COURSE TECHNOLOGY
CENGAGE Learning™

A+ Guide to Hardware: Managing, Maintaining, and Troubleshooting, 5e

Chapter 2

Form Factors, Power Supplies, and Working Inside a Computer

Objectives

- Learn about different form factors used for computer cases, motherboards, and power supplies
- Learn how electricity is measured and about electrical components
- Learn how to select a power supply
- Learn how to protect yourself and your equipment against the dangers of electricity
- Learn how to work inside a computer case
- Learn how to troubleshoot electrical problems

Form Factors Used By Computer Cases, Motherboards, and Power Supplies

- Computer case, motherboard, power supply
  - Interconnected system
  - Must be compatible

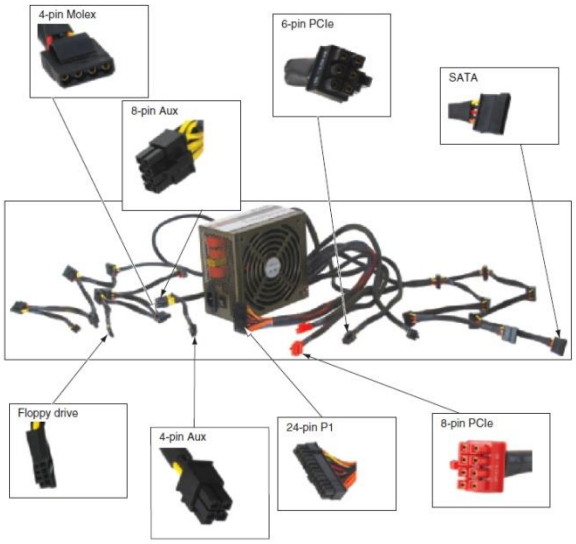


Figure 2-1 Computer power supply with connectors
Courtesy: Course Technology/Cengage Learning

Form Factors Used By Computer Cases, Motherboards, and Power Supplies

- Form factor
  - Refers to the physical dimensions that specifies size, shape, and features of a device
    - Determined by motherboard
- Using the same form factor (PSU, motherboard and case) assures
  - Motherboard fits the case
  - Powers supply cords provide proper voltage
  - Motherboard and case holes align properly
  - Case and motherboard ports align
  - Wires on case match connections on motherboard
  - Power supply holes align with case

Types of Form Factors

- Intended use
  - Influences computer case, motherboard, power supply selection (form factor)

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

Table 2-1 Form factors

Types of Form Factors (cont'd.)

- AT form factor
  - P8/P9 connector to supply electrical requirements to the motherboard
- ATX form factor
  - Most common
  - Three major differences
    - Main power connector is now a 20-pin keyed
    - Cooling fan pours cool air over the motherboard
    - Additional connectors supply voltage for drives (+3.3v)
  - Motherboard dimensions: up to 12" x 9.6"

Types of Form Factors (cont'd.)

- Versions
  - Original ATX form factor used P1 connector
  - ATX Version 2.1 specifications added 2-pin auxiliary connector
  - ATX Version 2.2 allowed for 22-pin P1 connector
  - Version 2.2 provides +12 volts, +5 volts, and +3.3 volts pins
- Motherboard offers soft switch feature

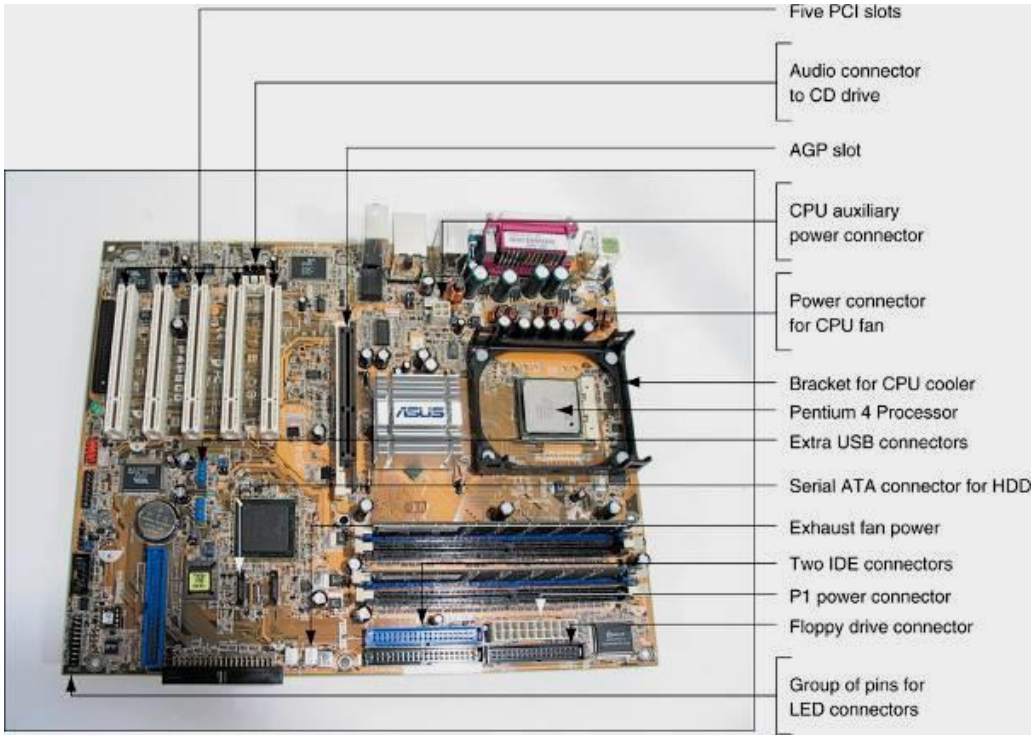


Figure 2-2 The CPU on an ATX motherboard sits opposite the expansion slots and does not block the room needed for long expansion cards
Courtesy: Course Technology/Cengage Learning

Types of Form Factors (cont'd.)

- MicroATX form factor
  - Reduces total cost of a system
- FlexATX
  - Variation of MicroATX with maximum flexibility
- BTX (Balanced Technology Extended) form factor
  - Reduces heat with better airflow
- NLX form factor
  - Developed to improve older and similar LPX form factor

Figure 2-7 This MicroATX motherboard by Biostar is designed to support an AMD processor
Courtesy: Course Technology/Cengage Learning

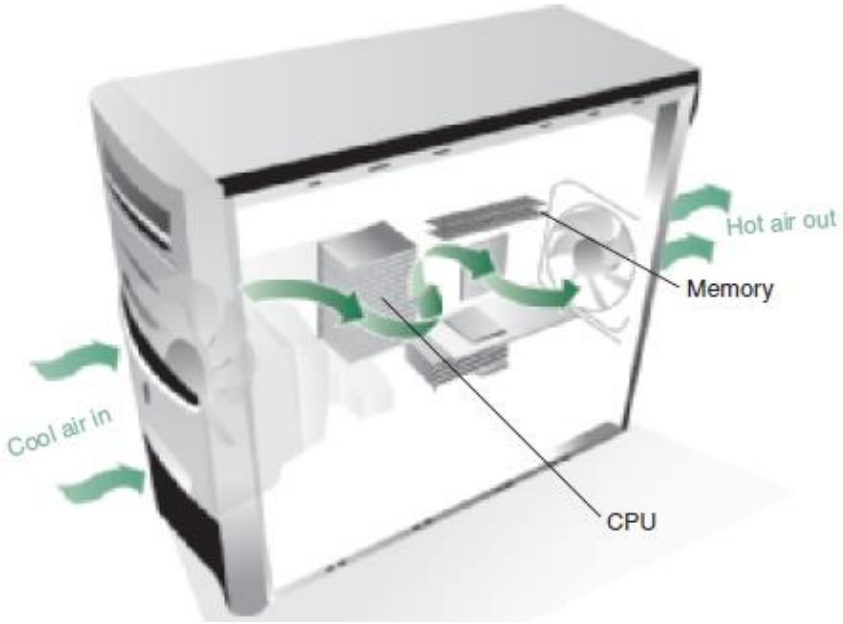


Figure 2-8 Improved airflow in a BTX case and motherboard makes it unnecessary to have a fan on top of the processor
Courtesy: Course Technology/Cengage Learning

Types of Computer Cases

- Computer case (chassis)
  - Houses power supply, motherboard, cards, drives
  - Panel switches/lights to control/monitor PC
  - Ports connecting cables to motherboard
    - Mounted on front, top, side, rear
  - Match power supply to system electrical needs

Types of Computer Cases (cont'd.)

- Desktop cases
  - Motherboard on bottom; power supply to the rear
- Tower cases
  - Up to 2 feet high; can contain several drives
- Notebook cases
  - Used for all portables; includes desktop components

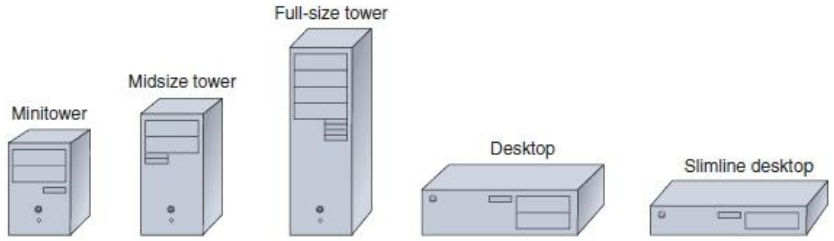


Figure 2-11 Tower and desktop cases
Courtesy: Course Technology/Cengage Learning

Measures and Properties of Electricity

- Successful PC technicians:
  - Understand electricity
  - Know how to use electricity
  - Know how to measure electricity
  - Can protect computer equipment from electricity
- Units used to measure characteristics of electricity
  - Volt, amp, ohm, watt

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.

Table 2-3 Measures of electricity

AC and DC

- Alternating current (AC)
  - Oscillatory current driven by an alternating voltage
    - Example: house current oscillates at 60 Hz
- Direct current (DC)
  - Single direction current driven by constant voltage
    - Required by computer in small amounts, such as 5 V
- Power supply acts as a transformer and rectifier
  - Rectifier: converts AC to DC
  - Transformer: changes ratio of current to voltage

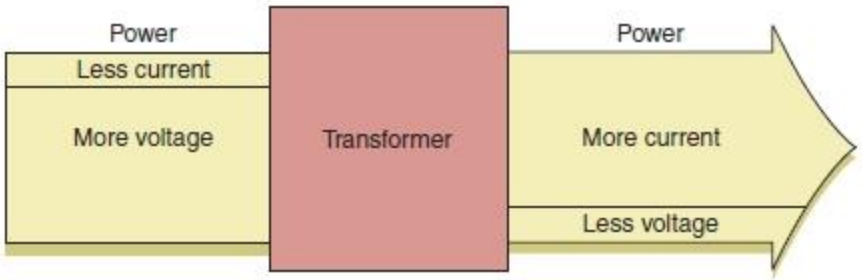


Figure 2-14 A transformer keeps power constant but changes the ratio of current to voltage
Courtesy: Course Technology/Cengage Learning

Hot, Neutral, and Ground

- Completing a circuit:
  - AC travels from power station to house on a hot line
  - AC travels from panel to device using black (hot) wire
  - AC flows out of device circuit in a white (neutral) wire
  - AC returns to power station on a neutral line
- Short circuit: failure due to excess flow of electricity
  - Fuses protect circuits by melting wire (breaking circuit)
  - Grounded neutral lines pass detoured AC to earth
- Lines in three-prong plugs: hot, neutral, ground
  - Receptacle tester verifies outlet wiring

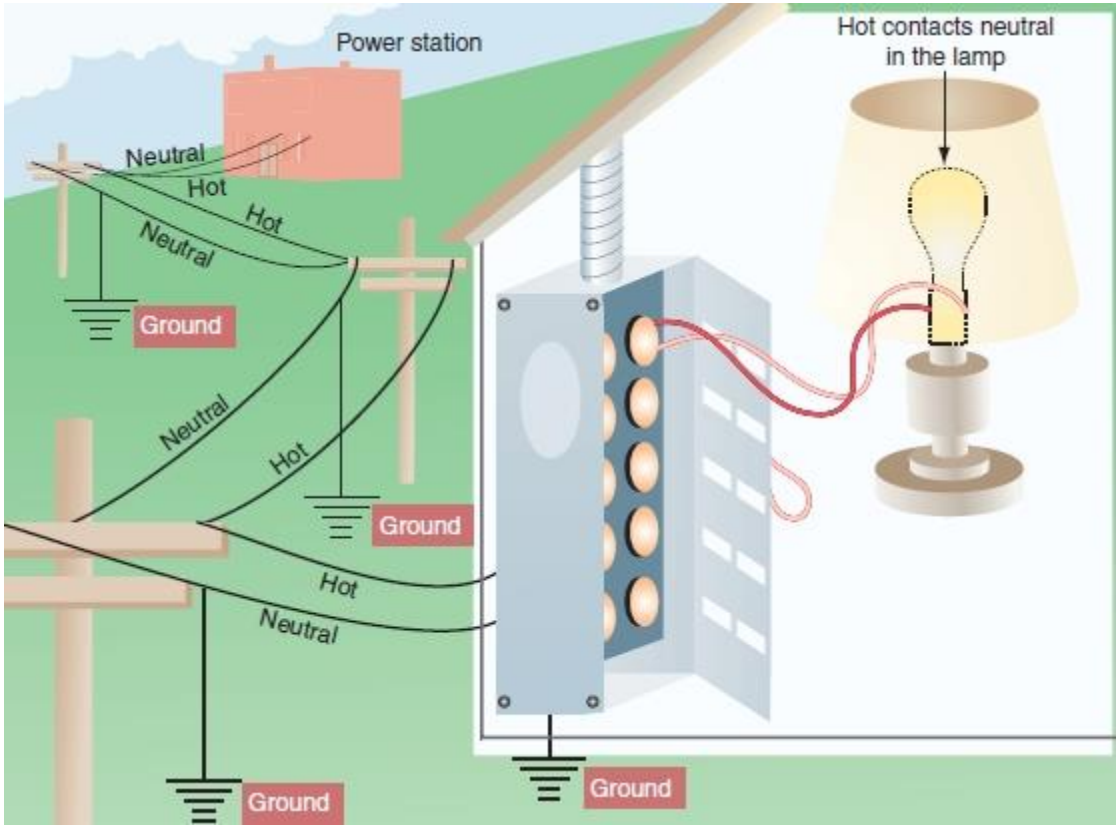


Figure 2-15 Normally, electricity flows from hot to neutral to make a closed circuit in the controlled environment of an electrical device such as a lamp
Courtesy: Course Technology/Cengage Learning

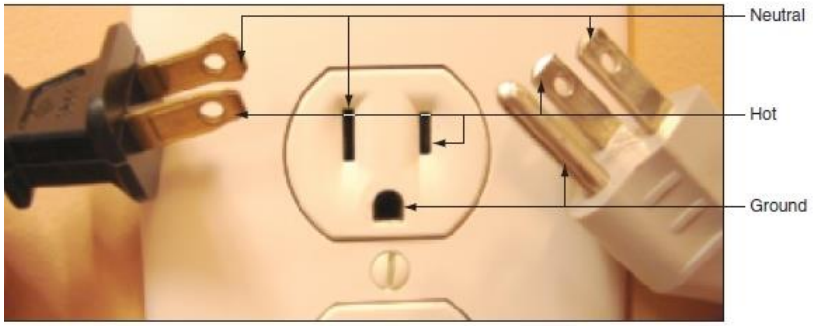


Figure 2-16 A polarized plug showing hot and neutral, and a three-prong plug showing hot, neutral, and ground
Courtesy: Course Technology/Cengage Learning

Figure 2-17 Use a receptacle tester to verify that hot, neutral, and ground are wired correctly
Courtesy: Course Technology/Cengage Learning

Some Common Electronic Components

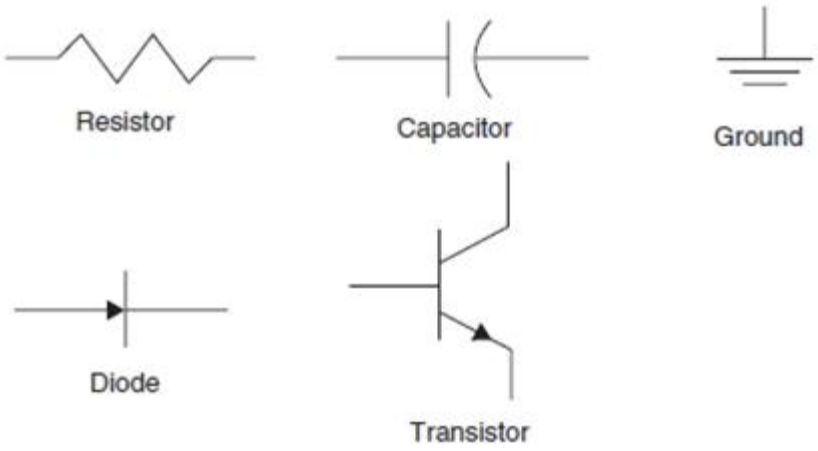


Figure 2-18 Symbols for some electronic components and for ground
Courtesy: Course Technology/Cengage Learning

Some Common Electronic Components (cont'd.)

- Materials to make components:
  - Conductors: weakly resist current flow (copper)
  - Insulators: highly resist current flow (ceramics)
  - Semiconductors: allow flow if charged (silicon)
- Transistor
  - Switches current on (1) and off (0)
  - Amplifies current
  - Contains three layers of semiconductor material
  - Charge applied to center layer
    - Controls switching

Some Common Electronic Components (cont'd.)

- Capacitor
  - Holds electrical charge for a period of time
  - Creates even flow of current in a PC
- Diode
  - Allows electricity to flow in one direction only
  - Rectifies current (convert AC to DC)
- Resistor
  - Controls amount of current flowing through device
  - Degree of resistance is measured in ohms

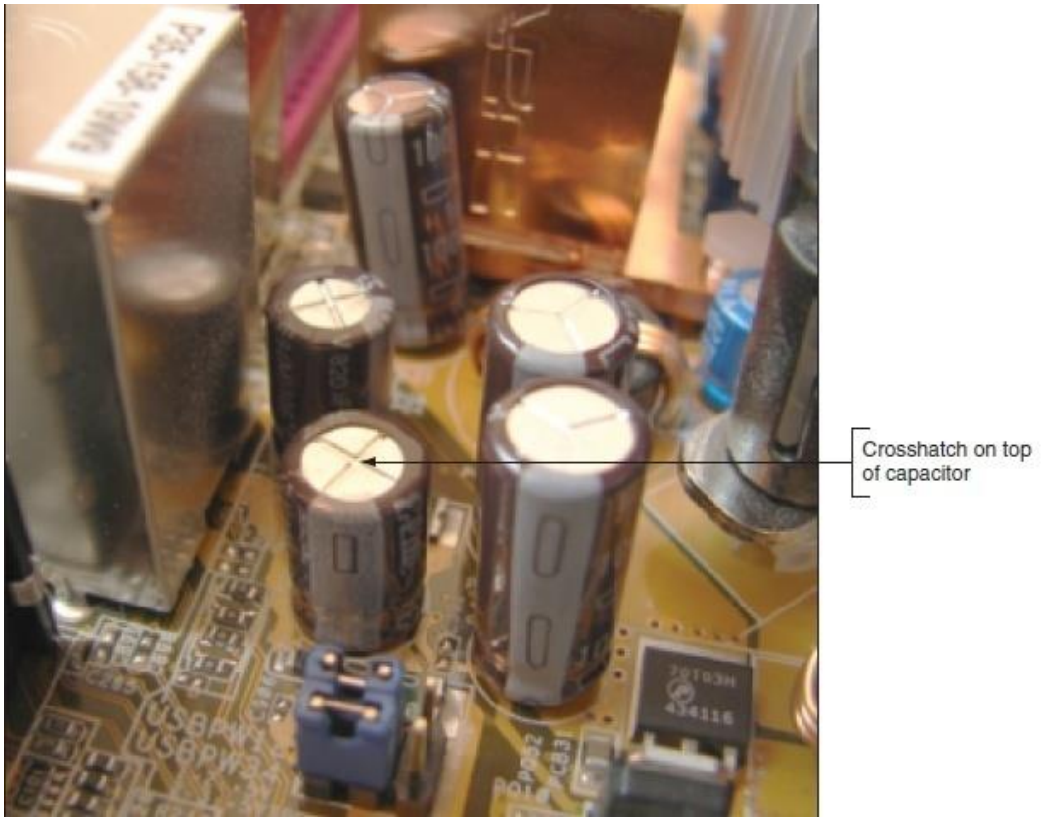


Figure 2-19 Capacitors on a motherboard or other circuit board often have embedded crossed lines on top
Courtesy: Course Technology/Cengage Learning

Power Supply

- Power supply or power supply unit (PSU)
  - Microprocessor → computer's brain and the power supply is its heart
  - In a personal computer (PC), the power supply is the metal box usually found in a corner of the case. The power supply is visible from the back of many systems because it contains the power-cord receptacle and the cooling fan
  - Box inside a computer case supplying power to motherboard and other installed devices

Power Supply

- The main tasks of power supply
  - Both a rectifier and transformer
    - Converts AC house current to regulated DC
    - Steps down voltage from 110 V or 220 V to 3.5, 5, and 12 V to provide the required voltages and currents that are needed to operate the components of the computer
- Power supply features:
  1. Form factor determines power supply size
  2. Wattage ratings
     - Maximum amount of power watts required by the computer

Characteristics of Power Supply

- Depends on the components of the computer
- Available PC power-supply ratings are as follows:
  - AT clone: 250 watts
- 400-watt switching power supply will not necessarily use more power than a 250-watt supply. A larger supply may be needed if you use every available slot on the motherboard or every available drive bay in the personal computer case. It is not a good idea to have a 250-watt supply if you have 250 watts total in devices, since the supply should not be loaded to 100 percent of its capacity

Characteristics of Power Supply

- According to PC Power & Cooling, Inc., some power consumption values (in watts) for common items in a personal computer are:

PC Item	Watts
Accelerated Graphics Port (AGP) card	20 to 30W
Peripheral Component Interconnect (PCI) card	5W
small computer system interface (SCSI) PCI card	20 to 25W
floppy disk drive	5W
network interface card	4W
50X CD-ROM drive	10 to 25W
RAM	10W per 128M
5200 RPM Integrated Drive Electronics (IDE) hard disk drive	5 to 11W
7200 RPM IDE hard disk drive	5 to 15W
Motherboard (without CPU or RAM)	20 to 30W
550 MHz Pentium III	30W
733 MHz Pentium III	23.5W
300 MHz Celeron	18W
600 MHz Athlon	45W

Characteristics of Power Supply

3. AC power voltage
   - AC power-line voltages and frequencies vary according to country:

United States: 120V/60 Hz

Canada: 120V/60 Hz

United Kingdom: 240V/50 Hz

Europe: 220V/50 Hz

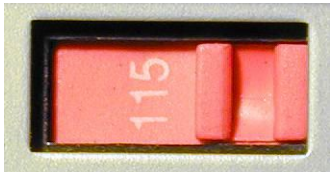
Japan: 100V/50 Hz

Kuwait: 240V/50 Hz

4. Type and number of power cables, and connectors
5. Warranty and overall quality

Components of Power Supply

- External items of ATX Power Supply
  - The AC input socket for the main AC power cord.
  - The input voltage selector switch. This switch must be set to match the AC line voltage to which the computer will be connected



  - AC output socket for monitor
  - The air vents for the cooling fan

- External items of ATX Power Supply (contd)
  - The power switch
    - Older form factor desktop PC/XT cases had the power switch at the back of the machine, usually on the right side of the case
    - Starting with the AT form factor, tower cases changed to a remote, physical toggle power switch that was connected to the power supply using a cable
    - Starting with the ATX/NLX form factor, the way the power switch works has been changed altogether. Instead of using a physical toggle switch connected to the power supply, on modern systems the power switch is electronic. It connects to the motherboard, much the way that the reset switch does, using a feature called soft power. So on an ATX system, when you press the power switch, you aren't really turning on the power supply; it is more like sending a "request" to the motherboard to turn the system on

Components of Power Supply

- Internal items of ATX Power Supply
  - Power Connectors:
    - The types of connectors used on computer power supplies are different. When looking at the ends of each connector we notice that some have flat-blades, some have round pins, and others have square pins.
    - There are five types of power connectors:
      - Motherboard Connector: The power supply in your computer has one 20-pin connector that supplies power to the motherboard. This style of power connector was introduced as part of the ATX form factor. It is a female 20-pin connector, which plugs into a male connector on your ATX motherboard.

Components of Power Supply

- Internal items of ATX Power Supply (contd.)
  - Large 4-pin DC connector (Molex): These large, round-pin type connectors with 4-pins are used for some drives like HDD. The connector is polarized so it can only be installed in one direction
  - Medium DC connector (Berg): these medium, square-pin type Connectors with 4-pins are used on some drives like FDD. The connector is polarized so it can only be installed in one direction
  - Small DC connector: this small, connector with 2 or 3 pins is sometimes used for the CPU cooler or other devices. Never plug this connector directly into the motherboard
  - Auxiliary 12V connector: this is 4-pin square type connector used to provide the motherboard with 12V power

Troubleshooting Power Supply

- Types of Power Supply Problems

1. Power Up Problems: problems occurred during cold boot up
   - Symptom:
     - System is completely dead after power-up (no fan noise, LED indicators do not turn on)
   - Possible faults:
     - AC power cord
     - Blown fuse in power supply
   - Troubleshooting procedures:
     - Check AC power-cord connection: Plug the cord into another power socket (make sure AC wall outlet is good)
     - Substitute good power supply

Troubleshooting Power Supply

- Symptom:
  - System shuts off almost immediately or emits a continuous beep or repeating short beeps
- Possible faults:
  - New adapter card is overloading the power supply
  - Defective adapter card or motherboard
  - Defective power supply
- Troubleshooting procedures:
  - Remove all adapter cards and check power-supply status after power-up
  - If power supply shuts down with only the motherboard connected, substitute good power supply
  - Add adapter cards one at a time while checking power-supply status (remember to turn off power when removing or inserting cards)

Troubleshooting Power Supply

2. In-Use Problems: problems occurred during working on PC
   - Symptom:
     - System reboots or shuts down while in use
   - Possible faults:
     - AC power-line disturbance
     - Defective power supply
     - Thermal problems; e.g., clogged vent
   - Troubleshooting procedures:
     - Check AC power line
     - Substitute good power supply

Troubleshooting Power Supply

Cooling the PC:

Cooling Methods

Includes the methods or components used by the manufacturer for cooling the PC

- Some of the available replacement power supplies have higher-capacity cooling fans than the originals, which can greatly prolong system life and minimize overheating problems—especially for the newer, hotter-running processors. If system noise is a problem, models with special fans can run more quietly than the standard models.

Troubleshooting Power Supply

These power supplies often use larger-diameter fans that spin more slowly, so they run more quietly but move the same amount of air as the smaller fans.

- Ventilation in a system is also important. You must ensure adequate airflow to cool the hotter items in the system.
- Heat-sink is a piece of metal usually Aluminum to dissipate the heat generated by the CPU, the larger the surface the better.

Troubleshooting Power Supply

Cooling Techniques

Includes the techniques and skills used by the user for cooling the PC

- If you have free expansion slots, you should space out the boards in your system to permit airflow between them.
- Place the hottest running boards nearest the fan or the ventilation holes in the system.
- Always be sure to run your computer with the case cover on, especially if you have a loaded system. With the cover off, the power supply fan no longer draws air through the system. Instead, the fan ends up cooling the supply only, and the rest of the system must be cooled by simple convection.

Troubleshooting Power Supply

- In addition, be sure that any empty slot positions have the filler brackets installed. If you leave these brackets off after removing a card, the resultant hole in the case disrupts the internal airflow and can cause higher internal temperatures.

Troubleshooting Power Supply

- Repairing Power Supply:
  - It is rarely recommended that an inexperienced user open a power supply to make repairs because of the dangerous high voltages present. Even when unplugged, power supplies can retain dangerous voltage and must be discharged (like a monitor) before service.
  - Also the price of the power supply is cheap.
  - So repairing a power supply is by replacing it.

How to Select a Power Supply

- Considerations
  - Match form factor to case, motherboard
  - Make sure it provides necessary connectors
  - Match wattage capacity to system requirements
  - Consider warranty, price, and additional features
- Determining wattage capacity
  - Consider all components inside case
  - Consider USB and FireWire devices
    - Get power from ports connected motherboard

How to Select a Power Supply (cont'd.)

- Point to keep in mind
  - It may have two ratings
    - Room temperature (peak rating)
    - Continuous operation (actual rating)
  - Video cards draw the most power
  - Use power supply rated 30 percent higher than expected
  - Web sites have wattage calculators
  - Never use Dell power supply with non-Dell motherboard
    - Pinout verification or pinout converter

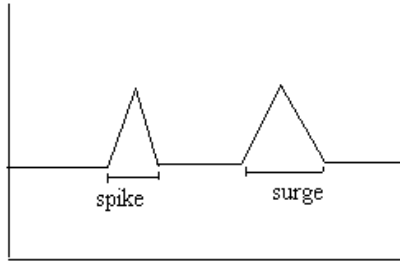
Devices	Approximate Wattage
Moderately priced motherboard, processor, RAM, keyboard, and mouse	100 watts
High-end motherboard, processor, RAM, keyboard, and mouse	100 to 150 watts
Fan	5 watts
IDE hard drive	25 watts
SATA or SCSI hard drive	35 watts
CD-RW drive	25 watts
DVD-RW or Blu-ray drive	35 watts
Tape drive	25 watts
Low-end AGP or PCI video card	40 watts
Moderately priced video card	100 watts
High-end PCIe x16 video card	150–300 watts
PCI card	20 watts
PCI e x16 card	100 watts
Liquid cooling system	50–150 watts

Table 2-5 To calculate power supply rating, add up total wattage

Power Disturbance

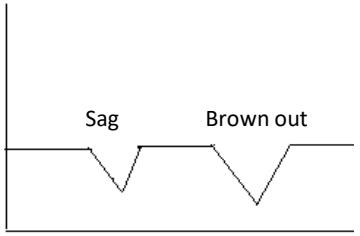
- Power Disturbances

1. Complete power failure:
   - Power-line voltage drops to zero for extended periods of time Consequences: data loss
2. Transients:
   - It is an over voltage condition caused by lighting or electric motors resulting in possible permanent system damage
   - Classified as:
     - Spikes (nanosecond)
     - Surges (millisecond)



Power Disturbance

3. Sags
   - It is an under voltage condition where voltage dips below voltage required by power supply resulting in data loss.
   - Classified as:
     - Voltage sag (milliseconds)
     - Brown out (longer seconds)



•Causes of Power-Line Disturbances

1.Power Company
   - Disturbances in power supplied by utility company may be intentional or due to natural causes; e.g., lightning

Power Disturbance

2. Building-related
   - Power fluctuations may be caused by faulty or inadequate building wiring
   - Building machinery; e.g., air conditioners, lighting, heating systems
3. User wiring
   - Multiple PCs plugged into the same power line
   - PCs plugged into power line shared by high-current machines; e.g., laser printers, air conditioners, coffee makers, copiers, etc.
   - PC plugged into an ungrounded power strip

Power Disturbance

- Solutions to power line disturbances

1. Surge Suppressors
   - What is a surge suppressor?
   - Power-distribution box that suppresses voltage spikes using a Metal Oxide Varistor (MOV)
   - Protects equipment from sudden power changes
   - Absorbs and/or blocks surge (AC filter)
   - **Metal oxide varistor:**
     - Electrical circuit protection component placed across AC power-line inputs
     - Short-circuits high-voltage spikes
     - Effectiveness deteriorates with use (over voltage conditions)

Power Disturbance

- Solutions to power line disturbances

1. Surge Suppressors
2. Backup Power Supplies
   - What is a backup power supply?
   - Power supply incorporating a battery and an AC inverter circuit that provides continuous power when line power fails
   - Two basic types are available: SPS and UPS

- Standby Power Supply (SPS):
  - Batteries charged while current level is monitored
  - If power fails, batteries switch on automatically
  - Faster switch times desirable (5 ms or less)

Power Disturbance

- Uninterruptible power supply (UPS):
  - Batteries always used to provide power to system
  - Input power used to charge batteries while in use
  - More expensive than SPS

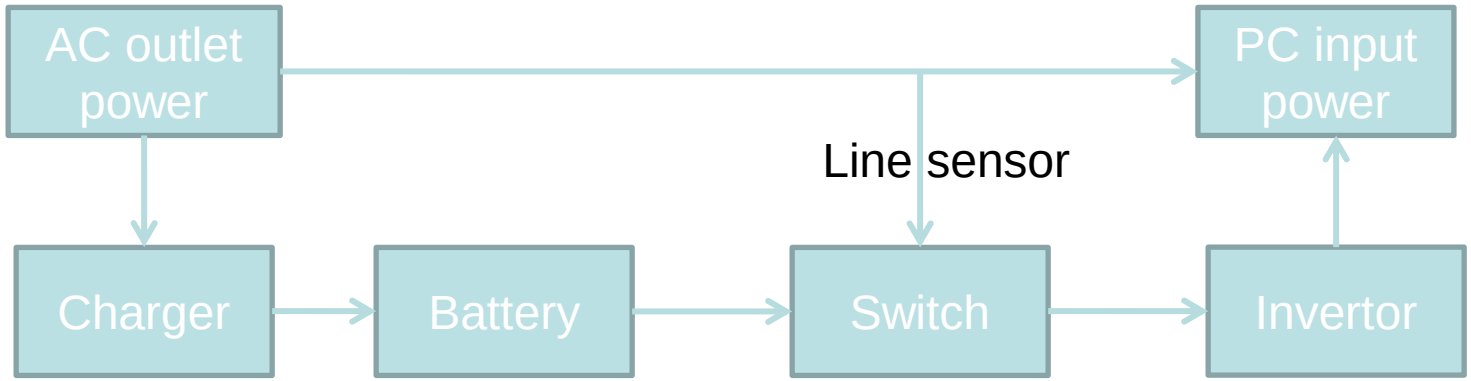


Figure 2-26: SPS Block Diagram

Figure 2-27: UPS Block Diagram

Protect Yourself and the Equipment Against Electrical Dangers

- PC support activities present physical dangers
  - PC technicians must protect themselves and others
  - PC technicians must protect the equipment

Protect Yourself Against Electrical Shock and Burns

- Protection from electrical shock
  - Disconnect power
    - Pull plug at AC outlet
  - Protect power cord
    - Do not pull on cord itself
  - Remove jewelry
  - Power supplies and CRT monitors contain capacitors
    - Technician must not be grounded
    - Both considered field replaceable unit (FRU)

Protect the Equipment Against Static Electricity or ESD

- Static electricity (electrostatic discharge or ESD)
  - Touching device causes discharge, damaging device
  - Particularly severe in dry and cold climates
- Protecting system from ESD
  - Use ground bracelet, static mat, static shielding bags, ESD gloves
  - Touch computer case before touching components
  - Touch person when passing components
  - Remove jewelry, work on hard floors
  - Unplugged power cord before working inside case

Protect Against Electromagnetic Interference

- Caused by magnetic fields generated by current flow
- RFI (radio frequency interference)
  - EMI in radio frequency range affecting reception
- Crosstalk problem
  - Data in cables crossing EM fields gets corrupted
  - Control crosstalk by shielding cables, power supply
- Detect EMI using tuned-down AM radio
- Other ways to protect device:
  - Use line conditioners; shield cables, power supply
  - Move PC to a new location

Surge Protection and Battery Backup

- Storms and uneven AC flow cause power surges
  - Prevented by installing an AC filter
- Devices between AC outlet and computer equipment:
  - Power Strips
  - Surge suppressors
  - Power conditioners
  - Uninterruptible power supplies (UPSs)
- Use devices with UL (Underwriters Laboratory) logo
  - UL 1449

Surge Protection and Battery Backup (cont'd.)

- Surge protector
  - Protects equipment from sudden power changes
  - Absorbs and/or blocks surge
- Recommended features:
  - Joules rating greater than 600 joules
  - Protection activation time (2 nanoseconds or less)
  - Warranty for connected equipment and UL seal
  - Light indicating surge protection working
  - Data line protector for telephone line to modem
  - Let-through voltage rating and line noise filtering

Figure 2-28 Both surge suppressors alert you when protection is not working. The small surge suppressor is designed to travel with a laptop
Courtesy: Course Technology/Cengage Learning

Surge Protection and Battery Backup (cont'd.)

- Line conditioners (power conditioners)
  - Protect against spikes or swells (voltage surges)
  - Raise voltage during brownouts (voltage sags)
  - Filter EMI/RFI interference from the electrical line
- Power conditions are measured in watts, volt-amperes (VA), kilovolt-amperes (kVA)
- Determining VA needed
  - Multiply amperage of each component by 120 V
  - Add up the VA for each component
- Provide no protection against a total blackout

Surge Protection and Battery Backup (cont'd.)

- Uninterruptible power supply (UPS) benefits
  - Conditions line to account for brownouts, spikes
  - Provides backup power during a blackout
  - Provides protection against very high spikes
- Designs: standby, inline, line-interactive
- Smart (intelligent) UPS: controlled with software
- Considerations when buying
  - VA rating and watts
  - Degree of line conditioning
  - Warranties, guarantees, and service policies

How to Work Inside a Computer Case

- Skills needed to:
  - Replace computer parts inside the case
  - Build a system from scratch
- Requires tools and safety precautions
- Taking a PC apart and putting it back together
  - Should follow step-by-step procedures

PC Support Technician Tools

- Essential tools
  - Ground bracelet, ground mat, ground gloves
  - Flat-head screwdriver
  - Phillips-head or cross-head screwdriver
  - Torx screwdriver set (size T15)
  - Insulated tweezers
  - Extractor
  - OS recovery CD or DVD
- Many other non-essential tools exists
- Use a toolbox

Figure 2-31 PC support technician tools
Courtesy: Course Technology/Cengage Learning

PC Support Technician Tools (cont'd.)

- Post Diagnostic Cards
  - Helps discover, report computer errors and conflicts at power-on self test (POST)
    - Tests performed by startup BIOS

Figure 2-32 Post Code Master diagnostic card by Microsystems Developments, Inc.
Courtesy: Course Technology/Cengage Learning

PC Support Technician Tools (cont'd.)

- Power Supply Tester
  - Measures output of each power supply connector

Figure 2-33 Use a power supply tester to test the output of each power connector on a power supply
Courtesy: Course Technology/Cengage Learning

PC Support Technician Tools (cont'd.)

- Multimeter
  - Measure several characteristics of electricity in a variety of devices

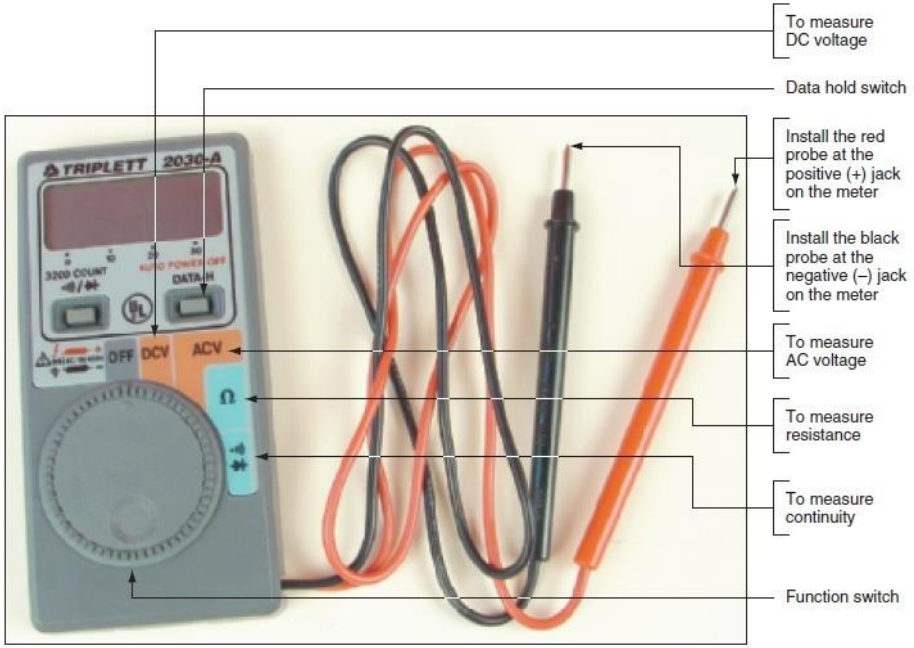


Figure 2-34 This digital multimeter can be set to measure voltage, resistance, or continuity
Courtesy: Course Technology/Cengage Learning

Safety Precautions

- Make notes for backtracking
- Stay organized, do not stack boards
- Do not touch board chips
  - With hands, magnetized screwdriver
- Do not change dual inline package (DIP) switch settings with a graphite pencil
- Protect yourself and the equipment
  - Never ever touch inside of a turned on computer
  - Consider monitor, power supply as “black boxes”
  - Protect against static electricity

Steps to Take Apart a Computer

- Tools needed
  - Ground bracelet, a Phillips-head screwdriver, a flat-head screwdriver, paper, pen
- Guidelines
  - Back up data
  - Power down system, unplug it, press power button
  - Put computer on a table with plenty of room
  - Open computer case
  - Diagram all cable connections

Steps to Take Apart a Computer (cont'd.)

- Guidelines (cont'd.)
  - Before removing ribbon cables, look for red color or stripe down one side of each cable
  - Remove cables to all drives
  - Remove expansion cards
  - Remove motherboard
  - Remove power supply
  - Remove drives

Steps to Put a Computer Back Together

- Reverse disassembly process
- Component installation order
  - Power supply, drives, motherboard, cards
  - Connect all data and power cables
  - Plug in keyboard, monitor, mouse
  - Turn on power
  - Verify PC working properly

Troubleshooting the Electrical System

- Electrical problems can occur before or after boot
  - May be consistent or inconsistent
- Possible electrical problem symptoms:
  - PC appears “dead”
  - PC sometimes halts during booting
  - Error codes or beeps occur during booting
  - Smell burnt parts or odors exists
  - PC powers down at unexpected times
  - Hear a whine coming from the power supply
- Most PC problems have simple solutions

Problems with External Power

- Brownout (reduced current) may create issues
  - Check out other devices using same circuit
  - Remove other devices
    - See if voltage increases
- Resolution
  - Install line conditioner
    - Conditions voltage to the PC

Problems with Loose Internal Connections

- Can cause a system to appear dead or reboot itself
- Troubleshooting tasks:
  - ATX and BTX power supplies
    - Verify power switch wire connected properly to motherboard and turned on before power comes up
  - Remove case cover
    - Check all power connections
    - Check cables linking power supply to motherboard
    - Check cables linking power supply to drives
  - Verify case front panel in place before power-on

Problems that Come and Go

- Intermittent symptoms indicating a post-boot problem
  - Computer stops, hangs, reboots for no reason
  - Memory errors appear intermittently
  - Data written incorrectly to the hard drive
  - Keyboard stops working at odd times
  - Motherboard fails or is damaged
  - Power supply overheats, becomes hot to the touch
  - Power supply fan becomes very noisy or stops
- Intermittent problems are more difficult to solve

Problems with an Inadequate Power Supply

- Power supply may not meet needs of new devices
- Testing for an adequate power supply
  - Make all devices in the system work at the same time
    - Example: copy files from new drive to old drive
- Simple solution: upgrade to a higher power supply
- Calculate total wattage needed by system

Problems with a Faulty Power Supply

- Test with a power supply tester or multimeter
- Power supply with correct voltages
  - May still be problem source
- ATX power supply monitors motherboard voltage range
  - Halts motherboard if voltages inadequate
- If power supply appears “dead”, replace it

Problems with the Power Supply Fans

- Fans usually hum, whine before failing
  - Replace fan or entire power supply
  - Suspect another short if failure continues
  - Do not operate PC if fan not working
- Troubleshooting nonfunctional fan
  - Turn off power; remove all power cord connections to all components except motherboard; turn on power
  - Turn off power; reconnect one card or drive at a time
  - Motherboard power supply problem
    - Fan does not work when all devices except motherboard disconnected

Problems with Overheating

- Computer powers down after operating for a few minutes or a few hours
- Troubleshooting
  - Leave system turned off for about 30 minutes, try again
  - Check computer's internal temperature
  - Install additional fans

Power Problems with the Motherboard

- Bad contact between board component and chassis
  - Short can seriously damage motherboard
  - Check for missing or extra standoffs (spacers)
- Shorts in the circuit on motherboard
  - Look for damage to the bottom of the motherboard
  - Look for burned-out capacitors

Replacing the Power Supply

- Criteria for replacement power supply
  - Uses correct form factor
  - Adequately rated for power in watts
  - Has necessary power connectors
- Determining power supply problem
  - Turn off PC, open computer case, set new power supply on top of the old one
  - Disconnect old power supply's cords, plug PC devices into the new power supply
  - Turn on PC, verify new power supply solves problem

Summary

- Form factor specifies size, shape, features of device
  - Motherboard, power supply, and case share the same form factor
- Types of cases: desktop, tower, notebook
- Quantities characterizing electricity
  - Voltage, current, resistance, power
- Current flows from hot wires to neutral wires
  - Excess current escapes through grounds

Summary (cont'd.)

- AC supplied by power station
  - Transformed, rectified before flowing into PC
- Major components in a circuit board
  - Transistor, capacitor, diode, resistor
- Electrical threats
  - ESD, EMI, uneven current flow, sudden power surges (or spikes)