Basic Electronics Part 9
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The discussion up to this point has dealt with circuits that have steady voltages applied and steady currents flowing. Many electronic circuits, however, include some voltages and currents that are changing. Circuit currents and voltages may increase and/or decrease over time even if their direction doesn't change. Such currents are called direct currents (DC). For example, consider the circuit in Fig. 1

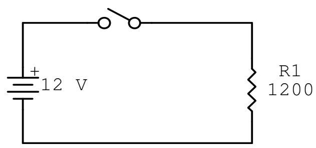

Fig. 1

If we open an close the switch once every second we will generate a series of pulses, each 1 second long. The voltage across R1 will be 12 volts when the switch is closed and 0 volts when the switch is open. The current through R1 will be 10 mA when the switch is closed and 0 when the switch is open. Voltage and current both change each time the switch opens or closes The electrons always move in the same direction through the circuit, so we have a direct-current signal (DC).

Some electronic circuits are such that electrons move through the circuit in one direction part of the time and in the opposite direction part of the time. When electrons flow first in one direction and then in the other, we say there is an alternating current. This is usually abbreviated AC.

An AC waveform that you will frequently find in electronics is the sine wave. A sine-wave current varies gradually between its peak positive and peak negative values. A sine-wave current graph looks like Fig. 2.

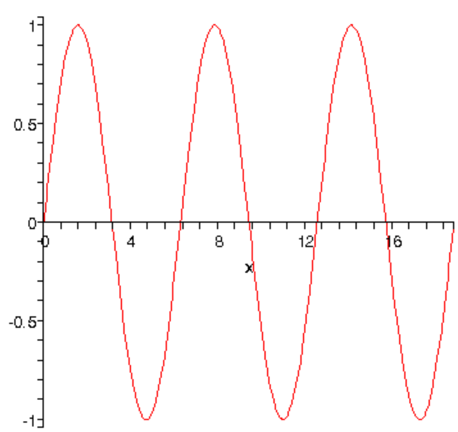

Fig. 2

In this graph we think of those values above the horizontal axis as positive and those below the horizontal axis as negative. Notice that the wave starts at zero and increases positively to a maximum or peak value. It then decreases to zero and continues to decrease through negative values to a maximum negative value or peak. From this negative peak it increases until it is again zero. This completes one cycle of the alternating current. You see that a cycle consists of a positive half cycle followed by a negative half cycle.

Alternating current signals travel through conductors in much the same way as DC signals do. Alternating signals also produce electromagnetic radiation. We refer to electromagnetic radiation as radio waves; however, visible light, ultraviolet radiation, X-rays, and many other types of radiation are also electromagnetic radiation.

AC currents can change direction at almost any rate. The frequency of a wave is the number of complete cycles the wave makes in one second. Frequency is measured in hertz, abbreviated Hz. For example, if the current completes 60 complete cycles in one second, then it has a frequency of 60 Hz. The power company supplies electricity to your house as 60 Hz AC. If you tune in to a two meter signal at 144.200 megahertz (MHz), this means that you are listening to a signal that is alternating at a rate of 144.2 million cycles per second.

Wavelength is another quality that we associate with every AC signal. Wavelength refers to the distance the wave travels through space in a single cycle. We use the symbol lambda (λ) to represent wavelength. All electromagnetic radiation travels through space at the speed of light, 300,000,000 meters per second. The faster a signal alternates the less distance it can travel during one cycle. The equation that relates a signal's frequency and wavelength to the speed of light is

$$c = f\lambda$$

where c is the speed of light, $3 \text{ X } 10^8$ meters/second

f is the frequency of the wave in hertz, and

λ is the wavelength of the wave in meters.

For example, if we have a radio signal with a frequency of 7.125 MHz, which is $7.125 \text{ X } 10^6$ Hz, then the wavelength is given by

$$\lambda = \frac{c}{f}$$

Therefore,

$$\lambda = \frac{3 \text{ X } 10^8 \ meters/\sec ond}{7.125 \text{ X } 10^6 \ Hz}$$

or

$$\lambda = 42.1 \ meters.$$

What is the wavelength of a signal operating at 144.2 MHz?