (PCI) Slots” on page 35
- “Accelerated Graphics Port (AGP) Slot” on page 36
- “System Memory and Processors” on page 37

Peripheral Component Interconnect (PCI) Slots

The x4000 system board has five PCI slots available:

- Three 5 V, 33 MHz, 32-bit slots
- Two 3.3 V, 66 MHz, 64-bit slots

NOTE

Cards requiring 5 V must go in the 32-bit slots. Cards requiring 3.3 V must go in the 64-bit slots. Universal cards, which use either voltage, can be placed in either slot, but can only function at 66 MHz in the 64-bit slots.

The total power consumption across all used PCI slots depends on what type of AGP graphics card is installed. When there is an AGP Pro 50 card, the maximum is 80W total across all PCI slots. When there is an AGP Pro 110 card, the maximum is 45W. The power consumption must comply with the electrical specifications of the PCI 2.2 specification.

Table 7-1 on page 94 describes the PCI 33 MHz, 32-bit connector. Table 7-2 on page 97 describes the PCI 66 MHz, 64-bit connector.

Accelerated Graphics Port (AGP) Slot

The 1.5 V, AGP Pro 110 4X slot provides graphics performance for high-end graphics cards, combining AGP 4X bandwidth (data transfer rates as fast as 1056 MB/sec) with the ability to accept high-end graphics cards drawing up to 110 W of power.

To accommodate AGP Pro cards, the AGP Pro 110 4X slot connector is wider than the standard AGP 4X connector. To meet the increased power requirements of AGP Pro graphics cards, additional pins are present at both ends of the connector.

An AGP Pro card may draw power either from the existing part of the AGP Pro 110 4X connector, the extended part, or a combination of the two. In all cases, the maximum power that an AGP Pro card may draw is limited to 110 W in the Workstation models. Power on the existing part of the connector is delivered on 5.0 V and 3.3 V rails. Power on the extension is delivered on the 12 V and 3.3 V rails.

You can use either standard AGP graphics cards or AGP Pro graphics cards that draw less than 110 W of power. Power is provided through 3.3 V, 5 V, or 12 V power rails.

CAUTION

Do not use AGP Pro cards that draw more than 110 W or 3.3 V.

The AGP Pro 110 4X slot is backward compatible with both AGP 1x and 2.x modes (using 1.5 V signalling) and AGP 4x mode (where 1.5 V signalling is necessary).

Table 7-3 on page 102 describes the AGP Pro 110 4X connector.

3 System Memory and Processors

Overview

This chapter contains information on the x4000:

- “System Memory” on page 39
- “Processor” on page 41

System Memory

The main memory for the x4000 Workstation is not located on the system board. Instead, a Memory Expander Card (MEC) plugs into the system board and contains up to eight memory modules. PC800 Rambus In-Line Memory Modules (RIMMs) with Error Correction Code (ECC) are installed on the MEC in pairs.

Rambus

The layout of RDRAM channels on the MEC follows Rambus recommendations that minimize trace noise. This puts pair members diagonal to each other on the MEC. RDRAM achieves high speed transmission through a combination of techniques:

- dense packaging
- high quality transmission lines
- topology

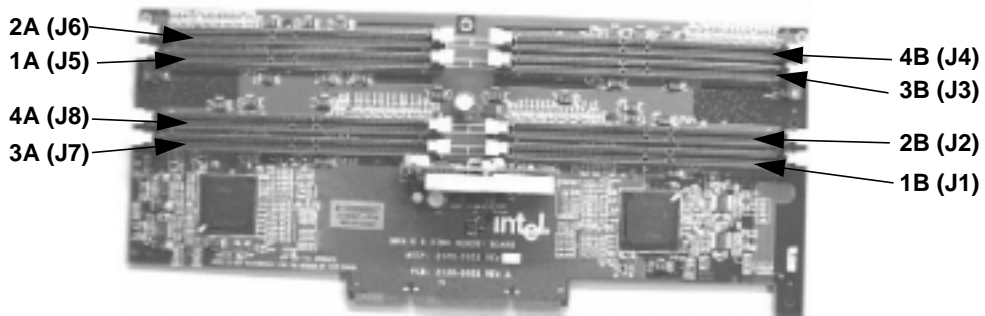
The MEC RIMMs must be loaded in a specific order. Memory loading rules are explained in “Upgrading Memory on the 8-RIMM MEC” on page 159.

Each direct RDRAM channel contains two RIMM slots and is terminated at the end opposite from the memory controller. If only one RIMM is in the channel then the other slot must be filled with a Continuity RIMM (CRIMM) in order to allow a continuous path from the controller, through both slots, to the hard-wired terminator at the other end.

Eight-RIMM MEC

The eight-RIMM MEC can have the voltage regulator hardwired on the MEC or it may have the removable module (VRM). The MEC shown in Figure 3-1 has a VRM slot.

Figure 3-1 **x4000 8-RIMM Memory Expander Card**



The eight-RIMM MEC uses two memory repeater hubs for RDRAM (MRH-R). Each MRH-R supports two Direct RDRAM channels with two RIMMs per channel. The Memory Controller Hub (MCH) interfaces to the MEC using an expansion channel for each MRH-R. The MEC supports 400 MHz operation delivering up to 3.2 GB/s memory bandwidth using two expansion channels operating in lock step. The expansion channel is a super set of the Direct RDRAM channel using an additional two Rambus Signaling Levels (RSL) to communicate channel and control information from the MCH to the MRH-R. The RDRAM memory interface can achieve greater than 95% use of the maximum bandwidth.

Processor

The x4000 supports up to two Intel dp Xeon processors on a 400 MHz front side bus (quad-pumped 100 MHz frequency). Xeon processor features include:

- L1 and L2 cache on die
- L2 is 256 KB 8-way set associative
- NetBurst MicroArchitecture with 20-stage instruction pipeline

System Memory and Processors
Processor

4 **System BIOS and Resources**

Overview

This chapter contains information on:

- “System BIOS” on page 45
- “HP Setup Program” on page 49
- “BIOS Beep Codes” on page 59
- “System Resources” on page 60

System BIOS

The HP x4000 Workstation BIOS is based on a Phoenix BIOS and is compliant with:

- ACPI 1.0
- PCI 2.2
- PnP 1.0a
- DMI 2.0
- WFM 2.0
- MPS 1.4
- PC 99 (fast boot)

The BIOS supports:

- up to six processor microcodes
- boot block recovery mode
- administrator and user passwords
- configuration summary screen
- setup program
- temporary boot priority
- fast boot
- POST routines

The system ROM contains the Power-On Self-Test (POST) routines and the BIOS: the system BIOS, video BIOS, and low-option ROM. This chapter gives an overview of the following:

- Menu-driven Setup with context-sensitive help.
- POST routines, which are a sequence of tests the computer performs to ensure that the system is functioning correctly

BIOS Identification

The system BIOS is identified by the version number *XX.YM.mm*, where:

- *XX* is a two-letter code indicating the system
- *Y* is a one-letter code indicating the HP entity
- *M* is the major BIOS version
- *mm* is the minor BIOS version

Updating the System BIOS and Firmware

You can download the latest system BIOS and firmware for the HP x4000 workstations from HP's Web site at www.hp.com/workstations/support

Instructions for downloading and updating the BIOS and firmware are posted on the download site and are included as a text file in the downloadable file.

CAUTION

Don't turn off the computer until the system BIOS and firmware update procedure has completed. Otherwise, irrecoverable damage to the ROM might occur. If the power fails during the BIOS flash you may be able to restore the previous BIOS from the boot block. See "Recovering the BIOS from the Boot Block" on page

Restoring BIOS Default Settings

BIOS and configuration issues may cause suspected hardware errors. If the BIOS settings are wrong, perform the following steps to restore the BIOS to its default setting:

1. To access the Setup program, press **F2** while the initial HP logo displays immediately after restarting the workstation.
2. Press **F9** to load the default settings from the Setup program.
3. In the main menu, set the Reset Configuration Data to **Yes**.

NOTE

Take note of the current settings in the system setup utility before you make any modifications to the BIOS.

Clearing the CMOS

To clear the CMOS:

1. Turn off the Workstation, disconnect the power cord and all cables, then remove the cover.

2. Set system board switch 3 to ON. See “System Board Switches” on page 28.
3. Replace the cover, and reconnect the power cord and display cable.
4. Restart the Workstation. A message similar to the following appears:

```
“Configuration has been cleared, switch "Clear Configuration" to OFF position before rebooting.”
```
5. Turn off the Workstation, disconnect the power cord and display cables, and remove the cover. (You must press the power button for 5 seconds to get the system to power down.)
6. Set system board switch 3 to OFF.
7. Replace the cover, and reconnect the power cord and data cables.
8. Turn on the Workstation.
9. When prompted, press F2 to run Setup. See “Starting the HP Setup Program” on page 49 for more information about the Setup program.
10. Press F9. The system automatically downloads and saves the CMOS default values.
11. Exit Setup and save the new configuration.

Recovering the BIOS from the Boot Block

If you can't use the standard BIOS flash, the BIOS could be corrupted and unable to boot. You may be able to recover the BIOS from the Boot Block on the system board.

1. Obtain a bootable DOS floppy disk.
2. Copy the BIOS files onto the floppy disk. For information about how to download the system BIOS, see “Updating the System BIOS and Firmware” on page 46.
3. Create (or edit) the autoexec.bat file, which should contain the following line of text:

```
“phlash16 /c /mode=3 /s <BIOS filename>.wph”
```

(Rename the BIOS filename with the filename on the floppy disk.)
4. Turn off the Workstation, disconnect the power cord, and remove the cover.

System BIOS

5. Set switch 2 on the system board to **ON**. See “System Board Switches” on page 28.
6. Insert the floppy disk into the floppy disk drive.
7. Reconnect the power cord, and turn on the Workstation.
8. The workstation boots from the floppy disk, then flashes the BIOS. During the flash process, the screen remains blank. When you hear one long beep, the recovery process is finished.
9. Turn off the Workstation. Remove the floppy disk from the drive. Remove the power cord and display cables, and remove the cover. (You must press the power button for 5 seconds to get the system to power down.)
10. Set switch 2 back to **OFF**.
11. Replace the cover, reconnect the power cord, and reboot the Workstation.

HP Setup Program

The HP Setup program lets you configure your Workstation. You can:

- set up the system Administrator and User passwords
- change the system boot order
- solve configuration problems

HP recommends you note any changes you make to the system setup for later reference.

Starting the HP Setup Program

To start the Setup program:

1. Start your Workstation. If your Workstation is already up, shut it down and restart.
2. Press **F2** while **F2 Setup** is displayed at the bottom of the screen. If you fail to press **F2** in time and the start-up process continues, you must allow your system to finish booting up, then restart your Workstation and go through the POST again.

The opening screen of the Workstation's Setup program is displayed:

- A band along the bottom of the screen gives instructions on using the keyboard-driven menus:
 - **F1**: Help
 - **F7/F8**: Change value
 - **F9**: Return to system configuration to default
 - **F10**: Return to previous value
 - Up/Down arrow keys: Highlight an item or menu
 - **Enter**: Select an item or menu
 - **Esc**: Exit

- A band along the top displays the menus. For more information on the menus, see:
 - “Main Menu” on page 51
 - “Advanced Menu” on page 52
 - “Security Menu” on page 55
 - “IPMI Menu” on page 56
 - “Boot Menu” on page 57
 - “Power Menu” on page 57

Main Menu

Table 4-1 describes the functions available in the Setup program Main menu.

Table 4-1 Main Menu

Field	Description
BIOS Version	This field is view-only. It displays your current BIOS version. You can compare this to the most recent available BIOS located at www.hp.com/workstations/support .
Operating System	This field indicates the currently selected operating system. The BIOS needs this information to understand how to handle Plug-and-Play configuration and Quick Boot. If you are using different operating systems and don't want to modify this field every time you run a different one, select the default Other option.
Reset Configuration Data	When you reset configuration data, the BIOS dynamically reallocates resources (IRQs, I/O, memory) to cards and motherboard devices at the next boot. It then sets this field back to No . You would not select Yes and choose to reset your configuration data unless you were having problems with your Workstation.
System Time	The system time format is based on a 24-hour clock.
Numlock at Power-On	Use this field to specify whether the number keys on the number keypad are enabled when your computer starts. Otherwise, the number keypad keys act as cursor control keys.
System Date	The system date format is mm/dd/yyyy.

Advanced Menu

Table 4-2 describes the submenus available in the Setup program Advanced menu.

Table 4-2 **Advanced Menu**

Field	Description
Processors	Displays the type and the speed of the processor(s) you have in your Workstation. You can change your processor speed in the Processor Speed field by selecting a value from the drop down menu. Your processor cannot run any faster than what is displayed in the Current Type field. If you leave Processor Speed set to the default of Auto , the processor speed is automatically detected. Use a fixed frequency for troubleshooting only.
Chipset	<p><i>Memory Error Checking:</i> You can choose between ECC and Disabled. ECC scrubbing checks for and corrects errors at the source to prevent them from reoccurring. Change this field to Disabled if you want to find errors, but don't want them corrected.</p> <p><i>ECC Error Type:</i> When an ECC error occurs, it generates an interrupt. In this field, you can select the type of interrupt you want reported: NMI (Non-Maskable), SMI (System Management), SCI, (System Control), or None.</p> <p><i>SERR signal condition:</i> In this field, you can select the type of ECC error condition that triggers a critical system error (SERR#). Normally, only Multiple bit (unrecoverable) errors should be able to trigger SERR#. But you can also choose Single bit, None, or Both.</p>
Floppy Disk Drive	Contains the floppy disk drive type and controller fields. If you choose to disable your floppy disk drive, you must also disable your floppy disk controller.
IDE Devices	Lets you configure the settings for the IDE controller and any attached IDE devices.

Table 4-2 Advanced Menu

Field	Description
<p>Integrated SCSI Controller</p>	<p>Lets you configure the settings for the SCSI controller and any attached SCSI devices.</p> <p><i>Integrated SCSI:</i> The integrated SCSI ASIC has two controllers and this enables or disables both at the same time. You cannot disable just one SCSI controller.</p> <p><i>Option ROM Scan:</i> Enable this option if the SCSI device is used to boot the operating system. If too many option ROMs are enabled, some may not load due to insufficient available shadow memory. Always disable any that aren't needed.</p> <p><i>Enable Master:</i> The BIOS normally leaves Bus Mastering disabled, and the Operating System enables it when starting. Set this field to Enabled if you have a bus-mastering device and the device driver cannot enable bus mastering by itself.</p> <p><i>Latency Timer:</i> This field sets the minimum guaranteed time slice allotted for bus master, expressed in PCI bus clock cycles. The bigger the value, the greater the share of the bus to the device.</p>
<p>Integrated Network Interface</p>	<p>Lets you configure the settings for the integrated 10/100BT network interface. These fields are identical to the Integrated SCSI Controller fields listed above.</p>
<p>Integrated USB</p>	<p>Lets you configure the settings for the integrated USB interface. These fields are identical to the Integrated SCSI Controller fields listed above except there is no Option ROM Scan.</p>

Table 4-2 **Advanced Menu**

Field	Description
Integrated I/O Ports	Lets you configure both the integrated serial and parallel ports. <i>Serial port A, Serial port B, or Parallel Port:</i> These fields contain three choices. Auto lets the BIOS or a PnP OS configure the port. Enabled lets you set each resource. Disabled leaves the port disabled by the BIOS, but a PnP OS can still enable it. <i>Parallel Port Mode:</i> You can set the parallel port mode to Output only , Bi-directional , EPP , or ECP .
Integrated Audio	Lets you configure the integrated PCI audio controller. These fields are identical to the Integrated SCSI Controller fields listed above except there is no Option ROM Scan.
AGP Pro 110 4X Slot (Graphics)	Lets you configure your AGP Pro 110 4X slot. The first two fields describe the installed graphics card. The Enable Master and Latency Timer fields are described in the Integrated SCSI Controller entry above. <i>Graphics Aperture:</i> This field contains a pull-down menu that lets you choose the size of the graphics aperture for the AGP video device.
PCI Device Slot #	Lets you configure a PCI device plugged into the specified slot. The first two fields describe the installed PCI card. The next three fields are identical to the Integrated SCSI Controller fields listed above.

Security Menu

Table 4-3 describes the fields available in the Setup program Security menu.

Table 4-3 Security Menu

Field	Description
Administrator Password	This field is view-only. It tells you whether there is an Administrator password set.
Set Administrator Password	This password prevents unauthorized access to this your Workstations Setup program. This password can also be used to start the computer when the power-on password is Enabled . You must set an administrator password before you can set a user password.
Clear All Passwords	Selecting this field and pressing Enter clears both the User and Administrator passwords.
User Password	This field is view-only. It tells you whether there is a User password set.
Set User Password	If an administrator password has been set, you can enter this field to set a user password. The User password prevents unauthorized access to this your Workstations Setup program. This password can also be used to start the computer when the power-on password is Enabled .
Power-On Password	If Enabled , you must enter a password before the Workstation boots. You can only enable this field if an administrator password has been set.
Start from Floppy	If Disabled , unauthorized use of the floppy disk drive to start the computer is prevented. (The drive is still available for reading and writing data.)
Start from CD-ROM	If Disabled , unauthorized use of the CD-ROM to start the computer is prevented. (The drive is still available for reading data.)

Table 4-3 Security Menu

Field	Description
Start from Hard Disk Drive	If Disabled , unauthorized use of the hard disk drive to start the computer is prevented. (The drive is still available for reading and writing data.)
Write on Floppy Disks	If Locked , users are prevented from copying information to a diskette.
Locked Setup Configuration	If Locked , a Plug-and-Play operating system cannot change the BIOS configuration settings.
Hard Disk Boot Sector	If Locked , the boot sector on the hard disk drive is protected against viruses.

IPMI Menu

This menu contains one field that lets you choose to force the BIOS to clear the System Event log.

Power Menu

Table 4-4 describes the functions available in the Setup program Power menu.

Table 4-4 Power Menu

Field	Description
Remote Power-On	Lets you enable remote power-on (wake-up) from devices and operating systems that support this feature.
After Power Failure	If you experience a power failure, the setting for this field determines the state the Workstation returns to when power is restored. Power On turns the Workstation back on. Stay Off leaves the Workstation off and disables remote power-on. Last State restores the state the Workstation was in when the power failed.

Boot Menu

Table 4-5 describes the functions available in the Setup program Boot menu.

Table 4-5 Boot Menu

Field	Description
QuickBoot Mode	QuickBoot involves skipping some Power-On-Self-Test (POST) tasks, such as floppy seek test and memory check. However, QuickBoot cannot skip ECC initialization. If a chassis-intrusion was detected, an invalid CMOS checksum was encountered, or there was a CMOS battery failure, a full POST is performed regardless of this setting. (CMOS is volatile memory powered by a battery that contains data needed by the BIOS.)
Display Option ROM Messages	Allows the POST screen to display the Option ROM messages. You should enable it when you install an accessory board.

Table 4-5 **Boot Menu**

Field	Description
Preferred Video	If you have two video cards, this field allows you to choose which one to use during boot.
Boot Device Priority	Lets you select the device boot order.

BIOS Beep Codes

If a terminal error occurs during POST, the system issues a beep code before attempting to display the error in the upper left corner of the screen. Beep codes are useful for identifying the error when the system is unable to display the error message.

Beep Code	Numeric Code	Description
1-2-2-3	16h	BIOS ROM checksum failure
1	B4h	one short beep before boot
1-3-1-1	20h	DRAM refresh test failure
1-2	98h	Video configuration failure or option ROMs checksum failure
1-3-1-3	22h	8742 Keyboard controller test failure
1-3-3-1	28h	Memory initialization failure
1-3-4-1	2Ch	RAM failure on address line xxxx ^a
1-3-4-3	2Eh	RAM failure on data bits xxxx1 of low byte of memory bus
2-1-2-3	46h	ROM copyright notice check failure
2-2-3-1	58h	Unexpected interrupts test failure
4-4-2-4	F7	Crisis Recovery Failure

- a. If the BIOS detects error 2C or 2E (base 512K RAM error), it displays an additional word-bitmap (xxxx) indicating the address line or bits that failed. For example, "2C 0002" means address line 1 (bit one set) has failed. "2E 1020" means data bits 12 and 5 (bits 12 and 5 set) have failed in the lower 16 bits.

System Resources

System resources consist of:

- “PCI IRQ Lines” on page 60
- “IRQ Routing” on page 61
- “System Memory Map” on page 65
- “I/O Port Map (I/O Addresses Used by the System)” on page 65
- “DMA Channel Controllers” on page 67
- “Interrupt Controllers” on page 63

PCI IRQ Lines

PCI devices generate IRQs using up to four PCI IRQ lines (INTA#, INTB#, INTC#, and INTD#).

PCI interrupts can be shared; several devices can use the same interrupt. However, optimal system performance is reached when minimizing the sharing of interrupts. Refer to “Interrupt Controllers” on page 63 for a table of the PCI device interrupts.

IRQ Routing

Figure 4-1 shows the IRQ graphical representation. Table 4-6 describes the routing shown in Figure 4-1.

Figure 4-1 **IRQ Diagram**

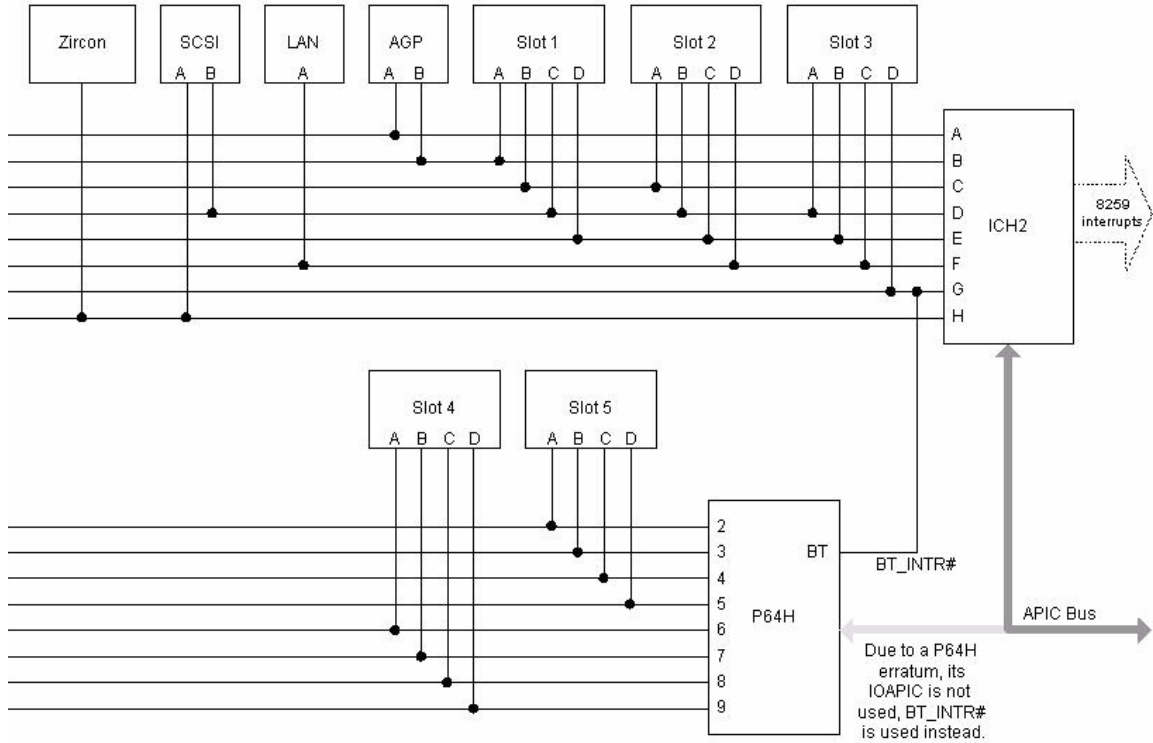


Table 4-6 **IRQ Routing Table**

Device	Interrupt	ICH2 IRQ	P64H IRQ
AGP	A	A	
AGP	B	B	
PCI Slot 1	A	B	
PCI Slot 1	B	C	
PCI Slot 1	C	D	
PCI Slot 1	D	E	
PCI Slot 2	A	C	
PCI Slot 2	B	D	
PCI Slot 2	C	E	
PCI Slot 2	D	F	
PCI Slot 3	A	D	
PCI Slot 3	B	E	
PCI Slot 3	C	F	
PCI Slot 3	D	G	
PCI Slot 4	A		6
PCI Slot 4	B		7
PCI Slot 4	C		8
PCI Slot 4	D		9
PCI Slot 5	A		2
PCI Slot 5	B		3
PCI Slot 5	C		4
PCI Slot 5	D		5
P64H BT_INTR#	G		

Table 4-6 **IRQ Routing Table**

Device	Interrupt	ICH2 IRQ	P64H IRQ
82550 LAN	A	F	
53C1010R	A	H	
53C1010R	B	D	
Zircon	(All)	H	

Interrupt Controllers

The system's interrupt controller is equivalent in function to two 82C59 interrupt controllers. The following table shows how the interrupts are connected to the APIC controller. The IRQs are numbered sequentially, starting with the master controller and followed by the slave (both of 82C59 type).

I/O APIC Input	IRQ	IRQ Description
INTIN0	ICH	
INTIN1	IRQ1	Super I/O keyboard controller
INTIN2	IRQ0	ICH system timer
INTIN3	IRQ3	Super I/O - Used by serial port if enabled
INTIN4	IRQ4	Super I/O - Used by serial port if enabled
INTIN5	IRQ5	Free if not used for parallel port or audio
INTIN6	IRQ6	Super I/O - floppy disk controller
INTIN7	IRQ7	Super I/O - LPT1
INTIN8	IRQ8	ICH - RTC
INTIN9	IRQ9	Available for PCI devices
INTIN10	IRQ10	Available for PCI devices
INTIN11	IRQ11	Available for PCI devices
INTIN12	IRQ12	Super I/O - mouse
INTIN13	IRQ13	Coprocessor
INTIN14	IRQ14	ICH - Integrated IDE Controller (primary)

System BIOS and Resources
System Resources

I/O APIC Input	IRQ	IRQ Description
INTIN15	IRQ15	ICH - Integrated IDE Controller (secondary)
INTIN16	PCINTA	
INTIN17	PCINTB	
INTIN18	PCINTC	
INTIN19	PCINTD	
INTIN20	TFPC IRQ	
INTIN21	SCI IRQ	
INTIN22	not connected	
INTIN23	ICH SMI (not used)	

Three major interrupt modes are available:

- **PIC mode:** This mode uses only legacy interrupt controllers, so the system can support only one processor. You can select this mode when you install Windows NT.
- **Virtual wire mode:** This mode, which is implemented using the 82C59 interrupt and the I/O APIC controller, is used during boot time. The virtual wire mode allows the transition to the symmetric I/O mode. In the virtual wire mode, only one processor executes operations.
- **Symmetric I/O mode:** This mode is implemented using the I/O APIC controller and allows for multiple processor operations.

NOTE

In PIC mode and virtual wire mode, PCI interrupts are routed to the INT line. In symmetric I/O mode, PCI interrupts are routed to the I/O APIC controllers and forwarded over an APIC bus to the processors.

System Memory Map

Reserved memory that accessory boards use must reside in the area from C8000h to EFFFFh.

0000 0000 - 0000 03FF	Real-mode IDT
0000 0400 - 0000 04FF	BIOS data area
0000 0500 - 0009 FC00	Used by operating system
0009 FC00 - 0009 FFFF	Extended BIOS data area
000A_0000 - 000B_FFFF	Video RAM or SMRAM (not visible unless in SMM)
000C 0000 - 000C 7FFF	Video ROM (VGA ROM)
000C 8000 - 000F FFFF	Adapter ROM, RAM, memory-mapped registers, BIOS
000E 0000-000F FFFF	128KB BIOS (Flash/Shadow)
0001 0000-000F FFFF	Memory (1MB to 16MB)
0010 0000-001F FFFF	Memory (16MB to 32MB)
0020 0000-003F FFFF	Memory (32MB to 64MB)
0040 0000-007F FFFF	Memory (64MB to 128MB)
0080 0000-FFFF FFFF	Memory (128MB to 4GB)
FECO 0000	I/O APIC
FEEO 0000	Local APIC (each CPU)
FFF8 0000-FFFF FFFF	512KB BIOS (Flash)

I/O Port Map (I/O Addresses Used by the System¹)

You access peripheral devices, accessory devices, and system controllers through the system I/O space, which isn't located in system memory space. The 64 KB of addressable I/O space comprises 8-bit and 16-bit registers (called I/O ports) located in the various system components. When you install an accessory board, ensure that the selected I/O

1. If configured.

System BIOS and Resources
System Resources

address space is in the free area of the space reserved for accessory boards (100h to 3FFh).

Default Values for I/O Address Ports	Function
0000 - 0CF7	DMA controller 1
0020 - 0021	Master interrupt controller (8259)
002E - 002F	Super I/O
0040 - 0043	Timer 1
0060, 0064	Keyboard controller (reset, slow A20)
0061	Port B (speaker, NMI status, and control)
0070	Bit 7: NMI mask register
0070 - 0071	RTC and CMOS
0080	Manufacturing port (POST card)
0081 - 0083, 008F	DMA low page register
0092	PS/2 reset and Fast A20
00A0 - 00A1	Slave interrupt controller
00C0 - 00DF	DMA controller 2
00F0 - 00FF	Coprocessor error
0170 - 0177	Free (IDE secondary channel)
01F0 - 01F7	IDE primary channel
0278 - 027F	LPT 2
02E8 - 02EF	Serial port 4 (COM4)
02F8 - 02FF	Serial port 2 (COM2)
0372 - 0377	Free (IDE secondary channel, secondary floppy disk drive)
0378 - 037F	LPT1
03B0 - 03DF	VGA
03E8 - 03EF	COM3
03F0 - 03F5	Floppy disk drive controller
03F6	IDE primary channel
03F7	Floppy disk drive controller
03F8 - 03FF	COM1
04D0 - 04D1	Interrupt edge/level control
0778 - 077F	LPT1 ECP
0CF8 - 0CFF	PCI configuration space

Default Values for I/O Address Ports	Function
C000 -	Power management I/O space and ACPI registers
C100 - C10F	SMBus I/O space

DMA Channel Controllers

The system permits only I/O-to-memory and memory-to-I/O transfers. The hardware configuration doesn't allow I/O-to-I/O or memory-to-memory transfers.

The system controller supports seven DMA channels, each with a page register that extends the channel's addressing range to 16MB.

The following table shows how the system allocates DMA channels.

DMA controller	
Channel	Function
DMA 0	Free
DMA 1	Free if not used for parallel port in Setup
DMA 2	Floppy disk drive controller
DMA 3	Free if not used for parallel port in Setup
DMA 4	Used to cascade DMA channels 0-3
DMA 5	Free
DMA 6	Free
DMA 7	Free

System BIOS and Resources
System Resources

5**Hardware Management
(Monitoring and Reporting)**

Overview

This chapter contains the following topics:

- “General Firmware Information” on page 71
- “Hardware Monitoring” on page 72
- “Reporting” on page 77
- “Security” on page 79

General Firmware Information

Firmware processing is provided by QLogic's Zircon Lite chip and an auxiliary Winbond chip. The firmware implements industry standard IPMI Specification 1.0 with the following extensions:

- BIOS configuration tokens
- Additional hardware control
- BIOS security

KCS 1 and BT protocols are supported. Only KCS 1 is used during BIOS POST. BT is supported at run-time (after the operating system boots).

Date/Time Initialization

The Zircon Lite's date and time is initialized after each power-on by the BIOS. This enables accurate logging of timestamp information for events in the SEL.

SEEPROM Organization

There are three Atmel SEEPROMs attached to the main SMBUS for information storage. These contain the SEL, FRU, and HP NBA Tokens. The FRU stores the product model, serial number, and other chassis and system board information.

Hardware Monitoring

Built-in Self Test (BIST)

Zircon Lite does a BIST after resetting and displays the result on the Diag LEDs (see “Understanding the Diag LEDs” on page 212) if an error occurs. The following items are checked:

- Accessibility of SEL device
- Accessibility of FRU device
- Accessibility of SDR Repository (read only)
- Viability of Hardware Management Controller (HMC) firmware (firmware corrupt)
- HMC hardware problem (general HMC failure)

Sensor Scan

Voltages, temperatures, fan tachometers, processor-related items, and chassis intrusion are scanned.

Voltages

Pin 10 of Winbond W83782D is be used as a 2.5 V reference. This voltage is used to calibrate all of the voltage readings in Table 5-1.

Table 5-1 Voltage Scan

Sensor #	Sensor ID	Signal	Approx. Lower Limit	Mid	Approx. Upper Limit	Zircon Pin	Winbond Pin	Description
20h	+12VIO	+12VIO	10.7V	12V	13.2V	9	-	12V Supply for non-VRM
21h	+3.3VSB	3.3VSB	3.05V	3.3V	3.55V		35	3.3V Standby
22h	+2.5V	2.5V	2.3V	2.5V	2.7V	7	-	2.5V RDRAM Supply

Table 5-1 Voltage Scan

Sensor #	Sensor ID	Signal	Approx. Lower Limit	Mid	Approx. Upper Limit	Zircon Pin	Winbond Pin	Description
23h	VDDQ	VDDQ	1.4V	1.5V	1.6V	5	-	AGP Termination Voltage
24h	+1.8VSB	SB1_8	1.65V	1.8V	1.95V	4	-	1.8V Standby
25h	+1.8V	P1_8V	1.65V	1.8V	1.95V	3	-	1.8V Supply
26h	VCC_CORE	VCC_CORE	1.1V	1.65V	1.9V	-	36	Processor Core Voltage
27h	+3.3V	+3_3V	3.05V	3.3V	3.55V	-	34	3.3V Supply
28h	+5V	+5V	4.15V	5V	5.6V	-	33	5V Supply
29h	+12V	+12V	13.7V	12V	12.95V	-	32	12V Supply
2Ah	-12V	-12V	-11.15V	-12V	-10.3V	-	31	-12V Supply
2Bh	VBAT	VBAT	2.7V	3.2V	3.6V	-	30	Battery Voltage
2Ch	+5VSB	5VSB	4.65V	5V	5.35V	-	29	5V Standby

Temperatures

Table 5-2 Temperature Scan

Sensor #	Sensor ID	Signal	Lower Limit	Mid	Upper Limit	Zircon Pin	Winbond Pin	Description
42h	EXT_TEMP	EXT1_TEMP	2C	28C	38C	-	Pin 40	Ambient air temp

Fan Speed and Control

Fan tach speeds are given in revolutions per second. Multiply by 60 for rpm.

Table 5-3 Fan and Speed Control Scan

Sensor #	Sensor ID	Signal	Lower Limit	Mid	Upper Limit	Zircon Pin	Winbond Pin	Description
51h	CPU0FANTACH	P1FANTACH	15	65	120	-	Pin 20	Fan #1: Processor 1 fan tach
52h	CPU1FANTACH	P2FANTACH	15	65	120	-	Pin 19	Fan #2: Processor 2 fan tach
53h	SYSFANTACH	FAN1TACH	10	29	60	-	Pin 18	Fan #3: System fan tach
54h	PCIFANTACH	FAN4TACH	10	31	60	GPIO 0	-	Fan #4: PCI fan tach
55h	HDDFANTACH	FAN5TACH	15	28	80	GPIO 1	-	Fan #5: HDD fan tach
56h	PSUFANTACH	FANM	10	51	100	GPIO 3	-	Fan #6: Power supply fan tach
61h	CPU0FANCTRL	WP1FANCTRL	-	-	-	-	Pin 23	Fan #1: Processor 1 fan ctrl
62h	CPU1FANCTRL	WP2FANCTRL	-	-	-	-	Pin 11	Fan #2: Processor 2 fan ctrl
63h	SYSFANPWM	WFAN123CTL	-	-	-	-	Pin 10	Fan #3: System fan PWM (& unused spare fan PWM)
64h	PCIFANPWM	FAN4CTL	-	-	-	GPIO21 PWM1	-	Fan #4: PCI fan PWM
65h	HDDFANPWM	FAN5CTL	-	-	-	GPIO20 PWM0	-	Fan #5: HDD fan PWM

Additional Sensors

The SDR for Processor 0 includes three separate functions:

- presence detect
- IERR
- processor voltage mismatch

Table 5-4 Additional Sensor Scans

Sensor #	Sensor ID	Signal	Sensor Type	Zircon Pin	Winbond Pin	Description
70h	CPU0 PRESENT	SKTOCC_0_L	Processor	GPIO23	-	Processor 0 Presence/Absence
71h	CPU1 PRESENT	SKTOCC_1_L	Processor	GPIO24	-	Processor 1 Presence/Absence
72h	CPU0IERR	IERR#	Processor	GPIO27	-	Processor 0 IERR
73h	CPU MISMATCH	VID_ERROR#	Processor	GPIO28	-	Processor Voltage Mismatch
80h	CHASSIS OPEN	INTRU#	Chassis Intrusion	-	C_OPEN	General Chassis Intrusion

Fan Control

Individual fan speed is controlled by the HMC, based on temperature and configuration information. This allows fans to run slower in most circumstances, thus making the machine quieter.

Sense Power State

Zircon senses power state using signal pins from the ICH2.

This is used for fan control and indicating power state on the status LED.

Chassis Intrusion

Chassis intrusion is detected via the Winbond W83782D C_OPEN pin. There is an SDR (sensor data record) for the chassis intrusion event.

If the hardware indicates an intrusion, the HMC clears the hardware latch in the Winbond, logs the event in the System Event Log (SEL), which is non-volatile storage, and sets the state of the NBA token for chassis intrusion based on the current chassis intrusion status.

The BIOS queries the NBA token to determine if it should display a chassis intrusion message. It then clears the chassis intrusion status in the NBA token.

Applications such as TopTools query for a chassis intrusion event by searching the SEL.

Pre-boot Device Test

The HMC detects presence of processors. The BIOS detects presence of memory and memory errors. If it is a condition that prevents the BIOS from completing POST, it notifies the HMC so that the HMC can display error LEDs on the front panel.

PCI/AGP Power

The BIOS detects presence and power consumption of PCI/AGP devices plugged in the system. It then passes this information on to the HMC, to detect overpower situations and to know whether it's possible to turn off the PCI fan to make the system quieter.

Reporting

Event Logging

Hardware monitoring errors, detected by the Hardware Management Controller, are logged to the SEL (System Event Log). External agents, such as the BIOS, can ask the Hardware Management Controller to log errors on their behalf.

Sensor Report Using IPMI

Sensor information is available using the standard IPMI command, **Get Sensor Reading**. The optional Sensor Device commands are not supported by the HMC firmware. Dynamic setting of sensor thresholds is not supported.

System Event Log (SEL)

Events are logged in the SEL using the standard SEL Event Record format as defined in the IPMI spec, section 19.1. OEM SEL records are also supported. The following SEL device commands are supported as specified in section 18.1 of the IPMI spec:

- Get SEL Info
- Get SEL Entry
- Add SEL Entry
- Clear SEL
- Get SEL Time
- Set SEL Time
- Reserve SEL

Power Status LED

The Power Status LED indicates the state of the system. See “HP x4000 Control Panel” on page 21. Error info has priority over power state info, when the computer is on.

Diag LEDs

When a sensor indicates an error, the corresponding LED is turned on. See “Understanding the Diag LEDs” on page 212.

In general, auto re-arm is used for sensors. That is, if a sensor threshold has been exceeded and the error is displayed on the LEDs, once the sensor drops below the threshold, the sensor is automatically re-armed so that if its reading rises up above the threshold again, it triggers another error. Each of these errors is also logged in the SEL.

Firmware Failure Handling

The boot code checks for a valid firmware runtime image and displays a Diag LED code if it is not valid.

BIOS is Running OK

The HMC detects if the BIOS is running OK and displays a Diag LED code if the BIOS does not provide a message.

IPMI Platform Event Trap

The firmware sends a platform event as an SNMP trap, using IPMI Platform Event Trap Specification version 1.0.

Security

Lock Status Panel

The HMC can lock out the front panel, when necessary, to prevent the user from pressing the power button or the reset button at an inopportune time (while the firmware flash update is in process). The BIOS also has this capability. This is because there are two separate flash update utilities: one to update the BIOS flash device, and another to update the HMC flash device. The BIOS and firmware flash utilities are packaged together in the BIOS/firmware flash update package at www.hp.com/workstations/support.

BIOS Configuration Tokens

Some CMOS tokens are backed up to NVRAM (serial eeprom). They can be modified by TopTools, and the BIOS is in charge of synchronization.

Once the system has booted, a valid password must be entered to access tokens, provided that passwords have been set in the Setup program. User and administrator passwords give different rights.

Hardware Management (Monitoring and Reporting)
Security

6 **Power Specifications**

Power Delivery

Figure 6-1 shows a block diagram of the overall power generation. Table 6-1 has a description of the signals given in Figure 6-1.

Figure 6-1 Power Generation Diagram

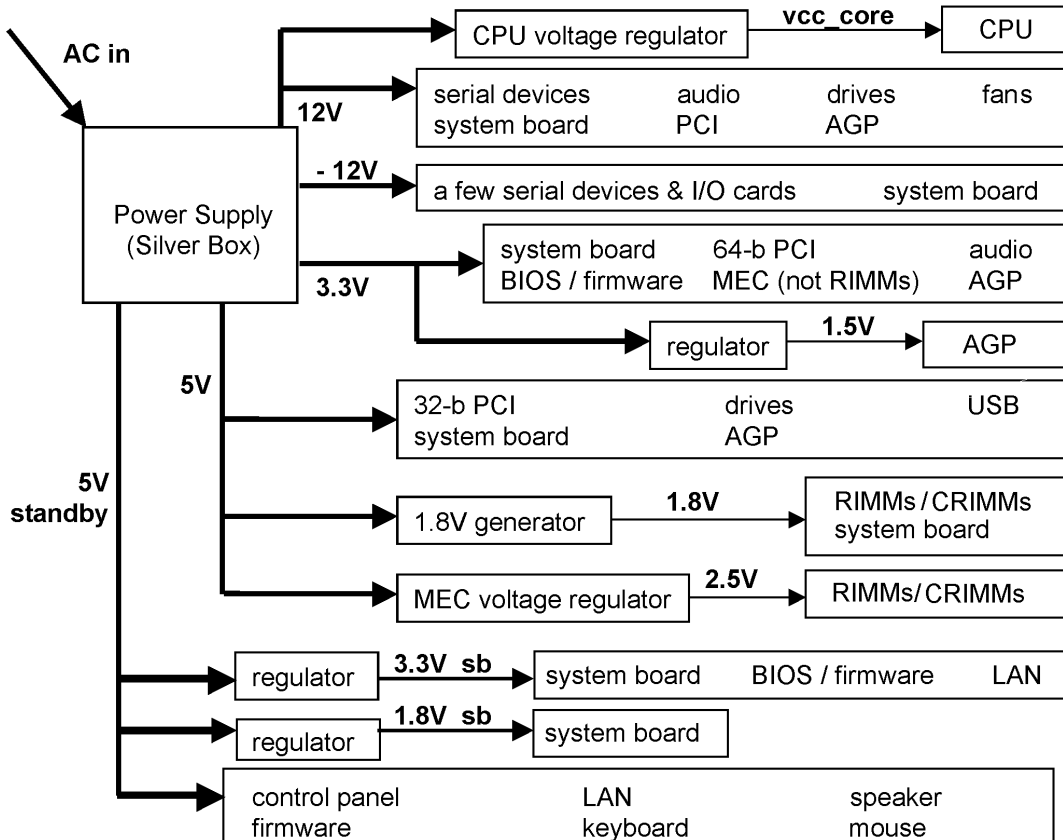


Table 6-1 Power Signal Description

Supply	Description
12 VDIG	Supplies power to the dc-to-dc converter that delivers power to the processor(s).
12 VIO	Supplies power to: <ul style="list-style-type: none"> • fans • hard disk drive(s) • floppy disk drive • PCI slots • AGP Pro 110 4X
-12 V	Supplies power to: <ul style="list-style-type: none"> • AGP Pro 110 4X • PCI • serial port
3.3 V	Supplies power to: <ul style="list-style-type: none"> • Memory Expander Card (MEC) • Peripheral Component Interconnect (PCI) slots • Accelerated Graphics Port (AGP Pro 110 4X) • Intel 860 chip set • audio • SCSI • 1.5 circuit
5 V	Supplies power to: <ul style="list-style-type: none"> • hard disk drive(s) • floppy disk drive • PCI slots • AGP Pro 110 4X • 1.8 V switching regulator circuit • MEC 2.5 V Voltage Regulator Module (VRM)

Table 6-1 Power Signal Description

Supply	Description
5 V Standby	<p>Supplies power to:</p> <ul style="list-style-type: none"> • Diag LEDs • Network activity LED • Hard disk drive activity LED • Power LED • Local Area Network (LAN) connector • Universal Serial Bus (USB) connector • PS2KB • Winbond WB782D hardware monitoring ASIC • 3.3 VSB • SB1_8V
VCC_CORE	<p>The exact processor voltage is determined by VID bits from the processor(s).</p> <p>In a dual-processor system, the processors share a power plane. A single VCC_CORE is generated by a +12 VDIG to VCC_CORE dc-to-dc converter that is placed on the system board. This is called VR down. The maximum current each processor can draw is 57 A.</p>
1.5 V	<p>This 1.5 V supply is generated from a three terminal regulator on the system board. The current is limited to 5 A.</p>
1.8 V	<p>This supply is used for the Intel 860 Memory Controller Hub, the P64H, and the MEC. It is generated by a switching dc-to-dc converter. the output voltage is 1.8 V and the output current is limited to 15 A.</p> <p>A separate 1.8 V power supply is used for the ICH2. This 1.8 V supply is generated from a three terminal linear regulator which limits the output current to 1 A.</p>
2.5 V	<p>This supply is generated by a voltage regulator on the Memory Expander Card (MEC).</p>

Table 6-1 **Power Signal Description**

Supply	Description
3.3 V Standby	This supply is derived from the 5 VSB with a 1 A three terminal regulator. It is used by the LAN and the Intel 860 ICH2.
1.8 V Standby	This supply is derived from the 5 VSB with a 1 A three terminal regulator. It is used by the Intel 860 ICH2.

Power Supply

Table 6-2 shows the voltage and current specifications for the power supplies. Total continuous output power does not exceed 465W.

Table 6-2 Voltage and Current Specification

	+3.3 V	+5 V	+12 VDIG	+12 VIO	-12 V	+5 VSB
Voltage: Max	3.14 V	4.5 V	11.4 V	11.4 V	-10.8 V	4.75 V
	3.46 V	5.25 V	12.6 V	12.6 V	-13.2 V	5.25 V
Current: Max	40 A	27 A	22 A	17 A	-0.55 A	1.5 A
	4.0 A	1.0 A	0.0 A	1.0 A	0.0 A	0.0 A

Power Supply Specifications

Parameter	Total Rating	Maximum PCI Slots	Maximum for AGP Pro 110 4X Slot		
			Connector	Extension	Total
Input voltage and current	100 V, 5 A 120 V, 4.2 A 200 V, 2.5 A to 240 V, 2.1 A	— —	— —	— —	— —
Input frequency	50 to 60 Hz	—	—	—	—
Available power	465 W	80W 45W	AGP Pro 50, 50W AGP Pro 110, 110W		
Max current at +12 VIO	12 A ^a	0.5 A	1 A	9.2 A	10.2 A
Max current at +12 VCPU	22 A	—	—	—	—
Max current at -12 V	0.55 A	0.1 A	—	—	—
Max current at +3.3 V	40 A ^a	7.6 A	6 A	7.6 A	13.6 A
Max current at +5 V	27 A ^a	5 A			2 A
Max current at +5 V stdby	2 A				

- a. The system can draw a maximum of 110 W from the AGP Pro 110 4X slot. Total combined output power on +3.3 V and +5 V shall not exceed 250 W. Total combined output current on +12 VCPU and +12 VIO shall not exceed 27.6 A nominal.

Resetting the Power Supply

If an overload triggers the power supply's overload protection, all power is immediately cut. To reset the power supply unit:

1. Disconnect the power cord.
2. Determine what caused the overload, and fix the problem.
3. Reconnect the power cord, and reboot the workstation.

When you power down the Workstation through the operating system, power consumption falls below the low power consumption (refer to the table on page 88), but doesn't reach zero. This on/off feature extends the power supply's lifetime.

Power Consumption and Cooling

The power consumption and acoustics listed in the following table are valid for a typical maximum configuration:

- two processors
- 768 MB memory
- two hard disk drives
- DVD ROM
- 3.5-inch floppy disk drive
- graphics card

All information in this section is based on primary power consumptions.

Input power consumption (approximate values)	<i>230V/50Hz and 115V/60Hz</i>	
• Typical operating mode	360 W	1228.4 Btu/h ^a
• Standby mode (Windows 2000 only)	150 W	511.8 Btu/h
• Hibernate mode (Windows 2000 only)	< 11 W	< 37.33 Btu/h

a. 1 W = 3.4121Btu/h

Power Saving and Ergonometry

Depending on the operating system, the following power management modes are available:

- Full on (S0)
- Standby (S1)
- Hibernate (S4)
- Full off (S5)

NOTE

Windows NT 4.0 does not support S1 or S4.

Using Power Management

Power management lets you reduce the Workstation's overall power consumption by slowing down the Workstation's activity when it is idle.

Operating systems differ in their power management capabilities. In Windows 2000, you can select from two power management modes:

- *Stand By (S1)* is a low power state where the processor is shut off, but memory remains powered. Waking up the Workstation from Stand By mode is faster than from Hibernate mode because the RAM contents do not need to be restored. However, when the Workstation is in Stand By mode, it consumes more power than Hibernate mode because the memory remains powered.
- *Hibernate (S4)* makes the machine look and behave like it is off except that it remembers the state it was in before hibernation and can be awakened without a full operating system boot. This is because the operating system copies the RAM contents out to a special location on the hard disk before entering hibernation.

You must enable Hibernate mode through Power Options in the Control Panel before it can be a shut down option.

Power Specifications
Power Saving and Ergonometry

To change your power management settings in Windows 2000:

1. Select **Start > Settings > Control Panel**.
2. Double click on **Power Options**.

For more information on changing your power options, refer to your Windows 2000 documentation.

Power Saving Modes and Resume Events

	Full On (S0)	Standby (S1)	Hibernate (S4)	Full Off (S5)
Processor	Normal speed	Halted	Off	Off
Display	On	Blanked	Off	Off
Hard Disk Drive	Normal speed	Halted	Off	Off
Active Power Planes	VCC VCCAux	VCC VCCAux	VCCAux	VCCAux
Power Consumption	< 500 W	< 150 W	< 11 W	< 11 W
Resume Events		Power button, LAN ^a , Modem, USB, Real Time Clock ^b , Keyboard	Power button, LAN, Modem, Scheduler, Keyboard	Power button
Resume Delay		10 - 20 seconds	BIOS boot delay	Regular boot delay

a. Wake-on-LAN is generated by a PME# signal. PME initialization is compliant with PCI Power Management 1.1. Specification chapter 8.8.

b. The RealTime Clock wake-up can be used, provided you have software that can configure it.

Power Specifications
Power Saving and Ergonometry

7

Connector Pin-Outs

Expansion Slots

Peripheral Component Interconnect (PCI) Slots

Table 7-1 describes the PCI 33 MHz, 32-bit connector. Table 7-2 describes the PCI 66 MHz, 64-bit connector.

Table 7-1 PCI 33 MHz, 32-bit Connector

Pin	Signal			Pin	Signal		
	Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)		Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)
A1	PTRST#			A32	AD16		
A2	+12VIO			A33	+3_3V		
A3	PTMS			A34	FRAME#		
A4	PTDI			A35	GND		
A5	+5V			A36	TRDY#		
A6	PIRQB#	A37	GND	A37	GND		
A7	PIRQD#	A38	STOP#	A38	STOP#		
A8	+5V			A39	+3_3V		
A9	NC			A40	NC		
A10	+5V			A41	NC		
A11	NC			A42	NC		
A12	GND			A43	PAR		
A13	GND			A44	AD15		
A14	3.3VSB			A45	+3_3V		
A15	1PCIRST#			A46	AD13		

Table 7-1 PCI 33 MHz, 32-bit Connector

Pin	Signal			Pin	Signal		
	Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)		Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)
A16	+5V			A47	AD11		
A17	PGNT1#	A48	GND	A48	GND		
A18	GND			A49	AD9		
A19	PCIPME#			A50	Key		
A20	AD30			A51	Key		
A21	+3_3V			A52	CBE0#		
A22	AD28			A53	+3_3V		
A23	AD26			A54	AD6		
A24	GND			A55	AD4		
A25	AD24			A56	GND		
A26	AD26R	A57	AD2	A57	AD2		
A27	+3_3V			A58	AD0		
A28	AD22			A59	+5V		
A29	AD20			A60	REQ64B#	REQ64C#	REQ64A#
A30	GND			A61	+5V		
A31	AD18			A62	+5V		
B1	-12V			B32	AD17		
B2	PTCK			B33	CBE2#		
B3	GND			B34	GND		
B4	NC			B35	IRDY#		
B5	+5V			B36	+3_3V		

Connector Pin-Outs
Expansion Slots

Table 7-1 PCI 33 MHz, 32-bit Connector

Pin	Signal			Pin	Signal		
	Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)		Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)
B6	+5V			B37	DEVSEL#		
B7	PIRQC#	B38	GND	B38	GND		
B8	PIRQE#	B39	PLOCK#	B39	PLOCK#		
B9	PRSNTB1#	B40	PERR#	B40	PERR#		
B10	NC			B41	+3_3V		
B11	PRSNTB1#	B40	PERR#	B42	SERR#		
B12	GND			B43	+3_3V		
B13	GND			B44	CBE1#		
B14	NC			B45	AD14		
B15	GND			B46	GND		
B16	PCLK_S1	B47	AD12	B47	AD12		
B17	GND			B48	AD10		
B18	PREQ1#	B49	GND	B49	GND		
B19	+5V			B50			
B20	AD31			B51			
B21	AD29			B52	AD8		
B22	GND			B53	AD7		
B23	AD27			B54	+3_3V		
B24	AD25			B55	AD5		
B25	+3_3V			B56	AD3		
B26	CBE3#			B57	GND		

Table 7-1 PCI 33 MHz, 32-bit Connector

Pin	Signal			Pin	Signal		
	Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)		Slot #1 (J4B1)	Slot #2 (J3B1)	Slot #3 (J2B2)
B27	AD23			B58	AD1		
B28	GND			B59	+5V		
B29	AD21			B60	ACK64B#	ADK64C#	ADK64A#
B30	AD19			B61	+5V		
B31	+3_3V			B62	+5V		

Table 7-2 PCI 66 MHz, 64-bit Connector

Pin	Signal		Pin	Signal	
	Slot #1 (J4B1)	Slot #2 (J3B1)		Slot #1 (J4B1)	Slot #2 (J3B1)
A1	P64TRST#		A48	GND	
A2	+12VIO		A49	P64AD9	
A3	P64TMS		A50	NC	
A4	P64TDI		A51		
A5	+5V		A52	P64CBE0#	
A6	P64IRQ6#	P64IRQ2#	A53	+3_3V	
A7	P64IRQ8#	P64IRQ4#	A54	P64AD6	
A8	+5V		A55	P64AD4	
A9	NC		A56	GND	
A10	+3_3V		A57	P64AD2	
A11	NC		A58	P64AD0	
A12	Key		A59	+3_3V	

Table 7-2 PCI 66 MHz, 64-bit Connector

Pin	Signal		Pin	Signal	
	Slot #1 (J4B1)	Slot #2 (J3B1)		Slot #1 (J4B1)	Slot #2 (J3B1)
A13			A60	P64REQ64#	
A14	3.3VSB		A61	+5V	
A15	P64RST#		A62		
A17	P64AD21R	P64AD20R	A63	GND	
A18	GND		A64	P64CBE7#	
A19	P64PME#		A65	P64CBE5#	
A20	P64AD30		A66	+3_3V	
A21	+3_3V		A67	P64PAR64	
A22	P64AD28		A68	P64AD62	
A23	P64AD26		A69	GND	
A24	GND		A70	P64AD60	
A25	P64AD24		A71	P64AD58	
A26	P64AD21R	P64AD20R	A72	GND	
A27	+3_3V		A73	P64AD56	
A28	P64AD22		A74	P64AD54	
A29	P64AD20		A75	+3_3V	
A30	GND		A76	P64AD52	
A31	P64AD18		A77	P64AD50	
A32	P64AD16		A78	GND	
A33	+3_3V		A79	P64AD48	
A34	P64FRAME#		A80	P64AD46	

Table 7-2 PCI 66 MHz, 64-bit Connector

Pin	Signal		Pin	Signal	
	Slot #1 (J4B1)	Slot #2 (J3B1)		Slot #1 (J4B1)	Slot #2 (J3B1)
A35	GND		A81	GND	
A36	P64TRDY#		A82	P64AD44	
A37	GND		A83	P64AD42	
A38	P64STOP#		A84	+3_3V	
A39	+3_3V		A85	P64AD40	
A40	NC		A86	P64AD38	
A41			A87	GND	
A42	GND		A88	P64AD36	
A43	P64PAR		A89	P64AD34	
A44	P64AD15		A90	GND	
A45	+3_3V		A91	P64AD32	
A47	P64AD11		A92	NC	
B1	-12V		B48	P64AD10	
B2	P64TCH		B49	P64M66EN	
B3	GND		B50	GND	
B4	NC		B51		
B5	+5V		B52	P64AD8	
B6			B53	P64AD7	
B7	P64IRQ7#	P64IRQ3#	B54	+3_3V	
B8	P64IRQ9#	P64IRQ5#	B55	P64AD5	
B9	PCI5A	PCI4A	A56	P64AD3	

Table 7-2 PCI 66 MHz, 64-bit Connector

Pin	Signal		Pin	Signal	
	Slot #1 (J4B1)	Slot #2 (J3B1)		Slot #1 (J4B1)	Slot #2 (J3B1)
B10	NC		B57	GND	
B11	PCI5B	PCI4B	B58	P64AD1	
B12	Key		B59	+3_3V	
B13			B60	P64ACK64#	
B14	NC		B61	+5V	
B15	GND		B62		
B16	P64CLK_S5	P64CLK_S4	B63	NC	
B17	GND		B64	GND	
B18	P64REQ2#	P64REQ1#	B65	P64CBE6#	
B19	+3_3V		B66	P64CBE5#	
B20	P64AD31		B67	GND	
B21	P64AD29		B68	P64AD63	
B22	GND		B69	P64AD61	
B23	P64AD27		B70	+3_3V	
B24	P64AD25		B71	P64AD59	
B25	+3_3V		B72	P64AD57	
B26	P64CBE3#		B73	GND	
B27	P64AD23		B74	P64AD55	
B28	GND		B75	P64AD53	
B29	P64AD21		B76	GND	
B30	P64AD19		B77	P64AD51	

Table 7-2 PCI 66 MHz, 64-bit Connector

Pin	Signal		Pin	Signal	
	Slot #1 (J4B1)	Slot #2 (J3B1)		Slot #1 (J4B1)	Slot #2 (J3B1)
B31	+3_3V		B78	P64AD49	
B32	P64AD17		B79	+3_3V	
B33	P64CBE2#		B80	P64AD47	
B34	GND		B81	P64AD45	
B35	P64IRDY#		B82	GND	
B36	+3_3V		B83	P64AD43	
B37	P64DEVSEL#		B84	P64AD41	
B38	GND		B85	GND	
B39	P64LOCK#		B86	P64AD39	
B40	P64PERR#		B87	P64AD37	
B41	+3_3V		B88	+3_3V	
B42	P64SERR#		B89	P64AD35	
B43	+3_3V		B90	P64AD33	
B44	P64CBE1#		B91	GND	
B45	P64AD14		B92	NC	
B46	GND		B93		
B47	P64AD12		A94	GND	

Accelerated Graphics Port (AGP) Slot

Table 7-3 describes the AGP Pro 110 4X connector.

Table 7-3 AGP Pro 110 4X Connector

Pin	Signal	Pin	Signal
A1	+12VIO	A34	VDDQ
A2	NC	A35	AGP_AD22
A3	NC	A36	AGP_AD20
A4	USBAGP-	A37	GND
A5	GND	A38	AGP_AD18
A6	PIRQA#	A39	AGP_AD16
A7	1PCIRST#	A40	VDDQ
A8	GGNT_L	A41	AGP_FRAME_L
A9	+3_3	A42	
A10	AGP_ST_1	A43	
A11	NC	A44	
A12	AGP_PIPE_L	A45	
A13	GND	A46	AGP_TRDY_L
A14	AGP_WBF_L	A47	AGP_STOP_L
A15	AGP_SBA1	A48	AGPPME#
A16	+3_3	A49	GND
A17	AGP_SBA3	A50	AGP_PAR
A18	AGP_SBSTB_L	A51	AGP_AD15
A19	GND	A52	VDDQ
A20	AGP_SBA5	A53	AGP_AD13
A21	AGP_SBA7	A54	AGP_AD11

Table 7-3 AGP Pro 110 4X Connector

Pin	Signal	Pin	Signal
A22	NC	A55	GND
A23	GND	A56	AGP_AD9
A24	NC	A57	AGP_C_BE_L0
A25	+3_3	A58	VDDQ
A26	AGP_AD30	A59	AGP_ADSTB0_L
A27	AGPP_AD28	A60	AGP_AD6
A28	+3_3	A61	GND
A29	AGP_AD26	A62	AGP_AD4
A30	AGP_AD24	A63	AGP_AD2
A31	GND	A64	VDDQ
A32	AGP_ADSTB1_L	A65	AGP_AD0
A33	AGP_C_BE_L3	A66	NC
B1	OC-2	B34	VDDQ
B2	+5V	B35	AGP_AD21
B3	+5V	B36	AGP_AD19
B4	USBAGP+	B37	GND
B5	GND	B38	AGP_AD17
B6	PIRQB#	B39	AGP_C_BE_L2
B7	CLK66_AGP	B40	VDDQ
B8	GREQ_L	B41	AGP_IRDY_L
B9	+3_3V	B42	
B10	AGP_ST_0	B43	
B11	AGP_ST_2	B44	

Table 7-3 AGP Pro 110 4X Connector

Pin	Signal	Pin	Signal
B12	AGP_RBF_L	B45	
B13	GND	B46	AGP_DEVSEL_L
B14	NC	B47	VDDQ
B15	AGP_SBA0	B48	GPERR_L
B16	+3_3V	B49	GND
B17	AGP_SBA2	B50	AGP_SERR_L
B18	AGP_SBSTB	B51	AGP_C_BE_L1
B19	GND	B52	VDDQ
B20	AGP_SBA4	B53	AGP_AD14
B21	AGP_SBA6	B54	AGP_AD12
B22	NC	B55	GND
B23	GND	B56	AGP_AD10
B24	3.3VSB	B57	AGP_AD8
B25	+3.3V	B58	VDDQ
B26	AGP_AD31	B59	AGP_ADSTB0
B27	AGP_AD29	B60	AGP_AD7
B28	+3.3V	B61	GND
B29	AGP_AD27	B62	AGP_AD5
B30	AGP_AD25	B63	AGP_AD3
B31	GND	B64	VDDQ
B32	AGP_ADSTB1	B65	AGP_AD1
B33	AGP_AD23	B66	VREF_MCH_TO_AGP

System Board Connectors

Figure 2-1 on page 26 shows the position of all the connectors on the system board. The pin-outs for these connectors are described in the following topics:

- “Floppy Disk Drive Connector” on page 106
- “IDE/ATA 100 Connectors” on page 107
- “SCSI Connectors” on page 109
- “Parallel Port Connector” on page 111
- “Serial Port Connectors” on page 112
- “Keyboard and Mouse Connector” on page 113
- “Universal Serial Bus Connectors” on page 113
- “Front Panel Connector” on page 114
- “ATX Power Connector” on page 115
- “LAN Connector” on page 116
- “Audio Connector” on page 116
- “CD Audio In Connector” on page 117
- “Microphone Connector” on page 117
- “System Speaker Connector” on page 118
- “Processor Fan Connectors” on page 118
- “Chassis Fan Connectors” on page 118
- “Chassis Intrusion Connector” on page 119

Floppy Disk Drive Connector

Table 7-4 describes the floppy disk drive connector.

Table 7-4 Floppy Disk Drive Connector

Pin	Signal	Pin	Signal
1	GND	18	FDIR#
2	DRVEN0	19	GND
3	GND	20	STEP#
4	NC	21	GND
5	Key	22	WDATA#
6	DRATE0	23	GND
7	GND	24	WGATE#
8	INDEX#	25	GND
9	GND	26	TRK0#
10	MTR0#	27	GND
11	GND	28	WPROT#
12	DS1#	29	GND
13	GND	30	RDATA#
14	DS0#	21	GND
15	GND	32	HDSEL#
16	MTR1#	33	GND
17	GND	34	DSKCHG#

IDE/ATA 100 Connectors

Table 7-5 describes the connectors.

Table 7-5 IDE/ATA Primary and Secondary Connectors

Pin	Signal	
	Primary (J8C1)	Secondary (J8C2)
1	3PCIRST#	3PCIRST#
2	GND	GND
3	PDD7	SDD7
4	PDD8	SDD8
5	PDD6	SDD6
6	PDD9	SDD9
7	PDD5	SDD5
8	PDD10	SDD10
9	PDD4	SDD4
10	PDD11	SDD11
11	PDD3	SDD3
12	PDD12	SDD12
13	PDD2	SDD2
14	PDD13	SDD13
15	PDD1	SDD1
16	PDD14	SDD14
17	PDD0	SDD0
18	PDD15	SDD15
19	GND	GND
20	Key	Key

Table 7-5 IDE/ATA Primary and Secondary Connectors

Pin	Signal	
	Primary (J8C1)	Secondary (J8C2)
21	PDDREQ	SDDREQ
22	GND	GND
23	PDIOW#	SDIOW#
24	GND	GND
25	PDIOR#	SDIOR#
26	GND	GND
27	PDIORDY	SDIORDY
28	PRIIDE1	SECIDE1
29	PDDACK#	SDDACK#
30	GND	GND
31	IRQ14	IRQ14
32	NC	NC
33	PDA1	SDA1
34	PRIIDE2	SECIDE2
35	PDA0	SDA0
36	PDA2	SDA2
37	CS1P#	CS1S#
38	CS3P#	CS3S#
39	IDEAP#	IDEAP#
40	GND	GND

SCSI Connectors

Table 7-6 describes the SCSI internal and external connectors.

Table 7-6 SCSI Connector

Pin	Signal		Pin	Signal	
	Internal (SC1)	External (SC2)		Internal (SC1)	External (SC2)
1	LVSCDBP12	LVSCDAP12	35	LVSCDBM12	LVSCDAM12
2	LVSCDBP13	LVSCDAP13	36	LVSCDBM13	LVSCDAM13
3	LVSCDBP14	LVSCDAP14	37	LVSCDBM14	LVSCDAM14
4	LVSCDBP15	LVSCDAP15	38	LVSCDBM15	LVSCDAM15
5	LVSCDBPHP	LVSCDAPHP	39	LVSCDBM0	LVSCDAM0
6	LVSCDBP0	LVSCDAP0	40	LVSCDBPHM	LVSCDAPHM
7	LVSCDBP1	LVSCDAP1	41	LVSCDBM1	LVSCDAM1
8	LVSCDBP2	LVSCDAP2	42	LVSCDBM2	LVSCDAM2
9	LVSCDBP3	LVSCDAP3	43	LVSCDBM3	LVSCDAM3
10	LVSCDBP4	LVSCDAP4	44	LVSCDBM4	LVSCDAM4
11	LVSCDBP5	LVSCDAP5	45	LVSCDBM5	LVSCDAM5
12	LVSCDBP6	LVSCDAP6	46	LVSCDBM6	LVSCDAM6
13	LVSCDBP7	LVSCDAP7	47	LVSCDBM7	LVSCDAM7
14	LVSCDBPLP	LVSCDAPLP	48	LVSCDBPLM	LVSCDAPLM
15	GND	GND	49	GND	GND
16	DIFFSENSEB	DIFFSENSEA	50	GND	GND
17	LVTRMPWRB	LVTRMPWR	51	LVTRMPWRB	LVTRMPWR
18	LVTRMPWRB	LVTRMPWR	52	LVTRMPWRB	LVTRMPWR
19	NC	NC	53	NC	NC
20	GND	GND	54	GND	GND

Connector Pin-Outs
System Board Connectors

Table 7-6 **SCSI Connector**

Pin	Signal		Pin	Signal	
	Internal (SC1)	External (SC2)		Internal (SC1)	External (SC2)
21	LVATNBP	LVATNAP	55	LVATNBM	LVATNAM
22	GND	GND	56	GND	GND
23	LVBSYBP	LVBSYAP	57	LVBSYBM	LVBSYAM
24	LVACKBP	LVACKAP	58	LVACKBM	LVACKAM
25	LVRSTBP	LVRSTAP	59	LVRSTBM	LVRSTAM
26	LVMSGBP	LVMSGAP	60	LVMSGBM	LVMSGAM
27	LVSELBP	LVSELAP	61	LVSELBM	LVSELAM
28	LVCDBP	LVCDAP	62	LVCDBM	LVCDAM
29	VREQBP	VREQAP	63	LVREQBM	LVREQAM
30	LVIOBP	LVIOAP	64	LVIOBM	LVIOAM
31	LVSCDBP8	LVSCDAP8	65	LVSCDBM8	LVSCDAM8
32	LVSCDBP9	LVSCDAP9	66	LVSCDBM9	LVSCDAM9
33	LVSCDBP10	LVSCDAP10	67	LVSCDBM10	LVSCDAM10
34	LVSCDBP11	LVSCDAP11	68	LVSCDBM11	LVSCDAM11

Parallel Port Connector

Table 7-7 describes the parallel connector.

Table 7-7 **Parallel Port Connector**

Pin	Signal	Pin	Signal
1	LPSTB#	14	LPAUTFD#
2	LPD0	15	LPERROR#
3	LPD1	16	LPINIT#
4	LPD2	17	LPSLIN#
5	LPD3	18	GND
6	LPD4	19	GND
7	LPD5	20	GND
8	LPD6	21	GND
9	LPD7	22	GND
10	LPACK#	23	GND
11	LPBUSY	24	GND
12	LPPE	25	GND
13	LPSLCT		

Serial Port Connectors

Table 7-8 describes the serial connector.

Table 7-8 **Serial Port Connectors**

Pin	Signal	
	Port A (J16)	Port B (J18)
1	SP1-1	SP2-1
2	SP1-2	SP2-2
3	SP1-3	SP2-3
4	SP1-4	SP2-4
5	GND	GND
6	SP1-6	SP2-6
7	SP1-7	SP2-7
8	SP1-8	SP2-8
9	SP1-9	SP2-9
10	GND	GND
11	GND	GND

Keyboard and Mouse Connector

Table 7-9 describes the keyboard and mouse connectors.

Table 7-9 Keyboard and Mouse Connector

Pin	Signal	Pin	Signal
1	KBDATOUT	10	KBAUXPWR
2	NC	11	AUXCLKOUT
3	GND	12	NC
4	KBAUXPWR	13	GND
5	KBCLKOUT	14	GND
6	NC	15	GND
7	AUXDATOUT	16	GND
8	NC	17	GND
9	GND		

Universal Serial Bus Connectors

Table 7-10 describes the USB connector.

Table 7-10 Universe Serial Bus Connector

Pin	Signal	Pin	Signal
1	USBE5VOUT	7	EXTUSBP1+
2	EXTUSBP0-	8	GND
3	EXTUSBP0+	9	GND
4	GND	10	GND
5	USBE5VOUT	11	GND
6	EXTUSBP1-	12	GND

Front Panel Connector

Table 7-11 describes the front panel connector.

Table 7-11 Front Panel Connector

Pin	Signal	Pin	Signal
1	FPHDPWR	16	+5V
2	LEDGRN_ZIRCON	17	SPKDRV
3	HDLED	18	BUZZER
4	LEDYEL_ZIRCON	19	LED0RED
5	GND	20	LED0GRN
6	FPPWBTN#	21	LED1RED
7	RSTBTN#	22	LED1GRN
8	GND	23	LED2RED
9	+5V	24	LED2GRN
10	NC	25	LED3RED
11	IRRX	26	LED3GRN
12	GND	27	5VSB
13	GND	28	LANLED#
14	NC	29	SMBUS_DATA
15	IRTX	30	SMBUS_CLK

ATX Power Connector

Table 7-12 and Table 7-13 describe the ATX power connectors.

Table 7-12 ATX Power #1 Connector (J9C2)

Pin	Signal	Pin	Signal
1	+3_3V	13	+3_3V
2	+3_3V	14	+3_3V
3	+3_3V	15	GND
4	GND	16	GND
5	GND	17	+5V
6	+5V	18	+5V
7	5VSBOUT	19	+5V
8	GND	20	-12V
9	GND	21	+12VIO
10	GND	22	+12VIO
11	PWRGD0	23	PSON#
12	NC	24	FANM

Table 7-13 ATX Power #2 Connector (J9J1)

Pin	Signal	Pin	Signal
1	+12VDIG	5	GND
2	+12VDIG	6	GND
3	+12VDIG	7	GND
4	NC	8	NC

LAN Connector

Table 7-14 describes the LAN connector.

Table 7-14 LAN Connector

Pin	Signal	Pin	Signal
1	GND	7	L2???
2	L2TDP	8	L2ACTIVITY
3	L2TDN	9	L2SPEED2
4	L2RDP	10	L2SPEEDLED
5	L2RDN	11	GND
6	L2TXCTR	12	

Audio Connector

Table 7-15 describes the audio connector.

Table 7-15 Line In/Out Audio Connector (A1)

Pin	Signal	Pin	Signal
1	GND	7	NC
2	AC97P20	8	
3	AC97P19	9	
4	JS1	21	GND
5	GND	22	AC97P8
6	NC	23	AC97P9

CD Audio In Connector

Table 7-16 describes the CD Audio In connector.

Table 7-16 CD Audio In Connector (J21)

Pin	Signal
1	AC97P1
2	CD_GND
3	CD_GND
4	AC97P2

Microphone Connector

Table 7-17 describes the microphone connector.

Table 7-17 Microphone Connector (J22)

Pin	Signal
1	GND
2	AC97P7
3	AC97P6
10	AC97P7
11	GND

System Speaker Connector

Table 7-18 describes the system speaker connector.

Table 7-18 System Speaker Connector (J23)

Pin	Signal
1	VO1
2	GNDA_AUDIO
3	NC
4	VO2

Processor Fan Connectors

Table 7-19 describes the processor fan connector.

Table 7-19 Processor Fan Connectors

Pin	Signal	
	Processor 0 (J32)	Processor 1 (J33)
1	GND	GND
2	P1FAN1	P2FAN1
3	P1FANTACH	P2FANTACH

Chassis Fan Connectors

Table 7-20 describes the chassis fan connector.

Table 7-20 Chassis Fan Connectors

Pin	Signal		
	Rear System Fan (J34)	PCI Fan (J35)	Hard Disk Drive Fan (J37)
1	GND	GND	GND
2	FAN1S1	FAN4S1	FAN5S1

Table 7-20 Chassis Fan Connectors

Pin	Signal		
	Rear System Fan (J34)	PCI Fan (J35)	Hard Disk Drive Fan (J37)
3	FAN1TACH	FAN4TACH	FAN5TACH

Chassis Intrusion Connector

Table 7-21 describes the chassis intrusion connector.

Table 7-21 Chassis Intrusion Connector (J59)

Pin	Signal
1	CHASSIS_CBL#
2	NC
3	GND
4	INTRU#

Connector Pin-Outs
System Board Connectors

8 Mechanical Specifications

System Fans and Air Flow

The x4000 Workstation x4000 includes five fans:

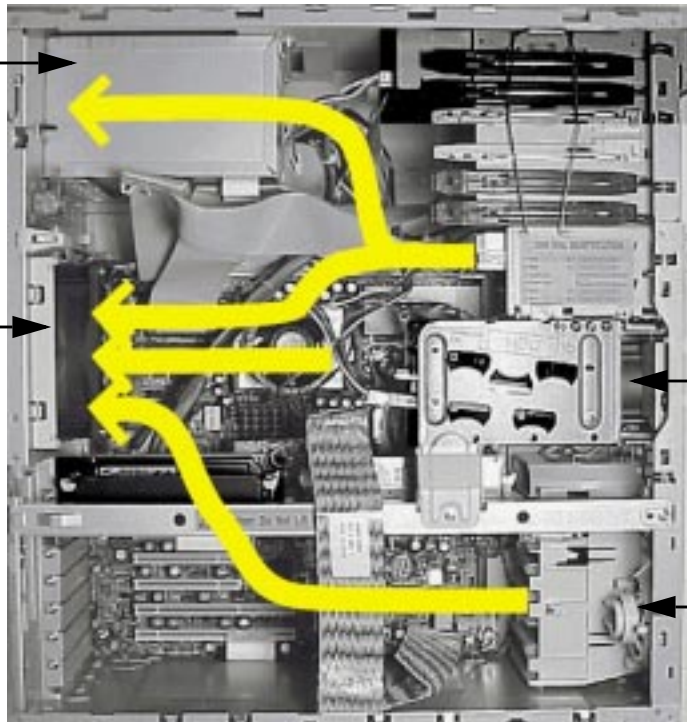
- one turbo-cooler heat sink fan for each of the processors
- one system fan at the back of the chassis
- a PCI fan (in a speaker/fan assembly)
- a hard drive fan

Figure 8-1 shows the system air flow.

Figure 8-1 **Air Flow Diagram**

92 mm Fan
(Power Supply)

120 mm Fan
(System
Exhaust)



60 mm Fan
(Disks)

92 mm Fan
(PCI /
Graphics)

Physical Specifications

Table 8-1 **x4000 Physical Characteristics**

Weight	Minimum configuration: 40.20 lb. (18.24 kg) Maximum configuration: 45.40 lb. (20.60 kg)
Dimensions	Width: 8.22in. (20.90 cm) Height: 19.02in. (48.30 cm) Depth: 18.62in. (47.3 cm)
Footprint	153.06 sq in (988.57 sq cm)
Power Supply:	
Input voltage	90 - 250 VAC
Input frequency	50/60 Hz
Maximum output power	465 W
Max avg input power	500 W

Environmental Specifications

Environmental Specifications (System Processing Unit with Hard Disk)	
Storage Humidity	90% (relative, non-condensing)
Operating Humidity	15% to 80% (relative, non-condensing)
Storage Temperature	-40° C (-40° F) to 70° C (158° F)
Operating Temperature	5° C (41° F) to 35° C (95° F)
Altitude	<ul style="list-style-type: none">• Operating: 0 to 10,000 ft. (3100m)• Non-operating: 0 to 15,000 ft. (4500m)
Shock	<ul style="list-style-type: none">• Operating: Maximum 20 G at less than 3 ms (1/2 sine)• Non-operating: Maximum 80 G at less than 3 ms (1/2 sine)
Vibration	<ul style="list-style-type: none">• Operating Random: Maximum 0.21 G (RMS)• Operating Swept-Sine: Maximum 0.5 G (0 - Peak)• Non-Operating Random: Maximum 2.09 G (RMS)
Acoustics	<ul style="list-style-type: none">• +5 to +25 degrees C: Less than 5.0 Bels (sound power)• +25 to +35 degrees C: Less than 5.5 Bels (sound power)

Operating temperature and humidity ranges may vary depending on the installed mass storage devices. High humidity levels can cause improper disk operation. Low humidity levels can aggravate static electricity problems and cause excessive wear of the disk surface.

9 **Hardware Components**

Overview

This chapter describes:

- Graphics cards
- Network cards
- SCSI adapter cards
- Mass storage devices
- Connectors and sockets
- The rear panel

Graphics Cards

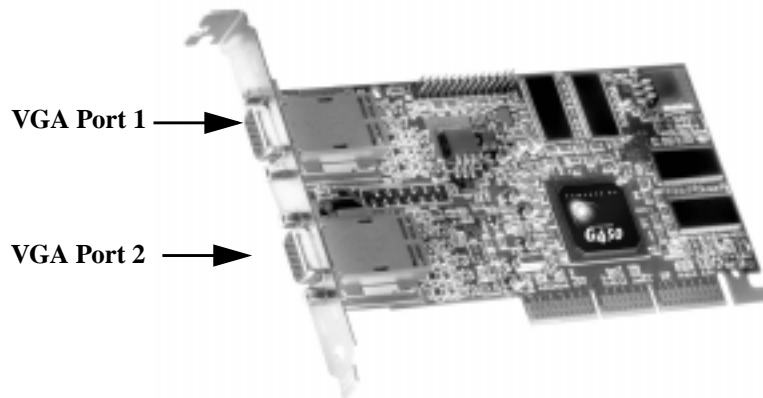
HP x4000 Workstation models provide installation and factory support for the following graphics cards:

- Matrox Millennium G450 (for more information than is presented below, see <http://www.matrox.com/mga/home.htm>)
- NVIDIA Quadro2 MXR and Quadro2 Pro (for more information, see <http://www.nvidia.com/Products.nsf>)
- ATI Fire GL2 or Fire GL4 (for more information, see <http://www.ati.com>)

Matrox Millennium G450 Graphics Card

Figure 9-1 shows the Matrox Millennium G450 graphics card.

Figure 9-1 Matrox Millennium G450 Graphics Card



The Matrox Millennium G450 Dual Head AGP graphics card is powered by the 256-bit DualBus Matrox G450 chip and has:

- 16 MB of DDR video memory (non-upgradeable)
- Matrox DualHead technology for connecting two monitors
- PowerDesk desktop manager:

- Easy multiple resolutions support
- Simple dialog box positioning
- Effortless multiple-window management
- TV output (composite video and S-video, NTSC and PAL) via an optional cable from Matrox which connects to the second VGA port in place of a monitor
- Full AGP 2X/AGP 4X support (up to 1GB/sec bandwidth)
- 360 MHz main RAMDAC and 230MHz secondary RAMDAC
- Support for all VESA standards:
 - VBE 2.0 (Super VGA modes)
 - DPMS energy saving
 - DDC2B support for Plug and Play (PnP) detection of monitor
- Support for true 32-bit color (16.7 million colors) at resolutions up to 2048 x 1536 on the main display
- Support for monitors with 16/10 aspect ratio, at resolutions up to 1920 x 1200 on the main display

3D Features

- VCQ2 or Vibrant Color Quality2
- Supports 32-bit Z buffering for exceptional rendering precision
- Environment-mapped bump mapping for more realistic 3D images
- Stencil buffering
- Bilinear, trilinear, and anisotropic filtering
- Single, double, and triple buffering
- Texture mapping
- MIP mapping
- Gouraud shading
- Alpha blending, anti-aliasing, fogging, specular highlighting

NOTE

If you use only one monitor, you must use Port 1. If you connect a second monitor, the driver detects it during startup. This means that you must connect both monitors to the graphics card before startup.

If the driver detects only one monitor, only the mono head settings are available in the driver configuration screens.

Available Video Resolutions

The number of supported colors is limited by the graphics device and the video memory. The resolution/color/refresh-rate combination is limited by a combination of the display driver, the graphics device, and the video memory. If the resolution/refresh-rate combination is set higher than the display can support, you risk damaging the display.

The following table summarizes the maximum supported resolutions.

Maximum Display Resolution		
Aspect Ratio	Main Display	Second Display
Traditional 4:3/5:4 aspect ratio	2048 x 1536	1600 x 1200
Wide screen 16:9/16:10 aspect ratio	1920 x 1200	1600 x 1024

The maximum refresh rates are always attainable with 8-bit or 16-bit color. They may not be attainable with 24-bit or 32-bit color and the highest refresh rates.

Hardware Components
Graphics Cards

The following table summarizes the maximum supported refresh rates.

Maximum Refresh Rates (Hz)			
Aspect Ratio	Resolution	Main Display (360MHz RAMDAC)	Second Display (230MHz RAMDAC)
Traditional 4:3/5:4 aspect ratio	640 x 480	200	200
	800 x 600	200	200
	1024 x 768	160	160
	1152 x 864	140	150
	1280 x 1024	120	120
	1600 x 1200	100	85
	1800 x 1440	85	—
	1920 x 1440	85	—
	2048 x 1536	85	—
Wide screen 16:9/16:10 aspect ratio	856 x 480	200	200
	1280 x 720	160	140
	1600 x 1024	120	90
	1920 x 1080	110	—
	1920 x 1200	100	—

Limitations

- The second display supports only 16-bit and 32-bit color.
- 3D acceleration is available only when you use 16-bit and 32-bit color.

NOTE

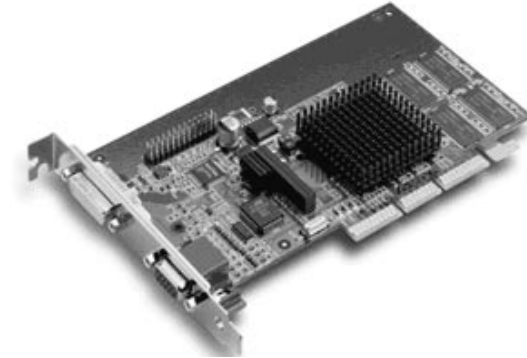
For complete information on the Matrox graphics cards, see
<http://www.matrox.com/mga/home.htm>

nVIDIA Quadro2 MXR

Figure 9-2 shows the nVIDIA Quadro2 MXR graphics card.

Figure 9-2

nVIDIA Quadro2 MXR Graphics Card



Actual graphics
card may differ
from the one
shown

The NVIDIA Quadro2 MXR graphics card's main features include:

- TwinView architecture, supporting:
 - single DVI-I (digital LCD)
 - single VGA (analog CRT)
 - one analog and one digital display (This is configurable from the twin view control panel.)
- AGP 4X with fast writes
- 350 MHz RAMDAC (for primary display only)
- Digital Vibrance Control (DVC) for accurate color adjustment giving bright, accurate colors in all conditions
- High-performance hardware anti-aliasing for smoother edges

3D Features

- Second-generation transform and lighting engines dedicated graphics-specific GPU frees your workstation's main processor for other tasks and provides faster transform and lighting processing
- nVIDIA shading rasterizer provides natural visual properties such as cloud, smoke, water, textiles, and plastic to images
- 32 MB unified frame buffer allows the use of high-resolution 32bpp textures

Hardware Components

Graphics Cards

- 32-bit Z/Stencil buffer eliminates polygon-popping problems in high-polygon 3D imaging

nVIDIA Quadro2 Pro

Figure 9-3 shows the nVIDIA Quadro2 Pro graphics card.

This card only supports one monitor:

- Analog (VGA-Dsub connector)
- LCD (DVI-D connector)

The nVIDIA Quadro2 Pro graphics card's main features include:

- Hardware anti-aliased line engine
- 6.4 GB/sec bandwidth enabling work in fully textured mode while achieving real-time frame rates
- 64 MB unified frame buffer providing ample room for high resolution, 32bpp textures
- 1.0 G pixels/sec rendering power
- 31 M triangles/sec geometry processing power

Figure 9-3

nVIDIA Quadro2 Pro Graphics Card



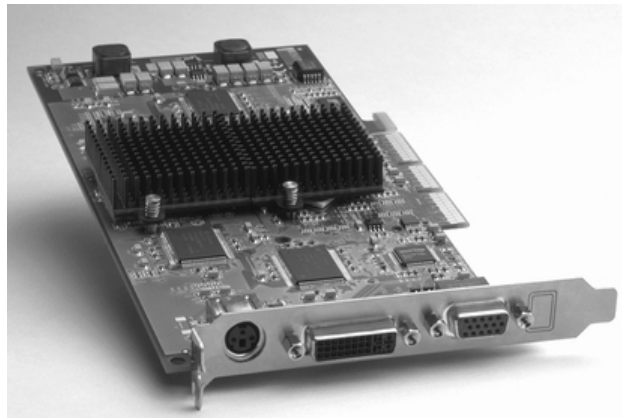
NOTE

For complete information on nVIDIA graphics cards, see <http://www.nvidia.com/Products.nsf>

Fire GL2 and Fire GL4

Figure 9-4 shows the Fire GL2 graphics card.

Figure 9-4 **Fire GL2 Graphics Card**



The ATI Fire GL graphics cards' main features include:

Controller

IBM Chipset: RC 1000 256-bit Graphics Rasterizer and GT1000 hardware geometry engine with integrated features including:

- VGA Controller
- 2D/3D Raster Engine and dual Texture Unit
- 8-bit Double Buffered Overlays
- Video Overlay Unit
- 2 DMA / BLIT Units
- Polygon Setup Processor
- 300 MHz / 30-bit Palette DAC, including four color lookup tables and gamma correction table
- 256-bit Rasterizer and DDR memory interface

Resolution

- True color resolution up to 1920 x 1200, double-buffered and 24-bit, Z-buffered
- Full scene anti-aliasing and dual displays (Fire GL4 only)

3D Performance

- 27 million (29 million for Fire GL4) Triangles/second, G-Shaded, Z-buffered, non-Textured
- 31 million (33 million for Fire GL4) Anti-Aliased Vectors/second
- 410 million (512 million for Fire GL4) Pixels/second fill rate, G-Shaded, Z-buffered, non-Textured
- 200 million (250 million for Fire GL4) Pixels/second Trilinear Texture fill rate (Mip-mapped)

Professional 3D Rendering

- Full OpenGL 1.1 ICD with 1.2 functional extensions
- 3D Acceleration w/ Texture Environments
- Single-pass bump mapping and hardware 3D textures
- Gouraud shading
- Bilinear and trilinear MIP-mapping
- Alpha blending
- Fogging and depth cueing
- Anti-aliased lines and sorted polygons
- Scissoring and stippling
- Overlay and stencil buffer
- Z-buffering

Hardware geometry acceleration

- 100% OpenGL geometry pipeline
- Full geometry transform processing
- Full lighting calculations for 16 sources, including directional, positional and spot
- Gamma Corrected Anti-Aliased Lines
- Back Face Culling
- Occlusion Culling
- Linked Queues

Broadcast Video

- Bilinear scaling (up/down)
- YUV-RGB converter for video and textures

- Supports 422 YUV & RGB Pixels
- Two Triple Buffered, Video Overlays

NOTE

For complete information on FireGL graphics cards, see <http://www.ati.com>

Mass Storage Devices

You can find HP product numbers and replacement part numbers for mass storage devices in the *x4000 Service Handbook* on HP's Web site at www.hp.com/workstations/support.

Flexible Disk Drives

The front-access shelf has a 3.5-inch, 1.44 MB flexible disk drive.

Hard Disk Drives

Table 9-1 lists the 3.5-inch (1-inch high) SCSI hard disk drives that may be supplied with the HP x4000 Workstation.

Table 9-1

SCSI Hard Disk Drives

	Quantum Atlas 10K II SCSI (10 krpm)	Quantum Atlas 10K II SCSI (10 krpm)
Capacity	18.4 GB	36.7 GB
Interface	Ultra160 SCSI	Ultra160 SCSI
External peak transfer rate	160MB/sec	160MB/sec
Average seek time (read)	4.7 ms	4.7 ms
Internal data rate (MB/sec)	280 MB/sec min. to 478 MB/sec max.	280 MB/sec min. to 478 MB/sec max.
Number of discs/heads	3/6	5/10
Buffer size	8 MB	8 MB

Setting SCSI IDs for a Quantum Atlas Hard Disk Drive

You must assign an unused SCSI ID to your hard disk drive. SCSI IDs range from 0 to 15 for wide 16-bit SCSI.

Table 9-2 SCSI ID Settings

SCSI ID	Used By
0	First SCSI hard drive
1	Optional second SCSI hard drive
2 - 6	Unused
7	SCSI controller
8 - 15	Unused

To set the SCSI ID:

1. Assign an unused SCSI ID. See Table 9-2:
 - If you are *adding* a SCSI hard drive to your system, consider setting the new hard drive SCSI ID to 1. However, if you have other SCSI devices connected externally, or have changed the SCSI ID of the currently installed hard drive, remember this SCSI ID must be unique.
 - If you are *replacing* a SCSI hard drive, you can use the SCSI ID number of the current hard drive for the replacement hard drive.
2. Using the jumpers provided, set the SCSI ID on the 28-pin jumper block located on the bottom of the hard disk drive. See Figure 9-5.

CAUTION

Do *not* use the 12-pin jumper block next to the power connector.

Figure 9-5 **28-Pin Jumper Block**

28-Pin Jumper Block

When viewed from the top side, pin 1 is on the bottom row, closest to the edge of the drive.

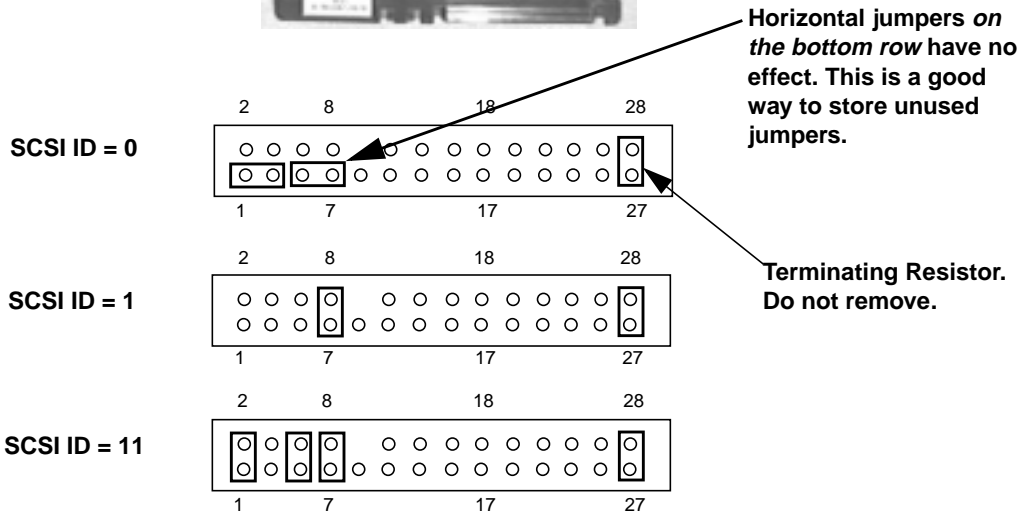
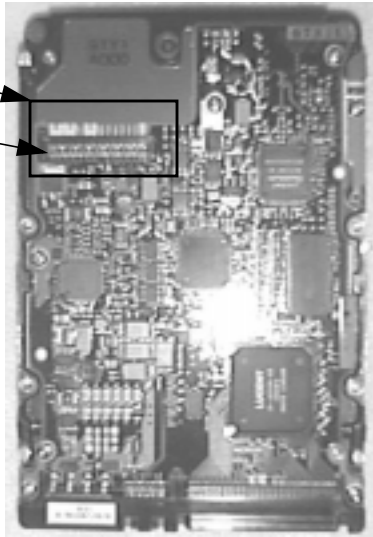


Table 9-3 Jumper Locations for Hard Drive SCSI ID Settings

SCSI ID	Jumper the following pins when indicated:			
	Pins 1 - 2	Pins 3 - 4	Pins 5 - 6	Pins 7 - 8
0				
1				Jumper
2			Jumper	
3			Jumper	Jumper
4		Jumper		
5		Jumper		Jumper
6		Jumper	Jumper	
7		Jumper	Jumper	Jumper
8	Jumper			
9	Jumper			Jumper
10	Jumper		Jumper	
11	Jumper		Jumper	Jumper
12	Jumper	Jumper		
13	Jumper	Jumper		Jumper
14	Jumper	Jumper	Jumper	
15	Jumper	Jumper	Jumper	Jumper

Optical Drives

IDE 48X CD-ROM Drive

The x4000 Workstation may have a 48X IDE CD-ROM drive, which features:

- ATAPI commands
- Audio CD playback capability
It can play any standard audio CD or CD-ROM conforming to optical and mechanical standards as specified in the Red, Yellow, Green, and Orange Book.
- Application disk type
- CD-ROM data disk (Mode 1 and Mode 2)
- Photo-CD Multisession
- Mixed-mode CD-ROM (data and audio)
- CD-ROM XA, CD-I, CD-Extra, CD-R, CD-RW

	Description
Data capacity	650 MB
Data transfer rate	Sustained transfer rate (1X=150 KB/sec) Outsider: 7,200 KB/sec Burst transfer rate: PIO mode 4 - 16.6 MB/sec maximum Single Word DMA Mode 2 - 8.3 MB/sec maximum Multi Word DMA Mode 2 - 16.6 MB/sec maximum
Buffer memory size	128 KB
Access time	Average stroke (1 / 3) 110 ms Full stroke 180 ms
Rotational speed	2,048 bytes (Mode 1) 2,336 bytes (Mode 2)
Interface	ATAPI
Power requirements	5 V, 1.2 A 12 V, 0.8 A

8X Video IDE DVD-ROM Drive

The x4000 Workstation may have a DVD-ROM drive that features standard audio CD and CD-ROM playback. It can play any standard audio CD or CD-ROM conforming to optical and mechanical standards as specified in the Red, Yellow, Green, and Orange Book. The DVD-ROM drive is DVD video capable, when you install the DVD-video software (not included with the HP x4000 Workstation).

	Description
Data capacity	650 MB
Data transfer rate	Sustained transfer rate (1X = 150 KB/sec); Outerside: 7,200 KB/sec Burst transfer rate: PIO mode 4 - 16.6 MB/sec maximum Single Word DMA Mode 2 - 8.3 MB/sec maximum Multi Word DMA Mode 2 - 16.6 MB/sec maximum
Buffer memory size	128 KB
Access time	Average stroke (1 / 3) 110 ms Full stroke 180 ms
Rotational speed	2,048 bytes (Mode 1) 2,336 bytes (Mode 2)
Interface	ATAPI
Power requirements	5 V, 1.2 A 12 V, 0.8 A

12X IDE CD-Writer Plus Drive

The x4000 Workstation may have a 12X IDE CD-RW drive that features:

- Support for ATAPI commands
- Audio CD playback capability

It can play any standard audio CD or CD-ROM conforming to optical and mechanical standards as specified in the Red, Yellow, Green, and Orange Book.

- Support for recording both CD-R and CD-RW optical media (you must install CD-RW software to use this feature, a CD-RW software installation CD is provided when a CD-RW accessory is order for the HP x4000 Workstation.

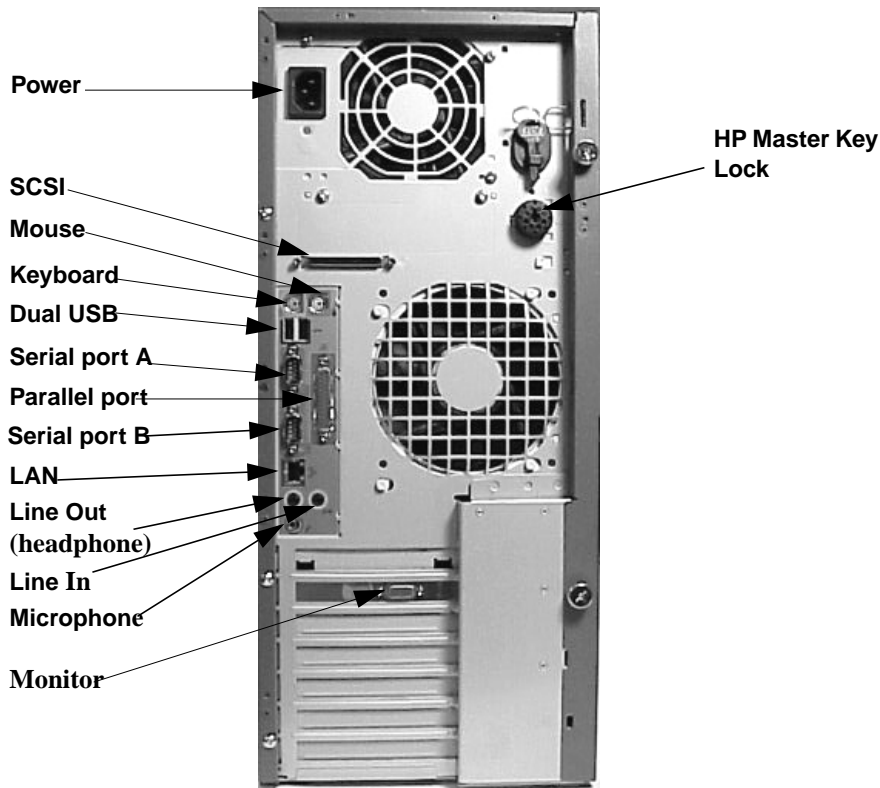
	Description
Data capacity	650 MB or up to 74 minutes of audio per disc 547 MB in CD-UDF data format
Performance	Typical: 110 ms (random, 1/3 access including latency) Maximum: 130 ms (random, 1/3 access including latency)
	Data transfer rate: Read: Up to 32X (1X = 150KB/sec) Write: 12X (CD-R); 8X (CD-RW)
Burst transfer rate	16.67 MB/sec
Spin-up time	3.2 seconds (disk high speed to stop)
Spin-down time	2.5 seconds (disk high speed to stop)
Corrected error rate	ECC On (max. 32X): 1 block/1012 bits ECC Off (max. 32X): 1 block/109 bits
Data Buffer Capacity	2 MB
Write methods	- Track at once - Variable packet writing - Session at once - Fixed packet writing - Disc at once - Multisession
Format and EEC standard	Red, Yellow, Orange, Green books

	Description
MTBF	120,000 POH
Interface	E-IDE and ATAPI

Rear Panel Connectors

Figure 9-6 shows the rear panel of the x4000 Workstation.

Figure 9-6 **x4000 Rear Panel**



The connector pin descriptions are given in Chapter 7 for:

- SCSI
- Keyboard and Mouse
- USB
- Serial
- LAN
- Parallel

10

Installing or Replacing Parts and Accessories

Overview

This chapter explains how to install and remove the following accessories:

- “Cover and Front Bezel” on page 145
- “Hard Disk Drive Cage” on page 149
- “Chassis Beam Assembly” on page 152
- “Memory Expander Card (MEC)” on page 155
- “System Memory” on page 157
- “Graphics Card” on page 162
- “SCSI Hard Drive” on page 167
- “CD-ROM, CD-RW or DVD” on page 171
- “Processor” on page 175

NOTE

Check your configuration every time you install, remove, or upgrade an accessory. For instructions on how to check your configuration using the HP Setup program, refer to the *Getting Started Guide* that came with your x4000 Workstation, or the *HP x4000 Workstation Technical Reference Guide* located at www.hp.com/workstations/support.

Cover and Front Bezel

Removing the Left Side Cover

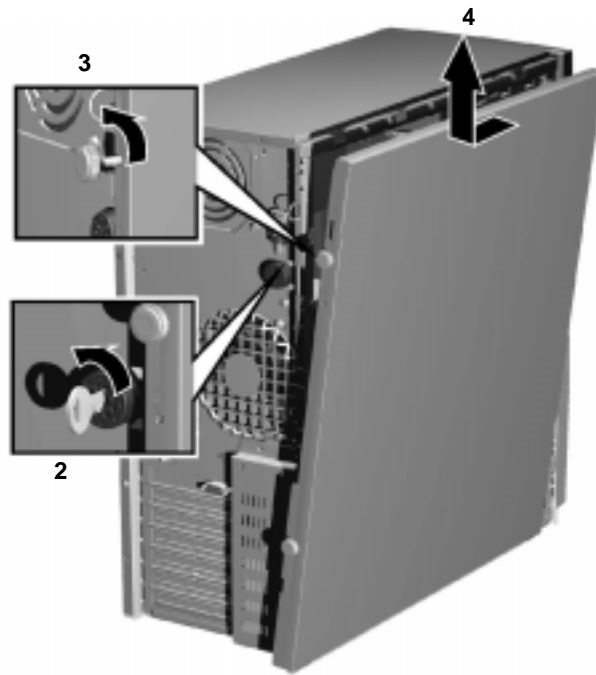
WARNING

For your safety, never remove the Workstation cover without first disconnecting the power cord from the power outlet and removing any connection to a telecommunications network. If a Power Protection Device is fitted to your Workstation, you must shut down your computer through the operating system, then remove the power cord before removing the Workstation's cover. Remove the Power Protection Device cables before any servicing operation. Always replace the cover before switching the Workstation on again.

To remove the cover (Figure 10-1):

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. If necessary, unlock the cover on the back of the Workstation.
3. Unscrew the two thumb screws located at the back of the Workstation until they release. You may need to use a T15 Torx driver. The thumb screws do not need to be completely removed to remove the cover.
4. Standing at the back of the Workstation, slide the cover towards you, tilt it open, then lift it off.

Figure 10-1 **Removing the Cover**



Removing the Front Bezel

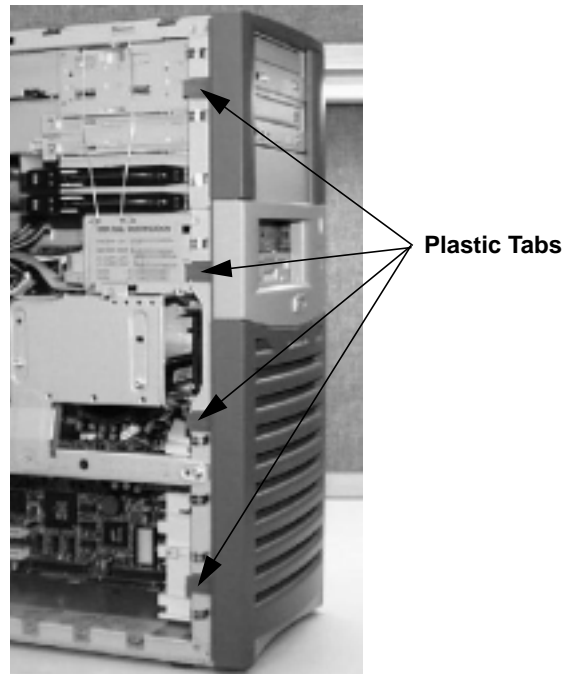
You only need to remove the front bezel when you are adding or removing devices in the 5.25-inch or 3.5-inch front drive bays.

To remove the bezel:

1. Gently lift the four plastic tabs starting with the bottom tab and working your way to the top.
2. Rotate the bezel off the Workstation chassis.

Figure 10-2

Removing the bezel



Replacing the Cover and Front Bezel

To replace the cover and front bezel:

1. Ensure that all internal cables are properly connected and safely routed.
2. If necessary, replace the front bezel:
 - a. Align the plastic quarter rounds on the inside of the bezel with the sheet metal sockets on the right side of the chassis.
 - b. Rotate the bezel into position and verify that the plastic tabs on the left side of the bezel click into position on the Workstation chassis.

The bezel should be flush against the Workstation.

3. Standing at the back of the Workstation, lower the cover onto the chassis (aligning the guide rail on the bottom inside edge of the cover with the bottom edge of the Workstation chassis).
4. Shut the cover ensuring that the guides on the top of the cover slide into the rails at the top of the chassis.
5. Slide the cover forward, then tighten the two thumbscrews.
6. If required, lock the cover using the key provided.

Hard Disk Drive Cage

Opening the Hard Disk Drive Cage

To open the cage (Figure 10-3):

1. Disconnect the SCSI cable(s) and power cable(s) from the hard disk drive(s).

CAUTION

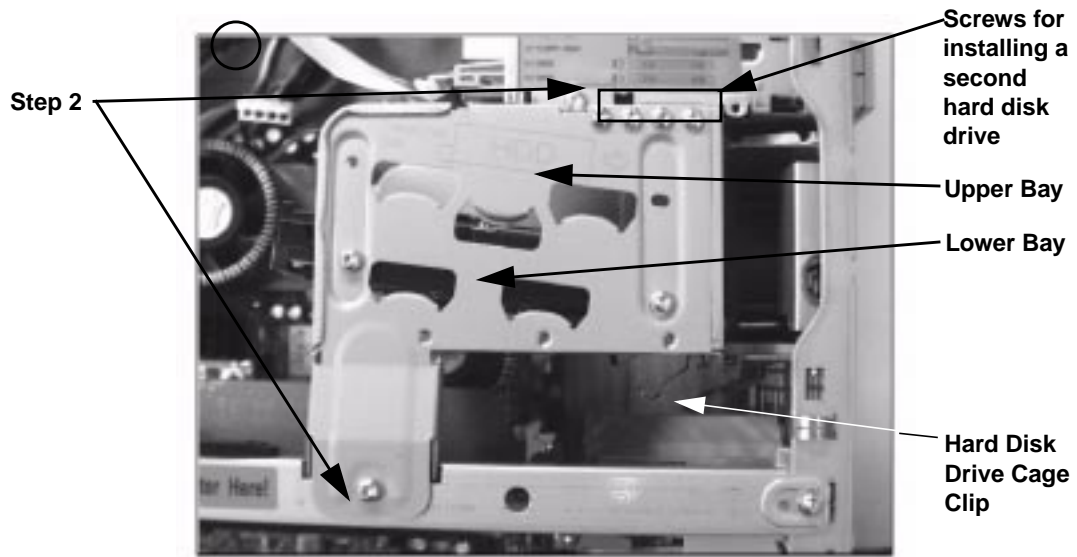
Do not rotate the cage before you disconnect the cables.

2. Remove and retain the two torx screws that hold the cage closed as shown in Figure 10-3.
3. Pull the cage toward you until you hear the hard disk drive cage clip catch the cage.

WARNING

Confirm the clip has latched the cage in the open position. Injury could be result if the cage falls.

Figure 10-3 **Hard Disk Drive Cage**



Closing and Securing the Hard Disk Drive Cage

CAUTION

Clear all cables from the area where the hard disk drive cage rests on the chassis beam assembly. If cables are in the way, you may damage them when you move the hard disk drive cage back into the closed position.

To close and secure the hard disk drive cage:

1. Push in the clip shown in Figure 10-3 on page 150 and rotate the hard drive cage *carefully* into the closed position.

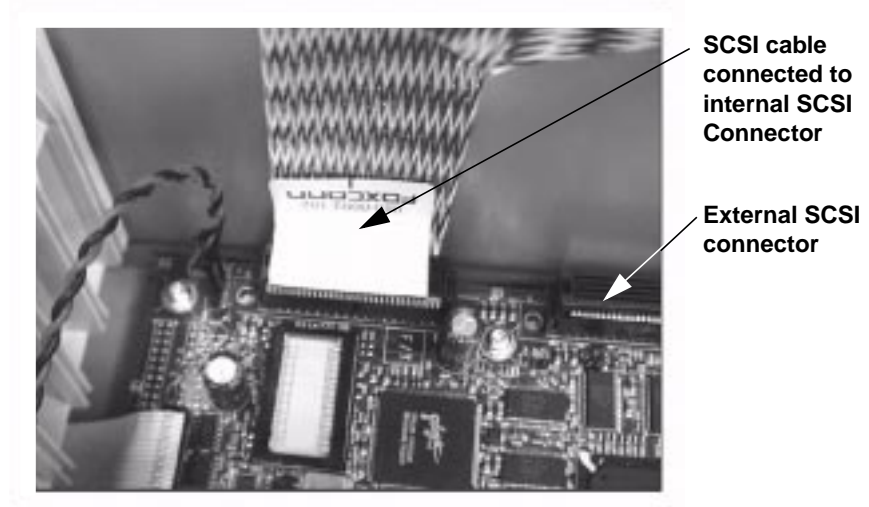
CAUTION

Do not allow the cage to drop into place. This could damage the hard drive(s).

2. Fasten the cage with two screws in the locations shown in Figure 10-3 on page 150.

3. If it is not already attached, connect the SCSI cable to the system board internal SCSI connector as shown in Figure 10-4.

Figure 10-4 Internal SCSI Connector and Cable



4. Connect the SCSI cable to the hard disk drive(s):
 - a. Attach the SCSI connector farthest from the system board to the hard drive in the upper bay.
 - b. Attach the remaining SCSI connector to the hard drive in the lower bay.
5. Connect the power supply cable(s) to the hard disk drive(s):
 - a. Connect the power supply cable labeled P3 to the hard disk drive in the upper bay.
 - b. Attach the power supply cable labeled P4 to the hard disk drive in the lower bay.

Chassis Beam Assembly

Before you can access many of the components inside your Workstation, you must remove the chassis beam assembly.

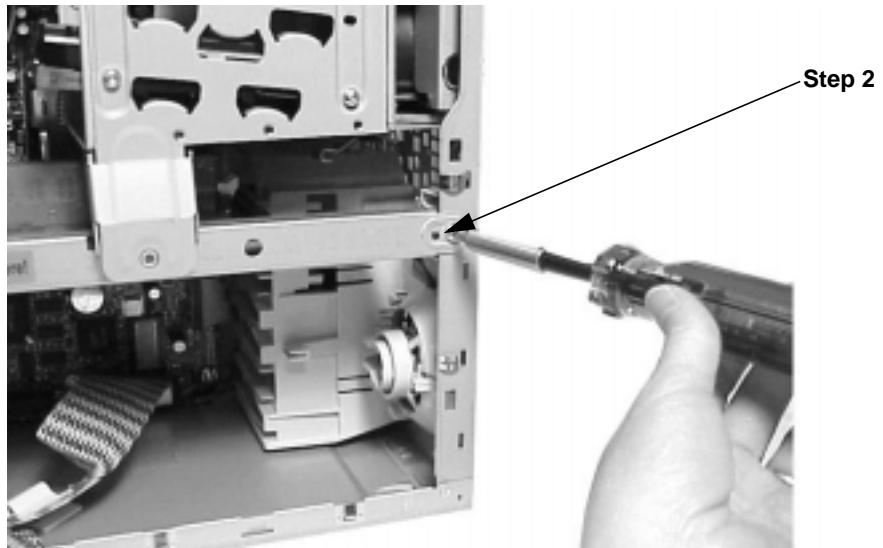
Removing the Chassis Beam Assembly

To remove the chassis beam assembly:

1. Open the hard disk drive cage (see page 149).
2. Remove the screw that holds the chassis beam assembly in place.
3. Carefully rotate the chassis beam assembly off the chassis.

Figure 10-5

Chassis Beam Assembly



Installing the Chassis Beam Assembly

To install the chassis beam assembly:

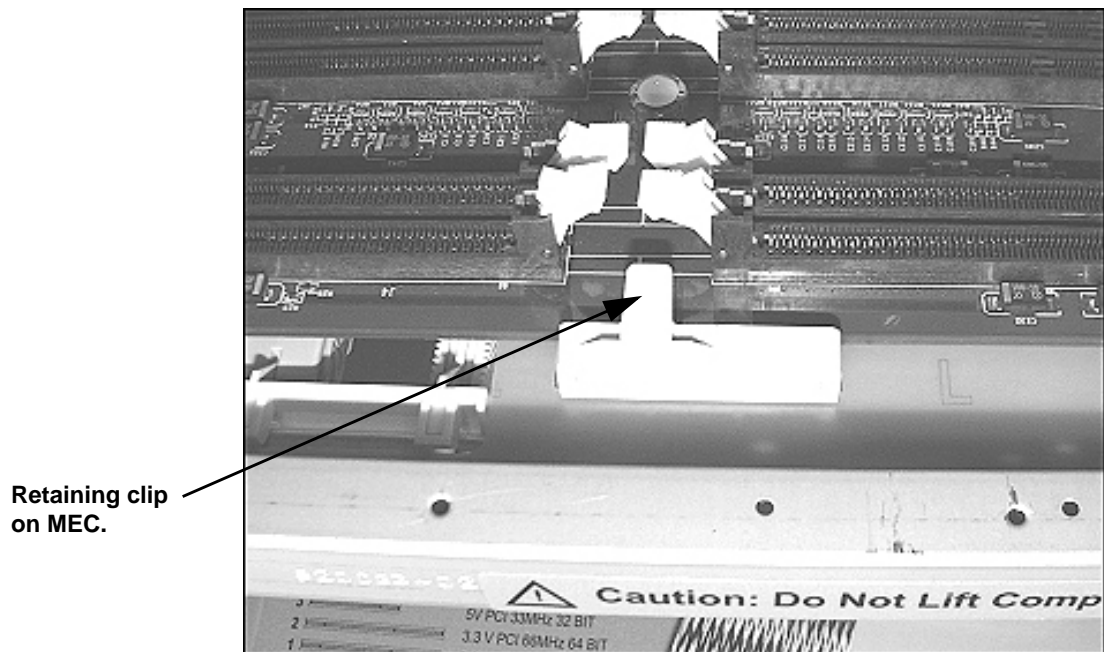
1. Hook the chassis beam assembly to the left side of the chassis and rotate it down over the MEC and the graphics card making sure the MEC and graphics card retainer clips are centered on the cards as shown in Figure 10-6 and Figure 10-7.

CAUTION

Make sure the retaining clips slide easily over the cards, or the clips may put undue pressure on the card connectors.

2. Replace the screw that holds the chassis beam assembly in place.

Figure 10-6 MEC Retainer Clip



Installing or Replacing Parts and Accessories

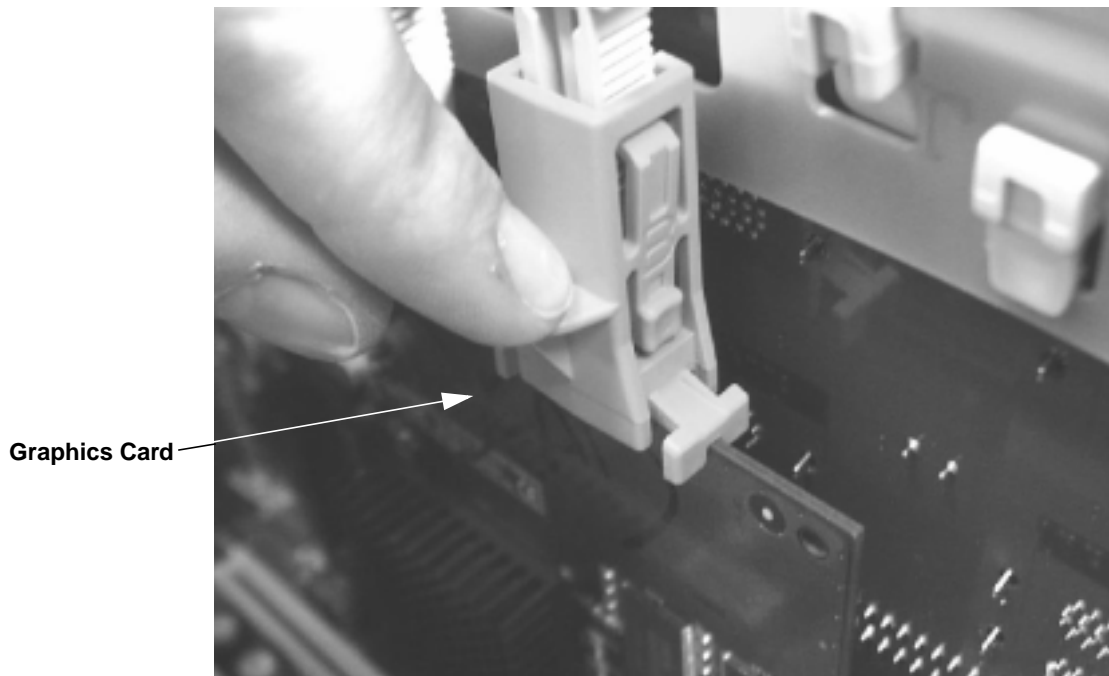
Chassis Beam Assembly

3. If your graphics card does not have a separate graphics card retainer beam, you must secure the graphics card by engaging the Universal Retainer piece (see Figure 10-7).

NOTE

Not all systems use the chassis beam assembly Universal Retainer piece to hold the graphics card in place. Your system may use a separate graphics card retainer beam (see Figure 10-14).

Figure 10-7 **Secure the Universal Retainer Piece**



Memory Expander Card (MEC)

Removing the MEC

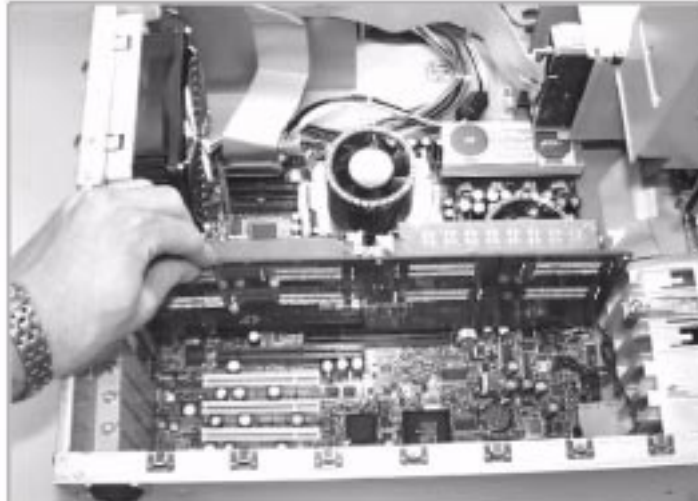
To remove the MEC:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. To ease installation, place the Workstation on its side with the system board facing upwards.
4. Rotate the hard disk drive cage to the open position (see page 149).
5. Remove the chassis beam assembly (see page 152).
6. Remove retaining screw that holds the MEC in place and gently remove the MEC from the chassis as shown in Figure 10-8.

CAUTION

You must remove the MEC to install RIMMs. The MEC card guides are not strong enough to bear the force of the RIMMs being inserted.

Figure 10-8 **Removing the MEC**



Installing the MEC

To install the MEC:

1. Replace the MEC, making sure it is fully seated, and tighten the retaining screw.
2. Replace the chassis beam assembly (see page 153).
3. Close and secure the hard disk drive cage (see page 150).
4. Replace the Workstation cover (see page 148).
5. Reconnect all power cables and any LAN or telecommunications cables.

System Memory

NOTE

Use only HP RIMMs specifically designed for your Workstation model. To find out about available accessories for your Workstation, go to www.hp.com/workstations/support.

Upgrading Memory on the 8-RIMM MEC

The memory for the HP x4000 Workstation is located on a Memory Expander Card (shown in Figure 10-9 on page 158), which plugs into the system board.

There are two memory banks (RDRAM channels):

- Bank I includes sockets 1B (J1), 2B (J2), 1A (J5), and 2A (J6).
- Bank II includes sockets 3B (J3), 4B (J4), 3A (J7), and 4A (J8).

This allows for a total of 8 RIMMs.

You must adhere to the following rules when loading memory:

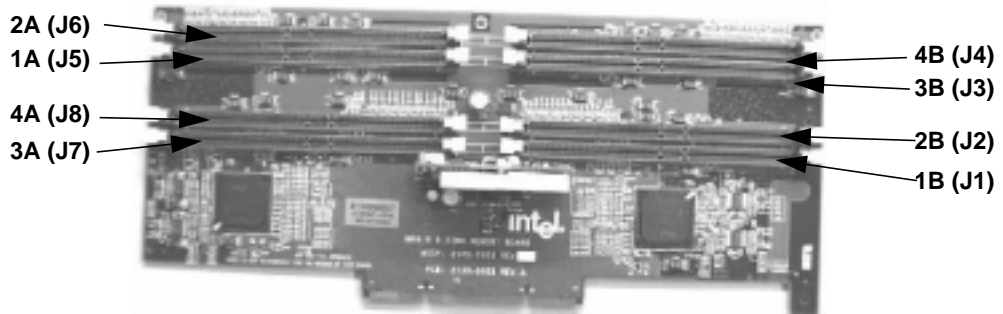
- RIMMs must be loaded in *matched pairs*. Matching RIMMs have the same RDRAM size, speed and Mbit technology.
- Each RDRAM bank (channel) must be either completely empty or completely filled as shown in Figure 10-10. Therefore, if only one pair of RIMMs is installed in a bank, then the remaining sockets in the bank must contain continuity modules (CRIMMs) to ensure continuity.

NOTE

All Workstations (unless they already have 8 RIMMs) ship with a pair of CRIMMs in case they are needed in future memory configurations. CRIMMs may be stored in an unused memory bank.

Installing or Replacing Parts and Accessories
System Memory

Figure 10-9 x4000 Memory Expander Card (MEC)



Memory Bank I consists of:

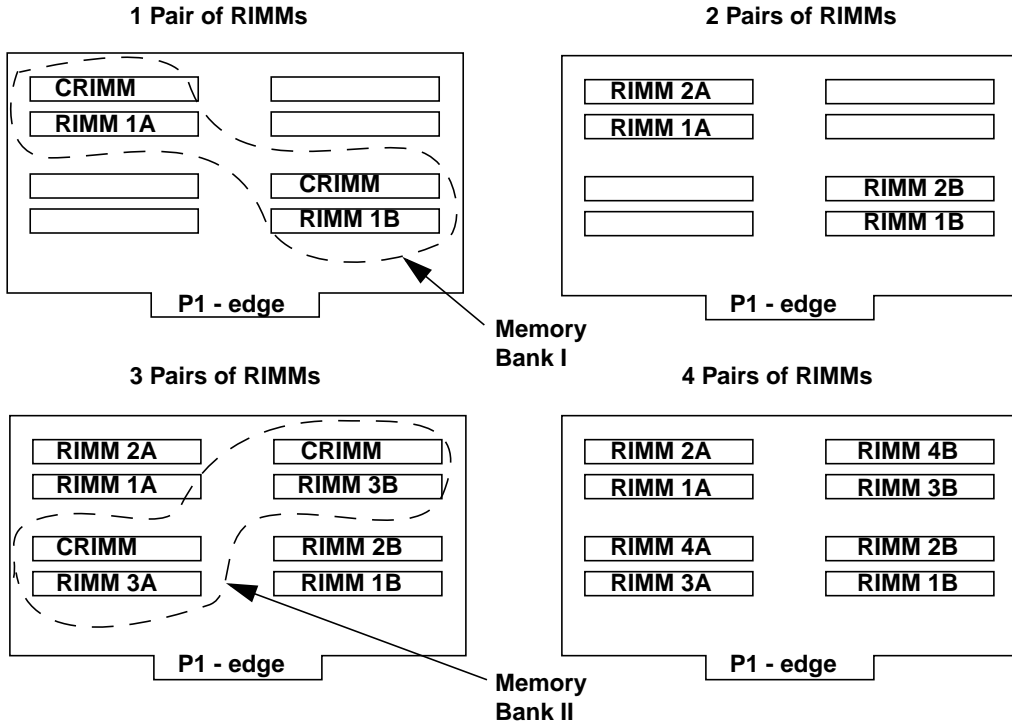
RIMM pair 1: 1A (J5) and 1B (J1)
RIMM pair 2: 2A (J6) and 2B (J2)

Memory Bank II consists of:

RIMM pair 3: 3A (J7) and 3B (J3)
RIMM pair 4: 4A (J8) and 4B (J4)

If a memory bank only contains 1 pair of RIMMs, the remaining 2 connectors must contain CRIMMs to ensure continuity.

Figure 10-10 Replacing or Upgrading Memory



Note: RIMM 1A and 1B are a matched pair, 2A and 2B are a matched pair, 3A and 3B are a matched pair, and 4A and 4B are a matched pair.

Installing Memory

1. Before turning off your Workstation, check the current amount of installed memory. Refer to your operating system documentation for instructions on finding this information.
2. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
3. Remove the Workstation's cover (see page 145).
4. To ease installation, place the Workstation on its side with the system board facing upwards.

Installing or Replacing Parts and Accessories

System Memory

5. Rotate the hard disk drive cage to the open position (see page 149).
6. Remove the chassis beam assembly (see page 152).
7. Remove the Memory Expander Card (MEC) (see page 155).

CAUTION

You must remove the MEC to install RIMMs (and CRIMMs). The MEC card guides are not strong enough to bear the force of the RIMMs being inserted.

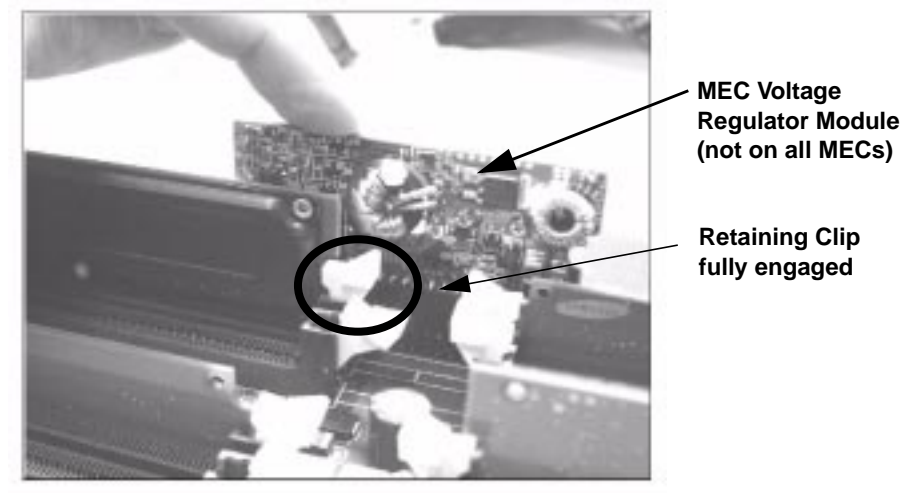
8. Install the RIMMs (and CRIMMs if required) on the MEC according to Figure 10-10.
 - a. If you are installing additional RIMMs, you may need to remove the CRIMMs. Open the retaining clips by pushing down on them, and remove the CRIMM from the socket. See Figure 10-11 on page 161.
 - b. If you are replacing existing RIMMs, open the retaining clips by pushing down on them, and remove the existing RIMMs from their sockets.

NOTE

Always store any removed RIMMs and CRIMMs in a safe place for future use. CRIMMs may be stored in an empty memory bank if one is available.

- c. Install your new RIMMs or CRIMMs, ensuring that the two notches on the bottom edge are aligned with those of the socket. With the two retaining clips open, press the RIMM fully into the socket until the retaining clips click into position. You can also close the retaining clips by hand to ensure that the RIMM is correctly inserted.

Figure 10-11 Inserting RIMMs and CRIMMs



9. Replace the MEC (see page 156).
10. Replace the chassis beam assembly (see page 153).
11. Close and secure the hard disk drive cage (see page 150).
12. Replace the Workstation cover (see page 148).
13. Reconnect all power cables and any LAN or telecommunications cables.
14. Start the Workstation and check the Summary Screen by pressing **Esc** when prompted to verify the new configuration. The Summary Screen displays the amount of memory.

Graphics Card

Removing a Graphics Card

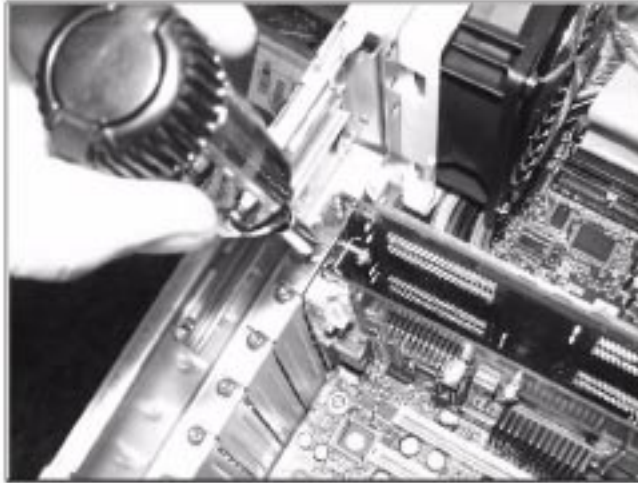
NOTE

You can uninstall the driver for the old graphics card before installing a new graphics card. This keeps you from getting a warning when the old driver tries to load in the operating system.

To remove a graphics card:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. Remove any cables connected to the graphics card on the rear panel.
4. To ease installation, place the Workstation on its side with the system board facing upwards.
5. Rotate the hard disk drive cage to the open position (see page 149).
6. Remove the chassis beam assembly (see page 152).
7. Before removing the graphics card:
 - If your graphics card came with a separate graphics retainer beam as shown in Figure 10-14 on page 164:
 - a. Remove the screw that attaches the graphics card and the graphics retainer beam to the rear slot panel.
 - b. Remove the full-length graphics card retaining screw.
 - If your graphics card did not come with a separate graphics retainer beam, remove the retaining screw as shown in Figure 10-12 on page 163.
8. Carefully pull out the card.
9. Store the card in a static bag.

Figure 10-12 **Removing the Graphics Card Retaining Screw**



Installing a Graphics Card

To install a graphics card:

1. If you are replacing an existing card, remove the current card (see page 162).
2. Unscrew and remove the rear slot panel that corresponds AGP Pro 110 4X connector. The screw you removed is used to retain the graphics card.

NOTE

If you are installing a full-length graphics card, you must remove the graphics board retaining screw near the front of the chassis as shown in Figure 10-13.

Figure 10-13 Full-Length Graphics Card Retaining Screw



3. Align the new card carefully and slide it into position. Press it firmly into the slot.
4. Secure your graphics card:
 - If your graphics card came with a separate graphics retainer beam:
 - a. Remove both of the universal retainer pieces from the chassis beam assembly shown in Figure 10-15 and store these in a safe place for future use.
 - b. Using the screw that you removed from the rear slot panel and the graphics card retaining screw shown in Figure 10-13, attach the graphics retainer beam as shown in Figure 10-14.

Figure 10-14 Graphics Card Retainer Beam

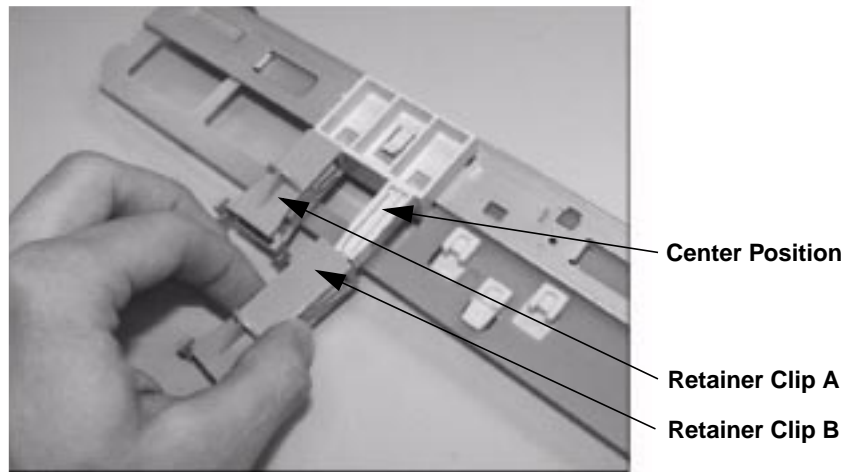


- If your graphics card did *not* come with a separate graphics retainer beam, you must use the retainer clip on the chassis beam assembly to secure your graphics card. The retainer clip holds the graphics card securely in the AGP Pro 110 4X slot:
 - a. Use the screw you removed the rear slot panel to attach the graphics card to the chassis.
 - b. There are two universal retainer clips on the chassis beam assembly (see Figure 10-15). The longer clip (A) is used for shallower graphics cards. The shorter clip (B) is used for deeper graphics cards. Remove the retainer clip you don't need.
 - c. Move the remaining retainer clip to the center position shown in Figure 10-15. If your graphics card is too shallow for the clip to hold it tightly in this position, return it to the other arm.

Figure 10-15 Retainer Pieces on the Chassis Beam Assembly

Remove the unused retainer clip and move the required retainer clip to the center position.

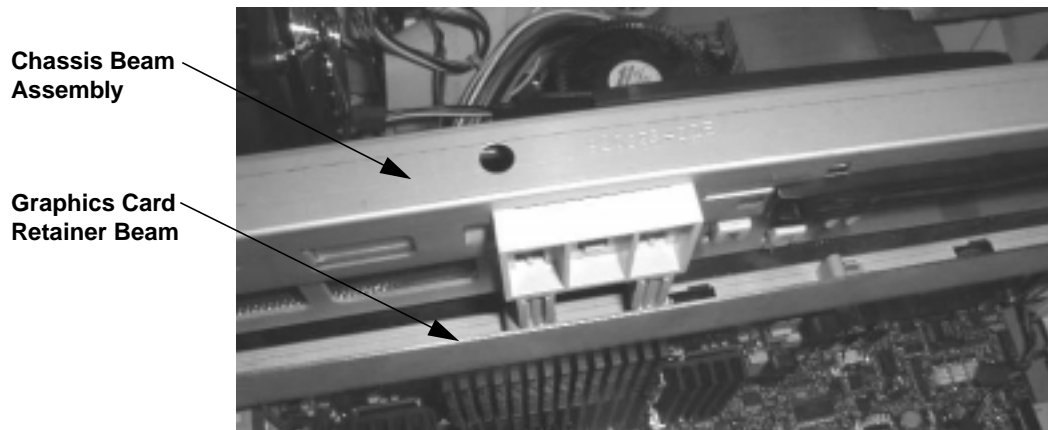
The retainer clip keeps the graphics board seated on the system board when the chassis beam assembly is installed.



5. Replace the chassis beam assembly (see page 153).

If your graphics card has a retainer beam, once the chassis beam assembly is in place it looks like Figure 10-16.

Figure 10-16 Graphics Card Retainer Beam and Chassis Beam Assembly



6. Close and secure the hard disk drive cage (see page 150).
7. Replace the Workstation cover (see page 148).
8. Reconnect all power cables and any LAN or telecommunications cables.

SCSI Hard Drive

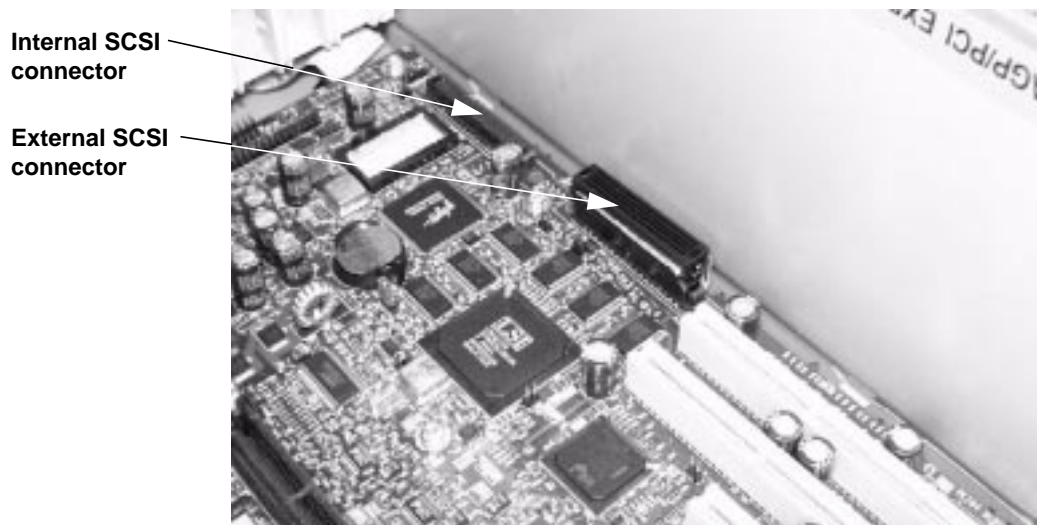
CAUTION

Back up your files before you install a hard disk drive.

Your Workstation has on-board SCSI capability. You can connect up to two internal SCSI hard disk drives.

Figure 10-17 shows the internal and external SCSI connectors on the system board.

Figure 10-17 **SCSI System Board Connectors**

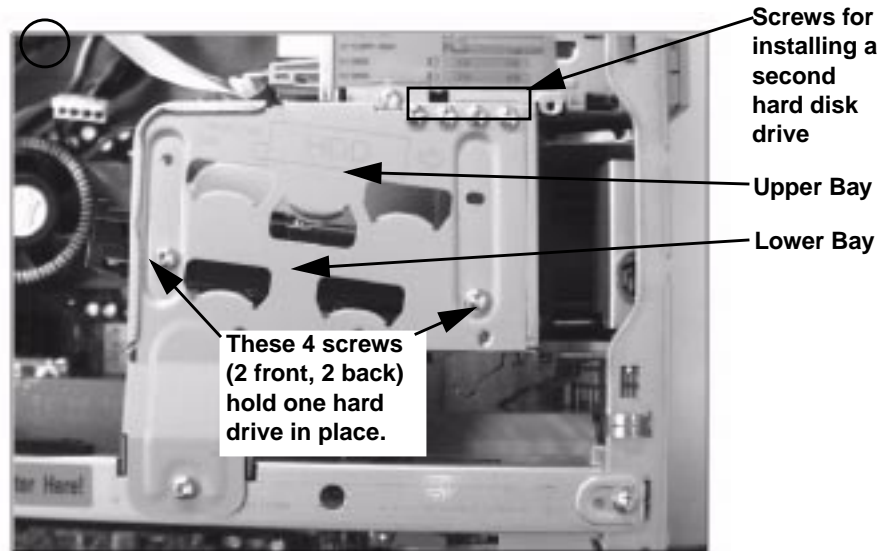


Removing a SCSI Hard Disk Drive

To remove the SCSI hard disk drive:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. Open the hard disk drive cage (see page 149).
4. Remove the hard disk drive from the cage by removing the four torx screws that hold the drive in place as shown in Figure 10-18.

Figure 10-18 Removing the Hard Disk Drive



Setting SCSI IDs for a New Hard Disk Drive

You must assign an unused SCSI ID to your hard disk drive. SCSI IDs range from 0 to 15 for wide 16-bit SCSI.

SCSI ID 0 is used by the first SCSI hard disk drive. SCSI ID 7 is reserved for the integrated SCSI controller (see Table 10-1). You should assign an unused SCSI ID to the second SCSI hard disk drive (SCSI ID 1 is recommended).

Table 10-1 SCSI ID Settings

SCSI ID	Used By
0	First SCSI hard drive
1	Optional second SCSI hard drive
2 - 6	Unused
7	SCSI controller
8 - 15	Unused

The SCSI ID is configured with jumpers on the SCSI hard disk drive. Refer to the information label on the hard disk drive, or “Hard Disk Drives” on page 134, for additional details on setting the SCSI ID.

Installing a SCSI Hard Disk Drive

CAUTION

Before proceeding with this section, make sure you have set the SCSI ID for your hard disk drive (see page 169). Devices that are incorrectly configured cause the Workstation to behave unpredictably.

Take care when handling the hard disk drive during installation. A one-quarter inch drop can damage it.

To install one or two hard disk drives:

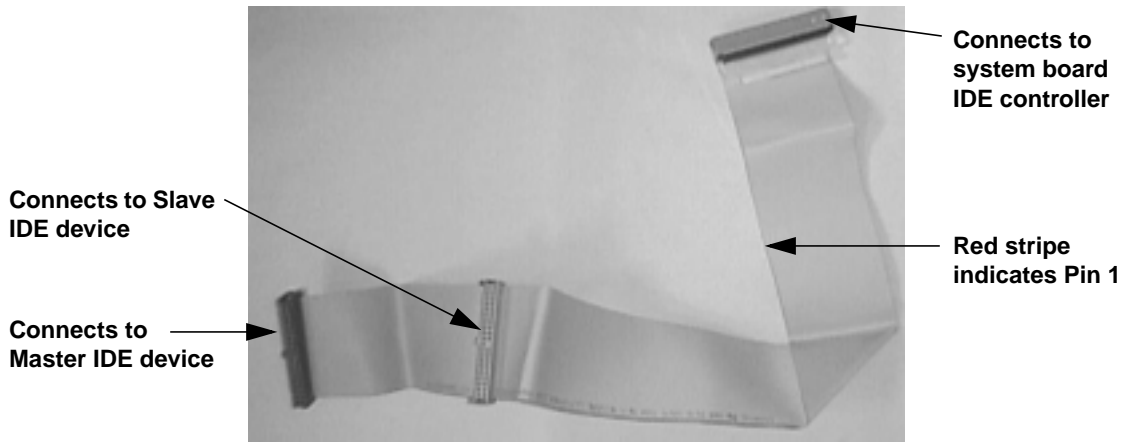
1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. Open the hard disk drive cage (see page 149).
4. Install the hard disk drive(s) in the cage using the screws provided on the hard disk drive cage as shown in Figure 10-18 on page 168:
 - a. If you only have one hard drive, install it in the bottom bay.
 - b. If required, install a second hard drive in the top bay.
 - c. Align the screw holes on each hard drive with the openings in the hard disk drive cage.
 - d. Fasten each hard disk drive to the cage with four screws, two on each side of the cage. The screws for installing the new drive are attached to the hard disk drive cage.
5. Close and secure the hard disk drive cage (see page 150).
6. Replace the Workstation cover (see page 148).
7. Reconnect all power cables and any LAN or telecommunications cables.
8. Start the Workstation and check the Summary Screen by pressing **Esc** when prompted to verify the new configuration.

CD-ROM, CD-RW or DVD

The CD-ROM, CD-RW and DVD are IDE devices.

An IDE cable is shown in Figure 10-19.

Figure 10-19 IDE Data Cable



Determining IDE Connections

The following table explains which data connectors to use when you install IDE devices. All the IDE devices are jumpered Cable Select at the factory. This means that Master and Slave configurations are determined by the device position on the IDE cable:

- The device attached to the connector closest to the system board is the Slave.
- The device attached to the connector farthest from the system board is the Master.

IDE Drive Cabling Suggestions (always use the secondary IDE controller)	
1 CD-ROM drive	Master
1 CD-RW drive	Master
1 DVD drive	Master
1 CD-ROM drive 1 CD-RW drive	Master Slave
1 CD-ROM drive 1 DVD drive	Master Slave
1 DVD drive 1 CD-RW drive	Master Slave

Removing a CD-ROM, CD-RW, or DVD

To remove an optical device:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover and front bezel (see page 145) for instructions).
3. Disconnect the power, data, and audio cables from the old drive.
4. Remove the drive by pressing the two front rail clips inward and sliding the drive out the front of the chassis.
5. Remove the guide rails by gently prying them off the drive. These guide rails are required for the new drive.

Figure 10-20 **Removing the Old Drive**



Installing a CD-ROM, CD-RW or DVD

To install an optical device:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover and front bezel (see page 145) for instructions).
3. Remove the 5.25-inch metal filler plate from the chassis of the Workstation by using your finger to pull the plate from the chassis.
4. Add the guide rails to the new drive. Refer to the sticker on the Workstation chassis for the correct rails for your drive. Insert the guide rails in the two holes located at the bottom of the drive. The guide rails are not side-specific.
5. Align the guide rails on both sides of the drive with the internal shelf guides, then slide the drive until it clicks into position. You should put your Master device in the top bay and your Slave device in the lower bay. For more information on Master/Slave configuration, see page 172.
6. Connect the power, data, and audio cables to the rear of the new drive.
7. Remove the plastic cover piece from the Workstation's bezel that corresponds to your new drive before attaching the bezel and front cover (see page 148).
8. Reconnect all the power and telecommunications cables.

NOTE

If you installed a CD-RW, you must install the software that came with the drive before you can write to the device.

The CD-ROM driver is pre-loaded and is used by the CD-ROM, CD-RW, and DVD to read standard CD-ROM format media.

Load the Software Applications for Your CD-RW

If you have a CD-RW in your Workstation, you must install the Direct CD and Easy CD Creator applications located on the *Applications* CD-ROM before you can use the write/re-write functionality of the drive.

To install these applications:

1. Put the *Applications* CD-ROM in your CD-RW drive. Installation begins automatically.
2. When the installation window appears, a dialog box appears asking you to select your language. Select the language you wish to install.
3. Select one of these choices and follow the on-screen directions for installation:
 - **Easy CD Creator**
 - **Direct CD**
4. When the installation wizard returns, you *must* restart your system before installation is complete. To restart your system:
 - a. Select **Exit**.
 - b. Remove the *Applications* CD-ROM and click **Yes** to restart your system.

NOTE

Repeat these instructions to install the second application. You *must* restart your system between each installation in order for both applications to install correctly.

If you do not install either Easy CD Creator and Direct CD, you can only use the CD-RW drive's read functionality.

Processor

The x4000 Workstation can have two processors. The processors must be identical.

CAUTION

If you are upgrading your current processor, you must update the BIOS. The latest BIOS is located at www.hp.com/workstations/support.

If you are adding a second processor, you must update your operating system (see “Updating Your Operating System” on page 179).

Removing a Processor

CAUTION

Before removing your processor, turn on the Workstation and let it run for 3 to 5 minutes. This warms up the processor and makes it easier to detach the heatsink. *Be very careful when removing the heatsink.* If your processor turbo cooler fan is not operating, the heatsink may be very hot. Under normal circumstances, the turbo cooler fan is operational and a slight twist of the heatsink should release it from the processor.

To remove a processor:

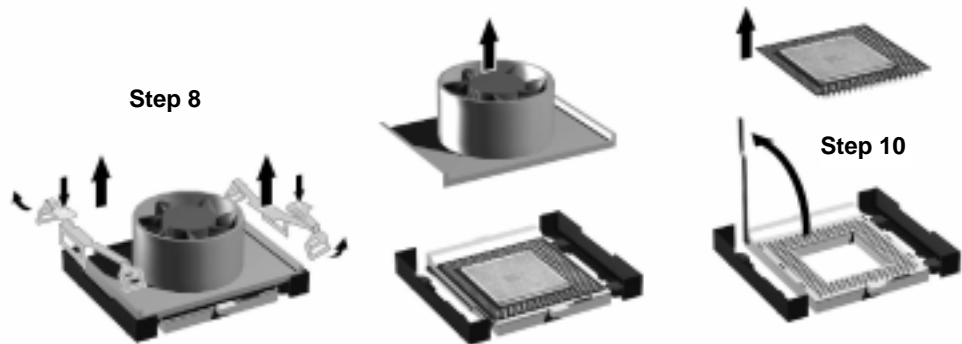
1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. Place the Workstation on its side for better access.
4. Open the hard disk drive cage (see page 149).
5. Remove the Chassis Beam Assembly as shown in Figure 10-5 on page 152.
6. Remove the MEC card (see page 162).
7. Remove the heatsink power connector from the system board.

Installing or Replacing Parts and Accessories

Processor

8. Remove the two heatsink clips by pressing the release lever on the clips. Then lift off the heatsink. There is a thermal interface material between the heatsink and the processor. This may cause the processor to stick to the heatsink.

Figure 10-21 **Removing a Processor**



9. Remove the thermal interface material from the heatsink and discard it. You can leave any residue that remains on the heatsink. This does not impair the heat transfer.
10. Open the Zero Insertion Force (ZIF) lever, located at the side of the processor socket, until it is in the vertical position (depending on the socket design, the handle may need to go past vertical), then carefully lift out the processor. To avoid bending the processor pins, keep the processor perfectly flat when removing it.
11. Store the processor in an anti-static bag (such as the one provided with the replacement processor).
12. If you are permanently removing a second processor, you must update your operating system (see page 179). You should also store the heatsink and clips in a safe place.

Installing a Processor

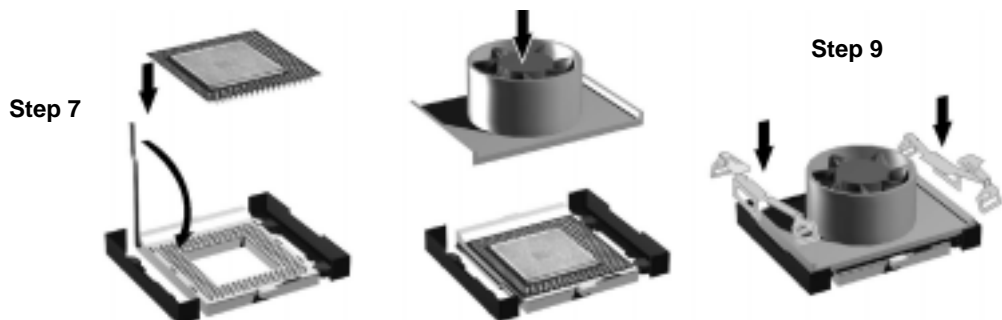
To install a processor:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (see page 145).
3. Place the Workstation on its side for better access.
4. Open the hard disk drive cage (see page 149).
5. Remove the Chassis Beam Assembly (see page 152).
6. Remove the MEC card (see page 162).
7. Ensure the processor is correctly oriented by matching the notches on the processor to the notches on the ZIF socket. Then carefully lower the new processor into place. When the processor is fully inserted, close the ZIF lever.

CAUTION

Be extremely careful when you insert the processor. If you bend one of the pins, it will not go into the socket.

Figure 10-22 Inserting a Processor



8. Affix the new thermal interface material, provided with the new processor, to the top of the processor.
9. Attach the heatsink to the processor. Use the retaining clips to attach the heatsink. For easier installation, partially attach both clips by hooking one end of the side slot in each clip. Press down on the remaining ends of both clips until they click into place.

Installing or Replacing Parts and Accessories

Processor

10. Connect the heatsink turbo fan power connector to the system board.
The fan connectors are labeled **CPU0** and **CPU1** on the system board.
11. Replace the MEC card.
12. Replace the Chassis Beam Assembly (see page 153).
13. Close and secure the hard disk drive cage (see page 150).
14. Replace the Workstation's cover (see page 148).
15. Reconnect all the power and telecommunications cables.
16. Update your operating system (see page 179).

Updating Your Operating System

If you are adding a second processor to your Workstation (or removing a processor), you must update your operating system to reflect these changes.

Windows 2000

To update your operating system in Windows 2000:

1. Go to the Control Panel by selecting **Start > Settings > Control Panel**.
2. Select the **System** icon.
3. In the Hardware tab, select **Device Manager**.
4. Expand the **Computer** branch. The type of support that you currently have is displayed:
 - **ACPI UniProcessor PC**
 - **ACPI MultiProcessor PC**

To change the type of support, double click on this icon to bring up the ACPI PC properties.

5. In the Driver tab, select **Update Driver**. The Upgrade Device Driver Wizard appears and you must select **Next** to continue.
6. Choose to display a list of all the known drivers and click **Next**.
7. When all the drivers are located, click the radio button to show all hardware of this device class, select one of the following and click **Next** to install the new driver:
 - **ACPI MultiProcessor PC** if you have added a second processor.
 - **ACPI UniProcessor PC** if you have removed your second processor.

Windows NT

To update your operating system in Windows NT, use the HP DualExpress utility which is posted at www.hp.com/workstations/support.

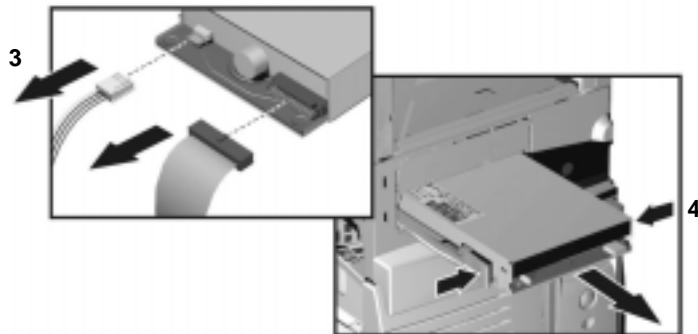
Floppy Disk Drive

Removing the Floppy Disk Drive

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover and front bezel (refer to "Cover and Front Bezel" on page 145 for these instructions).
3. Disconnect the power and data cables from the old drive.
4. Remove the drive by pressing the two front rail clips inward and sliding the drive out the front of the chassis.
5. Remove the two guide rails by gently prying them off the drive. These guide rails are required for the new drive.

Figure 10-23

Removing the Floppy Disk Drive



Installing the Floppy Disk Drive

1. Add the guide rails to the new drive. Insert the guide rail labeled “L” on the left-hand side (cable connectors facing towards you and positioned at the top), and the guide rail “R” on the right-hand side of the floppy disk drive.
2. Align the guide rails on both sides of the drive with the internal shelf guides, then slide the drive until it clicks into position.
3. Connect the power and floppy data cables to the new drive. The connectors are shaped to go in one way only.
4. Replace the front bezel and Workstation’s cover (refer to “Replacing the Cover and Front Bezel” on page 148).
5. Reconnect all the power and telecommunications cables.

Power Supply

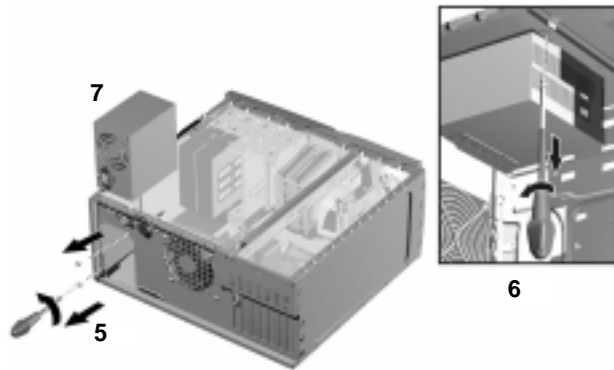
WARNING

Hewlett-Packard does not support power supply upgrades. This information is provided to help you replace a defective power supply unit. For your safety, only use a power supply provided by HP support services.

Removing the Power Supply Unit

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (refer to "Removing the Left Side Cover" on page 145 for instructions).
3. Place your Workstation on its side with the system board facing upwards.
4. Remove *all* internal power supply connectors.
5. Remove the three screws located on the rear of the chassis that secure the power supply unit in position.
6. Remove the screw located inside the Workstation at the top of the power supply unit.
7. Push the supply unit forward until it is clear of the guide rail and remove it from the chassis.

Figure 10-24 Removing the Power Supply Unit



Installing the Power Supply Unit

To install the power supply unit:

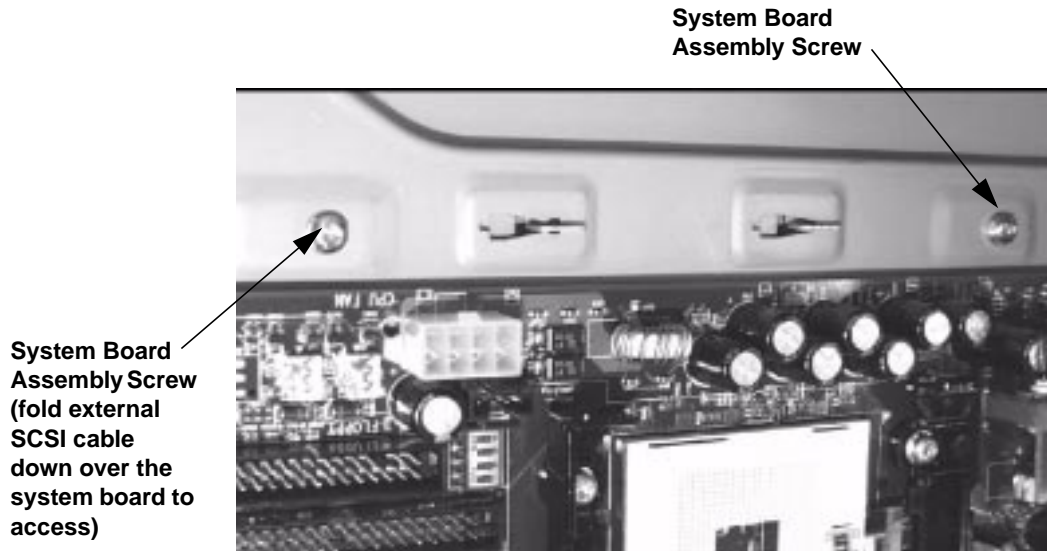
1. Insert the new power supply unit.
2. Secure it to the back and top of the chassis using the four screws you previously removed.
3. Reconnect *all* internal power supply connectors.
4. Return the Workstation to its upright position.
5. Replace the Workstation's cover (refer to "Replacing the Cover and Front Bezel" on page 148).
6. Reconnect all the power and telecommunications cables.

System Board

Removing the System Board

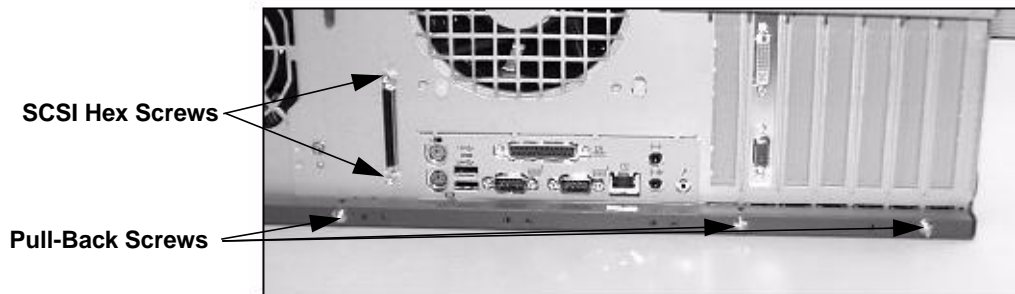
1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover and bezel as described in "Cover and Front Bezel" on page 145.
3. To ease removal of the system board, slide the floppy disk drive at least partially out the front of the chassis as described in "Removing the Floppy Disk Drive" on page 180.
4. Place your Workstation on its side with the system board facing upwards.
5. Open the hard disk drive cage as described in "Opening the Hard Disk Drive Cage" on page 149.
6. Remove the Workstation chassis beam assembly as described in "Removing the Chassis Beam Assembly" on page 152.
7. Remove the Memory Expander Card (MEC), the graphics card, and any other accessory cards you may have added to your system. See "Removing a Graphics Card" on page 162.
8. Remove the system fan. See "Removing the Fan" on page 190.
9. Disconnect any cables attached to the system board.
10. Remove the processor(s) and heatsink(s) from the system board. See "Removing a Processor" on page 175.
11. Remove the two screws that fasten the system board to the chassis as shown in Figure 10-25.

Figure 10-25 System Board Assembly Screws



12. Unscrew, but *do not remove*, the three pull-back screws shown in Figure 10-26.

Figure 10-26 Pull-Back Screws and SCSI Hex Screws



13. Remove the screws that attach the external SCSI connector to the rear panel as shown in Figure 10-26.

14. Remove the system board, being careful not to damage the Workstation's cables and rear panel connectors.

Installing the New System Board

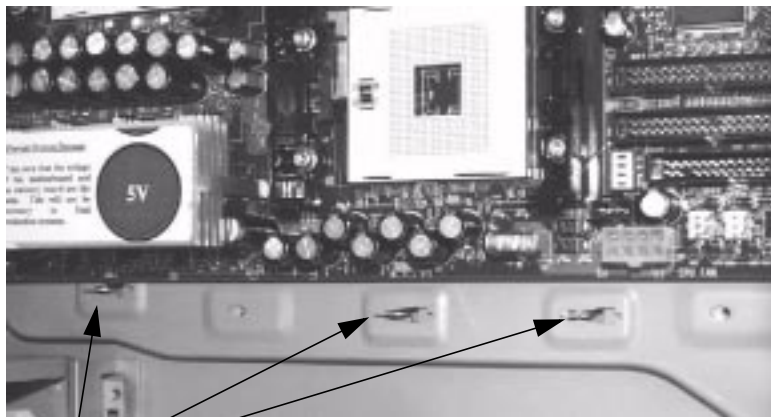
1. Clear all cables from the area where the system board will sit.
2. Align the hooks with their corresponding sockets as shown in Figure 10-27, and insert the system board. Ensure that all hooks are correctly positioned. Check that the rear panel connectors are correctly aligned in their sockets.

CAUTION

If you have problems getting the hooks to seat properly, don't force them. There may be cable that has crept under the system board.

When inserting the system board, be careful not to damage or bend the metal hooks on the rear connector EMI shield. If the shield is damaged it can be very difficult to install the system board correctly.

Figure 10-27 Inserting the System Board



Align the hooks with the corresponding sockets.

3. Tighten the pull-back screws as shown in figure 10-26, that attach the external SCSI connector to the rear panel as shown in Figure 10-26 on page 185. These screws pull the system board to the rear of the chassis and ensure proper alignment with the rear connectors.

4. Replace the external SCSI connector in the I/O bulkhead and tighten the hex screws as shown in Figure 10-26 on page 185.
5. Replace the system board assembly screws shown in Figure 10-25 on page 185.
6. Replace the processor(s) and heatsink(s) as described in “Installing a Processor” on page 177.
7. Reconnect any cables you disconnected from the system board. The cables that need to be reconnected for a factory-configured system are:
 - 2 system power
 - 3 chassis fan (rear system, hard disk drive, PCI)
 - processor turbocooler fan (two, if dual processor system)
 - tamper detect
 - speaker
 - CD audio
 - front control panel
 - floppy
 - IDE for optical
 - internal SCSI (external SCSI is part of the system board assembly)

To find out the positions of system board connectors, refer to “System Board Diagram” on page 198 or to the label located on the inside of the cover.

8. Replace the system fan as described in “Installing the System Fan” on page 191.
9. Replace the MEC, graphics card, and any accessory cards as described in “Installing a Graphics Card” on page 163.
10. Compare the system board switches to the information given in “System Board Switches” on page 189.
11. Replace the chassis beam assembly as described in “Installing the Chassis Beam Assembly” on page 153.
12. Close and secure the hard disk drive cage as described in “Closing and Securing the Hard Disk Drive Cage” on page 150.
13. Return the Workstation to its upright position.
14. Slide the floppy disk drive back in to place as described in “Installing the Floppy Disk Drive” on page 181.

Installing or Replacing Parts and Accessories

System Board

15. Replace the Workstation's cover and bezel as described in "Cover and Front Bezel" on page 145.
16. Connect all the power and telecommunications cables.
17. After installing the system board, you need to update your BIOS.

NOTE

The latest BIOS and firmware for your Workstation are available from:
www.hp.com/workstations/support.

System Board Switches

There are four system board switches used for configuration, numbered from 1 to 4. See “System Board Diagram” on page 198 for the location of these switches.

Switch	Default	Description
1	OFF	Clear BIOS Password
2	OFF	Boot Block Recovery Mode
3	OFF	Clear CMOS. Reset CMOS setting to BIOS defaults.
4	OFF	Safe Mode Enable. Forces processors to run at 800 MHz.

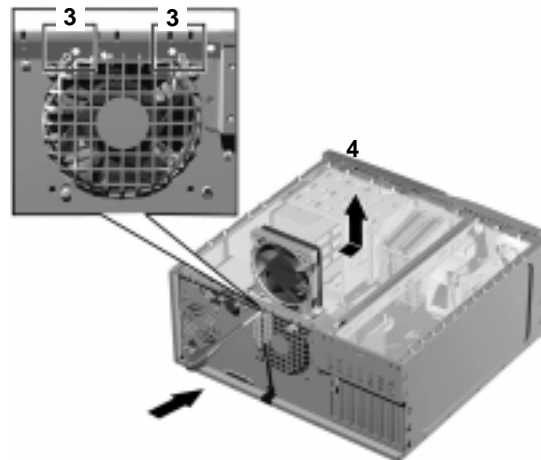
System Fan

Removing the System Fan

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover (refer to page 145 for instructions).
3. Holding the fan with one hand, use a screwdriver to gently push the retaining clips in, then slide the fan up and out of the chassis.

Figure 10-28

Removing the Fan



4. Disconnect the fan connector from the system board.

Installing the System Fan

NOTE

Ensure that all cables are clear of the fan and will not easily come into contact with the fan during normal use or following transportation.

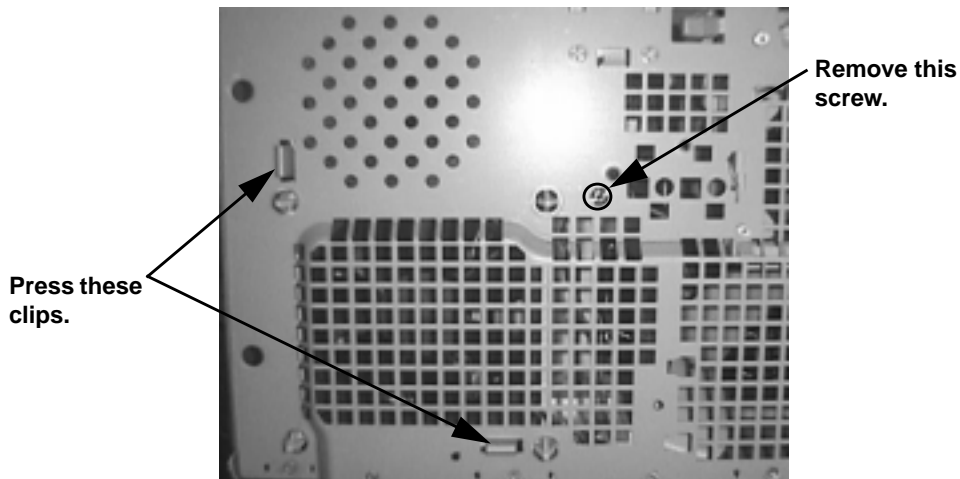
1. The fan unit can only be installed in one way. The distance between the two retaining clips is shorter at the top than the bottom. Align the fan clips with their corresponding holes.
2. Gently push the fan downwards until it clicks into place.
3. Connect the fan connector to the system board.
4. Replace the Workstation's cover (refer to page 148). Reconnect all the power and telecommunications cables.

Fan and Speaker Assembly

Removing the Fan and Speaker Assembly

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover as described in "Removing the Left Side Cover" on page 145.
3. Remove the bezel as described in "Removing the Front Bezel" on page 147.
4. Place the Workstation on its side with the system board facing upwards.
5. Open the hard disk drive cage as described in "Opening the Hard Disk Drive Cage" on page 149.
6. Remove the chassis beam assembly as described in "Removing the Chassis Beam Assembly" on page 152.
7. Remove the MEC. Remove the separate graphics retainer beam and full length PCI or graphics cards if installed.
8. Remove the fan and speaker cables from the system board.
9. On the front of the chassis, remove the screw holding the fan and speaker assembly in place as shown in Figure 10-29 on page 192.

Figure 10-29 Removing the Fan and Speaker Assembly



10. Unclip the two clips on the front of the chassis.
11. Slide the fan and speaker assembly towards the rear of the Workstation until it is clear of the chassis, then remove it from the Workstation.

Installing the Fan and Speaker Assembly

1. Ensure all cables are clear of the assembly, then carefully move the fan and speaker assembly towards the front of the chassis.
2. Align the clips and guide pins with their appropriate sockets and slide the assembly forward to secure it into place.
3. Replace the screw on the front of the chassis as shown in Figure 10-29 on page 192.
4. Connect the fan and speaker cables to their connectors located on the system board. See Figure 10-32 on page 198.
5. Insert any PCI and graphics cards. Install the separate graphics retainer beam. Insert the MEC..
6. Replace the chassis beam assembly as described in “Installing the Chassis Beam Assembly” on page 153.
7. Close and secure the hard disk drive cage as described in “Closing and Securing the Hard Disk Drive Cage” on page 150.

Installing or Replacing Parts and Accessories
Fan and Speaker Assembly

8. Return the Workstation to its upright position.
9. Replace the cover and bezel as described in “Replacing the Cover and Front Bezel” on page 148.
10. Reconnect all power and LAN cables.

Hard Disk Drive Fan

Removing the Hard Disk Drive Fan

To remove the hard disk drive fan:

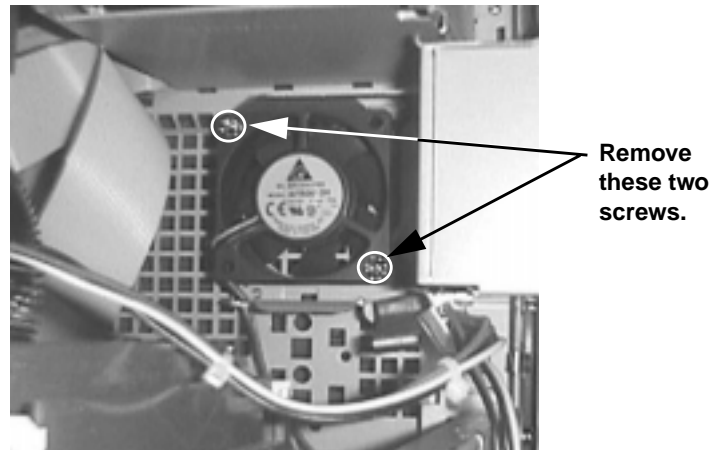
1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover as described in "Removing the Left Side Cover" on page 145.
3. Place your Workstation on its side with the system board facing upwards.
4. Open the hard disk drive cage as described in "Opening the Hard Disk Drive Cage" on page 149.

NOTE

The hard disk drive fan is located behind the hard disk drive cage.

5. Disconnect the hard disk drive fan's power cable from the system board.
6. Remove the two screws that mount the hard disk drive fan to the chassis as shown in "Removing the Fan and Speaker Assembly" on page 192.

Figure 10-30 Removing the Hard Disk Drive Fan



Installing the Hard Disk Drive Fan

To install the hard disk drive fan:

1. Attach the new hard disk drive fan to the chassis using the two screws you removed previously.
2. Connect the hard disk drive fan power cable to the system board. For the connector location, see “System Board Diagram” on page 198.
3. Close and secure the hard disk drive cage as described in “Closing and Securing the Hard Disk Drive Cage” on page 150.
4. Return the Workstation to its upright position.
5. Replace the Workstation’s cover as described in “Replacing the Cover and Front Bezel” on page 148.
6. Reconnect all power and LAN cables.

Battery

WARNING

There is a danger of explosion if the battery is incorrectly installed. For your safety, never attempt to recharge, disassemble, or burn the old battery. Replace the battery only with the same or equivalent type recommended by the manufacturer. The battery is a lithium battery which does not contain heavy metals. Nevertheless, in order to protect the environment, do not dispose of batteries in household waste. Please return used batteries to the shop from which you bought them, or to the dealer from whom you purchased your Workstation, or to HP, so that they can be either recycled or disposed of in an environmentally sound way. Returned batteries will be accepted free of charge.

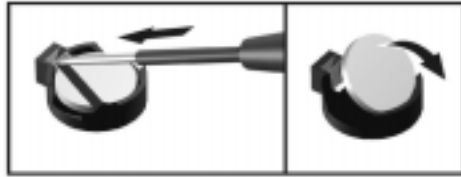
Replacing the System Battery

If your Workstation repeatedly loses its configuration settings, you should consider changing the battery. Replace it with a CR2032 coin type manganese/lithium battery, available from most Workstation stores.

To change the battery:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover as described in "Removing the Left Side Cover" on page 145.
3. Remove the old battery by sliding it from under the retaining clip(s).

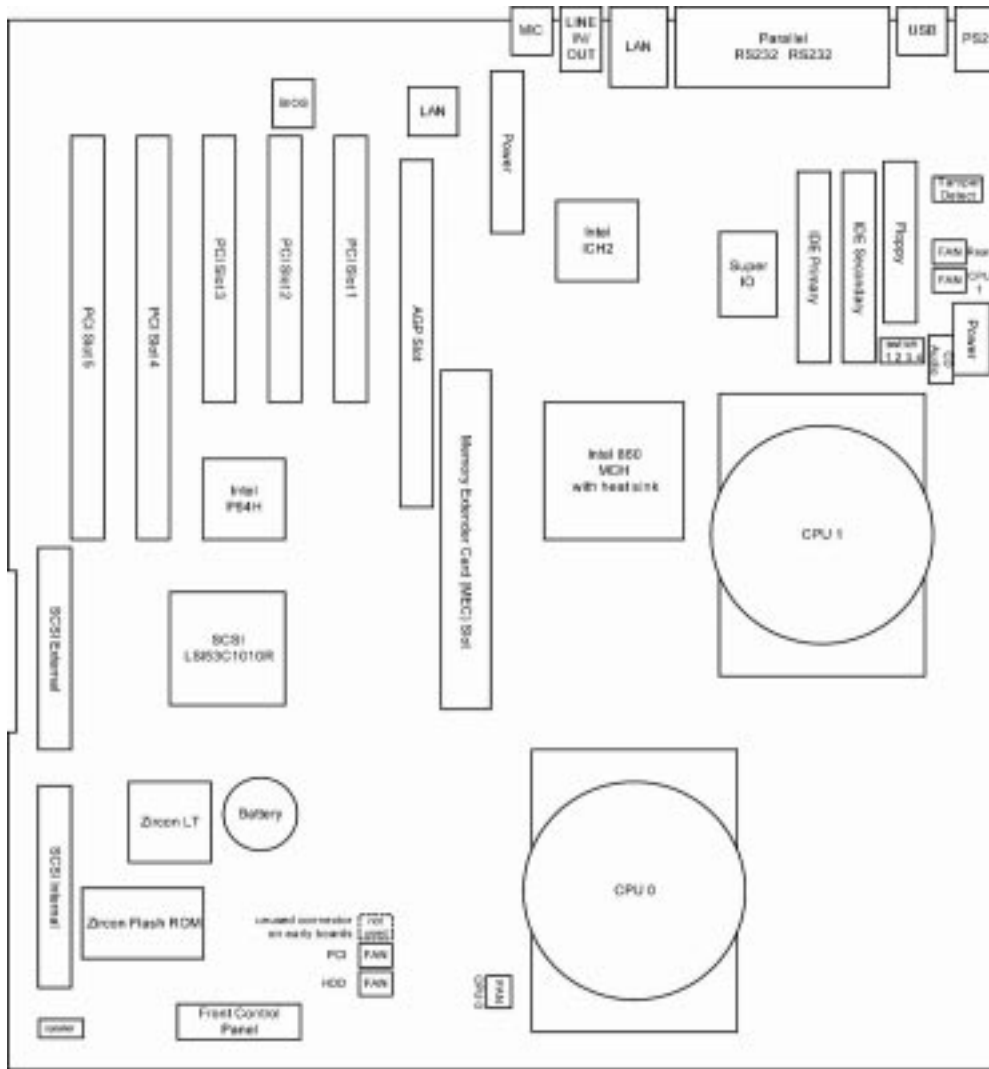
Figure 10-31 Replacing the Battery



4. Place the new battery in the battery holder and ensure that it is properly seated. Ensure that the clip holds the battery firmly in place.
5. Replace the Workstation's cover as described in "Replacing the Cover and Front Bezel" on page 148.
6. Reconnect all cables and power cords.
7. Run the Setup program to configure the Workstation.

System Board Diagram

Figure 10-32 System Board Diagram



Installing or Replacing Parts and Accessories
System Board Diagram

11 **Troubleshooting**

Overview

The following sections contain information to help you get your Workstation up and running in the unlikely event that you experience a problem:

- “Solving Hardware Problems” on page 205
- “Understanding the Diag LEDs” on page 212
- “Setting and Removing System Passwords” on page 224
- “Using e-Diag Tools for Hardware Problems” on page 225
- “Recovering or Reconfiguring Windows 2000 or Windows NT” on page 227

Solving Hardware Problems

The following topics describe specific hardware errors that may occur.

Workstation Does Not Start Properly

Display is Blank

If your display is blank after you turn on your Workstation, check that:

- The Workstation and monitor are turned on. (The power lights should be illuminated.)
- Both the Workstation and monitor power cords are firmly connected and plugged in.
- The outlet power is functioning.
- The monitor is firmly connected to the graphics card connection and the graphics card is firmly seated on the system board. (Reseating the graphics card requires opening the Workstation.)
- The monitor's contrast and brightness settings are set correctly.

A POST Error Message is Displayed

The Power-on-Self-Test (POST) can detect both an error and a change to the configuration. In either case, a code and short description is displayed. Depending on the message, one or more choices are displayed:

- Press **F1** to ignore the message and continue.
- Press **F2** to run the Setup program and correct a system configuration error.
- Press **Enter** to see more details about the message. After viewing these details, you are returned to the original POST display screen.

Added a Second Processor

If you have added a second processor and the system won't boot:

1. Turn off the display and shut down the Workstation. Disconnect all power cables and any LAN or telecommunications cables.
2. Remove the Workstation's cover.
3. Set system board switch 4 to **ON** (see "System Board Switches" on page 28).
4. If the system boots, enter the setup program by pressing **F2** and go to the advanced menu (see "Advanced Menu" on page 52) to check the processor speed setting. If it is set to **Auto**, your processors may have different frequencies. This is not supported.

Keyboard Doesn't Work

If your keyboard does not work as expected:

- Ensure that all the keyboard cables are firmly connected.
- Ensure the keyboard is connected to the keyboard connector rather than the mouse connector on the rear panel of the Workstation.
- Ensure you are using a PS2 keyboard rather than a USB keyboard.
- Replace the keyboard with a known working unit to ensure the keyboard itself is not defective.

Monitor Doesn't Work

If the display is blank, refer to "Display is Blank" on page 205.

If the display works properly during the Power-on-Self-Test (POST), but goes blank when Windows starts, the display settings in the operating system may not be compatible with your monitor. To correct this, restart your Workstation in VGA mode:

- Windows NT: Enter VGA mode when prompted during start-up.
- Windows 2000: When prompted, press **F8** and start the Workstation in VGA mode.

After the Workstation is up and running, change the display settings in the control panel (**Start > Settings > Control Panel**). Refer to your operating system documentation for more information.

Mouse Doesn't Work

If your mouse does not work as expected:

- Ensure that the mouse cable is firmly connected.
- Ensure that the mouse is connected to the mouse connector rather than the keyboard connector on the rear panel of your Workstation.
- Ensure you are using the correct driver. The driver for the HP enhanced mouse is provided with all Windows preloaded systems as well as on the *HP Workstation Recovery CD-ROMs*. However, drivers are constantly being updated. You can download the latest driver from the HP web site (www.hp.com/workstations/support).
- Clean the mouse ball with a dry, lint-free cloth if the cursor moves sporadically.
- Replace the mouse with a known working unit to ensure the mouse itself is not defective.

Audio Doesn't Work

The internal speaker is deactivated when you use the Output Line jack on the rear of the Workstation. If you have connected the keyboard headphones connector to this jack, you must connect speakers to the keyboard for audio output.

Power LED is Flashing

The Power LED located on the Power On/Off button has the following states:

- Solid green indicates system on.
- Solid yellow indicates the Workstation is in Stand By or Hibernate mode. See "Power Saving and Ergonometry" on page 89.
- Solid red or flashing yellow indicates a system error. The error is indicated by the pattern on the Diag LEDs. See "Understanding the Diag LEDs" on page 212.

Hard Disk Drive Problems

To correct hard disk drive problems:

1. If possible, back up the hard disk drive.
2. Ensure the hard disk drive power and SCSI cables are correctly connected as described in “SCSI Hard Drive” on page 169.
3. Check that booting from the hard drive has not been disabled in the BIOS Setup Utility and has been detected by looking in the Boot menu of the Setup program as described in “Boot Menu” on page 57.
4. Refer to your operating system documentation for instructions on running system diagnostic tools like scan disk or defragmentation.
5. Run the SCSI test in the **Advanced System Test** option from HP e-Diag Tools. HP e-Diag Tools is described in “Using e-Diag Tools for Hardware Problems” on page 225.

Hard Disk Drive Activity LED Doesn't Work

If the hard disk drive activity LED does not flicker when the Workstation is accessing the hard disk drive:

1. Make sure the control panel connector is firmly attached to the system board.
2. Ensure the hard disk drive power and SCSI cables are correctly connected as described in "SCSI Hard Drive" on page 169.

CD-ROM, DVD or CD-RW Drive Doesn't Work

1. Check that a CD (or DVD) is inserted in the drive.
2. Ensure all cables (data, power and audio) have been properly connected both to the drive and to the system board as described in "CD-ROM, CD-RW or DVD" on page 173.
3. Verify that the drive has been detected in the Setup program Advanced menu by displaying the IDE Devices as described in "Advanced Menu" on page 52. You should see a drive declared in the **IDE Secondary Master** or **IDE Secondary Slave** field.
4. If you intend to boot from the CD-ROM, CD-RW or DVD, place the device before the hard disk drive in the boot order as described in "Boot Menu" on page 57.

CD-RW Won't Allow Recording

If you can read a CD in your CD-RW, but you can't write to a CD, you may be missing the CD-RW software.

If you have a CD-RW in your Workstation, you must install the software that came with the drive before you can write to the device. For more information, refer to the *Adaptec Easy CD Creator* disc that came with your CD-RW.

DVD Drive Doesn't Play DVD Video

DVD drivers are not preloaded at the factory. The DVD uses the CD-ROM driver, which is part of the operating system. To use special DVD features, such as reading DVD video, you must install separate software.

You Forgot Your Password

Clearing the User Password

If you forgot your User password and remember the Administrator password, you can clear the User password through the setup menu.

To clear the User password:

1. Start the Setup Program.
2. Enter the Administrator password when prompted.
3. Navigate to the Security menu.
4. Select **Clear all Passwords**.
5. Enter and confirm a new User password if needed.
6. Press **ESC** to leave the Security menu.
7. Select **Exit Saving Changes** to save your changes.

Clearing the Administrator Password

To clear the Administrator password:

1. Turn off the Workstation and remove the cover.
2. Set switch 1 on the system board switch block to **ON**.
3. Replace the Workstation cover.
4. Turn on the Workstation and press **ESC** when prompted to see the summary page.
5. When a message appears indicating that the passwords have been cleared, turn off the Workstation and remove the cover. You must press the power button for 5 seconds to turn off system.
6. Set switch 1 on the system board block back to **OFF**.
7. Replace the Workstation cover.
8. If you want to set new passwords, follow the instructions given in “Setting Passwords” on page 224.

Understanding the Diag LEDs

The Diag LEDs on the front panel of the Workstation can help you identify specific problems with your Workstation:

- During system start up, all four LEDs are green.
- If a problem is detected, one or more of the LEDs changes color.
- If no problems are detected during start up, all four turn off.

A list of possible combinations, an explanation of the problem, and suggested solutions are listed in Table 11-1 on page 213.

The LED patterns are defined by:

- R = Red
- Y = Yellow
- G = Green
- ● = Off

Unless the LED pattern indicates that the BIOS is in recovery mode (YR●●), or that BIOS recovery is complete (GR●●), you should:

1. Flash the system BIOS and firmware. For complete instructions and the latest BIOS and firmware versions, go to www.hp.com/workstations/support.
2. Attempt the solutions given in Table 11-1 on page 213. Possible solutions are listed in order of ease and probability. Follow the solutions in sequence in sequence.

NOTE

If your LED pattern does not appear in Table 11-1 on page 213, your problem could still stem from corrupted BIOS or firmware. Always flash the BIOS and firmware before attempting other solutions.

If you still have a problem after flashing the BIOS and firmware and following the suggested solutions in Table 11-1 on page 213, contact customer support.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
RRYY	Fatal internal processor error.	<ol style="list-style-type: none"> 1. Restart the Workstation. If it's a random event that is not a hardware error, it will not recur. 2. Reseat the processor(s). 3. Replace the system board as described in "System Board" on page 186. 4. Replace the processor(s) as described in "Processor" on page 177.
RRY●	Processor 0 not detected.	<ol style="list-style-type: none"> 1. Reseat the processor. 2. Replace the processor as described in "Processor" on page 177.
RYRY	The FRU table in SEEPROM is inaccessible. The system cannot identify the system serial number and model type.	Replace the system board as described in "System Board" on page 186.
RYRG	The system event log is unavailable.	Replace the system board as described in "System Board" on page 186.
RYR●	The hardware management controller firmware is corrupt.	Replace the system board as described in "System Board" on page 186.
RYYR	The external temperature exceeds the normal limit. This may be due to an obstruction of airflow in front of or in back of the workstation.	<ol style="list-style-type: none"> 1. Ensure the workstation has adequate clearance. 2. Ensure the room temperature is below 95 degrees Fahrenheit (35 degrees Celsius).

Troubleshooting
Understanding the Diag LEDs

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions ^a
RYYY	The detected memory is corrupt.	<ol style="list-style-type: none"> 1. Reseat the RIMMs. 2. Reseat the memory expander card. 3. Replace the RIMMs as described in “System Memory” on page 159. 4. Replace the memory expander card.
RYY●	No memory detected.	<ol style="list-style-type: none"> 1. Insert or reseat the RIMMs. 2. Reseat the memory expander card. 3. Replace the RIMMs as described in “System Memory” on page 159. 4. Replace the memory expander card.
RY●●	A memory pair is mismatched.	<ol style="list-style-type: none"> 1. Ensure each pair of RIMMs are matched in size and type as described in “Upgrading Memory on the 8-RIMM MEC” on page 159. 2. Replace the RIMMs as described in “System Memory” on page 159. 3. Replace the memory expander card.
YR●●	The BIOS is in Boot Block Recovery Mode. Boot Block Recovery Mode can be initiated automatically by the BIOS from corruption caused by a power failure during flash. Boot Block Recovery Mode can be forced by setting system board switch 2 to ON .	<ol style="list-style-type: none"> 1. Wait until the BIOS recovery operation is complete (LED pattern GR●●) and follow the solution steps for pattern GR●●. 2. Ensure system board switch 2 is OFF. 3. Replace the system board as described in “System Board” on page 186.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
YYRY	<p>There is an error in the main power (5V) circuit. This could be due to something in the 5V circuit that is poorly seated or out of specification. This includes I/O cards, the memory expander card, hard disk drives, optical drives, floppy drives, the system board, and the power supply.</p>	<ol style="list-style-type: none"> 1. Reseat the power connections to the hard disk drive, floppy disk drive, and any optical drives. 2. Try to narrow down the device causing the problem by removing the power connection to the hard disk drive, floppy disk drive, and any optical drives one at a time, restarting the Workstation after each change. If a single device seems to be the source of the error, replace the device. 3. Reseat the 32-bit PCI and AGP I/O cards and the memory expander card. 4. Try to narrow down the problem by removing the I/O cards one at a time. If a single card seems to be the source of the error, replace the card. 5. Replace the power supply as described in “System Memory” on page 159. 6. Replace the system board as described in “System Board” on page 186.

Troubleshooting
Understanding the Diag LEDs

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
YYRG	AGP (graphics card) 1.5V circuitry error.	<ol style="list-style-type: none"> 1. Remove the graphics card from the AGP Pro 110 4X slot and restart the Workstation. If the error goes away or changes, replace the graphics card as described in “Graphics Card” on page 164. 2. Replace the system board as described in “System Board” on page 186.
YYR●	3.3V circuitry error.	<ol style="list-style-type: none"> 1. Reseat I/O cards. 2. Try to narrow down the problem by removing the 64-bit PCI and AGP I/O cards one at a time. If a single card seems to be the source of the error, replace the card. 3. Replace the power supply as described in “Power Supply” on page 184. 4. Replace the system board as described in “System Board” on page 186.
YYYY	The fan inside the power supply is not functioning.	<ol style="list-style-type: none"> 1. Replace the power supply as described in “System Memory” on page 159. 2. Replace the system board as described in “System Board” on page 186.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions ^a
YY●R	<p>The PCI fan is not functioning. This fan is located at the front of the Workstation.</p> <p>The sensor reads the state of the fan that is connected to the “PCI fan” power connector on the system board, regardless of which fan is connected.</p>	<ol style="list-style-type: none"> 1. Reseat the fan's power cable to the system board. 2. Verify that the cabel leads to the PCI fan and replace the fan as show in the “Fan and Speaker Assembly” on page 194. 3. If you cannot verify that the cabel leads to the PCI fan, replace both the PCI and hard disk drive fans as described in “Fan and Speaker Assembly” on page 194 and “Hard Disk Drive Fan” on page 197
Y●RY	There is an error in the 3.3V standby power circuit on the system board.	Replace the system board as described in “System Board” on page 186.
Y●●R	The turbo cooler fan for processor 0 is not functioning.	<ol style="list-style-type: none"> 1. Reseat the fan's power cable to the system board. 2. Replace the turbo cooler as described in “Processor” on page 177. 3. Replace the system board as described in “System Board” on page 186.
GR●●	BIOS Boot Block Recovery is complete.	<ol style="list-style-type: none"> 1. If you have previously set system switch 2 on the system board to ON, turn off the Workstation and set the switch to OFF. Restart the Workstation. 2. Replace the system board as described in “System Board” on page 186.

Troubleshooting
Understanding the Diag LEDs

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions ^a
GYRY	<p>-12V power circuitry failure.</p> <p>This circuit is only used by a few serial devices and PCI cards.</p>	<ol style="list-style-type: none"> 1. Reseat all the I/O cards and serial device connections. 2. Try removing the I/O cards and serial devices one at a time to see which card or device may be causing the error. Replace any device or card that appears to cause the error. 3. Replace the power supply as described in “System Memory” on page 159. 4. Replace the system board as described in “System Board” on page 186.
GYRG	<p>Processor core (VCC_CORE) power circuit error.</p>	<ol style="list-style-type: none"> 1. If you have recently added a processor, reseat the processor. 2. If you have recently added a processor, remove it. If the error goes away or changes, replace it as described in “Processor” on page 177. 3. Replace the system board as described in “System Board” on page 186.
GYR●	<p>1.8V power circuitry error.</p>	<ol style="list-style-type: none"> 1. Reseat the memory expander card. 2. Replace the memory expander card. 3. Replace the system board as described in “System Board” on page 186.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
GGRY	Battery voltage error.	<ol style="list-style-type: none"> 1. Reseat the battery. 2. Replace the battery as described in “Battery” on page 199. 3. Replace the system board as described in “System Board” on page 186.
GGRG	Processor voltage mismatch. A non-HP processor has been installed as a second processor, or the processors are different frequencies.	<ol style="list-style-type: none"> 1. Replace the unsupported processor with an HP processor identical to the first as described in “Processor” on page 177. 2. Replace the system board as described in “System Board” on page 186.
G●RY	1.8V standby circuit error.	Replace the system board as described in “System Board” on page 186.

Troubleshooting
Understanding the Diag LEDs

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
●R●●	The BIOS cannot load.	<ol style="list-style-type: none"> 1. Try using a known good keyboard in place of the current keyboard. Replace the keyboard if the error goes away. 2. Try removing the floppy disk drive, the optical drives, and any other IDE devices one at a time, restarting the Workstation each time. If it appears that one device is causing the error, replace it. 3. Try removing the I/O cards one at a time, restarting the Workstation each time. If it appears that one card is causing the error, replace it. 4. Reseat the RIMMs. 5. Remove the RIMMs. If the error goes away or changes, replace the RIMMs as described in “System Memory” on page 159. 6. If a second processor was just added, remove the second processor and restart the Workstation. If the error goes away, replace the second processor with one that is identical to the first processor as described in “Processor” on page 177. 7. Replace the system board as described in “System Board” on page 186.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
●YRY	12V power circuitry error.	<ol style="list-style-type: none"> 1. Reseat PCI and AGP I/O cards. 2. Try removing the I/O cards one at a time, restarting the Workstation each time. If it appears the error is being caused by one card, replace the card. 3. Replace the power supply as described in “System Memory” on page 159. 4. Replace the system board as described in “System Board” on page 186.
●YRG	2.5 V RDRAM power circuitry error.	<ol style="list-style-type: none"> 1. Reseat the memory expander card. 2. If the memory expander card has a separate voltage regulator module, reseat or replace the voltage regulator module. 3. Replace the RIMMs or CRIMMs as described in “System Memory” on page 159. 4. Replace the memory expander card.

Troubleshooting
Understanding the Diag LEDs

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
●YR	<p>The hard disk drive fan is not functioning. This fan is located behind the hard disk drive cage.</p> <p>The sensor reads the state of the fan that is connected to the “hard disk drive fan” power connector on the system board, regardless of which fan is connected.</p>	<ol style="list-style-type: none"> 1. Reseat the fan's power cable on the system board. 2. Verify that the cabel leads to the hard disk drive fan and replace the fan as in “Hard Disk Drive Fan” on page 197. 3. If you cannot verify that the cable leads to the hard disk drive fan, replace both the PCI and hard disk drive fans as described in “Fan and Speaker Assembly” on page 194 and in “Hard Disk Drive Fan” on page 197.
●Y●R	<p>The turbo cooler fan for processor 1 is not functioning.</p>	<ol style="list-style-type: none"> 1. Reseat the fan's power cable to the system board. 2. Replace the turbocooler as described in “Processor” on page 177. 3. Replace the system board as described in “System Board” on page 186.
●●RY	<p>The rear system fan is not functioning.</p>	<ol style="list-style-type: none"> 1. Reseat the fan's power cable to the system board. 2. Replace the fan. 3. Replace the system board as described in “System Board” on page 186.

Table 11-1 **Diag LED Patterns** (R = Red, Y = Yellow, G = Green, ● = Off)

Pattern	Description	Possible Solutions^a
●●YR	5 V standby power circuit error.	<ol style="list-style-type: none">1. Replace the power supply as described in “System Memory” on page 159.2. Replace the system board as described in “System Board” on page 186.

- a. Possible solutions are listed in order of ease and probability. Follow the solutions in sequence in sequence. Remember to flash the BIOS and firmware before attempting *any* of the solutions in the table.

Setting and Removing System Passwords

Setting Passwords

You can set passwords to provide different levels of protection.

Using the **Security** menu in the Setup program:

- The Administrator can access and change all settings in the Setup program. The User can only access and modify certain items in the Main menu.
- You can enable the Power-on Password option so that a password is required every time you start the Workstation.

NOTE

You must set an administrative password before you can set a user password.

To set up passwords:

1. Start the Workstation and press **F2** when prompted to enter the Setup utility.
2. Select the **Security** menu.
3. Choose **Set Administrator Password** or **Set User Password**. When prompted, enter, then re-enter your password.
4. Select the **Exit** menu, then **Exit Saving Changes**.

Removing Passwords

To remove a password:

1. Start the Workstation and press **F2** when prompted to enter the Setup utility.
2. Select the **Security** menu.
3. Select **Clear All Passwords**.
4. Select the **Exit** menu, then **Exit Saving Changes**.

Using e-Diag Tools for Hardware Problems

NOTE

Run e-Diag Tools before contacting HP for warranty service. e-Diag Tools gives you information your support agent needs.

Use e-Diag Tools to diagnose hardware-related problems on your HP Workstation. These tools help you:

- Distinguish between software and hardware problems
- Diagnose hardware-related problems
- Provide precise information to support providers so that they can solve any problem quickly and effectively.

HP e-Diag Tools is supplied on the following media:

- Pre-installed on your hard disk drive (recommended)
Your hard disk includes a hardware diagnostic partition containing HP e-Diag Tools hardware diagnostic utilities. Do NOT delete this partition.
- The *HP Workstation Recovery CD-ROMs* that came with your Workstation

Starting e-Diag Tools from the Hard Drive's Utility Partition (Recommended Method)

NOTE

This method only works if the diagnostics partition on your hard disk drive is intact.

1. Restart your Workstation.
2. Press function key **F10** when you see the message "Press F10 to enter HP Utility Partition or any other key to proceed."
3. Select the option to run e-Diag Tools hardware diagnostics and follow the directions on the screen.

Starting e-Diag Tools from the *HP Workstation Recovery CD-ROM*

Use this method if for any reason you are unable to start this utility from the hard disk drive partition. Before running e-Diag Tools from the CD-ROM ensure:

- No operating system is specified:
 - Start the Setup program as described in “HP Setup Program” on page 49. If the Main or Advanced menu has an item Plug and Play OS, set it to **No**.
 - If the Main or Advanced menu has an item to select the operating system, set it to **Other**.
- All Hardware Protection items in the Security menu are set to **Enabled** or **Unlocked**.
- The option to start from the CD-ROM is enabled and the CD-ROM is configured to be the first boot device.

To start e-Diag Tools from the *HP Workstation Recovery CD-ROM*:

1. Insert the CD-ROM in the CD-ROM drive.
2. Restart the Workstation. The Workstation should boot from the CD-ROM rather than the hard drive.
3. Select the option to run the hardware diagnostics and follow the directions on the screen.

NOTE

If you are unable to boot from your CD-ROM drive, restart your Workstation and press **F12** to change the system boot order. You can also change the boot order from the Setup utility as described in “Boot Menu” on page 57. Check the Boot device settings to ensure that your Workstation can boot from the CD-ROM.

Recovering or Reconfiguring Windows 2000 or Windows NT

The *HP Workstation Recovery CD-ROMs* let you:

- restore your computer to its original factory configuration
- change or reconfigure the operating system
- reinstall drivers or other factory-supplied software components

The drivers and software utilities, including documentation and navigational aids, help you to recover either the full set of pre-loaded software or subset of it.

Some of the available functions on the *HP Workstation Recovery CD-ROMs* are:

- Install Windows 2000 — returns your HP Workstation to its original state.
- Install Windows NT — install Windows NT operating system on your Workstation.
- Windows 2000 or NT Minimal Installation — installs Windows 2000 with a minimal set of drivers (appropriate for advanced users only).
- Windows 2000 or NT Master Files — allows you to copy Windows 2000 master files to the \i386 directory on your hard disk.
- Help — displays the help text.

NOTE

Some of the operations you can perform using the *HP Workstation Recovery CD-ROMs* permanently erase the current contents of your hard disk. You should always back up your data and personal files before using the *HP Workstation Recovery CD-ROMs*.

Preparing to Recover Windows NT or Windows 2000

Before you perform a recovery:

- Ensure the Workstation model matches the *HP Workstation Recovery CD-ROM* labels (the operating system recovery is locked to the specific Workstation model).
- Back up all data files and, if necessary, software applications.
- Upgrade to the latest BIOS version. For instructions, refer to www.hp.com/workstations/support.
- Clear any BIOS-level passwords as described in “Removing Passwords” on page 224.
- In the Security menu, set all Hardware Protection items to “Enabled” or “Unlocked” (if applicable). See “Security Menu” on page 55.
- In the Boot menu, ensure booting from the CD-ROM is enabled and the CD-ROM drive is configured to boot before the hard disk drive in the Boot Device Priority List. See “Boot Menu” on page 57.
- Ensure that you have the Certificate of Authenticity from Microsoft available. (This is a label on the cover of your Workstation.)

NOTE

Windows NT 4.0 does not install with 4 GB of memory. If you have 4 GB of memory, you must remove 4 RIMMs from slot pairs 3 and 4 (see the memory loading label on the chassis cover or “System Memory” on page 159). After Windows NT 4.0 is loaded, you can reinstall this memory.

Performing a Full Recovery of Windows NT or Windows 2000

Depending on the hardware configuration, a full system recovery takes 30 minutes to 2 hours.

CAUTION

Remember, this procedure erases everything from the hard drive (primary partition if defined). Make sure you have backed up *all* data files and software applications.

1. Shut down the operating system and turn off your Workstation.
2. Unplug the Workstation from the power source.
3. If any non-standard components were added after you received the Workstation, you must restore it to its original factory configuration (remove the components).
4. Plug the Workstation into the power source.
5. Insert the *HP Workstation Recovery CD-ROM* containing your operating system, either Windows 2000 or Windows NT, into the CD-ROM drive and start the Workstation.
6. Press the **F12** key and select the CD-ROM to boot first. The computer boots from the CD-ROM and displays a DOS-style menu.
7. Follow the on-screen instructions.
8. Several reboots are carried out. This is normal. Do not interrupt the process. Wait until a message indicates the operation has been successfully completed.
9. Remove the *HP Workstation Recovery CD-ROM* from the CD-ROM drive.
10. The operating system and drivers are installed.

NOTE

The full recovery function restores a factory disk image of your computer. We recommended you install updated drivers, BIOS, and firmware available from www.hp.com/workstations/support.

NOTE

If you have accessories that you removed, replace them now. You must also re-install the drivers for these accessories.

All data files and software applications that were saved before performing the full recovery also need to be restored.

12 **Contacting Support**

Online Support for Troubleshooting

HP's support web site provides extensive support materials that can help you troubleshoot problems on your Workstation, including:

- Technical notes and white papers
- Documentation for your Workstation (described on the following page)
- BIOS updates (including the upgrade utility and instructions)
- The latest drivers and software utilities including e-diagtools, updates for the utility partition, and HP TopTools

HP's support web site is www.hp.com/workstations/support.

Documentation Set Overview

HP's web site allows you to download documentation for your Workstation free of charge. The documents provided are in Adobe Acrobat (PDF) format and are available from HP's web site at www.hp.com/workstations/support.

The available documents include:

- *x4000 Getting Started Guide* — describes how to set up your Workstation for the first time.
- *x4000 Workstation Technical Reference Guide* — provides technical information on system components and troubleshooting information.

Hewlett-Packard Support and Information Services

Collecting Information Before Contacting HP Support

You can learn more about HP service and support from the support Web site www.hp.com/workstations/support.

Before you contact HP Support, record the information mentioned below. This helps HP support deal with your problem quickly and efficiently.

Table 12-1 Collecting Information for Support

Information needed	Details	Your information
<i>General information</i>		
Workstation model number	<p>The model number is located on the back of the Workstation on separate label next to the serial number label, or on the right side of the chassis.</p> <p>If your system is running, select Start > Settings > Control Panel and double click on the System icon. The model number is displayed under the General tab.</p>	
Workstation serial number	<p>The serial number is located on the label on the back panel of your Workstation or on the right side of the chassis.</p> <p>If your system is running, select Start > Settings > Control Panel and double click on the System icon. The serial number is displayed under the General tab.</p>	

Table 12-1 Collecting Information for Support

Information needed	Details	Your information
Memory: number of MB installed	You can determine the amount of memory that is installed on your system by pressing the ESC key during system startup. If your system is already running, select Start > Settings > Control Panel and double click on the System icon. The total amount of memory installed is displayed under the General tab.	
Is the memory HP supplied or from another source?	There may be some compatibility problems with non-HP memory modules. HP supports and recommends only HP supplied memory modules.	
<i>Details of the problem</i>		
Frequency of problem	How often has the problem occurred?	
Normal functionality	How long was the Workstation running before the problem appeared?	
Recent changes to the Workstation	Have there been any recent hardware or software changes made to the Workstation?	
<i>Hardware Configuration</i>		
Which BIOS version is used?	The BIOS version is displayed in the Setup program main menu, accessed by pressing F2 during start-up. This information is also in the summary screen, accessed by pressing ESC during start-up.	
Any BIOS parameter changes?	Did the problem occur after changes were made to the BIOS using the Setup program?	
A list of slots and interrupts used by additional cards	This is to check for interrupt conflicts. You can find IRQs by running e-DiagTools as described in "Using e-Diag Tools for Hardware Problems" on page 225.	

Table 12-1 Collecting Information for Support

Information needed	Details	Your information
<i>Operating System</i>		
Original operating system?	Are you using the original operating system software that came preloaded on your Workstation?	
If not, what is the operating system version?	Select Start > Settings > Control Panel from the and double-click on the System icon. The operating system version is displayed in the General tab.	
Any operating system-generated error messages?	Write down the exact text of error message.	
Any errors during boot (Power-On Self Test)?	This test checks all installed components. Any POST errors are displayed on your monitor screen or on your Diag LEDs. Record the exact error message and any Diag LED patterns.	

HP Customer Care Center Phone Numbers

HP Customer Care Centers can help you solve issues related to HP products and, if necessary, initiate appropriate service procedures. In the U.S.A, telephone support is available 24 hours a day, 7 days a week. In other locations, it is available during normal office hours.

NOTE These phone numbers were correct when this document was printed. The most recent support numbers can be found at www.hp.com/support.

North & Latin America		Europe, Middle East & Africa	
Argentina	0810 555 5520 (Argentina) (5411) 4778 8380 (other locations)	Austria	+43 (0) 810 00 6080
Brazil	(11) 3747 7799 (Sao Paulo) 0800 157751 (other locations)	Belgium	Dutch +32 (0)2 626 8806 French +32 (0)2 626 8807
Canada	905 206 4663	Denmark	+45 39 29 4099
Chile	800 360 999	English International	+44 (0)207 512 52 02
Mexico	01 800 472 6684	Finland	+358 (0)203 47 288
United States	(970) 635-1000	France	+33 (0)1 43 62 34 34
Venezuela	800 47 777 207 8488 (Caracas)	Germany	+49 (0)180 52 58 143 (24PF/min)
Asia Pacific		Israel	Tel. +972 (0)9 9524848 Fax. +972 (0)9 9524849
Australia	(03) 8877-8000	Italy	+39 02 264 10350
China	+86 (0) 10 6564 5959	Middle-East	Tel. 971 4 883 8454 Fax 971 4 883 9495
Hong Kong	+85 (2) 2802 4098	Netherlands	+31 (0)20 606 8751
India	+91 (11) 682 6035	Norway	+47 22 11 6299
Indonesia	+62 (21) 350 3408	Poland	Tel. +48 22 865 9800
Japan	+81 3 5344 7181	Portugal	+351 21 3176333

Contacting Support
HP Customer Care Center Phone Numbers

Korea, Republic of	+82 (2) 3270 0700 +82 80 999 0700 (outside Seoul)	Russian Federation	+7 095 797 3520 (Moscow) +7 812 346 7997 (St. Peter)
Malaysia	+60 (3) 2695 2566	South Africa	+27-11 258 9301 (outside RSA) 086 000 1030 (inside RSA)
Penang	1 300 88 00 28	Spain	+34 902 321 123
New Zealand	+64 (9) 356 6640	Sweden	+46 (0)8 619 2170
Philippines	+63 (2) 867 3551	Switzerland	+41 (0)848 80 11 11
Singapore	+65 272 5300	Turkey	+90 212 221 69 69
Taiwan	+886 (2) 2717 0055	United Kingdom	+44 (0)207 512 52 02
Thailand	+66 (2) 661 4000		
Viet Nam	+84 (0) 8 823-4530		