A+ Certification Guide

Chapter 4
Power Supplies and System Cooling

Chapter 5
Objectives

- **Power Supplies:**
  - Describe the device that transforms AC power from the wall outlet into DC power that your computer can use.
  - Describe the various form factors and voltage levels, and how to protect your power supply.
- **Power Protection Types:**
  - Describe devices that can protect your computer from voltage extremes.
- **Troubleshooting Power Problems:**
  - Demonstrate how to troubleshoot complete failure and intermittent power supply problems that you might encounter.
- **System Cooling:**
  - Describe the various ways to cool your system, including fans and liquid cooling, and demonstrate how to monitor the system temperature.

Power Converter
Power Supply Unit (PSU)

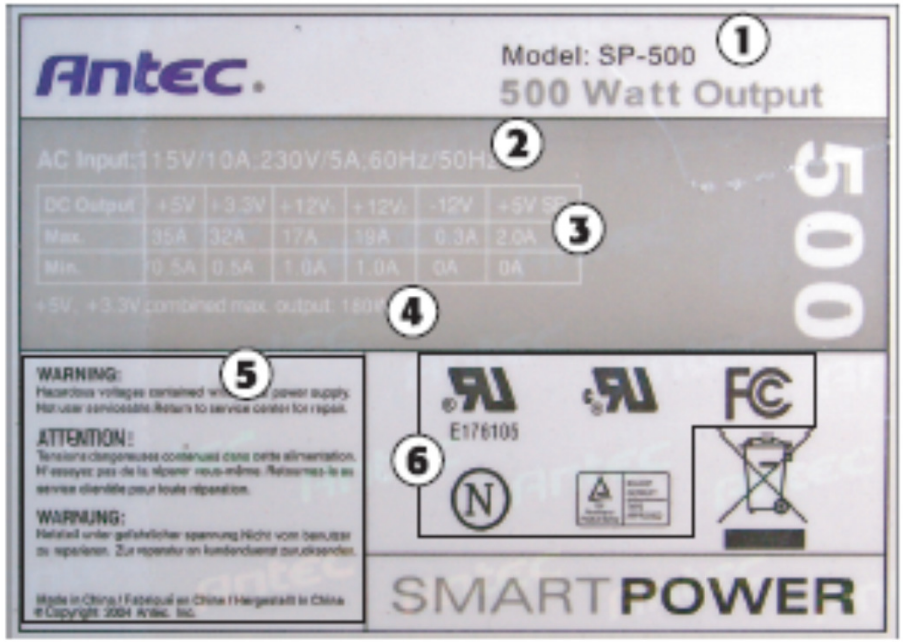
- Power converter is a more accurate term.
  - Converts AC 120v to DC 3.3v, 5v, and 12v as needed.
- PSU is important because:
  - No power = no computing!
  - Inconsistent/unpredictable power =
    - Poor read/writes to hard drive
      - Data corruption
    - Video delivery problems
    - System overheating
    - Catastrophic failure
- Not normally repairable:
  - Capacitors can cause serious injury.
  - Easier/safer/less expensive to replace the whole PSU.

Power Converter

Figure 4-1

How Much Power?

- Bigger the PSU rating =
  - More expensive
- Too little power (overloaded) =
  - Poor performance (lost or corrupt data)
  - Spontaneous rebooting
  - Overheating



1. Power supply rating
2. AC input voltage levels
3. DC output levels by type
4. 3.3V and 5V output and peak output
5. Hazard warnings
6. Product certifications

Figure 4-2

How Much Power?

1. Add up the total wattage of the devices attached to the system.
2. Divide the total wattage by **.7.**
3. Round up to the next wattage PSU available.

- **Example:**
  - Assume your system uses 472 watts.
  - 472 watts / **.7** = 674 (That's *point* seven, not just seven.)
  - Round up to 700 watts.
    - PSU units are often sold in increments of 50 watts.
    - In no case would you buy less than 674 watts.

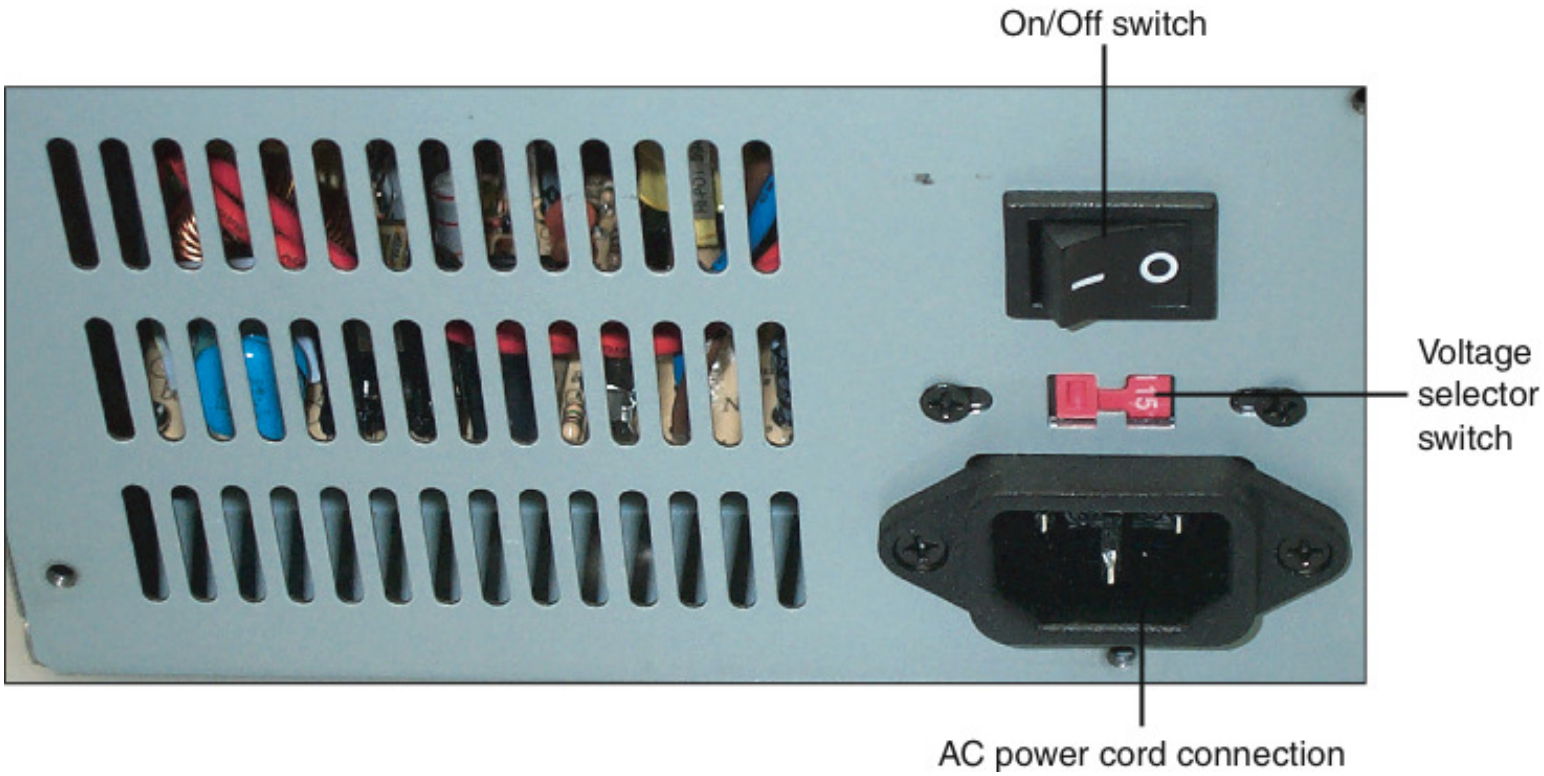
CAUTION: If you plan to add more devices, account for them:

- Hard drives, second DVD, and second graphics card.

Power Converter Back Panel

PSU's capacity is rated in watts (volts x amps):

- European 240v versus North American 120v.
  - Some units have an auto-detection feature.
- Must be set properly to avoid PSU failure.



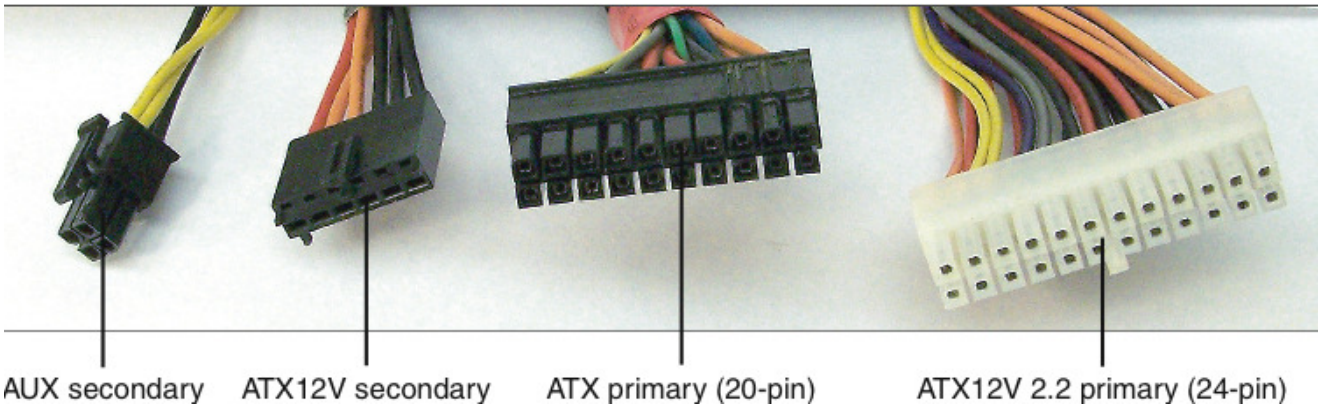
Causes of Overheating

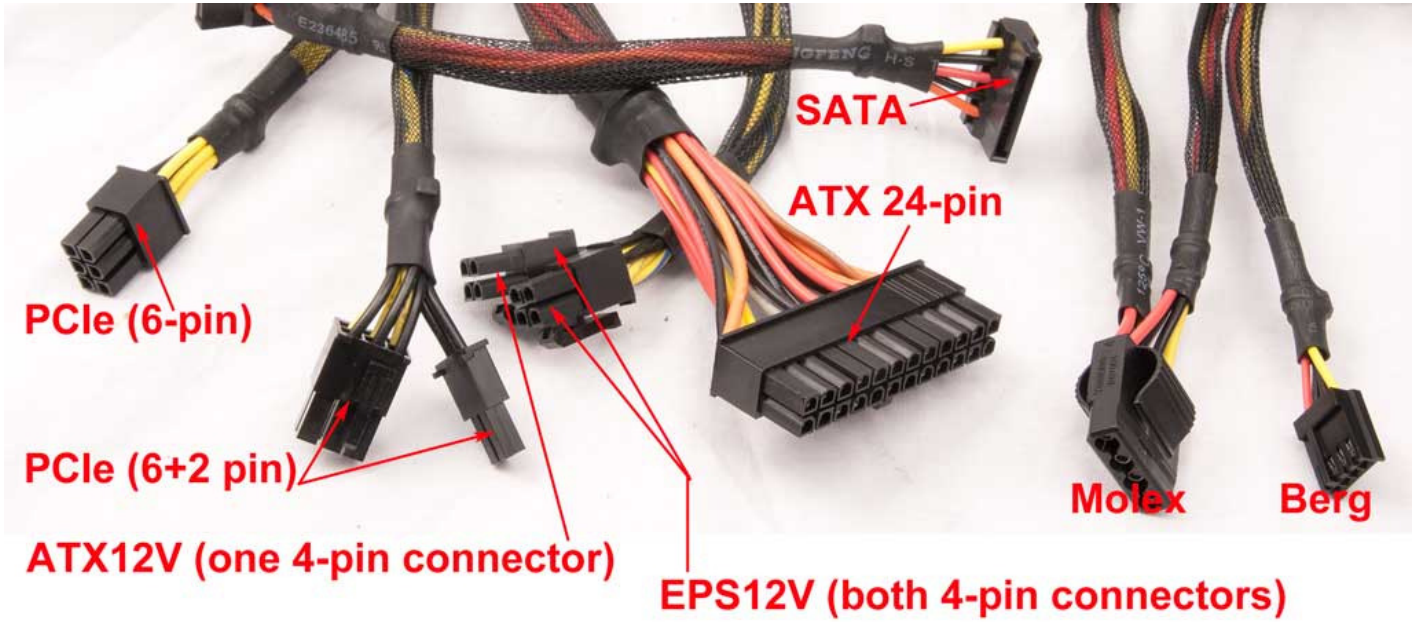
- Inadequate power supply wattage
- Failed fans:
  - Inside PSU
  - On CPU/GPU
  - Inside the case
- Blockage of vents:
  - Poor PC placement.
  - Dirty vents—intake or outtake
- Running in a room with high ambient temperature:
  - Greater than 85 degrees poses a risk.
    - Less than 75 degrees is recommended.

Power Supply Connectors

- **From Power Supply to**
  - **Motherboard:**
    - Large 20-pin or 24-pin ATX connector
  - **Drives:**
    - PATA and CD-ROM/DVD:
      - Four-pin Molex power connector
    - SATA:
      - L-shaped thin-line power connector
    - Floppy drive:
      - Mini Molex connector.
  - **Fans:**
    - Case fans use Molex connector.
  - **Video cards**—PCI E x16
    - PCI Express six-pin power cable.

Power Connectors





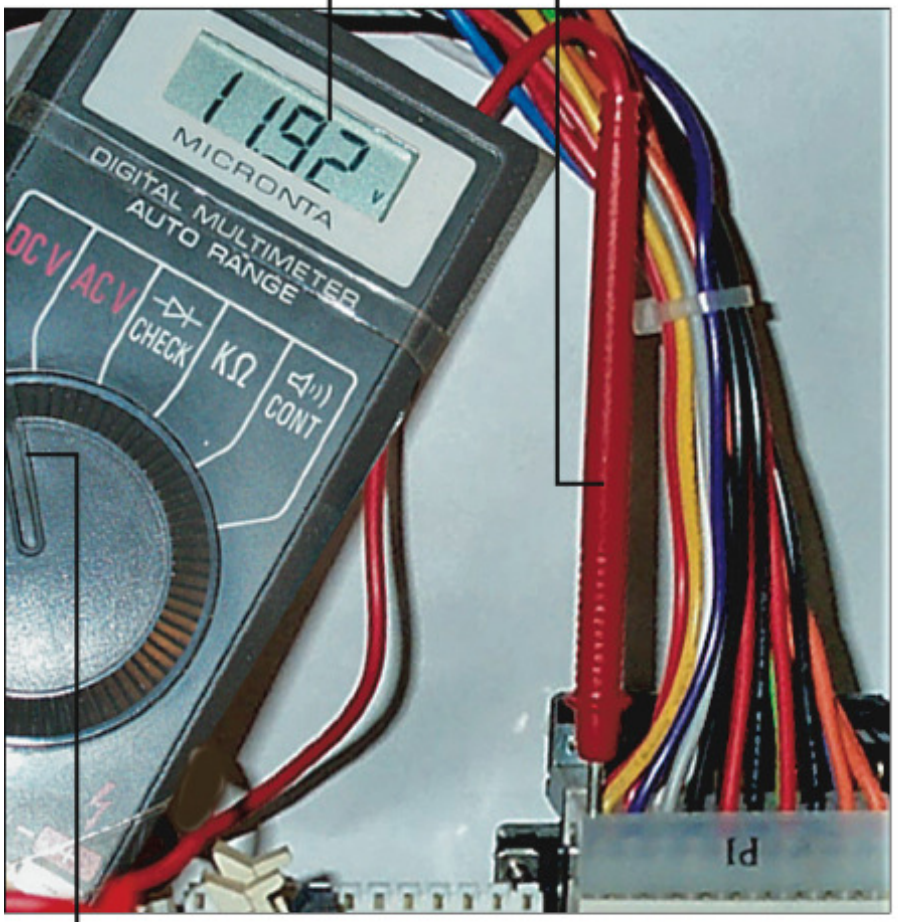
PSU Replacement Checklist

- ✓ Same power supply connectors and the same pinout as the original.
- ✓ Same form factor (shape, size, and switch location).
- ✓ Same or higher wattage rating; a higher wattage rating is highly desirable.
- ✓ Support any special features required by your CPU, video card, and motherboard, such as SLI support.

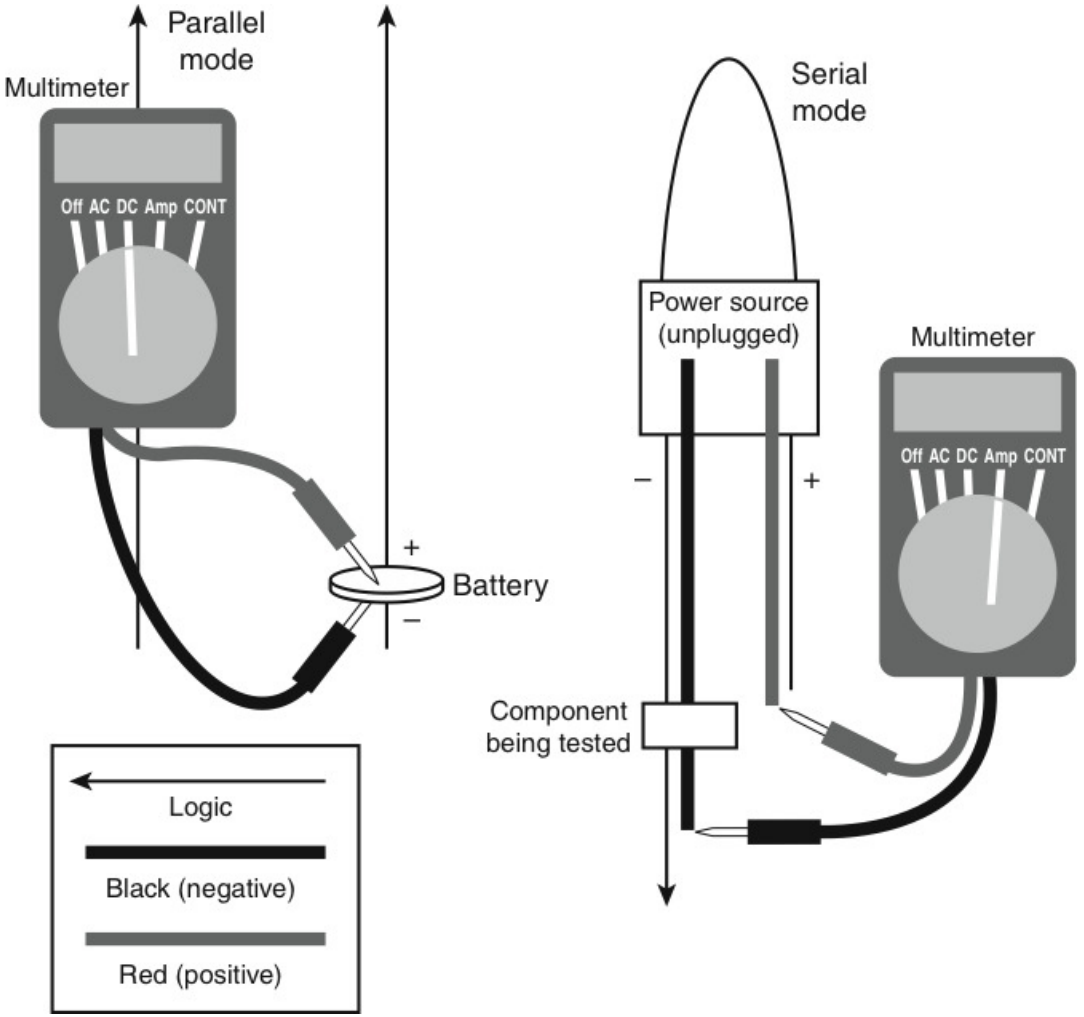
Testing the Power Supply

- Multimeters are designed to perform electrical tests, including:
  - DC voltage and polarity
  - AC voltage and polarity
  - Resistance (Ohms)
  - Diodes
  - Continuity
  - Amperage
- Red lead:
  - Attach to power source.
- Black lead:
  - Attach to ground.

Testing the Motherboard Power



Multimeter Circuit Testing



Troubleshooting Power Supplies

- Overheating:
  - Overloaded?
  - Fan failure?
- Spontaneous rebooting:
  - Incorrect voltage?
- Intermittent device failure:
  - Particularly of bus-powered USB devices
- Loud noises:
  - Fan failure imminent

Overheating Issues

- Overloaded PSU
- Fan Failure
- Inadequate Air Flow Outside the System (Room Temp)
- Inadequate Air Flow Inside the System
- Dirt and Dust

Troubleshooting Power Problems

Sources of Problems:

- Defects in AC power to the system:
  - Low voltage (<105v).
- Power supply failure or misconfiguration.
- Temporary short circuits in internal or external components:
  - Disconnected CPU fan.
- Power supply or other component failure.
  - Check for “electrical smell’ from PSU

First Step: Identify the Problem:

- Is the problem with the external power source, or is it inside the case with the PSU or some subsystem?
  - Measure the source voltage. Is it >105 volts?
  - Check the AC voltage switch on the power supply; it should be set to 115V for North America.

Troubleshooting Power Problems

- Check for a loose keyboard connector (could cause a short circuit).
- Open the system and check for loose screws or other components, such as loose slot covers, modem speakers, or other metal items that can cause a short circuit.
- Verify that the cable from the front-mounted power switch is properly connected.
- Check for blown fuses on the motherboard (mainly found in old systems).
- Remove all expansion cards and disconnect power to all drives:
  - Restart the system, and use a multimeter to test power to the motherboard and expansion slots.
- Reinstall one card at a time and check the power:
  - If the power tests within accepted limits, reattach one drive at a time and check the power.
  - If a defective card or drive has a dead short, reattaching the defective card or drive should stop the system immediately upon power-up. Replace the card or drive and retest.

Power Protection

- **Four problems often encountered:**
  - Overvoltages (spikes and surges)
  - Undervoltages (brownouts)
  - Power failure (blackouts)
  - Noisy power (interference)

- **Protection from these problems can be mitigated with:**
  - Surge suppressors, which are also referred to as surge protectors
  - Battery backup systems, which are also referred to as UPS or SPS systems
  - Power conditioning devices

Surge Protectors

- **Power spikes:**
  - Very momentary.
  - Can hit voltage levels in the thousands
- **Power surges:**
  - Last longer than 1 second
  - Lower voltage but potentially more damaging
- **Surge protectors absorb extra voltage. Look for**
  - TVSS (transient voltage surge suppressor) rating
    - Less than 400 volts
  - High joule rating
    - The more equipment plugged into it, the higher the joule rating needed.
  - Fast response time.
  - Warranty inclusion for lightning strikes.

Battery Backup Systems

Note the presence of battery backup receptacles versus surge only

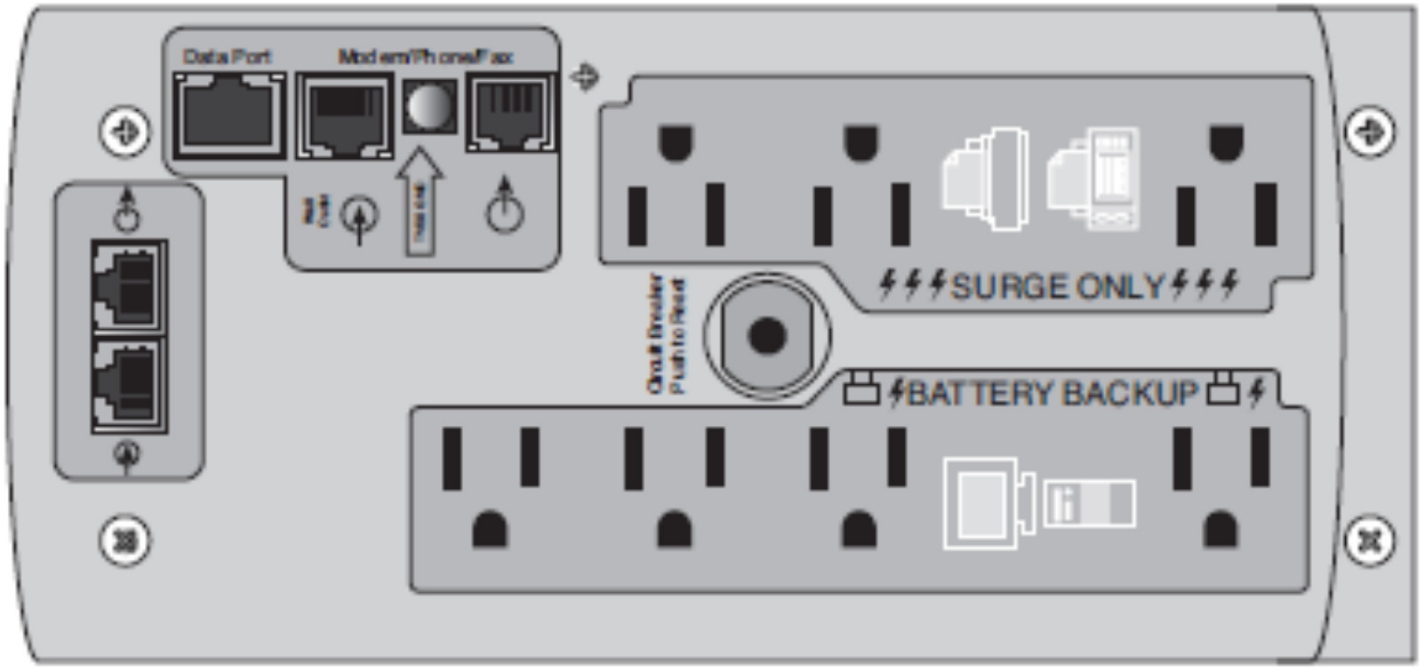


Illustration: This is a pick up of Figure 5-13 from "CompTIA A+ 220-701 and 220-702 Cert Guide“ 2e (ISBN: 978-0-7897-4790-7).

Figure 4-17

04fig17

Battery Backup Systems
UPS Versus SPS

UPS = Uninterruptible Power Supply:

- Power always comes from the battery.
- Charger keeps the battery supplied with power.
- Heavier and more expensive.
- Better line conditioning.
  - Longer computer equipment life.

SPS = Standby Power Supply:

- Power comes from the facility power.
- Backup battery is employed only if the facility power fails.
- Most SPS are also surge suppressors.

Note: Most SPS units in use are marketed as “UPS” units.

UPS—What to Look For

- **Run times:**
  - The time a computer will keep running on power from the UPS.
  - Longer runtime unit uses a bigger battery and costs more.
  - Fifteen minutes is a minimum recommendation for a UPS for an individual workstation. Servers have a longer shutdown time.
- **Network support:**
  - Software can send a message to users about a shutdown so that users can save open files and close open applications.
  - Shuts down the PC automatically before the battery runs down.
- **Automatic shutdown:**
  - Essential for servers or other unattended units.
  - The automatic shutdown feature requires an available USB port and appropriate software from the UPS maker.
- **Surge suppression features:**
  - Look for Category A rating (UL-1449 and IEEE-587).

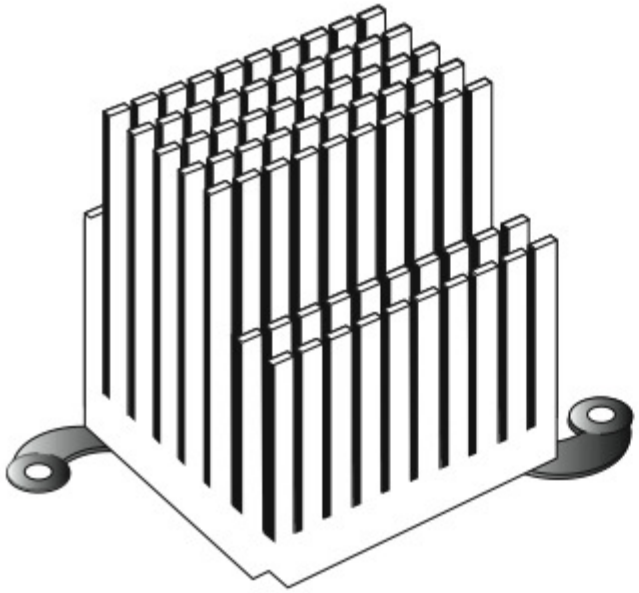
Correctly Sizing the UPS

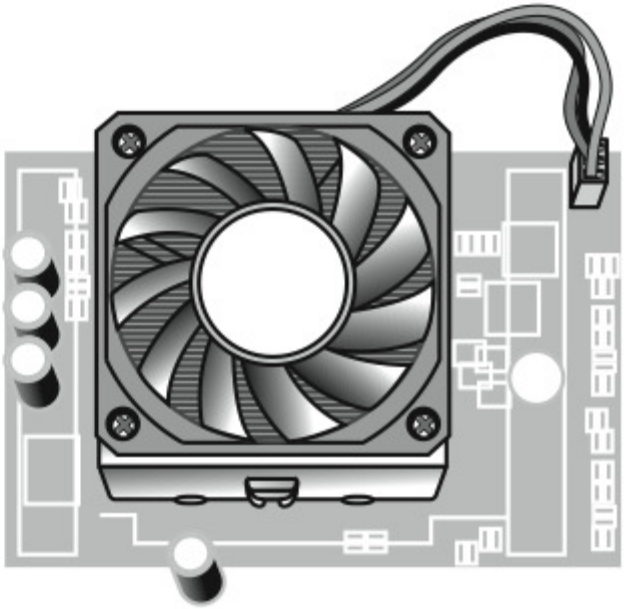
- UPS is rated using “volt-amps” (VA):
  - Larger VA enables longer runtime.
  - Inadequate VA causes loss of data.
- Example:
  - Multiply the power supply wattage x 1.4.
  - Multiply the monitor wattage x 1.4.
  - Add them together. This is the minimum size needed.
  - Note: Doubling this number can triple the runtime.
- Pay attention to the outlets on the UPS. Many UPS units have both outlets that are on the battery backup system and outlets that are surge protected-only.
  - Do not attach printers or unnecessary devices to the UPS outlets on battery backup systems.
    - Reduces runtime significantly.

System Cooling

- **Faster CPU = bigger PSU = more heat:**
  - Overheating causes component and system failure.
- **Active versus passive cooling:**
  - Active: Use of powered device to move heat:
    - Typically fans.
    - Liquid cooling also available.
  - Passive: Use of heat sinks to draw heat away:
    - No moving parts—never fails.
- Because active heat sinks are more effective, they are more useful on devices where more heat is generated.
  - Downside: Any active device can be prone to fail.
  - Newer passive devices use heat pipes to draw heat away from the onboard northbridge and southbridge chipsets.

Passive Versus Active Cooling

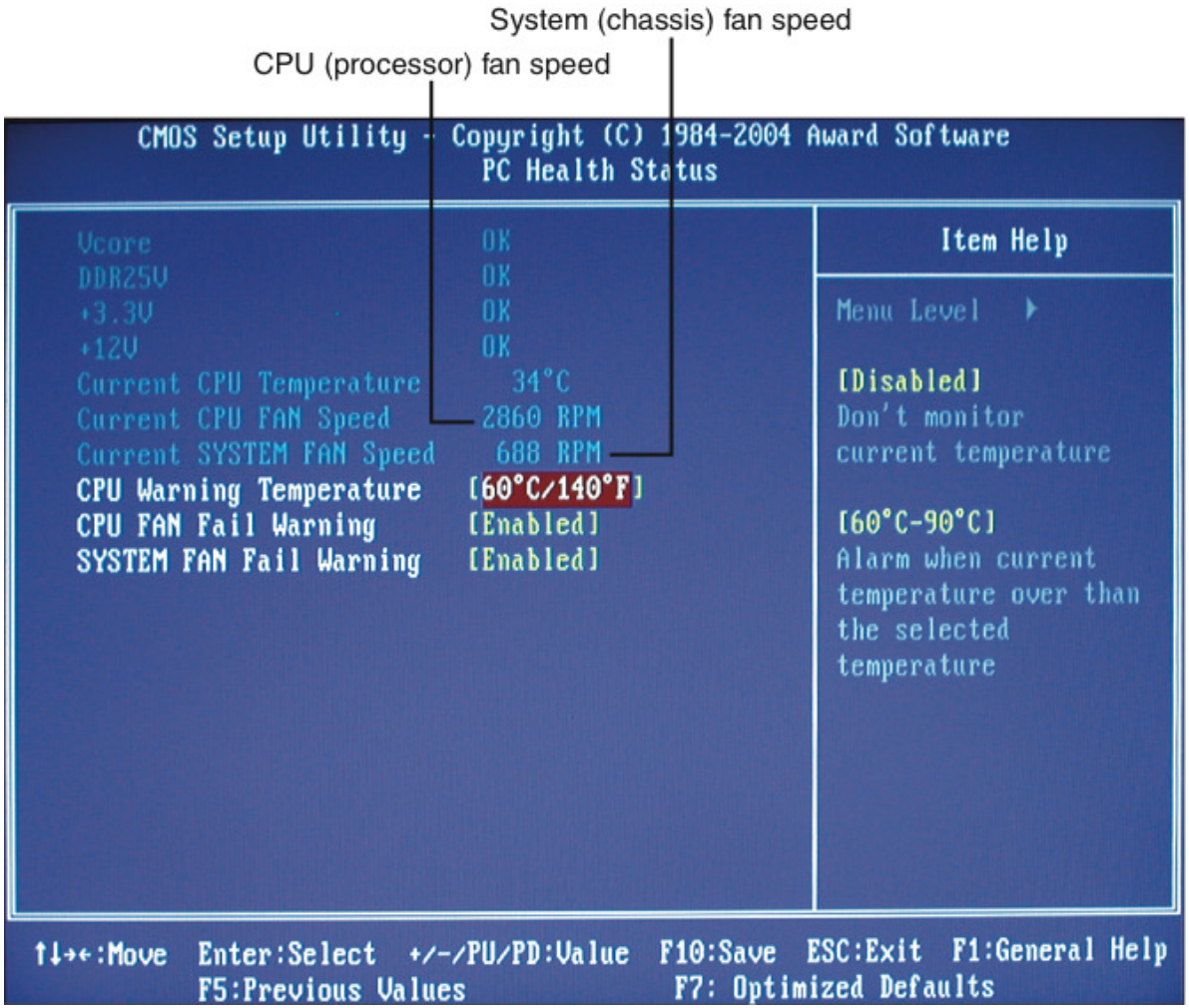




Case Fans

- Normally, at least two case fans:
  - Front-side case fan draws air in.
  - Rear case fan pushes air out.
- The PSU also has a fan that draws air out of the case and exhausts it near the top where most hot air migrates:
  - Case fan sizes are typically 80mm to 120mm.
  - Larger sizes can move more air with slower rotation:
    - Less noise.
    - Better cooling capacity.
  - Newer case fans are temperature-sensitive:
    - Adjust fan speed for inside case temperature.

BIOS Temperature Monitor



What Have You Learned?

- Write down three things that you did not know before this chapter discussion started.
- Suggest a troubleshooting scenario that would result from
  - High voltage surge
  - Blocked air vents
  - Low facility voltage
  - Failed CPU fan
  - Poorly applied thermal compound

Chapter 4
Summary

- **Power Supplies:**
  - Describe the device that transforms AC power from the wall outlet into DC power that your computer can use.
  - Describe the various form factors and voltage levels, and how to protect your power supply.
- **Power Protection Types:**
  - Describe devices that can protect your computer from voltage extremes.
- **Troubleshooting Power Problems:**
  - Demonstrate how to troubleshoot complete failure and intermittent power supply problems that you might encounter.
- **System Cooling**

Next Lesson: Chapter 5