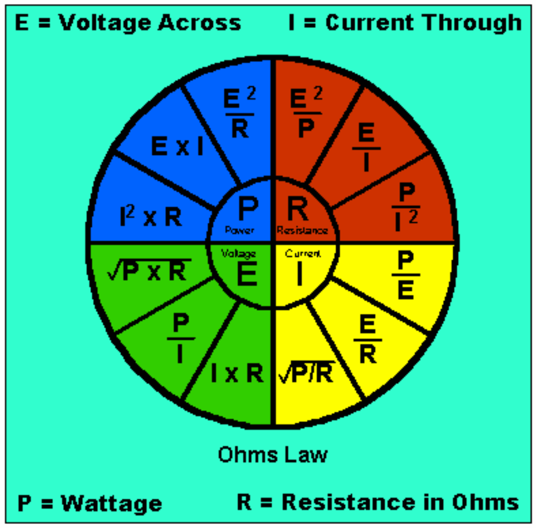
Chapter 4 Energy notes



Electromotive force

- Is the *energy that forces electrons through a circuit*.
- Abbreviation is ***emf.***
- Measured in units called ***volts***.

Voltage

- Is the ***force*** that pushes the electrons through the conductor.
- Is abbreviated by the letter (***E***).
- Measured in units called volts.
- 120 volts would be abbreviated 120***V***

Electrons flow from a negative point to a positive point.

Current

- Is the amount of electricity.
- Is abbreviated with the letter (***I***)
- Is measured in units called amperes. (amps.)
- Amps is abbreviated with the letter (***A***)

A source must be able to supply??

- First, it must supply the correct ***VOLTAGE***.
- Second, it must supply the ***CURRENT*** for which the devise was designed.

4.1 Power

- ***Power*** is the time rate of doing work.
- Is abbreviated by the letter (***P***)
- Is measured in units called ***WATTS***.
- Watt is *abbreviated* by the letter (***W***)
- This *circle* is known as **Watts Law**.

Energy: Electric Power

- An understanding of electrical power will enable you to *select the proper size of components* needed to build or maintain a circuit.
- Once the amount of power required is determined, *we can calculate such factors as conductor and fuse size*.

4.2 Ohm's Law and Watts Law

- It is possible to combine Ohm' law and Watts law to produce simple formulas that permit you to solve for current, voltage, resistance, or power.

Power??? Wattage???

Selecting the proper size of components

•We need to calculate the Power (wattage) of the 100 Ω resistor.
–The formula for calculating Power is P = I x E
–Ohm's Law will help us find the value of the current (I). I = E/R 12 V/100 Ω =.12 A

•Now that we know the Current and the Voltage we can calculate the Power or Wattage using the formula P = I x E
•P = I x E (.12 A x 12 V = 1.44 Watts
–This would mean that we *could not use a 1 W resistor* it would have to be a ***2 Watt resistor***.

•Remember that the Wattage of a resistor is given by its physical size of the resistor.

How does this apply to a household circuits???

- •Let's use an Electric Water Heater for an example.
- •A typical water heater element will have a 5500 Watt element that is supplied by 240 Volts. ***What size wire and breaker needs to be used for this circuit?***
- •Wire size determines how much Current can safely travel through the wire, so we need to calculate the amount of current. P = I x E
- •So for this example P = 5500 W/240 V. I = 22.91 A

Next we would to need to look up the ampacitie of wire in the NEC book, to see what size wire will safely carry 23 Amps.

Table 310.16 from the NEC is used to size wire according to how much current can safely flow through the wire.

Explanation of (*) on table 310.16

•(D) Small Conductors. Unless specifically permitted in 240.4(E) through (G), *the overcurrent protection shall* ***<u>not exceed</u>*** *15 amperes for 14 AWG, 20 amperes for 12 AWG, and* ***<u>30 amperes for 10 AWG copper</u>****; or 15 amperes for 12 AWG and 25 amperes for 10 AWG* aluminum and copper-clad aluminum after any correction factors for ambient temperature and number of conductors have been applied.

•This means that we must use 10 AWG wire to handle the 23 Amps that will be supplied to the water heater, and a 25 Amp breaker.

4.3 Wattmeter and Watt-hours

- •Wattage can be measured with a Wattmeter.
- •The consumption of electric power at your house is measured with a Watt-hour meter.
- •Since a watt-hour is a very small unit, standard utility meters read in Kilowatt-hours (kWh)
- •Killowatt-hours can be calculated with the formula kWh = E x I /1000

The power company charges by the kilowatts used per hour ***kilowatthour*** (kWh)