

Presented by:



CHAPTER 16

Problem Solving and Troubleshooting



Basic Troubleshooting Guidelines

Troubleshooting laptop and portable PC hardware problems can seem like a huge challenge, even if you're experienced with solving problems on desktop PCs. Some components that can be easily removed and replaced on desktop computers, such as hard disks, floppy drives, optical drives, processors, and BIOS chips, are built in to the system or use different interfaces than desktop PCs. Some types of diagnostic procedures, such as power supply testing, BIOS POST code analysis, and others, must be performed in different ways because of the differences between portable and desktop hardware.

The proprietary nature of typical portable hardware is another challenge. Although the basic layout of one desktop PC is similar to another, different brands of portables are often extremely different internally, making it essential to obtain model-specific information before you open the system or make repairs.

Although these challenges make laptop and portable computer problem solving and troubleshooting a bigger challenge than for desktop systems, you can still solve many hardware problems yourself by applying the techniques covered in this chapter.

Modern Laptop Computers—More Complicated and More Reliable

Consider this: The modern laptop computer is an incredible collection of hardware and software. When you consider only the hardware, there are tens of millions of transistors in typical processors alone; nearly 4.3 billion transistors in a 512MB stick of RAM; hundreds of millions of transistors in the motherboard chipset, video processor, and video RAM; and millions more in the other adapter cards and logic boards in the system.

Not only must each of these billions of interconnected transistors function properly, they must all operate in an orderly fashion within strictly enforced timing windows, some of which are measured in picoseconds (trillionths of a second)! When you realize that your laptop will lock up or crash if any one of these transistors fails to operate properly and on time, and/or if any one of the billions of circuit paths and interconnections between the transistors or devices containing them fails in any way, it is a wonder that laptops work at all!

Note

A typical mobile processor such as the Intel Mobile Pentium 4-M contains 55 million transistors, whereas the latest mobile processor from Intel, the Pentium M, has 77 million transistors. The Pentium M is the processor component of Intel's Centrino technology, which also includes a sophisticated chipset (the Intel 915 Express) and the Intel PRO/Wireless 2200 Wi-Fi IEEE 802.11b/g wireless network adapter.

The latest mobile processor from AMD, the Athlon XP-M, contains 37.5 million transistors. It has a 512KB L2 cache and uses AMD's PowerNow! technology to dynamically control the processor's power usage, which helps to optimize the laptop's battery life.

Every time I turn on one of my systems and watch it boot up, I think about the billions upon billions of components and trillions upon trillions of machine/program steps and sequences that have to function properly to get there. As you can now see, there are many opportunities for problems to arise.

Although modern laptop computers are exponentially more complicated than their predecessors, from another point of view, they have also become simpler and more reliable. When you consider the

complexity of the modern laptop computers, it is not surprising that occasionally problems do arise. However, modern design and manufacturing techniques have made laptop computers more reliable and easier to service despite their ever-increasing internal complexity. Today's systems have fewer and fewer replaceable components and individual parts, which is sort of a paradox. The truth is that as laptop computers have become more complex, they have become simpler and easier to service in many ways as well!

Desktop and Laptop Components Compared

Although laptop and portable computers use the same operating systems and external peripherals as their desktop siblings, internally they are much different. Although there are industry standards for processors, memory, hard drives, and other components inside a typical laptop computer, they are much different from the standards supported by a typical desktop computer, as you can see from Table 16.1.

Table 16.1 Desktop and Laptop Component Standards

Component Type	Desktop Standard	Laptop Standard	Notes
Memory module	DIMM (168, 184-pin); RDRAM (184, 232-pin)	SODIMM (144-pin, 200-pin); SORIMM (160-pin)	SO stands for <i>small outline</i> . SODIMMs and SORIMMs are physically smaller than desktop memory modules. Older systems often use proprietary modules.
Hard disk	ATA/IDE (40-pin) Serial ATA; 3.5-inch form factor	ATA/IDE (44-pin); 2.5-inch form factor or proprietary swappable	Laptop versions of ATA/IDE use a single connector for power and data. Models that support swappable drives usually allow special types of hard, floppy, and optical drives to be swapped in place of each other.
Processor	Socket 478, Socket 754, Socket 775 processors	Mobile processors	Mobile processors use lower voltages and are sometimes optimized for different chipsets than standard processors.
Modem	PCI card or integrated	Built-in or Mini PCI card	Typical Mini PCI modems also support 10/100 Ethernet networks.
10/100 Ethernet	PCI card or integrated into motherboard	Built-in or Mini PCI card	Typical Mini PCI 10/100 Ethernet network adapters also provide modem functions.
Floppy drive	34-pin floppy interface	Proprietary fixed or proprietary swappable	Different models from the same vendor might use the same swappable floppy drive, but different brands are not interchangeable.
Optical (CD, DVD, rewritable) drive	40-pin ATA/IDE interface	Proprietary fixed or proprietary swappable	Different models from the same vendor might use the same swappable optical drive, but different brands are not interchangeable.
Power supply	LPX (12-pin) or ATX (20-pin)	Proprietary	Some older models have built-in power supplies, but most use an external "brick" AC/DC power converter.

As you can see from Table 16.1, many of the components used in notebook computers follow different standards than those used in desktop computers. As a consequence, most parts cannot be freely interchanged between different models and brands of notebook computers the way they can between desktop computers. However, many of the parts listed in Table 16.1, as well as the CMOS battery used to maintain BIOS settings, can normally be removed for upgrades or repairs.

Devices that are normally not industry standard (and therefore not generically replaceable) include the following:

- Motherboard
- CPU heatsink/fan
- Chassis
- Video card (integrated into the motherboard chipset, or a separate graphics chip might be built in to the motherboard)
- LCD display panel
- Modem (if not part of a Mini PCI card; it might be integrated into the motherboard on some systems)
- Sound card (might be integrated into the motherboard chipset or might be a separate chip built in to the motherboard)
- Speakers
- Keyboard (built in)
- Pointing device (TrackPoint or touchpad)

Although many of these components may not be industry standard, they can occasionally be repaired or replaced (depending on the specific make, model, and implementation of the component). From a hardware troubleshooting/repair perspective, any one of these components could be either improperly installed (configured) or defective. If improperly installed or configured, the component can be “repaired” by merely reinstalling or configuring it properly. If truly defective, the component can be replaced. When any laptop or desktop PC is broken down into its basic replaceable parts, you can see that it really isn’t too complicated, which is why I’ve spent my career helping people easily perform their own repairs and upgrades, and even build entire systems from scratch.

Reinstall or Replace?

When you are dealing with hardware problems, the first simple truth to understand is that you do not normally *repair* anything; you *reinstall* or *replace* it instead. *Reinstall* comes from the fact that the many laptop hardware problems are due to a particular component being improperly installed or configured. I remember hearing from IBM many years ago that it had found 60% or more of the problems handled by their service technicians were due to improper installation or configuration, meaning the hardware was not actually defective. This was in fact the major impetus behind the Plug and Play revolution, which has eliminated the need to manually configure jumpers and switches on most hardware devices, minimizing the expertise needed to install hardware properly, and thus also minimizing installation, configuration, and resource-conflict problems. Still, Plug and Play has sometimes been called “Plug and Pray,” because it does not always work perfectly, sometimes requiring manual intervention to get things to work properly. Although most laptop hardware is built in to the system or attaches to hot-swappable connections such as PC Card or CardBus slots, USB ports or IEEE 1394a (FireWire 400, i.LINK) ports, problems with BIOS configuration, Windows configuration, or improper internal connections can still cause laptop hardware to fail.

Replace comes from the economics of the situation with computer hardware. The bottom line is that it financially is much cheaper to replace a failed component with a new one than to repair it. Modern boards use surface-mounted chips that have pin spacing measured in hundredths of an inch, requiring sophisticated and expensive equipment to attach and solder the chip. Even if you could figure out which chip had failed and had the equipment to replace it, the chips themselves are usually sold in quantities of thousands, and obsolete chips are normally not available. The net effect of all this is that the replaceable components in your laptop have become disposable technology, including drives and LCD panels. Even a component as comprehensive as the motherboard is replaced rather than repaired.

Sources for Laptop Computer Parts

Obtaining known-working components for use with desktop computers is fairly simple because most components can be swapped between different brands and models of PCs. However, this is a more challenging task when you are supporting laptop and portable computers. Here are some ways to make parts-swapping easier:

- **Buy identical laptop computers whenever possible.** As I discuss in Chapter 17, “Portable Resource Guide,” different lines of laptop computers from the same vendor can vary greatly because most laptop computers are produced by one of several offshore (primarily Taiwanese) OEM vendors. If you buy multiple units of the same model, you can use one as a parts source for others. If you cannot afford to buy identical models, try to buy models in the same product family to improve the odds of interchanging parts.
- **Determine the “real” OEM manufacturer of the laptop(s) you support.** Review sources such as *PC Magazine* sometimes identify the actual maker of a particular laptop. In Chapter 17, I provide the names and websites for the major OEM makers of laptops. This information might enable you to contact the vendor directly for parts or at least determine which other brands/models might be similar to yours. Another method of determining this information is the FCC ID Search Page at <https://gulfoss2.fcc.gov/prod/oet/cf/eas/reports/GenericSearch.cfm>. Enter the FCC ID from the computer to determine its manufacturer.
- **Keep broken/defective laptops for parts.** Even if a laptop has suffered a catastrophic failure such as a broken LCD panel or motherboard, it can still provide replacements for keyboard, drive, power supply, and other modules for identical or similar models.
- **Save parts removed during upgrades for use in testing or as spares.** If you upgrade memory, drives, or batteries and the components you replaced still work, keep them for use as replacements for identical or similar models.

As an alternative to contacting the vendor for replacement parts using the contact information in Chapter 17, you might want to contact third-party vendors that specialize in notebook components—either OEM or equivalents. Some of these vendors (listed in alphabetical order) include the following:

- **Advanced Computer Services**—Sells new, used, and pulled parts for IBM, Compaq, and Toshiba desktop and laptop computers as well as computers and other types of parts.

www.partsandsystems.com

2262 South Arlington Road, Akron, OH 44319

Phone: 330-785-5500

Fax: 330-785-5501

- **Altech**—Sells new, used, and refurbished notebook parts as well as other types of computer components.

www.altechco.com

10612B Hempstead, Houston, TX 77092

Phone: 713-680-9323

Fax: 713-680-3519

- **Chhabra Enterprises, LLC**—Sells used, refurbished, and new laptop/notebook batteries, drives, and other components for major brands of laptop computers to end users.

www.betterdealcomputers.com

344 Fee Fee Road, Maryland Heights, MO 63043

Phone: 314-770-1070

Fax: 314-770-0935

Service shops and stores can order from the sister company, LaptopUniverse.com (same street address and phone number).

- **Computer Parts Unlimited**—Distributes parts for major brand-name notebook computers.

www.cpumart.com

3949 Heritage Oak Court, Simi Valley, CA 93063

Phone: 800-644-4494

Fax: 805-306-2599

- **Express Technology Incorporated**—Distributes parts for Compaq, Dell, IBM, and other major notebook and desktop computer and peripheral vendors. Offers a model-specific lookup system for some brands.

www.etiexpress.com

410 South Perry Lane, Suite 2, Tempe, AZ 85281

Phone: 480-921-2888

Fax: 480-921-0454

- **IDParts, Inc.**—Specializes in replacement LCD displays for most recent laptop computers. Also replaces defective LCD displays and repairs laptops.

www.idparts.com

Corporate office:

1009 Omeide Park, Greensburg, PA 15601-8608

Phone: 724-838-9588

Fax: 724-838-9589

Wisconsin location:

2000 O'Neil Road, Suite 200, Hudson, WI 54016-8167

Phone: 715-531-0393

Fax: 715-531-0394

See the website to determine which location to contact for your specific computer model.

- **SourceOne Computer Products, Inc.**—Sells laptop parts for most major brands. Also performs repairs.

www.sourceonecomputer.com

8343 North Steven Road, Milwaukee, WI 53223

Phone: 414-355-9448

Fax: 414-355-9778

Troubleshooting by Replacing Parts

There are several ways to troubleshoot a laptop, but in the end it often comes down to simply reinstalling or replacing parts. This process is more effective with desktop systems because more of their components are industry standard and readily replaceable. However, it's still a plausible way to solve problems with defective laptops. You just have a smaller pool of parts that you can easily replace. Regardless, that is why I normally use a very simple "known-good spare" technique that requires very little in the way of special tools or sophisticated diagnostics. In its simplest form, say you have two identical laptops sitting side by side. One of them has a hardware problem; in this example, let's say the removable memory module (SODIMM or small outline dual inline memory module) is defective. Depending on how the SODIMM is defective and where the defect lies, this could manifest itself in symptoms from a completely dead system to one that boots up normally but crashes when running Windows or software applications. You observe that the system on the left has the problem, but the system on the right works perfectly, and they are otherwise identical. The simplest technique for finding the problem would be to swap the memory module from one system with another, one at a time, retesting after each swap.

Note

Although many laptop components require you to disassemble the computer to access them, you can access most laptop memory modules by flipping over the computer and removing a small cover on the bottom of the unit.

At the point when the SODIMMs were swapped, upon powering up and testing (in this case, testing is nothing more than allowing the system to boot up and to run some of the installed applications), you find that the problem has now moved from one system to the other. Knowing that the last item swapped over was the SODIMM, you have just identified the source of the problem! This did not require an expensive (\$2K or more) memory test machine or any diagnostics software. Because components such as SODIMMs are not economical to repair, replacing the defective SODIMM would be the final solution.

Although very simplistic, this is often the quickest and easiest way to identify a problem component as opposed to specifically testing each item with diagnostics. Instead of having an identical system standing by to borrow parts from, most technicians will have an inventory of what they call *known-good spare parts*. This means parts that have been previously used, are known to be functional, and can be used to replace a suspicious part in a problem machine. Note that this is different from new replacement parts, because when you open up a box containing a new component, you really can't be 100% sure it works. I've been in situations in which I've had a defective component, replaced it with another (unknown to me) defective *new* component, and the problem remained. Not knowing that the new part I just installed was also defective, I wasted a lot of time checking other parts that were not the problem. The reason is that so few parts are needed to make up a laptop computer, and the known-good parts don't always have to be the same (for example, a smaller-capacity hard disk or memory module can be used to verify that the original, higher-performance component has failed).

Troubleshooting by the Bootstrap Approach

Another method that can be useful for troubleshooting a malfunctioning laptop is the *bootstrap approach*, which is especially good for what seems to be a dead system. This approach involves taking the system apart, stripping it down to the bare-minimum necessary functional components, and testing it to see if it works. Because laptops have fewer removable components, this approach can be a little trickier than when using it on a desktop PC. However, even with portables, the bootstrap troubleshooting approach is still viable. For example, to prep a laptop for testing, you would disconnect or remove the following items:

- Printer
- Network cable
- External mouse and keyboard
- External modem
- External floppy drive
- USB devices
- Port replicator
- Main battery
- Hard disk
- SODIMMs (except for one; note that many laptops have nonremovable memory along with one or more sockets for removable memory; in such cases, you should take out all removable memory)
- Bay devices (drives, battery, and so on)
- PC Cards

After you've removed these components, power up the system to see if it works. If any of the removed components are defective, removing them should enable the system to start up, at least to the point where the Power On Self Test (POST) or splash (logo) screen is visible on the display. If the system displays this information, you know that the motherboard, CPU, RAM, video circuits, and LCD display are functional. If you don't see this information, turn off the system and plug an external monitor into the laptop computer and try starting it again. If the external display shows the startup information, but the internal display does not, the system might be configured improperly.

If you can get the system to a minimum of components that are functional and the system starts, reinstall or add one part at a time, testing the system each time you make a change to verify that it still works and that the part you added or changed was not the cause of a problem. For example, add an external floppy drive and try booting from a bootable floppy disk. If that works, then try adding a swappable hard drive. Essentially, you are rebuilding the system, using the existing parts, but doing it one step at a time. If the system fails to start up properly after you add a component, it's likely you've found the source of your problems.

Note

If the laptop won't boot even after you disconnect all optional hardware, there might be a problem with the Power On Self Test (POST). See "Problems During the POST," later in this chapter, for solutions and testing procedures.

The single most important step to follow when you run a laptop in bootstrap mode is to remove the main battery and run the laptop from AC power. Defective batteries can cause laptops to crash, get stuck in suspend or sleep modes, and other problems.

Many times, problems can be caused by corrosion on contacts or connectors, so often the mere act of disassembling and reassembling accessible components on a laptop “magically” repairs it. Over the years I’ve disassembled, tested, and reassembled many systems only to find no problems after the reassembly. How can merely taking a system apart and reassembling it repair a problem? Although it may seem that nothing was changed and everything is installed exactly like it was before, in reality the mere act of unplugging and replugging renews all the slot and cable connections between devices, which is often all the system needs. Here are some useful troubleshooting tips:

- Eliminate unnecessary variables or components that are not pertinent to the problem.
- Reinstall, reconfigure, or replace only one component at a time.
- Test after each change you make.
- Keep a detailed record (write it down) of each step you take.
- Don’t give up! Every problem has a solution.
- If you hit a roadblock, take a break and work on another problem. A fresh approach the next day often reveals things you overlooked.
- Don’t overlook the simple or obvious. Double- and triple-check the installation and configuration of each component.
- Keep in mind that batteries and power adapters are two of the most failure-prone parts in a laptop computer, as well as some of the most overlooked components. A “known-good” spare power adapter is highly recommended to use for testing suspect systems. If a system runs without the battery but fails when the battery is installed, the battery is defective and should be replaced.
- Cables and connections are also a major cause of problems. Keep replacements of all types on hand.
- Don’t rule out consulting a pro. Whereas most problems with desktop systems can be resolved with your own blood, sweat, and tears, with laptops sometimes the only viable solution is to consult the manufacturer of the laptop or the business from which you purchased it.

Before starting any system troubleshooting, you should perform a few basic steps to ensure a consistent starting point and to enable isolating the failed component:

1. Turn off the system and any peripheral devices. Disconnect all external peripherals from the system.
2. Make sure the system is plugged into a properly grounded power outlet.
3. If the LCD panel has a brightness control, make sure the display is set to at least two-thirds of the maximum. The brightness or brightness/contrast control might use a sliding switch or keyboard controls. Consult the display documentation for more information on how to adjust these settings. If you can’t get any video display on the built-in LCD panel but the system seems to be working, plug in an external monitor and press the key combination needed to send video output to an external display.
4. To enable the system to boot from a hard disk, make sure no media are in a removable storage drive. In the case of laptops, this usually is either the floppy disk drive or CD/DVD-ROM drive (or both). Alternatively, put a known-good bootable floppy or CD with DOS or diagnostics on it in the drive for testing.
5. Turn on the system. Check the chassis fan (if any) and the lights on the system front panel. If the fan doesn’t spin and the lights don’t light, the power supply or motherboard might be defective.

Note

The exhaust fan on a given laptop computer model might be located on the left or right side or the rear of the system. Laptop computers use very small and quiet fans, so use your hand to determine whether the fan is blowing air; you probably won't be able to hear it.

6. Observe the Power On Self Test (POST). If no errors are detected, the system beeps once and boots up. Errors that display onscreen (*nonfatal* errors) and do not lock up the system offer a text message that varies according to BIOS type and version. Record any errors that occur and refer to the BIOS error codes listed later in this chapter for more information on any specific codes you see. Errors that lock up the system (*fatal* errors) are indicated by a series of audible beeps. Beep codes for popular BIOS chips are also listed later in this chapter.
7. Confirm that the operating system loads successfully.

Problems During the POST

Problems that occur during the POST are usually caused by incorrect hardware configuration or installation. Actual hardware failure is a far less frequent cause. The POST reports errors three ways:

- Onscreen error messages
- Beep codes
- Hex codes

Some onscreen error messages are self-explanatory, whereas numeric error messages require you to look up the error in a listing for the BIOS version the computer uses.

To determine the meaning of the beep codes generated by the POST, you also need to look up the beep codes in a listing for the BIOS version the computer uses.

On a typical desktop computer, hex codes (which change during the boot process and can be used to determine startup problems) can be displayed through the use of a POST diagnostics card that plugs into a PCI or ISA slot. Although notebook computers lack these slots, some notebook computers have BIOS chips that direct hex code output to the parallel port, where a device such as the MicroPOST from Ultra-X (about \$60; visit www.uxd.com) can display it (see Figure 16.1). POST diagnostic devices such as MicroPOST include lists of hex codes for popular BIOSes.

Note

According to Ultra-X, almost all IBM and most newer Toshiba notebook computers output POST hex codes to the parallel port. Some Compaq and other brands of notebook computers also output POST codes to the parallel port. However, Dell notebooks do not support this feature. Some desktop computers also support parallel-port POST code output.

It's important to realize that a given computer's support for parallel-port output of POST hex codes is determined by the BIOS revision the computer uses. If you update the BIOS on a particular laptop (or desktop) computer, that computer might support parallel-port POST output, or it might lose support for parallel-port POST output.

Regardless of type, if you have a POST error, be sure to check the following:

- Are all cables correctly connected and secured?
- Are the configuration settings correct in Setup for the devices you have installed? In particular, ensure the processor, memory, and hard drive settings are correct.

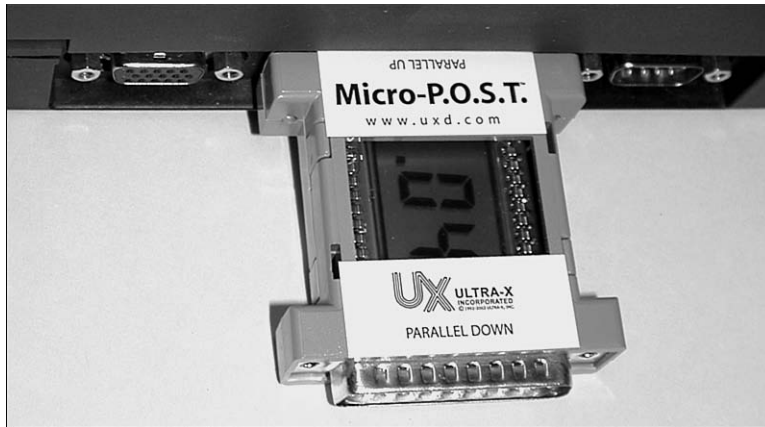


Figure 16.1 Using the Ultra-X MicroPOST to read POST codes (the code displayed is 04) from a typical laptop computer.

- Are all drivers properly installed?
- Are all resource settings on add-in and peripheral devices set so that no conflicts exist (for example, two add-in devices sharing the same interrupt)?
- Are PC Card/CardBus adapters and swappable disk drives installed correctly?
- Is a bootable hard disk (properly partitioned and formatted) installed?
- Does the BIOS support the drive you have installed? If so, are the parameters entered correctly?
- If you are booting from floppy disk, is the disk installed in drive A: bootable?
- Are all memory modules installed correctly? Try reseating them.

Hardware Problems After Booting

If problems occur after the system has been running and without your having made any hardware or software changes, a hardware fault possibly has occurred. Here is a list of items to check in that case:

- Try reinstalling the software that has crashed or refuses to run.
- Use the Reset button to restart the computer. It might be recessed and require a paperclip or pen point on some models.
- Check for loose cables, a marginal power supply, or other random component failures.
- A transient voltage spike, power outage, or brownout might have occurred. Symptoms of voltage spikes include a flickering video display, unexpected system reboots, and the system not responding to user commands. Reload the software and try again.
- Try reseating the removable memory modules if installed.

Problems Running Software

Problems running application software (especially new software) are usually caused by or related to the software itself, or they are due to the fact that the software is incompatible with the system. Here is a list of items to check in that case:

- Does the system meet the minimum hardware requirements for the software? Check the software documentation to be sure.
- Check to see whether the software is correctly installed. Reinstall it if necessary.
- Check to see whether the latest drivers are installed. You can use Windows Update or download updated drivers directly from the laptop or peripheral vendors' website.
- Scan the system for viruses using the latest antivirus software and updated signature files.

Note

Many laptops use integrated video, which borrows part of the main memory for video use. On recent systems, this can result in as much as 32MB or more of memory being "lost" to system use. For example, a system with 128MB of RAM with 32MB dedicated to video has only 96MB (128MB – 32MB) available for system (Windows) use. When you are determining whether a system has enough memory, be sure to consider the net amount of memory available after video requirements have been met.

Problems with Adapter Cards

Because laptops use PC Card and CardBus adapter cards, which are configured by Windows, it's pretty difficult to have IRQ or other conflicts. However, in rare cases it can happen if the cards' settings can be changed manually and you decide to start fiddling around with them.

On a notebook computer that runs Microsoft Windows, various types of driver issues are the mostly likely cause of adapter card problems. To solve these problems with Windows, view the card's properties in the Windows Device Manager and follow the recommendations given for cards that are not working (yellow exclamation point) or have been disabled (red X). In most cases, the first thing to try is to install updated drivers that match the hardware and work with the operating system version in use.

Note

To open the Windows Device Manager in Windows XP, right-click the My Computer icon and select Properties. Select the Hardware tab and click the Device Manager button.

Diagnostics

This section describes several levels of diagnostic software that are either included with your system or are available from your system manufacturer as well as third parties. It describes how you can get the most from this software. It also details the various ROM BIOS audio codes and error codes and examines aftermarket diagnostics and public-domain diagnostic software.

Diagnostics Software

Several types of diagnostic software are available for laptops. Some diagnostic functions are integrated into the laptop hardware or into peripheral devices, such as PC Card or CardBus cards and their driver/setup software, whereas others take the form of operating system utilities or separate software products. This software, some of which is included with the system when purchased, assists users in identifying many problems that can occur with a computer's components. In many cases, these programs can do most of the work in determining which component is defective or malfunctioning. The types of diagnostic software are as follows:

- **POST**—The Power On Self Test operates whenever any laptop is powered up (switched on). These routines are contained within the motherboard ROM as well as the ROM chip on expansion cards.
- **Manufacturer-supplied diagnostics software**—Many of the larger manufacturers (especially high-end, name-brand manufacturers such as IBM, Hewlett-Packard, Dell, and others) make special diagnostics software expressly designed for their systems. This manufacturer-specific software normally consists of a suite of tests that thoroughly examine the system. In some cases, these utilities are included with the system, or you can download these diagnostics from the manufacturer's online services at no charge (otherwise, you might have to purchase them). Many vendors include a limited version of one of the aftermarket packages customized for use with their systems. In some older IBM and Compaq systems, the diagnostic software is installed on a special partition on the hard drive and can be accessed during startup. This was a convenient way for those system manufacturers to ensure that users always had diagnostics available.
- **Peripheral diagnostics software**—Many hardware devices ship with specialized diagnostics software designed to test their particular functions. A network adapter usually includes a diagnostic specific to that adapter on a disk, also normally with the drivers. Other devices or adapters also might provide a diagnostic program or disk, usually included with the drivers for these devices.
- **Operating system diagnostics software**—Operating systems, such as Windows 9x/Me and Windows NT/2000/XP, include a variety of diagnostic software utilities designed to identify and monitor the performance of various components in the computer.
- **Aftermarket diagnostics software**—A number of manufacturers make general-purpose diagnostics software for laptops. This type of software is often bundled with other system maintenance and repair utilities to form a general laptop software toolkit.

The Power On Self Test

When IBM first began shipping the original PC in 1981, it included safety features that had never before been seen in a personal computer. These features included the Power On Self Test (POST) and parity-checked memory. Although parity-checked memory, or even error correcting code (ECC) memory, is no longer available in most low-end chipsets, every laptop still executes a POST when you turn it on. The following subsections provide more detail on the POST, a series of program routines buried in the motherboard's ROM BIOS chip that test all the main system components at power-on time. This series of routines is partially responsible for the delay when you turn on your laptop; the computer executes the POST before loading the operating system.

We've already covered some of the features and functions of the POST in the previous sections. The following subsections review some of that material but also more thoroughly cover the output beeps and codes that specific BIOSes generate.

What Is Tested?

Whenever you start up your computer, it automatically performs a series of tests that check the primary components in your system, such as the CPU, ROM, motherboard support circuitry, memory, and major peripherals. These tests are brief and are designed to catch hard (not intermittent) errors. The POST procedures are not very thorough compared with available disk-based diagnostics. The POST process provides error or warning messages whenever it encounters a faulty component.

Although the diagnostics performed by the system POST are not very thorough, they are the first line of defense, especially when it comes to detecting severe motherboard problems. If the POST encounters a problem severe enough to keep the system from operating properly, it halts the system boot

process and generates an error message that often identifies the cause of the problem. These POST-detected problems are sometimes called *fatal errors* because they prevent the system from booting.

How Are Errors Reported?

The POST on a laptop or notebook system normally provides two types of output messages: audio codes and onscreen text messages.

POST errors can be revealed in the following ways:

- **Beep codes**—These beeps are heard through the speaker attached to the motherboard.
- **Onscreen messages**—These error messages are displayed onscreen after the video adapter is initialized.

Beep codes are used for fatal errors only, which are errors that occur so early in the process that video circuits and other devices are not yet functional. Because no display is available, these codes take the form of a series of beeps that identify the faulty component. When your computer is functioning normally, you should hear one short beep when the system starts up at the completion of the POST, although some systems (such as Compaq's) beep once or twice at the end of a normal POST. If a problem is detected, a different number of beeps sounds, sometimes in a combination of short and long tones.

Onscreen messages are brief messages that attempt to indicate a specific failure. These messages can be displayed only after the video adapter card and display have been initialized.

These different types of error messages are BIOS dependent and vary among BIOS manufacturers, and in some cases even among different BIOSes from the same manufacturer. The following subsections list the codes used by the most popular ROM BIOS versions (AMI, Award, Phoenix, and IBM BIOS), but you should consult your motherboard or ROM BIOS manufacturer for the codes specific to your board and BIOS.

AMI BIOS POST Error Codes

Laptops that use the AMI BIOS use the beep codes in Table 16.2 to report the problems indicated. The corrective actions listed in this table were originally written for desktop computers, so I've adapted them for use with laptop computers.

Table 16.2 AMI BIOS POST Beep Codes

Beeps	Error Description	Action	Notes for Laptop Users
1	DRAM Refresh Error	Clean the memory contacts and reseal the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed, and the system must be serviced or replaced.
2	Memory Parity Error	Replace the memory. Replace the power supply. Replace the motherboard.	This error is unlikely to apply to most recent systems because most laptops don't use parity-checked memory.
3	Base 64KB Memory Failure	Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed, and the system must be serviced or replaced.

Table 16.2 Continued

Beeps	Error Description	Action	Notes for Laptop Users
4	System Timer Failure	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Remove and clean the first bank of memory and reseat the module. Replace the memory. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed, and the system must be serviced or replaced. This problem can also be caused by a memory error in the first bank of memory.
5	Processor Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Make sure the processor and heat sink are installed properly (remove and reseat). Replace the processor. Replace the motherboard.	Remove the processor only if the processor is installed in a ZIF socket. Be sure to replace the thermal material between the processor and the heatsink with approved material after removing the old thermal material from both the processor and the heatsink. If the processor is soldered to the motherboard, the system must be serviced or replaced.
6	Gate A20 Failure	Caused by a defective keyboard controller. Replace the keyboard controller on the motherboard.	The keyboard controller normally allows Gate A20 to switch the processor to protected mode.
7	Virtual Mode Processor Exception Error	Make sure the processor and heat sink are installed properly (remove and reseat). Replace the processor. Replace the motherboard.	Be sure to replace the thermal material between the processor and the heatsink with approved material after removing the old thermal material from both the processor and the heatsink.
8	Display Memory Read/Write Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
9	ROM Checksum Error	Try reseating the motherboard ROM chip. Try reflashing the motherboard ROM. Replace the motherboard.	If the ROM BIOS is soldered in place, follow the directions to reflash the BIOS as your first step.
10	CMOS Shutdown Register Read/Write Error	Replace the CMOS battery. Replace the motherboard.	The CMOS battery is often a proprietary module that uses a short cable to plug into the motherboard.
11	Cache Memory Bad	Make sure cache settings in BIOS Setup are properly configured. Replace the processor. Replace the motherboard.	All modern processors (Pentium II and newer; AMD Athlon and newer) contain the cache memory used by the system.
1 long, 3 short	Conventional/Extended Memory Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed, and the system must be serviced or replaced.

Table 16.2 Continued

Beeps	Error Description	Action	Notes for Laptop Users
1 long, 8 short	Display/Retrace Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.

AMI BIOS codes used by permission of American Megatrends, Inc.

Award BIOS and Phoenix FirstBIOS POST Error Codes

Currently, only one standard beep code exists in the Award BIOS (also known as the Phoenix FirstBIOS). A single long beep followed by two short beeps indicate that a video error has occurred and that the BIOS cannot initialize the video screen to display any additional information. If multiple or continuous beeps occur with an Award BIOS, this usually indicates problems with the power supply or memory (refer to Tables 16.3 and 16.4).

Table 16.3 Award BIOS/Phoenix FirstBIOS POST Beep Codes

Beeps	Error Description	Action	Notes for Laptop Users
One long, two short	Video Card Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
One long, three short	Video Card Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
Continuous Beeps	Memory Error	Clean the memory contacts and reseal the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed, and the system must be serviced or replaced.

Table 16.4 Award BIOS POST Onscreen Error Messages

Message	Description
BIOS ROM checksum error - System halted	The checksum of the BIOS code in the BIOS chip is incorrect, indicating the BIOS code might have become corrupt. Contact your system dealer to replace the BIOS.
CMOS battery failed	The CMOS battery is not functional. Replace the CMOS battery. Contact a laptop parts dealer to determine the type and location of the CMOS battery used in your laptop.
CMOS checksum error - Defaults loaded	The checksum of CMOS is incorrect, so the system loads the default equipment configuration. A checksum error can indicate that CMOS has become corrupt. This error might have been caused by a weak battery. Check the battery and replace it if necessary.

Table 16.4 Continued

Message	Description
CPU at <i>nnnn</i>	Displays the running speed of the CPU.
Press ESC to skip memory test	You can press Esc to skip the full memory test.
Floppy disk(s) fail	Can't find or initialize the floppy drive controller or the drive. Make sure the controller is installed correctly. If no floppy drives are installed or connected to the computer, be sure the Diskette Drive selection in Setup is set to NONE or AUTO.
HARD DISK initializing. Please wait a moment	Some hard drives require extra time to initialize.
HARD DISK INSTALL FAILURE	Can't find or initialize the hard drive controller or the drive. Make sure the controller is installed correctly. If no hard drives are installed, be sure the Hard Drive selection in Setup is set to NONE.
Hard disk(s) diagnosis fail	The system might run specific disk diagnostic routines. This message appears if one or more hard disks return an error when the diagnostics run.
Keyboard error or no keyboard present	Can't initialize the keyboard. Make sure the keyboard is attached (installed) correctly and no keys are pressed during POST. If you have removed the integrated keyboard to install a component, make sure you reconnected and reinstalled the keyboard correctly. If you use an external keyboard, shut down the laptop, unplug the keyboard, and restart the system using the integrated keyboard.
Keyboard is locked out - Unlock the key	This message usually indicates that one or more keys have been pressed during the keyboard tests. Be sure no objects are resting on the keyboard.
Memory Test:	This message displays during a full memory test, counting down the memory areas being tested.
Memory test fail	If POST detects an error during memory testing, additional information appears giving specifics about the type and location of the memory error. If the memory location with the error is found in removable memory, swap memory modules and retry the system. If the memory location is found in built-in memory, service or replace the laptop.
Override enabled - Defaults loaded	If the system can't boot using the current CMOS configuration, the BIOS can override the current configuration with a set of BIOS defaults designed for the most stable, minimal-performance system operations.
Press TAB to show POST screen	System OEMs might replace Phoenix Technologies' Award BIOS POST display with their own proprietary displays. Including this message in the OEM display permits you to switch between the OEM display and the default POST display.
Primary master hard disk fail	POST detects an error in the primary master IDE hard drive. If the drive is swappable, or if you have replaced the original drive with a new drive, shut down the computer, recheck the drive installation, and restart the system.
Primary slave hard disk fail	POST detects an error in the primary IDE hard drive. If your system supports multiple hard disks with a swappable bay, shut down the system, eject and reconnect the additional hard disk, and restart the system.

(continues)

Table 16.4 Continued

Message	Description
Resuming from disk, Press TAB to show POST screen	Phoenix Technologies offers a save-to-disk feature for notebook computers. This message might appear when you restart the system after a save-to-disk shutdown.
Secondary master hard disk fail	POST detects an error in the secondary master IDE hard drive. If your system supports multiple hard disks with a swappable bay, shut down the system, eject and reconnect the additional hard disk, and restart the system.
Secondary slave hard disk fail	POST detects an error in the secondary slave IDE hard drive. If your system supports multiple hard disks with a swappable bay, shut down the system, eject and reconnect the additional hard disk, and restart the system.

Phoenix BIOS POST Error Codes

The beep codes listed in Tables 16.5 and 16.6 are for the current version of Phoenix BIOS, version 4.0, release 6.1. Other versions have somewhat different beeps and Port 80h codes.

Table 16.5 Phoenix BIOS 5.x and Earlier POST Beep Codes

Beeps	Error Description	Action	Notes for Laptop Users
1-2	Video Card Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
1-3	CMOS RAM Read/Write Error	Replace the CMOS battery. Replace the motherboard.	The CMOS battery is a proprietary model on most notebooks. Check the cable connection from the battery to the motherboard.
1-1-4	ROM Checksum Error	Try reseating the motherboard ROM chip. Try re-flashing the motherboard ROM. Replace the motherboard.	If the ROM BIOS is soldered in place, follow the directions to re-flash the BIOS as your first step.
1-2-1	Timer Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
1-2-2	DMA Initialization Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
1-2-3	DMA Page Register Read/Write Error	Check for proper motherboard installation, foreign objects inside causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.

Table 16.5 Continued

Beeps	Error Description	Action	Notes for Laptop Users
1-3-1	RAM Refresh Verification Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-3-3	First 64KB RAM Multibit Data Line Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-3-4	First 64KB RAM Odd/Even Logic Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-4-1	First 64KB RAM Address Line Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-4-2	First 64KB RAM Parity Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
3-1-1	Slave DMA Register Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
3-1-2	Master DMA Register Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
3-1-3	Master Interrupt Mask Register Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.

(continues)

Table 16.5 Continued

Beeps	Error Description	Action	Notes for Laptop Users
3-1-4	Slave Interrupt Mask Register Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
3-2-4	Keyboard Controller Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the keyboard. Replace the motherboard. Replace the processor.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
3-3-4	Screen Initialization Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
3-4-1	Screen Retrace Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
3-4-2	Video ROM Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	Laptops must be serviced or replaced because their video is built in to the motherboard or integrated into the chipset.
4-2-1	Timer Interrupt Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
4-2-2	Shutdown Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the keyboard. Replace the motherboard. Replace the processor.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
4-2-3	Gate A20 Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the keyboard. Replace the motherboard. Replace the processor.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.

Table 16.5 Continued

Beeps	Error Description	Action	Notes for Laptop Users
4-2-4	Unexpected Interrupt In Protected Mode	Check for a bad expansion card. Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	Remove any PC Card or CardBus cards and retry.
4-3-1	RAM Address Error >FFFh	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
4-3-3	Interval Timer Channel 2 Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
4-3-4	Real Time Clock Error	Replace the CMOS battery. Replace the motherboard.	If replacing the CMOS battery fails to solve the problem, the motherboard has probably failed and the system must be serviced or replaced.
4-4-1	Serial Port Error	Reset the port configuration in BIOS Setup. Disable the port.	
4-4-2	Parallel Port Error	Reset the port configuration in BIOS Setup. Disable the port.	
4-4-3	Math Coprocessor Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Make sure the processor and heat sink are installed properly (remove and reseat). Replace the processor. Replace the motherboard.	Be sure to replace the thermal material between the processor and the heatsink with approved material after removing the old thermal material from both the processor and the heatsink.
Low 1-1-2	System Board Select Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Make sure the processor and heat sink are installed properly (remove and reseat). Replace the processor. Replace the motherboard.	Be sure to replace the thermal material between the processor and the heatsink with approved material after removing the old thermal material from both the processor and the heatsink.
Low 1-1-3	Extended CMOS RAM Error	Replace the CMOS battery. Replace the motherboard.	The CMOS battery is a proprietary model on most notebooks. Check the cable connection from the battery to the motherboard.

Table 16.6 Phoenix BIOS 6.x and Later POST Beep Codes

Beeps	Error Description	Description/Action	Notes for Laptop Users
1-2-2-3	BIOS ROM Checksum Error	Try reseating the motherboard ROM chip. Try re-flashing the motherboard ROM. Replace the motherboard.	If the ROM BIOS is soldered in place, follow the directions to re-flash the BIOS as your first step.
1-3-1-1	DRAM Refresh Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-3-1-3	8742 Keyboard Controller Error	Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the keyboard. Replace the motherboard. Replace the processor.	If there are no loose components or screws inside the laptop, the motherboard has probably failed and the system must be serviced or replaced.
1-3-4-1	Memory Address Line Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-3-4-3	Memory Low Byte Data Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
1-4-1-1	Memory High Byte Data Error	Clean the memory contacts and reseat the modules. Remove all modules except the first bank. Replace the memory. Replace the power supply. Replace the motherboard.	If the system has no removable memory installed, the built-in memory or the motherboard has failed and the system must be serviced or replaced.
2-1-2-3	ROM Copyright Error	Try reseating the motherboard ROM chip. Try re-flashing the motherboard ROM. Replace the motherboard.	In many cases, reseating the ROM chip is not possible and the system must be serviced or replaced.
2-2-3-1	Unexpected Interrupts	Check for a bad expansion card. Check for proper motherboard installation, foreign objects causing shorts, loose screws, and over-tightened screws. Replace the motherboard.	Remove all nonessential components and retry. If the system still fails, it needs to be serviced or replaced.

Table 16.6 Continued

Beeps	Error Description	Description/Action	Notes for Laptop Users
1-2	Video Card Error	Check the video card for proper installation. Try replacing the video card memory. Replace the video card. Replace the motherboard.	In most cases, the laptop must be serviced or replaced.

IBM ThinkPad BIOS Error Codes

Because laptops use different technologies than desktop computers, IBM developed a special range of beep codes for its ThinkPad notebook computers. The beep codes, the symptoms they list, and the recommended actions are detailed in Table 16.7.

Table 16.7 IBM ThinkPad BIOS Beep Codes

Beep Code/Symptom	Action
One beep and a blank, unreadable, or flashing LCD.	Reseat the LCD connector. Replace the LCD assembly. Reseat or replace the DIMMs. Replace the motherboard.
One long and two short beeps and a blank or unreadable LCD.	Reseat or replace the DIMMs. Replace the LCD assembly. Replace the motherboard.
Two short beeps with error codes.	POST error. See error codes.
Two short beeps and a blank screen.	Reseat or replace the DIMMs. Replace the motherboard.
Three short beeps, pause, three more short beeps, and one short beep.	Reseat or replace the DIMMs. Replace the motherboard.
One short beep, pause, three short beeps, pause, three more short beeps, and one short beep. Only the cursor appears.	Reinstall the operating system.
Four cycles of four short beeps and a blank screen.	Replace the security chip. Replace the motherboard.
Five short beeps and a blank screen.	Replace the motherboard.

The codes in Table 16.8 are especially for IBM's line of ThinkPad laptop computers.

Table 16.8 IBM ThinkPad-Specific BIOS POST Numeric Error Codes

Code	Message	Action
0175	Bad CRC1 - The EEPROM checksum is not correct.	Reflash the BIOS and replace the motherboard.
0176	System Security - The system has been tampered with.	This message is displayed if you remove the security chip and reinstall it or install a new one. Run BIOS Setup, load the defaults, and save the settings.
0177	Bad SVP data, stop POST task.	The Supervisor password is corrupt. Replace the motherboard.

Table 16.8 Continued

Code	Message	Action
0182	Bad CRC2. Enter BIOS Setup and load Setup Defaults.	Run BIOS Setup, load the defaults, and save the settings.
0185	Bad startup sequence settings. Enter BIOS Setup and load setup defaults.	Run BIOS Setup, load the defaults, and save the settings.
0187	EATA data access error - The access to EEPROM is failed.	Reflash the BIOS. Replace the motherboard.
0188	Invalid RFID serialization information area or bad CRC2 - The EEPROM checksum is not correct.	Reflash the BIOS. Replace the motherboard.
0189	Invalid RFID configuration information area - The EEPROM checksum is not correct.	Reflash the BIOS. Replace the motherboard.
0190	Critical low-battery error.	Charge the battery (replace it if necessary).
0191	System Security, invalid Remote Change requested.	Run BIOS Setup, load the defaults, and save the settings.
0192	System Security, IBM Embedded Security hardware tamper detected.	Run BIOS Setup and select Config, IBM Security Chip, Clear IBM Security Chip. Replace the security chip. Replace the motherboard.
0195	Security hardware tamper detected.	Run BIOS Setup and select Config, IBM Security Chip, Clear IBM Security Chip. Replace the security chip. Replace the motherboard.
0196	Security hardware removed.	Run BIOS Setup and select Config, IBM Security Chip, Clear IBM Security Chip. Replace the security chip. Replace the motherboard.
0197	Invalid remote change requested.	The remote configuration for the security chip has failed. Confirm the operation and try again.
0199	System Security - IBM Security password retry count exceeded.	Occurs if you enter the wrong Supervisor password more than three times in a row. Restart and try again with the correct password.
01C8	More than one modem devices are found. Remove one of them. Press <Esc> to continue.	Remove either the Mini PCI modem card or the modem daughtercard.
01C9	More than one Ethernet devices are found. Remove one of them. Press <Esc> to continue.	Remove either the Mini PCI Ethernet card or the Ethernet daughtercard.
0200	Hard disk error, the hard disk is not working.	Reseat the hard disk, load the BIOS Setup defaults, and replace the drive.
021x	Keyboard error.	Test the keyboard (replace it if necessary).
0220	Monitor type error, monitor type does not match the one specified in CMOS.	Run BIOS Setup, load the defaults, and save the settings.

Table 16.8 Continued

Code	Message	Action
0230	Shadow RAM error, shadow RAM fails at offset <i>nnnn</i> .	Reseat or replace the SODIMMs. Replace the motherboard.
0231	System RAM error, system RAM fails at offset <i>nnnn</i> .	Reseat or replace the SODIMMs. Replace the motherboard.
0232	Extended RAM error, extended RAM fails at offset <i>nnnn</i> .	Reseat or replace the SODIMMs. Replace the motherboard.
0250	System battery error, system battery is dead.	Replace the backup battery and run BIOS Setup to reset the date and time.
0251	System CMOS checksum bad, default configuration used.	Replace the backup battery and run BIOS Setup to reset the date and time.
0252	Password checksum bad, the password is cleared.	Reset the password by running BIOS Setup.
0260	System timer error.	Replace the backup battery and run BIOS Setup to reset the date and time.
0270	Real time clock error.	Replace the backup battery and run BIOS Setup to reset the date and time.
0271	Date and time error, neither the date nor the time is set in the computer.	Run BIOS Setup to reset the date and time.
02B2	Incorrect drive A type.	Run BIOS Setup, load the defaults, and save the settings. Replace floppy drive.
02F4	EISA CMOS not writable.	Run BIOS Setup, load the defaults, and save the settings. Replace the backup battery.
02F5	DMA test failed.	Reseat or replace the SODIMMs. Replace the motherboard.
02F6	Software NMI failed.	Reseat or replace the SODIMMs. Replace the motherboard.
02F7	Fail-safe timer NMI failed.	Reseat or replace the SODIMMs. Replace the motherboard.
1801	Attached docking station is not supported.	Remove the docking station or port replicator.
1802	Unauthorized network card is plugged in - Power off and remove the Mini-PCI network card.	Remove the Mini PCI network card.

Table 16.9 lists the BIOS POST error messages that are specific to IBM ThinkPad laptop computers.

Table 16.9 IBM ThinkPad-Specific BIOS POST Error Messages

Error Message/Symptom	Action
No beep, power-on indicator on, LCD blank, and no POST.	Make sure every connector is connected tightly and correctly. Reseat or replace the DIMMs. Replace the motherboard.
No beep, power-on indicator on, and LCD blank during POST.	Reseat or replace the DIMMs. Replace the motherboard.
Device address conflict.	Run BIOS Setup, load the defaults, and save the settings. Replace the backup battery.
Allocation error for device.	Run BIOS Setup, load the defaults, and save the settings. Replace the backup battery.
Failing bits: <i>nnnn</i> .	Reseat or replace the DIMMs. Replace the motherboard.
Invalid system configuration data.	Reseat or replace the DIMMs. Replace the motherboard.
I/O device IRQ conflict.	Run BIOS Setup, load the defaults, and save the settings. Replace the backup battery.
Operating system not found.	Reseat the hard disk. Check the drive and operating system for proper installation. Reinstall the operating system. Replace the hard disk.
Hibernation error.	Restore the system configuration to what it was before the computer entered hibernation mode. If the memory size has been changed, re-create the hibernation file.
Fan error.	Check or replace the fan.
Thermal sensing error.	Replace the motherboard.
The power-on password prompt appears.	A power-on password or a Supervisor password is set. Type the password and press Enter.
The hard-disk password prompt appears.	A hard disk password is set. Type the password and press Enter.
The DOS full screen looks smaller.	Run BIOS Setup or the ThinkPad Configuration program and set the screen expansion function.

POST Memory Count

On some systems, the POST also displays the results of its system memory test on the LCD. The last number displayed is the amount of memory that tested successfully. For example, a system might display the following message:

131072 KB OK

The number displayed by the memory test (the example indicates that 128MB of RAM is installed) should agree with the total amount of memory installed on the system motherboard. Some older systems display a slightly lower total because they deduct part or all of the 384KB of upper memory area (UMA) from the count. This memory test is performed before any system software loads, so many memory managers or device drivers you might have installed do not affect the results of the test. If the POST memory test stops short of the expected total, the number displayed can indicate how far into the system memory array a memory error lies. This number can help you identify the exact module that is at fault and can be a valuable troubleshooting aid in itself.

Note

The memory test reflects the total amount of memory installed in a system, including any memory set aside for integrated video.

General-Purpose Diagnostics Programs

A large number of professional third-party diagnostics programs are available for laptop systems. Technicians use these commercial programs to perform testing of new systems (often called *burn-in testing*) or testing of existing systems either in the shop or in the field.

Most of the commercial laptop diagnostics can test all your laptop's key components. In addition, specific programs are available to test memory, floppy drives, hard disks, video adapters, and most other areas of the system. Here are some of the programs I recommend most highly:

- **AMIDiag Suite**—See www.ami.com for more information.
- **MicroScope**—See www.micro2000.com for more information.

Tip

Before trying a commercial diagnostic program to solve your problem, look in your operating system. Most operating systems today provide at least some of the diagnostic functions that diagnostic programs do. You might be able to save some time and money.

Unfortunately, no clear leader exists in the area of diagnostic software. Each program has unique advantages, and as a result, no program is universally better than another. When deciding which diagnostic programs, if any, to include in your arsenal, look for the features you need.

One of the most popular is AMIDiag from AMI. This program runs on virtually any desktop or laptop PC and tests most of the hardware in the system. AMIDiag is available in a native Windows version that also supports third-party diagnostics modules or in a DOS version that can be used to test hardware, regardless of the operating system, by using a DOS boot disk to start the system.

Operating System Diagnostics

In many cases, it might not be necessary to purchase third-party diagnostic software because your operating system has all the diagnostic tools you need. Windows 9x/Me and 2000/XP include a large selection of programs that enable you to view, monitor, and troubleshoot the hardware in your system. Some of these include the following:

- **Windows Device Manager**—Displays installed hardware, resources in use, and conflicts/problems with installed hardware. Can also be used to update drivers.
- **DirectX Diagnostics**—Tests 3D graphics and sound features.
- **Microsoft System Information**—Displays hardware and software information in more detail than Windows Device Manager.
- **ScanDisk/CHKDSK**—Checks the disk file system and surface for errors.
- **Event Viewer**—Gives a chronological list of errors that Windows encounters while the system is running.
- **Windows Troubleshooters**—A series of mini-programs that assist with troubleshooting specific hardware and software problems.

Top Troubleshooting Problems

This section includes some of the most frequently asked troubleshooting questions I receive for laptop and notebook systems. I've divided these questions into categories to help you find the answer you need more quickly.

Power and Startup Problems

If your laptop won't boot or, worse, won't even power on, the cause can be difficult to pin down. Use the following subsections to help you troubleshoot the root of the problem.

When I power the system on, I see the power LED light and determine that the fan spins, but nothing else ever happens.

The fact that the LEDs illuminate and the fan spins indicates that the power supply subsystem (which includes the external power adapter, power cord, and battery) is partially working, but that does not exclude it from being defective. This is a classic "dead" system, which can be caused by almost any defective hardware component. Because in my experiences I've had more problems with power supplies than most other components, I'd immediately use a multimeter to measure the outputs at the power adapter connectors and ensure they were within the proper 5% tolerances of their rated voltages. The power adapter is usually marked with the rated DC voltage output. If power is flowing to the adapter but no power is coming from the adapter, change the cord. Most laptop power adapters use one of several two-wire standard power cords. Replace the cord with a known-working spare and retest the voltage.

Even if the voltage measurements check out, I'd swap in a known-good spare power adapter and retest. If that doesn't solve the problem, I would revert to the "bootstrap approach" I mentioned earlier, which is to strip the system down to the bare minimum and retest. If the system now starts, you should begin adding the components you removed one at a time, retesting after each change. If the laptop uses a two-wire cord that goes directly into the unit, the AC/DC power converter is built in to the laptop. You would need to disassemble the laptop to test the power adapter.

The system beeps when I turn it on, but there is nothing on the screen.

The beep indicates a failure that was detected by the ROM POST routines. Look up the beep code in the table corresponding to the ROM version in your motherboard. You can sometimes find this in the system manual; however, you can also see the beep codes for the most popular AML, Award, Phoenix, and IBM ThinkPad BIOSes earlier in this chapter.

The system won't boot up. It says "Missing operating system" on the screen.

When your system boots, it reads the first sector from the hard disk, called the *master boot record (MBR)*, and runs the code contained in that sector. The MBR code then reads the partition table (also contained in the MBR) to determine which partition is bootable and where it starts. Then it loads the first sector of the bootable partition, called the *volume boot record (VBR)*, which contains the operating system-specific boot code, but before executing the VBR, the MBR checks to be sure the VBR ends with the signature bytes 55AAh. The MBR will display the "Missing operating system" message if it finds that the first sector of the bootable partition (the VBR) does not end in 55AAh.

Several things can cause this to occur:

- **The drive parameters entered in the BIOS Setup are incorrect or corrupted.** These are the parameters defining your drive that you entered in the BIOS Setup, and they are stored in a CMOS RAM chip powered by a battery on your motherboard. Incorrect parameters will cause the MBR program to translate differently and read the wrong VBR sector, thus displaying the

“Missing operating system” message. A dead CMOS battery can also cause this because it will lose or corrupt the stored drive translation and transfer mode parameters. In fact, in my experience a dead battery is one of the more likely causes. To repair this problem, check and/or replace the CMOS battery, run the BIOS Setup, go to the hard drive parameter screen, and enter the correct drive parameters. Note that most drive parameters should be set to auto or auto-detect.

- **The drive is not yet partitioned and formatted on this system.** This is a normal error if you try to boot the system from the hard disk before the OS installation is complete (such as if you replace the laptop’s original hard disk with a larger model or if you have removed the original partitions with FDISK). Boot to an OS startup disk (floppy or CD) and run the Setup program, which will prompt you through the partitioning and formatting process during the OS installation.
- **The MBR and/or partition tables are corrupted.** This can be caused by boot sector viruses, among other things. To repair with Windows 9x, cold boot (power off, then on) the system from a known noninfected, write-protected floppy or bootable CD containing the FDISK program (preferably Windows 98 or later). Enter **FDISK /MBR** at the command prompt, which will recopy the MBR code but not alter the partition table. Reboot.

With Windows 2000/XP, select the Recovery Console option at startup (you might need the original Windows 2000 or XP CD-ROM) and run **FIXMBR**, followed by **FIXBOOT**. Reboot the system.

If the message still persists and you need to recover the data on the drive, you will then either need to rebuild the partition tables from scratch using a third-party utility such as the DISKEDIT program included with the Symantec Norton Utilities, or hire a data-recovery specialist who can do this for you. If you don’t need to recover the data on the drive, simply reinstall the OS from scratch, which will prompt you through partitioning and formatting the drive.

- **The VBR is corrupted.** To repair with Windows 95/98/Me, secure a bootable floppy created by the same OS version on the hard disk that contains the SYS command from that OS. Run **SYS C:**, which will recopy a good VBR and system files to the volume. For Windows NT/2000/XP, you can use the Recovery Console or DiskProbe utility (found on the bootable operating system CD).
- **You have a nonbootable floppy or CD in the system.** Remove any floppy disks or CDs present in the laptop and reboot the system.

The power button won’t turn off the system.

Most recent laptop systems are configured to shut down automatically when you exit Windows. However, you sometimes need to shut down the system manually. There are several possible reasons why the power button might not shut down the system. Check the following before you consider sending the system in for service:

- **Buggy system BIOS**—Reflash the BIOS with a different version. If you are using the most recent BIOS version, go back to the previous version if possible.
- **Power-management problems**—Some systems might not implement power management properly. Make sure the system is set to shut down when you push the power button; some systems might be configured to go into a sleep mode instead.

Note

The freeware **Shutdown.exe** utility can be used to force laptop and desktop computers running Windows XP to shut down, log off the current user, hibernate, stand by, or restart. **Shutdown.exe** runs from the command line and can be used if the normal shutdown menu options don't work or the power button doesn't work correctly. You can get it from www.budja.com/shutdown/.

If you need to remove the battery or use the reset button to shut down/restart the system, it is a good idea to run ScanDisk (found in the Windows Accessories, System Tools folder) in Windows 95/98/Me/NT/2000 or CHKDSK in Windows XP to check and correct any file system issues after a forced shutdown.

Note that some laptop computers have both a power and a sleep button. Make sure you use the correct button for the task you want to perform.

Windows Problems

Many problems with both laptop and desktop computers are caused by the operating system. The following subsections provide useful tips for dealing with typical problems caused by Windows.

I see a "STOP" or "STOP ERROR" in Windows 2000/XP.

Many different things, including corrupted files, viruses, incorrectly configured hardware, or failing hardware, can cause Windows STOP errors. The most valuable resource for handling any error message displayed by Windows is the Microsoft Knowledge Base (MSKB), an online compendium of over a quarter of a million articles covering all Microsoft products. You can visit the MSKB at support.microsoft.com, and from there you can use the search tool to retrieve information specific to your problem.

For example, say you are receiving "Stop 0x0000007B" errors in Windows XP. In that case you would visit the MSKB at the address listed and enter the error message in the search box. In this case, I entered "stop 7B error Windows XP" in the box, and it returned two articles, one of which was Microsoft Knowledge Base Article number 324103, titled "HOW TO: Troubleshoot 'Stop 0x0000007B' Errors in Windows XP." Following this link I was taken to the article at support.microsoft.com/default.aspx?scid=kb;en-us;324103, which had a complete description of the problem and possible solutions. The article states that this error could be caused by one of the following:

- Boot-sector viruses
- Device driver issues
- Hardware issues
- Other issues

The article proceeds to explain each issue and solution in detail. All things considered, the MSKB is a valuable resource when you are dealing with any problems related to or reported by any version of Windows or any other Microsoft software.

Note

The symptoms of a virus/spyware infection can appear to be caused by damaged hardware, a malfunctioning installation of Windows, or both. Before disassembling a laptop to check for hardware problems, check the system using antivirus and antispyware software.

I have an old software program that crashes when I try to run it in Windows XP.

Some software programs that were designed for older versions of Windows experience problems when running under Windows XP or Windows XP with Service Pack 2 installed. A workaround you can use in the case of the former is the Program Compatibility Wizard, which can be found on the Start menu under Accessories. Optionally, you can right-click on a program's shortcut, select Properties from the menu, and choose the Compatibility tab.

You can choose to run a program in Windows 95, Windows 98/Me, Windows NT (SP5), and Windows 2000 compatibility modes. Select the mode that matches the program you're trying to run. If the program still won't run, try disabling your antivirus and antispyware programs before launching the program in compatibility mode.

I installed a new device driver for a hardware item, and now Windows XP is crashing or locking up.

If you know which device driver is causing the problem, you can revert back to the previous driver by using the Device Driver Roll Back feature in Windows XP. To do this, open the Control Panel and double-click on the System applet icon. Select the Hardware tab and click on the Device Manager button.

Open the hardware category that the device driver applies to and double-click on the device. Select the Driver tab and click on the Roll Back Driver button. Windows will replace the new driver with the last version.

I see "Fatal Exception" errors in Windows 9x/Me.

A "Fatal Exception" error is the equivalent of the STOP error in Windows 2000/XP. As indicated in the previous answer, this error can be caused by hardware and/or software problems, and the best place to check for specific solutions is in the Microsoft Knowledge Base (MSKB) at support.microsoft.com.

The system won't shut down in Windows.

Shutdown problems are another example where the MSKB comes to the rescue. By searching for "shutdown problems Windows XP," for example (substitute the version of Windows you are using), you will quickly find several articles that can help you troubleshoot this type of problem. This problem has been caused by bugs in motherboard ROM (try upgrading your motherboard ROM to the latest version), bugs in the various Windows versions (visit www.windowsupdate.com and install the latest fixes, patches, and service packs), or in some cases configuration or hardware problems. I'll defer to the MSKB articles for more complete explanations of the Windows issues.

Note that problems with system software can also cause shutdown problems. Media players and other programs that run in the background might prevent proper shutdown. Use MSConfig to selectively disable these programs at startup or manually close them down before you shut down the computer.

If your laptop uses Windows 98/Me/XP, you can use MSConfig to selectively turn off some startup programs or services as part of the process of determining the cause of a computer that won't shut down.

I can't find drivers for my hardware.

Unlike desktop computers, whose hardware components are usually supported by the individual vendors, laptop computers' onboard components (video, network, modem, CD/DVD-ROM drive, audio, and so on) are supported by the laptop computer vendor. In many cases, laptop vendors provide driver software only for the version of Windows supplied with the system. Although upgrading to a

newer version of Windows will usually work well because newer Windows versions are distributed with more hardware drivers, attempting to install an older Windows version can be difficult, especially if you don't know which drivers you need to acquire.

Even if you plan to reinstall the same version of Windows on your system, driver problems can still make the installation difficult if your system was shipped with a restore CD instead of a full version of Windows. A restore CD contains an image of your operating system and the drivers for the standard hardware installed in your system. Some laptop vendors don't do a good job of making driver updates easy to locate on their websites, so if you don't use the restore CD to reinstall Windows, you might not have all the drivers you need for your system.

Whether you plan to reinstall the same version of Windows, some other version of Windows, or another operating system, take these precautions:

- Use the Windows Device Manager to determine the makes and models of the internal hardware in your system, such as the chipset, modem, network adapter, video chip, optical drive, and so on.
- Download the drivers for the version of Windows (or other operating system) you want to install from your vendor if possible. Use a website search engine such as Google to track down drivers for your system if your vendor doesn't have the drivers you need. Note that in some cases the laptop vendors might post a collection of drivers in a single archive rather than individual driver files. For example, Compaq (now owned by Hewlett-Packard) calls its driver sets SoftPaqs.
- Consider creating a dual-boot configuration that enables you to continue running your existing operating system as well as providing space for another operating system. You can use a partitioning program such as Norton Partition Magic, which is now available from Symantec at www.powerquest.com/partitionmagic, to free up the space. Partition Magic also includes a boot manager (a program that enables you to choose which operating system to run when you start your computer).
- Keep in mind that you are responsible for supporting your laptop yourself when you install another operating system. Many vendors won't help you if you install a different version of Windows (or another operating system such as Linux). Research any installation you plan to do carefully. By using a website search engine such as Google, you might find a user-created page that has links and notes about the laptop computer you have and the operating system upgrade you're preparing to perform.
- You might need to use "generic" drivers that aren't necessarily optimized for your particular hardware. Laptop vendors often make changes to basic OEM-provided drivers or use customized hardware components, so a driver provided by an OEM (or an open-source driver for Linux) might not have all the features the original driver for your hardware provided or might not fully support your hardware.

Hardware Problems

Laptop hardware is different in many ways from desktop hardware, as you learned earlier in this chapter. Use these tips to deal with some of the most common problems.

The dial-up modem doesn't work.

First, verify that the phone line is good and that you have a dial tone. Then check and, if necessary, replace the phone cable from the modem to the wall outlet. The next steps to take depend on the type of modem in use. Laptop computers could use any of the following types of modems:

- Modems built in to the motherboard.
- Modems (often combined with 10/100 Ethernet networking) installed in a Mini PCI card slot. These resemble built-in modems because the RJ-11 port is built in to the computer, but a Mini PCI card can be removed, usually by removing a cover on the bottom of the computer.
- Modems installed in a PC Card or CardBus slot. These cards might also contain 10BASE-T or 10/100 Ethernet ports.
- Modems that plug into a USB or serial port.

If the modem is integrated into the motherboard, check the BIOS Setup to see that the modem is enabled. Note that some laptops use a Windows-based BIOS configuration program. Try clearing the extended system configuration data (ESCD) option in the BIOS Setup if this option is available. This will force the Plug and Play routines to reconfigure the system, which may resolve any conflicts. If the modem is internal, and you aren't using the COM (serial) ports integrated into the motherboard (as for an external modem), try disabling the serial ports to free up additional system resources.

If the modem is part of a Mini PCI card, remove and reinstall the card to make sure it makes a good connection. If the Mini PCI card also contains a 10/100 Ethernet port, make sure the network port is working. If neither the modem nor the network port works, the card or the slot has failed. Use an identical known-working Mini PCI card as a replacement to determine where the problem lies.

Note

Although Mini PCI is a standard interface, in reality, Mini PCI cards are custom designed for the requirements of a particular OEM. Use a Mini PCI card from the same or similar model of laptop as a replacement if possible; Mini PCI cards are not yet sold in retail stores.

If the modem is plugged into a PC Card or CardBus slot, try the other slot if the computer has two slots. If the PC Card or CardBus modem card uses a dongle (a proprietary cable that runs between the card and a standard telephone line or jack), make sure the dongle is tightly attached to the card and to the telephone line or jack. Test the dongle with a multimeter set to CONT (continuity) if you can obtain a pinout to verify the dongle is working properly. Try a known-working replacement dongle from the same or similar model of PC Card (some PC Card dongles can also be obtained from third-party parts sources). If the dongle is damaged or defective, the modem cannot work. If the card also contains a network adapter, make sure the network adapter works. If neither the network adapter nor the modem works, the card or the PC Card/CardBus slot might be defective.

If the modem plugs into a serial or USB port, make sure the port has not been disabled and works correctly. If a USB port works with a mouse or other device, it can also support a modem. Most external modems require a separate AC power source, so make sure the modem is plugged into a working AC power source and that the modem is turned on. Make sure the modem is properly connected to the serial or USB port on the laptop. Try replacing the external modem power brick and the serial/USB cable.

Try removing and reinstalling the modem drivers, making sure you are using the most recent drivers from the modem manufacturer. If the modem is identified as a standard modem, download model-specific drivers from the modem vendor.

Note that modems are very susceptible to damage from nearby lightning strikes. Consider adding lightning arrestors or surge suppressors on the phone line running to the modem and unplug the modem during storms. If the modem has failed after a storm, you can be almost certain that it has been damaged by lightning. It is possible that in addition to the modem, the strike may have

damaged the serial port or motherboard. Any items damaged by lightning will most likely need to be replaced.

The keyboard doesn't work.

Try attaching an external keyboard, either via a standard keyboard port (usually called a *PS/2 port*) or via USB. If this works, the internal keyboard may be defective or have a bad connection. Try removing and reinstalling the internal keyboard; if that doesn't work, replace it.

Depending on the laptop model in question, removing the keyboard can be simple or more complex. In some cases, you can lift the keyboard free of the system by removing a couple of screws on the bottom of the case to enable the top of the bezel around the keyboard to be removed; on some systems with a snap-apart case, you release the bezel with a flat-bladed screwdriver or special case-removal tool. With other models, additional steps might be necessary.

To determine which steps are necessary, check the notebook computer vendor's website for repair (subsystem tear-down and replacement) documentation. I like to use the Google search engine's site-specific search feature. For example, I might use the following search in Google:

Compaq "Maintenance and Service" site:Compaq.com

Google displays all maintenance and service pages on the Compaq website. These pages provide details of disassembling various Compaq laptop computers for service and repairs. Even if the exact model you want to disassemble isn't listed, you might be able to find information about a similar model.

If you are unable to locate repair information, try to determine the identity of the actual OEM vendor (see Chapter 17 for vendor names and websites) from product reviews or other sources and see if you can get the information needed from the OEM vendor.

Tip

Another way to determine how to remove the keyboard is to check the documentation provided by third-party hard disk upgrade vendors such as SimpleTech (www.simpletech.com) and Apricorn (www.apricorn.com). Although you can remove many laptops' hard disks through the bottom of the case, some models require you to remove the keyboard to access the hard disk. A hard disk upgrade kit built for your specific model of laptop will include instructions for removing and installing the drive; the vendors listed post this information online for the models they support.

Be very careful when you work with the integrated keyboard. A fragile ribbon cable is often used to connect the keyboard to the motherboard; if this cable is loose or damaged, the keyboard will malfunction. If the system was serviced just before the keyboard malfunctioned, contact the servicer for help. The service technician might not have reconnected the keyboard cable or might have damaged it.

The mouse pointer is moving when I didn't move it.

If you have this problem on a system with an integrated pointing device (touchpad or pointing stick), there are several possible reasons for this problem:

- Defective cap on the pointing stick (TrackPoint and so on)
- Defective pointing stick (TrackPoint and so on)
- Accidental tapping of the pointing stick or touchpad
- Defective touchpad

To solve this problem, you should first determine whether your laptop uses a touchpad or a pointing stick (such as the IBM TrackPoint or Toshiba AccuPoint). If your laptop uses a pointing stick, try replacing the cap over the pointing stick (see Chapter 13, “Keyboards and Pointing Devices,” for sources for replacement TrackPoint III/IV caps, which also work on earlier TrackPoint keyboards and the Toshiba AccuPoint).

If the pointer continues to drift on its own after you replace the TrackPoint/AccuPoint cap, replace the keyboard. The pointing stick is built in to the keyboard. If you experience pointer drift with a system using a touchpad, replace the touchpad (usually a different subassembly than the keyboard).

However, before you jump to conclusions about pointer drift, watch your typing! It’s very easy to bump a touchpad with your thumbs while you’re typing; most touchpads are so sensitive that you might not even notice when your thumbs or fingers brush the surface. A pointing stick can also be bumped accidentally, but in my experience it’s harder to overlook the fact you nudged it when typing.

If you’re still not sure you’re having real problems with your system’s touchpad, put cardboard over it and work with keyboard commands for a while. If your cursor always stays where it’s supposed to, you’ve been bumping the touchpad without realizing it. However, if the cursor is still roving when you can’t touch the touchpad, it’s time for a touchpad replacement.

If you prefer to use a separate pointing device that’s plugged into the computer’s PS/2 or USB port, you might want to disable the built-in touchpad or pointing stick with the laptop’s BIOS Setup or Windows-based configuration program. Although some systems automatically disable the onboard touchpad or pointing stick when you plug in an external pointing device, others don’t.

Tip

Some late-model IBM laptops feature both a touchpad and a TrackPoint pointing stick. You can use both, or disable one or the other, through the Windows-based configuration utility.

I can’t hear any sound from the speakers.

This problem can often be as simple as the volume controls being turned down, so don’t overlook the obvious and check to be sure! Check the system volume control as well as the volume controls in Windows or your application to ensure they are turned up and not muted. When you are sure the volume is turned up, check the internal connections. If that doesn’t help, try reconfiguring the integrated sound or updating the drivers.

The monitor appears completely garbled or unreadable.

If you have an external monitor plugged into a notebook computer, a completely garbled screen is most often due to improper, incorrect, or unsupported settings for the refresh rate, resolution, or color depth. Using incorrect drivers as well can also cause this. To check the configuration of the card, the first step would be to power on the system and verify whether you can see the POST or the system splash screen on the monitor and then enter the BIOS Setup. If the screen looks fine during the POST but goes crazy once Windows starts to load, then almost certainly the problem is due to an incorrect setting or configuration of the card. To resolve this problem, boot the system in Windows Safe Mode (hold down the F8 function key as Windows starts to load). This will bypass the current video driver and settings and will place the system in the default VGA mode supported by the BIOS on the video card. When the Windows Desktop appears, you can right-click the Desktop, select Properties, and then reconfigure the video settings or change the drivers as necessary.

If the problem occurs from the moment you turn on the system—and even, for example, if you boot to a DOS floppy, such as a Windows 98 startup floppy—you definitely have a hardware problem with most likely either the video circuit cable, or monitor. First, try replacing the monitor with another one; if the cable is detachable, try replacing that too. If replacing the monitor and cable does not solve the problem, most likely the video circuit in the laptop is defective. Because laptops use integrated video or a discrete chip built in to the motherboard, you will need to service or replace the unit.

The system runs fine for a few minutes but then freezes or locks up.

The system freezing or locking up is the classic symptom of a system that is overheating. Most likely, it is the CPU that is overheating, but it can also be other components such as the video card or motherboard chipset. If the system is brand new, it is possible that the design is insufficient for proper cooling, and a replacement heat spreader or other solutions may be required. If the system is one that was working fine but now is exhibiting the problem, check to see whether the problem started after any recent changes were made. If so, determine whatever change could be the cause of the problem. If not, most likely something such as a cooling fan has either failed or is starting to fail.

Tip

Cooling fans are often controlled by the system BIOS. If you flash update your laptop's BIOS and notice that your system's cooling fan is running erratically or not at all, the BIOS update is a likely culprit.

If a laptop system locks up when additional memory is installed, the additional heat from the memory module might appear to be the cause, but in reality the problem could be that the system wasn't designed with adequate thermal protection.

When the processor's heatsink or the system's heat spreader is removed and better thermal transfer material is applied between the processor and the heatsink or the heat spreader and hardware, many of these systems run reliably with both standard and additional amounts of memory installed. With some models, a firmware and keyboard driver upgrade also improves system cooling (the keyboard driver helps control the power-management features of many typical laptops). Make sure the fan built in to your laptop is spinning: Use your hand to make sure there's airflow. These fans are very small and virtually silent in normal operation. If the laptop's fan is making grinding or growling noises, it is probably experiencing bearing failure. Note that many newer systems have thermostatically controlled fans. In these systems, it is normal for the fan speeds to change with the temperature. Make sure the chassis is several inches from walls and that the fan ports are unobstructed. I also recommend raising up all four corners of the laptop to improve airflow underneath the unit. If your laptop doesn't have swing-out legs, you can get additional supports or cooling devices from a variety of vendors.

If your laptop has a socketed processor, you can try to improve cooling by removing and reseating the processor. Reinstall the CPU heatsink or system heat spreader with new thermal-interface material; many users prefer to use silver-based thermal material to provide better heat transfer. Check the power adapter for correct voltage and make sure the battery doesn't overheat when charged. Try replacing the power adapter with a high-quality replacement or a known-good spare.

I am experiencing intermittent problems with the hard drive(s).

Most systems use ATA (AT Attachment, commonly called *IDE*) interface drives, which consist of a drive and integrated controller, a ribbon cable, and a host adapter circuit in the motherboard. Most often intermittent problems are found with the cable and the drive; it is far more rare that the host adapter will fail or exhibit problems. Many problems occur with the cables. The laptop version of the ATA drive uses a 44-pin connector that integrates power and data connectors.

Check the cable to be sure it is not cut or damaged, and try unplugging and replugging it into the drive and motherboard. If replacing the cable does not help, try replacing the drive with a spare, installing an OS, and then testing it to see whether the problem remains. If it does, the problem is with the motherboard, which will most likely need to be replaced. If it doesn't, the problem was most likely with your original drive. You can simply replace it or try testing, formatting, and reinstalling to see whether the drive can be repaired. To do this, you will need the low-level format or test software provided by the drive manufacturer. These programs can be downloaded from the drive vendors' websites.

The system is experiencing intermittent memory errors.

If the memory was recently added or some other change was made to the system, I would suggest undoing that addition/change to see whether it is the cause. If it's not, try removing and reseating all memory modules. If the contacts look corroded, try cleaning them with contact cleaner and then apply contact enhancer for protection. Check the memory settings in the BIOS Setup; generally, all settings should be on automatic. Try upgrading to the latest BIOS for your motherboard. Try removing all memory except one bank. Note that if the laptop doesn't have removable memory, you need to service the system if the memory displays errors. If the system has removable memory, replace the module with a new or known-good spare.

If you get this far, the problem is most likely either the motherboard or the power supply, or possibly some other component in the system. Try removing other components from the system to see whether they are causing problems. Try reseating the CPU. Try replacing the power adapter with a known-good spare.

I installed a 60GB drive in my system, but it is recognizing only 8.4GB.

Motherboard ROM BIOSes have been updated throughout the years to support larger and larger drives. BIOSes older than August 1994 will generally be limited to drives of up to 528MB, whereas BIOSes older than January 1998 will generally be limited to 8.4GB. Most BIOSes dated 1998 or newer will support drives up to 137GB, and those dated September 2002 or newer should support drives larger than 137GB. These are only general guidelines. To accurately determine this for a specific system, you should check with your motherboard manufacturer. You can also use the BIOS Wizard utility from www.unicore.com/bioswiz/index2.html. It will tell you the BIOS date from your system and specifically whether your system supports the Enhanced Disk Drive specification, which means drives over 8.4GB.

If your BIOS does not support EDD (drives over 8.4GB), you have two possible solutions:

- Upgrade your motherboard BIOS to a 1998 or newer version that supports sizes larger than 8.4GB.
- Install a software patch to add support for sizes larger than 8.4GB. Vendors that supply replacement drives for laptops usually provide these software patches as part of the installation kit.

Of these possible solutions, the first one is the most desirable because it is normally free. Visit your motherboard manufacturer's website to see whether it has a newer BIOS available for your motherboard that will support large drives. I almost never recommend the software patch solution because it merely installs a special driver in the boot sector area of the hard drive, which can result in numerous problems when booting from different drives, installing new drives, or recovering data.

The 137GB barrier is a bit more complicated because there are not only BIOS issues but also operating system and chipset-based ATA host adapter driver issues as well. Drives larger than 137GB are accessed using 48-bit logical block address (LBA) numbers, which require BIOS support, chipset driver support,

and operating systems support. Generally, you will need a BIOS with 48-bit LBA support (normally dated September 2002 or newer); the latest chipset driver, such as the Intel Application Accelerator (for motherboards using Intel chipsets; go to www.intel.com/support/chipsets/iaa); and Windows XP with Service Pack 1 (or later) installed. The original version of XP and Windows 2000/NT and Windows 95/98/Me do not currently provide native support for hard drives that are larger than 137GB.

If you have a system without BIOS support, check with your motherboard manufacturer for an update. If your motherboard uses a non-Intel chipset, check with the motherboard or chipset manufacturer for driver updates to enable 48-bit LBA support.

My CD-ROM/DVD drive doesn't work.

The CD/DVD drive is one of the more failure-prone components in a laptop. It is not uncommon for one to suddenly fail after a year or so of use. If the drive plugs into a swappable drive bay, remove and reinstall the drive. If the drive is built in to the system, open the system (if possible) and make sure the drive is properly plugged into the system. Make sure the BIOS Setup is set properly for the drive and verify that the drive is detected during the boot process. Finally, try replacing the drive and, if necessary, the motherboard. If the drive has already been installed and was working before, first try reading different discs, preferably commercial stamped discs rather than writeable or rewriteable ones. Then try the preceding steps.

Note

If a rewritable CD or DVD drive reads media but can't write to the media, make sure the CD or DVD creation software you are using supports the drive. If you are not using the software provided with the system, you might need to download updates from the software vendor to enable support for your drive. If you are using Windows XP, you can have problems if Windows XP is configured to handle the drive as a rewritable drive and you are also using third-party software. To disable Windows XP's own recording feature, right-click the drive in My Computer, click the Recording tab, and clear the check box next to Enable CD Recording for this drive.

My USB port or device doesn't work.

Make sure you have enabled the USB ports in the BIOS Setup. Make sure your operating system supports USB; Windows 95 Version A and NT do not, whereas Windows 98 and later do have USB support. Try removing any hubs and plugging the device directly into the root hub connections on your system. Try replacing the cable. Because many USB devices require additional power, ensure that your device has an external power supply connected if one is required. Then try replacing the computer's power adapter.

Tip

If you want to use a hub with USB devices, I recommend using a generic hub that has its own AC power source (a self-powered hub). Self-powered hubs provide a full 500mA of power for each USB port, but bus-powered hubs provide only 100mA of power (or less) per port. Therefore, a self-powered hub can be used with devices that require more power than a bus-powered hub can provide.

If the laptop has USB 2.0 (Hi-Speed USB) ports, but they aren't recognized as Hi-Speed USB ports by external hard or optical drives designed for Hi-Speed USB, make sure you have done the following:

- Enabled Hi-Speed USB (USB 2.0) support in the system BIOS.
- Installed the correct Hi-Speed USB (USB 2.0) drivers for the chipset and version of Windows in use.

I installed an additional memory module, but the system doesn't recognize it.

Verify that the memory is compatible with your laptop. Many subtle variations on memory types that may appear to be identical on the surface can cause a memory module to be incompatible with a given system. Just because the memory module will fit in the slot does not mean it will work properly with your system. Check your laptop manual for the specific type of memory your system requires and possibly for a list of supported modules. You can visit www.crucial.com and use its memory selector to determine the exact type of memory for a specific system or motherboard. Also note that all motherboards have limits to the amount of memory they will support; many boards today will support only up to 512MB or 1GB. Again, consult the motherboard manual or manufacturer for information on the limits for your board. If you are sure you have the correct type of memory, follow the memory troubleshooting steps listed previously for intermittent memory problems.

While I was updating my BIOS, the system froze and now the system is dead!

This problem can occur when a flash ROM upgrade goes awry. Contact the laptop vendor to determine if your system supports a feature called BIOS recovery or if you need to return your laptop for service. BIOS recovery is designed to reflash the BIOS from an image file on a floppy disk, depending on the system. Unlike the BIOS recovery feature found on some motherboards (in which a motherboard jumper is moved to enable this option), the few laptop systems that support this feature typically use special keystroke combinations.

As an alternative to returning your system to the vendor for a replacement BIOS in the event of a failed BIOS flash update, you can contact ACS Computer Services for its LaptopBIOS repair/recovery service (www.laptopbios.com). Prices range from about \$100 to \$130. This option is considerably less expensive than returning a typical system to the vendor for a nonwarranty repair.