Understanding Your IntelliStation E Pro Professional Workstation Type 6893

Note:
Before using this information and the product it supports, be sure to read the general information under Appendix A, "Notices and Trademarks" on page 50.

Second Edition (September 1998)

Contents

About This Book

This book is an overview of the features and technologies of your IBM IntelliStation E Pro. It includes information about the following:

- Microprocessors

- Memory

- Bus architectures

- Video and monitors

- Input/output features

- Storage devices

- System management

- Asset security

- Software

Note:
Not all features and capabilities described in this book are available on all models.

Who Should Read This Book

This book is for anyone who has an interest in the technical concepts of the personal computer. Although you do not need an in-depth knowledge of computer science to read this book, some computer familiarity is necessary.

With few exceptions, this book does not include specific instructions on how to set up, operate, program, modify, or maintain your computer. Refer to the related computer publications described below for more information on these subjects.

Related Publications

The following publications and README files, together with this book, contain information about your computer.

- *IntelliStation E Pro User Guide*
  The hard copy version of this publication comes with your computer. The online version is provided on the *Ready-to-Configure Utility Program CD* that comes with your computer. It is also provided in printable Adobe® .PDF format on the *Ready-to-Configure Utility Program CD* and from the World Wide Web at:

  `http://www3.pc.ibm.com/support?page=IBM+IntelliStation`

  It contains the following:

  - Instructions for setting up your computer

  - Instructions for configuring, operating, and maintaining your computer

  - Information on diagnosing and solving computer problems and how to get help and service

  - Warranty information

- *Installing Options in Your IntelliStation E Pro*
  This online publication is provided on the *Ready-to-Configure Utility Program CD* that comes with your computer. It contains instructions for adding memory, adapters, drives, and other options to your computer. It also available in Adobe® .PDF format on the *Ready-to-Configure Utility Program CD* and from the World Wide Web at:

  `http://www3.pc.ibm.com/support?page=IBM+IntelliStation`

- *About Your Software*
  This publication (provided only with computers that have IBM-preinstalled software) contains information about the preinstalled software package.

- Graphics adapter README files
  These files on the *Ready-to-Configure Utility Program CD* contain instructions for installing device drivers for the graphics adapter installed in your computer.

- *Netfinity Services User's Guide*
  This publication contains detailed information on how to use each of the applications included with IBM Netfinity Services.

- Audio README file
  This file on the *Ready-to-Configure Utility Program CD* contains instructions for installing device drivers for the Audio feature.

- Ethernet README file
  This file on the *Ready-to-Configure Utility Program CD* contains instructions for installing device drivers for the Ethernet controller.

- Adaptec SCSI Documentation
  This documentation provided on the *Ready-to-Configure Utility Program CD* includes information on installing SCSI devices, configuring the SCSI controller, and loading device drivers.

- *Your Guide to IBM IntelliStation Information*
  This publication contains information about other resources that will help you set up, understand, and use your computer. It also contains information about the *Ready-to-Configure Utility Program CD* that comes with your computer and instructions for starting the CD.

The following publications contain more information about your computer. Both publications can be found on the World Wide Web at:

`http://www3.pc.ibm.com/support?page=IBM+IntelliStation`

It can also be ordered from IBM. To purchase a printed copy of these publications, refer to the section on "Ordering Publications" in the "Getting Help, Service, and Information" chapter in the *IntelliStation E Pro User Guide*.

- *Hardware Information Manual*
  This separately purchased publication contains information for trained service technicians.

- *Technical Information Manual*
  This separately purchased publication contains information for individuals who want to know more about the technical aspects of their computer.

Chapter 1. Your IntelliStation E Pro

Your IBM IntelliStation E Pro is a versatile product designed to give you state-of-the-art computing power with room for growth in the future.

What Your IntelliStation E Pro Offers

The key features of your computer are:

- Intel® Pentium® II Xeon™ microprocessor with 100 MHz FSB
- 512 KB L2 cache with ECC (error checking and correction)
- Support for up to 384 MB of main memory with ECC
- ISA and PCI bus architectures
- 3.5-inch, 1.44 MB diskette drive
- High-capacity 7200 RPM hard disk drive (EIDE or SCSI, depending on the model)
    - EIDE hard disk drives support Ultra DMA mode and SMART Reaction software
    - SCSI hard drives support Fast/Ultra/Wide modes
- CD-ROM drive
- Accelerated Graphics Port (AGP)
- Preinstalled AGP graphics adapter
- Integrated audio subsystem
- Integrated ethernet subsystem with Wake on LAN and Alert on LAN
- Parallel port
- Two Serial ports
- Two USB (universal serial bus) ports
- DDC2B-compliant monitor port
- Audio ports for a microphone, line in, and line out
- RJ-45 port for Ethernet
- Mouse port
- Keyboard port
- Enhanced security
- System management features
- Asset security features
- Industry-standard compatibility
- Expansion slots
    - One AGP slot
    - Two PCI slots
    - One ISA slot

          – One shared ISA/PCI slot

- Four drive bays

Input/Output Connectors

Input/output connectors (ports) are located on the back of your computer. You can attach the keyboard, mouse, and other devices to these connectors. Most of these connectors are marked with a symbol that represents the type of connection or device that is used. These symbols are shown in the following section.

Note:
The monitor connects to the 15-pin connector on the AGP graphics adapter card that is preinstalled in your computer. The monitor connector on the input/output connector panel at the rear of your computer is not used.

Microphone: Use this connector to attach a microphone to your computer so that you can record your voice or other sounds.
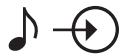
Audio line in: Use this connector to send audio signals from an external device (such as a CD player or stereo) to your computer so that the signals can be recorded.

Audio line out: Use this connector to send audio signals from the audio controller in your computer to external devices, such as self-powered stereo speakers or a multimedia monitor. Also, you can use this connector to attach headphones to your computer.

RJ-45 Ethernet: Use this connector to attach an 8-pin Ethernet cable.

Parallel: Use this connector to attach a 25-pin signal cable for a parallel printer.

USB: Two USB (universal serial bus) connectors are provided. You can attach a 4-pin cable for USB devices to each of these connectors.

Serial: Two serial connectors are provided. You can attach a 9-pin serial signal cable for serial devices to each of these connectors. If you are using a 25-pin signal cable, you will need a 9-pin to 25-pin cable connector.

Mouse: Use this connector to attach the mouse provided with your computer or another PS/2-style mouse.

Keyboard: Use this connector to attach the keyboard cable.

SCSI connectors (some models only): Models with a preinstalled SCSI adapter have an external, 16-bit SCSI connector located on the adapter. Use an external, 68-pin SCSI cable to connect an optional SCSI device here. (The SCSI adapter also has one 68-pin, 16-bit *internal* connector.) For more information on SCSI, see "SCSI Connectors" on page 26 and "SCSI" on page 40. If your computer has a preinstalled SCSI adapter, refer to the SCSI documentation that comes with the computer for additional information.

Expansion Features

Expansion features allow you to add more or different capabilities to your computer. These features vary by computer model.

Drive Bays

A 3.5-inch, 1.44 MB diskette drive and a hard disk drive are installed in two of the drive bays in your computer. The CD-ROM drive is also installed in a drive bay. Additional bays provide space for optional devices. Refer to *Installing Options in Your IntelliStation E Pro* for information about available bays, the types of drives they support, and how to install drives in them.

Expansion Slots

Your computer provides expansion *slots* for installing adapters. By installing adapters, you can expand the capabilities of your computer and take advantage of a variety of peripheral devices and applications.

When an adapter is installed on the riser card, it is connected to either the *industry standard architecture (ISA)* or *peripheral component interconnect (PCI)* bus of your computer. The PCI bus supports 32-bit adapters; the ISA bus supports 16-bit or 8-bit adapters. The number of connections to the ISA and PCI bus varies by computer model. Refer to Chapter 3, "Expansion Buses and Adapters" on page 13 for more information on ISA and PCI.

Your computer comes with an AGP (accelerated graphics port) adapter installed in the AGP option slot that is integrated with the system board.

For information on installing adapters, see *Installing Options in Your IntelliStation E Pro*.

Chapter 2. Microprocessor and Memory

The microprocessor-and-memory subsystem consists of components on the system board that perform logical operations and calculations, control memory, and manage data-transfer operations.

The devices and features that make up the microprocessor-and-memory subsystem are:

- Microprocessors and buses
- Memory and control logic

Microprocessors

The microprocessor controls most of the activity in your computer. Almost all information passes through it, whether it is a keyboard stroke, data from a disk drive, or information from a communication network. The microprocessor reads, changes, processes, and reroutes information as needed.

Your computer has an Intel Pentium II Xeon microprocessor. With its 64-bit internal data path, the Pentium II microprocessor can take in, process, and return information at a faster rate than previous microprocessors. The Pentium II also features *system management mode (SMM)*, which enables the microprocessor to control power used by peripheral devices and other components.

The microprocessor in your computer incorporates Intel's MMX™ technology. According to Intel, MMX (multimedia extensions) technology boosts the performance of the microprocessor in processing graphics, video, and audio data, thereby enhancing the performance of certain multimedia and communications software. Another key feature of MMX technology, is that it operates at a lower voltage level than previous microprocessors. A voltage regulator on the system board provides the necessary core voltage (1.8 or 2.8 volts, depending on the model). More specifically, MMX technology does the following when used with software written to take advantage of MMX technology capabilities:

- Improves audio quality by providing better noise reduction and music synthesis for compressed audio files.
- Improves video quality by enabling the use of more colors with smoother viewing.
- Enables quicker manipulation of photographs and other graphic images.
- Makes it possible to run video with multiple channels of audio. This can be done simultaneously within the same application program.
- Makes it possible to use video-conference applications without having to add expensive hardware.

Microprocessor Speed

The microprocessor operating speed is referred to as *clock speed* and is measured in *megahertz (MHz)*. The design of the microprocessor determines the maximum clock speed at which it operates. A quartz crystal on the system board generates a pulse to the microprocessor, causing the microprocessor to operate at a specific speed.

Microprocessors can operate at two clock speeds: an *internal speed* for operations within the microprocessor and an *external speed* (or *bus speed*) for transferring data in and out of the microprocessor.

Note:
The microprocessor uses cache memory to help speed up the exchange of data. See "Cache Memory" on page 8 for more information.

Microprocessor Bus

The microprocessor has an external data bus that connects it with main memory and control circuits. This pathway, which is also called the *microprocessor bus* or *local bus*, can have the same data width and operate at the same external speed as the microprocessor. The microprocessor in your computer has a 64-bit local bus that can operate at speeds of up to 100 MHz.

Math Coprocessor

The microprocessor in your computer also has an advanced, built-in numeric coprocessor. This coprocessor allows processing of complex mathematical (floating-point) calculations in much less time than many other coprocessors. With the math coprocessor performing these calculations, the microprocessor is free to perform other functions at the same time.

The math coprocessor in the microprocessor is *pipelined*, which means that it decodes address and other relevant information for pending instructions while the current instruction is in progress. This, along with other internal improvements, allows the microprocessor to process information faster than its predecessors.

Microprocessor Instructions

The microprocessor needs data and instructions for each processing operation that it performs. Data and instructions are copied from memory into *registers* within the microprocessor. Registers are also used to store the data that results from each processing operation until the data is returned to memory.

The size of the registers determines the *instruction set* that the microprocessor uses to perform operations. The instructions that the microprocessor can perform determine whether the computer can run a particular program. Programs written for 32-bit computers require a microprocessor capable of performing 32-bit instructions. The microprocessor in your computer has a register size of 32-bits and uses a 32-bit instruction set.

Memory

Although a computer is a complex machine, the method it uses to store information is quite simple. All information (data) is stored in a coded format made up of 0's and 1's. Computer memory is a series of switches, with an open switch representing a 0 and a closed switch representing a 1. Each switch represents the smallest unit of computer storage, a *bit*; eight consecutive bits of storage equals a *byte*. Memory is allocated in *kilobytes (KB), megabytes (MB)*, and *gigabytes (GB)*, where 1 KB equals approximately 1 000 bytes, 1 MB equals approximately 1 000 000 bytes, and 1 GB equals approximately 1 000 000 000 bytes. In 1 GB of memory, the computer can store over 1 000 000 000 characters of information. The computer organizes its memory by assigning an *address* to each byte as a point of reference. The first address is 0, and the addresses increase sequentially. When information is written to memory, the encoded character is placed at a specific address.

Your computer uses several types of memory to store information. This section explains memory concepts, types of memory, and how the types are used.

Main Memory

Main memory, also called *system memory*, is a temporary workspace that is active only while your computer is on. The main memory in your computer uses *synchronous dynamic random access memory (SDRAM)* modules for temporary storage of data and instructions. Because SDRAM is *volatile* memory, which means that it must be constantly refreshed by an electric current, any information placed in main memory is lost when you turn off your computer. Therefore, if you create or modify information, you must save the data to permanent storage, such as a diskette or hard disk. In comparison, other types of memory retain their contents when the computer is turned off.

The SDRAM modules that comprise main memory are grouped onto a module called a *dual inline memory module (DIMM)*. There are three connectors located on the system board for DIMMs. Your computer supports up to 384 MB of main memory.

Memory DIMM Options
Important: Be sure to observe the following guidelines when adding memory DIMM options to your computer.

- The IntelliStation E Pro does not support EDO memory.

- Only 168-pin, 100 MHz, 3.3v industry standard memory DIMMs are supported.

- There are two types of memory DIMMs available for the IntelliStation E Pro computer: *Registered Memory* technology and *Unregistered Memory* technology.

- Registered Memory DIMMs are not compatible with Unregistered Memory DIMMs.

- The 256 MB ECC Memory DIMM is *Registered Memory* technology.

- Only the 256 MB ECC Registered Memory DIMM (IBM OBI Part Number 01K1132) is supported on the IntelliStation E Pro computer.

- The 32 MB, 64 MB, and 128 MB DIMMs are *Unregistered Memory* technology.

- When adding additional memory DIMMs, be sure that all installed memory DIMMs are of the same type. For example:

  – All installed DIMMs are Registered Memory
  - or -
  – All installed DIMMs are Unregistered Memory

Video (Graphics) Memory

Your computer comes with video memory that helps speed up the graphics operations of your computer. The video memory of your computer is synchronous graphics random access memory (SGRAM) that supports speeds up to 100 MHz. For more information on the graphics operations of your computer, see Chapter 4, "Graphics Features" on page 16.

Cache Memory

Microprocessors can be so fast that main memory cannot respond to read and write requests as quickly as the microprocessor can send them. In some cases, main memory imposes one or more *wait states* on the microprocessor when it reads data from or writes data to memory. A method of reducing the need for wait states is by using *cache memory*. Cache memory improves system performance by temporarily storing frequently used data and instructions in a cache or buffer between the microprocessor and main memory.

Note:
A wait state is a period of time (one microprocessor clock cycle) during which the microprocessor suspends processing and waits for memory to respond to a read or write operation (a *memory I/O operation*). The speed of a memory I/O operation is measured in microprocessor clock cycles, so the microprocessor clock speed affects the minimum time required for a memory I/O operation. Wait states cause the computer to operate less efficiently than if the microprocessor were able to continue processing data during memory I/O operations.

Level-1 Cache
The microprocessor in your computer has a *level-1 (L1) cache* that stores the information most often used by the microprocessor. L1 cache contains high-speed memory, known as *static random access memory (SRAM)*, that can respond to memory input/output (I/O) operations without imposing wait states on the microprocessor. This allows the microprocessor to handle information faster than if it had to use the system memory each time it needed new information.

During processing, the cache controller copies other data and instructions into the cache, replacing data and instructions that are no longer needed. Performance is improved each time the microprocessor finds what it needs in the cache (a *cache hit*). If it does not find what it needs (a *cache miss*), the cache controller must locate the data or instruction in memory and copy it into the cache, while one or more wait states are imposed on the microprocessor. The cache controller manages the use of the cache so that the number of cache hits far exceeds the number of cache misses.

Note:
Models with a Pentium II microprocessor have a 32 KB L1 cache that is split into two 16 KB caches: a two-way cache for instructions and a two-way write-back cache for data.

Level-2 Cache

Computers with *level-2 (L2)* cache memory have 512 KB of L2 cache located inside the microprocessor cartridge. Level-2 cache complements level-1 cache to increase the probability of cache hits. If the microprocessor cannot find what it needs in level-1 cache, it searches level-2 cache. If the data or instruction is not in L1 or L2 cache, the cache controller locates it in main memory and copies it into both caches.

Note:

Some computers do not have L2 cache. To view the amount of L2 cache in your computer, see the "System Summary" menu in the Configuration/Setup Utility program. For more information on using the Configuration/Setup Utility program, see the *IntelliStation E Pro User Guide*.

Cache Mode

You computer uses the *write-back mode* to update cache memory. In write-back mode, the microprocessor updates the cache and goes on to perform other functions. The cache controller then updates main memory only when necessary, such as when more space is needed for new cache data or when another device is attempting to access stale data in main memory.

Write-back mode provides better performance than *write-through mode*, which is used in some memory caches. In write-through mode, a microprocessor updates main memory directly and waits for the completion of the write cycle before performing its next task. Write-through mode is slower because the microprocessor interacts directly with main memory, which is slower than cache memory.

Flash Memory

To store programs for startup procedures and other internal operations, some computers use *read-only memory (ROM)*. These programs are encoded in ROM modules on the system board. Generally, the contents of ROM modules cannot be modified after they have been originally programmed. However, nonvolatile memory, referred to as *electrically erasable programmable ROM (EEPROM)*, can be reprogrammed while it is in the computer and has replaced the ROM modules on the system board in IBM Personal Computers. Your computer stores various programs and data in EEPROM modules referred to as *flash memory*. Stored in flash memory are:

- Basic input output system (BIOS)

- Configuration/Setup Utility program

- Enhanced security features

- Power-on self-test (POST)

- Processor update code

- Asset ID information

- Vital product data (VPD)

Note:

IBM might update or make enhancements to some of the information stored in flash memory. When updates are released, they are made available on the World Wide Web at:

`http://www.pc.ibm.com`

Also, updates are available through the Bulletin Board Service in files that can be downloaded onto a diskette. Instructions for using the updates will be available in a README file included in the download files. For further information on updates, refer to the *IntelliStation E Pro User Guide*.

CMOS Memory

The configuration and setup information for your computer are stored in *complementary metal-oxide semiconductor (CMOS)* memory. CMOS is a type of *nonvolatile RAM (NVRAM)* that retains its contents when the computer is turned off. CMOS NVRAM is powered by a small battery and maintains information about the following:

- Date and time
- I/O addresses and interrupts
- ISA legacy configuration information
- Keyboard and mouse
- Plug and Play configuration information
- Port assignments
- Power management settings
- Security features
- Storage devices
- Other selectable features

Memory Organization

Operating systems are responsible for allocating memory space, assigning addresses, and performing many other tasks associated with memory management.

DOS Memory Management

DOS organizes memory into the following types:

- Conventional
- Extended
- Expanded

Conventional memory is the first 1 MB of memory-address space. Of this, the first 640 KB is available for use by DOS and application programs. Memory from 640 KB through 1 MB is reserved as a work space for hardware devices and the BIOS.

Extended memory starts above the 1 MB address, appended to conventional memory. Use of this space is dependent on the operating system and application programs. Not all programs can use extended memory.

Expanded memory is controlled through an expanded memory specification (EMS) device driver, such as the one provided with DOS. The EMS device driver is commonly known as a *memory manager*. The EMS device driver uses part of the reserved area of conventional memory as a work space, and the memory above the 1 MB address as a storage area. The memory above the 1 MB address is not written to or read from directly. It is broken into 16 KB pieces called *pages*, or 64 KB pieces called *frames*, and is moved in and out of the reserved area as needed.

When a page or frame is moved into the reserved area, it can be read from and written to as any other address in conventional memory.

Other Types of Memory Management
Other operating systems, such as OS/2 and Windows NT have very sophisticated memory-management systems.

With these operating systems, all memory is addressed sequentially, starting at 0 and ending at 4 GB (GB equals approximately 1 000 000 000 bytes). Although these addresses exceed the amount of memory you can physically install in your computer, OS/2, Windows 95, and Windows NT use them through a technique called *disk swapping* or *disk paging*. If your computer does not have enough memory to meet the needs of your active programs, these operating systems transfer the least-used information from memory to the hard disk in order to make more memory available. When the information on the hard disk is needed, it is exchanged with other information in memory.

OS/2 and Windows NT use memory in another way, also. These operating systems assign blocks of memory as *virtual DOS machines (VDM)*. Each VDM runs independently of the others, providing the same function as a separate computer running DOS. With very few exceptions, these operating systems are fully compatible with application programs written for DOS.

Adding memory can enhance the overall performance of OS/2, Windows 95, or Windows NT.

Physical and Virtual Memory
Physical memory consists of all the addressable memory locations in the computer. Physical memory is used to store such items as the operating system, video data, and instructions and data the computer uses to run programs.

Virtual memory is memory that appears to be allocated to application programs. The operating system uses a portion of the hard disk as virtual memory, swapping data and instructions between the hard disk and physical memory.

Virtual memory makes *multitasking* possible. In a multitasking session, the memory requirements of all the programs that might be running in the system at the same time can far exceed the amount of physical memory that is available. The operating system allocates virtual memory to meet the total memory requirements of each program and then manages the available physical memory to meet the actual requirements at a given point in time. Thus, the amount of virtual memory that is allocated can be much greater than the amount of physical memory installed in the computer.

Control Logic

The control logic consists of the modules on the system board that control access to main and cache memory by the microprocessor and I/O devices. Control logic includes the following devices and functions:

- AGP interface
- Alert on LAN controller
- Asset ID interface
- Audio port controller and interface
- Bus-mastering IDE interface
- Direct memory access (DMA) controller
- Diskette drive controller and interface
- Counters and timers
- Ethernet port controller and interface
- Interrupt controller
- Keyboard and mouse port controller and interface
- Memory (SDRAM) controller
- Microprocessor-interface control
- Parallel port controller and interface
- PCI-bus interface
- PCI-to-ISA interface
- Power management controller
- Serial port controller and interface
- USB port controller and interface
- Video port controller (AGP) and interface
- System management controller

Chapter 3. Expansion Buses and Adapters

A computer *bus* is a pathway of wires and signals that carry (or transfer) information inside the computer; information includes data, addresses, instructions, and controls.

The microprocessor has an external bus, called the *microprocessor bus* (or *local bus*), that carries information between the microprocessor and main memory. The microprocessor bus has the same bus width as the microprocessor (64 bits) and operates at the same external speed (up to 66MHz or 100 MHz, depending on the model). Other computer buses called *expansion buses* carry information between the microprocessor or memory and input/output (I/O) devices. Your computer has two expansion buses: the *ISA bus* and the *PCI bus*. This section contains information about those buses and the types of adapters that you can connect to them.

Note:
Your computer also has an AGP-expansion slot on the system board for connecting an AGP adapter. For more information, see "Accelerated Graphics Port" on page 16.

ISA Bus

One of the most widely used and successful expansion buses is the *industry standard architecture (ISA) bus*, also called the *AT bus*. The ISA bus is a 16-bit bus that operates at a speed of approximately 8 MHz. It can transfer up to 8 MB of data per second between the microprocessor and an I/O device. Practical performance ranges between 4 MB and 8 MB per second.

The ISA bus continues to be popular because so many adapters, devices, and applications have been designed and marketed for it. Peripheral devices that do not require faster throughput, such as fax modems, can use ISA. Also, ISA is adequate for users of DOS applications in a stand-alone environment, or for DOS network requesters with moderate performance requirements.

Although the ISA bus is widely used, it cannot transfer data fast enough for today's high-speed microprocessors and I/O devices. For example, the ISA bus might not provide the performance needed by video devices and applications with high resolution and high-color content. Also, ISA might not be capable of handling the throughput required by some fast hard disk drives, network controllers, or full-motion graphics adapters.

PCI Bus

The *peripheral component interconnect (PCI)* bus is an advanced bus standard developed by the computer industry to keep up with performance improvements of microprocessor buses and advanced I/O devices. Although advanced designs cannot match the performance of the microprocessor bus, they do achieve higher throughput by speeding up and widening the data path.

PCI architecture offers many features that improve expansion-bus performance such as:

- Automatic configuration

- Enhanced peripheral-device performance

- Faster data-transfer rates

- Industry-standard compatibility

- Microprocessor independence

- More efficient data-transfer methods

- Wider data path (32 bits)

Interface

The PCI bus connects to the microprocessor bus through a buffered *bridge* controller. (A bridge translates signals from one bus architecture to another.) The PCI bridge controller controls information and provides data for both PCI and ISA devices. The PCI controller looks at all signals from the microprocessor bus and then passes them to either the ISA controller, or to peripheral devices connected to the PCI bus. However, the PCI bus is not governed by the speed of the microprocessor bus. PCI can operate at speeds as fast as 33 MHz, slow down, or even stop if there is no activity on the bus, all independent of the operation of the microprocessor. Microprocessor independence also makes PCI adaptable to various microprocessor speeds and families and allows consistency in the design and use of PCI devices across multiple computer families.

PCI Compared to ISA

One of the most significant features of PCI is its 32-bit data path, which is twice the width of the ISA data path. With a 32-bit data path, the PCI bus can transfer more information per second than the ISA bus, with its 16-bit data path. Also, PCI operates at higher speeds of up to 33 MHz.

Depending on the mode of operation and computer components used, the PCI bus can transfer data at speeds up to 132 MB per second. While many factors can reduce practical performance, achieving just half or a third of the theoretical PCI maximum throughput far exceeds the practical performance of the ISA bus, which operates at 4 MB to 8 MB per second.

Note:
Although PCI performance is a significant improvement, PCI is intended to add to, not replace, the capability provided by the ISA bus.

Adapters

If you want to expand the capabilities of your computer, you can install *adapters*. Your computer provides expansion slots for adding ISA adapters and high-performance PCI adapters such as graphics, SCSI, or network adapters. You can also install AGP adapters in the AGP slot.

Dedicated ISA slots accept only ISA adapters (16-bit), and dedicated PCI slots accept only PCI adapters (32-bit). Your computer provides two dedicated PCI slots, one dedicated ISA slot, and one shared PCI/ISA slot. A shared expansion slot supports either an ISA adapter or a PCI adapter installed in that slot; however, you cannot install a PCI and an ISA adapter together in the shared slot. These

expansion slots are located on a *riser card* that attaches to the system board. The AGP slot is located on the system board.

Notes:

1. PCI slots support 5-volt and universal adapters.

2. When installing an adapter, you might need to manually set switches on the adapter. These switches control the assignment of computer resources such as interrupt request (IRQ) lines, direct memory access (DMA) channels, and memory address ranges.

   For information about installing adapters, refer to *Installing Options in Your IntelliStation E Pro*.

Plug and Play Adapters

Plug and Play is a configuration method that makes expanding your computer easier. Plug and Play adapters are easier to install and set up because they are auto-configuring. A Plug and Play adapter comes with identification and configuration specifications built into its memory to provide installation information to the computer during startup. This information is interpreted by the *basic input/output system (BIOS)* of the computer, which supports Plug and Play. The BIOS routines automatically configure the adapter as long as the required resources are not already in use.

Generally, adapters designed for PCI slots are Plug and Play devices. Many adapters designed for ISA slots are not Plug and Play devices. If the adapter you are installing is not Plug and Play, you must configure it manually.

Legacy Adapters

Adapters that are not Plug and Play devices are referred to as *legacy* devices. The Configuration/Setup Utility program can help you manually configure legacy adapters.

The screens of the Configuration/Setup Utility program show the resources typically required by adapters:

- Direct memory access (DMA) resources
- Interrupt resources (IRQs)
- I/O port resources
- Memory resources

From these screens, you can select available resources for the adapter you are installing. Resources not being used by ISA legacy adapters already installed in your computer are highlighted. Set the resources used by installed ISA legacy adapters to **ISA Resource** so that Plug and Play software can configure around legacy adapters. Then make the appropriate switch settings on the adapter. If you remove an ISA legacy adapter, set the resources it used back to **Available** to free up those resources for future configurations.

Refer to the documentation that comes with the adapter for information about resources required for the adapter. Refer to the *IntelliStation E Pro User Guide* for more information about using the Configuration/Setup Utility program.

Chapter 4. Graphics Features

This section describes the graphics features of your computer. Also included is information about monitors which are sold separately from your computer.

Accelerated Graphics Port

The graphics subsystem in your computer includes an Accelerated Graphics Port (AGP) and is supported by device drivers that are provided on the *Ready-to-Configure Utility Program CD* that comes with your computer. If your computer has IBM-preinstalled software, the device drivers have already been installed on the hard disk in your computer. For further information on video device drivers, including information on device driver installation, refer to "Video Device Drivers" on page 47.

The Accelerated Graphics Port (AGP) provides a full bus-mastering subsystem dedicated to graphics operations. Generally, computers without AGP use the PCI bus to access main memory and the microprocessor for graphics operations. Using the PCI bus requires that graphics functions share PCI bandwidth with other computer operations. (Sharing resources can decrease video performance.) In comparison, computers with AGP have a dedicated graphics subsystem that works independently of the microprocessor and that provides direct access to main memory (if supported). AGP also provides high-bandwidth capabilities and operates at a minimum clock rate of 66 MHz, compared to the 33 MHz speed of the PCI bus. The higher bandwidth allows for faster graphics in applications that use 2D and 3D design.

SVGA Mode

The graphics subsystem in your computer supports super video graphics array (SVGA). SVGA is a video display standard for the personal computer. Like other video standards, SVGA supports a variety of *video modes* which are combinations of resolutions, refresh rates, and colors for displaying text and graphics. The SVGA standard provides higher-resolution graphics, faster refresh rates, and more colors than previous video standards, such as video graphics array (VGA). At the same time, SVGA video supports all standard VGA modes.

Note:
For a listing of the supported video modes for your computer, see the *IntelliStation E Pro User Guide*.

Your computer supports SVGA modes on a variety of monitors. The SVGA modes supported by your computer comply with the specifications of the *International Organization for Standardization (ISO) (9241 Part 3, Visual Display Requirements*. SVGA supports reduced-flicker operation when used with noninterlaced monitors that meet ISO standards. (For information on monitors, see "Monitors" on page 17.)

Some application programs require video device drivers to use SVGA modes. The device drivers required to use SVGA modes with your computer are provided on the *Ready-to-Configure Utility Program CD* that comes with your computer. If your computer has IBM-preinstalled software, the device drivers have already been installed on the hard disk of your computer. For more information on video device

drivers, including installation information, refer to "Video Device Drivers" on page 47.

Some application programs provide their own video device drivers to take advantage of SVGA modes. These device drivers are installed through a setup program built into the application program. Setting up these applications to operate in SVGA modes might be confusing because terminology for these modes is not consistent throughout the industry. If you are uncertain about the terminology used by your application program, refer to the documentation that comes with the application for additional information.

Special Characters and Languages

The graphics controller can display a variety of characters and languages. The language that is supported depends on the *code page* loaded by your operating system.

You can find additional information about code pages in the documentation that comes with your operating system.

Monitors

Although there are various types of monitors, the most common distinguishing characteristics are resolution, dot pitch, scanning rates, screen size, and color.

Resolution and Dot Pitch

The entire image on a monitor screen is made up of many tiny dots called picture elements. (They also are called pixels or pels.) The monitor *resolution* is described by the number of pels that fill the screen in an array of horizontal rows and vertical columns. For example, the pels might be arranged in a horizontal-by-vertical array of 640 x 480 pels to make up a typical screen image. Higher resolutions, such as 800 x 600 or 1024 x 768 pels, mean more dots on the screen. The benefit of a higher resolutions is that it is possible to display more information at one time or display the same information with a sharper image.

Dot pitch refers to the space between the individual dots or pels. The inside of the monitor screen is coated with light-emitting materials called *phosphors*. Color monitors use three phosphors: red, green, and blue. The phosphor coating consists of dots arranged in a red-green-blue pattern. The distance from the center of one phosphor dot to the center of the next phosphor dot of the same color is the dot pitch. Dot pitch is measured in millimeters, such as 0.26, 0.28, 0.31, and 0.39. In general, the monitor with the highest resolution and finest dot pitch produces the sharpest image. A monitor with a fine dot pitch, such as 0.26, produces sharper, better-defined characters than a similar monitor that uses a coarser dot pitch, such as 0.31.

Monitor characteristics can be very important. A computer used extensively for detailed graphics might need a monitor that shows more colors at a higher resolution and finer dot pitch than one used exclusively for word processing. For some applications, a black-and-white (monochrome) monitor might work as well as a color monitor.

Scanning Characteristics

The phosphors on the inside of the monitor screen hold their brightness and color for a very short time. Therefore, the image has to be scanned (redrawn) many times each second to refresh the phosphors. The *vertical refresh rate* is the speed at which the image on the screen is redrawn (or scanned). Refresh rates are specified in cycles-per-second or *hertz (Hz)*.

The image is redrawn from top to bottom (or vertically). By the time the bottom pel rows are drawn, the top rows are starting to fade. There are two ways of redrawing the image: *interlaced* scanning and *noninterlaced* scanning. The interlaced method draws every other row from top to bottom, then starts at the top to fill in the rows that were skipped on the first pass. The noninterlaced method draws the complete image on each pass.

The vertical refresh rate affects the stability of the image on the screen. Monitors that have a fast, noninterlaced refresh rate provide a very stable image with little or no detectable *flicker*. Monitors with slower refresh rates tend to have more noticeable flicker. Flicker can be particularly noticeable with white and other light-colored backgrounds. You can minimize flicker by changing the colors you work with. Many programs allow you to select colors.

Sensitivity to flicker varies from person to person. Noninterlaced flicker occurs when the screen is redrawn at a rate that is slow enough to be detected by the human eye. Interlaced flicker, or jitter, occurs when the pattern of pels in adjoining lines is very different, or when an object on the screen is made up of alternating bright and dim lines.

Some application programs cannot reproduce all colors and use a technique called *dithering* to combine two colors. For example, light red might be produced by alternating lines of white and red. As the image is continually refreshed using the interlaced method, the red lines are drawn on one pass and the white lines on the next pass. As a result, the light-red object might appear to flicker while the rest of the image on the screen remains stable.

DDC Protocol

Potential problems with monitor flicker are reduced by operating a monitor at its highest refresh rate. To simplify the job of setting the refresh rate, some monitors offer Plug and Play capability using the *VESA Display Data Channel (DDC)* protocol. DDC is an industry standard for passing configuration information between a monitor and a computer. Both the monitor and the computer must have DDC capability.

Your computer supports the DDC2B protocol. With DDC, the computer can receive configuration information sent from a DDC monitor. When you turn on the computer with a DDC monitor connected, the monitor immediately starts sending its identification information to the computer. This information, called *Extended Display Identification Data (EDID)*, includes a description of the monitor and its operational limits and timings. Video device drivers use the information from the monitor to select the highest refresh rate for each resolution supported by the monitor and the graphics controller in your computer. (For information on video device drivers, refer to "Video Device Drivers" on page 47.) If your monitor is DDC-compliant, it is probably already set to the highest refresh rate that the monitor and graphics controller can support. If you change the default resolution

setting, the highest refresh rate that the monitor and graphics controller can support is automatically selected. (You can view and change the video resolution through your operating system. For instructions, refer to the README file that corresponds to your operating system; these files are on the *Ready-to-Configure Utility Program CD* that comes with your computer. If your computer has IBM-preinstalled software, the README files are already installed on the hard disk in your computer.)

Important:
Before you change any monitor settings, be sure to review the information that comes with your monitor. Using a resolution or refresh rate that is not supported by your monitor might cause the screen to become unreadable and damage the monitor. The information that comes with your monitor usually includes the resolutions and refresh rates that the monitor supports. If you need additional information, contact the manufacturer of the monitor.

Power Management

Power management reduces the power consumption of your computer when you are not using it. A monitor with *VESA Display Power Management Signaling (DPMS)* support can save a significant amount of energy and have a longer useful life. DPMS-compliant monitors can be powered down in three modes: *Standby, Suspend,* and *Off*. The stages that can actually be used, however, depend on the power-management capabilities of your computer.

In *Standby* mode, the monitor (and other devices) are switched to a reduced-power state if you do not use your mouse or keyboard for a specified period of time. The devices remain in a state of readiness and return to full power if you press a key or move the mouse. *Suspend* further decreases monitor power, and *Off* reduces monitor power to its lowest level. Refer to "Power Management Features" on page 48 for more information on power management.

Check the documentation that comes with your monitor to see if your monitor is enabled for power management. If you find no information about power management, your monitor probably does not support this feature. If your monitor does not have DPMS support, deactivate it in the power-management features of your software or use the Configuration/Setup Utility program to disable *Display* in all three levels of power management. Even if you deactivate the display for power-management purposes, you can still take advantage of screen savers. Refer to "Screen Savers" on page 20 for more information.

Selecting a Monitor

Your computer has a preinstalled, high-resolution, graphics adapter that improves video performance. Your computer also has a DDC2B-compliant monitor port on the rear connector panel that is unused.

The graphics adapter supports various SVGA monitor resolutions. If you connect a multisync monitor to your computer, you can take advantage of SVGA resolutions such as 1024 x 768. However, the default resolution might be different for certain software packages, especially if they are not SVGA-ready. Also, you might have to install video device drivers for certain software packages in order to take advantage of SVGA resolutions. Refer to "Video Device Drivers" on page 47 for information on installing video device drivers.

To take full advantage of the video capabilities provided by your computer, use a noninterlaced monitor capable of supporting 1024 x 768 resolution (or higher) with a fast refresh rate. Also, the type of monitor you select depends on the software you use. Some applications are less demanding than others.

Note:
For information on the video modes (resolution, refresh rate) supported by your computer, see the *IntelliStation E Pro User Guide*.

Monitor Controls

A monitor has brightness and contrast controls for adjusting the image on the monitor screen for maximum viewing comfort. On a new monitor, set the controls near their center position. Setting these controls to their maximum position can decrease the useful life of the monitor. As the monitor is used more, the image tends to become dimmer. You can adjust the brightness and contrast controls to compensate for this condition. Monitors also have additional controls for fine-tuning the screen image. Check the documentation that comes with your monitor for more information on controls.

Screen Savers

The monitor can be damaged if it is left on for prolonged periods with no change in screen image. Depending on what is on the screen, the image might be permanently burned into the phosphor coating or cause darkening of some areas of the screen.

With DPMS-enabled monitors, you can avoid this problem by using the power-management features of your computer. Also, you can use a *screen-saver* program, which turns off the video signal when the keyboard or mouse has not been used for a defined period. This action results in a dark, blank, or animated screen. When you are ready to use the computer again, you can restore the image to the screen by pressing a predefined key or typing a password. Several companies produce screen-saver programs. For more information, contact your IBM reseller or IBM marketing representative.

Chapter 5. Input/Output Connections

Input/output (I/O) devices provide you with many ways of getting information into and out of your computer. You can attach a variety of standard and optional devices (monitor, keyboard, mouse, printer) to the I/O connections of your computer. The I/O connections refer to the physical connectors on the computer that allow you to connect external I/O devices. These connectors are also called *ports* because they provide communication pathways into the computer for I/O devices. Each port is identified by a number and an address that distinguishes it from other ports, and no two ports can have the same address. In this section, the terms connector and port are often used interchangeably.

The following connectors are available for your computer:

- Parallel connector
- Two 16550-UART serial connectors
- Two USB connectors
- Monitor connector (on AGP adapter)
- Audio connectors (microphone, line in, line out)
- Ethernet 10/100, RJ-45 connector
- Keyboard connector
- Mouse connector
- One external and one internal SCSI connector (some models only)

Refer to the *IntelliStation E Pro User Guide* for an illustration of the location of the connectors.

Parallel Connector

Your computer comes with one parallel connector as a standard, built-in feature. The parallel port is most often used to communicate with a parallel printer, but it can also be used with a variety of other parallel devices. In order to increase the number of parallel connectors for your computer, you must install a parallel adapter in one of the expansion slots. Refer to *Installing Options in Your IntelliStation E Pro* for information about installing adapters.

The parallel port transfers data 8 bits at a time, compared to the serial port, which transfers data 1 bit at a time. The parallel port on your computer supports extended, high-speed modes, which means that it can transfer data up to 10 times faster than a standard parallel port.

Operating systems and application programs often designate parallel ports with the name *LPT* (*line printer*). Many programs use *LPT1*, *LPT2*, and *LPT3* in their setup commands or menus to identify parallel ports. When setting up your applications, you might have to identify the LPT port to which a particular device is connected. Some operating systems query the LPT port through Plug and Play BIOS calls to provide automatic configuration. Also, if you are adding a parallel adapter, you might have to configure the adapter for a specific LPT port. This might involve setting switches on the adapter as well as changing settings in the Configuration/Setup Utility program.

Input/Output Connections

Each parallel connector or adapter in your computer can use any of three available port settings, provided that a different setting is used for each. The settings include the I/O *address* (in hexadecimal) and the *IRQ (interrupt request line)*, which determines how the microprocessor responds to an interrupt from the parallel port. The three available port addresses are (in hex) 3BC, 378, and 278. The two available IRQs are IRQ 7 and IRQ 5.

When you start the computer, the POST program assigns LPT numbers to the port addresses that are actually in use at the time. POST goes down the list of addresses and assigns LPT numbers sequentially (beginning with LPT1) to each address in use by a parallel device. If an address is not in use, an LPT number is not assigned to it. POST assigns the next available LPT number to the next address in use, if any.

The port address and IRQ for the built-in parallel port are preset at the factory to hex 3BC and IRQ 7.

If you add another parallel adapter that uses the next sequential address and IRQ, POST assigns LPT numbers as follows: hex 3BC and IRQ 7 (LPT1) for the built-in port and hex 378 and IRQ 5 (LPT2) for the adapter port.

You can view the port address and IRQ setting for the built-in parallel port using the Configuration/Setup Utility program. However, you will not see the LPT numbers on the configuration screen. To see port settings and LPT assignments for all parallel ports, you can use one of the diagnostic programs provided with your computer. For information on diagnostic programs, refer to the *IntelliStation E Pro User Guide*.

Generally, you do not have to change the parallel-port setting. However, if you add a parallel adapter or use special hardware or software that causes a configuration conflict, you might have to change the parallel-port setting. You can change the setting using the Configuration/Setup Utility program. Refer to the *IntelliStation E Pro User Guide* for more information about using this program.

The parallel port can operate in five modes. One is a *standard,* unidirectional mode; the other four are *extended,* bidirectional modes that provide additional function and higher performance. Refer to the documentation that comes with printers and other parallel devices to determine the appropriate parallel mode to use and the required device drivers.

Standard This AT-compatible mode is the default mode. In this mode, the parallel port is limited to writing information to the device attached to it. You can use this mode with most IBM-compatible parallel printers.

Bidirectional This PS/2-compatible mode is a bidirectional mode used for data transfer to other computers and supported devices.

ECP The extended capabilities port (ECP) mode is a high-performance, bidirectional mode that uses direct memory access (DMA) for data transfer to a high-speed printer or other devices.

EPP The enhanced parallel port (EPP) mode is a high-performance, bidirectional mode that has capabilities similar to ECP mode; the main difference is that EPP data

transfers are processor-initiated instead of DMA-initiated. EPP supports the connection of up to eight external devices (such as hard disk drives, CD-ROM drives, tape drives, diskette drives, or a printer) to the parallel port. These devices can be connected to each other in a *daisy-chain* arrangement, or they can be connected through an external multiplexer. The attachment of multiple devices requires device drivers supplied by the device manufacturers.

ECP/EPP This mode combines the capabilities of the ECP and EPP modes. Select this mode if you have both ECP and EPP devices connected to the parallel port.

You can set these modes of operation for the parallel port using the Configuration/Setup Utility program. Refer to the *IntelliStation E Pro User Guide* for more information about using this program.

To add a parallel I/O device, such as a printer, use a parallel cable (purchased separately) to connect the device to the parallel connector on the back of the computer. Refer to the documentation that comes with your I/O device for specific installation instructions.

Serial Connectors

Your computer comes with two serial connectors. The serial ports are used to communicate with devices such as printers, plotters, and modems. (Modems can be installed inside the computer or attached externally using a serial connector.)

The serial ports transfer data one bit at a time at speeds ranging from 300 to 115 000 *bits per second (bps)*. This transfer rate is sometimes referred to as *baud rate*. The serial port is *16550-UART (universal asynchronous receiver/transmitter)* compatible so it can support high-speed modems.

You can increase the number of serial ports by installing a serial adapter in one of the expansion slots. Refer to *Installing Options in Your IntelliStation E Pro* for more information about installing adapters.

Operating systems and application programs often designate serial ports with the name *COM* (*communication*). Many programs use *COM1*, *COM2*, *COM3*, and *COM4* in their setup commands or menus to identify serial ports. When setting up your applications, you might have to identify the COM port to which a particular device is connected. Also, if you are adding a serial adapter or modem, you might have to configure the adapter or modem for a specific COM port. This might involve setting switches on the adapter or modem, as well as changing settings in the Configuration/Setup Utility program.

Each serial connector or adapter in your computer can use any of four available port settings, provided that a different setting is used for each. The settings include the I/O *address* (in hexadecimal) and the *IRQ (interrupt request line)*, which determines how the microprocessor responds to an interrupt from the serial port.

Serial port settings are selected through the Serial-Port Setup menu of the Configuration/Setup Utility program.

The four available port addresses for the serial ports are (in hex) 3F8, 2F8, 3E8, and 2E8. Use the safest IRQ assignments for the serial ports; IRQ 4 and IRQ 3. You can also use IRQ 9, IRQ 10, IRQ 11, IRQ 14, and IRQ 15, but these settings might not work with some operating systems and applications.

When you start the computer, the POST program assigns COM numbers to the port addresses that are actually in use at the time. POST goes down the list of addresses and assigns COM numbers sequentially (beginning with COM1) to each address in use by a serial device. If an address is not in use, a COM number is not assigned to it. POST assigns the next available COM number to the next address in use, if any.

You can view the port address and IRQ settings for serial ports using the Configuration/Setup Utility program. You will not see the COM numbers on the setup screens. To see port settings and COM assignments for all serial ports, you can use one of the diagnostic programs provided with your computer. For information on diagnostic programs, refer to the *IntelliStation E Pro User Guide*.

The port address and IRQ for the first built-in serial port are factory preset at hex 3F8 and IRQ 4. The port address and IRQ for the second built-in serial port are factory preset at hex 2F8 and IRQ 3.

Generally, you do not have to change serial-port settings. However, if you add a serial adapter or use special hardware or software that causes a configuration conflict, you might have to change port settings. If so, you can change the settings for the serial port using the Configuration/Setup Utility program. Refer to the *IntelliStation E Pro User Guide* for more information about using the Configuration/Setup Utility program.

To add a device to your serial port, use a serial cable (purchased separately) to connect the device to the serial connector at the back of the computer. Refer to the documentation that comes with your I/O device for specific installation instructions.

Universal Serial Bus Connectors

The universal serial bus (USB) interface is a new, emerging technology being developed to add more diversity and capabilities to personal computers. IBM has provided two, 4-pin USB connectors in your computer as a standard feature so you can be ready to take advantage of new USB devices as they become available.

Using this new technology, you will be able to plug many different types of optional, USB-compatible devices into the USB port on your computer. Because USB incorporates Plug and Play technology, you can install and remove devices easily without turning off your computer or opening the cover. Once installed, the devices configure automatically.

In addition, an option called a *hub* can be connected to a USB port on your computer, which enables you to plug in more than one device at a time. A hub converts a single USB connector into multiple ports where USB devices can be attached. You can attach up to seven USB devices to a hub. You can also plug a hub into a hub that is already connected to a USB port on your computer. By plugging in a number of hubs, you can connect up to 127 different devices.

Note:
Your computer supports a USB keyboard or a USB mouse connected to a USB port.

USB provides full-speed and low-speed bandwidths. The full-speed bandwidth of 12 megabits-per-second (Mbps) supports high-end peripherals, such as multimedia and telephony devices, and provides ISDN and PBX interfaces to accommodate future system expansion. The low-speed bandwidth of 1.5 Mbps supports low-end devices for additional cost savings. You can run full-speed and low-speed devices attached to a single USB port (through a hub) simultaneously. USB provides a maximum signal distance of five meters (16.5 ft.) from host to hub or from hub to hub.

For the latest information, visit the USB World Wide Web page at:

`http://www.usb.org`

Monitor Connector

The monitor connector on the AGP adapter allows you to connect a variety of VGA or SVGA monitors. For information on monitors, refer to "Monitors" on page 17. For information on video modes, see "SVGA Mode" on page 16.

Audio Connectors

Your computer has three audio connectors on the rear connector panel: microphone, line in, and line out. The connectors are industry-standard, 3.5 mm (1/8 in.) mini-jacks.

Your computer has an integrated audio controller that provides all the digital audio and analog mixing functions required for recording and playing high-quality sound on your computer. The audio controller supports Sound Blaster applications and is compatible with the Microsoft Windows Sound System. The audio controller also has the following features:

- Compatible with ISA Plug and Play Specification 1.0a and supports a maximum of three logical devices

- Provides full duplex operation (simultaneously recording and playing back using two 8- or 16-bit DMA channels)

- Supports record and playback of 8- or 16-bit stereo sound data up to 48 KHz stereo

Procedures for recording and playing back sound vary by operating system. Refer to your operating-system documentation for information and instructions.

Ethernet Connector

Your computer has an RJ-45 Ethernet port that is enabled for connection to a network. For instructions on connecting a network cable to your computer, refer to the *IntelliStation E Pro User Guide*.

System-management features enable your computer to be remotely manage over a network. For more information on these features, see "System Management Features" on page 41 and the *IntelliStation E Pro User Guide*.

Keyboard Connector

You can attach a keyboard cable to the connector provided on the back of the computer. For information on the keyboard that comes with your computer, see "Keyboard Features" on page 27. For information on connecting the keyboard to the computer, see the *IntelliStation E Pro User Guide*.

Mouse Connector

The mouse connector provided with your computer is capable of accepting PS/2 mouse devices. For information on the mouse that comes with your computer, see "Mouse Features" on page 32. For information on connecting the mouse to the computer, see the *IntelliStation E Pro User Guide*.

SCSI Connectors

Note:
SCSI components are standard on some models only.

SCSI adapters, which are standard in some computer models, provide an interface through which the computer can communicate with SCSI-compatible devices, such as hard disk drives, CD-ROM drives, tape drives, read-and-write optical drives, scanners, and printers.

Models with preinstalled SCSI have a single channel Ultra SCSI adapter that provides the following SCSI connections:

- Channel A, one external 68-pin 16-bit connector

- Channel A, one internal 68-pin 16-bit connector and one internal 50-pin, 8-bit connector.

  Note:
  Only two of the three connectors can be used at one time.

Refer to "SCSI" on page 40 for further information on the SCSI interface. If your computer has a preinstalled SCSI adapter, refer to the SCSI documentation provided with your computer for information on the adapter and for instructions on installing SCSI devices.

Chapter 6. Keyboard and Mouse

This section contains information about the keyboard and mouse provided with your computer. For details on connecting the keyboard and mouse to your computer, see the *IntelliStation E Pro User Guide*.

Keyboard Features

The keyboard provided with your computer attaches to the keyboard port on the back of your computer. The keyboard is used to do the following:

- Type information

- Perform application functions

- Perform computer operations

- Enter numbers with the numeric keypad
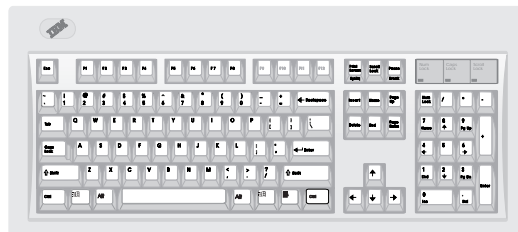
104-Key Keyboard

Key Layout

The illustrations in this section show the 104-key keyboard. This keyboard includes the following groups of keys:

- Standard typing keys

- Function keys

- Special computer keys

- Cursor keys

- Numeric keypad

- Windows interface keys

Typing Keys
The layout of the typing keys is similar to that of a typewriter. The standard typing keys are *typematic*; that is, they repeat typing a character as long as you hold them down. The home row contains raised identifiers for the touch-typist. Unlike some typewriters, "1" (one) and "l" (lowercase L) are not interchangeable on this keyboard.

The Shift key is used with the typing keys to produce uppercase characters and symbols. When you press the Caps Lock key, a light turns on at the top right corner of your keyboard. When the Caps Lock light is on, the alphabet keys you

27

type appear on the screen in capital letters. Caps Lock does not affect the number or punctuation keys.
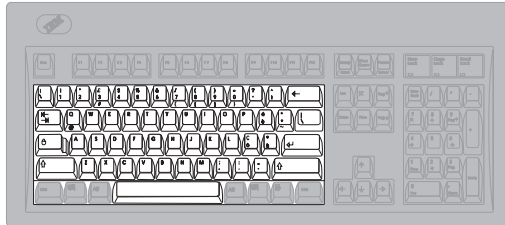
Typing Keys

The function of the Enter key is controlled by the program you are using. For example, a word-processing program uses the Enter key to move the cursor to the beginning of the next line. A spreadsheet program uses it to enter information into a specific cell or field. Your operating system uses it to accept a command.

Some programs use the Ctrl and Alt keys in combination with the typing keys to perform a specific operation. Refer to your application-program documentation for information about the key assignments.

Function Keys
The function keys, which are arranged across the top of your keyboard, are used to send instructions to the software you are using. Think of them as shortcuts for doing routine tasks on your computer.
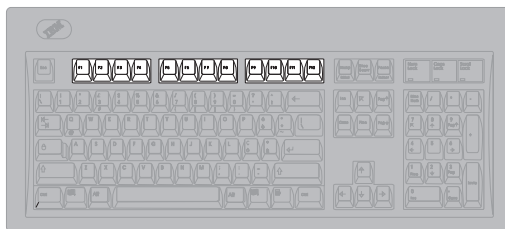
Function Keys

Function-key tasks can vary from one application program to another. For example, you press the F1 key in one application program to display a help message; you might press the same key in another program to display a list of files.

Some application programs use the Ctrl, Alt, and Shift keys in combination with the function keys to define additional operations. Many programs provide a template that you can place above the function keys. Refer to your operating-system and application-program documentation for the definition of the function keys.

Special Computer Keys
The keyboard has several other keys that are not on a typewriter. These are Escape (Esc), Control (Ctrl), Alternate (Alt), Insert (Ins), Delete (Del), Print Screen, Scroll Lock, and Pause/Break.
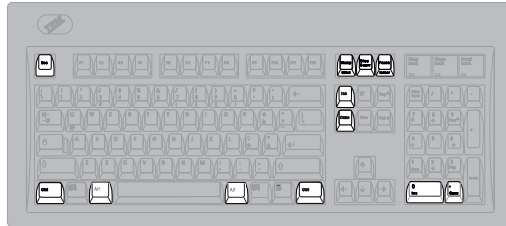
Special Computer Keys

Your software controls these keys. It can disable them or modify their purpose.
The following list describes the most common uses of these keys.

Esc   *Escapes* from an operation, window, message, or program
                   and returns you to what you were doing previously.

Ctrl and Alt   Used with other keys to perform a specific operation defined
                   by the program in use. When two or more keys are used
                   together to perform a certain function, they are called
                   combination keys. To use combination keys, you simply hold
                   them down at the same time. For example, pressing
                   Ctrl+Pause/Break stops the operation of most programs.

                   Combination keys might work differently, depending on your
                   software.

Insert   Activates the insert mode, which allows you to *insert*
                   information between two existing characters. When you
                   press *insert* again, you return to the replace mode and write
                   information over existing characters.

Delete   *Deletes* a character or field.

Print Screen   Prints information on your screen to a printer. If the screen
                   contains graphic images, they might not be printed correctly.

Scroll Lock   Determines how you move through information. When you
                   press the Scroll Lock key, a light turns on at the top right
                   corner of the keyboard. With scroll locking on, the cursor
                   can move through the information on the screen. With scroll
                   locking off, the cursor remains stationary, and the information
                   on the screen moves. Not many programs use this function.

Pause/Break   Allows you to stop a program temporarily.

Cursor Keys

The Cursor keys are used to move the *cursor* (a flashing short line or small box) to
various positions on the screen.
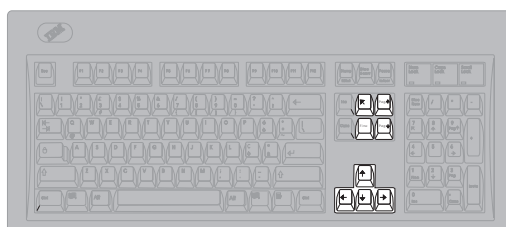
Cursor Keys

Arrow keys	Moves the cursor up, down, right, or left on the screen, one space at a time. Like the standard typing keys, the arrow keys are *typematic*; that is, they keep repeating their function as long as you hold them down.
Home	Moves the cursor to the beginning of a line or document.
End	Moves the cursor to the end of a line or document.
Page Up	Moves the cursor up one screen of information.
Page Down	Moves the cursor down to the next screen of information.

Numeric Keypad

The numeric keypad is arranged like a calculator. It is useful for entering numeric information.
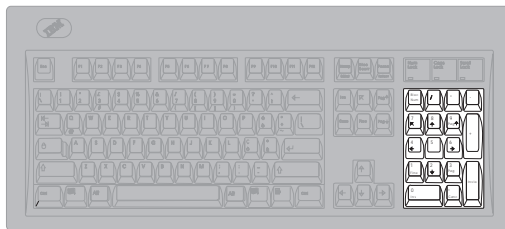
Numeric Keys

When the Num Lock light is on, the numbers marked on the keys are active. When the light is off, the symbols marked *below* the numbers are active.

You can use the numeric keypad to:

- Activate the Num Lock key to enter numeric information.

- Deactivate the Num Lock key to control cursor movement.

- Type special characters when used in conjunction with the Alt key. This is done by holding down the Alt key while entering a numeric value on the keypad. The special characters are determined by the *code page* used by your operating system. Refer to "Special Characters" on page 31 for more information. Code pages vary from language to language.

Windows Interface Keys

The 104-key keyboard provides three keys that are supported by Windows NT 4.0 and Windows 95. In order to use these keys with earlier versions of Windows, you must use the appropriate device driver.
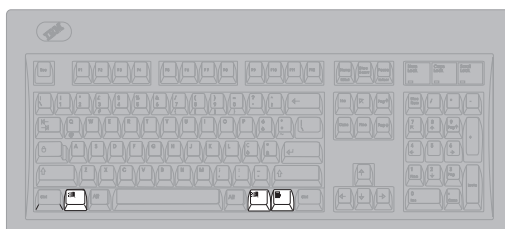
Windows Interface Keys

The two keys with the Windows logo are supported by the operating system and provide system-level functionality. The third key, with an arrow pointing to a menu item, provides a context menu when pressed, although other functions might be available for different applications.

Special Characters

The following table shows the special characters available for the two most common code pages, along with the numeric values for each character. The first character represents the standard U.S. code page (437). The second character represents the standard multilingual code page (850). If a numeric value is followed by only one character, that character is the same for both code pages.

#			#			#			#			#			#		
96	`		149	ò		171	½		193	┴		215	╫	î	237	Ø	Ÿ
128	Ç		150	û		172	¼		194	┬		216	╪	ï	238	∈	¯
129	ü		151	ù		173	¡		195	├		217	┘		239	∩	´
130	é		152	ÿ		174	«		196	─		218	┌		240	≡	-
131	â		153	Ö		175	»		197	┼		219	█		241	±	
132	ä		154	Ü		176	▒		198	╞	ã	220	▄		242	≥	=
133	à		155	¢	ø	177	▒		199	╟	Ã	221	▌	¦	243	≤	
134	å		156	£		178	▓		200	╚		222	▐	ì	244	⌠	
135	ç		157	¥	Ø	179	│		201	╔		223	▀		245	⌡	
136	ê		158	Pt		180	┤		202	╩		224	α	Ó	246	÷	
137	ë		159	ƒ		181	╡	Á	203	╦		225	ß		247	≈	¸
138	è		160	á		182	╢	Â	204	╠		226	Γ	Ô	248	°	
139	ï		161	í		183	╖	À	205	═		227	π	Ò	249	•	¨
140	î		162	ó		184	╕	©	206	╬		228	Σ	õ	250	•	
141	ì		163	ú		185	╣		207	╧	¤	229	σ	Õ	251	√	1
142	Ä		164	ñ		186	║		208	╨	>	230	µ		252	ⁿ	3
143	Å		165	Ñ		187	╗		209	╤	Ð	231	τ	þ	253	2	
144	É		166	ª		188	╝		210	╥	Ê	232	Φ	Ó	254	■	
145	æ		167	º		189	╜	¢	211	╙	Ë	233	Θ	Ú			
146	Æ		168	¿		190	╛	¥	212	╘	È	234	Ω	Û			
147	ô		169	⌐	®	191	┐		213	╒	I	235	δ	Ù			
148	ö		170	¬		192	└		214	╓	Í	236	∞	ý			

For additional information about code pages, refer to the documentation for your operating system.

Languages

The operating system you use determines what characters can appear on your screen. Your operating system provides programs that allow you to use characters from other languages. Keyboard templates are also available to show you which keys on your keyboard correspond to the characters of another language. Refer to your operating-system documentation for additional information.

Mouse Features

A *mouse* is a device that you use to point to and select objects on the monitor screen. Your computer comes with a three-button Mouse that attaches with a cable to the PS/2 mouse connector on the back of the computer.

For information on connecting the mouse to the computer, see the *IntelliStation E Pro User Guide*

Note:
A mouse device designed to be used through a serial port or USB connection can also be used with your computer.

Mouse Basics

A mouse allows you to move the *pointer* on the screen. This section discusses the basic use of a two-button mouse.

Note:
If you have never used a mouse before, it might feel a bit awkward at first. However, with a little practice, the mouse movements will become more natural.

To set up the mouse, place the mouse beside the keyboard on a flat surface or *mouse pad*. A mouse pad is a flat, smooth foam-rubber pad available at most computer stores. The mouse has a ball on the bottom, so working on a flat, smooth surface is important. Most operating systems allow you to configure the mouse buttons for either right-hand or left-hand operation. When the mouse is configured for right-handed user, the left button is used for most tasks. When it is configured for a left-handed user, the right button is used for most tasks. For more information, see your operating system documentation.

To use the mouse, slide it from side to side and forward and backward over a flat surface. When you see an item that you want to select on the screen, simply move the pointer to that item (this is called *pointing*), and press and release either the left or right button on the mouse (this is called *clicking*).

To learn how to use the mouse with the software in your computer, see the documentation accompanying the software. Some programs support only one mouse button, others support two, and some support three. Despite the differences, some terms are fairly standard throughout the industry.

Point	Move the mouse so the pointer is on the object you want.
Click	Press and release the mouse button once.
Double-click	Rapidly press and release the mouse button twice.
Drag	Point to an object, press the mouse button, and hold it down as you move the mouse to relocate the object.
Drop	After dragging an object to a new location, release the mouse button.

Chapter 7. Storage Devices and Media

This section contains information about data-storage devices available for your computer. These devices enable you to expand the capacity of your computer.

The common types of storage devices that can be used with your computer are:

- Diskette drives

- Hard disk drives

- CD-ROM drives

- Tape drives

Each drive has a letter assigned to it, so you can tell your computer where to find information. For example, if your computer has two diskette drives, one is called *drive A*, and the other is called *drive B*. If you have only one hard disk drive, it is called *drive C*. If you partition the drive, the partitions are named as if they were separate drives: *drive D*, *drive E*, and so on.

The type and number of devices that you can have in your computer vary by model. You can add internal storage devices if expansion bays are available.

Diskette Drives

Most personal computer models come with a 1.44 MB diskette drive. This drive uses only 3.5-inch diskettes.

Identifying Diskettes

The labeling on 3.5-inch diskettes is not consistent among manufacturers. Some diskettes are labeled with the letters DD or HD to identify the diskette type; other diskettes might not be labeled. However, the appearance of the lower-right corner of a 3.5-inch diskette always can be used to identify the diskette type, as shown in the following illustrations.
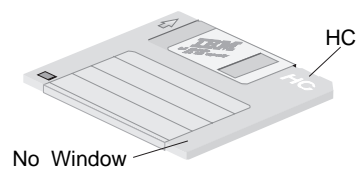
1 MB Double Density (DD)
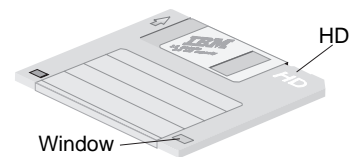
2 MB High Density (HD)

Handling and Storing Diskettes

Inside the protective diskette case is a flexible disk with a magnetic-sensitive coating. This disk can be damaged by heat, dust, a magnetic field, or even a fingerprint. Use the following guidelines when handling and storing diskettes.

- Data is stored on the magnetic surface of the diskette. On 3.5-inch diskettes, this surface is protected by a plastic cover. If the cover is damaged, *do not* use the diskette. A damaged diskette might damage the diskette drive.

- A protective slide on the top of a 3.5-inch diskette covers part of the magnetic surface. The diskette drive moves this slide to read data from or write data to the diskette. *Do not* move this slide, because fingerprints and dust can cause loss of data.
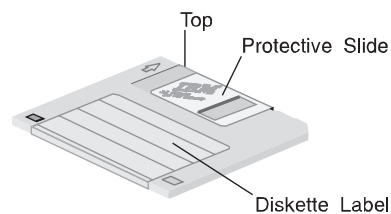
- Never touch the magnetic disk itself.

- Keep diskettes away from magnets or devices that create a strong magnetic field, such as electric motors and generators. Diskettes are sensitive to magnets found in television sets, telephones, stereo speakers, and other such items. A magnetic field can erase the data on your diskettes. *Do not* place diskettes on the monitor or use magnets to attach notes to your computer.

- Do not store diskettes at high temperatures, low temperatures, or in direct sunlight. Temperatures ranging from 4° to 53°C (39° to 127°F) are acceptable for 3.5-inch diskettes. Keep diskettes away from heat. The plastic outer covering might warp, damaging the diskette.

Labeling Diskettes

Before using a diskette, label it so that you can identify the data stored on it. Labels usually come in the package with the diskettes. Diskette labels can become a problem if you do not apply them correctly. Loose edges or an excessive buildup of labels can prevent the diskette from being inserted or ejected.

To prevent this problem, take the following precautions:

- Remove an old label before you apply a new one.

- Apply labels carefully to ensure that all edges are secure.

- Apply labels only to the front of diskettes. Do not place a label where it interferes with the protective slide or covers an opening in the protective diskette case.

Inserting and Removing Diskettes

To insert a 3.5-inch diskette, hold the diskette with the label facing up and insert the end with the protective slide first. Push the diskette into the diskette drive until the diskette clicks into place.

To remove the diskette, press the eject button and slide the diskette out of the drive. Do not remove the diskette while the in-use light is on.
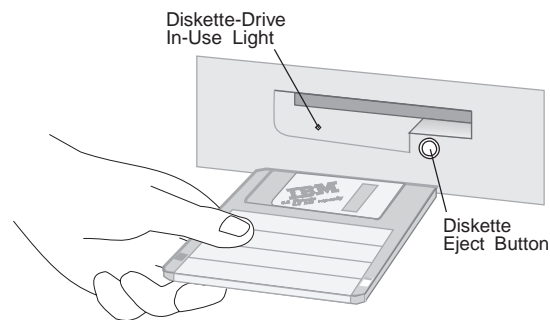
Write Protecting Diskettes

It is possible to accidentally format a diskette or unintentionally write data to it. Important information can be written over or lost. For this reason, it is a good idea to write protect important diskettes. You can read data from a write-protected diskette, but you cannot erase or change the data.

Most 3.5-inch diskettes have a write-protect switch that can be used to prevent data from being written to or erased from the diskette. If a 3.5-inch diskette does not have a write-protect switch, it is permanently write protected.

The write-protect switch is located on the back of 3.5-inch diskettes.

Write-Protect Switch
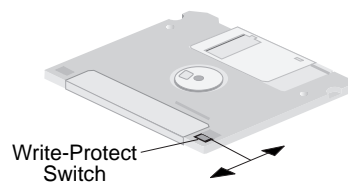
- To allow writing to the diskette, slide the switch so the write-protect window is covered.
- To prevent writing to the diskette, slide the switch so the write-protect window is open.

Formatting Diskettes

You can buy diskettes either formatted or unformatted. Formatted diskettes are ready to use; unformatted diskettes must be formatted by your operating system before you can use them. The format operation checks a diskette for defects and prepares it for storing data. If data is already stored on the diskette, the format operation writes over it, and the data is lost.

The operating system FORMAT command specifies how to format a specific type of diskette.

Important:
Always format diskettes to their correct capacity. Failing to do so might cause unreliable results. Differences such as magnetic coatings, the thickness of the diskette material, and the recording technique used all affect the formatting operation. Refer to your operating-system documentation for detailed information on formatting diskettes.

The following table shows diskette types, their formatted capacities, and the drive type that can be used with each diskette.

```
3.5-Inch Diskette Type      Formatted Capacity    Drive Type
----------------------      ------------------    ----------
1 MB (MF2DD)                720 KB                1.44 MB
2 MB (MF2HD)                1.44 MB               1.44 MB
```

Notes:

  1. MF2DD = Mini-floppy, two-sided, double density

  2. MF2HD = Mini-floppy, two-sided, high density

  3. If you are using DOS, you must use *FORMAT A: /F:720* to format a 1 MB diskette in a 1.44 MB drive.

Copying Diskettes

If you are using DOS, you can copy one or more files to or from a diskette using the COPY command. Groups of files can be copied faster using the XCOPY command. Both COPY and XCOPY can copy files to different types of diskettes. For duplicating a diskette, use the DISKCOPY command. DISKCOPY requires that both the source diskette (the diskette you copy from) and the target diskette (the diskette you copy to) be the same type.

Refer to your operating-system documentation for more information on copying diskettes.

Hard Disk Drives

Most IBM Computers come with one hard disk drive installed, and the capacity of the drive varies by model. Expansion bays are available for installing additional hard disk drives and other types of drives. Refer to *Installing Options in Your IntelliStation E Pro* for information about available bays and how to install drives in them.

Hard disk drives have different types of interfaces, or controllers. The main function of the interface is to transmit data to and from the hard disk drive. The different interface types provide various degrees of performance and differ in the speed with which they can transfer data between the hard disk drive and other system components. The most common interface specifications used in IBM computers are discussed below.

EIDE

Some IntelliStation E Pro models have a hard disk drive with an *EIDE (enhanced integrated drive electronics*) interface. This interface is an extension of the original IDE (ATA) interface. The original IDE interface specification refers to a hard disk drive with the controller built into the drive (as opposed to a hard disk drive with a separate controller). The IDE single-unit drive and controller plugs into a connector located on the riser card in the computer. IDE has several advantages, including easier installation and increased reliability. EIDE improves upon these capabilities by increasing maximum drive capacity and by enabling speedier data transfer.

The EIDE hard disk drive has built-in support for Ultra Direct Memory Access (DMA). Ultra DMA is an enhanced mode that allows the hard disk drive to read and write to memory without intervention by the microprocessor. Also, the EIDE hard disk drive is a SMART (self-monitoring, analysis and reporting technology) drive capable of predicting potential problems. When used with a network-software application such as SMART Reaction, the SMART hard disk drive protects data and improves reliability. For more information on SMART Reaction, see the *IntelliStation E Pro User Guide*.

The EIDE drive plugs into one of the two EIDE connectors located on the riser card inside your computer. The two EIDE connectors support up to four IDE or EIDE internal devices in your computer. The number of devices you can install in your computer is dependent upon the number of available bays in your computer model. (A cable for the second connector on the riser card is provided with models that have a preinstalled CD-ROM drive.)

If you add a hard disk drive to a cable that already has a hard disk drive connected to it, the two drives can potentially send and receive data at the same time (because each drive has its own controller). To prevent the drives from competing for priority, you must designate one drive as the primary (master) drive, and the other as the secondary (subordinate) drive. For more information about adding drives, refer to the instructions for the drive or to *Installing Options in Your IntelliStation E Pro*.

SCSI

Some models have a hard disk drive with a type of interface referred to as *SCSI (small computer system interface)*. These computers have a SCSI adapter installed in one of the PCI-expansion slots. The SCSI adapter has an external and an internal connector.

SCSI can be faster than EIDE, particularly when used with a multitasking operating system, such as OS/2 or Windows NT. With SCSI, instructions can be sent concurrently to every drive in the system, and the drives can then execute these instructions simultaneously. This is not possible with EIDE. SCSI is well suited for high-end computers or for computers in which expandability is important. However, depending on your needs, EIDE might be a better choice because it is more economical than SCSI and can have high performance capabilities. Connecting EIDE devices is easier, and when used in a stand-alone computer with a single-tasking operating system, such as DOS or Windows, EIDE can sometimes be faster than SCSI.

If your computer has a preinstalled SCSI adapter, refer to the SCSI documentation that comes with the computer for additional information.

CD-ROM Drives

An *IDE compact disc-read only memory drive (CD-ROM)* uses a removable compact disc (CD) that stores various formats of audio and video information. A CD-ROM drive can play back or read from a CD, but it cannot write information to it. The information on the CD can be heard or viewed, but not changed or updated as it can on a diskette, hard disk, or tape.

CD-ROM technology offers quick access to enormous amounts of information. Diskettes, hard disks, and tapes are magnetically recorded. CDs are optically recorded at a much higher density. CD-ROM drives use industry-standard 12 cm (4.75 in) CDs with formatted capacities of approximately 650 MB of data. CDs are used for music, voice, animated graphics, multimedia, education, software distribution, and many other applications.

Chapter 8. System Management and Security

This section provides an overview of the system-management and security features provided with your computer.

Note:
Additional hardware or software (supplied by IBM or other manufacturers) might be required to use some of these features.

System Management Features

The system-management features of your computer are a collection of hardware and software features designed to make it easier to manage your system over a computer network. When used in conjunction with the appropriate network-management software, these features provide systems administrators with tools necessary to remotely manage and monitor your computer. Some system-management features provided by IBM are:

- Alert on LAN support

- Asset ID capability

- Built-in network protocols

- Chassis-intrusion detector

- Connectors for Modem Ring Detect and Wake on LAN

- Enablement for LANClient Control Manager

- Serial Port Ring Detect support

- System-management controller

- Various software features

- Wake on LAN support

Note:
System management features vary by computer model. For more information on these features, see the *IntelliStation E Pro User Guide*.

System Security Features

Note:
Because security features vary by computer model, your computer might not have all the features discussed in this section.

This section provides information about security features that protect your computer assets.

Security is important for protecting your computer and the data stored in it. If you use your computer in a public environment, such as an office, you might want to protect the computer and your data by using one or more of the security features available to you.

These features include:

System Management and Security

- A power-on password to help prevent unauthorized use of the computer
- An administrator password to deter persons from tampering with system settings
- Selectable enabling of enhanced security, which locks the administrator password and startup sequence in a security EEPROM where they are not affected by loss of battery power
- An unattended start mode to enable the computer to operate without input from the keyboard or mouse
- A selectable startup sequence to prevent use of unauthorized programs to bypass security controls
- Selectable disabling of diskette and hard disk drives to prevent unauthorized use
- Input/output port control to disable input and output functions of the serial and parallel ports and their attached devices
- Diskette drive write protection (prevents the diskette drive from writing to diskettes)
- Software-readable and radio-frequency readable hardware identification data to aid in managing assets
- Bolt-down feature that can be used to prevent others from moving the computer
- Chassis-intrusion detector that requires a password to be entered if the cover has been opened, even if the power was off when the cover was opened

The use of some security features depends on your operating system and network software. For more information about security features, refer to the following World Wide Web page:

`http://www.pc.ibm.com/us/asset`

Also, look in the *IntelliStation E Pro User Guide* for information on the Enhanced Security features for your computer.

While the security features can offer a good deal of protection for your computer and data, there are limitations, depending on the operating environment. For example, these features cannot authenticate or identify the adapter that attaches the computer to a LAN, and they cannot prevent outside persons or computers from gaining access to the computer, if your computer is equipped with a modem set to the automatic answering mode.

A major aspect of security is protecting the data stored in your computer. Some of the considerations of data security are:

- Backup and recovery
- Erased files
- Computer viruses

Information Backup

Most of the information stored on a hard disk is contained in *data files*. Data files contain the information you put in the computer, such as letters and reports.

You can lose data files from your hard disk for a variety of reasons. Security violations, improper handling during a move, or computer viruses can destroy stored information. To avoid losing information, make copies of the data files using storage devices such as diskette drives, tape drives, or optical drives. Also, if you are connected to a LAN, you might be able to back up information to a server. Backup copies can save you time and money recovering files accidentally erased from a hard disk or lost when a hard disk drive fails.

Back up your hard disks on a regular basis (daily, weekly, or monthly depending on how often the information changes). Also, back up the hard disk before moving the computer. Backup procedures differ from one operating system to another.

Erased Files

Erasing a file from a diskette or hard disk does not necessarily destroy the file. With the proper software tools, someone might be able to restore all or part of an erased file. An erased file, therefore, might be a security risk if you sell your computer or give someone a diskette that once contained confidential information.

One way to help ensure that you leave no readable information on a hard disk is to do a *low-level format*. The standard operating-system format commands do not remove all information from a hard disk. Low-level format programs are available from a number of manufacturers.

Diskettes are a little different. An operating-system format command writes a repeated pattern over the entire surface of the diskette. As a result, any information that was on the diskette becomes unreadable.

Depending on the type of information stored, you might require additional safeguards.

Computer Viruses

A computer virus is a program (or instructions hidden within a program) that can "infect" files and programs on your computer. Unlike most other programs, viruses are typically designed to spread themselves. Some viruses can display a message or cause erratic screen behavior. Others are destructive, erasing or damaging files, or overloading memory and communication networks.

Viruses are difficult to detect. Many stay inactive until triggered by a specified event such as a date, command, or some other operation. Some are activated when an infected program is started a specified number of times. When the symptoms of the virus appear, it might be difficult to determine if the problem is a hardware failure, a software problem, or a virus in action.

Viruses are generally spread unknowingly from computer to computer when programs are copied or exchanged. If you don't know where a program came from, be careful. Most reputable bulletin-board owners and distributors of programs scan their files to guard against viruses and maintain records identifying program owners. You can take steps to protect your information by using a virus-scan

System Management and Security

program such as IBM AntiVirus. IBM AntiVirus is included on the
Ready-to-Configure Utility Program CD that comes with your computer.

Chapter 9. Software

The term *software* refers to a variety of instructions, programs, utility programs, and tools that enable your computer to do what you want it to do.

Software Layers

Several layers of software work together to make your computer work.

System programs are the basic layer of software built into every IntelliStation E Pro. They include the *power-on self-test (POST)*, the *basic input/output system (BIOS)*, and the *Configuration/Setup Utility program*. POST is a set of tests and procedures performed every time you turn on your computer. The BIOS is a layer of software that translates instructions from other layers of software into instructions that the computer hardware can understand. The Configuration/Setup Utility program enables you to view and change the configuration and setup of your computer.

Other software used by your computer includes *device drivers*, which support a specific type of hardware device, and *Advanced Power Management (APM)*, which allows you to select energy-saving settings for certain features of your computer. With APM, you can also enable and disable features that turn your computer on automatically.

An *operating system* is the layer of software that manages all computer operations by directing the flow of information to and from the various parts of the computer. The operating system interprets instructions from you and your application programs and directs these instructions to the BIOS. Your computer needs an operating system to run application programs.

Application programs are the highest layer of software. An application program allows you to do a specific type of work, such as word processing, desktop publishing, or financial accounting. These are the programs you use to get work done on your computer. Some application programs, called *tools* or *utility programs*, are designed for very specific tasks such as configuring the computer, using a feature, or testing the computer. And, of course, there are games to keep you entertained.

Your software might have been preinstalled for you, or you might have to install it yourself. If not preinstalled, your software package usually contains program diskettes, CDs, and instruction manuals. Refer to the information provided with your software for installation and operation instructions.

POST Programs

Each time you turn on your computer, it automatically runs the POST programs. These programs are stored in flash memory on the system board along with the BIOS and the Configuration/Setup Utility program. The functions of POST are to:

- Test the computer hardware and subsystems

- Update the computer configuration

- Load the BIOS into system memory

- Load the operating system into system memory

- Report problems

While POST is running, numbers showing the amount of memory being tested appear in the top-left corner of the screen until the total amount of memory in the system is reached. Options for running a fast POST or accessing the Configuration/Setup Utility program appear in the lower-left corner of the screen. If POST finishes without detecting a problem, you hear one beep, and the first screen of your operating system or application program appears. (However, if you have set a power-on password, a prompt requesting your password appears on the screen before your operating system or application program appears.)

Note:
If POST detects problems or configuration changes when you start your computer, you hear multiple beeps or no beep. In most cases, an error code appears in the top-left corner of the screen, and in some cases a description of the error is displayed beside the code. Refer to the problem-solving section of the *IntelliStation E Pro User Guide* for information on what caused an error message to appear and what action to take.

Configuration/Setup Utility Program

Most computer devices (storage devices, ports, adapters, and other optional features) have programmable settings. Your computer has a special type of nonvolatile memory (called *CMOS NVRAM*) where it saves these settings. This memory is kept active by a battery so that the settings are not lost when you turn off the computer. Each time you turn on the computer, a POST routine copies the configuration settings from memory to the various devices to get them ready for operation. If the battery fails, the settings in memory are lost, and the Configuration/Setup Utility program automatically reconfigures built-in devices to their default settings.

When you add or remove hardware from your computer and restart the computer, the configuration settings must be updated. In most cases, POST detects the change in hardware and *automatically* updates the configuration. In other cases, you might need to use the Configuration/Setup Utility program to *manually* update the configuration. In both cases, the computer displays a configuration-error message on the screen, and you have the option of accessing the Configuration/Setup Utility program. You must enter the Configuration/Setup Utility program and either *save* the automatic update or manually change the configuration settings. For more information on using the Configuration/Setup Utility program and saving configuration changes, see the *IntelliStation E Pro User Guide*.

Operating Systems

An operating system is a complex collection of utility programs and device drivers that control what a computer does. It is the operating system that enables a computer to accept information from a keyboard, display it on a monitor, print it, and save it on a disk. The operating system has built-in routines for performing input and output operations, such as reading and writing disk files. When an application program gives a command to the operating system to save a file, the operating system communicates with the BIOS to transfer the file from memory to disk.

Just as the BIOS defines how the hardware works, the operating system defines how the software works by establishing a set of rules that all software must conform to. For example, the operating system defines how files are named, what commands can be used, and how memory is organized. Your IBM IntelliStation E Pro is designed to work with a variety of operating systems in order to meet many different needs.

Device Drivers

Device drivers are programs that support a specific type of hardware device, such as a printer or high-resolution monitor. These programs provide instructions that allow the computer to interact with the device or take advantage of the special features of a device. Device drivers are necessary because the BIOS cannot be large enough or current enough to contain all the code needed to control every hardware device. If your computer has IBM-preinstalled software, device drivers might be included with your operating system or application programs. Also, some device drivers are located on the *Ready-to-Configure Utility Program CD* that comes with your computer. Hardware optional features also might include diskettes that contain the device drivers you need to make the optional features work.

Device-Driver Types

Device drivers fall into two general categories: application-specific and device-specific. Application programs load application-specific device drivers into memory. These device drivers stay in memory while the application is running, and generally are cleared from memory when you exit from the application.

Device-specific drivers are loaded into memory each time you turn on the computer. Some device drivers check for the presence of a device each time you turn on the computer. If the device it supports is not attached or is not turned on, the device driver is not loaded and might generate an error message. After they are loaded, device-specific drivers stay in memory.

Video Device Drivers

Video device drivers for several operating systems are provided on the *Ready-to-Configure Utility Program CD* that comes with your computer. If your computer has IBM-preinstalled software, the video device drivers are probably already installed on the hard disk in your computer.

Instructions for installing video device drivers are included in README files that are on the *Ready-to-Configure Utility Program CD*. If your computer has IBM-preinstalled software, the README files are also on the hard disk of your

computer. Be sure to use the README file that corresponds to your graphics adapter and operating system.

In addition to video device driver installation instructions, the README files include information on updating the video device drivers in your computer. Most of the README files also include information on changing the video resolution and color depth for your monitor.

Power Management Features

Conserving energy is important for your computer and is also environmentally friendly. For both of these reasons, your computer provides energy-saving software as a part of the BIOS in your computer.

You can view or change the settings for power-management features through the Configuration/Setup Utility program. See the *IntelliStation E Pro User Guide* for more information.

The following power management features are included:

- **Advanced Configuration Power Interface (ACPI)** is a BIOS mode that when enabled, allows the operating system to control the power management features of your computer. When ACPI is enabled, settings for APM BIOS mode are ignored (see below). Because some operating systems do not support the ACPI BIOS mode, refer to your operating system documentation to determine if ACPI is supported.

- **Advanced Power Management (APM)** are BIOS features that allow automatic power reduction of the computer or of specific system hardware (monitor, disk drives, etc.). Features of APM include Automatic Hardware Power Management, which allows you to reduce or suspend power to components of the computer after a preset time of inactivity, and Activity Monitor, which keeps track of system hardware selected for automatic power management.

  Note:
  If a device, such as a monitor, does not have power-management capabilities, it might be damaged when exposed to a reduced-power state.

- **Automatic Power On** is a group of BIOS settings that when enabled, allow the computer to turn on from a remote location or when it is unattended. Features of Automatic Power On include system-management related functions such as Wake on LAN and PCI Wake Up. (For more information on system management, see "System Management Features" on page 41 and the *IntelliStation E Pro User Guide*.) Optional hardware and software might be required for some Automatic Power On features.

Application Programs

Application programs provide the tools necessary to complete a specific type of job, such as editing text or preparing a spreadsheet. A variety of programs are available to aid you in generating reports, working with numbers, using graphics, and performing many other personal and business functions.

Many application programs are commercially available for your computer. After you determine the types of programs you need, be sure to select those that will work

with your computer. Most application program packages list the computer equipment you need to run the program. Read the package carefully and look for the following information:

Computer Type   Make sure the box is labeled for IBM or IBM-compatible computers.

Diskette Size   Your computer has a 3.5-inch diskette drive. Make sure the package contains 3.5-inch diskettes. If you installed an optional 5.25-inch diskette drive, you can use 5.25-inch diskettes also.

CD-ROM Support   Your computer has a preinstalled CD-ROM drive. You can purchase application programs that are available on CDs.

Video Support   Your computer has an SVGA graphics controller that also supports video graphics array (VGA) standards.

Software Protection

Under normal circumstances, there is little you can do to damage your software. However, accidents can happen. If you establish good habits when using your computer, you will be less likely to experience problems.

Your computer might come with the operating system and other software already installed on the hard disk. The operating system might fail if you modify operating system files incorrectly or if you try to install software that is not designed to operate on your computer. Back up your operating system and other software so that you can more easily recover from an operating system or hard disk drive failure. For instructions on how to back up operating system programs, refer to the documentation provided with your operating system.

Also, make backup copies of any original software diskettes. Using the backup copy can prevent damage to the original diskettes. Your operating-system documentation provides instructions for making backup copies of diskettes.

Appendix A. Notices and Trademarks

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A

adapter.   A printed circuit board that modifies the system unit to allow it to operate in a particular way.

address.   (1) A value that identifies a register or a particular part of storage. The value is represented by one or more characters. (2) The location in the storage of a computer where data is stored. (3) To refer to a specific storage location by specifying the value that identifies the location.

address bus.   The path used for the transmission of address information in a computer.

analog.   (1) Pertaining to data consisting of continuously variable physical quantities. (2) Contrast with digital.

application program.   (1) A program that is specific to the solution of an application problem. (2) A program written for or by a user that applies to the user's work, such as a program that does inventory control or payroll.

architecture.   See computer architecture.

audio adapter.   An audio board that receives input from a microphone or input line, digitizes the signal, and stores it in the computer. The adapter can play back the digitized signal to an external speaker, headphone, or line output.

auxiliary storage.   Addressable storage, other than memory, that can be accessed by means of an input/output channel; for example, direct access storage devices or magnetic tape.

B

back up.   To copy information, usually to diskette or tape, for safekeeping.

backup.   Pertaining to a system, device, file, or facility that can be used in the event of a malfunction or loss of data.

baud rate.   A number representing the speed at which information travels over a communication line. The higher the number, the faster communication occurs.

bay.   An area within a personal computer that provides space and physical support for storage devices.

binary.   Pertaining to a system of numbers to the base 2; binary digits are 0 and 1.

BIOS (basic input/output system).   Code that controls basic hardware operations such as interactions with diskette drives, hard disk drives, and the keyboard.

bit.   Either of the digits 0 or 1 when used in the binary numeration system.

buffer.   (1) A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another. (2) A portion of storage used to hold input or output data temporarily.

bus.   One or more conductors used for transmitting signals, data, or power. See also address bus, data bus, and expansion bus.

bus master.   A device or subsystem that controls data transfers between itself and a slave.

byte.   A string that consists of a number of bits, usually 8, that are treated as a unit and represent a character.

C

cable.   The physical medium for transmitting signals; it includes copper conductors and optical fibers.

cache.   A buffer storage that contains frequently accessed instructions and data; it is used to reduce access time.

CD.   Compact disc. A disc, usually 4.75 inches in diameter, from which data is read optically by means of a laser.

CD-ROM.   Compact disc-read only memory. High-capacity read-only memory in the form of an optically read compact disc. See also CD and ROM.

central processing unit (CPU).   (1) The section of the microprocessor where arithmetic and logical operations are performed, and instructions are decoded and executed. (2) The functional unit that controls the operation of the computer.

chip set.   An integrated circuit or a set of integrated circuits that provide hardware support for a related set of functions, such as the generation of video.

clock.   A device that generates periodic, accurately spaced signals used for purposes such as timing, regulation of the operations of a processor, or generation of interrupts.

clock cycle. For a microprocessor, the amount of time that the microprocessor takes to perform at a given clock speed. Clock cycles are measured in nanoseconds (ns).

clock speed. For a microprocessor, the operating speed of the microprocessor. Clock speed is typically measured in megahertz (MHz).

CMOS. Complementary metal-oxide semiconductor. A technology that combines the electrical properties of n-type semiconductors and p-type semiconductors.

code. A collection of instructions that are in a form that can be read and processed by a computer.

code page. An assignment of graphic characters and control function meanings to all code points; for example, assignment of characters and meanings to 256 code points for an 8-bit code, assignment of characters and meanings to 128 code points for a 7-bit code.

compatibility. The capability of a hardware or software component to conform to the interface requirements of a given computer without adversely affecting its functions.

computer architecture. (1) The logical structure and functional characteristics of a computer, including the interrelationships among its hardware and software components. (2) The organizational structure of a computer system, including hardware and software.

computer security. (1) Concepts, techniques, technical measures, and administrative measures used to protect the hardware, software, and data of an information processing system from deliberate or inadvertent unauthorized acquisition, damage, destruction, disclosure, manipulation, modification, use, or loss. (2) Protection resulting from the application of computer security.

configuration. The manner in which the hardware and software of an information processing system are organized and interconnected.

configure. To set up a computer for operation by describing to the system the devices, optional features, and programs installed in the computer.

connector. An electrical part used to join two or more other electrical parts.

control. The determination of the time and order in which the parts of a computer and the devices that contain those parts perform the input, processing, storage, and output functions.

controller. A device that coordinates and controls the operation of one or more input/output devices, such as

workstations, and synchronizes the operation of such devices with the operation of the system as a whole.

coprocessor. In personal-computer systems, a microprocessor that supplements the operations of the system microprocessor, enabling the computer to perform complex mathematical operations in parallel with other operations.

cycle. (1) An interval of space or time in which one set of events or phenomena is completed. (2) A complete vibration, electric oscillation, or alternation of current.

D

daisy chain. A method of device interconnection for determining interrupt priority by connecting the interrupt sources.

data. (1) A re-interpretable representation of information in a formalized manner suitable for communication, interpretation, or processing. (2) Any representations such as characters or analog quantities to which meaning is or might be assigned.

data bus. A bus used to communicate data internally and externally to and from a processing unit, storage, and peripheral devices.

DDC. Display Data Channel.

decibel (dB). A unit that expresses the intensity of a sound.

decimal. Pertaining to a system of numbers to the base 10; decimal digits range from 0 through 9.

default. Pertaining to an attribute, condition, value, or option that is assumed when none is explicitly specified.

device. A mechanical, electrical, or electronic piece of equipment designed to serve a special purpose or perform a special function.

device driver. A file that contains the code needed to use an attached device.

DHCP. Dynamic host configuration protocol.

diagnostic. Pertaining to the detection and isolation of errors in programs and faults in equipment.

diagnostic program. A computer program that is designed to detect, locate, and describe faults in equipment or errors in computer programs.

digital. (1) Pertaining to data in the form of digits. (2) Contrast with analog.

DIMM.   Dual inline memory module.

direct memory access (DMA).   The transfer of data between memory and input/output devices without microprocessor intervention.

diskette.   A small magnetic disk permanently enclosed in a rigid or semi-rigid protective jacket.

diskette drive.   The mechanism used to seek, read, and write data on diskettes.   It can be installed in, or attached to, a computer.

disk swapping.   A form of memory management whereby if additional memory is needed for the active programs, the operating system transfers the least-used information from memory to the hard disk to make more memory available.   When the transferred information is needed, it is exchanged with other information in memory.

Display Data Channel (DDC).   An industry standard for passing monitor configuration information between a monitor and the attached personal computer.   Plug and Play technology is used to provide automatic performance optimization for the monitor.   A DDC-enabled computer can interpret configuration information from a DDC-enabled monitor and then set the display mode that best uses the capabilities of the monitor.

Display Power Management Signaling (DPMS).   A monitor feature that makes it possible for the attached personal computer to safely lower and manage the power consumption level of the monitor, based on defined modes of inactivity of the keyboard and mouse. The power level can be progressively lowered each time the monitor is placed into the next mode—from On, to Standby, to Suspend, to Off.   To take advantage of this feature, the monitor must be used with a computer and operating system that are hardware and software enabled for DPMS.   If the monitor is attached to a video adapter, the adapter must also be DPMS enabled.

DMA.   Direct memory access.

DPMS.   Display Power Management Signaling.

DRAM.   Dynamic random-access memory.

Dual inline memory module.   A small circuit board with memory-integrated circuits containing signal and power pins on both sides of the board.

E

EEPROM.   Electrically erasable programmable read-only memory.

electrically erasable programmable read-only memory (EEPROM).   EPROM that can be reprogrammed while it is in the computer.

EIDE.   Enhaced integrated drive electronics.

EPROM.   Erasable programmable read-only memory.

erasable programmable read-only memory (EPROM).   Programmable read-only memory that can be erased by a special process and reused; specifically, a PROM that must be removed from the computer to be reprogrammed.

expansion bus.   An extension of the I/O bus that has connectors for attaching adapters to the bus.

expansion slot.   In personal-computer systems, one of several receptacles in the rear panel of the system unit into which a user can install an adapter.

F

file.   A named set of records stored or processed as a unit.

flash memory.   A data storage device that is programmable, erasable, and does not require continuous power.   The chief benefit of flash memory over other programmable and erasable data storage devices is that it can be reprogrammed without being removed from the circuit board.

format.   To prepare a hard disk or diskette to hold information.

frequency.   The rate of signal oscillation, expressed in hertz.

G

GB.   Gigabyte.

gigabyte.   (1) For processor storage and real and virtual memory, 2^{30} or 1073741824 bytes.   (2) For disk storage capacity, 1000000 KB.   (3) For transmission rates, 1000000000 bytes.

H

hard disk drive. A disk drive that reads and writes data on rigid disks and can be installed in or connected to a computer.

hardware. (1) All or part of the physical components of an information processing system, such as computers or peripheral devices. (2) The equipment, as opposed to the programming, of a computer. (3) Contrast with software.

hertz (Hz). A unit of frequency equal to one cycle per second.

hex. See hexadecimal.

hexadecimal. Pertaining to a system of numbers to the base 16; hexadecimal digits range from 0 through 9 and A through F, where A represents 10 and F represents 15.

I

input/output. Pertaining to a device, process, or channel involved in data input, data output, or both.

input/output device. A device in a data processing system by means of which data can be entered into the system, received from the system, or both.

instruction. A statement that specifies an operation to be performed by a microprocessor and that identifies data involved in the operation.

instruction set. The set of instructions of a computer, of a programming language, or of the programming languages in a programming system.

interrupt. An instruction that directs the microprocessor to suspend what it is doing and run a specified routine. When the routine is complete, the microprocessor resumes its original work. See also routine.

I/O. Input/output.

ISA. Industry Standard Architecture.

ISO. International Organization for Standardization. An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

J

jack. A connecting device to which a wire or wires of a circuit can be attached and that is arranged for insertion of a plug.

jumper. A device, such as a short wire, used to open or close a circuit.

K

Kb. Kilobit

KB. Kilobyte.

kilobit. Approximately 1000 bits.

kilobyte. Approximately 1000 bytes.

L

LAN. See local area network.

legacy device. A device that is not Plug and Play (automatic configuring) compatible. A legacy device must be manually configured by setting its switches or jumpers, and then manually assigned computer resources using the computer configuration/setup utility program. Contrast with Plug and Play device.

load. To bring all or part of a computer program into memory from auxiliary storage so that the computer can run the program.

local area network (LAN). (1) A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. (2) A network in which a set of devices are connected to one another for communication and that can be connected to a larger network.

logical. (1) Pertaining to content or meaning as opposed to location or actual implementation. (2) Pertaining to a view or description of data that does not depend on the characteristics of the computer system or the physical storage. (3) Contrast with physical.

low-level format. A type of disk formatting that erases all readable information from a hard disk by writing zeros on all data sections of the disk to ensure that no readable information is left on the disk. Low-level formatting requires a low-level format program, which is available from a number of manufacturers.

M

MB. Megabyte.

megabyte. (1) For processor storage and real and virtual memory, 2^{20} or 1048576 bytes. (2) For disk storage capacity, 1000 KB. (3) For transmission rates, 1000000 bytes.

megahertz (MHz). A unit of measure of frequency equal to 1000000 cycles per second.

memory. Addressable storage space in the computer that is used for temporary storage of instructions and data while a program is running, or for permanent storage of microcode. Contrast with auxiliary storage.

menu. A list of choices that gives users access to actions that can be applied to an object.

MHz. Megahertz.

microprocessor. An integrated circuit that contains the central processing unit (CPU) of a computer. See processor and central processing unit.

millimeter (mm). One thousandth of a meter.

millisecond (ms). One thousandth of a second.

milliwatt (mw). One thousandth of a watt.

modem (modulator/demodulator). (1) A functional unit that modulates and demodulates signals. One of the functions of a modem is to enable digital data to be transmitted over analog transmission facilities. (2) A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

multitasking. A mode of operation that provides for concurrent performance, or interleaved execution, of two or more tasks.

N

nanosecond (ns). One thousandth of one millionth (10^{-9}) of a second.

network. (1) An arrangement of nodes and connecting branches. (2) A configuration of data processing devices and software connected for information interchange.

network administrator. The person responsible for the installation, management, and control of a network. The network administrator gives authorization to users for accessing shared resources, and determines the type of access those users can have.

network server. See server.

nonvolatile. (1) Pertaining to a storage device whose contents are not lost when power is cut off.
(2) Contrast with volatile.

ns. nanosecond.

O

operating system. Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management.

P

parallel. Pertaining to a process in which all events occur within the same interval of time, each handled by a separate but similar functional unit.

parallel port. An access point through which a computer transmits or receives data that consists of several bits sent simultaneously on separate wires. Contrast with serial port.

parity bit. A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd or always even.

password. A string of characters known to the computer system and to a user, who must specify it to gain full or limited access to a system and to the data stored within it.

PC Card. A credit-card-sized adapter used to add memory, storage, or I/O capabilities to a personal computer, personal communicator, or other electronic device.

PCI. Peripheral component interconnect.

pel. (1) Picture element. (2) In computer graphics, the smallest element of a monitor surface that can be independently assigned color and intensity.

peripheral device. Any device that can communicate with a particular computer; for example, input/output units, auxiliary storage.

physical. (1) Pertaining to actual implementation or location as opposed to conceptual content or meaning. (2) Contrast with logical.

picture element (pel). In computer graphics, the smallest element of a monitor surface that can be independently assigned color and intensity.

pin. One of the conducting contacts of an electrical connector.

pipeline. A serial arrangement of processors or a serial arrangement of registers within a processor. Each processor or register performs part of a task and passes results to the next processor; several parts of different tasks can be performed at the same time.

plotter. An output unit that directly produces a hardcopy record of data on a removable medium, in the form of a two-dimensional graphic representation.

Plug and Play device. A device that is auto-configuring. A Plug and Play device comes with built-in identification and configuration specifications that enable the computer BIOS to automatically configure the device and assign it computer resources. Contrast with legacy device.

port. An access point for data entry or exit.

POST. Power-on self-test.

power-on self-test (POST). A series of diagnostic tests that are run automatically by a device when the power is turned on.

priority. (1) A rank assigned to a task that determines its precedence in receiving system resources. (2) The relative significance of one job to other jobs in competing for allocation of resources.

processing. The performance of logical operations and calculations on data, including temporary retention of data in microprocessor storage while the data is being handled.

processor. A functional unit that interprets and executes instructions. A processor consists of at least an instruction control unit and an arithmetic and logic unit. See microprocessor and central processing unit.

program. (1) A sequence of instructions that a computer can interpret and execute. (2) To design, write, modify, and test computer programs.

programmable read-only memory (PROM). A storage device that, after being written to once, becomes read-only memory.

PROM. Programmable read-only memory.

prompt. A visual or audible message sent by a program to request the user's response.

R

random access memory (RAM). (1) A storage device in which data can be written and read. (2) A storage device into which data is written and from which data is read in a nonsequential manner.

read. To acquire or interpret data from a storage device, from a data medium, or from another source.

read-only memory (ROM). Memory in which stored data cannot be modified by the user except under special conditions. See also EEPROM, EPROM, and PROM.

record. (1) A set of data treated as a unit. (2) A set of one or more related data items grouped for processing.

refresh. (1) To recharge a memory location in volatile memory with an electric current so that it retains a state or binary value. (2) In computer graphics, the process of repeatedly producing a monitor image on a monitor surface so that the image remains visible.

register. (1) An integrated circuit that contains 8, 16, or 32 storage locations, each of which can store 1 bit of binary data. See also binary. (2) An area that stores binary data while it is being processed by the computer.

resolution. In computer graphics, a measure of the sharpness of an image, expressed as the number of lines and columns on the monitor screen or the number of pels per unit of area.

resource. Any of the computer-system elements needed to perform required operations, including storage, input/output devices, processors, data, and programs.

riser card. A circuit card that connects to the system board and provides expansion slots for adding adapters.

ROM. Read-only memory (A).

routine. A program, or part of a program, that may have some general or frequent use.

RPL. Remote program load.

S

seek time. The time required for the access arm of a direct access storage device to be positioned on the appropriate track.

serial. Pertaining to the sequential or consecutive occurrence of two or more related activities in a single device or channel.

serial port. An access point through which a computer transmits or receives data, one bit at a time. Contrast with parallel port.

server. (1) A functional unit that provides shared services to workstations over a network. (2) In a network, a data station that provides facilities to other stations.

slot. (1) A position in a device used for removable storage media. (2) One of several receptacles in the rear panel of the system unit into which a user can install an adapter.

small computer system interface (SCSI). A standard input/output interface used by personal computers.

SMM. System management mode.

software. (1) All or part of the programs, procedures, rules, and associated documentation of a computer. Software is an intellectual creation that is independent of the medium on which it is recorded. (2) Contrast with hardware.

startup sequence. In personal-computer systems, the order that the computer uses to search the direct access storage devices for an operating system.

storage. A functional unit into which data can be placed, in which it can be retained, and from which it can be retrieved.

subsystem. A secondary or subordinate system, usually capable of operating independently of a controlling system, and usually having a single purpose, such as displaying video or reading from and writing to hard disks. A subsystem can be integrated into the system board or on an adapter.

super video graphics array (SVGA). A video standard that supports high-resolution, 1024 x 768-pel graphic images.

SVGA. Super video graphics array.

symmetric multiprocessing. In personal computers, a multiprocessing design that enables two or more microprocessors to run concurrently and work independently, with each microprocessor capable of performing any task.

system board. In a system unit, the main circuit board that supports a variety of basic system devices, such as a keyboard or a mouse, and provides other basic system functions.

system management mode. A state controlled by the microprocessor that reduces the power consumed by components of the computer.

system programs. In personal-computer systems, startup routines, such as POST and BIOS code, and utility programs that are used to configure, test, and update the computer. See also POST, BIOS, and utility program.

system unit. In personal-computer systems, the part of the computer that contains the processor circuitry, read-only memory (ROM), random access memory (RAM), and the I/O channel.

U

UART (universal asynchronous receiver/transmitter). An electrical circuit that converts analog data to digital data and digital data to analog data; it is used in communications devices.

universal serial bus (USB). A serial interface standard for telephony and multimedia connections to personal computers.

universal serial bus port. On personal computers, a port that uses a single connector for devices that previously used serial, parallel, keyboard, mouse, and game ports. The USB port connector uses Plug and Play technology to determine what device is connected to the port. A hub device can be used to convert a single USB connector into multiple attachment points. Data is transmitted in asynchronous or isochronous mode.

USB. Universal serial bus.

utility program. (1) A computer program in general support of computer processes; for example, a diagnostic program, a trace program, a sort program. (2) A program designed to perform an everyday task such as copying data from one storage device to another.

V

VGA. Video graphics array.

virtual. Pertaining to a functional unit that appears to be real, but whose functions are accomplished by other means.

volatile. (1) Pertaining to a storage device whose contents are lost when power is cut off. (2) Contrast with nonvolatile.

W

wait state. A period during which a microprocessor suspends processing while waiting for a response to a request for an unavailable source.

write. To make a permanent or transient recording of data in a storage device or on a data medium.

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