Ohm's Law
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Electricity

Electricity is a form of energy that is carried by the flow of electrons through the atoms of a conducting medium such as a copper or tungsten wire. An electric wire is a long line of (usually copper) atoms. All atoms like to contain a certain number of electrons. If an atom has one too many electrons, it will immediately shed another electron. If an atom is missing an electron, it starts looking for an electron to steal.

The flow of electrons is like a long pipe that is completely filled with glass marbles. If an extra marble is poked into the input end of the already full pipe, a marble must simultaneously pop of the (output) end of the pipe. If five marbles per second are poked into the input end of the pipe, five marbles per second will simultaneously pop out of the output end of the pipe. It can be said that the flow rate of the marbles is five marbles per second. If a paddle wheel is connected to the output of the pipe, the flow of marbles can be made to perform work.

The flow rate of electrons is called **current** and it is measured in electrons per second. The **ampere** is the unit for the flow rate or current of electrons. One ampere is defined as **6.24 X 10 to the 18th power (6,240,000,000,000,000,000)** electrons per second. That sounds like a lot of electrons but electrons are so small that the ampere unit is very practical. One ampere is the current required to operate the dome light in a typical automobile.

The process of pushing marbles through a pipe, or electrons through a wire is rarely 100% efficient. A certain amount of resistance to movement, due to friction, takes place with the marbles bumping and scraping along the way. Electrons also resist movement and this loss is called resistance. This loss appears as heat.

The electric force or pressure that pushes the electron current through the resistance of the wire is measured in units called volts. The standard unit of energy is the watt (per second) which measures work. A watt is equal to .73756 foot pounds/seconds or 101.9716 gram meters/second or .001341 horse power. *One volt is the amount of electric pressure or potential that it takes to cause one ampere of current to dissipate one watt of energy per second.* Work, or watts, equals volts multiplied by amperes. The resistance (R) to the flow of current can be described as the number of volts it takes to make one ampere of flow rate, or *volts per ampere or volts/ampere.* In this case the resistance (R) would be: one *volt/ampere.* This relationship can be written as R equals volts/amperes. The unit of the volt/ampere was named the **Ohm** to honor Georg Simon Ohm who was an early pioneer in the field of electricity. The abbreviation for the ohm is .

The equations that describe the relationship between voltage,
current, power, and resistance are referred to as Ohm's Law. Before getting into these equations, the not always logical, standard abbreviations need to be explained.

Other Abbreviations

Lower case letters are used for ac and upper case letters are used for DC. The abbreviations for alternating current (ac) voltage is **v** and **V** for direct current (DC) voltage. Voltage is referred to in Ohm's Law formulas as electro motive force which is abbreviated as **EMF** or just **E** for DC and **e** for ac. For example: E=3V means that the electro motive force is 3 volts of DC. Voltage is also referred to as a "potential" or a "potential difference", which is the difference between two voltages.

The ampere is abbreviated by the letter **A** for DC and **a** for AC. DC current in formulas is designated I; for AC i. For example, "the AC current is equal to 5 amperes" would be i=5a. Amperes are also referred to as **amps**.

Work or power is referred to as **P** for DC and **p** for AC. Watts are abbreviated by **w** or **W**. For example, "the DC power is equal to 4 watts" would be P=4W. "The AC power is equal to 4 watts" would be p=4w.

OHM'S LAW for DC

Resistance in s equals volts x amperes or R=E/I.
Power in watts equals volts x amperes or P=IE.
By using basic algebra, these formulas can be rearranged and/or combined to yield other formulas such as:

I=E/R,   E=IR,   P=E /R,   P=IR
plus a few other variations of the same information.

For AC, the formulas are similar except that the letters would be lower case instead of upper case.

Next month I will show some practical applications for Ohm's Law.