

Chapter 3 Power Point Notes

What electrons do and how they can be controlled in a circuit depends mostly on the kinds of materials through which they flow.

Conductor

- Is a material through which electrons flow *easily*
- A good conductor contains has three or less electrons in its outer shell
- A conductor is a material having many free electrons
- Has very little *Resistance*

Most metals are good conductors

- but don't forget many liquids and some gasses also conduct

Three of the most common conductors are

- Silver*
- Copper*
- Aluminum*

Electrons flow from a *negative* point to a *positive* point

How fast does electricity travel?

- Electricity travels at the speed of light
- 186,000 miles per second

Conductor Size

- Conductors are sized by their *cross sectional area*...
- The American Wire Gauge (AWG) has developed a system to size wires...
- NUMBERS
- OUGHT'S
- Kcm (thousands of circular mil)

AWG's Numbering system

- The numbered system, numbers the wires from 1 to 50

—#1 being the largest wire diameter

—#50 the smallest wire diameter

—A # 12 wire can carry more current than a # 20 wire

OUGHT system

- The OUGHT system, numbers the wires from 0, 00,000, and 0000
 - #0 being the larger than # 1 wire
 - #0000 the largest of the OUGHT system
 - A # 0000 wire can carry more **current** than a # 0 wire

kcm system

- The kcm system, numbers the wires in units of Thousands of circular mil (**kcm**)
- A circular mil is equal to .001” (1/1000th of an inch)
- Ex. 250 kcm
- 500 kcm
- 500 Mcm

Color of the insulation...

- The color of the insulation has meaning also...
- DC voltage:
 - Red indicates the positive wire
 - Black indicates the negative wire
 - Green indicates the ground
- AC voltage:
 - Black indicates the Hot wire (supply)
 - White indicates the return wire or Common wire.
 - Green or bare indicates the ground

Resistance

- Is the **opposition to current**
- Is abbreviated by the letter **R**
- Is measured in units called **ohms**
- An ohm is abbreviated with the Greek letter omega **Ω**

The ohm is named after my good friend

- Georg Simon Ohm

Resistance of a material depends on

- *the atomic structure of the material*
- *its temperature*
- *its length*
- *its cross-sectional area*

Resistance generally increases as the temperature of the material increases

Super-conductivity

- ***Is a condition in which, as materials reach temperatures of absolute zero they have no resistance***

Insulators

- Is a material that ***does not easily conduct electricity***
- Usually have 5 or more electrons in their outer shell
- The ability of a material to insulate is known as its ***dielectric strength***
- We must never forget that all insulators have a point at which they will conduct

Some common insulating materials are

- *air*
- *wood*
- *glass*
- *mica*

Insulating materials are just as important as conductors

- Because they protect our circuits from us
- Because they protect us from our circuits

Insulation codes

- ***Insulators are marked with code letters indicating their approved uses.***
 - Example:
 - R for rubber
 - H for heat
 - UF for underground feeder

Special Conductor Pathways

- Breadboards
- Printed Circuits Boards
- Chassis

Breadboards...

- *A breadboard is a useful device for learning about electric circuits.*
- It consists of a series of holes aligned in rows.
- *The breadboard provides a easy system for constructing circuits quickly.*
- You have been using a breadboard to set up circuits in the brown boxes...

Printed Circuits Boards

- Printed Circuits Boards (**PCB**)
- PCB's are made from a thin layer of conductor material, usually copper foil.
- *Components are inserted through holes and then **soldered**.*

Chassis Wiring...

- In the early days components were mounted on metallic surfaces called **chassis**
- The automobile is an example of chassis wiring...
 - The negative post of the battery is connected to the frame (chassis) of the car....
 - a red wire is connected to the fuse panel then routed to the tail light, then it changes to black and is tied to the frame of the car for its path back to the battery.

Switches....

- Switches are installed in circuits to control the flow of electrons though the circuit.
- The ***actuator*** is the mechanical device that causes the circuit to open and close.
 - Slide
 - Toggle
 - Rotary
 - Push button
 - Can you think of any others?

Switch *ratings*....

- Switches are rated for **ampacity** and **voltage**
- Switch SPST (single pole single throw)
- Switch SPDT (single pole double throw)

Circuit Protection Devices..

- The two most common types of circuit protection are
 - Fuses
 - Circuit breakers

•**Fuses and breakers are rated in Amps.**

Resistors...

- Resistors are one of the most common components used in electronics.
- They are use to create desirable voltage drop and limit current.***
- There is several different types....
 - Fixed resistor
 - Ceramics
 - Potentiometers
 - Thermistors

Power Rating

- The power rating of a resistor indicates how much heat a resistor can throw off before burning out.
- The power rating is given in **Watts**
- The larger (physical size) of a resistor the larger wattage rating

The stripes of a carbon composition resistor indicate

- The resistance value***
- The tolerance value***
- Sometimes the failure rate***

Tolerance

- The actual resistance of a resistor may be greater or less than its rated value. This variation is called the tolerance.***

The most common tolerances of carbon-composition resistors

- +/-5%
- +/-10%
- +/-20%
- Example a 100 ohm resistor with a tolerance of +/-10% could actually have any value between 90 ohms and 110 ohms

The *fifth stripe indicates the failure rate*, the amount by which the resistance will change during a given period of time (1,000 hours)

Resistors a very rugged devices

- They seldom become defective unless too much current passes through them
- If too much current passes through a resistor it may become scorched or bulge out
- Its resistance will increase sometimes to infinity