Technical Reference Manual
Hardware and BIOS

HP KAYAK XA PC WORKSTATION

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Preface

This manual is a technical reference and BIOS document for engineers and technicians providing system level support. It is assumed that the reader possesses a detailed understanding of AT-compatible microprocessor functions and digital addressing techniques.

Technical information that is readily available from other sources, such as manufacturer's proprietary publications, has not been reproduced.

This manual contains summary information only. For additional reference material, refer to the bibliography, on the next page.

Conventions

The following conventions are used throughout this manual to identify specific numeric elements:

- Hexadecimal numbers are identified by a lower case h.
  For example, 0FFFFFFFh or 32F5h
- Binary numbers and bit patterns are identified by a lower case b.
  For example, 1101b or 10011011b

Bibliography

- HP Kayak XA PC Workstation DT *User's Guide* manual (D4790-90001).
- HP Kayak XA PC Workstation MT *User's Guide* manual (D4800-90001).
- HP Kayak XA PC Workstation (Desktop and Minitower) *Familiarization Guide* (online - D4790-90901).
- HP *Network Administrator's Guide* (online).
- HP Kayak XA PC Workstation *Service Handbook - 1st edition* (5966-8261).
- HP *Support Assistant* CD-ROM (by subscription).

Data sheets can be obtained at:

- *Analog AD1816 (sound card controller)*
  http:\\www.analog.com\products\sheets\ad1816a.html.
- *Cirrus 5465 (graphic controller)*
  http:\\www.cirus.com\products\categories\graphicsvid.html.
- *Intel Chipsets. 440LX AGPSet (82443LX) and, PIIX4 PCI/ISA Bridge Chip (82371SB)*
  http:\\www.intel.com\pcisets\datashts\index.html.
- *Memory*
  http:\\www.chips.ibm.com\products\memory\sdamart\sdramart.html.
- *Pentium II Processor*
  http:\\www.intel.com\design\pcisets\datashts\index.html.
- *SCSI Chips*
  http:\\www.symbios.com\products\scsichps.html.
- *Super I/O*
  http:\\www.national.com\catalog\personal_superi_desktop.html.

For further information about the availability and where to find the different documentation, refer to page 21.

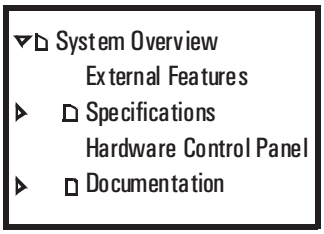
How to use this online guide

Click the Go Back button in the toolbar to go back to your previous place in the guide.

Click the Next Page button in the toolbar to go to the next page in the guide.

Click the Previous Page button in the toolbar to go to the previous page in the guide.

Click the First Page button in the toolbar to go to the opening screen of the guide.



Click a bookmark name (to the left of the screen) to go to the topic corresponding to that bookmark. Clicking a right-pointing triangle, for example, will reveal the subordinate bookmarks. Clicking a downward pointing triangle will hide the subordinate bookmarks.

Click underlined red text to go to the topic indicated. Underlined red text is text that is “linked” to another topic in the guide.

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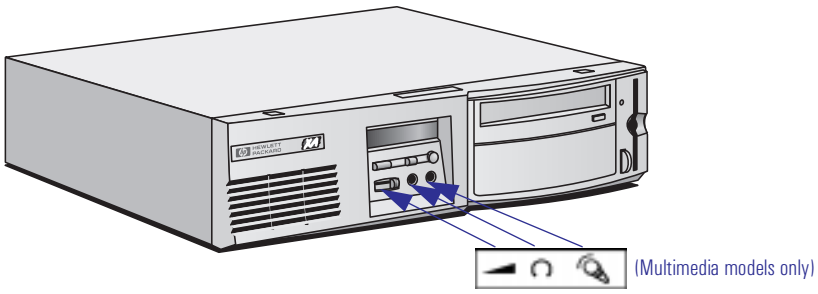
System Overview

This manual describes the *HP Kayak XA PC Workstation*, and provides detailed system specifications.

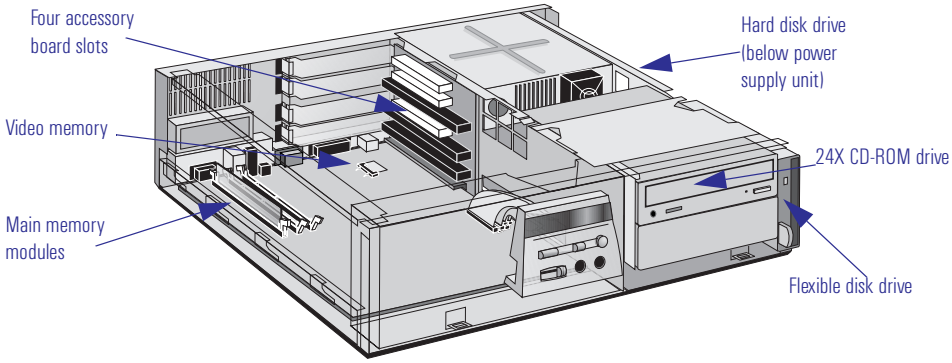
This chapter introduces the external features, and lists the specifications and characteristic data of the system. It also summarizes the documentation which is available.

Package for the Desktop Models

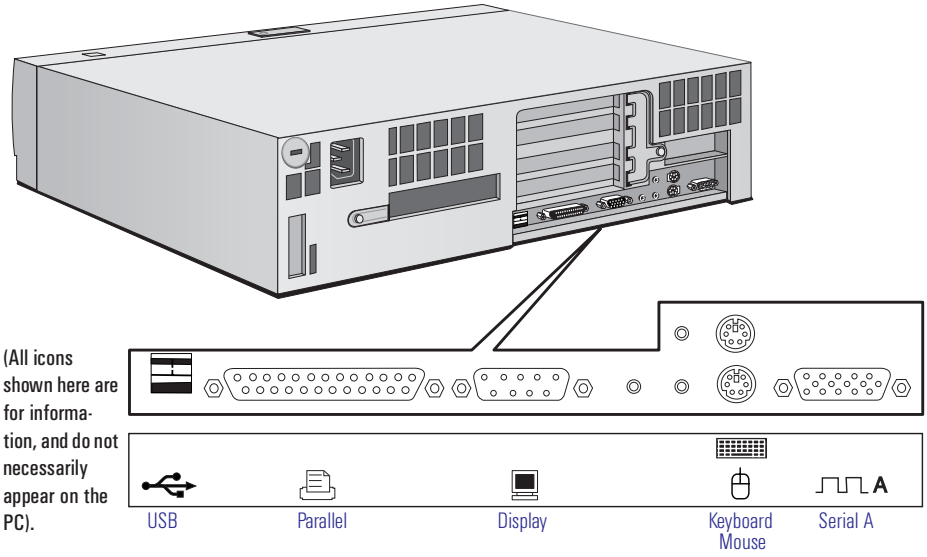
Front view



Front view with cover removed

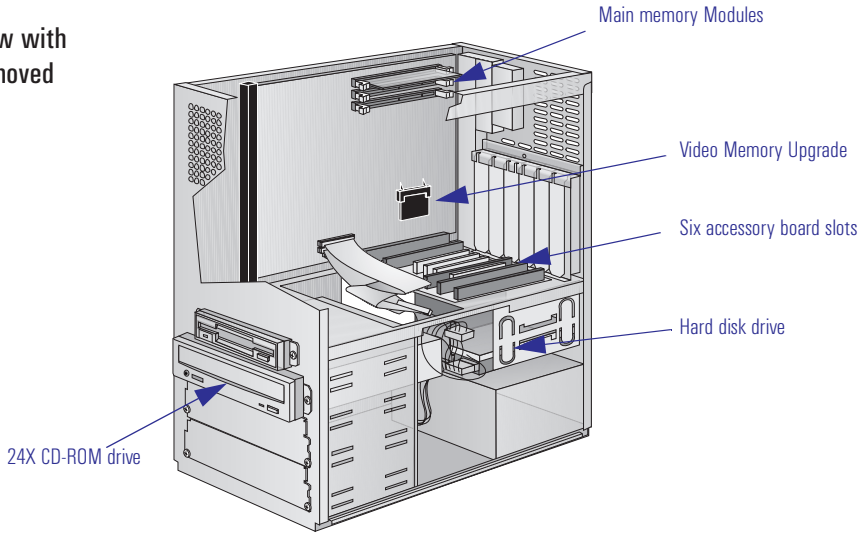


Rear view

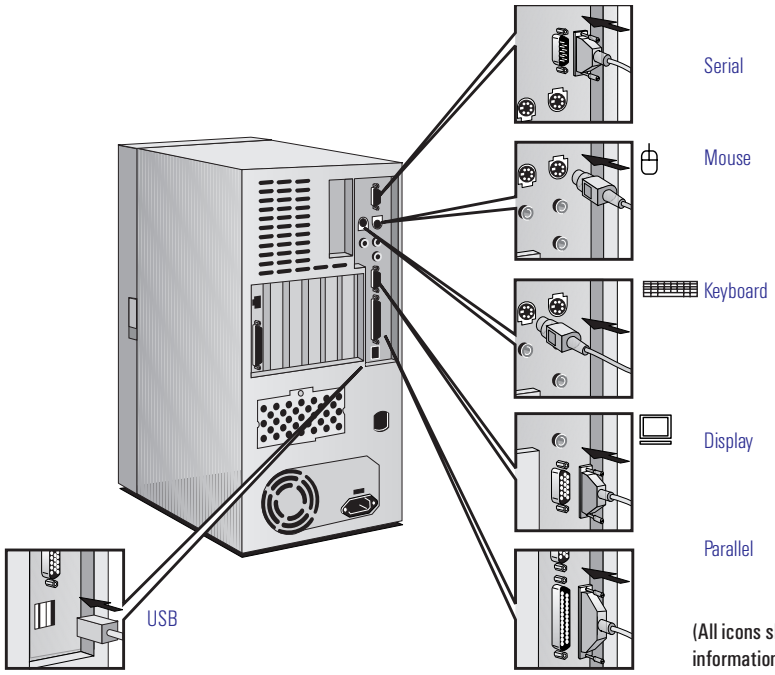


Package for the Minitower Models

Front view with cover removed



Rear view



(All icons shown here are for information, and do not necessarily appear on the PC).

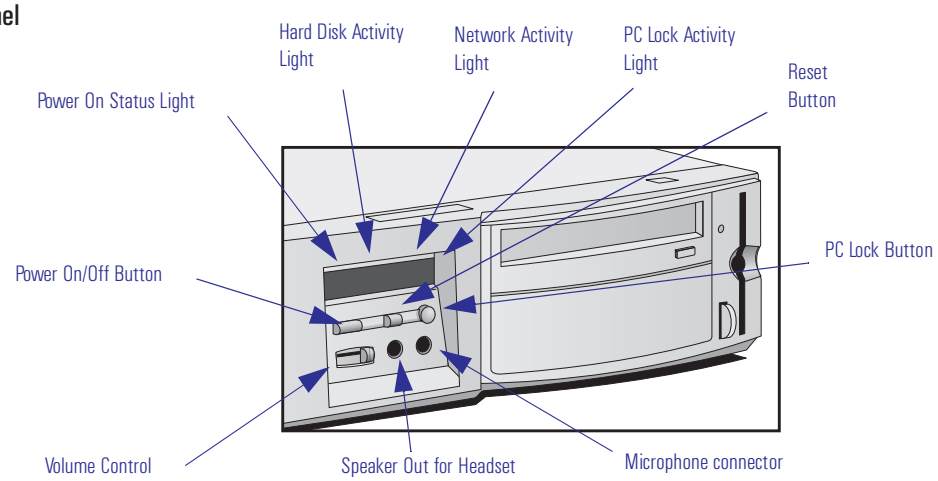
HP Kayak XA PC Workstation Overview

Component	Desktop	Minitower
Microprocessor	233, 266 or 300 MHz Pentium II MMX processor with 512 KB cache memory	
Main memory	Three DIMM sockets using: 32 MB, 64 MB or 128 MB ECC SDRAM to a maximum of 384 MB, or 16 MB, 32 MB, or 64 MB non-ECC SDRAM to a maximum of 192 MB	
Graphics controller	Integrated AGP video controller with 2 MB of built-in video memory and 2 MB of removable video memory (Rev. A). Or, an on-board 4 MB (soldered onto the system board) video module (Rev B).	
Communications	2 USB connectors, 1 serial port, 1 parallel port	
Mass storage	2.5 GB IDE, or 2.1 or 4.5 GB SCSI 5 shelves (3 front-access, 2 internal[1])	2.5 or 4.3 GB IDE, or 4.5 GB SCSI 6 shelves (4 front access, 2 internal)
Accessory board slots	5 slots (1 ISA, 2 PCI[2], 2 combination ISA/PCI)	6 slots (2 ISA, 2 PCI, 2 combination ISA/PCI)
SCSI connectors (SCSI models only)	Ultra-wide internal SCSI connector and Ultra-narrow external SCSI connector	
Audio	Integrated 16-bit hi-fi audio processor with music synthesizer and mixer	
CD-ROM drive	24X speed IDE CD-ROM on all models	
Flexible disk drive	New version without bezel	New version without bezel
Power supply	Input voltage: 100-127, 200-240V ~ Input frequency: 50/60Hz Maximum output power: 120W continuous	Input voltage: 100-127, 200-240V ~ Input frequency: 50/60Hz Maximum output power: 160W continuous
Power saving	On (idle - no file transfer) - Windows 95: 32W (115V/60Hz), 35W (230V/50Hz) On (idle - no file transfer) - Windows NT 4.0: 45W (115V/60Hz), 45W (230V/50Hz) Sleep/Suspend mode - Windows 95: 25.5W (115V/60Hz), 29W (230V/50Hz) Off: 1.6W (115V/60Hz), 3W (230V/50Hz)	

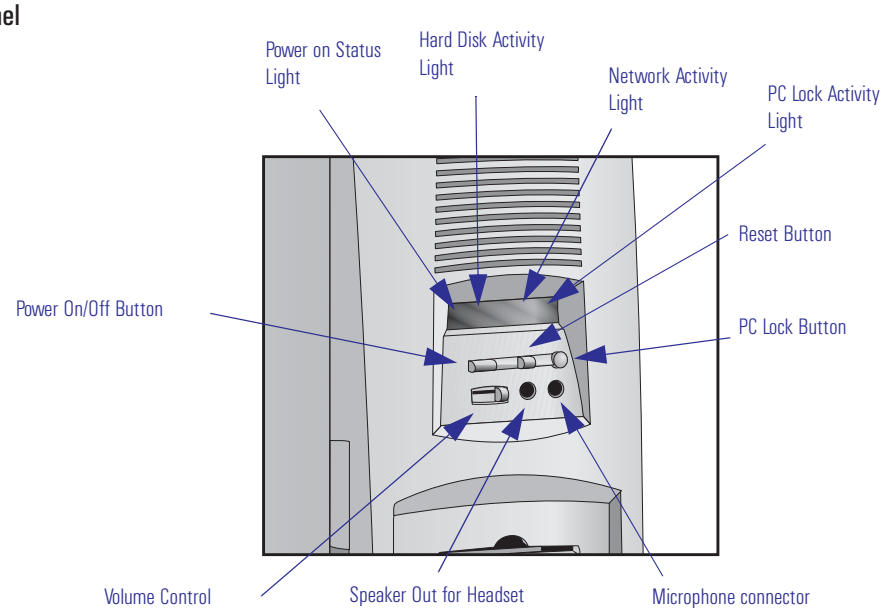
1. Models with a LAN or LAN/SCSI board only have one internal mass storage shelf.
2. Models with a LAN or LAN/SCSI board only have one PCI slot.

Hardware Control Panel

Desktop Hardware Control Panel



Minitower Hardware Control Panel



Specifications and Characteristic Data

Physical Characteristics

Desktop	Characteristic	Description
	Weight (excluding display and keyboard)	9 kg (20 pounds)
	Dimensions	Width: 43.5 cm (17.1 inches) Height: 13.2 cm (5.2 inches) Depth: 44.6 cm (17.5 inches)
	Footprint	0.194 m^2 (2.08 ft^2)
	Keyboard	18 inches (W) by 7 inches (D) by 1.3 inches (H), when flat, or 18 inches (W) by 7 inches (D) by 2 inches (H), when standing
Minitower	**Characteristic**	**Description**
	Weight (excluding display and keyboard)	15 kg (33 pounds)
	Dimensions	Width: 19.2 cm (7.56 inches) Height: 43.8 cm (17.24 inches) Depth: 44 cm (17.32 inches)
	Footprint	0.085 m^2 (0.91 ft^2)
	Keyboard	18 inches (W) by 7 inches (D) by 1.3 inches (H), when flat, or 18 inches (W) by 7 inches (D) by 2 inches (H), when standing

Electrical Specifications

Desktop	Parameter	Total Rating			Notes	Typical per PCI Accessory Slot	Typical per ISA Accessory Slot
	Input voltage	100-127 Vac	200-240 Vac		Selected automatically[1]		
	Power	120 W					
	Voltage range	90 to 264 VAC					
	Frequency range	45 Hz to 66 Hz					
	Input Surge Current Protection	Maximum of 90A					
	Safety Ground Leakage Current	> 3.5mA					

Desktop	Parameter	Total Rating			Notes	Typical per PCI Accessory Slot	Typical per ISA Accessory Slot
	Efficiency	70% at maximum power output					
	Output Voltage Regulation	Min	Nom	Max			
		11.0	12.0	13.0			
		4.8	5.0	5.25			
		3.15	3.3	3.6			
		-4.5	-5.0	-5.5			
		-10.8	-12.0	-13.2			
		4.7	5.0	5.3	(5 VStd By)		
	Overvoltage Protection	Not more than 6.5V for 5V output					
		Not more than 16V for 12V output					
	Isolation Voltage	3000Vac primary/secondary					
		1500Vac primary/ground					
	Safety Standard	IEC950/UL 1950/CSA950/EN60950					
	Maximum input current	3 A					
	Current at +5 V	14 A				2.5 A	1 A
	Current at +3.3 V	8 A				—	—
	Total cumulated current on +3.3 V and +5 V	20 A				—	—
	Current at -5 V	0.1 A				—	0.2 A
	Current at +5V standby	0.3 A				—	0.2 A
	Current at +12 V	4 A				0.2 A	0.2 A
	Current at -12 V	0.3 A				0.2 A	0.5 A

Minitower	Parameter	Total Rating			Notes	Typical per PCI Accessory Slot	Typical per ISA Accessory Slot
	Input voltage	100-127 Vac	200-240 Vac		Manual Switch[2]		

Desktop	Parameter	Total Rating			Notes	Typical per PCI Accessory Slot	Typical per ISA Accessory Slot
	Power	160 W (200 W peak)					
	Voltage range	90-140 Vac	180-264 Vac				
	Frequency range	45 Hz to 66 Hz					
	Maximum input current	5 A					
	Input Surge Current Protection	Maximum of 90A					
	Safety Ground Leakage Current	> 3.5mA					
	Efficiency	75% at maximum power output					
	Output Voltage Regulation	Min	Nom	Max			
		11.0	12.0	13.0			
		4.8	5.0	5.25			
		3.15	3.3	3.6			
		-4.5	-5.0	-5.5			
		-10.8	-12.0	-13.2			
		4.7	5.0	5.3	(5 VStd By)		
	Overvoltage Protection	Not more than 6.5V for 5V output					
		Not more than 16V for 12V output					
	Isolation Voltage	3000Vac primary/secondary					
		1500Vac primary/ground					
	Safety Standard	IEC950/UL 1950/CSA950/EN60950					
	Output Voltage Regulation	Min	Nom	Max			
	Current at +5 V	20 A				2.5 A	1 A
	Current at +3.3 V	12 A			—		
	Total cumulated current on +3.3 V and +5 V	20 A			—		
	Current at -5 V	0.2 A				—	0.2 A
	Current at +5V standby	0.3 A				—	1 A

Desktop	Parameter	Total Rating		Notes	Typical per PCI Accessory Slot	Typical per ISA Accessory Slot
	Current at +12 V	4.4 A		—	0.2 A	0.2 A
	Current at -12 V	0.5 A		—	0.2 A	0.5 A

1. Note that even though the desktop power supply is autoselect, it is not a full range power supply. It works in 2 input voltage range and not in one big 90 V to 240 V range.
2. On minitower models, always check the voltage switch position at first power-on.

An attempt to draw too much current (such as a short circuit across edge-connector pins, or an accessory board that is not suitable for these PC Workstations), will cause the overload protection in the power supply to be triggered, and the PC Workstation could fail to boot.

Both power supplied on the desktop and minitower models are new compare to the ones used on previous platforms (Vectra VL 6/xxx and XA 6/xxx). The difference is at the V standby level, which has been extended to deliver 300mA instead of 100mA. This extra current is required by the 100TX hardware layer so it can perform a remote power-on at reception of a magic frame. Using an older power supply for a repair will prevent a remote power-on at reception of a magic frame.

NOTE

When the PC Workstation is turned off with the power button on the front panel, the power consumption falls below 5 Watts, but is not zero. The special on/off method used by this PC Workstation extends the lifetime of the power supply. To reach zero power consumption in “off” mode, either unplug the PC Workstation from the power outlet or use a power block with a switch. You should be aware that the PC Workstation will lose its time settings within a few days if you unplug the PC, or switch off the PC Workstation at the power block.

Environmental Specifications (Desktop and Minitower)

Environmental Specifications (System Processing Unit, with Hard Disk)	
Operating Temperature	+5°C to +40°C (+ 40°F to 104° F)
Recommended Operating Temperature	+15°C to +70°C (+59°F to +158°F)
Storage Temperature	-40°F to +158°F (-40°C to +70°C)
Over Temperature Shutdown	+50°C (+122°F)
Operating Humidity	15% to 80% (relative)
Storage Humidity	8% to 80% (relative)
Acoustic noise emission: Sound power Sound pressure	(as defined ISO 7779) LwA ≤ 42 db LpA ≤ 37 db
Operating Altitude	10000 ft (3100m) max
Storage Altitude	15000ft (4600m) max

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

Documentation

The table below summarizes the availability of documentation that is appropriate to the *HP Kayak XA PC Workstation*s.

Only selected publications are available on paper. Most are available as viewable files (which can also be printed) from the HP division support servers, and on the *HP Support Assistant* CD-ROM.

	Division Support Server (where available)	**Online at HP WWW Site (see address below)**	**Paper-based**
HP Kayak XA PC Workstation User's Guide	PDF file	PDF file	*DT*: D4790A *MT*: D4800A
HP Kayak XA PC Workstation Familiarization Guide (D4790-90901)	PDF file	PDF file	no
HP Kayak XA PC Workstation Technical Reference Manual	PDF file	PDF file	no
HP Kayak XA PC Workstation Service Handbook (1st Edition)	PDF file	PDF file	5966-8261
Network Administrators Guide	WinHelp, HTML and text formats	PDF file	no
HP 10/100BT NightDIRECTOR/10 Ethernet Card Installation Guide (D3998-90001)	PDF file	PDF file	no

Each PDF file (Portable Document Format) can be viewed on the screen by opening the file with Acrobat Reader. To print the document, press Ctrl+P whilst you have the document on the screen. You can use the page-up, page-down, goto page, search string functions to read the document on the screen.

Access HP World Wide Web

Additional online support documentation, BIOS upgrades and drivers are available from HP's World Wide Web site, at the following address:

World-Wide Web URL:	http://www.hp.com/go/kayaksupport

Where to Find the Information

The following table summarizes the availability of information within the *HP Kayak XA PC Workstation* documentation set.

	User Guide	User Online	Familiarization Guide	Service Handbook	Technical Reference Manual
Introducing the computer					
Product features	Key features	Key features[1]	New features	Exploded view Parts list	Key features
Product model numbers				Product range CPL dates	
Using the computer					
Connecting cables and turning on	Keyboard, mouse, display, network, printer, power				
Finding on-line information	Finding READ.MEs and on-line documentation	Configuring your Web Browser			
Environmental	Setting Up and Using Your PC Workstation	Working in comfort			System overview
Formal documents	Software license agreement Warranty information	S/w license agreement			
Upgrading the computer					
Opening the computer	Full details		New procedures		
Supported accessories	Some part number details		Full PN details	Full PN details	
Replacing accessories	How to install		New procedures		
Configuring devices	Installing drivers	Configuring the HP Enhanced Keyboard			
Fields and their options within *Setup*	Key fields				Key fields
Repairing the computer					
Troubleshooting	Basic		Repair policy	Service notes	Advanced
Technical information	Basic	Detailed			Advanced

	User Guide	User Online	Familiarization Guide	Service Handbook	Technical Reference Manual
System board	Jumpers, switches and connectors		Jumpers, switches and connectors How to replace	Jumpers, switches and connectors	Jumpers, switches and connectors Chip-set details
BIOS	Basic details		Upgrading		Technical details Memory maps
Power-On Self-Test routines (POST)	Key error codes and suggestions for corrective action				Error codes and suggestions for corrective action Order of tests Complete list
Peripheral Devices					
Audio User's Guide	Setting up and configuring	Setting up, configuring and troubleshooting			
LAN Administrator's Guide	Setting up and configuring	Setting up and configuring			

[1] For the address, refer to "Access HP World Wide Web" on page 21.

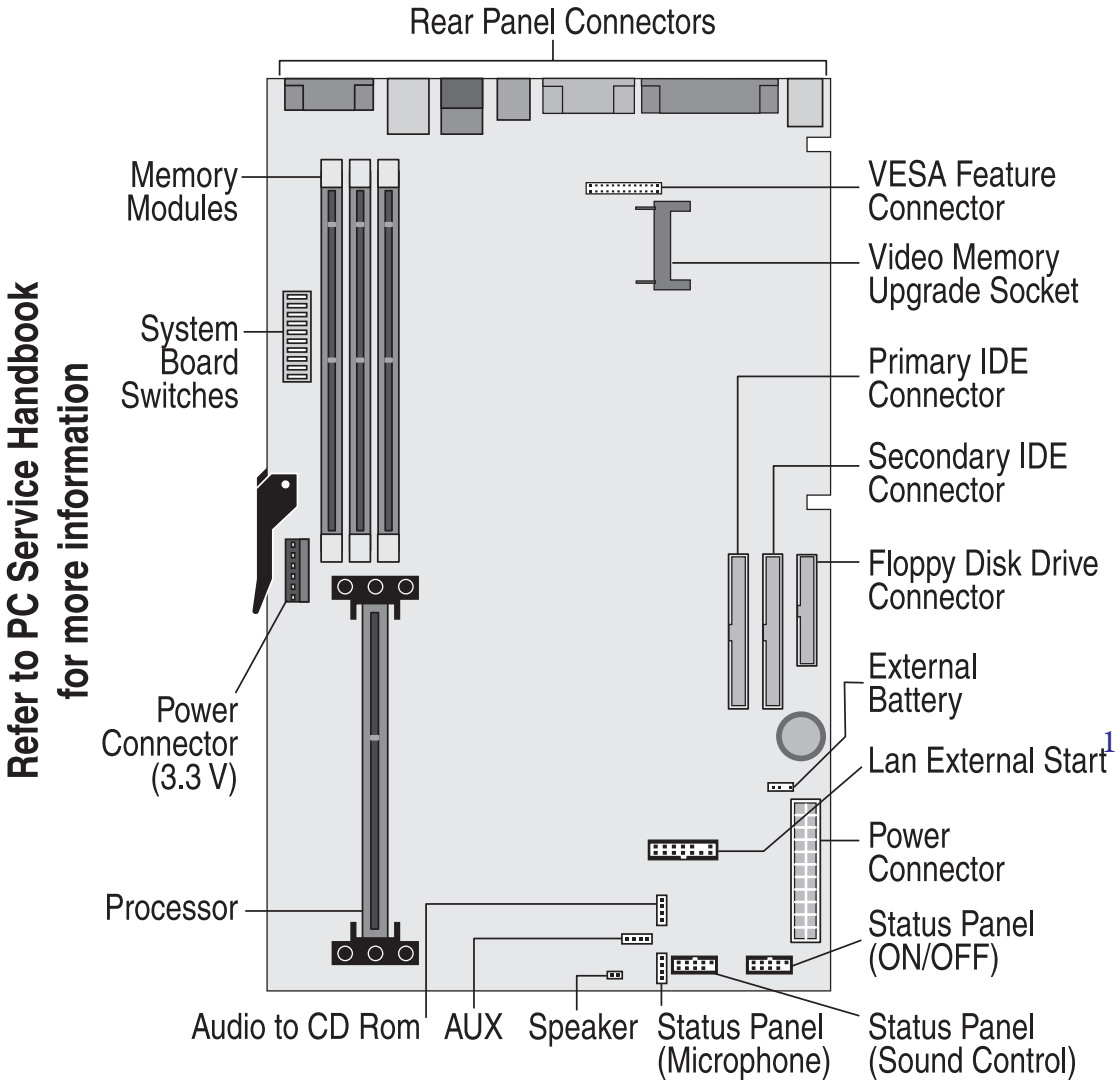
2

System Board

This chapter describes the components of the system board, taking in turn the components of the Processor-Local Bus, the Peripheral Component Interconnect (PCI) bus, the System Management (SM) bus and the Industry Standard Architecture (ISA) bus and the AGP Accelerated Graphics Port Controller.

System Board and Backplane Boards

Both desktop and minitower models have an AGP graphics controller built into the system board.

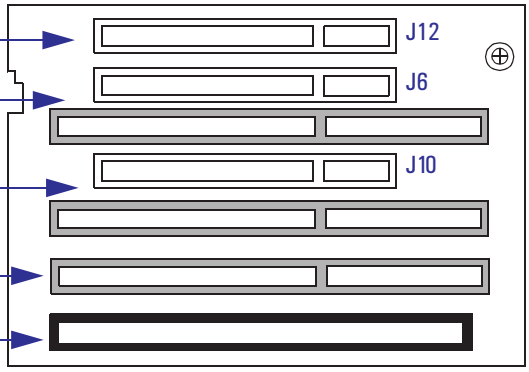


1. Also includes: SCSI Led and external SCSI cable detection.

Desktop Backplane (front view)

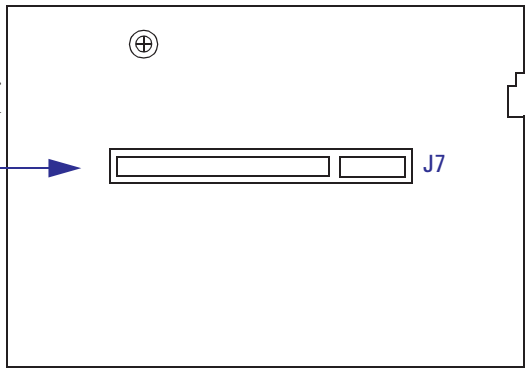
Slot 1(the top slot). Can be used for a 32-bit PCI board).
Slot 2. Can be used for a 32-bit PCI or a 16-bit ISA board (maximum length 17-cm/6.7-inches).
Slot 3. Can be used for either a full-length 32-bit PCI or a full-length 16-bit ISA board.
Slot 4 (the bottom slot). Can be used for a full-length 16-bit ISA board.

System board slot.



Desktop Backplane (rear view)

Slot 5 (the supplementary slot) is under the power supply unit. There is probably already a LAN board or a SCSI/LAN board installed in this slot. This slot can be used for a 32-bit PCI board (maximum length 16-cm/6.3-inch).



Desktop Backplane PCI Mapping Table

Device	#AD[xx]	PCI Device	Slot#
0	11	440LX PAC	
4	15	PIIX4	
12	23	J12	3
6	17	J6	2
10	21	J10	1
7	18	J7	Rear of Backplane Board
11	22	(not used)	

Minitower Backplane (top view)

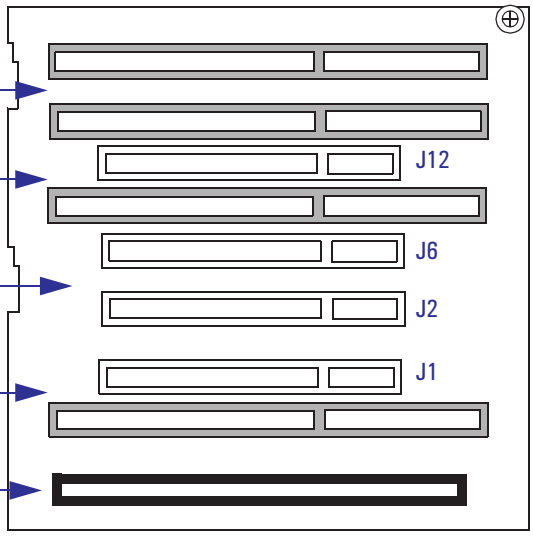
Slots 5 and 6. These slots can be used for full-length 16-bit ISA boards.

Slot 4. These slots can be used for a 16-bit ISA or a 32-bit PCI board.

Slots 2 and 3. Can be used for 32-bit PCI boards.The maximum length for a board in slot 2 is 17-cm/6.7 inches.

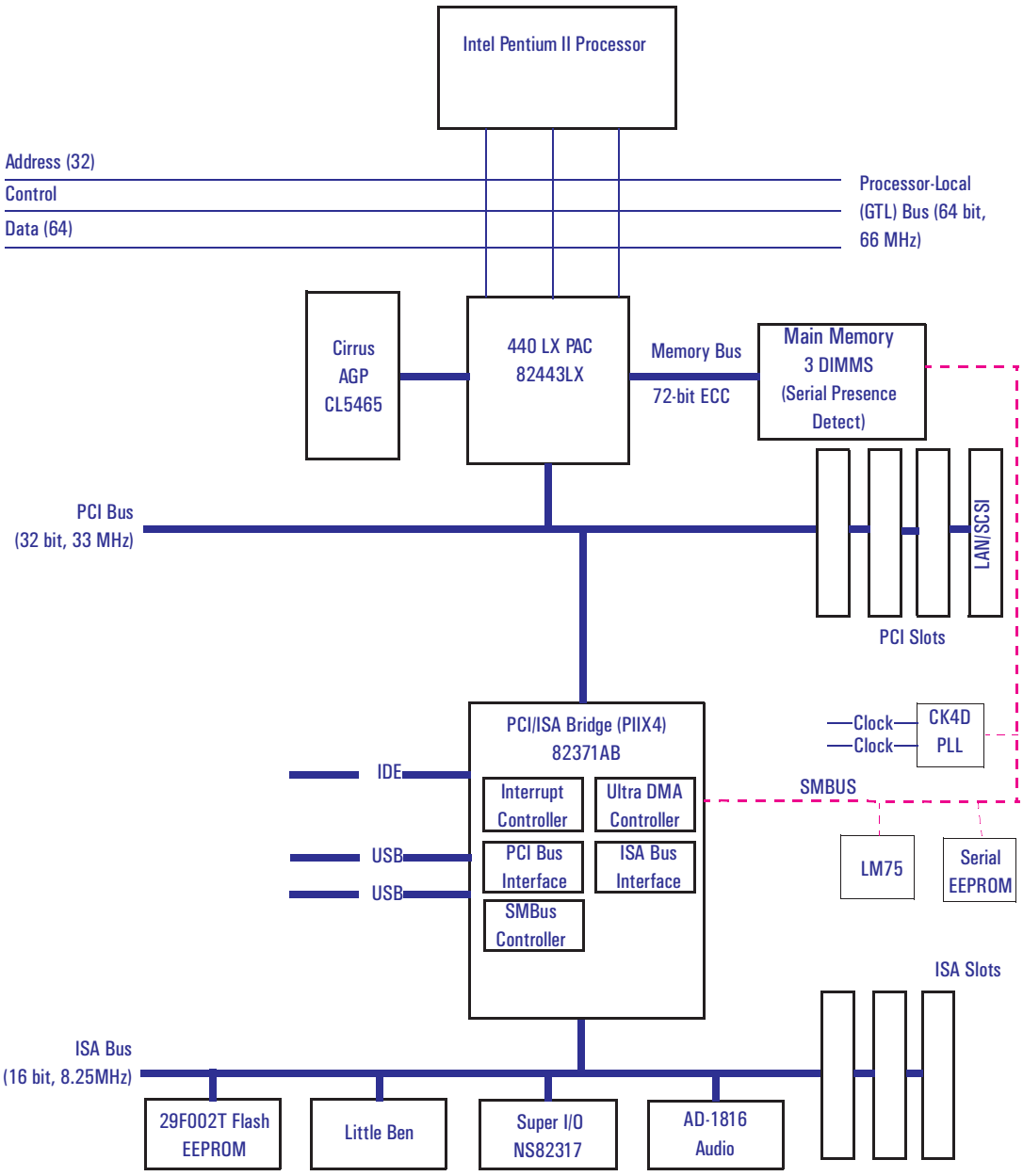
Slot 1. Can be used for a 16-bit ISA or a 32-bit PCI board (17-cm/6.7 inch maximum length).

System board slot.



Minitower Backplane PCI Mapping Table			
Device	#**AD**[xx]	**PCI Device**	**Slot#**
0	11	440LX PAC	
4	15	PIIX4	
12	23	J12	4
6	17	J6	3
10	21	J10	2
7	18	J7	1
11	22	(not used)	

Architectural View



Chip-Set

The Intel AGPset is comprised of two chips. The 440LX PAC chip and the PIIX4chip.

- The PAC chip (440LX) is the bridge between four buses: the PL (GTL) bus, the main memory bus, the PCI bus and the AGP (graphic) bus.
- The PIIX4 chip is the bridge between three buses: the PCI bus, the SM bus and the ISA bus. In addition, it contains the *IDE controller*, *USB controller and Power Management logic*

The PAC Chip (440LX)

The PAC chip, called the *Intel 440LX AGPset*, is contained in a Ball Grid Array (BGA) package, giving a smaller footprint and higher reliability.

The PAC chip integrates a Host-to-PCI bridge, optimized DRAM controller and data path, and an Accelerated Graphics Port (AGP) interface. The AGP is a high performance, component level interconnect, targeted at 3D graphics applications.

PL Bus Interface

The PAC chip monitors each cycle that is initiated by the processor, and forwards those to the PCI bus that are not targeted at the local memory. It translates PL bus cycles into PCI bus cycles.

The chip can support one or two Pentium II processors, at up to 66 MHz FSB clock frequency. Refer to page 35 for a description of the devices on the Processor-Local Bus.

PCI Bus Interface

The PCI bus interface is PCI 2.1 compliant.

Sequential PL-to-PCI memory write cycles are translated into PCI zero wait state burst cycles. The maximum PCI burst transfer can be between 256 bytes and 4 KB. The chip supports advanced snooping for PCI master bursting, and provides a pre-fetch mechanism dedicated for IDE read.

The PCI arbiter supports PCI bus arbitration for up to six masters using a rotating priority mechanism. Its hidden arbitration scheme minimizes arbitration overhead. Additional logic on the PC Workstation extends the number of fully supported masters to seven (440LX master not counted). Refer to page 39 for a description of the devices on the Processor-Local Bus.

AGP Bus Interface

A controller for the AGP (Accelerated Graphics Port) slot is integrated in the 440LX PAC chip. The PAC chip supports only a synchronous AGP interface, coupling to the host bus frequency. The AGP characteristics are described in detail in "Accelerated Graphics Port (AGP) Controller" on page 41.

Main Memory Controller

The main memory controller supports three DIMM slots. Each slot can host a 168-pin unbuffered SDRAM module, running at 66MHz, for a total of up to 348 MB of dynamic random access memory (ECC SDRAM).

The memory bus is 72-bits wide, comprised of 64 bits of data and 8 bits of ECC. Refer to "Main Memory Bus" on page 38, for more detail on the main memory.

Read/Write Buffers

The PAC chip defines a data buffering scheme to support the required level of concurrent operations and provide adequate sustained bandwidth between the DRAM subsystem and all other system interfaces (CPU, AGP and PCI).

System Clocking

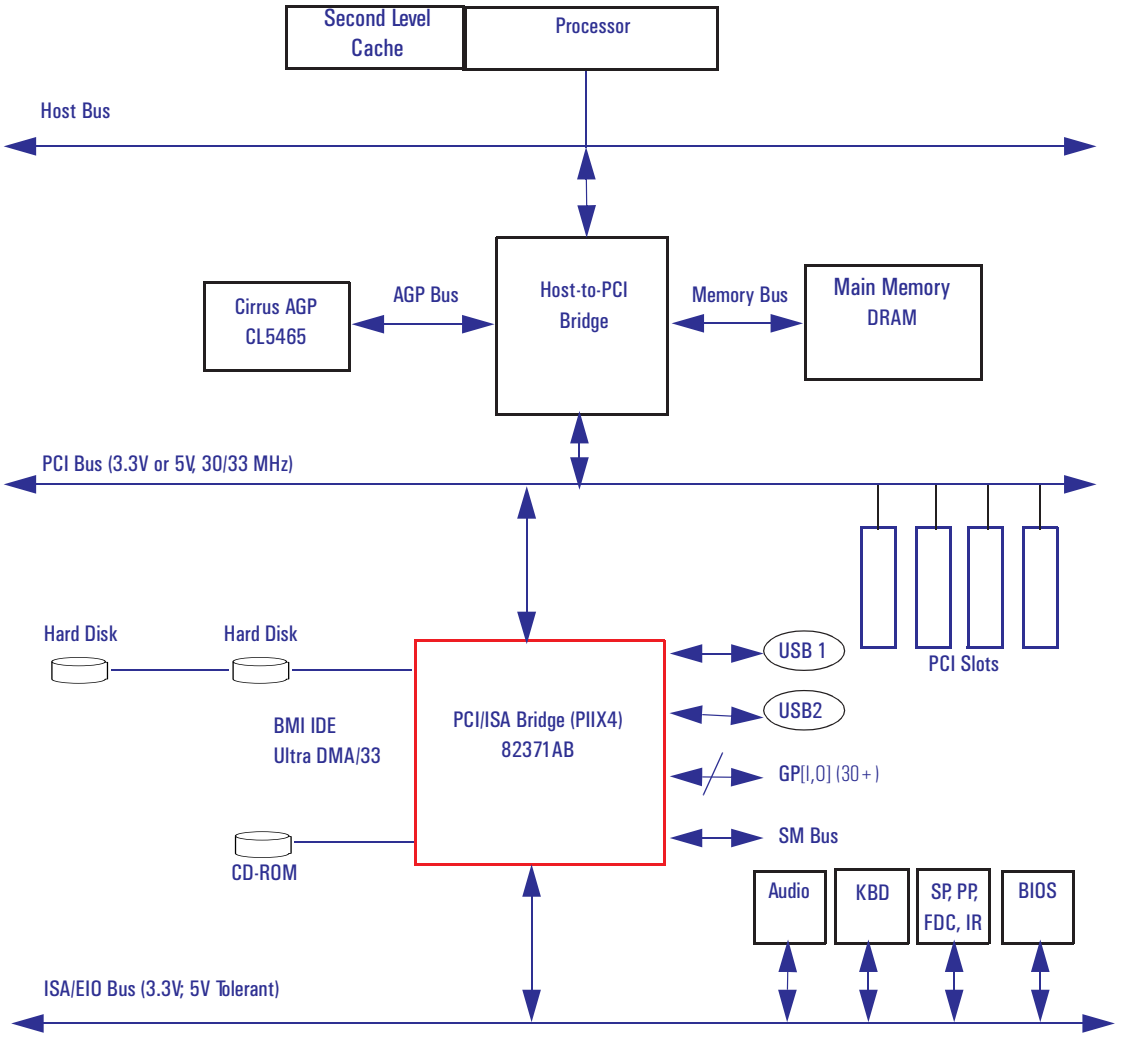
The PAC chip operates the host interface at 66MHz, PCI at 33 MHz and AGP at 66/133 MHz. Coupling between all interfaces and internal logic is done in a synchronous manner. The PAC chip is not designed to support host bus frequencies lower than 66 MHz. The clocking scheme uses an external clock synthesizer (which produces reference clocks for the host, AGP and PCI interfaces).

The PIIX4, PCI/ISA Bridge Chip (82371AB)

The universal host controller interface (UHCI) chip, known as PIIX4, is encapsulated in a Ball Grid Array (BGA) package.

The PIIX4 chip is a multi-function PCI device implementing a PCI-to-ISA bridge function, a PCI IDE function, a Universal Bus host/hub function, and an Enhanced Power Management function.

The following figure shows an example of the system block diagram using the PIIX4 chip.



PCI Bus Interface

This part of the chip is responsible for transferring data between the PCI bus and the ISA expansion bus. It performs PCI-to-ISA, and ISA-to-PCI bus cycle translation. It supports the Plug-and-Play mechanism. Data buffers are provided, to isolate the PCI and ISA buses. Refer to page 39 for a description of the devices on the PCI Bus.

ISA Bus Interface

As well as accepting cycles from the PCI bus interface, and translating them for the ISA bus, the ISA bus interface also requests the PCI master bridge to generate PCI cycles on behalf of a DMA or ISA master. The ISA bus interface contains a standard ISA bus controller and data buffering logic. It can directly support six ISA slots without external data or address buffering. Refer to page 45 for a description of the devices on the ISABus.

SMBus Controller

The System Management (SM) bus is a two-wire serial bus provided by the PIIX4 controller. It runs at a maximum of 16 kHz. The bus monitors some of the hardware functions of the main board, both during boot-up and run-time. All accesses to the SM bus are handled by the main processor, via the PIIX4 SM bus registers. Refer to page 43 for a description of the devices on the SM (System Management) Bus.

IDE Controller

The PCI master/slave IDE controller, supporting four devices, two on each of two channels, is described on page 39.

USB Controller

The PCI USB (Universal Serial Bus) controller, supports two stacked USB connectors on the back panel. These ports are built into the PIIX4 controller, as standard USB ports. The USB is described in detail on page 40.

Ultra DMA Controller

The seven channel DMA controller incorporates the functionality of two 82C37 DMA controllers. Channels 0 to 3 are for 8-bit DMA devices, while channels 5 to 7 are for 16-bit devices (see page 82). The channels can be programmed for any of the four transfer modes: the three active modes (single, demand, block), can perform three different types of transfer: read, write and verify. The address generation circuitry supports a 24-bit address for DMA devices.

Interrupt Controller

The interrupt controller incorporates the functionality of two 82C59 interrupt controllers. The two controllers are cascaded, supporting 15 interrupts (edge/level triggered). A table on page 83 shows how the master

and slave controllers are connected.

Counter / Timer

The chip contains a three-channel 82C54 counter/timer. The counters use a division of the 14.318 MHz OSC input as the clock source.

Serial EEPROM

This is the non-volatile memory which holds the values for the *Setup* program (they are no longer stored in the CMOS memory). The Serial EEPROM is described on page 43.

Cache Memory

There are two integrated circuits sealed within a single Pentium II package. One of these contains the Level-2 (L2) cache memory chip; the other contains the processor, which itself includes two banks of Level-1 (L1) cache memory.

The L1 cache memory has a total capacity of 32KB (16 KB data, 16 KB instruction). The L2 cache memory has a capacity 512 KB, and is composed of four-way set-associative static RAM. Data is stored in lines of 32-bytes (256 bits). Thus two consecutive 128-bit transfers with the main memory are involved for each transaction.

The amount of cache memory is set by Intel at the time of manufacture, so cannot be changed.

Devices on the Processor-Local Bus

The Processor-Local (PL) bus of the Pentium II processors, also referred to as their FSB (Front Side Bus), is implemented in the GTL+ technology. This technology features open-drain signal drivers that are pulled-up to 1.5 V through 56 ohm resistors on both ends of the bus; these resistors also act as bus terminators, and are integrated in the Pentium II processors.

The supported operating frequencies of the GTL+ bus are 60 MHz and 66 MHz. The width of the data bus is 64 bits, the width of the address is 32 bits.

The control signals of the PL bus allows the implementation of a *"split -transaction"* bus protocol. This allows the Pentium II processor to send its request (such as asking for the contents of a given memory address) and then to release the bus, rather than waiting for the result, thereby allowing to accept another request. The 440LX as target device then requests the bus again when it is ready to respond, and sends the requested data packet. Up to four transactions are allowed to be outstanding at any given time.

Intel Pentium II Microprocessor

The Pentium II processor has several high-performance features that enhance performance:

- Dual Independent Bus architecture, which combines a dedicated 64-bit L2 cache bus (supporting level cache sizes of 256K or 512K), plus a 64-bit system bus with ECC that enables multiple simultaneous transactions (refer to above *"split -transaction"*).
- Intel MMX technology, which gives higher performance for media, communications and 3D applications.
- Dynamic execution to speed up software performance.

The Pentium II processor and level-2 cache memory are packaged in a self-contained, pre-sealed module, installed in a socket on the system board.

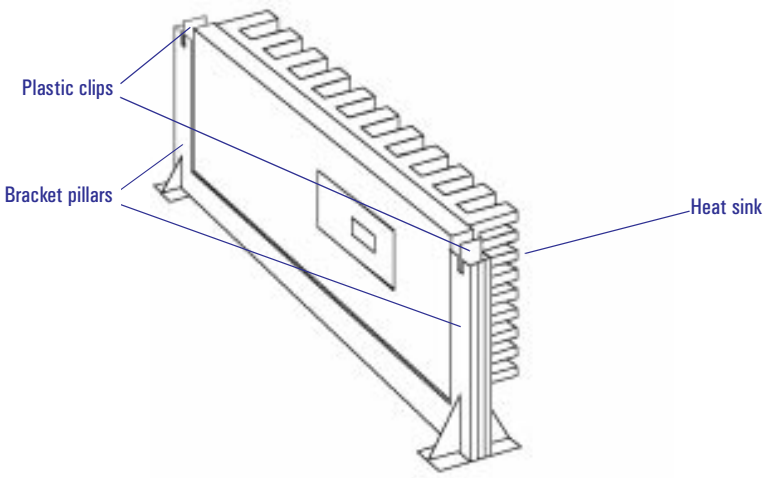
The heat-sink is supplied with the processor, and is bolted to it by the manufacturer. The module is held in place by a bracket. There are two plastic clips, one on the top of each pillar of the bracket, to hold the processor module in place.

To remove the old processor module:

1 Press the two plastic clips towards each other.

2 Carefully pull the processor module away from its connector on the system board.

Only upgrades, pin compatible with the original processor, manufactured by Intel, are supported.



Bus Frequencies

There is a 14.318 MHz crystal oscillator on the system board. This frequency is multiplied to 66 MHz by a phase locked loop. This is further scaled by an internal clock multiplier within the processor.

For example, the Pentium II 300 MHz processor multiplies the 66 MHz system clock by 4.5. Switches 1 and 2, on the system board switches, set the frequency of the Processor-Local bus, which for all *HP Kayak XA PC Workstation* models, is 66 MHz. Switches 3, 4 and 5 set the clock multiplier ratio.

Processor Frequency	Switch		Processor Local Bus Frequency[1]	PCI Bus Frequency	ISA Bus Frequency	Switch[2]			Frequency Ratio Processor: Local Bus
	1	2				3	4	5	
233 MHz	Open	Open	66 MHz	33 MHz	8.25 MHz	Open	Closed	Closed	3.5 : 1
266 MHz	Open	Open	66 MHz	33 MHz	8.25 MHz	Closed	Open	Open	4 : 1
300 MHz	Open	Open	66 MHz	33 MHz	8.25 MHz	Closed	Open	Closed	4.5 : 1
333 MHz	Open	Open	66 MHz	33 MHz	8.25 MHz	Closed	Closed	Open	5 : 1

[1] Processor bus frequency is always set at 66MHz for all XA PC Workstations models.
[2] Switches are provided to match the system board to processor frequency when a system board repair is performed.

The computer may execute erratically, if at all, or may overheat, if it is configured to operate at a higher processor speed than the processor is capable of supporting. This can cause damage to the computer.

Setting the switches to operate at a slower speed, than the processor is capable of supporting, can still cause erratic behavior in some cases, and would reduce the instruction throughput in others.

Main Memory Bus

The memory bus is 72-bits wide, comprised of 64 bits of data and 8 bits of ECC. It is connected to the Main Memory and to the PAC (440LX) chip.

There are three 168-pin DIMM slots on the system board for installing main memory; slots A, B and C. All *HP Kayak XA PC Workstation* models are supplied with one memory module (either 16 MB, 32 MB or 64 MB ECC SDRAM) in one of the three slots, leaving the other slots free for memory upgrades.

The slots can be filled in any order, but there is a performance advantage in filling the slots in the order A, B, C. Memory upgrades are available in single 32 MB, 64 MB or 128 MB ECC SDRAM modules. Note that replacement of the supplied memory module may be necessary to obtain the 384 MB maximum memory, unless the supplied module was 128 MB.

With non-ECC SDRAM memory modules, a maximum of 192 MB can be obtained. These memory modules can be either; 16 MB, 32 MB or 64 MB.

NOTE

If ECC and non-ECC memory modules are both installed, ECC will be invalidated for all memory modules.

Error Correcting Code Operation

The *error correcting code* (ECC) memory of the *HP Kayak XA PC Workstation* allows any single bit error that occurs in any 72-bit line of memory (64 data bits plus 8 parity bits) to be corrected (automatically and transparently) by the PAC chip.

The ECC detects single and dual bit errors. It can correct single bit errors during SDRAM reads. The corrected data is transmitted to the requester (PCI or CPU) but *not* written back to the SDRAM. A double bit error would cause an NMI to be generated, and the PC Workstation to be halted.

If more bits are faulty within any given 72-bit line, the effect is the same as it would have been without error correction. The effect of executing a faulty instruction is always unpredictable, and might cause the program to ‘hang’. The effect of reading a faulty data word is often similarly unpredictable, but can sometimes be tolerated (for instance, it might merely appear as a corrupted pixel on a video display).

Devices on the PCI Bus

PCI Device	Device Name	Device Number	Function	AD[xx]	Chip-set Interrupt Connection			
					INTA	INTB	INTC	INTD
PL/PCI bridge	440LX PAC	0	N/A	11	—	—	—	—
Virtual PCI-to-PCI bridge (AGP)	440LX PAC	1	N/A	12	—	—	—	—
PCI/ISA bridge	PIIX4	4	0	15	—	—	—	—
IDE controller			1		—	—	—	—
USB Host controller			2		—	—	—	—
Power Management and SM Bus			3		—	—	—	—
PCI slot #1 (LAN) - Minitower Backplane Rear Board - *Desktop*	16	7	0-7	18	A	B	C	D
PCI slot #2 - Minitower PCI slot #1 - *Desktop*	17	10	0-7	21	D	A	B	C
PCI slot #3 - Minitower PCI slot #2 - *Desktop*	18	6	0-7	17	C	D	A	B
PCI slot #4 - Minitower PCI slot #3 - *Desktop*	19	12	0-7	23	B	C	D	A

The distribution of the interrupt lines is described more fully on page 83.

Integrated Drive Electronics (IDE)

The IDE controller is implemented as part of the PIIX4 chip (the PCI/ISA bridge). It is driven from the PCI bus, and has PCI-Master capability. It supports Enhanced IDE (EIDE) and Standard IDE. To use the Enhanced IDE features the drives must be compliant with Enhanced IDE.

The IDE controller supports two devices (one master and one slave) connected to a single channel. The channel is fitted with an IDE cable with two connectors.

It is possible to mix a fast and a slow device, such as a hard disk drive and a a CD-ROM, on the same channel without affecting the performance of the fast device. The BIOS determines automatically, the fastest configuration that each device supports. However, in general, the IDE cable is recommended for CD-ROM drives, and the SCSI cables for hard disk drives.

Universal Serial Bus (USB) Controller

The USB controller is implemented as part of the PIIX4 chip. It is accessed through the PCI bus, and provides support for the two stacked USB connectors on the back panel. Over-current detection and protection is provided, but shared between the two ports.

USB works only if the USB interface has been enabled within the HP *Setup* program. Currently, only the Microsoft Windows 95 and Windows NT operating systems provides support for the USB.

The Microsoft Supplement 2.1 software called (called **`USBSupp.exe`**), which provides support of the Universal Serial Bus, can be obtained from the Hewlett-Packard World Wide Web site (refer to "Access HP World Wide Web" on page 21).

Other PCI Accessory Devices

PCI accessory boards are for high-speed peripheral accessories. A network board could already occupy one of the PCI slots. A diagram showing the PCI slots that are available for the desktop and minitower models is on page 27.

Plug and Play

The *HP Kayak XA/ PC Workstation*s have a "PnP level 1.0A" BIOS and meets the "Windows 95 Required" level for Plug and Play. Accessory boards which are Plug and Play are automatically configured by the BIOS.

Accelerated Graphics Port (AGP) Controller

The AGP technology was developed as a means to access system memory as a viable alternative to augmenting the memory of the graphics subsystem needed for high quality 3D graphics applications. All models of *HP Kayak XA PC Workstations* support an AGP (Accelerated Graphics Port) device (Laguna Graphic Controller from Cirrus).

The AGP bus is based upon a 66 MHz, 32 Bit PCI bus architecture, to which several signal groups have been added. These additional signals allow to implement AGP specific control and transfer mechanisms, which are:

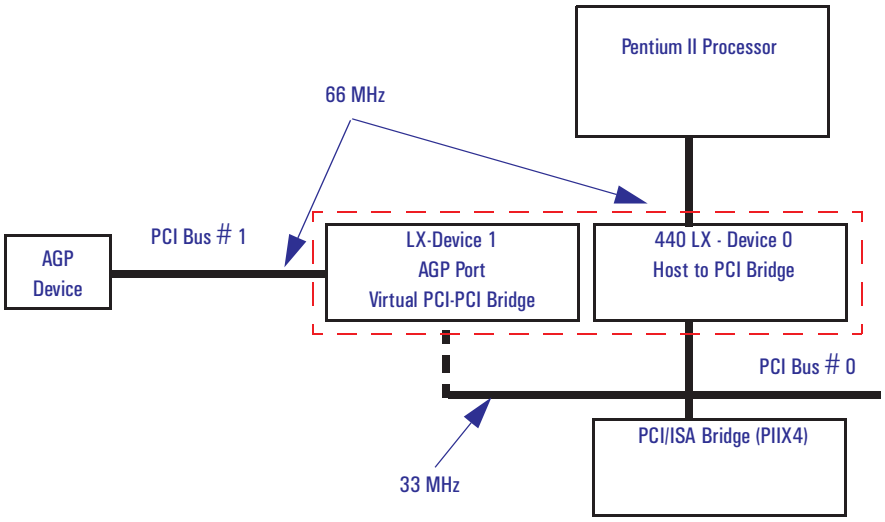
- *Pipelining* and *sideband addressing*. These control mechanisms increase the bus efficiency compared to the PCI protocol.
- *Double clocking* (2x mode). This is a transfer mechanism that doubles the peak transfer rate to 528 MB/s, as two 32 Bit words are transferred in each clock period (2 x 32 bits x 66 MHz).

AGP specific transactions always use pipelining. The other two mechanisms can combine independently to pipelining, which leads to these operating modes:

- FRAME based AGP. Only the PCI protocol is used: 66 MHz, 32 Bits, 3.3V, 264 MB/s peak transfer rate.
- 1 X AGP with pipelining, sideband addressing can be added: 66 MHz, 32 Bits, 3.3V, increased bus efficiency, 264 MB/s peak transfer rate.
- 2 X AGP with Pipelining, sideband addressing can be added: 66 MHz double clocked, 32 Bits, 3.3V, increased bus efficiency, 528 MB/s peak transfer rate.

AGP PCI Bus Implementation

In the below diagram, the AGP Bus is viewed as a PCI bus with extra data lines.



Devices on the SM Bus

Device	SM Bus Address
PIIX4 SM Bus Master	10
Serial EEPROM	A8, AA, AC, AE
LM75	90
SDRAM slot 1	A0
SDRAM slot 2	A2
SDRAM slot 3	A4
PLL	D2

The System Management (SM) bus is used to monitor several of the hardware functions (such as voltage levels, temperature, fan speed, DIMM presence and type) of the system board. It is controlled by the SM bus controller located in the PIIX4 chip.

Serial EEPROM

This is the non-volatile memory which holds the default values for the CMOS memory (in the event of battery failure).

When installing a new system board, the Serial EEPROM will have a blank serial number field. This will be detected automatically by the BIOS, which will then prompt the user for the serial number which is printed on the identification label on the back of the PC Workstation.

The computer uses 4 Kbit of Serial EEPROM implemented within a single 512 K × 8-bit ROM chip. Serial EEPROM is ROM in which one byte at a time can be returned to its unprogrammed state by the application of appropriate electrical signals. In effect, it can be made to behave like very slow, non-volatile RAM. It is used for storing the tatoo string, the serial number, and the parameter settings for the *Setup* program.

LM75 Chip

The LM75 chip is a temperature sensor and alarm located on the system board. It is used to measure the temperature in one area of the PC Workstation, and to send an alarm to the processor in case of overheating. This chip includes a security mechanism which prevents the system fan from being disabled using software controls so long as the temperature measured by the sensor is above the maximum operating temperature.

Main PLL

The registers of the main PLL are accessed through the SM bus. These registers control the PLL clock signal outputs and are write-only.

WARNING:

Writing over the SM bus may be destructive to the PC Workstation, as it allows to access information necessary to the System BIOS, without which the system will not run.

Devices on the ISA Bus

ISA Device	Index	Data
Ultra I/O	2Eh	2Fh
Little Ben (HP ASIC)	96h	97h

The Super I/O Controller (NS 82317)

The *Ultra I/O* chip (NS 82317) provides the control for two FDD devices, one serial port and one bidirectional multi-mode parallel port.

Serial / parallel communications ports

The 9-pin serial port (whose pin layouts are depicted on page 71) supports RS-232-C and are buffered by 16550A UARTs, with 16 Byte FIFOs. They can be programmed as COM1, COM2, COM3, COM4, or disabled.

The 25-pin parallel port (also depicted on page 71) is Centronics compatible, supporting IEEE 1284. It can be programmed as LPT1, LPT2, or disabled. It can operate in the following four modes:

- ❒ Standard mode (PC/XT, PC/AT, and PS/2 compatible).
- ❒ Bidirectional mode (PC/XT, PC/AT, and PS/2 compatible).
- ❒ Enhanced mode (enhanced parallel port, EPP, compatible).
- ❒ High speed mode (MS/HP extended capabilities port, ECP, compatible).

FDC

The integrated *flexible disk controller* (FDC) supports any combination of two of the following: tape drives, 3.5-inch flexible disk drives, 5.25-inch flexible disk drives. It is software and register compatible with the 82077AA, and 100% IBM compatible. It has an A and B drive-swapping capability and a non-burst DMA option.

RTC

The real-time clock (RTC) is 146818A-compatible. With an accuracy of 20 ppm (parts per million). The configuration RAM is implemented as 256 bytes of CMOS memory.

Keyboard and Mouse Controller

The computer has an 8042-based keyboard and mouse controller. The connector pin layouts are shown on page 71.

Audio Controller

The *HP Kayak XA PC Workstation* has an audio chip (AD1816) integrated on the system board. This single chip is a Plug and Play multimedia audio subsystem for concurrently processing multiple digital streams of 16-bit stereo audio.

Host Interface

The AD1816 audio chip contains all necessary ISA bus logic on chip. This logic includes address decoding for all onboards resources, control and signal interpretation, DMA selection and control logic, IRQ selection and control logic, and all interface configuration logic.

Audio Chip Specifications

It is driven from the ISA bus, and has the following specification:

Feature:	Description:
Digitized Sounds	• 16-bit and 8-bit stereo sampling from 4 kHz to 55.2 kHz • Programmable sample rates with 1 Hz resolution • Hardware Full Duplex Conversion • 16-bit software-based real-time audio compression/ decompression system
Music Synthesizer	• Integrated OPL3 compatible music synthesizer
Mixer	• AC'97 and MPC-3 audio mixer • Input mixing sources: microphone, LINE In, CD Audio, AUX Audio, and digitized sounds • Output mixing of all audio sources to the LINE Out or integrated PC Workstation speaker • Multiple source recording and Left/Right channels swapping or mixing
Line Input	• Input impedance: 15 kohms • Input range: 0 to 2 Vpp
Line Output	• Stereo output of 5 mW per channel with headphone speakers (impedance > 600 ohms)
Audio Front Panel	• Microphone input jack • Stereo output jack • Master volume control potentiometer

Feature:	Description:
Microphone Input	• 20 dB gain preamplifier. The boost can be muted with software • 16-level programmable volume control • Input impedance: 600 ohms • Sensitivity: 30 mVpp to 200 mVpp
Stereo Out Jack	• Impedance: 32 ohms

The headphones jack and the stereo-out (audio) jack can be used interchangeably. The Windows 95 and Windows NT operating systems each have integrated drivers (*Directions III*).

Flash EEPROM

The PC Workstation uses 256 KB of Flash EEPROM implemented using one 8-bit ROM chip. Flash EEPROM is ROM in which the whole memory can be returned to its unprogrammed state by the application of appropriate electrical signals to its pins. It can then be reprogrammed with the latest upgrade firmware.

The System ROM contains: the LAN boot firmware, and the system BIOS (including the boot code, the ISA and PCI initialization, the *Setup* program and the Power-On Self-Test routines, video BIOS, plus their error messages). These are summarized in Chapters 4 and 5.

The Flash EEPROMs on the HP Kayak XA PC Workstation implement a bootblock feature which allows recovery from a failed attempt at updating the System BIOS. The bootblock contains the minimum system BIOS information necessary to reprogram the Flash EEPROM.

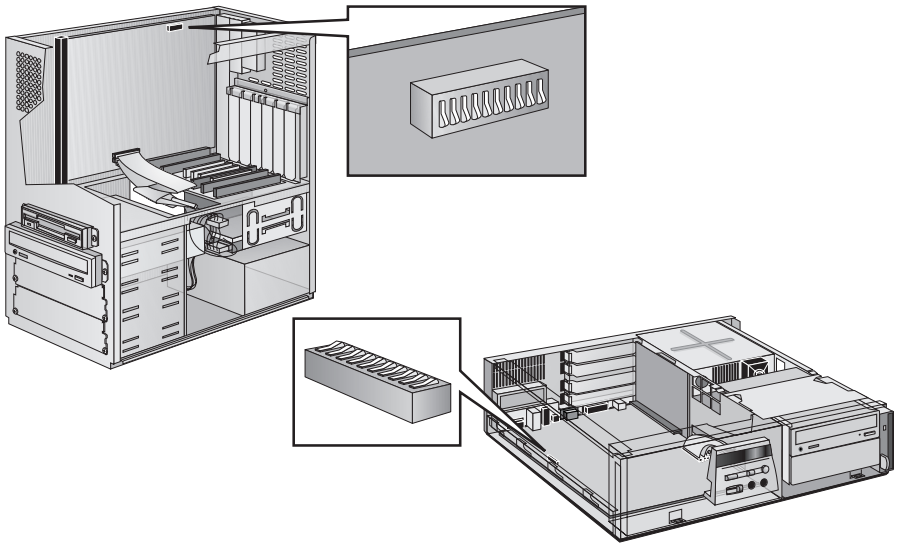
System Board Switches

The first two of the *system board switches* set the frequency of the Processor-Local bus, and the next three the ratio of processor-frequency to Processor-Local-bus-frequency, as summarized on page 37.

The next five switches set the configuration for the PC Workstation, as summarized in the table below.

Switch		Switch Function	Default
1	**Open**	Reserved - Do not use (always set to Open).	**Open**
2 - 5	**-**	Bus Frequencies (see the table on page 37).	**-**
6		*Retain or clear the CMOS configuration stored in serial EEPROM:*	**Open**
	Open	Do not clear CMOS.	
	Closed	Clear CMOS and reload default values in *Setup.*	
7		*Enable or disable User and System Administrator Passwords stored in EEPROM:*	**Open**
	Open	Enable passwords.	
	Closed	Disable /Clear User and Administrator passwords.	
8		*Keyboard power-on:*	**Closed**
	Open	Disable keyboard power on.	
	Closed	Enable keyboard power on.	
9		*Boot block:*	**Open**
	Open	Idle. Normal operation	
	Closed	Recovery boot active. Enable crisis recovery.	
10	**Open**	Reserved = do not use	**Open**

The following diagrams show the position of the system board switches on the desktop and minitower models.



BIOS Update Crisis Recovery Procedure

If, for example, during a BIOS update process, the procedure is interrupted by a power failure, and the system does not start, then you can still recover the situation of a destroyed system BIOS. However, it should be noted that during the recovery procedure, there is no image on the screen, nor access to the keyboard or mouse (only "vital" devices that are required to boot on the floppy are initialized). Follow these steps to recover the BIOS:

1 Ensure that you have created a DOS-bootable diskette. This floppy diskette contains all the recovery and system BIOS programming software (phlash.exe, platform.bin and hblxxxyy.Ful). Include the flash command in the autoexec.bat, for example: phlash /mode=3 HC1xyyzz.Ful

   H = HP Professional PC
   C = Kayak XA (Pentium II models)
   1 = Kayak family
   x = major revision
   yy = minor revision
   zz = language

2 Turn off the computer. Set Switch 9 to the Closed position.

3 Insert the DOS-bootable diskette.

4 Power on the computer.

5 During the recovery process, short beeps are emitted. The recover process is finished when there is a much longer beep (after approximately 1 to 2 minutes).

6 Power off the computer. Press the power ON/OFF button (for about 5 seconds), until the ON/OFF light switches off. Set the switch 9 to the Open position.

Updating the system ROM

The System ROM can be updated with the latest BIOS firmware. This can be downloaded from HP's World Wide Web site:

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

To download a BIOS upgrade, connect to the HP Web site and follow the on-screen instructions to download the flash utility programs (**`FLASH.BAT`**, **`AUTOEXEC.BAT`** and **`PHLASH.EXE`**), the BIOS file (**`HC11xx.FUL`**), and a file called **`pfmhd106.bin`**, onto a bootable diskette.

Before updating the System ROM, it is necessary to disable the "PSWRD" switch on the system switches (SW-7), and to type in the System Administrator's Password when starting up the computer. The PCI and PnP information is erased in the process.

Do not switch off the computer until the system BIOS update procedure has completed, successfully or not, otherwise irrecoverable damage to the ROM may be caused. While updating the flash ROM, the power supply switch and the reset button are disabled to prevent accidental interruption of the flash programming process.

Little Ben

Little Ben is an HP application specific integrated circuit (ASIC), designed to be a companion to the Ultra I/O chip, that is connected between the chip-set and the processor. It contains the following:

- BIOS timer
  - ❒ hardware wired 50 ms long 880 Hz beep module.
  - ❒ automatic blinker that feeds the LEDs module with a 1 Hz oscillator signal.
- Security protection (access, flash and anti-virus protection)
  - ❒ For 128, 256 or 512 KB Flash EEPROMs.

- ❒ For the Ultra I/O space: the Serial EEPROM, serial port, parallel port and mass storage drives (disable write on Flexible Disk Drive, disable boot on any drive, disable use of any embedded drive)

- Advanced Power Management (APM) version 1.2
- Glue logic (such as programmable chip selects)

When the user requests a ShutDown from the operating system, the environment is first cleared. Any request to turn off the PC Workstation, from the control panel, or from the operating system, can only be granted if the PC Workstation is not locked by Little Ben's lock bit (otherwise the power remains on, a red light is illuminated, and the buzzer is sounded).

Other ISA Accessory Devices

ISA accessory boards are for slow peripheral accessories. A diagram showing the ISA slots that are available for the desktop and minitower models is on page 27.

Plug and Play

All PCI accessory boards are Plug and Play, although not all ISA boards are. Check the accessory board's documentation if you are unsure.

In general, in a Plug and Play configuration, resources for an ISA board have to be reserved first (using the *Setup* utility) and then you can plug in your board.

The procedure for installing an ISA accessory board that is not Plug and Play is described in the *User's Guide* that is supplied with the PC Workstation.

NOTE

The Windows NT 4.0 operating system is not Plug and Play. Information explained above is only applicable for Plug and Play operating systems (for example, Windows 95).

3

Interface Devices and Mass-Storage Drives

This chapter describes the graphics, mass storage and audio devices which are supplied with the computer. It also summarizes the pin connections on the internal and external connectors.

Cirrus 5465 Graphics Controller Chip

The HP Kayak XA PC Workstation Desktop and Minitower models are supplied with a Cirrus 5465 graphics controller chip integrated on the system board (refer to the architectural view on page 29 for its location).

This chip integrates the necessary hardware for a flexible multimedia display system. Including an integrated palette DAC, clock generators, Enhanced V-Port bus for easy expandability, glueless AGP/PCI host interface, glueless Rambus channels, and a 64-bit graphics engine featuring GUI acceleration hardware (such as BitBLT, color expansion, 3D engine, and hardware cursor).

The Cirrus 5465 Graphics Controller Chip also offers advanced features such as BitBLT and line accleration, a general-purpose I/O port for expansion, front-end and back-end video playback scaling, and color-space conversion for video applications.

The Cirrus 5465 Graphics Controller Chip uses one of two Rambus channels providing 500 to 600 Mbytes/second of memory bandwidth, displaying true-color images of up to 1024 x 768 resolution, and 256-color modes that can reach a maximum of 1600 x 1200 resolution.

The Cirrus Logic AGP 5465, can be characterized as follows:

- 100% hardware- and BIOS-compatible with IBM® VGA display standard.
- 64-bit video memory access with 2 MB, 50 ns, EDO, video DRAM (this is not upgradeable since it is already fitted to capacity).
- 24-bit pixel bus (video playback width).
- 24-bit fractional component of texel addressing.
- 4- and 8-bit indexed texture source to 16- and 24-bpp display modes.
- Acceleration for playback, continuous interpolation on X, continuous interpolation on Y.
- Chroma keying for substitution of graphics on video.
- Color expansion for 8-, 16-, 24-, and 32-bpp modes.
- Color keying for substitution of video on graphics.
- Color key support.
- DDC 2B compliant.

- Green power saving features.
- GUI acceleration width (in bits).
- Hardware acceleration of graphical user interface (GUI) operations through a bit-block transfer mechanism.
- Hardware cursor.
- Integrated programmable, dual-clock synthesizer.
- Integrated triple 8-bit DAC.
- Integrated 24-bit, 135 MHz RAMDAC.
- Lighted and shaded textures with Gouraud ramp and transparent texture.
- Maximum pixel clock.
- Maximum memory clock.
- PCI Bus Master mode for 2D/3D display list instruction fetch (Processor mode) and data fetch and store to system memory.
- Point and line draw support via polygon engine DDAs.
- Specular lighting.
- Standard and Enhanced Video Graphics Array (VGA) modes.
- Superior TV-like quality video performance: hardware video window; YUV video support; color key, chroma key; X & Y interpolated zooming.
- Support for up to 4 MB, 50 ns EDO video DRAM (though space is only provided on the system board for 2 MB).
- Support for Gouraud shading in 8-, 16-, and 24-bpp display modes.
- Texture map source from system memory or RDRAM.
- Three-operand BitBLT.
- Video Overlay Support.
- Video playback acceleration.
- X, Y interpolated scaling.
- YCrCb support.
- YUV-to-RGB conversion in stretch engine path, supports MPEG textures.
- Z-storage and retrieval from either system memory or RDRAM.

Connectors

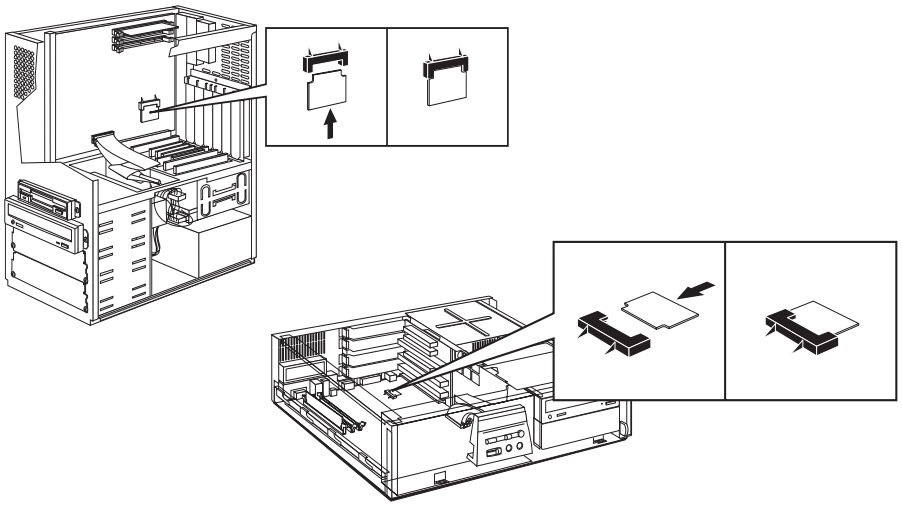
The Video Electronics Standards Association (VESA) defines a standard video connector, variously known as the VESA *feature* connector, *auxiliary* connector, or *pass-through* connector. The graphics controller supports an input/output VESA *feature* connector. This connector (whose pin names are listed in a table on page 71) is integrated on the system board, and is connected directly to the pixel data bus and the synchronization signals.

Video Memory

The HP Kayak Workstation PCs are supplied with 4 MB of video memory integrated on the system board (revision B). There is either, an on-board 4 MB video memory soldered onto the system board. Or, 2 MB of built-in video memory (revision A) and a 2 MB video memory module installed in the video memory upgrade socket, giving 4 MB in total.

The video RAM (also known as the frame buffer) is a local block of 50 ns EDO DRAM for holding both the on-screen surface (reflecting what is currently displayed on the screen), and the off-screen surface (video frame, fonts, double buffer).

The following diagrams show the position of the video memory module on the minitower and desktop computers.



The soldered video memory (revision B) is located in the same area on the system board as the video memory module.

Available Video Resolutions

The number of colors supported 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, lists the video resolutions that are embedded in the system BIOS.

Resolution	Minimum video memory required for these color scales				Refresh rates[1]
	256 colors (8 bits per pixel)	64 K colors hi-color (16 bits per pixel)	16.7 M colors true-color (24 bits per pixel)	16.7 M colors true-color (32 bits per pixel)	
640 × 480	2 MB				60, 75, 85 Hz
800 × 600	2 MB				60, 75, 85 Hz
1024 × 768	2 MB		4 MB		i43, 60, 75, 85 Hz
1280 × 1024	2 MB	4 MB		Not Available	i43, 60, 75, 85 Hz
1600 × 1200	2 MB	4 MB	Not Available		i48, 60, 75, 85 Hz

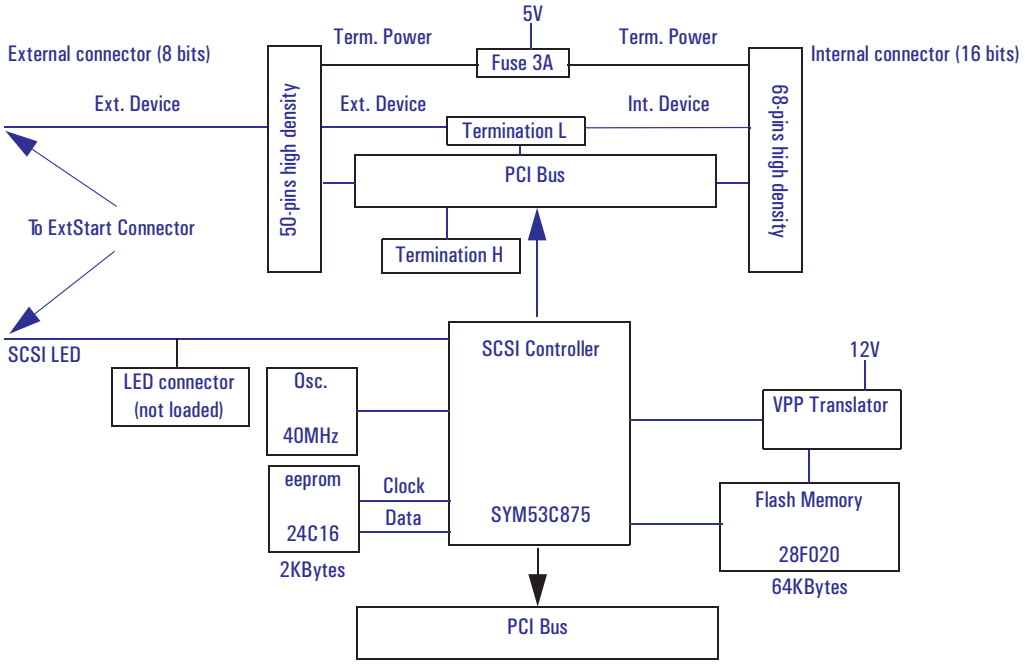
1. The display may not support the refresh rates shown here. Refer to the *User's Guide* supplied with the display for details of the refresh rates supported.

A complete list of available standard VGA and enhanced video modes are shown in the Appendix on page 100.

SCSI / LAN Combo Board

Certain *HP Kayak XA PC Workstations* are supplied with an integrated SCSI / 10BT/100TX LAN combo board. Because the SCSI / LAN combo board includes two controllers, only one PCI slot is necessary for installing this board. The PCI and SCSI controllers access the PCI bus through a PCI bridge. The SCSI and PCI functionalities of the SYM8751SP are contained within the Symbios Logic SYM5C875J PCI-SCSI I/O Processor chip.

The following hardware functional diagram shows the SCSI part of the SCSI/ LAN Combo board.



PCI Interface

The PCI interface operates as a 32-bit DMA bus master. The connection is made through the edge connector. The signal definitions and pin numbers conform to the PCI Local Bus Specification Revision 2.0 standard. The PCI interface conforms to the PCI universal signaling environment for a 5 volt or 3.3 volt PCI bus.

10BT/100TX PCI LAN Connector

The LAN adapter supports the following two standards: 100 VG-AnyLAN, 100 Mbits per second over 4-pair, category-3, unshielded twisted pair (UTP), voice grade (VG) cable (IEEE 802.12 standard for Ethernet); 10 BaseT, 10 Mbits per second, ISO 8802-3 (IEEE 802.3 standard). On the rear panel there is one RJ-45 unshielded-twisted-pair (UTP) connector. The 10BT/100TX LAN Features on page 62 are also valid for the 10 BT/100 TX PCI LAN controller.

SCSI Interface

The Symbios Logic SYM5C875J PCI-SCSI I/O Processor chip connects directly the SCSI bus and generates timing and protocol in compliance with the SCSI standard.

The SCSI interface operates as 16-bit, synchronous or asynchronous, single-ended, and supports Ultra SCSI protocols and 16-bit arbitration. The interface is made through two (and only two) of the connectors J2, J3 and J4.

Connector	Description	Location
J2	Shielded 68-pin high density right-angle receptacle.	Protrudes through the rear panel bracket.
J3	68-pin high density right-angle receptacle.	Internal connector at the end of the board.
J4	External Start, SCSI Led and External SCSI cable detection.	Internal connector at the bottom right-hand-side of the Combo card.

Ultra wide (16-bit) SCSI connector

The Ultra wide 16-bit SCSI connector is for internal devices and has an address range from 0 to 15, with the SCSI address 0 used by the first SCSI hard disk drive and SCSI address 7 reserved for the integrated SCSI controller (the default for wide and narrow SCSI devices).

Data is transferred at 40 MB per second on 16-bit wide, single-ended bus. The controller is fitted with a 16-bit SCSI flat cable with five connectors, plus a SCSI termination device; so a maximum of 4 internal wide-SCSI hard drives are supported.

By default, the internal SCSI bus is configured to run in Ultra-SCSI mode (providing a maximum band-width of 40 MB/s. The user may configure the SCSI system using the SCSI Configuration Utility, included in the system BIOS. This utility is described in more detail on page 77.

SCSI-configured-automatically (SCAM) support is provided at level 2, for Plug and Play. However, hot swap is not supported. The controller is BBS compliant.

External (8-bit) SCSI connector

The Ultra narrow 8-bit SCSI connector uses addresses ranging from 0 to 7. As with the 16-bit internal SCSI connector, the SCSI address 0 is used by the first SCSI hard disk drive and SCSI address 7 is reserved for the integrated SCSI controller (the default for wide and narrow SCSI devices).

SCSI / PCI LAN Combo Board Features

Interface	Features
PCI Interface	Full 32-bit DMA bus master.
	Zero wait-state bus master data bursts.
	Universal PCI bus voltage support.
SCSI Interface	16-bit single ended.
	Automatically enabled active termination
	Fast and Ultra SCSI data transfer capability.
	SCSI TERMPWR source with auto-resetting circuit breaker
	SCAM (SCSI Configured AutoMatically).
	Serial NVRAM (Non-Volatile RAM) for configuration utility and SCAM.
	Flash BIOS.
	Fast and Ultra SCSI controlled by external SCSI cable detection. Ultra speed requires 1.5m maximum SCSI bus.

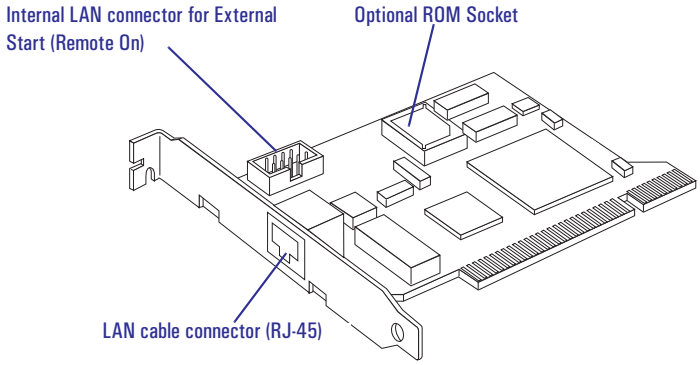
10BT/100TX LAN Controller

Certain models of the *HP Kayak XA PC Workstation* are supplied only with a 10BT/100TX LAN adapter which supports the following standards: 100 Mbits per second over 2-pair, category-5, unshielded twisted pair (UTP), or shielded twisted pair (STP); 10 BaseT, 10 Mbits per second, ISO 8802-3 (IEEE 802.3 standard).

On the rear panel there is one RJ-45 connector. There is an LED which indicates the LAN connection status as follows:

- Off - when there is no Autonegotiation response (for example, when the LAN cable is not connected to the network HUB.
- Blinking - during Autonegotiation
- Green (ON) - the connection has passed the Autonegotiation and a link has been established between the LAN adapter and the network HUB/ Switch.

The LAN adapter contains a connector to which an internal LAN cable may be connected to the external start connector on the system board, necessary for the use of the Remote Power On feature, described in detail in the *User's Guide* provided with the PC Workstation. The LAN adapter that uses the Remote Power On feature must be installed nearer the processors than any other supplementary LAN adapter card.



NOTE

Refer to the *User's Guide* for details concerning system configuration changes necessary after installing a LAN adapter.

10BT/100TX LAN Features

Feature:	Description:
LAN Controller	AMD PCNET-Fast chip
RJ45 Connector	10BT/100TX autonegotiation
Remote Boot	Protocols integrated in System BIOS
ExtStart Connector	• Connection to CPU board • LAN remote power on signals
Remote Power On	• Full remote power on with Magic Packet
Remote Wake Up	• Wake Up from Suspend state with Magic Packet

Remote Power On

Remote Power On (RPO) is available at 10 and 100 Mbits per second.

Vstandby requirements supporting RPO

The Vstandby requirements for HP network cards supporting RPO, is:

- A power supply able to deliver at least 250mA on Vstandby output. This is the case for all HP Kayak systems.

Optional Bootrom Socket

It is possible to add a flash device on the network card socket with a specific LAN bootrom code. This new bootrom code will be seen and mapped automatically by the system BIOS instead of the embedded version (system BIOS).

NOTE

At the time this TRM was produced, there was no flashing tool available to allow you to update the bootrom content in the flash on the LAN adapter. A flashing tool for any AMD based card may be available, but in order to use this tool on HP cards, only 29fxxx flash devices must be used. *At present, no test has been carried out using this tool on HP cards.*

Flash / ROM Devices

The 10BT/100TX card provides a PLCC 32-pin socket and any size of flash device can be used up to 256KB§.

Installing Two LAN Remote Power On Cards

From a pure network standpoint, this is supported and both cards will be functional (for example, from the operating system, it will be possible to have two LAN cards up and running at the same time).

However, there are restrictions due to the remote manageability boot features implementation. To support these features, an internal cable is required between the LAN card and the system board. Only one card can be attached to this cable, therefore remote manageability features are supported only on one card.

The problem is that current BIOS and hardware implementation doesn't allow to identify to which card the cable is attached and this may result in having none of the remote capabilities working properly. Also, remote boot can only work on one card.

Therefore, if a customer wants to use two HP LAN cards without using HP LAN enhanced features (Remote boot, Remote power on), then there is no problem. However, if there is a requirement to use the HP LAN enhanced features, then it is not possible, at the present time, to use the two LAN cards on one system.

Even though it is possible to install two LAN Remote Power On cards in the computer, only one card is seen by the operating system.

Mass-Storage Drives

The IDE controller is described on page 39. The flexible disk controller is described on page 45.

Hard Disk Drives

A 3.5-inch hard disk drive is supplied on an internal shelf in some models.

	2.5 GB Ultra-ATA 33	4.3 GB Ultra-ATA 33	2.1 GB SCSI	4.5 GB SCSI
HP part number	D2678-6X001	D2677-6X001	D5094-6X001	D5095-6X001
Manufacturer	Quantum	Quantum	Quantum	Quantum
Product name	Stratus	Stratus	Viking	Viking
Average seek time	11.0 ms	11.0 ms	8 ms	8 ms
Revolutions per minute (RPM)	5400	5400	7200	7200
Average Latency	5.6 ms	5.6 ms	4.17 ms	4.17 ms
Maximum internal transfer rate	16.7/33 MB/s	16.7/33 MB/s	83 -140 MB/s	83-140 MB/s
Maximum external transfer rate	NA	NA	10 MB/s (avg) 40 MB/s (max)	10 MB/s (avg) 40 MB/s (max)

Flexible Disk Drives

Both desktop and minitower models are supplied with the new bezelless version of the drive (either Sony or Alps).

CD-ROM Drives

Most models have a 24× Max IDE CD-ROM drive supplied in a 5.25-inch front-access shelf ATAPI, supporting ATAPI commands and with audio playback capability. It can play any standard CD-Audio discs, in addition to CD-ROM discs, conforming to optical and mechanical standards as specified in the Red and Yellow Book.

Features of the Panasonic CD-ROM (CD-585-B)

- Application Disc type (confirmed by Red, Yellow, Green, Orange Book).
- CD-ROM data disc (Mode 1 and Mode 2).
- Photo-CD Multisession.
- CD Audio disc.
- Mixed mode CD-ROM disc (data and audio).
- CD-ROM XA, CD-I, CD-Extra, CD-R, CD-RW.

	Description
HP product number	D4383A
Disc Diameter	120 mm
Data Block Size	2,048 bytes (Mode-1) 2,336 bytes (Mode-2)
Storage Capacity	650 Mbytes (Mode-1) 742 Mbytes (Mode-2)
Read Mode	Full CAV[1] 10.3X to 24X
Burst Transfer Rate	PIO mode 4 - 16.6 Mbytes/s maximum Single Word DMA Mode 2 - 8.3 Mbytes/s maximum Multi Word DMA Mode 2 - 16.6 Mbytes/s maximum.
Access Time	Average Stroke (1 / 3) 90 ms Full Stroke 150 ms
Data Error Rate	Less than 10-12 (Mode-1) Less than 10-9 (Mode-2)[2]
Spin Up Time	From standby mode. Typical 6s to drive ready mode With tray loading. Typical 8.5s to drive ready mode.[3]
Buffer Memory Size	128 kbytes

[1] CAV = Constant Angular Velocity
[2] It is assumed that raw error rate of the disc is 10-3 in the worst case. This excludes “retries”.
[3] Photo-CD (Multisession) is not applicable.

If a disk is still in the drive after power failure or drive failure, the disk can be reclaimed by inserting a stout wire, such as the end of a straightened paper-clip, into the small hole at the bottom of the door.

Connectors and Sockets

IDE and Flexible Disk Drive Connectors

IDE Connector			
Pin	**Signal**	**Pin**	**Signal**
1	Reset#	2	Ground
3	HD7	4	HD8
5	HD6	6	HD9
7	HD5	8	HD10
9	HD4	10	HD11
11	HD3	12	HD12
13	HD2	14	HD13
15	HD1	16	HD14
17	HD0	18	HD15
19	Ground 7	20	orientation key
21	DMARQ	22	Ground 2
23	DIOW#	24	Ground 3
25	DIOR#	26	Ground 4
27	IORDY	28	CSEL
29	DMACK#	30	Ground 5
31	INTRQ	32	IOCS16#
33	DA1	34	PDIAG#
35	DA0	36	DA2
37	CS1FX	38	CS3FX
39	DASP#	40	Ground 6

Flexible Disk Drive Data Connector			
Pin	**Signal**	**Pin**	**Signal**
1	Ground	2	LDENSEL#
3	Ground	4	Microfloppy
5	Ground	6	EDENSEL
7	Ground	8	INDX#
9	Ground	10	MTEN1#
11	Ground	12	DRSEL0#
13	Ground	14	DRSEL1#
15	Ground	16	DTEN0#
17	Ground	18	DIR#
19	Ground	20	STP#
21	Ground	22	WRDATA#
23	Ground	24	WREN#
25	Ground	26	TRK0#
27	Ground	28	WRPRDT#
29	Ground	30	RDDATA#
31	Ground	32	HDSEL1#
33	Ground	34	DSKCHG#

Status Panel Connector

Status Panel Connector			
Pin	**Signal**	**Pin**	**Signal**
1	Red Led	2	Green Led
3	Reset	4	Lock
5	Ground	6	Power Leds
7	On_Off Button	8	Lan Led
9	Lock Leds	10	IDE/SCSI Led

USB Stacked Connector

USB Stacked Connector			
Pin	**Signal**	**Pin**	**Signal**
1	USB0 Power	2	USB0 Neg.
3	USB0 Pos.	4	Chassis Ground
5	USB1 Power	6	USB1 Neg.
7	USB1 Pos.	8	Chassis Ground
9	Chassis Ground	10	Chassis Ground
11	Chassis Ground	12	Chassis Ground

Power Supply Connector

Power Supply Connector for System Board			
Pin	**Signal**	**Pin**	**Signal**
1	PwrGood	2	
3	Remote On	4	Ground
5	Ground	6	Ground
7	+12 Volt supply	8	5V STDBY
9	+5 Volt supply	10	+5 Volt supply
11	+5 Volt supply	12	-12 Volt supply
13	-5 Volt supply	14	Low Power
15	-12 Volt supply	16	+12 Volt supply

Battery Pack Connector

Battery Pack Connector	
Pin	**Signal**
1	VBAT
2	
3	NC
4	Ground

Power Supply 3V3 for System

Power Supply 3V3 for System			
Pin	**Signal**	**Pin**	**Signal**
1	Ground	2	Ground
3	Ground	4	+ 3V3 Volt supply
5	+ 3V3 Volt supply	6	+ 3V3 Volt supply

PCI Wakeup Connector

PCI Wakeup (J25)	
Pin	**Signal**
1	Ground
2	PCI Wakeup
3	Ground

Power Supply 3V3 on Backplane

Power Supply 3V3 on Backplane			
Pin	**Signal**	**Pin**	**Signal**
1	+ 3V3 Volt supply	2	+ 3V3 Volt supply
3	Ground	4	Ground
5	+ 3V3 Volt supply	6	+ 3V3 Volt supply

Fan Connector on Backplane

Fan Connector	
Pin	**Signal**
1	Ground
2	12V Power
3	Control Signal

ExtStart Connector

ExtStart Connector (J24)			
Pin	**Signal**	**Pin**	**Signal**
1	SCSI Led	2	Ultra SCSI
3	Ring	4	Ground
5	LAN Wake	6	VStandby Modem
7	Enable Remote On	8	LAN Start
9	External Reset	10	LAN Led
11	VStandby	12	
13	Not connected	14	Not connected

16-Bit SCSI Connector

16-Bit SCSI Connector							
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	not connected	2	not connected	35	SCD12	36	SCD13
3	not connected	4	not connected	37	SCD14	38	SCD15
5	not connected	6	not connected	39	SCDP1	40	SCD0
7	not connected	8	not connected	41	SCD1	42	SCD2
9	not connected	10	not connected	43	SCD3	44	SCD4
11	not connected	12	not connected	45	SCD5	46	SCD6
13	not connected	14	not connected	47	SCD7	48	SCDP
15	not connected	16	not connected	49	not connected	50	INT_DEV
17	TERMPWR3	18	TERMPWR4	51	not connected	52	not connected
19	RESERVED2	20	not connected	53	not connected	54	not connected
21	EXTARBACK	22	CGROUND0	55	ATN	56	not connected
23	not connected	24	not connected	57	BSY	58	ACK
25	not connected	26	not connected	59	RST	60	MSG
27	not connected	28	not connected	61	SEL	62	C_D
29	not connected	30	not connected	63	REQ	64	I_O
31	not connected	32	not connected	65	SCD8	66	SCD9
33	not connected	34	not connected	67	SCD10	68	SCD11

8-Bit SCSI Connector

16-Bit SCSI Connector							
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	not connected	2	SCD0	27	RESERVED2	28	RESERVED4
3	not connected	4	SCD1	29	not connected	30	not connected
5	not connected	6	SCD2	31	not connected	32	ATN
7	not connected	8	SCD3	33	not connected	34	not connected
9	not connected	10	SCD4	35	not connected	36	BSY
11	not connected	12	SCD5	37	not connected	38	ACK
13	not connected	14	SCD6	39	not connected	40	RST
15	not connected	16	SCD7	41	not connected	42	MSG
17	not connected	18	SCDP	43	not connected	44	SEL
19	not connected	20	not connected	45	not connected	46	C_D
21	not connected	22	EXTDEV	47	not connected	48	REQ
23	RESERVED1	24	RESERVED3	49	not connected	50	I_O
25	not connected	26	TERMPWR	51	CGROUND1	52	CGROUND2

Internal Audio Connectors

CD AUDIO Connector		
Pin	**Signal**	**I/O**
1	Analog Ground	-
2	CD Right Channel	IN
3	Analog Ground	-
4	CD Left Channel	IN

AUX Connector		
Pin	**Signal**	**I/O**
1	Analog Ground	-
2	AUX Right Channel	IN
3	Analog Ground	-
4	AUX Left Channel	IN

Audio Front Panel Connector		
Pin	**Signal**	**I/O**
1	Analog Ground	-
2	Key Way	-
3	Front Panel input Left	IN
4	Front Panel Return Left	OUT
5	Front panel Input Right	IN
6	Front Panel Return Right	OUT
7	Volume Low Limit	-
8	Volume High Limit	-
9	Volume Adjust Left	-
10	Volume Adjust Right	-

Front Panel Microphone Connector (Rev. A)		
Pin	**Signal**	**I/O**
1	MIC Signal + Power (tip)	IN
2	Analog Ground	-
3	MIC Signal + Power (ring)	-

Front Panel Microphone Connector (Rev. B)		
Pin	**Signal**	**I/O**
1	MIC Signal + Power (ring)	IN
2	Analog Ground	-
3	MIC Signal + Power (tip)	-

External Audio Connectors

On the PC Workstation there is a Headphone Out jack and Microphone In jack on the Audio Front Panel. A Line In jack, Line Out jack and Mic In jack connector are located on the rear panel. These external jacks are standard connectors.

Internal Speaker Connector

Internal Speaker (J18)	
Pin	**Signal**
1	Speaker Signal
2	Analog Ground

Package Intrusion Connector

Package Intrusion (J8)	
Pin	**Signal**
1	Open detect
2	Ground

VGA DB15 Connector

VGA DB Connector Pins		
Pin	**Standard VGA**	**DDC2B**
1	Analog RED	Analog RED
2	Analog GREEN	Analog GREEN
3	Analog BLUE	Analog BLUE
4	Monitor ID2	Monitor ID2
5	n/c	DDC return
6	Analog RED return	Analog RED
7	Analog GREEN return	Analog GREEN
8	Analog BLUE return	Analog BLUE
9	n/c	V_{CC} supply (optional)
10	Digital ground	Digital ground
11	Monitor ID 0	Monitor ID 0
12	Monitor ID 1	Data:SDA
13	HSYNC	HSYNC
14	VSYNC	VSYNC
15	n/c	Clock:SCL

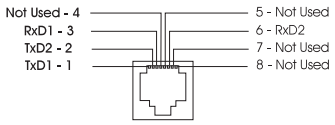
VESA Pass-Through Connector

VESA Pass-Through Connector		
Pin	**Z**	**Y**
1	Ground	P[0]
2	Ground	P[1]
3	Ground	P[2]
4	EVIDEO#	P[3]
5	ESYNC#	P[4]
6	EDCLK#	P[5]
7	I^2C Clock[1]	P[6]
8	Ground	P[7]
9	Ground	DCLK
10	Ground	Blank#
11	Ground	HSYNC
12	VCLK	VSYNC
13	I^2C Data[1]	Ground

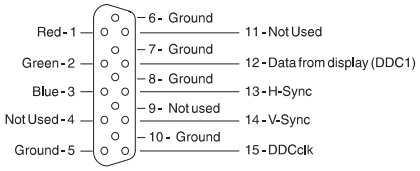
[1] These pins are reserved by VESA.

Socket Pin Layouts

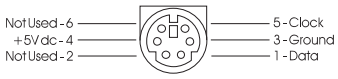
Ethernet UTP Connector



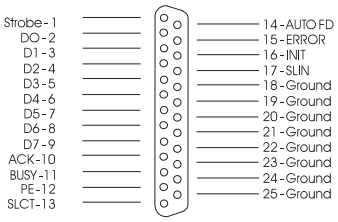
VGA Connector



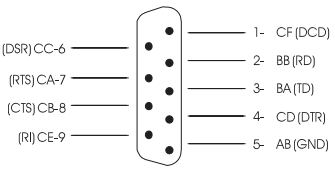
Keyboard and Mouse Connector



Parallel Port Connector



Serial Port Connector



4

HP BIOS

The *Setup* program and BIOS are summarized in the two sections of this chapter. The POST routines are described in the next chapter.

HP/Phoenix BIOS Summary

The System ROM contains the POST (power-on self-test) routines, and the BIOS: the System BIOS, video BIOS (for models with an integrated video controller), and low option ROM. This chapter, and the following one, give an overview of the following aspects:

- menu-driven *Setup* with context-sensitive help, described next in this chapter.
- The address space, with details of the interrupts used, described at the end of this chapter.
- The Power-On-Self-Test or POST, which is the sequence of tests the computer performs to ensure that the system is functioning correctly, described in the next chapter.

The system BIOS is identified by the version number **HC.11.xx**. The procedure for updating the System ROM firmware is described on page 50.

Using the HP *Setup* Program

Press F2, to run the *Setup* program, while the initial “Kayak” logo is being displayed immediately after restarting the PC.

Alternatively, press Esc to view the summary configuration screen. By default, this remains on the screen for 20 seconds, but by pressing F5 once, it can be held on the screen indefinitely until F1 is pressed again. Pressing F10 will cause the computer to be turned off.

The band along the top of the *Setup* screen offers five menus: Main, Advanced, Security, Boot, Power and Exit. These are selected using the left and right arrow keys. For a more complete description, see the *User’s Guide* that was supplied with the PC Workstation.

Main Menu

The Main Menu presents a list of fields, such as “System Time” and “Key Click”.

Advanced Menu

The Advanced Menu does not have the same structure as the Main Menu and Power Menu. Instead of presenting a list of fields, it offers a list of sub-menus. The Advanced Menu contains the following sub-menus:

- *Memory and Cache.* Define how to configure the specified block of memory.
- *Video*. Set the best ergonomic refresh rate supported by the display. This feature, can also be used to set the preferred refresh rate for each graphic mode.
- *Flexible Disk Drives.* Enable or disable the on-board flexible disk controller.
- *IDE Devices.* Configure IDE Primary and Secondary devices.
- *SCSI Interface.* Enable or disable the integrated SCSI interface. In the Ultra SCSI item, the Auto option will enable or disable automatically the Ultra SCSI by the BIOS, depending on whether external SCSI devices are detected or not.
- *Integrated Network Interface.* Enable or disable the integrated network interface. This feature must be enabled when an ethernet card is installed.
- *Integrated Peripherals.* Enable or disable the on-board parallel and serial ports at the specified address.
- *Integrated USB Interface.* Enable or disable the integrated USB (Universal Serial Bus) interface.
- *Integrated Audio Interface.* Enable or disable the audio interface. This feature is useful on non plug-and-play operating systems, because the integrated audio chip is plug-and-play.
- *PCI Devices.* Enable this option if you need the BIOS to set the PCI Bus Master bit. This could be necessary for some older PCI accessory boards.
- *ISA Resource Exclusion.* reserves interrupts for legacy ISA devices to prevent conflict with PCI/PnP devices.

Security

Sub-menus are presented for changing the characteristic and values of the System Administrator Password, User Password, Hardware Protection and Boot Device Security, the amount of protection against the system's drives and network connections, and the amount of protection against being able to boot from the system's drives and network connections. The Security Menu contains the following sub-menus:

- *User Password*. This password can only be set when an administrator password has been set. The User Password prevents unauthorized use of the computer, protects stored data.
- *Administrator Password*. This password prevents unauthorized access to the computer's configuration. It can also be used to start the computer.
- *Hardware Protection*. The following devices can have their accesses unlocked/locked: Integrated Flexible Disk Controller, Integrated ICD Controller, Integrated Data Communications Ports and Integrated Interfaces.
- *Boot Device Security*. Select which devices are to be used for booting up the system. The option Disabled prevents unauthorized use of a device to start the computer.

Boot Menu

Select the order of the devices from which the BIOS attempts to boot the operating system. During POST, if the BIOS is unsuccessful at booting from one device, it will then try the next one on the *Boot Device Priority* list until an operating system is found.

The QuickBoot Mode option allows the system to skip certain tests while booting. This decreases the time needed to boot the system.

Power Menu

This menu allows you to set the standby delay. It also allows the system administrator to decide whether the mouse is enabled as a means of reactivating the system from *Standby*. It is also possible to specify whether the space-bar is enabled as a means of reactivating the system from *Off*.

Symbios Logic SCSI Configuration Utility

The Symbios Logic SCSI Configuration Utility lets you view and change the default configuration for the host adapter and all SCSI devices connected to it, or for individual SCSI devices. If, while using this utility, you accidentally disable all the controllers, pressing F6 during the power-on self test (after the memory test) lets you recover and configure settings.

Default Settings You Can Change

The following two tables show the configuration settings that can be changed. The first table shows the global settings which impact the host adapter and all SCSI devices connected to it. The second table shows the device settings which apply to individual devices.

Settings for the Host Adapter and All Devices	Default Settings
SCAM Support	On
Parity Checking	Enabled
Host Adapter SCSI ID	7
Scan Order	Low to High (0-Max)

Settings for Individual SCSI Devices	Default Settings
Synchronous Transfer Rate (MB/sec)	40
Data Width	16
Disconnect	On
Read Write I/O Timeout (secs)	10
Scan for Devices at Boot Time	Yes
Scan for SCSI LUNs	Yes
Queue Tags	Enabled

Starting the SCSI Configuration Utility

You access the SCSI Configuration Utility by pressing F6 when the message **`Press F6 to start Configuration Utility...`** is displayed during the PC Workstation's start-up routine. A further message is then displayed: **`Please wait, invoking Configuration Utility...`** before the Main menu of the Symbios Logic SCSI Configuration utility appears.

The Symbios Logic SCSI Configuration Utility is described in detail in the *User's Guide* supplied with the PC Workstation.

Power Saving and Ergonometry

	Full On	Standby	Suspend	Shutdown
Processor	Normal speed	Normal speed	Halted	Halted
Display	On	Blanked, < 30 W, on models with integrated graphics	Blanked, < 5 W (typ)	Blanked, < 5 W (typ)
Hard disk drive	Normal speed	Normal speed	Halted	Halted
Power consumption	24 W to 62 W depending on configuration & activity	< 30 W (230V, 50 Hz) < 27 W (115V, 60 Hz)	< 25 W (230V, 50 Hz) < 21 W (115V, 60 Hz)	< 5 W (plugged in but turned off)
Resume events		Keyboard, mouse	Keyboard, mouse, network (RPO)	Space bar
Resume delay		Instantaneous	a few seconds	Boot delay

Power-On from Space-Bar

The *power-on from the space-bar* function is enabled, provided that:

- The computer is connected to a Power-On keyboard (recognizable by the Power-On icon on the space bar).
- The computer is running a Windows operating system.
- The function has not been disabled by setting SW-8 to **open** on the system board switches.
- The function has not been disabled in the “Power” menu of the *Setup* program.

Soft Power Down

When the user requests the operating system to shutdown, the environment is cleared, and the computer is powered off. *Soft Power Down* is available with the Windows NT and Windows 95 operating systems.

The hardware to do this is contained within the PIIX4. This chip is described on page 50.

BIOS Addresses

This section provides a summary of the main features of the HP system BIOS. This is software that provides an interface between the computer hardware and the operating system.

The procedure for updating the System ROM firmware is described on page 50.

System Memory Map

Reserved memory used by accessory boards must be located 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 OS
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
000C 8000 - 000F FFFF	Adapter ROM, RAM, memory-mapped registers
000E 0000 - 000F FFFF	128 KB BIOS (Flash/Shadow)[1]
10 0000 - FF FFFF	Memory (1 MB to 16 MB)
100 0000 - 1FF FFFF	Memory (16 MB to 32 MB)
200 0000 -3FF FFFF	Memory (32 MB to 64 MB)
400 0000 -1FFF FFFF	Memory (64 MB to 512 MB)
FFFE 0000 - FFFF FFFF	128 KB BIOS (Flash)

1. This is for Physical memory. As soon as the PST has been completed, the E000-EFFF area has to be released for UMBs.

HP I/O Port Map (I/O Addresses Used by the System[1])

Peripheral devices, accessory devices and system controllers are accessed via the system I/O space, which is not 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 installing an accessory board, ensure that the I/O address space selected is in the free area of the space reserved for accessory boards (100h to 3FFh).

Although the *Setup* program can be used to change some of the settings, the following address map is not completely BIOS dependent, but is determined partly by the operating system. Note that some of the I/O addresses are allocated dynamically.

I/O Address Ports	Function
0000 - 000F	DMA controller 1
0020 - 0021	Master interrupt controller (8259)
002E - 002F	NS-317 Configuration registers
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 data
0080	Manufacturing port (POST card)
0081 - 0083, 008F	DMA low page register
0092	PS/2 reset and Fast A20
0096 - 0097	Little Ben
00A0 - 00A1	Slave interrupt controller
00C0 - 00DF	DMA controller 2
00F0 - 00FF	Co-processor error
0130 - 013F	AD1816 sound system
0170 - 0177	IDE secondary channel
01F0 - 01F7	IDE primary channel
0200 - 0207	AD1816 Joystick port
0220 - 0232	AD1816 Soundblaster
0278 - 027F	LPT 2
02E8 - 02EF	Serial port 4 (COM4)
02F8 - 02FF	Serial port 2 (COM2)
0372 - 0377	IDE secondary channel, secondary flexible disk drive

1. If configured.

I/O Address Ports	Function
0378 - 037A	LPT1
0388 - 038B	AD1816 Ad-lib (FM)
03B0 - 03DF	VGA
03E8 - 03EF	COM3
03F0h- 03F5	Flexible disk drive controller
03F6	IDE primary channel
03F7	Flexible disk drive controller
03F8 - 03FF	COM1
04D0 - 04D1	Interrupt edge/level control
0678 - 067B	LPT2 ECP
0778 - 077B	LPT1 ECP
0CF8 - 0CFF	PCI configuration space

DMA Channel Controllers

Only “I/O-to-memory” and “memory-to-I/O” transfers are allowed. “I/O-to-I/O” and “memory-to-memory” transfers are disallowed by the hardware configuration.

The system controller supports seven DMA channels, each with a page register used to extend the addressing range of the channel to 16 MB. The following table summarizes how the DMA channels are allocated.

DMA controller	
Channel	**Function**
0	AD1816 Capture
1	AD1816 Playback
2	NS317 Flexible disk controller
3	NS317 LPT ECP
4	Used to cascade DMA channels 0-3
5	Free
6	Free
7	Free

Interrupt Controllers

The Interrupt Requests (IRQ) are numbered sequentially, starting with the master controller, and followed by the slave.

IRQ (Interrupt Vector)	Interrupt Request Description
INTR	
IRQ1	NS317 Keyboard Controller
IRQ0	PIIX4 System Timer
IRQ3	
IRQ4	NS317 COM1, COM3
IRQ5	AD1816, LPT2
IRQ6	NS317 Flexible Disk Controller
IRQ7	NS317 LPT1
IRQ8	NS317 RTC
IRQ9	
IRQ10	
IRQ11	
IRQ12	NS317 Mouse
not connected	
IRQ14	PIIX4 IDE
IRQ15	

PCI Interrupt Request Lines

PCI devices generate interrupt requests using up to four PCI interrupt request lines (INTA#, INTB#, INTC#, and INTD#).
PCI interrupts can be shared; several devices can use the same interrupt. However, optional system performance is reached when minimizing the sharing of interrupts. Refer to pages 27 and 28 for the Desktop and Mini-tower Backplane PCI Mapping tables, and page 39 for a table of the PCI device interrupts.

5

Power-On Self-Test and Error Messages

This chapter describes the Power-On Self-Test (POST) routines, which are contained in the computer's ROM BIOS, the error messages which can result, and the suggestions for corrective action.

Order in Which the Tests are Performed

Each time the system is powered on, or a reset is performed, the POST is executed. The POST process verifies the basic functionality of the system components and initializes certain system parameters.

The POST starts by displaying a graphic screen of the HP PC Workstation's logo when the PC is restarted. If you wish to view the POST details, press Esc to get the HP Summary Screen.

If the POST detects an error, the error message is displayed inside a *view system errors* screen, in which the *error message utility* (EMU) not only displays the error diagnosis, but the suggestions for corrective action (see page 93for a brief summary). Error codes are no longer displayed.

Devices, such as memory and newly installed hard disks, are configured automatically. The user is not requested to confirm the change. Newly removed hard disks are detected, and the user is prompted to confirm the new configuration by pressing F4. Note, though, that the POST does not detect when a hard disk drive has been otherwise changed.

During the POST, the BIOS and other ROM data is copied into high-speed shadow RAM. The shadow RAM is addressed at the same physical location as the original ROM in a manner which is completely transparent to applications. It therefore appears to behave as very fast ROM. This technique provides faster access to the system BIOS firmware.

An example of an Error Code Message

This example explains the different coding messages that appear in the lower left corner of the screen when the POST detects an error during startup.

For example, if the error **0101 - 52** is displayed.

- **0101** - Post Error Code failure. This error code is accompanied by short message. For this example, the message "keyboard error" is displayed.
  A table listing the error codes, causes and symptoms is on page 94.
- **52** - Post Checkpoint Code. This checkpoint code indicates that a test has failed at this stage of the POST.
  A table listing the error codes, causes and symptoms is on page 87.

The following table lists the POST checkpoint codes written at the start of each test.

Checkpoint Code	POST Routine Description
02h	Verify Real Mode
03h	Disable Non-Maskable Interrupt (NMI)
04h	Get CPU type
06h	Initialize system hardware
08h	Initialize chipset with initial POST values
09h	Set IN POST flag
0Ah	Initialize CPU registers
0Bh	Enable CPU cache
0Ch	Initialize caches to initial POST values
0Eh	Initialize I/O component
0Fh	Initialize the local bus IDE
10h	Initialize Power Management
11h	Load alternate registers with initial POST values
12h	Restore CPU control word during warm boot
13h	Initialize PCI Bus Mastering devices
14h	Initialize keyboard controller
17h	Initialize cache before memory autosize
18h	8254 timer initialization
1Ah	8237 DMA controller initialization
1Ch	Reset Programmable Interrupt Controller
24h	Set ES segment register to 4 GB
26h	Enable A20 line
28h	Autosize DRAM
29h	Initialize POST Memory Manager

Checkpoint Code	POST Routine Description
2Ah	Clear 512 KB base RAM
32h	Test CPU bus-clock frequency
33h	Initialize POST Dispatch Manager
34h	Test CMOS RAM
35h	Initialize alternate chipset registers
36h	Warm start shutdown
37h	Reinitialize the chipset (MB only)
38h	Shadow system BIOS ROM
39h	Reinitialize the cache (MB only)
3Ah	Autosize cache
3Ch	Configure advanced chipset registers
3Dh	Load alternate registers with CMOS values
40h	Set initial CPU speed
42h	Initialize interrupt vectors
44h	Initialize BIOS interrupts
45h	POST device initialization
47h	Initialize manager for PCI Option ROMs (Rel. 5.1 and earlier)
48h	Check video configuration against CMOS
49h	Initialize PCI bus and devices
4Ah	Initialize all video adapters in system
4Bh	Display QuietBoot screen
4Ch	Shadow video BIOS ROM
4Eh	Display BIOS copyright notice
50h	Display CPU type
51h	Initialize EISA board

Checkpoint Code	POST Routine Description
52h	Test keyboard
54h	Set key click if enabled
56h	Enable keyboard
59h	Initialize POST display service
5Ah	Display prompt "Press F2 to enter SETUP"
5Bh	Disable CPU cache
5Ch	Test RAM between 512 and 640 KB
60h	Test extended memory
62h	Test extended memory address lines
64h	Jump to UserPatch1
66h	Configure advanced cache registers
67h	Initialize Multi Processor APIC
68h	Enable external and CPU caches
69h	Setup System Management Mode (SMM) area
6Ah	Display external L2 cache size
6Ch	Display shadow-area message
6Eh	Display possible high address for UMB recovery
70h	Display error messages
72h	Check for configuration errors
74h	Test real-time clock
76h	Check for keyboard errors
7Ah	Test for key lock on
7Ch	Set up hardware interrupt vectors
7Eh	Initialize coprocessor if present
80h	Disable onboard Super I/O ports and IRQs

Checkpoint Code	POST Routine Description
81h	Late POST device initialization
82h	Detect and install external RS 232 ports
83h	Configure non-MCD IDE controllers
84h	Detect and install external parallel ports
85h	Initialize PC-compatible PnP ISA devices
86h	Re-initialize onboard I/O ports
87h	Configure Motherboard Configurable Devices
88h	Initialize BIOS Data Area
89h	Enable Non-Maskable Interrupts (NMIs)
8Ah	Initialize Extended BIOS Data Area
8Bh	Test and initialize PS/2
8Ch	Initialize floppy controller
8Fh	Determine number of ATA drives
90h	Initialize hard disk controllers
91h	Initialize local-bus hard disk controllers
92h	Jump to UsersPatch2
93h	Build MPTABLE for multi-processor boards
94h	Disable A20 address line (Rel. 5.1 and earlier)
95h	Install CD ROM for boot
96h	Clear huge ES segment register
97h	Fixup Multi Processor table
99h	Check for SMART drive
9Ah	Shadow option ROMs
9Ch	Set up Power Management
9Eh	Enable hardware interrupts

Checkpoint Code	POST Routine Description
9Fh	Determine number of ATA and SCSI drives
A0h	Set time of day
A2h	Check key lock
A4h	Initialize typematic rate
A8h	Erase F2 prompt
AAh	Scan for F2 key stroke
ACh	Enter SETUP
AEh	Clear IN POST flag
B0h	Check for errors
B2h	POST done - prepare to boot operating system
B5H	Terminate QuietBoot
B6h	Check password (optional)
B8h	Clear global descriptor table
B9h	Clean up all graphics
BAh	Initialize DMI parameters
BBh	Initialize PnP Option ROMs
BCh	Clear parity checkers
BDh	Display MultiBoot menu
BEh	Clear screen optional
BFh	Check virus and backup reminders
C0h	Try to boot with INT 19
C1h	Initialize POST Error Manager (PEM)
C2h	Initialize error logging
C3h	Initialize error display function
C4h	Initialize system error handling

Checkpoint Code	POST Routine Description
The following are for boot block in Flash ROM	
E0h	Initialize the chipset
E1h	Initialize the bridge
E2h	Initialize the CPU
E3h	Initialize system timer
E4h	Initialize system I/O
E5h	Check force recovery boot
E6h	Checksum BIOS ROM
E7h	Go to BIOS
E8h	Set Huge Segment
E9h	Initialize Multi Processor
EAh	Initialize OEM special code
EBh	Initialize PIC and DMA
ECh	Initialize Memory type
EDh	Initialize Memory size
EEh	Shadow Boot Block
EFh	System memory test
F0h	Initialize interrupt vectors
F1h	Initialize Run Time Clock
F2h	Initialize video
F3h	Initialize beeper
F4h	Initialize boot
F5h	Clear Huge segment
F6h	Boot to Mini DOS
F7h	Boot to Full DOS

Error Message Summary

The EMU utility (.COM application written in C language) is to provide full screen online help messages (localized) on most common POST errors. When an error is generated in POST during the boot process, EMU is run by typing ENTER. The entry point of each EMU message is a 4-digits error code generated by POST.

If the POST reports an error, one of the following four error categories will be displayed.

Category #1: if the error requires to run Setup, the POST should prompt:

<F1= Continue>, <F2= Setup>, <Enter= View System Error>

and pause. (refer to autoconfig specification for more details on POST prompts)

Category #2: if the error is only a warning (i.e. key stuck), the POST should prompt:

<Enter= View System Error>

for 2 seconds then boot. (refer to autoconfig specification for more details on POST prompts)

Category #3: if the error is because a device has been unplugged or removed, the POST should prompt :

"If errors are reported because one or more of the listed components have been removed, press <F4> to validate the changes."

<F1= Continue>, <F2= Setup>, <F4= Validate Change>, <Enter= View System Error>

and pause. (refer to autoconfig specification for more details on POST prompts)

Category #4: if the error is serious, the POST should prompt:

The BIOS has detected a serious problem that prevents your PC from booting."

<F2= Setup>, <Enter= View System Error>

and stop. Only the setup and the EMU can be run. The BIOS must never boot on HDD.

The following table list the error codes, causes and symptoms and the accompanied short message that are displayed in the upper left corner of the screen.

Code #	Cause / Symptom	Short message (US)
0000h	Any POST error that is not listed below	*System error*
0010h	CMOS Checksum error (if no Serial EEProm)	*Incorrect CMOS Checksum*
0011h	Date and Time most (CMOS backed up from SE2P)	*Date and Time Lost*
0012h	PC configuration lost (both SE2P and CMOS lost)	*Incorrect PC Configuration*
0020h	Any POST error regarding an AT option ROM	*Option ROM Error*
0021h	Any POST error regarding an external PCI card issue	*PCI Error*
0022h	Any POST regarding an AT PnP issue	*ISA P1P Error*
0030h	Unsupported CPU speed switch setting	*Wrong CPU Speed Setting*
0040h	Serial number corrupted (bad checksum or null #)	*Invalid PC Serial Number*
0041	Product flag not initialized or bad	*Invalid Internal product type*
0050h	Fan not connected (according to CPU)	*Fan Not Connected*
0060h	RPO initialization failure	*Remote Power On Error*
0100h	Keyboard stuck key	*Keyboard Error*
0101h	Keyboard self-test failure	*Keyboard Error*
0102h	Keyboard controller I/O access failure	*Keyboard Error*
0103h	Keyboard not connected	*Keyboard Not Connected*
0105h	Mouse self-test failure	*Mouse Error*
0106h	Mouse not detected (but configured in CMOS)	*Mouse Error*
0108h	Mouse and Keyboard connectors reversed	*Keyboard and Mouse Error*
0200h	Conflict on serial port (@, IRQ)	*Serial Port Error*
0201h	Conflict on parallel port (@, IRQ, DMA)	*Parallel Port Error*
0300h	Floppy A: self-test failure	*Flexible Disk Drive A Error*
0301h	Floppy B: self-test failure	*Flexible Disk Drive B Error*

Code #	Cause / Symptom	Short message (US)
0310h	Floppy A: not detected (but configured in CMOS)	*Flexible Disk Drive Error*
0311h	Floppy B: not detected (but configured in CMOS)	*Flexible Disk Drive Error*
0305h	Floppy A: plugged on Floppy B: connector	*Flexible Disk Drive Error*
0306h	General failure on floppy controller	*Flexible Disk Drive Error*
0307h	Conflict on floppy disk controller	*Flexible Disk Drive Error*
0400h	CD-ROM test failure	*CD-ROM Error*
0401h	CD-ROM not detected (but configured in CMOS)	*CD-ROM Error*
0500h	General failure on HDD onboard primary ctrl	*IDE Device Error*
0501h	General failure on HDD onboard secondary ctrl	*IDE Device Error*
0510h	HDD # 0 self-test error	*IDE Device # 0 Error*
0511h	HDD # 1 self-test error	*IDE Device # 1 Error*
0512h	HDD # 2 self-test error	*IDE Device # 2 Error*
0513h	HDD # 3 self-test error	*IDE Device # 3 Error*
0520h	HDD # 0 not detected (but configured in CMOS)	*IDE Device # 0 Error*
0521h	HDD # 1 not detected (but configured in CMOS)	*IDE Device # 1 Error*
0522h	HDD # 2 not detected (but configured in CMOS)	*IDE Device # 2 Error*
0523h	HDD # 3 not detected (but configured in CMOS)	*IDE Device # 3 Error*
0530h	Found a drive on slave connector only (primary)	*IDE Device Error*
0531h	Found a drive on slave connector only (secondary)	*IDE Device Error*
0540h	Conflict on hard disk controller	*IDE Device Error*
0600h	Found less video memory than configured in CMOS	*Video Memory Error*
0700h	Found less DRAM memory than at previous boot	*System Memory Error*
0711h	Defective SIMM (module 1, bank 1)	*System Memory Error*
0712h	Defective SIMM (module 2, bank 1)	*System Memory Error*
0721h	Defective SIMM (module 1, bank 2)	*System Memory Error*
0722h	Defective SIMM (module 2, bank 2)	*System Memory Error*

Code #	Cause / Symptom	Short message (US)
0731h	Defective SIMM (module 1, bank 3)	*System Memory Error*
0732h	Defective SIMM (module 2, bank 3)	*System Memory Error*
0800h	Found lower cache size than configured	*System Cache Error*
0801h	Cache self-test failure	*System Cache Error*
0900h	Lan (Chanteclerc) self-test failure	*Integrated LAN Error*
0901h	Lan (Chanteclerc) not detected (but enabled in *Setup*)	*Integrated LAN Error*
0A00h	Plug and Play video auto-setting failure (DDC hang)	*DDC Video Error*

The following table summarizes the most significant of the problems that can be reported.

Message	Explanation or Suggestions for Corrective Action
Operating system not found	Check whether the disk, HDD, FDD or CD-ROM disk drive is connected. If it is connected, check that it is detected by POST. Check that your boot device is enabled on the *Setup* Security menu. If the problem persists, check that the boot device contains the operating system.
Missing operating system	If you have configured HDD user parameters, check that they are correct. Otherwise, use HDD type "Auto" parameters.
Resource Allocation Conflict -PCI device 0079 on system board	Clear CMOS.
Video Plug and Play interrupted or failed. Re-enable in Setup and try again	You may have powered your computer Off/On too quickly and the computer turned off Video plug and play as a protection.
System CMOS checksum bad - run Setup	CMOS contents have changed between 2 power-on sessions. Run *Setup* for configuration.
No message, system "hangs"	Check that cache memory and main memory are correctly set in their sockets.
Other	An error message may be displayed and the computer may "hang" for 20 seconds and then beep. The POST is probably checking for a mass storage device which it cannot find and the computer is in Time-out Mode. After Time-out, run *Setup* to check the configuration.
4 - 4 - 2 - 4	Switch 9 is not correctly set or flash is corrupted. The BIOS update crisis recovery procedure is to be used.

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 Pattern	Beep Code	Numeric Code	Description
— -- -- ---	1-2-2-3	16h	BIOS ROM check-sum failure
— --- — —	1-3-1-1	20h	DRAM refresh test failure
— --- — ---	1-3-1-3	22h	8742 Keyboard controller test failure
— --- ---- —	1-3-4-1	2Ch	RAM failure on address line *xxxx*[1]
— --- ---- ---	1-3-4-3	2Eh	RAM failure on data bits *xxxx*[1] 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
— --	1-2	98h	Video configuration failure or option ROMs check-sum failure
---- ---- -- ----	4-4-2-4	F7	Crisis Recovery Failure
-	1	B4h	This does not indicate an error. There is one short beep before system startup.

[1]. 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.

Lights on the Hardware Control Panel

When the computer is first powered on, the *power-on* light on the status panel illuminates yellow for about a second before changing to green. This change of color is caused by the execution of an instruction early in the System BIOS code.

If the light remains at yellow, therefore, it indicates a failure of the processor or the System ROM in the instruction-fetch process. Check that the processor is correctly seated in its socket, and that the memory DIMMS and accessory cards are properly installed.

Appendix

Video Modes

Standard VGA Modes

Mode No.	VESA® No.	No. of Colors	Char. x Row	Char. x Cell	Resolution	Interface Type	Pixel Freq. MHz	Horizontal Refresh	Vertical Refresh
0, 1	0, 1	16/256K	40 x 25	9 x 16	360 x 400	Text	14	31.5	70
2, 3	2, 3	16/256K	80 x 25	9 x 16	720 x 400	Text	28	31.5	70
4, 5	4, 5	4/256K	40 x 25	8 x 8	320 x 200	Graphics	12.5	31.5	70
6	6	2/256K	80 x 25	8 x 8	640 x 200	Graphics	25	31.5	70
7	7	Monochrome	80 x 25	9 x 16	720 x 400	Text	28	31.5	70
D	D	16/256K	40 x 25	8 x 8	320 x 200	Graphics	12.5	31.5	70
E	E	16/256K	80 x 25	8 x 14	640 x 200	Graphics	25	31.5	70
F	F	Monochrome	80 x 25	8 x 14	640 x 350	Graphics	25	31.5	70
10	10	16/256K	80 x 25	8 x 14	640 x 350	Graphics	25	31.5	70
11	11	2/256K	80 x 25	8 x 16	640 x 480	Graphics	25	31.5	60
11[1]	11	2/256K	80 x 25	8 x 16	640 x 480	Graphics	31.5	37.5	75
12	12	16/256K	80 x 25	8 x 16	640 x 480	Graphics	25	31.5	60
12[2]	12[2]	16/256K	80 x 25	8 x 16	640 x 480	Graphics	31.5	37.5	75
13	13	256/256K	40 x 25	8 x 8	320 x 200	Graphics	12.5	31.5	70

[1.] Interlaced mode.
[2.] Higher refresh modes available with generic fix-up TSR.

NOTE

An 8 x 14 font for the EGA modes can be provided with a DOS TSR (terminate and stay resident) program. If the TSR has not been loaded when the mode is set, the 8 x 16 font is used with the two bottom rows deleted. This causes truncation of characters with descenders, but does not restrict program operation. The TSR should be used for absolute compatibility with DOS applications that use the 8 x 14 font.

Extended Video Modes

Mode No.	VESA® No.	No. of Colors	Char. x Row	Char. x Cell	Resolution	Interface Type	Pixel Freq. MHz	Horizontal Refresh	Vertical Refresh
5E	100	256/256K	80 x 25	8 x 16	640 x 400	Graphics	25	31.5	70
7A	-	64K	-	-	640 x 400	Graphics	25	31.5	70
5F	101	256/256K	80 x 30	8 x 16	640 x 480	Graphics	25	31.5	60
5F	101	256/256K	80 x 30	8 x 16	640 x 480	Graphics	31.5	37.9	72
5F	101	256/256K	80 x 30	8 x 16	640 x 480	Graphics	31.5	37.5	75
5F	101	256/256K	80 x 30	8 x 16	640 x 480	Graphics	36	43.3	85
64	111	64K	-	-	640 x 200	Graphics	25	31.5	60
64	111	64K	-	-	640 x 350	Graphics	31.5	37.9	72
64	111	64K	-	-	640 x 350	Graphics	31.5	37.5	75
64	111	64K	-	-	640 x 480	Graphics	36	43.3	85
71	112	16M	-	-	640 x 480	Graphics	25	31.5	60
71	112	16M	-	-	640 x 480	Graphics	31.5	37.9	72
71	112	16M	-	-	640 x 480	Graphics	31.5	37.5	75
71	112	16M	-	-	640 x 480	Graphics	36	43.3	85
76[1]	-	16M + A[2]	-	-	640 x 480	Graphics	25	31.5	60
76[1]	-	16M + A	-	-	640 x 480	Graphics	31.5	37.9	72
76[1]	-	16M + A	-	-	640 x 480	Graphics	31.5	37.5	75
76[1]	-	16M + A	-	-	640 x 480	Graphics	36	43.3	85
58, 6A	102	16/256K	100 x 37	8 x 16	800 x 600	Graphics	36	35.2	56
58, 6A	102	16/256K	100 x 37	8 x 16	800 x 600	Graphics	40	37.8	60
58, 6A	102	16/256K	100 x 37	8 x 16	800 x 600	Graphics	50	48.1	72
58, 6A	102	16/256K	100 x 37	8 x 16	800 x 600	Graphics	49.5	46.9	75
58, 6A	102	16/256K	100 x 37	8 x 16	800 x 600	Graphics	56.25	53.7	85.1
5C	103	256/256K	100 x 37	8 x 16	800 x 600	Graphics	36	35.2	56

Mode No.	VESA® No.	No. of Colors	Char. x Row	Char. x Cell	Resolution	Interface Type	Pixel Freq. MHz	Horizontal Refresh	Vertical Refresh
5C	103	256/256K	100 x 37	8 x 16	800 x 600	Graphics	40	37.9	60
5C	103	256/256K	100 x 37	8 x 16	800 x 600	Graphics	50	48.1	72
5C	103	256/256K	100 x 37	8 x 16	800 x 600	Graphics	49.5	46.9	75
5C	103	256/256K	100 x 37	8 x 16	800 x 600	Graphics	56.25	53.7	85.1
65	114	64K	-	-	800 x 600	Graphics	36	35.2	56
65	114	64K	-	-	800 x 600	Graphics	40	37.8	60
65	114	64K	-	-	800 x 600	Graphics	50	48.1	72
65	114	64K	-	-	800 x 600	Graphics	49.5	46.9	75
65	114	64K	-	-	800 x 600	Graphics	56.25	53.7	85.1
78	115	16M	-	-	800 x 600	Graphics	36	35.2	56
78	115	16M	-	-	800 x 600	Graphics	40	37.9	60
78	115	16M	-	-	800 x 600	Graphics	50	48.1	72
78	115	16M	-	-	800 x 600	Graphics	49.5	46.9	75
78	115	16M	-	-	800 x 600	Graphics	56.25	53.7	85.1
72[1]	-	16M + A[2]	-	-	800 x 600	Graphics	36	35.2	56
72[1]	-	16M + A[2]	-	-	800 x 600	Graphics	40	37.8	60
72[1]	-	16M + A[2]	-	-	800 x 600	Graphics	50	48.1	72
72[1]	-	16M + A[2]	-	-	800 x 600	Graphics	49.5	46.9	75
72[1]	-	16M + A[2]	-	-	800 x 600	Graphics	56.25	53.7	85.1
5D[3]	104	16/256K	128 x 48	8 x 16	1024 x 768	Graphics	44.9	35.5	43i[3]
5D	104	16/256K	128 x 48	8 x 16	1024 x 768	Graphics	65	48.3	60
5D	104	16/256K	128 x 48	8 x 16	1024 x 768	Graphics	75	56	70
5D	104	16/256K	128 x 48	8 x 16	1024 x 768	Graphics	78.7	60	75
5D	104	16/256K	128 x 48	8 x 16	1024 x 768	Graphics	94.5	68.3	85
60[3]	105	256/256K	128 x 48	8 x 16	1024 x 768	Graphics	44.9	35.5	43i[3]

Mode No.	VESA® No.	No. of Colors	Char. x Row	Char. x Cell	Resolution	Interface Type	Pixel Freq. MHz	Horizontal Refresh	Vertical Refresh
60	105	256/256K	128 x 48	8 x 16	1024 x 768	Graphics	65	48.3	60
60	105	256/256K	128 x 48	8 x 16	1024 x 768	Graphics	75	56	70
60	105	256/256K	128 x 48	8 x 16	1024 x 768	Graphics	78.7	60	75
60	105	256/256K	128 x 48	8 x 16	1024 x 768	Graphics	94.5	68.3	85
74[3]	117	64K	-	-	1024 x 768	Graphics	44.9	35.5	43i[3]
74	117	64K	-	-	1024 x 768	Graphics	65	48.3	60
74	117	64K	-	-	1024 x 768	Graphics	75	56	70
74	117	64K	-	-	1024 x 768	Graphics	78.7	60	75
74	117	64K	-	-	1024 x 768	Graphics	94.5	68.3	85
79	118	16M	-	-	1024 x 768	Graphics	44.9	35.5	43i[3]
79	118	16M	-	-	1024 x 768	Graphics	65	48.3	60
79	118	16M	-	-	1024 x 768	Graphics	75	56	70
79	118	16M	-	-	1024 x 768	Graphics	78.7	60	75
79	118	16M	-	-	1024 x 768	Graphics	94.5	68.3	85
73[1]	-	16M + A[2]	-	-	1024 x 768	Graphics	44.9	35.5	43i[3]
73[1]	-	16M + A[2]	-	-	1024 x 768	Graphics	65	48.3	60
73[1]	-	16M + A[2]	-	-	1024 x 768	Graphics	75	56	70
73[1]	-	16M + A[2]	-	-	1024 x 768	Graphics	78.7	60	75
73[1]	-	16M + A[2]	-	-	1024 x 768	Graphics	94.5	68.3	85
6C[3]	106	16/256K	160 x 64	8 x 16	1280 x 1024	Graphics	75	48	43i[3]
6C	106	16/256K	160 x 64	8 x 16	1280 x 1024	Graphics	108	65	60
6C	106	16/256K	160 x 64	8 x 16	1280 x 1024	Graphics	126	76	71.2
6C	106	16/256K	160 x 64	8 x 16	1280 x 1024	Graphics	135	80	75
6C	106	16/256K	160 x 64	8 x 16	1280 x 1024	Graphics	157	91.1	85
6D[3]	-	256/256K	160 x 64	8 x 16	1280 x 1024	Graphics	75	48	43i[3]

Mode No.	VESA ® No.	No. of Colors	Char. x Row	Char. x Cell	Resolution	Interface Type	Pixel Freq. MHz	Horizontal Refresh	Vertical Refresh
6D	-	256/256K	160 x 64	8 x 16	1280 x 1024	Graphics	108	65	60
6D	-	256/256K	160 x 64	8 x 16	1280 x 1024	Graphics	126	76	71.2
6D	-	256/256K	160 x 64	8 x 16	1280 x 1024	Graphics	135	80	75
6D	-	256/256K	160 x 64	8 x 16	1280 x 1024	Graphics	157	91.1	85
75	11A	64K	-	-	1280 x 1024	Graphics	75	48	43i[3]
75	11A	64K	-	-	1280 x 1024	Graphics	108	65	60
75	11A	64K	-	-	1280 x 1024	Graphics	126	76	71.2
75	11A	64K	-	-	1280 x 1024	Graphics	135	80	75
75	11A	64K	-	-	1280 x 1024	Graphics	157	91.1	85
7B	-	256/256K	200 x 75	8 x 16	1600 x 1200	Graphics	135	62.5	48i[3]
7B	-	256/256K	200 x 75	8 x 16	1600 x 1200	Graphics	162	75	60

[1.] 16M colors, but with 32-bit-per-pixel format.
[2.] +A indicates 16M colors + Alpha Channel
[3.] Interlaced mode.

NOTE

An 8 x 14 font for mode 55h is provided with a DOS TSR (terminate and stay resident) program. If the TSR has not been loaded when the mode is set, the 8 x 16 font is used with the two bottom rows deleted. This causes truncation of characters with descenders, but does not restrict program operation nor does it make characters particularly difficult to read. For absolute compatibility with some DOS applications that use the 8 x 14 font, the TSR should be used.

It should also be noted, that some modes are not supported by all monitors. The fastest refresh rate for that particular monitor type selected is automatically used.

Maximum Refresh Rates

Resolution	170-MHz DAC	230-MHz DAC
1024 x 768	100+ Hz	100+ Hz
1280 x 1024	85 Hz	100+ Hz
1600 x 1200	60 Hz	85 Hz

BIOS Modes Supported

Mode	VESA® Mode No.	Cirrus Logic Mode No.	dX	dY	Text bpp[1]	Colors	Refresh Rates	Mode Type[2]
VGA	0		40	25	40 x 25	64, 16 gray	70	V
VGA	1	0, 1	40	25	40 x 25	64, 16/8 color	70	V
VGA	2		80	25	80 x 25	64, 16 gray	70	V
VGA	3	2, 3	80	25	80 x 25	64, 16/8 color	70	V
VGA	4	4, 5	320	200		4 (256)	70	V
VGA	5		320	200		4, gray	70	V
VGA	6	6	640	200		2, gray	70	V
VGA	7	7	80	25		2, monochrome	70	V
VGA	D	D	320	200		16	70	V
VGA	E	E	640	200		16 planar	70	V
VGA	F	F	640	350		monochrome	70	V
VGA	10	10	640	350		16, 64	70	V
VGA	11	11	640	480	80 x 25	2	60	V
VGA	12	12	640	480	80 x 25	16 planar	60	V
VGA	13	13	640	200	40 x 25	256 linear	60	V
Cirrus Logic	11C[3]	7A	640	400	16	65K	70	S, L, T
VESA	100	5E	640	400	8	256	70	S, L, T

Mode	VESA ® Mode No.	Cirrus Logic Mode No.	dX	dY	Text bpp[1]	Colors	Refresh Rates	Mode Type[2]
VESA	101	5F	640	480	8	256	60, 72, 75, 85	S, L, T
VESA	111	64	640	480	16	65K	60, 72, 75, 85	S, L, T
VESA	112	71	640	480	24	16M	60, 72, 75, 85	S, L, T
Cirrus Logic	11D[3]	76	640	480	32	16M	60, 72, 75, 85	S, L, T
VESA	102	58, 6A	640	600	4	16	56, 60, 72, 75, 85	S
VESA	103	5C	640	600	8	256	56, 60, 72, 75, 85	S, L, T
VESA	114	65	800	600	16	65K	56, 60, 72, 75, 85	S, L, T
VESA	115	78	800	600	24	16M	56, 60, 72, 75, 85	S, L, T
Cirrus Logic	11E[3]	72	1024	600	32	16M	56, 60, 72, 75, 85	S, L, T
VESA	104	5D	1024	768	4	16	43i, 60, 70, 75, 85	S
VESA	105	60	1024	768	8	256	43i, 60, 70, 75, 85	S, L, T
VESA	117	74	1024-	768	16	65K	43i, 60, 70, 75, 85	S, L, T
VESA	118	79	1024	768	24	16M	43i, 60, 70, 75, 85	S, L, T
Cirrus Logic	11F[3]	73	1024	768	32	16M	43i, 60, 70, 75, 85	S, L, T
VESA	106	6C	1280	1024	4	16	43i, 60, 70, 71.2, 75, 85	S

Mode	VESA® Mode No.	Cirrus Logic Mode No.	dX	dY	Text bpp[1]	Colors	Refresh Rates	Mode Type[2]
VESA	107	6D	1280	1024	8	256	43i, 60, 70, 71.2, 75, 85	S, L, T
VESA	11A	75	1280	1024	16	65K	43i, 60, 70, 71.2, 75, 85	S, L, T
Cirrus Logic	120[3]	7B	1600	1200	8	256	48i, 60, 65, 70, 75, 80, 85	S, L, T

1. 16 bpp is 5:6:5 (RGB); 24 bpp is 24 bpp packed pixel; 32 bpp is 24 bpp packed into a 32-bit dword.
2. "V" indicates VGA compatible mode;
   "S" indicates Super VGA mode;
   "L" indicates Linear mode;
   "T" indicates Tiled mode.
3. VBE v2.0 reported mode number.