WHATEVER AILS YOUR PC.

Someday your PC will let you down. Don't let the machine's sophistication—or a repairman—intimidate you. Armed with the information in the following five articles, you needn't be helpless when your system fails.

Photography: Dennis Kitchen Diagrams: Andre Duzant


COMPUTER UNIVERSITY
on the recommendation of the faculty in recognition of the completion of the prescribed course in the
School Of Arts And Cybernetics
has conferred upon
Hans Ahn
the degree of
Doctor Of Computer Psychology
with all the honors, rights, and privileges belonging thereto.
In witness whereof this diploma has been signed by the duly

MAINTAIN YOUR SANITY: MAINTAIN YOUR DISK DRIVES

HENRY F. BEECHHOLD

Disk drives trouble is the greatest cause of downtime. If you keep them clean and lubricated and learn to trouble-shoot, you'll minimize repair bills—and lost time.

The major cause of computer downtime is disk drive failure. Every user at some point will go to boot up a disk and get a data error, seek error, or some other such annoying message in return. But before getting into the causes of disk drive failure, take a look at a typical disk drive, the full-height Tandon TM 100 that probably came with your PC.

Components of Disk Failure

Any disk drive is a hybrid device: part electromechanical and part electronic. The major mechanical components of a disk drive are the chassis, door mechanism, hub, drive motor, spindle, head-positioning motor and head assembly, logic board, and servo board. (See Figures 1 and 2 for illustration.) In the TM 100, the logic board and the servo board are separate, though in some makes, the servo circuitry is included on the logic board.

The chassis is mainly a casing to hold the various parts and assemblies. Although it has been demonstrated that uneven torquing of the mounting screws can deform the chassis enough to throw a head temporarily out of alignment, this rare occurrence primarily affects quad density (80-track-per-inch or 96-track-per-inch) drives.

The black plastic part of the drive holds the door assembly and the disk-retaining hub to which the door is attached. It is very unlikely that the doorlatch will malfunction, although the hub can be gummed up through the use of do-it-yourself disk-hub-ring kits. A disk has a limited life, after all, and should be backed up long before the hub hole needs whatever reinforcement a hub ring presumably provides.

Delving deeper into the disk drive, you finally come to the heart of the matter, the machinery. To start, take a look at the drive motor and spindle. (See Figure 3.) The drive motor, one of two motors in a disk drive, causes the spindle to turn and in turn causes the disk itself to turn. The spindle is fitted with a hub on which the large center hole of the disk is positioned. When you close the disk drive, the disk is pressed into position by a hub clamp.

Four major problems are commonly associated with the drive motor and spindle: motor burnout, motor-bearing wear, drive-belt failure, and incorrect spin rate. Occasionally, the spindle bearing acts up, causing the spindle to bind. If spin-rate deviation is caused by an electronic problem, it can probably be corrected by tweaking the servo pot, a variable resistor known in the Tandon TM 100 as R4. If the motor is going bad, however, tweaking will only provide fleeting relief. A slipping drive belt will also cause irregularities in spin rate. And, of course, a broken belt puts the spin rate at a rock-solid zero.

The head-positioning motor quickly and accurately steps the head(s) back and forth over the read/write slot of the disk. The grinding or buzzing sounds emitted when the disk drive is active are made by the head stepper at work. The primary cause of failure here is misalignment of the head(s). This misalignment can result from rough handling of the disk drive, wear, or heat.

Tandon drives get warm in the best of circumstances. Should the computer be operating in a particularly stuffy environment, therefore, don't be surprised if the drives become erratic. And don't try to fix anything yourself. Head alignment should be done by a professional who has the proper tools.

The task of the computer is to obey the commands that come through DOS.

The practical implementation of those commands, however, is carried out by the floppy disk controller board (FDCB) in conjunction with the logic board—the circuitry on the disk drive itself. (See Figure

4.) The FDCB, referred to by IBM as the Diskette Adapter Board, is installed in one of your computer's expansion slots. The FDCB can be the source of disk drive misbehavior, but the only practical way to ascertain its state of health is to substitute a controller board you know is good. Servicing a floppy disk controller board is not a job for just anyone. Warning: Before handling any plug-in boards, discharge any static charge you have (static electricity kills electronic components!) Then place the loose board, circuitry side down, on a piece of aluminum foil.

The Chain of Commands

If you tell the computer to read a file, appropriate signals, sent first to the FDC and then to the disk drive logic board, cause the disk drive motor to turn on, load the read/write head, and move the head stepper back and forth across the surface of the disk. Considering the amount of carefully coordinated electronic and electromechanical activity going on, this system works remarkably well. Still, mishaps occur—some IC or other will get flaky, or a capacitor or transistor will open or short out. And unfortunately, these repairs, too, must be sent out. Before packing anything up, though, try swapping boards. At least in the case of the FDCB, it's an easy enough task and may quickly root out the culprit.

Swapping circuit boards is also a good idea if there are problems with the servo

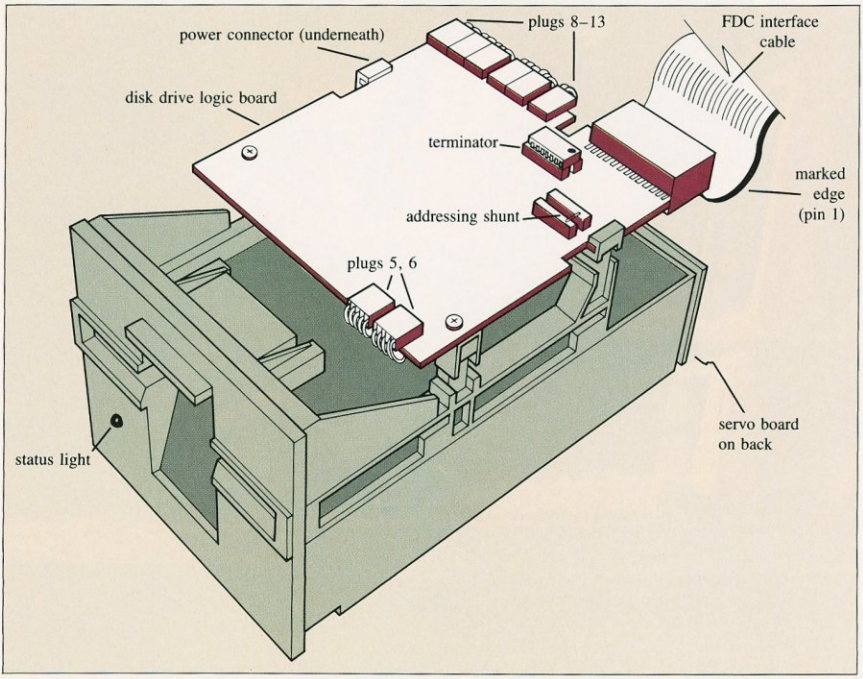

Figure 1: *Overview of Tandon TM 100 disk-drive interior.*

board. Or, if that doesn't work, you can try adjusting the spin rate with the spindle-speed-adjustment control (R4 on Tandon's TM 100) mentioned earlier.

Tandon's TM 100 manual does a good job of detailing all of these problems and more. The manual organizes the disk drive activity into seven functional groups and lists malfunctions associated with each grouping. These include:

1. Index-pulse shaper, consisting of an LED, a phototransistor, and pulse-shaping circuitry. The pulse shaper turns the interruptions of light caused by the disk's index hole passing over the LED into a standard digital data stream. LEDs burn out and phototransistors fail—both problems are jobs for the professional.

2. Write-protect sensor, which senses when the write-protect notch on the disk is covered, closes a microswitch, and causes inhibition of the write function.

3. Track 00 sensor. The track 00 position is home base for the head stepper. If the drive is out of alignment, it can't read track 00 of the disk and will crash.

4. Spindle-drive control, which I have already discussed.

5. Carriage-position control.

6. Write/erase control.

7. Read amplifier and digitizer. These groupings comprise the major part of the logic board electronics.

Different Problems

Floppy disk drives are either single or double sided. A single-sided disk drive has only one read/write head. When used in the single-density mode, this drive is the most reliable type. Double-sided disk drives have two heads, the second of which is located where the single-sided drive has a simple pressure pad. Dual-headed drives are more susceptible to misalignment than single-headed drives, especially in double- and quadruple-density modes. The older IBMs have single-sided drives (writing double density), whereas the newer computers come with double-sided drives (also double density). The recording density is under the control of the FDC board, meaning that any disk drive can be made to read and write double-density information. Extended densities can also be squeezed out of these drives. However, where quad density will be used consistently, designers generally specify 80-track (96 tracks per inch) instead of the "normal" 40-track (48 tpi) drives. Bear in mind, though, that an 80-track width is so narrow that even the slightest deviation from spec will throw the system into a tizzy.

Dual-headed drives are more susceptible to misalignment than single-headed drives, especially in double- and quadruple-density modes.

The FDC board talks to the disk drives over a standard 34-conductor cable. Once in a while, a disk drive problem can be ascribed to a defective cable or connector.

The process of formatting a disk on computer is very similar to making a standard tape recording. The information that the drive records is digital, however, meaning that there is a magnetic pattern understood by the system as 1s and 0s, as opposed to the analog information recorded in the magnetic material of recording tape. The formatting procedure works by setting up a set of digital pigeon holes that the operating system uses for storing and retrieving your files. Since files are recorded in little packages not necessarily contiguous with one another, formatting also provides pointers or "road signs" to help the operating system keep everything organized.

Tools for the Good Disk-keeper

Disk drives are partially mechanical devices, and, like living rooms, they accumulate dirt and dust and must be maintained on a regular schedule. Several tools and materials are needed to perform this "disk-keeping" task. They include:

- Vacuum cleaner, battery-operated, flashlight-sized, with soft utility brush. When you vacuum, place the cleaner itself as far from the equipment as possible and aim the exhaust in the opposite direction.
- Compressed air. This is available at the photo shop in an aerosol can. Radio Shack calls it Dust/Particle Remover. Animal hairs and little bits of stuff seem to be more easily dislodged by a blast of air than they are by suction. Use the plastic nozzle that is provided, and while you blast away, suck the flying debris up with the vacuum cleaner.
- Isopropyl alcohol, uncolored type. Ethyl alcohol will do just as well, as will tape-head cleaner. (RS Cat. #44-4010 or 44-1171).
- Swabs. When I go on a cleaning binge, I find that no-name brand cotton swabs answer my needs very nicely. Radio shack sells reusable lintless foam swabs with long handles for $1.95 per 10 swabs (Cat. #44-1094). However, I'm not convinced that these do as good a job as the no-names.
- Cleaner/degreaser. For cleaning connector contacts.
- High-quality lubricant. A Teflon based lubricant, such as Jensen TriFlow, is pref-

erable, but Radio Shack's Precision Oiler will do nicely. Nyoil and 3-in-1 are also good machine-oil lubricants but should not be used on rubber or plastic. And, of course, there's always the gunsmith's favorite, WD-40, a versatile cleaner/lubricant.

- Pink eraser. For burnishing contacts.
- Miniature screwdriver, large needle, or polished wood toothpick (round cross section, with sharp tips)—for lubricating tight spaces.
- Technical manual for your brand of disk drive. This isn't an absolute necessity, but for routine maintenance, it's nice to know what you're playing around with.

And, of course, you'll need your regular tools, such as dentist's mirror, tweezers, small screwdrivers, and vicegrips for disassembly and assembly of equipment.

Disk drive maintenance should be performed every 100 hours of use or every 6 months, whichever one comes first. Warning: On dual-sided drives, closing the drive door without inserting a disk (or thin piece of cardboard cut like a disk) can damage one or both of the heads. This kind of damage is not a problem with single-sided drives because the pressure pad is soft and won't hurt the head even if it touches it.

Tuning Up for a Better Drive

Maintenance on any brand of disk drive is basically the same. The only differences are the location of some connectors and some screws and a few other odds and ends that won't matter to what we're doing here. However, for purposes of illustration, assume here that you have just removed the drives of the Tandon TM 100 from the computer enclosure.

Below are the steps you will want to take to keep that disk drive in perfect running condition.

1. Gently pull all the plugs from their connectors. On the Tandon drives, the plugs will be numbered 5 and 6 (to the right front of the logic board), 8, 9, 10, 11, 12, and 13 (to the left rear of the logic board), and 20 and 21 (on the servo board at the back of the drive). (Warning: Don't yank these plugs. The wires, especially to plugs 5 and 6, are quite fine and can be easily broken or pulled loose. Gently work the plugs off. And note where each goes. The four rightmost plugs in the rear bank are not used.)

Drive maintenance should be performed every 100 hours of use or every 6 months.

2. Remove the logic board by taking out the two Phillips screws and sliding the board back to the cut-out. Place the board, with the circuitry side down, on foil or conductive foam.

3. Clean the interior of the drive with compressed air. Use small, precisely aimed blasts. Be careful not to touch the heads with the nozzle.

4. Check the condition of the drive belt. If it slips easily or shows wear, replace it. Turn the flywheel (the wheel with the strobe pattern) to test for smooth movement. If there seems to be any binding, the drive motor may be going bad, the drive motor may need lubrication, and/or the

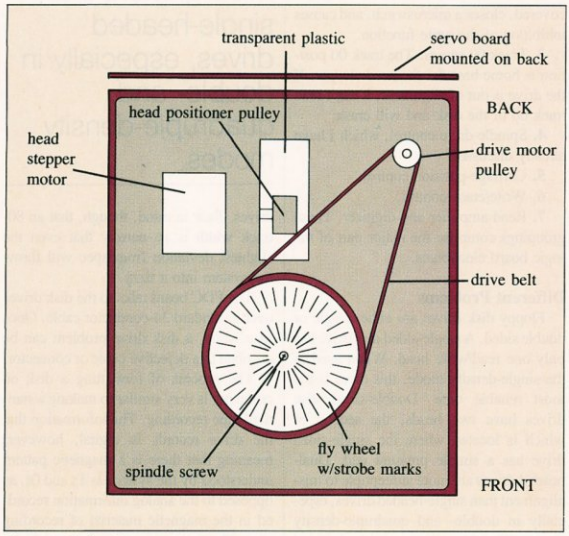

Figure 2: *Underside view of disk-drive interior.*

spindle bearing may need lubrication.

5. Lubricate the drive motor. First remove the plastic cap on the top of the motor and put a drop of lubricant on the bearing point in the center. Next, turn the drive over and with a miniature screwdriver, a large needle, or even a toothpick, put a drop of lubricant on the drive shaft in that tight space between the pulley and the body of the motor. It's important that this drop work its way down the shaft to the bearing. When you're finished, rotate the spindle to work the lubricant in and replace the plastic cap. Note: WD-40 has a limited lifespan on the job. For longer-term oiling, use TriFlow or fine machine oil (3-in-1 or Nyoil).

6. Lubricate the spindle. The only semi-handy place to lubricate the spindle is beneath the hub on the top side of the drive. Using a miniature screwdriver (or needle or toothpick), dribble in a drop or two of lubricant. Take great care not to touch the heads or to bend anything. Next, rotate the spindle to work in the lubricant.

7. Lubricate the head stepper. Once again, you must apply the lubricant with a fine tool to the space where the motor shaft of the stepper motor enters the body. You can get at this juncture from the top of the drive. Slide the head carriage gently back and forth a few times to work the lubricant in. (Warning: When moving the head carriage, grasp it by the plastic guide at the right front of the assembly. *Do not handle the top head assembly.)*

8. Clean the heads and carriage. Lightly dampen a swab with tape-head cleaner or isopropyl alcohol; then, with a gentle circular motion, swab the bottom head and then the top head. Repeat this action with a second and even a third swab. To clean the top head, place the swab on the bottom head and press upward. The swab should eventually come away clean. Don't allow alcohol to dribble around the head mountings. The carriage rails can be cleaned by swabbing them with a small amount of cleaner/degreaser and then sliding the carriage assembly back and forth. (Note: I do not recommend using disk-type head cleaners. These can cause premature head wear.)

9. Lubricate the carriage rails. You should put a drop or two of the lubricant on a swab and brush it onto each of the two rails, then move the carriage assembly back and forth a couple of times. You want to leave only a very thin film of lubricant behind.

10. Lubricate the door assembly. Rub the swab you just used on the two flanges inside the door handle. Don't add any lubricant. All you need here is the lightest film.

11. Clean the connectors. Moisten a clean piece of cloth with cleaner/degreaser and rub the pin connectors on the servo board until they are bright and shiny. Repeat for the pin connectors on the logic board. Pencil erase the flat finger connectors (right rear of board) to remove static electricity and then clean off with cleaner/degreaser. Blow the board clean and dry with compressed air.

12. Replug the servo-board connectors.

13. Replace the logic board and replug the connectors.

14. Two-drive users should go back to step one.

15. Replace the drive(s), the power plug, and the disk-drive cable. The power cable can be inserted only one way, but an

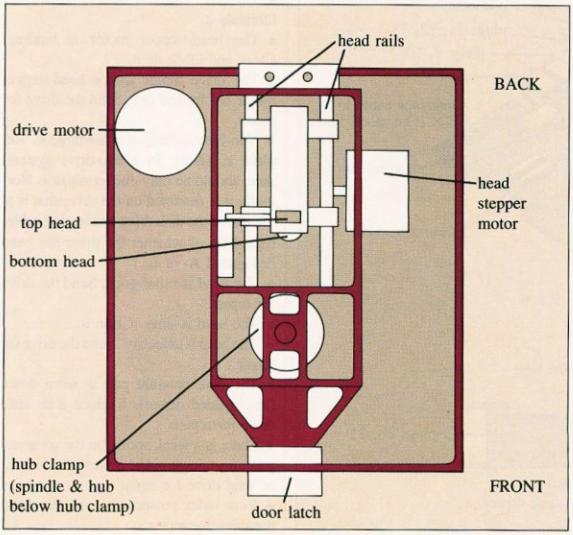

Figure 3: *Overview of disk-drive interior with logic board removed.*

unkeyed disk-drive connector can be misconnected. Pin 1, whose cable is marked by a colored stripe, should be to the right as you face the front of the drive.

16. Reassemble your computer, and fire it up for testing. All should be well. If not, open it up and check the connectors for correct placement.

Searching for Culprits

Unfortunately, even if you maintain your disk drive perfectly, there may be times when everything doesn't function as expected. To prepare you for this eventuality, I recommend two documents: the *Technical Reference Manual* for your computer and the technical manual for your brand of disk drive. There is no sense in pawing around hoping to happen upon what the problem is. We need all the help we can get.

In certain cases, you're told to return the unit to your dealer for repair. And unless you intend to become your neighborhood disk-drive repair person, you're better off letting the specialists handle the sticky problems. Before trekking off to the computer store, however, first check the obvious. Here's a list of problems, possible causes, and remedies.

If the drive doesn't respond when you issue the boot command (the busy light doesn't come on):

- Your disk drive cable may not be securely plugged into its socket.
- You may have a defective cable (one or more broken conductors). Replace it.
- The power-supply cable is not securely plugged into the power receptacle on the disk drive.
- You have problems on your FDC board and/or disk drive logic board. Substitute boards if possible; if not, send it for repair.

If your disk-busy light turns on when you give the boot command, but the disk will not boot:

- You have no system on the disk.
- The disk is defective.
- The spin rate is out of spec. Check and adjust it.
- The drive belt is broken or off the pulley. Replace it.
- The drive motor is binding. You must lubricate it.
- The head-stepper motor is binding. Clean and lubricate it.
- The drive motor and/or head-stepper motor has burned out. Send the drive for repair.
- You have a defective terminator. Replace it. (Note: In a two-drive system, there should be only one terminator. Normally it is mounted on the drive that is at the end of the disk drive connecting cable, regardless of whether the drive has been designated A: or B:.)
- The head is misaligned. Send the drive for repair.
- The head is dirty. Clean it.
- The head is defective. Send the drive for repair.
- The disk pressure pad is worn down (single-sided drives). Replace it or send drive for repair.
- There is a weak spring on the pressure-pad arm (single-sided drives). Replace it or send drive for repair.
- Your index sensor is burned out. Send the drive for repair.
- You have a faulty FDC board and/or

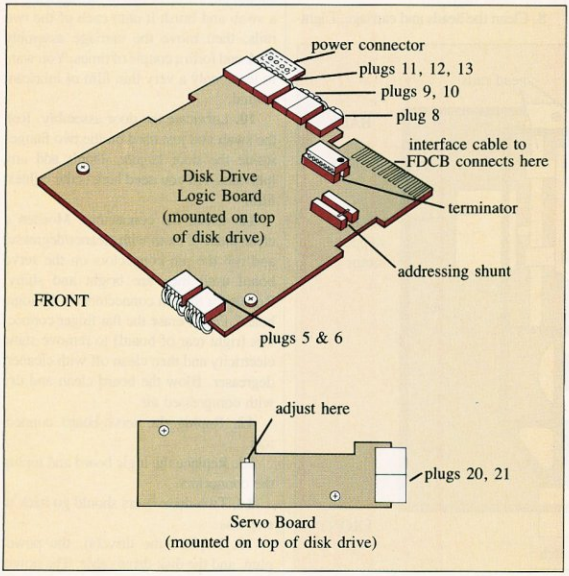

Figure 4: *Overview of disk drive logic board and servo board.*

disk drive logic board. Substitute if possible; if not, send the drive for repair.

- You have a defective system ROM. Substitute a working ROM. This problem is uncommon.
- You have a defective CPU, clock, bus controller, or other system board component. Troubleshoot, substituting chips where feasible. This problem is also uncommon.

If you get busy lights from two (or more) disk drives when you access the system:

- The disk drive cable is plugged in backwards. Remove it; then reconnect it, making sure that pin 1 on the cable connectors is properly mated with pin 1 of the FDC board and the disk-drive logic board.

Unless you intend to become your neighborhood disk-drive repair person, you're better off letting the specialists handle the sticky problems.

- The disk drives are improperly addressed. Check the addressing shunts and readdress correctly.

If you have problems inserting or removing disks:

- The head is not released from the read/write (loaded) position. Turn the system off and then on. Try to insert a scratch disk.
- The springs or catches are bent or broken. Turn off the system. Then open the disk drive, remove the logic board, and use a scratch disk to observe what's happening. Repair the problem if possible, or else send the drive for repair.
- The drive hub is gummed up with adhesive from hub rings. Carefully clean the hub with lint-free cloth moistened with lighter fluid.
- A write-protect or other label is stuck somewhere in the disk pathway. Remove it and carefully clean off the adhesive.

Good Driving Advice

I have a few additional bits of advice that can save you money, time, and aggravation.

Where feasible, check several things at the same time. For example, you can easily check the drive motor, the cleanliness of the head(s), and the cleanliness of the head carriage rails at pretty much the same time. At any rate, on the basis of your best judgment, go first to the most likely source of the problem at hand.

Never use force on anything in a disk drive—with the exception of a frozen drive motor that you've just lubricated. Forcing here should be of a very gentle sort. Lubrication should be applied *sparingly* to the area where the motor shaft enters the motor housing and to the area where the shaft can be seen on the top of the motor housing. Do not allow lubricant to dribble anywhere else.

Replacement pressure pads, springs, and other little odds and ends can be ordered from companies that specialize in disk-drive sales and repair.

It's a good idea to comparison shop for disk-drive service. The dealer you bought your computer from may neither be the best place for service nor the least expensive. You can usually get worthwhile guidance from computer club or user group members.

Buy a spare disk drive—even two—so that you won't be out of business when your regular ones go on the blink. You can own a new replacement drive for the cost of two to three repair jobs. And do your own replacement. It will cost you as much as $75 to have the job done. Working slowly, you can replace a drive in your PC or PC*jr*. in less than an hour.

Don't feel obligated to replace a disk drive with one of the same brand. You'll be paying a premium for the IBM logo, beneath which is another maker's disk drive. My recommendation is for the brushless, direct-drive type of drive available from mail-order houses for as little as $150 each. Just make sure that you get the correct size (full height or half height) and that the vendor assures you that the drive is PC compatible, which most are.

Don't feel obligated to replace a disk drive with one of the same brand.

Don't leap in and try to do a job that you neither fully understand nor have the proper equipment to tackle.

A little time spent on mothering your disk drives will put you in good stead over the long haul. Use your expensive piece of productivity software to remind you when the drives should be taken care of and to keep a record of your ministrations—sort of like the lube-and-oil-change sticker on the door frame of your car. Good luck and good driving!

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COVER STORY

CIRCUIT BOARD HOME REMEDIES

GENE B. WILLIAMS

With your PC making its own diagnosis, it won't be hard for you to track down the problem—and perhaps effect a cure.

Fantastic as it may sound, a weird coincidence accompanied the writing of this article. I sat down at the computer and flipped the switch. Instead of its usual reliable operation, my computer gave out a long beep, followed by a short one. This is the signal given by the power-on self-test (POST) to indicate there's a problem with the system board. So, before I could write this article on how to diagnose and repair circuit boards, I was obliged to diagnose and repair my own.

Despite the reliability of the PC, at times something will go wrong. You don't have to be a trained technician to find the source of the malfunction. If you can operate your PC, you can diagnose it. And most of the time, you can fix it yourself, saving both time and money. The job isn't as difficult as it might sound. The computer will take care of most of the problems if you let it. It will let you know what is going on before a problem becomes more serious.

Each time you turn on your IBM PC, the computer automatically implements the first step for diagnosis by going through POST, which takes anywhere from a few seconds to a couple of minutes, depending on what you have installed. The more memory you have, the longer POST will take.

Along with a check of the memory, POST also runs a quick check on the rest of the system (system board, keyboard, monitor adapter card, printer card, drive adapter card, and so on) to verify that everything is functioning as it should. It signals audibly, and sometimes with written codes, if it finds something wrong.

Normal response is for the computer to give off a single, short beep just before the LED on the drive lights up and the program begins to load.

Anything other than this tells you something is wrong. For example, a long beep followed by a short beep indicates that the system board is malfunctioning or about to malfunction. A series of short beeps tells you the power supply is bad or is being dragged down by a short elsewhere in the computer. (See Figure 1.)

POST is always your first step in the diagnosis of a problem. It's also something you don't have to think about doing, since it runs automatically every time you turn on the computer.

Dr. Disk

If you get an error during POST or while operating, you can get out the diagnostics floppy disk that came with your computer or an advanced version of the same thing (available at your dealer). For circuit board problems, use the multiple testing option (option "1" on the menu that appears after you've entered the diagnostics routine). You may not catch the trouble with fewer than 25 testings. (When I was diagnosing the problem with my PC, it wasn't until the 31st pass that the errors began to show.)

Each question mark in the codes listed in Figure 2 means that any number displayed in that spot—other than zero—denotes an error. For example, an error code of "201" indicates a problem with RAM; a "200" means the RAM tested successfully. (The only exception is a "199" error, which simply means that you answered "no" to the "Is this list correct?" prompt at the beginning of the routine.)

After running the diagnostics routine and making a note of any error codes, it's still not time to open the computer. Check for the obvious. Are all external connections secure? A cable between the computer and an external device may have come loose. This check includes the power cord.

If the board indicated by POST codes is connected to something outside the cabinet, such as the monitor or printer, disconnect the external device and run the test again. A bad device can easily make the adapter board seem to be malfunctioning, while in fact it is the external device (or the cable to it) that is causing the problem. If the problem is in the device, the error code should disappear when the device is disconnected. Naturally, if the fault is in the board, the error code will remain. (Always be sure and play it safe. Shut off the power

before making or breaking any electrical connections!)

Check the cables and other connectors for continuity with a VOM (volt/ohm meter) to be sure the problem isn't caused by the cable. Set the VOM to read resistance in the *1x* range. Touch the black lead to the pin on one side of the cable and the red lead to the same pin on the other side. If the wire is broken inside the cable, you'll get an infinite resistance reading. Depending on the VOM you are using, the needle of the meter will either swing to the far side of the scale or not move at all. Either way, most meters have an infinity symbol (∞) to mark the spot. A reading of infinite ohms means the circuit is broken and no contact is being made. If the wire is good, the reading will be near zero ohms.

Be sure that you know which pins are which before you proceed. Often a ribbon cable will have a number of pins that will not be used for a particular application. If the documentation that came with the device doesn't tell you, you may have to take apart the connector head to determine how the pins and wires are used.

Under the Hood

If you still haven't found the problem, it's time to open the cabinet. Again, look for the obvious. Is there anything that could be causing a short, such as a screw or small piece of metal? Has an internal cable come loose? Look at everything carefully. With the power *off*, disconnect and reconnect each cable *(carefully!)*.

Check the switch settings, both on the

Signal	Cause
Nothing, continuous beep, or series of short beeps	Power supply
1 long beep and 1 short	System board
1 long beep and 2 short, or normal short beep but blank display	Monitor adapter card and/or monitor and/or monitor cable
Normal short beep with either the drive LED staying on or cassette BASIC loading	Drive and/or drive adapter card

Figure 1: *POST's audio codes and the parts in which they indicate problems.*

Code	Meaning	Code	Meaning
02?	Power	9??	Printer adapter
1??	System board	11??	Async port
2??	RAM	13??	Game control
3??	Keyboard	14??	Printer
4??	Monochrome monitor	15??	SDLC adapter
5??	Color monitor	17??	Winchester drive
6??	Drives	18??	Expansion chassis
7??	Coprocessor	20??	BSC adapter

Figure 2: *Written POST error codes and the parts in which they indicate problems.*

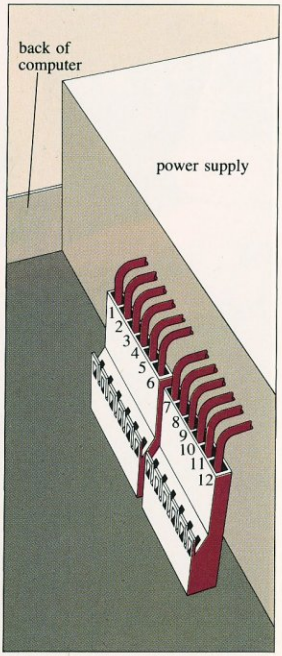


Figure 3: *Pin numbers of the system board.*

system board and on the expansion boards. This check is important if you've made any changes to your system. The switches tell the computer what to look for. If they're set incorrectly, you're bound to have improper operation.

A new board may have spots that have to be jumpered (or unjumpered). Read the instructions carefully. You're unlikely to cause any damage by not having the jumper connection blocks correct, but operation could be strange.

Are all the boards tight in their slots? And all the chips firm in their sockets? Either can work loose and cause an apparent malfunction. A gentle push will reseat the boards or chips. If reseating doesn't work, remove the boards and clean the contacts using a special contact cleaner—not a cleaner with a lubricant such as the kind meant for TV tuners—or using technical-grade isopropyl alcohol and a swab. (Don't use rubbing alcohol; it may contain water, oils, and other contaminants.) Or you can clean the contacts using a soft pencil eraser. Do this off from the computer, and blow off the eraser tailings before reinserting the boards.

Don't forget to shut off the power before you take out or insert anything! If power is flowing and you yank out a board, you could easily end up causing considerable damage to the computer.

Occasionally, a malfunctioning power supply can make something else seem to be faulty. It can also work the other way around, with a bad board causing the power supply to fail.

To test the second possibility, remove all boards and options and try again. If the system now powers up, insert the boards one at a time, making sure you shut down the power before removing or installing a board. When the computer fails again, you'll have found the board that is causing the problem.

You can test the power supply easily with a VOM. It connects to the system board through the 12-pin connector located next to the power supply. (See Figure 3.) Pin 1 is closest to the rear of the computer. Pin 2 is empty. You can test the voltages either with the supply still connected or with the plugs disconnected. (If you decide to check the voltages with the plugs disconnected, be sure you shut off the computer before unplugging the connectors.) If the voltages don't match those in Figure 4, the problem isn't in a board at all but in the power supply.

The switches tell the computer what to look for. If they're set incorrectly, you're bound to have improper operation.

You can test the system board further by checking the resistance across the power connector pins. You do this check with the power off and the power supply to the board connectors unplugged. Set the VOM to read resistance in the *1x* range. Unplug the two power connectors and take the readings according to Figure 5. The readings you get should be fairly close to the ones listed there. Any reading below those in Figure 5, or any reading of infinity, could indicate that the system board has failed.

RAM Repairs

If the problem is in RAM, locating the faulty module is easy. The computer will tell you exactly which one it is through the use of a code. The first two digits tell you the bank; the last two tell you the specific module in that bank.

The older system boards hold only 64K on the system board itself. Newer boards can hold up to 256K on the system board. Either way, the chips on the system board are divided into 4 banks, from bank 0 to bank 3. Bank 0 is farthest back on both. Bank 4 is the first bank of RAM on an expansion card.

Bank 0 will generate a 00 code for the first two digits on both the new and the old boards. (See Figure 6.) The other banks generate different codes depending on the board type.

On both types, the modules are arranged the same way, with nine chips per bank (data bits 0 through 7, with the parity bit as the ninth.) On each bank, the chip nearest the edge represents the parity bit. There is a space between this chip and the data bit chips, with bit 0 being the first (closest to the parity bit chips) and bit 7 being toward the center of the board. (See Figure 7.)

Thus, an error code of 2020 tells you the failing module is in the bit 5 chip of bank 2, when you have a 256K system board. A code of 0002 indicates that the bit 1 module (second from the left of the bit modules) of bank 0 (farthest back) is at fault.

To test the module, simply swap it with another chip. The address for the error should change. For example, if the original error code was 0002, and you swap this for the bit 7 chip in the bank, the code should change to 0080. If you swap it for the same chip in the next bank, the code should change to 1002 (or 0402 with the 64K board).

Unless you can swap a chip or see obvious physical damage, repair is usually by replacement of the board. If this becomes necessary, keep in mind that the malfunctioning board has a trade-in value. You

Common	+Lead	Voltage
4	8	10.8-12.9
5	10	4.8-5.2
5	1	2.4-5.2
7	3	11.5-12.6
9	6	4.5-5.4

Figure 4: *VOM/pin connections and voltage readings that indicate a properly functioning power supply.*

Black	Red	Minimum Ohms
8	10	0.8
8	11	0.8
8	12	0.8
5	3	6
6	4	48
7	9	17

Figure 5: *VOM/pin connections and the resistance readings that indicate a properly functioning power supply.*

	64K Board	256K Board
Bank 0	00	00
Bank 1	04	10
Bank 2	08	20
Bank 3	0C	30

Figure 6: *The first two digits—representing banks of chips—in the RAM codes.*

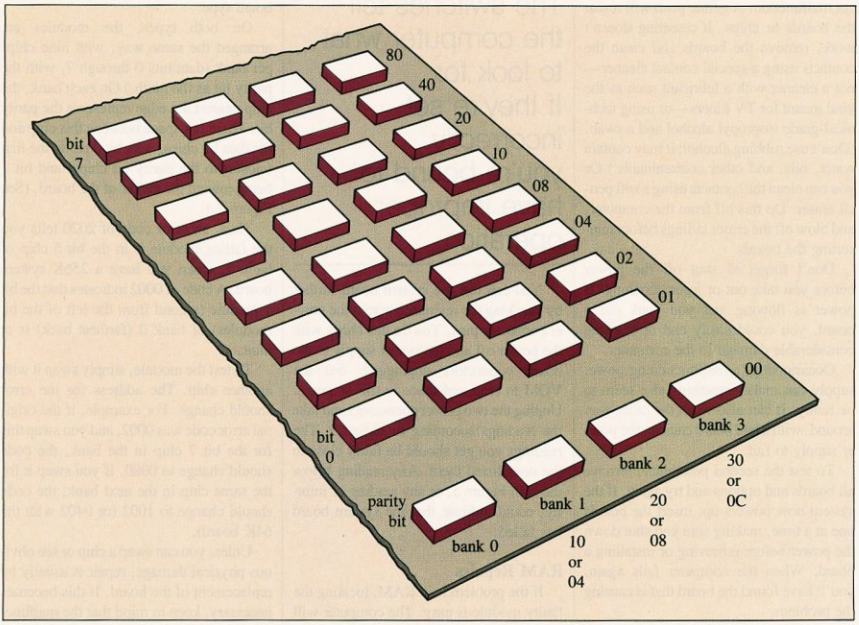


Figure 7: *RAM address scheme for the four banks of chips on a system circuit board.*

may also be able to find a refurbished board for considerably less than a new one. If you can't find a single RAM chip and have to buy a whole bank, keep the others around as spares. (Label the bad chip. It's still useful as a test chip.)

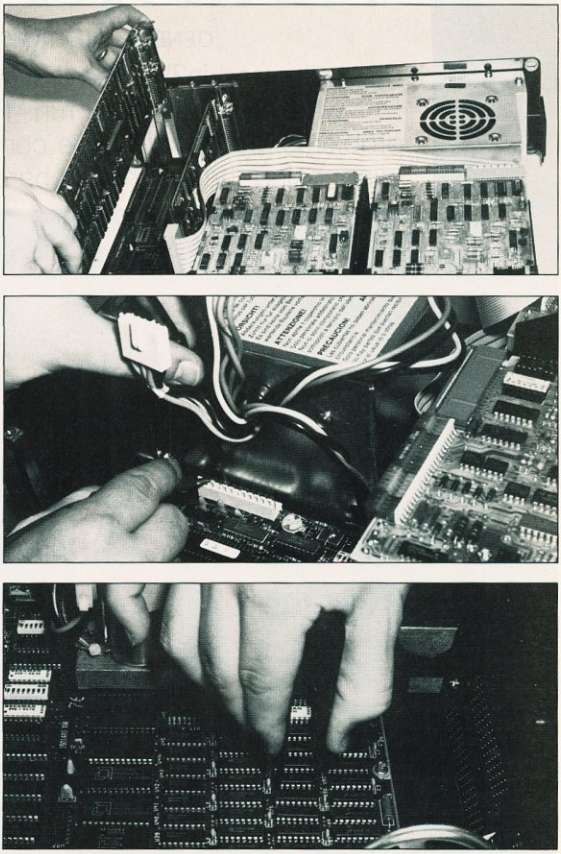
To review, be sure you've eliminated all the obvious things. A system board error could be caused by one of the ROM chips being loose. A screw or other conducting object can cause a variety of problems—or apparent ones. Sometimes you'll be able to tell a burned-out component by its appearance. You could even be making an error operating a program.

If the problem is in RAM, locating the faulty module is easy. The computer will tell you exactly which module it is, using a code.

Once you've eliminated the obvious, make use of the diagnostics disk. A single pass may not reveal the trouble, so select the multiple testings option. If you can't sit there for the testings, select the "log utilities" option to keep track of errors.

Above all, don't panic. Take one step at a time. The process of elimination can take you a long way toward finding the actual cause of the problem. ■

Gene B. Williams is a freelance writer living in Mesa, Arizona. He is the author of How to Repair and Maintain Your IBM PC *(Chilton Book Company, Radnor, PA, 1984), the first in a series of books on computer repair maintenance.*



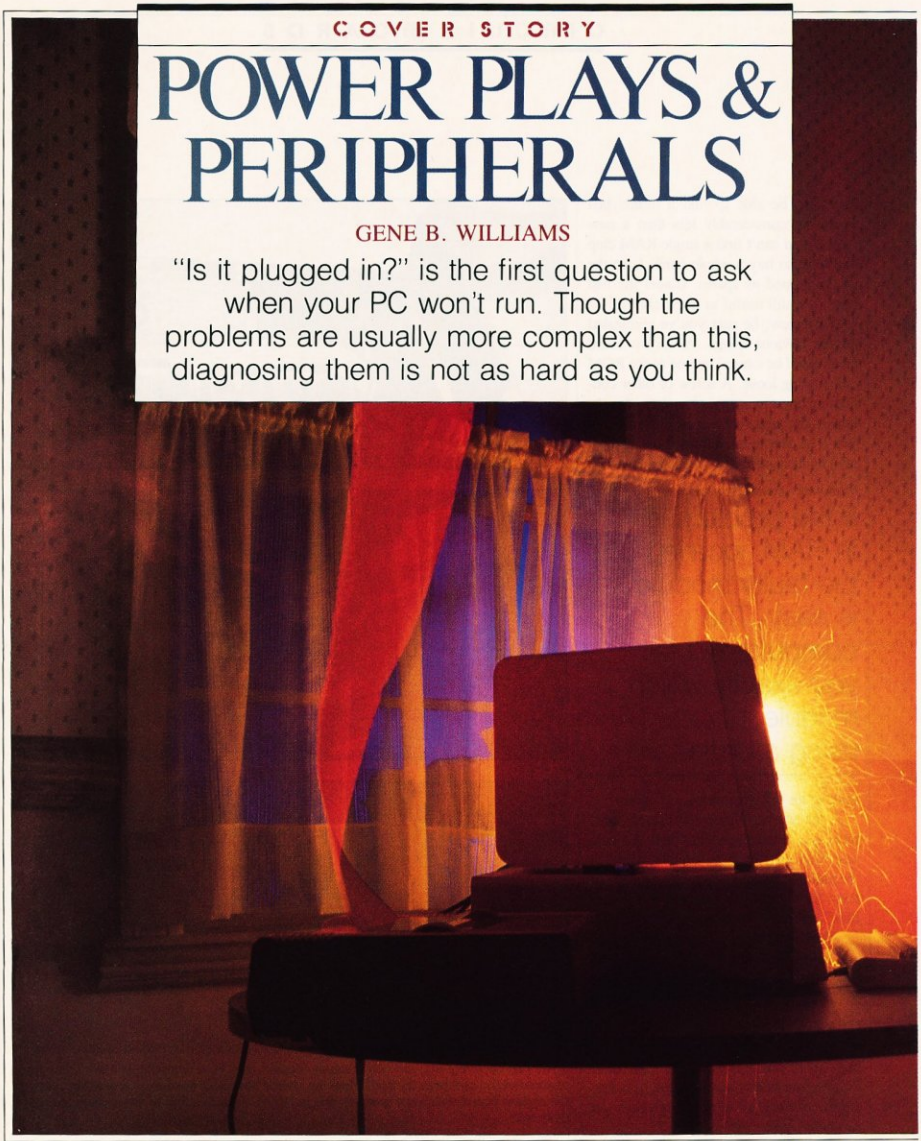
If you can operate a PC, you can probably repair it, too. Your computer will even take care of some of the problems by itself. Here the user is removing the circuit board (top), testing the system board resistance (middle), and using an extracting tool to swap chips around (bottom).

COVER STORY

POWER PLAYS & PERIPHERALS

GENE B. WILLIAMS

"Is it plugged in?" is the first question to ask when your PC won't run. Though the problems are usually more complex than this, diagnosing them is not as hard as you think.



Few things are more frustrating than when your computer doesn't work right. One is when it doesn't work at all. When nothing happens, the power supply may be the cause. But problems with power supplies and peripherals aren't always obvious, and diagnosing them seems more difficult than it really is. Finding out what's wrong, however, simply involves eliminating other causes and making a few easy measurements with a voltmeter.

Diagnostics Steps

When something doesn't work, your first step should always be to proceed conservatively and look for the most likely cause. Be sure all cables and connectors are secure, including the power cord. If the printer is malfunctioning, also check to see that the mechanical parts are clear, without paper jammed inside. Don't forget to check the fuses, if there are any. (You cannot check the PC fuse, nor can you replace it without a great deal of effort. But it will automatically reset itself if you shut off power for 5 seconds.)

The power-on self-test (POST) runs a quick check automatically on your system each time you turn on the computer. The diagnostics diskette does more to help spot problems. If at all possible, use both *before* tearing things apart. If both these fail to yield the answer, try the methods given in the next section in this article; then use the diagnostics diskette as soon as you have power again.

POST and the diagnostics diskette generate signals and error codes that will help you find the problem quickly. Make a note of them. The *x*'s in Figure 1 can be any numbers. A code number followed by zeros means that the test was completed successfully. For example, a code of 300 means that the keyboard has tested successfully. A code of 301 means that you have a problem with the keyboard.

Some companies' options, those not "approved" by IBM, may give false readings during diagnostic procedures. Keep this in mind while trying to find the problem. Diagnostics might indicate that there's a problem with the graphics card, for example, when in fact that device is fine. Make it a point to run the diagnostic routines whenever you install something new so you know what will show during the testing. (It's also a good idea to run the diagnostics diskette regularly as a step in "preventive medicine.")

Code or Signal	Meaning
Nothing -or- Continuous beep -or- Repeating beeps -or- 02x displayed	Power
No input -or- 30x or xx30x	Keyboard
1 long beep, 2 short -or- 1 short beep & incorrect display -or- 4xx (monochrome) -or- 5xx (color)	Monitor
No printing -or- 9xx -or- 14xx	Printer

Note: For a more complete listing of diagnostics error codes and signals, see "Circuit Board Home Remedies" in this issue.

Figure 1: *Diagnostics error codes.*

Nothing Happens

If nothing happens when you flip the power switch, you are likely to accuse the power supply without thinking further. The power supply may have died, but also something else could have gone awry. (This applies too when a printer or other peripheral doesn't run. Read more on peripheral power supplies below.)

The fan is wired directly to the incoming 120-volt line. If the fan isn't working, chances are the problem is outside the computer. (It's rare for the fan and the power supply to give out at the same time.) If the fan is operating, the power is probably getting to the computer.

The next time you switch on your com-

puter, listen carefully for a slight "click" coming from the speaker. This click means that power is getting to the system board. If you hear the click, the power supply is probably functioning properly, with the problem occurring elsewhere in the system. (This assumption isn't *necessarily* true, but use it as a general guideline.)

The best way to check for incoming power is with a voltmeter (set for 120 volts AC), but you can use a lamp for a quick but less-reliable test. The power supply of the PC can operate in the range of 104 to 127 volts. Other power supplies will have different tolerances for power. If the incoming power goes beyond the tolerance of the power supply, everything (except the fan) will shut down. (Since a lamp will operate beyond the tolerance of many power supplies, it may not show any apparent difference when you use it instead of a voltmeter for your test.)

Your computer will also shut itself down if something draws too much power from it. If a multifunction card develops an internal short, for example, it could draw too much power. An occurrence of this type is rare, but it can happen.

If the problem is in one of the connected devices (printer, modem, option cards, and so forth), you can locate it simply by disconnecting them and checking for power again. (Don't forget: the keyboard is also a connected device.) Shut down all power and disconnect everything connected to the computer externally. Apply power again. If there's still no power, open the cabinet and carefully remove all internal options (with the power off!). Pay particular attention to the drives.

If you have power flowing again, you know that one of the devices is at fault. To find out which one it is, merely plug them in one at a time (with the power shut down each time!) until the power fails again.

If you still don't have power, check the output of the power supply itself. This step involves using your multimeter set to the 12-volt DC range. The first test points are where the cable from the power supply plugs into the system board (see Figure 2). The power is on during this test; so be *very* careful and do not cause any accidental shorts. Move slowly and methodically.

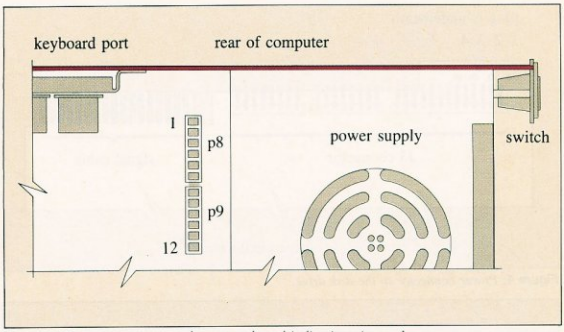


Figure 2: *Power connector to the system board indicating pin numbers.*

+ pin	− pin	reading
8	4	10.8 – 12.9
1	5	2.4 – 5.2
10	5	4.8 – 5.2
3	7	11.5 – 12.6
6	9	4.5 – 5.4

Figure 3: *System board power connector readings.*

Check each pair of pins for the correct voltage range. Check the other pins. Figure 2 gives the pin locations. Refer to Figure 3 for the correct voltage readings on the pins.

The power supply also powers the disk drives. The power connector is located at the left rear of the drive circuit board (Figure 4). Most drives have four pins on top of the circuit board. You don't even have to unplug the connector. Touch the common (black) probe to pin 2 and the positive (red) probe to pin 4. A reading between 4.8 and 5.2 volts is okay. Between pin 3 (black) and pin 1 (red) you should get a reading of from 11.5 to 12.6 volts.

If any of these voltages are incorrect, you'll know that the power supply is the problem. All you can do is replace the faulty unit (with an exact match). Otherwise, the problem is in one of the connected devices. Or you have too many options attached and are simply trying to pull more from the power supply than it can give.

The Keyboard

Quite a few people have complained about the PC keyboard. Most complaints

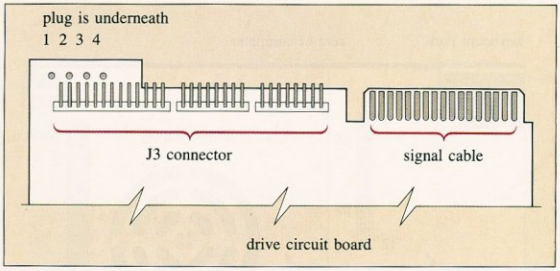


Figure 4: *Power connector to the disk drive.*

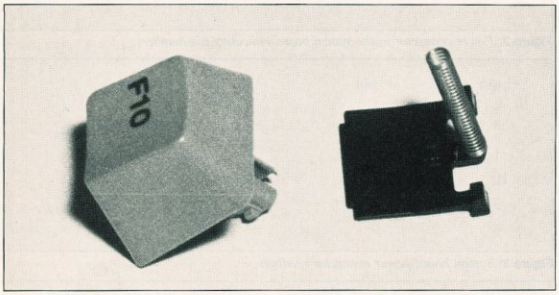


Figure 5: *Underneath each key is a small spring—the only part likely to wear out.*

focus on the layout or on what the keyboard lacks in the way of features. As a unit of construction, however, the PC keyboard is rather nice. There are no contacts, as such, and therefore there's no chance of arcing or other electronic wear to the keys.

Under each key is a small spring (see Figure 5), which is the only part of the key that experiences wear to any extent. It moves a small plastic paddle beneath the key (causing the little click you hear). The motion of the paddle changes the capacitance in a cell below the key. It is the change in capacitance that makes the keyboard work. The electronics of the keyboard read this change and send the signals to the computer.

With or without an error code, if you have reason to suspect that the keyboard is malfunctioning, check the voltages. Remove the keyboard plug from the back of the computer. Set your meter to read in the 6-volt DC range. The common (ground) should go to pin 4. Touching the other pins should give you a reading of between 2 and 5.5 volts. If any of the voltages are incorrect, the problem is inside the computer. If the power supply has tested correctly from above, the trouble is probably in the system board (see "Circuit Board Home Remedies" in this issue for more information on how you can test the system board). Otherwise the problem is either in the cable or somewhere in the keyboard.

Before you give up and toss the keyboard in the garbage, you should check the continuity of the keyboard cable. It's unlikely that one of the wires inside is causing the trouble, but it's a possibility. In order to check for continuity, remove the cable from both the keyboard and the computer; then set your meter to read ohms ($x1$). Touch the probes to the ends of each wire (pin 1 to pin 1, and so forth—see Figure 6).

Printers

The manual that came with your printer is the best source for specific information. Become familiar with it to find out what capabilities your printer has and how to take care of various possible problems when they arise.

Since the printer is a mechanical as well as electronic device, it is prone to more wear and tear than most things connected to the computer. It has at least two motors (for head and platen) and maybe more. The printhead moves back and forth across the platen and also either spins (as with a daisywheel printer) or makes characters by punching at the paper with wires (dot matrix type printer). All this motion causes wear. It can also create fair amounts of heat, which, if allowed to build up, can cause all sorts of damage, both mechanical and electrical.

The first thing to look at is the manual. Specific error signals displayed there may tell you what has gone wrong. Also included will be information specific to your printer, such as how to remove the platen and other parts to free up a paper jam, how to load the ribbon, and so forth.

Paper can jam as it feeds through the printer. Even single sheets can cause a

paper jam. Printers that use multiple sheets are even more prone to jams. When a jam occurs, the printer can grind to a halt. Sometimes the jam isn't apparent. Look carefully.

All sorts of strange things can happen if the ribbon isn't installed properly. Part of a character might print, leaving the other part weak or gone completely. The printer could shut down entirely, or print a couple of characters and then act as though the signal had stopped.

You can make lots of adjustments with most printers—the usual spacing and forms thickness adjustments, the release catches, plus others. Just as a typewriter won't function properly if the adjustments aren't correct, neither will a printer. Checking for these things entails looking for the obvious. Most of the time, the problem will be very simple.

By doing occasional maintenance checks and cleaning the printer regularly, you can greatly reduce the malfunctions. Clean the ribbon guides, the print shield, and the inside of the machine. A build-up of ink or paper dust can cause problems. If your printer has a built-in self-test, run it occasionally. (Run it once when you first get the machine to see what the test should look like.)

The printer self-test allows you to carry your diagnostic procedures one step further. If the test shows that the printer is operating correctly, you'll know that the problem is in the printer interface, the cable, or the computer. You can eliminate the cable by testing for continuity with your meter. The diagnostics diskette is able to tell you if the printer adapter card is functioning in the correct manner. About the only thing left is the interface in the printer itself.

Monitors

Monitor problems are usually obvious: the screen will be blank, or the display will be strange. Unfortunately, "repair" normally involves replacing the entire unit. In any case, there's high-voltage current inside the monitor, plus an all-too-delicate CRT tube. So *stay out*, unless you know what you're doing.

Monitor "repair" really means "replace" in almost all cases. But don't forget that your old expansion board will probably have trade-in value.

These same symptoms could also simply mean that the adjustments are off. This is the first thing to check if the monitor is blank or garbled.

Next, check the cables, the connectors, and the monitor driver board inside the computer. With the power off, unplug and reconnect each one in turn; then try again. Take a moment to check the cables for continuity.

If POST and/or the diagnostics diskette indicate a malfunction, most likely the circuit board is at fault. An audio signal indicates monitor problems (one long beep and two short), and so even if you can't see anything on the screen, you can still run the test. The visible error code is 4xx for a monochrome screen and 5xx for a color monitor.

Testing involves using another monitor, another cable, and perhaps another adapter card (one at a time, through a process of elimination). If a different monitor works with your computer, for example, the original monitor is at fault. If your own monitor works on another computer, the cable or the adapter card is causing the trouble.

"Repair" really means "replace" in almost all cases. But don't forget that your old expansion board will probably have trade-in value to someone. Even a malfunctioning monitor might be worth something, although you'll be glad to get rid of it and have your system powered up and ready to go again. After all, power's the key, and nothing's worse when your computer doesn't have the power to do what you want. ■

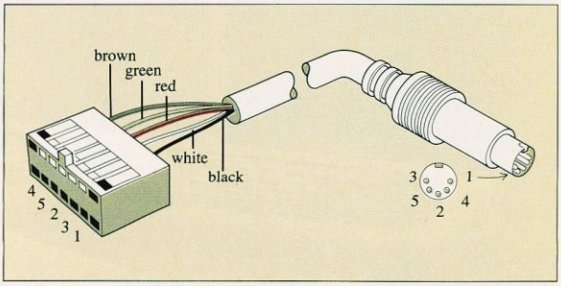


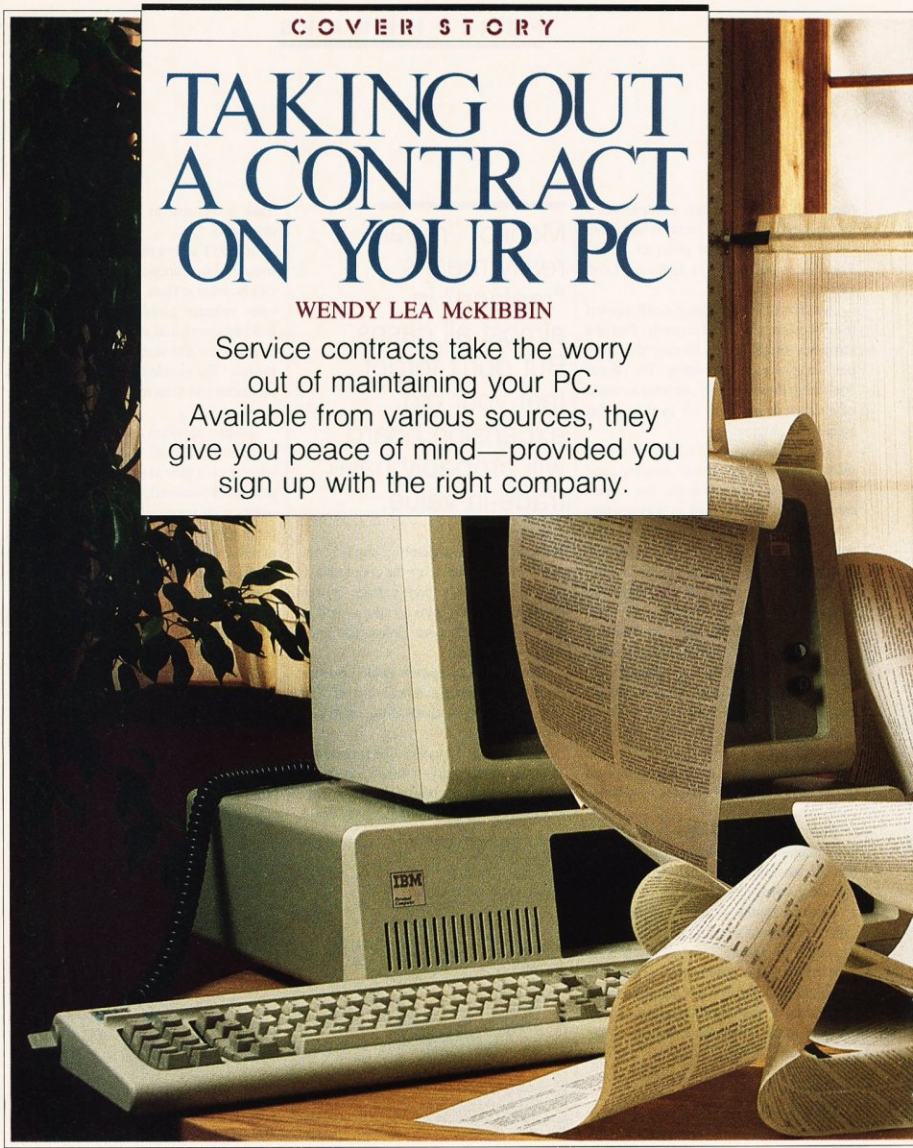
Figure 6: *Keyboard cable locations. Blacked-in slots are unused.*

COVER STORY

TAKING OUT A CONTRACT ON YOUR PC

WENDY LEA McKIBBIN

Service contracts take the worry out of maintaining your PC. Available from various sources, they give you peace of mind—provided you sign up with the right company.



When John Browning bought an IBM PC for his small accounting business in San Francisco, he didn't worry too much about maintenance. The new system was under warranty, and if he was going to spend more money, he preferred investing it in a few enhancements rather than in a service contract. After all, didn't the salesman at the retail outlet promise support if anything went wrong?

For the most part, John's faith was justified. He used the system an average of 40 hours a week the first year, with never a moment's trouble. Considering John's situation, this record was really quite remarkable.

Three chain smokers shared his large one-room office in an old Victorian building, where, with no air conditioning, open windows let in ample amounts of dust and grit. (No one had bothered to explain to John that smoke and airborne debris can leave a damaging film on the disk drive head.) Another important fact had escaped his notice—the building's old wiring produced an uneven circuit that sagged and spiked. John never thought to buy surge protection for his system. He had, instead, added a hard disk, a multifunction board from a third-party vendor, a modem, and a high-resolution color monitor.

John was no doubt on the road to a repair bill. The situation came to a head in a dramatic way. One morning, at the peak of John's business cycle, an electrical storm left part of the city without electricity for 2 hours. The storm not only caused John's system to crash, destroying an entire morning's work, but left in its wake a critically damaged disk drive and an impaired memory board.

Frantic, John made a beeline to his original point-of-sale contact, only to find that the store's single technician had a 1-week backlog of repair jobs. And sorry, he was told, but customers with service contracts come first. The store couldn't help him at all with the now out-of-warranty hard disk drive, which had been purchased through a mail-order firm.

If this story makes your heart beat faster, you probably purchased your PC for your business, as John did. At least half of all the units installed today are owned by individuals like you with businesses to run. Unless your corporation issued you a PC under the benevolent dictatorship of the data processing department, you're probably on your own for maintenance. Even if you purchased a system with funds from the departmental budget, you may still be one of hundreds of business users who don't have a contract or a contingency plan for ailing equipment.

It's no secret that service dealers put the needs of their contract clients before those of other customers.

Insure Against Disaster

According to Prognostics, Inc., a firm based in Palo Alto, California, the average failure rate for a business PC not under warranty is twice a year. The most frequent failures involve printers and disk drives, followed by memory boards and keyboards. Maintenance can become fairly expensive if you have to pay for labor plus parts at cost every time the system goes down.

The sensible approach to maintenance? Consider buying a policy from one of several sources. A good service contract can probably minimize downtime and save you money. It's no secret that service dealers put the needs of their contract clients before those of their incidental customers. And if you want the uninterrupted service you get with a swap-out program or a loaned PC, a contract can guarantee it for you. If you know you can't be without your system for a single day, you can buy a policy that ensures on-site service within 4 hours of your call. You'll also be ensuring your peaceful sleep.

Although you might not see a financial benefit from a contract in the first year, a service agreement is likely to save you money over a 3- to 5-year period. A $600-a-year contract covering all parts and labor would more than pay for itself if you had to replace your $1,500 disk drive.

Smorgasbord of Service

The menu of maintenance options for the individual PC owner is extensive. Choices include the manufacturer, IBM; third-party maintenance vendors like Sorbus, Honeywell, Control Data, General Electric, and Xerox; dealers and distributors like ComputerLand and Businessland; specialty micro maintenance chain stores like Serviceland and Computer Doctor; and miscellaneous local shops, including some TV and electronics stores.

IBM extended its service coverage recently. It now includes all equipment sold through IBM product centers. The small but growing list now includes AST Research's five multifunction boards, the Hayes Smartmodem, the Epson FX-100 and MX-100 printers, the Okidata M-L 93 printer, and the NEC 3550 Spinwriter.

The new service contract from Big Blue offers five options: IBM on-site exchange, IBM on-site repair, customer on-site exchange, customer carry-in exchange, and customer carry-in repair. Translation: you can only repair, not exchange, the system unit itself. Either an IBM service rep comes to your house or office and fixes it (IBM on-site repair), or you take the system to a walk-in center (customer carry-in repair).

The exchange policies cover monitors, keyboards, and printers. You either have a service rep come to your system site and do the disconnecting and reconnecting for you (IBM on-site exchange), or you take the defective part to a nearby company outlet and get a new one (customer carry-in exchange). The final option, customer on-site exchange, means that IBM delivers the new unit to your door, but you install it yourself.

Big Blue, It's You

It's now easier than ever to have IBM fulfill your requirements for service. Whether you live in the Big Apple, San Juan, Puerto Rico, or Desolation, Montana, you can get attention for your service needs. Mileage restrictions no longer exclude customers in outlying areas. Nor does it matter if your warranty has expired. You can still buy an Annual Maintenance Agreement from IBM. You can choose from a variety of options including exchange, repair, on-site service, and carry-in service, depending on your circumstances and budget requirements. A single payment covers all normal maintenance, no matter how often you need service.

Because of recent policy change at IBM, owners are no longer required to have their computer routinely inspected before obtaining a contract. Instead, the new contract includes a certification letter stating that your machine is in good working order and that you'll agree to make your machine available for inspection within 1 month of signing the contract.

IBM owners are no longer required to have their computers routinely inspected before obtaining a service contract.

Aside from psychological comfort, contracting with IBM offers some solid advantages, notably readily available parts and the expertise one would expect from a manufacturer.

But the IBM solution has some limitations. Third-party vendors are pouring out enhancements for the PC and PC-XT, but IBM's service policy covers few of these products. They will service two printers, the Epson FX-100 and the Okidata Microline 93, as well as a few non-IBM adapter boards, such as the IRMA and six different AST cards. But if you have a diverse configuration of hardware and prefer the convenience of service from a single source, you may have to go with a third-party maintenance (TPM) vendor like Sorbus.

TPM Contracts

Most major TPM vendors offer three types of yearly contracts: on-site service, depot service, and some form of mail-in, ship-in, or courier service. The standard turnaround time for on-site repairs is 24 hours, whereas depot and mail-in service can take anywhere from 1 day to 2 weeks. Although prices vary slightly, on-site service for a hypothetical configuration of an IBM PC-XT with a color monitor, an AST SixPakPlus board, and an Epson FX-100 printer costs roughly $900. (The Serviceland contract is clearly a bargain at $665 for 12 months.) But don't choke; there's at least one alternative. Mail-in and carry-in service cost at least 20 to 40 percent less than on-site repair.

If you don't have a contract, you can still get service on a time and materials basis. But be prepared for a flat labor charge of up to $100 per hour, plus the cost of parts.

They Promised Support

Maintenance through the dealer or distributor will probably be comparable in quality with other sources on the market. But remember: These people are primarily interested in selling. Even though it's to their obvious advantage to keep you the customer happy through post-sales support, their technical staff may be skeletal and supplies scanty. Turnaround time could be slow, and in some cases, on-site service may not be available.

Beware, too, of nontransferrable contracts. If you purchased a service contract from a ComputerLand in downtown Chicago, for example, and then moved to the suburbs, at present you could not transfer your contract to another local store. ComputerLand may change this policy in the near future, but be sure you don't unwittingly enter into such a contract if your future may include transfer to another location.

On the positive side, the dealer or distributor is the only source, other than the software manufacturer, that offers some

form of software support. And in the final analysis, the sales relationship may work to your advantage, since the dealer is unquestionably interested in repeat sales. So if you're trying to make a maintenance choice between a local TV store that services micros and the retail store that sold you your system, you might find that your contact at the point of sale has that added incentive.

Bargain Hunting

One of the latest entrants in the maintenance market is the PC service chain store, a new type of organization that promises to offer fast and economical service. The best-known examples are Computer Doctor, based in Pleasantville, New York, and Serviceland, headquartered in Westlake, California. Each plans to open nationwide outlets within the next 13 months. Both offer on-site, courier, and carry-in service of comparable quality at moderate prices.

The big question is, will they last? According to Input, a California-based research firm that follows maintenance trends, service chain stores face two major obstacles to success. Input says that it can cost up to $1 million to properly staff and launch a micro maintenance store. And these stores face a tough tussle for the maintenance dollar, pitted as they are against large, established service vendors and manufacturers. So before you buy a service contract with a chain store, evaluate the tenure of the organization. If they do manage to achieve their potential, however, these service outlets will probably offer one of the best maintenance bargains on the market.

Discriminating Choice

A bargain price is just one aspect of an appropriate maintenance agreement. And in fact, it may be the least of your concerns. To discriminate among IBM, your

Comparison Shopping for Service Contracts

All contracts are for a sample system—IBM PC-XT with IBM color monitor, AST SixPakPlus multifunction card, and Epson FX-100 printer. The rates are for a 1-year contract, including all parts and labor, with 24-hour response to on-site calls.

Manufacturer

Company	On-Site		Notes
IBM	$968.00	(IBM on-site exchange for display and printer)	For on-site service, the system unit is automatically charged the IBM on-site repair rate. However, the rates for the display and printer can vary.
	$913.00	(Customer on-site exchange for display and printer)	
	Carry-In		
	$634.00	(Carry-in repair for system unit, display, and printer)	The mail-in choice is no longer a separate contract option but has been incorporated into carry-in service. (Call (800) 428-2569 for more information on mail-in procedures.)
	$624.00	(Carry-in exchange for display and printer)	

Third-Party Maintenance Vendors

Company	On-Site	Carry-In	Mail-In	Notes
Sorbus	$918.00 (or $76.50 per month)	$545.40	$545.40	Sorbus bills monthly for on-site service. (For more information, call (800) 423-2797, or (818) 502-1946 within California.)
Honeywell	$935.00	$635.00	$785.00 (Pick-up and delivery)	(For more information, call (800) 282-4350.)
Control Data Corp.	$966.00 (Available in 15–16 major metropolitan areas)		$792.00 (24-hour courier service)	CDC encourages on-site repair for at-home users. (For more information, call (800) 346-6789.)
			$588.00 (Ship-in) (3–5 days)	

Third-Party Maintenance Vendors (continued)

Company	On-Site	Carry-In	Mail-In	Notes
Xerox	$819.00 (Begins surcharging after 25 miles)	$525.00 (2-day service)	$525.00 (2-day service)	Under some contracts, you may be required to pay a percentage of parts' cost. (For more information, call (800) 238-2300.)
General Electric	$720.00	$660.00 (3-day turn-around)	$660.00 (3-day turn-around)	These rates are for West Coast. Rates vary according to locale. (For more information, call (800) 634-0001.)

Dealer/Distributor

Company	On-Site	Carry-In	Mail-In	Notes
Computer-Land (picked at random in Chicago)	$1200.00 (36-hour turnaround)	$650.00	$650.00	Obviously, each store establishes its own rates and policies.
Computer-Land (picked at random in Boston)	$799.68–$932.96	$533.12–$666.40	Same as carry-in	On-site service is available within 25-mile radius of store. Lowest prices are for systems purchased through store.
Computer-Land (picked at random in San Francisco)	None	$350.00 (3–5 day turnaround)	$350.00	

Micro Maintenance Chain Stores

Company	On-Site	Carry-In	Mail-In	Notes
Serviceland	$665.00	$460.00	$460.00 (plus shipping costs one-way)	Courier for business customers only. (For more information, call (805) 495-8045.)
Computer Doctor	$840.00	$504.00	$672.00	Surcharge for on-site service after 50 miles. (For more information, call (914) 747-2777.)

—W.L.M.

dealer, a TPM, a service chain store, or a local electronics shop, first analyze your situation realistically. Look at price, of course. But also assess how much downtime you would be able to tolerate and whether loaned equipment or exchange units are available. Also, consider convenience. Nothing is more convenient than on-site service, but it is also the most costly coverage. Decide whether it is feasible for you to trade off the hassle of transporting the equipment yourself for the economy of carry-in service.

If your system happens to be an amalgam of every new device available for the PC, select a service vendor that can handle all or most of them. Think about all of the possible contingencies. If you use a portable system on the road, for example, choose a contract from a company that has nationwide outlets, not one from a small, local shop.

Before You Sign

Note: Before you sign a contract with anyone, make sure that you fully understand the type of maintenance you are buying, whether it's for on-site, walk-in, or mail-in service. Look carefully at the fine print. Are there any clauses that cover escalating prices? Don't accept or settle for anything less than a full parts and service guarantee. Examine your prospective vendor thoroughly. Ask about the number and location of service centers. Try to get a written guarantee on turnaround time.

Perhaps most importantly, look for a service contract that includes some type of preventive maintenance measure. Make sure that you'll get a yearly tuneup to align the disk drives, adjust the printer, and check voltages. With a little intelligent forethought and careful planning, you should be able to avoid repeating John Browning's fiasco and ensure a more trouble-free life for your system, and for yourself. ■

KEEPING THE REPAIRMAN AWAY

DOROTHEA ATWATER

Don't be caught unaware: Someday your computer will let you down. Simple precautions and a spot checklist can help keep disaster away from your door.

Some day, your computer will stop," says the matter-of-fact advertisement of Sorbus/MAI, a national computer repair company. Although you may be horrified to think that your indispensable tool might let you down, you should be prepared for the worst. The good news is that more services are now available than ever before to fix your computer; the bad news is, most of them are unnecessary and expensive. However, you can do many things yourself to avoid the trouble of unnecessary repairs.

The number of companies available to repair your computer is growing by leaps and bounds. Several large electronics companies, including General Electric, Sorbus/MAI, Xerox, TRW, and Data Products, have seized the opportunity to increase their businesses by repairing other manufacturers' computers, terminals, and printers.

These companies offer what is called "third-party maintenance" for a wide variety of microcomputers, ranging from the PC and its lookalikes to Apple and Commodore machines. They hope that retail stores will parcel out service and repair contracts to them.

Many independent or discount store owners are only too happy to make such an arrangement. For computer retailers, the profit per square foot of store floorspace is what really counts. In-store service centers don't always contribute much to those figures, although some manufacturers require that their authorized dealers have them. By referring the customer to a large, third-party repair company, dealers not only keep their profit margins up, they get customers off their backs and may even pocket a small referral fee or incentive.

Where does that arrangement leave you, the customer? National repair service fees start at around $90 an hour. IBM charges $96 an hour with a .7-hour minimum, plus parts and tax. That rate means you're looking at a minimum payment of around $67. The Xerox Repair Division, which repairs over 50 different computers, printers, and monitors, charges a minimum of $50 to check the unit, even if the problem is just a blown fuse.

Minimums

According to Earl Dennis, repair technician at one busy West Los Angeles computer outlet, it takes time to track down a problem over the phone or in the shop, and that costs money. "If a computer isn't broken, I sure don't want to see it," says Dennis "but this is a business, and if customers bring the machine in, no matter what is or isn't wrong with it, I'm going to have to charge them."

Most larger repair depot chains have minimum charges. They maintain an extensive inventory and must keep up with all the latest technical innovations, so they charge accordingly. The price of individual repairs depends on the complexity of the system in question, availability of parts, and simplicity of repair. The minimum charge at Xerox service centers covers the checkup and replacement of a blown fuse, for example. But if the inspection shows something more serious is wrong, the technician will then give you an estimate for the remainder of the work. Service contract subscribers get a bit of a break: since they pay anywhere from $199 a year to $199 a month, they usually receive fast telephone troubleshooting assistance, which saves them a far more expensive on-site service call. Louis Senno, field manager for Sorbus's Glendale, California, branch, explains how the company's 170 depots across the country handle trouble calls.

"When a client calls," he says, "our receptionist takes a message. She then refers the call to the appropriate service specialist. The client gets a call back from Sorbus within 30 minutes, and the specialist asks the questions to determine the nature of the problem and how urgent it is." In fact, Sorbus has recently developed an in-house comprehensive diagnostic program, called *The Investigator*, which has reduced the time needed to diagnose clients' computer problems. However, this program is used only by Sorbus technicians.


THE HUMOR OF
GREATNESS

Human Error

Technicians unanimously say the most common problem isn't a hardware breakdown at all.

"The number one problem I see is what you could call pilot error," says Earl Dennis. The user just can't get a program to work properly. Dennis says some people refuse to acknowledge that nothing is wrong with their computers. "I had a new computer owner come back 2 weeks in a row, claiming the computer had lost data right off the screen. He packed in his entire unit, and I sat patiently beside him as he tried to replicate the situation in which the data had been lost. Nothing happened. He tried again. Still nothing. Experience told me that he was one of those panicky new owners who was absolutely convinced that he was doing everything right, although he had obviously overlooked a step somewhere."

Dennis says he finally told the customer that there was, in fact, nothing wrong with his computer.

"The customer asked, 'But what about what happened to me?' and I replied, 'Sometimes these things happen; it could have been a minor power dip, but there doesn't seem to be anything wrong with the computer.'

"The customer got flustered and said, 'Well, if you can't fix it, I'll just have to telephone the manufacturer!' and he packed up and left. Since then, he's gotten more familiar with his software program, and he's feeling better."

A Few Guidelines

Before taking your computer in for diagnosis, you can save both time and money by taking precautions and by following a few commonsense troubleshooting guidelines that can help you separate software problems from hardware problems and what is working from what isn't. The important thing is to take nothing for granted: Start by making sure everything is plugged in. Here's a brief checklist:

- Have you followed all your cords and connections from the wall sockets right on through to the screen, making sure everything is plugged in correctly and securely?
- Have you tried using a different program on a different disk and gotten the exact same result as before?
- Have you rebooted before trying the same thing again?
- Are you missing any essential messages on the screen?
- Has your software been correctly installed and configured for your system (PC and printer)?
- Have you changed anything recently, inserted a new RAM card yourself, for example?

> "The number one problem I see is what you could call pilot error. The user just can't get a program to work properly."

While these questions may seem ridiculously basic, they will help narrow down the diagnosis, and, if they don't take care of the problem, will save costly time with your service technician. The final resort is to pack it all up and carry it in.

After human error and software have been ruled out as causes of your problems, the most common sources of computer breakdowns are in two major areas: disk drives and printers.

Disk Drives

Disk drives tend to get dirty and become oxidized from constantly moving over the disks. You can easily clean them yourself with a commercial head-cleaning kit. To save even more money, get an expert to show you how to do it with alcohol and cotton swabs. Some sources say heads should be cleaned after every 10 hours of continuous use. Others say every 6 months, so as not to wear down the heads. Some people have never cleaned their drive heads and swear they never will; they're afraid of wearing them down. On the other hand, service technicians have had to repair brand-new units out of the sealed factory boxes—by cleaning the filthy heads.

John Puccini, new products and marketing manager for Sorbus, recommends a moderate approach to head cleaning and explains that even if your computer is on 8 hours a day, your disk drive heads usually won't be active for the entire period. He does recommend that the heads be cleaned at the first sign of read/write trouble.

Other common problems with disk drives are caused by the heads going out of their high-precision alignment. Regular use gradually moves the heads out of position, and they must be realigned with an oscilloscope. Keeping your equipment stationary will help reduce the amount of servicing your disk drives will need. If you do have to move the equipment around, use the original cardboard disk drive braces to help protect them from jolts and bumps.

Printers

As with disk drives, heavily used printers will need servicing more often than lightly used ones. The most common printer problems involve bad cables, loose switches and connectors, and plain old dirt inside the unit, on the roller or platen, and

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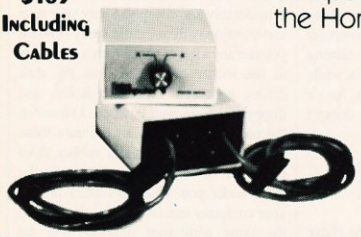

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when the room is to be vacuumed. The dust stirred up then is even more likely than usual to find its way into vulnerable places. If you want to vacuum your keyboard, get a crack-and-crevice attachment for a small battery-operated vacuum cleaner (but don't put it near the disks: the motor has a magnetic field).

Your household electrical power circuits can be another source of hazard. The same interference that causes "snow" on your screen, such as a neighbor's power saw, a refrigerator, or a microwave oven, can cause your screen to go blank. Use a good line filter to eliminate noise and "spikes." Good ones are available for between $45 and $100. The investment is well worth it.

While Sorbus and other repair services are happy to help users solve their own problems, there is one repair that John Puccini cautions not to try yourself. "Never try to oil your printer," he says. "Many do-it-yourselfers are used to oiling any moving parts—on sewing machines, motors, and so on. But most printers have self-sealed bearings, so regular machine oil is disastrous." The other job he recommends leaving to an experienced technician is keyboard cleaning: "If you spill soda pop on your keyboard, the sugar can cause a chemical reaction that can affect the keyboard circuits. My advice would be to get the keyboard in for expert cleaning as soon as possible."

Last, in case of disaster, lessen your cost in time and inconvenience by backing up your data and software and storing it in a safe place. Then, if your computer is out of commission, you can borrow or rent another one and carry on.

Dorothea Atwater is a Los Angeles-based computer consultant and author. The first of her new book series, First Aid for Your IBM PC, *for Ballantine Books, hit the stands in January.*

on the daisywheel. Reduce your frequency of repair by keeping the inside free of dust and dirt, occasionally cleaning the platen or roller with alcohol and lint-free cloth, and cleaning the carbon dust from your daisywheel with a small brush. Naturally, keeping your dust cover on whenever your printer is not in use will help prevent dirt buildup. As the saying goes, an ounce of prevention is worth a pound of cure.

Prevention

Although computer owners spend anywhere from $3,000 to over $10,000 on their equipment, they generally don't devote much thought to prevention. So, if you are in the glow of new computer ownership, now is the time to consider some safety precautions. Even if you've had your machine a while, you can cut down on your repair dollars through some simple measures, and there's no better time than right away.

Three everyday things can cause computer problems: heat, static electricity, and dust. Ideally you should take precautions against these dangers before your equipment is moved in. If your computer is in place, it still isn't too late.

Excessive heat is bad for all parts of your computer system. When considering where to put the equipment, pick an area out of the direct heat of sunlight or a heater. High summer temperatures will also affect the computer—they can make perfectly good machines go slightly and temporarily batty. So, if you are working in a very warm room and your computer begins behaving differently, try turning your computer off altogether for a while and giving it a rest to cool it down. An air conditioner is also helpful, if it doesn't cause power fluctuations.

However, if you have a choice between an air conditioner that affects the power circuits by constantly cutting in and out, and slightly warmer temperatures, stay with the warmer room.

Static electricity is another hidden enemy. More prevalent in dryer climates, higher altitudes, and in areas prone to thunderstorms, static lurks in wall-to-wall rugs and dehumidified rooms. As you know, it's unpleasant enough for you to become electrically charged and "zap" yourself when you touch a doorknob or other metallic object. A shock can be even more unpleasant when it damages your computer memory, the program you are running, and your disks.

If you touch a disk and accidentally shock it, you are likely to lose whatever information you had stored on it. If you zap an operating computer, you are likely to lose whatever is in the computer's memory at the time; you could also damage the internal microcircuits.

But you can reduce static hazard considerably and cheaply. Spray your rugs and curtains with antistatic spray. (When you use any kind of spray with a computer in the room, make sure that the disk drives, computer ventilation holes, and floppy disks are well covered. Otherwise the particles of spray can infiltrate these areas.) Although antistatic rubber floor pads can be expensive, consider using them under your chair to further protect your computer from accidental shocks. Do the same with your desktop: rest the computer on an antistatic rubber pad.

Dust can convey static electricity within your computer and may cause a dangerous data loss if it contacts your disk drive head.

Dust

Dust is another danger. Not only does dust build up on the keys, the casing, and in the cracks of the keyboard, but it can seep through the computer's air vents and into the disk drives, where it will cause serious problems. It is wise to invest in dust covers for your computer and printer. Always keep the covers on when not using your equipment.

Dust can convey static electricity within your computer and may cause dangerous data loss if it contacts your disk drive head. A particle of dust may be only a few millionths of an inch thick, but it can do the same kind of damage as a bulldozer crossing your newly landscaped garden. It can prevent the head from recording a crucial bit of information onto your disk or cause the computer to misread a program instruction off the disk. The error might occur infrequently, which means the problem can be hard to detect—for you or your technician. You might have to make repeated trips for repair and you will lose confidence in the reliability of your equipment, not to mention your technician.

Don't forget to cover your equipment