Electricity and Power Supplies and Other Safety Issues in Technology

Module 2

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Sno Isle Skills Center

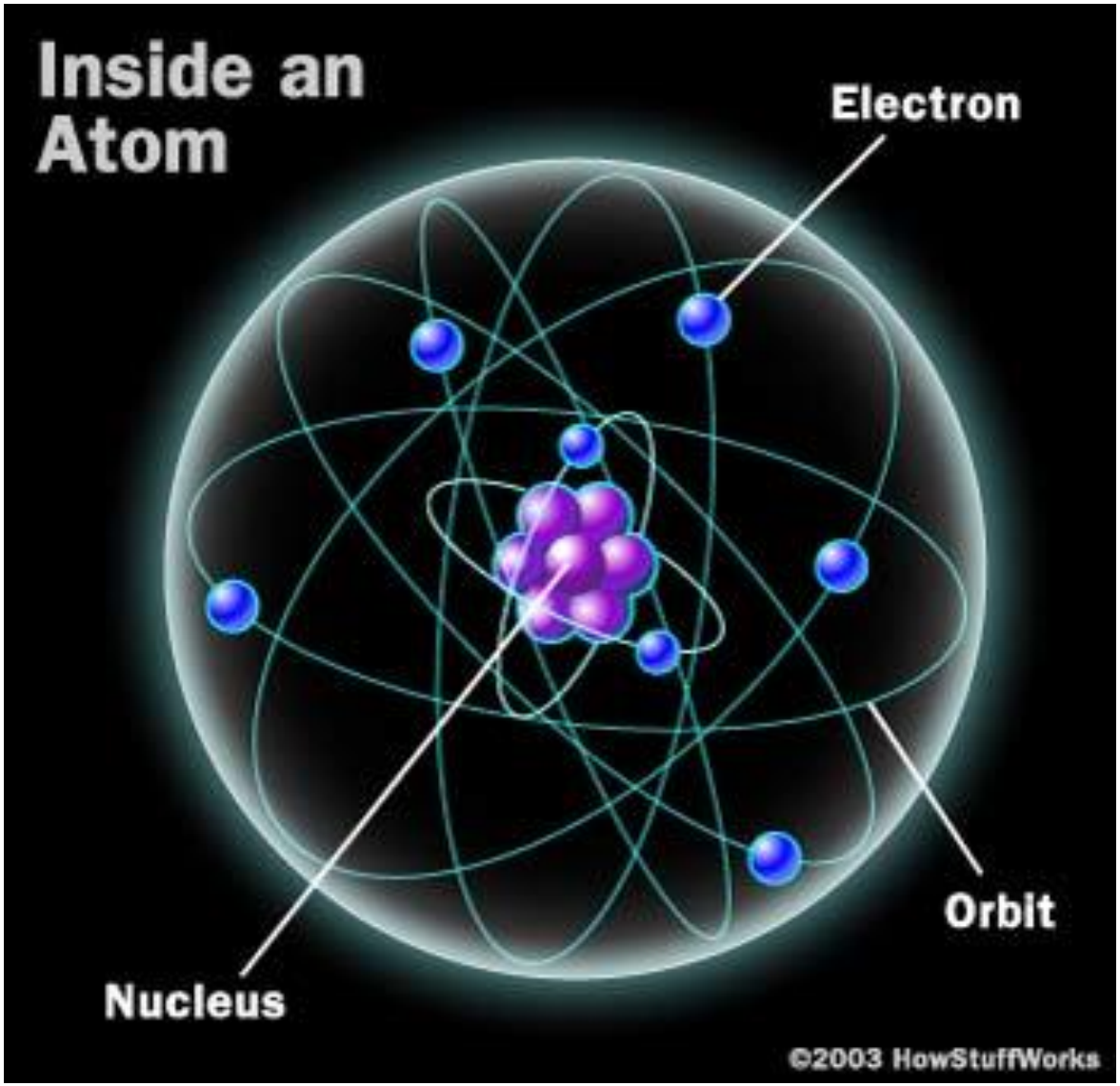
Electricity

- To troubleshoot problems with the power supply, you need a basic understanding of electricity.

Introduction to Basic Electricity

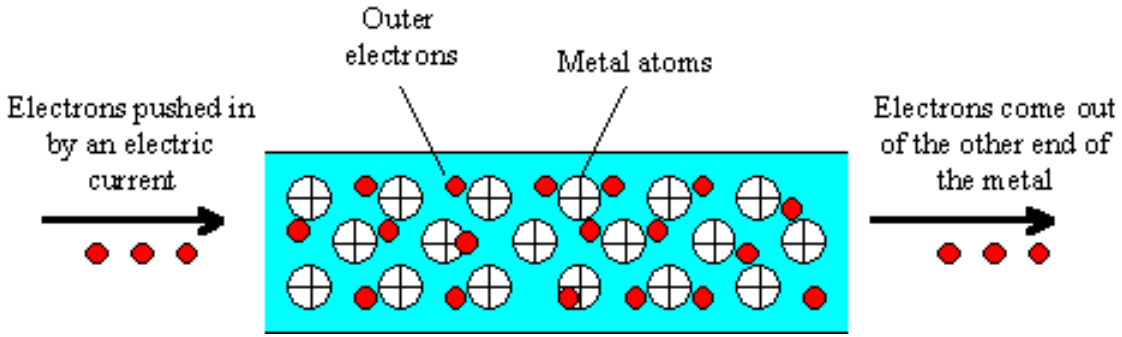
- Electricity starts with the atom.
  - Every atom contains one or more electrons
  - Every electron has a negative charge
  - Electrons orbit around the nucleus of the atom
  - The nucleus has a positive charge
- Most items (wood, plastic, etc.) have electrons tightly bound to them. They don't give off a charge. These would be electrical insulators.
- Some items have free electrons that can detach and move around. These are called electrical conductors.
- In order for electrons to move, the must have some form of conductor.*

The Lowly Atom



Introduction, cont

- The flow of electrons is from a negatively charged location (terminal) to a positively charged location (terminal).
- Energy causes electrons to move from one atom to another.
- This is known as electron current flow.*

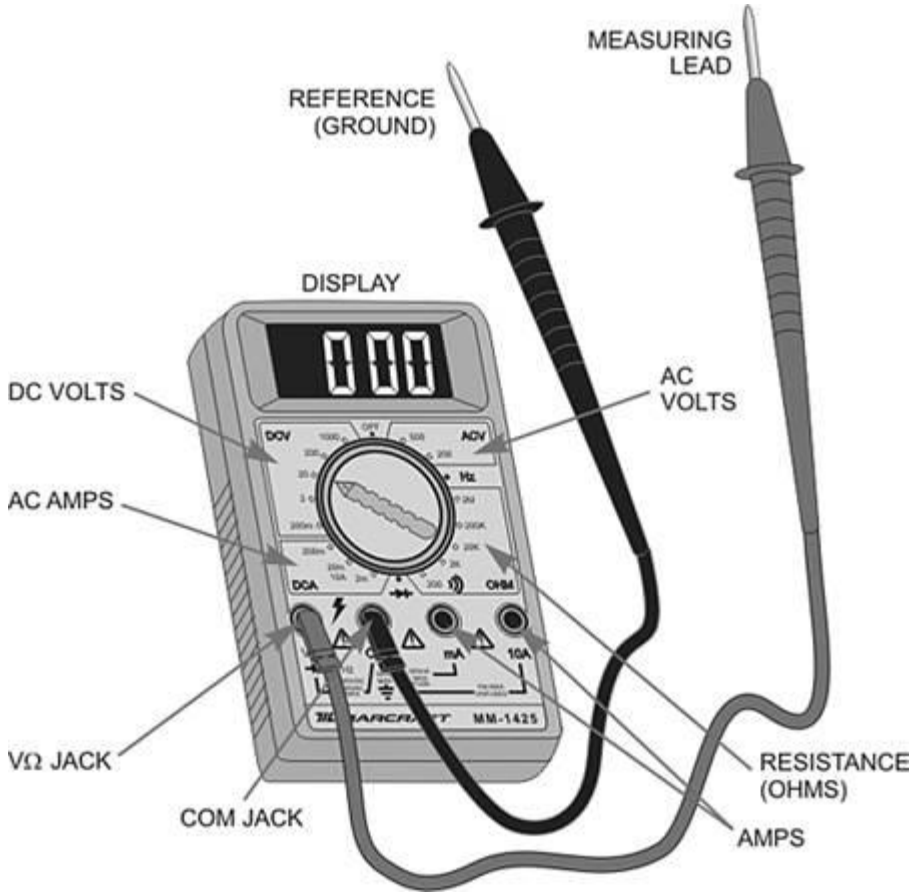


Circuit

- What makes electrons move through a circuit?
- Electrons are attracted to a positive charge and repelled by a negative charge.
- If there is a difference between the positive and negative points, this is called potential or electromotive force.
- Electrons always move in the direction of the positive, away from the negative.
- This force is measured in volts.*

Measuring Electricity

- Use a multimeter for most electrical measurements



Measuring Electricity

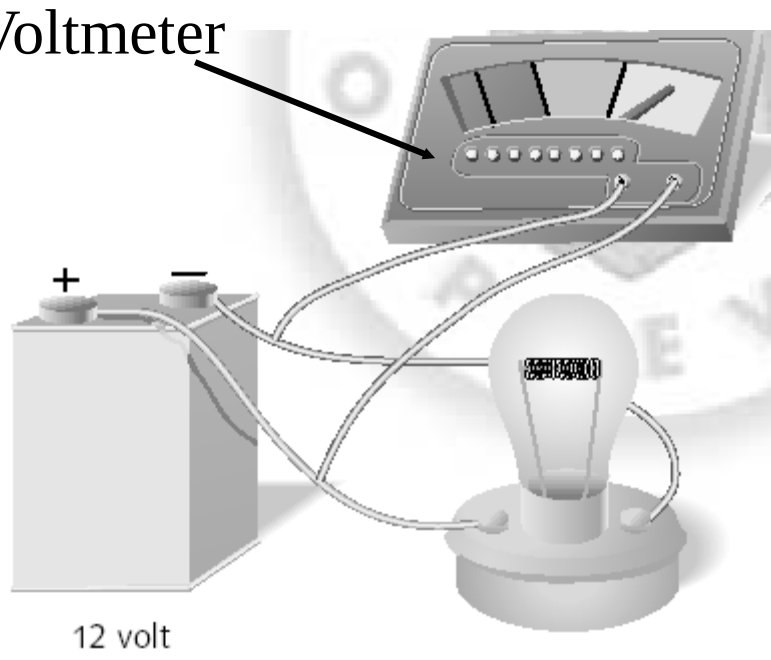
- Voltage—measure the electrical difference using a voltmeter.
  - Attach the leads to either side of a component and measure the difference between the two.
  - The difference or drop in voltage is measured across the wire
- Amps—measure the volume of electricity flow using an ammeter
  - place in the path of the flow with power on.*

Measuring Electricity, cont.

- Ohms—measure the resistance of a cable using an ohmmeter.
  - The device should not be plugged in.
  - The ohmmeter or multimeter sends a small charge through the wire and measures the resistance in the wire*

Voltage

- **Voltage** is the measure of the electrical force that drives electrons through a system.
- The difference in "electrical pressure" between two points is called the voltage and is measured in **volts**.*



Amperes (Amps)

- An electrical system maintains the same amount of "current" throughout the whole system.
- The measurement of this electrical "current" is called **amperes** or **amps** for short.*

The Relationship Between Voltage and Current

- To increase the amount of water flow through the water system you simply increase the water pressure.
- The same holds true for electricity: to increase the amount of electrical "current" (amps), you simply increase the amount of electrical "pressure" (Volts).*

OHMS

- **Resistance** is the force that opposes the flow of electricity.
- An **ohm** is the electrical measurement for resistance.
- A **resistor** controls electricity by resisting its natural flow.
- Objects with low resistance are conductors (copper, for example)
- Objects with his resistance are insulators (plastic, glass)*

Relationships Among Voltage, Current, and Resistance

- An electrical system has a direct relationship between pressure differential (voltage) and current.
- Resistance (measured in ohms) has an inverse relationship between voltage and current
- As resistance increases, either current or voltage decreases.
- As resistance decreases, current increases. This is known as **Ohms law** and states that there is an inverse relationship between resistance and current.*

Wattage

- **Wattage** measures the total amount of power needed to operate an electrical device.
- To determine wattage, use the following formula: **Volts x Amps = Wattage (watts)***

Ground

- What is a ground?
- Ground potential means there is no difference in voltage between a circuit point and the earth.
- In other words, there is not pathway for electricity to flow. Electrons stop.
- A grounding strap allows us to not attract the electrons if there is a short in the system.

Review

- ____ are a measurement of resistance.
- ____ is a measurement of differential.
- ____ is a measurement of the flow of current.
- What is wattage?
- What is the purpose of a ground?
- If you increase ____ you reduce amps.
- If you increase ____ you increase amps.
- If you decrease ____ you increase amps.

AC and DC Current

- AC stands for **alternating current**, a type of electrical current that cycles back and forth, rather than traveling in only one direction.
- Most homes today use AC current from wall sockets.
- DC stands for **direct current** that travels in only one direction.
- Computers use both AC and DC voltages, but most of the computer works on DC.*

Going from AC to DC and vice versa

- A **rectifier** is a device that converts AC current or voltage to DC current or voltage.
- A computer power supply converts the house voltage from 110 volts to 3.3, 5, or 12 volts for the computer to use.*

Review

- Define voltage
- Define amperes
- How do you measure voltage?
- Define ohms
- What is current?
- Watt (he he) is electricity?
- AC is?
- DC is?

Review 2

- What converts AC to DC and vice versa?
- Wall plugs give you __ current.
- How can you determine wattage?
- What is Ohms Law?
- What is a resistor? What are they used for?
- A power supply converts house current from ___ volts to ___ or ___ volts.

Shorts and Grounding

- Short–when electricity flows un-controlled from hot line to neutral line or from hot line to ground.
- The ground line helps contain the energy to avoid fire.
- A fuse in a circuit prevents too much current from flowing through. *

Wiring

- In most home wiring, a green or bare wire is used for ground, white for neutral, and black for hot.
- In most PC wiring, however, black is used for ground, red for hot, and green for neutral.*

PCs Electrical Components May Be Made From

- **Conductors** such as gold or copper wire that easily conduct electricity.
- **Insulators** such as glass or ceramic that resist the flow of electricity.
- **Semiconductors** such as silicon that conduct electricity.
- **Transistors** made of layers of semiconductor material that serve as a gate or switch for an electrical signal and can amplify the flow of electricity. *

PC Electrical Components May Be Made From:

- **Capacitors** that hold an electrical charge for a period of time are used to smooth out the uneven flow of electricity through a circuit such as those in monitors or power supplies.
- **Diodes** that allow electricity to flow in only one direction and may act as a rectifier.*

ESD and EMI

- **ESD (electrostatic discharge)—a** brief flow of electricity caused by two objects with different voltage potentials coming into contact with each other.
- ESD can cause **permanent** damage to computer components.
- Before you work on a computer, it is very important that you are grounded.*

Just a Little Shock, Right?

- The human body carries an electrical charge of 200-300 volts.
- A “shock” can send 10,000+ volts of power into a computer.
- This is enough to damage electrical equipment.
- The more painful the shock, the more volts.*

Exceptions

- When working on **power supplies** or **monitors**.
- Capacitors in these devices maintain a high charge even when they are turned off.*

EMI

- **Electromagnetic interference** is a magnetic field produced as a side effect from the flow of electricity.
- EMI can cause corrupted data in data lines that are not properly shielded.
- EMI is temporary and does not cause permanent damage to computer equipment.*

Review

- What is a short?
- What is the purpose of a fuse in a circuit?
- What does a ground line do?
- How is wiring in a computer and wiring in a house different?
- What is ESD?
- Why do you need to protect from ESD.

Review again

- The human body carries ____ of voltage.
- How many volts can a “shock” of static electricity cause?
- What is EMI?
- Is EMI dangerous?
- How can you protect data from EMI?
- When should you use a grounding strap?
- When not?

Measuring the Voltage of a Power Supply

- One of the first things to do if you suspect a problem with a power supply is to test the voltage.
- Since problems with power supplies may be intermittent, voltages that test correctly may not rule out power supply problems.*

Using A Multimeter

- A **multimeter** measures voltage, ampere, or resistance, and tests for continuity.
- Note that multimeters are sometime referred to as **DVMs (digital voltmeters)**.
- They come in a range of sizes and capabilities from desktop to handheld portable units.

Using a Multimeter

- Before using a multimeter, you must set the following three parameters:
  - 1. What to measure (voltage, current or resistance)
  - 2. Type of current (AC, DC)
  - 3. The range of electricity it should expect (high voltage or low voltage)*

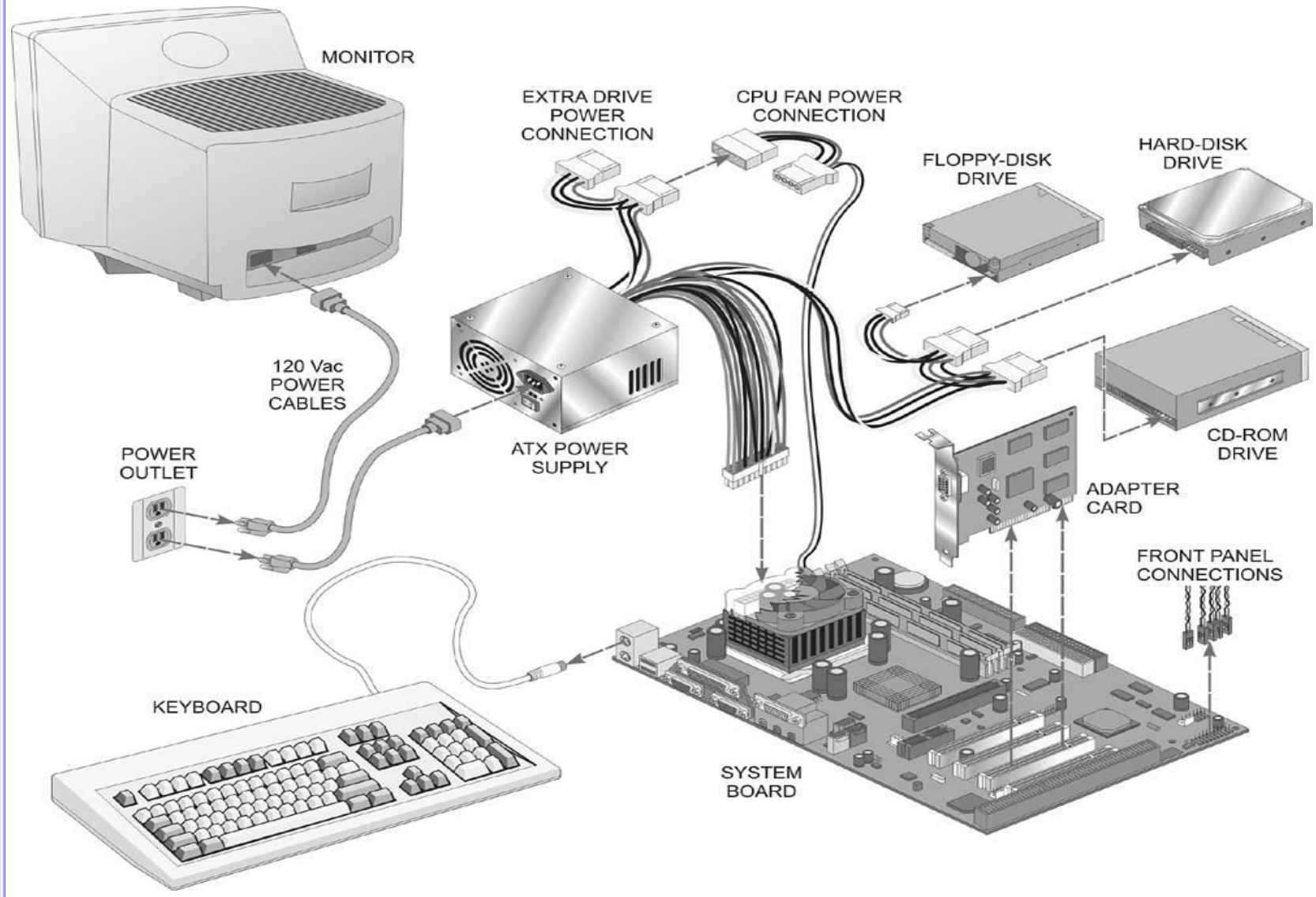
Safety When Measuring Voltage

- When measuring the voltage of a power supply, be careful.
- You can hurt yourself if you create a **short circuit**, or **short,** by connecting a side circuit of very low resistance to a circuit of a higher resistance.
- This causes the electricity to be diverted through the side circuit and might cause a spark or melt the probe.*

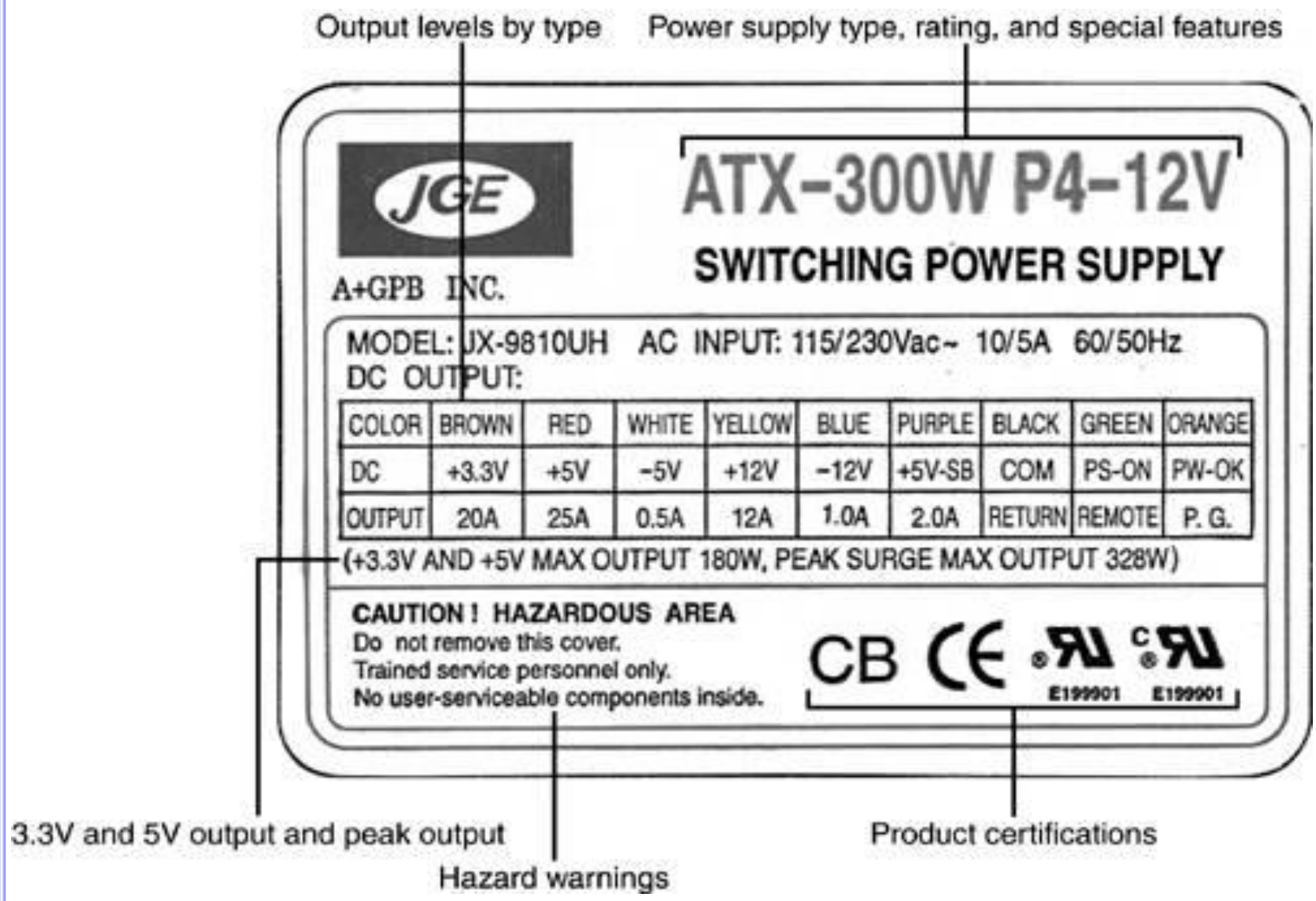
Review

- When you suspect a problem with the power supply, what should you measure?
- What tool should you use?
- What does a multimeter measure?
- What three things do you have to set before using a multimeter?
- What safety measures do you use when using a voltmeter?

Is Power Important?



Typical Power Supply Label



What does my PSU do?

- Convert AC to DC
- Converts voltages to meet the needs of the variety of components in the system.
- Cleans up the power (to some extent).
- Problems with the PS can show up in a variety of ways.
- Most work either in the US or Europe
  - 120v US
  - 230v Europe

Power Supply Troubleshooting Guidelines

- A failing power supply may display a variety of symptoms.
- Power supplies typically convert about 400 watts, enough for all of the typical components found in a computer.
- You can calculate the total wattage required for all your computer devices and compare the total to the rated capacity of the power supply.*

Remember!!

- A power supply should typically run at about 60% of its rated capacity or less.
- Since the power supply contains the fan that cools the computer with the flow-through of air, be sure to keep the vents on the power supply clear. Otherwise, the computer can overheat.
- Since a faulty power supply can destroy a system board, never replace a system board without first verifying that the power supply is functioning properly.*

Upgrading the Power Supply

- If the power supply can no longer supply enough power or watts for the system to operate normally, it should be replaced.

Review

- What are some symptoms of power supply problems?
- How many watts does a typical power supply convert?
- What can be a worst case scenario with a bad PSU?
- How do you figure what wattage rating your power supply should have?
- Power supplies should run at ____ of capacity for safety.

Surge Protection and Battery Backup

- The following are three categories of backup power and conditioning devices:
  - surge suppressors
  - power conditioners
  - uninterruptible power supplies (UPSs).
- These devices install between the house current and the computer to filter the AC input and provide backup power when the AC current fails.*

Surge Suppressor

- **A surge suppressor** or **surge protector** provides power outlets that are protected from an over-voltage of AC power.
- Not always reliable because a fuse that is used to protect the devices plugged into it may be blown, but everything apparently continued to function properly.
- For this reason, it is best to replace surge protectors every six months.*

Buying a Surge Protector

- When purchasing a surge suppressor, it will have a **Let-through** rating that indicates the maximum voltage allowed through a surge protector to the devices.
- The smaller the let-through measurement, the better the surge protection.
- The degree of protection of a surge suppressor is measured in **joules.***

Line Conditioner

- In the event of “dirty power” a line conditioner can clean up the signal.
- Often used in stereo equipment to produce static-free sound.
- Can also be used in the home/business.*

Uninterruptible Power Supply

- The best kind of power protection is an **uninterruptible power supply (UPS)**.
- It provides excellent surge protection as well as backup power in the event that the AC current fails.
- A UPS is rated by the amount of VA it provides and the length of time it can provide power during a blackout.

The Intelligent UPS

- Connects to the serial or USB port and can:
  - Send a warning to users logged into a server about pending shutdown.
  - Run a program or batch file when power is lost.
  - Send a second message to users if power is restored.
  - Shut down a server/computer correctly before batteries die.*

When Buying a UPS

- Consider:
  - Whether it conditions the line for both brownouts and spikes.
  - Whether it provides power during a blackout.
  - Whether it protects against very high spikes
  - Whether the VA rating for the UPS is at least 25 percent higher than your total wattage output
  - Whether the warranty and service policies are satisfactory
  - Whether the length of time the battery backup will last fits your needs*

Review

- What are three things you can purchase to protect your computer from spikes, browns, and other electrical problems?
- What does a surge protector do?
- What is the purpose of a line conditioner?
- How does a UPS work?
- What are two types of UPSs?
- What can a smart UPS do?

Other Safety Issues

- Fire
- Handling chemicals in the workplace
- Ergonomics and proper lifting techniques

Fire Extinguishers

FIRE CHART						
WATER	✓	X	X	X	X	X
FOAM	✓	✓	X	X	X	X
CLASS F WET CHEMICAL	✓	X	X	X	✓	X
ABC DRY POWDER	✓	✓	✓	X	X	✓
CLASS D POWDER	X	X	X	✓	X	X
CARBON DIOXIDE	X	✓	X	X	X	✓

Handling Chemicals in the workplace

- A Materials Safety Data Sheet is required for every chemical used in a workplace.
- AKA MSDS
- It has information on how to handle spills, exposure, clean up, etc.
- It is usually in a bright yellow binder on the wall in the manager's office, easily found by anyone on the floor of the main work area.

MSDS

ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Ammonium hydroxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ammonium hydroxide

Catalog Codes: SLA3667, SLA3490, SLA1144

CAS#: 1336-21-6

RTECS: BQ9625000

TSCA: TSCA 8(b) inventory: Ammonium hydroxide

CI#: Not applicable.

Synonym: Aqueous Ammonia; Strong Ammonia Solution; Stronger Ammonia Water

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

MSDS

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ammonia, anhydrous	7664-41-7	27-31
Water	7732-18-5	69-73

Toxicological Data on Ingredients: Ammonia, anhydrous: GAS (LC50): Acute: 2000 ppm 4 hours [Rat]. 4230 ppm 1 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, . Non-corrosive to the eyes. Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.

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MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Ammonia, anhydrous].
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to upper respiratory tract, skin, eyes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention immediately. Finish by rinsing thoroughly with running water to avoid a possible infection.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:

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Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Hazardous decomposition include Nitric oxide, and ammonia fumes

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Ergonomics