TYPES OF FORM FACTORS

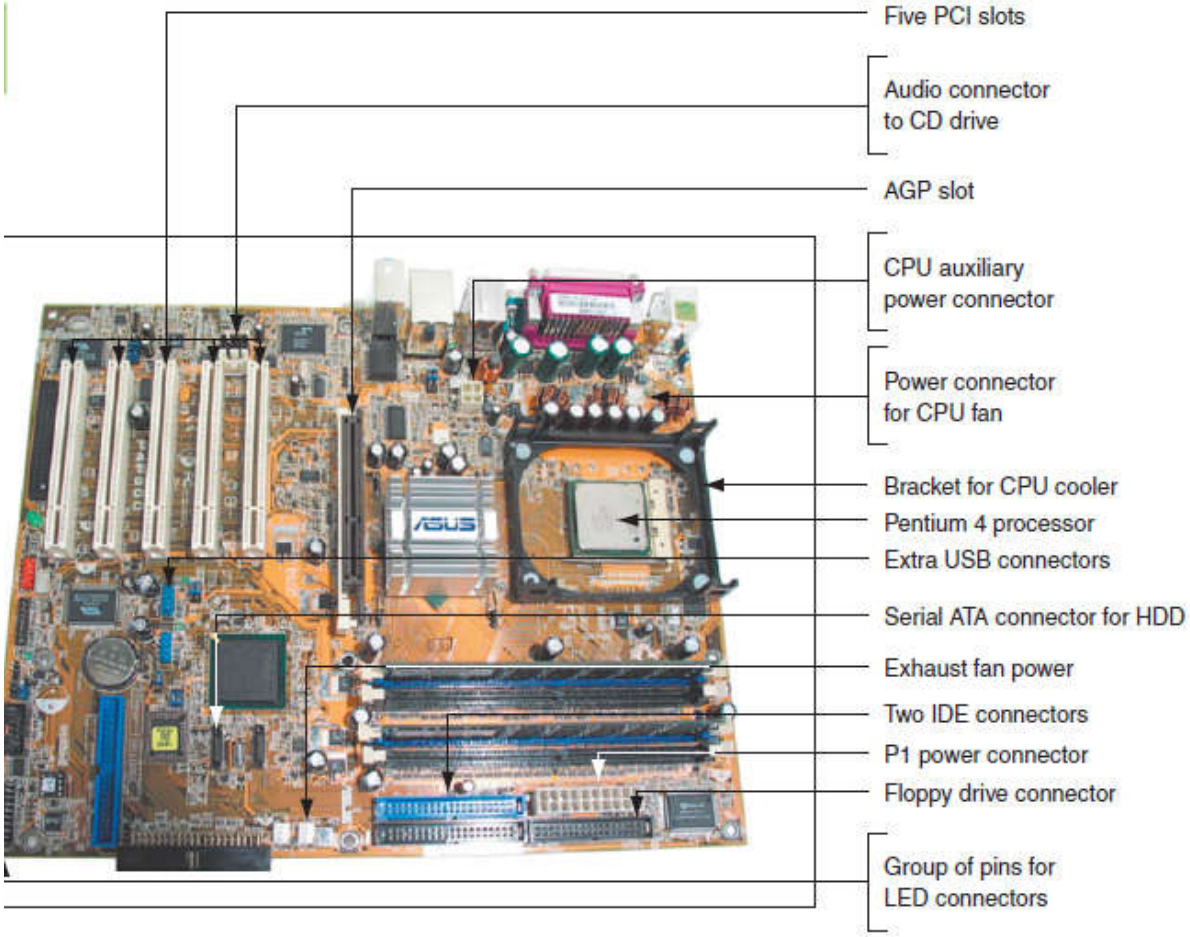
When selecting a computer case, motherboard, and power supply, choose a design that fits its intended use. For instance, you might find that you need a high-end tower system, a rack-mounted server, or a low-profile desktop. When you understand the intended use, you then can decide which form factor you will use.

Form Factor	Motherboard Size	Description
ATX, full size	Up to 12" x 9.6"	Most popular form factor, which has had many revisions
MicroATX	Up to 9.6" x 9.6"	Smaller version of ATX
FlexATX	Up to 9" x 7.5"	Smaller version of MicroATX
BTX	Up to 12.8" wide	Has improvements over ATX and can have up to seven expansion slots
MicroBTX	Up to 10.4" wide	Has up to four expansion slots
PicoBTX	Up to 8" wide	None or one expansion slot
NLX	Up to 9" x 13.6"	Used in low-end systems with a riser card

ATX FORM FACTOR

ATX (Advanced Technology Extended) is the most commonly used form factor today. It is an open, nonproprietary industry specification originally developed by Intel in 1995, and has undergone several revisions since then. An ATX motherboard measures up to 12 inches x 9.6 inches. The first ATX power supplies and motherboards used a single power connector

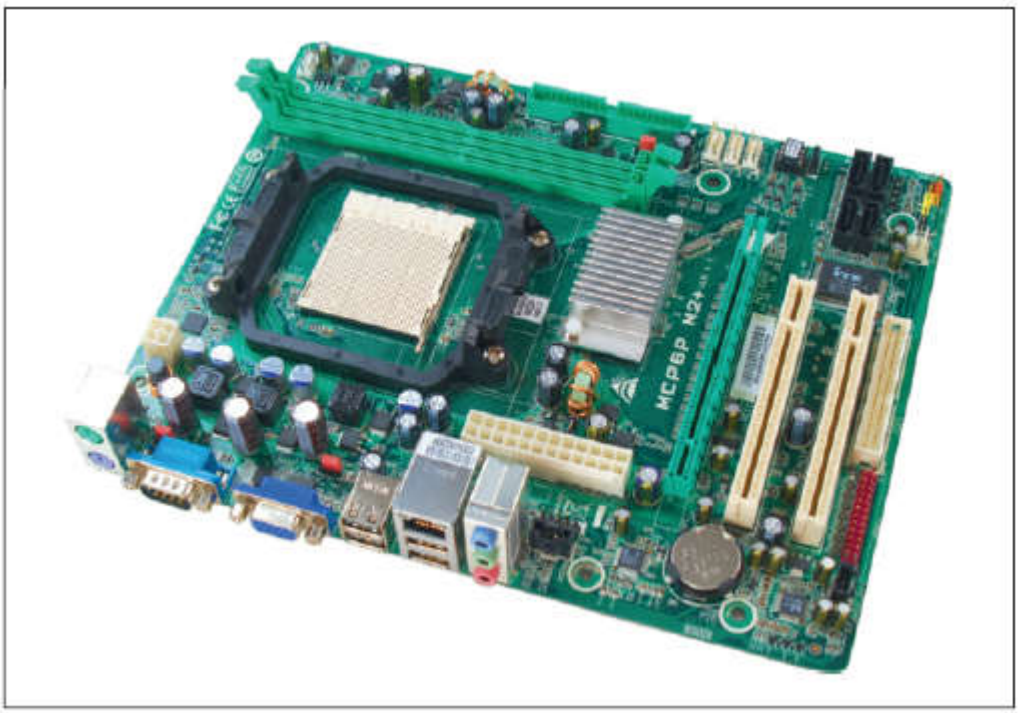
called the **P1 connector** that had 20 pins.



ATA Form factor

MICROATX FORM FACTOR

The **MicroATX** form factor is a major variation of ATX and addresses some technologies that have emerged since the original development of ATX. MicroATX reduces the total cost of a system by reducing the number of expansion slots on the motherboard, reducing the power supplied to the board, and allowing for a smaller case size. A variation of the MicroATX is the Mini-ITX. This form factor is smaller than the MicroATX and designed for small systems such as a home theatre system.



MicroATX Form factor

FLEXATX FORM FACTOR

FlexATX is a variation of MicroATX. It allows for maximum flexibility (giving it the name FlexATX), and therefore can be a good choice for custom systems. A FlexATX motherboard can be up to 9 inches x 7.5 inches. The motherboard costs less, has fewer features, and is smaller than a MicroATX board. FlexATX is commonly used in slimline and all-in-one cases, but can fit into any FlexATX, MicroATX, or ATX case.

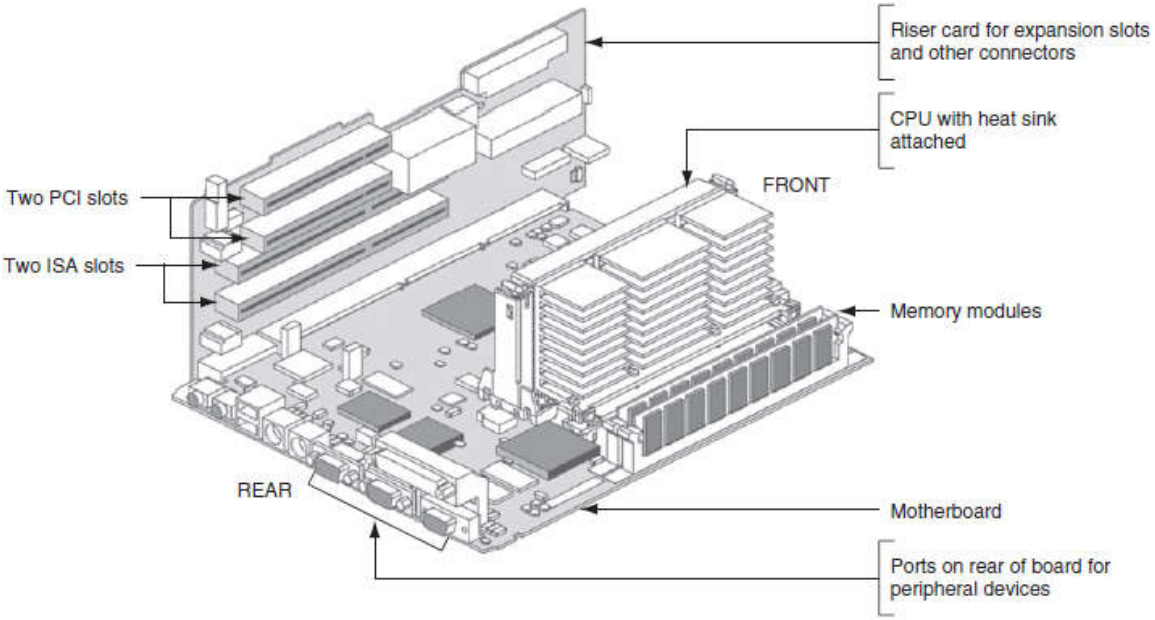
BTX FORM FACTOR

Intel designed the BTX (Balanced Technology Extended) form factor in 2003 for flexibility and can be used by everything from large tower systems to those ultra-small systems that sit under a monitor. The BTX form factor design focuses on reducing heat with better airflow and improved fans and coolers. It also gives better structural support for the motherboard than does ATX. BTX motherboards use a 24-pin power connector that has the same pinout arrangement as the ATX 24-pin P1 connector. Because the 24-pin connectors are the same, a BTX motherboard can use an ATX power supply.

BTX System for maximum airflow

NLX FORM FACTOR

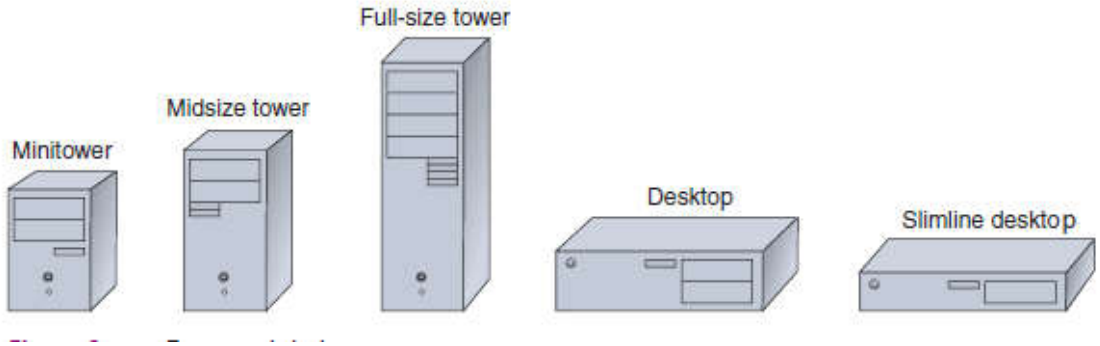
The **NLX (New Low-profile Extended)** form factor for low-end personal computer motherboards was developed by Intel in 1998 to improve on an older and similar form factor, called the LPX form factor. In these systems, the motherboard has only one expansion slot, in which a **riser card** (also called a **bus riser**, **daughter card**, or daughter board), is mounted. Expansion cards are mounted on the riser card, and the card also contains connectors for the floppy and hard drives. The riser card on an NLX motherboard is on the edge of the board. The NLX standard applies only to motherboards; NLX motherboards are designed to use ATX power supplies. An example of an NLX system is shown in the Figure below.



NLX Form Factor with a riser card

TYPES OF COMPUTER CASES

Several types and sizes of cases are on the market for each form factor. The computer case, sometimes called the chassis, houses the power supply, motherboard, expansion cards, and drives. The case has lights and switches on the front panel that can be used to control and monitor the PC. **Generally, the larger the case, the larger the power supply and the more amps (current) it carries.** These large cases allow for the extra space and power needed for a larger number of devices, such as multiple hard drives needed in a server. **When you select a case, be aware that the power supply is often included with the case and it is important to match the power supply to the electrical needs of the system.**



Tower and desktop cases

DESKTOP CASES

The first personal computers used a **desktop case** that sat flat on a desktop doing double duty as a monitor stand. The motherboard sat on the bottom of a desktop case, and the power supply was near the back. Desktop cases are built to accommodate all form factors for personal computers. Low-end desktop systems, **compact cases**, sometimes called **low-profile cases** or **slimline cases**, follow the MicroATX, FlexATX, or NLX form factor. Likely to have fewer drive bays, they generally still provide for some expansion.

TOWER CASES

A **tower case** sits upright on the floor or a desk, can be as high as two feet, and has room for several drives. The variations in tower cases are as follows:

- Midsize towers, also called mid-towers, are the most versatile and most popular. They are midrange in size and generally have around six expansion slots and four drive bays, providing moderate potential for expansion. They are used for ATX, MicroATX, Extended ATX, Mini-ATX, and BTX systems.
- The minitower, also called a microtower, is the smallest type of tower case and does not provide room for expansion. They are popular for MicroATX and FlexATX systems.
- Full-size towers are used for high-end personal computers and servers. They are usually built to accommodate ATX, Mini-ATX, and BTX systems.

MEASURES AND PROPERTIES OF ELECTRICITY

To become a successful PC technician, you need to understand electricity. Let us start with the basics. To most people, volts, ohms, watts, and amps are vague terms that simply mean electricity. All these terms can be used to measure some characteristic of electricity, as listed in Table below.

Unit	Definition	Computer Example
Volt (for example, 115 V)	A measure of electrical "pressure" differential. Volts are measured by finding the potential difference between the pressures on either side of an electrical device in a circuit. The symbol for volts is V.	An ATX or BTX power supply provides these separate voltages: +12 V, -12 V, +5 V, and +3.3 V. (-5 V is included in the specs for these power supplies but is almost never used.)
Amp or ampere (for example, 1.5 A)	A measure of electrical current. Amps are measured by placing an ammeter in the flow of current. The symbol for Amps is A.	A 17-inch monitor requires less than 4 A to operate. A small laser printer uses about 2 A. A CD-ROM drive uses about 1 A.
Ohm (for example, 20 Ω)	A measure of resistance to electricity. Devices are rated according to how much resistance they offer to electrical current. The ohm rating of a resistor or other electrical device is often written somewhere on the device. The symbol for ohm is Ω.	Current can flow in typical computer cables and wires with a resistance of near zero Ω (ohm).
Watt (for example, 20 W)	A measure of electrical power. Whereas volts and amps are measured to determine their value, watts are calculated by multiplying volts by amps. Watts measure the total electrical power needed to operate a device. The symbol for watts is W.	A computer power supply is rated at 200 to 800 W.

Measures of electricity

AC AND DC

Electricity can be either AC, alternating current, or DC, direct current**. Alternating current (AC) goes back and forth, or oscillates, rather than traveling in only one direction.** Voltage in the system is constantly alternating from positive to negative, which causes the electricity to flow first in one direction and then in the other. Voltage alternates from +230 V to -230 V. When alternating current reaches its destination, it is made more suitable for driving our electrical devices by decreasing voltage and increasing current. **Direct current (DC) travels in only one direction and is the type of current that most electronic devices require, including computers. A rectifier is a device that converts AC to DC, and an inverter is a device that converts DC to AC. A transformer is a device that changes the ratio of voltage to current.** Large transformers reduce the high voltage on power lines coming to your neighbourhood to a lower voltage before the current enters your home. The transformer does not change the amount of power in this closed system; if it decreases voltage, it increases current. The overall power stays constant, but the ratio of voltage to current changes.

A computer power supply changes and conditions the house electrical current in several ways, functioning as both a transformer and a rectifier. It steps down the voltage from the 230-volt house current to 3.3, 5, 12 volts, and changes incoming alternating current to direct current, which the computer and its peripherals require. The monitor, however, receives the full 230 volts of AC voltage, converting that current to DC. Direct current flows in only one direction.

HOT (LIVE), NEUTRAL, AND GROUND

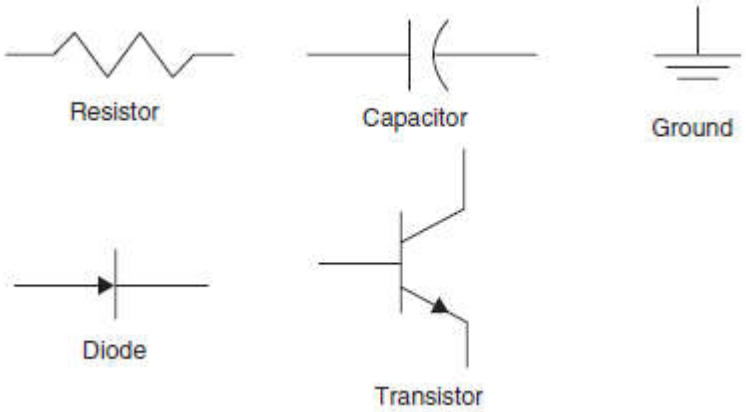
When AC comes from the power source at the power station to your house, it travels on a hot line and completes the circuit from your house back to the power source on a neutral line. When the two lines reach your house and enter an electrical device, such as a lamp, electricity flows through the device to complete the circuit between the hot line and the neutral line. The device contains resistors and other electrical components that control the flow of electricity between the hot and neutral lines. A short circuit, or a short, occurs when uncontrolled electricity flows from the hot line to the neutral line or from the hot line to ground. Electricity naturally finds the easiest route to a state of rest. Normally that path is through some device that controls the current flow and then back through the neutral line. If an easier path (one with less resistance) is available, the electricity follows that path. This can cause a short, a sudden increase in flow that can also create a sudden increase in temperature—enough to start a fire and injure both people and equipment.

WARNING: **Never put yourself in a position where you are the path of least resistance between the hot line and ground!**

A **fuse** is a component included in a circuit and designed to prevent too much current from flowing through the circuit. A fuse is commonly a wire inside a protective case, which is rated in amps. If too much current begins to flow, the wire gets hot and eventually melts, breaking the circuit, as an open switch would, and stopping the current flow. Many devices have fuses, which can be easily replaced when damaged. To prevent uncontrolled electricity from continuing to flow indefinitely, which can happen because of a short, the neutral line is grounded. Grounding a line means that the line is connected directly to the earth, so that, in the event of a short, the electricity flows into the earth and not back to the power station. Grounding serves as an escape route for out-of-control electricity. The earth is at no particular state of charge and so is always capable of accepting a flow of current.

SOME COMMON ELECTRONIC COMPONENTS

It is important you understand what basic electronic components make up a PC and how they work. Basic electronic components in a PC include transistors, capacitors, diodes, and resistors.

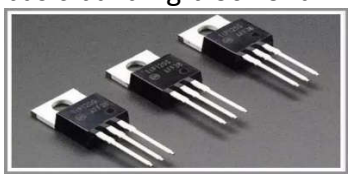


Symbols of electronic components.

TRANSISTOR

A **transistor** is an electronic device that can serve as a gate or switch for an electrical signal and can amplify the flow of electricity. Manipulating these charges to the transistor allows it

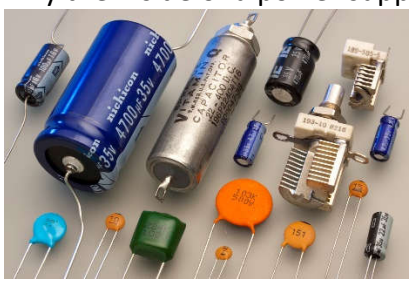
to hold a logic state of either on or off. The on state represents binary 1 and the off state represents binary 0 when used to hold data in a computer. The transistor is also used as the basic building block of an integrated circuit (IC), which is used to build a microchip.



CAPACITOR

A **capacitor** is an electronic device that can hold an electrical charge for a period of time and can smooth the uneven flow of electricity through a circuit. Capacitors inside a PC power supply create the even flow of current the PC needs.

WARNING: Capacitors maintain their charge long after current is no longer present, which is why the inside of a power supply can be dangerous even when it is unplugged.



DIODE

A **diode** is a semiconductor device that allows electricity to flow in only one direction. (A transistor contains two diodes.) One to four diodes used in various configurations can be used to convert AC to DC. Singularly or collectively, depending on the configuration, these diodes are called **a rectifier**.

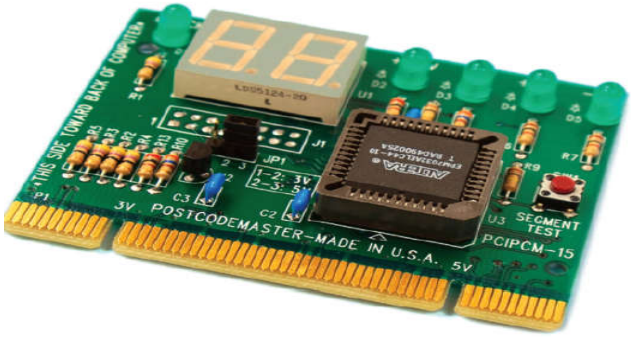
RESISTOR

A **resistor** is an electronic device that limits the amount of current that can flow through it. In a circuit, a resistor is used to protect a circuit from overload or to control the current. Resistors are color-coded to indicate the degree of resistance measured in **ohms**.

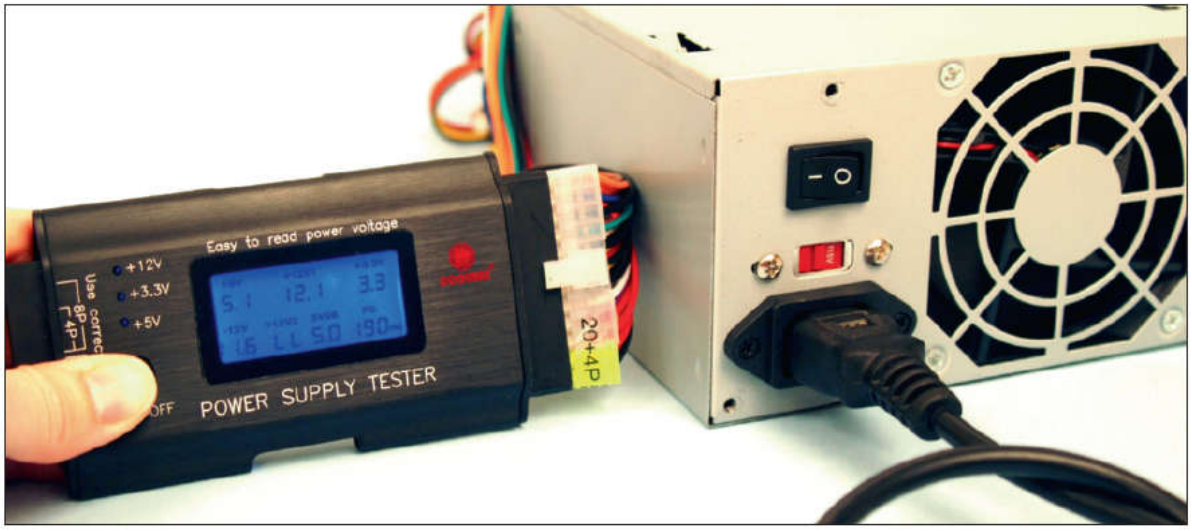
BASIC HARDWARE TOOLS

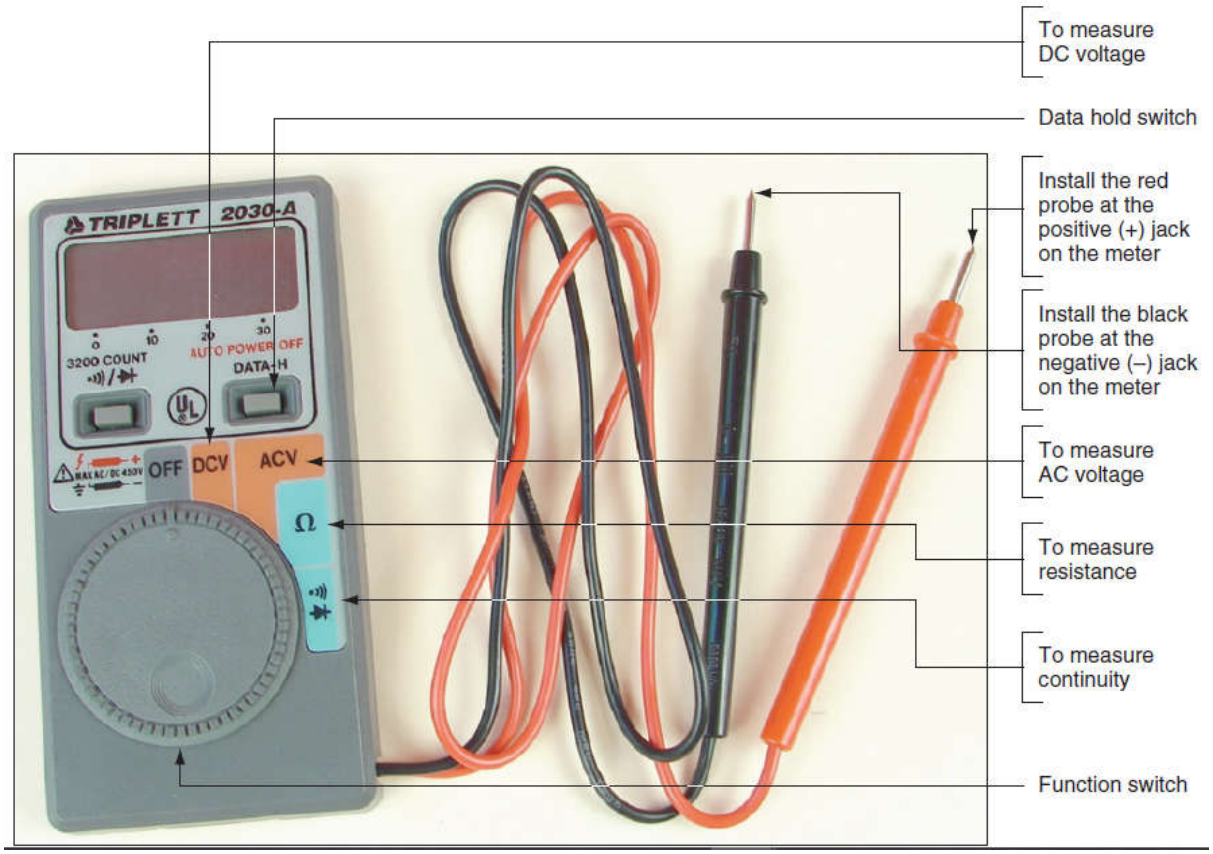
Several hardware and software tools can help you maintain a computer and diagnose and repair computer problems. Here is a list of essential tools:

- Ground bracelet, ground mat, or ground gloves to use when working inside the computer case.
- Flathead screwdriver
- Phillips-head or crosshead screwdriver
- Torx screwdriver set, particularly size T15
- Tweezers, preferably insulated ones, for picking pieces of paper out of printers or dropped screws out of tight places
- Recovery CD or DVD for any OS you might work on (You might need several, depending on the OSs you support.)
- Multimeter to check cables and the power supply output
- Cable ties to tie cables up and out of the way inside a computer case
- Flashlight to see inside the PC case
- Cleaning solutions and pads such as contact cleaner, monitor wipes, and cleaning
- solutions for CDs, DVDs, tapes, and drives
- Pen and paper for taking notes
- POST diagnostic cards
- Network cable Testers
- Power supply tester




Dust Off
XT
PartitionMagic
Cable ties
Network cable testers
AC ground tester
Multimeter


Easy to read power voltage
+12V
+3.3V
+5V
POWER SUPPLY TESTER
20+4P



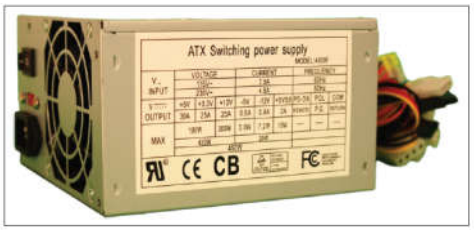
SELECTING A POWER SUPPLY

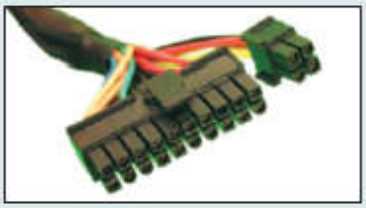
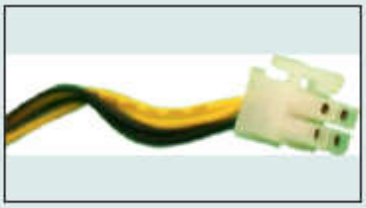
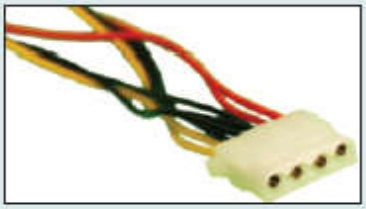
Now that you have a basic understanding of electricity, you are ready to take a closer look at the features of a power supply and how to select one. A **power supply**, also known as a **power supply unit (PSU)**, is a box inside a computer case that supplies power to the motherboard and other installed devices. Power supply serves as both a rectifier and transformer to convert AC house current to DC and to step down voltage from 110 V or 230 V to 3.5, 5, and 12 V.

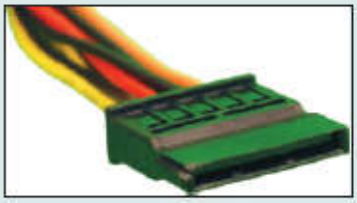
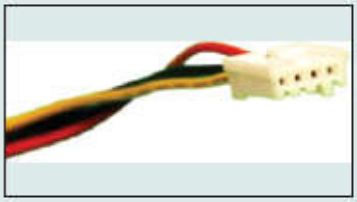
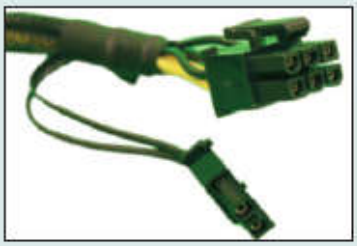
TYPES AND CHARACTERISTICS OF POWER SUPPLIES

As you select the right power supply for a system, you need to be aware of the following power supply features:

1. The form factor of a power supply determines the size of the power supply and the placement of screw holes used to anchor the power supply to the case
2. Consider the type and number of power cables and connectors the unit provides.
3. A power supply might have a **voltage selector switch** on the back. For example, the voltage selector switch on the power supply can be set to 230 V or 115 V. When in the United States, set the switch to 115 V. Be sure to never change the switch setting until you first turn off and unplug the power supply.



Connector	Description
	P1 20+4 pin connector is the main motherboard power connector
	P1 20+4 pin connector with four pins removed so the connector can fit into a 20-pin P1 motherboard connector
	4-pin 12 V auxiliary motherboard connector used for extra power to the processor
	8-pin 12 V auxiliary motherboard connector used for extra power to the processor, providing more power than the older 4-pin auxiliary connector
	Molex 4-pin connector is used for IDE drives

Connector	Description
	SATA connector used for SATA drives
	Floppy drive connector
	6-pin plus 2-pin +12 V connector is used by high-end video cards using PCIe x16 slots to provide extra voltage to the card. PCI Express, Version 1, uses the 6-pin connector and PCI Express, Version 2, uses the 8-pin connector. To get the 8-pin connector, combine both the 6-pin and 2-pin connectors

4. Every power supply has a fan inside its case; some have two fans. The fan can be mounted on the back or top of the PSU.
5. A power supply might have an on/off switch that controls power to the system
6. A power supply has wattage ratings, which are the amounts of power it can supply. These wattage capacities are listed in the documentation and on the side of a power supply.
7. Consider the warranty of the power supply and the overall quality. Some come in bright colors, and cables might be of higher quality than others. The more expensive power supplies are quieter, last longer, and don't put off as much heat as less expensive ones.

HOW TO SELECT A POWER SUPPLY

1. When selecting a power supply, match the form factor to that used by the case and motherboard, make sure it provides the connectors you need.
2. Match the wattage capacity to the requirements of the system. When deciding what wattage capacity, you need for the power supply, consider the total wattage requirements of all components inside the case as well as USB and FireWire devices that get their power from ports connected to the motherboard.
3. Consider the warranty, price, and the additional features you learned about in the previous section.

Potential danger that can cause damage

1. The power cord is frayed or otherwise damaged in any way.
2. Water or other liquid is on the floor around the device or spilled on it.
3. The device has been exposed to excess moisture.

4. The device has been dropped or you notice physical damage.
5. You smell a strong electronics odor.
6. The power supply or fans are making a whining noise.
7. You notice smoke coming from the computer case or the case feels unusually warm.

SAFETY PRECAUTIONS

Here are some important safety precautions that will help keep you and your equipment safe as you go through the process of taking it apart and putting it back together:

1. Make notes as you work so that you can backtrack later if necessary. (When you're first learning to take a computer apart, it's really easy to forget where everything fits when it's time to put it back together. Also, in troubleshooting, you want to avoid repeating or overlooking things to try.)
2. To stay organized and not lose small parts, keep screws and spacers orderly and in one place, such as a cup or tray.
3. Don't stack boards on top of each other: You could accidentally dislodge a chip this way.
4. When handling motherboards and expansion cards, don't touch the chips on the boards. Hold expansion cards by the edges. Don't touch any soldered components on a card, and don't touch the edge connectors unless it's absolutely necessary. All this helps prevent damage from static electricity.
5. To protect the chip, don't touch it with a magnetized screwdriver.
6. To protect both yourself and the equipment when working inside a computer, turn off the power, unplug the computer, and then press the power button to completely drain the power. Always use a ground bracelet.
7. Never touch the inside of a computer that is turned on.
8. Consider the monitor and the power supply to be "black boxes." Never remove the cover or put your hands inside this equipment unless you know about the hazards of charged capacitors, and have been trained to deal with them. Both the power supply and the monitor can hold a dangerous level of electricity even after you turn them off and disconnect them from a power source. The power supply and monitor contain enough power to kill you, even when they are unplugged.

TROUBLESHOOTING THE ELECTRICAL SYSTEM

Possible symptoms of a problem with the electrical system are:

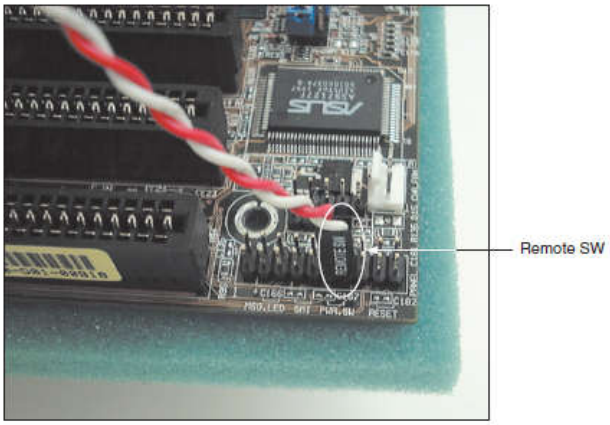
- The PC appears "dead"—no lights, no spinning drive, or fan.
- The PC sometimes halts during booting. After several tries, it boots successfully.
- Error codes or beeps occur during booting, but they come and go.
- You smell burnt parts or odours.
- The PC powers down at unexpected times.

PROBLEMS WITH EXTERNAL POWER

A brownout (reduced current) of the house current might cause symptoms of electrical power problems. If you suspect the house current could be low, check other devices that are using the same circuit. A copy machine, laser printer, or other heavy equipment might be drawing too much power. Remove the other devices from the same house circuit.

PROBLEMS WITH LOOSE INTERNAL CONNECTIONS

Loose connections inside the computer case can cause a system to appear dead or reboot itself. For most of the ATX and BTX power supplies, a wire runs from the power switch on the front of the case to the motherboard. This wire must be connected to the pins on the motherboard and the switch turned on before power comes up. Check that the wire is connected correctly to the motherboard. If you are not sure of the correct connection on the motherboard, see the motherboard documentation. While inside the case, check all power connections from the power supply to the motherboard and drives.



Power wire connected correctly on the motherboard.

PROBLEMS THAT COME AND GO

If a system boots successfully to the Windows desktop, you still might have a power system problem. Some problems are intermittent; that is, they come and go. Here are some symptoms that might indicate an intermittent problem with the electrical system after the boot:

- The computer stops or hangs for no reason. Sometimes it might even reboot itself.
- Memory errors appear intermittently.
- Data is written incorrectly to the hard drive.
- The keyboard stops working at odd times.
- The motherboard fails or is damaged.
- The power supply overheats and becomes hot to the touch.
- The power supply fan becomes very noisy or stops.

PROBLEMS WITH AN INADEQUATE POWER SUPPLY

If you have just installed a new device such as a second hard drive or a DVD drive and are concerned that the power supply is not adequate, you might test it after you finish the installation. Make all the devices in your system work at the same time. For instance, you can make two hard drives and the DVD drive work at the same time by copying files from one hard drive to the other while playing a movie on the DVD. If the new drive and the other drives each work independently, but data errors occur when all work at the same time, suspect a shortage of electrical power. If you prefer a more technical approach, you can estimate how much total wattage your system needs by calculating the watts required for each device and adding them together. A system with a standard power supply of about 250 watts that has multiple hard drives, multiple CD drives, and several expansion cards is most likely operating above the rated capacity of the power supply, which can cause the

system to unexpectedly reboot or give intermittent, otherwise unexplained, errors. If the power supply is grossly inadequate, it will whine when you first plug up the power. Upgrade the power supply as needed to accommodate an overloaded power system.

PROBLEMS WITH A FAULTY POWER SUPPLY

If you suspect the power supply is faulty, you can test it using either a power supply tester (the easier method) or a multimeter (the more tedious method). However, know that a power supply that gives correct voltages when you measure it might still be the source of problems, because power problems can be intermittent. Also be aware that an ATX power supply monitors the range of voltages provided to the motherboard and halts the motherboard if voltages are inadequate. Therefore, if the power supply appears "dead," your best action is to replace it.

PROBLEMS WITH THE POWER SUPPLY FANS

An improperly working fan sometimes causes power supply problems. Usually just before a fan stops working, it hums or whines, especially when the PC is first turned on. If this has just happened, replace the fan if you are trained to service the power supply. If not, replace the entire power supply. If you replace the power supply or fan and the fan still does not work, assume the problem wasn't the fan. A short somewhere else in the system drawing too much power might cause the problem. **Don't operate the PC if the fan does not work.** Computers without cooling fans can quickly overheat and damage chips. To troubleshoot a non-functional fan, which might be a symptom of another problem and not a problem of the fan itself, follow these steps:

1. Turn off the power and remove all power cord connections to all components except the motherboard. Turn the power back on. If the fan works, the problem is with one of the systems you disconnected, not with the power supply, the fan, or the motherboard.

2. Turn off the power and reconnect one card or drive at a time until you identify the device with the short.

3. If the fan does not work when all devices except the motherboard are disconnected, the problem is the motherboard or the power supply. Since the power supply is less expensive and easier to replace than the motherboard, try replacing it first.

PROBLEMS WITH OVERHEATING

If a computer powers down after it has been operating for a few minutes or a few hours, the problem might be caused by overheating. Leave the system turned off for about 30 minutes and then try again. If the computer works for a while and then stops again, check its internal temperature. You might need to install additional fans.

POWER PROBLEMS WITH THE MOTHERBOARD

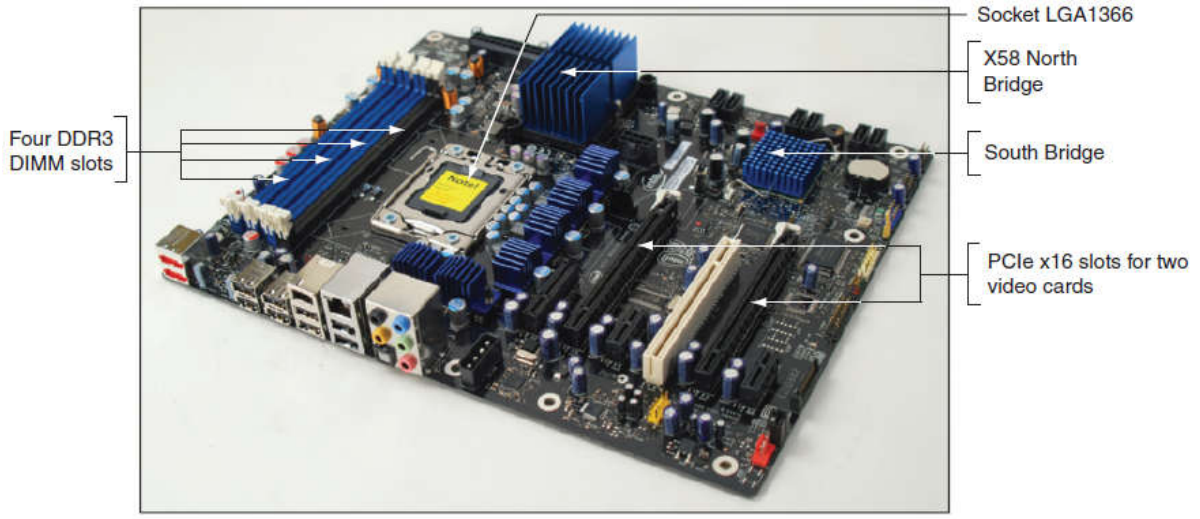
The motherboard, like all other components inside the computer case, should be grounded to the chassis. Look for a metal screw that grounds the board to the computer case. However, a short might be the problem with the electrical system if some component on the board makes improper contact with the chassis. This short can seriously damage the motherboard.

REPLACING THE POWER SUPPLY

The easiest way to fix a power supply you suspect is faulty is to replace it. When selecting a replacement power supply, be sure the new power supply uses the correct form factor that provides the correct output voltages, is adequately rated for power in watts, and has all the power connectors needed by your system. To determine if the power supply really is the problem, turn off the PC, open the computer case, and set the new power supply on top of the old one. Disconnect the old power supply's cords and plug the PC devices into the new power supply. Turn on the PC and verify that the new power supply solves your problem before installing it.

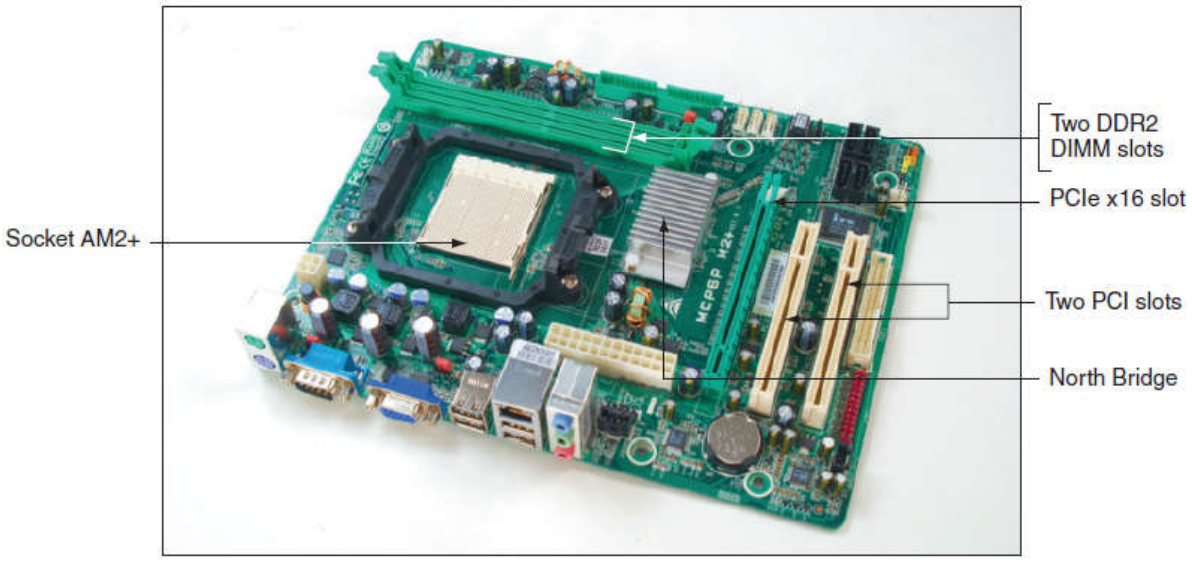
MOTHERBOARD TYPES

When you put together a computer from parts, generally you start with deciding on which processor and motherboard you will use. Everything else follows those decisions. Generally, you will need to pay attention to form factor, processor sockets, chipsets, buses and number of bus slots, and other connectors, slots, and ports.

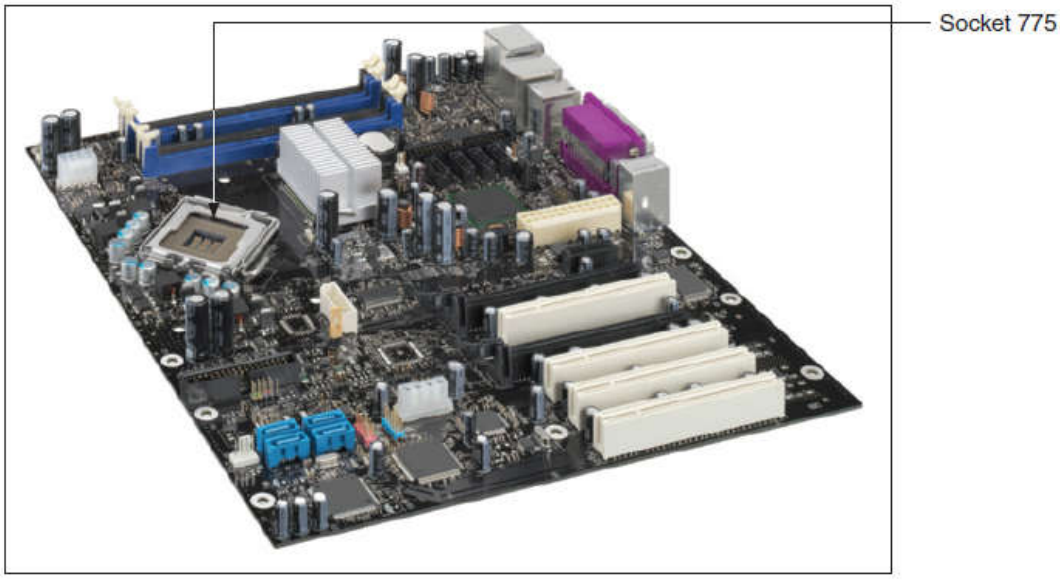


MOTHERBOARD FORM FACTORS

Recall that a motherboard form factor determines the size of the board and its features that make it compatible with power supplies, cases, processors, and expansion cards. The most popular motherboard form factors are ATX, MicroATX, FlexATX, BTX, and NLX, in that order. Each form factor has several sizes for motherboards. In addition to these form factors, you might encounter the ITX form factor. It's smaller than a MicroATX and sometimes used in home theatre systems.



Micro ATX board



BTX motherboard

PROCESSOR SOCKETS

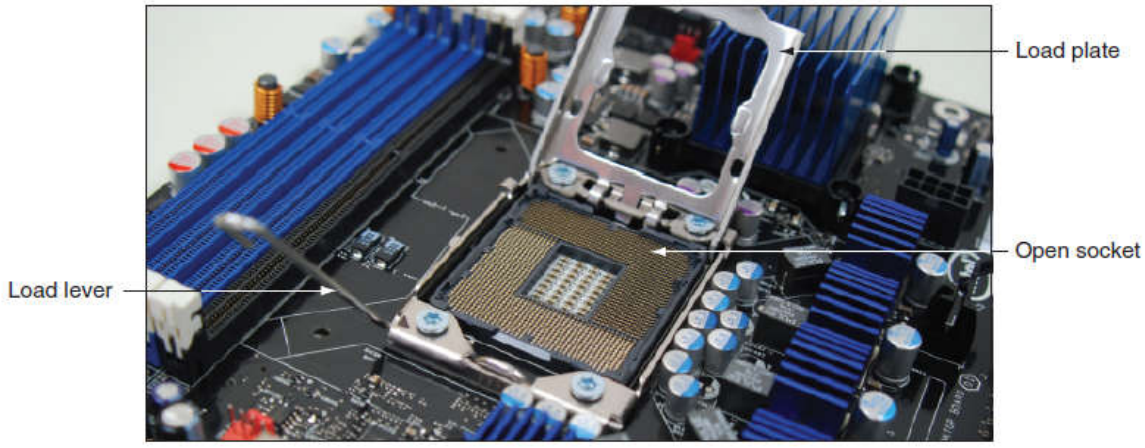
Another important feature of a motherboard is the processor socket. This socket and the chipset determine which processors a board can support. A socket will hold either an Intel or AMD processor. Also know that Intel makes several Itanium and Xeon processors designed for servers. These server processors use different sockets than those listed in the table. Earlier Pentiums used a **pin grid array (PGA)** socket, with pins aligned in uniform rows around the socket. Later sockets used a **staggered pin grid array (SPGA)**, with pins staggered over the socket to squeeze more pins into a small space. Small pins can easily be bent as the processor is installed in the socket. Later Intel sockets use a **land grid array (LGA)** that uses lands rather than pins.
AMD has chosen to use the PGA socket architecture for its desktop processors. Also, look at the motherboard documentation for a list of processors that the motherboard supports. It is not likely to support every processor that uses its socket because the motherboard chipset is designed to only work with certain processors.

Intel Socket Names	Used by Processor Family	Description
LGA1366 or Socket B	**Core i7**	• **1366 pins that touch pads on the processor** • **Works with DDR3 memory** • **Expected to replace LGA771 and LGA775 sockets**
LGA771 or Socket J	**Core 2 Extreme**	• **771 pins that touch pads on the processor Used on high-end workstations and low-end servers** • **Works with DDR2 memory on boards that have two processor sockets**
LGA775 or Socket T	**Core 2 Extreme Core 2 Quad Core 2 Pentium Dual-Core Pentium Extreme Edition Pentium D Pentium Pentium 4 Many Celeron processors**	• **775 lands or pads** • **Works with DDR3 and DDR2 memory** • **Duo Most popular Intel socket**
Socket 478	**Pentium 4 Celeron processors**	• **478 holes for pins** • **Uses a dense micro PGA (mPGA)** • **No longer sold**
Socket 423	**Pentium 4**	• **423 holes for pins** • **39 x 39 SPGA grid** • **No longer sold**

Sockets for Intel processors used for desktop computers

AMD Socket	Used by Processor Family	Description
AM3 or AMD3	Phenom II	◢ 938 holes for pins (PGA) ◢ Works with DDR3 memory
AM2+ or AMD2+	Phenom II, Phenom, and Athlon	◢ 940 holes for pins (PGA) ◢ Works with DDR2 memory ◢ Faster than AMD2
AM2 or AMD2	Athlon and Sempron	◢ 940 holes for pins (PGA) ◢ Works with DDR2 memory
Socket 754	Athlon and Sempron	◢ 754 holes for pins (PGA) ◢ Works with DDR memory
Socket 940	Athlon	◢ 940 holes for pins (PGA) ◢ Works with DDR memory
Socket 939	Athlon and Sempron	◢ 939 holes for pins (PGA) ◢ Works with DDR memory ◢ No longer sold
Socket A	Athlon, Sempron, and Duron	◢ 462 holes for pins (PGA) ◢ Works with DDR memory ◢ Rarely sold today

Sockets for AMD processors used for desktop computers

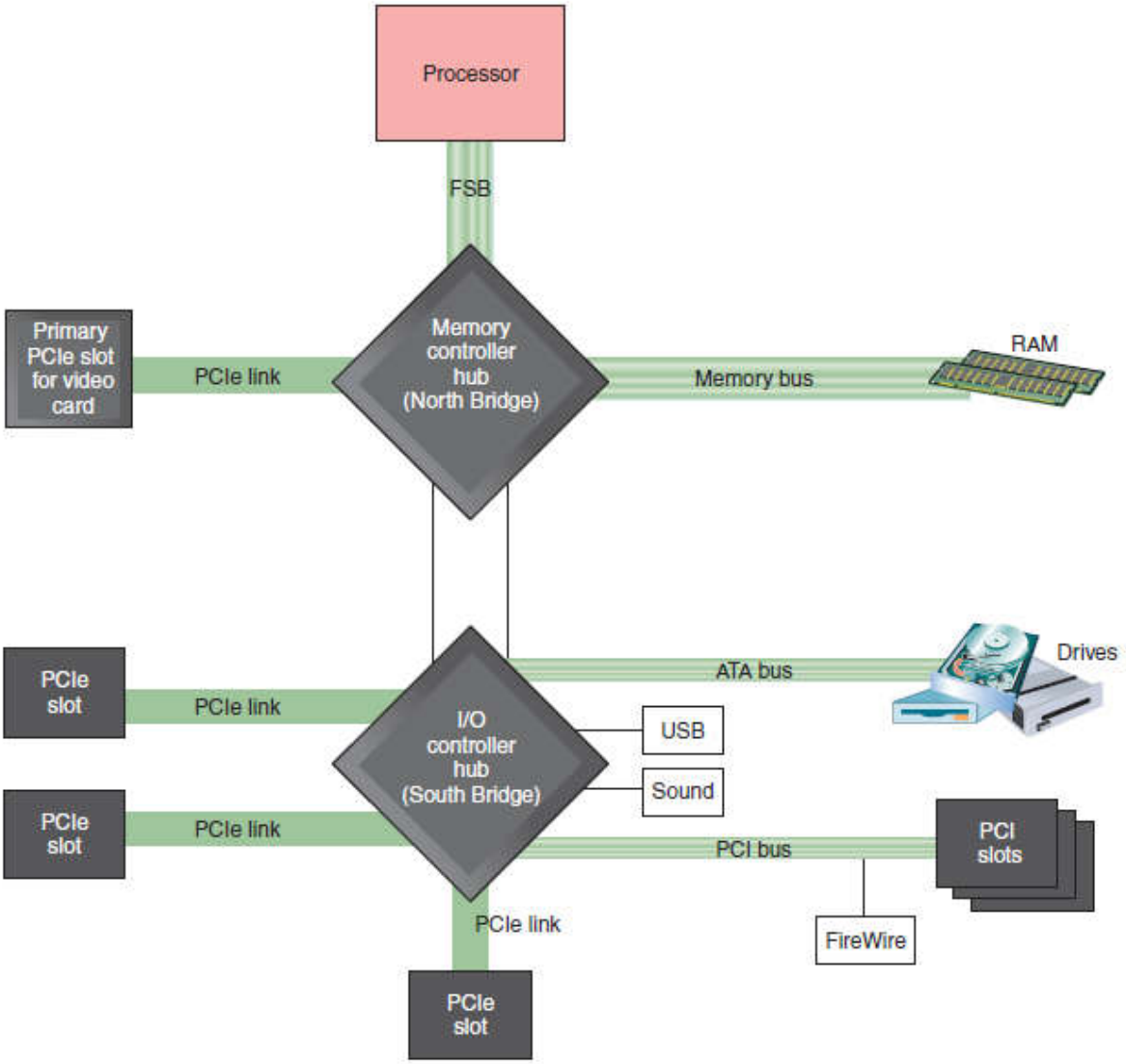


Pin grid array

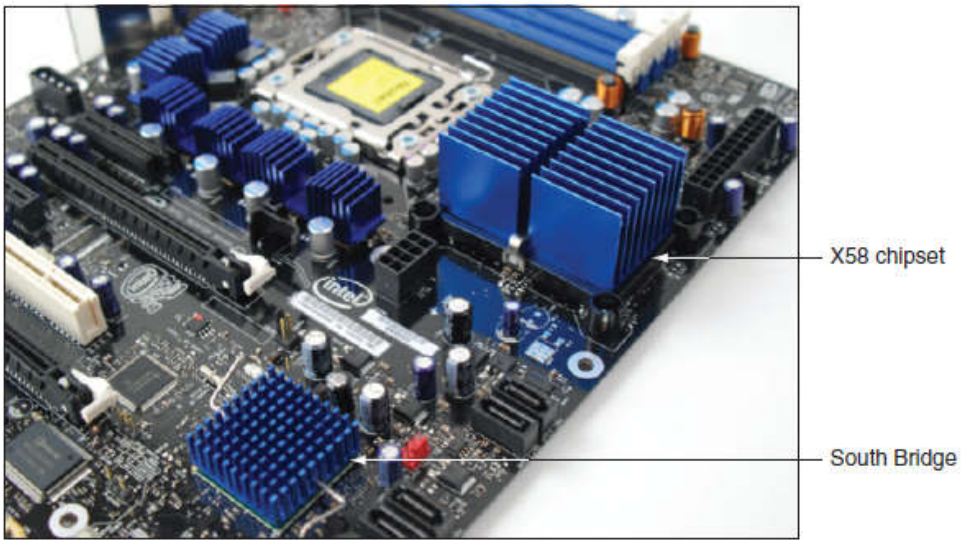
land grid array

THE CHIPSET

A chipset is a set of chips on the motherboard that collectively controls the memory, buses on the motherboard, and some peripherals. A few motherboard manufacturers, such as Intel and AMD, make their own chipsets. But other motherboard manufacturers use chipsets made by another manufacturer. The major chipset manufacturers are Intel (*www.intel.com*), AMD (*www.amd.com*), NVIDIA (*www.nvidia.com*), and SiS (*www.sis.com*), in that order. The fast end of the hub, which contains the graphics and memory controller, connects to the system bus and is called the hub's **North Bridge**. The slower end of the hub, called the **South Bridge**, contains the I/O controller hub. All I/O devices, except display and memory, connect to the hub by using the slower South Bridge. On a motherboard, when you see two major chips for the chipset, one is controlling the North Bridge and the other is controlling the South Bridge.



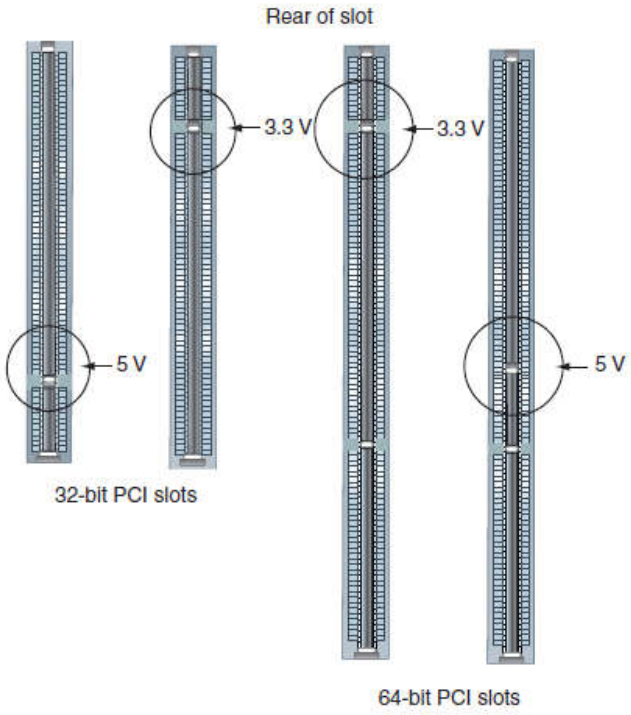
The chipset's North Bridge and South Bridge control access to the processor for all components



BUSES AND EXPANSION SLOTS

Conventional PCI

The first PCI bus had a 32-bit data path, supplied 5 V of power to an expansion card, and operated at 33 MHz. It was the first bus that allowed expansion cards to run in sync with the CPU.

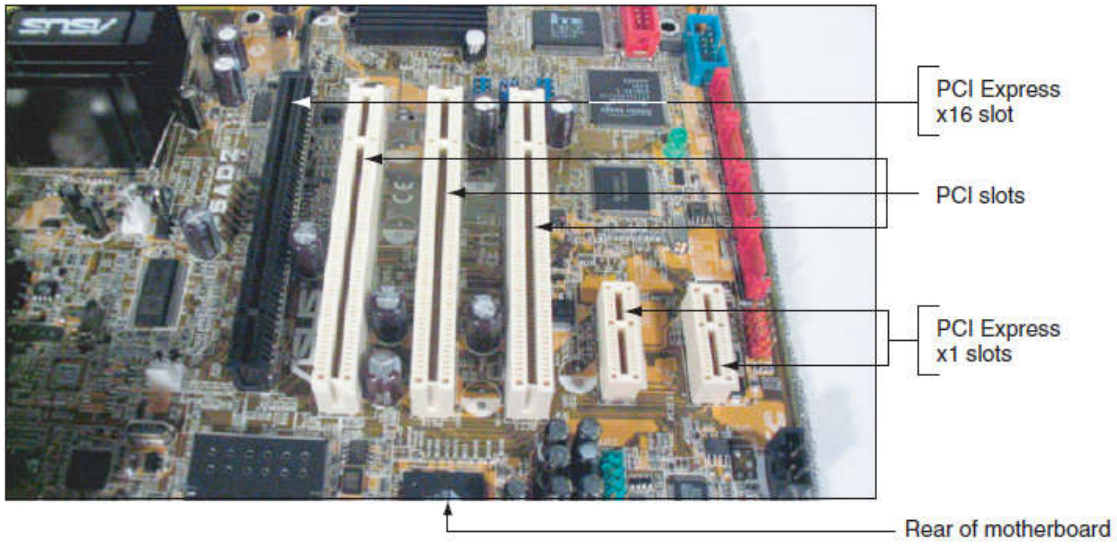


PCI-X

The next evolution of PCI is PCI-X, which has had three major revisions; the latest is PCI-X 3.0. All PCI-X revisions are backward compatible with conventional PCI cards and slots, except 5-V PCI cards are no longer supported.

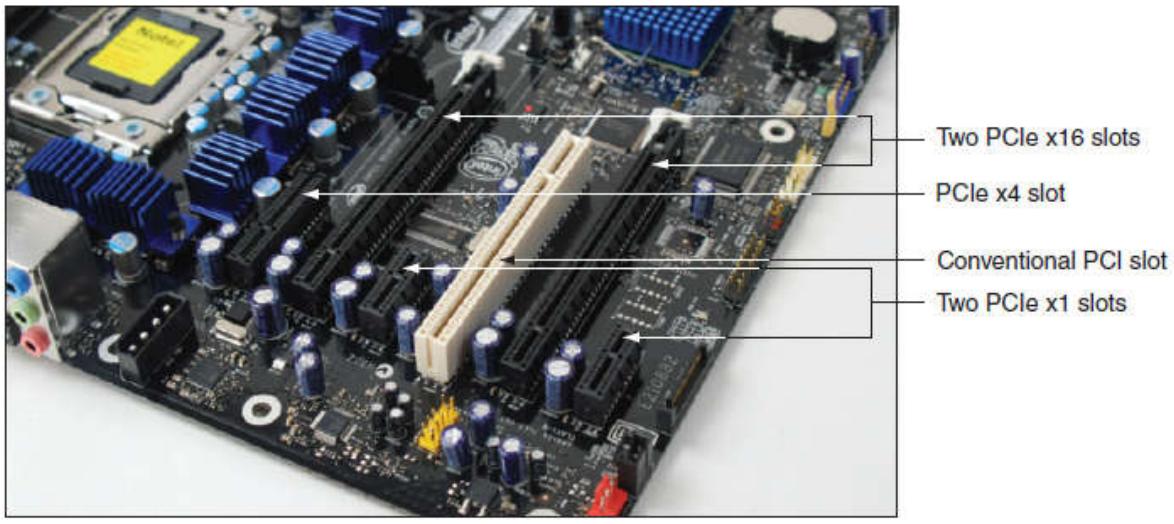
PCI Express

PCI Express (PCIe) uses an altogether different architectural design than conventional PCI and PCI-X; PCIe is not backward compatible with either. PCI Express slot for a PCIe card has its own link or bus to the South Bridge, and one PCI Express slot has a direct link to the faster memory controller hub or North Bridge. This last PCI Express slot is intended to be used by a PCIe video card.



PCI Express currently comes in four different slot sizes called PCI Express x1 (pronounced “by one”), x4, x8, and x16. Figure 3-15 shows three of these slots. PCIe slots are not as tall and the pins closer together

than the conventional PCI slot. A PCI Express x1 slot contains a single lane for data, which is actually four wires. One pair of wires is used to send data and the other pair receives data, one bit at a time. The x16 slot contains 16 lanes, each lane timed independently of other lanes. The more lanes you have, the more data gets transmitted in a given time. Therefore, a x16 slot is faster than a x4 slot, which is faster than a x1 slot. A shorter PCI Express card (such as a x1 card) can be installed in a longer PCI Express slot (such as a x4 slot). There has been one minor revision of PCIe (version 1, 2 etc). How do you know what version PCIe card or slot you have? You can't tell by looking at the card or slot, so you have to depend on finding the information in the documentation, user manual, or manufacturer Web site.



THE AGP BUSES

Motherboard video slots and video cards used the **Accelerated Graphics Port (AGP)** standardsfor many years, but AGP has mostly been replaced by PCI Express. Even though AGP is a dying technology, you still need to know how to support it. A motherboard will have a PCI Express x16 slot or an AGP slot, but not both.