PLTW Engineering

10-12/AC vs DC

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10-12/DE

Lesson: **4/30/2020**

Students will learn the differences between alternating and direct current, how they are generated, applications where they are used.

Alternating Current (AC)

Alternating current describes the flow of charge that changes direction periodically. As a result, the voltage level also reverses along with the current. AC is used to deliver power to houses, office buildings, etc.

AC can be produced using a device called an alternator. This device is a special type of electrical generator designed to produce alternating current.

How an alternator works

A loop of wire is spun inside of a magnetic field, which induces a current along the wire.

The rotation of the wire can come from any number of means: a wind turbine, a steam turbine, flowing water, and so on.

Because the wire spins and enters a different magnetic polarity periodically, the voltage and current alternates on the wire.

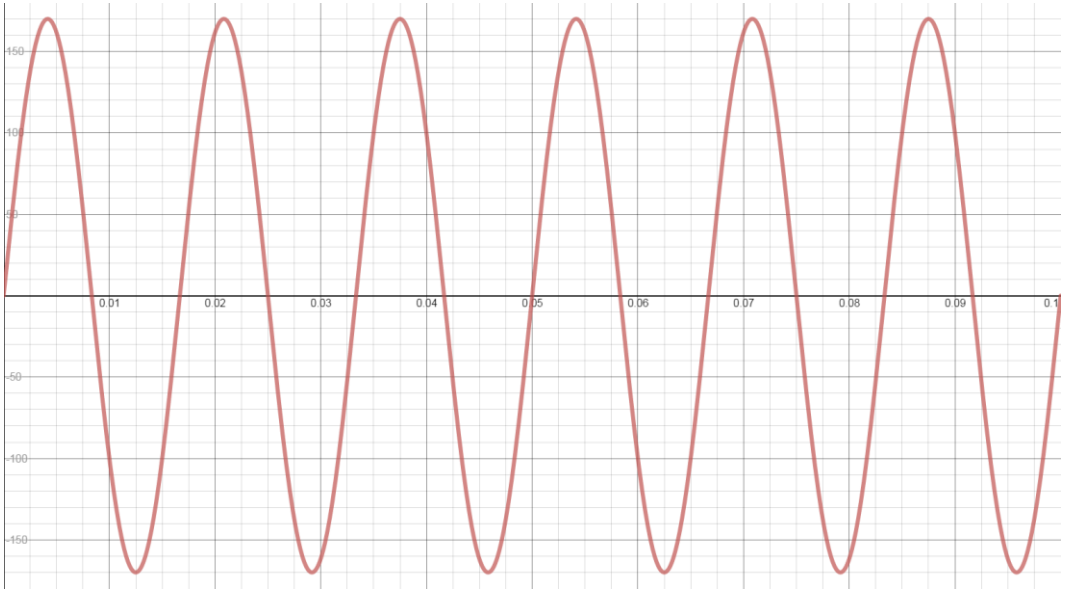
AC Waveforms

AC can come in a number of forms, as long as the voltage and current are alternating. If we hook up an oscilloscope to a circuit with AC and plot its voltage over time, we might see a number of different waveforms.

The most common type of AC is the sine wave. The AC in most homes and offices have an oscillating voltage that produces a sine wave.

AC Sine Waves

In the United States, the power provided to our homes is AC with about 170V zero-to-peak amplitude and 60Hz frequency.



AC current applications

Home and office outlets are almost always AC. This is because generating and transporting AC across long distances is relatively easy.

At high voltages (over 110kV), less energy is lost in electrical power transmission. Higher voltages mean lower currents, and lower currents mean less heat generated in the power line due to resistance. AC can be converted to and from high voltages easily using transformers.

AC current applications

AC is also capable of powering electric motors. Motors and generators are the exact same device, but motors convert electrical energy into mechanical energy.

If the shaft on a motor is spun in reverse, a voltage is generated at the terminals.

This is useful for many large appliances like dishwashers, refrigerators, and so on, which run on AC.

Direct current (DC)

Direct current can be generated in a number of ways:

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

Direct current (DC)

DC is defined as the "unidirectional" flow of current; current only flows in one direction.

Voltage and current can vary over time so long as the direction of flow does not change.

To simplify things, we can assume that voltage is constant.

Direct current (DC)

Most DC sources provide a constant voltage over time.

In reality, a battery will slowly lose its charge, meaning that the voltage will drop as the battery is used.

For most purposes, we can assume that the voltage is constant.

Quiz yourself

1. What are the advantages of alternating current (AC) electricity?

2. What are the disadvantages of direct current (DC) electricity?

3. Why do you think AC is used in residential or home applications?

4. What happens if an AC motor shaft is spun backwards?

Helpful links

Video explanation of difference between AC/DC motors

Types of Electric motors and applications

Thomasnet article about AC vs DC motors