

# Chapter 3

## **Overview**

This module will discuss how to install computer components and how to assemble a functional computer. This module guides students through the computer assembly process. Safety precautions are emphasized and reviewed to protect students and expensive computer components. Upon completion of this module, students will be able to boot the system and explore the BIOS configuration and CMOS setup. Students will also be able to troubleshoot initial boot problems using POST errors.

### Using a Wrist Strap

A wrist strap is a device that is attached to the technician’s wrist and clipped to the metal system chassis on which the work is being done. The wrist strap prevents ESD damage by channelling static electricity from the person to the ground.

### When should a wrist strap not be used for grounding?

There are some exceptions to wearing a wrist strap in order to provide a safe ground. A wrist strap is never worn when working on a monitor or when working on a computer power supply. Monitors and power supplies are considered replaceable components. Only highly skilled professionals will attempt to open and repair them.

### Attaching Power.

After successfully installing the motherboard in the computer case, proceed with attaching the appropriate power supply connectors to it. This process is easy with an ATX (boards and power supply) because there is only one connector that is also keyed to fit only one way. Take more care with the older AT systems because there are two separate, but physically identical connectors that must be plugged in a specific way. This is covered in the next section.

The following are the steps for connecting the power supply cables to the motherboard:

- 1 On an AT system, first locate the two large wire leads from the power supply labeled P8 and P9.
- 2 Locate the large 12-pin power connector on the motherboard. It is usually found right behind the keyboard connector.
- 3 Plug the P8 and P9 wire lead connectors in the 12-pin power connector.

Caution: Make sure the black wires are in the middle, right next to each other. If this configuration is reversed, the motherboard is likely to be damaged when the power is turned on. Pressure might have to be applied to insert the connectors.

On an ATX system, there is one large 20-pin (P1) connector. It is keyed for easy installation.

Voltage	Wire Color	Use	Power Supply	
			AT	ATX
+12V	Yellow	Disk drive motors, fans, cooling devices, and the system bus slots	*	*
-12V	Blue	Some types of serial port circuits and early programmable read only memory (PROM)	*	*
+3.3V	Orange	Most newer CPUs, some types of system memory, and AGP video cards		*
+5V	Red	Motherboard, Baby AT and earlier CPUs, and many motherboard components	*	*

### DC Voltages Produced by PC Power Supplies.

The power supply is one of the most important parts of the computer that needs to be understood. The power supply unit provides electrical power for every component inside the system unit.

Whether buying a tower or desktop (to be discussed in the following sections), it is recommended that it conforms to the ATX standard and has at least a 250-watt power supply (300 watts is ideal).

It is important to be able to identify the uses for each voltage level and the corresponding colour-coded wire. This will allow testing of the

wires using a multimeter to determine if there are problems with the power supply. It is important to note that the computer power supply produces a voltage only when it has a load. In other words, some component must be running on the machine before a voltage can be found in the power cable connectors that supply power to the internal components. Never attempt to repair a defective power supply.

**Form factor** – Cases come in different form factors. As mentioned previously, the form factor simply describes the general layout of the computer case, the positioning of the slots in the case, and the type of motherboard the case will accommodate. The newest form factor, and the one most often encountered, is the ATX. It accommodates the ATX motherboard, which has integrated I/O ports and is designed for easier access to the common components as well as better airflow.

### **Memory.**

There are two types of memory modules used on most PCs. These are 168-pin dual inline memory module (DIMM) cards and 72-pin single inline memory module (SIMM) cards.

When the DIMM card or SIMM card is inserted into the slot, each edge connector makes contact with a corresponding gold trace on the motherboard. Each gold line represents an individual data path.

The slots in which RAM is inserted are called Banks.

It is important to remember to put the **DIMM** with the largest memory size in the first bank. The system automatically reads the size of the first DIMM and records it as the largest. If a smaller DIMM were put in the first bank, the system would read it as the largest and might fail to recognize or use the additional memory capacity of the DIMMs placed in the subsequent banks. Insert the DIMM module straight into the slot.

Banking with **SIMM** modules is slightly different. Each bank of memory for a SIMM has two sockets. Users must fill the first bank before moving onto the next. Additionally, each bank must be filled with RAM modules that have the same access time and size. The SIMM module is inserted at an angle of about 45 degrees.

When using other types of memory modules such as Rambus inline memory modules (RIMMs) know that other considerations have to be taken into account. Unlike DIMMs and SIMMs, RIMM modules use only the direct Rambus memory chips (RDRAM). Some systems require that RIMM modules be added in identical pairs, and others allow single RIMMs to be installed.

### **Attaching the LEDs**

Light emitting diodes (LEDs), or status lights, are useful in indicating whether components inside the computer are on or working.

Because LEDs involve very small connectors, sometimes one or two connections could be wrong. If the wrong connector is used, the LED will not light up when the computer is powered up. Simply turn off the system and readjust or switch the connectors between different plugs until all of the LEDs illuminate.

The floppy drive, hard drive, and CD-ROM communicate with the rest of the system using ribbon cables. This section discusses the types of ribbon cables used as well as how to connect them to the various drives.

### **Characterizing Ribbon Cables**

Ribbon cables are widely used to connect peripherals such as floppy drives and hard drives internally. They are rarely used outside of the system case. They are thin, flat, multiconductor cables that must be connected correctly or the component will not work.

### **Floppy Drive Cable**

The floppy drive exchanges data with the motherboard devices, including the microprocessor, via a 34-pin flat ribbon (data) cable.

A red stripe on the edge of the cable identifies pin 1.

Pin 1 on most floppy data connectors is usually on the near side to the power connector. However, floppy drives (normally 3.5 inch) from different manufacturers may have their data connectors reversed so that pin 1 (and the red wire on the ribbon cable) points away from the power connector.

Incorrectly oriented cable becomes immediately apparent on power up by the fact that the floppy drive LED light comes on immediately and stays on.

Current system BIOS versions can support up to two floppy drives on one controller via a daisy chain cable arrangement. Cable pin-outs 10 through 16 are cross-wired between the middle drive connector and end drive connector, producing a twist that reverses the Drive Select (DS) configuration of the drive plugged into the end connector of the ribbon cable. The twist consists of 7 data wires. This feature, called cable select, automatically configures the drive on the middle connector as Drive B and the drive on the end connector as Drive A. This greatly simplifies installation and configuration of the floppy drives.

### **Hard Drive/CDROM Drive IDE**

The hard drive and CD-ROM, just like the floppy drive, exchange data signals with the controller on the motherboard by means of a flat ribbon cable. The ribbon cable pin-outs and cable width are dependent on the type of interface.

An IDE cable typically has 40 pins and can also have two devices attached to it (like the floppy cable). In this case though, one device must be set as the master and the other as a slave using jumpers.

You should never move a computer when the power is turned on as it will damage the hard-drive

## **The BIOS**

BIOS stands for Basic Input Output System. It contains the program code required to control all the basic operating components of the computer system. In other words, the BIOS contains the software required to test hardware at boot up, load the operating system, and support the transfer of data between hardware components.

When setting up the computer for the first time, it is necessary to run the CMOS Configuration Setup utility. As mentioned in the previous section, the computer checks the CMOS to determine what types of options are installed in the system.

Simply pressing the Del key during the opening boot sequence provides access to the BIOS on some computers. But in general, early in the startup process, the BIOS places a prompt on the display to tell the user that the CMOS Setup utility can be accessed by pressing a special key, or a given key combination. Typical keys and key combinations include the Esc key, the Del key, the F2 function key, and the Ctrl+Alt+Esc key combination. Note that the keys, or key combinations, used to access the setup menus may vary from one BIOS manufacturer to another, and sometimes from one BIOS version to another.

### **Standard CMOS setup screen**

The instructions regarding choices in the CMOS setup screen can be found in the corresponding section in the motherboard manual.

**Hard Disks** – This section contains fields that identify devices attached to the two IDE controllers integrated on the motherboard. IDE controllers can have up to two hard drives or one hard drive and another IDE device such as a CD-ROM. Normally, one is configured as a master and the other as a slave. There can be four configuration entries, including Primary Master, Primary Slave, Secondary Master, and Secondary Slave. It is usually recommended to set the drive type to Auto. This allows the BIOS to auto-detect and configure the hard drives so that this information does not have to be entered manually.

**Date and Time** – These first two fields are used for setting the clock that governs the settings in the operating system.

### **Password screens**

**User Password** – This option allows the installation of a password that will keep the system from booting unless the proper password is entered. This option also prevents access to the BIOS, eliminating the possibility of other people changing the BIOS setup on the computer. This option is particularly useful when booting up the computer for the first time. It is recommended to follow the on-screen and password instructions in the motherboard user manual.

**Supervisor Password** – This feature is normally found only in large institutions (corporations, school districts, and so on) where BIOS settings are kept standardized by computer support personnel. Once set, these computer BIOS setups are locked with a master password only known to the network administrator or an administrator designee. The instructions for this option can also be found in the motherboard manual.

If a password has been set, and the user has/supervisor has forgotten the password, the only way to clear this password, is to use the clear CMOS jumper setting on the motherboard

## **Startup sequence**

Even after careful post-assembly inspection, the first boot can still run into problems. If this happens, depending at what stage of the boot sequence it occurs, there may not be an opportunity to go into the BIOS menu to configure the BIOS setup.

Whenever a computer starts up, a series of tests are automatically performed to check the primary components in the system, such as the CPU, ROM, memory, and motherboard support circuitry. The routine that carries out this function is referred to as the POST.

The POST routine provides error or warning messages whenever it encounters a faulty component. Post error codes take the form of a series of beeps that identify a faulty hardware component. If everything has been installed correctly during the assembly process and the new system is functioning normally, one short beep will usually be heard at the completion of POST. If a problem is detected, a different number of beeps will be heard, sometimes in a combination of short and long tones. These are mainly BIOS-dependent codes. They vary according to BIOS manufacturer and even between different versions of BIOS.

The beep codes can be used to troubleshoot hardware failures occurring during the POST routine. Although the POST routine is not very thorough compared to existing disk-based diagnostics, it is a first line of defense, especially in detecting severe motherboard problems. POST typically provide three types of output messages. These messages include audio codes (beeps), onscreen text messages, and hexadecimal numeric codes that are sent to an I/O port address. POST generally continues past non-fatal problems, but fatal problems cause POST to halt the boot process.

Error Code/Range	Possible Problem
1xx	System board or BIOS
16x	CMOS, options or time not set
2xx	Main memory
3xx	Keyboard

## **Bootup Sequence.**

One important setup option on the BIOS Features Setup screen allows the system boot order to be specified. For example, on newer systems it is preferable to boot from the hard drive or CD-ROM rather than from the 3.5" floppy drive as older systems did.

Boot Sequence	Description
A, C	System first searches for a master boot record on the floppy disk drive, then the hard drive.
C, A	System first searches for a master boot record on the hard disk drive, then the floppy disk drive.
C, CD-ROM, A	System first searches for a master boot record on the hard disk drive, then the CD-ROM, and lastly the floppy disk drive.
CD-ROM, C, A	System first searches for a master boot record on the CD-ROM, then the hard drive, and lastly the floppy disk drive.