## Beep Codes

When a fault is detected before the video system is initialized, errors are indicated with a series of beeps (or beep codes). Because each BIOS is a bit different, the accuracy, precision, and quality of error detection and reporting varies from BIOS to BIOS. Although most POST routines today follow a remarkably similar pattern, the reporting style can vary greatly. Some routines (such as AMI) generate a continuous string of beeps, and other routines (such as Phoenix) create short beep sequences. This part of the chapter is intended to help you understand and interpret beep codes produced by major BIOS makers:

**BEEPS ERROR MESSAGE FOR AMI BIOS**

| BEEPS | ERROR MESSAGE |
|---|---|
| 1s | System RAM refresh failure The Programmable Interrupt Timer (PIT) or Programmable Interrupt Controller (PIC) has probably failed. Replace the motherboard. |
| 2s | Memory parity error. A parity error has been detected in the first 64KB of RAM. The RAM IC is probably defective. Replace the memory or motherboard. |
| 3s | Base 64KB memory failure. A memory failure has been detected in the first 64KB of RAM. The RAM IC is probably defective. Replace the memory or motherboard. |
| 4s | System timer failure. The system clock/timer IC has failed. |
| 5s | CPU failure. The system CPU has failed. Try replacing the CPU or motherboard. |
| 6s | Gate A20 failure. The keyboard controller IC has failed, so Gate A20 is no longer available to switch the CPU into protected mode. Replace the keyboard controller or motherboard. |
| 7s | Exception error The CPU has generated an exception error because of a fault in the CPU or some combination of motherboard conditions. Try replacing the motherboard. |
| 8s | Video memory read/write error. The system video adapter is missing or defective. Try replacing the video adapter. |
| 9s | ROM checksum error. The contents of the system BIOS ROM do not match the expected checksum value. The BIOS ROM is probably defective and should be re-placed. |
| 10s | CMOS shutdown register read/write error. The shutdown register for the CMOS memory has failed. Try replacing the RTC/CMOS IC. |
| 1l–3s | Memory test failure A fault has been detected in memory over 64KB. Replace the memory or the motherboard. |
| 1s | System RAM refresh failure The Programmable Interrupt Timer (PIT) or Program |

1l–8s Display test failure. The display adapter is missing or defective. Replace the video adapter board. If the video adapter is on the motherboard, try replacing the motherboard.

**BEEPS ERROR MESSAGE**

1s No error
1l–1s BIOS ROM checksum error
2s General error
1l–2s Video adapter error

**PHOENIX BEEP CODES**

**BEEPS ERROR MESSAGE**

1–1–2 CPU register test failure The CPU has likely failed. Replace the CPU Low
1–1–2 System board Select failure the motherboard is suffering from an Undetermined fault. Try replacing the motherboard.
1–1–3 CMOS read/write failure The RTC/CMOS IC has probably failed. Try replacing the RTC/CMOS IC Low
1–1–3 Extended CMOS RAM failure The extended portion of the RTC/CMOS IC has failed. Try replacing the RTC/CMOS IC.
1–1–4 BIOS ROM checksum error The BIOS ROM has probably failed.
1–2–1 Programmable–Interval Timer (PIT) failure The PIT has probably failed.
1–2–2 DMA initialization failure The DMA controller has probably failed.
1–2–3 DMA page–register read/write failure The DMA controller has probably failed.
1–3–1 RAM refresh failure the refresh controller has failed.
1–3–2 64KB RAM test disabled The test of the first 64KB of system RAM could not begin. Try replacing the motherboard.
1–3–3 First 64KB RAM IC or data line failure The first RAM IC has failed.
1–3–4 First 64KB odd/even logic failure the first RAM control logic has failed.
1–4–1 Address–line failure 64KB of RAM.
1–4–2 Parity failure first 64KB or RAM The first RAM IC has failed.
1–4–3 EISA failsafe timer test fault Replace the motherboard.
1–4–4 EISA NMI port 462-test failure Replace the motherboard.
3–1–1 Slave DMA–register failure The DMA controller has probably failed.
3–1–2 Master DMA–register failure The DMA controller has probably failed.
3–1–3 Master–interrupt mask–register failure the interrupt controller has probably failed.
3–1–4 Slave–interrupt mask–register failure The interrupt controller has probably failed.
3–2–2 Interrupt vector–loading error BIOS is unable to load the interrupt vectors into low RAM. Replace the motherboard.
3–2–3 Reserved
3–2–4 Keyboard–controller test failure The keyboard controller has failed.

3–3–1 CMOS RAM power bad Try replacing the CMOS backup battery. Try replacing
the RTC/CMOS IC. Replace the motherboard.
3–3–2 CMOS configuration error The CMOS configuration has failed. Restore the configuration. Replace the CMOS backup battery. Replace the RTC/CMOS IC. Re-place the motherboard.
3–3–3 Reserved
3–3–4 Video–memory test failed. There is a problem with the video memory.
Replace video memory or replace the video adapter board.
3–4–1 Video–initialization test failure There is a problem with the video system. Replace the video adapter.
4–2–1 Timer–tick failure The system timer IC has failed.
4–2–1 Shutdown–test failure The CMOS IC has failed.
4–2–3 Gate A20 failure The keyboard controller has probably failed.
4–2–4 Unexpected interrupt in protected mode There is a problem with the CPU.
4–3–1 RAM test–address failure System RAM addressing circuitry has failed.
4–3–3 Interval–timer channel–2 failure The system timer IC has probably failed.
4–3–4 Time–of–day clock failure The RTC/CMOS IC has failed.
4–4–1 Serial–port test failure A fault has developed in the serial–port circuit.
4–4–2 Parallel–port test failure A fault has developed in the parallel–port circuit.

## ERROR CODES

In spite of the proliferation of diagnostics and test equipment in the PC industry, most computers are remarkably adept at testing their own hardware and reporting serious errors during start time. This is accomplished through the *Power-On Self-Test (POST)* written into BIOS. Because BIOS is written expressly for a particular processor, chipset, and other motherboard hardware, the BIOS is an ideal choice for startup diagnostics. However, startup diagnostics pose a unique problem—it's hard to report an error when the system isn't fully functional. BIOS reports POST errors through the use of audible signals (called *beep code*s), as well as through hexadecimal codes written to established I/O addresses (called *POST code*s). IBM has also established a standardized set of diagnostic codes for indicating system problems. This chapter explores the IBM diagnostic codes, then presents a compilation of beep and POST codes tracked down from just about every BIOS maker.

### IBM Diagnostic Codes

IBM has taken an unusually thorough approach to diagnosing and reporting system errors through the use of their Advanced Diagnostics program (which can be purchased directly from IBM, but is available on many PS/2 reference disks). When the diagnostic is run, it will test and report on every possible subsystem—new or old—that might be in the PC. Unfortunately, IBM has never really done a very good job of documenting their vast array of codes. This section of the chapter is intended as a source of reference to assist you in interpreting these codes and to help you select some repair alternatives.

## READING THE CODES

Diagnostic codes are split into two sections: the test code and the fault code. The *test code* is simply the number that corresponds to the particular test being run. The *fault code* is a two-digit decimal number that corresponds to the specific type of error that is identified. A fault code of 00 indicates that no problem was found. For example, the message "100" means that the motherboard was tested (01) and that no errors were detected (00)—thus "0100," or just "100." If a fault code appears other than 00, a problem has been detected that a technician will have to address. System initialization might or might not continue depending on the location and severity of the error. Table below provides some common list of diagnostic codes for XT, AT, PS/2 systems.

## SYSTEM BOARD (01xx)

101 Interrupt failure (unexpected interrupt)
102 BIOS ROM checksum error (PC, XT); timer error (AT, MCA)
103 BASIC ROM checksum error (PC, XT); timer-interrupt error (AT, MCA)
104 Interrupt controller error (PC, XT); protected-mode error (AT, MCA)
105 Timer failure (PC, XT); keyboard-controller failure (MCA)
106 System-board converting-logic test failure
107 System-board adapter-card or math co-processor fault; Hot NMI test failed (MCA)
108 System-board timer bus failure
109 DMA-test memory-select failure
115 Cache parity error, BIOS ROM checksum error, or DMA error
116 System board port R/W error
118 System board L2 cache error
119 2.88MB floppy drive installed but not supported by floppy disk controller
120 CPU self-test error
121 Unexpected hardware interrupt occurred
162 CMOS checksum or CRC error
163 CMOS error—time and date not set (the clock not updating)
164 Memory-size error—CMOS data does not match system memory found
173 Bad CMOS/NVRAM checksum
174 Bad system configuration

**SYSTEM MEMORY (02xx)**

201 Memory error (physical location will likely be displayed)
202 Memory address line 0–15 error
203 Memory address line 16–23 error; line 16–31 error (MCA)
204 Memory remapped to compensate for error (PS/2)
205 Error in first 128K (PS/2 ISA) of RAM
207 BIOS ROM failure
210 System-board memory parity error
211 Error in first 64K of RAM (MCA)
215 Memory-address error; 64K on daughter/SIP 2 failed (70)
216 Memory-address error; 64K on daughter/SIP 1 failed (70)
221 ROM to RAM copy (shadowing) failed (MCA)
225 Wrong-speed memory on system board (MCA)
230 Memory on motherboard and adapter-board overlaps
231 Non-contiguous adapter memory installed
235 Stuck data line on memory module
241 Memory module 2 failed
251 Memory module 3 failed

**KEYBOARD (03xx)**

301 Keyboard did not respond correctly (stuck key detected)
302 Keyboard locked (AT, models 25, 30)
303 Keyboard/system-board interface error—keyboard controller fault
304 Keyboard or system unit error (keyboard clock stuck high)
305 Keyboard fuse failed on system board (PS/2 50, 60, 80) or +5 V error (PS/2 70)
306 Unsupported keyboard attached
341 Keyboard error
342 Keyboard cable error
343 Enhancement card or cable error
365 Keyboard failure
366 Interface cable failure
367 Enhancement card or cable failure

**MONOCHROME DISPLAY ADAPTER (04xx)**

401 Memory, horizontal-sync frequency, or vertical-sync test failure
408 User-indicated display-attribute failure
416 User-indicated character-set failure
424 User-indicated 80-´-25-mode failure
432 MDA-card parallel-port test failure

**COLOR GRAPHICS ADAPTER (05xx)**

501 Memory, horizontal-sync frequency, or vertical-sync test failure
503 CGA-adapter controller failure
508 User-indicated display-attribute failure
516 User-indicated character-set failure
524 User-indicated 80X25 mode failure
532 User-indicated 40X25 mode failure
540 User-indicated 320X200 graphics-mode failure
548 User-indicated 640X200 graphics-mode failure
556 Light-pen test failed
564 User-indicated screen-paging test failed

**FLOPPY DRIVES AND ADAPTERS (06xx)**

601 General diskette or adapter-test failure
602 Diskette boot sector is not valid
603 Diskette-size error
604 Media-sense error
605 Diskette drive locked
606 Diskette-verify test failure
607 Write-protect error
608 Drive-command error
610 Diskette-initialization failure
613 Floppy-system DMA error
616 Drive-speed error
621 Drive-seek error
622 Drive CRC error
623 Sector-not-found error
624 Disk address mark error
628 Diskette removed from drive
645 No index pulse
646 Drive track 00 detection failed
647 No transitions on Read Data line
648 Format test failed
649 Incorrect media type in drive
650 Drive speed incorrect
627 Diskette change-line error 651 Format failure
652 Verify failure
653 Read failure
654 Write failure
655 Drive-controller error
656 Drive-mechanism failure
657 Write protect stuck in “protected” state
658 Change line stuck in “changed” state
659 Write protect stuck in “unprotected” state
660 Change line stuck in “unchanged” state

**PARALLEL PRINTER ADAPTER (09xx)**

901 Data-register latch error
902 Control-register latch error
903 Register-address decode error
904 Address decode error
910 Status-line wrap-connector error
911 Status-line bit-8 wrap error
912 Status-line bit-7 wrap error
913 Status-line bit-6 wrap error
914 Status-line bit-5 wrap error
915 Status-line bit-4 wrap error
916 Printer adapter interrupt wrap error
917 Unexpected printer-adapter interrupt
92x Feature register error

**COMMUNICATION DEVICES (11xx)**

1101 16450/16550 UART error
1103 Port 102h register-test failure
1107 Communications-cable or system-board error
1108 IRQ 3 error
1109 IRQ 4 error
1110 16450/16550 chip-register failure
1113 UART transmit error
1114 UART receive error
1115 UART transmit and receive data unequal—receive error
1116 UART interrupt function error
1117 UART baud-rate test failure
1118 UART interrupt-driven receive external data-wrap test error
1120 UART interrupt enable register failure: all bits cannot be set
1121 UART interrupt enable register failure: all bits cannot be reset
1122 Interrupt pending—stuck on
1123 Interrupt ID register stuck on
1124 Modem-control register failure: all bits cannot be set
1125 Modem-control register failure: all bits cannot be reset
1126 Modem-status register failure: all bits cannot be set
1127 Modem-status register failure: all bits cannot be reset
1128 Interrupt ID error
1129 Cannot force overrun error
1130 No modem status interrupt
1131 Invalid interrupt pending
1133 No data available at interrupt
1134 No transmit holding at interrupt

1135 No interrupts
1136 No received-line status interrupt
1137 No receive data available
1138 Transmit holding register not empty
1139 No modem status interrupt
1140 Transmit holding register not empty
1141 No interrupts
1142 No IRQ4 interrupt
1143 No IRQ3 interrupt
1144 No data transferred
1145 Maximum baud-rate error
1146 Minimum baud-rate error
1148 Time-out error
1149 Invalid data returned
1150 Modem-status register error
1151 No DSR and delta DSR
1152 No DSR
1153 No delta DSR
1154 Modem-status register not clear
1155 No CTS and delta CTS
1156 No CTS
1157 No delta CTS

**GAME-PORT ADAPTERS (13xx)**
1301 Game-port adapter test failure
1302 Joystick test failure

**HARD DRIVES AND ADAPTERS (17xx)**
1701 Fixed-disk or adapter general error
1702 Drive and controller time-out error
1703 Drive-seek error
1704 Drive controller failed
1705 Drive-sector not-found error
1706 Write-fault error
1707 Drive-track 00 error
1708 Head-select error
1709 Bad ECC returned
1710 Sector buffer overrun
1711 Bad-address mark
1712 Internal-controller diagnostics failure
1713 Data-compare error
1714 Drive not ready
1715 Track-00 indicator failure
1716 Diagnostics-cylinder errors

1717 Surface-read errors
1718 Hard-drive error
1720 Bad diagnostics cylinder
1726 Data-compare error
1730 Drive-controller error
1731 Drive-controller error
1732 Drive-controller error
1733 BIOS-undefined error return
1735 Bad-command error
1736 Data-corrected error
1737 Bad drive-track error
1738 Bad-sector error
1739 Bad-initialization error
1740 Bad-sense error
1750 Drive-verify error
1751 Drive-read error
1752 Drive-write error
1753 Drive random-read test failure
1754 Drive-seek test failure
1755 Drive-controller failure
1756 Controller ECC test failure

**PRIMARY PC NETWORK ADAPTER (30xx)**
3001 Network-adapter test failure
3002 ROM-checksum test failure
3004 RAM test failure
3006 +/-12-Vdc test failure

**Internal Modem (48xx)**
48xx The internal modem has failed—replace the internal modem

**3.5" FLOPPY DISK DRIVE (73xx)**
7301 Diskette drive/adapter test failure
7306 Diskette change-line error
7307 Write-protected diskette
7308 Drive-command error
7310 Diskette initialization failure—track 00 error
7311 Drive time-out error
7313 DMA error
7315 Drive index-timing error
7316 Drive-speed error
7321 Drive-seek error
7322 Drive CRC-check error
7323 Sector-not-found error
7324 Address-mark error

**SCSI ADAPTER (16-BIT W/O CACHE) (112xx)**

112xx A fault has been detected in the SCSI adapter—replace the SCSI adapter

**SYSTEM BOARD SCSI ADAPTER (113xx)**

113xx A fault has been detected in the SCSI adapter—replace the motherboard

## TROUBLESHOOTING WITH DIAGNOSTIC CODES

Now that you have an idea of the diagnostic areas that are covered and error codes you can expect to see, you should have an understanding of how to deal with those errors when they occur. Generally speaking, a PC can be divided down into a motherboard, expansion boards, drives, and a power supply—each area can be considered as a replaceable module. When an error code is generated, you can match the code to its description. You should generally replace the failed module. For example, if a video adapter fails, it should be replaced. If a motherboard fails, it should be replaced; if a hard drive fails, it should be replaced, etc. The following notes will explain some of the finer points.

**Motherboard notes** The motherboard manages virtually all of the PC's processing resources (i.e., DMAs, IRQs, memory, etc.). As a consequence, the motherboard is perhaps the most expensive module to replace. Before electing to replace the motherboard, be certain that the faulty component(s) cannot be swapped out. For example, the CPU, BIOS ROM, math co-processor, expansion memory (SIMMs), RTC/CMOS IC, and CMOS backup battery are almost always socket mounted. In fact, when you purchase a new motherboard, it typically comes without those socket-mounted elements. If an error message indicates that the CPU has failed, try another CPU. If the math co-processor appears to be defective, try a new MCP. Of course, if the defective element is hard-soldered to the motherboard, you should probably go ahead and order another motherboard, then simply transfer any of the socket-mounted devices from the old motherboard.

**Memory notes** Memory plays a vital role in every PC—the CPU is useless unless memory is available to hold data and program instructions. Because even one bad bit can cause an error that might crash a system, memory is perhaps the most thoroughly tested area of a computer. From a troubleshooting standpoint, memory can often be divided into two areas, the memory located on the motherboard, and the memory added in the form of SIMMs. When a failure occurs in a SIMM, it is a simple matter to locate and replace the SIMM. If the fault is on the motherboard, you are often faced with the prospect of replacing the defective RAM IC(s), or (more frequently) replacing the entire motherboard.

**Keyboard notes** Not only is the keyboard the most popular and reliable input device for the PC, the keyboard controller IC is also in control of the A20 Gate, which allows the CPU to enter its "protected mode." While in the protected mode, a CPU can address memory above 1MB. When a problem is detected in the keyboard assembly itself, it is usually a quick-and-easy process to replace the keyboard assembly. When a problem is located outside of the keyboard itself (or a protected-mode fault is found), the keyboard controller IC on the motherboard has probably failed. On some motherboards, the keyboard controller is mounted in an IC socket, and can be replaced easily. Where the keyboard controller is hard-soldered to the motherboard, it will probably be easiest to simply replace the motherboard outright.

**Video notes** As you look over the error codes, If you encounter a system with older video adapters that prove to be defective, it will be extremely difficult (if not impossible) to locate new replacement boards. As a result, you should expect to replace an older video board with one of the newer video adapters, such as VGA or SVGA, which offer backward compatibility to the older standards. Unfortunately, older video used TTL monitors, where VGA and SVGA adapters are designed for analog monitors. Remember that it might be necessary to upgrade your customer's monitor as well as their video adapter.

**Serial/parallel notes** Diagnostics typically attempt to test any serial or parallel ports that can be identified. In the early days of PCs, serial and parallel ports were typically added as expansion boards. When such add-on ports fail, it is a simple matter to replace the defective board. With most of today's systems, however, at least one serial and parallel port are integrated right on the motherboard. When these built-in ports check bad, often little can be done, other then replace the motherboard outright. Also, if an error code indicates a fault outside of the port circuit (e.g., the modem or printer), always try a new cable between the port and peripheral first. If a new cable does not correct the problem, try replacing the suspect peripheral. Also remember that some test procedures require you to attach a loop-back plug (rather than connect a live peripheral).

**Drive notes** Diagnostics typically check the complete suite of floppy drives, hard drives, and even CD-ROM drives. However, you must realize that a drive system includes not only the drive itself, but its controller board. If a drive problem is indicated, you should automatically inspect the signal and power cables at the drive. A loose power connector or frayed signal cable can easily disable the drive. If in doubt, try a new signal cable (much less expensive than replacing a drive). Of course, if a new cable fails to correct the fault, you must decide whether the drive or controller has failed. Often, the diagnostic error code will pinpoint the fault to either the drive or controller circuit for you. If the drive has failed, replace the drive. If the controller has failed, things can get a bit more complicated.

If the controller is implemented as an expansion board, it is easy enough to replace, but be sure that the new controller has any jumpers and DIP switches set similarly to the defective controller. If the controller is incorporated on the motherboard, you might find yourself replacing the entire motherboard.

## THE PRE-SERVICE CHECKOUT

The ability to identify and isolate a PC or peripheral fault quickly and decisively requires a keen eye, some common sense, and a little bit of intuition. It also requires an understanding of the troubleshooting process, and a reliable plan of action. Even though the number of PC configurations and setups are virtually unlimited, the methodology used to approach each repair is always about the same. This chapter is intended to illustrate the concepts of basic troubleshooting and show you how to apply a suite of cause-and-effect relationships that will help you narrow the problem down before you even take a screwdriver to the en-closure. By applying a consistent technique, you can shave precious time from every re-pair.

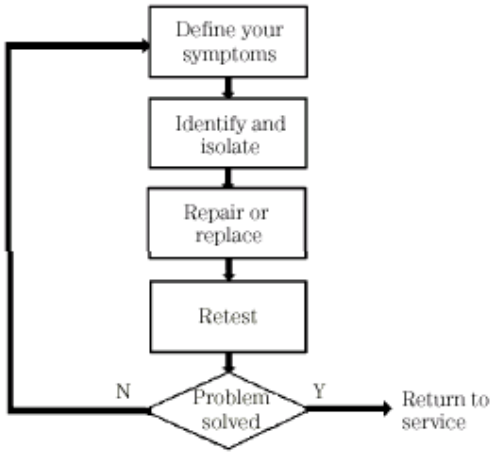
### The Universal Troubleshooting Process

Regardless of how complex your particular computer or peripheral device might be, a dependable troubleshooting procedure can be broken down into four basic steps as shown in the figure define your symptoms, identify and isolate the potential source (or location) of your problem, replace the suspected sub-assembly, and re-test the unit thoroughly to be sure that you have solved the problem. If you have not solved the problem, start again from Step #1. This is a “universal” procedure that you can apply to any sort of troubleshooting—not just for personal computer equipment.

## DEFINE YOUR SYMPTOMS

When a PC breaks down, the cause might be as simple as a loose wire or connector, or as complicated as an IC or sub-assembly failure. Before you open your toolbox, you must have a firm understanding of all the symptoms. Think about the symptoms carefully for example:

- Is the disk or tape inserted properly?
- Is the power or activity LED lit?
- Does this problem occur only when the computer is tapped or moved?




By recognizing and understanding your symptoms, it can be much easier to trace a problem to the appropriate assembly or component. Take the time to write down as many symptoms as you can. This note taking might seem tedious now, but once you have begun your repair, a written record of symptoms and circumstances will help to keep you focused on the task at hand. It will also help to jog your memory if you must explain the symptoms to someone else at a later date. As a professional troubleshooter, you must often log problems or otherwise document your activities anyway.

**IDENTIFY AND ISOLATE**

Before you try to isolate a problem within a piece of computer hardware, you must first be sure that the equipment itself is causing the problem. In many circumstances, this will be fairly obvious, but some situations might appear ambiguous (i.e., there is no power, no DOS prompt, etc.). Always remember that a PC works because of an intimate mingling of hardware and software. A faulty or improperly configured piece of software can cause confusing system errors. When you are confident that the failure lies in your system's hardware, you can begin to identify possible problem areas. The troubleshooting procedures throughout will guide you through the major sections of today's popular PC components and peripherals, and aid you in deciding which sub-assembly might be at fault. When you have identified a potential problem area, you can begin the actual repair process and swap the suspect sub-assembly.

**REPLACE**

Because computers and their peripherals are designed as collections of sub-assemblies, it is almost always easier to replace a sub-assembly outright, rather than attempt to troubleshoot the sub-assembly to its component level. Even if you had the time, documentation, and test equipment to isolate a defective component, many complex parts are proprietary, so it is highly unlikely that you would be able to obtain replacement components without a significant hassle. The labor and frustration factor involved in such an endeavor is often just as expensive as replacing the entire sub-assembly to begin with (perhaps even more expensive). On the other hand, manufacturers and their distributors often stock a selection of sub-assemblies and supplies. You might need to know the manufacturer's part number for the sub-assembly to obtain a new one. During a repair, you might reach a roadblock that requires you to leave your equipment for a day or two, or maybe longer. This generally happens after an order has been placed for new parts, and you are waiting for those parts to come in. Make it a point to reassemble your system as much as possible before leaving it. Gather any loose parts in plastic bags, seal them shut, and mark them clearly. If you are working with electronic circuitry, be sure to use good-quality anti-static boxes or bags for storage. Partial re-assembly (combined with careful notes) will help you remember how the unit goes together later on. Another problem with the fast technological progress we enjoy is that parts rarely stay on the shelf long. When a PC fails and you need to replace a broken device, chances are that you'll need to upgrade simply because you cannot obtain an identical replacement device. From this standpoint, upgrading is often a proxy of troubleshooting and repair.

**RE-TEST**

When a repair is finally complete, the system must be reassembled carefully before testing it. All guards, housings, cables, and shields must be replaced before final testing. If symptoms persist, you will have to reevaluate the symptoms and narrow the problem to another part of the equipment. If normal operation is restored (or greatly improved), test the computer's various functions. When you can verify that the symptoms have stopped during actual operation, the equipment can be returned to service. As a general rule, it is wise to let the system run for at least 24 hours to ensure that the replacement sub-assembly will not fail prematurely. This is known as letting the system *burn i*n. Do not be discouraged if the equipment still malfunctions. Perhaps you missed a jumper setting or DIP switch, or maybe software settings and device drivers need to be updated to accommodate the replacement sub-assembly. If you get stuck, simply walk away, clear your head, and start again by defining the current symptoms. Never continue with a repair if you are tired or frustrated—tomorrow is another day. Even the most experienced troubleshooters get overwhelmed from time to time. You should also realize that there might be more than one bad assembly to deal with. Remember that a PC is just a collection of assemblies, and each assembly is a collection of parts. Normally, everything works together, but when one assembly fails, it might cause one or more interconnected assemblies to fail as well.

## SOME COMMON SYMPTOMS

### THE SYSTEM DOESN'T START AT ALL:

**Symptom 1. There is no power light, and you cannot hear any cooling fan Chances are that there is insufficient power to the computer.** Use a voltmeter and confirm that there is adequate ac voltage at the wall outlet. Check the ac cord next it might be loose or disconnected. See that the power switch is turned on and connected properly. Check the power-supply fuse(s). The main fuse might have opened. Replace any failed fuse.

**Symptom 2. There is no power light, but you hear the cooling fan running this usually means that some level of ac power is reaching the system.** Use a voltmeter and confirm that there is adequate ac voltage at the wall outlet. Unusually low ac voltages (such as during "brownout" conditions) can cause the power supply to malfunction. Verify that the power-supply cables are attached properly and securely to the motherboard. Use a voltmeter to verify that each output from the power supply is correct. Table illustrates the proper voltage for each wire/color. If any output is very low or absent (especially the +5-volt output), replace the power supply. Finally, use a voltmeter and verify that the *Power good* (or *Pwr O*K) signal is +5 V. If this signal is below 1.0 V, it might inhibit the CPU from running by forcing a *Reset* condition. Because the *Power good* signal is generated by the power supply, try replacing the power supply.

**PINOUTS OF ATX AND BABY AT POWER CONNECTORS**

**ATX POWER CONNECTOR**

| COLOR | VOLTAGE | PIN |
|---|---|---|
| Orange | +3.3 Vdc | 1 |
| Orange | +3.3 Vdc | 2 |
| Black | GND | 3 |
| Red | +5 Vdc | 4 |
| Black | GND | 5 |
| Red | +5 Vdc | 6 |
| Black | GND | 7 |
| Gray | PwrOK | 8 |
| Purple | +5V standby | 9 |
| Yellow | +12 Vdc | 10 |
| Orange (22AWG) | +3.3 Vdc | 11 |
| Brown (22AWG) | 3.3 V sense | 11 |
| Blue | –12 Vdc | 12 |
| Black | GND | 13 |
| Green | PS-ON | 14 |
| Black | GND | 15 |
| Black | GND | 16 |
| Black | GND | 17 |
| White | –5 Vdc | 18 |
| Red | +5 Vdc | 19 |
| Red | +5 Vdc | 20 |

**BABY AT POWER CONNECTORS**

| COLOR | VOLTAGE | PIN |
|---|---|---|
| Orange | PwrOK | 1 (P8) |
| Red | +5 Vdc | 2 (P8) |
| Yellow | +12 dc | 3 (P8) |
| Blue | –12 Vdc | 4 (P8) |
| Black | GND | 5 (P8) |
| Black | GND | 6 (P8) |
| Black | GND | 1 (P9) |
| Black | GND | 2 (P9) |
| White | –5 Vdc | 3 (P9) |
| Red | +5 Vdc | 4 (P9) |
| Red | +5 Vdc | 5 (P9) |
| Red | +5 Vdc | 6 (P9) |

**Symptom 3. The power light is on, but there is no apparent system activity Check the power-supply voltages.** Use a voltmeter to verify that each output from the power supply is correct. Table above lists the proper voltage for each wire color. If any out-put is very low or absent (especially the 5V output), replace the power supply. Use a voltmeter and verify that the *Power good* (or *PwrO*K) signal is +5 V. If this signal is below 1.0 V, it might inhibit the CPU from running by forcing a continuous *Reset* condition. Because the *Power good* signal is generated by the power supply, try replacing the power supply. Check to see that the CPU is cool, that the heat sink/fan assembly is fitted on correctly, and that the CPU itself is inserted properly and completely into its socket. Check the CPU socket—if the CPU is seated in a *Zero Insertion Force (ZIF)* socket, be sure that the socket's tension lever is closed and locked into place. If there is a separate math co-processor on the motherboard (i286 and i386 systems), be sure that the MCP is inserted properly and completely into its socket. Next, check the expansion boards and be sure that all expansion boards are seated properly. Any boards that are not secured properly, or that are inserted unevenly, can short bus signals and prevent the PC from starting. Check the motherboard for shorts. Inspect the motherboard at every metal standoff and see that no metal traces are being shorted against a standoff or screw. You might want to free the motherboard and see if the system starts. If it does, use non-conductive spacers (such as a small piece of manila folder) to insulate the motherboard from each metal standoff. If the system still fails to start (and all voltages from the power supply are correct), replace the motherboard.

**THE SYSTEM STARTS BUT WON'T INITIALIZE:**

**Symptom 4. The power light is on, but you hear two or more beeps there is no video. Check the video board first.** Video problems can easily halt the initialization process. Turn off and unplug the PC, then be sure that your video board is inserted completely into its expansion slot. Consider the beep code itself—a catastrophic fault has been detected in the *Power On Self-Test (POST)* before the video system could be initialized. BIOS makers use different numbers and patterns of beeps to indicate failures. You can determine the exact failure by finding the BIOS maker (usually marked on the motherboard BIOS IC), then finding the error message. In the vast majority of cases, the fault will be traced to the CPU, RAM, motherboard circuitry, video controller, or drive controller.

**Symptom 5. The power light is on, but the system hangs during initialization Video might be active, but there might be no text in the display**. The *Power On Self-Test (POST)* has detected a fault, and is unable to continue with the initialization process. BIOS makers mark the completion of each POST step by writing single-byte hexadecimal completion codes to port 80h. Turn off and unplug the PC, then insert a POST board to read the completion codes. Reboot the computer and find the last code to be written before the initialization stops—that is the likely point of failure. You can determine the meaning of that POSTcode by finding the BIOS maker (usually displayed in the initial moments of power-up), then locating the corresponding error

message. Without a POST board available, it will be extremely difficult to identify the problem.

**Symptom 6. You see a message indicating a CMOS setup problem** The system parameters entered into CMOS RAM do not match the hardware configuration found during the POST. Enter your setup routine. If you are working on an older system (early i386 and i286 systems), you will probably need to boot the PC from a setup disk. If there is no setup disk available, you might be able to find a suitable routine at one of the sites at**:** **http://www.ak.oakland.edu:/SimTel/msdos/at** or **ftp.uu.net:/systems/msdos/simtel/at.** Review each entry in the CMOS setup—especially things like drive parameters and installed memory—and be sure that the CMOS entries accurately reflect the actual hardware installed on your system. If not, correct the error(s), save your changes, and reboot the system. Finally, test the CMOS battery. See if CMOS RAM will hold its contents by turning off the PC, waiting several minutes, then rebooting the PC. If setup problems persist, and you find that the values you entered have been lost, change the CMOS backup battery.

**Symptom 7. You see no drive light activity the boot drive cannot be located.** The most frequent cause of drive problems is power connections. Inspect the 4-pin power cable and see that it is attached properly and completely to the drive. Check the power-supply voltages next. Use a voltmeter and verify that the +5- and +12-V levels (especially +12 V) are correct at the 4-pin connector. If either voltage is low or absent, replace the power supply. Locate the wide ribbon cable that connects to the drive and be sure that it .is attached correctly and completely at the drive and controller ends. Look for any scrapes or nicks along the cable that might cause problems. Start the CMOS setup. If you are working on an older system (early i386 and i286 systems), you will probably need to boot the PC from a setup disk. Check the CMOS setup next. Review the drive parameters entered in the CMOS setup, and be sure that the CMOS entries accurately reflect the actual boot drive installed on your system. If not, correct the error(s), save your changes, and reboot the system. Also, be sure that the drive-controller board is installed properly and completely in its expansion slot, and see that any jumpers are set correctly. Try booting the system from your boot floppy. If the system successfully boots to the A: prompt, your problem is limited to the hard-drive system. Now try switching to the C: drive. If the drive responds (and you can access its information), there might be a problem with the boot sector. Try a package, such as PC Tools or Norton Utilities, to try and "fix" the boot sector. If you can't access the hard drive, try a diagnostic to check the drive controller and drive. Check for boot-sector viruses. A boot-sector virus can render the hard drive unbootable. If you haven't checked for viruses yet, use your anti-virus work disk now, and focus on boot-sector problems. If you cannot determine the problem at this point, try replacing the drive with a known-good working drive. Remember that you will have to change the CMOS setup parameters to accommodate the new drive. If all else fails, try a new drive-controller board.

**Symptom 8. The drive light remains on continuously; the boot drive cannot be located.** This typically happens if the signal cable is inserted backwards at one end. In most cases, this type of problem happens after replacing a drive or upgrading a controller. Be sure that the cable is inserted in the correct orientation at both the drive and controller ends. If you cannot determine the problem at this point, try replacing the drive with a known-good working drive. Remember that you will have to change the CMOS setup parameters to accommodate the new drive. If all else fails, try a new drive-controller board.

**Symptom 9. You see normal system activity, but there is no video, be sure that the monitor is plugged in and turned on.** This type of oversight is really more common than you might think. Be sure that the monitor works (you might want to try the monitor on a known-good system). If the monitor fails on a known-good system, replace the monitor. Next, trace the monitor cable to its connection at the video board and verify that the connector is inserted securely. Check the video board. It is possible that the video board has failed. If the problem persists, replace the video board.

**THE SYSTEM STARTS BUT CRASHES/REBOOTS INTERMITTENTLY:**

**Symptom 10. The system randomly crashes/reboots for no apparent reason, check for viruses first**. Some viruses (especially memory-resident viruses) can cause the PC to crash or reboot unexpectedly. If you haven't run your virus checker yet, do so now. Check the power-supply cables and verify that they are attached properly and securely to the motherboard. Use a voltmeter to verify that each output from the power supply is correct. If any output is low (especially the +5-V output), replace the power supply.

**AFTER AN UPGRADE:**

**Symptom 11. The system fails to boot, freezes during boot, or freezes during operation for no apparent reason:-** this is the classic sign of a hardware conflict. A PC is designed with a limited number of resources (i.e., memory, I/O addresses, IRQ lines, DMA channels, etc.). For the PC to function properly, each device added to the system must use its own unique resources. For example, no two devices can use the same IRQ, DMA, or I/O resources. When such an overlap of resources occurs, the PC can easily malfunction and freeze. Unfortunately, it is virtually impossible to predict when the malfunction will occur, so a conflict can manifest itself early (any time during the boot process) or later on (after DOS is loaded) while an application is running. Resolving a conflict is not difficult, but it requires patience and attention to detail. Examine the upgrade and its adapter board, and check the IRQ, DMA, and I/O address settings of other boards in the system. Make sure that the upgrade hardware is set to use resources that are not in use by other devices already in the system. For example, some motherboards offer built-in video-controller circuits. Before another video adapter can be added to the system, the motherboard video adapter must be disabled—usually with a single motherboard jumper.

Some sophisticated adapter boards (especially high-end video adapters and video-capture boards) require the use of extra memory space. If memory exclusions are needed, be sure that the appropriate entries are made in CONFIG.SYS and AUTOEXEC.BAT files. If memory exclusions are not followed, multiple devices might attempt to use the same memory space and result in a conflict.

**Symptom 12. The system fails to recognize its upgrade device even if the hardware is installed in a system correctly,** the PC might not recognize the upgrade device(s) without the proper software loaded. A great example of this is the CD-ROM drive. It is a simple matter to install the drive and its adapter board, but the PC will not even recognize the drive unless the low-level CD-ROM device driver is added to CONFIG.SYS and the MS-DOS CD-ROM driver (MSCDEX) is included in AUTOEXEC.BAT. Be sure that you have loaded all required software correctly. If you are mixing and matching existing sub-assemblies from new and old systems, be sure that each device is fully compatible with the PC. Incompatibilities between vintages and manufacturers can lead to operational problems. For example, adding a 3.5" floppy drive to an i286 AT system can result in problems because the older BIOS could not for-mat 3.5" high-density (1.44MB) floppy disks. A DOS utility (such as DRIVER.SYS) is needed to correct this deficiency. It is also possible that the upgrade device might simply be defective or installed incorrectly. Open the system and double-check your installation. Pay particular attention to any cables, connectors, or drive jumpers. When you confirm that the hardware and software installation is correct, suspect a hardware defect. Try the upgrade in another system if possible. If the problem persists when you attempt the upgrade on another PC, one or more elements of the upgrade hardware are probably defective. Return it to the vendor for a prompt refund or replacement. If the upgrade works on another system, the original system might be incompatible with the upgrade or you might have missed a jumper or DIP switch setting on the motherboard.

**Symptom 13. One or more applications fail to function as expected after an upgrade:** this is not uncommon among video adapter and sound board upgrades. Often, applications are configured to work with various sets of hardware. When that hardware is altered, the particular application(s) might no longer run properly (this is especially true under Windows). The best way to address this problem is to check and change the hardware configuration for each affected application. Most DOS applications come with a setup utility. You can adjust most Windows configurations under the *Control panel* icon. Under Windows 95, you can access system-configuration settings under the *System* icon under the *Control pane*l.

**WINDOWS 95 BOOT SYMPTOMS:**

**Symptom 14. The Windows 95 boot drive is no longer bootable after restoring data with the DOS backup utility,** this happens frequently when a replacement drive is installed, and you attempt to restore the Windows 95 backup data. Un-fortunately, the DOS version of backup is not configured to restore system files. Start backup and restore your root directory with "System Files," "Hidden Files," and "Read-Only Files" checked. Next, boot the system from an MS-DOS 6.x upgrade setup disk #1 or a Windows 95 startup disk, then use the SYS command to make the hard drive bootable such as: A:\> sys c: <Enter> You should then be able to restore the remainder of your files. When backing up a Windows 95 system, your best approach is to use the Windows 95 Backup program. Once the new drive is installed, partitioned, and formatted, install a new copy of Windows 95, start Windows 95 backup, then restore the remaining files to the drive.

**Symptom 15. Windows 95 will not boot and Scandisk reports bad clusters that it cannot repair:-** this is a problem encountered with Western Digital hard drives. If your WD drive fails in this way, you can recover the drive, but you will lose all in-formation on it. Backup as much information from the drive as possible before proceeding: Download the Western Digital service files WDATIDE.EXE and WD_CLEAR.EXE from WD at: **http://www.wdc.com**/. You can also get these files from AOL by typing keyword *WDC*.

- Copy these files to a "clean" boot floppy diskette.
- Boot to DOS from a "clean" diskette (no CONFIG.SYS or AUTOEXEC.BAT files) and

  run WD_CLEAR.EXE. This utility clears all data on the media (and destroys all data).
- Next, run the WDATIDE.EXE utility to perform a comprehensive surface scan.
- Repartition and reformat the drive, then restore your data.

**Symptom 16. You see a "Bad or missing <filename>" error on startup:-** A file used by Windows 95 during startup has probably become corrupt. Locate the file mentioned in the error message. If you can find the file, erase it and try re-installing it from original Windows 95 disks or CD.

**Symptom 17. Windows 95 reports damaged or missing files, or a "VxD error", during startup,** Windows 95 depends on several key files being available. If a key file is damaged or missing, Windows 95 will not function properly (if it loads at all). Run Windows 95 setup again and select the *Verify* option in *Safe recovery* to replace the missing or damaged file(s).

**Symptom 18. After installing Windows 95, you can't boot from a different drive,** the Windows 95 setup program checks all hard disks to find just one that contains the 80h designator in the Drive Number field of a boot sector. Windows 95 will typically force the first drive to be bootable and prevent other drives from booting. However, there are two ways to correct the problem after Windows 95 is installed:

- Use the version of FDISK included with Windows 95 to set the primary active partition.
- Use a disk-editor utility to change a disk's Drive Number field so that you can boot from
  that hard disk.

**Symptom 19. Windows 95 Registry files are missing,** there are two registry files: USER.DAT and SYSTEM.DAT. They are also backed up automatically as USER.DA0 and SYSTEM.DA0. If a .DAT file is missing, Windows 95 will automatically load the corresponding .DA0 file. If both the .DAT and .DA0 registry files are missing or corrupt, Windows 95 will start in the *Safe mode* offering to restore the Registry. However, this cannot be accomplished without a backup. Either restore the *Registry* files from a tape or diskette backup, or run Windows 95 Setup to create a new Registry. Unfortunately, restoring an old registry or creating a new registry from scratch will reload programs and re add hardware to restore the system to its original state—a long and difficult procedure. Use the following DOS procedure to backup the Registry files to a floppy disk: attrib –r –s –h system. at
attrib –r –s –h user.dat
copy system.dat A:\
copy user.dat A:\
attrib +r +s +h system.dat
attrib +r +s +h user.dat

**Symptom 20. During the Windows 95 boot, I get an "Invalid System Disk" error,** this often happens during the first reboot during Windows 95 setup, or when you boot from the startup disk. When you see a message such as "Invalid system disk. Replace the disk, and then press any key." There might be several possible problems. First, your disk might be infected with a boot-sector virus. Run your anti-virus work disk and check closely for boot sector viruses. Windows 95 setup might also fail if there is anti-virus software running as a TSR, or your BIOS has enabled boot-sector protection. Be sure that any boot-sector protection is turned off before installing Windows 95. Check for disk-overlay software—Windows 95 might not detect overlay software such as Disk Manager, EZ-Drive, or Drive-Pro, and overwrite the master boot record (MBR). See the documentation that accompanies your particular management software for recovering the MBR.

To re-install the Windows 95 system files, follow these steps:
1 Boot the system using the Windows 95 Emergency Boot Disk.
2 At the MS-DOS command prompt, type the following lines:

```
c:> cd\windows\command
attrib c:\msdos.sys -h -s -r
ren c:\msdos.sys c:\msdos.xxx
a:
sys c:
del c:\msdos.sys
ren c:\msdos.xxx c:\msdos.sys
attrib c:\msdos.sys +r +s +h
```

3 Remove the Emergency Boot Disk and reboot the system.

**Symptom 21. Windows 95 will not install on a compressed drive,** you are probably using an old version of the compression software, which Windows 95 does not recognize. Be sure that your compression software is recent and see that there is enough free space on the host drive to support Windows 95 installation. If you have the Plus Pack for Windows 95, you should be able to install DriveSpace 3 for best Windows 95 support.

**Symptom 22. The drive indicates that it is in "MS-DOS compatibility mode"** For some reason, Windows 95 is using a real-mode (DOS) driver instead of a protected mode (32-bit) driver. Be sure that any software related to the hard drive especially hard-disk drivers) are using the protected-mode versions. Windows 95 should install equivalent protected-mode software, but you might need to contact the drive manufacturer and obtain the latest Windows 95 drivers. If you are using Disk Manager, be sure that you're using version 6.0 or later. Finally, check your motherboard BIOS—Windows 95 might use DOS-compatibility mode on large EIDE hard disks (hard disks with more than 1024 cylinders) in some computers. This might occur because of an invalid drive geometry translation in the system ROM BIOS that prevents the protected-mode IDE device driver from being loaded. Contact your system manufacturer for information about obtaining updated BIOS.

**Symptom 23. Disabling protected-mode disk driver(s),** hides the partition table when FDISK is used As with Symptom 22, there are problems preventing 32-bit operation of your hard drive(s). Do NOT use the "Disable all 32-bit protected-mode disk drivers" option. Instead, upgrade your motherboard BIOS to a later version.

**Symptom 24. You cannot achieve 32-bit disk access under Windows 95.** If the Windows 95 system refuses to allow 32-bit disk access, there might be a conflict between the motherboard CMOS setup entries and the BIOS on your EIDE controller. For example, if both BIOS have settings for *Logical Block Addressing (LBA*), be sure that only one entry is in use.

**Symptom 25._Windows 95 does not recognize a new device**, in some case; Windows 95 is unable to recognize a new device. When this happens, check to see if there is a hardware conflict between the device and other devices in the system (you can see conflicts represented in the Device Manager with small yellow exclamation marks). Also be sure that any necessary drivers have been installed properly. If problems continue, remove the new device through your Device Manager, and reinstall it through the *Add new hardware* wizard.

**Symptom 26. Windows 95 malfunctions when installed over Disk Manager.** Disk Manager should typically be compatible with Windows 95, but there are some points to remember. Check your Disk Manager version first. If you are using Disk Manager, be sure that you're using version 6.0 or later. You can get the latest patch (DM-PATCH.EXE) from the On track Web site at: **http://www.ontrack.com**/. Check the slave drive with Disk Manager. Although the Windows 95 file system is supposed to work properly with a slave drive only using Disk Manager, there are some circumstances where problems can occur:

1. When a Windows 3.1x virtual driver replaces the Windows 95 protected-mode driver
   (such as WDCDRV.386).
2. When the cylinder count in CMOS for the slave drive is greater than 1024 cylinders.
3. When the motherboard CMOS settings for the slave drive are set to *Auto-detec*t.

**Symptom 27. You have problems using a manufacturer-specific hard-disk driver (such as Western Digital's Fast Track driver WDCDRV.386)** for 32-bit access under Windows 95, generally speaking, Windows 95 has 32-bit protected- mode drivers for a wide variety of EIDE devices—in actuality, you should not need a manufacturer-specific driver. If Windows 95 has not removed all references to the driver from SYSTEM.INI, you should edit the file and remove those references manually, then reboot the system. Be sure to make a backup copy of SYSTEM.

## Troubleshooting BIOS Error Messages

Each time you start the PC, the *Power-On Self Test (POST)* initiates a comprehensive series of tests to verify the computer's hardware. Traditionally, the POST generates two types or error messages: beep codes, and POST codes. Beep codes are generated through the PC speaker before the video system has properly initialized. POST codes are single-byte hexadecimal characters written to I/O port 80h (or other I/O port) as each POST test is started. You can read the POST code using a POST reader card. By matching the beep code or POST code to your particular BIOS, you can determine the exact fault. The problem with beep codes and POST codes are their cryptic nature—you need a detailed code listing to match the code to the fault. However, current generations of BIOS and operating systems are starting to use more "user-friendly" error messages. By displaying complete error messages (rather than simple codes), a great deal of guesswork is removed from the troubleshooting process. Remember that BIOS error messages are de-signed to enhance (rather than replace) beep and POST codes. Also notice that unlike beep codes and POST codes, many BIOS error messages are not fatal—that is, the system will continue to run after the error has been generated.

### GENERAL BIOS ERROR MESSAGES

The following list outlines many of the most common BIOS error messages, explains their intended meaning, and suggests some corrective action. The list is a compilation developed from a variety of different systems and is presented in alphabetical order.

**Symptom 1. 8042 Gate—A20 error** There is a fault using gate A20 to access memory over 1MB. One or more SIMMs might be loose or the keyboard controller might have failed. Check that each of the SIMMs are installed securely. Try replacing the keyboard controller or replace the entire motherboard, if necessary.

**Symptom 2. BIOS ROM checksum error**—system halted The checksum of the BIOS code in the BIOS chip is incorrect—this is a fatal problem, indicating the BIOS code might have become corrupt. You will need to replace the motherboard BIOS before the system will initialize.

**Symptom 3. Cache memory bad,** do not enable cache POST has determined that your cache memory is defective. Do not attempt to enable the cache in your system. You should replace the cache RAM at your earliest opportunity. Until then, you might notice a decline in system performance.

**Symptom 4. CMOS battery failed** The CMOS battery is no longer functional. You will need to replace the CMOS battery as soon as possible. If you haven't yet lost CMOS contents, take a <PrintScreen> of each CMOS setup page immediately to record the setup configuration.

**Symptom 5. CMOS battery state low** The CMOS battery power is getting low. Record your CMOS settings as soon as possible, then replace the CMOS battery promptly.

**Symptom 6. CMOS checksum error**—defaults loaded CMOS RAM has be-come corrupt, so the CMOS checksum is incorrect. The system loads the default equipment configuration in an effort to ensure that the system can start. A weak battery might have caused this error. Check the CMOS backup battery and replace it, if necessary.

**Symptom 7. CMOS display type mismatch** The video type indicated in CMOS RAM is not the one detected by the BIOS. Check your CMOS setup and be sure that the correct video type is selected (usually "VGA"). Remember to save your changes before exiting and rebooting.

**Symptom 8. CMOS memory size mismatch** The amount of memory recorded in the CMOS setup configuration does not match the memory detected by the POST. If you have added new memory, start your CMOS setup and make the appropriate corrections (or simply "save changes and reboot"—even though you change nothing). If you've made no changes to the system, try rebooting the computer. If the error appears again, some of your memory might have failed. Try a systematic replacement to locate a defective SIMM.

**Symptom 9. CMOS system options not set** The values stored in CMOS RAM are either corrupted or nonexistent. Check your CMOS backup battery and replace it if necessary. Enter the CMOS setup routine and reload any missing or corrupted entries. Remember to save your changes before exiting and rebooting.

**Symptom 10. CPU at nnn Displays the running speed of the CPU (where *nnn* is the speed in MHz).** This is not an error, but a measurement. If the displayed speed is known to be different than the actual clock speed, you should check the motherboard's clock settings and multipliers, or suspect an error in BIOS speed detection (you might need to update the BIOS).

**Symptom 11. Data error** The diskette or hard-disk drive that you are accessing cannot read the data. One or more sectors on the disk(ette) might be corrupted. If you are using MS-DOS, run the CHKDSK or ScanDisk utility to check the file structure of the diskette or hard-disk drive.

**Symptom 12. Decreasing available memory** An error has been detected in memory and the "available memory" is being reduced below the point at which the fault was detected. Either a SIMM has failed or one or more SIMMs might be improperly seated.

**Symptom 13. Diskette drive 0 (or 1) seek failure** Your floppy drive was un-able to seek to the desired track. A cable might be loose, or the CMOS setup information might not match your actual floppy drive. Check your CMOS setup, check your signal cable, and replace the floppy drive, if necessary.

**Symptom 14. Diskette read failure** The system was unable to read from a floppy disk. A dirty read/write heads, a loose signal cable, or a defective floppy disk usually causes this. Try cleaning the read/write heads, trying a different diskette, checking the floppy signal cable, and replacing the floppy drive, if necessary.

**Symptom 15. Diskette subsystem reset failed** The PC was unable to access the floppy-drive system. The diskette drive controller might be faulty. Be sure that the drive controller is seated properly in its bus slot and that all cables are attached securely. Try the drive controller in another slot and replace the drive controller, if necessary.

**Symptom 16. Display switch is set incorrectly** Some motherboards provide a display switch that can be set to either monochrome or color. This message indicates the switch is set to a different setting than indicated in CMOS setup. Determine which video setting is correct, then either turn off the system and change the motherboard jumper, or enter CMOS setup and change the video selection.

**Symptom 17. DMA (or DMA #1 or DMA #2) error** A serious fault has occurred in the DMA-controller system of your motherboard. In virtually all cases, the motherboard will have to be replaced (unless you can replace the DMA controller).

**Symptom 18. DMA bus time-out** A device has driven the bus signal for more than 7.8 microseconds. This might be a random fault, but chances are that a device in the PC has failed. Try removing expansion devices first. Otherwise, replace the motherboard.

**Symptom 19. Drive not ready** No diskette is in the drive. Be sure that the valid diskette is secure in the drive before continuing.

**Symptom 20. Floppy disk(s) fail** The PC cannot find or initialize the floppy-drive controller or the floppy drive itself. Be sure that the drive controller is installed correctly (you might try a different expansion slot). If no floppy drives are installed, be sure that the *Diskette drive* entries in CMOS setup are set to *None* or *Not installe*d.

**Symptom 21. Hard-disk configuration error** The system could not initialize the hard drive in the expected fashion. This is often caused by an incorrect configuration in the CMOS setup. Be sure that the correct hard-drive geometry is entered for the drive (or try “auto-detecting” the drive). If the problem persists, try replacing the hard drive.

**Symptom 22. Hard-disk controller failure** There is a problem with the hard-drive system—either the hard drive or drive controller has failed. Check the drive controller first and be sure it's seated properly in its bus slot. Try a different bus slot. Check that all the drive cables are secure. Be sure that the hard drive is spinning up. Try a new drive controller and try a different hard drive, if necessary.

**Symptom 23. Hard disk(s) diagnosis fail** Your BIOS might run specific disk diagnostic routines. This type of message appears if one or more hard disks return an error when those diagnostics are run. In most cases, the drive itself is installed improperly or is defective. Check the drive installation, and replace the drive, if necessary.

**Symptom 24. Hard disk failure** The hard drive failed initialization, which usually suggests that the drive has failed. Be sure that the drive signal cable is attached properly, and see that the drive spins up, then replace the hard drive, if necessary.

**Symptom 25. Hard-disk drive read failure** The drive cannot read from the hard drive, which usually suggests that the drive has failed. Be sure that the drive signal cable is attached properly and see that the drive spins up, then replace the hard drive, if necessary.

**Symptom 26. Incompatible processor:** CPU0 (or CPU1) is B0 step or be-low You have installed an old version of a CPU that is not supported by the BIOS. In a single-microprocessor system, *CPU0* refers to the system board microprocessor; in a dual-microprocessor system, it refers to the secondary microprocessor on the add-in card. The CPU1 message appears only on a dual-microprocessor system and it always refers to the system-board microprocessor. Replace the microprocessor with a current version of the microprocessor.

**Symptom 27. Incompatible processors: cache sizes different** This message appears for a dual-microprocessor system if the CPUs use differing L2 cache sizes. Replace one of the microprocessors to make the L2 cache sizes match.

**Symptom 28. Insert bootable media** The BIOS cannot find a bootable media. Insert a bootable floppy diskette or bootable CD, or switch to a known-good bootable drive.

**Symptom 29. INTR #1 (or INTR #2) error** A serious fault has occurred with your interrupt controller on the motherboard. In virtually all cases, the motherboard will have to be replaced entirely.

**Symptom 30. Invalid boot diskette** The BIOS can read the disk in floppy drive A:, but cannot boot the system from it. Use another known-good boot disk or try booting from a different drive.

**Symptom 31. Invalid configuration information—please run SETUP program** The system-configuration information in your CMOS setup does not match the hardware configuration detected by the POST. Enter the CMOS setup program and correct the system configuration information. Remember to save your changes before exiting and rebooting.

**Symptom 32. I/O card parity error at xxxxx An expansion card failed.** If the address can be determined, it is displayed as *xxxx*x. If not, the message is "I/O card parity error ????" In either case, you'll need to find and replace the defective expansion card.

**Symptom 33. Keyboard clock-line failure BIOS has not detected** the keyboard clock signal when testing the keyboard. Often, the keyboard connector is loose or the key-board is defective. Check the keyboard cable and try another keyboard, if necessary. If the problem persists, the keyboard controller might have failed. Try replacing the keyboard-controller IC or replace the entire motherboard.

**Symptom 34. Keyboard controller failure** The keyboard controller on the motherboard is not responding as expected. Start by checking the keyboard connection and try a different keyboard. If the problem persists, the keyboard controller might have failed. Try replacing the keyboard-controller IC or replace the entire motherboard.

**Symptom 35. Keyboard data-line failure** BIOS has not detected the keyboard data signal when testing the keyboard. Often, the keyboard connector is loose or the key-board is defective. Check the keyboard cable and try another keyboard, if necessary. If the problem persists, the keyboard controller might have failed. Try replacing the keyboard-controller IC or replace the entire motherboard.

**Symptom 36. Keyboard error or no keyboard present** The system cannot initialize the keyboard. Be sure that the keyboard is attached correctly and see that no keys are pressed during POST. To purposely configure the system without a keyboard (i.e., if you're setting up a server), you can configure the CMOS setup to ignore the keyboard.

**Symptom 37. Keyboard is locked out—unlock the key** If your system comes fitted with a key lock switch, be sure that the switch is set to the "unlocked" position. If there is no key lock switch (or the switch is set properly), one or more keys might be pressed or shorted on the keyboard. Try a new keyboard.

**Symptom 38. Keyboard stuck key failure** In almost all cases, this is a keyboard problem. POST has determined that one or more keys on the keyboard are stuck. Be sure that nothing is resting on the keyboard and see that no paper clips or staples have fallen into the keyboard. Try a different keyboard.

**Symptom 39. Memory address line failure at <address>, read <value> expecting <value>** An error has occurred in the address decoding circuitry used in memory. In many cases, one or more SIMMs might be improperly seated. Check that all SIMMs are installed correctly. If the problem continues, try systematic replacement to locate a defective SIMM. If you cannot find a defective SIMM, there is likely a problem elsewhere on the motherboard. Replace the motherboard.

**Symptom 40. Memory data line failure at <address>, read <value> expecting <value>** An error has been encountered in memory. In virtually all cases, one or more SIMMs might be faulty or improperly seated. Be sure that every SIMM is seated correctly and try a systematic replacement to locate a defective SIMM.

**Symptom 41. Memory double word logic failure at <address>, read <value> expecting <value>** An error has been encountered in memory. In virtually all cases, one or more SIMMs might be faulty or improperly seated. Be sure that every SIMM is seated correctly and try a systematic replacement to locate a defective SIMM.

**Symptom 42. Memory odd/even logic failure at <address>, read <value> expecting <value>** An error has been encountered in memory. In virtually all cases, one or more SIMMs might be faulty or improperly seated. Be sure that every SIMM is seated correctly and try a systematic replacement to locate a defective SIMM.

**Symptom 43. Memory parity failure at <address>, read <value> expecting <value>** An error has been encountered in memory. In virtually all cases, one or more SIMMs might be faulty or improperly seated. Be sure that every SIMM is seated correctly and try a systematic replacement to locate a defective SIMM.

**Symptom 44. Memory write/read failure at <address>, read <value> expecting <value>** An error has been encountered in memory. In virtually all cases, one or more SIMMs might be faulty or improperly seated. Be sure that every SIMM is seated correctly and try a systematic replacement to locate a defective SIMM.

**Symptom 45. Memory size in CMOS invalid** The amount of memory recorded in the CMOS setup configuration does not match the memory detected by the POST. If you have added new memory, start your CMOS setup and make the appropriate corrections. If you've made no changes to the system, try rebooting the computer. If the error appears again, some of your memory might have failed. Try a systematic replacement to locate a defective SIMM.

**Symptom 46. No boot device available The computer cannot find a viable diskette or hard drive**—typically because the drives have not been entered properly into CMOS. Enter the CMOS setup program and configure the proper drive information. You should also verify that your diskette or hard drive has been prepared as bootable.

**Symptom 47. No boot sector on hard-disk drive The PC is refusing to boot from the hard drive.** This is usually because the drive is not configured properly. Check the CMOS setup and verify that the correct drive information has been entered (or select "auto-detect"). Also be sure to partition the drive with an active bootable partition, and format it as a bootable device. If the problem continues, try replacing the hard drive.

**Symptom 48. No timer tick interrupt** The interrupt timer on the motherboard has failed. This fatal error will probably require you to replace the motherboard.

**Symptom 49. Non-system disk or disk error** The diskette in drive A: or (your hard drive) does not have a bootable operating system installed on it. If you're booting from a floppy drive, make the diskette bootable. If you're booting from a hard drive, be sure that the drive is partitioned and formatted for bootable operation.

**Symptom 50. Not a boot diskette** There is no operating system on the diskette. Boot the computer with a diskette that contains an operating system.

**Symptom 51. Off-board parity error** A parity error is in memory installed in an expansion slot (i.e., a SIMM on the video adapter). The format is: OFF BOARD PARITY ER-ROR ADDR (HEX) = (XXXX), where *XXXX* is the hex address where the error occurred. Chances are that the memory installed at the error address has failed.

**Symptom 52. On-board parity error** There is a parity error in memory installed on the motherboard in one of the SIMM slots. The format is: ON BOARD PARITY ERROR ADDR (HEX) = (XXXX), where *XXXX* is the hex address where the error occurred. Chances are that the memory installed at the error address has failed.

**Symptom 53. Override enabled—defaults loaded** If the system cannot boot using the current CMOS configuration for any reason, the BIOS can override the current configuration using a set of defaults designed for the most stable, minimal-performance sys-tem operations. The CMOS might be ignored if the CMOS RAM checksum is wrong or if a critical piece of CMOS information is missing, which would otherwise cause a fatal error.

**Symptom 54. Parity error** A parity error has occurred in system memory at an un-known address. Chances are that memory has failed. Try a systematic "check and re-place" approach to isolate the replace the defective memory component.

**Symptom 55. Plug-and-Play configuration error** The system has encountered a problem in trying to configure one or more expansion cards. Start the CMOS setup routine and check that any PnP options have been set correctly. If any "configuration utilities" are included with your particular system, try running those utilities to resolve any configuration issues.

**Symptom 56. Press <TAB> to show POST screen** Some system OEMs (such as Acer) might replace the normal BIOS POST display with their own proprietary display— usually a graphic logo. When the BIOS displays this message, the operator is able to switch between the OEM display and the default POST display. This can be helpful for troubleshooting purposes.

**Symptom 57. Primary master hard disk fail** POST detects an error in the primary ("master") hard drive on the primary EIDE controller channel. Double check the drive's installation, jumpering, and cable connections. Otherwise, replace the drive outright.

**Symptom 58. Primary slave hard disk fail** POST detects an error in the secondary ("slave") hard drive on the primary EIDE controller channel. Double check the drive's installation, jumpering, and cable connections. Otherwise, replace the drive outright.

**Symptom 59. Resuming from disk** Award BIOS offers a save-to-disk feature for notebook computers. This message might appear when the operator re-starts the system after a save-to-disk shut down. You will almost never find this type of message on a desktop or tower system.

**Symptom 60. Secondary master hard disk fail** POST detects an error in the primary ("master") hard drive on the secondary IDE controller channel. Double check the drive's installation, jumpering, and cable connections. Otherwise, replace the drive outright.

**Symptom 61. Secondary slave hard disk fail** POST detects an error in the secondary ("slave") hard drive on the secondary IDE controller channel. Double check the drive's installation, jumpering, and cable connections. Otherwise, replace the drive out-right.

**Symptom 62. Shutdown failure** A serious fault is on the motherboard usually associated with the CMOS RAM/RTC function. In most cases, you'll need to replace the motherboard outright.

**Symptom 63. Terminator/processor card not installed** This error occurs with dual-CPU systems when neither a "terminator" card nor a secondary microprocessor card is installed in the secondary card connector. Be sure that either a terminator card or a Secondary microprocessor card is installed in the connector. Install the appropriate card and start the system again.

**Symptom 64. Time-of-day clock stopped** The *Real-Time Clock (RTC)* has stopped. The CMOS battery might be dead (or almost dead). Enter the CMOS setup and correct the date and time. If the trouble continues, try replacing the CMOS backup battery.

**Symptom 65. Time or date in CMOS is invalid** The time or date displayed in the CMOS setup does not match the system clock. This can happen often under Windows 95 (or other operating systems), which can "desynchronize" system clock. Enter the CMOS setup utility and correct the date and time. If the problem re-occurs, you might be able to determine a specific application that is causing the problem.

**Symptom 66. Timer chip counter 2 failed** A serious fault is on the motherboard probably caused by a failure of a *Programmable Interrupt Timer (PIT*). In most cases, you'll need to replace the motherboard outright.

**Symptom 67. Unexpected interrupt in protected mode** An interrupt has occurred unexpectedly. Loose or poorly inserted SIMMs can cause such a problem, so start by checking and reinstalling the SIMMs. A faulty keyboard controller can also result in interrupt problems. Try replacing the keyboard controller, if possible, or replace the entire motherboard.

**Symptom 68. Warning—Thermal probes failed** This error is usually found in Pentium Pro systems with one or two thermal probes. At system start-up, the BIOS has detected that one or both of the thermal probes in the computer are not operational. You can continue to use the system, but be aware that the temperature probe(s) are disabled— a processor overheat condition will not shut down the system. You will probably have to replace the motherboard to correct this fault.

**Symptom 69. Warning—Temperature is too high** During system start-up, the BIOS has detected that one or both microprocessors are overheated. This can happen if The Pentium Pro has a built-in thermocouple that halts microprocessor operation if the CPU exceeds its rated temperature you try to restart the system too soon after a thermal shutdown. After displaying this message, the BIOS halts the processes and turns off the system. Let the system cool down before attempting to restart it.

## CMOS Maintenance and Troubleshooting

Although it is very rare for CMOS RAM/RTC devices to fail, there are many circumstances where CMOS contents might be lost or corrupted, and system performance might be compromised by a poorly configured CMOS setup. Beyond the traditional beep and POST codes that suggest a CMOS problem or the more recent BIOS error messages, a wide range of PC symptoms can indicate an improperly or incompletely configured CMOS. This part of the chapter is intended to identify a series of symptoms that can suggest CMOS setup problems and offer suggestions for corrective action.

## TYPICAL CMOS-RELATED SYMPTOMS

**Symptom 1. Changes to CMOS are not saved after rebooting the PC** In virtually all cases, you have exited the CMOS setup routine incorrectly. This is a very common oversight (especially given the proliferation of different BIOS versions and CMOS setup routines). Try making your changes again, then be sure to "Save, then Exit, and Reboot."

**Symptom 2. The system appears to be performing poorly** The system must also be stable—if it crashes frequently, or certain devices refuse to work, you might be dealing with a system conflict in hardware or software. Use a diagnostic tool, such as. MSD (in DOS) or the Device Manager (in Windows 95), to help identify possible points of conflict. If the system is free of hardware or software conflicts, you can focus on performance. "Performance" is often a subjective evaluation, and should first be verified using a benchmark test compared to other similar PCs (identical systems, if possible). If you find that your particular system is performing below its optimum level, suspect a CMOS setup
Problem. In some cases, the CMOS RAM might have been loaded with its "power on" or "auto-configuration" defaults. Although defaults will almost always allow the system to function, it will rarely offer top performance. Check the advanced CMOS and chipset setup pages (particularly the memory, cache, and bus-speed related entries). Refer to the "Basic CMOS optimization tactics" section.

**Symptom 3. CMOS mismatch errors occur** These errors occur when the PC equipment found during the POST does not match equipment listed in CMOS. In most cases, the CMOS backup battery has failed and should be replaced. You can then load the CMOS defaults and tweak the setup as necessary to optimize the system (an easy task if you've got a record of the CMOS settings). Otherwise, refer to the "Basic CMOS optimization tactics" section.

**Symptom 4. Some drives are not detected during boot** This happens most often with hard drives or other devices in the Basic CMOS setup page. In some cases, the device simply might not be listed or entered properly (e.g., you might have forgotten to enter your newly installed hard drive or floppy drive in the CMOS setup). In other cases, the drive might need more time to initialize at boot time. Try increasing the "boot delay" or disabling any "quick boot" feature that might be in use.

**Symptom 5. The system boots from the hard drive—even though there is a bootable floppy disk in the drive** Notice that the system still boots and runs properly. The floppy disk is fully accessible (if not, check the floppy drive, power, and signal cables). This type of issue is usually not a problem, but is caused instead by an improper boot sequence. Most BIOS versions allow the PC to search through several different drives to locate an operating system, and will boot from the first suitable drive where an operating system is found.

Chances are that your boot sequence is set to "C: A:," where the C: drive is checked first. Because the C: drive is connected and functional, the A: drive will simply be ignored. To boot from the A: drive, you'll need to change the boot sequence to something like *"A: C*:." Remember to save any changes before exiting the CMOS setup.

**Symptom 6. Power-management features are not available** First, be sure that your BIOS supports power management to begin with. Modern PC power management is typically handled by a combination of BIOS and the operating system (e.g., APM under Windows 95). However, power management must be supported by BIOS and enabled under the CMOS setup in order for the operating system to make use of it. If you can't use power management (or it is not available in the Windows 95 Device Manager under *System* If you've cleared the CMOS setup (using a "clear" jumper on the motherboard), be sure that you've reset the jumper so as not to continue clearing the CMOS RAM. *device*s), it probably isn't enabled in the CMOS setup. Check the *Power Management* page of your CMOS setup (or the *Advanced Chipset Setu*p) and be sure that power-management features are enabled. You might also want to review and adjust the various device time-outs, as required. When you restart the operating system, you should then be able to configure the corresponding power-management features.

**Symptom 7. PnP support is not available, or PnP devices do not function properly** First, be sure that your BIOS supports Plug-and-Play (PnP) standards to begin with. If not, you'll need to use a DOS ISA configuration utility (or ICU) to support any PnP devices in the system. Also be sure that you're using an operating system that supports PnP (e.g., Windows 95). If you can't get support for PnP devices, be sure that PnP support is enabled in the CMOS setup, and verify that PnP-related settings (such as *Configuration mode* or *IRQ3- IRQ15*) are all configured properly. If necessary, try loading the BIOS defaults for your CMOS setup, which should give you baseline PnP support if your BIOS and OS supports it. Be sure to record your original CMOS settings before attempting to load defaults.

**Symptom 8. Devices in some PCI slots are not recognized or not working properly** First, be sure that your motherboard supports PCI (Peripheral Component Interconnect) slots, and verify that there is in fact at least one PCI adapter board in the system There are simply a proliferation of PCI-related configuration settings in the PnP/PCI area of a CMOS setup, so it is extremely difficult to suggest any one probable oversight. If you cannot get PCI devices to work (or work properly), try loading the BIOS defaults for your CMOS setup, which should provide you baseline PCI support. Be sure to record your original CMOS settings before attempting to load defaults.

**Symptom 9. You cannot enter CMOS setup even though the correct key combination is used** Be sure that you're pressing that key combination quickly enough—many BIOS versions only allow a few moments during POST to enter CMOS setup. Once the operating system begins to load, you'll need to reboot. Also verify that you are using the correct key or key combination. It is also possible that access to CMOS setup has been disabled through a motherboard jumper. Refer to the documentation for your particular motherboard and locate the "CMOS access" jumper. The jumper (if it exists) should be in the position that allows access.

**Symptom 10. The system crashes or locks up frequently.** There are many reasons for a PC to crash or lock up—everything from a hardware fault to a bad driver to a software bug can interfere with normal system operation. Before you check the CMOS setup, run a DOS diagnostic to verify that the system hardware is performing properly, and check that there is no hardware conflict in the system. Then check the Device Manager and look for any signs of conflicting or inoperative devices (marked with yellow or red exclamation marks). If the system runs properly when DOS is booted "clean" or Windows Be careful that you don't accidentally confuse this access jumper with the "CMOS clear" jumper—the two serve completely different purposes..95 is started in the "safe mode," there might be a buggy or conflicting driver (or TSR) that is interfering with system operation. If problems persist, there might be any of several different problems in the CMOS setup. Typical oversights include insufficient wait states, memory-speed mismatches (e.g., mixing 60- and 70-ns memory), and enabling cache (L1 or L2) when there is no such cache in the system. Review your system configuration very carefully. It is also possible that shadowing and snooping features can interfere with system operation. Try systematically disabling video ROM shadowing, motherboard ROM shadowing, and other shadowing options. Then, try disabling video palette snoop and other snooping or "pre-snoop" options. If problems still continue, try loading the BIOS defaults into CMOS. The defaults should ensure some level of hardware stability, but you'll still need to optimize the CMOS setup manually for best performance.

**Symptom 11. COM ports don't work** Assuming that the COM ports are installed and configured properly, operating problems can sometimes be traced to "IDE block mode" or "IDE multiple sector mode" issues. Try disabling the "Block mode" or "Multiple sector mode," or scale back the block mode to a lower level.

**Symptom 12. The RTC doesn't keep proper time over a month** This is a very common problem for real-time clock (RTC) units. RTCs are notoriously inaccurate devices anyway—often straying by as much as several minutes per month. Some "third tier" RTCs (or units burdened by heavy interrupt activity) might be off by more than several minutes per week (or even more). Very little can be done to correct this kind of poor time keeping other than to replace the motherboard with one using a better-quality RTC (hardly an economical solution), or use a "time-correcting utility," which compensates for the RTCs drift.

**Symptom 13. The RTC doesn't keep time while system power is off** Time seems maintained while system power is on, but the RTC appears to stop while the system is turned off. This is often a classic sign of CMOS backup battery failure. Because the RTC usually takes a bit more power than the CMOS RAM—and CMOS RAM can be maintained by a latent change—this kind of "clock stall" is often the first sign that the CMOS battery is failing. Record your CMOS setup and replace the CMOS battery at your earliest opportunity.

**Symptom 14. You see an "Invalid system configuration data" error** This type of error often means that there is a problem with the Extended System Configuration Data (ESCD). This is a storage space for the configuration data in a Plug-and-Play system. Once you have configured your system properly, the Plug-and-Play BIOS uses your ESCD to load the same configuration from one boot to the next. If this error message is displayed, take these steps:

1. Go into *Setup* and find a field labeled *reset configuration dat*a.
2. Set this field to *yes*.
3. Save and exit the CMOS setup program. The system restarts and clears the ESCD during POST.
4. Run whatever PnP configuration tool is appropriate for your system.

    - If you have Windows 95 (a Plug-and-Play operating system), just restart your computer. Windows 95 will automatically configure your system and load the ESCD with the new data.
    - If you don't have Windows 95, run the DOS ICU (ISA Configuration Utility) to reset the ESCD.

**Symptom 15. You encounter "CMOS checksum" errors after updating a flash BIOS** Flashing a BIOS IC will typically require you to clear the CMOS setup and reconfigure the *Setup* again from scratch. Most current motherboards offer a "Clear CMOS" jumper, which can be used to wipe out all the CMOS settings—this is sometimes referred to as a *CMOS clear* or *CMOS NVRAM clea*r. Try clearing the CMOS RAM, then load the BIOS defaults. At that point, the errors should stop, and you might need to optimize the CMOS setup entries to tweak the system. If you documented the original CMOS setup entries with <Print Screen> before upgrading the BIOS, you should be able to reset key entries in a matter of minutes. Remember to save your changes when exiting.

**Symptom 16. You notice that only some CMOS setup entries are corrupted when running a particular application** This kind of error sometimes happens with several games and other programs on the market that access memory locations used by CMOS RAM and the BIOS Data Area (BDA), which are shadowed into the Upper Memory Area. This can alter or corrupt at least some CMOS locations. One solution is to contact the program maker and see if there is a patch or fix that will prevent CMOS access. Another solution to this problem is to exclude the C000h to CFFFh range in the EMM386 device line in your CONFIG.SYS file. This prevents programs from accessing the section of memory that the BIOS uses for shadowing. Here is an example: DEVICE=C:\DOS\EMM386.EXE X=C000-CFFF CMOS PASSWORD TROUBLESHOOTING Passwords are usually regarded as a necessary evil—a means of keeping out the malicious and the curious. However, passwords also cause their share of problems. As systems are passed from person to person or department to department, passwords often become lost or forgotten. This means the system won't start. The trick with all system passwords is that they are stored in CMOS RAM. If you can clear the CMOS RAM, you can effectively disable the password protection. In actuality, any means of clearing the CMOS will work, but you know as well as I do that you don't have a backup of your CMOS settings (go ahead, admit it), and choosing "default" settings doesn't always work. Before you start "slashing and burning" your CMOS setup, start small and work your way up.

- *Does anybody know the password?* Check with friends, colleagues, supervisors— someone might know the password. This will save you a lot of hassle, and you can always disable the password in CMOS setup once you're in. If you're using an AMI BIOS and the password feature has been enabled (but no new password has been entered), try "AMI." For Award BIOS, you can try BIOSTAR" or "AWARD_SW." There's no guarantee such defaults will work, but it's worth a try.

- *Check for a password clear jumper.* Crack open the case and take a look at the motherboard. There's probably a jumper that will clear the password without wiping out the entire CMOS setup. In some cases, the jumper is even marked "clear password" (so much for security). If you can find such a jumper, set it, then boot the system. After the system boots, power down, and reset the jumper. Your password should now be clear.

- *Force a configuration change.* This is one of my personal favorites. Try taking out a SIMM and power up the PC. In many cases, the BIOS will recognize the configuration change and generate an error like: "CMOS Mismatch—Press <F1> for Setup." This gets you into CMOS, where you can disable the password without clearing the CMOS RAM entirely. You'll have to save your changes and reboot. Remember that when you finally replace that SIMM, you'll probably see another CMOS error—just go back into CMOS and do a quick correction.

- *Clear the CMOS RAM.* There's no doubt that this is your least desirable choice. There are several ways to clear the CMOS. Look for a motherboard jumper that says "CMOS clear" or has some similar marking. Set the jumper and power up the system. When you see a message indicating that CMOS is clear, or that default settings have been loaded, power down the PC and reset the jumper (the password is now gone). You can then restart the PC and reconfigure your CMOS setup.

  If you can't find the proper jumper, remove the CMOS battery and wait for the CMOS RAM to clear. As a rule, you should wait for at least 30 minutes, but I've seen CMOS RAM hold a latent charge for days. To accelerate the process, you can short a 10 resistor across the empty battery terminals (be sure to turn the power off first). If that doesn't work, you can use the same resistor to short the CMOS RAM power pins directly, Again, remember that all system power should be off before you do this. Once your CMOS RAM is clear, you will need to restore the setup (probably starting with defaults). After the CMOS is restored, be sure to take a <Print Screen> of each setup page and keep them with the PC's documentation.

Ordinarily, the RTC/CMOS IC requires no maintenance. However, the backup battery will need to be replaced on a fairly regular basis (often every few years). Before replacing the battery (or battery pack), be sure that you have a valid CMOS backup—either on paper or floppy disk. Turn off system power, unplug the system, and remove the battery. This will cause the CMOS RAM IC to lose its contents. Discard the original battery and install the new one according to the system manufacturer's instructions. Secure the battery and restart the system. When the system boots, go directly to the CMOS setup routine and restore each setting. If you have CMOS information recorded in a file, boot the system from a floppy disk and use the CMOS backup/restore utility to restore the file. You should then be able to restart the system as if nothing had ever happened. If you're going to be storing old (replaced) motherboards for any period of time, make it a point to remove the CMOS backup battery first. Batteries tend to be very safe and reliable, but there are many instances where they can and do leak. Because batteries use an acid-based electrolyte, battery leakage can easily damage battery contacts, or spill over onto the motherboard itself—damaging circuit traces and ruining the motherboard beyond repair. Some CMOS RAM ICs can retain their contents for hours on a "latent" charge, and might not have to be reprogrammed after replacing the battery. However, there is no guarantee of just how long CMOS contents will remain intact. Always be prepared to restore CMOS settings.

## Troubleshooting CPU Problems

The term *microprocessor troubleshooting* is not the misnomer it once was. Early CPUs, such as the 8088, carried only 29,000 transistors. When one of those transistors failed, it would usually result in a complete system failure—the PC would crash or freeze entirely. Further, the system would subsequently fail to boot at all. However, CPUs have become far more complex in the last 15 years or so, and new generations (such as the Pentium) are exceeding 8 million transistors. With so many more transistors, the probability of an immediate catastrophic fault is far less. Of course, any CPU fault is very serious, but there are now many cases where a system might boot, but crash when certain specific CPU functions are attempted (i.e., trying to execute protected-mode instructions). These kinds of errors might give the impression that a piece of software is corrupt or that one or more expansion devices is faulty. This part of the chapter looks at a selection of CPU failure modes and offers some tactics to help resolve the problem.

### GENERAL SYMPTOMS AND SOLUTIONS

**Symptom 1. The system is completely dead (the system power LED lights properly) CPU faults are never subtle.** When a CPU problem manifests itself, the system will invariably crash. Consequently, systems that do not boot (or freeze without warning during the boot process) stand an excellent chance of suffering from a CPU fault. The frustration with this kind of symptom is that the PC typically does not run long enough to execute its POST diagnostics, nor does the system boot to run any third-party DOS diagnostics. As a result, such "dead" systems require a bit of blind faith on the part of a technician. Your companion CD offers several utilities that can help you identify and quantify you CPU. Before considering a CPU replacement, you should use a multimeter and check the power supply outputs very carefully. Even though the power LED is lit, one or more out-puts might be low or absent. Excessively low outputs can easily result in logic errors that will freeze the system. If this problem occurred after adding an upgrade, the supply might be overloaded—try removing the upgrade. If system operation returns, consider upgrading the power supply. If an output is low or absent and there has been no upgrade (or the problem continues after removing the upgrade), try replacing the power supply. Next, strip the system of its peripherals and expansion boards, then try the system again. If operation returns, one of the expansion devices is interrupting system operation. Re-install one device at a time and check the system. The last expansion device to be installed when the PC fails is the culprit. Replace the defective device. If the failure persists, try a new CPU. Remember to shut down and unplug the PC before continuing. When removing the original CPU, be extremely careful to avoid bending any of the pins (you might want to re-install the CPU later). Use care when installing the new CPU as well—bent pins will almost always ruin the IC. If a new CPU fails to correct the problem, replace the motherboard outright.

**Symptom 2. A beep code or I/O POST code indicates a possible CPU fault The system will almost always fail to boot**. When the POST starts, it will test each of the PC's key motherboard components (including the CPU). If a CPU fault is indicated during the POST (usually a single-byte hexadecimal code written to port 80h and read with a POST card), check each output from the system power supply. If one or more outputs is low or absent, a problem might be in the supply. Try a new supply. If all supply outputs measure properly, try a new CPU. If a new CPU does not resolve the problem, replace the motherboard.

**Symptom 3. The system boots with no problem, but crashes or freezes when certain applications are run** It might seem as if the application is corrupt, but try a diagnostic (such as AMIDIAG from AMI or The Troubleshooter by All Micro). Run repetitive tests on the CPU. Although the CPU might work in real-mode, diagnostics can detect errors running protected-mode instructions and perform thorough register checking. AMIDIAG stands out here because of the very specific error codes that are returned. Not only will it tell you if the CPU checks bad, but you will also know the specific reason why. When an error code is returned suggesting a CPU fault, try another CPU. If a CPU fault is not detected, expand the diagnostic to test other portions of the motherboard. If the entire system checks properly, you might indeed have a corrupt file in your application.

**Symptom 4. The system boots with no problem, but crashes or freezes after several minutes of operation (regardless of the application being run)** Also, you will probably notice that no diagnostic indicates a CPU problem. If you shut the system off and wait several minutes, the system will probably boot fine and run for several more minutes before stopping again—this is typical of thermal failure. When the system halts, check the CPU for heat. Use extreme caution when checking for heat— you can be easily burned. An i486-series CPU might not be fitted with a heatsink. As a rule, i486 CPUs below 25MHz are run without a heatsink, and i486 CPUs running at 33Mhz and higher do use a heatsink. DX2 and DX4 versions almost certainly use a heatsink. All Pentium processors require a heatsink. Recent Pentium, Pentium MMX, and Pentium Pro processors require a heatsink/fan assembly for adequate cooling. If the CPU is not fitted with a heatsink, be sure that the system-cooling fan is working, and that there is an unobstructed path over the CPU. If not, consider applying a heatsink with a generous helping of thermal compound. If the CPU is already fitted with a heatsink, be sure that there is a ample layer of thermal compound between the CPU case and heatsink base. In many cases, the compound is omitted. This ruins the transfer of heat, and allows the CPU to run much hotter. If you find that there is no thermal compound, allows the PC to cool, then add thermal compound between the CPU case and heatsink.

**Symptom 5. An older system refuses to run properly when the CPU's internal (L1) cache is enabled** This type of symptom occurred frequently with older processors (such as the AMD Am486), and can almost always be traced to a configuration issue. The processor might fail if run at an incorrect bus speed (i.e., over clocking), so check and correct the motherboard bus speed to accommodate the CPU. This symptom can also occur when running the CPU at an incorrect operating voltage. Check the voltage level and reconfigure the motherboard for the correct voltage (if necessary). Finally, the motherboard must be compatible with the L1 cache type on the CPU. For example, in-stalling a CPU with a write-back cache on a motherboard that doesn't support write-back cache can cause problems.

**Symptom 6. You cannot run a 3.45-V CPU in a 5-V motherboard** even though an appropriate voltage regulator module is being used Double-check the *Voltage-Regulator Module (VRM*). The VRM must have adequate current-handling capacity to support the CPU's power demands. Otherwise, the VRM will be overloaded and fail to provide adequate power. Check with the CPU manufacturer for their VRM recommendations. You might also try the CPU/VRM in another 5-V motherboard. If the CPU/VRM fails in another 5-V motherboard, chances are that the VRM is underrated or has failed. If the CPU/VRM does work on another 5-V motherboard, it is possible that the original motherboard's BIOS could not support the particular requirements of the new CPU. Check with the motherboard manufacturer to see if an updated BIOS (either flash or ROM IC) is available for the system.

**Symptom 7. A system malfunctions under HIMEM.SYS or DOS4GW.EXE after installing a new CPU** This type of symptom occurred frequently with older CPUs, and could generally be traced to errors in the motherboard CPU voltage and type settings (opposed to the newer bus speed/multiplier configurations). Check the motherboard's CPU configuration jumpers. Also, running a 3.45-V CPU at 5 V, or running a non-SL enhanced CPU as an SL enhanced part can cause these types of problems to occur. So, be sure that the correct part is being used, and see that the CPU voltage is correct (use a voltage regulator module, if necessary).

**Symptom 8. The system runs fine, but reports the wrong type of CPU** In virtually all cases, the motherboard BIOS was not written to support the particular CPU directly. Start by checking the motherboard's CPU configuration jumpers to see that it is set properly for the particular CPU. If the problem persists, you'll probably need a BIOS upgrade (either a flash file or ROM IC) to accommodate the processor. Check with the motherboard or system maker to determine whether an appropriate BIOS up-grade is available.

**Symptom 9. After reconfiguring a VL motherboard for a faster CPU, the VESA VL video card no longer functions Other VL cards might also mal-function.** This frequently occurs on older VL motherboards with support for 40MHz bus speeds. Because the VL bus speed is tied to the motherboard bus speed, setting the motherboard to 40MHz can cause some VL cards to malfunction.

Try running the motherboard at 33MHz (the native frequency for VL cards) and set the local bus clock rate jumper for <=33MHz. If the problem disappears, you have an issue with one or more VL cards. Try altering the number of VL bus wait states until the VL devices will support 40MHz (this will compromise system performance). If you cannot resolve the issue, you might not be able to use the motherboard at 40MHz. You could also try finding a VL board that will operate properly at 40MHz.

**Symptom 10. Some software locks up on systems running 5x86 processors** This is a frequent problem with high-end software, such as AutoDesk's 3D Studio. Often, such programs as 3D Studio use software timing loops in the code. The 5x86 processor executes these loop instructions faster than previous x86 CPUs, which interferes with timing-dependent code inside the program. In most cases, the software manufacturer will offer a patch for the offending program. For 3D Studio,

**Symptom 11. The Windows 95 Device Manager identifies the CPU in-correctly In many cases, the CPU is misidentified as a 486 or other older CPU.** An issue with Windows 95 causes this. The algorithm used in Windows 95 to detect the CPU was likely completed before the particular CPU was released; therefore, the CPU responds to the algorithm just as a 486 does. Use a diagnostic that will identify your particular CPU correctly or check with the CPU maker for a Windows 95 patch that will support proper identification. This problem happens often with Cyrix 6x86 CPUs, and it can be corrected by downloading a patch, such as 6XOPT074.ZIP

**Symptom 12. The heatsink/fan will not secure properly** It is not tight against the surface of the CPU. This can be a serious problem for the system because a loose heatsink/fan will not cool the processor correctly. There are three classic solutions to this issue. First, be sure that you have the heatsink/fan model that is recommended for your particular CPU (a common error when building a new PC). Second, be sure that the heatsink attaches to either the CPU chip itself or the ZIF socket that the CPU mounts in. Third, verify that the CPU has not been altered or faked. Faked CPUs are often ground down to remove their original markings, then new markings are placed on the CPU. The grinding process reduces the package thickness, and can prevent the heatsink/fan from being secure (faked CPUs are common in Europe). From a technological standpoint, the Cyrix 6x86 (or *M*1, as it used to be called) is a strong competitor to the Intel Pentium. In a properly configured system, the 6x86 can actually out-class the Pentium in some areas. In addition, the 200MHz version of the 6x86 uses a bus speed of 75MHz (replacing the established 66MHz bus speed).

**Symptom 13. The Cyrix 6x86 system is crashing or freezing after some period of operation** This is almost always a heat-related problem caused by in-adequate cooling of the 6x86. If you're not using a heatsink/fan, install one before continuing (be sure to use a thin layer of thermal grease to improve heat transfer between the CPU and heatsink). Use a good-quality heatsink/fan with plenty of capacity and see that it is securely attached to the CPU. Also see that the CPU itself is securely seated in its socket. You might also consider installing a different 6x86 model. The Type C028 version uses 3.52 V and the Type C016 uses 3.3 V, so just changing models can reduce power demands. You might also try installing a version 2.7 (or later) 6x86, which is better able to deal with heat. Best yet, install a 6x86L CPU (and regulator). A third possible cause of intermittent system operation is poorly compatible BIOS. Check with the motherboard maker or sys-tem manufacturer and see if there is a BIOS upgrade to better support Cyrix CPUs.

**Symptom 14. The Cyrix 6x86 system crashes and refuses to restart** This is another classic heat-related problem, which often indicates that the CPU or its associated voltage regulator has failed. Check the voltage regulator—regulators are more susceptible to failure with Cyrix 6x86 CPUs because of the higher current demands. If the voltage regulator checks out, replace the CPU itself (perhaps with a lower-power model, as mentioned in Symptom 13).

**Symptom 15. The Cyrix 6x86 performs poorly under Windows NT 4.0** In virtually all cases, NT has detected the 6x86 and has elected to shut down the write-back L1 cache completely. This results in the performance hit. Fortunately, there are several ways to address this problem. First, you can download a patch from the Cyrix Web site **(http://www.cyrix.co**m), which re-enables the L1 cache under NT 4.0. This brings performance back up, but it also can cause instability for NT. A more practical resolution is to replace the CPU with a 6x86 version 2.7 (or higher) or a 6x86L (and suitable voltage regulator), as mentioned in Symptom 13.

**Symptom 16. Quake (or another graphics-intensive program) doesn't run nearly as well on a Cyrix 6x86 system as it does with a similar Pentium system** This is caused by issues with Cyrix FPU performance. There is no real resolution for the problem at this time—later 6x86 versions do not correct the FPU. You can replace the CPU with an AMD or Intel model, or wait to see the performance offered by the Cyrix 6x86MX (M2).

**Symptom 17. A Cyrix 6x86 CPU won't work on your motherboard** Several problems are possible when upgrading to any non-Intel CPU. First, check the motherboard's chipset and be sure that the chipset (and other attributes, such as bus speed) are compatible with the 6x86. As you saw earlier, some 6x86 iteration requires unusual bus speeds in order to function. Motherboard settings are always important when installing a CPU. You will probably need to set a new clock speed to accommodate the 6x86. In some cases, you might also need to specify a CPU type. Finally, you'll need to set the CPU voltage (if your mother-board provides a

"switchable" voltage regulator). Otherwise, you'll need to install a volt-age regulator with enough power capacity to handle a 6x86 adequately. If you select an underrated regulator, the regulator can overheat and burn out. The last issue to consider is your BIOS. Often the BIOS must detect a CPU correctly, and make slight variations in BIOS routines to use the new CPU most effectively. If the BIOS do not support your 6x86, you'll need to get a BIOS upgrade from the motherboard maker or system manufacturer. If all else fails, try slowing down the clock speed to the next slower level. If the CPU runs properly then, there is probably an incompatibility between your motherboard and the 6x86. Check with the motherboard manufacturer (or system maker) and see if any compatibility issues have been identified (and if there is a fix available).

**Symptom 18. The performance degrades when using a Cyrix 6x86 under Windows 3.1x or Windows 95** In many cases, performance problems when using non-Intel CPUs is related to BIOS support. Often the BIOS must identify a CPU, and adjust to accommodate any particular nuances. If the BIOS is not supporting the CPU correctly, it can result in overall performance problems. Check with the motherboard maker or system manufacturer for any BIOS upgrades that will better support your new CPU. Clock speed and cache are two other issues that can affect system performance. Check the motherboard jumpers and verify that the clock speed is set correctly for your Cyrix CPU. Also check for cache jumpers and see that any cache settings are correct. You can also verify that Internal (L1) and External (L2) caching are enabled in BIOS.

## OVERCLOCKING TROUBLESHOOTING

The process of CPU over clocking is hardly a perfect one. Many variables are involved, such as the CPU type, motherboard quality, available clock speed, and multiplier settings. In many cases, over clocking results in system problems. Some of the more common problems are:

**Symptom 19. The system does not boot up at all after reconfiguring the system for over clocking** This common problem almost always means that you cannot over clock the CPU at the level you have chosen. Scale back the clock speed or the multiplier until the system starts up or return the clock and multiplier to their original values.

**Symptom 20. The system starts after over clocking, but locks up or crashes after some short period of time** Over clocking causes substantial heat dissipation from the CPU, and cooling must be improved to compensate for this additional heat—otherwise, the overheated CPU can lock-up and crash the system. Check the heatsink/fan and see that it is attached correctly with a thin layer of thermal grease between the CPU and heatsink. It might be necessary to "up-size" the heatsink/fan or use a Peltier cooler.

**Symptom 21. Memory errors occur after increasing the bus speed for over clocking** Memory performance is tightly coupled to bus speed (or "clock speed"). Most 60-ns RAM types will work fine up to 66MHz, but you might need high-end 50-ns EDO RAM or 50-ns SDRAM when pushing the bus speed to 75MHz or 83MHz. Try some faster memory in the PC or do not attempt to overclock the system.

**Symptom 22. After reconfiguring for overclocking, the system works, but you see a rash of CPU failures** Chances are that the CPU is running far too hot, resulting in premature CPU failures. Check the cooling unit and see that it is securely attached using a thin layer of thermal grease between the CPU and heatsink. It might be necessary to "upsize" the heat sink/fan or use a Peltier cooler.

**Symptom 23. After reconfiguring for overclocking, you find that some expansion board or other hardware is no longer recognized or working** Because PCI and ISA clocks are typically tied to the system clock speed, increasing the clock speed will also increase the PCI and ISA clocks. This can upset the operation of some sensitive adapter boards. You might be able to replace the suspect hardware with a more tolerant adapter, but it is often safer to return the clock speed and multiplier settings to their original values.

**Symptom 24. After reconfiguring for overclocking, a number of recent files are corrupt, inaccessible, or missing In effect, the system is not stable** Check for excessive heat first (as in Symptom 22). Otherwise, you should not overclock this particular system. Try scaling back the overclocking configuration, or re-turn the clock speed and multiplier settings to their original values.

## Troubleshooting Floppy Disk Systems

This section of the chapter is concerned with drive problems that cannot be corrected with cleaning or mechanical adjustments. To perform some of the following tests, you should have a known-good diskette that has been properly formatted. The disk might contain files, but be certain that any such files are backed up properly on a hard drive or another floppy disk—if you can't afford to lose the files on a disk, don't use the disk.

**SYMPTOMS**

When floppy drive trouble occurs, running a diagnostic can help determine whether the drive mechanics or electronics are at fault. Although you can swap a drive symptomatically, thorough testing is an inexpensive means to verify your suspicions before spending money to replace sub-assemblies.

**Symptom 1. The floppy drive is completely dead** The disk does not even initialize when inserted. Begin troubleshooting by inspecting the diskette itself. When a 3.5" disk is inserted into a drive, a mechanism should pull the disk's metal shroud away and briefly rotate the spindle motor to ensure positive engagement. Be sure that the disk is properly inserted into the floppy-drive assembly. If the diskette does not enter and seat just right within the drive, disk access will be impossible. Try several different diskettes to ensure that the test diskette is not defective. It might be necessary to partially disassemble the computer to access the drive and allow you to see the overall assembly. Free or adjust any jammed assemblies or linkages to correct disk insertion. If you cannot get diskettes to insert properly, change the floppy drive. If the diskette inserts properly but fails to initialize, carefully inspect the drive's physical interface cabling. Loose connectors or faulty cable wiring can easily disable a floppy drive. Use your multimeter to measure dc voltages at the power connector. Place your meter's ground lead on pin 2 and measure +12 Vdc at pin 1. Ground your meter on pin 3 and measure +5 Vdc at pin 4. If either or both of these voltages is low or missing, troubleshoot your computer power supply. Before disk activity can begin, the drive must sense a disk in the drive. Locate the disk-in place sensor and use your multimeter to measure voltage across the sensor. When a disk is out of the drive, you should read a logic 1 voltage across the sensor output. When a disk is in place, you should read a logic 0 voltage across the sensor (this convention might be re-versed in some drive designs). If the sensor does not register the presence of a disk, replace the sensor. If the sensor does seem to register the presence of a disk, use your logic probe to check the *Disk change/ready* signal (pin 34) of the physical interface. If the interface signal does not agree with the sensor signal, replace the control-circuit IC on the drive PC board. You can also replace the entire drive-control PC board, or replace the entire drive outright. At this point, the trouble is probably in the floppy-drive PC board, or the floppy-drive controller board. Try replacing the floppy-drive PC board assembly. This is not the least expensive avenue in terms of materials, but it is fast and simple. If a new floppy-drive PC board corrects the problem, re-assemble the computer and return it to service. You could retain the old floppy-drive board for parts. If a new drive PC board does not correct the problem (or is not available), replace the entire drive. You could retain the old floppy drive for parts. If a new floppy-drive assembly fails to correct the problem, replace the floppy-controller board. You will have to disassemble your computer to expose the motherboard and expansion boards.

**Symptom 2. The floppy drive rotates a disk, but will not seek to the desired track**
This type of symptom generally suggests that the head positioning stepping motor is inhibited or defective, but all other floppy-drive functions are working properly. Begin by disassembling your computer and removing the floppy drive. Carefully inspect the head-positioning assembly to be certain that no broken parts or obstructions could jam the read/write heads. You might wish to examine the mechanical system with a disk inserted to be certain that the trouble is not a disk-alignment problem, which might be interfering with head movement. Gently remove any obstructions that you might find. Be careful not to accidentally misalign any linkages or mechanical components in the process of clearing an obstruction. Remove any diskette from the drive and re-connect the drive's signal and power cables. Apply power to the computer and measure drive voltages with your multimeter. Ground your multimeter on pin 2 of the power connector and measure +12 Vdc at pin 1. Move the meter ground to pin 3 and measure +5 Vdc on pin 4. If either voltage is low or absent, troubleshoot your computer power supply. Once confident that the drive's mechanics are intact and appropriate power is available, you must determine whether the trouble is in your floppy drive PC board or floppy-drive controller IC on the motherboard. Use your logic probe to measure the STEP signal in the physical interface (pin 20). When drive access is requested, you should find a pulse signal as the floppy controller attempts to position the R/W heads. If STEP pulses are missing, the floppy-drive controller board is probably defective and should be replaced. If STEP pulses are present at the interface, check the pulses into the coil driver circuit. An absence of pulses into the coil driver circuit indicates a faulty control-circuit IC. If pulses reach the coil driver, measure pulses to the stepping motor. If no pulses leave the coil driver, replace the coil driver IC. When pulses are correct to the stepping motor but no motion is taking place, replace the defective stepping motor. If you do not have the tools or inclination to replace surface-mount ICs, you can replace the drive PC board. You can also replace the entire drive outright.

**Symptom 3. The floppy drive heads seek properly, but the spindle does not turn**
This symptom suggests that the spindle motor is inhibited or defective, but all other functions are working properly. Remove all power from the computer. Disassemble the system enough to remove the floppy drive. Carefully inspect the spindle motor, drive belt (if used), and spindle assembly. Be certain that no broken parts or obstructions could jam the spindle. If a belt is between the motor and spindle, be sure that the belt is reasonably tight—it should not slip. You should also examine the floppy drive with a diskette inserted to be certain that the disk's insertion or alignment is not causing the problem. You can double-check your observations using several different diskettes. Gently remove any obstruction(s) that you might find. Be careful not to cause any accidental damage in the process of clearing an obstruction. Do not add any lubricating agents to the assembly, but gently vacuum or wipe away any significant accumulations of dust or dirt. Remove any diskette from the drive and re-connect the floppy drive's signal and power cables. Restore power to the computer and measure drive voltages with your multimeter.

Ground your multimeter on pin 2 and measure +12 Vdc on pin 1. Move the meter ground to pin 3 and measure +5 Vdc on pin 4. If either voltage is low or absent, troubleshoot your Computer power supply. Once you are confident that the floppy drive is mechanically sound and appropriate power is available, you must determine whether the trouble is in the floppy drive PC board or the floppy drive controller board. Use your logic probe to measure the *Motor on* signal in the physical interface (pin 16). When drive access is requested, the *Motor on* signal should become true (in most cases an active low). If the *Motor on* signal is missing, the floppy drive-controller board is probably defective and should be replaced. If the *Motor on* signal is present at the interface, check the signal driving the servo circuit. A missing *Motor on* signal at the servo circuit suggests a faulty control-circuit IC. If the signal reaches the servo circuit, the servo IC is probably defective. You can replace the servo IC, but your best course is usually to replace the spindle motor/PC board assembly as a unit. If you are unable to replace the spindle motor PC board, you can replace the floppy drive outright.

**Symptom 4. The floppy drive will not read from/write to the diskette All other operations appear normal.** This type of problem can manifest itself in several ways, but your computer's operating system will usually inform you when a disk read or write error has occurred. Begin by trying a known-good, properly formatted diskette in the drive. A faulty diskette can generate some very perplexing read/write problems. If a known-good diskette does not resolve the problem, try cleaning the read/write heads, as described in the previous section. Do not run the drive with a head-cleaning disk inserted for more than 30 seconds at a time, or you risk damaging the heads with excessive friction. When a fresh diskette and clean R/W heads do not correct the problem, you must determine whether the trouble exists in the floppy-drive assembly or the floppy-controller IC. If you cannot read data from the floppy drive, use your logic probe to measure the *Read data* signal (pin 30). When the disk is idle, the *Read data* line should read as a constant logic 1 or logic 0. During a read cycle, you should measure a pulse signal as data moves from the drive to the floppy-controller board. If no pulse signal appears on the *Read data* line during a read cycle, use your oscilloscope to measure analog signals from the R/W heads. If there are no signals from the R/W heads, replace the head or head carriage assembly. When signals are available from the R/W heads, the control-circuit IC is probably defective and should be replaced. If you are unable to replace the IC, you can replace the drive's control PC board. You can also replace the entire drive outright. If a pulse signal does exist during a read cycle, the floppy-disk controller board is probably defective and should be replaced. When you cannot write data to the floppy drive, use your logic probe to measure the *Write gate* and *Write data* lines (pins 24 and 22, respectively). During a write cycle, the *Write gate* should be logic 0 and you should read a pulse signal as data flows from the floppy controller IC to the drive. If the *Write gate* remains logic 1 or no pulse is on the *Write data* line, replace the defective floppy controller board.

When the two *write* signals appear as expected, check the analog signal to the R/W heads with your oscilloscope. If you do not find analog write signals, replace the defective control-circuit IC. If analog signals are present to the heads, try replacing the heads or the entire head carriage assembly. You can also replace the entire drive outright.

**Symptom 5. The drive is able to write to a write-protected disk** Before concluding that there is a drive problem, remove and examine the disk itself to ensure that it is actually write protected. If the disk is not write protected, write protect it appropriately and try the disk again. If the disk is already protected, use your multimeter to check the drive's write-protect sensor. For an unprotected disk, the sensor output should be logic 1; a protected disk should generate logic 0 (some drives might reverse this convention). If there is no change in logic level across the sensor for a protected or unprotected disk, try a new write-protect sensor. If the sensor itself appears to function properly, check the *Write protect* signal at the physical interface (pin 28). A write protected disk should cause a logic 0 on the *Write protect* line. If the signal remains logic 1 regardless of whether the disk is write protected or not, the control-circuit IC in the drive is probably defective. If you are unable to replace the IC, change the drive PC board or replace the entire floppy drive outright.

**Symptom 6. The drive can only recognize either high- or double-density media, but not both** This problem usually appears in 8.89-cm drives during the disk format process when the drive must check the media type. In most cases, the normal high-density sensor is jammed or defective. Remove the disk and use your multimeter to measure across the sensor. You should be able to actuate the sensor by hand (either by pressing a switch or interrupting a light path) and watch the output display change accordingly on your multimeter. If the sensor does not respond, it is probably defective and should be replaced. If the sensor itself responds as expected, check the *Normal/high-density* signal at the physical interface (pin 2). A double-density disk should cause logic 1 output, but a high-density disk should cause a logic 0 signal. If the signal at the physical interface does not respond to changes in the density sensor, the control-circuit IC on the drive PC board is probably defective. If you are unable to replace the control-circuit IC, you can replace the drive PC board or the entire floppy drive outright.

**Symptom 7. Double-density (720KB) 3.5" disks are not working properly when formatted as high-density (1.44MB) disks** This is common when double-density diskettes are pressed into service as high-density disks. Double-density disks use a lower-grade media than high-density disks—this makes double-density disks unreliable when used in high-density mode. Some good-quality diskettes will tolerate this misuse better than other lower-quality diskettes. In general, do not use double-density diskettes as high-density disks.

**Symptom 8. DOS reports an error, such as "Cannot Read From Drive A:" even though a diskette is fully inserted in the drive, and the drive LED indicates that access is being attempted** Start by trying a known-good diskette in the drive (a faulty diskette can cause some perplexing R/W problems). If the diskette is working properly, take a few minutes to clean the drive. Oxides and debris on the R/W heads can interfere with head contact. Do not run the drive with a head-cleaning disk inserted for more than 30 seconds at a time or you risk damaging the heads with excessive friction. Next, remove the floppy drive and check the assembly for visible damage or obstructions. Insert a diskette and see that the disk is clamped properly. Clear any obstructions that might prevent the disk from seating properly. Also inspect the 34-pin signal cable for obvious damage, and see that it is connected properly at both the drive and the drive controller. Try a new signal cable. If problems persist, the drive itself is probably defective. Try replacing the floppy drive. In most cases, this should correct the problem. If not, replace the floppy-drive controller.

**Symptom 9. When a new diskette is inserted in the drive, a directory from a previous diskette appears** You might have to reset the system to get the new diskette to be recognized. This is the classic "phantom directory" problem, and is usually caused by a drive or cable fault. Check the 34-pin signal cable first. In most cases, the cable is damaged, or is not inserted properly at either end. Try a new signal cable. If this is a new drive installation, check the floppy-drive jumpers. Some floppy drives allow the *Disk change* signal to be enabled or disabled. Be sure that the *Disk change* signal is enabled. If problems persist, the floppy drive itself is probably defective, so try replacing the floppy drive. In the unlikely event that problems remain, try replacing the drive-controller board (phantom directory problems are rare in the drive controller itself).

**Symptom 10. The 3.5" high-density floppy disk cannot format high-density diskettes (but can read and write to them just fine)** This problem plagues older computers (i286 and i386 systems), where after-market high-density drives were added. The problem is a lack of BIOS support for high-density formatting—the system is just too old. In such a case, you have a choice. First, you can upgrade your motherboard BIOS to a version that directly supports 3.5" high-density diskettes. You could also use the DRIVER.SYS utility—a DOS driver that allows an existing 3.5" to be "redefined" as a new logical drive providing high-density support. A typical DRIVER.SYS command line would appear in CONFIG.SYS such as: device = c:\dos\driver.sys /D: 1

**Symptom 11. An XT-class PC cannot be upgraded with a 3.5" floppy disk XT systems support up to four double-density 5.25" floppy-disk drives. It will not support 3.5" floppy diskettes at all.** To install 3.5" floppy disks, check your DOS version (you need to have DOS 3.3 or later installed). Next, you'll need to install an 8-bit floppy drive controller board (remember to disable any existing floppy controller in the system first). The floppy controller will have its own on-board BIOS to support floppy-disk operations. Finally, take a look at the XT configuration switches and see that any entries for your floppy drives are set correctly. If you're using a stand-alone floppy controller, you might need to set the motherboard jumpers to "no floppy drives."

**Symptom 12. The floppy drives cannot be "swapped" so that A: becomes B: and B: becomes A:** This often happens on older systems when users want to make their 3.5" after-market B: drive into their A: drive, and relegate their aging 5.25" drive to B: instead. First, check your signal cable. For floppy cables with a wire twist, the end-most connector is A:, and the connector prior to the twist is B:. Reverse the connectors at each floppy drive to reverse their identities. If the cable has no twist (this is rare), reset the jumper ID on each drive so that your desired A: drive is set to DS0 (Drive Select 0), and your desired B: drive is jumpered to DS1. If you accomplish this exchange, but one drive is not recognized, try a new floppy signal cable. Also remember to check if you suspect a phantom directory, do not initiate any writing to the diskette—its FAT table and directories could be overwritten, rendering the disk's contents inaccessible without careful data-recovery procedures. CMOS settings—you'll need to reverse the floppy drive entries for your A: and B: drives, then reboot the system.

**Symptom 13. When using a combination floppy drive (called a combo drive), one of the drives does not work, but the other works fine** This problem is often caused by a drive fault. First, be sure to check the power connector—be sure that both +5 V and +12 V are adequately provided to the drive through the 4-pin "mate-n-lock" connector. If the drive is receiving the proper power, the drive itself has almost certainly failed—try a new drive.

**Symptom 14. The floppy-drive activity LED stays on as soon as the computer is powered up** This is a classic signaling problem, which occurs after changing or upgrading a drive system. In virtually all cases, one end of the drive cable has been inserted backwards. Be sure that pin 1 on the 34-pin cable is aligned properly with the connector on both the drive and controller. If problems remain, the drive controller might have failed. This is rare, but try a new drive controller.

## Hard Drive Symptoms

Hard disk drives present some perplexing challenges for computer technicians and every day users alike. The problem with hard drives is that they are inaccessible devices. Unless you have the clean room environment to open the sealed drive platters, it is pointless to even consider replacing failed drive mechanics. Even if you could open a drive safely, the advances in hard-drive technology have been so fast and furious that no spare parts market has ever developed. Drive manufacturers themselves rarely bother to repair faulty drives or invest in specialized drive-testing equipment. Clearly, the course for hard-drive repair is to identify defective drives and replace faulty units with new (usually better) ones. Fortunately, not all hard-drive problems are necessarily fatal. True, you might lose some programs and data (backup your hard drive frequently), but many drive problems are recoverable without resorting to drive replacement. Instead of focusing on repairing a hard drive's electronics or mechanics, today's repair tactics focus on repairing a drive's data. By reconstructing or relocating faulty drive information, it is often possible to recover from a wide variety of drive problems.

### SYMPTOMS AND SOLUTIONS

It's time to take a look at some problems and solutions. The important concept here is that a hard-drive problem does not necessarily mean a hard-drive failure. The failure of a sector or track does not automatically indicate physical head or platter damage—that is why software tools have been so successful. Even if one or more sectors are physically damaged, millions of sectors are on a hard drive. A few bad sectors do not render a drive faulty. One of the only times that a drive is truly irreparable is when physical media damage occurs on track 00, but software tools will help you to identify the scope of the problem.

**Symptom 1. The hard drive is completely dead The drive does not spin up, the drive light doesn't illuminate during power-up, or you see an error message indicating that the drive is not found or ready.** In most cases, you should suspect a power problem first. Be sure that the 4-pin power connector is inserted properly and completely. If the drive is being powered by a "Y-connector," be sure any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V supply) is unusually low or absent, replace the power supply. Also check your signal cable. See that the drive's signal interface cable is connected securely at both the drive and controller ends. For IDE/EIDE drives, this is the 40-pin ribbon cable. If the cable is visibly worn or damaged, try a new cable. The PC cannot use a hard drive that it can't recognize, so enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write pre compensation must all be correct—otherwise, POST will not recognize the drive.

If you have an "auto-detect" option available, try that also. Remember to save your changes in CMOS and reboot the system. If problems continue, the hard drive itself might be defective. Try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective, and should be replaced. If a known-good hard drive fails to operate, replace the drive controller board.

**Symptom 2. You see drive activity, but the computer will not boot from the hard drive** In most cases, there is a drive failure, boot-sector failure, or DOS/Windows file corruption. Check the signal cable first. Be sure that the drive's signal interface cable is connected securely at both the drive and controller. If the cable is visibly worn or damaged, try a new one. You should check the CMOS setup next—see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write precompensation must all correct. Otherwise, POST will not recognize the drive. If it has an option to "auto-detect" the drive, try that as well. The boot sector might also be defective. Boot from a floppy disk and try accessing the hard drive. If the hard drive is accessible, chances are that the boot files are missing or corrupt. Try a utility, such as DrivePro's Drive Boot Fixer or DISKFIX with PC Tools. You might also try running "FDISK /MBR," which will rebuild the drive's master boot record. Careful: the FDISK /MBR command might render the files on your drive inaccessible. Finally, you might have a problem with your drive-system hardware. If you cannot access the hard drive, run a diagnostic such as Windsor Technologies' PC Technician. Test the drive and drive controller. If the controller responds, but the drive does not, try repartitioning and reformatting the hard drive. If the drive still doesn't respond, replace the hard drive outright. If the controller doesn't respond, replace the hard-drive controller.

**Symptom 3. One or more sub-directories appear lost or damaged** Both the root directory of a drive and its FAT contain references to sub-directories. If data in either the root directory or file allocation table is corrupt, one or more sub-directories might be inaccessible by the drive. Try repairing the drive's directory structure. Use DISKFIX (with PC Tools) or SCANDISK (with DOS 6.2 or later) to check the disk's directory structure for problems.

**Symptom 4. Errors occur during drive reads or writes Magnetic information does not last forever, and sector ID information can gradually degrade to a point where you encounter file errors.** Start by checking for file structure problems on the drive. Use a utility, such as DISKFIX or SCANDISK, to examine the drive and search for bad sectors. If a failed sector contains part of an .EXE or .COM file, that file is now corrupt and should be restored from a backup. If you cannot isolate file problems, you might need to consider a *Low-Level (LL)* format. This is an ideal solution because LL formatting rewrites sector ID information, but the sophistication of today's drives makes LL formatting almost impossible. If the drive manufacturer provides a "drive preparation" utility, you should backup the drive, run the utility, FDISK, FORMAT, and restore the drive.

**Symptom 5. The hard drive was formatted accidentally** A high-level format does not actually destroy data, but rather it clears the file names and locations kept in the root directory and FAT—this prevents DOS from finding those files. You will need to recover those files. Use a utility, such as UNFORMAT (with PC Tools), which can reconstruct root directory and FAT data contained in a MIRROR file. This is not always a perfect process and you might not be able to recover all files.

**Symptom 6. A file has been deleted accidentally** Mistyping or forgetting to add a drive specification can accidentally erase files from places you did not intend to erase. You can often recover those files if you act quickly. Use a utility, such as UN-DELETE (with PC Tools and DOS), to restore the deleted file. This is not always a perfect process and you might not be able to recover every file.

**Symptom 7. The hard drive's root directory is damaged** A faulty root directory can cripple the entire disk, rendering all sub-directories inaccessible. You might be able to recover the root directory structure. Use a utility, such as DISKFIX (with PC Tools), to reconstruct the damaged FATs and directories. If you have been running MIRROR, DISK-FIX should be able to perform a very reliable recovery. You might also try other recovery In order for MIRROR data to be useful, do not save new files before running UNFORMAT. In order for UNDELETE to be useful, do NOT save new files before running UNDELETE. Utilities, such as DrivePro or ScanDisk. However, if you cannot recover the root directory reliably, you will need to reformat the drive, and then restore its contents from a backup.

**Symptom 8. Hard drive performance appears to be slowing down over time** In virtually all cases, diminishing drive performance can be caused by file fragmentation. To a far lesser extent, you might be faced with a computer virus. Start the PC with a "clean" boot disk and be sure that no TSRs or drivers are being loaded. After a clean boot, run your anti-virus checker and be sure that there are no memory-resident or file-based viruses. If the system checks clean for computer viruses, you should check for file fragmentation next. Start your defragmentation utility (such as COMPRESS with PC Tools or DEFRAG with DOS) and check to see the percentage of file fragmentation. If it has more than 10% fragmentation, you should consider running the defragmentation utility after preparing Windows. Before defragmenting a drive, reboot the system normally, start Windows, access the *Virtual memory* controls for your version of Windows, and shut down virtual memory. Then leave Windows and boot the system "clean" again. Restart your defragmentation utility and proceed to defragment the disk. This process might take several minutes, depending on the size of your drive. Once defragmentation is complete, reboot the system normally, start Windows, access the *Virtual memory* controls for your version of Windows, and recreate a permanent swap file to support virtual memory. You should now notice a performance improvement.

**Symptom 9. The hard drive accesses correctly, but the drive light stays on continuously** A continuous LED indication is not necessarily a problem as long as the drive seems to be operating properly. Check the drive and drive controller for drive "light jumpers"—examine the drive itself for any jumper that might select *Latched* mode vs. *Activity* mode. If no such jumpers are on the drive, check the drive controller or motherboard. Set the jumper to *Activity* mode to see the drive light during access only. Next, consider the possibility of drive-light error messages. Some drive types (especially SCSI drives) use the drive-activity light to signal drive and controller errors. Check the drive and controller documents and see if the light remaining on indicates any error.

**Symptom 10. The hard drive is not accessible and the drive light stays on continuously** This usually indicates a reversed signal cable, which is most common when upgrading or replacing a drive system. In virtually all cases, one end of the signal cable is reversed. Be sure that both ends of the cable are installed properly (remember that the red or blue stripe on one side of the cable represents pin 1). If problems persist, replace the drive controller. It is rare for a fault in the drive controller to cause this type of problem, but if trouble persists, try a known-good drive controller board.

**Symptom 11. A "No fixed disk present" error message appears on the monitor** This kind of problem can occur during installation, or at any point in the PC's working life. Check the power connector first, and be sure the 4-pin power connector is inserted properly and completely. If the drive is being powered by a Y-connector, be sure any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V supply) is unusually low or absent, replace the power supply. Next, check the signal connector. Be sure that the drive's signal cable is connected securely at both the drive and controller. If the cable is visibly worn or damaged, try a new one. If problems persist, check the CMOS setup—enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write precompensation must all correct—otherwise, POST will not recognize the drive. You might also try "auto-detecting" the drive. Also check for hardware conflicts. Be sure that no other expansion devices in the system use the same IRQs or I/O addresses used by your drive controller. If so, change the resources used by the conflicting device. If your drive system uses a SCSI interface, be sure that the SCSI cable is terminated properly. If problems continue, try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective. If problems persist with a known-good hard drive, replace the drive-controller board.

**Symptom 12. The drive spins up, but the system fails to recognize it. Your computer might flag this as a "Hard-disk error" or "Hard-disk controller failure" during system initialization.** Start by checking the signal connector. Be sure that the interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. Next, check any drive jumpers, and see that a primary (master) drive is configured as primary, and a secondary (slave) drive is configured as secondary. For SCSI drives, see that each drive has a unique ID setting and check that the SCSI bus is terminated properly. Enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write precompensation must all correct—otherwise, POST will not recognize the drive. Try using the "auto-detect" feature if it is available. If the CMOS is configured properly, you should suspect a problem with the partition. Boot from a floppy disk and run FDISK to check the partitions on your hard drive. Be sure that there is at least one DOS partition. If the drive is to be your boot drive, the primary partition must be active and bootable. Repartition and reformat the drive, if necessary. If problems persist, try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective. If a known-good hard drive fails to work as expected, replace the drive controller. If problems persist with a known-good floppy drive, replace the drive-controller board.

**Symptom 13. The IDE drive spins up when power is applied, then rapidly spins down again** The drive is defective, or it is not communicating properly with its host system. Check the power connector first. Be sure that the 4-pin power connector is inserted properly and completely into the drive. Always check the signal connector next, and see that the interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. Inspect the drive jumpers—the primary (master) drive should be configured as primary, and a secondary (slave) drive should be configured as secondary. For SCSI drives, see that each drive has a unique ID setting, and check that the SCSI bus is terminated properly. If problems persist, try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective.

**Symptom 14. A "Sector not found" error message appears on the monitor** This problem usually occurs after the drive has been in operation for quite some time, and is typically the result of a media failure. Fortunately, a bad sector will only affect one file. Try recovering the file. Use a utility, such as SpinRite (from Gibson Research) or another data-recovery utility, and attempt to recover the damaged file. Notice that you might be unsuccessful, and have to restore the file from a backup later. Check the media itself. Use a disk utility, such as ScanDisk, to evaluate the drive, then locate and map out any bad sectors that are located on the drive. If problems persist, perform a low-level format (if possible). Lost sectors often occur as drives age and sector ID information degrades. LL formatting restores the sector IDs, but LL formatting is performed at the factory for IDE/EIDE and SCSI drives.

If an LL formatting utility is available for your particular drive (available right from the drive manufacturer), and ScanDisk reveals a large number of bad sectors, you might consider backing up the drive completely, running the LL utility, repartitioning, reformatting, then restoring the drive. Finally, if ScanDisk maps out bad sectors, you might need to restore those files from a backup.

**Symptom 15. A "1780 or 1781 ERROR" appears on the monitor** The classic 1780 error code indicates a "Hard disk 0 failure," and the 1781-error code marks a "Hard disk 1 failure." Start the PC with a "clean" boot disk and be sure that no TSRs or drivers are being loaded. If you haven't done so already, run your anti-virus checker and be sure that there are no memory-resident or file-based viruses. Next, if you can access the hard drive once your system is booted, chances are that the boot files are missing or corrupt. Try a utility, such as DrivePro's Drive Boot Fixer or DISKFIX with PC Tools. Otherwise, you will need to repartition and reformat the disk, then restore disk files from a backup. Check the hardware next—if you cannot access the hard drive, run a diagnostic such as Windsor Technologies' PC Technician. Test the drive and drive controller. If the controller responds but the drive does not, try repartitioning and reformatting the hard drive. If the drive still doesn't respond, replace the hard drive outright. If the controller doesn't respond, replace the hard-drive controller.

**Symptom 16. A "1790 or 1791 ERROR" appears on the monitor** The classic 1790 error code indicates a "Hard Disk 0 Error," although the 1791 error code marks a "Hard Disk 1 Error." Check the signal connector first. Be sure that the interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. There might also be a problem with the drive's partition. Boot from a floppy disk and run FDISK to check the partitions on your hard drive. Be sure that there is at least one DOS partition. If the drive is to be your boot drive, the primary partition must be active and bootable. Repartition and reformat the drive, if necessary. If problems persist, replace the hard drive. If a known-good drive works as expected, your original drive is probably defective. If problems persist with a known-good floppy drive, replace the drive-controller board.

**Symptom 17. A "1701 ERROR" appears on the monitor** The 1701 error code indicates a hard-drive POST error—the drive did not pass its POST test. Check the power connector first, and be sure that the 4-pin power connector is inserted properly and completely. If a Y connector is powering the drive, be sure that any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V supply) is unusually low or absent, replace the power supply. Enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write precompensation must all correct; otherwise, POST will not recognize the drive. Try "auto-detecting" the drive.

If problems persist, perform a low-level format (if possible). ST506/412 and ESDI drives might require LL formatting, but LL formatting is performed at the factory for IDE/EIDE and SCSI drives. If an LL-formatting utility is available for your particular drive (available right from the drive manufacturer), you might consider backing up the drive completely, running the LL utility, repartitioning, reformatting, then restoring the drive.

**Symptom 18. The system reports random data, seek, or format errors** Random errors rarely indicate a permanent problem, but identifying the problem source can be a time-consuming task. Check the power connector first. Be sure that the 4-pin power connector is inserted properly and completely. If the drive is being powered by a "Y-connector," be sure that any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V sup-ply) is unusually low, replace the power supply. Check the signal connector next. Be sure that the interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. Also try re-routing the signal cable away from the power-supply or "noisy" expansion devices. Check the drive orientation. If problems occur after remounting the drive in a different orientation, you might need to repartition and reformat the drive, or return it to its original orientation. Try relocating the drive-controller away from cables and "noisy" expansion devices. If your system has a "turbo" mode, your ISA drive controller might have trouble operating while the system is in turbo mode. Take the system out of turbo mode. If the problem disappears, try a new drive controller. The media might also be defective. Use a utility, such as Scan Disk, to check for and map out any bad sectors. Once bad sectors are mapped out, you might need to restore some files from your backup. Try the hard drive and controller in another system. If the drive and controller work in another system, excessive noise or grounding problems are probably in the original system. Reinstall the drive and controller in the original system and remove all extra expansion boards. If the problem goes away, replace one board at a time and retest the system until the problem returns. The last board you inserted when the problem returned is probably the culprit. If the problem persists, there might be a ground problem on the motherboard. Try replacing the motherboard as an absolute last effort.

**Symptom 19. A "Bad or Missing Command Interpreter" error message appears** This is a typical error that appears when a drive is formatted in one DOS version, but loaded with another. Compatibility problems occur when you mix DOS versions. Start by booting the PC with a "clean" boot disk, and be sure no TSRs or drivers are being loaded. If you haven't done so already, run your anti-virus checker and be sure that there are no memory-resident or file-based viruses. Finally, be sure that the drive is partitioned and formatted with the version of DOS that you intend to use. Also be sure to use FORMAT with the /S switch, or SYS C: to transfer system files to the drive.

**Symptom 20. An "Error reading drive C:" error message appears** Read errors in a hard drive typically indicate problems with the disk media, but might also interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. Next, start the PC with a "clean" boot disk and be sure that no TSRs or drivers are being loaded. If you haven't done so already, run your anti-virus checker and be sure that there are no memory-resident or file-based viruses. Consider the drive's orientation. If problems occur after remounting the drive in a different orientation, you might need to repartition and reformat the drive, or return it to its original orientation. Also check the media—use a utility, such as ScanDisk, to check for and map out any bad sectors. Once bad sectors are mapped out, you might need to restore some files from your backup. Try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective.

**Symptom 21. A "Track 0 not found" error message appears** A fault on track 00 can disable the entire drive because track 00 contains the drive's *File Allocation Table (FAT)*. This can be a serious error, which might require you to replace the drive. Before going too far with this type of problem, check the signal connector and see that the interface signal cable is inserted properly and completely at the drive and controller. Try a new signal cable. Boot from a floppy disk and run FDISK to check the partitions on your hard drive. Be sure that there is at least one DOS partition. If the drive is to be your boot drive, the primary partition must be active and bootable. Repartition and reformat the drive, if necessary. Try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective.

**Symptom 22. Software diagnostics indicate an average access time that is longer than specified for the drive** The average access time is the average amount of time needed for a drive to reach the track and sector, where a needed file begins. Before you do anything else, check the drive specifications and verify the timing specifications for your particular drive. Start your defragmentation utility (such as COMPRESS with PC Tools or DEFRAG with DOS) and check to see the percentage of file fragmentation. If there is more than 10% fragmentation, you should consider running the defragmentation utility after preparing Windows. Also remember that different software packages measure access time differently. Be sure that the diagnostic subtracts system overhead processing from the access-time calculation. Try one or two other diagnostics to confirm the measurement. Before you panic and replace a drive, try testing several similar drives for comparison. If only the suspect drive measures incorrectly, you might not need to replace the drive itself just yet, but you should at least maintain frequent backups in case the drive is near failure.

**Symptom 23. Software diagnostics indicate a slower data transfer rate than specified** This is often because of "less-than-ideal" data-transfer rates, rather than an actual hardware failure. Enter the CMOS setup routine and verify that any enhanced data-transfer modes are enabled (such as PIO Mode 3). This can increase data transfer rate substantially. Also check the drive specifications, and verify the timing specifications for your particular drive. Check for fragmentation next. Start your defragmentation utility (such as COMPRESS with PC Tools or DEFRAG with DOS), and check to see the percentage of file fragmentation. If there is more than 10% fragmentation, you should consider running the defragmentation utility after preparing Windows. Also remember that different software packages measure access time differently. Be sure that the diagnostic subtracts system overhead processing from the access-time calculation. Try one or two other diagnostics to confirm the measurement. If the drive is an IDE/EIDE type, be sure that the original user did not perform a low-level format—this might remove head and cylinder skewing optimization and result in a degradation of data transfer. This error cannot be corrected by end-user software. Finally, if the drive is a SCSI type, be sure that the SCSI bus is terminated properly—poor termination can cause data errors and result in re-transmissions that degrade overall data-transfer rates.

**Symptom 24. The low-level format process regularly hangs up on a specific head/cylinder/sector** Notice that this procedure does not apply to IDE/ EIDE or SCSI drives. Check the hard error list. Not all portions of an ST506/412 or ESDI drive are usable. These are called *hard errors* and the low-level format procedure must recognize and avoid these hard errors. Some low-level format procedures require you to enter these hard errors manually. If you forget to enter a hard error (or enter the wrong location), the format process will stop when the hard error is encountered. Try low-level for-matting the drive again, but be sure to enter the proper hard error locations. Also check the CMOS setup and be sure that the drive parameters entered for the drive in CMOS are correct. When working on an XT (without CMOS), check that the drive-controller board is set correctly for the drive.

**Symptom 25. The FDISK procedure hangs up or fails to create or save partition record for the drive(s) You might also see an error message, such as "Runtime error."** This type of problem often indicates a problem with track 00 on the drive. Before you do anything else, check the signal connector—be sure that the interface signal cables are inserted properly and completely at the drive and controller. Try some new signal cables. Enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write pre-compensation must all be appropriate. Check with the drive maker and see if there is an alternate "translation geometry" that you can enter instead. If the BIOS support auto-detection, try "auto-detecting" the drive. Check your version of FDISK. The version of FDISK you are using must be the same as the DOS version on your boot diskette—older versions might not work. Next, run FDISK and see if any partitions are already on the drive.

If so, you might need to erase any existing partitions, then create your new partition from scratch. Remember that erasing a partition will destroy any data already on the drive. Use a utility, such as Drive Pro (from Micro House) or ScanDisk, to check the media for physical defects—especially at track 00. If the boot sector is physically damaged, you should replace the drive. Finally, check for emergency drive utilities. Some drive makers provide low-level preparation utilities, which can rewrite track 00. For example, Western Digital provides the WD_CLEAR.EXE utility. If problems still persist, replace the defective hard drive.

**Symptom 26. A "Hard disk controller failure" message appears or a large number of defects occur in the last logical partition** This is typically a CMOS setup or drive-controller problem. Enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. If the geometry specifies a larger drive, the system will attempt to format areas of the drive that don't exist—resulting in a large number of errors. If CMOS is configured correctly, the problem might be with the hard drive controller. Try a new hard-drive controller. If a new drive controller does not correct the problem, the drive itself is probably defective and should be replaced.

**Symptom 27. The high-level (DOS) format process takes too long** In al-most all cases; long formats are the result of older DOS versions. Check your DOS version. MS-DOS version 4.x tries to recover hard errors, which can consume quite a bit of extra time. You will probably see a number of "Attempting to recover allocation units" messages. Your best course is to upgrade the MS-DOS version to 6.22 (or MS-DOS 7.0 with Windows 95). Later versions of DOS abandon hard-error retries.

**Symptom 28. The IDE drive (<528MB) does not partition or format to full capacity** When relatively small hard drives do not realize their full capacity, the CMOS setup is usually at fault. The drive parameters entered into CMOS must specify the full capacity of the drive—using a geometry setup that is acceptable. If you use parameters that specify a smaller drive, any extra capacity will be ignored. If there are more than 1024 cylinders, you must use an alternate "translation geometry" to realize the full drive potential. The drive maker can provide you with the right translation geometry. Also check your DOS version—older versions of DOS use a partition limit of 32MB. Upgrade your older version of DOS to 6.22 (or MS-DOS 7.0 with Windows 95).

**Symptom 29. The EIDE drive (>528MB) does not partition or format to full capacity** This type of problem might also be caused by a CMOS setup error, but is almost always caused by poor system configuration. Check the CMOS setup for drive geometry—the drive parameters entered into CMOS must specify the full capacity of the drive. If you use parameters that specify a smaller drive, any extra capacity will be ignored. If there are more than 1024 cylinders, you must use an alternate "translation geometry" to realize the full drive potential. The drive maker can provide you with the right translation geometry.

Also check the CMOS setup for LBA. EIDE drives need Logical Block Addressing to access over 528MB. Be sure that there is an entry such as "LBA mode" in CMOS. Otherwise, you might need to upgrade your motherboard BIOS to have full drive capacity. Check the drive controller. If you cannot upgrade an older motherboard BIOS, install an EIDE drive controller with its own controller BIOS—this will supplement the mother-board BIOS. Finally, check the drive-management software. If neither the motherboard nor controller BIOS will support LBA mode, you will need to install drive-management software, such as EZ-Drive or Drive Manager from Ontrack.

**Symptom 30. "Disk boot failure," "non system disk," or "No ROM basic—SYSTEM HALTED" error messages appear** There are several possible reasons for these errors. Start by checking the signal connector. Be sure that the interface signal cables are inserted properly and completely at the drive and controller. Try some new signal cables. Boot the PC with a "clean" boot disk and be sure that no TSRs or drivers are being loaded that interferes with drive operation. If you haven't done so already, run your anti-virus checker and be sure that there are no memory-resident or file-based viruses. Next, enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track; landing zone, and write precompensation must all be entered. Boot from a floppy disk and run FDISK to check the partitions on your hard drive. Be sure that there is at least one DOS partition. If the drive is to be your boot drive, the primary partition must be active and bootable. It is also possible that the hard drive itself is defective. Try a known-good hard drive. If a known-good drive works as expected, your original drive is probably defective. If problems persist with a known-good floppy drive, replace the drive controller.

**Symptom 31. The hard drive in a PC is suffering frequent breakdowns (i.e., between 6 to 12 months)** When drives tend to fail within a few months; there are some factors to consider. Check the PC power first. If the ac power supplying your PC is "dirty" (i.e., lots of spikes and surges), power anomalies can often make it through the power supply and damage other components. Remove any high-load devices, such as air conditioners, motors, or coffee makers from the same ac circuit used by the PC, or try the PC on a known-good ac circuit. You might also consider a good-quality UPS to power your PC. Drive utilization might be another factor. If the drive is being worked hard by applications and swap files, consider upgrading RAM or adding cache to reduce dependency on the drive. Keep the drive defragmented. Periodically run a utility, such as DEFRAG, to reorganize the files. This reduces the amount of "drive thrashing" that occurs when loading and saving files. Finally, check the environment. Constant, low-level vibrations, such as those in an industrial environment, can kill a hard drive. Smoke (even cigarette smoke), high humidity, very low humidity, and caustic vapors can ruin drives. Be sure that the system is used in a stable office-type environment.

**Symptom 32. A hard-drive controller is replaced, but during initialization, the system displays error messages, such as "Hard disk failure" or "Not a recognized drive type" The PC might also lock-up.** Some drive controllers might be incompatible in some systems. Check with the controller manufacturer and see if there have been any reports of incompatibilities with your PC. If so, try a different drive-controller board.

**Symptom 33. A new hard drive is installed, but it will not boot, or a message appears, such as: "HDD controller failure"** The new drive has probably not been installed or prepared properly. Check the power connector first. Be sure that the 4-pin power connector is inserted properly and completely. If the drive is being powered by a Y-connector, be sure that any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V supply) is unusually low or absent, replace the power supply. Next, be sure that the drive's signal interface cable is connected securely at both the drive and controller. If the cable is visibly worn or damaged, try a new one. Enter the CMOS setup routine and see that all of the parameters entered for the drive are correct. Heads, cylinders, sectors per track, landing zone, and write pre-compensation must all correct; otherwise, POST will not recognize the drive. Finally, the drive might not be pre-pared properly. Run FDISK from a bootable diskette to partition the drive, and then run FORMAT to initialize the drive. Then run SYS C: to make the drive bootable.

**Symptom 34. Disk Manager is installed to a hard drive, but is formatted back to 528 MB when DOS is reinstalled** After *Disk manager* is installed, you must create a "rescue disk" to use in conjunction with your DOS installation. There are two means of accomplishing this.

First:

- Create a "clean" DOS bootable disk.
- Copy two files from the original *Disk manager* disk to your bootable disk: XBIOS.OVL and DMDRVR.BIN.
- Create a CONFIG.SYS file on this bootable disk with these three lines: DEVICE=DMDRVR.BIN FILES=35 BUFFERS=35
- Remove the bootable diskette and reboot the system.
- When you see "Press space bar to boot from diskette," do so—the system will halt.
- Insert the rescue disk in drive A: and press any key to resume the boot process.
- At the A: prompt, remove your rescue disk, insert the DOS installation disk, then type *SETUP*.
- You will now install DOS files without overwriting the *Disk manager* files. or:
- Create a "clean" DOS bootable disk.

- Insert the original *Disk manager* diskette in the A: drive and type: DMCFIG/D=A:
- You will prompted to inert a bootable floppy in drive A:.
- You will need to remove and insert the bootable disk a few times as *Drive manager f*iles are copied.
- Remove the floppy and reboot the system
- When you see "Press space bar to boot from diskette," do so—the system will halt.
- Insert the rescue disk in drive A: and press any key to resume the boot process.
- At the A: prompt, remove your rescue disk, insert the DOS installation disk, then type *SETUP*.
- You will now install DOS files without overwriting the *Disk manager* files.

**Symptom 35. ScanDisk reports some bad sectors, but cannot map them out during a surface analysis** You might need a surface-analysis utility (provided by the drive maker) for your particular drive. For example, Western Digital provides the WDATIDE.EXE utility for its Caviar series of drives. It will mark all "grown" defects, and compensate for lost capacity by utilizing spare tracks.

**Symptom 36. The drive will work as a primary drive, but not as a secondary (or vice versa)** In most cases, the drive is simply jumpered incorrectly, but it might also have timing problems. Check the drive jumpers first. Be sure that the drive is jumpered properly as a primary (single drive), primary (dual drive), or secondary drive. These types of surface-analysis utilities are typically destructive. Be sure to have a complete backup of the drive before proceeding. Also, the utility might take a very long time to run, depending on your drive's capacity. The drive-signal timing might also be off. Some IDE/EIDE drives do not work as primary or secondary drives with certain other drives in the system. Reverse the primary/secondary relationship. If the problem persists, try the drives separately. If the drives work individually, there is probably a timing problem, so try a different drive as the primary or secondary.

**Symptom 37. 32-bit access does not work under Windows 3.1x** You are probably not using the correct hard drive driver. Check your EIDE BIOS. If your motherboard (or drive controller) BIOS supports LBA, obtaining a driver should be easy. The drive maker either provides a 32-bit driver on a diskette accompanying the drive or a driver can be downloaded from the drive maker's BBS or Internet Web site. If the motherboard (or drive controller) does not support LBA directly, you can install Ontrack's Disk Manager (6.03 or later) and run DMCFIG to install the 32-bit driver software.

**Symptom 38. Drive diagnostics reveal a great deal of wasted space on the drive** You probably have a large drive partitioned as a single large logical volume. Check the cluster size (Table 6-6 shows a comparison of partition size vs. cluster size). If you deal with large numbers of small files, it might be more efficient to create multiple smaller partitions utilizing smaller clusters.

**Symptom 39. A Y-adapter fails to work** Some Y-adapters are incorrectly wired, and can cause severe damage to any device attached to it. Examine the power connector first. Be certain that both of the female connectors are lined up with the two chamfered (rounded) corners facing up and both of the squared corners facing down. The four wires attached to the female connectors should now be in the following order from left to right: Yellow (12 V), Black (ground), Black (ground), and Red (5 V). If this order is reversed on one of the connectors, then your Y power adapter is faulty and should not be used.

**Symptom 40. During the POST, the drive begins to spin-up and produces a sharp noise** This problem has been encountered with some combinations of drives, motherboards, and motherboard BIOS. This type of problem can easily result in data loss (and media damage). Check the motherboard BIOS version first, then contact the PC system manufacturer and see if a BIOS upgrade is necessary. Try a BIOS upgrade. Otherwise, replace the drive controller. Often, a new drive controller might resolve the problem if the motherboard BIOS cannot be replaced.

**Symptom 41. Opening a folder under Windows 95 seems to take a long time** When you open a folder in Microsoft Explorer on a drive using the FAT32 file system, it might seem to take an unusually long time before the window is accessible or the "working in the background" pointer might appear for prolonged periods. This is a typical sign of FAT 32 problems under Windows 95, and is usually because the total space used by all directory entries in the particular folder exceeds 32KB. Until Microsoft provides a fix for their service release, you should simply move some files in the overloaded folder to a different folder.

**Symptom 42. The hard drive is infected by a bootblock virus** You might detect the presence of a bootblock virus (a virus that infects the MBR) by running an antivirus utility, or receiving a warning from the BIOS bootblock-protection feature. In every case, you should attempt to use the anti-virus utility to eradicate the virus. You might also remove a bootblock virus by using "FDISK /MBR" (although that could render the con-tents of your disk inaccessible). If you're using drive overlay software, such as Disk Manager, you can usually re-write the code through the "Maintenance Menu" within the *Disk manager* program itself.

**Symptom 43. An "Incorrect DOS version" error appears** You attempted to execute an external DOS command (i.e., FORMAT) using a version of the utility, which is not from the same DOS version as the COMMAND.COM file, which is currently running. Reboot with a corresponding version of COMMAND.COM, or get a version of the utility, which matches the current version of COMMAND.COM.

## SCSI

Even the best-planned SCSI setups go wrong from time to time, and SCSI systems already in the field will not run forever. Sooner or later, you will have to deal with a SCSI problem. This part of the chapter is intended to show you a variety of Symptoms and solutions for many of the problems that you will likely encounter.

**Symptom 1. After initial SCSI installation, the system will not boot from the floppy drive You might see an error code corresponding to this problem.** Suspect the SCSI host adapter first. An internal fault with the adapter might be interfering with system operation. Check that all of the adapter's settings are correct and that all jumpers are intact. If the adapter is equipped with any diagnostic LEDs, check for any problem indications. When adapter problems are indicated, replace the adapter board. If a SCSI hard drive has been installed and the drive light is always on, the SCSI signal cable has probably been reversed between the drive and adapter. Be sure to install the drive cable properly. Check for the SCSI-adapter BIOS message generated when the system starts. If the message does not appear, check for the presence of a ROM-address conflict between the SCSI adapter and ROMs on other expansion boards. Try a new address setting for the SCSI adapter. If a BIOS wait-state jumper is on the adapter, try changing its setting. If you see an error message indicating that the SCSI host adapter was not found at a particular address, check the I/O setting for the adapter.

Some more-recent SCSI host adapters incorporate a floppy controller. This can cause a conflict with an existing floppy controller. If you choose to continue using the existing floppy controller, be sure to disable the host adapter's floppy controller. If you'd prefer to use the host adapter's floppy controller, remember to disable the pre-existing floppy controller port.

**Symptom 2. The system will not boot from the SCSI hard drive** Start by checking the system's CMOS setup. When SCSI drives are installed in a PC, the corresponding hard drive reference in the CMOS setup must be changed to "none" or "not in-stalled" (this assumes that you will not be using IDE/EIDE hard drives in the system). If previous hard-drive references have not been "mapped out," do so now, save the CMOS setup, and reboot the PC. If the problem persists, check that the SCSI boot drive is set to ID 0. You will need to refer to the user manual for your particular drive to find how the ID is set. Next, check the SCSI parity to be sure that it is selected consistently among all SCSI de-vices.

Remember that all SCSI devices must have SCSI parity enabled or disabled—if even one device in the SCSI chain does not support parity, it must be disabled on all devices. Check the SCSI cabling to be sure that all cables are installed and terminated properly. Finally, be sure that the hard drive has been partitioned and formatted properly. If not, boot from a floppy disk and prepare the hard drive, as required, using FDISK and FORMAT.

**Symptom 3. The SCSI drive fails to respond with an alternate HDD as the boot drive** Technically, you should be able to use a SCSI drive as a non-boot drive (e.g., drive D:) while using an IDE/EIDE drive as the boot device. If the SCSI drive fails to respond in this kind of arrangement, check the CMOS setting to be sure that drive 1 (the SCSI drive) is "mapped out" (or set to *None* or *Not installed*). Save the CMOS setup and reboot the PC. If the problem persists, check that the SCSI drive is set to SCSI ID 1 (the non-boot ID). Next, be sure that the SCSI parity is enabled or disabled consistently throughout the SCSI installation. If the SCSI parity is enabled for some devices and disabled for others, the SCSI system might function erratically. Finally, check that the SCSI cabling is installed and terminated properly. Faulty cables or termination can easily interrupt a SCSI system. If the problem persists, try another hard drive.

**Symptom 4. The SCSI drive fails to respond with another SCSI drive as the boot drive** This typically occurs in a dual-drive system using two SCSI drives. Check the CMOS setup and be sure that both drive entries in the setup are set to "none" or "not installed." Save the CMOS setup. The boot drive should be set to SCSI ID 0 while the supplemental drive should be set to SCSI ID 1 (you will probably have to refer to the manual for the drives to determine how to select a SCSI ID).

The hard drives should have a DOS partition and format. If not, create the partitions (FDISK) and format the drives (FORMAT) as required. Check to be sure that SCSI parity is enabled or disabled consistently throughout the SCSI system. If some devices use parity and other devices do not, the SCSI system might not function properly. Be sure that all SCSI cables are installed and terminated properly. If the problem persists, try systematically exchanging each hard drive.

**Symptom 5. The system works erratically The PC hangs or the SCSI adapter cannot find the drive(s).** Such intermittent operation can be the result of several different SCSI factors. Before taking any action, be sure that the application software you were running when the fault occurred did not cause the problem. Unstable or buggy software can seriously interfere with system operation. Try different applications and see if the system still hangs up (you might also try any DOS diagnostic utilities that accompanied the host adapter). Check each SCSI device and be sure that parity is enabled or disabled consistently throughout the SCSI system. If parity is enabled in some devices and disabled in others, erratic operation can result. Be sure that no two SCSI devices are using the same ID.

Cabling problems are another common source of erratic behavior. Be sure that all SCSI cables are attached correctly and completely. Also check that the cabling is properly terminated.

Next, suspect that a resource conflict might be between the SCSI host adapter and another board in the system. Check each expansion board in the system to be sure that nothing is using the same IRQ, DMA, or I/O address as the host adapter (or check the *Device manager* under Windows 95). If you find a conflict, you should alter the most recently installed adapter board. If problems persist, try a new drive adapter board.

**Symptom 6. A 096xxxx error code appears** This diagnostic error code indicates a problem in a 32-bit SCSI host adapter board. Check the board to be sure that it is installed correctly and completely. The board should not be shorted against any other board or cable. Try disabling one SCSI device at a time. If normal operation returns, the last device to be removed is responsible for the problem (you might need to disable drivers and reconfigure termination when isolating problems in this fashion). If the problem persists, remove and re-install all SCSI devices from scratch, or try a new SCSI adapter board.

**Symptom 7. A 112xxxx error code appears** This diagnostic error code indicates that a problem is in a 16-bit SCSI adapter board. Check the board to be sure that it is installed correctly and completely. The board should not be shorted against any other board or cable. Try disabling one SCSI device at a time. If normal operation returns, the last device to be removed is responsible for the problem (you might need to disable drivers and reconfigure termination when isolating problems in this fashion). Try a new SCSI host-adapter board.

**Symptom 8. A 113xxxx error code appears** This diagnostic code indicates that a problem is in a system (motherboard) SCSI adapter configuration. If a SCSI BIOS ROM is installed on the motherboard, be sure that it is up-to-date and installed correctly and completely. If problems persist, replace the motherboard's SCSI controller IC or replace the system board. It might be possible to circumvent a damaged motherboard SCSI controller by disabling the motherboard's controller, then installing a SCSI host adapter card.

**Symptom 9. A 210xxxx error code appears A fault is in a SCSI hard disk.** Check that the power and signal cables to the disk are connected properly. Be sure that the SCSI cable is correctly terminated. Try repartitioning and reformatting the SCSI hard disk. Finally, try a new SCSI hard disk.

**Symptom 10. A SCSI device refuses to function with the SCSI adapter—even though both the adapter and device check properly** This is often a classic case of basic incompatibility between the device and host adapter. Even though SCSI-2 helps to streamline compatibility between devices and controllers, the two just don't work together in some situations.

Check the literature included with the finicky device and see if any notices of compatibility problems are included with the controller (perhaps the particular controller brand) you are using. If warnings are included, alternative jumpers or DIP switch settings might be included to compensate for the problem and allow you to use the device after all. A call to technical support at the device's manufacturer might help shed light on any recently discovered bugs or fixes (e.g., an updated SCSI BIOS, SCSI device driver, or host adapter driver). If problems remain, try using a similar device from a different manufacturer (e.g., try a Connor tape drive instead of a Mountain tape drive).

**Symptom 11. A "No SCSI controller present" error message appears** Immediately suspect that the controller is defective or installed improperly. Check the host adapter installation (including IRQ, DMA, and I/O settings) and see that the proper suite of device drivers has been installed correctly. If the system still refuses to recognize the controller, try installing it in a different PC. If the controller also fails in a different PC, the controller is probably bad and should be replaced. However, if the controller works in a different PC, your original PC might not support all the functions under the interrupt 15h call required to configure SCSI adapters (such as an AMI SCSI host adapter). Consider upgrading the PC BIOS ROM to a new version—especially if the PC BIOS is older. An upgraded SCSI BIOS or host adapter driver might be available to compensate for this problem.

**Symptom 12. The PCI SCSI host adapter is not recognized and the SCSI BIOS banner is not displayed** This often occur when installing new PCI SCSI host adapters. The host computer must be PCI REV. 2.0 compliant and the motherboard BIOS must support PCI-to-PCI Bridges (PPB) and bus mastering. This is typically a problem (or limitation) with some older PCI motherboard chipsets, and you'll probably find that the PCI SCSI adapter board works just fine on newer systems. If the system doesn't support PPB, it might not be possible to use the PCI SCSI adapter. You can try an ISA SCSI adapter instead or upgrade the motherboard to one with a more recent chipset. If the system hardware does offer PPB support and the problem persists, the motherboard BIOS might still not support PPB features as required by the PCI 2.0 standard. In this case, try a motherboard BIOS upgrade if one is available. If the problem continues, either the board is not in a bus-mastering slot, or the PCI slot is not enabled for bus mastering. Configure the PCI slot for bus mastering through CMOS setup or through a jumper on the motherboard (check your system's documentation to see exactly how).

**Symptom 13. During boot-up, a "Host-adapter configuration error" message appears** In virtually all cases, the problem is with the PCI slot configuration for the SCSI host adapter. Try enabling a IRQ for the SCSI adapter's PCI slot (usually accomplished through the CMOS setup). Be sure that any IRQ being assigned to the SCSI adapter PCI slot is not conflicting with other devices in the system.

**Symptom 14. An error message, such as "No SCSI functions in use," appears Even when a SCSI adapter and devices are installed and configured properly,** there are several possible causes for this kind of an error. First, be sure that no hard-disk drivers are installed when no physical SCSI hard disks are in the system. Also be sure that there are no hard disk drivers installed (i.e., in CONFIG.SYS) when the SCSI host-adapter BIOS is enabled. HDD drivers aren't needed then, but you could leave the drivers in place and disable the SCSI BIOS. Finally, this error can occur if the HDD was formatted on another SCSI controller that does not support ASPI, or uses a specialized format. For example, Western Digital controllers only work with Western Digital HDD's. In this case, you should try a more generic controller.

**Symptom 15. An error message, such as "No boot record found," appears** This generally simple problem can be traced to several possible issues. First, chances are that the drive has never been partitioned (FDISK) or formatted as a bootable drive (FORMAT). Repartition and reformat the hard drive. If you partitioned and formatted the drive with a third-party utility (e.g., TFORMAT), be sure to answer *Y*, if asked to make the disk bootable. A third possibility can occur if the disk was formatted on another manufacturer's controller. If this is the case, the only alternative might be to repartition and reformat the drive again on your current controller.

**Symptom 16. An error, such as "Device fails to respond—No devices in use. Driver load aborted," appears** In most cases, the problem is something simple, such as the SCSI device not being turned on or cabled correctly. Verify that the SCSI devices are on and connected correctly. In other cases, the SCSI device is on, but fails the INQUIRY command—this happens when the SCSI device is defective or not supported by the host adapter. The device might need default jumper settings changed (i.e., the drive should spin up and come ready on its own). You might find that the SCSI device is sharing the same SCSI ID with another device. Check all SCSI devices to verify that each device has separate SCSI ID. You might have the wrong device driver loaded for your particular device type. Check config.sys to be sure the correct driver is loaded for the drive type (e.g., TSCSI.SYS for a hard disk, not a CD-ROM).

**Symptom 17. An error, such as "Unknown SCSI device" or "Waiting for SCSI device," appears** The SCSI hard disk has failed to boot as the primary drive— check that the primary hard disk is set at SCSI ID 0. Be sure that the drive is partitioned and formatted as the primary drive. If necessary, boot from a floppy with just the ASPI manager loaded in CONFIG.SYS (and no other drivers), then format the drive. It might also be that the SCSI cable termination is not correct (or TERMPWR is not provided by the hard disk for the host adapter). Verify the cable terminations and the TERMPWR signal.

**Symptom 18. An error, such as "CMD failure XX," appears** This typically occurs during the format process—the "XX" is a vendor-specific code (and you'll need to contact the vendor to determine what the error means). The most common problem is trying to partition a drive that is not low-level formatted. If this is the case, run the low-level format utility that accompanied the SCSI drive, then try partitioning again. If you're suffering a different error, you might need to take other action, depending on the nature of the error.

**Symptom 19. After the SCSI adapter BIOS header appears, a message, such as "Checking for SCSI target 0 LUN 0," appears** The system pauses about 30 seconds, then reports "BIOS not installed, no INT 13h device found." The system then boots normally. In most cases, the BIOS is trying to find a hard drive at SCSI ID 0 or 1, but no hard drive is available. If you do not have a SCSI hard drive attached to the host adapter, then it is recommended that the SCSI BIOS be disabled.

**Symptom 20. The system hangs up when the SCSI BIOS header appears** This is usually caused by a terminator problem. Be sure that the SCSI devices at the end of the SCSI chain (either internally or externally) are terminated. Check all device IDs to be sure that they are unique, and also check for system resource conflicts (e.g., BIOS address, I/O address, and interrupts). You might also need to disable the Shadow RAM feature in the CMOS setup.

**Symptom 21**. **The SCSI BIOS header is displayed during system startup, then the message appears: "Host adapter diagnostic error"** The card either has a port-address conflict with another card or the card has been changed to port address 140h and the BIOS is enabled. Some SCSI host adapters are able to use the BIOS under port address 140h, so check for I/O conflicts. You might need to reconfigure the SCSI host adapter.

**Symptom 22**. **When a VL bus SCSI adapter is installed, the system hangs at startup** Chances are that the VL SCSI adapter is a bus-mastering device and requires that the VL slot support full 32-bit bus mastering. Most VL bus systems have either "slave" slots and/or "master" slots. The SCSI adapter must be inserted into a "master" slot. If you are not sure if the system supports bus mastering or if you have a master slot, contact the system manufacturer. Also, the slot that the SCSI VL card is inserted into must be a 5-Vdc slot that operates at 33MHz or less. The VL bus speed is typically set through a jumper on the motherboard. It should be set in the *<=33MHz* position. The motherboard might also need to be set for write-through caching. This might be set in the motherboard's CMOS setup utility or it might be configured via a jumper on the motherboard (if both a CMOS setting and a jumper are used, be sure that both are set the same way).

**Symptom 23. When upgrading a VL bus system CPU to a faster model, the system locks up with a SCSI VL card installed, or it won't boot from the SCSI HDD** Most likely a DMA or other timing discrepancy is between the SCSI adapter and the VL local bus. The SCSI adapter probably works fine on VL bus systems running up to 33MHz. Faster CPUs can increase the VL bus speed beyond 33MHz. Above this 33MHz speed, variations in motherboard, chipset, or CPU design might cause the SCSI adapter to function intermittently or to fail. In some cases, this problem can be resolved:

- The motherboard might have jumpers that govern the VL bus speed—be sure that the VL bus-speed jumper is set in the *<=33MHz* position.
- This might also be set in the motherboard's CMOS setup.
- In the CMOS setup, you can disable the CPU external cache or change the caching method to write-through instead of write-back.
- The internal cache on some CPUs might also cause the VL SCSI adapter to hang. Try disabling the CPU's internal cache.
- Reducing the CPU speed might be necessary to allow the SCSI adapter to function reliably.
- Try disabling the system's "turbo setting" during the boot-up sequence, then re-enable the turbo setting after the system has booted.

**Symptom 24. The VL SCSI adapter won't work with an "SLC" type** CPU VL SCSI adapters often refuse to run with "SLC" type CPUs because the SLC uses 16-bit architecture, rather than 32-bit at the VL bus. Some VL SCSI adapters will run in this configuration, but it is rare. Use an ISA SCSI adapter instead of a VL adapter in this circumstance.

**Symptom 25. When running the Qualitas 386MAX memory-manager software on ISA or VL systems with an SCSI host adapter, the system crashes when booting** 386MAX is known to cause problems with SCSI systems, and you'll need to adjust the 386MAX command line. Do not allow 386MAX to load during boot up, then include the key NOIOWRAP on the 386MAX command line. This will allow you to boot with 386MAX loaded.

**Symptom 26. When installing an EISA SCSI adapter and running the EISA configuration utility, you see an "EISA configuration slot mismatch" or "board not found in slot x" error** This error occurs because your board is not completely seated in the EISA slot. You can verify this by booting to a floppy diskette, and running the DOS Debug command. After typing Debug, you will receive the debug prompt (a dash). Then type "i (space) Xc80" where "X" is the EISA slot where your board is physically installed. If a "04" is returned, the board is correctly seated and the problem lies elsewhere. If "FF" is returned, the board needs to be pushed down further. Power down your system before re-seating your board.

**Symptom 27. An EISA SCSI adapter can't be configured in enhanced mode You get the error: "Unable to initialize Host Adapter" or the system hangs after the SCSI BIOS scans the SCSI devices.** These errors are usually limited to motherboards that do not support LEVEL INT triggering. These chipsets (such as the Hint and SIS) require a few modifications be made to the host adapter's EISA configuration (.CFG) file. Make the following changes to the ADP000X.CFG file:
CHOICE = "Enhanced Mode" FREE
INT=IOPORT (1) LOC (7 6 2 1 0) 10000B
LINK
IRQ=11|12|10|15|14|9
SHARE = "AHA-1740" (Change to: SHARE = NO)
TRIGGER = LEVEL (Change to: TRIGGER = EDGE)
INIT=IOPORT (3) LOC (4 3 2 1 0) 10010B | 10011B | 10001B | 1010B | 10101B | 10000B
(Change first zero in each binary number to a one: Example: 10010B = 11010B) Another option is to download the latest .CFG file for your SCSI adapter card (i.e., ASWC174.EXE). Reconfigure the card with new .CFG file and select edge-triggered IRQ.

## Troubleshooting a Drive Adapter

A properly configured drive adapter will rarely cause problems in a PC because BIOS, IRQ, and I/O assignments are very strongly established in the PC industry. However, variety problems can plague drive adapter replacements and upgrades. This part of the chapter looks at troubleshooting for ESDI and IDE/EIDE drive systems.

**Symptom 1. The drive adapter software will not install properly:** When installing or upgrading drive-controller software, it is not uncommon to encounter problems—usually because of the many advanced features of the drive controller itself. If you cannot get new software installed, try the following steps to overcome the problem. First, you should start the CMOS setup and disable the high-performance features usually related to drive controllers: "IDE Block Mode," "Multi-Sector Transfer," and "32-bit Disk Access." If there are other options for the secondary drive controller channel, try disabling them as well. You might also try moving the controller BIOS address range (i.e., change the address range from C800h to CF00h). If you still cannot get the controller software installed, there might also be trouble with "overlay software" (such as On track's Disk Manager or EZ-Drive software) used to partition and format a drive. You might need to uninstall the overlay software and update the CMOS setup by enabling LBA support for the drive. If you can't uninstall the overlay software, you can run FDISK /MBR to overwrite the overlay software. Once the overlay. software is removed, repartition and reformat the drive. If you cannot wipe the drive clean, check with the drive manufacturer for such a utility. You should now be able to in-stall the new drive software.

**Symptom 2. The controller will not support a drive with more than 1024 cylinders.** This often happens when building a new system, or piecing together a system from used parts. To support a drive with more than 1024 cylinders, the controller must support a feature called *Logical Block Addressing (LBA*), and the feature must be enabled. The controller's on-board BIOS should support LBA, but you might need to install a driver for the controller to support LBA (for example, a Promise Technology controller needs the DOSEIDE.SYS driver to support LBA). If the controller is integrated onto the motherboard, the motherboard BIOS must support LBA. If not, you'll need to upgrade the motherboard BIOS or install a drive adapter with an LBA-aware BIOS. Second, the hard drive itself must support LBA. Be sure that the drive is an EIDE hard drive. Finally, check the CMOS setup and verify that the drive is using the LBA mode, rather than the older CHS mode. You might need to repartition and reformat the hard drive.

**Symptom 3. Loading a disk driver causes the system to hang or generate a "Bad or missing COMMAND.COM" error** This is a known problem with some versions of the DTC DTC22XX.SYS or DOSEIDE.SYS drivers, but frequently occurs with other controller makers that use disk drivers. The controller is probably transferring data too fast to the drive. When the disk driver loads, it obtains information from the drive—including drive speed. Sometimes the drive reports that it can support PIO mode 4 or PIO mode 3 when, in actuality, it cannot. In many cases, the original drivers are outdated, and the immediate solution is to slow down the data-transfer rate manually. Download and install the newest drivers—until then, you might be able to add a command line switch to the disk driver. For example, DTC recommends adding a switch to their DOSEIDE.SYS driver, such as: DOSEIDE.SYS /v /dx:m0 /dx:p0 where *x* is the drive designation. If your problems started after loading the disk drivers "high" (into the upper memory area), adjust CONFIG.SYS to load the drivers into conventional memory. Some drive adapters have reported better success with driver software when the "Hidden Refresh" feature is enabled in CMOS setup (in the *Advanced CMOS setup* area). This alters the way in which the system timing refreshes RAM, and it can better support the disk drivers. Also try disabling advanced controller options, such as *IDE block mode*, *Multi-sector transfer*, and *32-bit disk access*. Finally, if you're using overlay software (such as *Disk Manager*), the disk driver might not work with the overlay software. You'll then need to remove the overlay software, and repartition and reformat the drive before the disk driver will work.

**Symptom 4. Drive performance is poor—data transfer rates are slow** This often happens when installing a replacement drive controller. First, be sure that This step is destructive to any data on the drive. Be sure to make a complete system backup (and have a bootable diskette on hand) before removing the overlay software. You're not running any anti-virus software. Anti-virus utilities that load at boot time can degrade drive performance. If the controller uses a "speed" jumper, be sure that you have properly configured the jumper settings on card to match speed of the IDE drive and processor (this is a known issue with DTC's 2278VL and 2270 controllers).

Also be sure that the highest possible data-transfer rate is selected in the CMOS setup (i.e., PIO Mode 4). If the drive adapter uses a disk driver for optimum performance, be sure that the correct disk driver software is loaded, and enter any necessary command-line switches. Finally, remove any third-party software (such as Disk Manager or EZ-Drive) that might have shipped with the drive itself.

**Symptom 5. The PC refuses to boot after a drive adapter is installed** There are many possible reasons for this kind of problem. First, be sure that the drive adapter is installed properly and completely into its bus slot, then verify that the drive signal cables are oriented and attached properly. If the drive adapter uses jumpers to match the drive and processor speeds (such as the DTC 2278VL or 2270), be sure that the adapter is configured correctly. Verify that the drive itself is properly jumpered as a "master" or "slave." Finally, check the CMOS setup and confirm that the proper drive parameters are being used. Try disabling such advanced features as *IDE block mode* and *32-bit disk acces*s. If the problem still persists, try repartitioning and reformatting the drive.

**Symptom 6. Windows generates a "Validation Failed 03,3F" error** This type of problem most frequently occurs after loading the Windows disk driver, and it is almost always caused by a 1024-cylinder limit in the drive system. Be sure that the drive and drive controller are able to support more than 1024 cylinders (both EIDE). Check the CMOS setup and verify that the LBA mode is selected. Once the proper hardware is configured correctly, try reinstalling the disk driver.

**Symptom 7. Windows hangs or fails to load files after loading the EIDE driver** In most cases, Windows hangs, or every file after the offending driver is unable to load. In some cases, you might see an error message, such as: "Can not find KRN.386." Load SYSTEM.INI into a text editor and move the EIDE driver (e.g., WINEIDE.386) to the last line in the [386enh] section. Also be sure that the classic WDCTRL driver is commented out such as: device=*WDCTRL If problems persist the EIDE driver might be old or buggy. Download and install the newest disk driver version from the controller maker. If all else fails, disable the block mode and mode speed using the driver's internal switches. For example, the WINEIDE.386 driver provides the switch WINEIDESWITCH, which you can use as: device=wineide.386 wineideswitch = /dx:m0 /dx:p0

**Symptom 8. After replacing a drive adapter with a different model, the hard drive is no longer recognized** This can happen frequently with ESDI drives and controllers. You will find that the format tracks are not the same from one drive manufacturer to another. For the new drive adapter card to recognize an existing drive, you'll have to perform a new low-level format of the drive with the new card in place using the DEBUG formatter in BIOS. Afterward, you'll need to repartition and reformat the drive with FDISK and FORMAT. Reinstall the original controller and perform a complete system backup before continuing.

**Symptom 9. A fatal error is generated when running DEBUG** In most cases, you're using disk controllers with older BIOS, which does not support later DOS versions of DEBUG A classic example of this problem is a "Fatal error 01h" when running DOS 5.0 or 6.x DEBUG with a DTC 6280 ESDI disk controller. To resolve this problem, use the DOS DEBUG utility from DOS 3.3 or 4.0. Once this is complete, reboot the system with DOS 5.0 or 6.x and continue on with the DOS FDISK and DOS FORMAT.

**Symptom 10. Trouble occurs when formatting ESDI drives over 670MB using an older drive adapter** Errors are generated during the low-level format process. This is often a limitation of the drive adapter itself. For example, the DTC 6280 only handles drives up to 10Mbits/s, but most ESDI drives over 400MB run faster than 10Mbits/s. If you try a newer controller, or upgrade the controller BIOS, you might be able to overcome this limitation.

**Symptom 11. When low-level ESDI formatting, a "Fatal error R/W head" message appears You might also encounter a situation where you cannot get the full capacity of the ESDI drive**. This common error occurs if the drive has been formatted with another manufacturer's drive controller. You'll need to go back into DEBUG and update the drive's defect table. You'll be asked: "Do you want to update defect table?." Answer, "Yes" and delete the defects that are currently in the defect table. Once this is complete, add (Append) two new defects: head 0, cylinder 100, bit length & byte offset = 1, the second defect will be: head 1, cylinder 100, bit length & byte offset = 1. Once this is complete, continue on with the low-level format, then repartition and reformat the drive.

**Symptom 12. After installing a new ESDI drive adapter, you cannot install Novell** When you low-level format the ESDI drive, do not use the "head mapping" mode if your operating system is going to be Novell. Also do not use the "head mapping" mode if your ESDI drive is greater than 528MB. Now under DOS, you won't see the full capacity of the drive, but you're only going to create a small DOS partition anyway—Novell will recognize the full capacity of the hard drive. Use the driver that is built into the Novell operating system (called *ISADIS*K, and load it with a "/b" switch). The "/b" tells Novell that the controller card has an onboard BIOS, and Novell will know where to get drive parameters.

**Symptom 13. System problems occur after installing a VL drive adapter** It is quite common for a combination of components on VL-bus systems to exceed the tolerance limits for that specific motherboard. VL-bus noise generated by the motherboard chipset can easily contribute to floppy, floppy tape, and other drive failures. This might cause the system to hang on boot up and render it unable to access the hard drive. VESA video and controller cards also contribute to the load on the VL-bus. If the load on the VL-bus for a given motherboards is too high, then you will see compatibility problems with VESA video cards, intermittent system crashes, and HDD controller failures.

In some cases, upgrading the disk controller to a later revision VL board, which causes less loading and signal issues may provide a proper solution. For an immediate solution, try rearranging the VL devices or slowing the VL bus speed to stabilize VL-bus operation.

**Symptom 14. You cannot enable 32-bit disk access under Windows 3.1x** In most cases, you are using the wrong protected-mode driver, or the driver should be upgraded with a newer version. Download and install the latest disk drivers for your drive adapter. Before installing the new driver(s), be sure to disable advanced data-transfer features, such as *IDE block mode* and *32-bit disk access* (if enabled). Load SYSTEM. INI into a text editor. Be sure that the protected-mode disk driver is installed under the [386enh] section, and verify that the WDCTRL driver is remarked out. Many Windows drivers will not support an IBMSLC2 processor or Ontrack's Disk Manager, and will not work with 32-bit disk access.

**Symptom 15. The EIDE drive adapter's secondary port refuses to work If the drive adapter has a secondary drive channel, that secondary channel is not working.** In many cases, this type of problem occurs when the drive adapter relies on a disk driver for proper operation—often the secondary channel must be enabled specifically through the disk driver's command line in CONFIG.SYS such as: DEVICE=DOSEIDE.SYS /V /2 Be sure that the drive attached to the secondary channel is jumpered as the "master" drive, and verify that the signal cable between the drive and controller is oriented properly. Also remember that a secondary drive channel requires a unique interrupt (usually IRQ 15). Be sure that no hardware conflict occurs between the secondary port's IRQ and other devices in the system. Try disabling such advanced data-transfer features as *IDE block mode* and *32-bit disk acces*s. If your hard drive is an older IDE drive, it might not support Multi-Sector Transfer. Try disabling *Multi-sector transfer* in the CMOS setup, or by adding the necessary command line switch to the disk driver command line in CONFIG.SYS, such as: DEVI CE=DOSEIDE.SYS /V /2 /D0:M0

**Symptom 16. The drive adapter's BIOS doesn't load** First, be sure that the BIOS is enabled (usually through a jumper on the drive adapter), and see that the BIOS IC is seated correctly and completely in its socket on the drive adapter. If problems persist, try changing the BIOS address—it's probably conflicting with another BIOS in the system. Also check the IRQ and I/O port assignments for the drive adapter for possible conflicts. If all else fails, try another drive controller.

**Symptom 17. The drive adapter BIOS loads, but the system hangs up** First be sure that the drive parameters are set properly in the CMOS setup. Inexperienced users frequently mistake the parameters for a second drive in CMOS with a drive on the secondary channel. When no drive is in the primary *Slave* position, the second drive should be *None* or *Not installe*d. If you have an onboard drive controller, be sure to disable it—otherwise, you'll have a hardware conflict between the two drive controllers.

Check the individual drives attached to the controller and verify that each drive is jumpered as a unique "master" or "slave" device (try reversing the drive order or working with only one drive). Finally, try disabling some of the advanced drive performance parameters in CMOS, such as *IDE block mod*e.

**Symptom 18. The ATAPI CD-ROM is not recognized as the "slave" device versus an EIDE "master"** First, verify that the CD-ROM is ATAPI compatible and suitable for use on an IDE/EIDE interface. Second, be sure that the proper low-level ATAPI driver for the CD-ROM drive is in use. If the driver is old, try downloading and installing the newest version of the driver. If problems persist, the trouble is probably due to a fast EIDE device co-existing with a slower IDE ATAPI device. Reconfigure the CD-ROM as the "master" device on the secondary drive controller channel. You might need to update the ATAPI driver command line.

**Symptom 19. Hard drives are not recognized on the secondary drive controller channel** Be sure that all the hard drives are jumpered correctly. If only one drive is on the secondary channel, it should be configured as the "single" or "master" drive. If two drives are on the secondary channel, verify that the drives are jumpered as "master" and "slave." If the drive adapter uses a disk driver to support EIDE or secondary-channel operation, be sure that the command line in CONFIG.SYS uses the correct switch(s) to enable the secondary drive channel. For example, the Promise Technologies 2300 would add an /S switch to the command line such as: device=c:\eide2300\eide2300.sys /S Check that your system's power-management features are not enabled on IRQ 15 (and confirm that no other devices are conflicting with IRQ 15). If the drive is set to "auto configure" in the CMOS setup, try entering the drive's parameters specifically (the drive might be too old to understand the *Identify Drive Command (IDC)* needed for auto configuration. Finally, try booting the system "clean" (with just disk-driver software, if necessary) to see if there are any other driver or TSR conflicts.

**Symptom 20. The drive adapter can only support 528MB per disk** First, be sure that the LBA mode is enabled—this is often accomplished through the CMOS setup, but it may also be necessary to enable an LBA support jumper on some older EIDE drive adapters. If problems persist, the drive adapter's BIOS is probably too old, and should be upgraded to a new version. If you cannot upgrade the drive-adapter BIOS, install a new drive adapter outright.

**Symptom 21. You get a "code 10" error relative to the drive adapter** You notice that Windows 95 is running in MS-DOS compatibility mode, and the system only boots in *Safe mod*e. You'll probably find one or more devices (including the drive adapter) marked with a yellow exclamation. Disk-overlay software (such as Disk Manager, EZ-drive, or Max Blast) will often cause problems when used in conjunction with drive adapters that use their own disk-driver software. The disk overlay must be removed before installing the adapter's disk drivers.

Remove the overlay software or simply repartition and reformat the drive (remember to do a complete backup before repartitioning). Next, remove or disable any 32-bit disk drivers previously installed under Windows.

With Promise Technology drive adapters, you'll probably see the following under SYSTEM.INI:
[386enh] device=*int13;device=*wdctrl
;device=c:\windows\system\eide2300.386 (for eide2300plus)
;device=ontrackw.386
;device=c:\windows\system\pti13.386 (for the 4030)
;device=c:\windows\system\ptictrl.386 (for the 4030)
;device=wdcdrv.386
;device=c:\windows\system\maxi13.386 (for the eidemax)
;device=c:\windows\system\maxctrl.386 (for the eidemax)
32bitdiskaccess=off

There might also be a DMA conflict. Some drive adapters take advantage of DMA when the parallel port is in the ECP mode (the conflict occurs most often with the sound board). To find out which devices use DMA, open the *Control pane*l, double-click on the *System* icon, select *Device manage*r, and double-click on *Compute*r. Choose *Direct memory access*. You can then either switch the controller's use of DMA or disable it altogether. You might need to alter the DMA setting on the drive controller itself, and then switch the parallel port's mode to EPP.

**Symptom 22. You encounter mouse problems after changing the drive adapter**
This is a known problem with Logitech pointing devices, or standard pointing devices using Logitech drivers. In most cases, you can correct the problem by downloading and installing version 7.0 (or later) Logitech drivers, or switch to the Windows 95 serial mouse driver.

- Open the *Control panel* and double-click on the *System* icon.
- Select *Device manager* and double-click on the *Mous*e.
- Click once on *Logitech* and choose *Remov*e.
- Start the *Add/new hardware* wizard in the *Control pane*l.
- Choose *No* when Windows prompts to auto-detect the device.
- Select *Mous*e. Click on *Standard serial mous*e. Click on *Finis*h.
- Reboot the computer.

Another solution is also to disable the COM port's FIFO buffer. Open the *Control panel* and choose the *System* icon. Click on *Device manage*r. Double-click on *Ports* (COM and LPT). Choose the communications port that the mouse uses (i.e., COM 1) by clicking on it once, then click on *Properties*. Select *Port settings* and choose *Advance*d. Uncheck the box next to *Use FIFO buffer*s, then click *O*K.

**Symptom 23. You cannot run Norton Anti-Virus 95 with Promise drive adapters** This appears to be an issue with the Norton Anti-Virus (NAV) software itself. According to Symantec **(http://www.symantec.com**), a patch has been released to correct this problem.

**Symptom 24. The system hangs after counting through system memory You might also receive error messages, such as "Get Configuration Failed!" or "HDD Controller Failure."** First, be sure that you have at least one hard drive attached to the controller, and see that the signal cable is oriented properly at both ends. It is also possible that you might have a problem when more than one drive is connected. See that the drives are jumpered in the desired "master" and "slave" relationship. Try working with only one drive or reverse the drive relationship. In all cases, verify that the CMOS setup entries accurately reflect the drives that are connected. If your drive adapter uses on-board RAM, the RAM might be bad. Try replacing the controller's on-board RAM.

**Symptom 25. After replacing/upgrading a drive adapter, the system hangs intermittently during use** This complaint is somewhat common with VL motherboards and drives adapters, and is often caused by bad memory on the drive controller or a bad VL bus slot. Try replacing the RAM on the drive adapter. If the problem persists, try putting the drive controller in a different VL bus slot. If you have a VESA VL video card also, try swapping in a 16-bit (ISA) video card. Some motherboards become unstable with two VL cards in the system—especially when the VL bus is being run over 33MHz (there is a great likelihood of this happening at 50MHz)

**Symptom 26. Errors occur when reading or writing to floppies after re-placing/ upgrading drive adapter** This is almost always caused by a hardware conflict between the floppy adapter on the new controller and another floppy adapter elsewhere in the system. Disable the floppy adapter port on the new drive controller card. If you're using the new floppy port, disable the floppy port already in the system.

## Troubleshooting CD-ROM Drives

Although the vast majority of CD-ROM problems are caused by software or setup problems, the drives themselves are delicate and unforgiving devices. Considering that their prices have plummeted over the last few years (and still continue to drop), there is little economic sense in attempting a lengthy repair. When a fault occurs in the drive or in its adapter board, your best course is typically to replace the defective drive outright.

**Symptom 1. The drive has trouble accepting or rejecting a CD** This problem is typical of motorized CD-ROM drives, where the disc is accepted into a slot or placed in a motorized tray. Before performing any disassembly, check the assembly through the CD slot for any obvious obstructions. If nothing is obvious, expose the assembly and check each linkage and motor drive gear very carefully. Carefully remove or free any obstruction. Be gentle when working around the load/unload assembly. Notice how it is shock mounted in four places. Disconnect the geared dc motor assembly and try moving the load/unload mechanism by hand. If you feel any resistance or obstruction, you should track it down by eye and by feel. Replace any worn or damaged part of the mechanism, or replace the entire load/unload assembly. Also check the geared motor for any damage or obstruction. Broken or slipping gear teeth can interfere with the transfer of force from motor to mechanism. Replace any damaged gears or replace the entire geared assembly. You might also simply replace the CD-ROM drive mechanism outright.

**Symptom 2. The optical read head does not seek** An optical head is used to identify pits and lands along a CD-ROM, and to track the spiral data pattern as the head moves across the disk. The optical head must move very slowly and smoothly to ensure accurate tracking. Head movement is accomplished using a linear stepping motor to shift the optical assembly in microscopic increment head travel appears perfectly smooth to the unaided eye. Check the drive for any damaged parts of obstructions. When the optical head fails to seek, the easiest and fastest fix is simply to replace the CD-ROM mechanism outright.

**Symptom 3. The disc cannot be read** This type of problem might result in a DOS level “sector not found” or “drive not ready” error. Before you reach for your tools, however, check the CD itself to ensure that it is the right format, inserted properly, and physically clean. Cleanliness is very important to a CD. Although the laser will often “look past” any surface defects in a disc, the presence of dust or debris on a disc surface can produce serious tracking (and read) errors. Try a different disc to con-firm the problem. If a new or different disc reads properly, the trouble might indeed be in (or on) the original disc itself. Not only the disc must be clean, but the head optics must also be clear. Gently dust or clean the head optics, as suggested by your drive’s particular manufacturer. If read problems persist, check the physical interface cable between the drive and its adapter board. Be sure that the cable is connected correctly and completely. Many CD drives use SCSI interfaces—if you are using multiple SCSI devices from the same controller card and other SCSI devices are operating properly, the SCSI controller board is probably intact. If other SCSI devices are also malfunctioning, try a new SCSI host controller board. At this point, either the drive’s optical head or electronics are defective. Your best course here is to replace the drive. If problems persist on a drive with a proprietary interface, replace the adapter board.

**Symptom 4. The disc does not turn** The disc must turn at a *Constant Linear Velocity (CLV)* that is directed and regulated by the spindle. If the disc is not spinning during access, check to be sure that the disc is seated properly, and is not jammed or obstructed. Before beginning a repair, review your drive installation and setup carefully to ensure that the drive is properly configured for operation. If the drive's BUSY LED comes on when drive access is attempted (you might also see a corresponding DOS error message), the drive spindle system is probably defective. If the computer does not recognize the CD drive (i.e., "invalid drive specification"), there might be a setup or configuration problem (either the low-level device driver or MSCDEX might not have loaded properly). If your particular drive provides you with instructions for cleaning the optical head aperture, perform that cleaning operation and try the drive again. A fouled optical head can sometimes upset spindle operation. If operation does not improve, replace the CD-ROM drive mechanism.

**Symptom 5. The optical head cannot focus its laser beam,** a CD-ROM drive must focus its laser beam to microscopic precision to properly read the pits and lands of a disk. To compensate for the minute fluctuations in disc flatness, the optical head mounts its objective lens into a small focusing mechanism, which is little more than a miniature voice-coil actuator—the lens does not have to move very much at all to maintain precise focus. If focus is out or not well maintained, the laser detector might produce erroneous signals. This might result in DOS drive error messages. If random, but consistent, DOS errors appear, check the disc to be sure that it is optically clean—dust and fingerprints can result in serious access problems. Try another disc. If a new disc continues to perform badly, try cleaning the optical aperture with clean (photography grade) air. If problems persist, the optical system is probably dam-aged or defective. Replace the CD-ROM drive mechanism outright.

**Symptom 6. No audio is generated by the drive** Many CD-ROM drives are capable of not only reading computer data, but reading and reproducing music and sounds under computer control. Audio CDs can often be played in available CD-ROM drives through headphones or speakers. Start your investigation by testing the headphones or speakers in another sound source, such as a stereo. Once you have confirmed that the speakers or headphones are working reliably, check the drive's audio volume setting, which is usually available through the front bezel. Set the volume to a good average place (perhaps mid-range). Be sure that the disk you are trying to play actually contains valid Red Book audio. Check any software required to operate the CD drive's audio output (usually set with a "mixer applet") to be sure that it is installed and loaded as expected. CD-ROMs will not play audio CDs without an audio driver. Also check the line output, which would drive amplified speakers or stereo inputs. If speakers work through the line output but headphones or speakers do not work through the front bezel connector, the volume control or output audio amplifier might be defective. If the headphone output continues to fail, replace the headphone PC board or replace the entire CD-ROM drive outright.

**Symptom 7. Audio is not being played by the sound card** Normally, the sound card will not play Red Book audio from a CD—that is usually fed directly to the CD's headphone or line output. However, audio can be channeled to the soundboard for playback. Most CDs offer an audio connector that allows audio signals to be fed directly to the soundboard. If this "CD audio cable" is missing or defective, Red Book audio will not play through the soundboard. Check or replace the cable. If the cable is intact (and audio is available from the CD-ROM headphone output), check the soundboard's configuration for any "mixer" applet (see that any control for CD audio is turned up, and remember to save any changes). If problems persist, replace the soundboard. If the CD audio cable is intact (and audio is not available from the CD-ROM headphone output), the audio amplifier circuit in the CD-ROM is probably defective—replace the CD-ROM drive.

**Symptom 8. You see a "Wrong DOS version" error message when attempting to load MSCDEX** You are running MS-DOS 4, 5, or 6 with a version of MSCDEX, which does not support it. The solution is then to change to the correct version of MSCDEX. The version compatibility for MSCDEX is:

- V1.01 14,913 bytes (No ISO9660 support—High Sierra support only)
- V2.00 18,307 bytes (High Sierra and ISO9660 support for DOS 3.1-3.3)
- V2.10 19,943 bytes (DOS 3.1-3.3 and 4.0—DOS 5.x support provided with SETVER)
- V2.20 25,413 bytes (same as above with Win 3.x support—changes in audio support)
- v2.21 25,431 bytes (DOS 3.1-5.0 support with enhanced control under Win 3.1)
- v2.22 25,377 bytes (DOS 3.1-6.0 & higher with Win 3.1 support)
- v2.23 25,361 bytes (DOS 3.1-6.2 and Win 3.1 support—supplied with MSDOS 6.2)

When using MS-DOS 5.x to 6.1, you will need to add the SETVER utility to CONFIG.SYS to use MSCDEX v2.10 or v2.20 properly (i.e., DEVICE = C:\DOS\SETVEREXE).is used to tell programs that they are running under a different version of DOS than DOS 5.0. This is important because MSCDEX (v2.10 and v2.20) refuses to work with DOS versions higher than 4.0. SETVER is used to fool MSCDEX into working with higher versions of DOS. In some versions of DOS 5.0 (such as Compaq DOS 5.0), you will need to add an entry to SETVER for MSCDEX (i.e., SETVER MSCDEX.EXE 4.00). This entry modifies SETVER without changing the file size or date.

**Symptom 9. You cannot access the CD-ROM drive letter You might see an error message, such as "Invalid drive specification."** This is typically a problem with the CD-ROM drivers. The MS-DOS extension MSCDEX has probably not loaded. Switch to the DOS sub-directory and use the MEM /C function to check the loaded drivers and TSRs. If you see the low-level driver and MSCDEX displayed in the driver list, check the CD-ROM hardware.

Be sure that the data cable between the drive and adapter board in inserted properly and completely. If problems persist, try replacing the adapter board. If you do not see the low-level driver and MSCDEX shown in the driver list, inspect your CONFIG.SYS and AUTOEXEC.BAT files. Check that the drivers are included in the startup files to begin with. Be sure that the label used in the /D switch is the same for both the low-level driver and MSCDEX. If the label is not the same, MSCDEX will not load. If you are using MS-DOS 5.0, be sure that the SETVER utility is loaded. You could also try updating MSCEDX to v2.30.

**Symptom 10. An error appears when trying to load the low-level CD-ROM driver** Check that you are using the proper low-level device driver for your CD-ROM drive. If you are swapping the drive or adapter board, you probably need to load a new driver. If the driver fails to load with original hardware, the adapter board might have failed or its jumper settings might not match those in the driver's command line switches. Check the signal cable running between the drive and adapter board. If the cable is crimped or scuffed, try replacing the cable. Next, try replacing the adapter board. If problems persist, try replacing the CD-ROM drive mechanism itself.

**Symptom 11. An error appears, such as "Error: not ready reading from drive D:"** Check that a suitable disc is inserted in the drive and that the drive is closed properly. Be sure that the low-level device driver and MSCDEX are loaded correctly. If the drivers do not load, the problem might be with the adapter board or drive mechanism itself. Also check that the data cable between the drive and adapter is connected properly and completely. If problems persist, suspect that a weakness is in the PC power supply (especially if the system is heavily loaded or upgraded). Try a larger supply in the system. If problems persist, replace the CD-ROM drive. If a new drive does not correct the problem, try a different interface adapter.

**Symptom 12. SmartDrive is not caching the CD-ROM properly** The version of SmartDrive supplied with DOS 6.2x provides three forms of caching, although older forms of SmartDrive (such as the ones distributed with Windows 3.1, DOS 6.0 and 6.1) will not adequately cache CD-ROM drives. The BUFFERS statement also does not help caching. So, if you are looking to SmartDrive for CD-ROM cache, you should be using the version distributed with DOS 6.2x. You should also set BUFFERS=10,0 in the CONFIG.SYS file, and the SmartDrive command line should come after MSCDEX. When using SmartDrive, you can change the buffers setting in the MSCDEX command line (/M) to 0. This allows you to save 2KB per buffer.

**Symptom 13. The CD-ROM drivers will not install properly on a drive using compression software** This is usually because you booted from a floppy disk and attempted to install drivers without loading the compression software first. Before doing anything else, check the loading order—allow your system to boot from the hard drive before installing the CD-ROM drivers. This allows the compression software to assign all drive letters.

As an alternative, boot from a compression aware floppy disk. If you must boot the system from a floppy disk, be sure that the diskette is configured to be fully compatible with the compression software being used.

**Symptom 14. You see an error indicating that the CD-ROM drive is not found:** This type of problem might also appear as loading problems with the low-level driver. There are several possible reasons why the drive hardware cannot be found. Check the power connector first and be sure that the 4-pin power connector is inserted properly and completely. If the drive is being powered by a Y-connector, be sure that any interim connections are secure. Use a voltmeter and measure the +5-V (pin 4) and +12-V (pin 1) levels. If either voltage (especially the +12-V supply) is unusually low or absent, replace the power supply. Check the signal connector next and see that the drive's signal interface cable is connected securely at both the drive and controller. If the cable is visibly worn or damaged, try a new one. Inspect the drive interface adapter and be sure that the adapter's IRQ, DMA, and I/O address settings are correct. They must also match with the command line switches used with the low-level driver. If the adapter is for a CD-ROM alone, you might also try installing the adapter in a different bus slot. If your CD-ROM uses a SCSI interface, be sure that the SCSI bus is properly terminated at both ends. If problems persist, replace the drive adapter.

**Symptom 15. After installing the CD-ROM drivers, system reports significantly less available RAM** This is usually a caching issue with CD-ROM driver software, and you might need to adjust the CD-ROM driver software accordingly. This type of problem has been documented with Teac CD-ROM drives and CORELCDX.COM software. If the software offers a command line switch to change the amount of XMS al-located, reduce the number to 512 or 256. Check with tech support for your particular drive for the exact command line switch settings.

**Symptom 16. In a new installation, the driver fails to load successfully for the proprietary interface card** In almost all cases, the interface card has been configured improperly. Check the drive adapter card first. Be sure that the drive adapter is configured with the correct IRQ, DMA, and I/O address settings, and check for hard-SmartDrive is not used by Windows 95, which uses its own CD-caching scheme. Try disabling SmartDrive when running under Windows 95 software conflicts with other devices in the system. In some cases, you might simply enter the drive maker (i.e., Teac) as the interface type during driver installation. Be sure that the interface is set properly for the system and your particular drive. Check the driver's command line next—the driver's command-line switches should correctly reflect the drive adapter's configuration.

**Symptom 17. The CD-ROM driver loads, but you see an error, such as: "CDR101" (drive not ready), or: "CDR103" (CD-ROM disk not HIGH SIERRA or ISO)** You are using a very old version of the low-level driver or MSCDEX. Check your driver version (it might be outdated). Contact the drive manufacturer's tech support and see that you have the very latest version of the low-level driver. For very old drives, a later "generic" driver might be available. Check your version of MSCDEX next. Because low-level drivers are often bundled with MSCDEX, you might also be stuck with an old version of MSCDEX. You can usually download a current version of MSCDEX from the same place you get an updated low-level driver, or download it from Microsoft at: **http://www.microsoft.com.**

**Symptom 18. You are having trouble setting up more than one CD-ROM drive** You must be concerned about hardware and software issues. Check the drive adapter first—be sure that the drive adapter will support more than one CD-ROM on the same channel. If not, you will have to install another drive adapter to support the new CD-ROM drive. Low-level drivers present another problem because you will need to have one copy of a low-level driver loaded in CONFIG.SYS—one for each drive. Be sure that the command line switches for each driver match the hardware settings of the corresponding drive adapter. Finally, check your copy of MSCDEX. You need only one copy of MSCDEX in AUTOEXEC.BAT, but the "/D:" switch must appear twice—once for each drive ID.

**Symptom 19. Your CD-ROM drive refuses to work with an IDE port** The drive might use a non-standard port (other than IDE). Try replacing the drive adapter board. You must connect the CD-ROM drive to a compatible drive adapter. If the drive is proprietary, it will not interface to a regular IDE port. It might be necessary to purchase a drive adapter specifically for the CD-ROM drive.

**Symptom 20. You cannot get the CD-ROM drive to run properly when mounted vertically** CD-ROM drives with "open" drive trays cannot be mounted vertically—disc tracking simply will not work correctly. The only CD-ROM drives that can be mounted vertically are those with caddies, but you should check with those manufacturers before proceeding with vertical mounting.

**Symptom 21. The SCSI CD-ROM drive refuses to work when connected to an Adaptec SCSI interface other drives are working fine.** This is a common type of problem among SCSI adapters, and is particularly recognized with Adaptec boards be-cause of their great popularity. In most cases, the Adaptec drivers are the wrong version or are corrupted. Try turning off *Sync negotiations* on the Adaptec SCSI interface, and re-boot the system. Your SCSI drivers might also be buggy or outdated. Try technical support **(http://www.adaptec.com**) to determine if you should use a later driver version instead.

**Symptom 22. You see a "No drives found" error when the CD-ROM driver line is executed in CONFIG.SYS** In most cases; the driver command-line switches do not match the hardware configuration of the drive adapter. Your low-level driver might be missing or incomplete. Open CONFIG.SYS into a word processor and see that the low-level driver has a complete and accurate command line. See that any command line switches are set correctly. Check the MSCDEX command line next. Open AUTOEXEC.BAT into a word processor and see that the MSCDEX command line is accurate and complete. Also confirm that any MSCDEX command-line switches are set correctly. If you are using SmartDrive with DOS 6.0 or later, try adding the /U switch to the end of your SmartDrive command line in AUTOEXEC.BAT. Check for hardware conflicts. Be sure that no other hardware devices are in the system that might be conflicting with the CD-ROM drive controller. If problems persist, replace the drive controller.

**Symptom 23. The CD-ROM LCD displays an error code** Even without knowing the particular meaning of every possible error message, you can be assured that most CD-based error messages can be traced to the following causes (in order of ease):

- *Bad caddy* The CD caddy is damaged or inserted incorrectly. The CD might also be inserted into the caddy improperly.
- *Bad mounting* The drive is mounted improperly or mounting screws are shorting out the drive's electronics.
- *Bad power* Check that +12 and +5 V are powering the CD-ROM drive. Low power might indicate that your system requires a new or larger supply.
- *Bad drive* Internal diagnostics have detected a fault in the CD-ROM drive. Try replacing the drive.
- *Bad drive controller* Drive diagnostics have detected a fault in the drive controller. Try replacing the drive controller or SCSI adapter (whichever interface you're using).

**Symptom 24. When a SCSI CD-ROM drive is connected to a SCSI adapter, the system hangs when the SCSI BIOS starts** In most cases, the CD-ROM drive supports Plug and Play, but the SCSI controller's BIOS does not. Disable the SCSI BIOS through a jumper on the controller (or remove the SCSI BIOS IC entirely) and use a SCSI driver in CONFIG.SYS instead. You might need to download a low-level SCSI driver from the adapter manufacturer.

**Symptom 25. You see an error, such as: "Unable to detect ATAPI IDE CD-ROM drive, device driver not loaded"** You have a problem with the configuration of your IDE/EIDE controller hardware. Check the signal cable first, and be sure that the 40-pin signal cable is attached properly between the drive and controller. IDE CD-ROM drives are typically installed on a secondary 40-pin IDE port. Be sure that no other device is using the same IRQ or I/O address as your secondary IDE port. Finally, be sure that any command-line switches for the low-level driver in CONFIG.SYS correspond to the controller's hardware settings.

**Symptom 26. The CD-ROM drive door will not open once the 40-pin IDE signal cable is connected** You should only need power to operate the drive door. If the door stops when the signal cable is attached, check for some possible problems. Check the power connector first and be sure that both +5 and +12 V are available at the power connector. See that the power connector is attached securely to the back of the CD-ROM drive. Check the IDE signal cable next—the 40-pin signal cable is probably reversed at either the drive or controller. Try a different signal cable. Also be sure that the 40-pin IDE drive is plugged into a "true" IDE port—not a proprietary (non-IDE 40-pin) port. If problems persist, try a known-good CD-ROM drive.

**Symptom 27. You are using an old CD-ROM and can play CD audio, but you cannot access directories or other computer data from a CD Older**, proprietary CD-ROM drives often used two low-level drivers—one for audio and one for data. You probably only have one of the drivers installed. Check your low-level drivers first, and see that any necessary low-level drivers are loaded in the CONFIG.SYS file. Also see that any command-line switches are set properly. Some older soundboards with integrated, proprietary CD-ROM drive controllers might not work properly with the drivers required for your older CD-ROM drive. You might have to alter the proprietary controller's IRQ, DMA, or I/O settings (and update the driver's command-line switches) until you find a combination where the driver and controller will work together.

**Symptom 28. The front-panel controls of your SCSI CD-ROM drive do not appear to work under Windows 95 Those same controls appear to work fine in DOS**. Windows 95 uses SCSI commands to poll removable media devices every two seconds to see if the status has changed. Because SCSI commands to the CD-ROM generally have higher priority than front-panel controls, the front-panel controls might appear to be disabled under Windows 95. Try pressing the front-panel controls repeatedly. You might be able to correct this issue by disabling the CD-ROM polling under Windows 95.

**Symptom 29. You cannot change the CD-ROM drive letter under Windows 95** You need to change the drive's settings under the *Device manage*r:

- Open the *Control panel* and select the *System* icon.
- Once the *System properties* dialog opens, click on the *Device manager* page.
- Locate the entry for the CD-ROM. Click on the + sign to expand the list of CD-ROM devices.
- Double click on the desired CD-ROM.
- Once the CD-ROM drive's *Properties* dialog appears, choose the *Settings* page.
- Locate the current drive letter assignment box and enter the new drive designation.
  Multiple letters are needed only when a SCSI device is implementing LUN addressing (i.e., multi disc changers).

- Click on the *OK* button to save your changes.
- Click on the *OK* button to close the *Device manage*r.
- A *System settings change* window should appear. Click on the *Yes* button to reboot the system so that the changes can take effect, or click on the *No* button so that you can make more changes to other CD-ROMs before rebooting system. Changes will not be-come effective until the system is rebooted.

**Symptom 30. You installed Windows 95 from a CD-ROM disc using DOS drivers, but when you removed the real-mode CD-ROM drivers from CON-FIG. SYS, the CD-ROM no longer works** You need to enable protected-mode drivers by running the *Add new hardware* wizard from the *Control pane*l:

- Boot Windows 95 using the real-mode drivers for your CD-ROM and its interface.
- Open the *Control panel* and select the *Add new hardware* icon.
- Proceed to add new hardware, but do not let Windows 95 attempt to "auto-detect" the new hardware. Use the diskette with protected-mode drivers for the new installation.
- When the new software is installed, Windows 95 will tell you that it must reboot before the hardware will be available—do not reboot yet.
- Open a word processor, such as Notepad, and edit the CONFIG.SYS and AUTOEXEC.BAT files to REMark out the real-mode drivers for your CD and the reference to MSCDEX.
- Shut down Windows 95, then power down the system.
- Check that the CD-ROM interface is set to use the resources assigned by Windows 95.
- Reboot the system. Your protected-mode drivers should now load normally.

**Symptom 31. Your CD-ROM drive's parallel port-to-SCSI interface worked with Windows 3.1x, but does not work under Windows 95** This problem is typical of the NEC CD-EPPSCSI01 interface, and is usually caused by a problem with the driver's assessment of your parallel-port type (i.e., bi-directional, unidirectional, or enhanced parallel port). Start your CMOS setup routine first and see what mode your parallel port is set to operate in. Be sure it is set to a mode that is compatible with your parallel-port drive. Next, update your version of MSCDEX. Change the MSCDEX command line in AUTOEXEC.BAT to load from the C:\WINDOWS\CONTROL\ directory, and remove the /L:x parameter from the end of the MSCDEX command line (if pre-sent). Finally, cold boot the computer. Because typical parallel port-to-SCSI interfaces get their power from the SCSI device, the external drive must be powered up first. If you're using real-mode drivers for the interface, place a switch at the end of the interface's command line that tells the driver what mode your parallel port is operating in. As an alternative, disable your real-mode drivers. Remove or REMARK out any references to the interface's real-mode drivers in CONFIG.SYS, then remove or disable the MSCDEX command line in AUTOEXEC.BAT. Start Windows 95, open the *Control pane*l, select the *System* icon, then choose the *Device manager* page.

Find the SCSI adapter settings and expand the "SCSI controllers" branch of the device tree. Select the device identification line for your parallel port-to-SCSI interface, then click on the *Properties* button. Click on the *Settings* page. In the *Adapter settings* dialog box, type in the same parameter that would have been used if you were using real-mode drivers. Click .on the *OK* buttons to save your changes, then select *Yes* to reboot the system. If problems persist, check the technical support for your parallel port-to-SCSI adapter and see if there are any known problems with your particular setup, or if any updated drivers are available for download.

**Symptom 32. You see a message that the: "CD-ROM can run, but results might not be as expected"** This simply means that Windows 95 is using real-mode drivers. If protected-mode drivers are available for the CD-ROM drive, you should use those instead.

**Symptom 33. The CD-ROM works fine in DOS or Windows 3.1x, but sound or video appears choppy under Windows 95** Several factors can affect CD-ROM performance under Windows 95. Windows 95 performance (and stability) is severely degraded by real-mode drivers, so start by removing or disabling any real-mode drivers. Try installing the protected-mode drivers for your CD-ROM drive instead. If protected- mode drivers are not available for your drive, you might consider upgrading the CD-ROM hardware. Also, avoid using DOS or Windows 3.1x applications under Windows 95. Real-mode applications run under Windows 95 can also cripple performance. Try exiting any DOS or Windows 3.1x applications that might be running on the Windows 95 desktop. Also exit unneeded Windows 95 applications because additional applications take a toll on processing power. Exit any Windows 95 applications that might be running in the background. Finally, reboot the system to ensure that Windows 95 has the maximum amount of resources available before running your CD-ROM application.

**Symptom 34. You can't read a Video CD-I disc in Windows 95 using any ATAPI/IDE CD-ROM drive The built-in ATAPI driver in Windows 95 cannot read raw data in 32-bit disk-access mode.** Such symptoms can also happen to any ATAPI/IDE-compatible CD-ROM as long as they are using the built-in ATAPI driver in Windows 95. You should update the CD-ROM's ATAPI driver to a current manufacturer-specific version. As another alternative, you can use the following procedure:

1 Disable the 32-bit disk-access feature of Windows 95.
2 Under the Windows 95 *Deskto*p, click *Start* and choose *Settings* and *Control pane*l.
3 Click on *System* icon and select the *Performance* option.
4 Choose *File system* and select the *Troubleshooting* option.
5 At the *Troubleshooting* dialog, click on "Disable all 32-bit disk access."

6 Edit AUTOEXEC.BAT and append the following line (where {path} is the path name of your Windows 95 software): C:\{path}\COMMAND\MSCDEX.EXE /D:MSCD000

**Symptom 35. An IDE CD-ROM is not detected on a 486 PCI motherboard** This is a known problem when using Aztec CD-ROM drives and 486 PCI motherboards with SIS 82C497 chipsets. The motherboard bus noise is far too high, which results in the misinterpretation of the IDE interface handshaking signals (namely DASP,PDIAG). As a consequence, the CD-ROM drive sometimes (or always) is not detected. You might be able to resolve this problem by connecting the IDE CD-ROM drive as a "slave" device to the hard disk—although you might need to slow the hard drive's data-transfer mode to accommodate the slower CD-ROM drive.

**Symptom 36. An IDE CD-ROM is not detected when "slaved" to an IBM hard drive** This is a known problem with Aztech IDE CD-ROM drives and IBM Dala 3450 hard drives. The pulse width for the drive-detection signal (DASP) is not long enough for the CD-ROM to identify itself properly. This results in the improper detection of an Aztech IDE CD-ROM. You should make the CD-ROM drive a master device on its own IDE channel, or (if possible) upgrade the CD-ROM drive's firmware to utilize more reliable timing. If the CD-ROM manufacturer has no firmware upgrades available, and you cannot reconfigure the CD-ROM on another IDE channel, you'll need to replace the CD-ROM or hard drive.

**Symptom 37. The CD-ROM drive will not read or run CD Plus or Enhanced CD titles** This is a known problem with Acer CD-ROM models: 625A, 645A, 655A, 665A, 525E, 743E, 747E, and 767E. The CD Plus (or Enhanced CD) titles use a new data format that was recently released by Sony. The new format is for interactive CD titles that incorporate video clips and music, and these CD-ROM drive models cannot recognize the data structures on these CDs. In this case, you'll need to upgrade the CD-ROM drive outright to a newer model that can accommodate newer file types.

**Symptom 38. You notice that the LED indicator on the CD-ROM is always on The drive seems to be working properly.** This is not necessarily a problem. Some CD-ROM drive models (such as the Acer 600 series) use the LED indicator as a "ready" light instead of as a "busy" light. Whenever a CD is loaded in the drive, the LED will be lit, and will remain lit whether the drive is being accessed or not. This feature tells the user whether or not a CD-ROM disc is currently loaded in the drive by simply checking the LED. The CD-ROM drive might have a jumper that allows you to switch the indicator light from "Ready" mode to "Busy" mode.

**Symptom 39. You cannot play CD-audio on a particular CD-ROM under Windows 95** Replacing the CD-ROM resolves the problem. This is a known incompatibility issue with Acer 525E CD-ROM drives and Windows 95 (this does not affect the integrity of programs and data). Windows 95 will mute the CD-audio on this and many other brands of double-speed IDE CD-ROMs. If you cannot obtain a patch directly from Microsoft or the CD-ROM manufacturer, your only real alternative is to replace the CD-ROM drive. Troubleshooting CD-R Drives Prices for CD recorders (or CD-Rs) have tumbled over the first half of 1997—recorders that would have cost thousands of dollars just a couple of years ago can now be purchased for just $400 to $600 (U.S.). These low prices, combined with readily available units from Philips, Sony, Hi-Val, Smart and Friendly, and other manufacturers, means that CD-Rs have begun appearing in desktop and tower systems. CD recorders offer some exciting potentials for computer users. Not only are CD-Rs ideal for file backup and archiving purposes, but CD-Rs support data-intensive uses, such as photo albums, personal clipart libraries, customized multimedia productions, and high-volume file distribution. However, CD recorders present some special problems for the typical PC. Virtually all CD-R units use the SCSI interface to handle more consistent data transfer from the system to the drive. Installing a CD-R might require the addition (and expense) of a SCSI adapter and driver software. CD recording demands a substantial commitment of hard-drive space (perhaps as much as 1GB) to create an image file for recording (an "image file" basically converts the data to be recorded into the "pits" and "lands" that must be encoded to the blank disc). So if you're tight on drive space, you might also need another hard drive to support the CD-R. Finally, CD-Rs require a constant and uninterrupted flow of data during the recording process. If the CD-R data buffer empties, the recording process will halt, and your blank CD will be ruined. This means that you need fast hard drives and a high-performance interface (i.e., PIO Mode 4). This part of the chapter explains some of the problems associated with installing and using a CD-R, and illustrates a series of troubleshooting symptoms and solutions. CD-RECORDING ISSUES Writing data to recordable compact disc is a complex process that demands a great deal from your PC's hardware and software—most of this complexity is hidden by the power of the CD authoring program, but you should be aware of a number of important factors that can influence the success of CD recording. File sizes The sheer amount of data being written to the CD is less important than the individual file sizes—the recorder might have trouble locating and opening the files quickly enough to send them smoothly to the CD recorder, where fewer large files are typically problem-free. System interruptions Any interruption in the flow of data is fatal to CD recording, so be sure that your CONFIG.SYS and AUTOEXEC.BAT files do not load any TSR utilities, which might periodically interrupt the computer's drive operations. Utilities, such as screen savers, calendar alarms or reminders, and incoming faxes are just a few "features" that will interrupt disc writing. If the PC is part of a network, you should temporarily disable network sharing so that no one tries to access the files you're trying to write to the CD.

Hard disk - The hard drive is a crucial component of the CD-R system because you must create a sizable "image file," which will then be sent to the CD-R. Consider three major issues when choosing your hard drive: speed, file fragmentation, and thermal calibration.

**Symptom 40. Absorption control error <xxx>** This error most often means that there is a slight problem writing to a recordable disc perhaps caused by a smear or speck of dust. It does not necessarily mean that your data has not been correctly recorded. A sector address is usually given so that you can (if you wish) verify the data in and around that sector. When writing is completed, try cleaning the disc (on the non-label side) gently with a lint-free cloth. If the error occurs again, try a new disc.

**Symptom 41. Application code error** This error typically occurs when you try to write Kodak recordable CDs (Photo CDs) on non-Kodak CD recorders. These discs have a protection bit that is recognized only by the Kodak CD-R—all other recorders will not record these discs. In this case, you'll need to use "standard" blank CDs.

**Symptom 42. Bad ASPI open The CD-R ASPI driver is bad or missing, and the SCSI CD-R cannot be found**. Check the installation of your CD-R drive and SCSI adapter, then check the driver installation. Try reinstalling the SCSI driver(s).

**Symptom 43. Buffer underrun at sector <xxx>** Once an image file is generated, CD writing is a real-time process that must run constantly at the selected recording speed—without interruptions. The CD recorder's buffer is constantly filled with data from the hard drive waiting to be written. This "buffering" action ensures that small slow-downs or interruptions in the flow of data from the computer do not interrupt writing. The "buffer underrun" message indicates that the flow of data from hard disk to CD recorder was interrupted long enough for the CD recorder's buffer to be emptied, and writing was halted. If this occurs during an actual write operation, rather than a test, your CD might be damaged. To avoid buffer underruns, you should remove as much processing load as possible from the system. For example, be sure that no screen savers or other *Terminate and Stay Resident (TSR)* programs are active (they can momentarily interrupt operations). Close as many open windows as possible. See that your working hard disk cannot be accessed via a network. Also, the CD recorder's position in the SCSI chain—or the cable length between the computer and CD recorder—might cause data slowdowns. Try connecting the CD recorder as the first peripheral in the SCSI chain (if not done already), and use a shorter SCSI cable (if possible) between the CD recorder and the SCSI host adapter.

**Symptom 44. Current disc already contains a closed audio session** Under the Red Book standard for audio CDs, all audio tracks must be written in a single session. If you add audio tracks in more than one session, playback results will be unpredictable. Most CD-ROM drives will playback all audio tracks on a CD—even if they are recorded in several different sessions, but most home and car CD players can only play-back the tracks in the first session. If you continue and record audio in a different session, you might have problems reading subsequent audio sessions.

**Symptom 45. Current disc contains a session that is not closed** In actuality; CD-ROM drives can only read back one data track per session, so avoid recording another data track in an open session. Be sure to close the session before writing additional data to the disc.

**Symptom 46. The currently selected source CD-ROM drives or CD recorder cannot read audio in digital format** This is more of a warning than a fault. Reading audio tracks in "digital format" is not the same as playing the music, and few CD-ROM drives are able to read audio tracks in digital format (only Red Book format).

**Symptom 47. Data overrun/underrun** The SCSI host adapter has reported an error that is almost always caused by improper termination or a bad SCSI cable. Recheck the installation of your SCSI adapter, cabling, and termination.

**Symptom 48. Destination disc is smaller than the source disc** This error commonly occurs when you're trying to duplicate an existing CD to the CD-R. There is not enough room on the recordable CD to copy the source CD. Try recording to a blank CD. Use 74-minute media instead of 60-minute media. Some CDs cannot be copied be-cause of the TOC (Table of Contents) overhead in CD recorders, and also because of the calibration zone overhead.

**Symptom 49. Disc already contains tracks and/or sessions that are in-compatible with the requested operation** This error appears if you are trying to add data in a format that is different from the data format already on the disc. For example, you'll see this type of error when trying to add a CD-ROM XA session to a disc that already contains a standard CD-ROM session. A disc containing multiple formats is un-readable, so you are not allowed to record the different session type.

**Symptom 50. Disc is write-protected** You are attempting to write to a disc that has already been closed. Use a fresh blank disc for writing.

**Symptom 51. Error 175-xx-xx-xx** This error code often indicates a "buffer underrun." See the Symptom 50.

**Symptom 52. Error 220-01-xx-xx** This error code often indicates that some of your software cannot communicate with a SCSI device—possibly because your SCSI bus was reset. In many cases, this is caused by conflicts between real-mode and protected-mode SCSI drivers working in a Windows 95 system. Try REMing out any real-mode SCSI drivers in your CONFIG.SYS file (the protected-mode drivers provided for Windows 95 should be sufficient on their own).

**Symptom 53. Error 220-06-xx-xx** This error code often indicates a SCSI Selection Time-out error, which indicates a SCSI setup problem—usually with the SCSI host adapter. Contact your SCSI host-adapter manufacturer for detailed installation and testing instructions.

**Symptom 54. Error reading the Table of Contents (TOC) or Program Memory Area (PMA) from the disc** This recordable disc is defective, or has been damaged (probably during a previous write operation). Do not write to this disc. Unfortunately, you can do very little, except discard the defective disc.

**Symptom 55. General-protection fault** This type of problem has been identified with the Adaptec AHAr-15xx family of SCSI host adapters, and is caused by outdated driver software. You can solve this problem by upgrading to version 3.1 or later of Adaptec's EZ-SCSI software. If you're not using Adaptec software, check for current drivers for whatever adapter you're using.

**Symptom 56. Invalid logical block address** This error message usually means that the CD mastering software has requested a data block from the hard disk, which either does not exist or is illegal (this might suggest that your hard disk is corrupted). Exit the CD mastering software and run ScanDisk and Defrag to check and reorganize your hard drive.

**Symptom 57. Last two blocks stripped** This message appears when copying a track to hard disk if the track you are reading was created as multi-session compliant (following the Orange Book standard). This is because a multi-session track is always followed by two run-out blocks. These are included in the count of the total size (in blocks) of the track, but do not contain data and cannot be read back. This message appears to alert you just in case you notice that you got two blocks fewer than were reported for the Read Length. Don't panic—you haven't lost any data.

**Symptom 58. "MSCDEX" errors are being encountered** Early versions of MSCDEX (prior to v.2.23) had problems with filenames containing "illegal" ASCII characters, such as a hyphen. If a directory contains a filename with an "illegal" ASCII character, you can still see all the files by doing a directory (DIR) from DOS, or you can open the illegally named file. However, one or more files listed after the illegal one might not be accessible or might give errors. You should update MSCDEX to the latest available version.

**Symptom 59. MS-DOS or Windows cannot find the CD-R drive** There are several possible reasons why the CD-R drive cannot be found by software. First, turn the computer off and wait at least 15 seconds. Be sure that the SCSI adapter card is firmly seated and secured to the computer case. The SCSI adapter must also be properly configured. Check the SCSI cable and see that it is properly attached to the adapter and drive. Turn the computer on. If problems persist, be sure that the correct SCSI drivers are in-stalled and that any command line switches are set correctly.

**Symptom 60. No write data (buffer empty)** The flow of data to the CD-R drive must be extremely regular so that its working buffer is never empty when it prepares to write a block of information to disc. This message indicates that the flow of data from the hard disk to the CD recorder has been interrupted (similar to the "Buffer underrun" error). Ensure that no screen savers, other TSR utilities, or unneeded open windows are active, which might momentarily interrupt operations. Your working hard disk should not be accessible over a network. The CD recorder's position in the SCSI chain, or the length of cabling between the SCSI adapter and CD recorder might also cause data slowdowns. Try connecting the CD recorder as the first device in the SCSI chain (you might need to re-terminate the SCSI chain), and keep the SCSI cable as short as possible. Windows 3.1x requires the use of a RAM cache to manage the flow of data. SmartDrive (the caching utility supplied with Windows 3.1x) is necessary for writing virtual images on-the-fly to CD. However, when writing a real ISO image from hard disk to CD, it might cause a buffer underrun. If a buffer underrun occurs during testing or writing of a real ISO 9660 image under Windows 3.1x, exit to the DOS shell and type the following: smartdrv x- where *x* is the letter of the hard drive from which you will write the ISO image. This disables SmartDrive for the specified drive so that CD writing can proceed smoothly.

**Symptom 61. Read file error** A file referenced by the virtual image database cannot be located or accessed. Be sure that someone else on a network is not using by you or the suspect file.

**Symptom 62. The selected disc image file was not prepared for the current disc** This type of error message occurs if you prepared the disc image file for a blank CD, but is now trying to record it to a CD already containing data, (or vice versa). In either case, you would wind up writing a CD that couldn't be read because the CD addresses calculated for the disc image are wrong for that actual CD. If you are given the option of writing anyway, select "No" to abort because it is very unlikely that the writing operation would yield a readable CD.

**Symptom 63. The selected disc track is longer than the image file** The Disc verify process fails immediately because the source ISO 9660 image file and the actual ISO 9660 track on CD are not the same size—the disc track is actually longer than the image file, which could indicate that the CD-R drive is defective.

**Symptom 64. The selected disc track is shorter than the image file** The disc-verify process fails immediately because the source ISO 9660 image file and the actual ISO 9660 track on CD are not the same size—the disc track is actually shorter than the image file, which could indicate that the CD-R drive is defective.

**Symptom 65. The "disc in" light on the drive does not blink after you turn on the computer** In virtually all cases, no power is reaching the CD-R drive. For internal CD-R drives, be sure that the computer's 4-pin power cable is properly connected to the CD-R drive unit. For external CD-R drives, be sure that the power cord is properly connected to the back of the CD-R drive unit and is plugged into a grounded power outlet. Be sure the power switch on the back of the drive is on. Refer to your CD-R drive's installation guide for more detailed information.

**Symptom 66. Write emergency** This error occurs if the drive is interrupted during a write action. It is commonly seen when writing Red Book audio, but it can also occur with data. For example, one typical reason for a write emergency is dust particles that cause the laser to jump off track.

**Symptom 67. Windows 95 recognizes the CD-R, but it will not function as a normal CD-ROM drive** The drive appears normally in the Windows 95 *Device manage*r. The driver that is operating the CD-R drive might not allow the drive to function as a normal CD-ROM reader. For example, this is a known problem with the Philips CDD2000 CD-R. Check to see if an updated Windows 95 CD-R driver is avail-able to overcome this limitation. If not, you might need to replace the CD-R drive with an upgraded model whose drivers do support CD-ROM-type functionality.

**Symptom 68. You cannot read CD-R (gold) discs in some ordinary CD-ROM drives** This is actually a very complex issue because a number of important factors can affect the way that a CD is read. Laser calibration plays a big role. Some CD-ROM drive lasers are not calibrated to read recordable discs (whose recorded surface is slightly different from that of "pressed" discs). If your CD-ROM drive reads mass produced (silver) CDs, but not recordable CDs, check with the CD-ROM drive manufacturer to determine whether laser calibration is the problem. You might be able to return the CD-ROM drive for factory recalibration or replace the CD-ROM drive with a model that is better calibrated for reading both CD-ROM and CD-R discs. Fast CD-ROM drive operations might be another problem. For some CD-ROM models to work as fast as they do, they must perform unconventional operations, such as a laser calibration in the lead-out area to determine the approximate position of several tracks. With some CD recorders, the session lead-out is not recorded correctly, which can cause problems with gold-disc compatibility. The CD-R authoring software can be a problem. Any authoring software can sometimes produce incorrect tracks because of bugs or recording glitches. A good way to check whether incompatibility problems lie with the originating software is to test the same gold disc on several CD-ROM drives. If one drive is capable of reading the gold disc back correctly, chances are that the problem was not in the recording process.

Finally, consider your version of MSCDEX. Although MSCDEX (the Microsoft extension for reading CD-ROMs) will allow non-ISO legal characters in filenames, versions of MSCDEX prior to 2.23 have a problem in dealing with filenames that contain the hyphen. If a directory contains a filename with a hyphen in it, you will be able to see all the files by doing a DIR from DOS. But any files listed after the file with the illegal name are not accessible— when trying to open them, you would get a "file not found" message. MSCDEX 2.23 appears to have fixed this bug.

## Basic DVD/MPEG-2 Troubleshooting

Even though a DVD package should install with an absolute minimum of muss and fuss, and run with all the reliability of a CD-ROM, there are times when things just don't go according

**Symptom 1 The DVD drivers refuse to install** This is almost always because Windows 95 is having a problem with one or more .INF files on your driver installation disk(s). Check with your DVD vendor to confirm whether you need to delete one or more entries in your OEMxx.INF file(s), where "xx" is any suffix. You might also need to delete one or more entries from a MKEDVD.INF file.DVD drives use lasers in normal operation. Although these are very low-power semi-conductor lasers, the chances of injury to your eyes is extremely slight, you should still take the proper precautions and not operate a DVD drive with the protective covers open. Turn off and unplug the PC before opening a DVD drive.

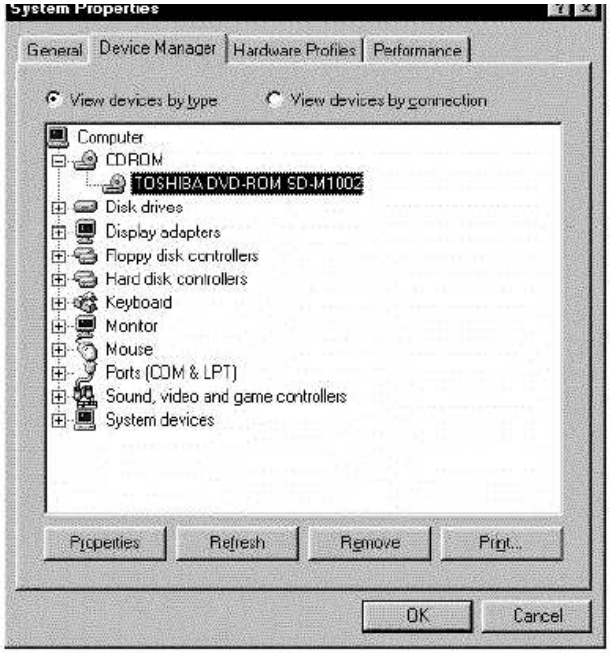



**FIGURE 14-10** The DVD-ROM drive entry under the *Device manager.*

**The DVD-ROM drive entry under the Device manager**.

Once you've corrected the appropriate .INF file(s), you can re-install the DVD drivers:

- Click *Star*t, select *Setting*s, and then click on *Control pane*l. Double-click on the *System* icon.
- Click on the *Device manager* tab, then select *Sound, video, and game controllers* or CD-*ROM.*
- Select the DVD driver(s), and then click *Remov*e.
- Exit the *Device manager* and reinstall the drivers again.

**Symptom 2. The DVD drive isn't detected** The DVD drive would not be detected for several possible reasons. Check the power connector attached to the drive, and be sure that the drive isn't being powered from a Y splitter power cable. Check the signal cable next. Both SCSI and EIDE signal cables must be attached securely to the drive. SCSI interfaces are complicated a bit by termination. Be sure that the drive is jumpered properly for its SCSI ID or EIDE "master" or "slave" relationship. Finally, be sure that the DVD drivers are installed and running. Check the drivers under the *Sound, video, and game controllers* (or *CDRO*M, as in Fig. 14-10) entry of your *Device manage*r.

**Symptom 3**. **The DVD motorized tray won't open or close** The most common issue here is the DVD application itself. Some DVD applications (such as DVD-Video player applications) will "lock" the disc tray closed while a video DVD disc is playing. Try closing all open applications. If the tray still won't open, try restarting the PC. This should clear any "software lock." If the tray still refuses to open or close, the drive itself might be defective—you can "force" the tray open using a straightened paper clip in the emergency eject hole in the front of the drive.

**Symptom 4. There is no audio when playing an audio CD** This is a common problem—especially during new DVD-ROM drive installations. Chances are that you did not connect the CD audio cable between the DVD-ROM drive and the sound board. If so, the cable might be reversed (or defective). Of course, if you're still using your original CD-ROM drive and the CD-ROM is connected to the sound board, there will be no CD audio from the DVD-ROM drive—there is no way to "parallel" or "gang" the sound cable. If the DVD-ROM audio cable is connected to the soundboard, be sure that the "CD-audio" input of your soundboard's mixer applet is turned up to a reasonable level.

**Symptom 5. There is no DVD audio while playing a movie or other multimedia presentation** Here's another common oversight during new DVD installations. Check the external audio cable attached between the MPEG-2 decoder board and the line input jack of your sound board. The cable might be plugged into the wrong jack(s), or the cable might simply be defective. Also check the soundboard's "mixer" applet and see that the *Line input* volume control setting is turned up to an acceptable level.

**Symptom 6. Video quality appears poor** MPEG-2 compression is well respected for its ability to reproduce high-quality images The problem with "poor" image quality is almost always because of your video configuration—your color Depth or resolution is too low. DVD-Video playback is best at resolutions of 800X600 or higher, and color depths of 16-bits (high color) or higher (i.e., 24-bit true color). In most cases, 256 colors will result in a "dithered" image.

**Symptom 7. The video image is distorted when trying to play an MPEG file Other video operations probably seem fine.** A full or partially distorted MPEG image can be the result of two problems. First, the video connections on the back of the card could be loose. Verify that all connections to the MPEG-2 decoder card are secure. Another common cause of distorted playbacks is that the refresh rate on your video card is set too high—it is recommended that the video refresh rate be kept below 85Hz when running MPEG files. Try adjusting the vertical refresh rate to 72Hz, or even 60Hz.

**Symptom 8. The picture is beginning to occasionally pixelize or "break apart" The audio might also seem periodically distorted.** It is highly likely that the DVD disc needs to be cleaned. Clean the DVD disc properly and try it again, or try another disc. Also try closing any unused applications running in the background. If the problem persists with another DVD disc as well (and if both discs are in good condition), try reinitializing the drive by powering down and rebooting the system. If the problem still persists, the internal optics of the DVD-ROM drive might need to be cleaned with a bit of photography-grade compressed air. Otherwise, try replacing the DVD-ROM drive.

**Symptom 9. The DVD-ROM light flashes regularly without a disc inserted System performance might be reduced.** This is often because the DVD-ROM drive's properties are set for *Auto insert notification* under Windows 95. Start the *Device Manage*r, highlight the DVD-ROM drive, and click the *Properties* button. You'll see the *DVD-ROM properties* dialog . In the *Options* area of the *Properties* dialog, locate the check box that says *Auto insert notificatio*n, and uncheck it. Save your changes (you might need to reboot the system). This should stop the drive's constant checking for a disc.

**Symptom 10. A "Disk playback unauthorized" error message appears The region code on the DVD disc does not match the code embedded into the drive.** Not much can be done when this error occurs. Notice that region code limitations are only applied to DVD-Video movie releases—programs and data discs are generally not marked with region codes.

**Symptom 11. An error indicates that the DVD device driver could not be loaded** You'll need to check the DVD driver installation, or manually install the drivers. To do this, you will need to open the *Control pane*l, open *System propertie*s, then select the *Device manager* tab. In the category of *Other device*s, select *PCI multimedia device* and click on *Propertie*s. In the *Properties* dialog, select the *Driver* tab and click on *Change* driver. Browse to the *DVD drivers installation disk* and click on *O*K. Click on *OK* again, select the proper MPEG board (such as "MKE DVD-AV Decoder Board"), and click on *OK* again. Exit the *PCI multimedia device properties* by clicking on *OK* again, and Windows 95 will copy over the proper drivers. You will then need to restart the machine.

**Symptom 12. You see an error, such as "Cannot open <filename>, video and audio glitches might occur"** This type of error almost always indicates a fault with the driver installation. You should rerun the "setup" utility, which accompanied your the DVD drive product.

**Symptom 13. The display turns magenta (red) when attempting to adjust the DVD video overlay feature** When adjusting the video overlay, you might have some trouble finding the video window. It often helps to change your background to magenta so you can see where the video window is. To do this, right click on your background, and select *Propertie*s. Select the *Background* tab and select "none" as both the *Pattern* and the *Wallpape*r. Then select the *Appearance* tab and select *Magenta* as the color of the desktop. Click on *OK* to finish changing your background color to magenta. It should now be easier to locate the video window while adjusting the overlay.

**Symptom 14. The DVD drive cannot read CD-R or Photo CD discs** This is not an error—most first-generation DVD drives will not read CD-recordable or Photo CD (Kodak) disks. In some cases, it is even possible to damage CD recordable disks because of the laser wavelength and energy used in the DVD drive. Do not attempt to read CD-R or Photo CD discs in the DVD unless the drive specifications specifically state that the drive is compatible with those types of discs.

# ZIP DRIVE TROUBLESHOOTING

**Symptom 1. An Iomega Zip drive displays a Floppy-disk icon under Windows 95 However, the drive appears to operate properly.** This is almost always because of the use of a real-mode DOS driver to support the Iomega drive and adapter. You will need to update the real-mode driver to an appropriate protected-mode driver for Windows95. For SCSI adapters, you need to find the protected-mode SCSI driver for your particular SCSI adapter and install it through the *Add new hardware* wizard in the *Control panel*. After the protected-mode driver is installed, you can remove the obsolete real-mode driver from CONFIG.SYS. For native Iomega SCSI adapters, get the protected-mode drivers directly from Iomega. For parallel-port Zip drives, uninstall the old drive software and install the new Windows 95 driver software.

**Symptom 2**. **The SCSI Zip drive has no drive letter under Windows 95 The drive does not appear to respond.** In virtually all cases, the SCSI driver has not loaded properly. First, open the *Device manager* and expand the *SCSI controllers* entry, then check the *Iomega adapter* line beneath it. If there is a yellow symbol with an exclamation mark on it, the Windows 95 driver did not load. Check the controller next by highlighting that *Iomega adapter* line, then select *Properties*. Click on the *Resources* page, then verify that your I/O range and IRQ options are set correctly—they must match the jumper settings on your adapter board. If you must update the resource settings manually, be sure that the *Automatic settings* box is not checked (and remember to save any changes). If you allocated new resources, you might have to shut off the PC and change jumper settings on
the controller board itself to match the resources allocated in the *Device manager*. Restart
the computer—once the system reboots, the Windows 95 driver should load normally. If problems persist, check the signal connector (especially for SCSI adapters). Be sure that the SCSI cable is intact and connected to the drive properly. If problems continue, your SCSI adapter is probably installed correctly, but the bus might be terminated improperly. Be sure that you terminate both ends of the SCSI bus properly.

**Symptom 3. The parallel-port Zip drive has no drive letter under Windows 95** Parallel-port drive problems can almost always be traced to faulty connections, port configuration issues, or driver problems. Check the external power connector first. Parallel-port drives are powered externally. Be sure that the power pack is working, and see that the power cable is connected properly to the drive. If the drive does not appear to power up, try a different power pack or drive. Check the signal cable next and be sure that you are using a good-quality, known-good parallel-port cable that is attached securely at the PC and drive. The Zip drive is very sensitive to devices, such as copy-protection modules (*dongles*), and other "pass-through" devices. Try connecting the drive directly to the parallel port. Also disconnect any printers on the parallel port. The parallel-port setup might be incorrect.

Reboot the PC and enter CMOS setup. Check to see that the parallel port is configured in EPP or bi-directional mode. If the problem continues in the EPP mode, try configuring the parallel port for "compatibility mode." For SCSI installations, check the SCSI host controller. There is a known incompatibility between the Iomega Zip drive and the Adaptec 284x adapter—the Iomega PPA3 driver does not work with the Adaptec 284x controller. Check with Iomega for an updated driver. The problem might be with your driver(s). Open the *Device manager* and find the *SCSI controllers* entry (even though it is a parallel-port device).

If there is no such entry, the driver is not installed. If you expand the *SCSI controllers* section, there should be an entry for the Iomega parallel-port Zip interface. If not, the driver is not installed. Check for hardware conflicts. If the *Device manager* entry for the Iomega parallel-port Zip interface has a yellow circle with an exclamation mark on it, the interface is configured improperly and is conflicting with other devices. Also check for device properties. Highlight the *Iomega parallel-port Zip interface* entry, click on *Properties*, then select the *Settings* page. Find the box marked *Adapter settings*, then type: /mode: nibble /speed:1 Save your changes and reboot the system. If that fails, try reinstalling the drivers. Highlight the *Iomega parallel-port Zip interface* and select *Remove*. Then reinstall the drivers from scratch. Next, try running in DOS. Start the PC in DOS mode (command prompt only), then install the Iomega installation disk and type: a:\guest <Enter>. If the Zip drive still does not receive a drive letter, the parallel port might be faulty or incompatible with the drive. Try the drive on another system. If this tactic works on another system, the problem is definitely related to your original PC hardware. If the problem follows the drive, the fault is likely in the drive. Try another drive.

**Symptom 4. The system hangs when installing drivers for Windows 95** System hang up during installation are usually the result of hardware conflicts or problems. Check the signal cable first and be sure that you are using a good-quality, known-good cable, which is attached securely at the PC and drive. Open the *Device manager* and find the *SCSI controllers*. If there is no such entry, the driver is not installed. If you expand the *SCSI controllers* section, an entry should be listed for the *Iomega parallel-port Zip interface*. If not, the driver is not installed. Check for hardware conflicts. If the *Device manager* entry for the Iomega parallel-port Zip interface has a yellow circle with an exclamation mark on it, the interface is configured improperly and is conflicting with other devices. Highlight the *Iomega parallel-port Zip interface* entry, click on *Properties*, then select the *Settings* page. Find the box marked *Adapter settings*, then type: /mode:niibble /speed:1 Save your changes and reboot the system. If problems continue, try running in DOS. Start the PC in DOS mode (command prompt only), then install the Iomega installation disk and type: a:\guest <Enter> If the Zip drive still does not receive a drive letter, the parallel port might be faulty or in-compatible with the drive. Try the drive on another system. If this tactic works on another system, the problem is definitely related to your original PC hardware. If the problem follows the drive, the fault is likely in the drive. Try another drive.

**Symptom 5. After installing a Zip drive, you find the other drives in the system are using the DOS-compatibility mode** This is almost always the result of the GUEST.EXE program. The real-mode GUEST.EXE program supplied by Iomega is designed to allow you to access the Zip drive in DOS and Windows 95, and this causes the other drives in your system to use the DOS-compatibility mode (you might also notice a decline in drive or system performance). Try installing the protected-mode drivers for the Iomega drive:

- In the *Control panel*, double click the *Add new hardware* icon.
- Click *Next*, click the *No* button, then click *Next*.
- Click *Other devices*, then click *Next*.
- In the *Manufacturers* box, click *Iomega*, then click *have disk*.

Install the files from the Windows 95 CD-ROM by inserting the CD-ROM in the drive, typing the following line in the *Copy manufacturer's files from* box, then clicking *Next*: <drive>:\drivers\storage\iomega where <drive> is the drive letter of the CD-ROM drive.

- After the files are copied, click *Finish*.
- Restart the computer when prompted to do so.

**Symptom 6**. **The Zip drive takes over the CD-ROM drive letter in Windows 95** You might simply need to switch drive letters between the Zip drive and CD-ROM drive:

- Open *Device manager* and double click on the *Disk drives* entry.
- Highlight the *Iomega Zip* drive entry and click on *Properties*.
- Click on the *Settings* page.
- In the *Reserved drive letters* section; there is a *Start drive letter* and an *End drive letter* setting. Enter the desired drive letter for the Zip drive in both start and end drive entries (be sure to use the same drive letter for both start and end). Click on *OK*.
- Doubleclick on the CD-ROM entry.
- Highlight your *CD-ROM drive* entry and click on *Properties*.
- Click on the *Settings* page.
- The *Reserved drive letters* section has a *Start drive letter* and an *End drive letter* setting.
- Enter the desired drive letter for the CD-ROM drive in both start and end entries (be sure to use the same drive letter for both start and end). Click on *OK*.
- Click on *OK* to close *Device manager*, then shut down and restart the computer.

**Symptom 7. Duplicate ZIP drive letters appear** you notice that the Zip drive (or another drive) has been assigned a duplicate drive letter. In most cases, the problem can be traced to a third-party SCSI adapter and drivers, which conflict with Iomega SCSI drivers. Do not use any drive before correcting this problem. Open your CONFIG.SYS file and examine each driver that scans the SCSI bus to assign drive letters. Chances are very good that you have a third-party driver, which is assigning a letter to the Zip drive, as well as an Iomega-specific driver assigning another letter to the Zip drive. Use a command-line switch with the third-party SCSI driver to limit the number of Ids that will be assigned.

**Symptom 8**. **A Zip guest locks up or cannot locate the drive or adapter** chances are that an ASPI manager referenced in the GUEST.INI file is conflicting with hardware in the PC. This often happens in systems with two SCSI adapters (and parallel ports). Try editing the GUEST.INI file. Open the GUEST.INI file on your Iomega install disk and specify which ASPI manager needs to load in order to access the Zip drive. Remember to make a backup copy of the GUEST.INI file before editing it. As an alternative, choose the Iomega SCSI adapter driver. If you are using a native Iomega SCSI adapter, choose the ASPI manager that applies to the adapter. Once you have identified the proper ASPI manager for your adapter, REM ark-out all of the other ASPI lines in GUEST.INI, except for the one that you need. If you are using a non-Iomega SCSI adapter, you will need to add the complete path and filename for the driver to GUEST.INI, and REM ark-out all of the other ASPI drivers. Once the GUEST.INI file is updated, save your changes and reboot the system, then run GUEST from the drive and directory containing the updated GUEST.INI file. If problems persist, try the drive on another system or try a new drive on the suspect system.

## Tape-Drive Troubleshooting

The motors, sensors, and mechanisms in a typical tape drive are all prone to eventual failure. Even the natural wear that occurs in mechanical systems has an impact on drive performance and data-error rates. This part of the chapter is intended to provide some general service guidelines and basic troubleshooting procedures. Bear in mind that tape drives (especially helical drives, such as DAT drives) contain a substantial amount of mechanical and electro-mechanical components. Given the nature of mechanical parts, many of your problems will be mechanically oriented. The following tips might help resolve some basic problems:

- Be sure that the tape drive's firmware is upgraded to the latest revision. This is especially important with more "intelligent" drives, such as DAT drives.
- Be sure that you're using the very latest drivers and tape-drive application software.

- Keep the drive clean by following the routine cleaning procedures for the drive. This is especially important after heavy usage or when "breaking in" new media.
- Poor media is often a source of errors. Identify and remove questionable media as soon as possible. Rotate aging media out of service regularly.
- Be sure that any tape-drive controller is installed and configured properly.
- Verify the drive-signal cabling is correct and intact.
- Check drive power. Do not "split" power from a hard drive or other crucial drive.
- Drives often use LEDs to indicate errors. Check any drive LED signals against the drive's user manual.

**SYMPTOMS**

**Symptom 1**. **The tape drive does not work at all** Begin your repair by checking for obvious setup-and-configuration errors. First, be sure that power is available to the drive (a power indicator will usually be lit on the drive). An internal tape drive is usually powered from the host computer, so be sure that the internal 4-pin power connector is correctly attached. External drives are almost always powered from a separate ac adapter or power supply, but a few proprietary drives can be powered through their interface cables. Check the output of any external ac adapter or power supply. If the ac adapter output is low or non-existent, replace the ac adapter. Check that the interface cable between drive and tape-controller card is connected properly. Also check that your backup software is running and properly configured to your particular drive. If you are troubleshooting a new, unproved installation, inspect the tape controller board address, interrupt, and DMA settings as necessary—configuration conflicts can lock up a software package or render a drive inoperative. Check the tape itself to be sure it is inserted properly and completely. If power, interface cables, and software setup check properly, your trouble is likely in your drive or host controller. Ideally, your next step would be to isolate further by substitution. Try a known-good tape drive and/or controller card in your system. For most of us, however, tape drives are few and far between, so simply "plugging in" a compatible system from a friend or colleague is not nearly as likely as it would be with floppy or even hard drives. If an ordinary floppy-drive controller board is controlling your tape drive, turn system power off and try disconnecting your tape drive and plugging in a floppy drive. When power is restored, you might have to disable any TSRs installed (to manage the tape drive) and change the CMOS system setup so that the floppy drive will be recognized. If your test floppy drive works properly, you can be confident that the controller board works properly. The problem is then likely in your tape drive or the problem is still in your tape system setup. If you cannot get the test floppy drive to work, the floppy-controller board might be defective, so try a new controller board. If a new controller board supports the test floppy drive, return the floppy drive to its original port, reinstall the tape drive, restore the system setup for the tape drive, and try the tape drive again.

As an alternative to hardware swapping, many drives are now shipped with a simple diagnostic routine on the installation disk. Try a diagnostic if it is available. If a diagnostic recognizes the controller, but not the drive, the drive is either defective, or is connected or setup incorrectly. You might see an error message, such as "No tape drive found." If the diagnostic does not recognize the tape controller at all, the controller is probably defective, or the controller is configured improperly. A typical error message might be something like "No tape controller found."

**Symptom 2**. **The tape does not read or write, but the tape and head seem to move properly** You will probably find read/write errors indicated by your backup software. Start your repair by inspecting the tape cartridge itself. The cartridge should be inserted completely and properly into the drive, and sit firmly over the reel. If the current tape is inserted properly, try loading from another tape. Old tapes might have degraded to a point where data can no longer be read or written reliably. If an alternate tape works properly, discard and replace the old tape. If problems persist, try cleaning the tape drive's R/W heads. Excessive buildups of dust or residual oxides can easily interfere with normal tape recording/playback operations. If you still encounter R/W trouble, the R/W heads or their associated circuitry has probably failed. Try replacing the tape drive.

**Symptom 3**. **The R/W head does not step from track to track The remainder of the drive appears to work properly.** This problem might also result in tape read or write errors. The head assembly must step across very small tracks laid out along the width of the tape. Depending on the vintage of tape and drive you are faced with, the tape might have 9 to 144 tracks. When the tape reaches its end, the head is positioned to another track, tape direction reverses, and reading or writing continues. Two physical elements are responsible for positioning a R/W head: a head-stepping motor and a mechanism called the *head-seek assembly*. A defect or jam in either one of these components can prevent the head from moving. You can see the stepping motor in the underside view of Check the LED/sensor pair that detect the EOT/BOT holes. If the LED transmitter or phototransistor receiver is defective, the drive will not know when to switch tracks. Remove the tape and place your multimeter across the receiving sensor. As you alternately pass and interrupt the light path from transmitter to receiver, you should see the logic output from the detector sensor switch from logic 1 to logic 0 (or vice versa). If the sensor does not work, replace the LED and phototransistor, and try the sensor pair again. If the sensor pair still malfunctions, replace the drive's control PC board, or replace the entire drive. If problems persist, the drive's control circuitry has probably failed. Try replacing the drive.

**Symptom 4**. **The tape does not move or its speed does not remain constant** When a tape is set into motion for reading or writing, it is vitally important that tape speed remain constant. Tape speed is a function of the reel motors and the encoder, which produces speed feedback signals. Begin by removing the tape and check for any accumulation of dust and debris that might be interfering with drive operation. Carefully clear away any obstruction that you might find. If the tape does not move, check the dc motor signal across the reel motor(s) with your multimeter. When activated, about +12 Vdc should be across the appropriate motor (forward or reverse motor, depending on the tape's initial direction). If no excitation voltage is present, a fault is probably in the drive's control PC board. Try replacing the drive-control PC board or replace the entire drive. If drive voltage is present, but the tape does not turn, replace both reel motors or replace the drive. If the reel motors turn as expected, but their speed is not constant, the problem might be in the encoder. Tape is normally kept in contact with a rubber encoder roller. As a tape moves, the encoder roller turns and spins the encoder. Pulse signals from the encoder are used by the drive-control PC board to regulate reel motor speed. Check the encoder roller. Tighten the encoder roller if it is loose or worn. A heavily worn encoder roller should be replaced. Be sure that one roller turn results in one encoder turn—the roller must not slip on the encoder shaft. Place your logic probe on the encoder output and check for pulses as the tape moves. If there are no pulses, replace the defective encoder or replace the drive. If pulses are present, replace the drive's control PC board or replace the entire drive.

**Symptom 5**. **There are problems in loading or ejecting the tape** Most of the mechanisms for loading or unloading a tape are incorporated directly into the drive chassis itself. Physical abuse and the accumulation of dust and debris can eventually cause problems in your tape-handling mechanisms. Before you disassemble your drive, however, check your tape very carefully. Old tapes can jam or wear out, and some tapes (such as Teac's digital cassette) can only be inserted into the drive in one orientation. Try a fresh tape and be sure that the tape is inserted properly into the drive. If the tape continues to load or unload with resistance, expose the drive's mechanical assemblies and inspect all levers and linkages for any signs of obstruction or damage. Gently clear away any obstructions that you might find. You might wish to use a fresh, dry cotton swab to wipe away any accumulations of debris. Do not add any lubricant to the load/unload mechanism, unless lubricant was there to begin with. Then, use only the same type of lubricant. Replace any components that show signs of unusual wear. Use extreme caution when working with tape assemblies. Mechanical systems are very precisely designed, so make careful notes and assembly diagrams during disassembly. An improperly reassembled mechanical system might damage the tape or hold the tape in an improper position, resulting in read/write or motor-speed errors. If you cannot rectify the problem, replace the drive outright.

**Symptom 6**. **The drive writes to write-protected tapes** When a tape is write protected, the drive should not be able to write to that protected tape. Your first step should be to remove and inspect the tape itself. Check to be sure that the write-protect ever is in the "protect" position. If the protect lever is not in the right place, the tape is vulnerable to writing. If the tape-protect lever is set properly, expose the drive mechanism and place your voltmeter across the sensor's output. Alternately, interrupt and free the optoisolator beam by hand and watch the sensor's output on your multimeter. If the output switches logic levels as you actuate the sensor manually, the trouble is probably in your drive's control PC board. Replace the drive-control PC board or replace the entire drive. If the output does not shift logic levels as expected, the sensor might be defective. Replace the write-protect sensor and repeat your test. If the sensor remains inoperative, replace the drive-control PC board or replace the entire drive.

**Symptom 7**. **The drive does not recognize the beginning or end of the tape** A tape drive must know when the end or beginning of a tape has been reached. The majority of tapes use a series of small holes at each end of the tape. An optoisolator provides a pulse signal to the drive-control PC board when holes pass by. Begin by removing the tape and checking for the presence of end holes. The wrong type of tape (i.e., a tape without holes) can cause problems for the drive. If the wrong type of tape is being used, retry the system using the correct type of tape. Focus next on the BOT/EOT sensor, which is an optoisolator located across the tape path (an LED on one side and a detector on the other). Remove the tape, expose the system and place your multimeter across the detector's output. Alternately, interrupt and free the light path by hand and watch the detector's output on your multimeter. If the output switches logic levels as expected, the trouble is probably in your drive's control PC board. Replace the drive-control PC board, or replace the entire drive. If the output does not shifts expected, replace the LED source and detector elements together, then retest the sensor air. If the sensor remains inoperative, replace the drive-control PC board or replace the entire drive.

**Symptom 8**. **A software program using a hardware copy-protection device on the parallel port locks up** This symptom is typical of parallel-port tape drives. The backup software attempts to communicate with the tape drive, but it winds up communicating with the copy-protection device instead. You can either switch the tape to a free parallel port or remove the copy-protection device.

**Symptom 9**. **The backup software indicates "Too many bad sectors" on the tape You might also see an error such as "Error correction failed."** This type of error generally indicates that more than 5% of the sectors on a tape are unreadable. In many cases, this is caused by dirty R/W heads. Try cleaning the R/W head assembly. If problems continue, try a new tape cartridge. If problems persist, check the drive's power and signal cables and be sure that they are installed properly and completely.

**Symptom 10. The tape drive works in DOS, but refuses to work in Windows 95** First, be sure that the backup software you're using under Windows 95 is able to detect the tape drive. If the backup software is working properly, chances are that one or more Windows 95 drivers are interfering with the tape drive. Try starting Windows 95 in the safe mode and try your tape access again. If the tape drive is accessible now, you're going to have to check for driver conflicts. This often happens with parallel-port tape backups when Windows 95 drivers block parallel-port access using third-party printer drivers loaded by SYSTEM.INI. You should check the [386Enh] section of SYSTEM.INI and use semi-colons to "remark out" any offending "device=" lines.

## SERIAL (RS232) PORT TROUBLESHOOTING

### SYMPTOMS

**Symptom 1. You hear a beep code or see a POST error, which indicates a serial-port fault.** The system initialization might or might not halt, depending on how the BIOS is written. Low-level initialization problems generally indicate trouble in the computer's hardware. If the computer's beep code sequence is indistinct, you could try rebooting the computer with a POST analyzer card installed. The BIOS POST code displayed on the card could be matched to a specific error explanation in the POST card's documentation. Once you have clearly identified the error as a serial-port fault, you can proceed with troubleshooting. Start with the system as a whole and remove any expansion boards that have serial ports available. Retest the computer after removing each board. If the error disappears after removing a particular card, then that card is likely at fault. You can simply replace the card with a new one or attempt to repair the card to the component level. If only one serial port is in the system, it is most likely built into the motherboard. Again, you can replace the defective UART, replace the motherboard or disable the defective motherboard port.

**Symptom 2. An 11xx or 12xx serial adapter error is displayed A hardware fault has been detected in one of the COM ports.** The 11xx errors typically indicate a fault in COM1, while 12xx errors suggest a problem with COM2, COM3, or COM4. In most cases, the fault is in the UART. You have the option whether to replace the UART IC, replace the motherboard, or disable the defective COM port and replace it with an expansion board.

**Symptom 3. The computer initializes properly, but the serial peripheral does not work** Your applications software might indicate that no device is connected. Before you even open your tool kit, you must determine whether the trouble lies in your computer or your peripheral. When your modem or printer stops working, run a self-test to ensure the device is at least operational. Check all cables and connectors (perhaps try a different cable). Also be sure to check the software package being used to operate the serial port. Ensure that the software is configured properly to use the appropriate COM port and that any necessary drivers are selected.

Disconnect the peripheral at the computer and install a serial loop back plug. Run a diagnostic to inspect each available serial port. Take note of any port(s) that register as defective. Locate the corresponding serial port. If the port is installed as an expansion board, replace the defective expansion board. If the port is on the motherboard, you can replace the defective UART IC, install an alternate expansion board or replace the motherboard outright.

**Symptom 4. Data is randomly lost or garbled** Your first step should be to check the communication cable. Be sure that the cable is intact and properly secured at both ends. Try a different cable. If the cable checks properly, either the port or peripheral is at fault. Start by suspecting the serial port. Be sure that the DTE and DCE are both set to use the same data frame and data rate. Incorrect settings can easily garble data. If problems persist, disconnect the printer at the computer and install a serial loop back plug. Run a diagnostic to inspect each available serial port. Take note of any port(s) that register as defective. Locate the corresponding serial port(s). If the port is installed as an expansion board, replace the defective expansion board. If the port is on the motherboard, you can replace the defective port-controller IC, install an alternate expansion board, or replace the motherboard outright. If you can not test the computer's serial port directly, test the port indirectly by trying the peripheral on another known-good computer. If the peripheral works properly on another computer, the trouble is probably in the original computer's serial-port circuitry. Replace any defective circuitry or replace the motherboard. If the peripheral remains defective on another computer, the peripheral itself (i.e., printer or modem) is probably faulty.

**Symptom 5. LapLink does not recognize the IR COM port When you attempt to use LapLink with virtual COM ports created by an infrared adapter, you might receive the following error message: This port is unavailable:** it might not be physically present in this computer. If no other communications program is currently running, check for a mouse or other serial device on this port. This problem occurs because LapLink accesses the hardware directly to determine the status of the COM port and does not recognize virtual COM ports created using the infrared adapter. To work around this problem, you'll need to contact Traveling Software for a possible patch for LapLink or discard the use of LapLink in favor of the *Direct Cable Connection (DCC)* tool included with Windows 95.

**Symptom 6. Problems occur when maintaining an IR connection in the daylight** This problem is common with all infrared devices, and is usually caused by "interference" from the natural IR component of ordinary sunlight. Try shortening the transmission distance between the transmitter and receiver, and be sure that the path between the two is as straight as possible.

## PLUG AND PLAY DEVICES

### SYMPTOMS

**Symptom 1. Windows 95 fails to recognize the computer as "Plug and Play"** This type of problem often occurs with Intel OEM motherboards. Windows 95 does not recognize the computer as a Plug-and-Play platform—even though you receive a message during startup, such as: "Intel PnP BIOS Extensions Installed." Intel has developed some OEM motherboards that are equipped with a Plug-and-Play BIOS that does not contain the run-time services necessary to configure motherboard devices. An example of such a motherboard is the Intel P5/90. Gateway 2000 (and possibly other OEMs) ship computers with the P5/90 motherboard. You'll need to upgrade the system BIOS to comply with the Plug-and-Play BIOS version 1.0a specification (or later).

**Symptom 2. The IRQ conflicts with PCI display adapters** When you in-stall a PCI video adapter that is configured to use a particular interrupt (IRQ), Windows 95 might configure it to use another IRQ that is already in use by another device. Although PCI devices can share PCI IRQs, Windows 95 does not support sharing PCI IRQs with other non-PCI devices (such as an IDE controller). Use the *Device manager* to resolve the conflict by assigning a different IRQ to one of the conflicting devices (usually the new PCI video adapter).

**Symptom 3. The resources for disabled devices are not freed** Even though you disable a device in your computer's CMOS setup, Windows 95 re-enables the device and allocates its resources. Windows 95 might also reinstall a device that is removed from *Device manager*. This happens because Windows 95 detects Plug-and-Play devices, regardless of the CMOS setup. To prevent Windows 95 from re-activating disabled hardware, you must disable the hardware in the computer's CMOS setup and remove it from the current configuration in Windows 95. This frees the device's resources for other devices to use:

1 Click the *Start* button, point to *Settings*, then click *Control panel*.
2 Double click the *System* icon.
3 Click the *Device manager* tab, then doubleclick the device you want to disable.
4 Click the *General* tab, then click the *Original configuration (current)* check box to clear it.
5 Click the *OK* button.
6 Restart Windows 95 when prompted.
7 Immediately start the CMOS setup routine and disable the device in the CMOS setup.
8 Save the changes to CMOS, and allow the system to boot normally. When you disable a device in Device manager, you must restart your computer first.

**Symptom 4. An AST PnP BIOS is not registered as PnP The AST Plug-and- Play BIOS is not registered as being Plug-and-Play capable under Windows 95.** This is usually because the AST PnP BIOS contains incorrect information in its 16-bit protected- mode entry point. When Windows 95 detects this incorrect code in the AST BIOS it will not recognize the BIOS as being Plug-and-Play capable. You will need to contact AST for a BIOS upgrade.

**Symptom 35-5. A PnP ISA adapter is not recognized automatically** If you insert a PnP ISA adapter in a computer whose motherboard does not contain PCI slots, Windows 95 might not recognize the new ISA adapter automatically. The *Device manager* might also display a "PCI bus" entry with an exclamation point in a yellow circle, with the status "No Plug-and-Play ISA bus was found. (Code 29)." A PnP BIOS that is not supported by Windows 95 on computers that have a PCI BIOS, but not a PCI bus typically causes this problem. On PCI computers, usually the PCI driver starts the PnP ISA driver. If the PCI driver fails, the ISA driver is not loaded; therefore, PnP ISA adapters are not automatically recognized or configured. To add a PnP adapter so that Windows 95 automatically recognizes it, enable the ISA PnP bus manually:

1 In *Control panel*, double click the *Add new hardware* icon, then click *Next*.
2 Click *No*, then click *Next*.
3 Click *System devices*, then click *Next*.
4 Click *ISA Plug-And-Play bus*, then click *Next*.
5 Click *Finish*.
6 Restart your computer when you are prompted to do so.

**Symptom 6. The computer no longer operates properly after docking or undocking** As an example, the keyboard or mouse might stop working. *Hot docking* and *hot undocking* refer to inserting the computer in a docking station or removing it from the docking station while the computer is running at full power. By contrast, *warm docking* refers to docking or undocking the computer while it is in suspend mode. Laptop or portable computers with a PnP BIOS can be hot or warm docked or undocked. In virtually all cases, the computer does not have a suitable PnP BIOS (this is mandatory for hot or warm docking and undocking). To correct this problem on a permanent basis, you'll need to upgrade the laptop's BIOS to a version that supports PnP. In the mean time, you can work around this problem by turning the computer off before you dock or undock it.

**Symptom 7. Serial PnP devices are not recognized when an adapter is used to connect them** For example, when you use a 9-pin to 25-pin serial adapter with a serial PnP device, the device might not be enumerated by the configuration manager at startup. This is caused by the adapter—some 9-pin to 25-pin serial adapters do not connect the lines that pass the PnP initialization string (including adapters made by Microsoft before the release of Windows 95). Try another (more current) serial adapter. If the problem persists, add the device manually using the *Add new hardware* wizard in the *Control panel*.

**Symptom 8. Windows 95 Setup hangs up when detecting SCSI controllers** This often happens with Adaptec SCSI controllers on the first reboot while PnP devices are being detected, and is known to happen when a SCSI hard disk is supported by an Adaptec AHA 2940, Adaptec 2940AU, or Adaptec 2940W controller. You can work around this problem by disabling the SCSI controller and allowing *Setup* to finish the PnP device detection:

1 Enable PnP SCAM support in the Adaptec SCSI controller BIOS setup.
2 Disable *BIOS Support For Int13 Extension* in the Adaptec SCSI controller BIOS setup.
3 Restart Windows 95, press the <F8> key when you see the "Starting Windows 95" message, then choose *Safe mode* from the *Startup* menu.
4 In *Control panel*, doubleclick the *System* icon, click the *Performance* tab, click *File System*, then click the *Troubleshooting* tab.
5 Enable the following two options: "Disable protect-mode hard-disk interrupt handling" and "Disable all 32-bit protected-mode disk drivers."
6 Click *OK*, then click *OK* again.
7 When you are prompted to restart your computer, click *yes* to continue with *Setup*.
8 After Windows 95 is installed, disable the options you enabled in step 5.

**Symptom 9. After installing an HP OfficeJet 300 printer, a "Fatal exception error" occurs each time you run the Add new hardware wizard You'll typically see Exception Errors 06, 0E, 0C, or 0D.** This is because the HP OfficeJet Series 300 *Device manager* contends with Windows 95 for control of PnP. The HP installation process sets up a shortcut in the *Startup* folder that runs "HPOJDMAN.EXE /AUTOPROMPT." This causes HPOJDMAN.EXE to run in the background. Start the *Close program* dialog box by pressing <Ctrl>+<Alt>+<Delete>. Click *HPOJDMAN* in the list of tasks, then click *End task*. Check with HP (**http://www.hp.com**) for updated printer software utilities.

**Symptom 10. The PS/2 mouse is disabled after installing an ISA PnP device** For example, installing a SoundBlaster 16 "value" sound card disables the PS/2 mouse. This problem can occur on computers where the PnP BIOS (rather than Windows 95) assigns resources to ISA PnP devices. The PnP BIOS might assign IRQ 12 to the IDE drive and disable the mouse port. To correct this problem, disable the BIOS PnP support in the computer's CMOS setup to allow Windows 95 to configure the hardware instead.

**Symptom 11. When running the Add new hardware wizard, it doesn't detect a device that has been removed in Device manager on a multiple-profile system** This is because removing a PnP device from one profile and leaving it in another causes a flag to be set in the registry to prevent the device from being enumerated on the next startup. This might also cause the *Add new hardware* wizard to bypass the device. The flag exists only in the profile in which the device was removed.

To prevent this type of problem from occurring, disable the device in *Device manager* instead of removing it. To disable a device, click the *Disable in this hardware profile* check box for the device in *Device manager*. To restore (or re-detect) the device, remove it from all profiles, then run the *Add new hardware* wizard.

**Symptom 12. An extra serial port is displayed in the Device manager** When you are using Windows 95 OSR 2 or 2.1, you might see an extra communications port in *Device manager*. An exclamation point is in a yellow circle next to the port. If you remove the port, it is re-detected again the next time you restart your computer. The computer's PnP BIOS is probably reporting (incorrectly) that the COM ports are not using re-sources— although they were detected during *Setup*. This is a problem with Windows 95. Check with Microsoft (**http://www.microsoft.com**) for any available upgrades or patches.

**Symptom 13. Windows 95 cannot setup with a PnP program active When you try to install Windows 95, you might receive the following error message: A fatal exception OE has occurred at 0028:xxxxxxxx in VxD VMM(06) + xxxxxxxx Or, you might receive a Vwin32 error message displayed on a blue screen, a registry error message, or a *general-protection (GP) fault* error message.** This problem can occur if you have a PnP program active in memory when you try to install Windows 95. To work around this issue, install Windows 95 from a command prompt. Restart the computer. When you see the "Starting Windows 95" message, press the <F8> key, then choose *Command prompt only* from the *Startup* menu. At the command prompt, type: <drive>:\setup.exe where <drive> is the drive containing your original Windows 95 setup disk or CD-ROM.

**Symptom 14. An IBM ThinkPad doesn't support PnP under Windows 95** Chances are that the ThinkPad required a BIOS update. The following IBM ThinkPad models are known to need specific BIOS versions:

- ThinkPad 750 family: 750/360/755 System Program Service Diskette version 1.20 (or later).
- ThinkPad 755C/Cs and 360/355 family: 750/360/755 System Program Service Diskette version 1.20 (or later).
- ThinkPad 755CE/CD, ThinkPad 755CX/CV, ThinkPad 755CDV: 755 System Program Service Diskette version 1.30 (or later).
- ThinkPad 701C: 701C System Program Service Diskette version 3H (or later).
- ThinkPad 340CSE and 370C: 340 System Program Service Diskette version 1.10 (or later).

The following ThinkPad models require APM BIOS 1.1 (or later) and PnP BIOS 1.0a (or later) for these features to work correctly with Windows 95:

- ThinkPad 755C/Cs
- ThinkPad 360/355 family
- ThinkPad 755CE/CD/CX/CV/CDV
- ThinkPad 340CSE
- ThinkPad 370C
- ThinkPad 701C
- ThinkPad 530CS

The following ThinkPad models require APM BIOS version 1.0 to work correctly with
Windows 95. There is no PnP BIOS support for these models:

- ThinkPad 750 family
- ThinkPad 340 monochrome display system
- ThinkPad 230Cs

**Symptom 15. A PnP pointing device is not detected** When you connect a PnP pointing device (e.g., Microsoft PnP serial mouse, Microsoft EasyBall, or Microsoft IntelliMouse), the new device might not be detected by Windows 95. Running the *Add new hardware* wizard does not correct the problem. This is almost always because the registry entries for your previous pointing device were not properly removed from the registry. This problem is known to occur when your previous pointing device was a Microsoft, Microsoft-compatible, or Logitech mouse. To work around this problem, use the registry editor (REGEDIT) to remove the registry entries for your previous pointing device. Remove the following registry keys: Hkey_Local_Machine\System\CurrentControlSet\Services\Class\Mouse\<nnnn>wher e <*nnnn*> is an incremental four-digit number starting at 0000. Also remove the following registry keys (if they exist): Hkey_Local_Machine\Enum\Root\Mouse\<nnnn>
where <*nnnn*> in an incremental four-digit number starting at 0000. Remove all registry keys under the following registry key (if they exist): Hkey_Local_Machine\Enum\Serenum
Remove the following registry key (if it exists):
Hkey_Local_Machine\Software\Logitech\Mouseware Use the right mouse button to click *My computer*, then click *Properties* on the menu that appears. Click the *Device manager* tab. Click each serial pointing device, then click *Remove*. Click *OK*, then restart Windows 95. When you restart Windows, the attached pointing device will be detected and the appropriate drivers will be installed.

**Symptom 16**. **The PnP printer is re-detected every time Windows 95 starts** This occurs even when the printer is already installed. When you start Windows 95, the following message might be displayed: New Hardware Found <device> Windows has found new hardware and is installing the software for it This problem is known to occur with Hewlett-Packard 4L and Hewlett-Packard DeskJet 660C PnP printers, and

is usually caused by damage to the following registry key: Hkey_Local_Machine\Enum\Lptenum Remove the registry key, then restart your computer. When Windows 95 starts, it will detect the printer and install support for it. Once the printer is installed, it will no longer be detected each time you start Windows 95.

**Symptom 17. After installing Windows 95, none of the APM features were installed** You might also notice that there is no "battery meter" for laptops. Some computers and BIOS revisions have known incompatibilities with the APM 1.1 specification. You are probably running Windows 95 on such a computer. As a result, the hardware "suspend" functions of your computer should still function correctly, but you cannot use the Windows 95 APM features. Windows 95 turns off APM support completely on the following computers:

- AMIBIOS 07/08/1994
- AMIBIOS 07/08/94
- Any Gateway ColorBook >1.0 w/SystemSoft BIOS
- Any Gateway ColorBook with APM 1.0
- AST Ascentia 900N
- Canon Innova 150C
- DECpc LPv+ 1.00
- DECpc LPv+ 1.01
- DECpc LPv+ 1.02
- NCR/AT&T 3150
- Ultra laptop 486sx33
- Wyse Forte GSV 486/66
- Zenon P5/90

Windows 95 turns off power status polling (so you do not see a battery meter) on the fol-lowing computers:

- IBM ThinkPad 500
- LexBook
- WinBook

Windows 95 uses APM 1.0 mode on NEC Versa and AT&T Globalyst systems with APM 1.1 BIOS and no Plug-and-Play BIOS. The following IBM ThinkPad computers support APM 1.1:

- ThinkPad 755C
- ThinkPad 360/355 Family
- ThinkPad 755CE/CD/CX/CV/CDV
- ThinkPad 340CSE
- ThinkPad 370C
- ThinkPad 701C
- ThinkPad 530CS

The following IBM ThinkPad computers work with Windows 95, but only APM BIOS 1.0 is supported:

- ThinkPad 750 family
- ThinkPad 340 (monochrome)
- ThinkPad 230Cs

The ASUS PCI/I P55SP4 motherboard with a SiS 5511/5512/5513 chipset and an Award BIOS has been known to exhibit similar problems (the battery meter might appear on the *Taskbar* when it should not). This problem should be fixed with PnP BIOS version 0110 (11/21/95) for revision 1.2 and 1.3 motherboards. Revision 1.4 motherboards have this fix using PnP BIOS version 0303 (11/21/95).

**Symptom 18. The Device manager reports a "PCI-to-ISA bridge conflict"** The *Device manager* displays a PCI-to-ISA bridge entry with as exclamation point in a yellow circle, indicating a resource conflict. A PnP BIOS that reports both a PCI and an ISA bus typically causes this problem, but only an ISA bus is present, so there is no actual conflict. You'll need to update the PnP BIOS to a version with better detection and reporting capability.

**Symptom 19. The PnP BIOS is disabled on a laptop or notebook computer** When you install Windows 95 on a dockable notebook computer with a PnP BIOS, you see no "Eject PC" command on the *Start* menu when the notebook computer is docked in a docking station. Also, no PnP BIOS node is displayed in *System devices* under the *Device manager*. This problem was known to occur on IBM ThinkPad (360/750/755 series) dockable notebook computers with a PnP BIOS; it occurs because early versions of dockable notebook computers with PnP BIOS are not fully compatible with Windows 95. When a PnP BIOS is disabled in Windows 95, certain features (such as warm docking) no longer work. To make your dockable notebook computer compatible with Windows 95, contact the manufacturer of your notebook computer and obtain the most recent PnP BIOS.

**Symptom 20. The sound device on a DEC HiNote Ultra isn't working** When you install Windows 95 over an existing Windows for Workgroups 3.1x or Windows 3.1x installation on a DEC HiNote Ultra computer with a PnP BIOS, the sound device no longer works properly. Also, the wrong sound device is installed in Windows 95. This is a PnP BIOS problem—early versions of the DEC HiNote Ultra shipped with a PnP BIOS are not compatible with Windows 95. Contact DEC and obtain the most recent PnP BIOS for the DEC HiNote Ultra.

**Symptom 21. Device resources are not updated in a "forced" configuration** You'll notice that an exclamation point appears over a resource icon in *Computer properties* in *Device manager*, or that changes you make to the resources assigned to a PnP device in the computer's CMOS setup are not reflected in the *Settings* column in *Computer properties* under *Device manager*. This is because the device is using a "forced" configuration instead of an automatic configuration.

To remove a "forced" configuration and allow the PnP device to be fully configurable by the computer's BIOS and Windows 95, set the device to use automatic settings:
1 Doubleclick the *System* icon in *Control panel*.
2 Click the *Device manager* tab.
3 Doubleclick the device, then click the *Resources* tab.
4 Click the *Use automatic settings* check box to select it.
5 Click *OK*.

**Symptom 22. Restarting the computer causes the PC to hang** This often happens when you try to restart your computer using the *Restart the computer* option in the *Shut down windows* dialog box. This problem can occur on computers with a BIOS that expects IRQ 12 to be used by a PS/2-style mouse port, but instead have a software-configurable hardware device (such as a PnP adapter) using IRQ 12. To work around this problem, reserve IRQ 12 in *Device manager* or change the IRQ for the software-configurable device in *Device manager*. You might also want to consider upgrading the BIOS in the computer to a later version. To reserve an IRQ with *Device manager*:
1 In the *Control panel*, doubleclick the *System* icon.
2 On the *Device manager* tab, doubleclick *Computer*.
3 On the *Reserve resources* tab, click the *Interrupt Request (IRQ)* option, then click *Add*.
4 In the *Value* box, click the IRQ that you want to reserve.
5 Click *OK* until you return to *Control panel*.

**Symptom 23. Adding a PCI device to a Dell Dimension causes the system to hang in Windows 95** The BIOS in the Dell computer has probably configured the new PCI device to use IRQ 10, but another legacy device installed in the system is already configured to use IRQ 10. Although Windows 95 is designed to recognize resource conflicts such as this, this particular conflict causes the computer to hang before the Windows 95 *Configuration manager* recognizes that the conflict exists. Although the PCI bus is normally a PnP-compatible bus, the BIOS in Dell Dimension computers statically allocates IRQ 10 to a new PCI device—there is no way to disable this behavior. To work around this problem, configure the existing legacy device to use an IRQ other than IRQ 10.

**Symptom 24. You cannot configure disabled devices in the Device manager When you're using a PnP BIOS,** you might not be able to configure (through *Device manager*) a device that has been disabled in the BIOS—even though the BIOS supports configuring devices for the next time the computer starts. When you click the device in *Device manager*, then click *Properties*, you see a message, such as: The device has been disabled in the hardware. In order to use this device, you must re-enable the hardware. See your hardware documentation for de tails This is a problem with Windows 95. You'll need to enable the device in the BIOS before you try to configure it in *Device manager*.

**Symptom 25. A Toshiba T4900 laptop doesn't switch from LCD to external monitor** If you place a Toshiba T4900 computer into its docking station while Windows 95 is running (a "warm dock" operation), the display might not switch from the LCD screen to the external monitor. Toshiba's PnP BIOS does not switch the display properly between the LCD screen and an external monitor. For a short-term work around, press the <F5> key to manually toggle the display between the LCD screen and the external monitor. In the mean time, contact Toshiba for a PnP BIOS upgrade.

**Symptom 26. A third port is detected with a CMD PCI dual-port IDE controller** When using a CMD PCI Dual Port IDE controller (with at least one device on both the primary and secondary port), the *Device manager* displays a third port. This "false" third port is displayed with an exclamation point inside a yellow circle. This happens because the PnP BIOS in your computer is erroneously reporting that a third port is present. Windows 95 does not allocate any resources to the third port, and the existence of the third port in *Device manager* should not cause any problems. However, if you want to disable the third port, follow these steps:

1 Use the right mouse button to click *My computer*, then click *Properties* on the menu that appears.
2 Click the *Device manager* tab.
3 Click the third port, then click *Properties.* You might need to expand a branch of the hardware tree by double-clicking the branch, or by clicking the plus sign (+) to the left of the branch, before you can click the port.
4 Click the *Original configuration (current)* check box to clear it, then click *OK*.

## MONITORS

**F**rom their humble beginnings as basic monochrome text displays, the *monitor* has grown to provide real-time photo-realistic images of unprecedented quality and color. Monitors have allowed real-time video playback, stunning graphics, and information-filled illustrations to replace the generic "command line" user interface of just a few years ago. In effect, monitors have become our "virtual window" into the modern computer. With many millions of computers now in service, the economical maintenance and repair of computer monitors represents a serious challenge to technicians and hobbyists alike. Fortunately, the basic principles and operations of a computer monitor have changed very little since the days of "terminal displays." This chapter explains the basic concepts behind today's computer monitors, and provides a cross-section of troubleshooting procedures.

## CRT

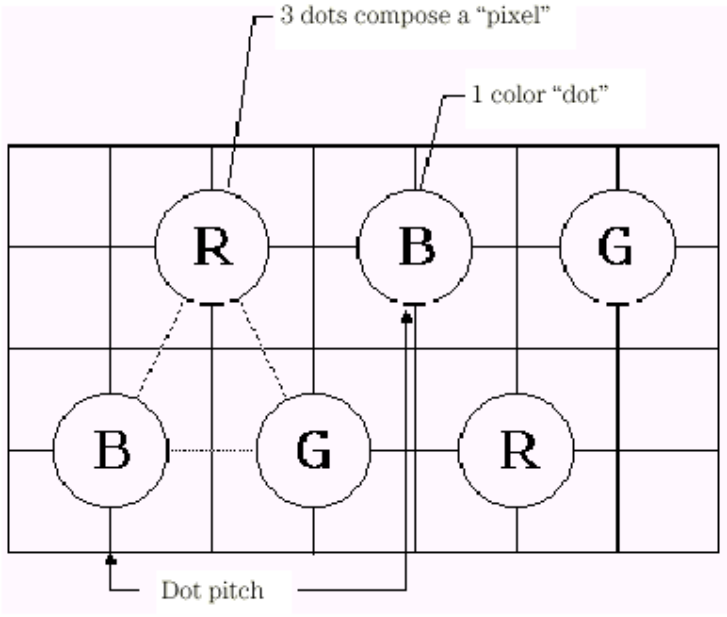
The *Cathode-Ray Tube (CRT)* is essentially a large vacuum tube. One end of the CRT is formed as a long, narrow neck, and the other end is a broad, almost-flat surface. A coating of colored phosphors is applied inside the CRT, along the front face. The neck end of the CRT contains an element (called the *cathode*), which is energized and heated to very high temperatures (much like an incandescent lamp). At high temperatures, the cathode liberates electrons. When a very high positive voltage potential is applied at the front face of the CRT, electrons liberated by the cathode (which are negatively charged) are accelerated toward the front face. When the electrons strike the phosphor on the front face, light is produced. By directing the stream of electrons across the front face, a visible image is produced. Of course, other elements are needed to control and direct the electron stream, but this is CRT operation in a nutshell. CRT face size (or screen size) is generally measured as a diagonal dimension—that is, a 43.2-cm (17") CRT is 43.2 cm (17") between opposing corners. Larger CRTs are more expensive, but produce larger images, which are usually easier on the eyes.

## PIXELS AND RESOLUTION

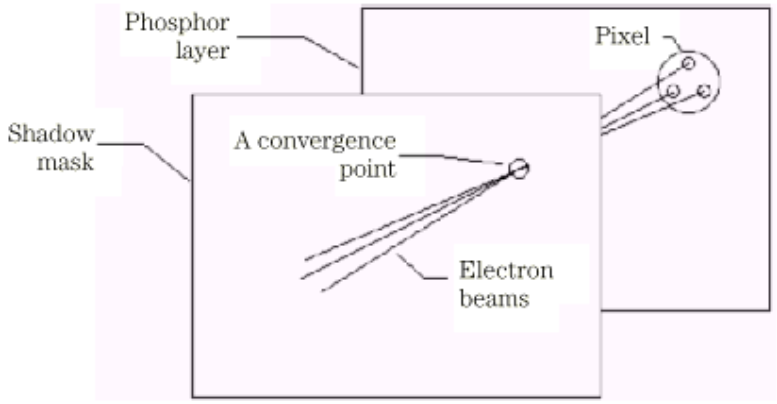
The picture element (or pixel) is the very smallest point that can be controlled on a CRT. For monochrome displays, a pixel can simply be turned on or off. For a color display, a pixel could assume any of a number of different colors. Pixels are combined in the form of an array (rows and columns). The size of the pixel array defines the display's resolution. Thus, resolution is the total number of pixels in width by the total number of pixels in height. For example, a typical EGA resolution is 640 pixels wide by 350 pixels high (a total of 224,000 pixels), and a typical VGA resolution is 640 pixels wide by 480 pixels high (a total of 307,200 pixels). Typical Super VGA (SVGA) resolution is 800 pixels wide by 600 pixels high. Resolution is important for computer monitors because higher resolutions allow finer image detail.

## TRIADS AND DOT PITCH

Although monochrome CRTs use a single, uniform phosphor coating (usually white, amber, or green), color CRTs use three color phosphors (red, green, and blue) arranged as triangles (or triads). Figure illustrates a series of color phosphor triads. On a color monitor, each triad represents one pixel (even though three dots are in the pixel). By using the electron streams from three electron guns (one gun for red, one for blue, and another for green) to excite each dot, a broad spectrum of colors can be produced. The three dots are placed so close together that they appear as a single point to the unaided eye. The quality of a color image is related to just how close each of the three dots are to one another. The closer together they are, the purer the image appears. As the dots are spaced further apart, the image quality degrades because the eye can begin to discern the individual dots in each pixel. This results in lines that no longer appear straight and colors are no longer.




**Arranging color phosphors in a triad.**




*Sizes and distances are NOT shown to scale.

**The importance of convergence in a color monitor.**

Dot pitch is a measure of the distance between two adjacent phosphor dots on the display. This is also the same dimension for the distance between openings in a "shadow mask." Displays with a dot pitch of 0.31 mm (or less) generally provide adequate image quality.

## SHADOW AND SLOT MASKS

The shadow mask is a thin sheet of perforated metal that is placed in the color CRT just behind the phosphor coating. Electron beams from each of the three "electron guns" are focused to converge at each hole in the mask—not at the phosphor screen . The microscopic holes act as apertures that let the electron beams through only to their corresponding color phosphors. In this way, any stray electrons are masked and color is kept pure. Some CRT designs substitute a shadow mask with a slot mask (or aperture grille), which is made up of vertical wires behind the phosphor screen. The "dot pitch" for CRTs with slot masks is defined as the distance between each slot. Remember that monochrome CRTs do not need a shadow mask at all because the entire phosphor surface is the same color.

## CONVERGENCE

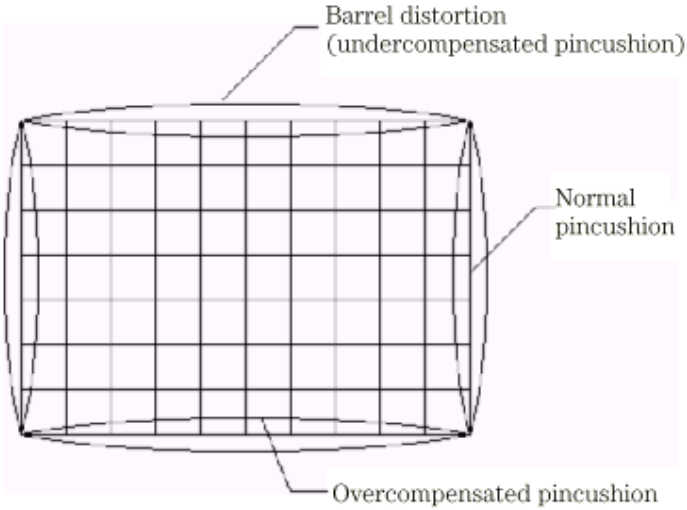
Remember that three electron guns are used in a color monitor—the electrons themselves are invisible, but each gun excites a particular color phosphor. All three electron beams are tracking around the screen simultaneously and the beams converge at holes in the shadow mask. This convergence of electron beams is closely related to color purity in the screen image. Ideally, the three beams converge perfectly at all points on the display and the resulting color is perfectly pure throughout (i.e., pure white). If one or more beams do not converge properly, the image color will not be pure. In most cases, poor convergence will result in colored shadows. For example, you might see a red, green, or blue shadow when looking at a white line. Serious convergence problems can result in a blurred or distorted image. Monitor specifications usually list typical convergence error as *mis-convergence* at both the display center and the overall display area. Typical center mis-convergence runs approximately 0.45 mm, and overall display area mis-convergence is about 0.65 mm. Larger numbers result in poorer convergence. Fortunately, monitor convergence can be calibrated.

## PINCUSHION AND BARREL DISTORTION

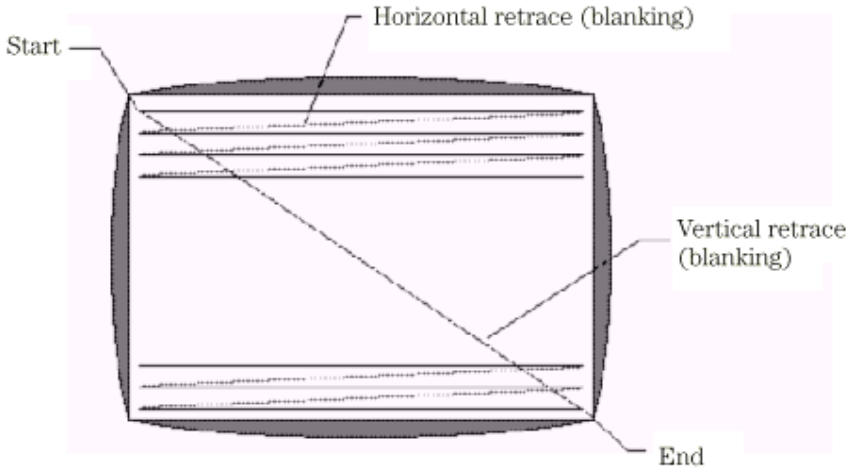
The front face of most CRTs is slightly convex (bulging outward). However, digital images are perfectly square (that is, two dimensional). When a flat (2D) image is projected onto a curved (3D) surface, distortion results. Ideally, a monitor's raster circuits will compensate for this screen shape so that the image appears flat when viewed at normal distances. In actuality, however, the image is rarely flat. The sides of the image (top-to-bottom) and (left-to-right) might be bent slightly inward or slightly outward. Figure illustrates an exaggerated view of these effects. *Pincushioning* occurs when sides are bent inward, making the image's border appear concave. *Barreling* occurs when the sides are bent outward making the image's border appear convex. In most cases, these distortions should be just barely noticeable (no more than 2.0 or 3.0 mm). Many technicians refer to barrel distortion as pincushioning as well, although this is not technically correct.

## HORIZONTAL SCANNING, VERTICAL SCANNING, RASTER, AND RETRACE

To understand what scanning is, you must first understand how a monitor's image is formed. A monitor's image is generated one horizontal line of pixels at a time, starting from the upper left corner of the display (Fig. 27-5). As the beams travel horizontally across the line, each pixel in the line is excited, based on the video data contained in the corresponding location of video RAM on the video adapter board. When a line is complete




**The effects of pincushion and barrel distortion.**

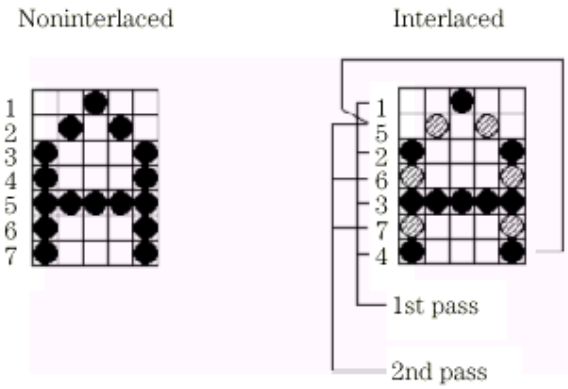



**Forming a screen image on a CRT.**

the beam turns off (known as *horizontal blanking*). The beam is then directed horizontally (and slightly lower vertically) to the beginning of the next subsequent line. A new horizontal line can then be drawn. This process continues until all horizontal lines are drawn and the beam is in the lower right corner of the display. When this image "page" is complete, the beam turns off (called *vertical blanking*) and is redirected back to the upper left corner of the display to start all over again. The rate at which horizontal lines are drawn is known as the *horizontal scanning rate* (sometimes called *horizontal sync*). The rate at which a complete "page" of horizontal lines is generated is known as the *vertical scanning rate* (*vertical sync*). Both the horizontal and vertical blanking lines are known as *retrace lines* because the deactivated beams are "retracing" their path before starting a new trace. A typical horizontal retrace time is 5 s, and the typical vertical retrace time is 700 s. This continuous horizontal and vertical scanning action is generally referred to as *raster*.

**INTERLACING**

Images are "painted" onto a display one horizontal row at a time, but the sequence in which those lines are drawn can be non-interlaced or interlaced




**VIDEO SIGNAL**

This specification lists signal levels and characteristics of the analog video input channel(s). In most cases, a video signal in the 0.7-Vpp (peak to peak) range is used. Circuitry inside the monitor amplifies and manipulates these relatively small signals. A related specification is *input impedance*, which is often at 75 ohms. Older monitors using digital (on/off) video signals typically operate up to 1.5 V.

**SYNCHRONIZATION AND POLARITY**

After a line is drawn on the display, the electron beams are turned off (blanked) and repositioned to start the next horizontal line. However, no data is contained in the retrace line. For the new line to be "in sync" with the data for that line, a *synchronization pulse* is sent from the video adapter to the monitor. There is a separate pulse for horizontal synchronization and vertical synchronization. In most current monitors, synchronization signals are edge-triggered TTL (transistor-transistor logic) signals. *Polarity* refers to the edge that triggers the synchronization. A falling trigger (marked "-" or "positive/negative") indicates that synchronization occurs at the high-to-low transition of the sync signal. A leading trigger (marked "+" or "negative/positive") indicates that synchronization occurs on the low-to-high transition of the sync signal.

**LCD DISPLAYS**

Borrowing technology from the Laptop manufacturers, some companies market monitors with LCD (Liquid Crystal Display) displays. LCD's have low glare screens that are completely flat, and low power requirements (5 watts versus 100 watts for ordinary monitors). The color quality of an active-matrix LCD panel actually exceeds that of most CRT displays.

At this point LCD screens usually are more limited in resolution than typical CRTs and are more expensive. For example a 14-inch LCD screen can cost more than $1000 than the cost of a high quality 17-inch CRT monitor. However it is important to consider that an LCD screen provides a larger viewable image than a CRT monitor of the same size. There are three basic LCD choices: passive-matrix monochrome, passive-matrix color and active-matrix color. The passive matrix designs are also available in single and dual scan versions. In an LCD, a polarizing filter creates two separate light waves. The polarizing filter allows light waves that are aligned only with the filter to pass through. After passing through the polarizing filter, the remaining light waves are all aligned in the same direction. By aligning a second polarizing filter at a right angle to the first, all those waves are blocked. By changing the angle of the second polarizing filter, the amount of light allowed to pass can be changed. It is the role of the liquid crystal cell to change the angle of polarization and control the amount of light that passes. In a color LCD , there is an additional filter that has three cells for each pixel – one each for displaying red, green, blue.

The light wave passes through a liquid-crystal cell, with each color segment having its own cell. The liquid crystals are rod- shaped molecules that flow like a liquid. They enable light to pass straight through, but an electrical charge changes their orientation and the orientation of light passing through them. Although monochrome LCDs do not have color filters, they can have multiple cells per pixel for controlling shades of gray.

In a passive-matrix LCD , each cell is controlled by the electrical charges of two transistors , determined by the cell's row and column positions on the display. The number of transistors along the screens horizontal and vertical edges determines the resolution of the screen. For example a screen with a 800*600 resolution has 800 transistors on the horizontal edge and 600 transistors on the vertical edge for a total of 1400. As the cell reacts to the pulsing charge from its two transistors, it twists the light wave, with stronger charges twisting the light wave more. ***Supertwist*** refers to the orientation of the liquid crystals, comparing on mode to off mode- the greater the twist the higher the contrast.

Charges in passive-matrix LCDs are pulsed , so the displays lack the brilliance of active-matrix , which provides a constant charge to each cell . To increase the brilliance, some vendors have turned to a mew technique called double***-scan*** LCD, which splits passive-matrix screens into a top half and bottom half, reducing the time between each pulse. Besides increasing the brightness, dual-scan designs also increase the response time and therefore the perceptible speed of the display, making this type more usable for full motion video or other applications where the displayed information changes rapidly.

In an active-matrix LCD , each cell has its own dedicated transistor behind the panel to charge it and twist the light wave. Thus, an 800*600 active matrix display has 480,000 transistors. This provides a brighter image than passive-matrix displays because the cell can maintain a constant , rather than a momentary , charge. However active-matrix technology uses more energy than a passive matrix . With a dedicated transistor for every cell , active-matrix displays are more difficult and expensive to produce. In both active and passive-matrix LCDs , the second polarizing filter controls how much light passes each cell. Cell twists the wavelength of light to closely match the filters allowable wavelength. The more light that passes through the filter at each cell, the brighter the pixel.

## SYMPTOMS IN CRT

### IDENTIFYING CRT PROBLEMS

CRTs enjoy a long, reliable working life because there is really no moving parts merely a set of stationary metal elements. However, the arrangement of grids and cathodes are located in very close proximity to one another. Physical shocks can dislodge elements and cause sudden short circuits. Eventually, regular use will alter the physical dimensions of cathodes and grids (resulting in the development of a slower, more gradual short-circuit). The stress of regular wear can also cause open circuits in the heater, cathode, or grid. When considering a CRT replacement, you should remember that the CRT is typically the most expensive part of the monitor. For larger monitors, the CRT becomes an even larger percentage of the monitor's overall cost. In many cases, the cost for a replacement CRT approaches the original cost of the entire monitor. As a consequence, you should carefully evaluate the economics of replacing the CRT versus buying a new monitor outright.

**Symptom 1. Heater opens in the CRT** Each time the heater runs, it expands. When the CRT turns off, the heater cools and contracts again. This regular thermal expansion and contraction might eventually fatigue the heater and cause it to open. You will see this as a complete loss of the corresponding color. Because heaters are all tied together electrically, there is no way to measure a particular heater directly, but you might see only two glowing heaters in the CRT neck, instead of three. An open heater cannot be recovered, and the only available alternative is to replace the CRT itself.

**Symptom 2. Heater shorts to a cathode in the CRT** This is not as strange as it might seem at first. To heat a cathode effectively, the heater must be extremely close to the cathode—especially to the barium element that actually liberates the electrons. Over time, the heater might develop accumulations of corrosion, which might eventually cause the heater to contact the cathode. In theory, this should never happen because the inert low-pressure gasses inside the CRT should prevent this. But in actuality, some small amount of oxygen will still be present in the CRT, and oxidation might occur. A shorted heater will cause the electron gun to fire at full power—in effect, the electron gun will be stuck "on." The image will appear saturated with the color of the defective electron gun.

**Symptom 3. Cathode shorts to the control grid in the CRT** A cathode can also short-circuit to the control grid. Often, corrosion flakes off the cathode and contacts the control grid. When this happens, the control grid loses its effectiveness, and the corresponding color will appear saturated. This symptom will appear very much like a heater short. Fortunately, you should be able to verify this problem with your meter by measuring resistance between the control grid and the suspect cathode. Ideally, an infinite resistance
should be between the control grid and all cathodes. If you read a measurable resistance (or a direct short-circuit), chances are good that you're facing a cathode-to-control grid short.

**Symptom 4. One or more colors appear weak** This is a common symptom in many older CRTs. Over time, the barium emitter in your cathodes will wear out or develop a layer of ions (referred to as *cathode poisoning*), which inhibit the release of electrons. In either case, the afflicted cathode will lose efficiency, resulting in weakened screen colors. Typically, you might expect all three cathodes to degrade evenly over time—and they will—but by the time the problem becomes serious enough for service, you will usually notice one color weaker than the others. Try increasing the gain of the afflicted signal on the video drive board. If the cathode is indeed afflicted, increasing signal gain should not have a substantial effect on the color brightness, and you should consider replacing the CRT.

**Symptom 5. CRT phosphors appear aged or worn** *Phosphors* are specially formulated chemicals that glow in a particular color when excited by a high-energy electron beam. Typically, phosphors will last for the lifetime of the monitor, but age and normal use will eventually reduce the sensitivity of the phosphors—for old CRTs, you might see this as dull, low-contrast colors. Perhaps a more dramatic problem occurs with "phosphor burn," which occurs when a monitor is left on displaying the same image for a very long period of time. If you turn the monitor off, you can see the latent image burned onto the CRT as a dark shadow. In both cases, there is no way to rejuvenate phosphors, so the CRT will have to be replaced. You can advise customers to prolong the life of their CRT by keeping the brightness at a minimum and using a screen-saver utility, if an image will sit unchanging for a long time.

**Symptom 6. The CRT suffers from bad cutoff (a.k.a. bad gamma)** On a CRT, color linearity is a function of the cathode's ability to adjust the level of electron emission—in other words, beam intensity must be linear across the entire range of the video signal (e.g., 0 to 20 V or 0 to 50 V). As cathodes age, however, they tend to become non-linear. When this happens, images tend to be too "black and white," rather than display a smooth transition of colors. Technicians often refer to this as a "gassy" CRT, which is actually a CRT gamma problem. In addition to cathode wear, control grid failure can adversely affect beam intensity.

**Symptom 7. The control grid in the CRT is open** The control grid is used to limit the beam intensity produced by a cathode by applying a potential on the grid. Occasionally, you will find that a control grid might open. In that case, there is no longer a potential available to control the beam intensity, and the beam will fire at full intensity. At first glance, you might think this is a cathode-to-control grid short or a heater-to-cathode short. But if you can't find a short with your multimeter, the control grid is probably open, and the CRT will have to be replaced.

**Symptom 8. The CRT screen grid is open** The screen grid plays an important role in image brightness by accelerating the electron beam toward the CRT phosphors. If the screen grid opens, no potential will be available to begin accelerating the beam. This will result in a very dark image—even with the screen voltage at maximum. You might think this is a control-to-screen grid short, but if you can't find the short with your multimeter, the screen grid is probably open, and the CRT will have to be replaced.

**Symptom 9. The CRT focus grid is open** A focus grid assembly concentrates electron beams into narrow pinpoints by the time the beam reaches the shadow mask. Typically, a focus control is located around the fly back transformer. If the focus grid fails, the image will appear highly distorted, and the focus adjustment will have no effect. When a focus grid fails, the entire CRT will have to be replaced.

**Symptom10. The control grid shorts to the screen grid in the CRT** The same flakes of oxidation that can short a cathode to the control grid can also short the control grid to the screen grid. The screen grid starts accelerating the electrons toward the CRT face. If the screen grid is shorted, it will reduce the energy imparted to the electrons in effect, a shorted screen grid will significantly reduce the overall image brightness (even with the brightness at maximum). In extreme cases, the image might disappear entirely. You can measure the screen grid voltage at G2, which typically runs from 250 to 750 V in normal operation. If the voltage is low (even with the screen grid control at maximum), power down the monitor, remove the video drive board from the monitor's neck, restart the monitor, and measure the screen voltage again. If the screen voltage returns to normal, you can be confident that the screen grid is shorted. If screen voltage remains low, you might have a fault in the screen voltage circuit.

# Troubleshooting Switching

## Power Supplies

Troubleshooting a switching power supply can be a complex and time-consuming task. Although the operation of rectifier and filter sections are reasonably straightforward, sensing/ switching circuits can be complex oscillators that are difficult to follow without a schematic. Sub-assembly replacement of dc switching supplies is quite common.

## TIPS FOR POWER-SUPPLY SERVICE

Power and power-supply problems can manifest themselves in a stunning variety of ways, but the following tips should help you to stay out of trouble:

- Power-supply cooling is important—keep the vent openings and fan blades clean.
- Be sure that the line-voltage switch (120/220 Vac) is set correctly for your region.
- Verify that the power-supply connectors are attached to the motherboard and drives securely.
- Remember that for AT-style power connections, the "black wires go together."
- Do not use a Y splitter to split power from a HDD (avoid Y splitters entirely, if possible).
- Some Y splitters are wired improperly. If you have trouble with a device after installing a Y splitter, check the splitter or try powering the device directly.
- Voltage tolerances are usually ±5% (±4% for 3.3 Vdc), so be sure that each output is within tolerance.
- If you experience erratic system behavior after adding a new device, this can be the result of an overload. Try removing the device.

## SYMPTOMS

**Symptom 1. The PC or peripheral is completely dead—no power indicators are lit** As with linear supplies, check the ac line voltage entering the PC before beginning any major repair work. Use your multimeter to measure the ac line voltage available at the wall outlet that is powering your computer or peripheral. Be extremely cautious whenever measuring ac line-voltage levels. Normally, you should read between 105 and 130 Vac to ensure proper-supply operation. If you find either very high or low ac voltage, try the device in an outlet that provides the correct amount of ac voltage.

Unusual line voltage levels might damage your power supply, so proceed cautiously. If ac line voltage is normal, suspect that the main power fuse in the supply has failed. Most power fuses are accessible from the rear of the computer near the ac line cord, but some fuses might only be accessible by disassembling the device and opening the supply. Unplug the device and remove the fuse from its holder. You should find the fusible link intact, but use your multimeter to measure continuity across the fuse. A good fuse should measure as a short circuit (0 ohms), but a failed fuse will measure as an open circuit (infinity). Replace any failed fuse and re-test the PC. If the fuse continually fails, a serious defect is elsewhere within the power supply or other computer/peripheral circuits. If your supply has an ac selector switch that sets the supply for 120-Vac or 240-Vac operation, be sure that switch is in the proper position for your region of the world (an improperly set ac switch can disable the entire system). Unplug the computer and disassemble it enough to expose the power supply clearly. Restore power to the PC and measure each dc output with your multimeter or oscilloscope (you can usually find a power connector at the motherboard or other main board). Be sure that any power cables are securely attached. If each output measures correctly, then your trouble lies outside of the supply—a key circuit has failed elsewhere in the device. You can try a POST board or diagnostic to trace the specific problem further. A low output voltage is suggestive of a problem within the supply itself. Check each connector and all interconnecting wiring leading to or from the supply. Remember that many switching supplies must be attached to a load for proper switching to occur. If the load circuit is disconnected from its supply, the voltage signal could shutdown or oscillates wildly. If the supply outputs continue to measure incorrectly with all connectors and wiring intact, chances are that your problem is inside the supply. With a linear supply, begin testing at the output, then work back toward the ac input. For a switching supply, you should begin testing at the ac input, then work toward the defective output.

Measure the primary ac voltage applied across the transformer (T1). Use extreme caution when measuring high-voltage ac. If voltage has been interrupted in that primary circuit, the meter will read 0 Vac. Check the primary circuit for any fault that might interrupt power. Measure secondary ac voltage supplying the rectifier stage. It should read higher than the highest output voltage that you expect. For the example of Fig. 36-7, the highest expected dc output is 24 V, so ac secondary voltage should be several volts higher than this. The example shows this as 28 Vac. If primary voltage reads correctly and secondary voltage does not, an open circuit might be in the primary or secondary transformer winding. Try replacing the transformer. Next, check the pre-switched dc voltage supplying the switching IC. Use your multimeter or oscilloscope to measure this dc level. You should read approximately the peak value of whatever secondary ac voltage you just measured. If this voltage is low or non-existent, unplug ac from the supply and check each rectifier diode, then inspect the filter capacitor. Use your oscilloscope to measure each chopped dc output signal.

You should find a high-frequency square wave at each output (20kHz to 40kHz) with an amplitude approximately equal to the pre-switched dc level (38 to 39 volts in this case). Set your oscilloscope to a time base of 5 or 10 S/DIV and start your VOLTS/DIV setting at 10 VOLTS/DIV. Once you have established a clear trace, adjust the time base and vertical sensitivity to optimize the display. If you do not read a chopped dc output from the switching IC, either the IC is defective or one (or more) of the polarized output filter capacitors might be shorted. Unplug the PC and inspect each questionable filter capacitor. Replace any capacitors that appear shorted. As a general rule, filter capacitors tend to fail more readily in switching supplies than in linear supplies because of high-frequency electrical stress and the smaller physical size of most switching-supply components. If all filter capacitors check out correctly, replace the switching IC. Use care when de-soldering the old regulator. Install an IC socket (if possible) to prevent repeat soldering work, then just plug in the new IC. If you do not have the tools to perform this work (or the problem persists), replace the power supply outright.

**Symptom 2. Supply operation is intermittent—device operation cuts in and out with the supply** Inspect the ac line voltage into your printer. Be sure that the ac line cord is secured properly at the wall outlet and printer. Be sure that the power fuse is installed securely. If the PC/peripheral comes on at all, the fuse has to be intact. Unplug the device and expose your power supply. Inspect every connector or interconnecting wire leading into or out of the supply. A loose or improperly installed connector can play havoc with the system's operation. Pay particular attention to any output connections. In almost all cases, a switching power supply must be connected to its load circuit in order to operate. Without a load, the supply might cut out or oscillate wildly. In many cases, intermittent operation might be the result of a PC board problem. PC board problems are often the result of physical abuse or impact, but they can also be caused by accidental damage during a repair. Lead pull-through occurs when a wire or component lead is pulled away from its solder joint, usually through its hole in the PC board. Re-inserting the pulled lead and properly re-soldering the defective joint can easily repair this type of defect. Trace breaks are hairline fractures between a solder pad and its printed trace. Such breaks can usually render a circuit inoperative, and they are almost impossible to spot without a careful visual inspection. Board cracks can sever any number of printed traces, but they are often very easy to spot. The best method for repairing trace breaks and board cracks is to solder jumper wires across the damage between two adjacent solder pads. You could also simply replace the power supply outright. Some forms of intermittent failures are time or temperature related. If your system works just fine when first turned on, but fails only after a period of use, then spontaneously returns to operation later on (or after it has been off for a while), you might be faced with a thermally intermittent component—a component might work when cool, but fail later on after reaching or exceeding its working temperature. After a system quits under such circumstances, check for any unusually hot components.

Never touch an operating circuit with your fingers—injury is almost certain. Instead, smell around the circuit for any trace of burning semiconductor or unusually heated air. If you detect an overheated component, spray it with a liquid refrigerant. Spray in short bursts for the best cooling. If normal operation returns, then you have isolated the defective component. Replace any components that behave intermittently. If operation does not return, test any other unusually warm components. If problems persist, replace the entire power supply outright.

## Troubleshooting Video Adapters

A PC video system consists of four parts: the host PC itself, the video adapter/accelerator, the monitor, and the software (video BIOS and drivers). To deal with a failure in the video system, you must be able to isolate the problem to one of these four areas. When isolating the problem, your best tool is a working (or tested) PC. With another PC, you can systematically exchange hardware to verify each element of the video system.

### ISOLATING THE PROBLEM AREA

The first step is to verify the monitor by testing it on a known-good working PC. Keep in mind that the monitor must be compatible with the video adapter on which it is being tested. If the monitor works on another PC, the fault lies in one of the three remaining areas. If the monitor fails on a known-good machine, try the known-good monitor on the questionable machine. If the known-good monitor then works on your questionable machine, you can be certain that the fault lies in your monitor, and you can refer to the appropriate chapter here for detailed troubleshooting if you wish. If the monitor checks out, suspect the video adapter. Follow the same process to check the video adapter. Try the suspect video adapter on a known-good PC. If the problem follows the video adapter, you can replace the video adapter.

If the suspected video adapter works in a known-good system, the adapter is probably good. Replace the adapter in the suspect machine, but try another expansion slot and be sure that the monitor cable is attached securely. If both the monitor and the video adapter work in a known-good PC, but the video problem persists in the original machine, suspect a problem with the PC motherboard. Try the working video adapter in another expansion slot. Either the expansion slot is faulty, or a fault has occurred on the motherboard. Run some PC diagnostics if you have some available. Diagnostics might help to pinpoint motherboard problems. You might then choose to troubleshoot the motherboard further or replace the motherboard outright at your discretion. If the video system appears to work properly during system initialization, but fails with a particular application (or in Windows/Windows 95), strongly suspect a problem with the selected video driver.

Because almost all video adapters support VGA at the hardware level, set your application (or change the Windows setup) to run in standard VGA mode (for Windows 95, you can start the PC in the safe mode). If the display functions properly at that point, you can be confident that the problem is driver related. Check with the manufacturer to see that you have the latest video driver available. Reload the driver from its original disk (or a new disk) or select a new driver. If the problem persists in VGA mode, the trouble might be in the video adapter. Problem isolation can be summarized with these points:

- *Check the driver(s)* Video drivers are crucially important in Windows 3.1x and 95. Older drivers might contain bugs or be incompatible with certain applications. This accounts for the majority of all video problems. Obtain the latest video driver release, and be sure that it is properly installed on the system. If the driver is most current, try a generic video driver (usually available from the video chipset manufacturer).
- *Check the physical installation* See that the video board is installed properly in its
  Expansion slot, and make sure that any jumpers are set properly for the particular
  system.
- *Check for memory conflicts* The memory space used by video adapters is hotly contested territory in the upper memory area. Printer drivers, sound cards, tape backups, SCSI adapters, and scanners are just some of the devices that can step all over the memory space needed by a video board. Many of today's video boards require you to exclude a range of upper memory through your memory manager (often A000h through C7FFh, though your particular video board might be different). Be sure that any necessary memory exclusions are made in CONFIG.SYS at the memory manager's command line. You might also have to add an EMM Exclude=A000-C7FF line to the [386enh] section of your SYSTEM.INI file.
- *Suspect your memory manager* Advanced memory managers, such as QEMM or Net-room, use very aggressive techniques to "find" memory. Often, this interferes
  with video operation. Try disabling any stealth or cloaking mode.
- *Check your system CMOS setup* Today's motherboards sport all manner of advanced features. Try systematically disabling such attributes as: video cache, video RAM shadow, byte-merge, palette snoop, or decouple/hidden refresh. If "PCI bus bursting" is used on the video bus, try disabling that also. If the video system requires the use of an interrupt, be sure that the IRQ is not being used by another device.

**Unusual Hardware Issues**

A lot of emphasis is placed on drivers and software configurations, but also quite a few unique hardware problems can affect your video system. Some of the most frequent oversights are outlined in the following sections.

**CLOCK SPEED AND THE VL BUS**

Video boards that use the VL bus are very sensitive to motherboard clock speeds over 40MHz. If your motherboard runs the VL bus at over 40MHz, it's quite possible that you will have trouble with VL bus video boards. The VESA specification states that one card can operate at 40MHz, or two can operate at up to 33MHz (a best-case scenario). Some manufacturers don't even guarantee that their cards will run at 40MHz—preferring to support bus speeds of 33MHz or less. So, if your VL bus video board is running at over 40MHz, and it refuses to run properly, your best option is usually to step your bus speed down. A motherboard jumper or an entry in CMOS can usually control bus speeds. If you cannot change bus speed for any reason, try a different brand of VL card.

**"SLC" MOTHERBOARDS AND THE VL BUS**

If you have an older motherboard using an i486SLC-type CPU, some VL bus video boards will not operate properly when used with that particular motherboard. This is because the 32-bit VL bus was not implemented properly in conjunction with the 16-bit data path of the i486SLC. This is a problem with the motherboard's design, not the particular video boards. Later-model motherboards with the i486SLC CPU largely overcame this problem, but take care when using any VL bus video board on i486SLC motherboards. Chances are that an older ISA video board will work just fine.

**8514/A AND COM4 CONFLICTS**

The 8514/a video adapter was designed to coexist with a VGA adapter. To achieve this, the 8514/a uses a different range of addresses. Some of these are 16-bit addresses, which are located at 42E8h, 82E8h, 92E8h, A2E8h, and E2E8h. Unfortunately, many serial- controllers only decode the first 12-bits of the I/O port address, and assume that calls to x2E8h (such as all of those listed) are intended for the serial port (e.g., 2E8h), rather than the video card. This means that COM4 cannot be used on most machines with an 8514/a compatible video card, unless the address of COM4 can be changed on the serial card (usually via jumpers), or the serial controller decodes all 16-bits of the I/O port addresses. There is no other way to get COM4 and any 8514/a compatible display adapter to coexist. Keep in mind that this is an issue with the serial controller, rather than the 8514/a video adapter.

## ATI MACH, S3 VISION/TRIO, AND COM4 CONFLICTS

As you saw in the last section, 8514/a video adapters will often conflict with COM4 because of poor I/O address decoding. ATI's Mach chipsets and S3's chipsets are based on IBM's 8514/a standard, and frequently suffer the same problems as the 8514/a video adapters.

## AWARD VIDEO BIOS GLITCH

Motherboards using the Award Modular BIOS 4.50G series with Matrox video cards might have problems loading drivers under Windows 95. This is because the 4.50G series of Award BIOS is not Plug-and-Play compliant, and cannot work under Windows 95. Upgrade the BIOS version on the motherboard to fix this problem, and set the following
CMOS configuration under the PCI configuration setup:

- PCI IRQ Activated By: Level
- If no other PCI devices are used in the system, set the "Slot X Using INT#" to: AUTO
- Be sure that the PCI IRQ is assigned to the slot the video card is in.

## SYMPTOMS

**Symptom 1. The computer is on, but there is no display** The PC seems to initialize properly. Be sure that the monitor is turned on and plugged into the video adapter properly. Also check that the monitor's brightness and contrast controls are turned up enough (it sounds silly, but it really does happen). Try the monitor on a known-good PC. If the monitor works properly, suspect the video adapter. Power down the PC and be sure the video adapter is seated properly in its expansion slot. If any of the board contacts are dirty or corroded, clean the contacts by rubbing them with an eraser. You can also use any electronics-grade contact cleaner. You might want to try the video board in another expansion slot. Chances are that the video adapter has at least one hardware jumper or DIP switch setting. Contact the manufacturer or refer to the owner's manual for the board and check that any jumpers or DIP switch settings on the board are configured properly. If this is a new installation, check the adapter-board settings against the configuration of other expansion boards in the system. When the hardware settings of one board overlap the settings of another, a hardware conflict can result. When you suspect a conflict, adjust the settings of the video adapter (or another newly installed device) to eliminate the conflict.

There might also be a memory conflict. Some video adapters make unusual demands of upper system memory (the area between 640KB and 1MB). It is possible that an Exclude switch must be added to the EMM386.EXE entry in a CONFIG.SYS file. Check with the adapter's instruction manual to see if any memory configuration changes or optimizations are required.

**Symptom 2. There is no display, and you hear a series of beeps when the PC initializes The video adapter failed to initialize during the system's POST.** Because the video adapter is not responding, it is impossible to display information—that is why a series of beeps are used. Remember that the actual beep sequence might vary from system to system depending on the type of BIOS being used. You can probably find the beep code for your BIOS in Chapter 15. In actuality, the video adapter could fail for several different reasons. Power down the PC and check that the video adapter is installed properly and securely in an expansion slot. Be sure that the video adapter is not touching any exposed wiring or any other expansion board. Isolate the video adapter by trying another adapter in the system. If the display works properly with another adapter installed, check the original adapter to see that all settings and jumpers are correct. If the problem persists, the original adapter is probably defective and should be replaced. If a new adapter fails to resolve the problem, a fault might be elsewhere on the motherboard. Install a POST board in the PC and allow the system to initialize. Each step of the initialization procedure corresponds to a two-digit hexadecimal code shown on the POST card indicators. The last code to be displayed is the point at which the failure occurred. POST cards are handy for checking the motherboard when a low-level fault has occurred. If a motherboard fault is detected, you might troubleshoot the motherboard or replace it outright at your discretion.

**Symptom 3. Large, blank bands are at the top and bottom of the display in some screen modes, but not in others** Multi-frequency and multi-mode monitors sometimes behave this way. This is not necessarily a defect, but it can cause some confusion unless you understand what is going on. When screen resolution changes, the overall number of pixels being displayed also changes. Ideally, a multi-frequency monitor should detect the mode change and adjust the vertical screen size to compensate (a feature called *auto-sizing*). However, not all multi-frequency monitors have this feature. When video modes change, you are left to adjust the vertical size manually. Of course, if information is missing from the display, a serious problem might be in the VRAM or the adapter's graphics-controller IC. In this event, try another video adapter board.

**Symptom 4. The display image rolls Vertical synchronization is not keeping the image steady (horizontal sync might also be affected).** This problem is typical of a monitor that cannot display a particular screen mode. Mode incompatibility is most common with fixed-frequency monitors, but it can also appear in multi-frequency monitors that are being pushed beyond their specifications. The best course of action here is to simply reconfigure your software to use a compatible video mode (or reduce the vertical refresh rate). If that is an unsatisfactory solution, you will have to upgrade to a monitor that will support the desired video mode. If the monitor and video board are compatible, the problem is synchronization. Try the monitor on a known-good PC.

If the monitor also fails on a known-good PC, try the known-good monitor on original PC. If the known-good monitor works on the suspect PC, the sync circuits in your original monitor have almost certainly failed. If the suspect monitor works on a known-good PC, the trouble is likely in the original video adapter. Try replacing the video adapter.

**Symptom 5. An error message appears on system startup indicating an invalid system configuration** The system CMOS backup battery has probably failed, and the video type might have defaulted to "EGA" or "MCA" instead of "VGA"— resulting in the error. This is typically a symptom that occurs in older systems. If you enter your system setup (either through a BIOS routine or through a disk-based setup utility) and examine each entry, you will probably find that all entries have returned to a default setting—including the video system setting. Your best course is to replace the CMOS backup battery and enter each configuration setting again (hopefully, you have recorded each setting on paper already, or saved the CMOS contents to floppy disk using a CMOS backup utility). Once new settings are entered and saved, the system should operate properly. If the CMOS still will not retain system configuration information, the CMOS RAM itself is probably defective. Use a software diagnostic to check the RTC/CMOS IC (and the rest of the motherboard) thoroughly. If a motherboard fault is detected, you can troubleshoot the motherboard or replace it outright at your discretion.

**Symptom 6. Garbage appears on the screen or the system hangs up** The display might be distorted for a variety of reasons. One potential problem is a monitor mismatch. Check the video adapter jumpers and DIP switch settings and be sure that the video board will support the type of monitor you are using. It is possible that the video mode being used is not supported by your monitor (the display might also roll as described in Symptom 4). Try re-configuring your application software to use a compatible video mode. The problem should disappear. If that is unsatisfactory, you will have to upgrade to a monitor that will support the desired video mode. Some older multi-frequency monitors are unable to switch video modes without being turned off, then turned on again. If such monitors experience a change in video mode, they will respond by displaying a distorted image until the monitor is reset. If you have an older monitor, try turning it off, wait several minutes, then turn it on again. Conflicts between device drivers and *Terminate-and-Stay-Resident (TSR)* programs will upset the display, and are particularly effective at crashing the computer. The most effective way to check for conflicts is to create a backup copy of your system startup files CONFIG. SYS and AUTOEXEC.BAT. From the root directory (or directory that contains your startup files), type: copy autoexec.bat autoexec. xyz copy config.sys config.xyz The extensions "xyz" suggest that you use any three letters, but avoid using "back" because many ASCII text editors create backup files with this extension.

Now that you have backup files, go ahead and use an ASCII text editor (such as the text editor included with DOS) to REM-out each driver or TSR command line. Reboot the computer. If the problem disappears, use the ASCII text editor to re-enable one REMed-out command at a time. Reboot and check the system after each command line is re-enabled.

If the problem occurs again, the last command you re-enabled is the cause of the conflict. Check that command line carefully. There might be command line switches that you can add to the startup file, which will load the driver or TSR without causing a conflict. Otherwise, you would be wise to leave the offending command line REMed-out. If you encounter serious trouble in editing the startup files, you can simply re-copy the backup files to the working file names and start again. Video drivers also play a big part in Windows. If your display problems are occurring in Windows, be sure that you have loaded the proper video driver, and that the driver is compatible with the video board being used. If problems persist in Windows, load the standard generic VGA driver. The generic VGA driver should function properly with virtually every video board and VGA (or SVGA) monitor available. If the problem disappears when using the generic driver setup, the original driver is incorrect, corrupt, or obsolete. Contact the driver manufacturer to obtain a copy of the latest driver version. If the problem persists, the video adapter board might be defective or incompatible with Windows. Try another video adapter.

**Symptom 7. When returning to Windows from a DOS application, the Windows screen "splits" from top-to-bottom** This is a DOS problem that is seen under Windows, which indicates an obsolete or corrupted video driver (for example, using a Windows 3.0 video driver under Windows 3.1). Chances are that the video adapter is running just fine. Be sure that the proper DOS "grabber" file is installed and specified in the SYSTEM.INI file. Check with the video-board manufacturer to obtain the latest assortment of drivers and grabber files. Try re-installing the drivers from their master disk. If you do not have current drivers available, try switching to the generic VGA driver.

**Symptom 8. The system hangs up during initialization, some characters might be missing from the display, or the screen colors might be incorrect** These are classic symptoms of a hardware conflict between the video adapter and one or more cards in the system, or an area of memory. Some video boards use an area of upper memory that is larger than the "classic" video area. For example, the Impact SVGA board imposes itself on the entire address range between A0000h and DFFFFh. In this kind of situation, any other device using an address in this range will conflict with the video board. A conflict might occur when the video board is first installed, or the board might work fine until another device is added or modified. Resolving a hardware conflict basically means that something has to give—one of the conflicting elements (i.e., IRQ lines, DMA channels, or I/O addresses) must be adjusted to use unique system resources.

As a technician, it rarely matters which of the conflicting devices you change, but remember that system startup files, device drivers, and application settings might also have to change to reflect newly selected resources. You might also be able to resolve some memory conflicts by adding the EXCLUDE switch to EMM386.EXE. The video adapter manual will indicate when an EXCLUDE switch is necessary.

**Symptom 9. Your system is generating DMA errors with a VGA board in the system, and video BIOS shadowing disabled** This is a fairly rare symptom that develops only on some older i486 systems, and is usually caused by an 8-bit VGA board in a system equipped with a slower version of the i486 CPU (in the 25MHz range). Eight-bit access takes so long that some DMA requests are ignored—thus, an error is generated. If you find such a problem, try enabling video ROM shadowing through the CMOS setup to allow faster access to video instructions. Also, you might try a newer revision of the i486 CPU.

**Symptom 10. The system hangs up using a 16-bit VGA board and one or more 8-bit controllers** This is typically a problem that arises when 8-bit and 16- bit ISA boards are used in the same system. Because of the way that an ISA bus separates the 8-bit and 16-bit segments, accessing an 8-bit board when 16-bit boards are in the system might cause the CPU to (falsely) determine that it is accessing a 16-bit board. When this occurs, the system will almost invariably crash. Try removing any 8-bit boards from the system. If the crashes cease, you have probably nailed down the error. Unfortunately, the only real correction is to either remove the 8-bit board(s) or reconfigure the board(s) to use a higher area of memory.

**Symptom 11. You have trouble sizing or positioning the display, or you see error messages, such as "Mode not supported" or "Insufficient memory"** These kinds of errors might occur in newer or high-end video boards if the board is not set up properly for the monitor it is being used with. Most new video boards include an installation routine that records the monitor's maximum specifications, such as resolution (and refresh frequencies), horizontal scanning frequencies, and vertical scanning frequencies. If such data is entered incorrectly (or the monitor is changed), certain screen modes might no longer work properly. Check the video adapter's installation parameters and correct its setup, if necessary.

**Symptom 12. You frequently encounter GPFs when using QuickTime for Windows 1.1** This is a notable problem with ATI Mach64 cards, but it has been known to occur with other advanced video boards. Often, the problem can be corrected by making a change in the Windows SYSTEM.INI file. For the ATI Mach64, you must turn Device Bitmaps=off under the [macx] section. As an alternative, start the ATI Flex Desk, type OPT (this starts a "hidden" window), then uncheck the Device Bitmap entry.

**Symptom 13. The video board will not boot up when used in a particular motherboard** Generally speaking, cases of hardware incompatibility occur between certain video boards and motherboards. This usually causes a great deal of confusion because the video board might work just fine when tested in a different motherboard, and other video boards might work well in the original motherboard—the technician simply winds up chasing ghosts. A noted example of this problem is the Boca Research VGAXL1/2 refusing to work in a Micronics 486DX2/66 motherboard. The solution to this problem demands that U13 on the video board be a Texas Instruments TI-74F04. If U13 is a Motorola IC, you will need to send the board back for rework—strange but true. For general troubleshooting purposes, if a certain video board and motherboard refuse to work together, don't waste your time chasing ghosts—contact both the board maker and PC (or motherboard) maker, and see if there are any reports of incompatibilities.

**Symptom 14. Diagnostics refuse to show all of the available video modes for a particular board—even though all video RAM was properly detected, or the board refuses to operate in some video modes** If a video board does not respond to certain video modes (usually the higher video modes), it is because a conflict is in the upper memory area and a memory range needs to be excluded. If a memory manager is at work (e.g., QEMM, 386MAX, or EMM386), try disabling the memory manager in CONFIG.SYS, or boot the system from a clean floppy. Try your diagnostic( s) again—chances are that the problem has disappeared. To fix this problem on a more permanent basis, re-enable the memory manager using an exclude command. Try x=B100h-B1FFh as the first parameter on the memory manager's command line. If that does not work, try x=A000h-BFFFh. Finally, try x=A000h-C7FF.

**Symptom 15. The characters shown in the display appear fuzzy** This is often the result of a speed problem, where the system is running too fast for the VL bus video board. In virtually all cases, you will find the VL bus to be running over 33MHz. Try slowing down the VL bus speed. This will sacrifice video performance, but should stabilize the system. Chances are also very good that the system has been locking up frequently— slowing down the video board should also correct such lock-ups.

**Symptom 16. Pixels appear "dropped" behind the mouse cursor and graphic images appear to break up under Windows** The two major causes for this type of problem are: bad video RAM or the system bus speed is too fast. Check the CMOS setup for an entry in Advanced Setup, such as "AT Bus Clock," "ISA Bus Speed," "AT Bus Speed." The corresponding entry should be set to 8.33MHz. Otherwise, excessive speed might result in "lost" video data. If the bus speed is set properly, run a diagnostic to check the integrity of video RAM (you might have to replace the video RAM or replace the video board entirely).

**Symptom 17. Video-related conflicts occur in Packard Bell systems The system refuses to boot or starts with "garbage" and erratic screen displays**. This symptom is encountered most frequently with Boca video boards on Packard Bell systems with video circuits already on the motherboard. Even when the on-board video has been disabled, reports indicate that the video circuitry remains active, then conflicts with the add-on video board. Packard Bell indicates that their Vxxx.16 BIOS will correct this problem, so contact Packard Bell for an appropriate BIOS upgrade.

**Symptom 18. Text appears in an odd color For example, text that should be green appears black.** This is almost always the result of a problem with the palette decoding registers on the particular video board, and will typically appear when using higher color modes (e.g., 64k or 16M colors). Be sure that the video drivers are correct, complete, and up-to-date. If the problem persists, you might need to replace the video board outright.

**Symptom 19. When an application is started (under Windows), the opening display appears "scrambled"** Although this might appear to be a video memory problem at first glance, it is actually more likely to be related to a buggy video driver. Upgrade the video driver to the latest version or try a generic video driver that is compatible with your video chipset.

**Symptom 20. The display colors change when exiting from a DOS shell under Windows** This problem has been noted with video boards, such as the Diamond Speed Star Pro, and is almost always the result of a video board defect (usually a palette problem). For the Diamond board, the product must be replaced with revision A2. For other video boards, such problems can usually be corrected by replacing the video board outright.

**Symptom 21. The computer locks up or crashes when starting an .AVI file** This problem is encountered frequently as computer users first begin to try multimedia applications. Rather than being a problem with the video board specifically, the trouble is often from using an outdated version of Video for Windows. Be sure to use Video for Windows 1.1E or later. You might also need to edit the [Draw Dib] section of the WIN.INI file and add an entry that says: DVA=0. If no [Draw Dib] section is present, you can add it. Remember to restart Windows after making any changes.

**Symptom 22. The computer is running very slowly (poor performance), and the hard drive light is continuously lit** This problem is particularly apparent with Diamond Edge 3D video boards on systems with more than 16MB of RAM. The Diamond Edge 3D board comes with both 1MB and 6MB MIDI bank files. Diamond recommends that you use only the 6MB bank file on systems with more than 16MB of RAM. To change the size of the MIDI bank file being used, right-click on *My computer* and choose *Properties*. Open the *System control panel* and click on the *Device manager* tab.

Click on the (+) symbol beside the *Sound, video, and game controller* line, then highlight the *Diamond EDGE 3D PCI multimedia device*, and click on *Properties*. Click on *Set-tings*. You will then see the 1MB and 6MB MIDI bank selection. Select the 6MB option and choose *OK*. Restart your computer when prompted.

**Symptom 23. The .AVI files have distorted colors or "grainy" playback** This usually occurs when playing 8-bit .AVI files that are not supported by DCI, and can usually be corrected by disabling the accelerated video playback features of the video board. For example, the Diamond Viper Pro Video board is noted for this problem; you would need to edit the COPRO.INI file located in the directory. In the [VCP] area, change the VCP Enable= line to OFF. Save the .INI file and restart Windows.

**Symptom 24. The PCI video board will not work under Windows unless the system's PCI SCSI devices are disconnected** This type of problem occurs only on certain combinations of PCI system hardware. For example, this type of symptom has been documented using Phoenix BIOS 4.04 and a UMC8810P-AIO motherboard on systems with an NCR SCSI controller and SCSI devices. You can often correct such problems by correcting the *advanced system setup* in CMOS. Start the CMOS setup, go to the *advanced system setup*, and select *PCI devices*. Setup the PCI slot for the SCSI controller as IRQ9 and Level edge select. The slot for the video board should have the IRQ set to *None* and *Level edge select*. Change the Base Memory Address from 0080000000 to 0081000000.

**Symptom 25. Boot problems occur after a new video board has been installed** Typical problems include no video or eight beeps when the system is turned on. This is usually the result of an outdated system BIOS, which is not capable of detecting the particular video chipset in use. The BIOS interprets this as meaning that no video board is in the system, and an error is generated accordingly. Contact the motherboard manufacturer (or PC maker) for an updated system BIOS. Most BIOS versions dated after the fall of 1994 should be able to detect most modern video chipsets.

**Symptom 26. Boot problems occur when a PCI video board is installed** Two common problems account for this. First, the system BIOS did not complete the configuration of the video board correctly and the board has not been enabled onto the PCI bus. The video board manufacturer might have a utility available that can "remap" the video card to a new address outside of physical memory. For the Matrox Millennium, use the PCIMAP.EXE utility. Other Matrox boards use the MGABASE.EXE utility. Other PCI video board manufacturers probably offer their own utilities. The second problem is that the system BIOS has assigned a base memory address to the video board, which is used by another device or is reserved for use by the motherboard chipset. Although the utilities mentioned might often help to correct this problem, a more permanent fix is usually to update the system BIOS. Investigate a BIOS upgrade from the motherboard (or PC) manufacturer.

**Symptom 27. The monitor over scans when entering a DOS shell from Windows This creates a highly distorted image, and it can (if left for prolonged periods) damage the monitor circuitry.** The cause of this problem is usually a bug in the video driver. For example, this type of problem is known to happen when using the Diamond Speed Star Pro with drivers prior to version 1.06. Obtain the latest video driver from the video-board maker or try a generic video driver written by the video chipset maker.

**Symptom 28. An intermittent "Divide by zero" error occurs** Although this type of error has several possible causes, they are all related to flaws in software—in this case, problems with the video driver or video "toolkit" that is installed with the particular video board. Often, upgrading the driver or video support tools will eliminate this problem. For example, "Divide by zero" errors can be corrected with the Diamond Stealth 64 Video 2001 series by opening the In Control Tools package, and changing a "Center to view port" selection to "Center to desktop." Similarly, the "Maximize to view port" selection should be changed to "Maximize to desktop."

**Symptom 29. During MPEG playback, the display flickers, shows low refresh rates, or appears to be in an interlaced mode** This is not necessarily an error. With some video boards (such as the Diamond MVP1100), MPEG files cannot play correctly at high refresh rates—typically over 72Hz. When an MPEG file is played, the driver will automatically switch to a 72Hz vertical refresh rate. This might result in an unexpected change of display quality during playback. After exiting from the MPEG player, the original (higher) refresh rate will be restored. If a vertical refresh rate lower than 72Hz was originally selected, then the vertical refresh rate will not change during MPEG playback, so you should see no difference in the display.

**Symptom 30. An error, such as "There is an undetectable problem in loading the specified device driver" occurs when starting an MPEG player or other video tool** In almost all cases, the related driver is missing, installed improperly, or corrupted. Reinstall the MPEG playback driver(s) for your particular video board and be sure to use the latest version. If problems persist, check for the driver under the WIN.INI or SYSTEM.INI file and see that it contains only one load= reference to the particular driver(s)—repeated references can cause conflicts or other loading problems.

**Symptom 31. On video boards with TV tuners, the TV window is blurry or fuzzy at 1024-□-768 (or higher) resolutions** This symptom is particularly noted with the Diamond DVV1100. Unfortunately, this type of symptom is usually the result of limited bandwidth of the particular video board—specifically of the video chipset. The only real option is to reduce the resolution to 800 □600 or 640 □480 when running the TV, and lower the refresh rate to 60Hz. Contact your video board's manufacturer—an RMA or other replacement/upgrade program might be available to correct the issue.

**Symptom 32. On video boards with TV tuners, the reception does not appear as good as that of an ordinary TV** This problem has been noted in conjunction with Matrox Media-TV boards, and is usually caused by the local cable company using the HRC carrier frequency instead of the standard carrier frequency. For Matrox boards, you can correct the problem by modifying the DVMCIMIL.INI file in the directory. Under the [Carrier] section, change the Carrier Type=0 entry to Carrier Type= 1. Other video/TV boards might utilize different .INI entries, or allow carrier selection through the use of an onboard jumper, but poor reception is almost always the result of an unusual cable carrier.

**Symptom 33. Errors appear, such as "Insufficient video memory"** Not enough video memory is on the board to handle screen images at the resolution and color depth you have selected. In most cases, the system might crash outright. Your immediate solution should be to select a lower resolution or a smaller color palette. If you are encountering such problems when attempting to play .AVI or MPEG files, you should be able to select smaller video windows and lower color depth without altering your Windows setup. As a more long-term solution, you should consider adding more video memory or replacing the video board with one that contains more video memory.

**Symptom 34. The PCI video board is not working properly. A BIOS conflict is occurring with PCI interrupt 1Ah** The lower 32KB of the ROM BIOS has been redirected for high memory use. Disable this memory with your memory manager by adding an exclude command, such as: x=f000-f7ff.

**Symptom 35. Video corruption or sporadic system rebooting occurs when using an SLC-type motherboard** This particular symptom has been most noted when using Number Nine video boards with Alaris SLC2 motherboards. The SLC2 microprocessor uses a 32-bit internal data bus, but the external data bus (seen by the motherboard) is 16 bit. Most of the registers on contemporary VL and PCI video boards are mapped as 32 bits, and cannot be accessed as two 16-bit registers. As a result, the video board simply cannot be used together with the particular motherboard. You will have to upgrade the motherboard or use a different video board.

**Symptom 36. Video playback experiences long pauses while the hard drive thrashes excessively** This problem appears under Windows 95, and it is almost always the result of disk-caching problems. Start Windows Explorer and highlight the drivers responsible for video playback (for a Motion Pixels video board, highlight MPXPLAY.EXE and MPXPLAY.PIF). Click the right mouse button and select *Properties*. In the *Memory* page, be sure that the "Protected" option has been set. Restart the video clip or restart Windows 95, if necessary.

**Symptom 37. The loop-through feature of your video board cannot be used Typical examples include the Number Nine 9FX Motion 771 VGA loop through connector with a Reel Magic board and a Number Nine driver.** Unfortunately, this is often the result of a limitation with the video board's graphics processor IC (refusing to support loop-through functionality). To use loop-through, try the standard VGA driver.

**Symptom 38. Windows appears with a "black box" cursor and/or icons that fail to appear on the screen** In most cases, the problem is caused by an in-compatibility with the motherboard's non-compliant PCI BIOS (the motherboard's BIOS does not comply with the PCI backward-compatibility requirement). To overcome this problem, set the video board's memory aperture manually by editing the SYSTEM.INI file located in the directory. For example, when working with a Number Nine 9GXE, find the [#9GXE] section of SYSTEM.INI, then add a command line, such as: APERTURE-BASE= 0x8800 or APERTURE-BASE=31. Save the file and restart Windows. The actual section for your particular video board might be different.

**Symptom 39. Video problems occur or the system locks up while using an anti-virus program** This error occurs frequently when using memory resident virus checking. Some video boards allow you to compensate for this by editing the SYSTEM.INI file. For the Number Nine 9GXE board, find the [#9GXE] area in SYSTEM.INI, then set the Fast MMIO= entry to *Off*. Remember to save the .INI file and restart Windows. The actual section for your particular video board might be different. As an alternative, you could also disable or remove the anti-virus program.

**Symptom 40. An error indicates that not enough memory is available for playback or re-sizing of the playback window** This type of program is directly caused by a lack of system (not video) memory in the PC. If your system uses SMARTDRV (Windows 3.1x), try reducing the memory used for caching. Try unloading various unneeded programs from memory, and consider disabling any RAM drives that might be active. Finally, consider adding more system RAM to the PC.

**Symptom 41. The video board refuses to accept a particular video mode** Mode problems are most frequent when attempting to use unusual palette sizes, such as 32,000 or 64,000 colors. Try setting the video board to 256 colors. If a higher color depth is needed, it might be possible to run the video board in a palletized mode or gray-scale mode by adding command-line switches to the video driver. Refer to the instructions that accompany the particular video board for detailed information. You might also consider a video BIOS upgrade or try using an upgraded VESA driver (such as UNIVBE 5.3 from SciTech Software).

**Symptom 42. The video system cannot lock memory using QEMM and linear video memory** This is often a DOS problem with Motion Pixels video boards when using QEMM 7.04 and earlier versions. The DPMI has a bug when accessing physical memory above the DPMI's host memory. Upgrade the version of QEMM to 7.5 (or later) or play video under Windows instead.

**Symptom 43. The video system cannot lock memory under Windows or the system hangs** This is also a problem noted most often with Motion Pixels video boards, and is almost always related to the use of a WINDPMI.386 DPMI driver loaded through SYSTEM.INI. WINDPMI.386 reports the wrong amount of free lockable DPMI memory. If your Windows platform is using Borland's WINDPMI.386, manually reduce the cache size with the /c option or remove (or disable) the driver from SYS-TEM. INI entirely. You might also consider upgrading WINDPMI.386 to a later version. Contact Borland technical support or contact the technical support department of the video board maker.

**Symptom 44. Other devices don't work properly after the PCI video card is installed For example, the sound card output is distorted or a fast modem loses data.** This can happen often with newer video adapters. Some computers require that software wait for the hardware to be ready to receive new data. Newer video board drivers are not normally set do this because it slows them down slightly (and it's not necessary for most current computers). Under Windows 95, right-click on the Windows 95 desktop background. Click the *Properties* menu item, select the video board's *Settings* tab. Select the *Advanced* button, then click the *Performance* tab. Clear the "Use automatic PCI bus retry" check box. Finally, accept your changes and reboot the computer when instructed to do so. Under Windows 3.1x, edit the SYSTEM.INI file in your directory to add the line Pci ChipSet=1 to the particular video board's section (e.g., [mga.drv]).

**Symptom 45. A Windows 95 game doesn't start or runs slower than normal** The program uses the Microsoft DirectX interface. DirectX might not be installed or an older version of DirectX is installed. Most programs that use DirectX install it as part of their installation, but some do not. Also, some older programs might install an earlier version of DirectX (overwriting a later version). To see if DirectX is installed:

- Right-click on the Windows 95 desktop.
- Click the *Properties* menu item and select the video adapter's *Settings* tab.
- Click the *Advanced* button and click the *Information* tab.
- Look at the Microsoft DirectX Version label. DirectX 5.x should be the current version. If the current version of DirectX is installed, you're finished. Otherwise, you'll need to in-stall DirectX.

## Troubleshooting Video Capture and PC-TV Boards

Like most other expansion boards, video-capture products generally use highly integrated, proprietary ICs. As a result, it can be extremely difficult to troubleshoot the capture board to the component level. Fortunately, a large number of capture problems can be tracked to installation, setup, and operational errors. When the use of diagnostics allows problems to be isolated to the capture board itself, it is a simple matter to replace the capture board outright.

### EFFECTS OF HARDWARE CONFLICTS IN VIDEO CAPTURE

Hardware conflicts are much more prevalent in today's systems than in systems only a few years ago. Sound boards, CD-ROM interfaces, modems, drive controllers, network interface cards (NICs), and video-capture boards all contribute to the congestion that fills up a system and demands its available resources. Most devices require an interrupt (IRQ), one or more I/O address settings, an occasional *Direct Memory Access (DMA)* channel, and possibly some small amount of memory for a BIOS. Unfortunately, those resources are scarce in most PCs, and you must be aware of what resources are available and what is being used before adding new devices to your system. When configuring a system from scratch, it is a simple matter to make a written record of each device setting. But with so many new upgrade options, keeping a written list up to date can be a difficult effort. The use of Plug and Play also makes "presetting" a device's resources difficult. As a technician servicing and upgrading customer's systems, you will rarely have the luxury to perform such a thorough analysis. Your most effective course is to use a diagnostic tool (such as Microsoft's MSD) or a hardware tool (such as the Discovery Card by AllMicro) to quickly check your system and report on the resources being used. All CPUs operate linearly—that is, they only tackle one task at a time. When a device, such as the keyboard, needs the CPU to perform important work that cannot wait for free CPU time, an interrupt signal is generated that forces the CPU to put aside whatever it was doing and respond to the interrupt immediately. When the device requesting the interrupt has been taken care of, the CPU can return to whatever it was doing until the next interrupt comes along. The problem is that only one device can use any one interrupt. If two or more devices try to use the same interrupt at the same time, one of those conflicting devices will not operate properly. In mild cases, this might appear simply as system hesitation. In serious cases, IRQ conflicts can crash your system. If you find that more than one device is using an interrupt, you must place one of those conflicting devices on an unused IRQ. IRQs can usually be changed by altering a jumper or DIP switch on the expansion board. You can recognize the effects of IRQ conflicts between a video-capture board and other devices in your system from the following symptoms:

- Video frames are dropped during video capture or playback.
- The video capture or playback process is slow or jumpy.
- The system hesitates or hangs up (crashes) completely.
- The display or data file generated during capture is corrupt.
- Audio is not captured or played back properly (if at all).

An I/O address works a bit differently. Most devices require one or more addresses to exchange data and instructions between its "registers" and the system. This I/O address works in conjunction with an IRQ, although an IRQ can be changed without changing the I/O address. All devices must use a unique I/O address. Otherwise, one device might try writing data while another device tries to read data, and the operation of both devices will be effected. I/O conflicts might also result in system crashes. Like IRQs, it is important that each device be assigned to its own unique I/O address. If more than one address is needed, there can be NO overlap of addresses at all. When more than one device attempts to use the same address(s), you must move one of the devices to an unused area. Altering hardware jumpers or DIPswitch settings on the expansion board can usually change I/O settings. You can recognize the effects of I/O conflicts between a video-capture board and other devices in your system from the following symptoms:

- The video-capture board installation program or device driver refuses to recognize or initialize the capture board.
- Microsoft Video for Windows (or other capture application) can't initialize the capture device.
- The video-capture board works erratically or fails to respond at all.

**TROUBLESHOOTING TIPS**

Although video capture and playback devices can sometimes be daunting, a series of fairly "standard" troubleshooting policies can help you track down potential problem areas quickly:

- Use the latest drivers. Video capture, MPEG, and PC-TV devices depend on drivers. Buggy or outdated drivers can easily result in errors and poor performance.
- Run in the 8-bit (256 color) graphics mode. Running in any "lower" mode will result in extremely poor image quality. If you have sufficient video memory and PC processing power, you should run in the 16-bit (high color) video mode. Use care in the installation of drivers—especially with PC-TV drivers, which depend on DirectDraw and ActiveX resources under Windows 95. You might need to update or reinstall these resources after the device is installed.
- Be sure to use a strong and clean signal for recording. Your capture is only as good as the original signal.

- Be sure to use good-quality cabling. Poor cabling and connectors can easily degrade even strong video signals. Check that all of your video/audio cables are secure.
- When using MPEG and PC-TV devices, use moderate video resolutions and refresh rates. These devices normally "downshift" higher refresh rates during play, and the flicker can be quite noticeable at high resolutions.
- Don't shift video modes while MPEG or PC-TV devices are in use. The change in the video drivers can crash the computer.
- Disable power-management features, such as APM, when using video capture, MPEG, and playback devices. The computer can crash if the system shuts down into suspend mode while these devices are in operation.
- PCI video devices often depend on the correct configuration of a PCI bus slot. Check the slot's configuration under your CMOS setup.

## INSTALLATION SYMPTOMS

**Symptom 1. Problems occur when installing the S-Video cable**. Most video-capture boards are designed to accept composite audio/video signals from either a single RCA connector or an S-Video connector. Unfortunately, the S-Video connector is not keyed to prevent incorrect insertion. This generally means that signals will not reach the capture board. It is possible to install the S-Video cable rotated 90 degrees from where it should be. Be sure that the arrow on the cable matches the marking on the capture board.

**Symptom 2. Even though a valid video source is available, vertical multi-colored lines appear in the capture application window** This is a problem particular to capture boards when the board itself is loose or installed improperly, or if the signal cabling is not secure. Check the capture board to see that it is fully inserted in the expansion slot. If any modules or sub-boards are attached to the capture board, see that they are secure and inserted properly. Also check any connectors and cables to be sure that they are all installed correctly.

**Symptom 3. Even though a valid video source is available, only black appears in the capture application window** There are several possible reasons for this symptom. First, check the video signal being fed to the capture board. With no signal, the video-capture window (i.e., the Video for Windows VIDCAP window) will be dark. You can test the video signal by disconnecting the video cable from the capture board and connecting it to a stand-alone monitor, such as a TV set. Damaged or defective video cables and connectors should be replaced. If you are using a camcorder as a real-time video source, be sure that the camera is turned on, the lens cover is off, and that you have selected the correct video source (i.e., composite or S-Video).

Also check that the capture board is inserted in the system properly and completely. Any sub-modules should be attached securely to the main expansion board. Finally, an IRQ conflict might be between your video-capture board and another device in your system. If you attempt to capture a video file while the capture window is dark and receive an error, such as "Wave input device not responding," it is almost certainly an IRQ problem. Run a diagnostic such as Microsoft's MSD (or use a hardware tool, such as AllMicro's Discovery Card) to identify unused IRQs, then set the video-capture board to use an available IRQ. In some cases, you must run an installation routine for the capture board when changing settings. If problems persist, the capture board might have failed.

**Symptom 4. During installation, the error "Unable to locate an available interrupt" appears** This type of symptom occurs with an IRQ conflict, or when a device driver or TSR interferes with the installation. Be sure that the capture board is configured to use an available IRQ (i.e., 9, 10, 11, or 12). You might have to use a diagnostic (such as Microsoft's MSD or the Discovery Card by All Micro) to locate available interrupts. Try booting the system from a clean DOS disk to prevent any TSRs or device drivers from interfering with installation. Unfortunately, if a conflict occurs during installation, it will also probably occur during actual use. So, if you suspect a TSR or device-driver conflict, you will have to disable TSRs and device drivers one by one until the conflict disappears, then work with the offending TSR or device-driver configuration to eliminate the conflict.

**Symptom 5. The capture board cannot be initialized** because of a lack of available IRQs On some systems, the capture board fails to initialize when launching the capture application. This is usually because of the lack of an available interrupt request (IRQ) for the capture board to use.
To check the IRQs on your system:

1 Go to the Windows 95 desktop.
2 Right-click the *My computer* icon and select *Properties*.
2 Click the *Device manager* tab.
3 Doubleclick on *Computer* to display all IRQ resources.

You see each of your system's interrupts and which devices are using them. If all IRQs are already assigned to other devices, you'll need to free an IRQ for the video-capture board. You can usually free an IRQ by removing a device no longer in use or by disabling the IRQ on a feature not being used (e.g., if you're not using the MIDI port of a sound board, disable it to free the IRQ).

**Symptom 6. When starting the capture utility, the error "Unable to initialize a capture device" appears** This error message is produced by the capture utility (i.e., the Video for Windows VIDCAP utility) when the capture board cannot be located. For most capture boards, an IRQ conflict is probably occurring with one or more devices in the system. This can happen easily when new devices are added to the system after the capture board has been installed. Use a diagnostic (such as Microsoft's MSD or the Discovery Card by All Micro) to locate unused IRQs. If new equipment has been added, change the new equipment to relieve the conflict. If the error manifested itself when the capture board was installed, change the board's IRQ to an available setting.

If interrupts check out properly, be sure that the capture board is inserted properly and completely into the motherboard. If any modules or sub-boards are attached to the capture board, see that they are inserted and secured properly. You might also have installed the capture software in the wrong order. Some boards require that DOS software be installed first, then Windows software drivers must be installed. If this process is reversed, the capture board's Windows drivers might not install properly. Try reinstalling the capture software. If software is correct, try another capture board.

**VIDEO-CAPTURE SYMPTOMS**

**Symptom 7. Colors appear washed out or bleeding** This can occur while viewing the video image before capture or during the actual playback of an image file. If the problem is manifesting itself before capture, begin by checking the signal quality from your video source, such as a VCR or video camera. A loose or damaged cable, or a poor quality video source can result in signal degradation at the video-capture board. If the video signal and connections are intact (and the signal looks good on a monitor, such as a TV), the problem might be in the Windows video driver being used. Better color depth in the video driver will result in better color quality in the video capture. In virtually all cases, a 16-color video driver (generic VGA) is totally inappropriate for video-capture applications—a 256-color driver is considered to be the minimum. If you are already using a 256-color video driver, try an upgrade to a 32K, 64K, or 16M color driver. You might have to contact the manufacturer of the particular video board to obtain an advanced video driver for Windows 3.1x or Windows 95.

**Symptom 8. The video signal appears to be weak or washed out even though the video signal source is acceptable** This is typical when a composite video signal output is being sent to the video-capture board as well as to a stand-alone monitor through a Y-connector. Composite output signals are usually power balanced for one connection load only. If the load on a composite output is not balanced properly, the video signal at your capture board will not contain enough power (signal degradation will occur). Try connecting the video signal directly to the video-capture board.

**Symptom 9. "Vertical sync" error appears when trying to capture Chances are that your computer has an IRQ conflict.** Check the IRQ assigned to the video card's PCI slot in the *Device manager* under Windows 95. If this PCI slot the video card is in is being used by another device, you will need to reassign the PCI slot for the video board a different IRQ. This can be done through your system's CMOS setup. If no IRQ is being assigned to the PCI slot the video card is in, that can also be a problem. Once again, you can assign an IRQ to the PCI slot through the CMOS setup. There could also be an IRQ conflict with the video capture driver. To check this, look in the *Control panel* under *Multimedia*. Click on the *Advanced* tab, then look under *Video capture drivers*. There, you'll see an entry, such as *Diamond Multimedia Capture Driver*. Doubleclick on it, then click on the *Settings* option. There, you can change the IRQ of the capture driver. Try a free IRQ or free an IRQ.

**Symptom 10. Up to 50% of small frames are being dropped (large frames appear to capture properly)** This symptom might occur in systems using fast 32-bit SCSI adapter boards, and is almost always caused by the effects of double buffering in the SMARTDRV.EXE utility. If possible, try to disable SmartDrive in the CONFIG.SYS file. If SmartDrive cannot be disabled (usually because it would have adverse side-effects on other devices that rely on Smart Drive's caching), try capturing video at a larger frame size, such as 320 ´ 240 before capturing at a small frame size. This lets SmartDrive adjust to the data needs of the larger frame size, so subsequent captures at a smaller frame size should work correctly until the system is rebooted. An updated video capture driver might also provide better performance.

**Symptom 11. When capturing video, the corresponding screen image appears broken-up or jerky** If the image being previewed on the screen prior to capture looks smooth and the captured video looks smooth when played back, you should suspect that the customer's hardware platform is not quite fast enough to update the screen while capturing. This is not necessarily a problem because many video capture applications (e.g., Video for Windows) is designed to sacrifice screen updates for the sake of smooth captures. If you need a smooth display during capture, start by relieving any unnecessary processing loads from the system:

- Close other Windows 95 applications running in the background.
- Close any DOS applications running through a window.
- Be sure that the Windows disk cache is set to at least 2MB (4MB, if possible).
- Set audio captures specifications to 8-bit, mono, 11kHz sample frequency for the lowest audio processing overhead.

**Symptom 12. The video-capture board is working, but captures are occurring very slowly** In most cases, very slow recording performance is caused as the result of an IRQ conflict between the capture board and another device on the system. Evaluate the components in your system or run a diagnostic (such as Microsoft's MSD) to locate and identify any unused interrupts in your system. If you are faced with a jumper only capture board, set the jumper(s) to use a free valid IRQ. If your capture board requires a software setup, run its setup utility and choose another valid interrupt (e.g., 9, 10, 11, or 15).

**Symptom 13. The Super Compressor option cannot be used in Video for Windows** This is not an actual user problem. The Super Compressor is an off-line compression utility that compresses and stores video files captured at 320 ´ 240, 15 frames per second (fps) at the same data rate as CD-ROM (150KB/sec). Video for Windows version 1.0 does not support the Super Compressor function when used with Indeo 3.0 device drivers. Only the Quick Compressor in the VIDEDIT utility is available. Later versions of Video for Windows make use of this function, and you should upgrade your version of Video for Windows at your earliest convenience.

**Symptom 14. More than one frame of motion video can't be captured** This problem is reported with the Intel SVR III. While trying to capture video, the capture process stops after one frame, but the capture application acts as if it is still capturing and you must click *Stop* to exit. The YUV9 video format always seems to exhibit this problem. The RGB24 video format seems to work at lower window sizes. There are no problems capturing still images or sequences of still images. This problem appears to be related to an improper or incomplete installation of Windows 95 Direct Draw drivers.

**Symptom 15. The color video being captured is shown as black and white** There are two possible causes for this. First, the capture window (e.g., the Video for Windows VIDCAP utility) is set to receive a composite video source, but the video signal being fed to the capture board through its S-Video cable. Check the configuration settings under your *Video capture* options. Be sure that the correct input type (*Composite* or *S-Video*) is selected in the video capture utility. Another possible source of problems is a bad connection. Check that the video signal is indeed color and that a good cable is securely attached to the capture board. Try a different video source. Next, check that the capture board is inserted properly and completely in the expansion slot. If any modules or sub-boards are attached to the capture board, see that they are secured correctly. If problems persist, try another capture board.

**Symptom 16. The video image shown in the VIDCAP capture window appears torn or bent at the top** This symptom is typical of signals being supplied by VCRs (or camcorders used as VCRs), and is almost always the result of a weak video synchronization signal from the signal source. The problem can often be rectified by using a different (stronger) signal source (e.g., another camcorder or VCR). If you are using a VCR signal source, be sure that the Video for Windows *VCR* box is checked.

Use the S-Video signal source, if possible, because S-Video signals are less prone to noise and losses than composite signals. Also be sure that the video cable feeding your capture board is not lying parallel to power cables because the power cable can induce unwanted noise into the video signal. Try placing the video-capture board in another expansion slot as far as possible from the system power supply and other expansion boards because electrical signals generated by other boards might cause interference with the video data. As a sanity check, be sure that any modules or sub-boards for the video-capture device are attached properly.

**Symptom 17. When capturing video, an error appears: "No frames captured. Confirm that vertical sync interrupts are configured and enabled"** Some issues are known to occur with the Intel SVR III, but these might also affect other capture devices:

- The Adaptec 1542B and 1542C 16-Bit ISA SCSI controllers were tested with the SVR III using IRQ 11 and I/O address 330h. When the SVR III was also set to IRQ 11, the VidCap utility in Video for Windows returned blank video, and no frames were captured, then returned the error message.
- Reconfigure the system devices to avoid IRQ conflicts.
- The Media Vision Pro Audio Spectrum 16 16-bit soundboard was tested with the SVR III using IRQ 5, IRQ 15, and I/O addresses 220h and 388h. When the SVR III and the Pro Audio Spectrum 16 were both set to IRQ 11, the SVR III software detected a conflict, and Video for Windows returned the error message. Reconfigure the system devices to avoid IRQ conflicts. A Diamond VLB Speed star Pro Video board using IRQ 2 by default can also cause this fault. Disable the use of IRQ 2 on the Diamond Video Board.
- SiS FI2 P54C motherboards using an Award BIOS also have been known to suffer this problem. You'll need to go into BIOS and tweak the chipset configuration. Change the *ISA BUS Clk Frequency* entry from *PCI Clk divided by 3* to *PCI Clk divided by 4*.

**Symptom 18**. **Artifacts appear when capturing video at high data rates** When capturing at high data rates (such as when using 640-´-480 resolutions and 30fps frame rates), occasional problems have been noted on some PCs—most notably with Intel SVR III or Pro capture products. *Artifacts*, which resemble black horizontal lines, might appear in your preview or capture window. Try repeating the capture (best if the problem only occurs infrequently). If the artifacts occur too frequently for you to recapture, you're probably trying to capture at too high a data rate for your computer's PCI bus to handle. Reduce PCI bus traffic by lowering the data rate of the video you're capturing:

- Use a lower frame rate.
- Use a lower window resolution.
- If you're using RGB24 as the video format, try using YUV9 instead.
- Use more compression (a lower-quality setting).
- Turn off the preview mode.

If you continue to find horizontal black lines in both preview and captured video (even at 320-´-240 resolution) when using the YUV9 video format, your computer's PCI chipset might be programmed to disable a featured called *host memory write posting*. When enabled, this feature allows your PCI chipset to write to memory at its maximum speed. When write posting is disabled, your PCI bus performance can be significantly reduced. Write posting is enabled in different ways on different systems. Some computers might permit this feature to be controlled through the CMOS setup, but other computers might require a BIOS upgrade from the system manufacturer.

**Symptom 19. Artifacts appear when capturing video using certain PCI graphics cards** The method used by some graphics cards and their drivers to utilize the PCI bus can sometimes cause horizontal line artifacts. For example, Intel has verified a problem using the Number Nine 9FX Motion 771 graphics card (which uses the S3 Vi-sion968 graphics chipset) together with the SVR III. The following problems seem to occur when the display color depth is 16 bit or 32 bit, and when *Preview* is on during the capture process. This also seems to occur in files captured at 320-´-240 resolutions at 15 fps using either the YUV9 or RGB24 video format. Try setting the graphics display to 8- bit (256 color) mode (this has no effect on the quality of the captured video—only on the previewed video). You might also try disabling "preview" during the capture process.

**Symptom 20. Systems with SiS 5596 or 5511 PCI chipsets lock up when using a video-capture device** This issue is known with the Video Logic Captivator This changes numerous settings in the chipset configuration (e.g., SRAM, Read Pulse, SRAM Burst, and Refresh) all of which go to slower value. PCI board. SiS has identified the problem and a fix is available through a BIOS update. Contact the system maker or motherboard manufacturer for a BIOS update.

**Symptom 21. Systems lockups when running video-capture devices on PCs with Phoenix BIOS** Some PCs are known to lock up with the Video Logic Captivator PCI card installed (such as members of the DEC Venturis family). This has been traced to a problem to the Phoenix v.1.6 BIOS. All PCs using Phoenix v.1.6 BIOS should be upgraded to Phoenix BIOS v.1.9 (or later).

**Symptom 22. You cannot use the capture device on a system with a SiS PCI chipset** this problem is known with the Intel SVR III, and is caused by a driver-compatibility issue. The SVR III driver 1.2 will cause the system to lock up when launching the capture utility. You can determine the current driver version by opening the README.TXT file on the SVR III CD-ROM. Download and install the version 1.3 driver or later (SVR3-14.EXE from Intel at **http:\www.intel.com**). You can find out which PCI chipset is in your system by checking the PCI chipset in the *Device manager*:

- Click *Start*, Settings, and *Control panel*.
- Doubleclick the *System* icon.
- Go to the *Device manager* tab.
- Click the + in front of *System devices*, and look for a reference to the "PCI to ISA bridge,".

**Symptom 23. The capture device cannot be used on a system with an S3 chipset-based video card** If your system uses: an Award BIOS version 4.51pg, Windows 95 Release 2 (OSR2), and an S3 968-based video graphics card, you might experience system lockups when trying to launch your capture program. This problem has occurred with the Intel SVR III and the Diamond Stealth 64, as well as the Number Nine Motion 771). It arises from a memory-address conflict between the Intel SVR III and the S3-based video-graphics card. According to Intel, it appears that the S3 only requests 32MB of virtual memory, rather than the 64MB it actually requires. If the BIOS allocates the memory for the capture device (such as the SVR III) right above the S3 board's range, the system will lockup. To correct this problem, you'll need to change the memory address range used by the video capture device:

- Open the *Device manager* and doubleclick on the capture device (e.g., the Intel Smart Video Recorder III). Ignore the exclamation point next to it, if it has one.
- Click on the *Resources* tab, then un-check the box titled *Use automatic settings*.
- Doubleclick on the memory range and enter an address of FFFBF000–FFFBFFFF (the spaces on each side of the "–" symbol are needed). Click on *OK*.
- If Windows 95 returns the message: "The setting you have chosen conflicts with another device," click on *No*, then scroll with the up and down arrows next to the address range until no conflict is noted. Click on *OK*.

## CAPTURE/TV APPLICATION SYMPTOMS

**Symptom 26. Bitmap or still-image files can't be imported into the Intel DVP 4.0 application** If you can import .WAV and .AVI files, but can't import .BMP and other static-image files, you need to move three files from the DVP 4.0 directory to the directory. The names of the files are: DSEQFI40.DLL, TGAFIL40.DLL, and FLIFIL40.DLL. These .DLL files are copied to the DVP 4.0 directory by the DVP 4.0 setup program. In very rare cases, the location of the files results in the error: "Can't import this media type" when trying to import single-image file formats. Manually moving these .DLL files to the directory should fix the problem.

**Symptom 27. Intercast viewer can't be started** If the viewer can't detect a valid signal source, it tries to locate one. If a valid signal exists, the software asks if you want to make it permanent. Click *OK* to make the setting permanent, or click *No* to repeat the same process the next time you run the program. If no valid signal exists, an error message appears and the software shuts down. To correct the problem, ensure that the cable or antenna connection to the PC-TV card is secure, and have the local cable company check the signal quality.

Symptom 28. You only receive incomplete Intercast broadcast Web page displays on the PC-TV card This happens most often when you change channels quickly—you might interrupt the reception of "billboards" and Web pages sent by the broadcaster. In those instances, the default billboard or a partial Web page might display. Be sure that you remain on any given channel for a few minutes to allow enough time to receive complete Web pages or billboards.

**Symptom 29. Intercast broadcast Web pages are missing** When tuned to a channel that broadcasts Intercast content, the Intercast channel indicator animates. If no Web page displays (even with the animated channel indicator), be sure that you are not actively browsing (using the Web browser). Doubleclick the desired Web page title or icon in the *Media library*. The broadcaster might send many Web pages connected by hypertext links before signaling the main Web page to display. If part or all of the pages are missing, you can still view the existing pages through the *Media library*. Unless the broadcaster re-sends the pages, you cannot view pages sent before you tuned to the channel—any links referring to those pages are also not valid. Finally, check with your local cable company. The cable company might have blocked the portion of the signal that sends Intercast content.

**Symptom 30. An error indicates that the computer can't find a .DLL file when trying to run the PC-TV application** This problem frequently arises with Diamond Multimedia DTV devices and Stealth 64 drivers. This error usually means that the Diamond Stealth 64 drivers aren't installed properly, or that wrong drivers are installed. Be sure that you're using the newest drivers available from the video-board manufacturer. You can tell which driver is loaded by looking in the *Device manager* in Windows 95. You can update the video driver through the *Add new hardware* wizard, or remove the existing video device through the *Device manager*, and let Windows 95 re-detect and reinstall it.

**Symptom 31. An error appears, such as: "The following entry should be in your system.ini file: [drivers] Msvideo=stlthcap.drv" You are then asked to press *OK* to add, or *Cancel* to exit**. This means that, for some reason, the capture driver for the PC-TV card was not installed in the SYSTEM.INI file. You would only need to click *OK* to have the software add it for you. The driver might have been replaced if you have had another capture driver (e.g., from a different video-capture board) installed recently. Click *OK* to re-install the current PC-TV software.

## VIDEO PLAYBACK SYMPTOMS

**Symptom 32. The error "MMTASK ERROR >> GPF IR30.DLL 0003:0B85" appears when trying to play a captured file** You encounter this error when trying to play a captured file with a utility, such as Media Player or VIDEDIT, and video and sound is in the same file (it does not occur if audio is not captured). The audio track can be played if video is not played. This problem is known to occur because of drive overlay software. For example, a Western Digital 1GB drive using overlay software was known to conflict with the IR30.DLL file. Drive-overlay software is used so that DOS can read a drive with more than 1024 cylinders. If you upgrade the motherboard BIOS or drive controller to support LBA mode operation, you can eliminate the use of overlay software and the error should disappear.

**Symptom 33. The video playback is choppy or contains dropped frames** This is typically not related to the video-capture board. For most video-capture systems, playback speed and quality is very dependent on machine speed—faster machines with higher-performance equipment will play back video files better than slower, simpler systems. Be sure that your customer's system is equipped with at least the minimum amount of hardware to ensure a proper playback. If playback performance still seems choppy, your customer might have to upgrade their hardware platform. If a platform upgrade is out of the question, try reducing the system load during capture and playback. For example, close all unused Windows and DOS applications, close any unused data files, and select a larger virtual memory size. This symptom appears frequently in EISA systems—even on fast EISA systems up to 50 MHz. In many cases, the afflicted EISA system CMOS was not reconfigured properly after adding memory. An EISA configuration diskette might have to be run in order to cache new memory—even though the new memory might be recognized correctly. Try booting the EISA system from its configuration disk and adjust the system from there.

**Symptom 34. An initial flash of color appears when playing back video files Chances are that your customer is trying to play video files using an older version of VIDEDIT or VIDCAP utilities in Video for Windows.** This is a known problem with these older utilities, and current versions of the software should correct the problem (**http://www.microsoft.com**). Until you can download and install updated versions of Video for Windows, you can do little other than play back video clips using the Windows
Media Player or Media Browser.

**Symptom 35. No sound is heard during playback** Not all video-capture products capture sound at the same time video is captured. If no sound was captured (intentionally), no sound will be heard when the video clip is played back through Video for Windows. Some capture boards (such as Intel's SVR family) do capture sound and video simultaneously as long as audio is made available on the composite or S-Video signal cables, and the *Audio* box is checked in the *Video capture* options dialog. Also check the *Audio setup* and *Audio level* settings in Video for Windows before proceeding. If all is well with Video for Windows, check to be sure that sound was provided to the SVR during capture. If sound was recorded, you should check the configuration of your soundboard. The soundboard should contain appropriate hardware settings (such as I/O, IRQ, and DMA). The proper Windows device drivers for the soundboard must also be installed, and the driver must be loaded with other Windows drivers. Missing Windows sound drivers will inhibit sound. If the system is configured properly and sound is avail-able, but no sound is recorded, the capture board might be defective—try another capture board. If the sound card is capturing sound, the sound card might be defective. Symptom 44-36. When playing video, the system locks up when power-management features are enabled this typically required a cold reboot. Unfortunately, video playback is often incompatible with a PC's power-management features, such as APM (even screen savers can cause this problem). For the immediate future, disable all APM or screen savers when using video-playback features. For the long term, check with the PC-TV maker and see if new drivers or playback software is available that can support APM or screen savers.

**Symptom 37. The system locks up when changing resolutions or color depths while using MPEG playback or video-capture functions** This common problem is typically caused by the behavior of the MPEG or capture software. You must close all MPEG and capture functions prior to changing resolutions or color depths.

**Symptom 38. Sound gaps occur and the image appears choppy during playback** This symptom is particular to capture boards (such as Intel's SVR family), and audio and video are integrated into a single .AVI capture file. The integrated file prevents audio and video from slipping out of sync. However, playing synchronized capture files requires substantial processing power. If a system is not fast enough, sound can "hiccup" and the video can be choppy. Unfortunately, this kind of playback problem is not a fault or defect—it is a limitation of slower PC systems (usually i486-class systems). First, remove any Windows or DOS applications running in the background so that Windows can concentrate on Video for Windows or another playback application. If playback does not improve enough, try running the playback in a smaller window. For example, try playing back in a 160-´-120 window instead of a 320-´-240 window. Smaller windows require less processing overhead for each frame. Beyond that, the hardware platform might need to be upgraded.

**Symptom 39. Blue or green flesh tones are in the live video and MPEG playback** This corruption is often caused when an MPEG player application (e.g., MPEG Player 4.0) is loaded on a system that already has a video/MPEG player installed. Video Logic has reported this problem with the Captivator Pro/TV. You can correct the problem by reinstalling the video/MPEG driver for the particular device:

- Close down all MPEG and live windows.
- Start a DOS window.
- Select the directory where the video/MPEG driver file resides (for the *Captivator*, the driver is PSTREAM.DRV normally in the VLPOWER directory).
- Rename this driver file to something else.
- Expand the driver file from your original MPEG player installation disk into your current directory, such as: EXPAND A:.DR_PSTREAM.DRV (This assumes that the Microsoft EXPAND utility is on the path).
- Exit DOS and Windows.
- Restart Windows and check the video again.

**Symptom 40. An MPEG movie clip cannot be scaled to full screen when using 16.7 million colors** This kind of problem is known with the Diamond MVP 2000, but can occur on other video-capture/playback platforms. You are usually missing an entry from the video device's .INI file. For the MVP 2000, you can add the following line to the [System] section of your STLTHMVP.INI file if you wish to playback MPEG full-screen in 16M color mode: NoVideoSizeLimit=1 If you are experiencing lockups when playing MPEG clips full-screen in a 16M color mode, your system might be encountering bandwidth limitations. If you encounter this problem, you should change the following line to the [System] section of your STLTH-MVP. INI file: NoVideoSizeLimit=0

**Symptom 41. The video looks grainy (or otherwise poor quality) when playing back or recording** This is a symptom that can occur across all video capture devices. Image quality is closely related to the color depth of your Windows video driver. Many older Windows 3.1x installations and some low-end Windows 95 platforms use the default 16-color VGA video driver supplied with the Windows operating system. 16 colors are almost never adequate to define a video image, so the image will look washed out or very grainy. You must install a 256-color (or higher) video driver written for the video board in your system. Contact the video-board manufacturer for their latest Windows 3.1/Windows 95 drivers. Most manufacturers will send a driver for free, or place the driver on a BBS or on-line service for free downloading.

**Symptom 42. With Active Movie installed, the MPEG options do not show up as a device under Media Player** If you install the MPEG video playback drivers while ActiveX (Active Movie) is installed on your system, you will not see the correct menu options in the Media Player. To correct this, uninstall the ActiveX software and reinstall the MPEG video playback drivers. To remove the Active Movie portion of ActiveX:

1 Click the *Start* button, then select *Settings*.
2 From *Settings*, choose *Control panel*.
3 Once in *Control panel*, choose and open the *Multimedia* icon.
4 Click on the *Advanced* tab.
5 Click on the "+" symbol next to the *Video compression codecs*.
6 Once a list of Codecs appears, select the *Intel Indeo (R) video interactive 32-bit driver [IV41]*.
7 Once highlighted, select the *Properties* button.
8 Click on the *Remove* button.
9 Apply or *OK* the selection.

You are now ready to install the MPEG video player drivers, then reinstall the ActiveX software later.

## MPEG/PC-TV BOARD TROUBLESHOOTING

**Symptom 43. The error: "No suitable DirectDraw provider" appears** PC-TV boards (such as WinCast/TV) typically require a Windows 95 DirectDraw driver for your PCs video accelerator to provide "TV-in-a-window" or to extract Intercast content from the TV signal. The error message appears when the PC-TV application(s) cannot find the DirectDraw driver. You'll need to install a DirectDraw driver for your particular video board or upgrade the DirectDraw video driver. Check with the video-board manufacturer for updated video drivers with DirectDraw support.

**Symptom 44. The PC locks up when using the PC-TV in full-screen mode** This is known to occur with some PC-TV boards (such as the Happauge Win-Cast/ TV) when using older video adapters based on the S3 Trio64V+ chipset and running the TV in full-screen mode. For the WinCast/TV board, you will need to use an update that is found in the Filesdirectory on your PC. To install this update so that it takes effect every time you turn your system on, add the following line to your AUTOEXEC.BAT file (found in the root directory): c:65 ActiveX (Active Movie) is included with most versions of Microsoft Internet Explorer 3.xx. If you install the ActiveX software before installing the MPEG video playback drivers, you will not have the option to use the MPEG video player for hardware MPEG playback. If your video adapter was sold before Windows 95 was introduced in August 1995, it is possible that your video chipset does not (and will not) have a DirectDraw driver.

In this case, you'll need to upgrade the video adapter. For other PC-TV boards, you might need to contact the individual manufacturer and obtain a driver update to correct the S3 issue or replace the video adapter with one using other than an S3 chipset.

**Symptom 45. TV images move only very slowly in an Intercast viewer** This will occur without an updated DirectDraw driver in the PC. If an updated DirectDraw driver is not installed, the Intercast viewer will still work with some VGA video adapters, but the video image is moved to the Intercast viewer window through a Video for Windows preview window (which displays at roughly 4fps). This problem can be fixed by installing an updated Direct Draw driver—usually along with updated video adapter drivers.

**Symptom 46. Bad or improper colors appear in the PC-TV window** If your video display is running in 256-color mode, the TV picture will be displayed with only 256 colors. This compares with the 16 million different colors in the original TV image. The color palette in the TV window will change, depending upon which Windows programs are being run, and what color palettes are being used. This causes a "shortage" of colors, which can result in the wrong colors displayed. To fix this problem, first try running your video adapter at a minimum of 16 bits per pixel (a "high-color" mode). If you do not have enough memory on your video adapter to run at 16 bits per pixel at your current resolution, either lower the resolution (e.g., from 1024 ´ 768 to 800 ´ 600) or add more memory to your video display adapter.

**Symptom 47.** The system locks up when using S3 Vision 968 or 868- based video adapters System lockups occur randomly and shortly after starting the PC-TV application. This is caused by a PnP resource-allocation problem (typically memory allocation) between the S3 video adapter and the PC-TV board. To correct this problem, you'll need to manually readjust the memory address of the PC-TV board:

- Click on the *Start* button, then *Settings* then *Control panel*.
- Double click on the *System* icon, then the *Device manager* tabs.
- Double click on *Sound, video and game controllers*, then double click on the PC- TV card (i.e., "Hauppauge WinCast/TV").
- This brings up the TV card's *Properties* window. Click on the *Resources* tab.
- Uncheck the "Use automatic settings" box. Highlight *Memory range* and click on *Change setting*.
- The memory address range of the PC-TV card is a set of two 8-digit hexadecimal numbers, such as: FFFA0000–FFFA0FFF To eliminate the memory overlap, either increase the second digit by four or decrease it by eight (remember to use hexadecimal arithmetic). This changes the memory space between the video adapter and the PC-TV to 64MB.

**Symptom 48. You cannot tune the PC-TV card above channel 13** This is almost always a card setup oversight. Check the video source setting in the video property dialog(s). When connecting local cable to your PC-TV card, you must set the video source setting for *Cable*. If you select *Antenna*, the tuner stops at channel 13.

**Symptom 49. The PC-TV picture suffers from poor quality** This is usually because of inadequate video board support. A poor TV image is usually caused when your video adapter does not have enough video RAM to hold the TV image. In this case, the PC-TV board will usually resorts to a lower-quality mode (such as Primary Surface mode) , which lowers image quality. A memory upgrade on your video display adapter might fix this problem. Another possible cause of this problem could be that your video adapter does not support Windows 95 DirectDraw. In this case, you should consider an upgrade to a new video accelerator that has DirectDraw support. A poor video picture might also indicate a bad signal. To verify a bad signal, move the antenna or check your local cable connection. Move possible interference sources (such as other computers or television sets) away from your PC. Contact the cable company to check your signal quality.

**Symptom 50. The TV picture displays a blue screen** In several conditions; the TV picture might display a blue screen, a momentary loss of signal, a weak video signal, changing the channel, or a scrambled channel. A momentary loss of signal is beyond your control and sometimes cannot be avoided. A weak video signal can be caused by weak reception from a distant station while using the antenna. The local cable company should address weak cable signals. Changing channels can sometimes cause momentary blue screens (switch the channel up or down, then return to the original channel). A scrambled channel is not a valid channel—you'll need to contact your local cable company and obtain a descrambler (and pay a premium for the channel).

**Symptom 51. Snapshots taken from a PC-TV board don't display correctly** This usually occurs when using a 256-color mode in the video adapter. Colors often corrupt when displaying an image with 16 or 24 bits per pixel. Try changing the Windows video mode to 16-bit color. Otherwise, copy the image to a third-party graphics program and re-save it as a 24-bit image, then display the image again.

**Symptom 52. The display flickers when using a PC-TV device** This often occurs with devices such as the Diamond DTV 1100. The DTV 1100 is designed to run at a 60Hz refresh rate, so your graphics card will automatically switch its refresh rate to 60Hz, no matter what you have currently set under Windows 95. The refresh rate is then switched back to the original setting once the DTV 1100 is no longer in use (you might see your screen might go blank momentarily while this happens). Also, you'll notice that the flickering will probably be more noticeable at higher resolutions. Unfortunately, little can be done about this because TV signals must be reproduced at their natural frequency of 60 frames per second (60Hz). The best way to get around this problem is to lower the display resolution.

**Symptom 53. Only channels 5 and 6 are available, and they are only in black and white** This problem is with the PC-TV software. You're using an old version of the PC-TV software. Contact the PC-TV device maker and obtain a patch or update driver that will correct this problem. For example, this is a known problem with the Diamond DTV 1100 when using driver versions prior to 1.02.

**Symptom 54. The television picture is green** This sometimes happens with PC-TV cards like the Diamond DTV 1100 card, and is usually the result of poor or faulty cabling. For the DTV 1100, be sure that the ribbon cable is connected between the Scenic Highway local peripheral bus connector on the video card and the DTV1100 Scenic High-way local peripheral bus connector. Also be sure that pin one (usually designated by a red stripe or dots at the edge of the cable) is connected to pin one on the video hardware.

**Symptom 55. All channels are available, but 14 and 15** This is a problem with the PC-TV software. You're using an old version of the PC-TV software. Contact the PC-TV device maker and obtain a patch or update driver that will correct this problem. For example, this is a known problem with the Diamond DTV 1100 when using driver versions prior to 1.02.

## SOUND BOARDS

### SYMPTOMS

**Symptom 1. A noticeable buzz or hum is being produced in one or both speakers** Low-cost speakers use unshielded cables. Unfortunately, strong signals from ac cords and other signal-carrying conductors can easily induce interference in the speaker wires. Try rerouting speaker cables clear of other cables in the system. If problems persist, try using higher-quality speakers with shielded cables and enclosures. In most cases, that should resolve everyday noise problems. If the noise continues, regardless of what you do, the fault might be in the soundboard amplifier. Try moving the soundboard to another bus slot away from other boards or the power supply. If that does not resolve the problem, try a new soundboard.

**Symptom 2. No sound is produced by the speaker(s)** The lack of sound from a soundboard can be caused by any one of a wide range of potential problems. If the soundboard works with some applications, but not with others, it is likely that the problem is caused by an improperly installed or configured application. See that the offending application is set up properly (and be sure it is even capable of using the sound card). Also check that the proper sound driver files (if any) are loaded into CONFIG.SYS and AUTOEXEC. BAT, as required. In many cases, one or two sound-related environment variables that are set in AUTOEXEC.BAT.

Be sure that your startup files are configured properly. Check your speakers next. See that they are turned on and set to a normal volume level. The speakers should be receiving adequate power and should be plugged properly into the correct output jack—if speakers have been plugged into the wrong jack, no sound will be produced. If the cable is broken or questionable, try a new set of speakers. Also see that the master volume control on the soundboard is turned up most (or all) of the way. If problems continue, a resource conflict might be occurring between the soundboard and another device in the system. Examine the IRQ, DMA, and I/O settings of each device in the system. Be sure that no two devices are using the same resources. You might like to use the PC Configuration Form at the end of this book to record your settings. If problems persist, and no conflict is present, try another soundboard.

**Symptom 3. CD audio will not play through the sound card** This problem can occur under both DOS and Windows. First, be sure that the soundboard is actually capable of playing CD audio (older boards might not be compatible). If the sound card is playing sound files, but is not playing CD audio, check several things. First, open the PC and be sure that the CD-audio cable (a thin, 4-wire cable) is attached from the CD-ROM drive to the soundboard. If this cable is broken, disconnected, or absent, CD audio will not be passed to the soundboard. If the cable is intact, be sure that the CD audio player is configured properly for the sound board you are using, and check the startup files to see that any drivers and environment variables needed by CONFIG.SYS and AUTOEXEC.BAT are available. If CD audio fails to play under Windows, be sure that an *MCI (Multimedia Control Interface)* CD Audio driver is included in the *Drivers* dialog box under Windows *Control panel*.

**Symptom 4. An error, such as "No interrupt vector available" appears** The DOS interrupt vectors used by the soundboard's setup drivers (usually INT 80h to BFh) are being used by one or more other drivers in the system. As a consequence, there is a software conflict. Try disabling other drivers in the system one at a time until you see the conflict disappear. Once you have isolated the offending driver(s), you can leave them disabled, or (if possible) alter their command-line settings so that they no longer conflict with the soundboard's software.

**Symptom 5. It has no MIDI output** Be sure that the file you are trying to play is a valid MIDI file (usually with a .MID extension). In most cases, you will find that the *MIDI mapper* under Windows is not set up properly for the soundboard. Load the Windows *MIDI mapper* applet from the *Control panel*, and set it properly to accommodate your soundboard.

**Symptom 6. Sound play is jerky** Choppy or jerky sound playback is typically the result of a hard drive problem—more specifically, the drive cannot read the sound file to a buffer fast enough. In most cases, the reason for this slow drive performance is excessive disk fragmentation. Under DOS, the sound file(s) might be highly fragmented.

Under Windows, the permanent or temporary swap files might be highly fragmented. In either case, use a reliable DOS defragmenter, such as PC Tools or Norton Utilities (leave Windows before defragmenting the disk), and defragment the disk thoroughly.

**Symptom 7. An error, such as "Out of environment space" appears: The system is out of environment space**. You will need to increase the system's environment space by adding the following line to your CONFIG.SYS file: shell=c:.com /E:512 /P. This command line sets the environment space to 512 bytes. If you still encounter the error message, change the E entry to 1024.

**Symptom 8. Regular "clicks," "stutters," or "hiccups" occur during the playback of speech: This might also be heard as a "garbled" sound in speech or sound effects.** In virtually all cases, the system CPU is simply not fast enough to permit buffering without dropping sound data. Systems with i286 and slower i386 CPUs typically suffer with this kind of problem. This is often compounded by insufficient memory (especially under Windows), which automatically resorts to virtual memory. Because virtual memory is delivered by the hard drive and the hard drive is much slower than RAM anyway, the hard drive simply can't provide data fast enough. Unfortunately, little can be done in this kind of situation (aside from adding RAM, upgrading the CPU, or changing the motherboard). If it is possible to shut off various sound features (i.e., music, voice, effects, etc.), try shutting down any extra sound features that you can live without. Be sure that no TSRs or other applications are running in the background.

**Symptom 9. The joystick is not working or is not working properly on all systems** This problem only applies to sound boards with a multi-function MIDI/joystick port being used in the joystick mode. Chances are that the joystick is conflicting with another joystick port in the system. Disable the original joystick port or the new joystick port—only one joystick port (game adapter) can be active at any one time in the system. Because joystick performance depends on CPU speed, the CPU might actually be too fast for the joystick port. Disable the joystick port or try slowing the CPU down.

**Symptom 10. The soundboard is installed and everything works properly, but now the printer does not seem to work** An interrupt conflict is between the soundboard and an IRQ line used by the printer. Although parallel printers are often polled, they can also be driven by an IRQ line (IRQ5 or IRQ7). If the soundboard is using either one of these interrupts, try changing to an alternative IRQ line. When changing an IRQ line, be sure to reflect the changes in any soundboard files called by CONFIG.SYS or AUTOEXEC.BAT.

**Symptom 11. The following error message appears: "Error MMSYS-TEM 337: The specified MIDI device is already in use"** This problem often occurs with high-end soundboards, such as the Creative Labs AWE64. This error is often caused by having the soundboard's mixer display on with the wave table synthesizer selected (i.e., the LED display in the Creative Mixer turned on and Creative Wave Synthesizer selected as the MIDI playback device). You can usually correct the problem by turning the mixer display off.

**Symptom 12. The following error message appears: "Error: Wave device already in use when trying to play wave files while a MIDI file is playing"** This problem often occurs with high-end sound boards, such as the Creative Labs AWE64, and it is usually the result of a device configuration problem. If "full-duplex" is turned on and you try to play a .WAV file and a MIDI file at the same time with the wave table synthesizer (e.g., the Creative Wave Synthesizer) selected as the MIDI play-back device, an error will occur. To resolve this problem, you need to turn off the full-duplex mode:

- Hold down <Alt>key and double click on *My computer*.
- Select the *Device manager* tab. A listing for *Sound, video, game controllers* should be included in the *Device manager*, double click on the listing to expand it.
- You should now see a listing for the sound board (e.g., Creative AWE32 16-Bit Audio). Double click on the listing, then select the *Settings* tab. Un-check the box labeled *Allow full-duplex operation*. Click *OK* until you are back to the *Control panel*.
- Now try to play a .WAV and MIDI file at the same time.

**Symptom 13. You hear "pops" and "clicks" when recording sound under Windows 95** Cache is insufficient to adequately support the recording process (or cache is improperly configured). Try the following procedure to alter the way cache is allocated:

- Open *Notepad* and load SYSTEM.INI
- Locate the area of SYSTEM.INI labeled [vcache].
- Add the following line [vcache]:maxfilecache=2048
- Save your changes to the SYSTEM.INI file.
- From the desktop, right-click on *My computer*, then select *Properties*.
- Select the *Performance* page, then click on *File system*.
- Find the slider marked *Read-ahead optimization*, then pull the slider to *None*.
- Save your changes and restart Windows 95.

**Symptom 14. You notice high frequency distortion in one or possibly in both channels** In many cases, the AT bus clock is set faster than 8MHz and data is being randomly lost. This problem usually occurs in very fast systems using an ISA sound board. Enter the system's CMOS setup and check the AT bus clock under the *Advanced chipset setup* area.

See that the bus clock is set as close as possible to 8MHz. If the bus clock is derived as a divisor of the CPU clock, you might see an entry, such as /4. Be sure that divisor results in a clock speed as close to 8MHz as possible. If problems still persist, try increasing the divisor to drop the bus speed below 8MHz (this might have an adverse effect on other ISA peripherals).

**Symptom 15. You hear "pops" and "clicks" when playing back pre-recorded files under Windows 95** An excessive processing load is on the system, which is often caused by virtual memory and/or 32-bit access. Start by disabling virtual memory: Open the *Control panel* and double click on the *System* icon. Select the *Performance* page and click on *Virtual memory*. Set the swap file to *None* and save your changes. Try the file playback again. If problems persist, try disabling 32-bit file access. If that still does not resolve the problem, try disabling 32-bit disk access.

**Symptom 16. "Pops" and "clicks" are audible on new recordings only, pre-existing files sound clean** This is often caused by issues with software caching. If you are using DOS or Windows 3.1, disable SmartDrive from both CONFIG.SYS and AUTOEXEC.BAT, then restart the computer for your changes to take effect. If problems continue (or you are using Windows 95), an excessive processing load on the system might be caused by virtual memory or 32-bit access. Follow the recommendations under Symptom 41-15.

**Symptom 17. "Pops" and "clicks" occur when playing back or recording any sound file** In most cases, there is a wiring problem with the speaker system. Check all of your cabling between the soundboard and speakers. If the speakers are powered by ac, be sure that the power jack is inserted properly. If the speakers are powered by battery, be sure that the batteries are fresh. Check for loose connections. If you cannot resolve the problem, try some new speakers. If the problem persists, replace the soundboard.

**Symptom 18. The soundboard plays back fine, but it will not record The board probably records fine in DOS, but not in Windows.** If the soundboard is using 16-bit DMA transfer (typical under Windows), two DMA channels are in use. Chances are that one of those two DMA channels is conflicting with another device in the system. Determine the DMA channels being used under Windows, and then check other devices for DMA conflicts. If you are using Windows 95, check the *Device manager* and look for en-tries marked with a yellow icon.

**Symptom 19. A DMA error is produced when using a sound board with an Adaptec 2842 controller in the system** This is a known problem with the Digital Audio Labs "DOC" product and the Adaptec 2842. You will need to alter the controller's FIFO buffer. Go in the controller's Setup by hitting <Ctrl>+<A> Open prompted during system startup. Select the *Advanced Configuration* option, then select the FIFO threshold—chances are that it will be set to 100%. Try setting the FIFO threshold to 0% and see if this makes a difference.

**Symptom 20. A DMA error is produced when using a sound board with an Adaptec 1542 controller in the system** This is a known problem with the Digital Audio Labs "DOC" sound product and the Adaptec 1542. The problem can usually be resolved by rearranging the DMA channels. Place the Adaptec controller on DMA 7, then place the soundboard on DMA 5 for playback and DMA 6 for recording.

**Symptom 21. The sound card will not play or record—the system just locks up when either is attempted The board will probably not play in either DOS or Windows, but might run fine on other systems.** This is a problem that has been identified with some soundboards and ATI video boards. ATI video boards use unusual address ranges, which sometimes overlap the I/O address used by the soundboard. Change the soundboard to another I/O address.

**Symptom 22. The sound card will record, but will not playback** Assuming that the soundboard and its drivers are installed and configured properly, chances are that a playback oscillator on the soundboard has failed. Try replacing the soundboard outright.

**Symptom 23. The sound application or editor produces a significant number of DMA errors** This type of problem is known to occur frequently when using the standard VGA driver that accompanies Windows—the driver is poorly written and cannot keep up with screen draws. Try updating your video driver to a later, more efficient version. If the driver is known to contain bugs, try using a generic video driver that is written for the video board's chipset.

**Symptom 24. The soundboard will not record in DOS** Several possible problems can account for this behavior. First, suspect a hardware conflict between the soundboard and other devices in the system. Be sure that other devices do not use the IRQs, DMA channels, and I/O port addresses used by the soundboard. If the hardware setup appears correct, suspect a problem between DOS drivers. Try a clean boot of the system (with no CONFIG.SYS or AUTOEXEC.BAT). If sound can be run properly now, there is a driver conflict. Examine your entries in CONFIG.SYS or AUTOEXEC.BAT for possible conflicts or for older drivers that might still be loading to support hardware that is no longer in the system. Finally, suspect the hard-drive controller. Try setting up a RAM drive with RAMDRIVE. SYS. You can install a RAMdrive on your system by adding the line: device=c:.sys /e 8000 The 8000 is for 8MB worth of RAM—be sure that enough RAM is in the PC. Once the RAMdrive is setup, try recording and playing from the RAMdrive (you might have to specify a new path in the sound-recorder program). If that works, the hard-drive controller might simply be too slow to support the soundboard, and you might need to consider upgrading the drive system.

**Symptom 25. When recording sound, the system locks up if a key other than the recorder's "hot-keys" are pushed** This is a frequent problem under Windows 3.1x. The system sounds (generated under Windows) might be interfering with the sound recorder. Try turning off system sounds. Go to the *Main* icon, choose the *Control panel*, then select *Sounds*. A box will appear in the lower left corner marked *Enable system sounds*. Click on this box to remove the check mark, then click *OK*.

**Symptom 26. After the sound-board driver is loaded, Windows locks up when starting or exiting** In virtually all cases, you have a hardware conflict between the sound board and another device in the system. Be sure that the IRQs, DMA channels, and I/O port addressed used by the sound board are not used by other devices.

**Symptom 27. When using Windows sound-editing software, the sound board refuses to enter the "digital" mode—always switching back to the analog mode** Generally speaking, this is a software-configuration issue. Be sure that your editing (or other sound) software is set for the correct type of sound board (i.e., an AWE32 instead of a Sound Blaster 16/Pro). If problems persist, the issue is with your sound drivers. Check the [drivers] section of the Windows SYSTEM.INI file for your soundboard driver entries. If more than one entry is listed, you might need to disable the competing driver. This is a known problem with the Digital Audio Labs CardDplus, and it is caused by incorrect driver listings. For example, the proper CardDplus driver must be entered as: Wave=cardp.drv and the companion driver must be listed as: Wave1=tahiti.drv You will need to be sure that the proper driver(s) for your sound board are entered in SYSTEM.INI. You might also need to restart the system after making any changes.

**Symptom 28. The microphone records at very low levels (or not at all)** Suspect that the problem is in your microphone. Most soundboards demand the use of a good-quality dynamic microphone. Also, Creative Labs and Labtec microphones are not always compatible with soundboards from other manufacturers. Try a generic dynamic microphone. If problems persist, chances are that your recording software is not configured properly for the microphone input. Try the following procedure to set up the recording application properly under Windows 95:

- Open your *Control panel* and double click on the *Multimedia* icon.
- The *Multimedia properties* dialog will open. Select the *Audio* page.
- In the *Recording* area, be sure to set the *Volume* slider all the way up.
- Also see that the *Preferred device* and *Preferred quality* settings are correct.
- Save your changes and try the microphone again.

**Symptom 29. The sound card isn't working in full-duplex mode** Virtually all-current sound boards are capable of full-duplex operation for such applications as Internet phones. Check the specifications for your soundboard and see that the board is, in fact, capable of full-duplex operation. If it is, and full-duplex isn't working, your audio properties might be set up incorrectly:

- Open your *Control panel* and double click on the *Multimedia* icon.
- The *Multimedia properties* dialog will open. Select the *Audio* page.
- If the *Playback* device and the *Record* device are set to the same I/O address, this is only half duplex.
- Change the *Playback device* I/O address, so it is different from the *Record* device.
- Hit the *Apply* button, then hit the *OK* button.
- You should now be in *Full duplex* mode.

Some of the very latest sound boards (such as the Ensoniq SoundscapeVIVO 90) will carry full duplex operation with the same Playback and Record device selected.

**Symptom 30. DMA errors occur using an older sound board and an Adaptec 1542** In many cases, you can clear DMA issues by slowing down the 1542 using the /n switch. Add the /n switch to the ASPI4DOS command line in CONFIG.SYS, such as: device=c:.sys /n2 If slowing the 1542 down with an /n2 switch doesn't fix the problem, then you should strongly consider upgrading the sound board. This is a known problem with the older Digital Audio Labs CardD soundboard.

**Symptom 31. Hard-disk recording problems occur under Windows 95** Recorded audio is saved to your hard drive. For most systems, sound data can be transferred to the HDD fast enough to avoid any problems—if data transfer is interrupted, your recorded sound might "pop" or break up. Many factors affect HDD data-transfer speed. The following sections outline a number of procedures that might help you optimize a system for sound recording. First, try disabling the *CD auto insert notification* feature:

- Go to the *Device manager*
- Open the *CD-ROM* entry
- Select your CD-ROM drive, and click *Properties*
- Go to the *Settings* page
- Uncheck the *Auto insert notification* box
- Select *OK*

Next, try turning down the level of graphics acceleration:

- Right-click on the *My computer* icon
- Left-click on *Properties*
- Select the *Performance* page
- Select the button labeled *Graphics*
- Start by turning down the acceleration one notch (you can return later to turn it down further if more performance is required)
- Select *OK*

It might also be necessary to adjust the size of your virtual memory swap file:

- Right-click on the *My computer* icon
- Left-click on *Properties*
- Select the *Performance* page
- Select the button labeled *Virtual memory*
- Choose *Let me specify my own virtual memory settings*
- If your PC has 16MB of RAM, set the minimum and maximum at 40MB. If you have 32MB of RAM, set the minimum and maximum at 64MB.
- Select *OK*

Try removing any active items from your Startup group:

- Click the *Start* button
- Go to the *Programs* menu, then select *Startup*. If you see anything here, it might be hurting your system performance. Eliminate anything that is not absolutely necessary.
- To remove items, click the *Start* button, go to *Settings*, then select *Taskbar*
- Choose the page labeled *Start menu programs*
- Click the *Remove* button
- Open the *Startup* group by double clicking it
- Remove any items that you feel are not necessary and are wasting resources
- Select the *Close* button when finished

Clear any indexes of the Find Fast utility:

- Click the *Start* button
- Go to *Settings*, then choose the *Control panel*
- Open the *Find Fast* utility
- Go to the *Index* menu
- Select *Delete index*
- Select an index in the *In and below* drop box
- Select the *OK* button
- Repeat steps 5 through 7 until all indexes are removed

Try defragmenting the hard drive:

- Click the *Start* button
- Go to *Programs*, *Accessories*, and *System tools*
- Choose *Disk defragmenter*
- Select the drive to defragment and click *OK*
- Click the *Start* button to begin defragmentation

Finally, you might want to suspend the System Agent (if installed):

- If System Agent is installed, open it by double clicking its icon in the taskbar
- Go to the *Advanced* menu
- Choose *Suspend system agent*
- Close the *System agent* window.

**Symptom 32. The microphone records only at very low levels or not at all** Check your phantom power settings first. In many cases, the microphone's gain is set too low in the soundboard's mixer applet. Start the soundboard's mixer, be sure that the microphone input is turned on, then raise the microphone's level control. Remember to save the mixer settings before exiting the mixer. You should not have to restart the system.

**Symptom 33. The dynamic microphone clips terribly, and recordings are noisy and faint** This is probably caused by phantom power being switched on in your soundboard. Try turning the phantom power off. If you cannot turn phantom power off, try plugging the dynamic microphone into the soundboard line input jack. Remember to start the soundboard mixer applet and set the line input level properly.

**Symptom 34. Trouble occurs when using Creative Labs or Labtec microphones with your (non-Creative Labs) soundboard** This is a common complaint among Ensoniq sound board users. It turns out that Ensoniq sound boards are not compatible with Creative Labs or Labtec microphones. Try a generic microphone instead.

**Symptom 35. Static is at the remote end when talking through a voice application, such as WebPhone Noise is occurring at the line input or microphone input, which is being transmitted to the remote listener**. Check the line input signal. You might try reducing or turning off the line input mixer level. If the problem persists, check your phantom power setting and your microphone. Try reducing the microphone level in the sound board's mixer. Try a different microphone.

# SYSTEM DATA AND TROUBLESHOOTING

## BATTERIES

Of all the elements in a PC, few are as overlooked and ignored as the battery. Batteries play an important role in all PCs by maintaining the system's configuration data while main ac power is turned off (just imagine how inconvenient it would be to re-enter the en-tire system setup in CMOS before being able to use the system each time). For portable systems such as notebook and sub-notebook PCs, battery packs also provide main power for the entire system. This chapter outlines the technologies and operating characteristics of today's battery families and illustrates a selection of battery-related problems that can plague a PC.

## TROUBLESHOOTING BACKUP-BATTERY PROBLEMS

Lithium CMOS backup batteries are typically rugged and reliable devices, whose greatest threat is simply old age. Because lithium cells are the primary type, they cannot be recharged, so they must be replaced. Under most circumstances, only a few symptoms occur for the majority of backup battery problems. Checking the CMOS backup battery It is usually a simple matter to check the CMOS backup battery. Power down the system and expose the motherboard. Locate the CMOS backup battery and find the two battery terminals leading from the battery to the motherboard. Measure the voltage between those two terminals—you should read between 2.5 to 3.7 Vdc. If the backup battery voltage is correct, there might be a software program or motherboard failure. If the backup battery reads low, replace the battery. If the battery discharges again quickly, there is a problem on the motherboard, which is shorting the CMOS backup battery.

If you act quickly when replacing the CMOS backup battery, there might be enough of a latent charge in CMOS RAM where the contents will remain intact for several minutes. However, each motherboard is designed differently, and there is no guarantee how long CMOS RAM contents might remain intact once the battery is removed. Always be pre-pared to restore CMOS settings from scratch before removing the CMOS backup battery. Do not remove the CMOS backup battery from the motherboard—this will clear your CMOS configuration and make it difficult for the system to boot until the CMOS settings are restored.

**Symptom 1. You see an error such as: "System hardware does not match CMOS configuration"** For some reason(s), the BIOS has identified different hardware than that listed in the CMOS setup, or the CMOS RAM contents have been lost. Start by checking your CMOS RAM contents through the CMOS setup routine. Make sure that the CMOS setup is configured properly (configuration errors can happen frequently when new drives or RAM is added to the system). Remember to save your changes to CMOS RAM before exiting the setup routine. If the CMOS RAM contents won't hold, check the battery connector to see that the battery is secure. A loose or corroded battery connector might effectively "disconnect" the battery—even if the battery is working perfectly. If the CMOS RAM contents still won't hold, you should replace the CMOS backup battery outright. When replacing the battery, be sure to install the new battery in the proper orientation, and verify that it is secure in its connector.

**Symptom 2. You notice corrosion from the CMOS battery on the battery holder and motherboard** This frequently occurs with older motherboards (i.e., i386 and i486 vintage motherboards) that have been stored for prolonged periods. The battery has ruptured and leaked onto the holder or onto the motherboard itself. Batteries are very caustic to metals, and chances are that any traces or solder connections that have come in contact with the battery leakage have been ruined. Unfortunately, this also means that the motherboard has been ruined and must be replaced.

**Symptom 3. The system configuration is lost intermittently** A lithium battery generally produces a very stable output voltage until the very end of its operating life. When the battery finally dies, it tends to be a permanent event. When a system loses its setup configuration without warning, but seems to hold the configuration once it is re-stored, the problem could be a lose or intermittent connection. Turn the PC off and unplug it. Check the battery and be sure it is inserted correctly and completely in its holder. A coin cell should fit snugly. If the cell is loose, gently tighten the holder's prongs to hold the cell more securely. Be sure to remove any corrosion or debris that might be interfering with the contact. High-quality electrical contact cleaner on a moistened swab is particularly effective at cleaning contacts. When a short cable attaches the battery, see that the cable is not broken or frayed, and be sure that it is inserted properly into its receptacle. If problems persist, replace the CMOS backup battery. This error often happens when RAM is added to the system—even though there is no entry for installed RAM anywhere in the CMOS setup. Try to "exit savings changes"— even though you might not have actually changed any settings. If you're planning to remove and store a motherboard for any period of time, take a <Print-Screen> of all CMOS setup pages before removing the motherboard, then store the old motherboard with the battery removed. You might place the battery in a small, heavy-gauge plastic bag at the bottom of the motherboard's anti-static box. When resurrecting the motherboard later, you can replace the battery and restore the CMOS set-tings from your printed record.

**Symptom 4. The backup battery goes dead frequently** This rare and perplexing problem is often difficult to detect because it might only manifest itself several times per year. Ideally, a lithium coin cell should last for several years (perhaps three years, or longer). A lithium or alkaline battery pack can last five years or longer. If a system loses its setup more than once a year because of battery failures, it is very likely that an error in the motherboard design is draining the backup batteries faster than normal. Unfortunately, the only way to really be sure is to replace the motherboard with a different or updated version. Before suggesting this option to your customer, you might wish to contact technical support for the original motherboard manufacturer and find out if similar cases have been reported. If so, find if there is a fix or correction that will rectify the problem.

**Symptom 5. You see a "161" error or a message that indicates that the system battery is dead Depending on the particular system you are working with, there might also be a message indicating that the CMOS setup does not match the system configuration.** In either case, the backup battery has probably failed and should be re-placed. Remember to turn off the system before replacing the battery. Once the backup battery is replaced, restart the system. You will likely receive a message that the CMOS setup does not match the system configuration. Restore the configuration from paper notes or a file backup. The system should now function normally.

**Symptom 6. The battery pack does not charge** In this type of situation, the computer might run fine from the ac-powered supply, and the system might very well run from its on-board battery when the ac-powered supply is removed. However, the battery pack does not appear to charge when the ac supply is connected and running. Without a charge, the battery will eventually go dead. Remember that some computers will not recharge their battery packs while the system is on the computer might have to be turned off with the ac supply connected for the battery pack to charge. Refer to the user manual for your particular system to review the correct charging protocol. Your clue to the charging situation comes from the computer's battery-status indicator. Most notebook/laptop systems incorporate a multicolor LED or an LCD status bar to show battery information. For example, the LED might be red when the small-computer is operating from its internal battery. A yellow color might appear when the ac-powered supply is connected to indicate the battery is charging. The LED might turn green when the battery is fully charged. If the battery-status indicator fails to show a charging color when the ac-powered supply is being used, that is often a good sign of trouble. Check the battery pack with all computer power off. Be sure that the battery pack is inserted properly and completely into its compartment. Also check any cabling and connectors that attach the battery pack to the charging circuit. Loose or corroded connectors, as well as faulty cable wiring, can prevent energy from the ac-powered supply from reaching the battery. Re-seat any loose connectors and re-attach any loose wiring that you might find.

The remaining pins on the battery pack are used for thermal sensors and other communication between the mobile PC and the battery. After you are confident of your connections, you should trace the charging voltage from the ac-powered supply to the battery terminals. If charging voltage does not reach the battery, the battery can never charge. Set your multimeter to measure dc voltage (probably in the 10- to 20-Vdc range) and measure the voltage across your battery pack. You should read some voltage below the pack's rated voltage because the battery pack is somewhat discharged. Now, connect the computer's ac-powered supply and measure voltage across your battery pack again. If charging voltage is available to the battery, your voltage reading should climb above the battery pack's rated voltage. If charging still does not seem to take place, try replacing the battery pack, which might be worn out or damaged. If charging voltage is not available to your battery pack, the charging circuit is probably faulty. Replace the charging circuit. Because the charging circuit is typically located on the motherboard, it might be necessary to replace the entire motherboard assembly.

**Symptom 7. The system does not run on battery power, but runs properly from main (ac) power** This symptom usually suggests that your computer runs fine whenever the AC powered supply is being used, but the system will not run from battery power alone. The system might or might not initialize, depending on the extent of the problem. Before you disassemble the computer or attempt any sort of repair, be sure that you have a fully charged battery pack in the system. Remove the battery pack and measure the voltage across its terminals. You should read approximately the battery voltage marked on the pack. A measurably lower voltage might indicate that the battery is not fully charged. Try a different battery pack or try to let the battery pack recharge. The charging process might take several hours on older systems, but newer small-computer battery systems can charge in an hour or so.

**Symptom 8. The system suffers from a short battery life** Today's small-computers are designed to squeeze up to 6 hours of operation (or more) from every charge. Most systems get at least 2 hours from a charge. Short battery life can present a perplex-problem—especially if you do a great deal of computing on the road. All other computer functions are assumed to be normal. Begin your investigation by inspecting the battery pack itself. Check for any damaged batteries. Be sure that the battery pack is inserted properly into the computer, and see that its connections and wiring are clean and intact. Try replacing the battery pack. Remember that rechargeable batteries do not last forever—typical NiCd packs are usually good for about 800 cycles, NiMH packs are often suitable for 500 cycles, and Li-ion packs are usually rated for 1200 cycles. Fast-charge battery packs are subject to the greatest abuse and can suffer the shortest life spans. It is possible that one or more cells in the battery pack might have failed. The battery pack might also have developed a "memory" problem. Try several cycles of completely discharging and recharging the pack. If the problem remains, replace the battery pack. The computer's configuration itself can largely determine the amount of running time that is available from each charge.

The CPU, the display (and its backlight), the hard drive, floppy drive/CD-ROM drive access each consume substantial amounts of power. Many mobile computers are designed to shut down each major power consumer after some preset period of disuse. For example, an LCD screen might shut off if there is no keyboard activity after two minutes, or the hard drive might stop spinning after three minutes if there is no hard drive access, etc. Even reducing CPU clock speed during periods of inactivity will reduce power consumption. The amount of time required before shutdown can usually be adjusted through setup routines in the computer or through the operating system.

**Symptom 9. The battery pack becomes extremely hot during charging** As you learned earlier in the chapter, current must be applied to a battery from an external source to restore battery charge. When a battery receives significant charging current (during or after the charging process), its temperature will begin to rise. Temperature rise continues as long as current is applied. If high charging current continues unabated, battery temperature might climb high enough to actually damage the cells. Even under the best circumstances, prolonged high-temperature conditions can shorten the working life of a battery pack. Today's high-current charging circuits must be carefully controlled to ensure a full, rapid battery charge, but prevent excessive temperature rise and damage. Battery packs or compartments are fitted with a thermistor (a temperature-sensitive resistor). When the battery pack is fully charged, the thermistor responds to the subsequent temperature increase and signals charging circuitry to reduce or stop its charging current. In this way, temperature is used to detect when full charge had been reached. It is normal for most battery packs to become a bit warm during the charging process—especially packs that use fast-charge currents. However, the cell(s) should not give off an obnoxious odor or become too hot to touch. Hot batteries are likely to be damaged. In many cases, the thermistor (or thermistor's signal-conditioning circuitry) has failed and is no longer shutting down charge current. Try another battery pack. If the new pack also becomes very hot, the fault is in the charging circuit, which should be replaced. If the new pack re-mains cooler, the fault is probably in the original battery pack.

**Symptom 10. The computer quits without producing a low-battery warning** Computers are rarely subtle in regard to low-power warnings. Once a battery pack falls below a certain voltage threshold, the computer initiates a series of unmistakable audible (and sometimes visual) queues that tell you there are only minutes of power remaining. Such a warning affords you a last-minute opportunity to save your work and switch over to ac power, if possible. If you choose to ignore a low-power warning, the system will soon reach a minimum working level and crash on its own whether you like it or not. Mobile computers measure their battery voltage levels constantly. A custom IC on the motherboard is typically given the task of watching over battery voltage. When voltage falls below a fixed preset level, the detector IC produces a logic alarm signal. The alarm, in turn, drives an interrupt to the CPU, or passes the signal to a power-management IC, which then deals with the CPU or system controller.

Once the alarm condition reaches the CPU, the computer typically initiates a series of tones, flashes a "power" LED, or some-times both. Most PCs produce at least one beep during initialization to test the internal speaker. If you do not hear this beep, the speaker or its driving circuit might be damaged. Try replacing the speaker, then try replacing the motherboard. When an audible beep is heard during initialization, there is probably a fault in the computer's battery-detection or power-management circuits. Try cleaning the battery contacts first, then try replacing the motherboard.

## PEN-TABLET SYMPTOMS

**Symptom 1.** The **pen seems to operate intermittently as it moves along the surface** when you slide a pen across the tablet, some portions of the stroke might not be visible as ink feedback on the display. In other cases, entire strokes might be missing while other strokes are fully visible. Fortunately, the ink that does appear shows up in the right places. This problem can be maddening—especially when attempting to write cursive characters. Resistive digitizers are extremely sensitive to pen contact. Be certain to hold the pen gently, but firmly, in contact. A careless touch might allow bad contact between the tablet and pen. Such a symptom is almost always the result of a faulty pen cable. Remove your pen from its input jack, open the pen body and jack (if possible), and use your multimeter to check the continuity along each cable wire. Once your multimeter is connected, wiggle the cable to stimulate any intermittent wiring. If your pen cable is hard wired into the tablet, you should remove the tablet's outer housing to expose the cable wiring. If you encounter a faulty pen, repair or replace the defective wiring, or replace the pen altogether. If your pen checks out properly (or is not cabled to begin with), check the pen batteries, replace the pen tip, or try a new pen entirely. Next, suspect that a fault is in your resistive tablet. Both single-layer and double-layer resistive digitizers are extremely prone to wear. As the pen wears out, tablet resistance and surface features might become irregular. Your pen might not make proper contact at all points of a worn surface. Try replacing the resistive tablet. Some small-computer manufacturers sell tablet assemblies as component parts. Use extreme caution when replacing a tablet to avoid accidental damage to the LCD or backlight assemblies. Take careful notes and pay close attention to maintain proper assembly dimensions.

For capacitive or RF digitizers, the sensing assembly is very rarely at fault because writing occurs against a sheet of thin, tempered glass. Intermittent writing performance with a capacitive or RF digitizer is usually the result of a faulty pen transmitter. Check or replace the pen batteries and try the system again. If the problem persists, try a new pen.

**Symptom 2. The pen or tablet does not appear to respond at all other computer functions seem normal. The external keyboard adapter (if available) appears to work properly.** Before you check anything else, be sure that the pen or tablet is properly connected to the computer. Also be sure that the pen tip is in good contact with the tablet surface. Good contact is crucial for resistive digitizers. A careless touch might allow bad contact between a tablet and pen—especially when the tablet surface is worn. For RF digitizers, you should suspect the pen transmitter first. Check the batteries or cabling to your pen. Replace the batteries (if necessary) and try the system again. Otherwise, try a new pen. An open pen cable wire can easily disable your pen input (if the pen is tethered). Remove your pen from its input jack, open the pen body and jack (if possible), and use your multimeter to measure continuity along each cable wire. Once your multimeter is connected, wiggle the cable to stimulate any possible intermittent wiring. Repair or replace any faulty wiring or replace the defective pen outright. If your pen cable is hard-wired into the computer, remove the pen computer's housing to expose the cable wires. If the digitizer still does not function, suspect that the problem is in your tablet or tablet controller IC. For a stand-alone pen tablet, you can usually replace the entire tablet outright. For a pen computer, disassemble the unit to expose the motherboard, and check any cabling between the tablet and motherboard. Try replacing the tablet controller IC. If you lack the tools or inclination to perform surface-mount work, try replacing the entire motherboard. If the problem persists, try another tablet assembly.

**Symptom 3. Ink appears on the LCD as the pen moves, but ink is not exactly under the pen** This symptom occurs with older pen computers, and is much more of a nuisance than an actual defect in resistive digitizers. You might assume that the pen is working adequately. The trouble is most likely in the resistive tablet material itself. Resistance is extremely dependent on temperature and humidity. Variations in a tablet's temperature or humidity can introduce small analog voltage errors when a pen passes over the resistive surface. The net result is a small shift in the visual feedback that appears on the LCD. You can do little with temperature or humidity problems, except to keep the pen computer in a stable, consistent room environment. If the tablet is damp for any reason, be certain to dry its surface very carefully. Problems can also occur when the tablet is extremely worn. As resistive material becomes thinner, its resistance at the thinner areas becomes greater. Worn areas can upset the overall resistance of the tablet and result in erroneous voltage signals at the pen. Again, such errors are digitized and appear somewhere in the display. Your best course of action with a worn resistive tablet is simply to replace it entirely. Use extreme caution when replacing an tablet to avoid accidental damage to the LCD or backlight, and to maintain all dimensional tolerances in the assembly.

**Symptom 4. The pen-computer locks up or suffers other strange problems once the RF digitizer has been repaired or replaced** This kind of a follow-up problem is not unusual for pen computers using RF digitizers. The RF sensor PC board located behind the backlight must be re-installed exactly as it was removed. No metal objects can be added or removed.

Be sure that any and all shielding is installed properly. Missing or damaged shields can allow stray RF signals to reach the motherboard and cause peculiar EMI problems that result in system crashes and intermittent bad data. It only takes one bad bit to crash a computer. Also inspect the way in which the display and digitizer arrangement has been reassembled. Missing spacers or loose screws can change the physical spacing of the display components and also result in system problems. It is important that no metal objects be added to the display/digitizer assembly as well. Metal acts as a shield that can interfere with RF signals. The presence of unwanted metal might cause trouble in pen tracking and system operation. Remove any metal that might have been added to the system or digitizer. It is worthwhile to keep thorough notes when working on a display/digitizer system. Notes help to ensure that you reassemble the small computer exactly as it should be.

**Symptom 5. As you write, no "ink" appears on the display, but the characters are recognized and translated properly** this is almost invariably a problem with the Windows/Windows 95 video driver. When the pen operating system is installed—especially as an extension, such as Microsoft Pen Extensions for Windows (there are versions for 3.1, 3.11, and 95), the video driver will be required to produce the "ink." Unfortunately, not all video drivers interact so smoothly with pen-enhanced or pen centric applications, and an "ink" trail is not left under the pen. Although hardly damaging, it can be a significant nuisance. Try a video driver that is designed to deal with pen operations. In actuality, this might be difficult because many pen-compatible video drivers do not provide extended color depths or resolutions that many Windows users have come to expect. Check with the pen-tablet vendor and video-adapter manufacturer for a "pen aware" video driver.

**Symptom 34-6. The DOS pen driver(s) will not load as the system initializes** this is typical of external, stand-alone tablets, and is often indicated by an error code or message when the PC initializes—usually because the tablet hardware cannot be located. First, be sure that the tablet is turned on (if necessary) and receiving power. Next, check that the tablet is connected properly to its serial port, and that the COM number and IRQ number correspond to any command-line settings used to execute the driver. For example, suppose the tablet driver is being started in your CONFIG.SYS file and its command line says that the driver should be installed for COM1 using IRQ3. If the tablet is plugged into COM2, the driver will probably not be able to load.

**Symptom 7. The pen buttons do not work correctly in your software** Button assignments for a stand-alone pen tablet are typically made in the tablet device driver's command line (in CONFIG.SYS or AUTOEXEC.BAT). Check the command line against your pen tablet's documentation and be sure that any button assignments are correct. Check your particular application as well to see if any options control button functions. If your application allows you to select a pointing device, you can usually keep the Microsoft Mouse selection.

**Symptom 8. The pen tablet does not work in Windows** This problem often surfaces with stand-alone pen tablets. If the tablet works with DOS applications (or its diagnostic), the problem is likely caused by a Windows driver conflict. Checks the device driver used in Windows setup (or the Windows 95 Device manager) and verify that the appropriate driver is selected to support the tablet. Many tablets give you the option of using the tablet as the sole pointing device, or using both the tablet and mouse together (you might also need a WINTAB driver to support multiple simultaneous input devices). The driver used with the tablet will depend on whether the tablet is used alone or with a mouse.

**Symptom 9. Windows locks-up or the tablet fails to respond** This type of problem might show up intermittently and is generally related to the cursor speed that is set through the Windows *Control panel*. When the tablet is set to work in relative mode and the cursor speed is set to fast, older PCs might not be able to respond to button clicks or pen movement fast enough under some circumstances. This condition almost always results in a fault that can crash Windows or its application. The easiest way to correct this type of problem is to reduce the cursor sensitivity to a low level (50% or so) when working in the relative mode. Most pen tablets designed to work with Windows/Windows 95 provide a Windows utility (i.e., a *Tablet control panel*), which allows you to adjust the tablet parameters.

**Symptom 10. The cursor is too sensitive or not sensitive enough to pen movement** When operating a stand-alone tablet in the "relative" mode, you might need to reduce the cursor-sensitivity parameter. When working in the "absolute" mode, you can adjust sensitivity by altering the size of the cursor's active area. Most stand-alone pen tablets designed to work in Windows/Windows 95 provide a Windows adjustment utility (i.e., *Tablet control panel*), which allows you to adjust the tablet parameters, such as sensitivity and active area.

**Symptom 11. The cursor seems to "jitter" or leave spikes when drawing** This type of problem is usually related to the serial port (COM port) being used with the stand-alone pen tablet. Older serial ports using the 8250 or 8250A UARTs have a subtle bug that the Windows/Windows 95 environments tend to find. The older serial port does not support current tablets as well as current serial ports. Running Windows 3.1x in the "standard" mode can sometimes improve the situation, but the very best solution is to replace the older UART (or entire serial port) with a current version (you can usually install a new multi-I/O board with high-speed serial ports, but remember to disable the older existing serial ports).

**Symptom 12. No matter what "stroke width" is chosen in the drawing application, only thin, narrow lines appear when drawing on the pen tablet** This type of issue arises most often with "pressure sensitive" applications like PhotoShop 4, and non-pressure-sensitive tablets like Ace CAD tablets. In many cases, the drawing application assumes that your tablet/digitizer is "pressure sensitive" by default—when in fact the pen tablet is not.

If the tablet is not pressure sensitive, be sure to turn off the pressure-sensitivity feature in the drawing application (you'll need to select line widths manually). If the tablet is supposed to be pressure sensitive, verify that the tablet and its drivers are configured properly for pressure-sensitive operation. Also check the pen for proper operation.

**Symptom 13. After installing the latest pen tablet drivers for Windows 95, you get an: "Invalid Dynamic Link call to a .DLL file" error once the PC restarts** In many cases, this kind of error message is generated as the result of a conflict between the WINTAB driver for your pen tablet and the "video capture" driver for your video board (i.e., these problems often crop up with Diamond Stealth 64 PCI video cards). You must remove the offending video capture driver. For the example of a Diamond video capture driver:

- Open your *Control panel*, and then select *Multimedia*.
- Under *Multimedia*, select *Advanced*, then click the "plus sign" just to the left of *Video-capture devices*.
- Highlight the *Diamond video capture* entry (or the capture device for your particular video board), then click *Properties*.
- Under *Properties*, click *Remove* to remove the driver.
- If you get the error message again, simply go back through the process one more time (the second time around, it should let you remove the driver without incident). Restart Windows 95 and the problem should be gone.

**Symptom 14. Installing the pen tablet on a Packard Bell PC results in various errors Error messages often start out, such as: "While initializing device PBCIR . . .", and the system winds up starting in safe mode.** Such problems are almost always the result of Packard Bell's "Remote Media Card." The following workaround will often get the pen tablet up and running, but it will disable the IrDA ("infra-red") functionality of this card—you can restore the card by just reversing this process:

1 Shut down the computer and turn it off.

2 Restart the computer. When you see the message: "Starting Windows 95," press the <F8> key.

3 When you see the Windows 95 startup menu, select *Command prompt only* and press the <Enter> key.

4 At the C: \> prompt, type CD WINDOWS and press the <Enter> key.

5 At the C:\WINDOWS\> prompt, type EDIT SYSTEM.INI and press the <Enter> key.

6 You will now be looking at the [boot] section of your Windows 95 system.ini file. Find the section entitled [386Enh].

7 Look for a line in the [386Enh] section that says DEVICE=PBEWD01S.VXD. When you find this line, type a semicolon (;) in front of the line. The line should then read

;DEVICE=PBEWD01S.VXD

8 Save the changes to the SYSTEM.INI file and exit.
9 You should now be back at the C:\WINDOWS\> prompt. Type: edit win.ini and press the <Enter> key.
10 You will now be looking at the [windows] section of your Windows 95 win.ini file.
11 Look for a line in the [Windows] section that says RUN=C:\FMEDIA\FMEDIA.EXE.
When you find this line, type a semicolon (;) in front of the line. The line should then read ;RUN=C:\FMEDIA\FMEDIA.EXE (it might be necessary to delete this line entirely).
12 Save the changes to the WIN.INI file and exit.
13 You should now be back at the C:\WINDOWS\> prompt. Type WIN and press the <Enter> key to return to Windows. At this point, your pen tablet should be working. However, it might be necessary to re-install the pen tablet drivers (be sure to use the most recent pen tablet drivers).

**Symptom 15. The pen cursor moves, but everything is reversed For ex-ample, when the pen moves up, the cursor moves down. The tablet also "thinks" it's the wrong size (i.e., 12" ´ 12" instead of 5" ´ 5").** This is usually because you're running a tablet-sizing utility when you shouldn't be. For example, AceCAD tablets can suffer this problem when mistakenly running the ACE12 utility. Open your AUTOEXEC.BAT file and verify that the proper command line switches are in place. For the AceCAD example, copy ACE12.COM from the ACE12 sub-directory on your drivers/utilities diskette to your C:directory, then add/modify the following line to your AUTOEXEC.BAT file:

C:\WINDOWS\COMMAND\ACE12.COM U (If your tablet is on COM1)
C:\WINDOWS\COMMAND\ACE12.COM U2 (If your tablet is on COM2)

Reboot your computer—the problem should be gone.

**Symptom 16. The pen is not "selecting" or "inking"** In virtually all cases, the fault is with the pen. If the pen is tethered to the tablet, check the pen wiring. If the pen is "free," try replacing the pen batteries. Also check the pen tip, and be sure that the pen tip is not sticking out or is loose inside the pen. Carefully unscrew the pen cap and inspect the battery casing for cracks. If the problem persists, try another pen.

**Symptom 17. The cursor flickers in Windows 95 Handwriting recognition works, but the "ink" often gets cut off.** This problem sometimes occurs when 16-bit applications (written for Windows 3.1x) are running under Windows 95. The cause is a minor incompatibility between the 16-bit application and Microsoft's Pen Services 2.0 for Windows 95. Turn off any 16-bit applications. If possible, upgrade the application from the 16-bit version to the 32-bit equivalent.

**Symptom 18. The cursor is moving, selecting items, or otherwise behaving strangely—even though the pen is not touching the tablet** Chances are that the tablet and pen operate at a frequency that might be shared by some monitors— this can cause the tablet to become "confused" if it is placed too close to the monitor. Be sure that the tablet is not physically located too close to the monitor (keep it at least 12 inches away). Another possible cause for odd cursor behavior is weak pen batteries. Try replacing the batteries.

**Symptom 19. There is no "inking" and handwriting recognition doesn't work** If you cannot see ink on the screen, or if you cannot get handwriting recognition to work, check the following points:

- In Windows 95, click *Start*, then *Run*. Point to the *Open* edit box. If you do not see a pen pointer, you need to install the operating system pen extensions (e.g., Microsoft Pen Extensions for Windows 95).
- Try writing in the *Open* edit box. If you do not see "ink," try writing in Notepad or WordPad. If you still do not get "inking" in these apps, reinstall the operating system pen extensions.
- If you see a pen pointer, try selecting text in the edit box. If the pen pointer does not change to an inverted arrow pointer, reinstall the operating system pen extensions.
- Check your video driver and notice the driver you are using (some drivers do not support pen environments well). Set your video to VGA, 16 colors. Try inking and/or handwriting-recognition again. If it works, update your video driver with a version that will support "ink."
- If you are still not getting handwriting recognition and/or "inking," try uninstalling the pen tablet's low-level software. Disable all TSRs (virus checkers, etc.) and reinstall the pen tablet's low-level software again.

**Symptom 20. The pen does not work properly in Microsoft Word using Windows 95 Pen Computing** A number of known problems occur with Windows 95 for Pen Computing and MS Word for Windows 95 (v 7.0a) and MS Word 97. Check with Microsoft (**http://www.microsoft.com**) for updates to either Word or the operating system that might overcome these problems. The following gestures do not work:

- Edit Text (check mark circled)
- Insert Text (caret circled)
- Context Menu (M circled) or can't right-click for Context menus (to work around this problem, press <Shift>+<F10> with the pen at the point you want a context menu).
- Select (lasso tap)

In addition, the following symptoms and problems might be experienced:

- The Pen Windows display does not refresh correctly when the pen is near the digitizer pad. To work around this problem, keep the pen away from the digitizer pad when not in use.
- When the pen is near the digitizer pad and the pen barrel button is pressed, the insertion point changes to an I-beam.
- The pen "drag handle" is not shown. This is a small button that floats along with the insertion point, allowing access to a context menu and easier access with a pen.

**Symptom 21. An "Invalid VxD dynamic link call" error occurs when trying to install pen-tablet software under Windows 95 For example, such problems might cause an error, such as "Invalid VxD dynamic link call from CICPEN(01) + 0000431D to device 'VCD', service 4" while trying to install CIC Handwriter software under Windows 95." Normally, an Invalid Dynamic Link Call error message is the result of an incompatibility between driver versions, or a damaged or missing driver.** Try uninstalling, then reinstalling any programs or components that you installed recently. You might also workaround this problem by bypassing the VCD (creating an additional binary entry in your Win95 Registry):

- Run the Regedit utility.
- Select HKEY_LOCAL_MACHINE
- Create a new binary entry.
- Enter "PORTPROTECTION."
- Assign a value of "0."
- Save the changes and reboot.

**Symptom 22. An error appears: "VxD not present: either Windows 95 is running in safe mode or xxx.VxD is not installed correctly"** This .VxD file is not loaded if you are running Windows 95 in safe mode. If you are not in safe mode, be sure that the named driver (i.e., CICPenC.VxD) is present in your directory. Try reinstalling the pen-tablet software.

**Symptom 23. The pen tablet works intermittently on a laptop** If your particular pen tablet (such as the CIC Hand writer Manta) has been designed to draw power from the serial port (RS232), the port might have a power-draw limitation (desktop PCs do not suffer this problem). For example, CIC has encountered some laptops that have power draw problems with their Manta. To conserve power, the laptop's current draw is reduced to the load so that the tablet stops working after a certain time.

The following lists the laptops CIC has identified as having this power-draw issue:

- IBM 750cs
- Gateway 2000 SOLO (REV 3)
- Samsung Sens Pro
- Winbook Fx
- Hitachi Mx
- Dell Latitude

Check with the pen tablet maker to see if a supplemental power supply or other patch might alleviate this problem.

**Symptom 24. After installing a pen tablet driver, the cursor moves very slowly** This is an issue with some Wacom drivers and it is almost always caused by problems with the video driver. Many of the current video drivers have cursor problems in high-resolution modes because of the amount of data that is being produced by the pen tablet. For example, a Wacom tablet produces approximately four times more data than a standard mouse, and the video drivers cannot keep up with the amount of data being transmitted. You should try to update your video driver to a version that is more compatible with high-resolution pen tablets. In the mean time, do not run with an enlarged or animated cursor. If cursor performance is still slow, reduce the color palette to 256 colors or less until the video driver can be updated.

**Symptom 25**. **After installing a pen tablet driver, SCSI devices are no longer present** This is almost always a pen-tablet driver problem, and it is a known problem with Wacom pen tablet drivers prior to version 2.44. Try installing the latest version of the pen-tablet driver (check with the pen-tablet manufacturer for the latest version). For the Wacom pen tablets, install the v.2.44 driver, then restart to MS-DOS mode. From the Wacom 2.44 driver disk, copy the SCSI.FIX file such as:
c:\XXXXX\win\3195\>copy scsi.fix c:\windows\system\wacom.vxd where *XXXXX* is the directory where the Wacom driver was extracted. You should be prompted to replace the WACOM.VXD file. Select *yes* to replace the file. Restart Windows and try the SCSI devices again. If you expanded the patch file to a floppy disk, restart to MS-DOS mode, place the floppy in the floppy drive, and from the c:\windows> prompt type:
c:\windows>copy a:\win\3195\scsi.fix c:\windows\system\wacom.vxd You should be prompted to replace the WACOM.VXD file. Select *Yes* to replace the file.

**Symptom 26. When you place a pen against the tablet surface, the cursor jumps to the top left corner of the screen You also might see an error, such as: "unable to implement function."** In most cases, this occurs after upgrading pen tablet hardware, and is caused by "leftover" pen-tablet drivers from other manufacturers.

You'll need to remove the "leftover" driver(s):

- *Removing ACECAT drivers* Edit your SYSTEM.INI file, go to the drivers= line in the [boot] section and remove AWINTAB, then go to the [drivers] section and remove the line that reads: AWINTAB=AWINTAB.DRV. Also look for any reference to "Virtual Tablet" and remove it. Save the changes to SYSTEM.INI and restart Windows 95.
- *Removing KURTA drivers* Edit your SYSTEM.INI, look for references to WTKURTA, and remove them. Save your changes to SYSTEM.INI and restart Windows 95.

**Symptom 27. After installing a pen-tablet driver, .AVI files do not open:-** This sometimes occurs with Wacom drivers, and is caused by a module in DirectX v.2.0. You should remove this module and install a newer version of DirectX. To remove the module, open the *Multimedia* control panel, select *Advanced*, then open the *Video-compression codecs* folder, highlight the *Direct Video driver* [Draw] entry and click on the *Properties* button. Select the *Remove* button, close the *Control panel*, and restart Windows 95.

**TOUCHPAD SYMPTOMS**

**Symptom 28. You notice that the system slows after installing touch-pad drivers in Windows 95** In almost all cases; this is caused by a conflict between touchpad drivers and older (pre-existing) mouse drivers. You'll need to isolate and remove the older mouse drivers:

- Shut down the PC (you might need to just turn the PC off, if you can't exit normally).
- Reboot the PC and press <F8> when you see "Starting Windows 95".
- You should now see the "Windows 95 Start-up Menu".
- Start the PC in the safe mode.
- Open the Windows 95 *Control panel*.
- With the *Control panel* open, doubleclick on the *Add/Remove programs* icon.
- In the list of programs available for removal, find the reference to the old mouse software (e.g., Mouseware or Logitech Mouseware) and highlight it by clicking on it once.
- Click on the *Add/Remove* button.
- The old software should uninstall (e.g., Mouseware Setup will initialize and prompt you to confirm removal).
- Windows should uninstall the software and prompt you that the computer needs to be restarted. Click the *Restart* button.
- The computer will restart and begin loading Windows 95 (you might see added information about the software's removal—this is normal).
- The system will boot into normal mode and should be functioning normally.

**Symptom 29. The touchpad cursor freezes in the center of the screen after installing the driver(s) You might also see this as a "Windows protection error" after installing the driver(s) under Windows 95.** This is usually caused by an improper mouse driver reference in SYSTEM.INI. You'll need to edit SYSTEM.INI manually without the benefit of the mouse:

- Press <Ctrl> and <Esc> together to bring up your Windows 95 *Start menu*.
- Use your arrow keys to move the highlight to *Run*, then press <Enter>.
- In the text box next to *Open*, type SYSEDIT and press <Enter>.
- The *Sysedit* window will appear, displaying your system files.
- Press <Alt> and <W> together to display a menu listing your system files.
- Use your arrow keys to move the highlight down to the line that has SYSTEM.INI in it, then press <Enter>.
- Use your arrow keys to scroll through the system.ini file until you find a line reading: [386enh].
- Find the line that reads mouse=c:\glide\xmvmd.386.
- Change this line to read mouse=*vmd.
- After you have made this change to the system.ini file, press the <Alt> and <F> keys together. This will bring down the *File* menu.
- Use your arrow keys to move the highlight down to *Exit*, and then press <Enter>.
- Windows will display a dialog box stating that the SYSTEM.INI file has been changed and will ask if you want to save these changes. Select *Yes*.
- After the *Sysedit* window has closed, press <Ctrl> and <Esc> together to bring up the Windows 95 *Start menu*.
- Use your arrow keys to move the highlight up to *Shut down*, and then press <Enter>.
- Use your arrow keys to select *Restart the computer* from the *Shut down* dialog, then press <Enter>.
- Windows will restart the system and the cursor should now move with the touchpad.

**Symptom 30. The touchpad and software were installed, but it refuses to operate—the mouse continues to operate** Most touchpad drivers (such as for the Cirque Glide Point) only accommodate one pointing device. If you still have an external mouse connected, unplug it and reboot your computer. If your computer has a built-in pointing device, consult your computer manual for instructions on disabling the device. If you have no way to disable the existing mouse, you might also be able to edit the touchpad's .INI file to specify how the touchpad is connected. For example, a Cirque touchpad uses the GLIDE.INI (or MOUSE.INI) file in the Cirque Glide Point directory. The line that reads MOUSETYPE= should be changed to indicate the port in which the touchpad is installed. If the touchpad is on a serial port, the line should read MOUSE-TYPE= SERIAL1 or MOUSETYPE=SERIAL2. If the touchpad is on a PS/2 port, the line would read MOUSETYPE=PS2.