Note

Before using this information and the product it supports, be sure to read the general information under Appendix E, “Notices and Trademarks” on page 58.

First Edition (March 1997)

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Preface

This *Technical Information Manual* provides information for the IBM IntelliStation Z Pro. It is intended for developers who want to provide hardware and software products to operate with this IBM computer and provides a more in-depth view of how this computer works. Users of this publication should have an understanding of computer architecture and programming concepts.

Manual Style

Warning: The term *reserved* describes certain signals, bits, and registers that should not be changed. Use of reserved areas can cause compatibility problems, loss of data, or permanent damage to the hardware. When the contents of a register are changed, the state of the reserved bits must be preserved. When possible, read the register first and change only the bits that must be changed.

In this manual, some signals are abbreviated. A minus sign in front of the signal indicates that the signal is active low. No sign in front of the signal indicates that the signal is active high.

The use of the letter “h” following a number indicates that it is a hexadecimal number. For example, 1245h or 342Bh. Also, when numerical modifiers such as “K”, “M” and “G” are used, they typically indicate powers of 2, not powers of 10. For example, 1 KB equals 1 024 bytes (2^{10}), 1 MB equals 1 048 576 bytes (2^{20}), and 1 GB equals 1 073 741 824 bytes (2^{30}).

When expressing hard disk storage capacity, MB equals 1 000 KB (1 000 000). The value is determined by counting the number of sectors and assuming that every two sectors equals 1 KB.

Note: Depending on the operating system and other system requirements, the storage capacity available to the user might vary.

Related Information

In addition to this manual, the following IBM publications and README files provide information related to the operation of the computer. To order publications in the U.S. and Puerto Rico, call 1-800-879-2755. In other countries, contact an IBM reseller or an IBM marketing representative.

- *Using Your IntelliStation Z Pro*
  This publication contains information about configuring, operating, and maintaining your computer. Also, information on diagnosing and solving problems, how to get help and service, and warranty issues is included.
- *Installing Options in Your IntelliStation Z Pro*
  This publication contains instructions for installing options in your computer.
- *Understanding Your IntelliStation Z Pro*
  This publication includes general information about using computers and detailed information about the features of your computer.
- *IntelliStation Z Pro Compatibility Report*
  This publication contains information about compatible hardware and software for your computer. This publication is available at *http://www.pc.ibm.com/cdt*.
- IBM Audio Feature *README file*
  This file, on the *Ready-to-Configure CD*, contains instructions for installing device drivers for the IBM Audio Feature feature.
- Ethernet Adapter *README file*
  This file, on the *Ready-to-Configure CD*, contains instructions for installing device drivers for the *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*.
- *Intergraph Intense 3D Graphics Adapter README file*
  This file, on the *Ready-to-Configure CD*, contains instructions for installing device drivers for the *Intergraph Intense 3D Pro 1000 Graphics Adapter* installed in some models. Also, this publication includes troubleshooting information for related video problems.
- *Matrox MGA Millennium Graphics Adapter README file*
  This file, on the *Ready-to-Configure CD*, contains instructions for installing device drivers for the *Matrox MGA Millennium Graphics Adapter* installed in some models. Also, this publication includes troubleshooting information for related video problems.
- *Adaptec SCSI Support Package*
  This documentation includes information on configuring the adapter and instructions for installing and configuring SCSI devices.

Chapter 1. System Overview

The IBM IntelliStation Z Pro is a versatile product designed to provide state-of-the-art computing power with room for future growth. Several model variations are available.

Hardware Features

Standard features in all models:

- Intel® Pentium® Pro microprocessor with 256 KB or 512 KB of internal L2 cache
- Dual processing support
- Support for up to 1 GB of system memory
- Enhanced IDE (EIDE) interface
- Audio ports for a microphone, audio input, and headphone or speaker output.
- *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*
- *Adaptec AHA-2940 Ultra Wide SCSI Adapter*
- Ultra Fast/Wide SCSI hard disk drive
- One 3.5-inch, 1.44 MB diskette drive
- One *16x Max* CD-ROM
- Two high-speed serial ports
- One high-speed parallel port
- A monitor port provided by the graphics adapter
- One universal serial bus port
- One infrared port capable of supporting a 4 Mbps infrared transceiver
- Keyboard and mouse ports
- 104-key keyboard and three-button mouse
- Riser card - 1 shared ISA/PCI connector, 2 dedicated ISA connectors, and 4 dedicated PCI connectors

Standard features that vary by model:

- Graphics adapter - *Intergraph Intense 3D Pro 1000 Graphics Adapter* or *Matrox MGA Millennium Graphics Adapter*
- Video Feature port for input from optional video features (provided with the *Matrox MGA Millennium Graphics Adapter*)
- Video In port for optional VGA input (provided with the *Intergraph Intense 3D Pro 1000 Graphics Adapter*)
- Stereo Sync port for optional stereoscopic viewing support (provided with the *Intergraph Intense 3D Pro 1000 Graphics Adapter*)

System Software Features

Your computer supports a variety of operating systems. Refer to *Using Your IntelliStation Z Pro* for a listing of supported operating systems.

Note: Your computer is shipped with Windows NT Workstation, version 4.0. Also, a Ready-to-Configure (RTC) CD-ROM is included with all models. The RTC CD-ROM has applications and device driver support for Windows NT Workstation, Windows 95, and OS/2 Warp.

System software includes:

- Basic input/output system (BIOS)
- Plug and Play
- Power-on self-test (POST)
- Configuration/Setup Utility program
- Advanced Power Management (APM)
- Flash update utility program
- Diagnostic programs

BIOS

The computer system uses the IBM SurePath BIOS which supports the following features:

- PCI bus, according to *PCI BIOS Specification 2.1*
- PCI bus-master EIDE interface
- Plug and Play, according to *Plug and Play BIOS Specification 1.1*
- Advanced Power Management (APM), according to *APM BIOS Interface Specification 1.1*
- Bootable CD-ROM
- IDE LBA support to allow BIOS access to hard disks greater than 527MB
- DBCS code for Japanese systems only
- Manufacturing hooks

Plug and Play

The system conforms to the following:

- *Plug and Play BIOS Specification 1.1*
- *Plug and Play BIOS Specification, Errata and Clarification 1.0*

The system follows the guidelines described in the following:

- *Plug and Play BIOS Extension Design Guide 1.0*
- *Guide to Integrating the Plug and Play BIOS Extensions with System BIOS 1.2*
- *Plug and Play Kit for DOS and Windows*

POST

The computer uses IBM power-on self-test (POST) software. Initialization code is included for the Pentium Pro microprocessor and the 82440FX chip set and the I/O chip. Also, the *Adaptec AHA-2940 Ultra Wide SCSI Adapter*, the *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*, the *Matrox MGA Millennium Graphics Adapter*, and the *Intergraph Intense 3D Pro 1000 Graphics Adapter* are given control to allow them to initialize themselves.

POST software locates any hardware problems or configuration changes. If an error occurs while POST is running, an error code in the form of a text message displays on the screen. For a description of a POST error code, see “POST Error Codes” on page 55.

Configuration/Setup Utility Program

The *Configuration/Setup Utility program* provides menus for selecting options for devices, I/O ports, date and time, system security, start options, advanced setup, ISA legacy resources, and power management. More information on using the Configuration/Setup Utility program is provided in *Using Your IntelliStation Z Pro*.

Advanced Power Management

Your computer comes with energy-saving software that meets Energy Star requirements. Advanced Power Management (APM) is a feature that reduces the power consumption when the entire system or components of the computer system are not in use. When enabled, APM initiates reduced-power modes for the monitor, microprocessor, or the entire system after a specified period of inactivity is reached.[1]

APM is implemented according to *APM BIOS Interface Specification 1.1*. For more information on APM, see *Using Your IntelliStation Z Pro* and *Understanding Your IntelliStation Z Pro*.

Flash Update Utility Program

The flash update utility is a stand-alone program to support flash code updates. This utility program updates the BIOS code in flash and the MRI to different languages. The flash update utility program is available on a 3.5-inch diskette.

Diagnostic Programs

Two diagnostic products are supplied with your computer: QAPlus/WIN-WIN, a Windows program, provides the best software coverage; QAPlus/PRO for DOS provides the best hardware coverage. For more information on these diagnostic programs, see *Using Your IntelliStation Z Pro*.

[1] APM does not support the 4.5GB hard disk.

System Management Features

Your computer has features that make it possible for a network administrator or file server to manage and control it remotely over a network. These features are:

- WOL (Wake on LAN)
- RPL (Remote Program Load) or DHCP (Dynamic Host Configuration Protocol) and BOOTP (Boot Protocol)
- Flash over LAN (Update POST/BIOS over network)
- DMI (Desktop Management Interface) BIOS and DMI software
- Thermal sensing

Wake on LAN

If you have remote network management software, you can use the IBM-developed Wake on LAN feature. For this feature to function correctly, *Wake on LAN* must be enabled, *Automatic Power On Startup Sequence* must be enabled, and the *Network* must be selected as the first startup device. These setting are selected using the *Configuration/Setup Utility program*.

You can use the Wake on LAN function to turn on any or all of the networked computers so that your remote network management software can perform the tasks it has been programmed to do. For instance, when Wake on LAN is used with IBM's remote network management software, TME 10 NetFinity Version 4 (or later), you can perform functions such as asset tracking and software and device driver updates on remote computers after hours and on weekends. Wake on LAN and NetFinity work together to turn on the networked computers and make the appropriate updates.

RPL (Remote Program Load) and DHCP (Dynamic Host Configuration)

RPL and DHCP are features that are built into the *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*. The RPL feature enables your computer to boot directly from a server on your LAN that has been configured for RPL. The DHCP feature makes it possible for a DHCP server on your intranet[2] to assign an IP (internet protocol) address to your computer so that the BOOTP feature can load a boot image from the server. The DHCP server must be one that supports BOOTP (Boot Protocol) on your intranet using software such as the Intel LANDesk Configuration Manager. Your computer requires network management software, such as the LANClient Control Manager in order to take advantage of the RPL and DHCP features built into the *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*.

Flash over LAN (Update POST/BIOS over network)

This feature enables your computer's POST/BIOS to be updated remotely by a network administrator. Network management software, such as the LANClient Control Manager, is required in order to take advantage of the Flash over LAN feature.

[2] An intranet is a private network that conforms to the same protocols as the internet, but is contained within an organization. The intranet contains one or more servers that provide services to the workstations on the private network. Some intranets are also connected to the internet.

DMI (Desktop Management Interface) BIOS and DMI software

DMI is a mechanism for gathering information about the hardware and software in your computer to enable a network administrator to remotely monitor and control it in a network environment. See your operating system documentation for information about using DMI.

Thermal sensing

Your computer has built-in thermal sensors that monitor the temperature of the processors. This sensor, used in conjunction with system management software, enables a network administrator to monitor the internal temperature of the computer and take appropriate action if it becomes too high. For example, if the computer fan stops, causing the internal temperature to rise, the computer could be shut down before internal components are damaged.

Chapter 2. System Board Features

This section includes information about system board features. To view an illustration of the system board, see “System Board” on page 17.

For a list of features provided with your computer, see “Hardware Features” on page 1.

Microprocessor

The primary microprocessor in your computer is the Intel® Pentium® Pro. A voltage regulator circuit on the system board provides the required power for the primary microprocessor. The Pentium Pro microprocessor features:

- Dynamic execution technology
- Multiprocessing support
- Optimized for 32-bit software
- Internal L2 cache
  - 4-way set associative
  - Non-blocking
  - 1 GB/second bandwidth communication with the microprocessor core
- 64-bit data bus
- 36-bit address bus
- Math coprocessor

Note: Refer to *http://www.intel.com* for more information on the Intel® Pentium® Pro microprocessor.

The microprocessor plugs directly into a zero-insertion-force (ZIF) socket (socket 8) on the system board.

Dual Processing Support

The combined technologies of the system board and the microprocessor provide support for dual processing. The dual processing configuration is known as symmetric multiprocessing (SMP). Your computer provides:

- Power-supply margins for dual processing
- Thermal margins for dual processing
- Advanced programmable interrupt control (APIC) on the system board. This is used for multiprocessor interrupt control.
- Code for APIC initialization

On the system board, directly beside the primary microprocessor, a second socket 8 is provided for installing a second Pentium Pro microprocessor. Also, sockets are provided for connecting a voltage-regulator module which supplies power to the second microprocessor, and a fan (part of a fan-sink assembly), which helps cool the second microprocessor. To locate these connectors, see “System Board” on page 17.

An upgrade kit for your computer is an available option from IBM. The upgrade kit includes a Pentium Pro microprocessor, a fan-sink assembly, and a voltage-regulator module. See *Installing Options in Your IntelliStation Z Pro* for instructions.

Chip Set Control

Your computer uses the Intel® 82440FX chip set. This chip set provides a bridge between the peripheral component interconnect (PCI) bus and the microprocessor bus. (For information on the PCI bus, see “PCI Bus” on page 9.) Also, this chip set controls the system memory interface.

Your computer also uses the Intel® PIIX3 chip. This chip provides a bridge between the PCI and the industry standard architecture (ISA) buses, a bus-master, enhanced integrated drive electronics (EIDE) interface, and a universal serial bus (USB) port.

System Memory

Four dual inline memory module (DIMM) connectors are provided on the system board. The DIMM connectors are powered by + 3.3 volts. Each DIMM connector is a 168-pin, gold-lead socket. For the pin assignments, see “System Memory Connectors” on page 36.

The system board supports:

- A maximum of 1 GB
- Extended Data Out (EDO), Dynamic Random Access Memory (DRAM) only.
- 64-bit (non-parity) and 72-bit (ECC) wide memory modules.

Any configuration of DIMMs is acceptable. Characteristics *required* by DIMMs include:

- 168-pin, unbuffered +3.3 V modules only
- Gold-lead tabs only
- 60 nanosecond or faster access speeds
- Height of no more than 3.81 cm (1.5 in.)
- To enable error-correcting, all installed memory must be of the ECC type (a combination of ECC and nonparity types is configured as nonparity)

Note: Single inline memory modules (SIMMs) are not supported in your computer.

PCI Bus

The PCI bus is compliant with *PCI Local Bus Specification 2.1*. The PCI bus runs synchronously to the host bus and is driven at a frequency of 33 MHz.

For information on the expansion connector to the PCI bus, see “Riser Card” on page 16.

ISA Bus

The Intel® PIIX3 chip provides the bridge between the peripheral component interconnect (PCI) and industry standard architecture (ISA) buses. The chip is used to convert PCI bus cycles to ISA bus cycles. The ISA bus operates at 8.33 MHz (one-quarter of the PCI bus speed).

For information on the expansion connectors to the ISA bus, see “Riser Card” on page 16.

The chip that provides the PCI-to-ISA bridge also includes all the subsystems of the ISA bus. These ISA-compatible subsystems are:

- Two cascaded 82C59 interrupt controllers
- Two 82C37 DMA controllers with four 8-bit and three 16-bit channels
- Three counters equivalent to a 82C54 programmable interval timer
- Power management features

The following table shows the system resources used for the PCI-to-ISA bridge.

Table 1. System Resource Assignments for PCI-to-ISA Bridge

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	00-0F, 20-43, 61, 70, 80-8F, 92, A0-BF, C0-DF, EE-F1, F4-F5
IRQ	NMI, 0, 2
DMA	None

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

Bus Master EIDE Interface

The system board incorporates a PCI bus master, enhanced integrated drive electronics (EIDE) interface that complies with *AT Attachment Interface with Extensions*; this allows concurrent operations on the PCI and EIDE buses.

Up to four IDE devices can be attached to the system board through a ribbon cable that connects to one of two connectors on the system board. The IDE devices receive their power through a four-position power cable containing +5, +12, and ground.

When devices are added to the EIDE interface, one device is designated as the primary or master device and another is designated as the secondary or subordinate device. These designations are determined by switches or jumpers on each device. A bootable hard disk drive can be installed on either EIDE connector.

Note: An IDE expansion adapter is not supported.

For a list of devices that might be installed in the computer, see “Internal Drives” on page 25.

The following table shows the system resources used by the EIDE interface.

Table 2. System Resource Assignments for EIDE Interface

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	170-177, 1F0-1F7, 376-377, 3F6-3F7
IRQ	14, 15
DMA	None

Two 40-pin connectors are provided on the system board for the EIDE interface. For information on the pin assignments, see “EIDE Connectors” on page 39.

USB Interface

Universal serial bus (USB) technology is a standard feature of the computer. The system board provides the USB interface with one connector. A USB-enabled device can be attached to the connector, and if that device is a hub, multiple peripheral devices can be attached to the hub and be used by the system. The USB connector uses Plug and Play technology for installed devices. The speed of the USB is up to 12 Mb/second with a maximum of 255 peripheral devices.

The USB is compliant with *Universal Host Controller Interface Design Guide 1.0*. Features provided by USB technology include:

- Support for hot pluggable devices
- Support for concurrent operation of multiple devices
- Suitable for different device bandwidths
- Connections of up to five meters in length from host to hub or hub to hub
- Guaranteed bandwidth and low latencies appropriate for specific devices
- Wide range of packet sizes
- Limited power to hubs

At the rear of the computer, one 4-pin connector is provided for the USB interface. For information on the pin assignments, see “USB Connector” on page 44.

Input/Output Controller

Control of the integrated input/output (I/O) ports and diskette drive is provided by a single chip, the National Semiconductor PC87308. This chip, which is compatible with *Plug and Play ISA Specification 1.0*, is a controller for the following:

- Diskette drive
- Serial ports
- Parallel port
- Keyboard and mouse ports
- Infrared port
- Real-time clock

Diskette Drive Support

The cable provided with your computer supports a maximum of two diskette drives and one tape backup drive (see “Internal Drives” on page 25 for more information). The following is a list of devices that the diskette drive subsystem will support:

- 1.44 MB, 3.5-inch diskette drive
- 1.2 MB, 5.25-inch diskette drive
- 1 Mbps, 500 Kbps, or 250 Kbps tape drive

Note: A 2.88 MB, 3.5-inch diskette drive is not supported.

One 34-pin, berg-strip connector is provided on the system board for the diskette drive. For information on the connector pin assignments, see “Diskette Drive Connector” on page 40.

Table 3. System Resource Assignments for Diskette Drive

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	3F0-3F5, 3F7, 370-375, 377
IRQ	6
DMA	2

Serial Ports

Two universal asynchronous receiver/transmitter (UART) serial ports are integrated into the system board. Both ports include a 16-byte data first-in first-out (FIFO) buffer, are 16550A compatible, and have programmable baud-rate generators.

One of the UART serial ports is used in the normal mode. The other serial port can be configured as an infrared port or used in normal mode. See “Infrared Port.”

The following table shows the possible port assignments for the serial ports.

Table 4. Serial Port Assignments

Port Assignment	Address Range	IRQ Level
Serial 1	03F8h–03FFh	IRQ4
Serial 2	02F8h–02FFh	IRQ3
Serial 3	03E8h–03FFh	IRQ4
Serial 4	02E8h–02FFh	IRQ3

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

On the system board, a 9-pin, male connector is provided for serial port 1. Serial port 2 is a 9-pin male connector with a shielded cable connecting it internally to the system board. For information on the connector pin assignments, see “Serial Ports 1 and 2 Connector” on page 41.

Infrared Port

Serial port 2 can be configured into an infrared port. When an optional infrared module is attached to the port, the computer is capable of transmitting and receiving wireless communications with other infrared-enabled devices.

The infrared module plugs directly into the infrared port and provides a link of up to approximately one meter. The infrared port uses any of the same four assignments as the serial ports. The infrared port is compliant with:

- IrDA-2, including 4 Mbps, 1.2 Mbps, and 1.15 Mbps baud rates
- Sharp-IR
- TV-Remote mode

The system board has one 9-pin connector for the infrared port. For information on the connector pin assignments for the infrared port, see “Infrared Port Connector” on page 44.

Parallel Port

Support for extended capabilities port (ECP), enhanced parallel port (EPP), and standard parallel port (SPP) modes is integrated into the system board. The modes of operation are selected through the Configuration/Setup Utility program with the default mode set to SPP. The ECP and EPP modes are compliant with IEEE 1284.

The following table shows the possible port assignments for the parallel port.

Table 5. Parallel Port Assignments

Port Assignment	Address Range	IRQ Level
Parallel 1	03BCh–03BEh[3]	IRQ7
Parallel 2	0378h–037Fh, 0778h–077Fh	IRQ5
Parallel 3	0278h–027Fh, 0678h–067Fh	IRQ5

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

On the system board, one 25-pin connector is provided for the parallel port. For information on the connector pin assignments, see “Parallel Port Connector” on page 42.

Keyboard and Mouse Ports

The keyboard-and-mouse subsystem is controlled by a general purpose 8-bit microcontroller. The controller consists of 256 bytes of data memory and 2 KB of read-only memory (ROM).

The controller has two logical devices; one controls the keyboard, and the other controls the mouse. The keyboard has two fixed I/O addresses and a fixed IRQ line and can operate without the mouse. The mouse cannot operate without the keyboard because, although it has a fixed IRQ line, the mouse relies on the addresses of the keyboard for operation. The following table shows the resource assignments for the keyboard and mouse.

Table 6. System Resource Assignments for the Keyboard and Mouse

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	60, 64
IRQ	1 (keyboard), 12 (mouse)
DMA	None

The system board has one 6-pin connector for the keyboard port and another 6-pin connector for the mouse port. For information on the connector pin assignments, see “Keyboard and Mouse Port Connectors” on page 43.

[3] ECP mode not available for this port assignment.

Real-Time Clock

The real-time clock is a low-power clock that provides a time-of-day clock and a calendar. The clock settings are maintained by an external battery source of +3 volts.

The real-time clock contains 242 bytes of memory to store system setup data in what is commonly referred to as complementary metal-oxide semiconductor (CMOS) memory. Moving a jumper (J8) on the system board erases CMOS memory. To locate the battery or J8, see “System Board” on page 17.

The following table shows the system resources used by the real-time clock.

Table 7. System Resource Assignments for the Real-Time Clock

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	70, 71
IRQ	8
DMA	None

Audio Ports

The system board supports a full function, single chip, stereo audio system with Sound Blaster-Pro capability. The controller chip is the Crystal CS4236. It features the following:

- Sound Blaster, Sound Blaster-Pro, and Windows Sound System compatible
- Fully Plug and Play compatible
- FM synthesizer
- Wave table synthesizer
- 16-bit ISA address decode

The system board has back panel connections for Stereo Line/Headphone Out, Stereo Line In, and Microphone In.

Table 8. System Resource Assignments for the Audio Ports

System Resource	Assignment
ROM	None
RAM	None
I/O (hex)	0220h–022Fh, 0388h–038Bh, 0534h–0537h
IRQ	5
DMA	0, 3

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

Thermal Sensors

Your computer has a thermal sensor under each of the micropocessors. Each thermal sensor monitors the ambient temperature between the microprocessor and the system board. The sensors are polled periodically and when a specific temperature is reached, the Desktop Management Interface (DMI) is signaled via a device driver of the over-temperature condition. A second, higher temperature will cause the system to be shutdown.

The thermal sensors are accessed at addresses 090h (primary microprocessor) and 098h (secondary microprocessor) via the IIC bus that is physically connected to GPIO pins on the Super I/O chip.

Riser Card

The system board uses an 7-slot riser card for expansion. The riser card plugs into the system board, and adapters plug into the ISA-expansion or PCI-expansion connectors on the riser card. Signals from adapters are routed to the ISA or PCI buses. Each ISA-expansion connector provides a 16-bit-wide data path; each PCI-expansion connector provides a 32-bit-wide data path.

Each PCI-expansion connector is capable of driving one low-power Schottky load and operates at 33 MHz. Each ISA-expansion connector is capable of driving two low-power Schottky loads and operates at 8.25 MHz.

The PCI bus shares interrupts with the ISA bus. IRQ 3, 4, 5, 7, 9, 10, or 11 is automatically assigned to PCI adapters during POST. If no interrupts are available for the PCI adapters during POST, an error message is generated.

The riser card has one shared ISA/PCI expansion slot, two dedicated ISA slots, and four dedicated PCI slots. The computer comes standard with adapters plugged into some of the expansion slots. For more information, see Chapter 3, “Adapters and Internal Drives” on page 20.

For information on the connector pin assignments, see “ISA Connectors” on page 45 and “PCI Connector” on page 47.

Physical Layout

The system board might look slightly different from the one shown.

Note: A diagram of the system board, including switch and jumper settings, is attached inside the computer.

System Board

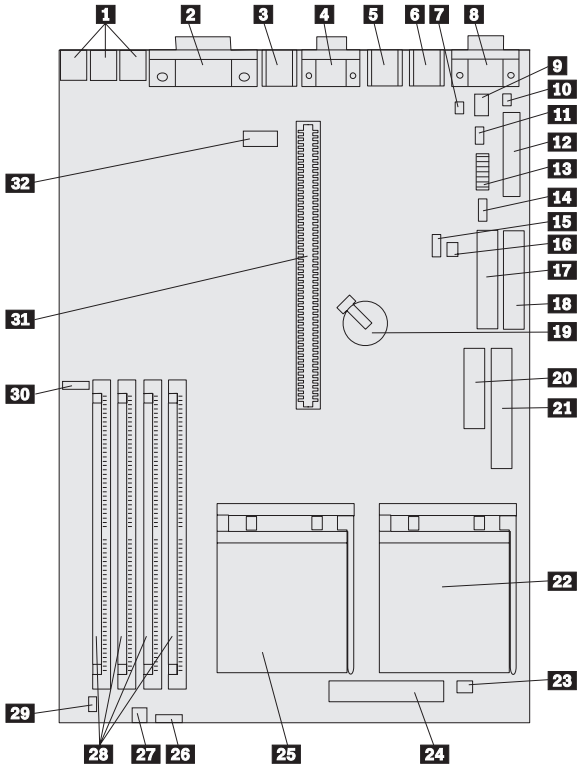


Figure 1. System Board

1. Audio connectors
2. Parallel port connector
3. Universal serial bus port connector
4. Serial port 1 connector
5. Mouse port connector
6. Keyboard port connector
7. Wake on LAN connector
8. Infrared port connector
9. 5 V auxiliary connector
10. Power switch connector
11. CMOS-clear jumper
12. Diskette connector
13. Microprocessor/diskette write-protection switches
14. SCSI LED connector
15. Wake on modem connector
16. Wake on modem connector
17. Primary EIDE connector
18. Secondary EIDE connector
19. Battery
20. Power connector
21. Power connector
22. Second microprocessor socket
23. Fan connector for second microprocessor
24. Second microprocessor VRM connector
25. Primary microprocessor
26. Power LED connector
27. Front panel fan connector
28. System memory (DIMM) connectors
29. Internal speaker connector
30. CD-ROM Audio connector
31. Riser connector
32. Serial port 2 connector

Connections and the CMOS-Clear Jumper

Connections and jumpers on the system board allow custom configurations. The following tables list the pin descriptions for specific connections and the CMOS-clear jumper. To locate these components, see “System Board” on page 17.

Table 9. J11 - Wake on Modem Ring Connection - For use with modems that do not need Aux 5

Pin	Description
1	Wake on Modem/Ring
2	Ground

Table 10. J13 - Wake on Modem Ring Connection - For use with modems that require Aux 5

Pin	Description
1	Aux 5
2	N/C
3	Wake on Modem/Ring
4	Ground

Table 11. J15 - Wake on LAN Connection

Pin	Description
1	Wake on LAN/Ring
2	Ground

Table 12. J8 - CMOS Clear Jumper

Pin	Description
1 and 2	Normal
2 and 3	Clear CMOS

Switches

On the system board, a row of switches allows custom configuration of the microprocessor speed and diskette write-protection. Refer to *Installing Options in Your IntelliStation Z Pro* for information on accessing the switches.

The following table shows the switch settings for IntelliStation Z Pro with a 200 MHz microprocessor.

Table 13. Switches 1 to 5 for 200 MHz Microprocessor Speed

Switch	200 MHz
1	On
2	Off
3	On
4	On
5	Off

Switch 6 has no function.

The following table shows the configuration of switch 7 used for Serial Port 2 Enable/Disable.

Table 14. Switch 7 for Serial Port 2 Connector

Switch	Installed	Not Installed
7	On	Off

The following table shows the configuration of switch 8 used for diskette drive operation.

Table 15. Switch 8 for Diskette Drive Operation

Switch	Normal	Read only
8	Off	On

Chapter 3. Adapters and Internal Drives

Your computer comes standard with a graphics adapter, a SCSI adapter, and an Ethernet adapter preinstalled. The graphics adapter provides support for video, the SCSI adapter provides support for the hard disk and optional SCSI devices, and the Ethernet adapter provides for a high speed LAN connection.

Note: The IBM PCMCIA adapter for PCI or an IDE expansion adapter is not supported.

Graphics Adapters

The video subsystem is provided by one of two types of graphics adapters: the *Intergraph Intense 3D Pro 1000 Graphics Adapter* or the *Matrox MGA Millennium Graphics Adapter*. Each adapter plugs into the riser card and connects to the PCI bus; both adapters are compliant with *PCI Local Bus Specification 2.1*. (For more information on the riser card, see “Riser Card” on page 16.) The graphics adapters support DDC 1.1 and DDC 2B standards. Also, each adapter provides a 15-pin monitor connector.

The *Matrox MGA Millennium Graphics Adapter* also provides a 26-pin multimedia connector for attaching optional video features. The *Intergraph Intense 3D Pro 1000 Graphics Adapter* also provides a 15-pin Video In port for connecting a VGA input device and a 5-pin Stereo Sync port for connecting a stereoscopic imaging device.

Instructions for installing device drivers for each of the graphics adapters are provided in README files on the *Ready-to-Configure CD*.

Intergraph Intense 3D Pro 1000 Graphics Adapter

If an *Intergraph Intense 3D Pro 1000 Graphics Adapter* comes standard in the computer, the following major features are provided:

- 16 MB of synchronous dynamic RAM (SDRAM)
- 4 MB of texture memory
- One 15-pin monitor connector (Video Output Port)
- One 15-pin Video Input Port for connecting a separate VGA device
- One 5-pin Stereo Sync Port for stereoscopic viewing
- Support for all VGA modes
- VESA 2.0 compliance for SVGA modes
- Video POST/BIOS code

The following table shows the system resources used by the *Intergraph Intense 3D Pro 1000 Graphics Adapter*.

Table 16. System Resource Assignments for the Intergraph Intense 3D Pro 1000 Graphics Adapter

System Resource	Assignment (hex)
ROM	C0000-C7FFF (32 KB)
RAM	A0000-BFFFF, 64 MB linear frame buffer as assigned by POST
I/O (hex)	3B4-3B5, 3BA, 3C0-3CA, 3CC, 3CE-3CF, 3D4-3D5, 3DA, 3DE-3DF
IRQ	None
DMA	None

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

Matrox MGA Millennium Graphics Adapter

If a *Matrox MGA Millennium Graphics Adapter* comes standard in the computer, the following major features are provided:

- 4 MB of Windows RAM (WRAM), upgradable to 8 MB
- One 15-pin monitor connector
- One 26-pin multimedia connector for attaching video devices
- Support for all VGA modes
- VESA 2.0 compliance for SVGA modes
- Video POST/BIOS code

The following table shows the system resources used by the *Matrox MGA Millennium Graphics Adapter*.

Table 17. System Resource Assignments for the Matrox Adapter

System Resource	Assignment (hex)
ROM	C0000-C7FFF (32 KB)
RAM	A0000-BFFFF, 8 MB linear frame buffer as assigned by POST
I/O (hex)	3B4-3B5, 3BA, 3C0-3C2, 3C4-3CA, 3CC, 3CE-3CF, 3D4-3D5, 3DA, 3DE-3DF
IRQ	None
DMA	None

Note: When the computer is started, the resource assignments are subject to change during the power-on self-test (POST).

Ethernet Adapter

Your computer comes Ethernet network-ready with a preinstalled *Intel® EtherExpress® Pro/100 Adapter w/ Wake on Lan™*. It has an 8-bit RJ-45 unshielded twisted pair (UTP) connector which provides for a high-performance LAN connection.

In addition to the normal LAN functions, this adapter provides for other important system management capabilities such as:

- Flash over LAN
- Wake on LAN (WOL)
- BOOTP and Dynamic Host Configuration Protocol (DHCP) or Remote Program Load (RPL)

For more information about these features, see “System Management Features” on page 4.

SCSI Adapter

Your computer comes with the *Adaptec AHA-2940 Ultra Wide SCSI Adapter*. This adapter provides the interface between the PCI bus and SCSI devices. Multiple internal and external drives can be attached to the SCSI adapter. SCSI technology is useful with multitasking operating environments because instructions can be sent concurrently to every drive in the system. The *Adaptec AHA-2940 Ultra Wide SCSI Adapter* has:

- One external 68-pin, 16-bit connector
- One internal 50-pin, 8-bit connector
- One internal 68-pin, 16-bit connector

Up to a total of fifteen internal and external SCSI devices can be attached to the SCSI adapter, but the number of internal devices installed is dependent upon the number of drive bays available.

Note: A maximum of four internal SCSI hard disk drives are supported.

For more information on connecting SCSI devices, see the *Adaptec SCSI Support Package*.

Internal Drives

The EIDE, SCSI, and diskette interfaces provide connectors for attaching internal drives. Your computer comes standard with an Ultra Wide SCSI hard disk drive, a diskette drive, and a CD-ROM drive.

Note: The appropriate device drivers are provided for the IBM-installed drives.

The following tables show the characteristics of internal drives that come standard with or are available for the computer.

Table 18. Diskette Drives

Characteristics	**Number/Size**
Standard	One 3.5-inch 1.44 MB
Maximum installed	Three (the cable provided allows for a maximum of two diskette drives)
Optional drives	5.25-inch 1.2 MB and 3.5-inch 1.44 MB

Table 19. Hard Disk Drives

Characteristics	**Number/Size**
Standard	One 2.1 GB or one 4.5 GB SCSI
Maximum installed (internal)	Four 2.1 GB or two 4.5 GB and two 2.1 GB

Note: Although the maximum number of internal and external drives that can be connected to the SCSI adapter is fifteen, the actual number of internal SCSI devices that can be installed is limited by the number of available drive bays in the computer.

Table 20. Drives with Optical Media

Characteristics	**Number/Size**
Standard	One *16x Max* CD-ROM

Chapter 4. Power Supply

Power is supplied by a 200-watt power supply that operates at either 115 V ac or 230 V ac. The voltage setting is manually selected with a switch on the rear of the computer. The power supply converts ac input voltages into dc output voltages and provides power for the following components:

- System board
- Keyboard and auxiliary ports
- Riser card (ISA and PCI adapters)
- Internal drives
- Local area network device

Power Input

The following table shows the input power specifications.

Table 21. Power Input Requirements

Description	Measurements
Input voltage, low range	90 V ac (min) to 137 V ac (max)
Input voltage, high range	180 V ac (min) to 265 V ac (max)
Input frequency	50 Hz ± 3 Hz or 60 Hz ± 3 Hz

Power Output

The power supply outputs shown in the following tables include the current supply capability of all the connectors, including system board, internal drives, PCI, and auxiliary outputs.

Table 22. Power Output

Output Voltage	Regulation	Minimum to Maximum (amps)
+5 V dc	+5% to –5%	1.5 to 20.0
+12 V dc	+5% to –5%	0.2 to 8.0
–12 V dc	+10% to –9%	0.0 to 0.5
–5 V dc	+10% to –10%	0.0 to 0.5
+3.3 V dc	+5% to –4%	0.0 to 20.0
+5 V dc (auxiliary)	+5% to –5%	0.0 to .02
+5 V dc (Wake on LAN)	+5% to –5%	0.0 to .70

Note: Simultaneous loading of +3.3 V dc and +5 V dc must not exceed 120 watts.

Component Outputs

The power supply provides separate voltage sources for the system board and internal storage devices. The following tables show the approximate power that is provided for specific system components. Many components draw less current than the maximum shown.

Table 23. System Board

Supply Voltage	Maximum Current	Regulation Limits
+3.3 V dc	3000 mA	+5.0% to –4.0%
+5.0 V dc	4000 mA	+5.0% to –4.0%
+12.0 V dc	25.0 mA	+5.0% to –5.0%
–12.0 V dc	25.0 mA	+10.0% to –9.0%

Table 24. Keyboard Port

Supply Voltage	Maximum Current	Regulation Limits
+5.0 V dc	275 mA	+5.0% to –4.0%

Table 25. Auxiliary Device Port

Supply Voltage	Maximum Current	Regulation Limits
+5.0 V dc	300 mA	+5.0% to –4.0%

Table 26. ISA-Bus Adapters (Per Slot)

Supply Voltage	Maximum Current	Regulation Limits
+5.0 V dc	4500 mA	+5.0% to –4.0%
–5.0 V dc	200 mA	+5.0% to –5.0%
+12.0 V dc	1500 mA	+5.0% to –5.0%
–12.0 V dc	300 mA	+10.0% to –9.0%

Table 27. PCI-Bus Adapters (Per Slot)

Supply Voltage	Maximum Current	Regulation Limits
+5.0 V dc	5000 mA	+5.0% to –4.0%
+3.3 V dc	5000 mA	+5.0% to –4.0%

Note: For each PCI connector, the maximum power consumption is rated at 25 watts for +5 V and +3.3 V combined.

Table 28. Internal Devices (DASD)		
Supply Voltage	**Maximum Current**	**Regulation Limits**
+5.0 V dc	1400 mA	+5.0% to –5.0%
+12.0 V dc	1500 mA	+5.0% to –5.0%

Note: Some adapters and hard disk drives draw more current than the recommended limits. These adapters and drives can be installed in the system; however, the power supply will shut down if the total power used exceeds the maximum power that is available.

Output Protection

The power supply protects against output overcurrent, overvoltage, and short circuits.

A short circuit that is placed on any dc output (between outputs or between an output and dc return) latches all dc outputs into a shutdown state, with no damage to the power supply.

If this shutdown state occurs, the power supply returns to normal operation only after the fault has been removed and the power switch has been turned off for at least one second.

If an overvoltage fault occurs (in the power supply), the power supply latches all dc outputs into a shutdown state before any output exceeds 130% of the nominal value of the power supply.

Power Connectors

Note: The total power used by the any of following connectors must not exceed the amount shown in “Component Outputs” on page 27.

The power supply provides 4-pin connectors for attaching internal devices. The following table lists the pin assignments for these connectors.

Table 29. Pin Assignments for 4-Pin Power Connectors

Connector	Location	Pin 1	Pin 2	Pin 3	Pin 4
P3	3.5-inch diskette drive	+5 V	Ground	Ground	+12 V
P4	–	+12 V	Ground	Ground	+5 V
P5	DASD	+12 V	Ground	Ground	+5 V
P6	DASD	+12 V	Ground	Ground	+5 V
P7	DASD	+12 V	Ground	Ground	+5 V
P8	DASD	+12 V	Ground	Ground	+5 V

Connectors with 6 pins are used to connect the power supply to the system board and riser card. The following table lists the pin assignments for these connectors.

Table 30. Pin Assignments for 6-Pin Power Connectors

Connector	Location	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
P1	System board	Power Good	+5 V	+12 V	–12 V	GND	GND
P2	System board	GND	GND	–5 V	+5 V	+5 V	+5 V
P10	Riser 3 V	+3.3 V	+3.3 V	+3.3 V	GND	GND	GND
P11	System board 3 V	+3.3 V	+3.3 V	+3.3 V	GND	GND	GND

Connectors with 3 pins are provided to connect the power supply with the system board and a LAN feature. The following table lists the pin assignments for these connectors.

Table 31. Pin Assignments for 3-Pin Power Connectors

Connector	Location	Pin 1	Pin 2	Pin 3
P9 [4]	System board	+5 V	Control	Ground
P12	LAN	+5 V	Control	Ground

[4] AUX 5

Chapter 5. Physical Specifications

The section lists the physical specifications for your computer. It has six drive bays for internal drives and seven expansion slots for adapters.

Note: Your computer is electromagnetically compatible with FCC Class A.

The following tables list the physical attributes.

Table 32. Size

Description	Measurement
Width	190 mm (7.48 in.)
Depth	435 mm (17.13 in.)
Height	435 mm (17.13 in.)
Weight, maximum (configuration as shipped)	12.9 kg (28.5 lb)

Table 33. Cables

Description	Measurement
Power cable	1.63 m (5 ft 4 in.)
Keyboard cable	1.83 m (6 ft)
Ribbon cable (IDE interface)	0.51 m (1 ft 8 in.)
SCSI cable	0.91 m (3 ft)

Table 34. Air Temperature

Description	Measurement
System on	10 to 35°C (50 to 95°F) at altitude 0-915m (3000ft)
System on	10 to 32°C (50 to 90°F) at altitude 915-2134m (3000-7000ft)
System off	10 to 43°C (50 to 110°F)

Note: The maximum altitude at which the specified air temperatures apply is 2134m (7000ft). At higher altitudes, the maximum air temperatures are lower than those specified.

Table 35. Humidity	
Description	**Measurement**
System on	8% to 80%
System off	8% to 80%

Table 36. Heat Output	
Description	**Measurement**
Maximum configuration as shipped	40 W (137 Btu per hour)
Maximum configuration	230W (785 Btu per hour)

Table 37. Electrical	
Description	**Measurement**
Low range	90 (min) to 137 (max) V ac
Low range nominal	100 to 127 V ac
High range	180 (min) to 265 (max) V ac
High range nominal	200 to 240 V ac
Frequency	50 ± 3 Hz or 60 ± 3 Hz
Input, maximum (configuration as shipped)	0.52 kVA

Chapter 6. System Compatibility

This chapter discusses some of the hardware, software, and BIOS compatibility issues for the computer. Refer to *IntelliStation Z Pro Compatibility Report* for a list of compatible hardware and software options.

Hardware Compatibility

This section discusses hardware and BIOS compatibility issues that must be considered when designing application programs.

Many of the interfaces are the same as those used by the IBM Personal Computer AT. In most cases, the command and status organization of these interfaces is maintained.

The functional interfaces are compatible with the following interfaces:

- The Intel 8259 interrupt controllers (edge-triggered mode)
- The National Semiconductor NS16450 and NS16550A serial communication controllers
- The Motorola MC146818 Time of Day Clock command and status (CMOS reorganized)
- The Intel 8254 timer, driven from a 1.193 MHz clock (channels 0, 1, and 2)
- The Intel 8237 DMA controller, except for the Command and Request registers and the Rotate and Mask functions; the Mode register is partially supported
- The Intel 8272 or 82077 diskette drive controllers
- The Intel 8042 keyboard controller at addresses 0060h and 0064h
- All video standards using VGA, EGA, CGA, and MDA
- The parallel printer ports (Parallel 1, Parallel 2, and Parallel 3) in compatibility mode

Use the following information to develop application programs. Whenever possible, use the BIOS as an interface to hardware to provide maximum compatibility and portability of applications among systems.

Hardware Interrupts

Hardware interrupts are level-sensitive for PCI interrupts and edge-sensitive for ISA interrupts. The interrupt controller clears its in-service register bit when the interrupt routine sends an End of Interrupt (EOI) command to the controller. The EOI command is sent regardless of whether the incoming interrupt request to the controller is active or inactive.

The interrupt-in-progress latch is readable at an I/O-address bit position. This latch is read during the interrupt service routine and might be reset by the read operation, or it might require an explicit reset.

Note: For performance and latency considerations, designers might want to limit the number of devices sharing an interrupt level.

With level-sensitive interrupts, the interrupt controller requires that the interrupt request be inactive at the time the EOI command is sent; otherwise, a new interrupt request will be detected. To avoid this, a level-sensitive interrupt handler must clear the interrupt condition (usually by a read or write operation to an I/O port on the device causing the interrupt). After processing the interrupt, the interrupt handler:

1. Clears the interrupt
2. Waits one I/O delay
3. Sends the EOI
4. Waits one I/O delay
5. Enables the interrupt through the Set Interrupt Enable Flag command

Hardware interrupt IRQ9 is defined as the replacement interrupt level for the cascade level IRQ2. Program interrupt sharing is implemented on IRQ2, interrupt 0Ah. The following processing occurs to maintain compatibility with the IRQ2 used by IBM Personal Computer products:

1. A device drives the interrupt request active on IRQ2 of the channel.
2. This interrupt request is mapped in hardware to IRQ9 input on the second interrupt controller.
3. When the interrupt occurs, the system microprocessor passes control to the IRQ9 (interrupt 71h) interrupt handler.
4. This interrupt handler performs an EOI command to the second interrupt controller and passes control to the IRQ2 (interrupt 0Ah) interrupt handler.
5. This IRQ2 interrupt handler, when handling the interrupt, causes the device to reset the interrupt request before performing an EOI command to the master interrupt controller that finishes servicing the IRQ2 request.

Diskette Drives and Controller

The following tables show the reading, writing, and formatting capabilities of each type of diskette drive.

Table 38. 5.25-Inch Diskette Drive Reading, Writing, and Formatting Capabilities

Diskette Drive Type	250/500 KB Mode	300/500 KB Mode	1 MB Mode
Single sided (48 TPI)	RWF	—	—
Double sided (48 TPI)	RWF	RWF	—
High capacity (1.2 MB)	RWF	RWF	RWF

Table 39. 3.5-Inch Diskette Drive Reading, Writing, and Formatting Capabilities

Diskette Drive Type	720 KB Mode	1.44 MB Mode	2.88 MB Mode
1.44 MB drive	RWF	RWF	Not supported

Notes:

1. Do not use 5.25-inch diskettes that are designed for the 1.2 MB mode in either a 250/500 KB or 300/500 KB diskette drive.
2. Low-density 5.25-inch diskettes that are written to or formatted by a high-capacity 1.2 MB diskette drive can be reliably read only by another 1.2 MB diskette drive.

Copy Protection

The following methods of copy protection might not work in systems using the 3.5-inch 1.44 MB diskette drive.

- Bypassing BIOS routines:
  - Data transfer rate: BIOS selects the proper data transfer rate for the media being used.
  - Diskette parameter table: Copy protection, which creates its own diskette parameter table, might not work in these drives.
- Diskette drive controls:
  - Rotational speed: The time between two events in a diskette drive is a function of the controller.
  - Access time: Diskette BIOS routines must set the track-to-track access time for the different types of media that are used in the drives.
  - 'Diskette change' signal: Copy protection might not be able to reset this signal.
- Write-current control: Copy protection that uses write-current control does not work, because the controller selects the proper write current for the media that is being used.

Hard Disk Drives and Controller

Reading from and writing to the hard disk is initiated in the same way as in IBM Personal Computer products; however, new functions are supported.

Software Compatibility

To maintain software compatibility, the interrupt polling mechanism that is used by IBM Personal Computer products is retained. Software that interfaces with the reset port for the IBM Personal Computer positive-edge interrupt sharing (hex address 02F*x* or 06F*x*, where *x* is the interrupt level) does not create interference.

Software Interrupts

With the advent of software interrupt sharing, software interrupt routines must daisy-chain interrupts. Each routine must check the function value, and if it is not in the range of function calls for that routine, it must transfer control to the next routine in the chain. Because software interrupts are initially pointed to address 0:0 before daisy chaining, check for this case. If the next routine is pointed to address 0:0 and the function call is out of range, the appropriate action is to set the carry flag and do a RET 2 to indicate an error condition.

Appendix A. Connector Pin Assignments

The following tables show the pin assignments for various system board connectors.

System Memory Connectors

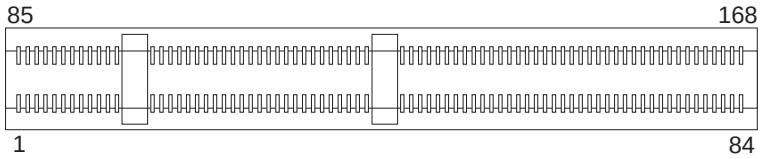


Figure 2. System Memory (DIMM) Connector

Note: Each system memory connector is a 168-pin, gold-lead socket.

Table 40 (Page 1 of 3). 168-Pin Assignments for the System Memory Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Ground	NA	85	Ground	NA
2	MD0	I/O	86	MD32	I/O
3	MD1	I/O	87	MD33	I/O
4	MD2	I/O	88	MD34	I/O
5	MD3	I/O	89	MD35	I/O
6	VDD	I/O	90	VDD	NA
7	MD4	I/O	91	MD36	NA
8	MD5	I/O	92	MD37	I/O
9	MD6	I/O	93	MD38	I/O
10	MD7	I/O	94	MD39	I/O
11	MD8	I/O	95	MD40	I/O
12	GND	NA	96	Ground	NA
13	MD9	I/O	97	MD41	I/O
14	MD10	I/O	98	MD42	I/O
15	MD11	O	99	MD43	I/O
16	MD12	O	100	MD44	I/O
17	MD13	O	101	MD45	I/O
18	VDD	O	102	VDD	NA
19	MD14	O	103	MD46	I/O
20	No connect/CB0	I/O	104	MD47	I/O
21	No connect/CB1	I/O	105	No connect/CB4	I/O
22	PAR2	I/O	106	No connect/CB5	I/O
23	Ground	I/O	107	Ground	NA
24	No connect	NA	108	No connect	NA
25	No connect	NA	109	No connect	NA
26	VDD	O	110	VDD	NA
27	WE0	O	111	DU	NA

Table 40 (Page 2 of 3). 168-Pin Assignments for the System Memory Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
28	CAS0	O	112	CAS4	O
29	CAS1	O	113	CAS5	O
30	RAS0	O	114	RAS1	O
31	OE0	O	115	DU	NA
32	Ground	O	116	Ground	NA
33	A0	O	117	A1	O
34	A2	O	118	A3	O
35	A4	O	119	A5	O
36	A6	O	120	A7	O
37	A8	O	121	A9	O
38	A10	O	122	A11	O
39	A12	O	123	A13	O
40	VDD	NA	124	VDD	NA
41	No connect	NA	125	DU	NA
42	No connect (DU)	NA	126	DU	NA
43	Ground	NA	127	Ground	NA
44	OE2	O	128	DU	NA
45	RAS2	O	129	RAS3	O
46	CAS2	O	130	CAS6	O
47	CAS3	O	131	CAS7	O
48	WE2	O	132	DU	NA
49	VDD	O	133	VDD	NA
50	No connect	NA	134	No connect	NA
51	No connect	NA	135	No connect	NA
52	No connect/CB2	I/O	136	No connect/CB6	I/O
53	No connect/CB3	I/O	137	No connect/CB7	I/O
54	Ground	NA	138	Ground	NA
55	MD16	I/O	139	MD48	I/O
56	MD17	I/O	140	MD49	I/O
57	MD18	I/O	141	MD50	I/O
58	MD19	I/O	142	MD51	I/O
59	VDD	NA	143	VDD	NA
60	MD20	I/O	144	MD52	I/O
61	No connect	NA	145	No connect	NA
62	DU	NA	146	DU	NA
63	No connect	NA	147	No connect	NA
64	Ground	NA	148	Ground	NA
65	MD21	I/O	149	MD53	I/O
66	MD22	I/O	150	MD54	I/O
67	MD23	I/O	151	MD55	I/O
68	Ground	NA	152	Ground	NA
69	MD24	I/O	153	MD56	I/O
70	MD25	I/O	154	MD57	I/O

Table 40 (Page 3 of 3). 168-Pin Assignments for the System Memory Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
71	MD26	I/O	155	MD58	I/O
72	MD27	I/O	156	MD59	I/O
73	VDD	NA	157	VDD	NA
74	MD28	I/O	158	MD60	I/O
75	MD29	I/O	159	MD61	I/O
76	MD30	I/O	160	MD62	I/O
77	MD31	I/O	161	MD63	I/O
78	Ground	NA	162	Ground	NA
79	No connect	I/O	163	No connect	NA
80	No connect	I/O	164	No connect	NA
81	No connect	I/O	165	SA0	I/O
82	SDA	I/O	166	SA1	I/O
83	SCL	I/O	167	SA2	I/O
84	VDD	NA	168	VDD	I/O

EIDE Connectors

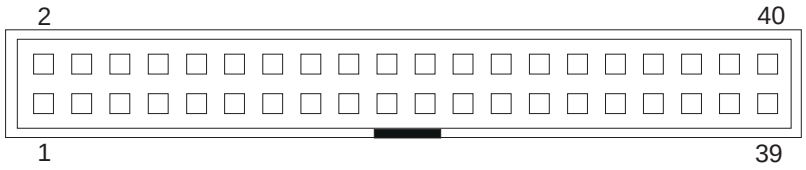


Figure 3. EIDE Connector

Note: Each EIDE connector is a 40-pin, shrouded berg strip.

Table 41. 40-Pin Assignments for the EIDE Connectors

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Reset	O	2	Ground	NA
3	D7	I/O	4	D8	I/O
5	D6	I/O	6	D9	I/O
7	D5	I/O	8	D10	I/O
9	D4	I/O	10	D11	I/O
11	D3	I/O	12	D12	I/O
13	D2	I/O	14	D13	I/O
15	D1	I/O	16	D14	I/O
17	D0	I/O	18	D15	I/O
19	Ground	NA	20	Key connector	NA
21	No connect	NA	22	Ground	NA
23	IOW#	O	24	No connect	NA
25	IOR#	O	26	Ground	NA
27	IOCHRDY	I	28	ALE	O
29	No connect	NA	30	Ground	NA
31	IRQ	I	32	CS16#	I
33	SA1	O	34	PDIAG	I
35	SA0	O	36	SA2	O
37	CS0#	O	38	CS1	O
39	Active#	I	40	Ground	NA

Diskette Drive Connector

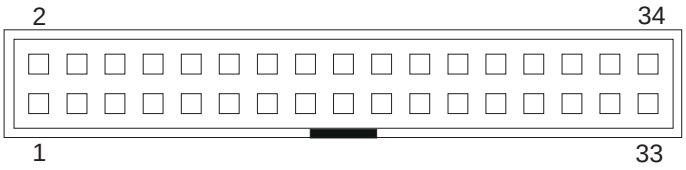


Figure 4. Diskette Drive Connector

Note: The connector for the diskette drive is a 34-pin, berg strip.

Table 42. 34-Pin Assignments for the Diskette Drive Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Reserved	I	2	High density select	O
3	Not connected	NA	4	Not connected	NA
5	Ground	NA	6	Data rate 0	NA
7	Ground	NA	8	Index#	I
9	Reserved	NA	10	Motor enable 0	O
11	Ground	NA	12	Drive select 1	O
13	Ground	NA	14	Drive select 0	O
15	Ground	NA	16	Motor enable 1	O
17	MSEN1	I	18	Direction in#	O
19	Ground	NA	20	Step#	O
21	Ground	NA	22	Write data#	O
23	Ground	NA	24	Write enable#	O
25	Ground	NA	26	Track0#	I
27	MSEN0	I	28	Write protect#	I
29	Ground	NA	30	Read data#	I
31	Ground	NA	32	Head 1 select#	O
33	Data rate 1	NA	34	Diskette change#	I

Audio Connectors

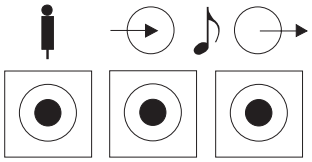
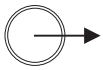


Figure 5. Audio Port Connectors

Mic In 	This is the connection for a microphone.
Line In 	This is the connection for an external sound source such as a CD player
Line Out/Headphone Out 	This is the connection for stereo headphones or powered speakers. Your audio system requires a set of speakers connected to the line output in order to hear audio. These speakers must be powered (with a built-in amplifier). In general, any powered speakers designed for use with personal computers can be used with your audio feature. These speakers are available with a wide range of features and power output.

Additional system board provisions allow for internal speaker and CD audio connection.

There is no hardware volume control. Volume may be controlled by software only.

Serial Ports 1 and 2 Connector

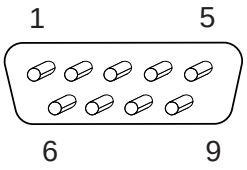


Figure 6. Serial Port Connectors

Note: The external interface for the serial ports is a male, 9-pin D-shell connector.

Table 43. 9-Pin Assignments for the Serial Port Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Data carrier detect	I	2	Receive data#	I
3	Transmit data#	O	4	Data terminal read	O
5	Ground	NA	6	Data set ready	I
7	Request to send	O	8	Clear to send	I
9	Ring indicator	I			

Parallel Port Connector

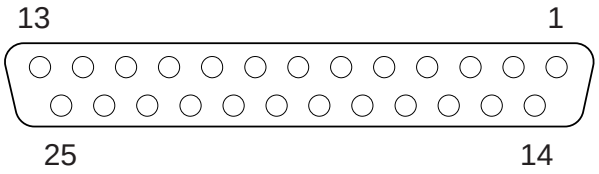


Figure 7. Parallel Port Connector

Note: The external interface for the parallel port is a female, 25-pin D-shell connector.

Table 44. 25-Pin Assignments for the Parallel Port Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	STROBE#	I/O	2	D0	I/O
3	D1	I/O	4	D2	I/O
5	D3	I/O	6	D4	I/O
7	D5	I/O	8	D6	I/O
9	D7	I/O	10	ACK#	I
11	BUSY	I	12	PE	I
13	SLCT	I	14	AUTO FD XT#	O
15	ERROR#	I	16	INIT#	O
17	SLCT IN#	O	18	Ground	NA
19	Ground	NA	20	Ground	NA
21	Ground	NA	22	Ground	NA
23	Ground	NA	24	Ground	NA
25	Ground	NA			

Keyboard and Mouse Port Connectors

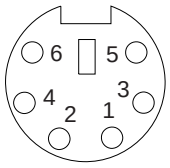


Figure 8. Keyboard and Mouse Port Connectors

Note: The external interface for the keyboard and mouse ports are 6-pin, mini-DIN connectors.

Table 45. 6-Pin Assignments for the Keyboard Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Data	I/O	2	Aux data	I/O
3	Ground	NA	4	+5 V dc	NA
5	Clock	I/O	6	Aux clock	I/O

Table 46. 6-Pin Assignments for the Mouse Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
1	Data	I/O	2	Reserved	NA
3	Ground	NA	4	+5 V dc	NA
5	Clock	I/O	6	Reserved	NA

USB Connector

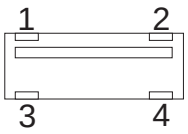


Figure 9. USB Connector

Table 47. 4-Pin Assignments for the USB Connector	
Pin	**Signal Name**
1	VCC
2	-Data
3	+Data
4	Ground

Infrared Port Connector

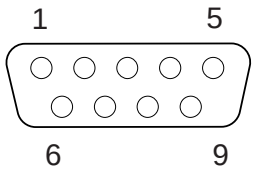


Figure 10. Infrared Port Connector

Note: The external interface for the infrared port is a female, 9-pin D-shell connector.

Table 48. 9-Pin Assignments for the Infrared Connector			
Pin	**Signal Name**	**Pin**	**Signal Name**
1	IR transmitted data (output)	2	Ground
3	Reserved	4	IR module select 2
5	IR module select 1	6	IR received data (input)
7	Voltage (+5 V dc)	8	IR module select 0
9	No connect		

ISA Connectors

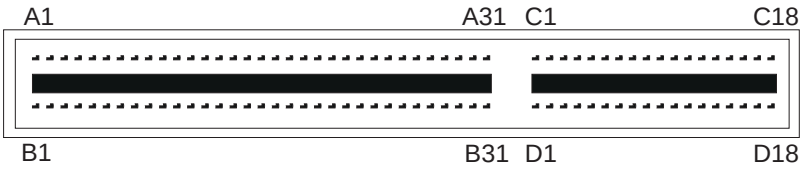


Figure 11. ISA Connector

Note: The ISA connectors are part of the riser card.

Table 49 (Page 1 of 2). 98-Pin Assignments for the ISA Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
B1	Ground	NA	A1	IOCHCK#	I
B2	RESET DRV	O	A2	SD7	I/O
B3	+5 V dc	NA	A3	SD6	I/O
B4	IRQ2	I	A4	SD5	I/O
B5	–5 V dc	NA	A5	SD4	I/O
B6	DRQ2	I	A6	SD3	I/O
B7	–12 V dc	NA	A7	SD2	I/O
B8	OWS#	I	A8	SD1	I/O
B9	+12 V dc	NA	A9	SD0	I/O
B10	Ground	NA	A10	IOCHRDY	I
B11	SMEMW#	O	A11	AEN	O
B12	SMEMR#	O	A12	SA19	I/O
B13	IOW#	I/O	A13	SA18	I/O
B14	IOR#	I/O	A14	SA17	I/O
B15	DACK3#	O	A15	SA16	I/O
B16	DRQ3	I	A16	SA15	I/O
B17	DACK1#	O	A17	SA14	I/O
B18	DRQ1	I	A18	SA13	I/O
B19	REFRESH#	I/O	A19	SA12	I/O
B20	CLK	O	A20	SA11	I/O
B21	IRQ7	I	A21	SA10	I/O
B22	IRQ6	I	A22	SA9	I/O
B23	IRQ5	I	A23	SA8	I/O
B24	IRQ4	I	A24	SA7	I/O
B25	IRQ3	I	A25	SA6	I/O
B26	DACK2#	O	A26	SA5	I/O
B27	TC	O	A27	SA4	I/O
B28	BALE	O	A28	SA3	I/O
B29	+5 V dc	NA	A29	SA2	I/O
B30	OSC	O	A30	SA1	I/O
B31	Ground	NA	A31	SA0	I/O
D1	MEMCS16#	I	C1	SBHE#	I/O

Table 49 (Page 2 of 2). 98-Pin Assignments for the ISA Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
D2	IOCS16#	I	C2	LA23	I/O
D3	IRQ10	I	C3	LA22	I/O
D4	IRQ11	I	C4	LA21	I/O
D5	IRQ12	I	C5	LA20	I/O
D6	IRQ15	I	C6	LA19	I/O
D7	IRQ14	I	C7	LA18	I/O
D8	DACK0#	O	C8	LA17	I/O
D9	DRQ0	I	C9	MEMR#	I/O
D10	DACK5#	O	C10	MEMW#	I/O
D11	DRQ5	I	C11	SD8	I/O
D12	DACK6#	O	C12	SD9	I/O
D13	DRQ6	I	C13	SD10	I/O
D14	DACK7#	O	C14	SD11	I/O
D15	DRQ7	I	C15	SD12	I/O
D16	+5 V dc	NA	C16	SD13	I/O
D17	MASTER#	I	C17	SD14	I/O
D18	Ground	NA	C18	SD15	I/O

PCI Connector

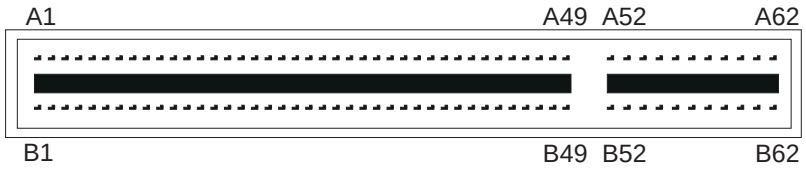


Figure 12. PCI Connector

Note: The PCI connectors are part of the riser card.

Table 50 (Page 1 of 2). 124-Pin Assignments for the PCI Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
A1	TRST#	O	B1	–12 V dc	NA
A2	+12 V dc dc	NA	B2	TCK	O
A3	TMS	O	B3	Ground	NA
A4	TDI	O	B4	TDO	I
A5	+5 V dc	NA	B5	+5 V dc	NA
A6	INTA#	I	B6	+5 V dc	NA
A7	INTC#	I	B7	INTB#	I
A8	+5 V dc	NA	B8	INTD#	I
A9	Reserved	NA	B9	PRSNT1#	I
A10	+5 V dc (I/O)	NA	B10	Reserved	NA
A11	Reserved	NA	B11	PRSNT2	I
A12	Ground	NA	B12	Ground	NA
A13	Ground	NA	B13	Ground	NA
A14	Reserved	NA	B14	Reserved	NA
A15	RST#	O	B15	Ground	NA
A16	+5 V dc (I/O)	NA	B16	CLK	O
A17	GNT#	O	B17	Ground	NA
A18	Ground	NA	B18	REQ#	I
A19	Reserved	NA	B19	+5 V dc (I/O)	NA
A20	Address/Data 30	I/O	B20	Address/Data 31	I/O
A21	+3.3 V dc	NA	B21	Address/Data 29	I/O
A22	Address/Data 28	I/O	B22	Ground	NA
A23	Address/Data 26	I/O	B23	Address/Data 27	I/O
A24	Ground	NA	B24	Address/Data 25	I/O
A25	Address/Data 24	I/O	B25	+3.3 V dc	NA
A26	IDSEL	O	B26	C/BE 3#	I/O
A27	+3.3 V dc	NA	B27	Address/Data 23	I/O
A28	Address/Data 22	I/O	B28	Ground	NA
A29	Address/Data 20	I/O	B29	Address/Data 21	I/O
A30	Ground	NA	B30	Address/Data 19	I/O
A31	Address/Data 18	I/O	B31	+3.3 V dc	NA
A32	Address/Data 16	I/O	B32	Address/Data 17	I/O
A33	+3.3 V dc	NA	B33	C/BE 2#	I/O

Table 50 (Page 2 of 2). 124-Pin Assignments for the PCI Connector

Pin	Signal Name	I/O	Pin	Signal Name	I/O
A34	FRAME#	I/O	B34	Ground	NA
A35	Ground	NA	B35	IRDY#	I/O
A36	TRDY#	I/O	B36	+3.3 V dc	NA
A37	Ground	NA	B37	DEVSEL#	I/O
A38	STOP#	I/O	B38	Ground	NA
A39	+3.3 V dc	NA	B39	LOCK#	I/O
A40	SDONE	I/O	B40	PERR#	I/O
A41	SBO#	I/O	B41	+3.3 V dc	NA
A42	Ground	NA	B42	SERR#	I/O
A43	+3.3 V dc	NA	B43	+3.3 V dc	NA
A44	C/BE(1)#	I/O	B44	C/BE 1#	I/O
A45	Address/Data 14	I/O	B45	Address/Data 14	I/O
A46	Ground	NA	B46	Ground	NA
A47	Address/Data 12	I/O	B47	Address/Data 12	I/O
A48	Address/Data 10	I/O	B48	Address/Data 10	I/O
A49	Ground	NA	B49	Ground	NA
A50	Key	NA	B50	Key	NA
A51	Key	NA	B51	Key	NA
A52	Address/Data 8	I/O	B52	Address/Data 8	I/O
A53	Address/Data 7	I/O	B53	Address/Data 7	I/O
A54	+3.3 V dc	NA	B54	+3.3 V dc	NA
A55	Address/Data 5	I/O	B55	Address/Data 5	I/O
A56	Address/Data 3	I/O	B56	Address/Data 3	I/O
A57	Ground	NA	B57	Ground	NA
A58	Address/Data 1	I/O	B58	Address/Data 1	I/O
A59	+5 V dc (I/O)	NA	B59	+5 V dc (I/O)	NA
A60	ACK64#	I/O	B60	ACK64#	I/O
A61	+5 V dc	NA	B61	+5 V dc	NA
A62	+5 V dc	NA	B62	+5 V dc	NA

Appendix B. System Address Maps

Memory Address Map

Table 51. Memory Address Map

Address (hex)	Size	Description
00000000–0009FFFF	640 KB	Application memory
000A0000–000BFFFF	128 KB	Video frame buffers
000C0000–000DFFFF	128 KB	Adapter ROM(s)
000E0000–000FFFFF	128 KB	System ROM
00100000–00FFFFFF	15 MB	Application Memory
01000000–1FFFFFFF	1008 MB	Application Memory
20000000–FEBFFFFF		unused
FEC00000–FEC00FFF	4 KB	I/O APIC (default)
FEC01000–FED00FFF	2044 KB	unused
FEE00000–FEE00FFF	4 KB	APIC (default)
FEE01000–FFF7FFFF	8188 KB	unused
FFF80000–FFFFFFFF	512 KB	System ROM (shadow)

Input/Output Address Space Map

The following table lists resource assignments for the I/O address space map. Any addresses below 100h that are not shown are reserved.

Table 52. I/O Address Space Map

Address (Hex)	Device
0000–000F	DMA controller 1
0020–0021	Interrupt controller 1
0040–0043	Timer 1
0048–004B	Timer 2
0060	Keyboard controller data byte
0061	NMI, speaker control
0064	Keyboard controller command/status byte
0070, bit 7	Enable NMI
0070, bits 6:0	Real-time clock, address
0071	Real-time clock, data
0078	Reserved (system board configuration)
007C	Reserved (system board configuration)
0080–008F	DMA page register
00A0–00A1	Interrupt controller 2
00C0–00DE	DMA controller 2
00F0	Reset numeric error
00F1	Clear numeric busy
0170–0177	Secondary IDE
01F0–01F7	Primary IDE
0278–027F	Parallel port 3
02E8–02EF	Serial 4
02F8–02FF	Serial 2
0376–0377	Secondary IDE
0378–037F	Parallel 2
03BC–03BF	Parallel 1
03E8–03EF	Serial 3
03F0–03F5	Diskette
03F6	Primary IDE
03F7 (Write)	Diskette
03F7, bit 7	Diskette
03F7, bits 6:0	Primary IDE
03F8–03FF	Serial 1
0678–067F	Parallel 3 (ECP mode)
0778–077F	Parallel 2 (ECP mode)
0CF8–0CFB	PCI configuration address register
0CFC–0CFF	PCI configuration data register
FF00–FF07	IDE bus master register

DMA I/O Address Map

The following table lists resource assignments for the DMA address map. Any addresses that are not shown are reserved.

Table 53 (Page 1 of 2). DMA I/O Addresses

Address (Hex)	Description	Bits	Byte Pointer
0000	Channel 0, Memory Address register	00–15	Yes
0001	Channel 0, Transfer Count register	00–15	Yes
0002	Channel 1, Memory Address register	00–15	Yes
0003	Channel 1, Transfer Count register	00–15	Yes
0004	Channel 2, Memory Address register	00–15	Yes
0005	Channel 2, Transfer Count register	00–15	Yes
0006	Channel 3, Memory Address register	00–15	Yes
0007	Channel 3, Transfer Count register	00–15	Yes
0008	Channels 0–3, Read Status/Write Command register	00–07	
0009	Channels 0–3, Write Request register	00–02	
000A	Channels 0–3, Write Single Mask register bits	00–02	
000B	Channels 0–3, Mode register (write)	00–07	
000C	Channels 0–3, Clear byte pointer (write)	NA	
000D	Channels 0–3, Master clear (write)/temp (read)	00–07	
000E	Channels 0–3, Clear Mask register (write)	00–03	
000F	Channels 0–3, Write All Mask register bits	00–03	
0081	Channel 2, Page Table Address register[5]	00–07	
0082	Channel 3, Page Table Address register[5]	00–07	
0083	Channel 1, Page Table Address register[5]	00–07	
0087	Channel 0, Page Table Address register[5]	00–07	
0089	Channel 6, Page Table Address register[5]	00–07	
008A	Channel 7, Page Table Address register[5]	00–07	
008B	Channel 5, Page Table Address register[5]	00–07	
008F	Channel 4, Page Table Address/Refresh register	00–07	
00C0	Channel 4, Memory Address register	00–15	Yes
00C2	Channel 4, Transfer Count register	00–15	Yes
00C4	Channel 5, Memory Address register	00–15	Yes
00C6	Channel 5, Transfer Count register	00–15	Yes
00C8	Channel 6, Memory Address register	00–15	Yes
00CA	Channel 6, Transfer Count register	00–15	Yes
00CC	Channel 7, Memory Address register	00–15	Yes
00CE	Channel 7, Transfer Count register	00–15	Yes
00D0	Channels 4–7, Read Status/Write Command register	00–07	
00D2	Channels 4–7, Write Request register	00–02	
00D4	Channels 4–7, Write Single Mask register bit	00–02	
00D6	Channels 4–7, Mode register (write)	00–07	

Table 53 (Page 2 of 2). DMA I/O Addresses

Address (Hex)	Description	Bits	Byte Pointer
00D8	Channels 4–7, Clear byte pointer (write)	NA	
00DA	Channels 4–7, Master clear (write)/temp (read)	00–07	
00DC	Channels 4–7, Clear Mask register (write)	00–03	
00DE	Channels 4–7, Write All Mask register bits	00–03	
00DF	Channels 5–7, 8- or 16-bit mode select	00–07	

[5] Upper byte of memory address register.

Appendix C. IRQ and DMA Channel Assignments

The following tables list the interrupt request (IRQ) and direct memory access (DMA) channel assignments.

Table 54. IRQ Channel Assignments

IRQ	System Resource
NMI	Critical system error
SMI	System/power management interrupt
0	Timer
1	Keyboard
2	Interrupt controller
3[6]	Serial port 2/Infrared (default)
4[6]	Serial port 1 (default)
5	Available
6	Diskette
7[6]	Parallel port (default)
8	Real-time clock
9	Available
10	Available
11	Available
12[6]	Mouse
13	Coprocessor
14	IDE drives (0, 1) if installed
15	IDE drives (2, 3) if installed

With dual processing, the advanced programmable interrupt controller (APIC) manages hardware interrupts to the system BIOS. The following interrupts are available only in the dual-processing APIC mode.

IRQ	System Resource
16	PCI device
17	PCI device
18	PCI device
19	PCI device
20	Not available
21	Not available
22	Not available
23	Not available
24	SMI

[6] Can be modified to alternate settings or disabled.

Table 55. DMA Channel Assignments

DMA Channel	Data Width	System Resource
0	Available	8 bits
1	Infrared[7] (default)	8 bit
2	Diskette	8 bits
3	Parallel port[7]	8 bits
4	DMA controller	–
5	Available	16 bits
6	Available	16 bits
7	Available	16 bits

[7] Can be modified to alternative settings or disabled.

Appendix D. Error Codes

The following tables list the POST error codes and beep error codes for the computer.

POST Error Codes

POST error messages appear when POST finds problems with the hardware during power-on or when a change in the hardware configuration is found. POST error messages are 3-, 4-, 5-, 8-, or 12-character alphanumeric messages. An *x* in an error message can represent any number.

Table 56 (Page 1 of 2). POST Error Codes

Code	Description
101	Interrupt failure
102	Timer failure
103	Timer-interrupt failure
104	Protected mode failure
105	Last 8042 command not accepted – keyboard failure
106	System board failure
108	Timer bus failure
109	Low MB chip select test
110	System board parity error 1 (system board parity latch set)
111	I/O parity error 2 (I/O channel check latch set)
112	I/O channel check error
113	I/O channel check error
114	External ROM checksum error
115	DMA error
116	System board port read/write error
120	Microprocessor test error
121	Hardware error
151	Real time clock failure
161	Bad CMOS Battery
162	CMOS RAM checksum/configuration error
163	Clock not updating
164	CMOS RAM memory size does not match
167	Clock not updating
175	Riser card or system board error
176	System cover has been removed
177	Corrupted administrator password
178	Riser card or system board error
183	Administrator password has been set and must be entered
184	Password removed due to checksum error
185	Corrupted boot sequence
186	System board or hardware security error

Table 56 (Page 2 of 2). POST Error Codes

Code	Description
189	More than three password attempts were made to access system
201	Memory data error
202	Memory address line error 00-15
203	Memory address line error 16-23
221	ROM to RAM remapping error
225	Unsupported memory type installed or memory pair mismatch
301	Keyboard error
302	Keyboard error
303	Keyboard to system board interface error
304	Keyboard clock high
305	No keyboard +5 V dc
601	Diskette drive or controller error
602	Diskette IPL boot record not valid
604	Unsupported diskette drive installed
605	POST cannot unlock diskette drive
662	Diskette drive configuration error
762	Math coprocessor configuration error
11xx	Serial port error (xx = serial port number)
1762	Hard disk configuration error
1780	Hard disk 0 failed
1781	Hard disk 1 failed
1782	Hard disk 2 failed
1783	Hard disk 3 failed
1800	PCI adapter has requested an unavailable hardware interrupt
1801	PCI adapter has requested an unavailable memory resource
1802	PCI adapter has requested an unavailable I/O address space, or a defective adapter
1803	PCI adapter has requested an unavailable memory address space, or a defective adapter
1804	PCI adapter has requested unavailable memory addresses
1805	PCI adapter ROM error
1962	Boot sequence error
2401	System board video error
8601	System board - keyboard/pointing device error
8602	Pointing device error
8603	Pointing device or system board error
12092	Level 1 cache error (Processor chip)
12094	Level 2 cache error
I9990301	Hard disk failure
I9990305	No operating system found

Beep Codes

For the following beep codes, the numbers indicate the sequence and number of beeps. For example, a “2-3-2” error symptom (a burst of two beeps, three beeps, then two beeps) indicates a memory module problem. An *x* in an error message can represent any number.

Table 57. Beep Codes

Beep Code	Probable Cause
1-1-3	CMOS write/read failure
1-1-4	BIOS ROM checksum failure
1-2-1	Programmable interval timer test failure
1-2-2	DMA initialization failure
1-2-3	DMA page register write/read test failure
1-2-4	RAM refresh verification failure
1-3-1	1st 64 K RAM test failure
1-3-2	1st 64 K RAM parity test failure
2-1-1	Slave DMA register test in progress or failure
2-1-2	Master DMA register test in progress or failure
2-1-3	Master interrupt mask register test failure
2-1-4	Slave interrupt mask register test failure
2-2-2	Keyboard controller test failure
2-3-2	Screen memory test in progress or failure
2-3-3	Screen retrace tests in progress or failure
3-1-1	Timer tick interrupt test failure
3-1-2	Interval timer channel 2 test failure
3-1-4	Time-of-Day clock test failure
3-2-4	Comparing CMOS memory size against actual
3-3-1	Memory size mismatch occurred

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