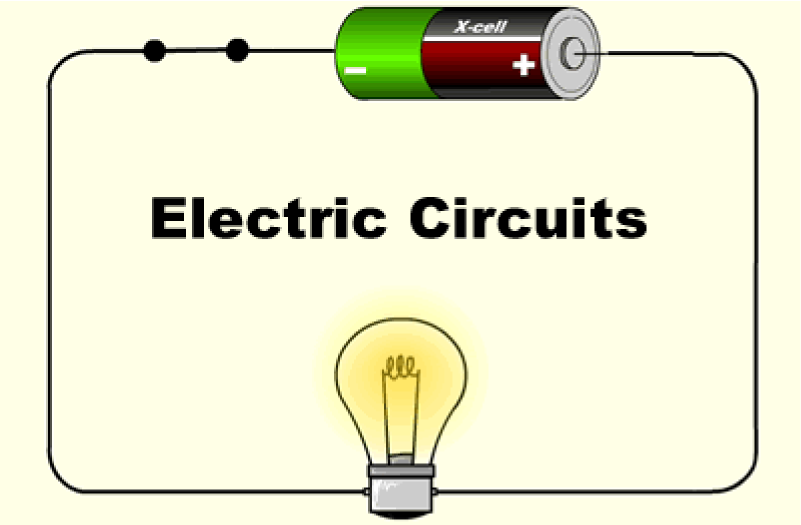
ELECTRICAL CIRCUITS

Believe in yourself! Have faith in your abilities! Without a humble but reasonable confidence in your own powers you cannot be successful or happy.

What is an electrical circuit?



An electrical circuit is a complete course of conductors through which current can travel. Circuits provide a path for current to flow. To be a circuit, this path must start and end at the same point. In other words, a circuit must form a loop.

For example, a simple circuit may include two components: a battery and a lamp. The circuit allows current to flow from the battery to the lamp, through the lamp, then back to the battery. Thus, the circuit forms a complete loop.

Remember that life's greatest lessons are usually learned from worst times and from the worst mistakes.

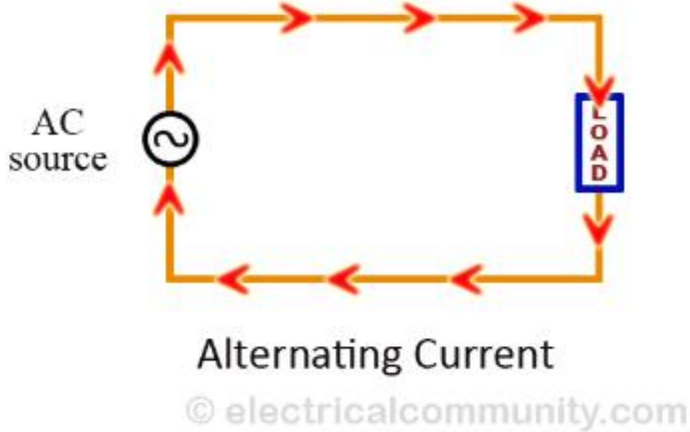
An electric circuit requires four elements:

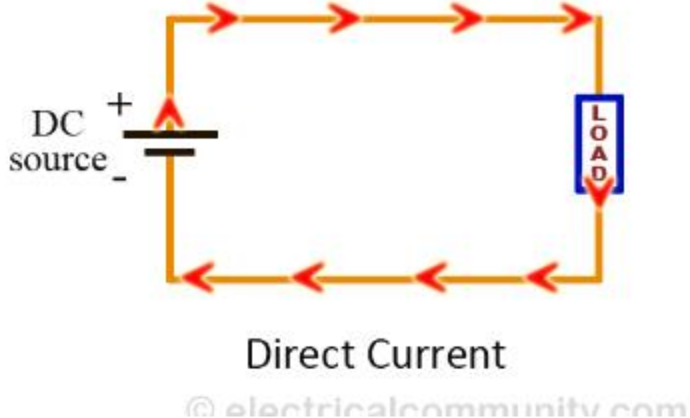
1. Conductors or Wires
2. AC or DC power source/supply
3. Load (Fan,light,TV,laptop,Refrigerator)
4. Switch

Types of electrical circuits

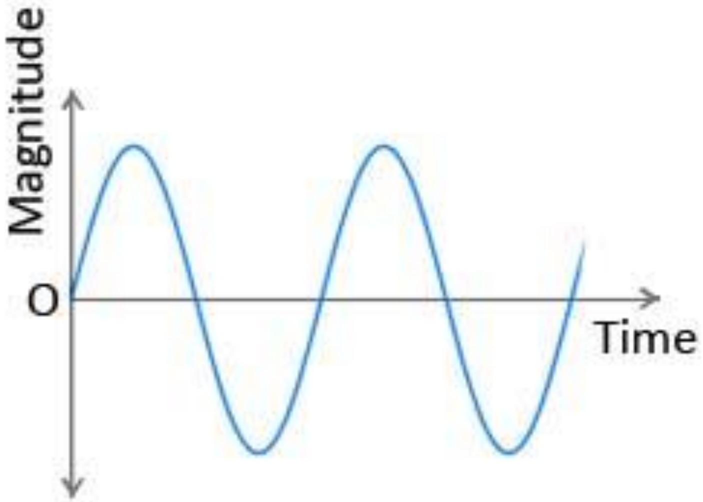
2 Types:

DC electric circuit
AC electric circuit

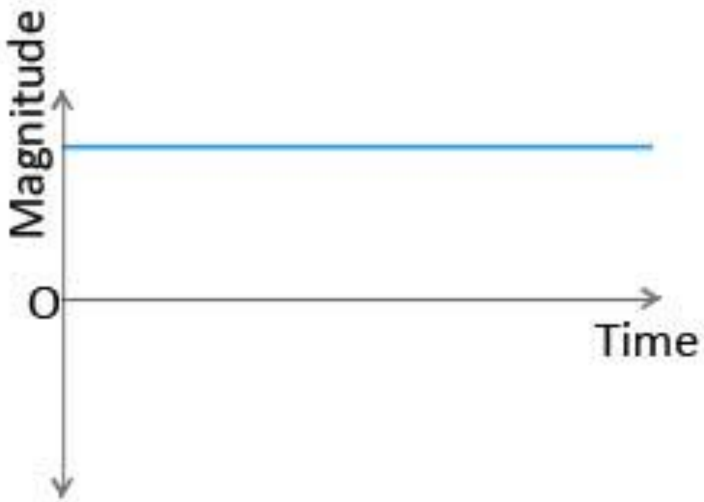




You are confined only by the walls you build yourself.



Alternating Current



Direct Current

Discipline is doing what needs to be done, even if you don't want to.

DC & AC Circuit

A Direct Current circuit is a circuit where Electric Current flows through in one direction. DC is commonly found in many low-voltage applications, especially where these are powered by Battery. Most electronic circuits require a DC power supply.

A Direct Electric Current flows only when the Electric Circuit is closed, but it stops completely when the circuit is open.

A Switch is a device for making or breaking an Electric Circuit. While the Switch is closed, Figure 1(a), the circuit is closed and the Light Bulb turns On; while the Switch is opened, Figure 1(b), the circuit is open and the Light Bulb turns Off.

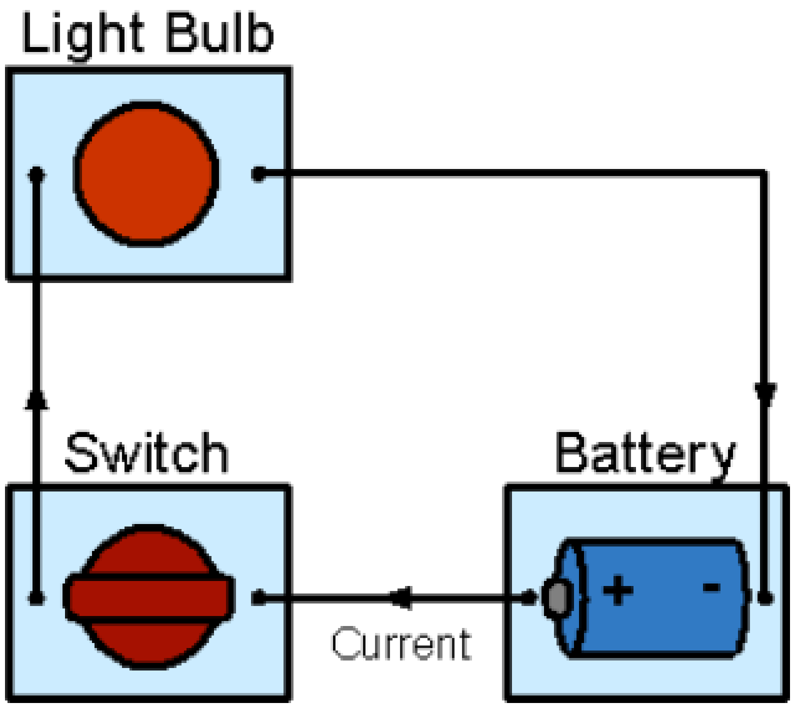


Figure 1(a): Switch is closed, the circuit is closed and the Light Bulb turns On

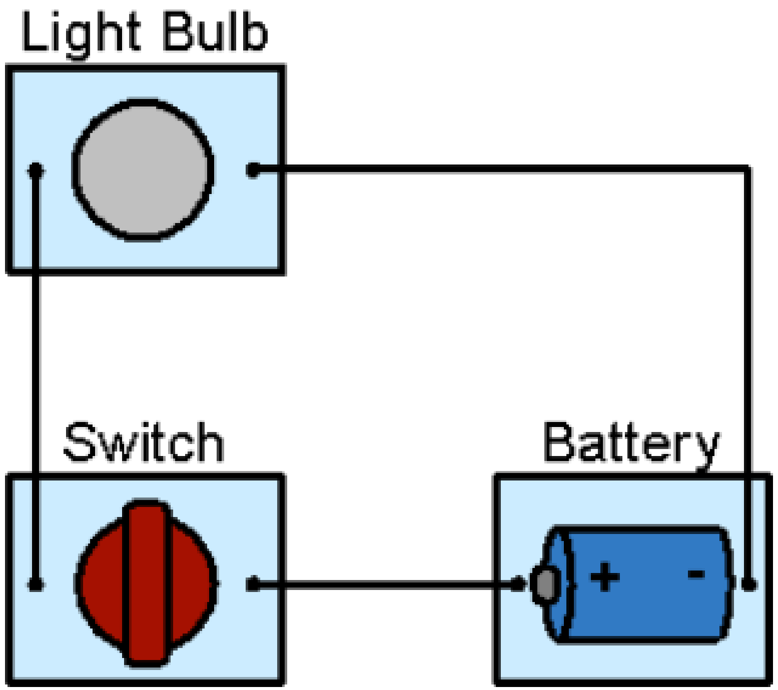


Figure 1(b): Switch is opened, the circuit is open and the Light Bulb turns Off

Hard work beats talent when talent doesn't work hard.

DC & AC Circuit

- In DC, the flow of electrons goes in one direction only. In alternating current, the electrons switch back and forth at regular intervals. This also causes voltage to reverse as the current changes direction. The difference in how these two currents travel make them useful in different applications. In a house circuit, an alternating current will always be used.

- When current comes into your household, it travels a long distance, coming from the power source into your home. Alternating current is used in this application because, when compared with direct current, it is less likely to lose power when traveling along this distance.

- High voltages and low currents are required for these ac transmissions. However, once electricity arrives at its destination, the voltage needs to be lowered so that it can be used safely. Unlike direct current, alternating current can easily be converted from low to high and high to low voltages with the use of a transformer.

Where AC and DC are used?

- ✓ We see both the types of supplies (AC as well as DC supply) everywhere. We receive AC power supply from an electric company to our homes and offices.
- ✓ The AC supply is standardized as sinusoidal AC with 50 Hz frequency in some part of the world and sinusoidal AC with 60 Hz frequency in the other part.
- ✓ The electric outlets we see in our homes and offices provide AC power supply. Thus, many of our home appliances, such as lights, air conditioners, heaters, etc., run on AC supply.
- ✓ Needless to say, there are endless applications which run on AC supply. Look around and you will find a lot.

Where AC and DC are used?

DC also find many applications. laptop uses DC power. Yes! you plug in the charger of your laptop to an AC outlet, but your laptop actually consumes DC. The Charger, converts AC power in to DC and charges the battery of your laptop.

Similar in case of your mobile phone or tablet. That's not all, DC power finds many applications in industries mostly because of the advantages of DC motors over AC motors.

DC & AC Circuit

- Is a house AC or DC?

When you plug things into the outlet in your house, you don't get DC. Household outlets are AC - Alternating Current.

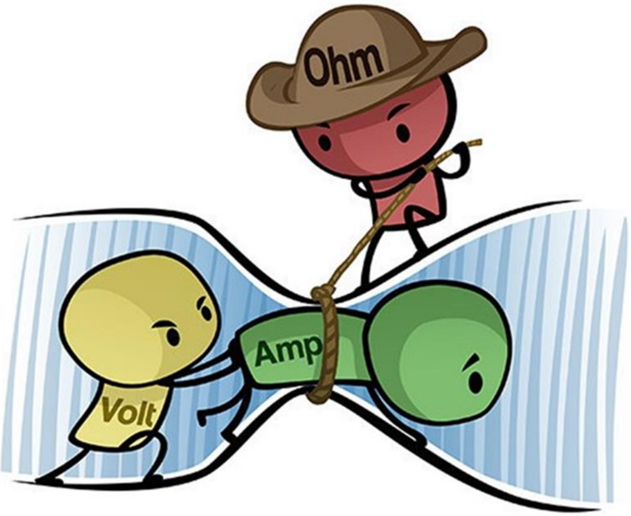
- DC can be generated in a number of ways:

I. An AC generator equipped with a device called a "commutator" can produce direct current.
II. Use of a device called a "rectifier" that converts AC to DC.
III. Batteries provide DC, which is generated from a chemical reaction inside of the battery.

AC	DC
It reverses its direction while flowing in a circuit. It is the current of magnitude varying with time. Electrons keep switching directions - forward and backward.	It flows in one direction in the circuit. It is the current of constant magnitude. Electrons move steadily in one direction or 'forward'.
A.C is obtained from Generator and mains.	DC is obtained from Cell or Battery
AC-Sinusoidal, Trapezoidal, Triangular, Square.	DC-Pure and pulsating.
Safe to transfer over longer city distances and can provide more power.	Voltage of DC cannot travel very far until it begins to lose energy.
The frequency of alternating current is 50Hz or 60Hz depending upon the country.	The frequency of direct current is zero.

Be stubborn about your goals and flexible about your methods

Current, Voltage, Resistance



- Electrical Current is the movement or flow of electrical charge. The rate at which charge is flowing is called current.

- This flow of electrons is called an electrical current. The electrons do not flow freely through the circuit. As they move through the circuit, the material of circuit (conductor) creates a restriction to the electron flow. This restriction is called resistance.

- Resistance is a material's tendency to resist the flow of charge. Resistance is the hindrance to the flow of charge.

Doing what is comfortable is rarely profitable

Current, Voltage, Resistance

- Voltage can be thought of as the force that pushes electrons through a conductor and the greater the voltage the greater is its ability to “push” the electrons through a given circuit.

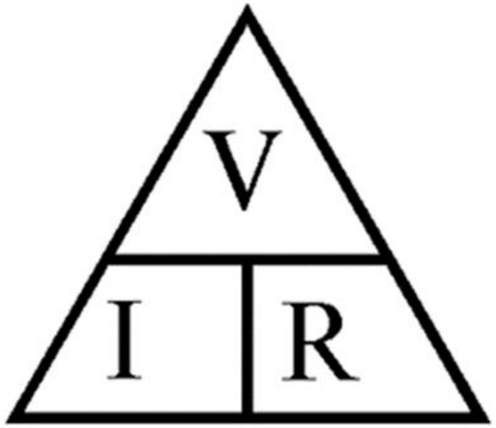
- Then all basic electrical or electronic circuits consist of three separate but very much related electrical quantities called: Voltage, (v), Current, (i) and Resistance, (Ω).

Ohm's Law

Ohm's Law explains the relationship between voltage (V or E), current (I) and resistance (R).

According to Ohm's law : At constant temperature, the current flowing through a conductor is directly proportional to the voltage across its end.

Introducing the constant of proportionality, the resistance, one arrives at the usual mathematical equation that describes this relationship



Work hard in silence, let your success be your noise

Ohm's Law

According to Ohm's Law: the Current I in a electric circuit is proportional to the applied Voltage V and inversely proportional to the Resistance R.

Ohm's Law: $I = V / R$

In other words, for a fixed Resistance (R), the greater the Voltage (V) across a Resistor, the more the Current (I) flowing through it; for a fixed Voltage across a Resistor, the more the Resistance of the Resistor, the less the Current flowing through it.

In Figure 2, a Resistor is added to the Direct Current Circuit, the total Resistance (R) of the circuit becomes larger but the Power Supply Voltage (V) remains unchanged, therefore, the Current (I) flowing through the circuit is reduced. With less Current flowing through, the Light Bulb becomes dimmer.

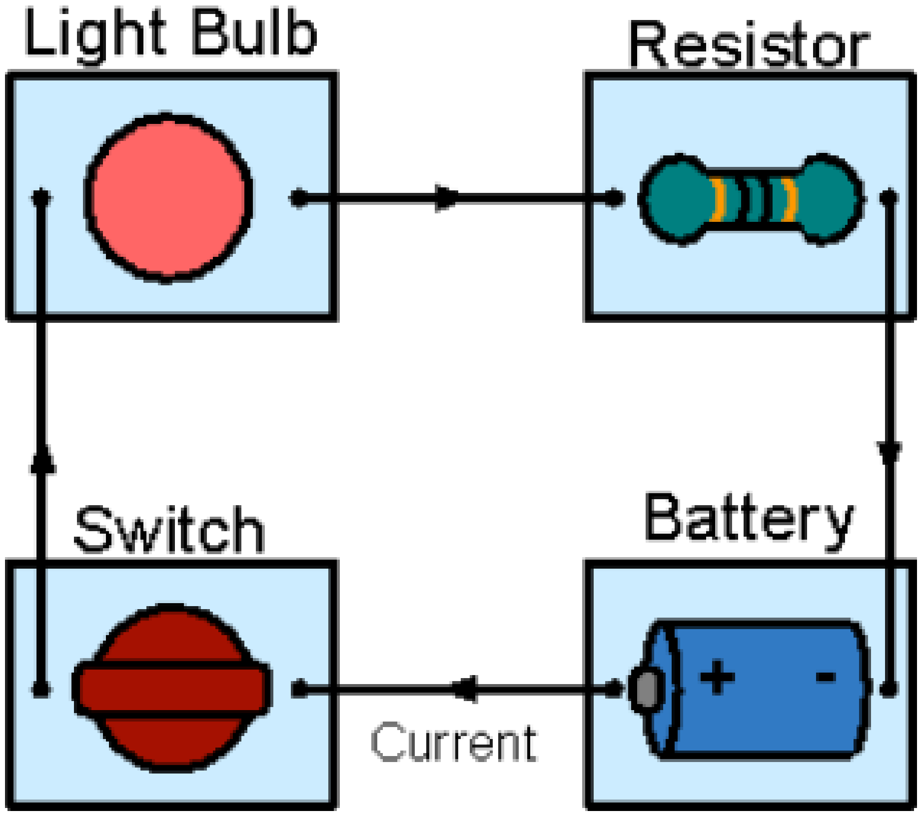


Figure 2: The Circuit contains a Battery, a Light Bulb, a Resistor and a Switch

Energy

Energy is stored work. Energy, in physics, the capacity for doing work. It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms. It has the same units as work, the Joule (J).

4.4 POWER

In general,

the term power is applied to provide an indication of how much work (energy conversion) can be accomplished in a specified amount of time; that is, power is a rate of doing work.

For instance, a large motor has more power than a smaller motor because it has the ability to convert more electrical energy into mechanical energy in the same period of time. Since energy is measured in joules (J) and time in seconds (s), power is measured in joules/second (J/s). The electrical unit of measurement for power is the watt (W) defined by

$$\boxed{1 \text{ watt (W)} = 1 \text{ joule/second (J/s)}} \tag{4.8}$$

In equation form, power is determined by

$$\boxed{P = \frac{W}{t}} \qquad \text{(watts, W, or joules/second, J/s)} \tag{4.9}$$

with the **energy** (W) measured in joules and the time t in seconds.

The power delivered to, or absorbed by, an electrical device or system can be found in terms of the current and voltage by first substituting Eq. (2.5) into Eq. (4.9):

$$P = \frac{W}{t} = \frac{QV}{t} = V\frac{Q}{t}$$

But

$$I = \frac{Q}{t}$$

so that

$$\boxed{P = VI} \qquad \text{(watts, W)} \qquad \textbf{(4.10)}$$

By direct substitution of Ohm's law, the equation for power can be obtained in two other forms:

$$P = VI = V\left(\frac{V}{R}\right)$$

and

$$\boxed{P = \frac{V^2}{R}} \qquad \text{(watts, W)} \qquad \textbf{(4.11)}$$

or

$$P = VI = (IR)I$$

and

$$\boxed{P = I^2R} \qquad \text{(watts, W)} \qquad \textbf{(4.12)}$$

The power supplied by a battery can be determined by simply inserting the supply voltage into Eq. (4.10) to produce

$$\boxed{P = EI} \qquad \text{(watts, W)} \qquad \textbf{(4.13)}$$

The importance of Eq. (4.13) cannot be overstated. It clearly states the following:

The power associated with any supply is not simply a function of the supply voltage. It is determined by the product of the supply voltage and its maximum current rating.

Don't wish it were easier. Wish you were better

Thank You