CHAPTER 3

Ohm’s Law, Power, & Decibels

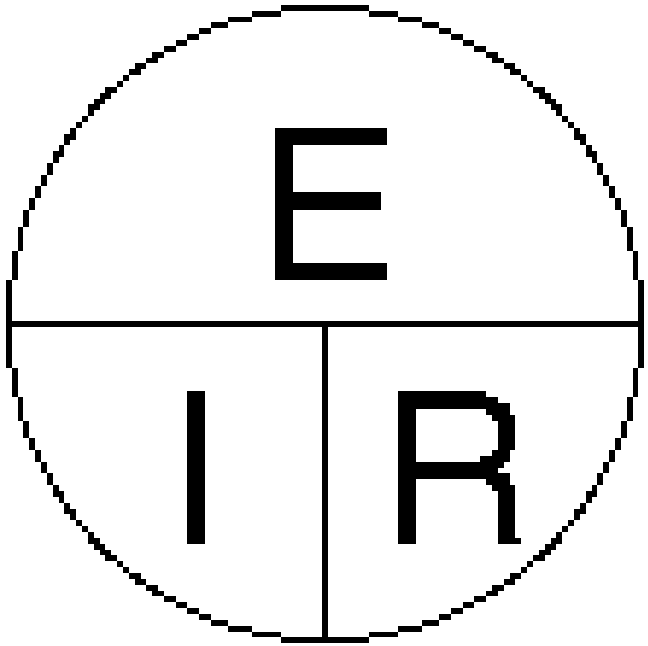
Ohm’s Law

There is a very easy way to determine how much current will flow through a circuit when the voltage and resistance is known.

The simple equation is as easy as (don't let the word scare you) “pie”

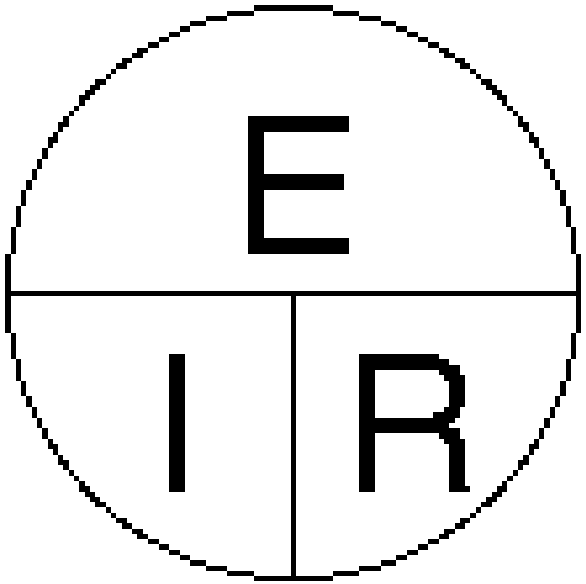
Remember the “pie” below. The pie/circle will help you to know how to figure out the answer to these electrical problems. The three letters stand for...

E = electromotive force (a.k.a. Voltage)
I = *intensity* (French term for Current)
R = resistance



Ohm's Law

- E = electromotive force (a.k.a. Voltage)
- I = *intensity* (the French term for Current)
- R = resistance



- **Voltage:** E = I x R *(Volts)*
- **Current:** I = E / R *(Amps)*
- **Resistance:** R = E / I *(Ohms)*

Ohm’s Law

A circuit has 200 volts with 100 ohms of resistance. How much current would flow?

Since our "unknown" value in this problem is the current, then we can put our finger over the "I“.

What’s left is "E over R". This means you take the Voltage and divide it by the Resistance. 200 volts divided by 100 ohms equals 2 amps.

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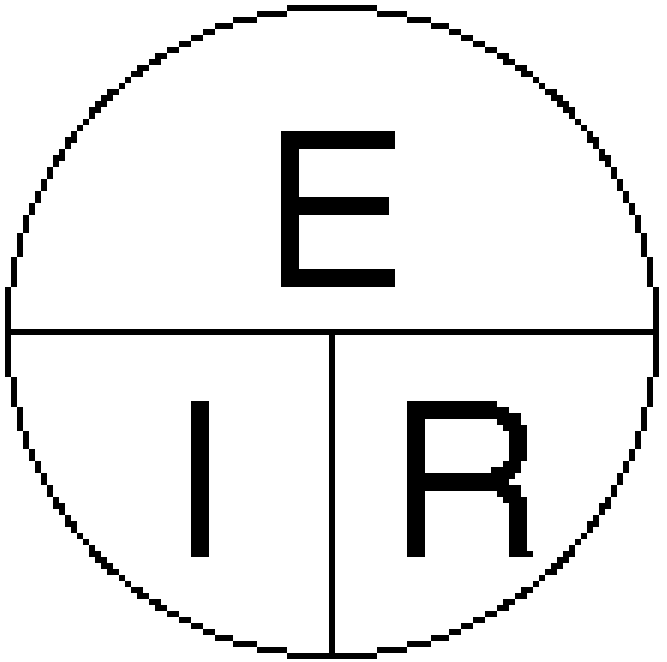
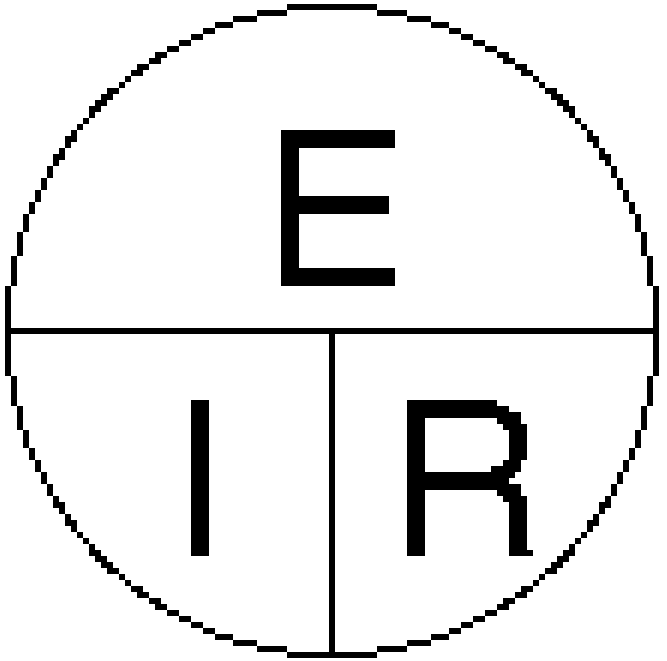


Ohm’s Law

We want to determine the voltage in a circuit when we know the current is 2 amps and the resistance is 50 ohms.

Look at the "pie" and cover up the E. You're left with I times R.

Voltage = 2 amps time 50 ohms = 100 volts



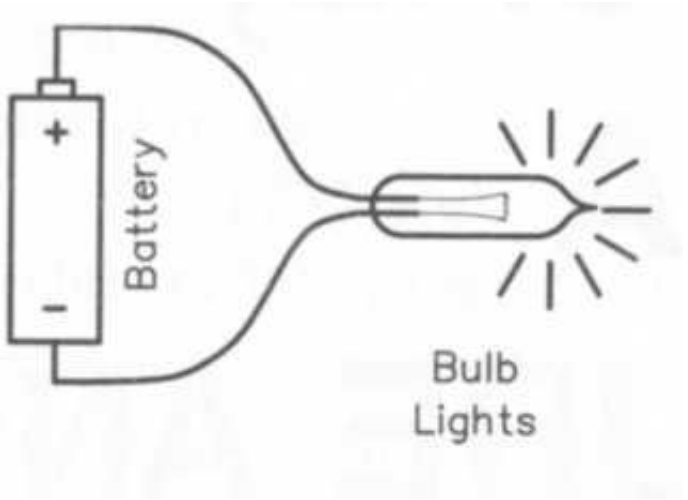
E = electromotive force (a.k.a. Voltage)
I = *intensity* (French term for Current)
R = resistance

Power

Every circuit uses a certain amount of power

Power describes how fast electrical energy is used

When you close a circuit containing an incandescent light bulb, heat and light are produced in the bulb by the current flowing through a resistive filament in the bulb.



The resistance turns the electrical power into primarily heat, and secondarily light.

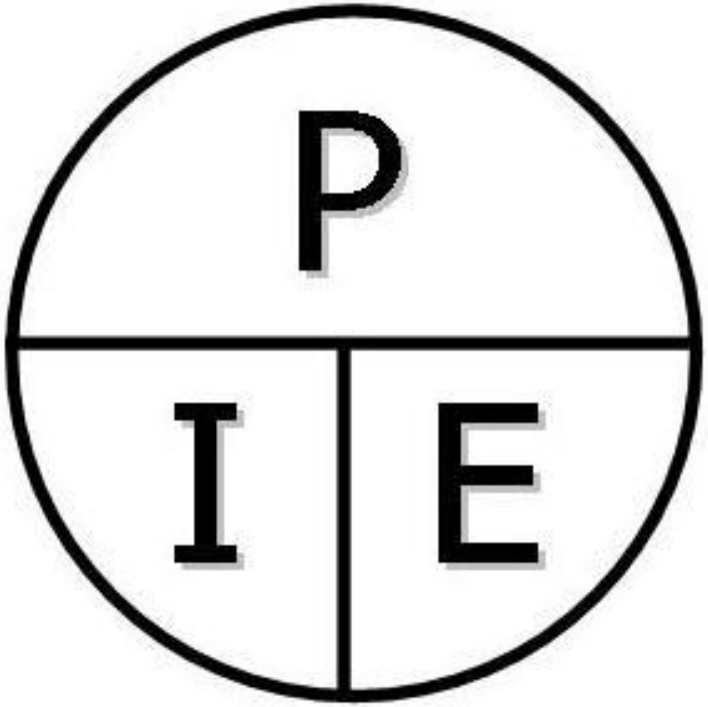
Each light bulb is rated at a certain power rating, an expression of how much power the bulb will use in the rated circuit. The rated power usage is expressed in **watts**.

Power Calculations

– The unit used to describe electrical power is the **Watt**.

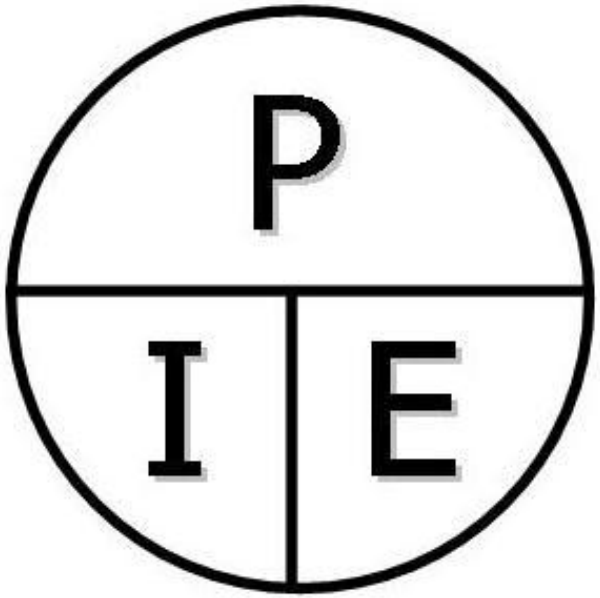
– The formula for calculating power is

- Power (P) equals voltage (E) times current (I) P = E X I
- Use another pie!



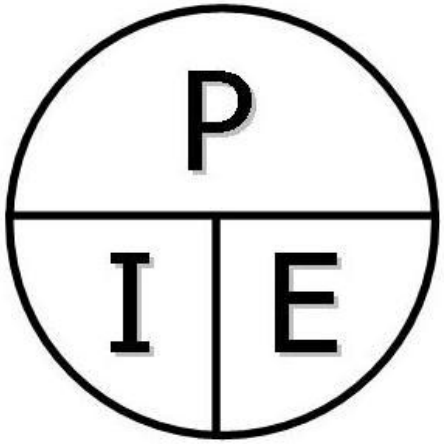
Power Calculations

- How much power is represented by a voltage of 13.8 volts DC and a current of 10 amperes?
  - P = I x E P = 10 x 13.8 = 138 watts
- How much power is used in a circuit when the voltage is 120 volts DC and the current is 2.5 amperes.
  - P = I x E P = 2.5 x 120 = 300 watts



Power Calculations

- How many watts are consumed by a transceiver when you are transmitting?
- By measuring the DC voltage at the transceiver and multiplying by the current drawn when you transmit…
  - P = E X I = (Power = 12 volts X 20 amps) = 240 watts
- How many amperes is flowing in a circuit when the applied voltage is 120 volts DC and the load is 1200 watts?
  - I = P / E = (Current = 1200 watts / 120 volts) = 10 amperes



Power Calculations

Memorizing Ohm's law

Power Formula P= I x E

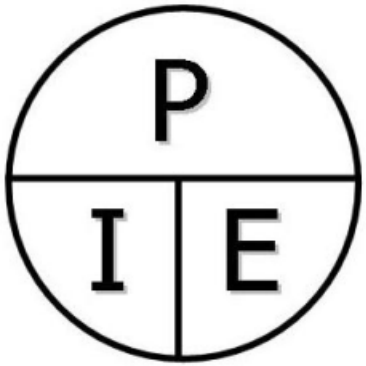
Lets try some examples we are familiar with;

P= 60 watt light bulb
E=120 volts
I= .5 amps

P=100 watt light bulb
E=120 volts
I=.83 amps

Electric Kettle consumes
P=900 watts
E=120 volts
I= 7.5 amps

Electric Toaster
P= 1200 watts
E=120 volts
I=10 amps



Power: P = I x E *(Watts)*
Current: I = P / E *(Amps)*
Voltage: E = P/ I *(Volts)*

E = Electromotive Force aka Volts
I = Intensity aka Current

- Decibels: Read Section A1.7 in your study guide

Decibels

The decibel is used rather than arithmetic ratios or percentages because when certain types of circuits, such as amplifiers and attenuators, are connected in series, expressions of power level in decibels may be added and subtracted

In radio electronics and telecommunications, the decibel is used to describe the ratio between two measurements of electrical power

Decibels are used to account for the gains and losses of a signal from a transmitter to a receiver through some medium (free space, wave guides, coax, fiber optics, etc.)

Decibels

- A doubling of power results in a change of 3dB higher

- Transmitter's power can be reduced 3dB by reducing the power by half

- Transmitter's power can be increased by 6dB by quadrupling power

Decibels

If a signal-strength report is “10dB over S9”, reducing transmitter power from 1500 watts to 150 watts should produce a report of “S9”

If a signal-strength report is “20dB over S9”, reducing transmitter power from 1500 watts to 150 watts should produce a report of “S9 plus 10dB”

Other examples:

Power output increases from 1 watt to 2 watts = 3.3 dB received power increase

Power output increases from 5 watts to 50 watts = 10 dB received power increase