

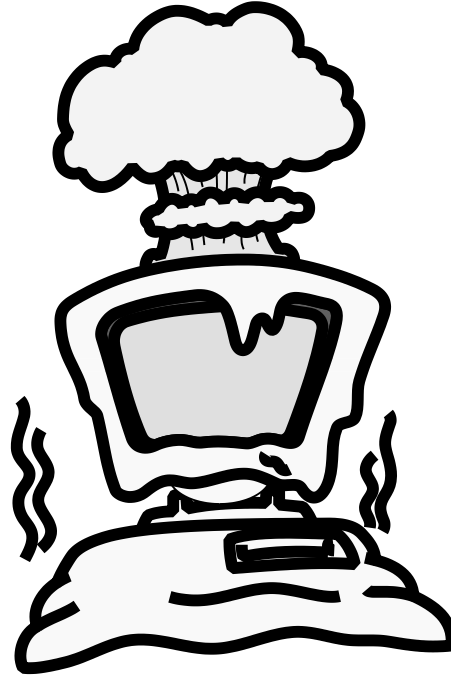
"The first rule to tinkering is to save all the parts." - Paul Erlich

# Chapter 12: Hardware Troubleshooting

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When faced with a computer problem, the first thing to determine is whether we actually need to solve the problem, or just get the system going again. This may sound like a cop-out, but the fact is many times the best handling for a computer failure is just to reboot and forget about it.

For instance, many soft errors are caused by cosmic rays. These are completely random, and that same exact error will probably never occur again. Trying to pinpoint the error is fruitless, because the memory will test 'good'. The best course of action is to reboot and get on with the show. Of course there are such things as intermittent errors, so if it happens repeatedly you will want to track down the source of it.



# HARDWARE VS. SOFTWARE

Once you've decided that there really is a problem, you've reached a fork in the road. Is it a hardware problem or a software problem? If you knew exactly what was causing the problem this would be an easy question to answer, but usually at this stage you won't know. However, you must decide what to pursue first, and if you guess wrong the result at best will be a lot of wasted time.

This is where a good diagnostic program like Micro-Scope really comes into its own. In just a couple of minutes you can test all of the major hardware components and either narrow the problem down to one of them for further testing, or eliminate hardware as the source of the problem. If you have eliminated hardware as the cause, then the problem must be software. Elementary, my Dear Watson!



*O/S Independence is what makes Micro-Scope so powerful.*

One thing to be aware of when running a diagnostic program is that most of them are loaded under either the DOS or Windows operating system. As you will see in Volume 3, these operating systems are designed to handle all sorts of hardware management details in the background so that the user and the applica-

tion do not have to deal with them directly. This is normally very convenient, but not exactly what you want when trying to test the hardware. And if the problem lies with the operating system itself, one of these diagnostics may have a very difficult time sorting out whether it's really a hardware or software problem, if indeed the diagnostic will run at all.

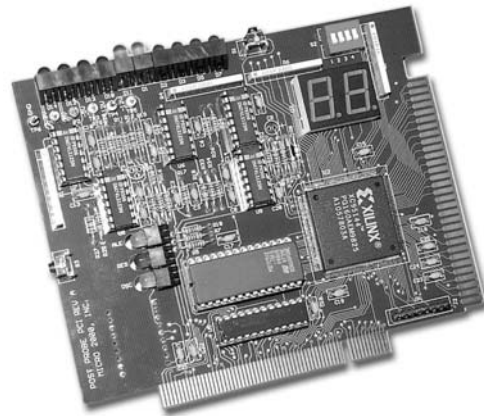
The answer to eliminating interference from the operating system is to use a diagnostic that is Operating System Independent. Such a diagnostic actually has its own operating system just to run the diagnostic, and this operating system will be designed to give the user and the diagnostic application direct access to the hardware, rather than trying to shield them from it.

To load an OS-independent diagnostic, you will need to turn off the system, put the diagnostic disk in the floppy drive or CD, and then turn the system back on. It will boot up with the diagnostic's OS in charge rather than DOS or Windows.

By the way, there is one pattern that is usually hardware-related, and that is a system that boots up just fine in the morning and works for a few minutes before crashing. Then it must be turned off for a while before it can boot up and run for a few more minutes. The problem here is probably heat, and the most likely culprit is a failing CPU fan. If the fan checks OK then make sure the vents are not blocked, either from something next to the cabinet or internally from dust.

# POST READERS

Sometimes the hardware will be damaged in such a way that the computer will not boot up at all, even to a diagnostic floppy with its own operating system. On the bright side, at least we can be positive in this situation that the problem is with hardware and not software. On the downside, we have no way to run diagnostic tests and if we can't figure out which part is failing, what we have on our hands is no longer a computer but a very expensive doorstop.



*Micro 2000's Universal POST Probe.*

As it turns out, there is some data we can use to figure out what is going on. You will recall from Chapter 2 that in addition to the bootstrap loader stored in the ROM BIOS, there is a set of instructions called the POST, or Power On Self Test. These instructions test various parts of the computer hardware, and they execute before the bootstrap loader does. If the computer can't boot up, it's safe to say that it failed to pass the POST. All we need to do is find out where during the POST it halted, and what it was testing at that step.

Fortunately, at each step of the POST it puts a byte of data out to a special port, and this data is different for each step. This makes a code that we can use to determine which test the POST was trying to do when it stopped.

Reading the data on that port requires the use of a special card called a POST Reader that is plugged into the bus. There are different versions of the card for the different types of bus. Some plug into the ISA bus, some into the PCI bus, and if you're troubleshooting an MCA system of course you'll need one that can plug into the MCA bus. There is even one called the 'Universal POST Probe' that can be used in all three (with an adapter for the MCA bus). This one is made, amazingly enough, by Micro 2000, the same company that produces the Micro-Scope diagnostic and this A+ course you are reading.

Whichever type you use, they all function in about the same way. A two-digit display will show the code that is currently on the bus. It would be nice if every BIOS version used the same codes, but they don't. The codes were put there not for troubleshooting hardware but for the benefit of the programmers writing the POST program, and each manufacturer uses their own sets of codes for the different BIOS versions they make. To interpret the code, you must know the make and version of BIOS being used, and then look up the code in a table for that particular BIOS. The tables are usually provided in the manual for the POST reader card.

Many POST routines will also put out beeps for different errors, but again the pattern of beeps for a particular error is unique to that BIOS and must be looked up in a table. The only point of agreement is that most BIOS versions will put out a single beep to indicate successful completion of the POST.

## TOOLS

Working on PCs in the field and working on PCs in the shop obviously have different requirements. In the field, what are usually needed are just the tools to open the case and remove the defective adapter board or device. A minimum set of tools to accomplish this might even be carried in a pocket. If you can carry a larger, heavier toolkit then more of the repairs can be completed in the field.



We will divide the tools into two lists, one for the minimum kit and another for the expanded kit.

### Minimum Toolkit

small flashlight	small common screwdriver
small Phillips screwdriver	needle-nose pliers
wire stripper/cutter	3/16" and 1/4" nut drivers
small multi-meter	ESD wrist-strap
small brush, soft-bristled	diagnostic diskette
hobby knife or one-edge razor blade	boot disk (see Vol. 3)
pencil and paper	

These tools will get you through many if not most field repair situations. If you can afford the expense and bulk, any of the tools listed below will also come in handy sooner or later.

## Expanded Toolkit

This includes everything on the basic list, plus these items:

POST reader card	can of compressed air
clean cloth	spray bottle
small bottle of detergent	slip-joint pliers
small diagonal cutting pliers	scissors
hemostat	pick-up claw
large common screwdriver	chip extractor
file	hand-held vacuum
soldering iron	braided solder wick
cable ties	heavy rubber gloves
Torx drivers (for Compaq cases)	hi-voltage probe
110V outlet tester	extension cord
test leads, 2+ with clips on both ends	anti-static spray
clip-on heat sink (can use hemostats)	
loopback plugs (9-pin & 25-pin female, 25-pin male)	
solder sucker (spring loaded, not squeeze-bulb)	

There may be other tools and supplies that you come to find indispensable. I know technicians who won't leave the office without a roll of duct tape and a Leatherman multi-purpose tool, and not much else. God bless 'em. Every technician develops their own style and that applies to tools as well. Just make sure you become familiar with each of the ones listed here and would recognize a use for it when it happens.

## Virus Protection

There is one 'tool' that is designed to prevent problems before they happen. I'm talking about Anti-virus Software. Yes, I realize it's not hardware, but if a virus trashes your master boot sector, believe me, you have a hardware problem.



Technically, a Virus is a piece of computer code that can make copies of itself, usually for the purpose of filling up your memory or hard drive. In practice, the term is used to describe any unwanted programs that can do nasty things to your system after hitchhiking there on e-mail, or on a floppy drive. A good anti-virus program tries to protect you from all of these, and I would heartily recommend their use on any system unless it's locked in a room with no connection to the outside world.

These destructive hitchhikers are becoming more of a problem as computers become more widespread and more connected. They are created by people, mostly young men, who are clever with computers but not very smart in the ways that really count.

# Preventive Maintenance

Of course virus protection is not the only thing you can do to stop problems before they start. In Volume 1 we discussed the hazards of dust and heat, and the importance of keeping cables out of harms way.

Vibration, from fans and other sources, is also a problem. Cable connectors and adapter cards can work loose and no longer make good contact with the bus. Whenever you have a case open, a quick visual check and maybe your thumbs applied to the top of adapter cards and memory modules will avoid the necessity of opening that case again anytime soon.

Speaking of connectors, tarnish can prevent a good electrical connection, and can be easily handled with the right solvent. Get one that's labeled as a 'contact cleaner', and if in doubt about its use or safety, look up the Material Safety Data Sheet (MSDS) for that solvent or cleaner.

Contact cleaner can come in handy on cable connectors, the contact pins on adapter cards and memory modules, or anywhere two metal surfaces meet to pass an electrical current.

There are also several preventive measures involving software rather than hardware, but we will be covering those in th enext volume.

## Look and Listen

It's been said before that the most important tools a technician has are his or her eyes and ears. Actually, these are second and third in importance. The most important tool is the mind, and these three tools in combination will solve a majority of computer problems. For example, when a computer boots up, the activity light on the front of the hard drive will flicker, and at the same time you should be able to hear the smooth whir of the drive as it spins.

If it doesn't whir and the light doesn't flicker, we have problems. The next step would be to listen for the cooling fans. If these aren't spinning either, it's a power problem. If the cooling fans are going but the hard drive isn't, open up the case and check the power cable to make sure it's firmly attached to the drive. On the other hand, if the drive was spinning but no activity light, we would check the ribbon cable instead.

By the way, this involves a fourth tool, the sense of touch. A huge number of computer problems have been fixed by the technician making sure there was a snug connection for all of the memory modules, adapter cards, cables and so forth. Often we won't even be sure which connection was at fault, but the problem is gone just the same. And the process so far has involved our senses and a little bit of thinking, but not a single meter or soldering iron. Of course we might have used a screwdriver to open the case, but you understand the point, I'm sure.

On the subject of listening, if you ever listen to the hard drive and instead of making a smooth whir it sounds like somebody dropped in a handful of gravel, you are hearing something called a head crash. The sooner you turn off the machine, the more likely that a data recovery lab will be able to salvage something from that drive, but don't just cross your fingers and hope it will get better because it won't.

Many parts of the computer don't make any sound, but the visual check is still important. With adapter cards of any kind, inspect the edge connector and also look in the bus slot for bent pins. On older motherboards many settings are made with jumpers rather than in the CMOS, and you should be familiar with these so you can tell if a jumper has fallen off.

With peripherals and ports of any kind, cables are prime suspects. Look at the connectors on the cable itself and also on the computer and the peripheral. Inspect the cable for any kinks, which are always a sign of trouble. Often enough though, a defective cable won't have any visual indication. Swapping with a cable that is known to be good is a quick elimination step.

**CHAPTER 12**

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