

# Know Your Personal Computer

## 10. You and your PC

*S K Ghoshal*



Siddhartha Kumar Ghoshal works with whatever goes on inside parallel computers. That includes hardware, system software, algorithms and applications. From his early childhood he has designed and built electronic gadgets. One of the most recent ones is a sixteen processor parallel computer with IBM PC motherboards.

**This article tells you how to maintain and operate your PC.**

### Introduction

By now we know enough of what is inside our PCs and of the software that runs on top of it. In this last article of the series, we shall see how to ensure a long trouble-free service life from your PC. This article is organized as a set of modules. When you buy or install your next PC, check these modules out before you use it extensively and depend on its correct and smooth functioning.

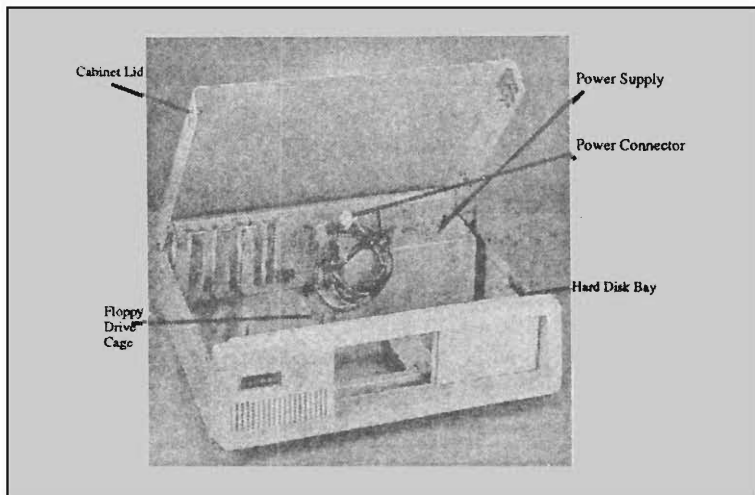
### Mechanical Assembly

Make sure all the mounting holes of the motherboard have the screws. No portion of the motherboard should bend if you gently press it down with your thumb. All the screws should be tight enough so that the motherboard does not move with respect to the cabinet, but not so tight as to crack the printed circuit board of the motherboard. Make sure that teflon washers are there between the head of the screw and the PCB surface for each mounting screw.

### Trends in Assembling PCs

Early PCs were packaged in rectangular boxes on top of which the video monitor was kept. See *Figure 1* for such a box. Many low cost PCs are assembled like this even now. See *Figure 2* for an assembled PC. Modern high-end PCs are encased in tower cabinets. This packaging idea came from the Japanese who value office real-estate. See *Figure 3* for such a cabinet.

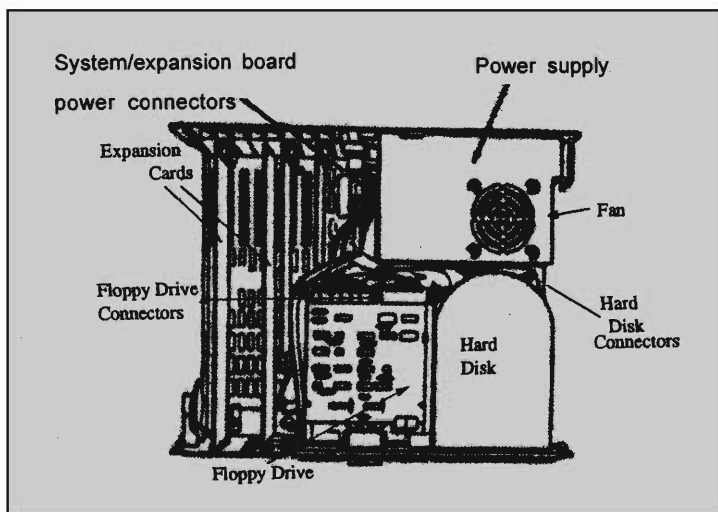




**Figure 1. A primitive PC cabinet with just the power supply.**

All mounting screws are to have their heads intact. Using the same screwdriver tool-bit and the same amount of torque, the screws should be turnable. Look for marks of abrasions or other signs of bad workmanship. The cabinet must not have loose screws, metal fillings or tiny balls of soldering metal inside.

**Figure 2. An assembled primitive PC with lid open.**



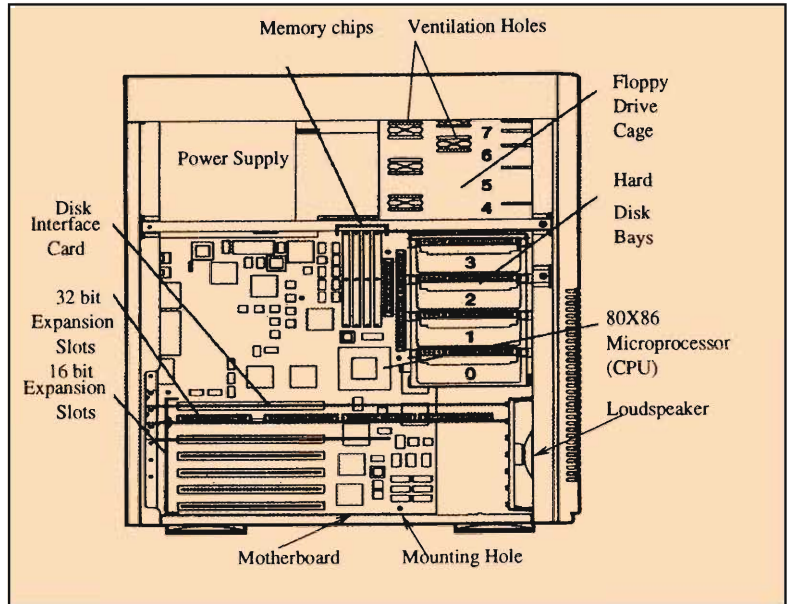
**Fix it Yourself**

You may find your motherboard very badly mounted. Do not panic. Most PCs assembled and sold at low prices are like that. Inspect and re-do the assembly yourself. Put in the missing screws. If any portion of the PCB touches the floor of the cabinet, put in a rectangular cardboard piece to make sure that there is no short circuit. Fix the cardboard to the floor of the cabinet with an adhesive.

**Thin Walls**

Do not accept a cabinet made of very thin sheet metal. A thin cabinet wall is dangerous. During usage and while transporting, the walls will bend and will cause short circuits. The motherboard PCB will also be stressed. To check this, place a 400-page book on all the walls (one by one), at the centre. If the centre sags visibly, reject the cabinet.

**Figure 3. A tower PC without a side wall.**



Some connectors are polarized. One cannot easily connect them the wrong way. There is a notch to enforce that. Make sure the notch has not been cut.

The hard disk must be supported at least at four points with proper bolts that go all the way inside the groove. The hard rubber cushion in the hard disk mounting must not be corroded or badly deformed. The floppy drive must be fixed inside a cage using at least two mounting screws. Before attempting to transport the PC, park the hard disk heads and insert a shock absorber template floppy inside the floppy drive and close the drive door. Remove the dummy before switching it on.

**Caution—Loose Components**

Loose metal nuts, bolts and washers as well as balls of metal are found inside many PCs which work correctly for months and you may find them only when you open a PC. It is very dangerous to have them however. If the PC is moved, lifted or tilted these may roll into the motherboard and fall between the contact fingers of a connector or between two tracks on the PCB. If that happens, the next time the PC is switched on, permanent damage will be caused to semiconductor components even before you realize that something is wrong. Shake the cabinet and listen if there are any rolling noises. Dust the inside regularly. Holding the cabinet and opening the lid, invert the cabinet. Repeat this procedure every time the PC comes back after a repair/upgrade.



**Be Organized**

Your PC should be maintained in such a way that you should be able to electrically dismantle and re-assemble your PC within thirty minutes any time during the service life of the PC. Put labels on important buses and connectors for your reference and convenience and maintain a log-book detailing the operations done and the observations made. From time to time, try to draw a diagram of the actual configuration of your PC with its geometric layout, entirely from your memory.

**Electrical Assembly and Power Supply**

All the power supply cables should have the proper colour coding and their insulation should be intact. Gently tug at all the connectors (e.g. power supply connectors, floppy/hard disk data/control connectors, printer port and serial port connectors etc.) and no connector should come off. If you find any bent/missing connector pin(s), straighten/ replace it (them). The DIP-headers (e.g. RESET, TURBO, LED, KBD LOCK etc.) should be properly fixed. No cable inside should be unduly taut with tension. Cables should not be entangled with each other.

Make sure all the three red wires (carrying +5V) and all the four black wires are properly connected to ensure trouble free operation. The 'Power Good' wire must be firmly secured mechanically and connected with a low contact resistance in a reliable manner. The power supply must be well-regulated and must have proper EMI/RFI filter which will prevent the line voltage surges from passing on to the semiconductor components. External voltage regulators and external filters must be provided where the power supply is very bad and in cases when the built-in regulators and filters within the power supply are deficient.

The casings of hard disk drives and floppy disk drives should be properly grounded. See *Figures 2* and *3*. Proper shielding should be provided within the cabinet. If there is a fan, its cables should use very good quality insulation and run apart from other cables and buses.

If the display flickers when you switch on a tube-light near your PC, EMI/RFI is not being filtered properly, and slowly the PC is getting damaged from surges present in the power grid.

### The Power Good Signal

Computer Power supplies (unlike the video/audio equipment power supplies) do not step down the 230V input to 5V using a transformer because transformers are heavy and computers do not need the power supply ripples to be highly smoothed. Instead they rectify AC to DC and chop that with the appropriate duty-cycle to get 5V DC which is filtered and fed. Due to ohmic resistance of the power supply lines, 5V will not reach the actual digital circuits, if the motherboard draws its rated full-load current from the power supply. It is ensured that 5V reaches the remotest point in the motherboard by sampling using a line called 'Power Good'. The power supply adjusts the duty cycle so that 5V is maintained at power good which implies that the arterial power supply lines get more than 5V. Thus if the power good line is cut, the power supply can possibly keep increasing the voltage until most hardware inside the PC is destroyed. On many low-budget PCs, power good is badly connected.

### Environment

The PC should not be placed where there is too much acoustic noise and mechanical vibration. It must never be exposed to direct sunlight, smoke, dust or toxic/corrosive fumes. Its ambience should not be too hot, too cold, too humid or too dry. Follow one good rule: *If it is uncomfortable for you, it is bad for your PC.* Do not eat near the PC. Never drop the PC, the monitor or the keyboard. After prolonged operation, open the cabinet and feel for very hot zones. If you find any, arrange for proper internal ventilation by disentangling cables and rearranging cards that are plugged in the expansion slots. (See Part 2.) Never block a ventilation hole. Never spill any liquid on the keyboard. Periodically dust the keyboard. Open it and remove human hair, dust, lint and other muck. Do not play games if you love your keyboard.

### PC Viruses

Viruses that infect your PC are computer programs written by criminals (who know the architecture of the PC and the internal details of the operating system) with the intention of damaging your hardware, destroying valuable information or at least irritating you. They are designed to be undetectable



**Watch out!**

Watch out for disk accesses without any apparent reason, for accesses that are longer than expected, and for sluggish response to commands. Beware of executable files whose size changes with the passage of time. Compile a list of TSRs and drivers that you have installed and compute the total amount of primary memory consumed by them. Check the amount of available primary memory in the virtual address space once everything is installed. If (apparently) more memory is consumed than this total, raise an alert. Volume-labels changing on their own and legitimate TSRs failing to work are symptoms of a virus. Watch out for too many disk sectors being marked bad. If this count increases every time you boot the PC, raise an alert. It could be a virus or a terminally ill hard disk. In any case it needs urgent and comprehensive attention.

and they hide in bit-patterns inside executable programs or inside the operating system. They are self-copying, self-porting and mutating and they change their hiding places from time to time. If you want to survive, you must always be on your guard.

There is no fool proof security against viruses. However, if you are alert and careful, you can considerably reduce the probability of severe attacks and control the damage caused by a typical attack. I shall elaborate the precautions.

You should never ever boot from a floppy drive whose antecedents you are not sure of. To play safe, never boot from a floppy. There are commercially available hardware locks which enforce this. Never copy an executable from an unknown source. Either buy, install yourself and use licensed software, or develop software yourself, generating executable files from trusted compilers.

There are detectors and removers for a few known viruses. Keep checking your hard disks periodically with as many of these utilities as possible. Using the detectors, screen all floppies which you intend to use, before attempting to use them. Do not allow people whose identity or whose nature of work you are not sure of, to work on your PC. Minimize, classify and manually log all exchanges of files between your PC and other computers.



<sup>1</sup> Meta-data is "data about data". Meta-data help system software manage data.

Be prepared for an attack. Back up your important files periodically. Keep a copy of the partition table and other relevant meta-data<sup>1</sup> (e.g. FAT) on a floppy and keep this floppy under lock and key, safely away from the PC. Manually log the file system structure from time to time.

If you let many executable files, whose origins and purpose you are not sure of, stay in your PC file system for a long time, you are probably breeding viruses. Periodically reformat your hard-disk, re-install the software you need to use and copy only those text/data files which you need. It is a good way to manage information also. If you come across a suspected virus writer, watch out. Do not entertain questions from suspects about partition tables, boot sectors, interrupt redirection and TSR programs. Do not interchange any file with suspects. Do not discuss the organization of your PC file system with anyone who has no business with it.

## Disks

Never switch a PC on or off with the floppy drive door closed as transient surges can over write data. Once a year, recalibrate the drive. Once a month, clean the drive head. Never insert a mechanically damaged floppy. If you have not exercised a floppy drive for a while, test it on a scratch floppy before you insert a floppy that has important data on it. While backing up information, always do a multiple-phase backup.

Most hard disks working in India are either factory-rejects or are extracted from old PCs and installed in new PCs. Check the defect-list (with a low-level disk-analyser utility) against the manufacturer-supplied list for that drive. If you find many more defects than what is advertised, do not accept the hard disk. Before formatting the disk and putting your valuable information on it, check if the disk is capable of continuous seek/read/write operations by running C programs that write a block of bytes containing all possible bit-patterns, reads it

back, verify it and repeat the process for all sectors in the disk. (See guidelines given in Parts 5, 7 and 9 as well as the BIOS call details given in the PC technical reference manual.) Keep the disk rigorously performing these exercises for several hours. If the disk breaks down or there are too many data errors, reject the disk. Otherwise switch the PC off, give the entire machine ten minutes of rest and then restart. Analyse the disk immediately after restart. If you find too many defects, reject the disk.

## Modems

An external modem is better than a built-in modem. With an external modem, it is easier to examine the setting and the status of the modem. The electrical surges from the telephone lines are isolated better if the modem is properly isolated from the PC. Put suitable filters and surge suppressors between the modem and the telephone exchange if the modem does not have them built-in.

## Ethernet

Ethernet cards plug directly into the I/O expansion slot and so there is no way one can isolate the PC from the electrical shocks that the Ethernet cable absorbs. However one can minimize the data error rate as well as the probability of damage to semiconductor components by ensuring that all the machines interconnected using the Ethernet have the same ground potential. This is best done by running a separate ground wire along the Ethernet cable with the power supply to the various nodes being fed through isolation transformers. Whenever the cable runs outdoors, it should be encased in a galvanized iron pipe with the concentric gap being small enough to prevent rodents. Ethernet cables should not run along powercables or along lift shafts. UTP connectors should not be opened and closed frequently.

The previous articles of this series were:

1. Introduction to computers, January 1996.
2. The personal computer hardware, February 1996.
3. The personal computer system software, April 1996.
4. The CPU base architecture, July 1996.
5. The CPU base instruction set and assembly language programming, November 1996.
6. Memory organisation, February 1997.
7. Input-Output ports, May 1997.
8. Basic input-output system (BIOS), July 1997.
9. High-level operating systems, September 1997.



### Opto-isolation

Two circuits are galvanically isolated if charge cannot flow between them. If two circuits are not isolated, they can interchange both wanted and undesirable information. Also, electrical impulses in either circuit propagate to the other and this can cause both malfunction and damage or one of the two. Opto-isolation is a technique of isolating two circuits while permitting the flow of desired information between them. An infrared LED (Light Emitting Diode) in one circuit and a photo-diode in the other circuit are optically coupled but galvanically isolated. The pulses that convey information are converted into photons that regenerate the information in the other circuit. Spurious electrical pulses in either circuit have no effect on the other. Noise cannot flow from the circuit having the photo-diode to the one with the LED. Opto-isolation is a fool proof method of protecting your PC from electrical surges as well as eliminating unwanted coupling of signals through electrical circuits.

### PCs in Experimental Set-ups

#### Suggested Reading

- ◆ **IBM PC/AT Technical Reference Manual.** IBM Corporation. Boca Raton. Florida. USA, 1984.
- ◆ **Scott Mueller. *Upgrading and Repairing PCs.*** Fourth Edition. Prentice Hall of India, 1995.

Many scientists use PCs to control experimental set-ups or to collect data from them. In these configurations, certain special precautions need to be taken. If the RS232 serial link is being used between the PC and the set-up, (this is the most common usage) use a serial communication card that plugs into the I/O expansion slot. Do not use those PCs where the RS232 interface is built on the motherboard, as they are difficult to repair. In the serial communication card, locate the level-converter cum line driver chips (1488 and 1489) in a readily accessible place so that they can be inspected and replaced easily. If anything fails in the link between the set-up and the PC, test these chips first. Keep a stock of these chips. Often electrical shocks from the set-up damage the PC. These chips are usually the first casualties. If you happen to draw power for your set-up from the PC, make sure you do not exceed the rated load of the power supply and you provide for adequate decoupling. Do not allow ground loops to form. If you need a better solution than this, go for *opto-isolation*.

*Address for Correspondence*  
 S K Ghoshal  
 Supercomputer Education and  
 Research Centre  
 Indian Institute of Science  
 Bangalore 560 012, India  
 email:  
 ghoshal@serc.iisc.ernet.in  
 Fax:(080) 334 1683