

Troubleshooting for the IA Platform

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INTRODUCTION

This guide is designed to give an overview of basic PC troubleshooting and to be used as a quick reference guide. To use this manual effectively, you should already be familiar with using and troubleshooting PCs. The first section will give an overview of the PC and describe the individual components as they relate to troubleshooting the PC. The second part will list common problems and will discuss on how to isolate these types of problems. This guide is designed for quick access of a lot of information.

Important Note: Disassembly, assembling, upgrading and troubleshooting computers should be performed only by a computer professional since the electronic devices may cause serious damage to the installer, the system and its components if it is done improperly. Before attempting to disassemble or assemble computers, install components in a computer or to troubleshoot computers, carefully review the documentation specific for the computer and its related components. Make sure that you will not be voiding the warranty of the system by opening the computer or replacing any of the components in the computer. Lastly, make sure to follow Electrostatic Discharge (ESD) procedures.

1 TROUBLESHOOTING OVERVIEW

When troubleshooting any PC, there are certain guidelines that you should follow to make yourself more effective. First, your mind must be clear and rested so that you are able to concentrate on the problem. If not, you may overlook something that was obvious such as the power cord not being plugged in.

Next, don't panic, don't get frustrated and allow enough time to do the job right. If you panic, you may do something that will make the situation worse. If you start to get frustrated, take a break. You will be amazed how five or ten minutes away from the problem will clear your mind and will allow you to look at the problem a little differently when you come back. Lastly, make sure that you have enough time to properly analyze the problem, fix the problem and properly test the system after the repair. Again, if you rush a job, you may make the problem worse or you may overlook something simple.

1.1 Types of Problems

When troubleshooting computer problems, you must keep an open mind on the cause of the problem. The problem could be a hardware failure, compatibility problem, improper configuration, software glitch, environment factor or user error. See Table 1. Many of these may appear as hard problems but are actually something else. Therefore, instead of only checking for faulty components (such as hard drives, floppy drives, power supplies, cables or expansion cards), problems can also be caused by a virus, software that isn't compatible with a screen saver, CMOS setup program settings, power management features, Control Panel settings, software drivers, hardware settings, power fluctuations or electromagnetic interference.

Table 1: Computer Problem Classifications

Reason for Failure	Description:
Hardware Failure	This is when one or more components fail inside the computer.
Hardware Compatibility	This error is when a component is not compatible with another component.
Improper Hardware Configuration	This error is when the hardware has not been installed or configured properly.
Improper Software Configuration	This error is when the software (Operating System or Application Software) is not installed or configured properly.
Software Failure	This error is when there is a glitch in the software. This can range from corrupted data to a flaw in the programming.
Software Compatibility	The software may not be compatible with the hardware or other software.
Environment	The location of the computer and its environment (temperature, air flow, electromagnetic interference, magnetic fields may affect the reliability of the PC and has a direct impact on the PC's life.
User Error	A very common situation where the user hits the wrong keys or is not familiar with the computer and/or software. It could be something as simple as the user hitting the zero (0) key rather than the letter O.

1.2 Troubleshooting Approach

Before trying to fix the problem, you need to gather information. First, make sure that you can duplicate the problem and that the user is not part of the problem. In addition, determine if the problem is always repeatable or is an intermittent problem. If it is an intermittent problem, does the problem follow a certain pattern (such as when the computer is on for a while) or does it occur completely randomly.

The more difficult problems are the intermittent problems. Since the intermittent errors do not happen on a regular basis, they may work fine when you test them, but, as soon as the customer takes it home, it fails again. When dealing with intermittent problems, you make a change that might fix the system. You must then thoroughly test the system over a period of time to see if the problem actually goes away.

You can gather additional information by trying to use software utilities to test your system and by using a digital multimeter (DMM). Some of the utilities include software to test the computer components, check for viruses, look for formatting errors on a disk or check software configuration. In addition, find out if the computer was serviced or changed recently. Many times servicing or changes can cause other problems.

After you have gathered as much information as you can, you are now ready to make the repair or fix. Sometimes, you will know exactly what to change or replace. Other times, you will have it narrowed down to several causes, which would require you to isolate the problem. If you suspect a faulty component, you can replace the component with a known good component. If the system works with the new component, the problem was the item that you just removed. Of course, while the component could be faulty, the problem could also be a compatibility problem, a BIOS problem or a driver problem. For example, if you replace a processor and the new processor works, the other processor could still be good. To determine if it is good, it would have to be tested in another known working machine.

Note: when a new item is taken off the shelf, it does not mean that the item is always good. In addition, you can try “reverse swapping” which is trying a suspected component into a second working system.

Other solutions including reconfiguring the software or hardware, reloading the operating system, application software or drivers, making changes to the CMOS Setup program or reconfigure the software. Whatever course of action that you choose, you should only make one change at a time. If the problem still exists, you will then make another change until the problem no longer exists. When determining which item to check or swap, you should first try to check items that are likely to cause the problem and are the easiest and quickest to check.

After you fixed the problem, you should always thoroughly test the computer before returning it to the customer or client. This will make sure that the problem did go away and that you did not cause another problem when fixing the first problem.

1.3 Field Replaceable Units

A field replaceable unit, also commonly referred to as a FRU, is any PC component that can be replaced without any special skills or tools. For the PC, the most common FRUs are:

- processors
- motherboards
- floppy disk drives
- hard drives
- CD/DVD drives
- drive cables
- expansion cards
- RAM
- power supplies
- keyboards
- monitors
- CMOS batteries

Before replacing any FRUs, you should do the following:

1. Confirm that all cables and connectors are connected properly and securely
2. Verify CMOS setup programs
3. Update the BIOS
4. Verify that all drivers are installed properly and that you have loaded the newest drivers
5. Look for updated device drivers

1.4 Electrostatic Discharge (ESD)

Electrostatic electricity is an electrical charge at rest created by friction and separation. If the proper steps are not taken to avoid electrostatic discharge (ESD), it could damage the electronic components of a PC or cause the PC to lose data and programs.

To give you an idea on how much charge can be generated from ESD, on a dry day, your body can generate up to 35,000 volts. To feel a voltage discharge such as being shocked when touching a doorknob is at least 3,000 volts. Lifting a foot or moving a chair can easily generate 1,000 volts. Today, computer components can be destroyed or degraded as low as 10 to 20 volts depending on the type of chip. These voltages are not lethal to a person because the discharge occurs within a fraction of a second.

As a technician, it is imperative to avoid electrostatic discharge. You will have fewer difficult-to-trace intermittent problems and fewer unnecessary service visits to make. This will lead to fewer disgruntled customers.

The best way to avoid electrostatic discharge is to properly wear a wrist strap that is grounded. It can be grounded by attaching to the metal frame of the PC (preferable an area free of paint). The wrist strap must make good contact (metal part within the strap) with the skin. It is you whom is being grounded not your clothing. It should be kept clean, in good condition and should be tested daily to verify that there is continuity

(good connection) between you and ground. In addition, you should roll up your sleeves and secure your neckties so that they don't make contact with the electronic device.

Some books will recommend an alternative method if you do not have a wrist strap. You can touch the power supply/metal case before working within the computer. You should then touch the power supply/metal case often while you are handling computer components to reduce any charge build up. This method is not as effective as using a wrist strap. Therefore, this method is not recommended.

Warning: When working on high voltage devices such as monitors or power supplies, a wrist strap should not be used since the voltage stored in these devices can kill a person. Note: Monitors and power supplies should only be serviced by trained experienced electronic technicians.

Another device that you can use is an **electrostatic mat**. The computer that you are repairing sits on top of the mat and the mat absorbs static electricity. Of course, the mat is grounded much like the electrostatic wrist strap.

When transporting and storing electronic devices, **electrostatic bags** should be used. An electrostatic shielded bag is usually silver, smoke-gray or grid-lined. The static shielded bag must be securely closed to be effective and should not have holes. You should always keep spare static shielded bags.

When handling integrated chips, you should avoid touching any of the metal parts. When handling circuit boards, you should avoid touching any of the chips, electronic components, metal traces and edge connectors. When inserting or removing any integrated chips or expansion cards, you should make sure that the computer is off and unplugged. If you need to hand a component to a person, make sure it is sealed in an electrostatic bag or you need to touch the person's hand with your other hand before handing the component over.



Figure 1: Warning for Electricity.

Safety Guidelines – Electricity

- Never use both hands to handle an electronic device.
- Wear rubber bottom shoes.
- Don't wear any jewelry or other articles that could accidentally contact circuitry and conduct current, or get caught in moving parts.
- Connect/disconnect any test leads or connections with the equipment off and unplugged.
- Never assume anything without checking it out for yourself.
- Don't take shortcuts.

2 WHERE DO ERRORS COME FROM

Knowing where errors are generated are very useful in trying to isolate a problem to fix a computer. When you first turn on the PC, the computer performs a quick power check. When the microprocessor receives a power good signal, the processor starts reading and executing the instructions in the System ROM BIOS on how to boot the computer. The processor will then initialize and test the essential PC components (RAM and motherboards) and perform an inventory of the hardware devices installed in the computer. When a component does not respond correctly to the test, the test failure will be identified as a series of beeps (audio codes) or a number code/message (video code).

During this time, the system ROM BIOS has instructions to go out and search for additional ROM BIOS chips. Since the system ROM BIOS cannot possibly hold instructions for every piece of hardware or could not include instructions for new pieces of hardware, which are introduced every day, there was a need for additional instructions to control hardware. The additional hardware instructions are located in the other ROM BIOS chips found on the expansion cards.

The last thing that the system ROM BIOS chip does during boot up is to find a boot device to load the operating system. If all goes well, the system will finish with a prompt waiting to input a command (DOS or UNIX/Linux) or will display a GUI interface (Windows* 95/98/Me or Windows NT/2000/XP).

Therefore, if the monitor has not been activated and you get a series of beeps, the errors are the audio beep codes that are generated by the system ROM BIOS. After the video system is initiated and before the operating system is loaded, the error message will be text messages or numeric codes displayed on the screen generated by the system ROM BIOS. If the error message occurs when the operating system starts to load then the error message is generated by the operating system or a software application.

3 PROCESSOR OVERVIEW

The computer is built around an integrated chip called the processor. It is considered the brain of the computer since all of the instructions it performs are mathematical calculations and logical comparisons. It is the main component that the rest of the computer is built around.

3.1 Processor Characteristics

All processors are described by the following characteristics:

- **Clock Speed** – The speed at which the microprocessor executes instructions. Every computer contains an internal clock that regulates the rate at which

instructions are executed. It is expressed in Megahertz (MHz), which is 1 million cycles per second or Gigahertz (GHz), which is 1 billion cycles per second.

- **Bus Speed** – The bus that connects the CPU to main memory (RAM). As microprocessors have become faster and faster, the system bus has become one of the chief bottlenecks in modern PCs. Today, typical bus speeds are 66 MHz, 100 MHz, 133 MHz or 400 MHz.
- **Architecture** – The architecture determines how the processor will execute instructions. The Intel® Pentium® II, Intel® Pentium® III and Intel® Celeron™ processors use the P6 architecture while the Intel® Pentium® 4 processor uses the Intel NetBurst™ Micro-Architecture. In addition, newer processors have used additional instruction sets (MMX™ technology and Streaming SIMD) designed to perform the same type of calculation on several values at the same time.
- **Cache** – An ultra fast memory typically included as part of the processor used to increase memory performance. By keeping as much of this information as possible in the cache, the computer avoids accessing the slower RAM. Most processors several levels of cache, referred to as L1 cache and L2 cache.
- **Technology** – The Pentium II processors, early Pentium III processors and some Intel Celeron processors were produced with .25 micron technology, while later Pentium III processors and the Pentium 4 processors are produced with .18 and .13 micron technology. The .25 micron, .18 micron and .13 micron indicate how big the transistors are. As the transistors get smaller, allows the processors to get faster, to run cooler and to run with less power.
- **Voltages** – The processor will need to run with a specific voltage to run properly. All current Intel processors provide a Voltage Identify signals to tell motherboards that can automatically detect the voltage on what the correct voltage is. Voltages are displayed on the label on a boxed processor.
- **Package Type** – The form and number of pins of a processor. See table 2. Currently, the package types include:

Table 2: Package Types Used in Processors

Package Type	Number of Pins or Contacts	Notes:
SECC2	242-contact slot connector (Slot 1)	Pentium II and Pentium Pentium III processors
SECC (330)	330-contact slot connector (previously called Slot 2)	Pentium II and III Xeon™ processors
Flip Chip PGA (FC-PGA)	370-pin socket	Pentium III processor Intel Celeron processor
423 Pin Package	423-pin socket	Pentium 4 processor
478 Pin Package	478-pin socket	Pentium 4 processor
603-pin micro- PGA	603-pin package	Intel Xeon processor

- **Boxed processor versus OEM processor** – A boxed Intel processor, sometimes referred to as a retail box, comes in a sealed box, which comes with a 3-year warranty from Intel. An OEM processor, sometimes referred as a tray processor, is a processor sold to an OEM manufacturer or distributor intended for installation. The warranty varies in length and is provided by the place of purchase. For more information on Intel's warranty policy, go to:

<http://support.intel.com/support/processors/warranty.htm>

- **Steppings** – Throughout the life of a processor life cycle, the processor may go through several steppings or versions. Newer steppings typically have some type of improvement over previous steppings of the processor. Note: Steppings can be identified by the CPUID number, also shown in the support website, the specification update guide and the Frequency ID Utility.

S-Spec	Core Steppings	CPUID	Speed (MHz) Core/Bus ¹	L2 Size (Kbytes)	Tag RAM/Steppings	ECC/Non-ECC	Processor Substrate Revision	Package and Revision	Notes
SL364	kB0	0672h	450/100	512	T6P-e/A0	ECC	D	SECC2	1, 2, 4
SL365	kB0	0672h	500/100	512	T6P-e/A0	ECC	D	SECC2	1, 2, 4, 8
SL3CC	kB0	0672h	450/100	512	T6P-e/A0	ECC	D	SECC2	1, 2, 3, 4
SL3CD	kB0	0672h	500/100	512	T6P-e/A0	ECC	D	SECC2	1, 2, 3, 4
SL38E	kB0	0672h	450/100	512	T6P-e/A0	ECC	D	S.E.C.C	1, 2, 4
SL38F	kB0	0672h	500/100	512	T6P-e/A0	ECC	D	S.E.C.C	1, 2, 4
SL35D	kC0	0673h	450/100	512	T6P-e/A0	ECC	E	SECC2	1, 4
SL3R3	cA2	0681h	550E/100	256	N/A	ECC	B	FC-PGA (370 pin)	7, 9, 10
SL3VH	cA2	0681h	600E/100	256	N/A	ECC	B	FC-PGA (370 pin)	9, 10
SL3NL	cA2	0681h	600E/100	256	N/A	ECC	B	FC-PGA (370 pin)	7, 9, 10

NOTES:

1. These parts will only operate at the specified core to bus frequency ratio at which they were manufactured and tested. It is not necessary to configure the core frequency ratios by using the A20M#, IGNEE#, LINT[1]/NMI and LINT[0]/INTR pins during RESET.
2. These processors will not shut down automatically upon assertion of THERMTRIP#.
3. This is a boxed processor with an attached heatsink.
4. Performance-monitoring event counters do not reflect MOVQ and MOVQB stores to memory on these processors.
5. These parts will not assert THERMTRIP#, nor will they shut down in the event of an over-temperature condition (e.g., Tj = -135° C).
6. Pin A13 is removed from these parts.
7. This is a boxed processor with an unattached fan heatsink.
8. This is a boxed processor with an attached fan heatsink.

Speed (MHz)	Boxed Test Specification (S-spec)	OEM Test Specification (S-spec)	Stepping	CPUID	L2 Cache Size	Thermal Spec (°C)	Thermal Design Power (W)	Notes
450	SL3CC	SL364	kB0	0672	512K	90	25.3	1,4,11
	SL37C	SL35D	kC0	0673	512K	90	25.3	1,4,11
500	SL3CD	SL365	kB0	0672	512K	90	28.0	1,4,11
	SL365	SL365	kB0	0672	512K	90	28.0	1,4,11
	SL37D	SL35E	kC0	0673	512K	90	28.0	1,4,11
900	n/a	SL4SD	cC0	0686	256K	75	23.2	2,3,4,9
933	SL47Q	SL448	cB0	0683	256K	75	25.5	1,3,5,9
	SL49J	SL44J	cB0	0683	256K	75	24.5	2,3,5,9
	SL4ME	SL4C9	cC0	0686	256K	75	24.5	2,3,5,9
	n/a	SL4BT	cC0	0686	256K	75	25.5	1,3,5,9
	SL4MF	SL4C8	cC0	0686	256K	70	26.1	2,3,5,9
1 GHz	SL4KL	SL4BR	cC0	0686	256K	70	26.1	1,3,4,9
	SL4FP	SL48S	cB0	0683	256K	70	26.1	1,3,5,9
	n/a	SL4BS	cC0	0686	256K	70	26.1	1,3,5,9

1. This processor is in S.E.C.C.2 form factor
2. This processor is in the FC-PSA form factor
3. This processor is a die shrink to .18 micron process technology
4. This processor's system bus operates at 100 MHz only
5. This processor's system bus operates at 133 MHz only
6. Vcc Core Voltage - 1.60 V
7. Vcc Core Voltage - 1.65 V
8. Vcc Core Voltage - 1.70 V
9. Vcc Core Voltage - 1.70 V/Requires a motherboard with a split plane for the Vcc
10. Vcc Core Voltage - 1.80 V
11. Vcc Core Voltage - 2.00 V
12. Vcc Core Voltage - 2.05 V

NOTE: All processors listed above have an L2 cache with a 4 GB address range. All the processors listed above have an L2 cache that supports ECC. The L2 cache's ECC cannot be disabled.

Figure 2: Sample Processor Specification Guide and Intel S-Spec Support Website

Processor can be identified with their S-Spec Number (A 5 character string starting with SL), which is printed on the box of a boxed processor or on the processor itself. By looking up the S-Spec Number at the processor support website or by using the Specification Update Guide, the characteristics of the processor can be identified including the stepping, cpuid, bus speed and cache speed. See Figure 2.

When viewing the specification update guide, each specification is assigned a CPUID string, which is four characters in length. The first character is typically a 0 and the second and third characters represent the family and model number. The fourth character represents the processor stepping. For example, if you find one processor with a CPUID of 0672 and a second processor with a CPUID of 0673, both processors have the same family and model number of 67, but with different steppings. You can identify the stepping by reference the CPUID with the Specification Update Guide or the S-Spec Support website. Note: using the Intel frequency ID utility, you can view the processors CPUID.

Processor Weblinks

Intel Pentium® III processor

Specification Update Guide

<http://developer.intel.com/design/pentiumiii/specupdt/>

S-Spec Information (Support)

<http://www.intel.com/support/processors/sspec/p3p.htm>

Known Issues & Solutions (Support)

<http://www.intel.com/support/processors/pentiumiii/>

Intel Pentium® III Xeon processor

Specification Update Guide

<http://developer.intel.com/design/pentiumiii/xeon/specupdt/244460.htm>

S-Spec Information (Support)

<http://www.intel.com/support/processors/sspec/p3xp.htm>

Known Issues & Solutions

<http://www.intel.com/support/processors/pentiumiii/xeon/>

Intel Pentium 4 processor

Specification Update Guide

<http://developer.intel.com/design/pentium4/specupdt/>

S-Spec Information (Support)

<http://www.intel.com/support/processors/sspec/p4p.htm>

Known Issues & Solutions

<http://www.intel.com/support/processors/pentium4/>

Intel Celeron processor

Specification Update Guide

<http://developer.intel.com/design/celeron/specupdt/>

S-Spec Information (Support)

<http://www.intel.com/support/processors/sspec/icp.htm>

Known Issues & Solutions

<http://www.intel.com/support/processors/celeron/>

Intel Xeon processor

Specification Update Guide

<http://developer.intel.com/design/Xeon/specupdt/>

S-Spec Information (Support)

<http://www.intel.com/support/processors/sspec/p4xp.htm>

Known Issues & Solutions

<http://www.intel.com/support/processors/xeon/>

3.2 Thermal Solutions

Since the processor (the processor generating the bulk of the heat) and other components produce heat, all systems require thermal management. Without it, the system will act erratic, generate errors, degrade performance or fail to operate. In this case, “thermal management” includes three major elements:

1. a heatsink properly mounted to the processor
2. local airflow to transfer the heat to the chassis air
3. airflow to evacuate the heated air from the chassis.

The power supply fan and sometimes other chassis fans provide the local airflow in the case and evacuate the heated air from the chassis. See Section 6.6 for more information on chassis and power supplies.

The ultimate goal of thermal management is to keep the processor at or below its maximum operating temperature. The maximum operating temperature is measured at the center of the surface of the processor's thermal plate and varies depending on the particular frequency and stepping of the processor.

Proper thermal management is achieved when heat is transferred from the processor to heatsink, from the heatsink to the chassis air, and from the inside the chassis to the outside. Boxed desktop processors are shipped with an attached high-quality heatsink and most come with a high-quality fan, can effectively transfer processor heat to the system air. It is the responsibility of the system integrator to ensure good system airflow to remove the heat from the heatsink, and from the chassis to the outside air. For OEM processors, you need to add a high quality heat sink/fan to the processor.

The heatsink design allows heat to transfer from the processor, through the thermal interface material, through the heatsink base, and up each of the heatsink fins. Airflow around the fins carries the heat off the fins and into the chassis interior. The heatsink is designed for maximum efficiency when air flows either horizontally or vertically across the heatsink. In some cases, air can be blown directly into the middle of the heatsink, provided that the exiting air is eventually removed from the chassis. The system integrator is responsible for removing the heat from the heatsink fins with localized airflow.

The fan power cable must be connected to the fan power connector and the motherboard power header. The motherboard 3-pin power header uses two pins to supply +12V and Ground (GND). The fan uses the third pin to transmit fan-speed information to motherboards that support fan-speed detection. Your motherboard must have a 3-pin fan power header located close to the slot or socket. Refer to your motherboard manual for the location of the power header.

3.3 Monitoring the Processor's Temperature

If a motherboard has a thermal sensor, the temperature of the processor can be monitored. If the motherboard thinks that the processor is running too hot, it will throttle the processor in attempt to cool it or it could shut down the entire system. These motherboards may allow you to view the temperature using the CMOS/BIOS setup program or by running a software package such as the Intel Active Monitor that comes with Intel boxed motherboards.

Sometimes, in particularly when a new family or stepping of a processor is released, the motherboard may misread the temperature of the processor. If this occurs with the different processors on the same motherboard, you should question is it the processor or is it the motherboard. If you feel little heat coming from the processor and/or heatsink, it is most likely the motherboard misreading the temperature. **Note: Since a heat sink can get very hot, you should be careful not to burn yourself.** To get an accurate reading, you will have to use a thermal measuring device that you will have to put on top

of the processor die. Note: If motherboard misreads the temperature, it can usually be corrected with a BIOS update.

3.4 Installing Processors

Motherboards used with an Intel processor must specifically support the processor type, core speed and stepping. Some older motherboards may not support all speeds and/or all steppings of newer processors. Using a processor in a motherboard that does not support its current electrical requirements can cause permanent damage to the processor or motherboard. Some older motherboards will require BIOS upgrades and microcode updates (for more information on the microcode update, see section 3.4) in order to properly recognize newer processors. In addition, using a processor with the incorrect BIOS revision may cause a system to be unstable. Verify that the specific motherboard and BIOS revision will support the processor that you want to install.

3.5 Slot-to-Socket Adapters (SSA)

Intel does not recommend using slot-to-socket adapters (SSA). See figure 3. If you decide to use a SSA, be sure to follow these critical recommendations:

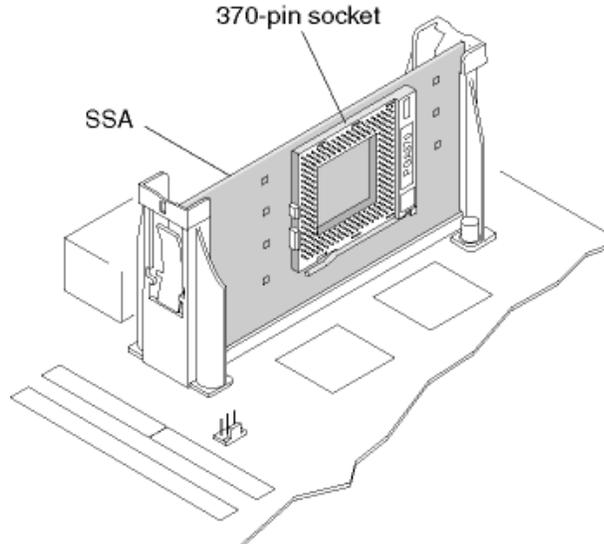
1. The SSA must be recommended by the motherboard manufacturer for use with the specific processor and your selected motherboard. Integrating the Pentium III processor in the FC-PGA package into SSAs that are designed for the Intel Celeron processor may damage the Pentium III processor. For specific validation of any SSA with your motherboard and processor, please check with your motherboard vendor.
2. The SSA must operate the processor within Intel's electrical, mechanical, and thermal specifications.
3. Intel does not validate SSAs for use with Intel branded boards or third-party motherboards.

Note: Severe mechanical and electrical damage may occur to the processor, motherboard, or both if these recommendations and considerations are not carefully followed.

Be aware of thermal considerations and mechanical requirements when installing any SSA. The fan heatsink included in the boxed processor package will provide sufficient cooling. However, this solution violates the maximum mechanical volumetric dimensions and weight restrictions that are recommended for motherboards with the 242-contact slot connector. Violating this recommendation will result in the SSA "leaning" to one side, which may cause broken electrical connections and interference with motherboard components. Therefore, system integrators using an SSA must follow two requirements when installing a Pentium III processor.

1. The SSA is electrically connected and mechanically held secure in the 242-contact slot connector (consider a SSA with a retention mechanism interface).

2. No motherboard components are adversely affected by installing the processor on the SSA.



**Figure 3. Slot-to-Socket Adapter (SSA)
Installed into a Motherboard**

3.6 Multiprocessor

Symmetric MultiProcessing (SMP) involves a computer that uses two or more microprocessors that share the same memory. If software is written to use the multiple microprocessors, several programs can be executed at the same time or multithreaded applications can be executed faster. A multithreaded application is an application that is broken into several smaller parts and executed simultaneously. For example, Microsoft* Word* uses a thread to respond to keys typed on the keyboard by the user to place characters in a document. Other threads are used to check spelling, paginate the document as you type and to spool a document to the printer in the background. The ability for an OS to use additional microprocessors is known as multiprocessing scalability.

When verifying if processors will work for your multiprocessing system, you must first determine if the processors will support multiprocessing and if the processors will work with each other. Therefore, you must check the following:

1. The only processors that are multiprocessing capable are Intel Pentium II, Intel Pentium III, Intel Pentium II Xeon and Pentium III Xeon processors. Note: not all of these processors support multiprocessing. The Intel Celeron, Pentium 4 and mobile processors do not support multiprocessing.
2. Make sure the processor supports multiprocessing. This can be determined by using the respective specification update guide. To determine if the processor supports multiprocessing, find your S-Spec in the Processor Identification and Package Information tables and read the notes for the particular processor to determine if the processor is multiprocessing capable. An S-Spec is the number starts with an "S" and is followed by 4 characters (for example, "SL3CC"). If there

are no notes specifying if the processor supports multiprocessing or not, assume that it supports multiprocessing. See figure 4.

3. The processors must have identical frequency, bus speed and cache size. Processors used in a multiprocessing system must share the same family and model number. This will ensure that processors used in a multiprocessing system will have the same speed, same cache size and same bus speed. In many cases, you may mix processor steppings in a multiprocessor system.
4. Processors must have compatible steppings. By using the specification update guide, you can determine the stepping by referring to the S-Spec in the Processor Identification and Package Information tables. Then you need to cross-reference both steppings, processor speed and bus speed with the DP Platform Population Matrix tables to see if there are any issues and if there are any issues, what are the issues. NI indicates no issues. See Figure 5. Note: Identical silicon steppings may sometimes be shipped with different test specification numbers, depending on whether they are for OEMs (tray processors) or for system integrators (boxed processors).

Even though Intel recommends using identical processor steppings in multiprocessor systems whenever possible (as this is the only configuration which receives Intel's full testing), Intel supports mixing processor steppings, and does not actively prevent various steppings of the Pentium III processor from working together in dual-processor systems. However, since Intel cannot test every possible combination of devices, each new stepping of a device is fully tested only against the latest steppings of other processors and chipset components. In addition, when partially populated systems are shipped, a customer returning for additional processors may have difficulty locating a processor with the same stepping. If this occurs, the customer may have to replace the original processor to obtain a system with two processors of the same stepping.

To make sure that the processors will work in a multiprocessing system, you must make sure that the motherboard will fully support multiprocessing and it will support the specific processors you want to use. Therefore, you should check the following:

1. Due to the variety of motherboard vendors in the market and the number of system BIOS revisions, some system-level issues may occur that lie outside the realm of any mixed stepping evaluation performed by Intel. Intel recommends the following:
 - Choose a motherboard vendor with a history of dual-processor experience.
 - Contact your motherboard vendor for information on mixed stepping validation performed on your particular dual processor motherboard.Note: Although Intel includes a multiprocessing "known issues" table, only the motherboard vendor can say definitively if a particular pair of mixed steppings has been validated in that particular board.
2. The power supply must be able to provide sufficient power to the motherboard with multiprocessors and all peripherals connected to the motherboard.
3. If you use two processors that have different voltages, the motherboard must have two voltage regulators to operate both processors properly.

S-Spec	Core Steppings	CPUID	Speed (MHz) Core/Bus ¹¹	L2 Size (Kbytes)	Tag RAM/Steppings	ECC/Non-ECC	Processor Substrate Revision	Package and Revision	Notes
SL4C7	cC0	0686h	600E/100	256	N/A	ECC	C	SECC2	10
SL4C6	cC0	0686h	600EB/133	256	N/A	ECC	C	SECC2	10
SL4C5	cC0	0686h	650/100	256	N/A	ECC	C	SECC2	
SL4C4	cC0	0686h	667/133	256	N/A	ECC	C	SECC2	
SL4C3	cC0	0686h	700/100	256	N/A	ECC	C	SECC2	
SL4C2	cC0	0686h	733/133	256	N/A	ECC	C	SECC2	
SL4KD	cC0	0686h	733/133	256	N/A	ECC	C	SECC2	8
SL4FQ	cC0	0686h	733/133	256	N/A	ECC	C	SECC2	8

NOTES:

- These parts will only operate at the specified core to bus frequency ratio at which they were manufactured and tested. It is not necessary to configure the core frequency ratios by using the A20M#, IGNEE#, LINT[1]/NMI and LINT[0]/INTR pins during RESET.
- These processors will not shut down automatically upon assertion of THERMTRIP#.
- This is a boxed processor with an attached heatsink.
- Performance-monitoring event counters do not reflect MOVQ and MOVQ stores to memory on these processors.
- These parts will not assert THERMTRIP#, nor will they shut down in the event of an over-temperature condition (e.g., Tj = ~135° C).
- Pin AJ3 is removed from these parts.
- This is a boxed processor with an unattached fan heatsink.
- This is a boxed processor with an attached fan heatsink.
- These processors will not be validated in Dual Processor (DP) applications.
- The "E" and "B" designators distinguish between Pentium® III processors with the same core frequency but different system bus frequencies and/or cache implementations.
B = 133 MHz System Bus
E = Processors with "Advanced Transfer Cache" (CPUID 068x and greater only if a frequency overlap exists)
If, for a given core frequency, Pentium III processors are only available with one system bus frequency and one cache implementation, the above designators will not be used (e.g., not all processors with "Advanced Transfer Cache" will have the "E" designation).

Figure 4: By looking up the S-Spec number in the specification update guide, you can look up the core stepping, speed, bus speed, cache size, package type and notes for the processor.

DP Platform Population Matrix for the Pentium® III Processor with 133-MHz System Bus in the SECC and SECC2 Package from 533MHz to 733MHz

Pentium® III Processor Stepping	533B MHz kB0	533B MHz kC0	600B MHz kC0	533EB MHz cA2	600EB MHz cA2	667 MHz cA2	733 MHz cA2	533EB MHz cB0	600EB MHz cB0	667 MHz cB0	733 MHz cB0	600EB MHz cC0	667 MHz cC0	733 MHz cC0
533B-MHz kB0	NI	NI	X	X	X	X	X	X	X	X	X	X	X	X
533B-MHz kC0	NI	NI	X	X	X	X	X	X	X	X	X	X	X	X
600B-MHz kC0	X	X	NI	X	X	X	X	X	X	X	X	X	X	X
533EB-MHz cA2	X	X	X	NI	X	X	X	NI	X	X	X	X	X	X
600EB-MHz cA2	X	X	X	X	NI	X	X	X	NI	X	X	NI	X	X
667-MHz cA2	X	X	X	X	X	NI	X	X	X	NI	X	X	NI	X
733-MHz cA2	X	X	X	X	X	X	NI	X	X	X	NI	X	X	NI
533EB MHz cB0	X	X	X	NI	X	X	X	NI	X	X	X	X	X	X
600EB MHz cB0	X	X	X	X	NI	X	X	X	NI	X	X	NI	X	X
667 MHz cB0	X	X	X	X	X	NI	X	X	X	NI	X	X	NI	X
733 MHz cB0	X	X	X	X	X	X	NI	X	X	X	NI	X	X	NI
600EB-MHz cC0	X	X	X	X	NI	X	X	X	NI	X	X	NI	X	X
667-MHz cC0	X	X	X	X	X	NI	X	X	X	NI	X	X	NI	X
733-MHz cC0	X	X	X	X	X	X	NI	X	X	X	NI	X	X	NI

NOTES:

- X= Mixing processors at different frequencies is not supported. This stepping/frequency is not supported in Dual Processor.
NI= Currently no known issues associated with mixing these steppings.

Figure 5: The DP Platform Matrix used in the Specification Update Guides can determine if steppings are compatible. In this example, a Pentium III processor running at 600 MHz with a 133 MHz bus and 256 KB cache have no issues between processors using the cB0 stepping and the cC0 stepping.

4. Intel does not recommend using slot-to-socket adapters (SSA) in dual processing systems. If you decide to use a SSA, be sure to that the motherboard manufacturer has validated the specific SSA with the specific motherboard and processor.

Recommendations for Integration of Dual Processor Systems:

1. In dual processor systems, the processor with the lowest feature-set, as determined by the CPUID Feature Bytes, must be the Bootstrap Processor (BSP). The BSP is the processor that starts the boot process. In the event of a tie in feature-set, the tie should be resolved by selecting the BSP as the processor with the lowest stepping as determined by the CPUID instruction. Example of mixing b0 and c0
2. Be sure to use an operating system that supports multiprocessing. Currently, Microsoft Windows NT 4.0, Windows 2000 and Windows XP (excluding Windows XP Home) support multiprocessor and some versions of Linux. Microsoft Windows 95, Windows 98, Windows ME and Windows XP Home edition do not. If you only have one processor installed when you install Windows NT, Windows 2000 or Windows XP, you will need to change the HAL to a multiprocessing HAL when you start using more than one processor. For Linux to support multiple processors, you may have to recompile the kernel. Check with the documentation that comes with the OS.
3. If you use a multiprocessing motherboard and you don't use all of the processors, some motherboards require having a special terminator in the empty processor slot. If the motherboard is self-terminating and you are having problems booting, you may try inserting a special terminator or a matched processor in the empty slot or socket to verify that the self-termination is actually working properly.
4. Check the CMOS Settings. Some boards may have options to retest or enable/disable processors.

3.7 Frequency ID Utility

The Intel® Processor Frequency ID Utility was developed by Intel Corporation to enable consumers the ability to identify and, in some circumstances, determine if their Intel processor is operating at the correct and rated frequency intended by Intel Corporation. Beginning with the Pentium® processor, this utility provides consumers with the ability to determine standard CPU identification of Intel processors. In addition, supported processors can utilize the Frequency Test feature of the utility to help determine if a processor has been overclocked.

Version 3.0 of the Intel Processor Frequency ID Utility has been updated to support the new Pentium® 4, Intel® Xeon™, Pentium III, Mobile Pentium III with Intel SpeedStep™ technology, Pentium III Xeon™ and Intel Celeron™ processors with 66, 100, and 133 MHz system memory bus products, as well as adding new processor identification functionality (CPUID).

There are two versions of the utility available. The Windows version of the utility can be used with systems that support the Windows operating system environment. The

"Bootable" version of the utility does not require an operating system. By installing the tool on a bootable device (e.g. floppy drive) the tool is run as the system is booted, but before the PC's operating system is loaded. This is normally done from a PC's floppy "A:" drive.

There are two separate testing & reporting capabilities in the Intel® Processor Frequency ID Utility represented by unique tabs. Each tab has specific features and acts independent of the other. See figure 6.

Frequency Test Tab (Windows Version) - On supported processors, the utility runs a speed test algorithm to determine the processor's operating frequency and compares it to the processor's expected frequency. Both the reported frequency and expected frequency are displayed on the Frequency Test Tab. If the processor is determined to be running as expected, the utility shows positive test with a "pass" icon. If the utility determines that the processor is running above its expected frequency, it cautions the user that the tested processor appears to be running above its expected frequency - a condition commonly referred to as "overclocked". Please note that the utility will automatically enable the Frequency Testing Tab only if you are using a system with a supported processor.

CPUID Data Tab (Windows Version) - Some operating systems can misidentify new processors. The CPUID Data Tab of the Intel® Processor Frequency ID Utility properly identifies Intel products beginning with the Pentium processor. It also displays the brand name for the Pentium III processor family.

For Intel processors starting from the Pentium processor generation, the utility identifies the product's brand designation (product name) and displays information about the processor's cache size, multimedia instructions, and Intel manufacturing designations. This information is occasionally helpful when communicating with Intel about a customer's specific processor.

For more information on the Processor Frequency ID Utility:

<http://www.intel.com/support/processors/tools/frequencyid/>

To download the Processor Frequency ID Utility:

<http://www.intel.com/support/processors/tools/frequencyid/download.htm>

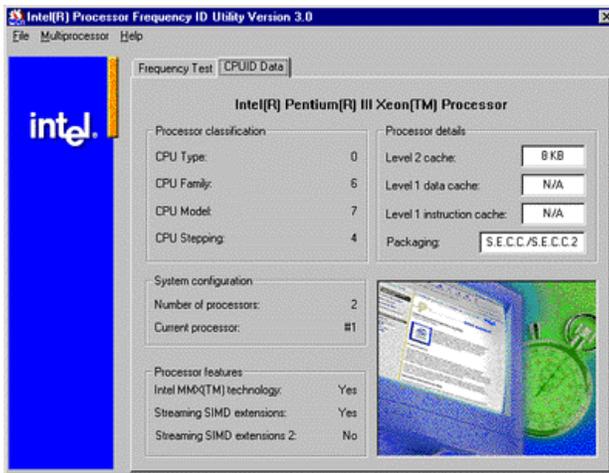
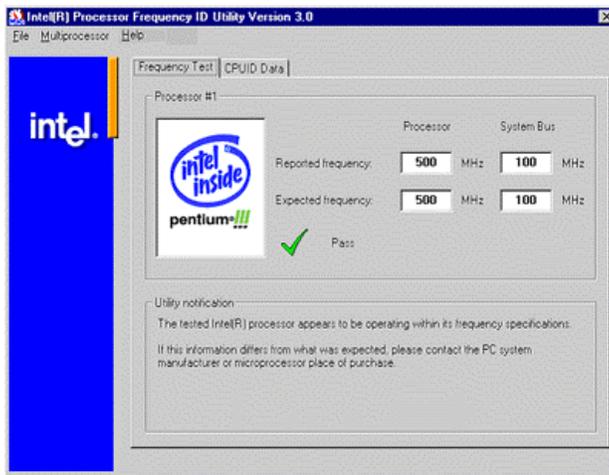


Figure 6: The Intel Processor Frequency ID Utility

4 MOTHERBOARDS

The motherboard, also referred to as the main board or the system board, is the primary printed circuit board located within the PC. It includes connectors for attaching additional boards (expansion slots) and additional devices (ports). In addition, it contains the microprocessor, the RAM chips, the RAM cache, several ROM BIOS chips, CMOS RAM, the real-time clock and several support chips.

4.1 Chipsets

A chipset consists of chips and other components on the motherboard, which allow different PC components to communicate with each other including the microprocessor. It consists of the bus controllers, peripheral controllers, memory controllers, cache controllers, clocks and timers. See table 3 and 4 to identify Intel chipsets.

Table 3: Intel Chipset with Integrated Graphics

Intel Chipset	I/O Controller Hub (ICH)	Graphics Memory Controller Hub (GMCH)	Firmware Hub (FWH)
Intel 810 chipset	82801AA or 82801AB	FW82810 or FW82810DC100	82802AB or 82802AC
Intel 810E chipset	82801AA or 82801AB	FW82810E or FW82810DC100	82802AB or 82802AC
Intel 810E2 chipset	82801AA or 82801AB	FW82810E or FW82810DC100	82802AB or 82802AC
Intel 815 chipset	82801AA or 82801AB	FW82815	82802AB or 82802AC
Intel 815E chipset	82801BA	FW82815E	82802AB or 82802AC
Intel 815EM chipset	82801BA	FS82815EM	82802AB or 82802AC

Table 4: Intel Chipset without Integrated Graphics

Intel Chipset	I/O Controller Hub (ICH)	Graphics Memory Controller Hub (GMCH)	Firmware Hub (FWH)
Intel 815EP chipset	82801BA	82815EP	82802AB or 82802AC
Intel 815P chipset	82801AA or 82801AB	82815P	82802AB or 82802AC
Intel 820 chipset	82801AA or 82801AB	82820	82802AB or 82802AC
Intel 820E chipset	82801BA	82820	82802AB or 82802AC
Intel 840 chipset	82801AA or 82801AB	82840	82802AB or 82802AC
Intel 850 chipset	82801BA	82850	82802AB or 82802AC

4.2 CMOS/BIOS Setup Program

The configuration information is stored in CMOS, a special form of RAM. When you disconnect the power from the RAM, it will forget its content. Yet, when you shut off your computer and you turn on the system later, the PC still remembers the configuration information and the clock still has the correct date and time. This is because the CMOS chip is connected to a battery, which keeps the CMOS circuit powered while the PC is off. This battery is often referred to as the CMOS battery.

The CMOS Setup program (also referred to as the BIOS setup program), which is stored in the system ROM BIOS, varies greatly from computer to computer. Even PCs from the same manufacturer containing the same CPU and system ROM BIOS from the same manufacturer may also have major differences.

Most Intel motherboards have a single jumper block. When the jumper specifies configure mode, the BIOS/CMOS setup program will run, which also includes a maintenance menu that is not available during normal access of the program. See figure 7. **CAUTION:** Do not move the jumper with the power on. Always turn off the power and unplug the power cord from the computer before changing the jumper.

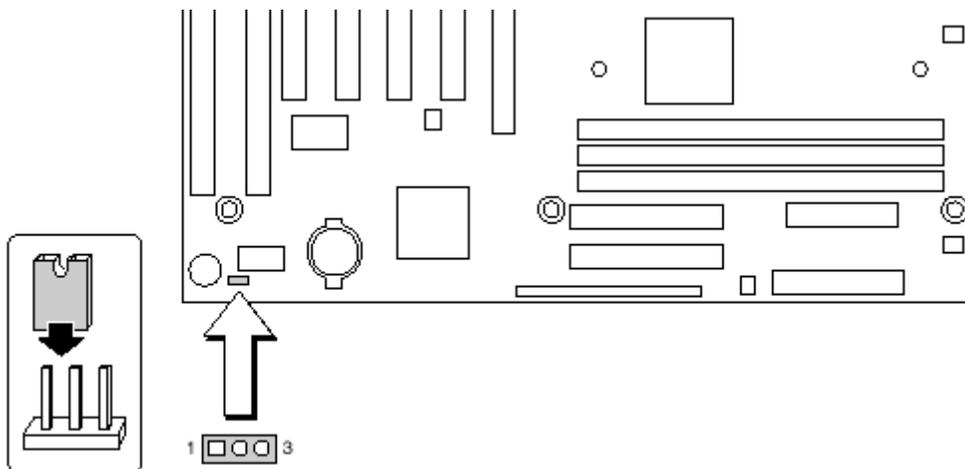


Figure 7: CMOS setup program

Table 5: BIOS Configuration Jumper Settings

Function	Jumper	Configuration
Normal	1-2	Normal operation and changing standard BIOS options
Configure	2-3	After the POST runs, Setup runs automatically. In this mode, you can access the maintenance menu, modify passwords, configure memory latencies and IRQs.
Recovery	none	The BIOS attempts to recover the BIOS configuration. A recovery diskette is required. Note: SPD system memory must be used to complete a BIOS recovery.

BIOS Recovery:

If you are sure that you have integrated the PC components correctly but the system is not booting properly, you cannot enter the BIOS/CMOS Setup program, or reflash the BIOS, then you may need to perform a BIOS recovery. To do this for Intel motherboards:

1. Place the latest BIOS revision on a bootable floppy disk
2. Make sure the system power is off
3. Ensure that you have known-good SPD PC100 or PC133 memory installed
4. Put the BIOS disk in the floppy disk drive
5. Remove the BIOS configuration jumper
6. Turn on the PC

7. Wait several minutes while the BIOS is reinstalled into the desktop board flash memory. There will not be any video during the BIOS recovery.
8. After you hear two beeps and the floppy disk drive light turns off, remove the BIOS disk.
9. Turn off the PC
10. Replace the BIOS configuration jumper
11. Turn the PC back on

To update a BIOS

Before Upgrading to the Latest BIOS, it is very important that you enter the “BIOS Setup Utility” and write down all of your current CMOS settings. For Intel boards, you can also go to the Exit menu and choose the “Save Custom Defaults” options. Choosing ‘Yes’ will cause the current BIOS settings to be saved as a custom default setting. When the CMOS memory is cleared during the BIOS upgrade, the BIOS will default to these custom default settings. If you do not choose to save the defaults as custom defaults, you will need to manually reenter these settings after you have upgraded to the latest BIOS.

For Intel boards, the easiest way to update the BIOS is to use the Intel Express BIOS Update program specific to the motherboard that you have. By executing the downloaded file within Windows* 98, Windows 98SE, Windows ME, Windows NT*, or Windows 2000, the executable file will run a Windows InstallShield* program, which automatically updates the BIOS.

Installation procedure:

1. Go to this Intel Web site: <http://developer.intel.com/design/motherbd/>
2. Click the Express BIOS Update utility for the board's BIOS you want to update.
3. Either download the file to your hard drive or select Run from Current Location. (If you opt to Run from Current Location, skip step 5). Note: Make a note of the path the file is saved to on your hard drive. In addition, You can save this utility onto a floppy disk. This is useful if you're updating the BIOS for multiple identical systems.
4. Close all other applications. Note: This is a required step. Your system will be rebooted at the last Express BIOS Update window.
5. Double-click the executable file from the location on your hard drive where it was saved. This runs the update program.
6. Follow the instructions provided in the dialog boxes to complete the BIOS update.

Intel also provides a DOS based Iflash utility to update your BIOS on all other operating systems. For more information about the Iflash utility, go to <http://developer.intel.com/design/motherbd/standardbios.htm>

4.3 Common BIOS setup option

For the most part, it will be pointless to cover every single BIOS settings. Therefore, I will not cover common well known BIOS setup options in this manual. Instead, this manual will discuss options that are important in troubleshooting a system. Instead of covering each of the BIOS parameters in this section, I will cover a couple of options (see table 6) that don't fit elsewhere in the manual or that are important to be aware of now and cover other parameters throughout the rest of the manual as needed.

Table 6: A couple of BIOS Setup Options

<p>Flash BIOS Protection</p>	<p>Options: Enabled, Disabled This function protects the BIOS from accidental corruption by unauthorized users or computer viruses. When enabled, the BIOS' data cannot be changed when attempting to update the BIOS with a Flash utility. To successfully update the BIOS, you'll need to disable this Flash BIOS Protection function. You should enable this function at all times. The only time when you need to disable it is when you want to update the BIOS. After updating the BIOS, you should immediately re-enable it to protect it against viruses.</p>
<p>Hardware Reset Protect</p>	<p>Options: Enabled, Disabled This function is useful for file servers and routers, etc., which need to be running 24 hours a day. When enabled, the system's hardware reset button will not function. This prevents the possibility of any accidental resets. When set as Disabled, the reset button will function as normal. It is recommended that you leave it as Disabled unless you are running a server and you have kids who just love to press that little red button running around.</p>
<p>Plug and Play Aware OS</p>	<p>This setting is shown on only some BIOSes. If present, enabling this tells the BIOS that you are using an operating system that supports the Plug and Play specification (such as Windows 95). When enabled, the BIOS will look for and initialize any Plug and Play cards in the system. Enable the setting if using Windows 95 or another Plug and Play compatible OS. The default is normally "Disabled".</p> <p>Note: Some BIOSes will perform the initialization of Plug and Play cards automatically regardless of the operating system being used, and will thus not have this setting. Some will work fine with Plug and Play regardless of how this option is set. However, on some systems that have this setting, Plug and Play may not function properly if the setting is disabled.</p>
<p>Virus Warning/ Anti-Virus Protection</p>	<p>Options : Enabled, Disabled, ChipAway When Virus Warning is enabled, the BIOS will flash a warning message whenever there's an attempt to access the boot sector or the partition table. You should leave this feature enabled if possible. Note that this only protects the boot sector and the partition table,</p>

	<p>not the entire hard disk. However, this feature will cause problems with the installation of certain software. One good example is the installation routine of Win95/98. When enabled, this feature will cause Win95/98's installation routine to fail. Disable it before installing such software.</p> <p>Also, many disk diagnostic utilities that access the boot sector can trigger the error message as well. You should first disable this option before using such utilities.</p> <p>Some motherboards will have their own rule-based anti-virus code (ChipAway) incorporated into the BIOS. Enabling it will provide additional anti-virus protection for the system as it will be able to detect boot viruses before they have a chance to infect the boot sector of the hard disk. Again, this is useless if the hard disk is on a separate controller with its own BIOS.</p>
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4.4 Intel Chipset Software Installation Utility

The Intel® Chipset Software Installation Utility was developed for updating Windows Operating Systems with the Plug and Play feature on Intel chipsets. This utility allows the operating system to correctly identify the Intel chipset components and properly configure the system. The Intel Chipset Software Installation Utility installs specific Windows INF files. The INF files inform the operating system how to properly configure the chipset for specific functionality, such as AGP, USB, Core PCI, and ISA PnP services. Since these components are necessary for optimum stability and performance, the Intel Chipset Software Installation Utility should be the first driver loaded after the Operating System is installed. The Intel Chipset Software Installation Utility is not required or compatible with Operating Systems without the Plug and Play feature, such as Windows NT* 4.0.

The Intel Chipset Software Installation Utility for Intel chipsets can be downloaded from the following Intel web site:

<http://developer.intel.com/design/software/drivers/platforms/inf.htm>

After installing the Intel Chipset Software Installation Utility, Device Manager should indicate that your system is now using the Intel Chipset Devices. An example of an Intel 850 Chipset is shown in figure 8. **Note:** After the Intel® Chipset Software Installation Utility is installed, there should not be any yellow exclamation points (!) associated with any of the Intel chipset devices.

For more information about the Intel Chipset Software Installation Utility:

<http://developer.intel.com/design/software/drivers/platform/inf.htm>

To find the Intel Chipset Software Installation Utilities User's Manual:

http://support.intel.com/support/chipsets/chip_man.htm

Note: The User's Manual contains a table that indicates if the Intel Chipset Software Installation Utility is needed for a specific chipset and a specific version of Windows.

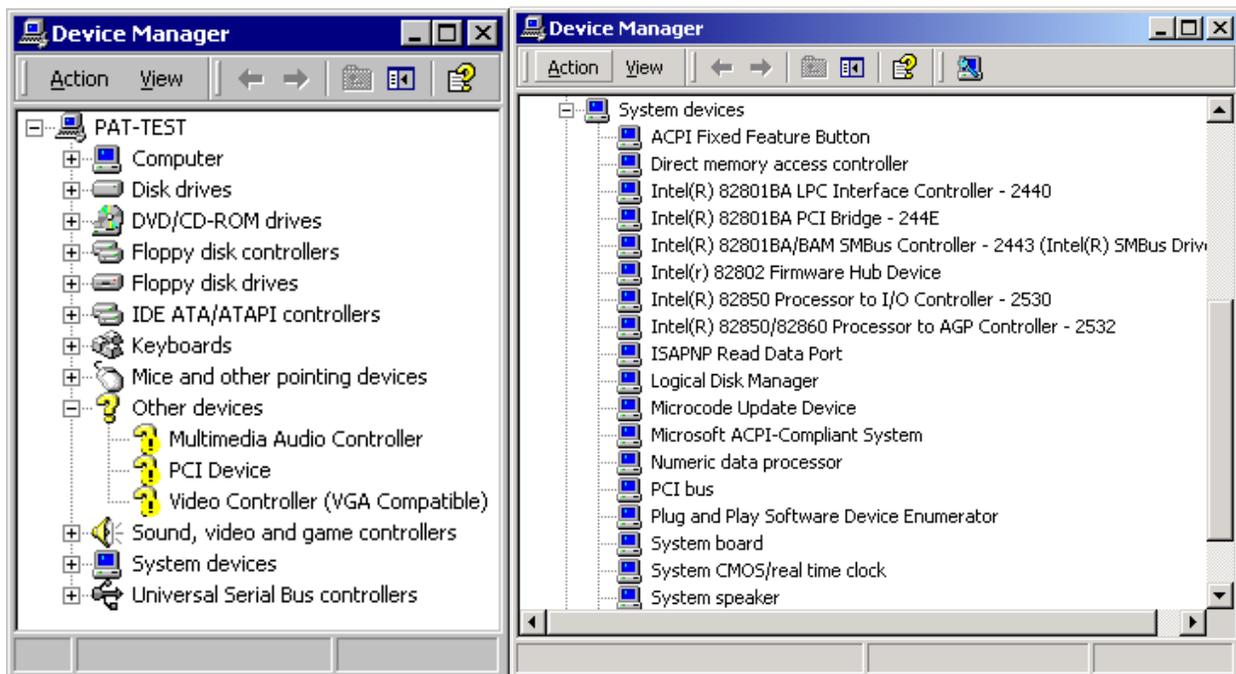


Figure 8: Before you load the Intel Chipset Software Installation utility (INF), you have some unknown devices and after they are identified.

5 RAM

The RAM is considered the main memory or the **primary memory** because RAM is the memory that the microprocessor accesses directly. This means the program instruction that the processor is executing must be first copied to the RAM from a device such as a disk. In addition, the data, such as letters, reports and charts, which are generated by programs, must be in the RAM to be manipulated. Therefore, it is the amount of RAM, which determines how many programs can be executed at one time and how much data can be available to a program. In addition, the amount of memory is a major factor in determining how fast your computer will operate.

5.1 Technologies (SDRAM, DDR, RDRAM)

The most common RAM chips are Dynamic RAM (DRAM) chips, which use a storage cell consisting of a tiny solid-state capacitor and a MOS transistor. A capacitor is a simple electrical device, similar to a battery, which is capable of storing a charge of electrons. The charge or lack of charge represents a single bit of data. If it is charged, it has a logic state of 1. If it is discharged, it has a logic state of 0. The storage cells are organized into a large two-dimensional array or table made up of rows and columns.

5.1.1 SDRAM

Synchronous DRAM or SDRAM differs from earlier types in that it does not run asynchronously to the system clock the way older, conventional types of memory do. SDRAM is tied to the system clock and is designed to be able to read or write from memory in burst mode (after the initial read or write latency) at 1 clock cycle per access (zero wait states) at memory bus speeds up to 133 MHz. SDRAM supports 5-1-1-1 system timing when used with a supporting chipset. The 5-1-1-1 means that it takes the RAM five clock cycles to access the first piece of data in a row. After that row is activated, it only takes one clock cycles each for the next three pieces of data contained within the same row.

SDRAMs are still DRAMs, and therefore still have latency. The fast 12, 10 and 8 nanosecond numbers that everyone talks about refer only to the second, third and fourth accesses in a four-access burst. The first access is still a relatively slow 5 cycles, just as it is for conventional EDO (Extended Data Out) and FPM (Fast Page Memory) memory.

SDRAM modules are generally speed-rated in two different ways: First, they have a "nanosecond" rating such as 8, 10 or 12 nanoseconds. A lower number indicates a faster speed. The second way is the MHz rating such as 100 MHz or 133 MHz. Second, they have a "MHz" rating, so they are called "83 MHz" or "100 MHz" SDRAMs for example. Because SDRAMs are, well, synchronous, they must be fast enough for the system in which they are being used. With SDRAM however, the whole point of the technology is to be able to run with zero wait states. In order to do this, the memory must be fast enough for the bus speed of the system. One place where people run into trouble in this regard is that they take the reciprocal of the "nanosecond" rating of the module and conclude that the module can run at that speed. For example, the reciprocal of 10 ns is 100 MHz, so people assume that 10 ns modules will definitely be able to run on a 100 MHz system. The problem is that this allows absolutely no room for slack. In practice, you really want memory rated slightly higher than what is required, so 10 ns modules are really intended for 83 MHz operation. 100 MHz systems require faster memory, which is why the PC100 specification was developed. Of course, PC66 is designed to run on a 66 MHz bus, PC100 SDRAM is designed to run on a 100 MHz bus and PC133 SDRAM is designed to run on a 133 MHz bus.

Most motherboards are now being created that requires the use of special SDRAM modules that include a technology called a Serial Presence Detect (SPD). This is an EEPROM that contains speed and design information about the module. The motherboard queries the chip for information about the module and makes adjustments to system operation based on what it finds.

As memory components get faster, chips become more dense and more circuits get squeezed onto smaller boards. Dissipation of excess heat becomes more of an issue. Newer memory module designs use heat sinks or heat spreaders to maintain safe operating temperatures.

5.1.2 DDR SDRAM

DDR SDRAM is similar in function to regular SDRAM, but doubles the bandwidth of the memory by transferring data twice per cycle--on both the rising and falling edges of the clock signal. The clock signal transitions from "0" to "1" and back to "0" each cycle; the first is called the "rising edge" and the second the "falling edge".

There are two current forms of DDR system memory running around, each with a variety of interesting names. The first is DDR1600 or DDR200, which runs at 100MHz DDR for an equivalent of 200MHz of bandwidth. On a 64-bit wide memory bus, the memory bandwidth is 1,600 MBps, hence the name DDR1600. The common one used today is DDR2100/DDR266, which runs on a 133MHz giving an equivalent of 266MHz of bandwidth. On a 64-bit wide memory bus, the theoretical peak is about 2,100 MBps of memory bandwidth, hence the name DDR2100.

5.1.3 RDRAM

One of the two main competing standards to replace SDRAM is called Direct Rambus DRAM or DRDRAM (formerly called "Rambus DRAM" or "RDRAM"). DRDRAM works more like an internal bus than a conventional memory subsystem. It is based around what is called the Direct Rambus Channel, a high-speed 16-bit bus running at a clock rate of 400 MHz. As with DDR SDRAM, transfers are accomplished on the rising and falling edges of the clock, yielding an effective theoretical bandwidth of approximately 1.6 Gbytes/second. This is an entirely different approach to the SDRAM and DDR SDRAM, which use a wide 64-bit memory bus. It may seem counterproductive to narrow the channel since that reduces bandwidth, however the channel is then capable of running at much higher speeds than would be possible if the bus were wide. As with SDRAM, DRDRAM makes use of a serial presence detect (SPD) chip to tell the motherboard certain characteristics of the DRDRAM module when the system is booted.

The Rambus Inline Memory Module (RIMM) conforms to the standard DIMM form factor, but it is not pin-compatible. Its architecture is based on the electrical requirements of the Direct Rambus Channel. Since the RAM runs at a faster speed than the DIMMs, RIMMs typically include a heat spreader to help dissipate heat faster. The motherboards support RIMMs will support two or more RIMMs. Since the RIMMs fit into a channel, low-cost continuity modules must be used to maintain channel integrity in systems that have RIMM modules in every memory slot or socket.

For example, for the Intel D850GB Desktop board, all RIMM sockets must be populated to achieve continuity for termination at the Rambus interface. Continuity RIMMs (or "pass-through" modules) must be installed in the second RDRAM bank if memory is not installed. If any of the RIMM sockets are not populated, the computer will not complete the Power-On Self-Test (POST) and the BIOS beep codes will not be heard. In addition, the Bank 0 (labeled on the board as RIMM1 and RIMM2) must be populated first

ensuring that the RDRAM installed in RIMM1 and RIMM2 is identical in speed, size, and density. If the desired memory configuration has been achieved by populating Bank 0, then Bank 1 should be filled with two Continuity RIMMs. If memory is to be installed in Bank 1, the RIMM modules installed in RIMM3 and RIMM4 must be identical in size and density to each other, and match the speed of the RIMM modules in Bank 0. The RIMM modules do not, however, need to match those in Bank 0 in size and density. If ECC functionality is required, all installed RIMM modules must be ECC-compliant. Some motherboards might have Bank 0 set as RIMM1 and RIMM3 and Bank 1 as RIMM2 and RIMM4. Therefore, you need to check your motherboard documentation.

5.2 Troubleshooting RAM Problems

The following are common ways for the computer to tell you it is having problems with memory:

1. The computer won't boot, merely beeps.
2. The computer boots but doesn't recognize all the installed memory.
3. The computer boots but the screen is blank.
4. The computer reports a memory error.
5. Memory mismatch error
6. Memory parity interrupt at xxxxx
7. Memory address error at xxxxx
8. Memory failure at xxxxx, read xxxxx, expecting xxxxx
9. Memory verify error at xxxxx
10. The computer has other problems caused by memory.
11. The computer intermittently reports errors, crashes frequently, or spontaneously reboots.
12. Registry Errors
13. General-protection faults, page faults, and exception errors
14. The server system manager reports a memory error
15. Serial Presence Detect (SPD) not detected

When you have a problem with memory, the cause is usually one of three things:

- Improper Configuration including having the wrong part for your computer or did not follow the configuration rules.
- Incompatibilities with memory modules from different manufacturers, different part numbers or different speeds.
- Improper Installation including the memory may not be seated correctly may need cleaning.
- Defective Hardware including a faulty motherboard or memory module.
- For RDRAM systems, all memory slots or sockets for a channel do not contain a RIMM or a Continuity RIMMs or the RIMM or Continuity RIMM is not installed properly. Note: You will have to check the motherboard documentation to determine which memory slots or sockets are assigned to which channels.

The fact that many computer problems manifest themselves as memory problems makes troubleshooting difficult. For example, a problem with the motherboard or software may produce a memory error message.

The following basic steps apply to almost all situations:

- Make sure you have the right memory part for your computer. At the manufacturer's Web site you can look up the part number. Many memory manufacturers have configurators, which indicate the compatibilities of your module. If not, phone the memory manufacturer, consult your computer manual, or phone the computer manufacturer. Note: On the Intel Support website, Intel list the tested memory list for the Intel motherboards.
- Confirm that you configured the memory correctly. Many computers require module installation in banks of equal-capacity modules. Some computers require the highest capacity module to be in the lowest labeled bank. Other computers require that all sockets be filled; still others require single-banked memory.
- Re-install the module. Push the module firmly into the socket. In most cases you hear a click when the module is in position. To make sure you have a module all the way in the socket, compare the height of the module to the height of other modules in neighboring sockets.
- Swap modules. Remove the new memory and see whether the problem disappears. Remove the old memory, reinstall the new, and see whether the problem persists. Try the memory in different sockets. Swapping reveals whether the problem is a particular memory module or socket, or whether two types of memory aren't compatible.
- Clean the socket and pins on the memory module. Use a soft cloth to wipe the pins on the module. Use a PC vacuum or compressed air to blow dust off the socket. Do NOT use solvent, which may corrode the metal or prevent the leads from making full contact. Flux Off* is a cleaner used specifically for contacts. You can purchase it at electronics or computer equipment stores.
- Update the BIOS. Computer manufacturers update BIOS information frequently and post revisions on their Web sites. Make sure you have the most recent BIOS for your computer. This applies especially when you have recently installed new software or you are significantly upgrading memory.
- Check the BIOS Settings.

6 POWER SUPPLIES AND CHASSIS

The chassis (also sometimes referred to as the case) of the PC is a large metal or plastic box, which is designed to hold and protect the motherboard, the drives and the power supply. Like motherboards and microprocessors, cases come in many different configurations. The cases can be characterized by the orientation of the box, how many drives it can hold, the number of the expansion slots and size of the expansion cards.

Typically, when you buy a case, the case includes the power supply. The primary function of the PC power supply is to convert AC power to clean DC power (+3.3 volts, ± 5 volts and ± 12 volts). The secondary function of the power supply is to provide cooling to the system using a fan.

6.1 Power Supplies and Power

Today, PCs will use either an ATX or ATX12V power supply. It contains software control of the power on/off signal so that it can shut down the system. Since the ATX/ATX12V power supplies are software activated/deactivated, you need to connect the “Power SW” cable from the chassis to the motherboard. If not, you will have to temporary short the two “Power SW” pins on the motherboard. In addition, if you decide to turn on a power supply. Most power supplies require to have a load connected to the power supply. In other words, you must have at least one component such as a drive or motherboard connected to the power supply.

The ATX12V power supply provides increased 12 V, 3.3 V, and 5 V current and provides additional cooling capability. An ATX12V power supply can be easily identified by the addition of an additional new 2x2 pin connector and an optional 1X6 pin connector. For the Pentium 4 and Intel Xeon processors, you should use an ATX12V power supply. See figure 9.

Note: System damage and poor system operation may result if your motherboard is not using the correct power supply. Consult the motherboard documentation to determine power supply requirements.

As already stated, most power supplies designed to be used in the United States operate at 120 volts with a frequency of 60 Hz. In other nations, the supply voltage and frequency may be different. In Europe, you will find 230 volt with a 50 Hz frequency as the standard.

Today, most PC power supplies are willing to operate at either voltage. Some can automatically switch over to the proper voltage while most are done by using a small switch on the rear of the power supply. Ensure when plugging in your PC and turning it on, the correct voltage is selected. If you have a power supply switched over to 230 V and the voltage is 120 V, the PC will not boot up. Unfortunately, if the power supply is set to 120 V and it is connected to a 230 V outlet, it will seriously damage your power supply and other important components.

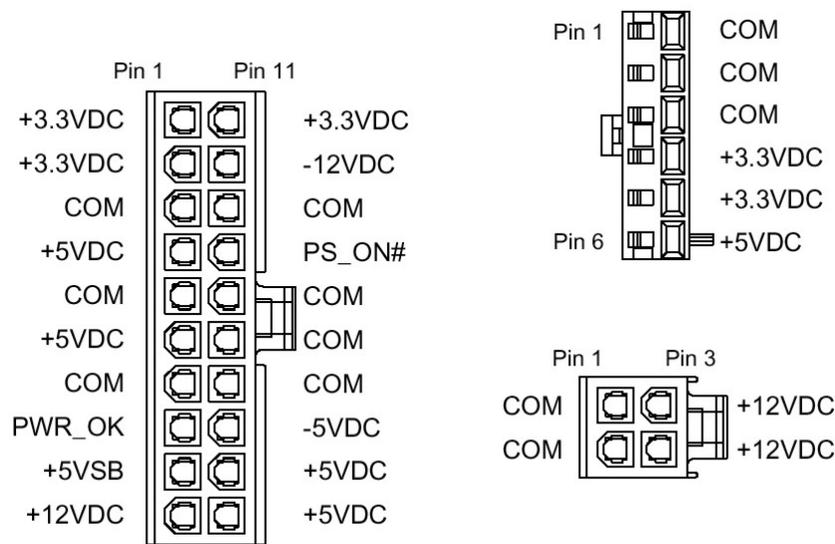


Figure 9: ATX/ATX12V Pinouts

6.2 On/Off Switch

Different from the AT power supply, the ATX power supply uses the PS_ON signal to power up the system. A +5 volt signal is constantly sent through pin 14 (PS_ON) of the ATX power connector. When the PS_ON is shorted tells the power supply to turn on and start the boot process. A push button contact switch is connected to two pins on the motherboard that link to the PS_ON signal to ground. When the push button is pushed, it connects the PS_ON signal to ground, shorting it out. Therefore, when you are installing an ATX motherboard, you need to connect the push button wires (usually labeled PWR SW) to the motherboard. If you decide to test a motherboard without physically installing it into an ATX case, you can start the system by either connecting a push button switch to the motherboard and pressing the button or by taking a small screw driver and make contact with the two pins that make up the power switch connector. Since the switch only toggles the on/off status, the switch carries only +5 V of DC power, rather than the full 110 V AC current used in the T power supplies.

6.3 Shorts and Overloads

Besides supplying the power to the PC components, the power supply also provides the power-good signal. During boot up, the processor tells the computer to constantly reset. As soon as the power supply performs a self-test, testing if all voltage and current levels are acceptable, the power supply will send a power good signal (+5 volts) to the microprocessor. When the power good signal is sent, the computer will finish the boot process.

If the power supply detects a short or overload, the power supply will stop sending the power good signal and the system will reboot. To check for shorts and overloads, you

need to use isolation. First take out all of the expansion cards except the video card and the floppy drive/hard drive controller card and disconnect any drives except your floppy disk drive and your primary hard drive. If the system powers on with the minimum devices, one of the components which you removed or disconnected is causing a short or overload or all of the components together is too much for the power supply. To find out which one is causing the problem, put one expansion card or connect one drive at a time and turn on the system to find out if that device causes the power supply to go into idle mode.

If it still does not work after removing all of the extra devices, it must be the motherboard/RAM, video card, floppy drive/hard drive controller card, floppy drive or the hard drive, which is causing the problem. In this case, you must then replace one device at a time until you find out which one is causing the problem.

If you have the computer working when it is lying on its side but does not work when it is standing erect, or vice versa, usually indicates a short. Check to see if any foreign objects fell into the chassis such as paper clips or screws. In addition, make sure that you have the correct type of spacers located in the proper place (refer to your motherboard documentation) and that the screws that hold the motherboard in place are not too tight.

6.4 AC Power Outlet

The AC power outlet has three wires leading to three connectors. A power plug connects to the AC power outlet and will have two blades and a ground. The smaller blade is the hot wire while the other blade is the return. The wire leading to the slot used for the small blade is usually black while the wire leading to the slot used by the large blade is usually white. The ground is usually green.

To test a power outlet, the voltage between the two slots should be between 110 and 125 volts AC. The voltage between the smaller slot and ground should be the same voltage as measured between the two slots. Lastly, the voltage between the larger blade and the ground should be .5 volts AC or less. See figure 10. Note: an inexpensive outlet wire tester can be bought at any hardware store.

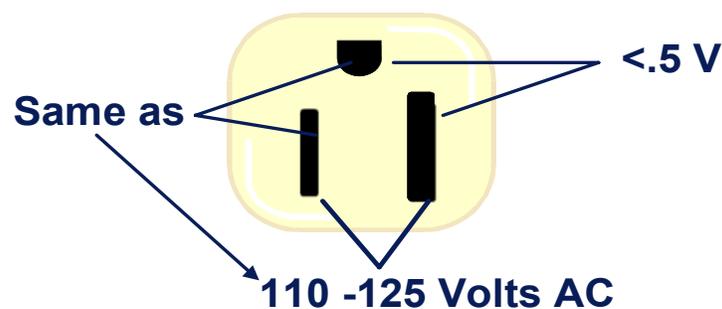


Figure 10: The correct voltage measurements when checking an AC outlet.

It is important to have and use the ground connector. It makes electronic equipment (including computers) safer to work with, prevents continuous electrical shock and will minimize errors on the PC.

6.5 Power Irregularities

When you turn on your PC, you expect the power to be there. Unfortunately, the power that you get from the power company is not always 120-volts AC. The voltage level may drop or increase. While the power supply can handle many of these power fluctuations, other power fluctuations may shut down or damage your computer, corrupt your data and/or lose any unsaved work.

Studies have shown a typical computer is subject to more than 120 power problems per month. The most common of these are voltage sags. Obvious power problems such as blackouts and lightning make up only 12% of the power problems. American Power Conversion states that data loss caused by power problems occur 45.3% of the time making it the largest cause. Symptoms of bad power can cause frozen computers/keyboards, errors in data transmissions, corrupt or lost data, frequently aborted modem transfers and total failure of a computer or computer component. To protect the computer from over voltages and under voltages, several devices can be used. They are surge protectors, line conditioners, standby power supplies and uninterruptible power supplies.

When troubleshooting the PC, you should always be concerned with power related problems. As you have seen, the power problems may be caused by the power supply, bad power provided by the AC power outlet or a PC component, which causes a short or overload. Power problems can cause errors and may cause failure in RAM chips, microprocessors and hard drives. Power related problems may be harder to diagnose because they are sometimes not obviously related to the power and they are often intermittent.

6.6 EMI

Protecting the PC components is not the only function of the case. It also limits the flow of RFI radiation from your computer and into your computer. Since some of the radiation is broadcast as radio and television signals, an electronic component can interrupt a radio, a television set or the navigation equipment used in an aircraft while RFI that enters your system can cause data corruption, lockups and reboots.

To minimize the RFI radiation, computer manufacturers use several techniques. A steel case does a fair job of limiting RFI. If the computer uses a plastic case, the case needs to be treated with conductive paint made with silver to minimize radiation. As the frequencies of the PC increase, so does the radiation. Radio signals can leak out through any cracks in the case or if parts of the chassis are not electrically connected to the case. Lastly, cables attached to the computer can act as an antenna, sending out radio signals. To reduce the emissions, special metal fingers on the edge of the case

and its lid ensure that the two pieces have good electrical contact and the cables are shielded.

6.7 Thermal Management

To provide a complete thermal solution, you must use a chassis that provides sufficient airflow to keep the processor, RAM and other components under its maximum operating temperature in the warmest user environment. Note: This may require extra fans in large tower cases. Running these components above their maximum temperature specification may void the warranty and can lead to functional and performance degradation. The combination of a good fan heatsink, an ATX or microATX form-factor motherboard, and an ATX or microATX-compliant chassis can be a good thermal management solution. If you use Baby AT or 1U chassis, be aware that the airflow varies significantly in the different chassis, depending on venting, internal brackets, and other factors. Chassis with low airflow can cause components to exceed their maximum thermal specification.

7 EXPANSION CARDS AND SLOTS

The **expansion slot**, also known as the **I/O bus**, extends the reach of the processor so that it can communicate with peripheral devices. They are called expansion slots because they allow you to expand the system by inserting circuit boards called expansion cards. They are essential for the computer because a basic system cannot satisfy everyone's needs. In addition, the expansion cards allow the system to use new technology as it becomes available.

By 1987, the Institute of Electrical and Electronic Engineers (IEEE) committee approved the AT bus as the **Industry Standard Architecture (ISA)**. Although the ISA slot is considered legacy technology, even the most advanced motherboards contain some ISA slots. Other names include the classic bus, the AT bus or Legacy bus.

The ISA bus has not had a significant change until 1993 when Intel and Microsoft* introduced the **Plug and Play (PNP) ISA**. The PNP ISA bus allows a PNP ISA card to be inserted and its resources automatically assigned without any need to use jumpers or DIP switches to configure the card. Note: ISA cards, which are not plug-and-play, are referred to as **Legacy cards**.

Instead of physically changing the ISA slot, a plug and play manager (software) identifies the card and assigns its needed resources. This is made possible because the PNP cards contain a ROM chip, which contains a number. Since the number identifies the card, not its model number, several of the same cards can be used within the same system, such as two network cards or two hard drive controllers. After the card is identified, the Plug-and-Play manager assigns the needed resources (I/O and memory addresses, the IRQs and the DMAs) to the card.

Today, when you hear the term local bus, it probably refers to **Peripheral Component Interconnect (PCI)** local bus. The PCI slot was developed by Intel and was designed to eventually replace the older bus designs. The PCI slot is mounted on the system board offset from the normal ISA, MCA or EISA connector. The PCI design provides between 3 to 5 slots.

PCI supports plug and play technology. Different from other expansion bus designs, the expansion cards have their own storage space to store the cards configuration information. Therefore, most PCI cards are not configured using jumpers or DIP switches, but are configured using software or a true plug and play system.

When an expansion card is inserted into a system, it must be configured to use the proper resources. The resources include I/O addresses (including COMx/LTPx), IRQs, DMAs and Memory addresses. When configuring a card, one general rule should apply. No two devices can use the same resource. Therefore, two expansion cards should not be set to use the same DMA channel or the same I/O address. If two devices are using the same setting, the devices will not work properly or not work at all. To determine what the available resources are, use software diagnostic software such as Dr. Hardware*, or Checkit Pro* or use utilities, which come with the operating system such as Windows Device Manager located within the control panel. Note: It is possible to share an IRQ among more than one device, but only under limited conditions. If you have two devices that are seldom used, and that you never use them simultaneously, you may be able to have them share an IRQ. Unfortunately, this can lead to more problems if you are not too careful.

After determining which resources the card can use, the card itself can be configured one of several ways:

1. DIP switches and/or Jumpers
2. Electronically using a software setup program
3. Using Plug and Play (PnP)

Normally, the BIOS assigns unique IRQs to PCI devices. If your system supports PCI IRQ Steering, and it is enabled, the BIOS will assign the IRQs to the PCI devices and Windows will typically only change the IRQ settings if it detects a conflict. If there are free IRQs to go around, IRQ Steering allows Windows to assign multiple PCI devices to a single IRQ, thus enabling all the devices in the system to function properly. Without IRQ Steering, Windows will begin to disable devices once it runs out of free IRQs to assign.

In Windows 95 (OSR2), Windows 98 and Windows Me, to determine if your system is using IRQ Steering, you can access the Windows' Device Manager, double-click the PCI Bus, click the IRQ Steering tab and look at the check box for IRQ Steering. See figure 10.

In Windows 2000, some or all of the devices on your ACPI motherboard may be listed on the Resources tab in Device Manager as using the same IRQ (IRQ 9). You cannot change the IRQ setting because the setting is unavailable. This occurs because Windows 2000 takes advantage of the ACPI features of the motherboard, including advanced PCI sharing. IRQ 9 is used by the PCI bus for IRQ steering. This feature lets you add more devices without generating IRQ conflicts.

The Plug and Play operating system settings in the computer's BIOS should not affect how Windows 2000 handles the hardware in general. However, Microsoft recommends that you set this setting to "No" or "Disabled" in the computer's BIOS. In addition, manually assigning IRQs to PCI slots in the System BIOS as a troubleshooting method may work on some non-ACPI systems when using a standard PC HAL, but these settings are ignored by Plug and Play in Windows 2000 if ACPI support is enabled. If you need to manually assign IRQ addresses through the BIOS to a device on an ACPI motherboard, you will have to disable ACPI support by installing the standard PC HAL, which usually means you will have to reinstall the operating system.

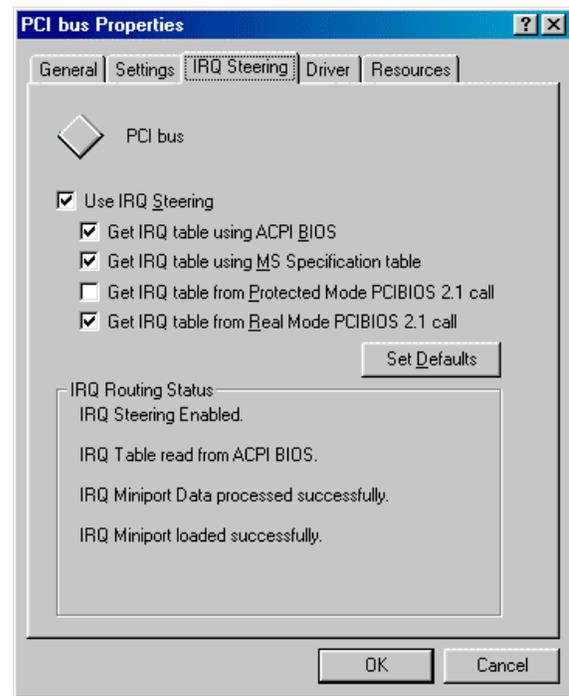


Figure 10: Enabling IRQ Steering in Windows

Note: after installing the expansion card, many expansion cards require software drivers to function. Windows drivers are typically loaded by running the Add New Hardware Driver icon or by using the installation disks that come with the expansion card. Lastly, make sure that you loaded the chipset software that comes with the motherboard immediately after the operating system and any service packs. See section 4.4. Lastly, if you install an expansion card such as a sound card that duplicates a feature that is built into a motherboard, you must make sure that the motherboard device is disabled.

8 DISK DRIVES

Disk drives are half electronic/half mechanical devices, which use magnetic patterns to store information onto rotating platters. They are considered long-term storage device because they do not forget their information when power is disconnected. They are also considered the primary mass storage system because they hold all of your programs and data files, which are fed into RAM. Disk drives communicate with the rest of the computer with a cable connected to a controller card. The controller card could be an

expansion card or could be built on the motherboard. Today, hard drives can be 50 GB or larger.

8.1 Floppy Disk Drives

The drive and controller (Almost always built into the motherboard) are connected together with a gray 34-pin ribbon cable. When connecting the gray ribbon cable, the cable must be connected properly. Pin 1 of the cable is designated with a red or blue stripe. The controller card and drive will use either a small number 1 or 2 to designate which end has pin 1 or use a square solder (other pins use a round solder). Note: Most floppy drives will have pin 1 next to the drive's power connector. Since most computers only have one drive connected to the floppy disk drive, Intel motherboards only have a cable with two connectors, one that connects to the motherboard and one that connects to the 3 ½ inch connector. The one end of the cable with pin 6 filled in connects to the motherboard while the end with all 34 holes connects to the floppy disk drive.

8.2 IDE Hard Drives

Today, there are two main types of hard drives, IDE and SCSI. The **IDE (integrated drive electronics)** interface The IDE hard drive connects to a controller card (expansion card or built-into the motherboard) using a 40-pin cable. Note: the Ultra DMA-66 and Ultra DMA-100 mode requires a special 40-pin cable that has 80 wires, 40 pins for the signal and 40 ground pins to reduce noise. This type of cable is referred to as a 40-pin, 80 conductor. Today, the IDE interface supports up to four IDE devices by using two IDE cables. In addition to hard drives, it supports non-disk peripherals, which follow the ATAPI (ATA Packet Interface). The ATAPI is the protocol used on the Enhanced IDE devices (IDE CD-ROM drives, IDE tape backup drives and other IDE storage devices).

When connecting the ribbon cable, you must make sure the cable has the correct orientation. Pin 1 of the cable (marked with a red or blue stripe along one edge) must be connected to pin 1 of the drive and pin 1 of the cable connector on the motherboard or expansion card. Pin 1 of the drive is designated by a small 1 or 2 printed on the drives circuit board. Pin 1 of the expansion card/motherboard connector can be identified with a small number 1 or 2 printed on the circuit board or will use a square solder (other pins use a round solder). Some drives and cables will have a notch, which will prevent the cable from being inserted incorrectly. If the cable is connected incorrectly, the hard drive may cause a short causing the computer not to boot.

Up to two hard drives can be connected to one IDE cable. If one drive is installed, the drive is known as a stand-alone drive. If two hard drives are installed, the first physical drive is known as the master drive (drive C) while the second physical drive is known as the slave drive (drive D). The master drive got its name because the controlling electronics on the logic board of the master drive control both the master drive and the slave drive. The stand-alone, master, and slave drives are determined with jumpers on the hard drive. Note: it does not matter where the drive and controller card is connected

to the cable. The most common jumpers used to determine a drive as a stand-alone, master and slave device are the Master (M/S) jumper and the Slave Present (SP).

Different from older IDE drives, the connectors on the cable define which connector goes with which device. The blue connector attaches to the controller. The gray connector is in the middle of the cable and goes to any slave drive (if present). The black connector is at the opposite end from the controller connector and goes to the master drive, or a single drive if only one is used. This was done because if you connect a single drive to the middle connector of the ribbon cable, the unconnected cable can cause signaling problems.

The two methods in transferring data are **Processor Input/Output (PIO)** and **Direct Memory Access (DMA)**. Depending on the transfer mode, hard drives can transfer rate up to 100 Megabytes/sec. PIO mode has the transfers directly controlled by the processor while the Direct Memory Access drives use a form of bus mastering. See table 8 and 9.

Table 8: PIO modes used with EIDE devices

PIO Mode	Average Transfer Rate	Flow Controlled	Specification
0	3.3 MB/s	No	ATA
1	5.2 MB/s	No	ATA
2	8.3 MB/s	No	ATA
3	11.1 MB/s	Yes	ATA-2
4	16.6 MB/s	Yes	ATA-2

Table 9: DMA Mode used with EIDE devices

DMA Mode	Average Transfer Rate	Requirements	Standard
0 – Single Word	2.08 MB/s		ATA
1 – Single Word	4.16 MB/s		ATA
2 – Single Word	8.33 MB/s		ATA
0 – Multi-Word	4.16 MB/s	Local-bus controller	ATA
1 – Multi-Word	13.33 MB/s	Local-bus controller	ATA-2
2 – Multi-Word	16.6 MB/s	Local-bus controller	ATA-3
3 – Multi-Word	33.3 MB/s	Local-bus controller	Ultra DMA-33
4 – Multi-Word	66.6 MB/s	Local-bus controller and 40-pin/80 conductor cable	Ultra DMA-66
5 – Multi-Word	100.0 MB/s	Local-bus controller and 40-pin/80 conductor cable	Ultra DMA-100

After the hard drive is configured and physically installed, the next step is to enter the CMOS Setup program and input the proper hard drive parameters for the installed hard drive (such as the number of cylinders, the number of read/write heads and the number of sectors/track or between various modes such as Large or LBA).

8.3 Intel® Ultra ATA Storage Driver

The Intel Ultra ATA Storage Driver is a driver that is designed to take advantage of devices supporting ATA DMA/Ultra DMA technologies and improve system performance. It is not a requirement for your operating system to work properly. Currently, the Intel Ultra ATA Storage Driver supports Intel 810, 815, 820, 840, 850 and 860 chipsets. In addition, you must have either Windows* 98, Windows 98 Second Edition (SE), Windows Millennium Edition (Me), Windows NT* 4.0, or Windows* 2000. To install the Intel Ultra ATA Storage Driver:

1. Install the Intel® Chipset Software Installation Utility before installing the Intel Ultra ATA Storage Driver so that the Intel chipset is properly recognized by the operating system.
2. Download the Intel® Ultra ATA Storage Driver from the Intel website (<http://support.intel.com/support/chipsets/storagedrivers/ultraATA/incon.htm>). Save the file to a known location on your computer's hard drive
3. The installation program will automatically launch from this location
4. Click "Next" at the Welcome screen
5. Read the license agreement and click "Yes" to continue
6. Click "Next" to install the driver in the default folder location
7. Click "Next" to create the default Program Folder
8. The driver files will now be installed. When finished installing, choose the "Yes" to reboot option and click "Finish" to restart your computer. The driver should now be loaded

8.4 SCSI Hard Drives

Another very popular hard drive and system interface is the small computer system interface (SCSI), which is ideal for high-end computers, including network servers. It is capable of supporting multiple devices in and out of the computer. SCSI interfaces that have an 8-bit data bus, referred to as narrow, allow up to seven devices (hard drives, tape drives, CD-ROM drives, removable drives/disks and scanners) connected to one SCSI adapter/controller. It would be eight devices if you count the controller card. SCSI interfaces with 16-bit data bus, referred to as wide, interfaces allow up to 15 devices (16 devices including the controller card). See Table 10.

Table 10: Types of SCSI devices and interfaces

Transfer Mode	SCSI Spec	Bus Width ¹ (bits)	Throughput (MB/s)	Cabling	Signaling Method	Maximum Devices Per Bus	Maximum Cable Length (m)
"Regular" SCSI (SCSI-1)	SCSI-1/ SCSI-2	8	5	50-pin	SE	8	6
					HVD	8	25
Wide SCSI	SCSI-2	16	10	50-pin	SE	16	6
					HVD	16	25
Fast SCSI (also known as Fast Narrow)	SCSI-2	8	10	50-pin	SE	8	3
					HVD	8	25
Fast Wide SCSI	SCSI-2	16	20	68-pin	SE	16	3

(also known as Fast SCSI)					HVD	16	25
Ultra SCSI (Also known as Ultra Narrow or Fast-20 SCSI)	SCSI-3/ SP1	8	20	50-pin	SE	8	1.5
					HVD	4	3
Wide Ultra SCSI (Also known as Fast Wide 20)	SCSI-3/ SP1	16	40	68-pin	SE	8	1.5
					HVD	4	3
Ultra2 SCSI	SCSI-3/ SPI-2	8	40	50-pin	LVD	16	12
					HVD	2	25
Wide Ultra2 SCSI	SCSI-3/ SPI-2	16	80	68-pin	LVD	8	25
					HVD	16	12
Ultra3 SCSI (also known as Ultra 160 SCSI)	SCSI-3/ SPI-3	16	160	68-pin	LVD	2	25
					HVD	16	12
Ultra320 SCSI	SCSI-3	16	320	68-pin	LVD	16	12
					HVD	2	25
Serial SCSI (fiber channel SCSI I)	SCSI-3	Serial	100 MB/s	126	NA	10,000	N/A
Serial SCSI (fiber channel SCSI II)	SCSI-3	Serial	200 MB/s	126	NA	10,000	N/A

¹Narrow=8 bits and Wide=16 bits

8.4.1 SCSI Encoding

Traditional SCSI uses single-ended signaling (SE), which is very similar to that used for most other interfaces and buses within the PC. A positive voltage is a one and a zero voltage is a zero. It was relatively simple to today's more advanced methods and inexpensive to implement.

As SCSI became faster, problems arose with bouncing signals, interference, degradation over distance and crosstalk from adjacent signals. In addition, the length of a single-ended SCSI cable is rather limited. To get around these problems, differential signaling, later renamed to high differential signaling, was used.

As SE could not handle the faster speeds and the cost of differential was considered to high, another form of differential signaling was created. Low voltage differential (LVD), which was defined in SPI-2, took the best attributes of both SE and HVD signaling. It used a lower voltage, which reduced cost and power requirements. It also allowed LVD devices to function on a single-ended SCSI bus. LVD signaling is required for Ultra2 or Wide Ultra2 SCSI (unless HVD) is used) and is required for any SCSI method faster than Ultra2. As you might imagine, LVD has become very popular.

Note: Since single-ended and HVD SCSI use very different voltage levels, they are incompatible at the electrical level. You should not mix single-ended or low voltage

differential devices with high voltage differential SCSI devices on the same bus. If you do, you may damage the single-ended or LVD devices.

Some LVD devices can automatically switch between LVD and single-ended operation by detecting whether the other devices on the chain are running in SE or LVD mode. These devices are called multimode LVD devices and are abbreviated LVD/SE or LVD/MSE (the M is for multimode). Note: As soon as multimode LVD devices begin running as single-ended, all the rules and restrictions of single-ended operations apply, including cable length.

In addition, to the usual SCSI rules, LVD operation requires the following:

- All devices on the chain must be LVD-capable; if even one device is only SE, all devices "drop down" and run as single-ended.
- All devices must not be set to run in SE mode; some multimode devices have a jumper to force SE operation, which will cause the entire SCSI chain to not work in LVD.
- LVD (or multimode LVD/SE) terminators must be used.
- Since single-ended signaling does not support bus speeds over 20 MHz, if you use a faster LVD/MSE device on a single-ended chain, it will run at only a maximum of 40 MB/s.

8.4.2 SCSI Cables

Currently, there are many types of SCSI cables available. Since each SCSI cable must meet the specific electrical requirements associated with the SCSI signaling speeds and signaling methods, the design of any SCSI cable is based on a combination of different attributes chosen to implement a particular kind of SCSI bus. Some of characteristics of the cable include the number of pins, the type of cable (internal or external), the connector type, the length of the cable, the number of connectors, spacing of the connectors on the cable, and the overall quality of the cable. In addition, some cables have a built-in terminator at the end of the cable while others require the addition of a separate terminator.

Narrow cables, officially called "A" cables, are used for all narrow (8-bit) SCSI transfer modes. These are also sometimes called 50-conductor or 50-pin cables after the number of wires in the cable and pins in its connectors. They are organized into 25 pairs of two wires each. Traditionally, each pair generally consists of a signal and a signal return, which is the same as a ground line. Wide cables, officially called "P" cables are used for 16-bit SCSI transfer modes. These are also sometimes called 68-conductor or 68-pin cables after the number of wires in the cable or pins in its connectors. Similar to the narrow cable, the wide cables are also organized into 34 pairs.

Lastly, cables are classified into single-ended and low voltage differential. LVD narrow cables are similar to the SE cables except on each pair consists of a positive and negative complement of the signal. There is also a change to the function of one cable

conductor is used to control the differential signaling. While you can the SE and LVD cables use the same connectors, the LVE are typically a much higher quality to accommodate the faster speeds used in LVD signaling. Therefore, it is not wise to use an SE cable for an LVD implementation. Of course, to determine if a cable is an SE cable or an LVD cable, you would have to look at the connectors for the appropriate icons or text stating the type of cable or to look on the cable itself.

For external cables, you want to use cabling that is specifically rated for LVD use; these cables have been designed and tested for LVD applications, even if they look the same as their single-ended cousins. As with regular wide cables, they may be found with either high density or very high-density connectors. Internal LVD cables are actually very different from SE cables. The reason is that to improve signal integrity, internal LVD cables typically don't use regular flat ribbon cabling. Instead, they use so-called "Twist-N-Flat" cabling, where adjacent pairs of wires are twisted between the connectors, and the wires "flatten out" where the connectors attach.

SCSI cables come in two distinct varieties, external and internal. External cables are used to connect SCSI devices that do not reside inside the PC, but rather have their own enclosures and power supplies. Internal cables connect SCSI devices installed within the PC case. Internal cables are flat ribbon cables like IDE or floppy disk drive cables.

Since external cases are more affected by external environment factors such as electromagnetic interference, the external cables are shielded to protect the data from being corrupted. First, they use twisted pair wiring where the two wires are twisted around each other to reduce the affects of crosstalk. Crosstalk is if you have two copper wires next to each other, the signal will induct (law of induction) or transfer from one wire to the other. Therefore, by twisting the wires around each other, the electromagnetic fields cancel each other, greatly reducing the crosstalk. So an external narrow cable with 50 wires actually contains 25 pairs and a 68-wire cable will have 34 pairs. Second, to reduce the noise and interference, the wires are shielded or wrapped with a metallic shield such as aluminum or copper foil or braid. Since these cables are not simple to manufacture, external SCSI cables quire expensive compared to the internal cables.

Even with internal cables, there are differences in construction such as the thickness of the wire and the insulation that goes over the wires. Better cables generally use Teflon as a wire insulation material, while cheaper ones may use polyvinyl chloride or vinyl. Regular flat cables are typically used for single-ended SCSI applications up to Ultra speeds (20 MHz). For Ultra2 or faster internal cables using LVD signaling, newer wires also use twisted pairs, but overall still keep the shape of a flat ribbon where the connectors go so that you can connect them easily.

8.4.3 SCSI ID Numbers

Each device, including the adapter/controller card, is numbered with a SCSI ID number from 0 to 7. The numbers are selected with jumpers, DIP switches, or a thumb wheel. The SCSI adapter is usually set to ID #7. The primary SCSI hard drive or any other boot device is set to #0. The SCSI ID number do not have to be in order, nor do they have to be sequential. Of course, no two devices within the same chain can use the same SCSI ID number.

The priority that a device has on the SCSI bus is based on its ID number. For the first 8 IDs, higher numbers have higher priority, so 7 is the highest and 0 the lowest. Therefore, if two devices need to be communicating on the SCSI bus, the device with the highest priority will go first and the lower-priority device will have to wait. For Wide SCSI, the additional IDs from 8 to 15 again have the highest number as the highest priority, but the entire sequence is lower priority than the numbers from 0 to 7. So the overall priority sequence for wide SCSI is 7, 6, 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, 8.

In high-traffic settings, you will typically want to set the slower devices (scanners, tape drives) to the higher-priority IDs, to ensure that they are not crowded off the bus by the faster devices like hard disks. For best performance, you might consider moving the slow devices to their own SCSI controller card as they may significantly degrade the performance of the bus. Lastly, if you have devices that absolutely cannot tolerate delays in receiving their stream of data such as CD recording drive or a video encoder, you should also give these devices top priority on the bus.

Today, most SCSI devices use jumpers to configure the SCSI ID numbers. For a narrow bus, three jumpers are required to set the SCSI ID. To represent the SCSI ID number would actually be derived from the binary representation of the jumpers. For example, setting all three ID jumpers off represents a binary number of 0 0 0, which would translate to an ID of 0. A binary setting of 0 0 1 equals ID 1, 0 1 0 equals 2, 0 1 1 equals 3, and so on. Of course, 1 1 1 would be 7. Unfortunately, the jumper can appear either forward or backward, depending on how the manufacturer set them up.

8.4.4 SCSI Termination

The two SCSI devices at either end of the chain must be terminated; the other devices should not be terminated. If only an internal cable is used, the adapter card and the device at the end of the cable need to be terminated, but the other devices in between should not be terminated. See Figure 11, 12, and 13. If using an internal cable and an external cable, the two devices located at the end of each cable should be terminated. To terminate or not terminate a device, the terminators are inserted/removed or enabled/disabled with jumpers or DIP switches. Some SCSI devices can be automatically terminated.

To terminate/not terminate a device, you would either insert or remove the terminators on the end device or enabled/disabled them with jumpers or DIP switches. Some SCSI devices have automatic termination. Today, most have a jumper to enable or disable the termination.

There are several different kinds of termination used on SCSI buses. They differ in the electrical circuitry that is used to terminate the bus. Better forms of termination make for more reliable SCSI chains; the better the termination, the fewer problems (all else being equal) with the bus, though cost is generally higher as well. In general terms, slower buses are less particular about the kind of termination used, while faster ones have more demanding requirements. In addition, buses using differential signaling (either HVD or LVD) require special termination.

- **Passive terminator** – The classic/standard terminator is the passive terminator. The passive terminator uses special electrical resistors to act as voltage dividers. Since they help ensure that the chain has the correct impedance load, they prevent signals from reflecting or echoing when the signal reaches the end of the chain. Passive terminating resistors work well for chains of short distances (2-3 feet) and slower speeds (SCSI-1 specification). The chain should never exceed 6 meters. It is for single-ended SCSI buses only that should only be used in narrow (8-bit) SCSI buses running at 5 MHz.
- **Active Termination** – Active termination acts as voltage regulator to maintain a stable voltage through the chain by utilizing the termination power lines to compensate for voltage drops. Since the active termination helps reduce noise, it allows for longer cable lengths and faster speeds. In fact, active termination is the minimum required for any of the faster-speed single-ended SCSI buses. The chain should never exceed 18 meters. It is for single-ended SCSI buses only.
- **Forced Perfect Terminator (FPT)** – The Forced Perfect Terminator diode clamps are added to the circuitry to automatically match the line impedance by forcing the termination to the correct voltage thus allowing “perfect” termination. It is for single-ended SCSI buses only and should be used for single-ended applications that experience high levels of electrical noise.
- **High Voltage Differential (HVD)** – Buses using high voltage differential signaling require the use of special HVD terminators.
- **Low Voltage Differential (LVD)** – Newer buses using low voltage differential signaling also require their own special type of terminators. In addition, there are special LVD/SE terminators designed for use with multimode LVD devices that can function in either LVD or SE modes; when the bus is running single-ended these behave like active terminators. Note: Many internal cables have a built-in LVD terminator at the end of the cable.

Note: LVD/SE multimode terminators are available. They will function as LVD types on an LVD bus, and as active types on a SE bus. Note that if there any SE devices on the bus, it will function in SE mode and never use LVD mode, severely limiting bus length and performance. If any SE-only terminators or SE devices are on the bus, the bus will default into SE mode.

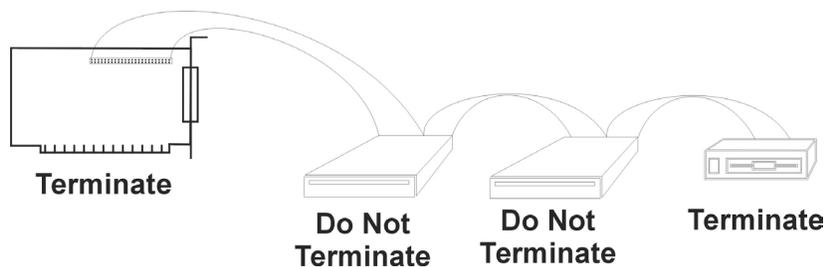


Figure 11: Internal daisy chain

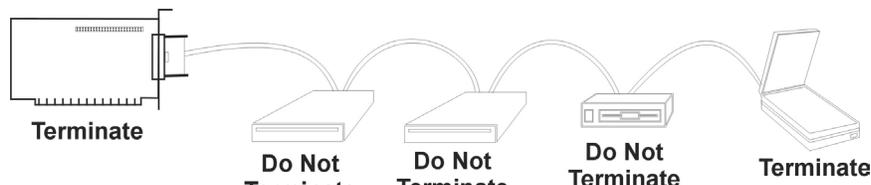


Figure 12: External daisy chain

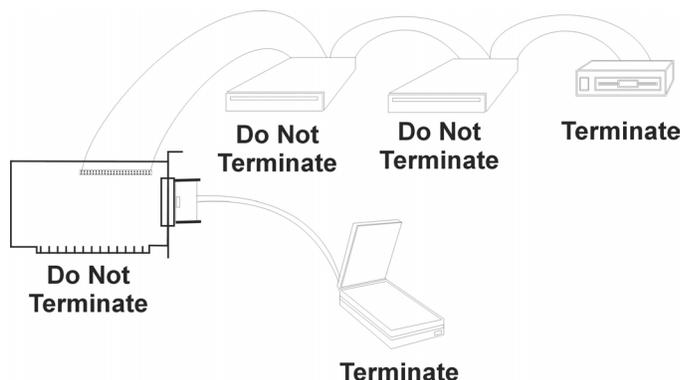


Figure 13: Internal and external daisy chain

8.4.5 SCSI BIOS Programs

While IDE drives are controlled by the system ROM BIOS, the SCSI devices are controlled by a SCSI ROM chip that is on the SCSI controller card or the motherboard if the SCSI is built into the motherboard. During boot up, the SCSI BIOS will search and activate the individual SCSI devices, which is shown during boot up before the operating system is loaded.

As the SCSI BIOS activates the individual SCSI devices, the SCSI BIOS will usually display a message to press a key or key combination to enter a SCSI setup program. Most of these setup programs will allow you to configure the SCSI card (setting the host adapters SCSI ID, enable/disable SCSI parity checking and host adapter SCSI termination), configure the SCSI devices (setup sync negotiation, maximum sync transfer rate, enable disconnection and so on) and SCSI disk utilities (low-level format SCSI hard drives and verify disk media).

The hard drive can consume three or four times more power during the first few seconds after power-on than during normal operations. If several drives are drawing all this power at the same time, the power supply may be overloaded, which can cause the system to hang, have intermittent start problems or to constantly reboot. Therefore, nearly all SCSI drives provide a way to delay drive spinning so that this problem does not occur. When enabled, the SCSI drive will wait until it gets a command from the SCSI host adapter before spinning. It actually does this in order from highest to lower priority. Note: this is not necessary for external hard drives since they get their power from an external power source.

The terminators at each end of the SCSI bus require power from at least one device on the bus. In most cases, the host adapter supplies this terminator power. If no device supplies terminator power, the bus will not be terminated correctly and will not function properly. To ensure that this is not a problem, some people configure all devices to supply terminator power.

8.5 CD Drives and DVDs

The **compact disk (CD)** is a 4.72-inch encoded platter, which is read by laser. To read a CD, you need a CD drive. Since they can hold large amounts of information (680 MB) and are very inexpensive, CDs are used to distribute programs and many people even use them to backup data. Through the years, there have been different kinds of compact disks available in the market. The more common ones include the audio CD, CD-ROM, CD-R and CD-RW and DVD.

Internal CD drives are half-height devices designed to fit into a standard 5.25" open drive bay. Like other drives, the drive is typically held in place with four screws. External drive bays of course sit outside of the computer. Today, most CD drives use an IDE or SCSI interface. Therefore, if it uses an IDE interface, you must configure the drive as either a stand-alone, master or slave and if it uses the SCSI interface, you must configure the drive's SCSI ID number and its terminating resistor.

After the drives are physically installed and configured, the final step to activating the CD drive is to load the device drivers and to configure the operating system so it recognizes the CD drive. This is usually done with an installation disk that comes with the CD drive and/or controller card. Some operating systems will install the proper drivers automatically during installation.

Today, some System ROM BIOS chips support a bootable CD drive (El Torito standard) without loading any CD drivers. Therefore, you can insert a bootable compact disk in the drive and if the CMOS Setup program is set to search the CD drive for a bootable and disk and boot just like the A drive or the C drive.

For DOS and Windows 9X machines, EIDE CD drives that don't follow the El Torito standard, to activate the drive, it requires a device driver to be loaded in the CONFIG.SYS while SCSI drives usually require a device driver for the controller card

and a device driver for the CD-ROM drive. The device drivers allow the operating system to control the CD-ROM drive. Of course, since there are many drives on the market, you must make sure that the driver matches the CD-ROM drive.

Another driver needed to activate the CD drive is a file system extension. The file system extension enables the operating system to identify and use data from CDs attached to the system. For DOS, the file system extension is the Microsoft Compact Disk Extension (MSCDEX.EXE), which is loaded in the AUTOEXEC.BAT. For Windows 9X, the file system extension is built into the operating system. Note: if you boot a Windows 95 or Windows 98 system to Windows DOS mode, the CONFIG.SYS will have necessary device drivers but will not have the file system extension (MSCDEX.EXE) loaded. Therefore, it needs to be executed at the command prompt.

Note: In Windows 9X, you can create a startup disk by double clicking the Add/Remove Programs applet in the Control Panel and clicking on the Startup Disk tab. The startup disk will have the common drivers for most CD drives and includes the MSCDEX.EXE file.

Many read/write errors are caused by dirty or damaged disks. These disks can be cleaned with a soft dry cloth. Make sure you wipe from the inside of the disk to the outside of the disk in a straight line. Scrubbing in circular motions can damage the surface. Never use a disk that has deep scratches, is cracked, or appears to be warped. Such a disk can damage the drive beyond repair.

9 FILE SYSTEMS

Through out the life of the PC, there have been a few different file systems. Today, the most common include:

1. FAT Used by DOS, Windows 95, Windows 98, Windows Me, Windows NT and Windows 2000
3. FAT32 Used by Windows 95B, Windows 98, Windows Me and Windows 2000
4. NTFS Used by Windows NT and Windows 2000

9.1 File System Characteristics

The Master Boot Record (MBR) is always found on the first sector of a hard drive (Master Boot Sector). It tells the system ROM BIOS how the hard drive is divided and which part to boot from. The first 466 bytes consist of a special program code called the Bootstrap Loader. The Bootstrap Loader is the program that locates the first active or bootable partition on the disk. The last 44 bytes contain the Master Partition Table, which list all partitions on the hard drive.

The Volume Boot Sector (VBS) is the first sector of any partition or the first sector of a floppy disk. It is created by a high-level format (DOS's FORMAT program or equivalent). Within the VBS, there is the media parameter block or disk parameter block. The

operating system uses this information to verify the capacity of the disk volume as well as the location of the file allocation table. It contains the partitions boot program. The partition boot program checks and execute the necessary boot files (IO.SYS/MSDOS.SYS, WINBOOT.SYS or NTLDR).

Disks are divided into a circular grid consisting of tracks and sectors. Tracks are concentric circles. Concentric means circles that share the same center much like rings in a tree. Tracks are numbered starting with the outside track as track 0. The tracks are then further divided into sectors where each sector is 512 bytes of useable data. Sectors are numbered on a track starting with 1.

For operating systems, the most basic storage unit is not a sector, but a cluster. Another name for cluster is allocation unit. It consists of one or more sectors (usually more). The size of the cluster depends on the operating system, the version of the operating system, the file system the operating system is using and the size of the volume (partition or floppy disks).

The file allocation table is an index used to remember which file is located in which cluster. It lists each cluster, if the cluster is being used by a file, the name of the file using the cluster and the next cluster if the file doesn't fit within the cluster.

9.2 FAT32

FAT32, which has 32-bit FAT entries, was introduced in the second major release of Windows 95 (OSR2/Windows 95B) and is an enhancement of the FAT file system. It supports hard drives up to two terabytes. It uses space more efficiently, such as 4 KB clusters for drives up to 8 GB, which resulted in 15% more efficient use of disk space relative to large FAT drives.

The root directory is an ordinary cluster chain. Therefore, it can be located anywhere in the drive. In addition, it allows dynamic re-sizing of FAT32 partitions (without losing data) and allows the FAT mirroring to be disabled, which allows a copy of the FAT other than the first to be active. Consequently, FAT32 drives are less prone to failure of critical data areas such as the FAT.

When running newer versions of FDISK on hard drives greater than 512 MB, it will ask whether to enable large disk support. If you answer yes, any partition you create that is greater than 512 MB will be marked as a FAT32 partition.

9.3 NTFS

NTFS is a new file system for Windows NT. Since it was designed for both the server and workstation, it has many enhancements and feature built into it. It supports long file names, yet maintain an 8.3 name for DOS. Since the NTFS is a 64-bit architecture, NTFS is designed to support up to $2^{64}=18,446,744,073,709,551,616$ bytes=16 exabytes.

Since Windows NT includes enhanced security, it supports a variety of multi-user security models and allows computers running other operating systems to save files to the NTFS volume on an NT server. This includes DOS, Windows 9X, Windows NT/2000 Workstation, UNIX (including Linux), and even Macintosh computers. It does not allow DOS to access an NTFS volume directory directly, only through the network (assuming you have the proper permissions or rights to access the volume). It can compress individual files or directories, including infrequently used files or directories. To make a NTFS volume more resistant to failure, NTFS writes updates to a log area. If a system crash occurs, the log area can be used to quickly cleanup problems.

While FAT is simpler and smaller than NTFS, NTFS is generally faster because it minimizes the number of disk accesses required to find a file, which makes access to the file faster, especially if it is a large folder. In addition, it tries to keep the hard drive unfragmented.

9.4 Troubleshooting File System Problems

Since the data on the disk is the most important part of the computer, it is necessary to protect the integrity of the disk. Disk problems and errors can occur without warning and may easily result in a data loss. Some causes include power fluctuations, viruses, parts of the hard drive wearing out, poorly written software, user wear and tear/errors. Some of the errors include:

- Invalid entries in the file allocation table
- Invalid directory entries
- Bad sectors (unreadable areas on the disk)
- Corrupt MBR or corrupt volume boot sector
- Compressed header, compressed file structure, compression structure and signatures
- Lost clusters
- Cross-linked files

The file allocation table and directory entries are databases. Therefore, if part of the database becomes corrupted, part or the entire database may be unusable. Of course, without these two databases, the operating system would not be able to find the clusters belonging to the file. Consequently, the data would be lost.

Bad sectors are areas on the disk, which cannot reliably store the magnetic patterns that make up data. If an area of the disk becomes unreliable, the operating system needs to indicate that those sectors are marked bad on the file allocation table. This way, the operating system will know not to use these areas in the future, which could lead to data loss.

The master boot record consists of the startup program to boot from the disk. If it becomes unreadable, the volume boot sector will not be found during bootup. Of

course, if the volume boot sector becomes corrupt, the computer cannot load the operating systems boot files. In either case, the computer does not boot.

Lost clusters are clusters that get “lost” or detached from a file when a program unexpectedly stops running or isn’t shut down properly, power fluctuations or disk system problems. Unfortunately, the lost clusters may be a very important part of the file (an executable file or a data file). Therefore, when the cluster is no longer part of the file, it may cause the computer to “lock up” or act erratic when the system tries to execute the missing instructions or it may make a data file inaccessible. If the disk system is going bad or the system is experiencing power problems, the system may generate lost clusters. When lost clusters are found on a system, the most likely suspect would be that the user may be shutting off the computer without closing all programs and performing the proper shut down procedure (File, Exit in Windows 3.XX Program Manager or Start, Shutdown in Windows 95/98).

Some utilities that search for and retrieve lost clusters will make them available as a file on the disk (converting lost clusters into chains). Unfortunately, since most files are in machine code, you could not reattach them back to the file in which they came from not to mention, you would have to figure which file it came from and exactly which part of the file the lost cluster is. Therefore, it is best to delete the file. Of course, if the lost cluster was vital for the program to run properly, the program would have to be reinstalled or the data file would have to be restored from a backup.

A cross-link file is the opposite of a lost cluster. Instead of the cluster not belonging to a file, the cross-linked errors occur when two or more files use the same cluster. Typically, the cluster belongs to only one of the files. Therefore, repairing cross-linked files usually results in only one file remaining usable.

To fix disk errors, there are several utilities, which can help. Some example of these utilities include:

- FDISK
- SCANDISK
- DEFRAG

The FDISK is the standard utility used to partition a hard drive. When the hard drive does not boot, FDISK causes the computer to lock up or the changes to the partition table cannot be saved may indicate that the Master Boot Record (MBR) may be bad. What most people who use FDISK don’t know is that it can also be used to recreate the Master Boot Record on Windows 9X systems without changing the partition table. To recreate the MBR, you just boot with a bootable floppy containing the FDISK.EXE program, change to the drive with the corrupt or damaged MBR and perform the following command:

- FDISK /MBR

If you are using a Windows NT, Windows 2000 or Windows XP and you need to repair the master boot record, refer to the Emergency Repair Disk explained in section 14.2.

If this corrects the problem, you should be concerned with what caused the corruption of the master boot record. It could be caused by a virus, power fluctuations when the drive is being access or a failing hard drive. If the problem still exists, try a low-level format.

ScanDisk, Norton* Disk* Doctor* and similar utilities, are design to try to fix disk errors. This includes invalid entries in the file allocation table, invalid directory entries, lost clusters, cross-linked files, problems with the compressed volume, files left in an open status and bad sectors. Unlike the previous two utilities, Scandisk is a menu-based utility. As Scandisk checks a hard drive, it can be divided into two parts. First, it checks disk structure followed by completing a surface scan.

With SCANDISK, you can choose to save the lost clusters to files or to delete them to free up the disk space. If you choose to save them, they will be saved with a CHK extension (examples FILE0000.CHK, FILE0001.CHK, FILE0002.CHK and so on) in the root directory. If you analyze the files with the converted files and find that you do not need them, they can be deleted at any time.

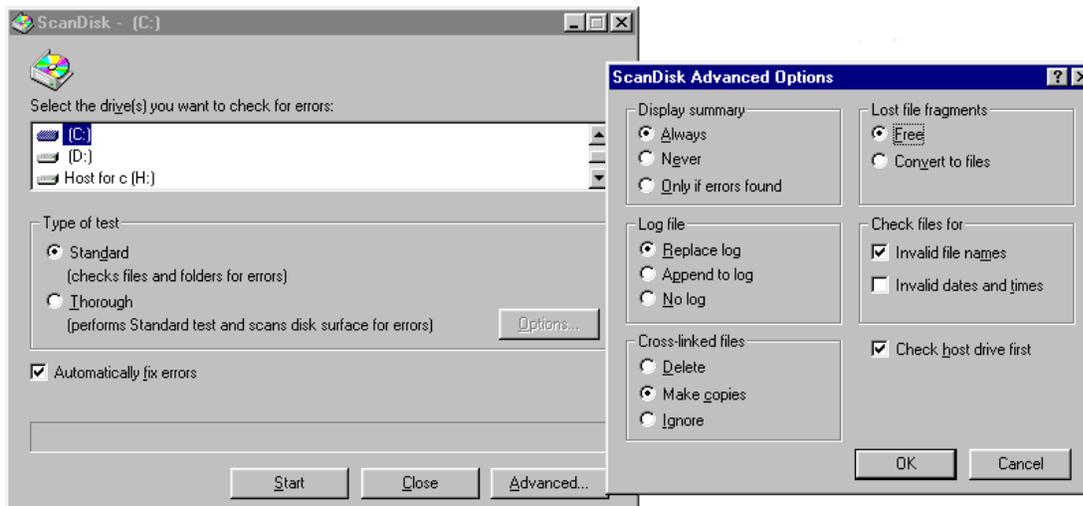


Figure 14: Windows 95's ScanDisk Utility

The surface scan test identifies any sector that may be failing. It accomplishes this by reading the data of a sector, write a predetermined pattern to the sector and reread the sector to make sure that it is the same. If the data is the same, the original information is placed back onto the sector. If it finds the sector unreliable, it marks the sector as bad and move the data to another sector.

Whichever disk utility is used, make sure that it is made for your operating system and file system. If not, the long file names maybe truncated or corrupted, the file allocation table and directories may be corrupted or files may be inaccessible.

Disk Defragmenter and other similar utilities reorganize the files on the hard drive to optimize disk performance. It does this by gathering all parts of a file and placing them in continuous sectors. If the drive is badly fragmented, the program may take several hours to finish. Defrag cannot move files that are marked as system (system file attribute) or hidden (hidden file attribute) since some of these are placed in a particular position on the disk.

10 VIDEO SYSTEM

The video card is the component that takes the visual output from the computer and sends it to the monitor. It tells the monitor which pixels to light up, what color the pixel should be and at what intensity. The video card is an expansion card or is built-into the motherboard.

10.1 Video Characteristics

The image (text, lines, boxes and pictures) on the monitor is made of many dots called picture elements or pixels. The number of pixels that can be displayed on the screen at one time is called the resolution of the screen. The resolution will consist of two numbers, the number of pixels going from left to right and the number of pixels going from top to bottom.

Color depth or bit depth is the amount of information that determines the color of a pixel. If more bits are used to define the number of colors for each pixel, the screen can show more colors. If you have more colors, you can have more shades of the same color, which can lead to a more realistic, detailed picture. Unfortunately, if each pixel has a higher color depth, the video system requires more video memory to store the pixels information and requires more processing by the computer.

For the electron guns to draw the entire screen before the phosphorous material fades, the electron guns must be fast. The number of times that the screen is redrawn in a second is referred to as the refresh rate, which is measured in Hertz (Hz). If the refresh rate is too low, the electron guns do not recharge the phosphorous material before it fades, which causes the monitor to flicker. Although the flicker is hardly noticeable, it can lead to eyestrain. To avoid flickering, you use a refresh rate with at least 70 Hz. The Video Electronics Standards Association (VESA) has established that an 85 Hz refresh rate is the standard flicker-free monitor.

10.2 PCI and AGP

Today, when you hear the term local bus, it probably refers to Peripheral Component Interconnect (PCI) local bus. It is usually found on Pentium systems. The PCI slot was developed by Intel and other companies (see <http://www.pcisig.com>) was designed to eventually replace the older bus designs. PCI boasts a 32-bit data path, 33 MHz clock speed and a maximum data transfer rate of 132 MB/sec.

AGP, short for Accelerated Graphics Port, is based on PCI, but is designed especially for the throughput demands of 3-D graphics. It is called a port because it introduces a dedicated point-to-point channel so that the graphics controller can directly access main memory.

AGP 1x and 2x are part of the original AGP Specification 1.0; AGP 4X is part of the AGP Specification 2.0. AGP 1X is the original version of AGP, running at 66 MHz clock speed, a 64-bit data bus and a maximum transfer rate of 266 MB/second. AGP 2X runs at 133 MHz and offers a transfer rate up to 533 MB/second. AGP 4X cards offers 1.07 GB/seconds, but will only run on boards that are AGP version 2.0 compliant. If you do run an AGP 4X video card onto a board that is only AGP version 1.0 compliant, it will run at 2X.

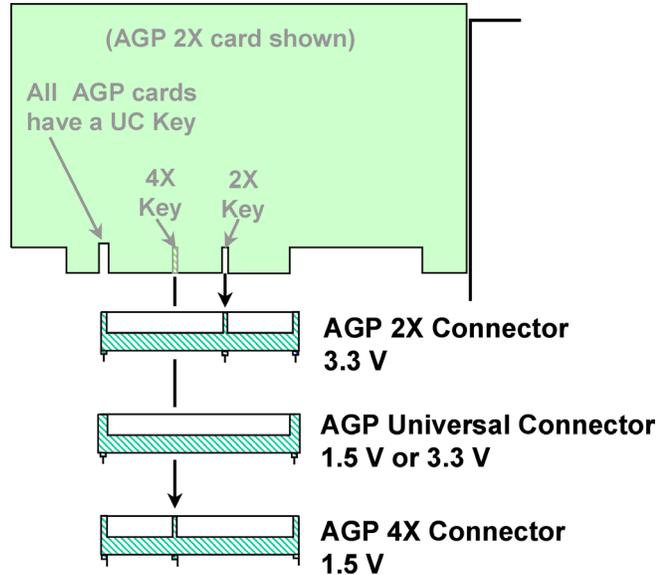


Figure 15: Various Types of AGP Cards

The AGP 2X connectors uses 3.3 volts while the AGP 4X connector uses 1.5 volts. To prevent a AGP 2X card to be inserted into an AGP 4X connector, and vice versa, keys have been added on most cards. Eventually, an AGP Universal connector was introduced that can accommodate both types of cards and support both voltages. Note: The D850GB only supports 1.5 AGP cards.

10.3 Video Driver

The software driver enables your software to communicate with the video adapter. All video adapters including those built into the motherboard come equipped with drivers supplied by the manufacturer. Most manufacturers of video adapters and chipsets maintain Web sites from which you can obtain the latest driver. These new versions may provide better performance or resolve a particular problem. Note: For motherboards with the Intel chipset, unless the operating system has the Intel Chipset Software Drivers built into the operating system, you should load Intel Chipset Software Installation Utility immediately after loading the operating system and service packs, even before the video driver is loaded. See section 4.4 for more information.

The video driver also provides the interface that you can use to configure the display produced by your adapter. On a Windows 9x system, the Settings page of the Control Panel's Display applet identifies the monitors and video adapter installed on your system and enables you to select the color depth and screen resolution that you prefer. By choosing the correct video card and monitor, the driver does not allow you to choose parameters that are not supported by the hardware.

If you click the Advanced button on the Settings page, you see the Properties dialog box for your particular video display adapter. The contents of this dialog box can vary, depending on the driver and the capabilities of the hardware. The Adapter tab displays detailed information about your adapter and the drivers installed on the system. It also enables you to set the Refresh Rate for your display.

Since every modern video card has a graphics accelerator, the Performance tab contains a Hardware Acceleration slider that you can use to control the degree of graphic display assistance provided by the adapter hardware. When troubleshooting, if you slide the bar away from full and the problem goes away will indicate a buggy video or mouse driver. Download and install updated video and mouse drivers and try to revert to full acceleration.

If you choose the wrong video driver or you select a resolution, color depth or refresh rate that your video system does not support and prevents you from viewing anything on the monitor, you can then reboot the computer and enter either VGA mode or Safe mode depending on which operating system you have.

11 PERIPHERALS

So far, we have talked about the basic devices that make up the PC. Now this section discusses how to expand your system by connecting peripherals to your system using the serial ports, parallel port, USB and infrared.

11.1 Serial and Parallel Port

The serial port is used for mice and external modems. Since today's mice are either PS/2 mice or USB, the serial port is not use as much as it used to be. While Windows will automatically have a driver for the serial port, the serial port driver is rarely the problem. Instead, most problems are either in the CMOS setup program. For example, the serial port can be enabled or disabled and the resources (IRQ and I/O addresses) can be assigned. Other problems may be a resource conflict with Windows and a defective cable.

The parallel port is used for printers and some external drives such as zip drives. While Windows will automatically have a driver for the parallel port, the parallel port driver is rarely the problem. Instead, most problems are either in the CMOS setup program. For example, the parallel port can be enabled or disabled, the resources (IRQ and I/O addresses) can be assigned and the transfer mode (ECP or EPP). Other problems may be a resource conflict with Windows and a defect cable.

11.2 USB

The universal serial bus (USB) is an external port allowing connection of external PC peripherals in series. The USB connector will accept any USB peripheral including mice,

keyboards, printers, modems and external disk drives. Seven devices can be connected directly using the standard four-pin connector. These seven devices can then be connected to other, to a total of 127 devices, by connecting external hub (each hub accommodates another seven devices) in a chain (hence, the term daisy chain for this type of serial connection). One of the biggest advantages of the USB interface is that it only requires a single interrupt from the PC for all 127 devices. Note: while USB can support up to 127 devices, it is usually limited by bus speed and power limitations. Lastly, Systems with Windows 98 or newer support hot swappable USB device where you can connect the USB devices while Windows is running and it will automatically be detected (assuming INF is installed) and you will not need to reboot the system.

A USB port or hub can provide power to the attached peripherals. A hub recognizes the dynamic attachment of a peripheral and provides at least 0.5 W of per peripheral during initialization. Under control of the host PC driver software, the hub may provide more device power, up to a maximum of 2.5 W, for peripheral operations. Typically, if you have a device more than 0.5 W, the device must have an external power source such as an AC adapter.

When you attach a Universal Serial Bus (USB) device on a Window system that supports USB, you may receive a "USB Hub Power Exceeded" error message containing the following text:

```
The hub does not have enough power available to
operate the device driver name. Would you like
assistance in solving this problem? If you click No,
the device may not function properly.
```

When this happens, the USB device mentioned in the error message does not work properly and the device listing (in the system properties of the Device Manager properties window for the device) appears with the following error message:

```
A USB device has requested more power than the hub can
provide. Windows cannot enable the device. Remove the
device and restart your computer.
```

To resolve this issue, replace the passive USB hub with an active (powered) hub or disconnect the affected device from the passive hub and connect it directly to the USB host controller's hub (in the back of the computer) or attach an AC adapter if one is available.

USB 1.1 offers a data transfer rate of up to 12 megabits/second. For low-speed peripherals such as pointing devices and keyboards, the USB also has a slower 1.5 Mbit/sec subchannel. Maximum cable length between two full-speed (12 Mbit/sec) devices or a device and a hub is five meters using twisted pair shielded cable with 20-gauge wire. Maximum cable length for low speed (1.5 Mbit/sec) devices using non-twisted pair wire is three meters. These distance limits are shorter if smaller gauge wire is used.

You can view how much bandwidth a USB device uses by right-clicking My Computer and selecting Properties. Click the Device Manager tab, followed by View Devices by Type. Double-click Universal Serial Bus Controllers, followed by the entry for the USB Controller. Next, choose the Advanced tab and click the Bandwidth Usage button.

11.3 Infrared

The IrDA port, sometimes known as Ir port, was developed by the Infrared Developers Association (IrDA), aimed at using wireless technology for the notebook and laptop computers. Today, you can find keyboards, serial port devices (mice and other pointing devices) and parallel port devices, which use IrDA.

Like the name indicates, IrDA ports use infrared light (same as your TV or VCR remote controls) to send data. Infrared is an invisible electromagnetic radiation that has a wavelength longer than that of visible light. So far, the IrDA data rate is four megabits per second. Unlike other wireless technology, Infrared does not use any radio waves. Infrared signals are generated by a tiny light emitting diode (LED), which focuses its beam into a 30 degree cone. To avoid interfering with other infrared devices, IrDA devices don't use much power. Consequently, the two communicating devices must be within a few feet of each other and they must have a clear line of sight between them. In addition, bright sunlight may drown out the signal.

12 NETWORK CARDS AND NETWORKING

As networks have grown in popularity, it is becoming more important to understand how to connect PCs together to form a network. Today, most networks are Ethernet networks on a 10BaseT/100BaseT using unshielded twisted pair cabling.

12.1 Network Cards and Cables

To communicate on LANS, network cards, or network interface card (NIC), found as an expansion card or are integrated into the motherboard, uses transceivers (devices that both transmit and receive analog or digital signals). Today, most network cards are plug and play, so you just have to insert into an empty expansion card while the computer is off and turn the computer on so the appropriate resources such as IRQ can be assigned. If the driver is not automatically loaded, you will have to load it using the Add/Remove Hardware in the Windows Control Panel.

Installing a network card is not much different from other expansion cards. First, you must configure the card's I/O address, IRQ, DMA and memory addresses and any options that are specific to the type of network card that you selected. This would be done with jumpers, DIP switches, configuration software or by plug and play. After the card is physically installed and the network cable is attached, you must then install the appropriate driver (included with the Operating System or a disk that comes with the network card or it will have to be downloaded from the Internet) and client software. In

addition, you must bind the protocol stack to the network card and install any additional network software needed. Depending on the type of the card, the driver may need to have the hardware resources specified (I/O address, IRQ, DMA and memory address). Of course, this needs to match the settings of the cards. Lastly, you should make sure that the LED for the expansion card is active.

A Media Access Control (MAC) address is a hardware address identifying a node on the network, much like a street address identifies a house or building within a city. Much like a street address within a city, you cannot have two network cards or nodes with the same MAC address on the same network. You can have the same MAC address on two separate networks. For Ethernet and Token Ring cards, the MAC address is embedded onto the ROM chip on the card.

When building a 10BaseT/100BaseT network, you must follow these rules:

- The minimum unshielded cable segment length is 2 feet or 0.6 meters.
- The maximum unshielded cable segment length is 328 feet or 100 meters.
- To avoid EMI, you must route UTP cable no closer than 5 feet to any high-voltage (power) wiring or fluorescent lighting.

One advantage of using 10BaseT/100BaseT is that if you need to add another workstation, you just run an additional cable to the hub and plug it in. If there is a break in the cable, the hub has its own intelligence that will route traffic around the defective cable segment. As a result, the entire network is not affected.

Unshielded twisted pair (UTP) is the same type of cable that is used with telephones except it consists of four pairs of wires in each cable. Each pair of wires are twisted around each other and used together to make a connection using an RJ-45 connector (phones connectors use an RJ-11 connector and are a little smaller than RJ-45 connectors). The biggest disadvantages of UTP are its limited bandwidth of 100 meters and it is quite susceptible to interference and noise. Traditional, UTP has had a limited network speed, but more recently UTP can be used in networks running between 4 Mbps and 1 Gbps.

A hub is a multiported connection point used to connect network devices via a cable segment. When a PC needs to communicate with another computer, it sends a data packet to the port, which the device is connected to. When the packet arrives at the port, it is forwarded or copied to the other ports so that all network devices can see the packet. A switch, which is similar to a hub, will only send the packet to port that the packets needs to go, greatly reducing traffic. Most hubs and switches are active hubs, which mean they require power and they act as a multiported repeater for the signal. Note: when installing an active hub, should make sure the fan (which provides cooling) is operating.

Most hubs have a crossover connection that allows you to use a normal cable to connect one hub to another hub. Some hubs will have a separate crossover connection,

some will have a crossover connection and a straight-through connection, which only one can be active at a time and some will have a port that can toggle between a crossover connection and a straight-through connection.

Cables cause the most problems in networks. Since you have an understanding of how the cables are connected together and how the signals travel through the cable system, this will give you a solid foundation in isolating and correcting cable problems.

If the conductor such as a wire has a break in it (known as an open) and there is no other pathway for the electrons, the current will not flow. A short is when a circuit has zero or abnormally low resistance path between two points, resulting in excessive current. A short on a network cable is usually when one wire connects to another wire when it is not supposed to.

To help troubleshoot cables, there are several tools that you can use. The most common are Digital multimeters (DMMs) and a cable testers. Digital multimeters contain at least a voltmeter and ohmmeter. An ohmmeter can be used to measure the resistance of a wire. If the wire is good, the ohmmeter should measure 0 ohms. If you measure infinite ohms, the wire will usually have a break in it. Some of the multimeters will also contain a continuity checker. A continuity check will beep when it measures 0 ohms (indicating a good connection) and will not beep when it measures more than 0 ohms.

A cable tester is a device specifically made to test a cable. An inexpensive cable tester will typically test for shorts and opens. More expensive cable testers (sometimes referred to as an advanced cable tester) can display additional information about the condition of the physical cable as well as message frame counts, error frame counts excess collisions, late collisions, congestion errors and beaconing.

When experiencing a network failure, you must first determine what is affected by the network failure. If only one computer is affected, it is most likely the cable that connects to the individual computer, the defective network card or the driver and client software is installed or configured incorrectly. If multiple computers have failed, you will need to look for a network item that is common to all of the computers. If you are using Ethernet using 10BaseT/100BaseT, look for a hub or a single cable that connects the hub to the rest of the network.

12.2 Cable Modems and DSL Modems

Cable Modem and DSL Modems will be expansion cards, or a small boxes that connect to the USB or a network card. If it were an expansion card or a USB device, you would have to load the appropriate driver. If is a box that connects to a network card, you install the driver for the network card. In either case, you then configure the TCP/IP properties such as the IP address, subnet mask and so on.

12.3 TCP/IP

Each connection on a TCP/IP address is called a host (including server and client) and is assigned an IP address. The format of the IP address is four 8-bit numbers divided by a period (.). Each number can be zero to 255. For example, a TCP/IP could be 131.107.3.1 or 2.0.0.1. Since the address is used to identify the computer, no two connections can use the same IP address.

To make TCP/IP more flexible, a network can be subnetted into smaller networks. To identify which bits are used to define the network number and which bits are used to define the host address, a subnet mask must be assigned. For a network, the network number and the subnet mask must be the same for all computers. The TCP/IP address and the subnet mask are assigned automatically when a computer connects to a network by a Dynamic Host Configuration Protocol (DHCP) server or are assigned by the network administrator. Note: if you are using DHCP and you have manually specified a TCP/IP address, subnet mask, gateway, DNS server or WINS server, the manual settings will always overwrite the DHCP settings.

When a single local area network is connected to other networks, the computers need to know the default gateway, which specifies the local address of a router. If the default gateway is not specified, you will not be able to communicate with computers on other networks.

In Windows 95, Windows 98 and Windows Me, the network components is installed and configured using the network dialog box, which is accessed by clicking on the network applet in the control panel or by accessing the short cut menu of the Network Neighborhood icon and selecting the Properties option. Note: the Network Neighborhood icon does not show on the desktop unless you have some network components installed.

The Identification tab is used to assign the NetBIOS computer name. Much like the MAC addresses, no two computers can have the same computer name on the same workgroup or domain. You can then use utilities such as the Network Neighborhood to access the computer and its network resources by using its computer name. Note: The Computer name is up to 15 characters.

While IP addresses are 32 bits in length, most users do not memorize the numeric addresses of the hosts to which they attach. Instead, people are more comfortable with host names or NetBIOS (Computer) names. Most IP hosts, then, have both a numeric IP address and a host name. While this is convenient for people, however, the name must be translated back to a numeric address for routing purposes. Name resolution is typically done by DNS and WINS. DNS, which stands for Domain Naming System, translates Fully Qualified Domain Names (FQDN) or Internet names to IP addresses. WINS translates NetBIOS name or Computer name to the IP address. The WINS Configuration and DNS Configuration are used to assign the addresses of the DNS and WINS servers, which are used for name resolution.

To show your TCP Settings, type either IPCONFIG /ALL at the prompt if you are using Windows NT4.0, Windows 2000 or Windows XP and WINIPCFG for Windows 9X. Another very useful command to verify a network connection is the PING.EXE command. If you ping the loopback address of 127.0.0.1 and the ping fails, you need to verify that the TCP/IP software is installed correctly. If you ping your own IP address and it is unsuccessful, you need to check the IP address. If you can't ping the IP address of the default gateway/router, you need to verify the IP address (make sure the address is in the correct subnet) and subnet mask. If you can't ping a remote computer on a different subnet or network, you need to verify the IP address of the default gateway/router, make sure the remote host/computer is functional and verify the link between routers.

The PING command can also be used to ping a host/computer by NetBIOS (computer) name or host/DNS name. If you ping by address but not by name tells you that the TCP/IP is running fine but the name resolution is not working properly. Therefore, you must check the WINS server to resolve computer names and the DNS server to resolve domain names.

Another useful command is the TRACERT.EXE command, which sends out a packet of information to each hop (gateway/router) individually, and does it three times. Therefore, the TRACERT command can help determine where the break is in a network.

12.4 Sharing Resources

File and Print Sharing for Microsoft networks gives you the ability to share your files or printers with Windows. Note: just because you enable file and print sharing for an individual computer, you must still share a drive, directory or printer before it can be accessed through the network.

If you enabled file sharing on a Windows computer, you can share any drive or directory by right-clicking the drive or directory and selecting the Sharing option from the File menu or by selecting the Sharing option from the shortcut menu of the drive or directory. You would then provide a Share Name, the name seen by other clients and type of access that users can have. A shared drive and directory will be indicated with an image of a hand under the drive or directory.

The shared drive or directory can then be accessed in one of three ways:

1. Using Network Neighborhood and accessing the resources under the server.
2. Specifying the Universal Naming Convention (UNC) using the Run... option under the Start button. The UNC format is specified as \\computername\sharename.

3. By selecting the Map Drive button on the toolbar of Network Neighborhood or Microsoft Explorer on machines using the Active Desktop.

To share a printer that is connected to a Windows machine, you would share the printer to make it available to other people. To share a printer is very similar to sharing files. You would first install the print driver using the Add Printer icon in the Printer folder. You would then select the printer and you would then choose the Sharing option. After assigning the printer share name and option password, you would then click on the OK button and a hand will appear under the printer to indicate that it is shared.

You would then go to the clients computers, run the Add Printer wizard. Instead of choosing the local printer option, you will be choosing the network printer option. You will then be prompted for the UNC name (//computername/sharename) of the printer. When you print to this printer, the print job will then be automatically redirected to the Windows 95/98 machine and sent to the printer.

12.5 Internet and Browsers

To connect to the Internet, you have to have a direct connection to the Internet, or you have to go through an Internet Service Provider (ISP). If you are using an analog modem to connect, you will typically use an Internet Server Provider. The most common two browsers are Microsoft* Internet Explorer* and Netscape* Navigator*.

If problems do occur when attempting to access the Internet, you must verify the TCP/IP settings including the IP address, subnet mask, gateway and DNS Server addresses. In addition, if you are behind a firewall or go through a proxy server, you must configure your browser. These configuration settings include automatic configuration, configuring through scripts or by manually specifying the settings.

To configure the proxy selection and proxy bypass settings in Internet Explorer:

1. Open the Tools menu, and then click Internet Options.
2. Click the Connections tab, and then click LAN Settings.
3. In the Proxy Server area, select the Use a proxy server check box.
4. Click Advanced, and then fill in the proxy location and port number for each Internet protocol that is supported.

Note: In most cases, only a single proxy server is used for all protocols. In those cases, enter the proxy location and port number for the HTTP setting, and then select the Use the same proxy server for all protocols check box. If you want to manual set the addresses, then enable the Use a proxy server and specify the address and port number of the proxy server. If you need to specify different addresses and/or port numbers for the various Internet services, click on the Advanced button. Note: if you don't know your proxy settings, contact your network administrator or ISP.

For Netscape, the same basic options are available if you:

1. Open the Edit menu and select the Preferences option.
2. Find and open the Advanced option
3. Click on the Proxy option.

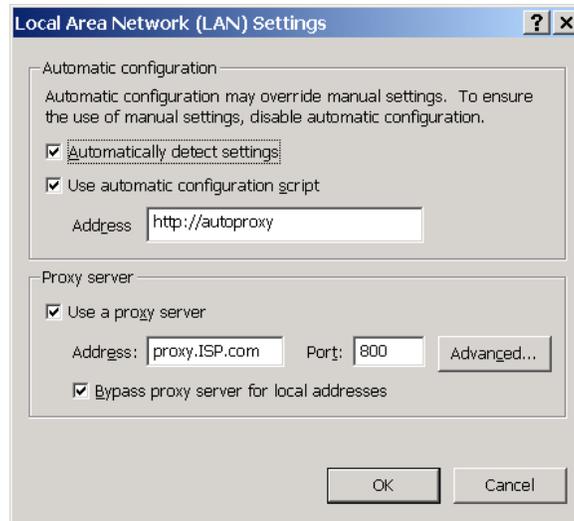


Figure 16: Changing the Proxy settings in Internet Explorer.

13 WINDOWS 95, WINDOWS 98 and WINDOWS MILLENIUM

13.1 Problems with Installation

Windows installation is usually successful; but on occasion problems do occur. These problems are often traceable to legacy hardware or poorly documented off-brand equipment. Windows Setup includes a Safe Recovery feature that helps you recover from failed installations. If Setup fails before hardware detection, when you restart, you'll be asked whether you want to use Safe Recovery to resume the installation. If you choose to use Safe Detection, Setup will inspect the log file setuplog.txt to determine where the installation terminated. Setup will then skip the step that caused the failure and resume the installation. If you choose not to use Safe Recovery, Setup will start over with the installation.

If Setup fails during hardware detection, a log file called detcrash.log will be created. detcrash.log gives Setup the information it needs to resume the hardware detection and bypass the step that caused the failure. If detcrash.log is present in the root directory of the boot partition, Setup will automatically switch to Safe mode. As you'll learn later in this section, a text-file equivalent of detcrash.log called detlog.txt is also created so that users can review hardware detection information. See Table 11.

Table 11: Various log files for Windows 9X.

Windows Setup Files	Description
setuplog.txt	<p>setuplog.txt is an ASCII text file that contains a log of the installation process. As Windows 9X installation progresses, entries are written into setuplog.txt for each step in sequence. This file is used by Windows 9X's Safe Recovery feature in case of setup failure, and you can use it to look for the source of Setup errors. setuplog.txt is stored as a hidden file on the computer's root directory. Because new entries are added to setuplog.txt chronologically, start at the end of the file if you're trying to determine what caused the Windows 9X Setup program to fail.</p>
detcrash.log	<p>detcrash.log is a binary file containing information on Windows 9X Setup's hardware detection process. When Setup fails during hardware detection, detcrash.log is created as a hidden file in the root directory of the installation drive. When you reboot, Setup will use the information in detcrash.log to restart the installation. An ASCII equivalent of detcrash.log, called detlog.txt, is also created.</p>
detlog.txt	<p>This is an ASCII text file that contains a record of all devices found during the hardware detection phase of installation. If a device is found, the detected parameters are identified and recorded. detlog.txt is stored as a hidden file on the computer's root directory. Information is added to this file in the same order as the hardware detection phase. If you need to determine what caused the Windows 9X Setup program to fail or lock up, refer to the entries at the bottom of this file before restarting the system.</p>
netlog.txt.	<p>This is an ASCII text file that contains a record of all detected network components found during installation. The network detection phase consists of four parts. These correspond with the four class types of network configuration: network clients, network protocols, network adapters, and network services (such as file and print sharing). netlog.txt is stored as a non-hidden file on the computer's root directory. Information is added to this file in the same order as the network detection phase. If you need to determine what caused the Windows 9X Setup program's failure to communicate across the network, refer to the entries in this file. You will see where Windows 9X found the network adapter and identified which protocols, clients, and services to bind to the card. At the end of each line, you should see OK. If you see a line such as Couldn't determine..., or some other failure notice, you have found your problem.</p>
bootlog.txt.	<p>This is an ASCII text file that contains a record of the current startup process when starting Windows 9X. When Windows 9X is started for the first time, bootlog.txt is created automatically. For subsequent reboots, you can create a bootlog.txt file by pressing F8 at startup (to invoke the Boot menu) and choosing the Boot menu option Logged (\bootlog.txt). You can also create a Boot log by running win.com from the command line and including the /b switch. bootlog.txt records the Windows 9X components and drivers as they are loaded and initialized, and records the status of each step. The information in bootlog.txt is written in sequence during startup. You might need to examine the information closely to determine which error occurred. The Windows 98 Resource Kit has a good description of the sections within this file. bootlog.txt is stored as a hidden file on the computer's root directory. Information is added to this file during the Windows 9X startup process. If you need to determine what caused Windows 9X to fail or lock up, refer to the entries within this file before restarting again. bootlog.txt seems to write everything twice. The first line will read something like Loading VXD=..., and the next line will read something like LoadSuccess VXD=.... In troubleshooting, it is important to see what loaded successfully, as well as what loaded unsuccessfully. bootlog.txt provides that information.</p>

Given Setup's elaborate recovery mechanisms, the best thing to do if Setup fails is to restart your system and let Setup try to work around the problem. Microsoft recommends the following action (in this order) if Setup stops unexpectedly:

1. Press F3 or click on the Exit button.
2. Press Ctrl + Alt + Del.
3. Turn off your computer, wait 15 seconds, then restart.

If Safe Recovery does not solve your Setup problems, you can use Setup's log files to guide your troubleshooting. The Windows Setup program creates the log files `setuplog.txt` and `detlog.txt` (if Setup fails during hardware detection). Another pair of files (`netlog.txt` and `bootlog.txt`) is created as Windows starts up the first time.

The first step in troubleshooting Windows 9X setup issues is to get back to the basics. When installation fails early in the setup process, it is often related to one or more of the following issues:

1. Is a disk management utility installed? If it is, can you safely remove it? This might entail a BIOS upgrade (if available) and quite possibly require using FDISK and repartitioning the drive. If this is the case, do you have a good backup?
2. Is the disk compressed with a third-party utility? If so, can you safely uncompress the drive?
3. Does Setup hang during the ScanDisk phase of installation? (An application is considered to be hung if it is still running, but not responding to any messages from the system.) If Setup does hang during the ScanDisk phase, you can manually run ScanDisk, and force a thorough inspection of the drive prior to Windows 98 installation.
4. Have you disabled virus protection? Remember, it may be loading automatically from your previous OS, or it may be enabled in the computer's BIOS. Some anti-virus programs prevent writing to the boot sector of the hard disk. If this is the case, Windows 98 Setup will either fail to install, or will not load correctly. To correct this situation, you must disable the virus protection. After Windows 98 is properly installed, you can re-enable virus protection.
5. Have you turned off power management? At times power management can cause problems (particularly if your computer decides to take a nap during a lengthy phase of Windows 98 Setup).
6. Have you made certain that your computer does not have a virus? Run a current anti-virus program and check for viruses after booting from a known clean disk. (Don't forget to disable virus protection before restarting Setup.)
7. SmartDrive can cause problems with some SCSI hard disks. By default, during Windows 9X Setup, Smart Drive is loaded, but double-buffering is turned off. To work around this situation, simply use the `/c` switch to run Setup without SmartDrive.
8. What is being loaded from the `autoexec.bat` and `config.sys`? To see if `autoexec.bat` or `config.sys` may be causing the problem, perform the following steps:
 - a. Rename `autoexec.bat` by typing the following from the command line: `ren c:\autoexec.bat autoexec.aaa.`

- b. Rename config.sys by typing the following from the command line: ren c:\config.sys config.aaa.
- c. Restart the computer and run Windows 98 Setup again.

If none of these helped, check for incompatible hardware, incompatible TSR or driver, faulty hardware and viruses

13.2 Boot Problems

A large majority of the technical problems that arise under Windows 98 can be traced back to the configuration files and how these files control the boot process. Isolating which of these settings are incompatible with Windows 98 can be difficult. Windows 98 includes a number of features that will help you restart your system after a boot failure and find the source of the problem:

1. The Startup menu
2. The Startup disk
3. Win.com switches
4. System Configuration Utility

Pressing the Ctrl key when you boot your Windows 98 computer invokes the Windows 98 Startup menu, which provides a number of different modes in which Windows 98 can be booted. If the system fails to start normally, you may still be able to reboot into one of these alternative modes in order to troubleshoot the problem. The Startup menu options depend in part on the parameters specified in the msdos.sys file, but generally consists of those listed in table 12:

Table 12: Windows 9X Startup Menu

Startup Menu	Description
Normal mode	This is the normal operation mode of Windows 98. If you boot to the Startup menu but then decide to complete the boot process and start Windows 98 under normal conditions, select this mode.
Logged mode	When you select Logged mode, the entire boot process is logged to a file called bootlog.txt, which catalogs VxD initializations, driver loads, and various other boot-related events. bootlog.txt was described earlier in this chapter. You can use the boot log to determine where the boot failure occurs and what the system is doing at the time. Aside from the logging, the Logged mode performs a normal boot procedure (of course it will be a bit slower because it writes to the bootlog.txt file). bootlog.txt will normally be found in the root directory. You can load bootlog.txt into a text editor such as Notepad to examine the contents.
Safe mode	Safe mode is likely the single most important troubleshooting tool available in Windows 98. In this mode, a number of key Windows 98 components and settings are disabled, including the following: <ul style="list-style-type: none"> • config.sys and autoexec.bat • The [Boot] and [386Enh] sections of system.ini • The Load= and Run= parameters of win.ini • The Startup program group • The Registry • All device drivers except the keyboard, mouse, and standard VGA video drivers

	<p>Disabling these items allows the separation of fundamental operating system problems from those caused by a combination of software factors. In a situation in which the display is not functioning properly in Normal mode, for example, if the problem does not appear in Safe mode, the problem probably is video driver-related and is not due to a defective video card.</p> <p>Similarly, you can use Safe mode to troubleshoot scenarios such as the following:</p> <ul style="list-style-type: none"> • GPFs (General Protection Faults) • Application hangs • A hang during the boot process • A blank screen at boot time
Step-by-Step Confirmation mode	This boot mode is similar to the F8 function of previous versions of MS-DOS; it permits the user to step through the various stages of the boot process and specify whether each should or should not be completed. This mode can be very useful when you are trying to isolate boot stages to determine which may be causing a given problem. You can also use it to view system responses to various parameters in <code>config.sys</code> and <code>autoexec.bat</code> , which otherwise are displayed far too quickly to read.
Command-Prompt-Only mode	Command-Prompt-Only boot mode is similar to a normal boot of MS-DOS. Only <code>config.sys</code> , <code>autoexec.bat</code> , <code>command.com</code> , and the Registry are processed (along with any necessary disk compression drivers). This mode is useful in troubleshooting problems running MS-DOS applications in a VM under Windows 98. If the application functions in this mode but not inside Windows 98, the problem is likely due to a compatibility issue. If the application does not function in Command-Prompt-Only mode, the problem is likely a configuration problem in <code>config.sys</code> or <code>autoexec.bat</code> , or the application may be corrupt.
Safe Mode Command-Prompt-Only mode	Safe Mode Command-Prompt-Only mode is similar to a Safe mode, except that <code>command.com</code> is processed. Also, Startup does not load <code>himem.sys</code> or <code>ifshlp.sys</code> and does not execute <code>win.com</code> to start the Windows interface. This mode is useful if your computer fails to boot properly in Safe mode. Safe Mode Command-Prompt-Only mode offers slightly different options from Safe mode, so you can use it for slightly different situations. For instance, you can use this mode if you don't want Windows to process <code>win.com</code> or <code>himem.sys</code> .
Previous Version of MS-DOS	Although the Previous Version of MS-DOS boot mode is not intended for troubleshooting, it can be used in situations in which particular MS-DOS-related functions worked in previous versions of MS-DOS but do not seem to function properly under Windows 98. Of course, you can boot to a previous version only if you upgraded the computer from a previous version.

You can create the Startup disk at installation time or later through the Startup Disk tab of the Add/Remove Programs Control Panel.

The disk serves as an emergency boot disk should the operating system fail to load. In addition to the boot files necessary to start Windows 98 in Command-Prompt-Only mode, the Startup disk contains several tools you can use to troubleshoot boot problems. Some of those tools are as follows:

If you can boot to the Windows 98 Startup disk, you can navigate through your hard drive to find a file that is interfering with the boot process. You can also troubleshoot your hard drive using ScanDisk, or even reformat and repartition your hard drive (start over) using `format` and `fdisk`. The CD-ROM drivers on the Startup disk will provide you

with access to the Windows 98 installation CD, in case you'd like to reinstall Windows 98 or copy files that are located on the CD.

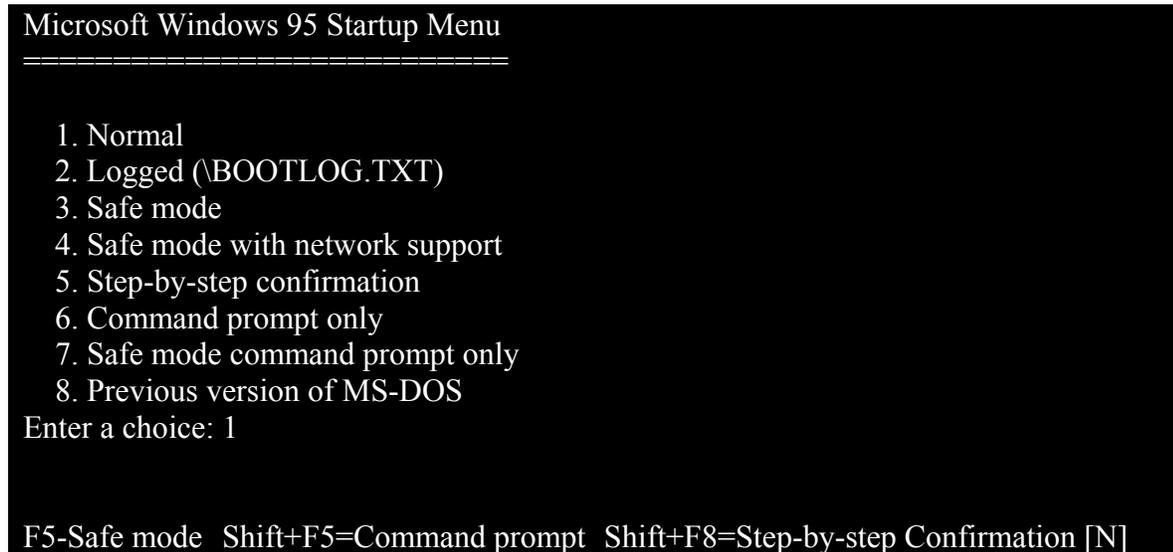


Figure 17: Windows Startup Menu

Win.com includes support for a number of error-isolation switches. Although some are available from within Windows 98, you may have to specify them from the command prompt in situations in which Windows 98 fails to load. These switches are specified in the following format:

```
win /d:[f] [m] [n] [s] [v] [x]
```

Table 13: WIN switches

Switch	Function
F	Disables 32-bit file system drivers
M	Starts Windows 98 in Safe mode
N	Starts Safe mode with networking
S	Excludes the ROM address space between F000 and 1MB from use by Windows 98
V	Tells Windows 98 that the ROM routine should handle disk interrupts
X	Excludes the adapter area from the area that Windows 98 scans when looking for unused disk space

You can use these switches independently or together as part of a single command. If Windows won't start normally, you may be able to boot to a system disk and run win.com using one or more of these switches to isolate the problem.

Boot failures are often caused by drivers or settings invoked through one of the Windows Startup configuration files.

System Configuration Utility is an ingenious tool that lets you turn off or turn on specific entries in the Startup files autoexec.bat, config.sys, system.ini, or win.ini. You can also make other changes to the startup process that may help with diagnosing startup problems. The System Configuration Utility General tab is shown in Figure 18.

Note that, in addition to a normal startup, you can choose Diagnostic startup, or you can choose to selectively disable files. The tabs named for the Startup files (autoexec.bat, config.sys, system.ini, and win.ini) let you enable or disable specific statements within the file.

You can also change the order of the statements within the file by using the Move Up and Move Down buttons. Or, you can add a new statement to the file or edit a statement by using the New and Edit buttons. The Startup tab lets you decide whether to load certain items at startup.

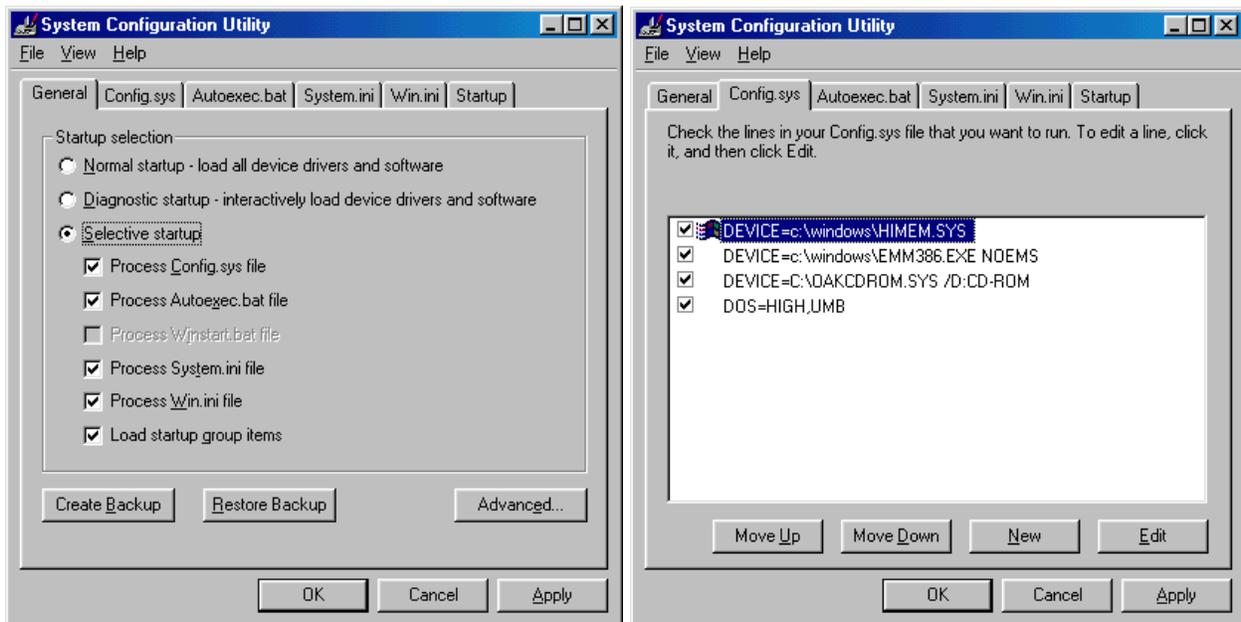


Figure 18: System Configuration Utility allows you to selectively load certain components.

Windows system problems often occur at startup. These problems are, of course, impossible to troubleshoot if you can't start your system. Windows includes several methods for starting Windows that may help you diagnose a problem, or at least, start the system so you can pursue other troubleshooting remedies. The preceding sections discussed some of these options. The first step is usually to boot your system using the option boot modes of the Startup menu such as Safe mode or Step-by-Step Confirmation mode. The win.com switches are usually for subtler problems. System Configuration Utility is often useful for troubleshooting startup problems related to older devices and applications.

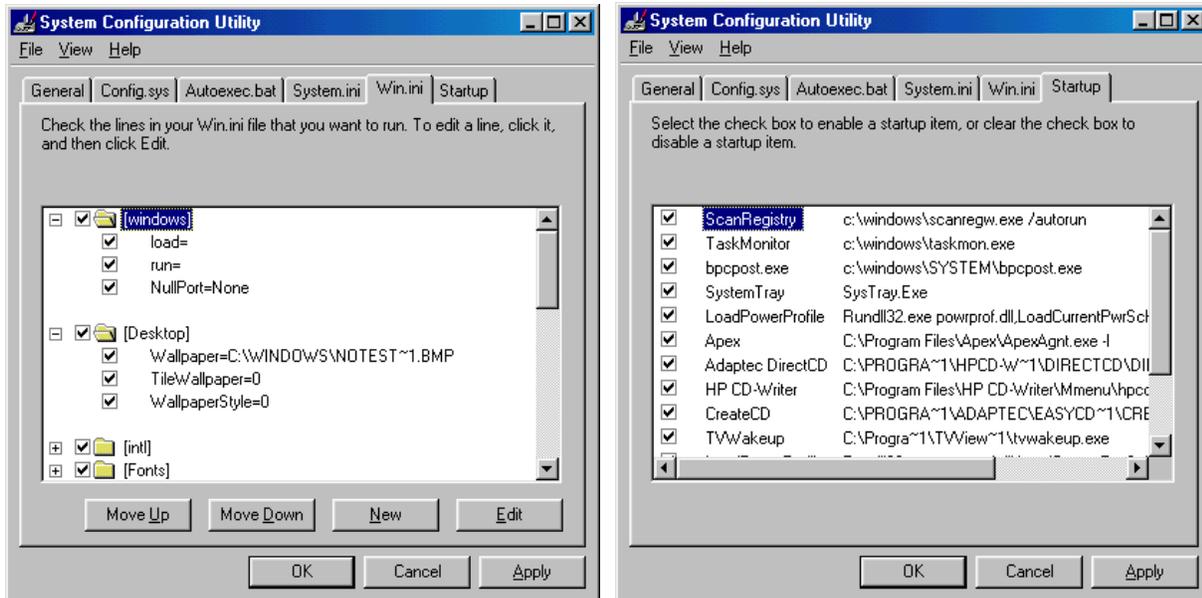


Figure 19: The WIN.INI and SYSTEM.INI options in the System Configuration Utility.

13.3 Windows Device Manager

The Windows Device Manager is a powerful resource that is designed to help you inspect the configuration and settings of almost every device in your system. By opening the System applet in the Control Panel, it will display the System Properties dialog box. Within the dialog box, you will see five tabs, General, Network Identification, Hardware, User Profiles and Advanced. The hardware tabs allow access to the hardware wizard, the device manager and hardware profiles. The hardware wizard helps you install, uninstall, repair, eject and configure your hardware.

The Device Manager lists all of the hardware devices on your computer and allows you to change the properties of any device. If you open the View menu and select Resources by type, you will see the IRQ, DMA, I/O address and memory areas used by the different hardware components.

If you open the view menu and select Devices by type or Devices by connection, you see all hardware devices organized in a tree structure. A red X appears through an icon means the hardware device has been disabled. A yellow circled exclamation point through the icon means that the hardware device has a problem. The problem could be a resource conflict (IRQ, DMA, I/O address or memory address) or the drivers are not installed properly.

To see hardware in a category, click on the plus sign next to the hardware type. To see information about a piece of hardware, double-click on the hardware device icon or select the hardware device and click on the properties button. The properties will usually contain several tabs indicating if the device is working properly, what drivers are installed and gives you an option to update them and to view and change the device resources (if it is a plug and play device).

When viewing device information on your Windows 2000-based computer using Device Manager, you may see an unknown device listed next to a yellow question mark. Determining the cause of this unknown device can be difficult, because there are few indications of what could be creating it. The unknown device may also cause a conflict when trying to install a driver for another device.

The most common reasons Device Manager may list a device as unknown are as follows:

- The Device Manager does not have a device driver.
- Windows does not recognize the device ID.
- The device is created by software.
- The system has faulty hardware or firmware.

When a device driver for a device is not available, Device Manager displays the device as unknown and places it in the Other Devices folder. This commonly occurs when universal serial bus (USB) and IEEE 1394 composite devices. A status of “Error Code 1” or “Error Code 10” also may be displayed when you view the properties of the device in Device Manager.

Don't forget that most motherboards today need to have their chipset drivers loaded to recognize all of the drivers. For example, for Intel motherboards in the 8xx series, there is the Intel Chipset Software Installation Utility. This program stalls specific Windows INF files, which inform Windows how to properly configure the chipset for specific function, such as AGP, USB, Core PCI and ISA PnP services. Since these components are necessary for optimum stability and performance, the Intel Chipset Software Installation Utility should be the first loaded after the operating system.

The unknown device can also be caused by faulty hardware or firmware. To isolate the correct hardware device, remove the hardware devices from the Windows computer one at a time until the unknown device is no longer listed in Device Manager.

13.4 System Information Utility

Starting with Windows 98, Microsoft includes the System Information Utility, which can be used to analyze your system for problems. System Information collects and displays your system configuration information. For example, you can view:

- Operating system information, such as the version number and system boot options, plus process, system, and user environment variables
- Hardware details such as BIOS information, video resolution, processor type, and processor steppings
- Physical memory, paging file information, and direct memory access (DMA) usage
- The current state of each driver and service on the computer

- Drives and devices installed on the computer, plus related interrupt (IRQ) and port information
- Network information, including transports, configuration settings, and statistics
- Printer settings, font settings, and system processes that are running

You can access the System Information utility by going to the Start menu and clicking Programs, clicking Accessories, clicking System Tools and selecting System Information.

System Information displays a comprehensive view of your hardware, system components, and software environment. The displayed system information is organized into three top-level categories that correspond to the Resources, Components, and Software Environment nodes.

- The Resources node displays hardware-specific settings, namely DMA, IRQs, I/O addresses, and memory addresses. The Conflicts/Sharing node identifies devices that are sharing resources or are in conflict. This can help identify problems with a device.
- The Components node displays information about your Windows configuration and is used to determine the status of your device drivers, networking, and multimedia software. In addition, there is a comprehensive driver history, which shows changes made to your components over time.
- The Software Environment node displays a snapshot of the software loaded in computer memory. This information can be used to see if a process is still running or to check version information.

Other applications may add nodes to System Information that display information specific to the application.

You can use the View menu to switch between the display of Basic and Advanced information. The Advanced view shows all of the information in the Basic view plus additional information that may be of interest to the more advanced user or to Microsoft Product Support Services.

While the first step to solving complex problems is to get more information about the problem, information alone doesn't fix what's wrong. For this reason, the System Information utility includes ten tools that you can use to possibly fix a malfunctioning system. In the following sections, we'll cover each of these tools in detail. To access any of these tools, simply choose the appropriate tool from the System Information utility's Tools menu. See table 14.

Table 14: Window 9X Support Utilities

Tools	Description
Windows Report Tool	The Windows Report Tool will help solve problems that you just can't seem to figure out yourself. This tool asks you to describe your problem, what you're trying to accomplish, and the steps you've taken to reproduce the problem. When you have answered these questions, simply click Next and enter a filename. Windows 9X will build a CAB file

	<p>containing answers to your questions and a summary of your system's configuration. You can now send this file to Microsoft's technical support staff for assistance with your problem.</p>
Update Wizard Uninstall	<p>As you're probably aware, Windows 98 contains a Windows Update utility you can use to install software patches from the Internet. Unfortunately, sometimes a patch can do more harm than good. If you install a patch and it causes problems, you can use the Update Wizard Uninstall utility to remove the patch quickly and easily.</p>
System File Checker	<p>Corrupted system files cause many of the most serious Windows problems. Until now, the easiest way to correct such problems was to reinstall Windows and replace all files. Unfortunately, since files get overwritten, you're forced to reload software (such as Exchange Client) that updates system files. Windows 98's System File Checker utility can examine Windows for changed or corrupted files and restore the original Windows 9X version if necessary. To do so, click Scan For Altered Files and click the Start button.</p>
Signature Verification Tool	<p>As you're probably aware, every piece of hardware in your computer requires a driver. Unfortunately, although several drivers come with Windows, many drivers are supplied by third parties—and aren't tested by Microsoft. A poorly written driver can affect more than just the device it controls: It can cause other devices to malfunction or result in General Protection Faults.</p> <p>With the release of Windows 98, Microsoft has begun digitally signing device drivers. The digital signature means that the driver has been tested by Microsoft and is certified to work with Windows 9X. The digital signature also proves that the driver hasn't been tampered with. Third-party vendors can now submit their drivers to Microsoft for testing and application of a digital signature.</p> <p>The Signature Verification Tool will check your system for files that don't contain a digital signature. It's important to point out that Microsoft doesn't sign every file—only driver files contain digital signatures.</p>
Registry Checker	<p>If a registry gets corrupted, it is very difficult to fix them. Many times, you end up losing Windows completely and have to reinstall it from scratch. However, Windows 9X is much more forgiving when it comes to registry problems. Each time Windows 9X successfully boots, it creates a backup copy of the registry. Windows 9X stores several backup registries in a compressed format.</p> <p>When Windows 9X starts, the Registry Checker utility runs in the background. It scans for corruption and, if no corruption is detected, creates a backup copy of your registry. If a problem is detected, the utility reboots your computer and launches an MS-DOS version of the utility, which automatically restores the most recent backup of your registry. If no backup is available, the utility will attempt to correct the error it has detected. Since the utility runs automatically, you may wonder why it's included in the System Information tool. Keep in mind that the utility runs automatically at boot up. Since many people don't shut down their computers at night, you may want to manually run the utility if you suspect a problem.</p>
Automatic Skip Driver Agent	<p>If you have the boot fail because of a malfunctioning driver or hardware components, you would typically boot to safe mode and guess which device may be causing the problem. Then you must disable the device, reboot, and hope that you guessed right. Unfortunately, this can be a time consuming activity. Windows 9X solves this problem with the Automatic Skip Driver Agent. This utility monitors the boot process. If a boot fails because of a driver or hardware problem, the agent makes a note of it. If a boot failure occurs twice in a row as a result of the same problem, the agent will disable the driver on the third attempt. You can then boot successfully and use the Automatic Skip Driver Agent to determine which driver is causing your problem.</p>
Dr. Watson	<p>At one time or another, you've probably seen a cryptic Application Fault screen. If this errors occurs on a regular basis, then you want to use Dr. Watson. When you launch Dr. Watson, it runs minimized on your toolbar. Dr. Watson captures information about the error when it occurs. It can then be analyzed by Microsoft technical support.</p>

System Configuration Utility	The System Configuration Utility allows you to perform a selective startup.
ScanDisk	ScanDisk utility repairs hard disk errors and correct problems such as cross-linked files or damaged file allocation tables. It can also flag bad hard disk sectors to prevent Windows from writing information to them.
Version Conflict Manager	The Version Conflict Manager will back up all altered files before switching to the Windows 98 version so that you can revert to the previous version if you have problems.

13.5 Terminate a Specific Application

Windows 98 lets you terminate a specific application without affecting other currently running processes. To terminate an application, press Ctrl+Alt+Del, which opens a Close Program dialog box. Listed in this dialog box are all currently running tasks (including system processes not otherwise listed on the taskbar). You must then select a process (Not Responding usually is indicated in brackets next to the process name) and click on the End Task button. The operating system then attempts to terminate the process (which might take several seconds). Depending on the reason why the application is hung, you also might be presented with the option to wait a few seconds for the application to respond, and then to terminate the application if no response is received.

13.6 General Protection Faults and Exception Errors

Although applications should normally run without interruption, situations do arise when, due to either programming errors or incompatibilities, applications cease to function properly. Knowing how to handle application problems is important in being able to administer the operating system properly. The two main problems that occur with applications are General Protection Faults (GPFs) and application hangs. A General Protection Fault (GPF) typically is caused by an application that attempts to violate system integrity in one of a number of ways:

1. By making a request to read or write to a memory address space owned by another application.
2. By attempting to access the system hardware directly.
3. By attempting to interact with a failing hardware driver. (Drivers operate at Ring 0, and so can seriously impact the operating system.)

The GPF is generated when the operating system shuts down an offending application to prevent a system integrity violation. How the offending application is specifically handled depends on its application type. Because MS-DOS applications reside in their own virtual memory and have their own message queue, if they cause a GPF, a message is displayed and the application is terminated without impacting the rest of the operating system.

In the case of WIN16 (Windows 3.XX) applications, the procedure is somewhat more complex. Because WIN16 applications share both a common address space and a

common message queue, when one application creates a GPF, all others are suspended until the offending application is terminated. After this is done, the remaining applications resume processing.

Finally, with 32-bit applications, the procedure is quite straightforward. Because 32-bit applications exist in their own separate address space, and each has a separate message queue, a GPF in one 32-bit application in no way affects any other 16- or 32-bit programs. Only the offending program is terminated.

Dr. Watson is a utility that tabulates information about the system at the time of an application fault. In order to tabulate this system information, Dr. Watson must be running at the time of the fault. If you know how to trigger the fault (for instance, if the fault always occurs when you open a specific application), start the Dr. Watson application, then trigger the fault. Dr. Watson will record the state of the software environment at the time of the failure. After the fault, the Details button in the error message dialog box will provide the information collected by Dr. Watson.

To start Dr. Watson, do the following:

1. Click on the Start menu and choose Programs, Accessories, System Tools.
2. Choose System Information from the System Tools menu.
3. In Microsoft System Information Utility, pull down the Tools menu and choose Dr. Watson.

Dr. Watson will start minimized in the system tray (next to the clock). When you click on the Dr. Watson icon, it will generate a snapshot of your system. After Dr. Watson records the system information, the Dr. Watson main window appears on your screen. The default view is the standard view showing the Diagnosis tab, which provides relevant diagnostic information based on the state of the system at the time the snapshot was recorded.

Note that the Diagnosis tab includes a space for the user to write a note to the support technician describing what was happening at the time of the failure. For additional information on the state of the system at the time of the snapshot, choose Advanced View in the View menu. Dr. Watson's Advanced view provides several tabs describing different aspects of the system at the time of the snapshot. See figure 20.

When an application fault occurs, Dr. Watson saves the logged information to a file called `watsonxx.wlg` in the `\Windows\Drwatson` directory. `xx` (in `watsonxx.wlg`) is an incremented number. You can also save a snapshot to a file using the Save and Save As options in the Dr. Watson File menu. You can view the contents of a Dr. Watson log file by opening it using the Open Log File option in the Dr. Watson File menu. You can also open a Dr. Watson in Microsoft System Information Utility.

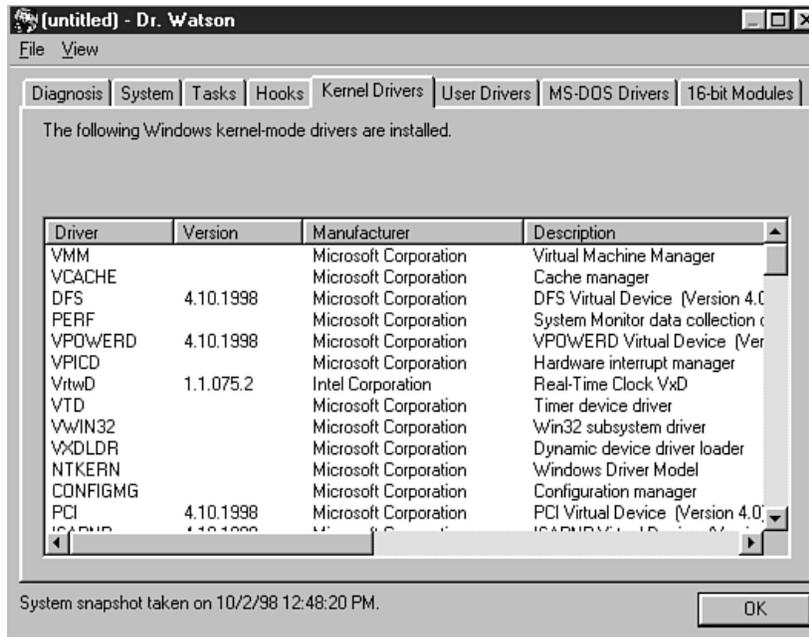


Figure 20: Dr. Watson Utility

If you know an application fault will occur again but you don't know how to reproduce it, Microsoft suggests that you add a shortcut to Dr. Watson to the Start, Programs, Startup folder for your computer or user profile. Putting a shortcut to Dr. Watson in the Startup folder will cause Dr. Watson to start automatically when the system starts.

If a General Protection Fault occurs repeatedly, isolating a GPF can be a long and lengthy process. If the General Protection Fault message indicates a GPF with the GDI.EXE, USER.EXE or Video driver, the problem is most likely caused by the video system and driver. Try to use a new video driver from the manufacturer or try to use Windows 95 generic video drivers (the generic SVGA or VGA drivers). In addition, you can use the Video Performance tab and move the slide bar a notch or two to the left. The Video Performance tab can be accessed by starting the Control Panel, double-clicking on the System applet, clicking on the Performance tab followed by clicking on the Graphics button.

If the General Protection Fault occurs with the same application, check for lost clusters with ScanDisk, check for viruses and delete any temporary files from the temporary directory (defined with the SET TEMP line in the AUTOEXEC.BAT file). Remember that both lost clusters and many temporary files in the temporary directory often indicate that a user has been shutting of the computer without properly exiting Window. You should also check to see if the software that you are using has a history of causing general protection faults and to see if there is a patch or fix that will correct the problem.

After checking for lost clusters, viruses and temporary files, try to reinstall the program so that any incomplete files will be restored. If the problem still exist, try to reinstall Windows.

One cause of a general protection fault is an invalid page fault (PFE). An invalid page fault occurs when the operating system cannot find specific data that is stored in the RAM or virtual memory. It occurs more often when the system has little RAM or the hard drive is badly fragmented. Therefore, systems with more RAM and lots of free disk space on an unfragmented hard drive are more resistant against general protection faults.

Lastly, GPFs can be caused by faulty RAM cache or faulty RAM chips. To determine if you have faulty RAM cache, you can disable it usually using the CMOS Setup program or by using jumpers/DIP switches on the motherboard. If the problem goes away, you know it is the RAM cache. If the problem still exist, you can enable the RAM cache and check elsewhere. To isolate the RAM, remove a bank of RAM chips at a time (if you have a lot of RAM) or swap a bank with a known good RAM chips.

13.7 Performance and System Monitor

Wherever possible, Windows 9X is self-tuning, adjusting cache sizes or other elements of the system environment to provide the best performance for the current configuration. Windows 9X can also detect when the loaded drivers or other performance-related components are not providing the optimal performance. In Control Panel, double-click System, and then click the Performance tab. Windows 9X reports the current performance status, including whether 32-bit, protected-mode components are being used.

13.7.1 Optimizing the Swap File

Virtual memory is disk pretending to be RAM. For Windows 9X virtual memory is known as a swap file. By default, the Windows 9X swap file is dynamic. If hard disk space is running low, the size of the swap file is decreased. If hard disk space is available and more memory is required, the size of the swap file is increased.

The single best way you can ensure high swap file performance is to make sure that the disk containing the swap file has ample free space so that the swap file size can shrink and grow as needed. If you completely disabling virtual memory might cause the computer to stop operating properly. You might not be able to restart the computer, or system performance might be degraded. If you have less than 10 MB of free disk space on the drive where the swap file is contained, may cause numerous read/write errors, general protection faults and drastically slow performance.

The most common reason for changing the default swap file is to move it to some drive other than the C drive. Many systems tend to fill up the C drive, so little or no room is left for the swap file. The swap file can use only the free space on a drive. When the space is filled, the swap file cannot get any larger, resulting in the "Not Enough Memory" error. The solution is to move the swap file to another drive. To move the file in Windows 9X, click on the Let me specify my own virtual memory settings and select another drive.

Although the system defaults usually provide the best performance, you can adjust the parameters used to define the swap file. For example, to optimize swap file performance on a computer with multiple hard disk drives, you might want to override the default location of the Windows swap file. The swap file should be placed on the drive with the fastest performance, unless that disk is overused. If a user usually loads all software from the same drive in a computer that has multiple drives, placing the swap file on one of the drives that is not as busy might boost performance.

You can manually set the minimum and maximum file sizes by selecting the Let me specify my own virtual memory settings button in the Virtual Memory dialogue box. Entering the same number for Minimum and Maximum will fix the file's size. This may improve system performance because Windows no longer has to adjust the file size. However, you risk a memory shortage if the file size isn't large enough.

To adjust the virtual memory swap file

1. In Control Panel, double-click System, click the Performance tab, and then click Virtual Memory.
2. To specify a different hard disk, click the Let me specify my own virtual memory settings option. Then specify the new disk in the Hard disk box. Or type values (in kilobytes) in the Minimum or Maximum box. Then click OK

Windows 9x allows the swap file to become fragmented on the disk—that is, not stored in a single, contiguous block. In systems that make heavy use of virtual memory, this fragmentation can take a steep toll on performance. The easiest way to defragment the swap file is to use Norton Utilities' Speed Disk utility. You can also try Windows 98's Disk Defragmenter utility (under the System Tools menu). But since Disk Defragmenter treats the swap file as immovable, you'll first have to move the swap file to a second disk or partition—using the swap file "Hard disk" setting—then defragment the disk and finally move the file back. If you have just one disk, check Disable virtual memory, reboot, defrag the disk, enable virtual memory and reboot again. But beware: If your system doesn't have enough RAM to run without virtual memory, it may not boot.

13.7.2 Optimizing File System Performance

In Windows, the disk cache is dynamic. You do not need to configure its size as part of system configuration. Changing the cache size is not a good method of limiting paging. Paging through the cache would quickly overwhelm it and make it useless for other file I/O. Although swap file I/O operations do not go through the cache, memory-mapped files and executable files do. The cache, however, is designed to make sure it cannot be overwhelmed by such I/O operations.

Changing the cache size (even if you could) probably would not have much effect on paging. The cache grows and shrinks as needed. If the system begins to page a lot, the

cache shrinks automatically. However, people often think they are seeing a lot of paging, but they are really seeing other disk activity.

A common reason for excessive paging is that the working set of the applications you are running is greater than the amount of physical RAM available. If the amount of paging is extreme, to the point where system performance is poor, a real-mode driver for the hard disk may be the cause, and should be replaced with a protected mode driver. If Windows 9X needs to use real-mode for its disk I/O operations, a lot of code has to be locked down that would otherwise be pageable, and your working set increases significantly. Note: Paging through a real-mode driver increases paging, and on a computer with 16 MB of memory, it can cause unacceptable performance.

In Windows, file system and disk performance can be controlled based on how the computer is used in most situations. If you double-click the system applet in the Control Panel, click on the Performance tab and click the File System button, you can select the typical role of the computer. This setting determines how much space is set aside in main memory to handle path and filename caching. The default is Desktop Computer, allocates space for 32 paths and 677 filenames, whereas the Network Server allocates space for 64 paths and 2,729 filenames. Even if the computer is not a network server, if there is more than 24 MB of RAM, it should be set to Network Server for better performance. (Note: Network Server is not an available option on the original release of Windows 95. To make this option available to the original version, the changes to the Registry shown in table 15 would have to be made.

Table 15 Computer role descriptions

Role	Description
Desktop computer	A normal computer acting primarily as a network client, or an individual computer with no networking. This configuration assumes that there is more than the minimum required RAM, and that the computer is running on power (rather than battery).
Mobile or docking system	Any computer with limited memory. This configuration assumes that RAM is limited and that the computer is running on battery, so the disk cache should be flushed frequently.
Network server	A computer used primarily as a peer server for file or printer sharing. This configuration assumes that the computer has adequate RAM and frequent disk activity, so the system is optimized for a high amount of disk access.

The 32-bit disk access feature is always turned on in Windows 98 unless Windows 98 detects a real-mode disk driver that does not have a protected-mode replacement. This could be, for example, an older Stacker driver or a hard-disk security or encryption driver for a disk drive. To prevent the performance loss that occurs when Windows 98 is forced to use a real-mode disk driver, upgrade to a protected-mode replacement for that driver. If you need to determine why a Windows 98 real-mode disk driver was installed, check the los.log file. The los.log file in the Windows directory is created when a protected-mode driver is not available or the operating system detects that an unknown device driver is controlling a device. In most cases, the first line in los.log states why the protected-mode driver was not loaded. If the first line mentions Mbrint13.sys, the

problem most likely is a virus (unless you are using a driver that replaces the master boot record).

13.7.3 Optimizing CD-ROM File System Performance

The CD-ROM cache is separate from the cache used for disk file and network access because the performance characteristics of the CD-ROM are different. This cache can be paged to disk (the file and network cache cannot), reducing the working set for Windows 9X but still allowing for better CD-ROM performance. When Windows 9X is retrieving data from a compact disc, it is still faster to read a record from the cache even if it has been paged to disk, because the disk-access time is much faster than the compact disc-access time. Note: A small CD-ROM cache makes a big difference in streaming performance, but a much larger cache does not pay off as significantly, unless the cache is large enough to contain entire multimedia streams. In addition, many multimedia programs perform better with a smaller cache, because they tend not to reuse data.

To set the supplemental cache size for CDFS:

1. In Control Panel, double-click System, click the Performance tab, and then click File System.
2. Click the CD-ROM tab, and drag the slider to set the Supplemental cache size. Move the Supplemental Cache Size slider to the right to allocate more RAM for caching data from the CD-ROM drive or to the left to allocate less RAM for caching data.
3. In the Optimize access pattern for box, select a setting based on your computer's CD-ROM drive speed. Table 16 shows the size of the cache created for each CD-ROM drive speed setting.

Table 16 Optimizing cache size

CD-ROM drive speed	Cache size
No read-ahead	1088 KB
Single-speed drives	1088 KB
Double-speed drives	1138 KB
Triple-speed drives	1188 KB
Quad-speed or higher	1238 KB

4. Click **OK**, and then shut down and restart the computer.

13.7.4 Using File System Troubleshooting Options

The System option in Control Panel presents a set of options for changing file system performance. You can use these options when you experience rare hardware or software compatibility problems. It is important to note that enabling any of the file

system troubleshooting options will seriously degrade system performance. Typically, you want to enable these options only if instructed to do so by a product support representative. Otherwise, these options should rarely, if ever, be used.

To display the file system troubleshooting options

1. In Control Panel, double-click System, and then click the Performance tab.
2. Click File System, and then click the Troubleshooting tab.

Table 17 summarizes the settings in Troubleshooting properties. Each option sets a value in the following registry key.

HKEY_LOCAL_MACHINE \System \CurrentControlSet \Control \FileSystem

Table 17: File system troubleshooting options

File system option	Description
Disable new file sharing and locking semantics.	This option alters the internal rules for file sharing and locking on hard disks, governing whether certain processes can have access to open files in certain share modes that guarantee a file will not be modified. This option should be checked only in the rare case that an MS-DOS-based application has problems with sharing under Windows 98. This sets <code>SoftCompatMode=0</code> in the registry.
Disable long name preservation for old programs.	This option turns off the tunneling feature, which preserves long file names when files are opened and saved by applications that do not recognize long file names. This option should be checked in the rare case that an important legacy application is not compatible with long file names. This sets <code>PreserveLongNames=0</code> in the registry.
Disable protected-mode hard disk interrupt handling.	This option prevents Windows 98 from terminating interrupts from the hard disk controller and bypassing the read-only memory (ROM) routine that handles these interrupts. Some hard disk drives might require this option to be checked in order for interrupts to be processed correctly. If this option is checked, the ROM routine handles the interrupts, slowing system performance. This sets <code>VirtualHDIRQ=1</code> in the registry. This setting is off by default in Windows 98.
Disable synchronous buffer commits.	The file commit API is used to guarantee integrity of user data that is being written by an application to a disk. Normally, the file commit API is used by applications to ensure that critical data that the application is writing is written to the disk before returning from a call made to the file commit API. Choosing this option disables this feature. Data is still written to disk, but it is written to disk in the background at the discretion of the file system. Choosing this option can compromise data written to disk by an application should the system crash before the data is actually written. This option was added to allow adequate performance of a defective database application that used the file commit API incorrectly and excessively.

Disable all 32-bit protected-mode disk drivers.	This option ensures that no 32-bit disk drivers are loaded in the system, except the floppy driver. Typically, you would check this option if the computer does not start because of disk peripheral I/O problems. If this option is enabled, all I/O will go through real-mode drivers or the BIOS. Notice that in this case, all disk drives that are visible only in protected mode will no longer be visible. This sets ForceRMIO=1 in the registry.
Disable write-behind caching for all drives.	This option ensures that all data is flushed continually to the hard disk, removing any performance benefits gained from disk caching. This option should be checked only in the rare case that you are performing risky operations and must ensure prevention of data loss. For example, a software developer who is debugging data at Ring 0 while creating a VxD would check this option. This sets DriveWriteBehind=0 in the registry.

13.7.5 Graphics Compatibility Options

In Windows 9X, graphics hardware acceleration features can be turned off when system performance indicates incompatibility problems. Specifically, problems can occur when Windows 9X assumes a display adapter can support certain functionality that it cannot. In such cases, the side effects might be anything from small irregularities on the screen to system failure. You can disable hardware acceleration features of the display adapter so that the computer can still be used if there is a problem with the display adapter. If changing these settings fixes otherwise unexplained system crashes or performance problems, the source of the problem is probably the computer's display adapter.

To change graphics performance settings, double-click the System applet in the Control Panel, click the Performance tab, and then click Graphics. Drag the slider to change the Hardware acceleration setting, as summarized in the following list. Then click OK.

The default setting is Full, which turns on all graphics hardware acceleration features available in the display driver. The first notch from the right can be set to correct mouse pointer display problems. This setting disables hardware cursor support in the display driver by adding SwCursor=1 to the [Display] section of System.ini. The second notch from the right can be set to correct certain display errors. This setting prevents some bit block transfers from being performed on the display card and disables memory-mapped I/O for some display drivers. This setting adds SwCursor=1 and Mmio=0 to the [Display] section of System.ini, and SafeMode=1 to the [Windows] section of Win.ini. The last notch from the right (None) can be set to correct problems if your computer frequently stops responding to input, or has other severe problems. This setting adds SafeMode=2 to the [Windows] section of Win.ini, which removes all driver acceleration support and causes Windows 9X to use only the device-independent bitmap (DIB) engine rather than bit block transfers for displaying images.

13.7.6 Optimizing Printing

The way printing to a printer attached to a file or print server occurs depends on your server's operating system. If you print to a server running Windows 9X, the rendering from the Enhanced Metafile graphics (EMF) format to the printer-specific language happens on the server. This means that less work is performed on the client computer, giving the user better performance.

When you print to NetWare or Windows NT servers, the rendering from EMF to the printer-specific format happens on the client computer. Although this happens in the background, it still means more work is performed on the client computer. Printing to a printer attached locally causes both the EMF rendering and the device-specific rendering to happen on the computer.

To define spool settings for print performance, double-click Printers in the Control Panel, right-click a printer icon, and then click Properties. Then click the Details tab, and then click Spool Settings. Select Spool print jobs so program finishes printing faster, and then click one of the following options:

- Click Start printing after last page is spooled if you want the return-to-application time to be faster. This requires more disk space and increases the total print time. The second rendering does not start until the entire file is written to the EMF file, decreasing the amount of work performed on the computer as you print, but increasing the disk space, because the entire file has to be written before the second rendering starts.
- Click Start printing after first page is spooled if you want the second rendering to take place simultaneously with the writing of the EMF file. This reduces the total print time and disk space required, but it increases the return-to-application time.

13.7.7 Windows 9X Resources

The kernel loads and runs Windows applications and handles their memory management, the GDI manages graphics and printing, and USER controls user input and output devices, including the keyboard and the mouse.

The GDI and USER use storage areas known as the *local heap*. The GDI heap contains information about graphical objects, such as pens, brushes, cursors, fonts, icons, buttons, scrollbars, and so on. The USER heap contains information about windows, icons, menus, and dialog boxes. Windows 9X has larger heaps than Windows 3.XX applications, including a larger 32-bit GDI heap, but it retains the same 16-bit GDI heap as Windows 3.XX so that it can support older programs. If any heap drops too low, the system can become unstable and cause problems even though there is a lot of free RAM. To view the amount of free system resources (the percentage of the heap, that has the lowest amount of free memory), use the Performance tab in the System applet in the Control Panel. To see the amount of free system resources for the System, USER, and GDI, use a utility called Resource Meter. See figure 21.

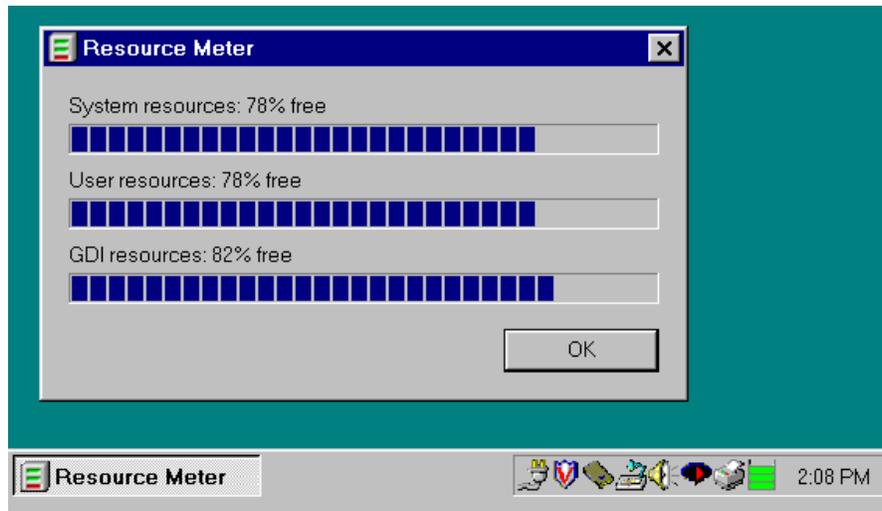


Figure 21: Windows 95 Resource Meter

13.7.8 Using System Monitor

System Monitor is a useful tool to help measure the performance of hardware, software, services, and applications to determine what is acting as a bottleneck and slowing the system. By using real-time graphs, it can provide a snapshot of key performance statistics on memory, processor and other settings. Running System Monitor before making a change to the system and then running it after making a change shows how much the change has affected performance. See figure 22.

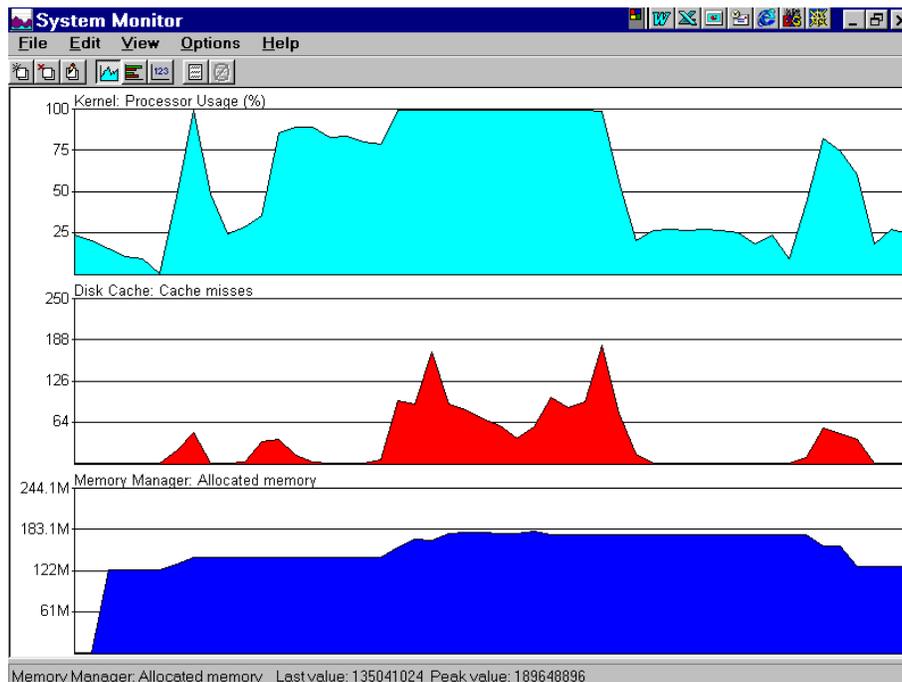


Figure 22: Windows 95 System Monitor

To install System Monitor:

1. In Control Panel, double-click Add/Remove Programs.
2. Click the Windows Setup tab.
3. Click System Tools, and then click Details.
4. Click System Monitor, and then click OK.

To run System Monitor:

On the Start menu, point to Programs, point to Accessories, point to System Tools, and then click System Monitor.

To start logging:

1. In System Monitor, click File, and then click Start Logging.
2. Type a file name for the log file, and then click Save.
3. On the File menu, click Stop Logging to stop logging.

To edit an item in a chart:

1. In System Monitor, click Edit, and then click Edit Item.
2. Click Add Item, Remove Item, or Edit Item, and then make the changes you want. Note To view a definition of an item in the Item list, click the item, and then click Explain.
3. Click OK. Note You can edit only a chart that you are currently viewing.

To change the look of a chart:

In System Monitor, click View, and then click Line Charts, Bar Charts, or Numeric Charts. Note: You can edit only a chart that you are currently viewing.

To use System Monitor to track performance problems:

1. In System Monitor, click the Edit menu, and then click Add Item.
2. In the Category list, click the resource that you want to monitor.
3. In the Item list, select one or more resources that you want to monitor. To select more than one item, press CTRL while clicking the items that you want to select. To select several items in a row, click the first item, and then press and hold down SHIFT while clicking the last item.
4. Click Explain for more information about a selected resource.
5. Click OK. A performance chart of the resource is added to System Monitor.
6. To change the view of the data from a line chart to a bar chart or a numeric listing, click the related button on the toolbar.

System Monitor offers menu commands for configuring the charts:

- To change the update interval, click the Options menu, and then click Chart.
- To configure the color and scaling for a selected item, click the Edit menu, and then click Edit Item.
- To control the display of the toolbar, status bar, and title bar, click the View menu, and then click Toolbar, Status Bar, or Hide Title Bar, respectively.

If you browse System Monitor, you will find that there are far more statistics available than you would ever want to put on a single screen. Most of them are too technical for the average user. But a handful of statistics are useful to just about every PC user. See table 18.

Table 18: Useful Statistics for System Monitor

Statistic	Description	Statistic Usage
Kernel:Processor Usage (%)	Specifies the percentage of the time that the processor is doing work.	If your processor usage consistently runs at over 80%, you're overtaxing your PC. The underlying cause may be insufficient memory, too many programs running at once or a corrupt program that won't release the processor. In some cases adding memory will fix the problem. In others you need to get a more powerful system.
Kernel:Threads	Specifies the Active threads, small pieces of software that occupy RAM.	The right number of threads for your PC depends on the software you happen to be running. For this to be useful, you need to perform a baseline, a measurement of normal use. A non-networked Windows 98 machine desktop system usually has 50 to 70 active threads with no other applications open. If you run a program, it will typically increase the number of threads when open but does not release those threads when closed (memory leak). In Windows 9x, you can usually release stranded threads by closing the offending application. If a newer 32-bit program (one written for Windows 9x) is causing a memory leak, the source of trouble may very well be a corrupted file. If this is the case, you need to reinstall the application.
Memory Manager:Unused physical memory	Specifies the amount of physical RAM that is still free for use.	You may be surprised at how little RAM remains available under Windows, even when only a few applications are running. This is because Windows constantly moves data in and out of the swap file on the hard disk. The "Unused physical memory" setting is most useful when viewed in conjunction with the following six memory statistics.
Memory Manager:Swapfile size	Windows uses a swap file (also called virtual memory) as a temporary holding area for RAM data not currently being used.	If your system has a limited amount of hard-disk space, you can use this statistic to balance your hard-disk storage needs against Windows' memory needs.
Memory Manager:Swapfile in use	This statistic indicates the amount of RAM data that is actually stored in the swap file at any given moment.	This space intentionally left blank
Memory Manager:Page faults Memory Manager:Page-outs	These indicate how much the paging file has to be accessed.	For this to be useful, you need to perform a baseline, a measurement of normal use. If either of these two statistics jumps to higher-than-normal levels, Windows may be relying too heavily on the swap file. If the increase coincides with sluggish performance, you need to add more physical RAM to your system.
Memory	This identifies the total	To determine exactly how much RAM a given program

Memory Manager:Allocated memory	amount of data that Windows is manipulating in memory.	requires, subtract the "Memory Manager: Disk cache size" value from the amount of "Allocated memory", with and without the program running. The difference is the amount of RAM used by that program.
Memory Manager:Locked memory	Locked memory refers to the amount of data that must remain in physical RAM and can't be swapped to the hard disk.	If an application forces a high percentage of data to be locked in physical RAM, other applications' performance can slow because a large amount of data must be shuttled on and off the hard disk.
Memory Manager:Disk cache size	This statistic reports the amount of RAM allocated to caching hard-disk data.	On systems running the original version of Windows 95 with the FAT16 file system, you may be able to rescue a few megabytes of RAM by lowering this setting. Watch your disk cache values to determine your system's maximum cache needs. If you see more than a megabyte of difference between what your disk cache uses and its fixed maximum value — which is determined by the MaxFile Cache= setting listed under [vcache] in your system.ini file — you can recover some of the wasted RAM by lowering the MaxFileCache= setting. Of course, the memory you save may not be worth the effort if your system has more than 32MB of RAM. But if you're working with 32MB of memory or less, your applications will benefit from the extra RAM.

14 WINDOWS NT, WINDOWS 2000 and Windows XP

14.1 Windows 2000 and Windows XP Boot Sequence

During boot up, the first Windows 2000/Windows XP file read is NTLDR, which switches the processor from real mode to protected mode and starts the appropriate minifile system drivers (built into NTLDR) so that it can read the VFAT/FAT16, FAT32 or NTFS file systems.

Next, NTLDR reads the BOOT.INI (if one is available) and displays the Boot Loader Operating System Selection menu. NTLDR then loads the operating system (such as Windows NT 4.0, Windows 2000 and Windows XP, Windows 9X or DOS) selected from the menu. If you do not select an entry before the timer reaches zero, NTLDR loads the default operating system specified in the BOOT.INI file. Note: if the BOOT.INI file is not present NTLDR tries to load Windows 2000/Windows XP from the Windows 2000/Windows XP directory (typically C:\WINNT). In addition, the menu will not be displayed if you only have the one operating system or if you have an operating system that cannot read the NTFS partition and Windows 2000/Windows XP.

NTLDR runs NTDETECT.COM, which attempts to detect the bus/adaptor type, serial ports, floating-point coprocessor, floppy disks, keyboard, mouse/pointing device, parallel ports, SCSI adapters and video adapters. If you have a system that has a SCSI hard disk, for which the BIOS on the SCSI adapter is disabled, NTLDR will load NTBOOTDD.SYS to access the SCSI devices during boot up.

After NTLDR collects the hardware information, it then gives you an option to press the Spacebar to invoke the Hardware Profile/Configuration Recovery menu. This menu will

list the hardware profiles that you have saved on your drive and list the Last Known Good configuration option.

The NTLDR finally loads the NTOSKRNL followed by the hardware abstraction layer (HAL.DLL). It will then load the HKEY_LOCAL_MACHINE\SYSTEM registry key from systemroot\system32\CONFIG\SYSTEM directory). The SYSTEM hive specifies which device drivers to load during boot up. When the device drivers are loaded, a hardware list is made and stored in the Registry. Lastly, the Session Manager (SMSS.EXE) is loaded which loads the appropriate services needed for Windows to function. Lastly, the NTLDR initializes the NT kernel (NTOSKRNL.EXE) and takes control of the boot process.

The active partition that contains the NTLDR and BOOT.INI file is known as the system partition. The partition that contains the Windows 2000 operating system files is called the boot partition. If a system has only one partition, which contains the initial boot files and the Windows 2000 directory, the partition is both the system partition and the boot partition.

DOS or Windows 9X uses a different volume boot sector. In addition, Windows NT 4.0, Windows 2000 or Windows XP starts with NTLDR while DOS, Windows 9X start with IO.SYS. If you have already DOS or Windows 9X boot files on a partition when you install Windows 2000 or Windows XP, the old boot sector gets copied into a file called BOOTSECT.DOS. Therefore, when you select the old operating system from the boot menu, NTLDR loads BOOTSECT.DOS and passes control to it. The operating system then starts up as normal. Note: if you are dual booting between Windows 2000/Windows XP and DOS or Windows 9X, DOS, Windows 9X cannot read NTFS partitions.

During boot up, the BOOT.INI file provides a Boot Loader Operating System Selection menu, which allows the selection between multiple operating systems. The BOOT.INI file is a read-only, hidden system text file located in the root directory of the system partition. See figure 23.

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Microsoft Windows 2000 Advanced Server" /fastdetect
multi(0)disk(0)rdisk(1)partition(1)\WINNT="Microsoft Windows 2000 Professional" /fastdetect
C:\="Windows 98"
```

Figure 23: Typical BOOT.INI file

The BOOT.INI file is divided into two sections, [boot loader] (see table 19) and [operating system]. The entries in the [boot loader] section configures the number the seconds that the Boot Loader Operating System Selection menu appears on the screen and the default operating system loaded.

Table 19: The Settings in the [boot loader] section of the BOOT.INI file

Timeout=XX	Specifies the number of seconds the user has to select an operating system from the boot loader screen before NTLDR loads the default operating system. If the value is 0, NTLDR immediately starts the default operating system without displaying the boot loader screen.
Default=	The ARC path to the default operating system

The [operating systems] section contains the list of available operating systems. Each entry includes an ARC path to the boot partition for the operating system, the string to display in the boot loader screen, and optional parameters. The optional parameters are shown in table 20.

Table 20: Optional Parameters found in the BOOT.INI file

/3GB	Changes the standard of allocating 2 GB for each process and 2 GB for the system to 3 GB for each process and 1 GB for the system.
/BASEVIDEO	Specifies that Windows NT uses the standard VGA video driver.
/fastdetect=[comx comx,y,z]	Disables serial mouse detection. Without a port specification, this switch disables peripherals detection on all COM ports.
/maxmem:n	Specifies the amount of RAM that Windows 2000 uses. Use this switch if you suspect is bad.
/noguiboot	Boots the computer without displaying the graphical boot status screen.
/SOS	Displays the device driver names while they are being loaded.

An **ARC (Advanced RISC Computing) path** is used to specify the location (partition) of an operating system. It follows the format:

multi(x)disk(y)rdisk(z)partition(a).

or

scsi(x)disk(y)rdisk(x)partition(a)

SCSI is used for a SCSI disk with its BIOS disabled. MULTI is used for disks other than SCSI or a SCSI disk with its BIOS enabled. The number after MULTI is the ordinal number of the hardware adapter card starting from 0. The number after DISK is the SCSI bus number and will always be 0 for a non-SCSI disk or for a SCSI disk with its BIOS enabled. The number after RDISK is the ordinal number of the disk starting from 0. The number after PARTITION is the ordinal number of the partition. Unlike the other values, it starts at 1. Note: Primary partitions are numbered first followed by the logical drives. Therefore, if you have a primary partition and a logical partition in the extended partition, the primary partition will be 1 and the logical partition will be 2. If you then add

another primary partition to the same drive, the first primary partition will be 1, the new primary partition will be 2 and the logical driver will change to 3.

If you boot from a computer that does not use the correct ARC path, you could get one of the following error messages:

BOOT: Couldn't find NTLDR. Please insert another disk

NT could not start because the following file is missing or corrupt: \winntroot\system32\ntoskrnl.exe

NTDETECT V1.0 Checking Hardware...
NTDETECT failed/missing

14.2 Boot Options for Windows NT, Windows 2000 and Windows XP

If you have problems where Windows 2000 cannot load or start, there are several tools that you can use. They are the Advance boot menu, Windows Recovery Console and Emergency Repair Disk.

If you press F8 while the Windows 2000/XP boot menu is displayed, it will display the advance boot menu. Safe mode lets you start your system with a minimal set of device drivers and services (PS/2 mouse, monitor, keyboard, mass storage, base video, default system services) with no network connection. Typically, you would use safe mode if you installed device driver or software that prevents the computer from starting, you might be able to start the computer in safe mode in the hopes to remove the software or device drivers from your system.

You can also use the Enable VGA mode option if the wrong video driver is loaded and you need to force the video system into 640x480 with 16 colors and the Last Known Good Configuration to start Windows 2000 using the last saved configuration stored in the registry.

The Directory Service Restore Mode is a special version of safe mode that loads all drivers and service and performs a CHKDSK on all volumes. After logging in, it allows you to restore the Active Directory of the domain controller from backup media. After getting into this mode, it will automatically set the computer to have the Active Directory check all indices next time you boot the domain controller normally.

Lastly, the Debugging Mode has Windows 2000/XP send debug information through a serial cable to another computer. This allows you to monitor the process of a server's boot from another server.

Note: All options except the Last Known good Configuration creates the NTBTLOG.TXT file located in the \WINNT directory and uses the VGA driver (resolution of 640X480 at 16 colors). The boot log can then be checked to see what was the last thing loaded.

Windows XP also includes a System Configuration Utility (MSCONFIG.EXE) and that lets you turn off or turn on specific entries in the Startup files system.ini, win.ini, boot.ini, services and startup. You can also make other changes to the startup process that may help with diagnosing startup problems. Note that, in addition to a normal startup, you can choose Diagnostic startup, or you can choose to selectively disable files. The tabs named for the Startup files let you enable or disable specific statements within the file. See figure 24.

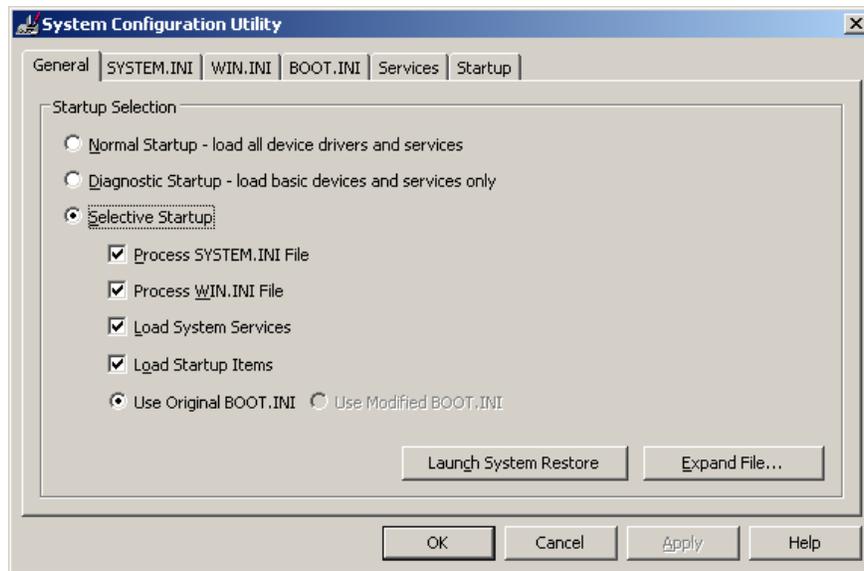


Figure 24: System Configuration Utility for Windows XP

If your computer doesn't boot at all, even in safe mode, the best thing to use is the Recovery Console. The Recovery Console provides a command-line interface that will let you repair system problems using a limited set of command-line commands, including enabling or disabling services, repairing a corrupted master boot record or read and write data on a local drive (FAT, FAT32 or NTFS). Note: since the Recovery Console is a very powerful tool, it should only be used by advanced users who have a thorough knowledge of Windows 2000. In addition, you must be an administrator to use the Recovery Console.

There are two ways to start the Recovery Console. You can run the Recovery Console from your Windows 2000 Setup disks or from the Windows 2000 Professional CD or you can install the Recovery Console on your computer to make it available in case you are unable to restart Windows 2000.

To start the computer and use the Recovery Console:

- 1 Insert the Windows 2000 Setup compact disc (CD), or the first floppy disk you created from the CD, in the appropriate drive: Of course, if you cannot boot from the CD drive, you must use floppy disk. Restart the computer. If you are using floppy disks, you will be asked to switch disks.

- 2 When the text-based part of Setup begins, follow the prompts and choose the repair or recover option by pressing R. When prompted, choose the Recovery Console by pressing C. Again, if you are using floppy disks, you will be asked to switch disks.
- 3 If you have a dual-boot or multiple-boot system, choose the Windows 2000 installation that you need to access from the Recovery Console.
- 4 When prompted, type the Administrator password.
- 5 At the system prompt, type the Recovery Console commands.
- 6 To exit the Recovery Console and restart the computer, type EXIT.

To install the Recovery Console as a Startup menu option:

- Insert the Windows 2000 Setup CD into your CD-ROM drive.
- Click No when prompted to upgrade to Windows 2000.
- At the command prompt, switch to your CD-ROM drive, and then type the following:
 - \I386\WINNT32.EXE /CMDCONS
- When it ask if you want to install the Recovery Console, click on the Yes button.
- Click OK when the Setup is complete.
- To run the Recovery Console, restart your computer and select the Recovery Console option from the boot menu.

To get a list of the commands that are available in the Recovery Console, you just have type in help while in the Recovery Console. To help about a specific command, type in HELP *commandname*. See table 21.

Table 21: List of Commands Used in the Recovery Console

Command	Description
ATTRIB	Changes or displays attributes of files or directories
CD	Changes directory
CHKDSK	Executes a consistency check of the specified disk
CLS	Clears the screen
COPY	Copies a file
DEL	Deletes a file
DIR	List Directory contents
DISKPART	Adds and Deletes partitions.
ENABLE	Starts or enables a system service or a device driver
DISABLE	Stops or disables a system service or device driver
EXTRACT	Extracts a file from a compressed file
FIXBOOT	Writes a new partition boot sector onto the system partition
FIXMRB	Repairs the master boot record of the partition boot sector
FORMAT	Formats a disk
LISTSVC	Lists the services and device drivers available on the computer.
LOGON	Logs on to a Windows 2000 computer
MAP	Displays the drive letter mappings

MD	Creates a directory
TYPE	Displays a text file
RMDIR	Deletes a directory
REPAIR	Updates an installation with files with the Windows 2000 installation CD
REN	Renames a file
SYSTEMROOT	Changes to the installation system root directory (typically \WINNT)

The Emergency Repair Disk (ERD) is a disk that contains information about your current Windows system settings. You can use this disk to repair your computer if it will not start or your system files are damaged or erased.

To create an Emergency Repair Disk:

1. Open the Backup program.
2. On the Tools menu, click Create an Emergency Repair Disk. Note: you could also use the Emergency Repair Disk wizard.
3. Insert a blank formatted floppy disk into the drive. Check the checkbox if you want a backup copy of the registry copied to the REPAIR folder (highly recommended) and click on the OK button.
4. Click on the OK button when the disk has been created.
5. Label the Emergency Repair Disk and put it in a safe place.

Note: When using the Emergency Repair Disk, it relies on information that has been saved to the *%systemroot%\REPAIR* folder. Therefore, do not change or delete this folder. In addition, you should recreate the ERD after each service pack, system change or updated driver.

To use an Emergency Repair Disk for system repairs:

1. Insert the Windows 2000 Setup compact disc (CD), or the first floppy disk you created from the CD, in the appropriate drive.
2. When the text-based part of Setup begins, follow the prompts; choose the repair or recover option by pressing R.
3. When prompted, insert the Windows 2000 Setup CD in the appropriate drive.
4. When prompted, choose the emergency repair process by pressing R.
5. When prompted, choose between the following:
 - a. Manual Repair (press M): This should be used only by advanced users or administrators. Use this option to choose whether you want to repair system files, partition-boot sector problems, or startup environment problems.
 - b. Fast Repair (press F): This is the easiest option, and does not require input. This option will attempt to repair problems related to system files, the partition boot sector on your system disk, and your startup environment (if you have a dual-boot or multiple-boot system).
6. Follow the instructions on the screen and, when prompted, insert the Emergency Repair Disk in the appropriate drive.

7. During the repair process, missing or corrupted files are replaced with files from the Windows 2000 CD or from the systemroot\Repair folder on the system partition. Note: Follow the instructions on the screen; you might want to write down the names of files that are detected as faulty or incorrect, to help you diagnose how the system was damaged.
8. If the repair was successful, allow the process to complete; it will restart the computer. The restarting of the computer indicates that replacement files were successfully copied to the hard disk.

Windows XP includes a System Restore feature that enables users and administrators to restore a computer to a previous state without losing data. System Restore automatically creates easily identifiable restore points, which allow you to restore the system to a previous time. Therefore, if you load a driver or software program which causes the computer to act erratic or become unstable, you can use the System Restore program to put Windows back to an earlier state before the problem occurred.

14.3 Event Viewer and Services Console

The **event viewer** is a very useful utility used to view and manage logs of system, program, and security events on your computer. Event viewer gathers information about hardware and software problems, and monitor Windows 2000 security events. For example, if you get a “At least one service or driver failed during system startup” error message during boot up, you should look at the event viewer to find out which service or services have stopped. The event viewer can be executed by clicking on the Start button, clicking on Programs, clicking on Administrative Tools and clicking on Event Viewer or by adding it to the MMC console.

Windows 2000 event viewer starts with three kinds of logs:

Application log - The application log contains events logged by programs. For example, a database program might record a file error in the programs log. Program developers decide which events to monitor. The application log can be viewed by all users.

Security log - The security log contains valid and invalid logon attempts as well as events related to resource use, such as creating, opening, or deleting files or other objects. For example, if you have enabled logon and logoff auditing, attempts to log on to the system are recorded in the security log. By default, security logging is turned off. To enable security logging, use Group Policy to set the Audit policy or by changing the registry. To audit files and folders, you must be logged on as a member of the Administrators group or have been granted the Manage auditing and security log right in Group Policy. See Chapter 12 for policies and rights.

System log - The system log contains events logged by the Windows 2000 system components. For example, the failure of a driver or other system component to load during startup is recorded in the system log. The event types logged by system

components are predetermined by Windows 2000. The application log can be viewed by all users.

All BackOffice family applications (Microsoft applications designed to work on Windows NT or Windows 2000 servers) can post security events to the Windows 2000 event log. In addition, several servers also make their own logs, which can also be viewed by the Windows 2000 Event Viewer.

There are five types of Event Types, error, warning, information, success audit and failure audit. They are shown table 22.

Table 22: Event Viewer Event Types

Event type	Description
Error	A significant problem, such as loss of data or loss of functionality such as when a service fails during startup.
Warning	An event that is not necessarily significant, but may indicate a possible future problem. For example, when disk space is low, a warning will be logged.
Information	An event that describes the successful operation of an application, driver, or service. For example, when a network driver loads successfully, an Information event will be logged.
Success Audit	An audited security access attempt that succeeds. For example, a user's successful attempt to log on the system will be logged as a Success Audit event.
Failure Audit	An audited security access attempt that fails. For example, if a user tries to access a network drive and fails, the attempt will be logged as a Failure Audit event.

When you double-click on an event, the Event Properties window will appear. The Event Properties can be divided into two parts, event header and event description. The event header information is shown in table 23.

Table 23: Event Header Information

Information	Meaning
Date	The date the event occurred.
Time	The local time the event occurred.
User	The user name of the user on whose behalf the event occurred.
Computer	The name of the computer where the event occurred. The computer name is usually your own, unless you are viewing an event log on another Windows 2000 computer.
Event ID	A number identifying the particular event type. The first line of the description usually contains the name of the event type.
Source	The software that logged the event, which can be either a program name, such as "SQL Server," or a component of the system or of a large program, such as a driver name.
Type	A classification of the event severity: Error, Information, or Warning in the

	system and application logs; Success Audit or Failure Audit in the security log. In Event Viewer's normal list view, these are represented by a symbol.
Category	A classification of the event by the event source. This information is primarily used in the security log. For example, for security audits, this corresponds to one of the event types for which success or failure auditing can be enabled in Group Policy.

The description of the event is the most important information within the Event Properties window and will usually indicate what happened or the significance of the event.

A service is a program, routine or process that performs a specific system function to support other programs. To manage the services, you would use the Services console (located under administrative tools) or the MMC with the Services snap-in. To start, stop, pause, resume or restart services, you would right-click on the service and click on the desired option. On the left of the service name, you can find a description.

To configure a service, you would right-click the service and click on the Properties option, On the General tab, under the Startup type pull-down option, you can set the following options:

- Automatic – specifies that the service should start automatically when the system starts
- Manual – specifies that a user or a dependent service can start the service. Services with manual startup do not start automatically when the system starts.
- Disable – prevents the service from being started by the system, a user, or any dependent service.

The workstation service allows a user sitting at the computer to access the network to access network resources such as shared folders. The workstation is also known as the Redirector.

The server allows a computer to provide network resources. When you pause the Server service, only users in the computer's Administrators and Server Operators groups will be able to make new connections to the computer. When you stop the Server service, all users who are connected over the network to the computer will be disconnected.

Of course, if you stop a Server service, the affected computer can no longer be administered remotely and you must start the Server service locally. Of course, it is a good idea to warn connected users before stopping the Server service.

14.4 Changing the HAL

If you get an error message stating that the Hardware Abstraction Layer is incorrect for the machine, you will need to change the HAL. This usually occurs when one machine

mixes single and dual processor configuration files. In Windows NT, restart the install and when the message “Windows NT is examining the hardware” appears, press F5. Choose your computer type from the list that appears and continue with the installation. In Windows 2000, you should begin the installation process again and install a clean copy of OS.

If Windows 2000 was originally installed on a computer with a single processor and you change your system to use multiple processors, then the HAL on your computer must be updated so that it will recognize and use the multiple processors. To change the HAL, take the following steps:

1. Click on the Start Button. Select Control Panel and then select System.
2. Click the Hardware tab and click on the Device Manager button.
3. Double-click the Computer branch to expand it.
4. Double-click the computer type listed under the Computer branch, click the Drivers tab, click the Update Driver and then click Next.
5. Click “Display a list of known drivers for this device,” and then click “Show all hardware for this device class.”
6. Click the appropriate computer type (one that matches your current type, except for multiple processors), click Next, and then click Finish.

14.5 Stop Errors and Exception Errors

Applications run in the User mode layer (Intel protection model – ring 3). When an application causes an error, Windows NT 4.0, Windows 2000 and Windows XP halts the process and generates Illegal Operation error. Because every Win32 application has its own virtual protected memory space, this error condition doesn't affect any other Win32 program running. If the application tries to access the hardware without going through the correct methods, Windows notices this and generates an exception error. In these cases, if the application faults, Windows or you can close the offending program and resume work.

The Windows NT kernel runs in the Kernel mode layer (Intel protection model – ring 0). When the kernel encounters a fatal error such as a hardware problem, inconsistencies within data necessary for its operation or similar error, Windows can displays a stop error, sometimes known as a “blue screen of death”. These errors would be similar to a General Protection Fault (GPF) for Windows 95/98. These errors can be caused by hardware errors, corrupted files, corrupted file system or software glitch.

Even though a stop screen may look intimidating, only a small amount of data on the stop screen is important in determining the cause of the error. At the top of the screen, you will find the error code and parameters. In the middle of the screen you will find the list of modules that have successfully loaded and initialized and at the bottom of the screen you will find a list of modules that are currently on the stack.

You can configure Windows to write a memory dump file each time it generates a kernel STOP error. This file contains all the information needed by the DUMPEXAM* utility to troubleshoot the kernel STOP error. To make a memory dump file, you must have sufficient space on a hard disk partition for the resulting memory dump file, which will be as large as your RAM memory. Therefore, if your system has 256 MB of RAM, you must have 256 MB of free disk space.

To configure the Windows to save STOP information to a memory dump file, you would double-click on the System applet in the control panel. Within the Startup/Shutdown tab, you would put a check in the Write debugging information under the Recovery section. You can then specify the file location and name. Note: if the Overwrite any existing file option does not have a check and there is a file with that name, Windows NT* will not overwrite the file.

The DUMPEXAM utility is included on the Windows NT Server CD. It is a command-line utility that examines a memory dump file (MEMORY.DMP), extracts information from it, and writes it to a text file (MEMORY.TXT). The text file can then be used by support personnel to determine the cause of the kernel STOP error. Note: the MEMORY.TXT file is significantly smaller than the MEMORY.DMP. In many cases, the DUMPEXAM analysis provides enough information for support personnel to determine the cause of the error without directly accessing the memory dump file. See the Windows NT Resource Kit for more information on the DUMPEXAM utility.

For Windows 2000 and Windows XP, you can create file dump by opening open the Control Panel and double-clicking on the System applet. Then in the Advanced Tab, click on the Startup and Recovery button. From there, you can select complete memory dump, kernel memory dump or small memory dump.

When isolating any stop error, you should check the following:

- Make sure that you have the most up-to-date BIOS with the most recent microcode.
- Using a recent anti-virus software package, check for viruses on your computer.
- Check the Event Viewer, specifically the System Log to help determine the device or driver causing the problem.
- Disable any newly installed drivers and remove any newly added programs. Try Known Last Good Configuration and Safe mode.
- Make sure that you have updated drivers for your hardware device.
- Remove any newly installed hardware.
- Verify that all hardware is on the Microsoft Hardware Compatibility List (HCL). It can be found at <http://www.microsoft.com/hcl/default.asp>.
- Run a PC hardware diagnostic package on your system. While you should perform a basic system that includes motherboard, you should do an intensive check on the memory.
- Disable memory caching in the BIOS, typically done in the CMOS setup program.
- Be sure that you are using the newest Windows service pack.

When a stop error appears, search Microsoft's web site for possible solutions. In any case, make sure that the system has the most updated BIOS and Windows NT/Windows 2000/Windows XP Service Pack. Also refer to section A10 in the Appendix for specific Stop error messages.

The virtual device drivers (VxDs) is software that helps Windows communicate with system hardware. If you get an error message that contains "Windows protection error" indicates that one of the VxDs is corrupt, missing, or inaccessible. You may need to reinstall Windows to fix this problem.

Runtime errors are errors that occur while an application is running. You may get a runtime error if the application runs out of memory, hits some buggy code, or hiccups at an inopportune time. Fortunately, runtime errors rarely affect the entire system. You can resolve these problems by closing the affected application. The text of a runtime error message should identify the affected application.

14.6 System Performance

The Performance option allows you to adjust how the processors resources are distributed between running programs. Selecting applications assign more resources to the foreground applications, while the background services assigns an equal amount of resources to all programs. You should select the background services if it is a server with network resources/services or an Applications server if you want the server to act more like a desktop machine.

The Virtual memory area allows you to configure the paging file size (virtual memory) and the maximum size of the registry. The minimum paging file is 2 MB. For Windows 2000 Professional, the default size of the file is equal to the total amount of RAM plus 12 MB, not to exceed the amount of available disk space. Usually the size of the paging file can stay at the default value assigned during installation, but the recommend size for the paging file should be 1.5 times the amount of RAM available on your system. Note: if you are changing the virtual memory settings, you must make sure to click on the OK button and not the cancel button.

As mentioned in earlier sections, virtual memory is much slower than physical RAM because the memory is on the hard drive, a mechanical device. If you want to enhance system performance and you have several physical hard drives (not necessary partitions/logical drives), you can create a paging file on each disk and by moving the paging file off the boot partition (the partition with the WINNT directory). This is because the hard disk controller can read and write to multiple hard disks simultaneously and the virtual memory management (VMM) tries to write the page data to the paging file on the disk that is the least busy.

Lastly, you can enhance system performance by setting the initial size of the paging file to the value displayed in the Maximum Size box in the Virtual Memory dialog. This is

because when the system needs more RAM beyond what it already has, it will increase the size of the paging file. If the file is already set to its maximum size, it eliminates the time required to enlarge the file from the initial size to the maximum size. Note: the maximum size of the file is determined the largest contiguous (continuous) space of disk space. Note: The disk defragmenter utility in the Accessories system tools is important because it ensures that a maximum amount of the drive is contiguous and available for page file use.

Note: For Pentium 4 systems, it is recommended to set the initial size and the maximum size of the virtual memory to twice the amount of RAM, assuming that you have enough free disk space. This way the paging file will not be fragmented and it does not have to grown and shrink.

If an error code has been generated, the code appears in the Device Status box on the General tab. In some cases, there will be a solution.

When you press the Ctrl+Alt+Delete keys in Windows NT 4.0, Windows 2000 or Windows XP, you bring up the Windows Security dialog box. To bring up the Task Manager button, you then click the Task Manager button, which will can be used to bring a list of the current programs that are running and the overall CPU (including the number of threads and processes) and memory usage. If the computer suddenly appears slow, use the Task Manager to see which threads are taking up most of the processor's utilization.

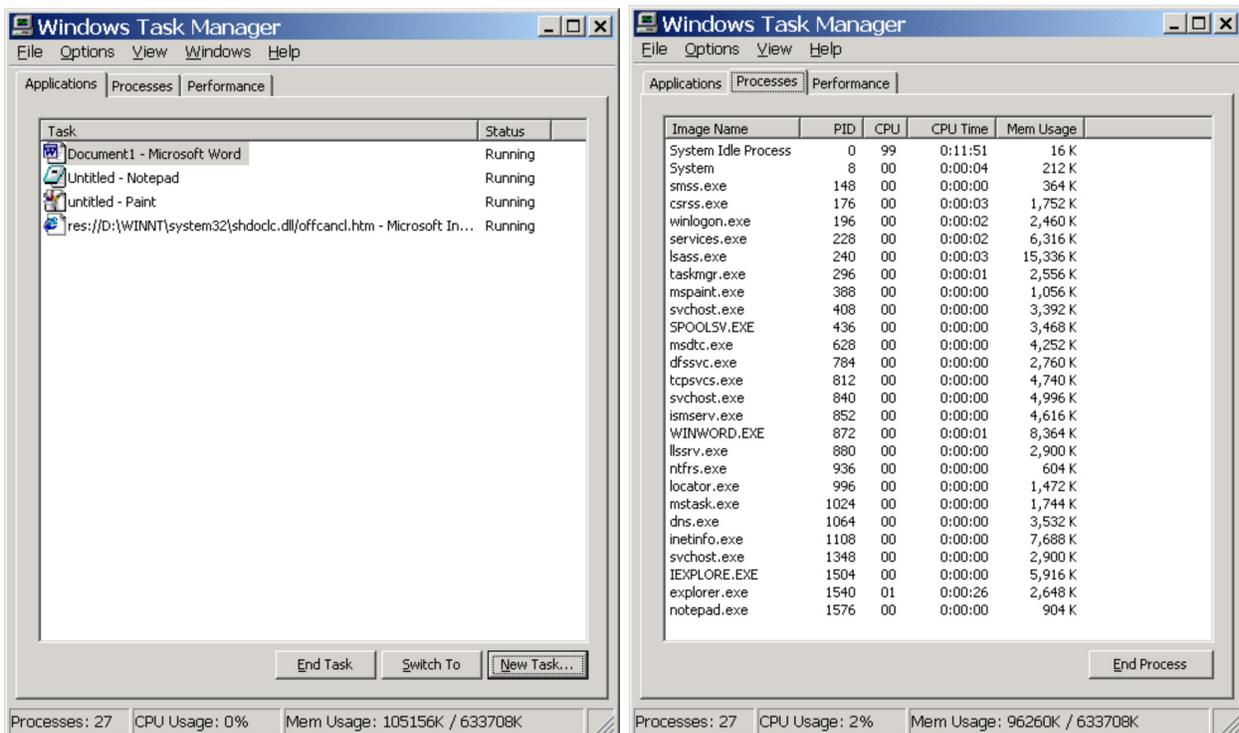


Figure 25: The Task Manager can be used to display what programs are running and how much processor utilization the program is using.

Performance is the overall effectiveness of how data moves through the system. To be able to improve performance, you must determine the part of the system that is slowing down the throughput; it could be the speed of the processor, the amount of RAM in the system, the speed of the disk system, the speed of your network adapter card, or some other factor. This limiting factor is referred to as the bottleneck of the system. With System monitor/Performance Monitor, you can measure the performance of your own computer or other computers on the network.

In Windows 2000, to open Performance Monitor, click the Start button, select the Setting Option and click the Control Panel. In the Control Panel, double-click the Administrative Tools and then double-click Performance.

When you first start System Monitor/Performance Monitor, all you see is a blank screen. You must select the objects, instances and counters that you want to monitor. An object is any Windows 2000 system component that possesses a set of measurable property. It can be a physical part of the system such as the processor, RAM, disk subsystem and network interface, a logical component such as a disk volume or software element such as a process or a thread. An Instance shows how many occurrences of an object are available in the system. A Counter represents one measurable characteristic of an object. See figure 26.

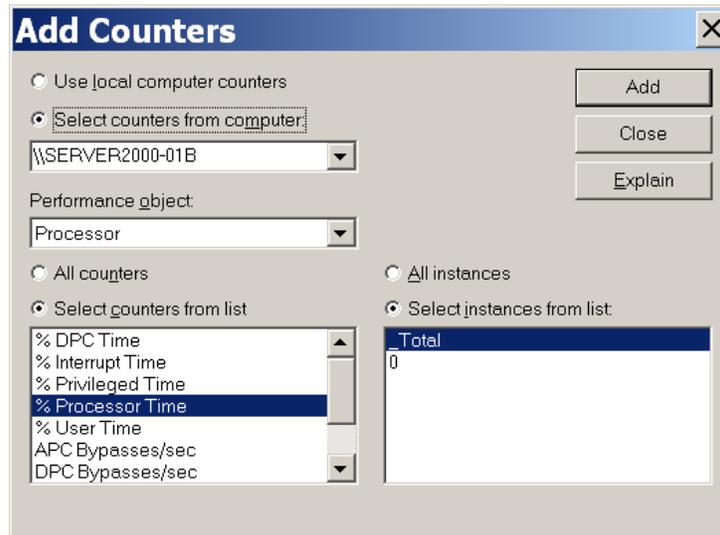


Figure 26: Adding counters to performance monitor.

The performance of the computer is greatly affected by the performance of the processor.

Processor Counter	Description
Processor:% Processor Time	% Processor Time measures how busy the processor is. While the processor may jump up to 100% processor usage, you need to look at the overall average. If the processor is at 80% all the time, you

	should upgrade the processor (faster processor or adding the number of processors) or move some of the services to other systems. If you want to see what % of the processor utilization each process is using, use the task manager. Note: Do not use 3D screen savers since they can consume 90% of the processor utilization. Instead, use a blank screen saver.
Processor:Interrupts/Second	Interrupts/Second measures how many hardware interrupts per second are occurring. A server running 100 interrupts/second can be normal. If the counter is increasing without a corresponding increase in the server load may be due to a hardware problem. You should always view this counter when you load a new device driver to make sure that it functions properly. A poorly written device driver can cause huge increases in interrupt activity.
System:Processor Queue Length	The number of threads indicated by the processor queue length is a significant indicator of system performance, because each thread requires a certain number of processor cycles. If demand exceeds supply, long processor queues develop and system response suffers. Therefore, a sustained processor queue length greater than 2 on a single processor generally indicates that the processor is a bottleneck. This counter is always 0 unless you are monitoring a thread counter as well.

RAM is one of the biggest factors in PC performance. You can typically increase the PC performance by adding more RAM. The best six RAM counters are:

Memory Counter	Description
Memory:Available Bytes	Available Bytes measures the amount of available virtual memory. It is calculated by summing space on the zeroed, free and standby memory lists. Free memory is ready for use. Zeroed memory are pages of memory filled with zeros to prevent later processes from seeing data used by a previous process. Standby memory is memory removed from a process' working set (physical memory) on route to disk, but is still available to be recalled. If it is less than 4 MB, consider adding more RAM.
Memory:Page Faults/Sec	A page fault occurs when a process attempts to access a virtual memory page that is not available in its working set in RAM. Hard page faults must be retrieved from disk, which greatly slows performance. Soft page faults are those that can be retrieved from the standby

	list, and therefore do not require disk I/O. If this value is high (20) or increasing, it is sign that you need to add physical RAM to your server.
Memory:Cache Bytes	The Memory\Cache Bytes monitor the size of the File System Cache. When memory is scarce the system trims the cache, and when memory is ample the system enlarges the cache. Note: you should compare this to general memory availability. In addition, you should keep track of how small the cache gets, and how often that happens. This data is useful when associating the size of the cache with its performance.
Memory:Pages/sec	The pages/second indicates the number of requested pages that were not immediately available in RAM and had to be read from the disk or written to the disk to make room in RAM for other pages. If your system experiences a high rate of hard page faults, the value for Pages/sec can be high.
Paging File:% Usage	% Usage of the Paging File is the percentage of space allocated to the page file (virtual memory) that is actually in use. To calculate how much more RAM you would need to add to a server to minimize paging, you would multiple the percentage by the size of the page file.
Paging File:%Usage Peak	The %Usage Peak is the highest percentage usage of the page file. If this value frequently exceeds 90%, allocate more space to the page file and possibly more RAM. A 100% usage peak indicates that the server has, at least momentarily, run out of both physical and virtual memory.

Since one of the task of a server is to provide file access. Therefore, a hard drive system is an important factor in server performance. The important hard drive counters include:

Disk Counter	Description
Physical Disk:% Disk Time	The % Disk Time measures the percentage of elapsed time that a disk drive is actually occupied in reading data from and writing data to the disk. A value greater than 90% indicates that the disk is the bottleneck.
Physical Disk:% Avg. Disk Queue Length	The % Avg. Disk Queue Length is the average number of read requests and write queued for the disk in question. A sustained average higher than 2 indicates that the disk is being over utilized.
LogicalDisk:% Free Disk Space	Free Disk Space reports the percentage of unallocated disk space to the total usable space on the logical volume.

LogicalDisk:Avg. Disk Bytes/Transfer and PhysicalDisk:Avg. Disk Bytes/Transfer	The Avg. Disk Bytes/Transfer measures the size of I/O operations. The disk is efficient if it transfers large amounts of data relatively quickly.
LogicalDisk:Avg. Disk sec/Transfer and PhysicalDisk:Avg. Disk sec/Transfer	Avg. Disk sec/Transfer indicates how fast data is being moved (in seconds). It measures the average time of each data transfer, regardless of the number of bytes read or written. A high value for this counter might mean that the system is retrying requests due to lengthy queuing or, less commonly, disk failures.
LogicalDisk:Disk Bytes/sec and PhysicalDisk:Disk Bytes/sec	Disk Bytes/sec indicates the rate at which bytes are transferred and is the primary measure of disk throughput.
LogicalDisk:Disk Transfers/sec and PhysicalDisk:Disk Transfers/sec	Disk Transfers/sec measures disk utilization by indicating the number of read and writes completed per second, regardless of how much data they involve. If value exceeds 50 (per physical disk in the case of a stripe set), then a bottleneck might be developing.

Note: By default, the system is set to collect physical drive data. For Windows NT 4.0 and Windows 2000, Logical drive data is not collected by default, you must enable it specifically. To enable the disk counters, you would execute the DISKPERF -Y command at the command prompt and restart the computer.

The Network Interface counters measure the performance of the network interface cards. The more important counters include:

Network Interface Counter	Description
Network Interface:Output Queue Length	Output Queue Length indicates the length of the output packet queue. The value should be low. Queues that are one or two items long constitute satisfactory performance; longer queues mean that the adapter is waiting for the network and cannot keep pace with server requests.
Network Interface:Bytes Total/Sec	The Bytes Total/Sec measures the rate that bytes, including data and framing characters, are sent and received on the network interface. If the value is close to or matching the network capacity, the network may be saturated.
Network Interface:Packets Outbound Errors	The packets outbound errors are the number of outbound packets that could not be send because of error. If you are seen an increasing amount of errors then more sophisticated troubleshooting tools need to be used to figure out the exact problem.
Network Interface:Packet Received Errors	The packet received errors are the number of inbound packets that had to be discarded because they

contained errors that prevented them from being delivered to the proper destination protocol stack.

There are several views in System Monitor including chart and report. A real-time activity chart displays the value of the counter over time in a graph. You want to use a chart to investigate why a computer or application is slow or inefficient, to continuously monitor the system to find intermittent performance problems and to discover why the capacity of a subsystem needs to be increased. A report view allows you to display constantly changing counter and instance values for selected objects.

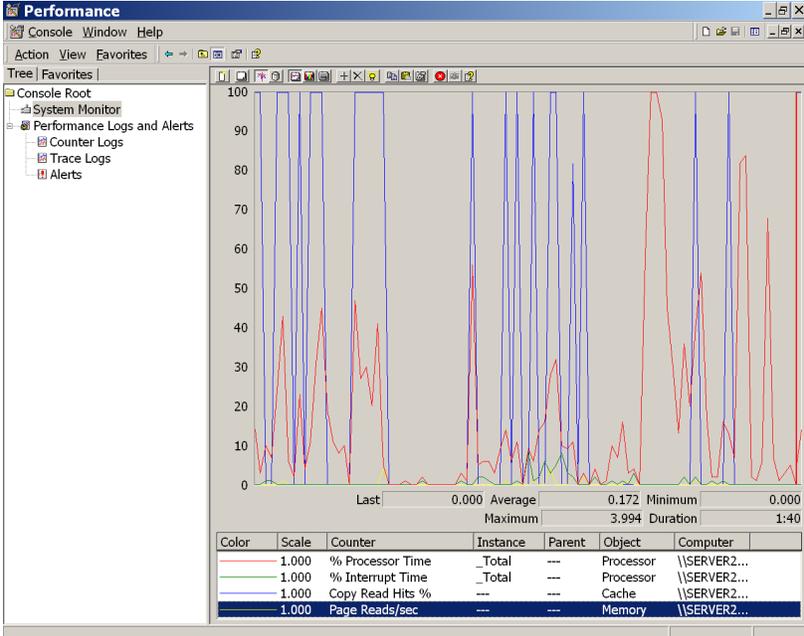


Figure 27: Performance Monitor Chart

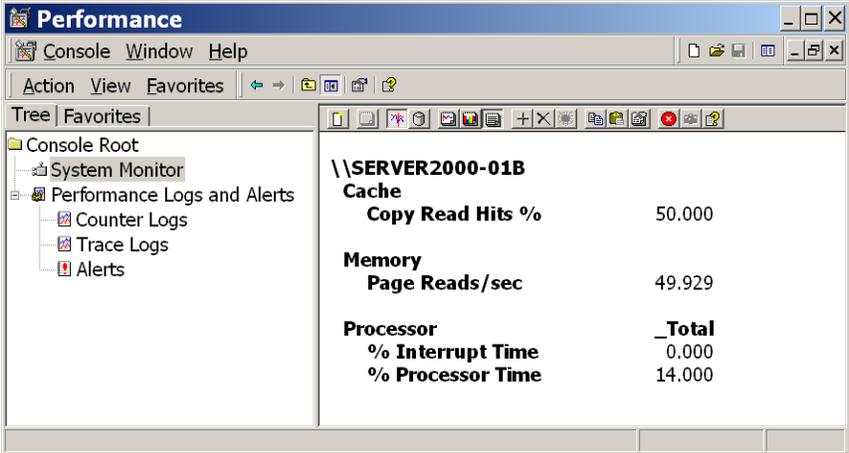


Figure 28: Performance Monitor Report

To add counters, right-click the chart or report pane (right-pane) and select the Add Counters option. After you have identified the counters you want to monitor, you can

save the information and reuse it later. To save chart settings, right-click the chart or report pane and select the Save as option.

The System Monitor supports three types of logs: counter logs, trace logs and alert logs. Counter logs record data from local or remote computers about hardware usage and system service activity. Trace logs are event-driven, recording monitored data such as disk I/O or page faults. When a traced event occurs, it is recorded in the log. Alert logs take trace logs one-step further. Alert logs are trace logs that monitor counters, wait for them to exceed user-defined tolerances and log the event. You can even setup the alert log to send a message or run an application when a particular value is exceeded.

To create a log, click on the Performance Logs and Alert in the left pane of System Monitor, and open the folder for the type of log that you want. Right-click the empty space in the Details window and choose an option from creating a new log from the pop-up menu that appears. If you save the file as a binary file (*.BLG), you can use System Monitor to open the log and view it later. If you save the file as a comma-delimited file (*.CSV) or a tab-delimited file (*.TSV), you can open them with Excel to do perform your own data analysis.

15 DIRECTX*

DirectX* is an Application Programming Interface (API) developed by Microsoft that enables programs to write programs that access hardware features of a computer without knowing exactly what hardware is installed on the machine. DirectX was original designed to allow Windows 95 to become a gaming platform but has grown into a multimedia platform. DirectX achieves this by creating an intermediate layer that translates generic hardware commands into specific commands for particular pieces of hardware.

A version of DirectX 5, included with Windows 98, you can check for a proper DirectX setup by doing the following:

1. Click on the start button and selecting the run option.
2. In the Open field type DXINFO and click on the OK button

The screen that appears is a split window. See figure 29. On the left-hand side, at the bottom, you will find a

section entitled DirectX Drivers. It lists the drivers being utilized by the DirectX subsystem. At the end of each of the lines it should show CERTIFIED. If one or more of the items does not say CERTIFIED, this is most likely causing the problem you are having. Most often, the drivers that are

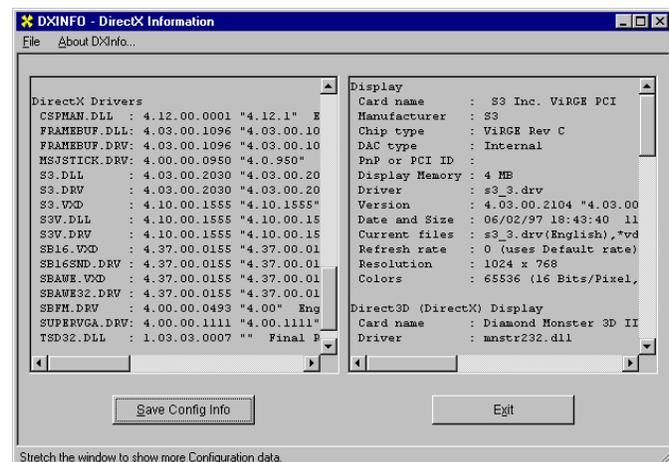


Figure 29: DirectX 5 DXINFO

not certified are either the Primary Display Driver and/or the Audio driver. Most manufacturers of video cards and sound cards are releasing updated drivers for Windows to meet the DirectX standard. You will want to contact the manufacturer of any component that is not supported and ask them about obtaining drivers that support DirectX.

If you experience trouble finding CERTIFIED drivers for a device, please be sure to download the newest End-User version of DirectX from Microsoft's website. Often the newer versions have support for hardware that was previously unsupported by DirectX. They should have a copy of DirectX at the following URL:

<http://www.microsoft.com/directx>

You may also want to check with Microsoft's Hardware Compatibility Labs to see if your device is listed as having drivers that are compatible.

With DirectX 6 or greater, you can check for a proper DirectX setup by doing the following:

1. Click on the start button and selecting the run option.
2. In the Open field type DXDIAG and click on the OK button. See figure 30.

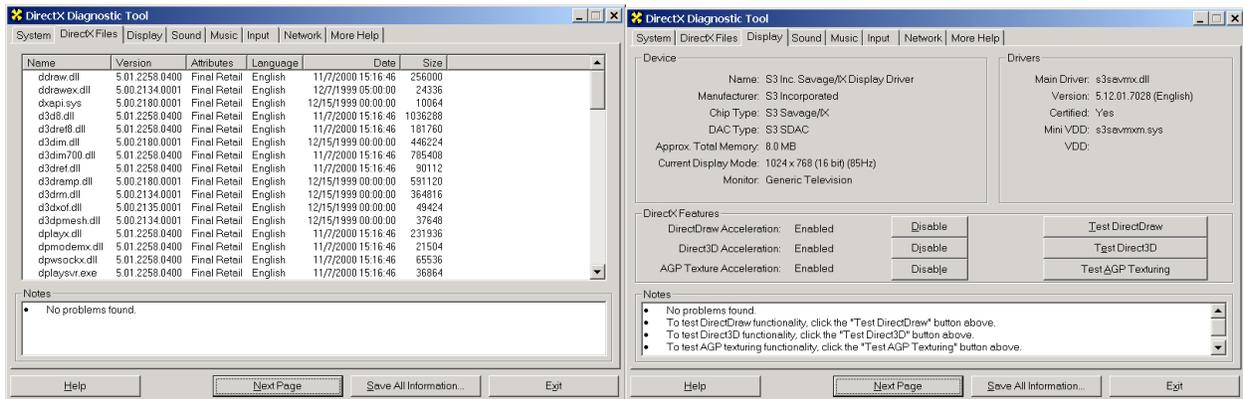


Figure 30: DirectX 6 DXDiag

16 DATA

Data is the most important part of the computer. Your data usually represents hours of work and data is sometimes irreplaceable. Since data is the most important part of the computer, it is essential that you protect it. Data loss can be caused by many things, including hardware failure, power fluctuations, software problems, viruses and user error. The best method to protect data is to perform a backup. Of course, a backup is an extra copy of data. Unfortunately, it is often ignored by most people and they do not think about doing it until it is too late.

17 VIRUSES

A virus is a program designed to replicate and spread, generally without the knowledge or permission of the user. Computer viruses spread by attaching themselves to other programs or to the boot sector of a disk. When an infected file is executed or accessed or the computer is started with an infected disk, the virus spreads onto the computer.

Depending on the virus, some viruses are cute, some are annoying and others are disastrous. Some of the disastrous symptoms of a virus include:

1. Computer fails to boot.
2. Disks have been formatted.
3. The partitions are deleted or the partition table is corrupt.
4. Can't read a disk.
5. Data or entire files are corrupt or are disappearing
6. Programs don't run anymore.
7. Files become larger.
8. System is slower than normal.
9. System has less available memory than it should.
10. System is running erratic or exhibiting strange behaviors
11. Intercept information being sent to and from a device.

To avoid viruses, you should do the following:

1. You should not use pirated software, since there is more of a chance for them having a virus.
2. You should treat files downloaded from the Internet and Bulletin boards with suspicion.
3. You should not boot from or access a floppy disk of unknown origin.
4. You should educate your fellow users.
5. You should use an updated anti-virus software package that constantly detects viruses.
6. You should backup your files on a regular basis.

A.1 COMPUTER DOES NOT COMPLETE BOOT

Computer Does Not Boot - No Lights or Fans – Nothing Displayed on the monitor

- Determine if the system worked before. Determine if there have been any recent changes. Often if a recent change is been made, the recent change is the cause of the problem.
- Make sure the computer is plugged in and on.
- Make sure that the monitor is plugged in and on.
- Use a voltmeter or an AC wall outlet tester found in a hardware store to confirm that there is adequate AC voltage at the wall outlet. See section 6.4.
- If your AC outlet is connected to an on/off outlet switch, make sure that it is on.
- Determine power supply voltage selector setting (230 volts vs. 115 volts) is correct.
- Ensure the selected motherboard is appropriate for the processor model, frequency, and stepping you are planning to use.
- Verify that your chassis/case and power supply is appropriate for the processor model and frequency and the motherboard you are planning to use.
- Verify that the power supply has the capacity to power all the devices used in your system.
- Make sure the power cables inside the computer are attached correctly and secure. You will need to attach the main power connector and a 2x2 power and/or 1x6 optional power connector.
- Make sure the drive ribbon cables inside the computer are attached correctly and secure. Be sure to check the orientation of pin 1 of Hard Drive. If the ribbon cable is connected backwards may cause the computer not to power up.
- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Check the cables that connect from the case to the motherboard. Be sure to include the power switch (PWR SW) and power LED (PWR LED). Refer to the motherboard manual for more information. See section 6.2.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output, replace the power supply).
- Use a voltmeter to verify the PowerGood signal is +5 volts. If the signal is below 1.0 volts, there may be a short or overload causing a constant reset. Consider replacing the power supply.
- Check for shorts and overloads inside computer by removing nonessential items such as extra controller cards and IDE/ATAPI devices and turning the computer on to see if it starts to boot. Leave the motherboard, power supply, RAM or processor. If the problem goes away, there was a short or overload with one of the components that you just removed or one of those components is faulty. Replace each of those one at a time until you isolate which is causing the problem. If the problem still occurs after removing the nonessential components, the problem has to be with the motherboard, power supply, RAM or processor. See section 6.3.
- Remove the processor and RAM and reinstall them to make sure that they are installed correctly.
- Make sure that you have mounted the motherboard correctly with the spacers/stand-

offs. In addition, make sure that when you insert the screws to tighten the motherboard into place, make sure not to tighten the screws too much.

- Determine if motherboard/system has any security features, which would disable boot.
- If you are using RDRAM, make sure that all memory sockets of a channel are filled with either a memory chip or a continuity module. In addition, if the motherboard has multiple channels, make sure that you fill the first channel once and that you check to see which memory sockets go with each channel. Lastly, the RDRAM often has to be installed in pairs of the same type of memory chips. For example, you would have to install two sticks of 64 MB of RDRAM running at 800 MHz. See section 5.1.3.
- If you are using SDRAM or DDR-SDRAM, some motherboards require you to populate the memory sockets starting with the first socket. Refer to your motherboard documentation for more information.
- If the problem still persists, swap the RAM with known good RAM. In addition, test the suspected RAM in another known working system.
- If the problem still persists, swap the processor with a known good processor. In addition, test the suspected processor in another known working system.
- If the problem still persists, swap the motherboard with a known good motherboard. In addition, test the suspected motherboard in another known working system.

Computer Does Not Boot - Has lights and/or fans – Nothing Displayed on the monitor

- Determine if the system worked before. Determine if there have been any recent changes. Often if a recent change is been made, the recent change is the cause of the problem.
- Make sure that the monitor is plugged in and that the monitor is on.
- Make sure that the video cable is connected properly at the monitor and the PC.
- Determine if there is power light on the monitor. Most monitors will have a green light indicating it has sufficient power and is getting a video signal and an amber light if it has power but it is not getting a video signal from the computer. If you have no lights, it is most likely a problem with the monitor. Make sure that the monitor is connected to a working AC outlet, the AC power cord is plugged into the wall outlet and the monitor. If you have any on/off switches for the outlet, make sure that the switches are on. If the problem still persists, try replacing the monitor and try the monitor on another AC outlet and another system. If you have an amber light, it is most likely a problem with the computer.
- Check the brightness and contrast controls on the monitor. The monitor might be dimmed where you cannot see anything on the monitor.
- If you have a light on the monitor, use a voltmeter or an AC wall outlet tester found in a hardware store to confirm that there is adequate AC voltage at the wall outlet for the computer.
- If your AC outlet for your computer is connected to an on/off outlet switch, make sure that it is on.
- Ensure the selected motherboard is appropriate for the processor model, frequency, and stepping you are planning to use.
- Verify that your chassis/case and power supply is appropriate for the processor

model and frequency and the motherboard you are planning to use.

- Verify that the power supply has the capacity to power all the devices used in your system.
- Make sure the power cables inside the computer are attached correctly and secure. Some systems may require a 2x2 and/or 1x6 power connector.
- Make sure the drive ribbon cables inside the computer are attached correctly and secure. Be sure to check the orientation of pin 1 of Hard Drive. If the ribbon cable is connected backwards may cause the computer not to power up.
- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Check the cables that connect from the case to the motherboard. Be sure to include the power switch (PWR SW) and power LED (PWR LED). Refer to the motherboard manual for more information.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output, replace the power supply).
- Use a voltmeter to verify the PowerGood signal is +5 volts. If the signal is below 1.0 volts, there may be a short or overload causing a constant reset. Consider replacing the power supply.
- Check for shorts and overloads inside computer by removing nonessential items such as extra controller cards and IDE/ATAPI devices and turning the computer on to see if it starts to boot. Leave the motherboard, power supply, RAM or processor. If the problem goes away, there was a short or overload with one of the components that you just removed or one of those components is faulty. Replace each of those one at a time until you isolate which is causing the problem. If the problem still occurs after removing the nonessential components, the problem has to be with the motherboard, power supply, RAM or processor.
- Remove the processor and RAM and reinstall them to make sure that they are installed correctly.
- Make sure that you have mounted the motherboard correctly with the spacers/stand-offs. In addition, make sure that when you insert the screws to tighten the motherboard into place, make sure not to tighten the screws too much.
- Determine if motherboard/system has any security features, which would disable boot.
- If you are using RDRAM, make sure that all memory sockets of a channel are filled with either a memory chip or a continuity module. In addition, if the motherboard has multiple channels, make sure that you fill the first channel once and that you check to see which memory sockets go with each channel. Lastly, the RDRAM often has to be installed in pairs of the same type of memory chips. For example, you would have to install two sticks of 64 MB of RDRAM running at 800 MHz.
- If you are using SDRAM or DDR-SDRAM, some motherboards require you to populate the memory sockets starting with the first socket. Refer to your motherboard documentation for more information.
- If the problem still persists, swap the RAM with known good RAM. In addition, test the suspected RAM in another known working system.
- If the problem still persists, swap the processor with a known good processor. In addition, test the suspected processor in another known working system.

If the problem still persists, swap the motherboard with a known good motherboard. In addition, test the suspected motherboard in another known working system.

Operating System starts but does not finish boot

- Determine if it started to load the OS. Either it will load a Windows startup logo (splash) screen or it will display one of the following messages: Starting MS-DOS, Starting Windows 9X, Starting OS Loader. If it does not, the computer is having trouble finding or loading the OS.
- Determine if the system worked before. Determine if there have been any recent changes. Often if a recent change is been made, the recent change is the cause of the problem.
- Determine if the machine always stops in the same place every time or it seems random. If it seems to stop in different places, it may be a hardware problem.
- Update the system BIOS to the newest version. In addition, check to see if your system has a firmware that could also be updated to the newest version. Refer to your motherboard documentation.
- Check the BIOS using the BIOS/CMOS setup utility, particularly the boot order. Make sure that your system is detecting all of the drives and make sure that the drive you are trying to boot is listed. See section 4.2, 4.3 and 5.1.
- Check the BIOS using the BIOS/CMOS setup utility, particularly the memory settings.
- Try booting the operating system in Safe mode/VGA mode. If it works fine in safe mode, it is mostly likely a driver or software that is not loaded correctly during Safe mode. See section 13.2 and 14.2.
- If the operating system supports, try a Step-by-Step boot. See section 13.2 and 14.2.
- Look at the boot log to find out what the last driver that it loaded. To access the advanced boot menu, press F8 as soon as Windows starts to load. For Windows 9X, the boot log is located at the C:\bootlog.txt. For Windows 2000 and Windows XP, the boot log is NTBTLOG.TXT file located in the C:\WINNT directory. See section 13.2 and 14.2.
- If the processor can boot to safe mode, try a Selective Startup using MSCONFIG (Windows 98, Windows Me or Windows XP only) program to isolate the offending driver or program. See section 13.2 and 14.2.
- For Windows NT, Windows 2000 or Windows XP, start the installing program for Windows from the installation CD and choose the R to start the Repair option. This will check the master boot record and the boot files. Refer to the Troubleshooting for the IA Platform PDF document for more information. See section 14.2.
- Suggest running ScanDisk to see if your hard drive has a lot of lost clusters and other anomalies. If you don't properly shutdown your computer using the Start button shutdown option, you may see some lost clusters and possible bad clusters.
- Suggest running an updated virus checker to see if your system is affected by a virus.
- Suggest reloading the OS, drivers or program.
- Suggest reformatting the hard drive and reinstalling everything
- Make sure that your system has enough ventilation around the fan outlet and that the fan is operating correctly.

- Make sure that the thermal solution for the processor is installed correctly and make sure that processor fan is operating correctly.
- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output, replace the power supply).
- Use a voltmeter to verify the PowerGood signal is +5 volts. If the signal is below 1.0 volts, there may be a short or overload. Consider replacing the power supply.
- Remove the processor and RAM and reinstall them to make sure that they are installed correctly.
- Make sure that you have mounted the motherboard correctly with the spacers/stand-offs. In addition, make sure that when you insert the screws to tighten the motherboard into place, make sure not to tighten the screws too much.
- If the problem still persists, swap the RAM with known good RAM. In addition, test the suspected RAM in another known working system.
- If the problem still persists, swap the processor with a known good processor. In addition, test the suspected processor in another known working system.
- If the problem still persists, swap the motherboard with a known good motherboard. In addition, test the suspected motherboard in another known working system.
-

You get a “The system did not load because of the computer disk hardware configuration problem. Could not read from the selected boot disk.”

The location of your OS is not configured correctly in the BOOT.INI file.

- You need to boot using an Emergency Repair Disk or the Recovery Console. At the command prompt, type `attrib -s -r C:\boot.ini`. Type `edit boot.ini` to read and change the file. Check to make sure that the path of the default OS in the boot loader section is identical to one listed in the “operating systems” section. If you recently added any CD, DVD, or disk drives or created any primary partitions, then the path to your OS probably has changed. Refer to section 14.2.

After installing a new BIOS or replacing the CMOS battery, the system now asks for a password

This is not the Windows password, but a BIOS password asked during POST.

- If you set a password using the BIOS Setup program, try the password. Be sure to check your caps lock key. If the password still does not work, turn the CAPs lock on and try it again. Also try a blank password where you just press enter.
- If you still cannot get in, clear the old configuration by looking for a jumper on the motherboard to “Clear CMOS” or “Clear Password” or remove the CMOS battery.

The PC does not boot after flashing the BIOS

If you flashed the BIOS and it stopped for whatever reason or you flashed the wrong BIOS version, there is nothing that you can do except to replace the BIOS IC.

- If the system has a boot block to restore the original BIOS, use it.
- If not, you will need to contact the system or motherboard manufacturer for a replacement.

The system hangs up when the SCSI BIOS headers appear during POST

- Check SCSI Termination.
- Check the SCSI ID numbers.
- Check the system resources (BIOS address, I/O address, DMA and interrupts) of the SCSI controller card.

A.2 BIOS BEEP CODES

AMI BIOS Beep Codes

You are getting beeps that indicate a memory failure:

- 1 Beep – Refresh Error (with nothing on the screen and it is not a video problem)
- 2 Beep – Parity Error
- 3 Beep – Base 64 K memory failure

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations.
- Swap the motherboard.

You are getting 4 beeps indicating a Timer not operational:

- Check for foreign objects such as screws that may ground the motherboard and make sure that screws that hold the motherboard are not too tight.
- Swap the motherboard.

You are getting 5 beeps indicating a Processor error:

- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Make sure the processor is seated properly.
- Swap the processor.
- Remove the motherboard and reinstall it.
- If the problem still persists, swap the motherboard.

You are getting 6 beeps indicating 8042 – gate A20 failure:

- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Try reseating the keyboard controller chip (if possible).
- Swap the keyboard.
- Swap the processor.

You are getting 7 beeps indicating Processor exception interrupt error

- Make sure the processor is seated properly.
- Swap the processor.
- Swap the motherboard.

You are getting 8 beeps indicating Display memory read/write failure

- Make sure that you have a video card on your system.
- If possible, swap the memory on the video card.
- Swap the video card.
- Swap the motherboard.

AMI BIOS Beep Codes

You are getting 9 beeps indicating ROM checksum error

- If possible, try reseating the System ROM BIOS chip.
- If possible, try reflashing the system ROM BIOS.
- Swap the motherboard.

You are getting 10 beeps indicating CMOS shutdown register read/write error

- Swap the motherboard

You are getting 11 beeps indicating Cache memory bad

- Make sure the system is configured properly (CMOS Setup Program and jumpers on the motherboard) for the RAM cache.
- If possible, replace the RAM cache.
- Swap the processor
- Swap the motherboard

Award BIOS Beep Codes

You are getting one long and two short beeps indicating a video problem

- Make sure that you have a video card on your system.
- If possible, swap the memory on the video card.
- Swap the video card.
- Swap the motherboard.

Any other beeps:

- Determine if the system worked before.
- Determine if there have been any recent changes
- Reseat the memory.
- Try a different motherboard.
- Make sure that the contacts on the memory and the socket are clean.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Swap RAM, motherboard and processor one at a time. If suspect one of these components, try it in another PC.

Phoenix Beep Codes – Fatal System Board Errors		
Beep Code	Description	Recommended Solution
None	CPU register test in progress	<ul style="list-style-type: none"> • Swap the processor. • Try reseating the motherboard • Swap the motherboard.
1-1-3	CMOS write/read failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
1-1-4	ROMBIOS checksum failure	<ul style="list-style-type: none"> • Try reflashing the BIOS. • Swap the motherboard
1-2-1	Programmable interval timer failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
1-2-2	DMA initialization failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
1-2-3	DMA page register write/read failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
1-3-1	RAM refresh verification failure	<ul style="list-style-type: none"> • Reseat the memory. • Make sure that the contacts on the memory and the sockets are clean. • Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0. • Try using RAM chips from the same manufacturer with the same part number and speed. • Check for a faulty memory module by trying the memory in a known good system. • Trying known good memory in the system. • Check the power supply and check for power fluctuations. • Swap the motherboard.
None	First 64K RAM test in progress	
1-3-3	First 64 KB RAM chip or data line failure, multibit	
1-3-4	First 64 KB RAM odd/even logic failure	
1-4-1	Address line failure first 64 KB RAM	
1-4-2	Parity failure first 64 KB	
2-x-x	First 64 KB RAM Failure	
3-1-1	Slave DMA register failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
3-1-2	Master DMA register failure	
3-1-3	Master interrupt mask register failure	
3-1-4	Slave interrupt mask register failure	
3-2-4	Keyboard controller test failure	Check keyboard XT/AT switch, keyboard cable, keyboard or motherboard.

Phoenix Beep Codes – Fatal System Board Errors

3-3-4	Screen initialization failure	<ul style="list-style-type: none"> • Make sure that you have a video card on your system. • If possible, swap the memory on the video card. • Swap the video card. • Swap the motherboard.
3-4-1	Screen retrace failure	
3-4-2	Search for video ROM in progress	

Phoenix BIOS Beep Codes – Nonfatal System Board Errors

Beep Code	Description	Recommended Solution
4-2-1	Timer tick interrupt test in progress or failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
4-2-2	Shutdown test in progress or failure	First check the keyboard for problems. If nothing, you have a bad motherboard.
4-2-3	Gate A20 failure	<ul style="list-style-type: none"> • Check for foreign objects such as screws that may ground the motherboard. • Try reseating the keyboard controller chip. • Swap the keyboard. • Swap the processor. • Try removing and reinstalling the motherboard. • If the problem still persists, swap the motherboard.
4-2-4	Unexpected interrupt in protected mode	<ul style="list-style-type: none"> • Check for a bad expansion card or bad motherboard.
4-3-1	RAM test in progress or address failure >FFFh	<ul style="list-style-type: none"> • Replace the motherboard.
4-3-3	Interval timer Channel 2 test or failure	<ul style="list-style-type: none"> • Try reseating the motherboard. • Swap the motherboard.
4-3-4	Time-of-day clock test or failure	<ul style="list-style-type: none"> • Try running the setup program that comes with the computer. Check the date and time. If that doesn't work, replace the battery or motherboard.
4-4-1	Serial port test or failure	<ul style="list-style-type: none"> • Reseat, or replace, the I/O card. If the serial port is on the motherboard, disable
4-4-2	Parallel port test or failure	<ul style="list-style-type: none"> • Reseat, or replace, the I/O card. If the serial port is on the motherboard, disable
4-4-3	Math coprocessor test or failure	<ul style="list-style-type: none"> • Run a test program to double-check it. If the problem does exist, replace the math coprocessor (or CPU).
Low 1-1-2	System board select failure	<ul style="list-style-type: none"> • Replace the motherboard.
Low 1-1-3	Extended CMOS RAM failure	<ul style="list-style-type: none"> • Replace the motherboard.

A.3: Operating Problems

The date and time seem to drift or you get one of the following messages indicating problems with the CMOS:

- **CMOS battery failed**
- **CMOS BATTERY HAS FAILED**
- **CMOS Battery State Low**
- **CMOS CHECKSUM ERROR**
- Replace the CMOS battery.
- If the problem still persists, try replacing the motherboard. Note: You may also consider using a battery backup. Refer to your motherboard manual.

The system boots with no problem, but crashes or freezes after several minutes of operation.

- Determine if the system worked before. Determine if there have been any recent changes. Often if a recent change is been made, the recent change is the cause of the problem.
- Check to see if your system feels warm and check the processor for overheating. NOTE: Use extreme caution when checking for heat, since you can be easily burned.
- Make sure that the power supply fan is running properly and any other external case fans are running properly. Make sure that the air intakes for the external fans are unobstructed and have at least several inches away from walls and other items.
- Make sure the fans on the processor are connected properly and running.
- Make sure that the thermal interface material or the thermal grease is applied properly.
- Disable thermal measurements and power saving features in the BIOS setup program.
- Update the system BIOS to the newest version. In addition, check to see if your system has a firmware that could also be updated to the newest version. Refer to your motherboard documentation.
- Check the BIOS using the BIOS/CMOS setup utility, particularly the boot order. Make sure that your system is detecting all of the drives and make sure that the drive you are trying to boot is listed.
- Do not overclock your system. Your system can become unreliable, may shorten the life of your PC components, may damage your PC components and may void your warranty.
- Check the BIOS using the BIOS/CMOS setup utility, especially the RAM settings. See section 5.2.
- Suggest running ScanDisk to see if your hard drive has a lot of lost clusters and other anomalies. If you don't properly shutdown your computer using the Start button shutdown option, you may see some lost clusters and possible bad clusters.
- Suggest running an updated virus checker to see if your system is affected by a virus.
- Suggest reloading the OS, drivers or program.
- Suggest reformatting the hard drive and reinstalling everything

- Verify that your chassis/case and power supply is appropriate for the processor model and frequency and the motherboard you are planning to use.
- Verify that the power supply has the capacity to power all the devices used in your system.
- Check for foreign objects such as screws that may ground the motherboard and make sure the screws that hold the motherboard are not too tight.
- Make sure the power cables inside the computer are attached correctly and secure. You will need to attach the main power connector and a 2x2 power and/or 1x6 optional power connector.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output, replace the power supply).
- Use a voltmeter to verify the Power Good signal is +5 volts. If the signal is below 1.0 volts, there may be a short or overload causing a constant reset. Consider replacing the power supply.
- Check for shorts and overloads inside computer by removing nonessential items such as extra controller cards and IDE/ATAPI devices and turning the computer on to see if it starts to boot. Leave the motherboard, power supply, RAM or processor. If the problem goes away, there was a short or overload with one of the components that you just removed or one of those components is faulty. Replace each of those one at a time until you isolate which is causing the problem. If the problem still occurs after removing the nonessential components, the problem has to be with the motherboard, power supply, RAM or processor.
- Remove the processor and RAM and reinstall them to make sure that they are installed correctly.
- Make sure that you have mounted the motherboard correctly with the spacers/stand-offs. In addition, make sure that when you insert the screws to tighten the motherboard into place, make sure not to tighten the screws too much.
- If the problem still persists, swap the RAM with known good RAM. In addition, test the suspected RAM in another known working system.
- If the problem still persists, swap the processor with a known good processor. In addition, test the suspected processor in another known working system.
- If the problem still persists, swap the motherboard with a known good motherboard. In addition, test the suspected motherboard in another known working system.

Error loading GDI.EXE. You must re-install Windows.

- The Fonts folder is moved, renamed or deleted. Recreate the Fonts folder in the C:\WINDOWS directory and extract the files from the Windows installation CD-ROM.
- Reinstall Windows.

You get an “Error loading Kernel. You must reinstall Windows” error message.

- The Kernel32.dll file, which contains the Windows kernel is corrupt or missing.
- Extract the Kernel32.dll file from your Windows setup disk and copy it to the appropriate folder on your hard drive (typically \windows\system).
- Reinstall Windows.

A.4 Processor Problems

The processor is not identified correctly during POST or in the BIOS setup program.

- Check the CMOS parameters or jumpers settings on the motherboard for the processor.
- Check to make sure the motherboard supports the processor.
- Update to the newest BIOS version and use the Processor Update Utility. See section 3.8 and 4.2.
- Run the Frequency ID Utility to verify the processor. See section 3.7.

The processor is not identified correctly by the operating system or an application.

- Check the CMOS parameters or jumpers settings on the motherboard for the processor.
- Check to make sure the motherboard supports the processor.
- Update to the newest BIOS version and use the Processor Update Utility. See section 3.8 and 4.2.
- Run the Frequency ID Utility to verify the processor. See section 3.7.
- Since many programs detect the processor so that they can better utilize their features, the software may have been written before the processor existed. Therefore, check with the software manufacturer for a patch or update. Note: If an application cannot identify a processor, the software will not run with the processor or it will assume it is an older processor without many of the features that the processor offers resulting in slower performance.

You are experiencing frequent processor failures.

- Make sure the motherboard supports the specific processor.
- Check the jumpers or BIOS setup program for the voltage settings of the processor.
- Check the jumpers or BIOS setup program for the operating frequency settings for the processor.
- Run the Frequency ID Utility. See section 3.7.
- Checking the thermal solution (heat-sink and fan). See section 3.2.
- Check for power fluctuations. Make sure that you have a reliable surge protector. See section 6.5.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output), replace the power supply. See section 6.1.

Processor is running hot

- Determine if the system worked before. Determine if there have been any recent changes. Often if a recent change is been made, the recent change is the cause of the problem.
- Do not overclock your system. Your system can become unreliable, may shorten the life of your PC components, may damage your PC components and may void your warranty.
- Verify that your chassis/case and power supply is appropriate for the processor model and frequency and the motherboard you are planning to use.

- If applicable, verify the voltage settings for the processor.
- Verify that your thermal solution for the Pentium 4 processor is adequate for the processor and frequency of the processor.
- Check to see if your system feels warm and check the processor for overheating. NOTE: Use extreme caution when checking for heat, since you can be easily burned. Many people may be running a software package or using their BIOS setup program, which is telling them the processor is running warmer than normal. Many times, these programs and/or BIOS setup programs may be wrong. Therefore, if you not feel a large amount of heat coming from the processor and heat sink, then the processor is probably not overheating.
- Make sure that the power supply fan is running properly and any other external case fans are running properly. Make sure that the air intakes for the external fans are unobstructed and have at least several inches away from walls and other items.
- Make sure that you have power cable for the fan connected to the correct fan header specifically for the processor. Refer to your motherboard documentation for more information.
- Make sure the fans on the processor are connected properly and running.
- Make sure that the thermal interface material or the thermal grease is applied properly.
- Disable thermal measurements and power saving features in the BIOS setup program.
- Update the system BIOS to the newest version. This will often correct problems with how the system measures the processor temperature.

A.5 Memory Problems

You get a Parity Error

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states. See section 5.2.
- Make sure that you have the right memory module for your system.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations. See section 6.1.

You get a ROM Error displayed on the monitor during POST

To guarantee the integrity of system ROM, a checksum error test is performed as part of the POST.

- Try reflashing the System ROM BIOS (if possible).
- Some motherboards have a dual system ROM BIOS so that the second can be used to restore the first one when the first becomes corrupt.
- Replace the System ROM BIOS chip or the motherboard.

You see a general RAM error with fault addresses listed. For example:

Memory address line failure at <XXXX>, read <YYYY>, expecting <ZZZZ>

Memory read/write failure at <XXXX>, read <YYYY>, expecting <ZZZZ>

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations.

Window 95, 98 or Me get a “Windows Protection Error” during boot.

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states. See section 5.2.
- Try removing one bank of memory modules at a time. Note: Some systems might

need to have a memory module in Bank 0.

- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations. See section 6.5.

Invalid VxD Dynamic Call to Device 3 Service B

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states. See section 5.2.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system. See section 6.5.
- Check the power supply and check for power fluctuations.

HIMEM.SYS had Detected Unreliable XMS Memory at <address>

- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states. See section 5.2.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and speed.
- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations. See section 6.5.
- Replace the motherboard.

You encounter random “fatal exception” errors under Windows 95, 98 or Me.

- Check for buggy or corrupted drivers by trying safe mode or by using the MSConfig to systematically disable software and drivers in order to isolate the offending software.
- Reseat the memory.
- Make sure that the contacts on the memory and the socket are clean.
- Check the memory parameters in the BIOS setup program including the number of wait states. If the memory is too slow, you need to increase the number of wait states. See section 5.2.
- Try removing one bank of memory modules at a time. Note: Some systems might need to have a memory module in Bank 0.
- Try using RAM chips from the same manufacturer with the same part number and

speed.

- Check for a faulty memory module by trying the memory in a known good system.
- Trying known good memory in the system.
- Check the power supply and check for power fluctuations. See section 6.5.

An error indicates that there is not enough memory to start Windows 95, 98 or ME or to start an application.

There is not enough real and virtual memory to start the Windows shell or a particular program.

- Make sure you have lots of free disk space on your hard drive. Try to boot from floppy and free some disk space.
- Try to Defrag the drive.
- Trying adding RAM.
- If the problem still persist, it could be caused by corrupt software. Try to reinstall the software.
- Reformat the system and reinstall the software.

You get the “Limited Virtual Memory. Your system is running without a properly sized paging file. Please use the virtual memory option of the System applet in the Control Panel to create a paging file, or to increase the initial size of your paging file.”

The size of the paging file is too small.

- Make sure that you have plenty of free disk space on your hard drive.
- Use the System applet in the Control Panel, access the virtual memory tool to set the paging file size to 0. Reboot the system and access the virtual memory tool again. Look for the recommended minimum and maximum sizes and set the values accordingly. Reboot the system.

A.6 Disk Problems

You see an “Invalid Media” error message when formatting.

- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon is connected properly.
- Check for viruses.
- Enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- Check the drive's power including the +5 and +12 volt connectors.
- If it an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0.
- Check to see if all of the device drivers have been installed correctly.
- For hard drives, try a low-level format. Then partition, format and add the system files to the hard drive. For floppy disks, try another floppy disk.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

Hard Drives

The hard drive is completely dead.

The drive does not spin up and the drive light doesn't illuminate during power-up.

- Make sure that the hard drive power connector is connected. See section 8.
- Make sure that the ribbon cable is connected properly. See section 8.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the hard drive.

You see drive activity, but the computer will not boot from the hard drive.

- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- Run the BIOS setup program and make sure that drive and the controller is enabled. In addition make sure that the drive has the correct parameters; most likely you can try the autodetect feature.
- If it an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers. See section 8.2.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0. See section 8.4.
- If it is a SCSI drive, check during POST to see if the SCSI BIOS is loading and finding any SCSI devices. If not, check the host adapter installation including IRQ, DMA and I/O settings. See section 8.4.

- Check to see if all of the device drivers have been installed correctly.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

The following error messages indicate that the computer cannot find an operating system to boot:

- **Non-System disk or disk error, Replace and strike any key when ready**
- **No ROM Basic**
- **Disk Boot Error, Replace and Strike Key to Retry**
- **DISK BOOT FAILURE, INSERT SYSTEM DISK AND PRESS ENTER**
- **BOOT: Couldn't find NTLDR, Please insert another disk**
- If you are trying to boot from the hard drive, make sure that there is no disk in drive A.
- If you are trying to boot from the floppy disk drive, try to boot from the hard drive and try to access the floppy disk. Then try to make sure that the disk has the necessary boot files and that the necessary boot files are not corrupt.
- If you are trying to boot from the floppy disk drive, try to boot from another bootable floppy disk.
- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- If using a removable/mobile IDE rack for the hard drive, verify that drive tray has been locked.
- Try reinstalling the necessary boot files.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- For hard drives, verify that your primary partition is active.
- For DOS, Windows 95, Windows 98 and Windows Me, try to reinstall the necessary boot files.
- For Windows NT, 2000 and XP, start the Windows installation program and choose R to repair. You will then be asked for an emergency repair disk. If you don't have one, don't repair the Registry when asked to do so. When you are in the Repair utility, the repair utility will detect the system file and reinstall it in the correct place.
- Try to reformat the drive and make the drive bootable again. See section 14.2.
- Try a low-level format. Then partition, format and add the system files to the hard drive.
- Check the drive's power including the +5 and +12 volt connectors.
- If it an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0.
- If it is a SCSI drive, check during POST to see if the SCSI BIOS is loading and

finding any SCSI devices. If not, check the host adapter installation including IRQ, DMA and I/O settings.

- Check to see if all of the device drivers have been installed correctly.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

You get a “No Fixed Disk Present” or “Error reading fixed disk” error message on the monitor.

- If you are trying to boot from the hard drive, make sure that there is no disk in drive A.
- If you are trying to boot from the floppy disk drive, try to boot from the hard drive and try to access the floppy disk. Then try to make sure that the disk has the necessary boot files and that the necessary boot files are not corrupt.
- If you are trying to boot from the floppy disk drive, try to boot from another bootable floppy disk.
- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- For DOS, Windows 95, Windows 98 and Windows Me, try to run the FDISK /MBR command.
- For Windows NT, 2000 and XP, start the Windows installation program and choose R to repair. You will then be asked for an emergency repair disk. If you don't have one, don't repair the Registry when asked to do so. When you are in the Repair utility, the repair utility will detect the system file and reinstall it in the correct place. See section 14.2.
- Try a low-level format. Then partition, format and add the system files to the hard drive.
- Check the drive's power including the +5 and +12 volt connectors.
- If it is an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0.
- If it is a SCSI drive, check during POST to see if the SCSI BIOS is loading and finding any SCSI devices. If not, check the host adapter installation including IRQ, DMA and I/O settings.
- Check to see if all of the device drivers have been installed correctly.
- If you have two drives on the same IDE cable, try swapping the master/slave.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

Your drive spins up, but the system fails to recognize the drive.

- If you are trying to boot from the hard drive, make sure that there is no disk in drive A.
- If you are trying to boot from the hard drive, try to boot from a bootable floppy disk and try to access the hard drive. Then try to make sure that the disk has the necessary boot files and that the necessary boot files are not corrupt.
- If you are trying to boot from the floppy disk drive, try to boot from the hard drive and try to access the floppy disk. Then try to make sure that the disk has the necessary boot files and that the necessary boot files are not corrupt.
- If you are trying to boot from the floppy disk drive, try to boot from another bootable floppy disk.
- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- Try reinstalling the necessary boot files.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- For hard drives, verify that your primary partition is active.
- For DOS, Windows 95, Windows 98 and Windows Me, try to reinstall the necessary boot files.
- For DOS, Windows 95, Windows 98 and Windows Me, try using the FDISK /MBR command.
- For Windows NT, 2000 and XP, start the Windows installation program and choose R to repair. You will then be asked for an emergency repair disk. If you don't have one, don't repair the Registry when asked to do so. When you are in the Repair utility, the repair utility will detect the system file and reinstall it in the correct place. See section 14.2.
- Try to reformat the drive and make the drive bootable again.
- Try a low-level format. Then partition, format and add the system files to the hard drive.
- Check the drive's power including the +5 and +12 volt connectors.
- If it is an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0.
- If it is a SCSI drive, check during POST to see if the SCSI BIOS is loading and finding any SCSI devices. If not, check the host adapter installation including IRQ, DMA and I/O settings.
- Check to see if all of the device drivers have been installed correctly.
- If you have two drives on the same IDE cable, try swapping the master/slave.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

The following error messages indicate that the computer cannot communicate with the hard drive:

- **Hard Disk Failure**
- **Hard Disk Controller Failure**
- **HDD Controller Failure**
- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- If you have no IDE drives, select no hard drives installed in the BIOS setup program.
- Check the drive's power including the +5 and +12 volt connectors.
- If it is an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

You get an "Error reading drive C:" error message.

- Make sure that the ribbon cable is connected properly.
- Enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- Check for viruses.
- Run ScanDisk or some other similar utility.
- For DOS, Windows 95, Windows 98 and Windows Me, try running the FDISK /MBR command.
- For Windows NT, 2000 and XP, start the Windows installation program and choose R to repair. You will then be asked for an emergency repair disk. If you don't have one, don't repair the Registry when asked to do so. When you are in the Repair utility, the repair utility will detect the system file and reinstall it in the correct place. See section 14.2.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.
- Try to reformat the drive and make the drive bootable again.
- Try a low-level format. Then partition, format and add the system files to the hard drive.

You see a “No SCSI Controller Present” error message

- Check the host adapter installation including IRQ, DMA and I/O settings.
- Check to see if all of the device drivers have been installed correctly.
- Try the controller in a different system. If the control fails in a different PC, the control is probably faulty.
- Try upgrading the System ROM BIOS and the SCSI ROM BIOS (if you are able).

You see a “No SCSI device found” or similar error

- Make sure SCSI devices have power and ribbon cables connected properly.
- Check SCSI Termination
- Check the SCSI ID numbers.
- Swap the SCSI device.
- Swap the SCSI Controller.

You see an error such as “Unknown SCSI Device” or “Waiting for SCSI Device”

- Check that the primary hard disk is set to SCSI ID 0.
- Make sure that the drive is partitioned and formatted at the primary active drive. Make sure the partition is active.

You get a “Sector not found” error message.

- Use a utility such as ScanDisk to examine the drive for bad sectors. Note: if a file is using a failed sector, the file will be corrupt and should be restored from backup.
- Check for viruses.
- If the problem continues, try a low-level format.
- Try swapping the cable, card and drive, one at a time.

The system reports random data, seek or format errors.

- Use a utility such as ScanDisk to examine the drive for bad sectors. Note: if a file is using a failed sector, the file will be corrupt and be restored from backup.
- Check for viruses.
- If the problem continues, try a low-level format.
- Try swapping the cable, card and drive, one at a time.

The drive will work as a primary drive, but not as a secondary (or vise-versa)

- The drive does not spin up and the drive light doesn't illuminate during power-up.
- Make sure that the hard drive power cable is connected.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- For hard drives, verify that your primary partition is active.
- Check the drive's power including the +5 and +12 volt connectors.
- If it an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

The FDISK procedure hangs up to fails to create or save a partition record for the drive(s).

- Make sure that the hard drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- Check for viruses.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- For hard drives, verify that your primary partition is active.
- Try to recreate the master boot record by using the FDISK /MBR command.
- For Windows NT, 2000 and XP, start the Windows installation program and choose R to repair. You will then be asked for an emergency repair disk. If you don't have one, don't repair the Registry when asked to do so. When you are in the Repair utility, the repair utility will detect the system file and reinstall it in the correct place. See section 14.2.
- Try a low-level format. Then partition, format and add the system files to the hard drive.
- Check the drive's power including the +5 and +12 volt connectors.
- If it is an IDE drive, check the jumper settings of all of the IDE devices, especially the master, slave or stand-alone jumpers.
- If it is a SCSI drive, check the jumper settings of all SCSI devices, especially the termination and SCSI ID numbers. To make sure that the primary hard disk is set to SCSI ID 0.
- If it is a SCSI drive, check during POST to see if the SCSI BIOS is loading and finding any SCSI devices. If not, check the host adapter installation including IRQ, DMA and I/O settings.
- Check to see if all of the device drivers have been installed correctly.
- Swap the controller card, cable and hard drive, one at a time.
- Swap the motherboard.

You get a "Track 0 bad, disk unusable" error message.

- Try to boot from the floppy disk drive and access the hard drive.
- If you can, make sure that the bootable files are there. Try reinstalling the necessary boot files.
- From the floppy disk drive, run FDISK to check the partitions on your hard drive. Make sure there is at least one DOS partition and that is active.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct CMOS settings are chosen for the drive and make sure that the hard drive and floppy controllers are enabled. Also check the boot order. Note: on most systems, you can use the autodetect feature to determine the correct CMOS parameters and to see if it can see the drive.
- Make sure that the ribbon cable and power connector is connected properly.
- Replace the ribbon cable.

- Check the drive's power including the +5 and +12 volt connectors.
- Swap the controller card (or motherboard), cable and hard drive, one at a time.
- Swap the motherboard.

My hard drive seems to be running slow.

- Check for viruses.
- Defrag the hard drive.
- Check to see if you have a slow device on the cable.
- For SCSI drives, check termination.
- For IDE drives, enter the BIOS setup program and check to see if it is set to Ultra DMA or PIO mode. For SCSI drives, enter the SCSI BIOS and check the settings.
- Check to see if any one did a low-level format on the drive. If they don't use the proper low-level format program, essential tracking information could have been erased.
- Try a clean boot/install

You are experiencing frequent drive failures

- Make sure that all fans are working properly in the case.
- If you have several drives running in the system, check to see how warm the case is and how warm the exhaust coming from the fan.
- Make sure that you are using the proper screws in mounting the drives in the case.
- Check for low-level vibrations.
- Check for power fluctuations. Make sure that you have a reliable surge protector.
- Use a voltmeter to verify that each output from the power supply is correct. If any output is very low (especially the +5 volt output), replace the power supply.
- Check other environment factors such as smoke, heavy dust, high humidity and anything that may generate a strong electromagnetic field such as heavy machinery and motors.

Floppy Disk Drives

Your system generates a "FDD Controller Failure" or similar error message

- Make sure that the floppy disk drive power connector is connected.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct floppy disk is connected and that the floppy disk drive controller is enabled.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the ribbon cable.
- Swap the floppy disk drive.
- Swap the controller card (if it is not built into the motherboard).
- Swap the motherboard.

When a new disk is inserted in the drive, a directory from a previous disk appears.

This is called a phantom directory caused by not receiving the change disk signals (Pin 34).

- Make sure the ribbon cable is attached properly.

- Swap the floppy drive cable.
- Swap the floppy disk drive.
- Swap the floppy disk drive controller/motherboard.

The system does not recognize the floppy disk drive.

- Make sure that the floppy disk drive power connector is connected properly.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct floppy disk is selected and that the floppy disk drive controller is enabled.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the ribbon cable.
- Swap the floppy disk drive.
- Swap the controller card (if it is not built into the motherboard).
- Swap the motherboard.

You cannot read from or write to a floppy disk.

- Try the floppy disk in another system to make sure that the disk is good.
- If you are getting an access denied or similar message, make sure that the tab on the disk is not set to lock.
- Make sure that the floppy disk drive power connector is connected properly.
- Make sure that the ribbon cable is connected properly.
- If you cannot access the drive, enter the BIOS setup program and make sure that the correct floppy disk is connected and that the floppy disk drive controller is enabled.
- Check the drive's power including the +5 and +12 volt connectors.
- Swap the ribbon cable.
- Swap the floppy disk drive.
- Swap the controller card (if it is not built into the motherboard).
- Swap the motherboard.

Compact Disk Drives

You get a "Buffer under-run error XX" or similar error message when data is getting transferred from one storage device to another such as a CD-R or CD-RW drive.

- Close all applications before running the CD recording software.
- Run Disk defragmenter and ScanDisk.
- Make sure you are using updated device drivers.
- Try using a different brand of storage media.
- If possible, try to reduce the recording speed.

You get a read error when reading a CD.

- Try the compact disk in another drive. If the CD is having problems with both drives, then try to clean it.
- Try another compact disk in the drive. If the drive cannot read either disk, try to clean the drive heads with a special CD cleaning disk.
- Check the CMOS setup program.

- Check the power and ribbon connections.
- Replace the CD drive.
- If the problem still exists, the problem is either the motherboard or related components. It is suggested that you contact your distributor or notebook vendor to setup additional troubleshooting or replacement.

A.7 General Expansion Card Problems

You get a “Optional XXXX Optional ROM Bad, Checksum=YYYY” error message.

A ROM chip on an expansion card is having problems.

- Remove one card at a time until you can isolate which card is causing the conflict.
- Check to see if you have a memory address conflict with another card, especially if you just installed another device recently.
- Replace the expansion card with the faulty ROM chip.

You get no dial tone for your modem

- If it is a modem built into the motherboard, check the CMOS setup program to ensure that the modem is enabled.
- In addition, ensure that the appropriate drivers are loaded and working correctly.
- If it is an external modem, make sure the modem has power and is connected properly to the PC.
- Make sure that the phone line is active.
- Replace the phone cable.
- Replace the modem.
- Replace the motherboard

A.8 Video Problems

Windows seems to start normally, but the monitor display is unreadable, has bad static, or is otherwise screwed up.

- Boot your system to VGA mode to correct your video setting. Check the video driver, resolution, number of colors and refresh rate.

The image is saturated with red blue or green or appears greenish-blue (cyan), bluish-red (magenta) or yellowish.

- If there are any color controls on the monitor, make sure those controls have not been accidentally adjusted.
- Replace the cable that connects the monitor and video card.
- Check the connection between the monitor and video card.
- Check to see if any of the pins on the monitor plug to see if they are bent or mangled.
- Try swapping the monitor.
- Replace the video card.

The display appears wavy or the image appears to shake.

- Make sure the power cable and the connection between the monitor and video card is connected properly.
- If your monitor has the option, try to degauss the monitor.
- Check the AC power and look for power irregularities. You may also try a different AC outlet. See section 6.3 and 6.4.
- Replace the cable that connects the monitor and video card.
- Replace the monitor. It usually indicates the power supply in the monitor is going bad.
- Replace the video card.
- Check for environment factors that may generate strong magnetic fields or power irregularities such as heavy machinery or motors.

On your monitor, you appear to have the colors bleed or smear.

- Make sure the power cable and the connection between the monitor and video card is connected properly.
- Check the AC power and look for power irregularities. You may also try a different AC outlet. See section 6.3 and 6.4.
- Replace the video card.
- Replace the monitor. It usually indicates the power supply in the monitor is going bad.

You cannot select a higher display resolution in the Windows Display Properties dialog.

- Make sure that you have the correct monitor driver installed.
- Make sure that you have the correct video card driver installed.
- Make sure that you have enough video memory installed to support the higher display resolution.

A.9 Sound Problems

Speakers do not produce any sound

- Check the volume control in Windows and the volume control in the application to see if the sound has been muted or has been adjusted low.
- Check the volume control on speakers.
- Make sure the speakers are turned on and have power.
- Make sure the speaker cable is installed into the correct port on the back of the sound card.
- Make sure the sound drivers are installed and functioning properly.
- Swap the speaker cables and power cable one at a time.

There is no audio when playing an Audio CD

- Check the volume control (specifically Master Volume and CD Player) in Windows and the volume control in the application to see if the sound has been muted or low.
- Check the volume control on speakers.
- Make sure the speakers are turned on and have power.
- Check to see if the four-wire CD audio cable is connected between the CD drive and the sound card.

When trying to play a high-quality audio file through a USB speaker system, you get an error message saying “Out of bandwidth”

- Disconnect extraneous USB devices such as joysticks, scanners, and others.
- Purchase an additional USB controller and attach the speakers to it so that they can have sole access to all of its bandwidth.
- Play the audio file at a lower playback quality or use a lower-quality version of the file.

A.10 Problems with Input Devices

Keyboards

Your keyboard fails to be recognized during boot up or the keyboard is completely dead and no keys appear to function.

- Swap the keyboard. Note: you should reboot the system when a keyboard is replaced.
- Use a multimeter to check the +5 V supply at the keyboard connector.
- Check to see if the motherboard has a fuse to protect the +5 V supply feeding the keyboard connector.
- Replace the motherboard.

Joysticks

The Joystick does not respond

- Make sure the joystick is plugged into the game port correctly.
- When the game port has more than one connector, be sure that the joystick is plugged into the correct connector (joystick 1 or joystick 2).
- If the game port is running through a sound card, make sure the sound card is configured to use the port as a game port instead of a MIDI port.
- Refer to the application and see that it is configured to run from the joystick. Note: since many new joysticks appear with supplemental functions (hat switches, throttle control, etc), make sure that the application is written to take advantage of the particular joystick.
- Using the Windows Device Manager, make sure that the game port is set for the proper I/O address and that the proper driver is loaded.
- Swap the joystick.

Joystick performance is erratic or choppy and the rest of the system is running fine.

- Make sure the joystick is plugged into the game port correctly.
- Make sure that you have the driver loaded correctly.
- Swap joysticks.

The joystick is sending incorrect information to the system or the joystick appears to be drifting.

- Make sure the correct driver is loaded.
- Make sure that the joystick is calibrated correctly. Refer to the documentation that came with the joystick and refer to the documentation of the application.
- Check for I/O conflicts.
- Try another joystick.
- Try another game port.

A.11 Serial Ports, Parallel Ports and Modems

Serial Port

The serial port on the motherboard doesn't work.

- Check the BIOS setup program and make sure that the serial port is enabled.
- Check for resource conflicts such as I/O addresses and IRQs.
- Replace the motherboard.

Parallel Port

The parallel port on the motherboard doesn't work.

- Check the BIOS setup program and make sure that the parallel port is enabled.
- Make sure that the correct transfer mode (ECP, EPP and etc...) has been selected for the parallel port that relates to the device currently connected
- Check for resource conflicts such as I/O addresses and IRQs.
- Replace the motherboard.

Data is randomly lost or garbled

- Make sure the parallel cable is connected properly.
- Make sure that the cable is less than 2 meters or 6 feet long.
- Replace the cable.
- Try to connect to a different peripheral.
- Try to connect to the peripheral using a different computer.
- Try swapping the motherboard.
- Check for environmental factors such as devices that generate electromagnetic fields such as heavy machinery and motors.

Modem

When you try to use your modem, you may receive an error message such as "Could not open port."

- Check for resource conflicts such as I/O addresses and IRQs.
- A program is loading in the Windows Startup folder that opens a COM port for some other use other than the modem.
- Try rebooting to see if the port was opened by another program. Rebooting may correct the problem.

The PC or communication software refuses to recognize the modem.

- If it is an external modem, make sure the modem has power and it is turned on. In addition, make sure the cables are connected to the serial port.
- If it is an internal modem, make sure the modem is seated properly in the slot.
- Check in the BIOS setup program that the modem and/or serial port is enabled.
- Check for resource conflicts such as I/O addresses and IRQs.
- Try the modem in another system.
- Replace the modem. Be sure to try the modem in another system.

A.12 Problems Shutting Down

The system will not turn off when you press the power button.

- For ATX power supplies, the power button is designed to turn off the system only when you press and hold the power button for more than 5 seconds. Therefore, if you to reconfigure you're the power button for "instant off", use the BIOS setup program.
- If you cannot reconfigure the power button for "instant off" you may need a BIOS upgrade.

Problems Shutting Down Windows 95/98/Me

When Windows does not shut down properly, it may appear to stop responding for several minutes while the "Please wait while your computer shuts down" is displayed on the screen or you may see only a blank screen and a blinking cursor, or your computer may restart instead of shutting down.

Windows 98 Second Edition tries to perform many functions during the shutdown process, including completion of all disk write functions, flushing the disk cache, running the Close Window code to close all currently running programs and transitioning all Protected-mode drivers to Real mode.

Shutdown problems can be caused by any of the following issues:

- The Fast Shutdown registry key is enabled.
- There is a damaged Exit Windows sound file.
- A program or terminate-and-stay-resident (TSR) program may not close correctly.
- An incompatible, damaged, or conflicting device driver is loaded.
- Determine if shutdown problems are being caused by a virtual device driver (.vxd file)
- There is an incompatible Advanced Power Management (APM) or Advanced Configuration and Power Interface (ACPI) setting.
- There is an incompatible Basic Input/Output System (BIOS) configuration setting.
- The computer contains incorrectly configured or damaged hardware.
- There is a video adapter that is not assigned an IRQ in real mode.

The Fast Shutdown Registry Key Is Enabled

WARNING: Using Registry Editor incorrectly can cause serious problems that may require you to reinstall your operating system. Intel cannot guarantee that problems resulting from the incorrect use of Registry Editor can be solved. Use Registry Editor at your own risk. Note that you should back up the registry before you edit it. If you are running Windows NT or Windows 2000, you should also update your Emergency Repair Disk (ERD).

Problems Shutting Down Windows 95/98/Me (Continued)

The Microsoft System Configuration utility includes an option to disable Fast Shutdown. If this option is not set in Windows, your computer may reboot instead of shutting down. To resolve this issue, change the FastReboot data value from 1 to 0 in the following registry key:

HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\Shutdown

Note: After you apply the Windows 98 Second Edition Shutdown Supplement (available from Microsoft), the Disable Fast Shutdown option is no longer listed on the Advanced tab in Msconfig.exe.

There is a damaged Exit Windows sound file

- Click Start, point to Settings, click Control Panel, and then double-click Sounds and Multimedia.
- Record the name and location of the Exit Windows sound, click Exit Windows in the Sound Events box, and then click None in the Name box.
- Click OK, and then restart your computer.

If the issue is resolved, your Exit Windows sound file is damaged and must be replaced. To replace the sound file, restore the file from a backup, or reinstall the program that provided the sound file.

A program or terminate-and-stay-resident (TSR) program may not close correctly

Determine if the shutdown problem is caused by a command or driver that is loaded automatically from the Win.ini or System.ini files:

1. Click Start, click Run, type msconfig, and then click OK.
2. Click Selective Startup, and then click to clear the following check boxes:
 - a. Process Win.ini file
 - b. Process System.ini file

NOTE: If any of these items is unavailable, that particular file does not contain any items to load.
3. Click OK, and then click Yes to restart the computer. Test to determine if the issue is resolved by restarting your computer.
4. If the problem still exist, re-enable the processing of the Win.ini and System.ini files. Then to determine if the problem is with a TSR or drivers loaded in the CONFIG.SYS and AUTOEXEC.BAT file.
5. Click Start, click Run, type msconfig, and then click OK.
6. Click Selective Startup, and then click to clear the following check boxes:
 - a. Process Config.sys
 - b. Process Autoexec.bat
7. Click OK, and then click Yes to restart the computer. Test to determine if the issue is resolved by restarting your computer.

Problems Shutting Down Windows 95/98/Me (Continued)

A program in the StartUp folder may not close correctly StartUp folder

Determine whether a program in the StartUp folder conflicts with the startup process:

1. Click Start, click Run, type msconfig in the Open box, and then click OK.
2. Click Selective Startup, click to clear the Load Startup Group Items check box, click Apply, click OK, and then click Yes to restart your computer.

Test to determine if the issue is resolved by restarting your computer. If your computer does not shut down correctly If your computer shuts down correctly, one of your startup programs is probably causing this issue. To determine which startup program is causing this issue:

1. Click Start, click Run, type msconfig in the Open box, and then click OK.
2. On the Startup tab, click to select a check box, click OK, and then click Yes to restart your computer. Test to determine if the startup program you disabled caused the issue. If not, repeat these steps but enable a different program. When your computer does not start correctly, you have determined that the last startup program you enabled is the cause of the issue.

If disabling startup programs does not resolve the problem, re-enable the startup programs.

Determine if the problem is listed in the startup log file. You can look in your startup log file (Bootlog.prv) to find information about problems that occur during shutdown. The Bootlog.prv file is a hidden file in the root folder of drive C. If Windows is configured to hide system files, use these steps to display hidden files:

1. On the Windows desktop, double-click My Computer.
2. On the Tools menu, click Folder Options.
3. Click the View tab.
4. Click to clear the Hide protected operating system files check box, and then click Yes when you are prompted to confirm this action.
5. Click OK, and then look for the Bootlog.prv file again.
6. Click Start, click Shut Down, click Shut Down, and then click OK.

If your computer does not automatically shut off, press the power button on your computer to turn it off. Leave your computer off for approximately 15 seconds, and then turn your computer back on. While your computer is starting, press and hold the CTRL key. When the Startup menu is displayed, use the UP ARROW and DOWN ARROW keys to choose Logged (\BOOTLOG.TXT), and then press ENTER.

After Windows starts, click Start, click Shut Down, click Restart, and then click OK.

To review your startup log file:

1. Double-click My Computer, double-click drive C, and then look for the Bootlog.prv file.
2. Double-click the Bootlog.prv file. If you are prompted to select a program to use to open the file, click WordPad, Notepad, or any text editor in the list.
3. Look for "Terminate=" entries. These entries, located at the bottom of the file, might provide clues about the cause of the problem. If a process that is started by a "Terminate=" entry is completed successfully, the file contains a matching "EndTerminate=" entry.

Problems Shutting Down Windows 95/98/Me (Continued)

4. Check the last line in the Bootlog.prv file to see if it is one of these items:
 - Terminate=Query Drivers: This is a Memory Manager problem. Your computer might have defective memory chips or damaged files. You might need to reinstall Windows.
 - Terminate=Reset Display: Try installing an updated video adapter driver.
 - Terminate=RIT: There may be timer-related problems with the sound card or an older mouse driver. Try installing updated drivers for these devices.
 - Terminate=Win32: A program is not shutting down properly. Try quitting all programs before you shut down Windows.

An incompatible, damaged, or conflicting device driver is loaded

Some of the most common device drivers that may cause problems are sound card drivers, video adapter drivers, and network adapter drivers. To disable device drivers:

1. Right-click My Computer, click Properties, and then click the Device Manager tab.
2. Double-click a device type, for example, Sound, Video, and Game Controllers, to expand it.
3. Click one of the listed devices, and then click Properties.
4. Click to select the Disable In This Hardware Profile check box.
IMPORTANT: Record all of the devices you disable in this manner so that you can enable them again later.
5. Click OK, click OK, and then restart your computer.

Test to determine if the issue is resolved by restarting your computer. If your computer does not shut down correctly, repeat the steps but with a different component.

To test your video adapter, click Start, click Run, type msconfig, click OK, click Advanced, click to select the VGA 640x480x16 check box, and then click OK. If you disable your sound card, video adapter, and network adapter, but the issue is still not resolved, re-enable these devices by clicking to clear the Disable In This Hardware Profile check box.

If you are unable to change the video adapter by using the preceding steps, change your video adapter driver to the Standard VGA driver by using these steps:

1. Click Start, point to Settings, click Control Panel, and then double-click Display.
2. Click the Settings tab, click Advanced, click the Adapter tab, and then click Change.
3. Click Next, click Display a list of all the drivers in a specific location, so you can select the driver you want, and then click Next.
4. Click Show All Hardware, click Standard Display Types in the Manufacturer box, click Standard Display Adapter (VGA) in the Models box, and then click Next.
5. Click Yes, click Next, and then click Finish.
6. Click Close, click Close, and then click Yes when you are prompted to restart your computer.
7. If changing your video adapter to the Standard VGA driver resolves the issue, contact your video adapter manufacturer to inquire about the availability of an updated Windows Me video adapter driver.

Problems Shutting Down Windows 95/98/Me (Continued)

Determine if shutdown problems are being caused by a virtual device driver (.vxd file):

1. Click Start, click Run, type msconfig, and then click OK.
2. Click Selective Startup, and then click to clear the Load Static VxDs check box.
3. Click OK, and then click Yes to restart the computer.

Test to determine if the issue is resolved by restarting your computer. If your computer does not shut down correctly, click to select the Load Static VxDs check box, and then continue with the next step. If the problem is fixed, suspect one of the following files:

This is a partial list of Microsoft static .vxd files:

Name of static .vxd file Provides support for

Vnetsup.vxd Microsoft networking

Ndis.vxd Microsoft networking

Ndis2sup.vxd Microsoft networking

Javasup.vxd Java support

Vrtwd.386 Clock

Vfixd.vxd Video Phone helper

Vnetbios.vxd Microsoft networking

Vserver.vxd Microsoft networking

Vredir.vxd Microsoft networking

Dfs.vxd Microsoft networking

Ndiswan.vxd Microsoft networking

Msmouse.vxd Microsoft Mouse

Check the properties of the incompatible static .vxd file to determine which program it is associated with. Uninstall and then reinstall the program to replace the .vxd file with a new copy. To check the properties of a file, click Start, click Search, type the name of the file in the For Files or Folders box, and then click Search Now. After the file you are looking for is displayed in the list, right-click the file, and then click Properties.

There is an incompatible Advanced Power Management (APM) or Advanced Configuration and Power Interface (ACPI) setting

Determine if Advanced Power Management (APM) is causing the shutdown problem by disabling it (Assuming that your system has APM):

1. Click Start, point to Settings, click Control Panel, double-click System, and then click the Device Manager tab.
2. Double-click the System Devices branch to expand it.
3. Double-click Advanced Power Management in the device list, click the Settings tab, and then click to select the Force APM 1.0 Mode and Disable Power Status Polling check boxes.
4. Click OK until you return to Control Panel, and then restart your computer.
5. Test to determine if the issue is resolved by restarting your computer. If your computer does not shut down correctly, repeat the steps, but click to clear the Force APM 1.0 Mode and Disable Power Status Polling check boxes.

Problems Shutting Down Windows 95/98/Me (Continued)

There is an incompatible Basic Input/Output System (BIOS) configuration setting - IRQ Steering

This option allows several PCI devices to share the same interrupt request line (IRQ). If the BIOS is not fully compliant, this option may cause your computer not to shut down properly, even if two or more devices are not sharing an IRQ. To disable PCI bus IRQ Steering, follow these steps:

1. Click Start, point to Settings, click Control Panel, and then double-click System.
2. On the Device Manager tab, click System Devices.
3. Double-click PCI Bus, and then click to clear the Use IRQ Steering check box on the IRQ Steering tab.
4. Click OK, click OK, and then restart your computer.
5. After you restart the computer, attempt to shut down your computer again.

If your computer shuts down successfully, you may need to change the BIOS configuration or you may need a BIOS update. For information about how to do so, contact your BIOS manufacturer.

There is an incompatible Basic Input/Output System (BIOS) configuration setting - Resume on Ring and LAN

Some shutdown-related issues may be solved by disabling the "Resume on Ring and LAN" feature in the computer's BIOS. For information about how to do so, contact your computer or BIOS manufacturer.

There is an incompatible Basic Input/Output System (BIOS) configuration setting - NVRAM/ESCD

There are specific settings for how the BIOS and Windows interact during the startup and shutdown processes. To check this, disable the NVRAM/ESCD updates feature to determine if doing so resolves the shutdown problem. To do this, follow these steps:

1. Click Start, point to Settings, click Control Panel, and then double-click System.
2. On the Device Manager tab, double-click System Devices.
3. Click Plug and Play BIOS, and then click to select the Disable NVRAM / ESCD updates check box on the Settings tab.
4. Click OK, click OK, and then restart your computer.
5. After you restart the computer, attempt to shut down your computer again.

There is an incompatible Basic Input/Output System (BIOS) configuration setting - Plug and Play BIOS

In some cases, the BIOS and Windows may not be communicating properly with the computer hardware during the shutdown process. You can configure Windows to ignore the presence of a Plug and Play BIOS and communicate directly with the hardware.

NOTE: Use this method for testing purposes only. Leaving the Plug and Play BIOS disabled may cause some hardware to stop working.

1. To configure Windows not to use the Plug and Play BIOS:
2. Restart your computer, and press and hold CTRL until you see the Windows Start menu.

Problems Shutting Down Windows 95/98/Me (Continued)

If the problem still exist, do the following:

1. Type the following line at the command prompt:
cd \windows\system
2. Rename the Bios.vxd file to Bios.old.
3. Restart your computer.
4. After the computer restarts, attempt to shut down Windows.

If the computer shuts down correctly, the system BIOS is likely to be contributing to the shutdown problems. Contact the motherboard or BIOS manufacturer for a possible update.

Antivirus Program

If you have an antivirus program that is configured to scan your floppy disk drive when you shut down your computer, your computer may stop responding.

A10 Windows NT 4.0, Windows 2000 and Windows XP Stop Errors

STOP 0x0000000A (0xA) IRQL_NOT_LESS_OR_EQUAL

Parameter:

- 1 Memory referenced
- 2 IRQL
- 3 Value: 0 = read operation, 1 = write operation
- 4 Address that referenced memory

An attempt was made to touch pageable memory at a process internal request level (IRQL) that is too high. In other words, a driver is using improper memory addresses. It is usually caused by a bad device driver, or using a Windows NT 4.0 driver on a Windows NT 3.51.

To isolate the cause of the STOP error, do the following:

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Turn your PC off and take out all cards except the video card and SCSI card if you are booting from the SCSI drive. After the OS is installed, shut down the computer and plug in one card at a time, boot the OS and installed the drivers for that card. If you get the error message again, try to update the driver.

STOP 0x0000001E (0x1E) KMODE_EXCEPTION_NOT_HANDLED

Parameters:

- 1 The exception code that was not handled
- 2 The address at which the exception occurred
- 3 Parameters 0 of the exception
- 4 Parameter 1 of the exception

While this is typically not a processor stop error, it is one of the most common bug code. Usually the exception address pinpoints the driver or function that caused the problem. Other causes include bad processor, bad memory, bad cache or bad BIOS or outdated BIOS. Always note this address as well as the link date of the driver or image that contains this address. A common error is exception code 0x80000003. This error means a hard-code breakpoint or assertion was hit, but the system was booted with the /NODEBUG switch. This problem should not occur very often. If it occurs repeatedly, make sure a debugger is connected and the system is booted with the /DEBUG switch.

To isolate the cause of the STOP error, do the following:

- Make sure that you have adequate disk space, especially for new installations.

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Update the offending driver or reinstall the offending driver/software package. You may need to use Last Known Good Configuration or Safe mode.
- If the motherboard and hard drive support Ultra DMA-66 or faster, enter the BIOS CMOS program and disable the Ultra DMA and set the PIO to mode 4 for that channel. Then after Windows is installed, try the Ultra DMA to see if Windows is stable. Be sure to use the 40-pin, 80 conductor cable.
- Replace the memory
- Replace the cache (if on motherboard)
- Replace the motherboard
- Replace the processor

STOP 0x00000023 and 0x00000024 FAT_FILE_SYSTEM or NTFS_FILE SYSTEM

This is usually caused by heavily fragmented drives, heavy file I/O, some types of drive-mirroring software or some types of antivirus software.

To isolate stop error:

- Temporarily disable any antivirus programs, backup programs and defragmentation utilities.
- Check for hard drive corruption by running ScanDisk.
- Try Safe mode and Last Known Good Configuration
- Delete all partitions, then repartition and reformat your system.

STOP 0x0000002E (0x2E) DATA_BUS_ERROR

Parameters:

- 1 Virtual address that caused the fault
- 2 Physical address that caused the fault
- 3 Processor status register (PSR)
- 4 Faulting instruction register (FIR)

This bug code is normally caused by a parity error in the system memory. This error can also be caused by a driver accessing a 0x8XXXXXXX address that does not exist.

To isolate the cause of the STOP error, do the following:

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Check for viruses.
- If you added a new device driver, start the computer in Safe mode, uninstall the driver and restart the computer.

- Update the offending driver
- Run hardware system diagnostic program. Run a general test for the entire system and an extensive test for the memory.
- Replace the memory
- Replace the Video memory (or video card)
- Replace the cache
- Replace the hard driver
- Replace the processor
- Replace the motherboard

**STOP 0x0000003E (0x3E)
MULTIPROCESSOR_CONFIGURATION_NOT_SUPPORTED**

The system has multiple processors, but they are asymmetric in relation to one another. To be symmetric, all processors must be the same type and level (same type, cache size and frequency with compatible stepping). In addition, make sure the processor supports multiprocessing. This information is stated in the Processor Specification Update guides.

STOP 0x0000003F NO_MORE_SYSTEM PTES

A driver is not cleaning up properly

To isolate the cause of the STOP error, do the following:

- Remove any recently installed software, including backup utilities or disk-intensive applications such as defragmenting, virus protection and backup utilities.

STOP 0x00000058

The failure of a primary drive in a fault-tolerance set.

- Using a Windows 2000 Startup disk, start your computer from the mirrored (secondary) system drive.
- Try Last Known Good Configuration.
- Delete all partitions, then repartition and reformat your system.
- If you are using an older machine and the drive is over 8,057 GB, you may need to load some special software so that the system can recognize over 8 GB or update the BIOS.

STOP 0x00000077 (0x77) KERNEL_STACK_INPAGE_ERROR

Parameters:

1 0
2 0

- 3 PTE value at time of error
- 4 Address of signature on kernel stack

or

- 1 Status code
- 2 I/O status code
- 3 Page file number
- 4 Offset into page file

The requested page of kernel data could not be read. This error is caused by bad block in a paging file or a disk controller error and in extremely rare cases, it is caused by running out of resources.

If the first and second arguments are 0, the stack signature in the kernel stack was not found. This error is caused by bad hardware.

If the status code is 0xC000009A, it's probably the L2 cache. If 0xC000009C and 0xC000016A, you have a failing hard drive. If the status is 0xC0000185 (STATUS_IO_DEVICE_ERROR) and the paging file is on a SCSI disk device, the cabling and termination should be checked. Other items to check would include defective L2 cache, defective memory, defective processor, defective motherboard and defective hard drive.

STOP ERROR 0x00000079 MISMATCHED HAL

- The Hardware Abstraction Layer is incorrect for the machine. This usually occurs when one machine mixes single and dual processor configuration files. In Windows NT, restart the install and when the message "Windows NT is examining the hardware" appears, press F5. Choose your computer type from the list that appears and continue with the installation. In Windows 2000, you should begin the installation process again and install a clean copy of OS. See
- Repartition and reformat your hard drive from scratch and install Windows.
- Replace the motherboard.
- Replace the processors.

Note: To change the HAL for Windows 2000 without reinstalling Windows 2000, see section 14.4.

STOP 0x0000007B INACCESSIBLE_BOOT_DEVICE

A problem occurred during the initialization of the I/O system (usually the startup device or the file system).

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Check for viruses on your computer.

- Remove any newly added hard drives or controllers.
- If you are using a SCSI adapter, obtain the latest Windows driver from the adapter vendor. In addition, try to disable sync negotiation, check termination and check the SCSI Ids of the devices.
- If you are using IDE devices, define the on-board IDE part to Primary only. Check the Master/Slave/Only settings for the IDE devices. Remove all Ide devices except for the hard disk.
- Run CHKDSK. The file system could be corrupt. If Windows cannot run CHKDSK, you might have to move the drive to another computer running Windows 2000 or Windows XP and run the CHKDSK command on that drive.
- Restart your computer. At the startup screen, press F8 for the Advanced Startup option, and select Last Known Good Configuration.

STOP 0x0000007F UNEXPECTED_KERNEL_MODE_TRAP

This error means a trap (exception) occurred in kernel mode, either a kind of trap that the kernel is not allowed to have or catch (a bound trap) or a kind of trap that is always instant death (double fault). This can be caused by a hardware or software problem, but is most commonly a hardware failure. The first number in the bug code parenthesis is the number of the trap (8 = double fault). To learn more about what these traps are, consult an Intel® Software Developer Manual, Volume 3: System Programming Guide, Chapter 5. Check for mismatched RAM, bad RAM, bad processor or outdated BIOS.

To isolate the cause of the STOP error, do the following:

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Run diagnostic software and test the RAM in the computer.
- Disable memory caching.
- Turn your PC off and take out all cards except the video card and SCSI card if you are booting from the SCSI drive. After the OS is installed, shut down the computer and plug in one card at a time, boot the OS and installed the drivers for that card. If you get the error message again, try to update the driver.
- Try removing or swapping out controllers, cards or other peripherals.
- Check to see if the RAM modules are the same speed and that they are compatible with each other.
- Make sure that you have sufficient RAM to run Windows.
- Try different RAM
- Try a different motherboard.
- Try a different processor.

STOP 0x00000080 NMI_HARDWARE_FAILURE

The HAL is supposed to report whatever specific data it has and to tell the user to call his or her hardware vendor for support.

To isolate the cause of the STOP error, do the following:

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Check to make sure the system is not using non-parity memory in a parity based system or mixing of parity/non-parity memory
- Try different RAM
- Try different motherboard
- Try different processor

STOP 0x0000009C Machine_Check_Exception

A fatal Machine Check Exception has occurred.

For Pentium processors, the parameters are:

- 1 Low 32 bits of P5_MC_TYPE MSR
- 2 Not Applicable
- 3 High 32 bit of P5_MC_ADDR MSR
- 4 Low 32 bits of P5_MC_ADDR MSR

Note: Machine-Check Exceptions are listed in the Intel Architecture Software Developer's Manual – Volume 3: System Programming Guide, chapter 12.

For a processor with a P6 architecture, the parameters are:

- 1 Bank number
- 2 Address of field of MCi_ADDR MSR for the MCA bank that had the error
- 3 High 32 bits of MCi_STATUS MSR for the MCA bank that had the error
- 4 Low 32 bits of MCi_STATUS MSR for the MCA bank that had the error

Note: Machine-Check Exceptions are listed in the Intel® Architecture Software Developer's Manual – Volume 3: System Programming Guide, chapter 12.

To isolate the cause of the STOP error, do the following:

- Make sure that you have the newest Windows Service Pack.
- Make sure that you have the most current BIOS update.
- Replace the RAM
- Try a different motherboard
- Try a different processor or processors

STOP 0x000000B4 VIDEO_DRIVER_INIT

The video driver is bad, corrupted, missing, or disabled.

To isolate the cause of the STOP error, do the following:

- Try starting your computer in safe mode or Enable VGA mode and trying removing the driver and reinstalling the driver.
- Make sure that you have the newest Windows Service Pack.
- Make sure that you have the most current BIOS update.

STOP 0XC0000185 STATUS_IO_DEVICE_ERROR:

- Make sure the SCSI controller and SCSI cable is connected correctly.
- Check for Resource Conflicts for your SCSI card.

STOP 0x00000221 STATUS_IMAGE_CHECKSUM_MISMATCH

The installer program found a corrupt driver or DLL file for some hardware device.

- Make sure that you have the most current BIOS.
- Make sure that you have the newest Windows Service Pack.
- Turn your PC off and take out all cards except the video card and SCSI card if you are booting from the SCSI drive. After the OS is installed, shut down the computer and plug in one card at a time, boot the OS and installed the drivers for that card. If you get the error message again, try to update the driver.