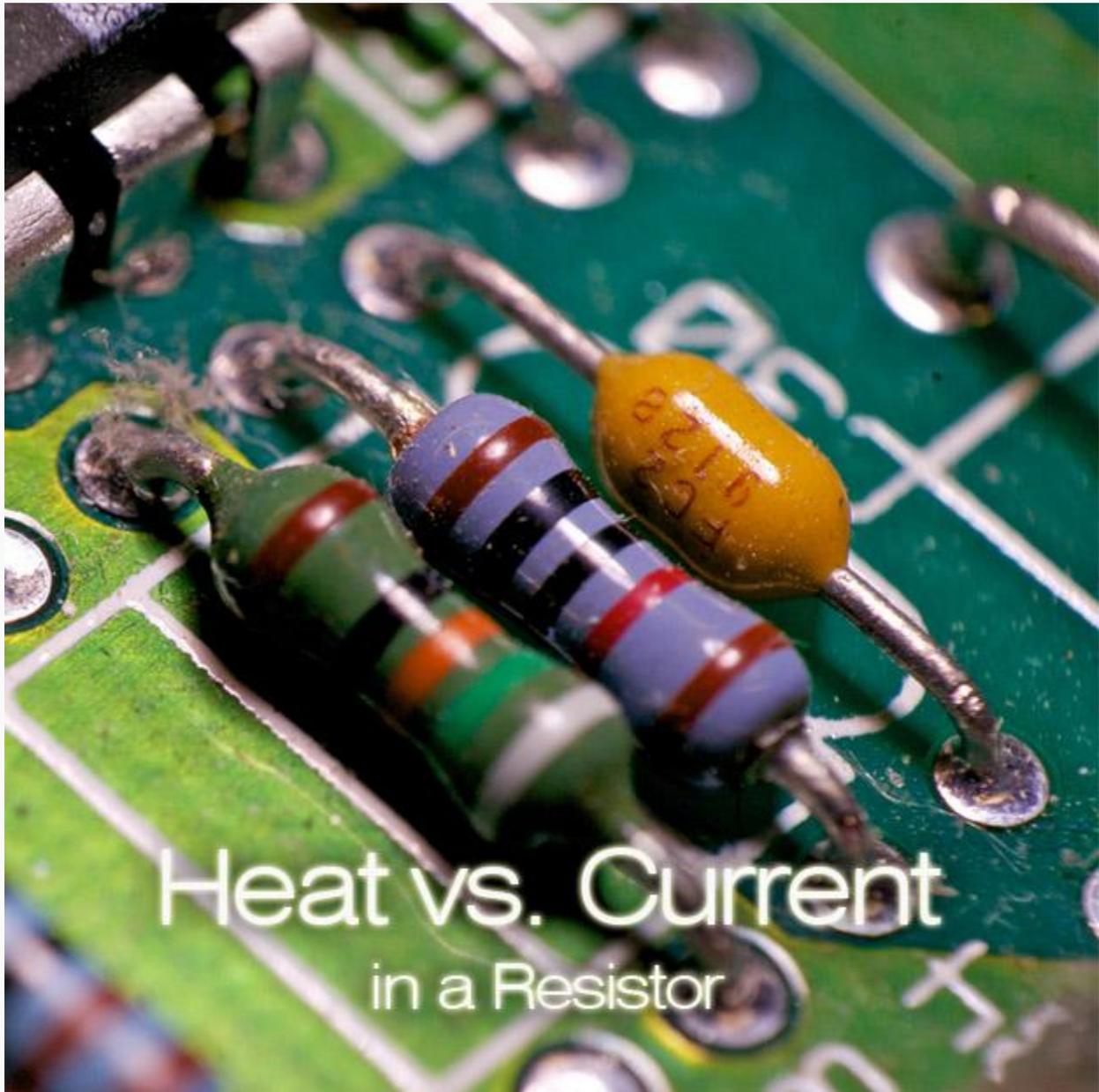# Heat vs. Current in a Resistor

Heat vs. Current in a Resistor (photo by Karen Blaha via Flickr)

Energy can never be destroyed

It is converted from one form to another. One of the most familiar forms of energy is **heat**. When a **current (I)** is forced through a **resistor (R)** by applying a **potential (V)**, the electrical energy is converted to heat energy as observed by the rise in temperature of the resistor. Remember that power is the rate at which energy is consumed.

The energy dissipated in the resistor then is equivalent to **the power it consumes** multiplied by the length of time current is flowing. In this case, *electrical power* (*in units of Watts*) consumed by a resistor is equivalent to the product of applied *Voltage* and the *Current* flowing through it. This is called active or real power.

Note: Heat is only produced by a resistive load (electrical friction) and not in an inductive or capacitive load.

The value of the real power (P) consumed by the resistor is:

Power = Voltage x Current (P = V x I)

Since we already know that an applied *Voltage (V)* is required to force *Current (I)* through a *resistor (R)*, another way of defining Power is:

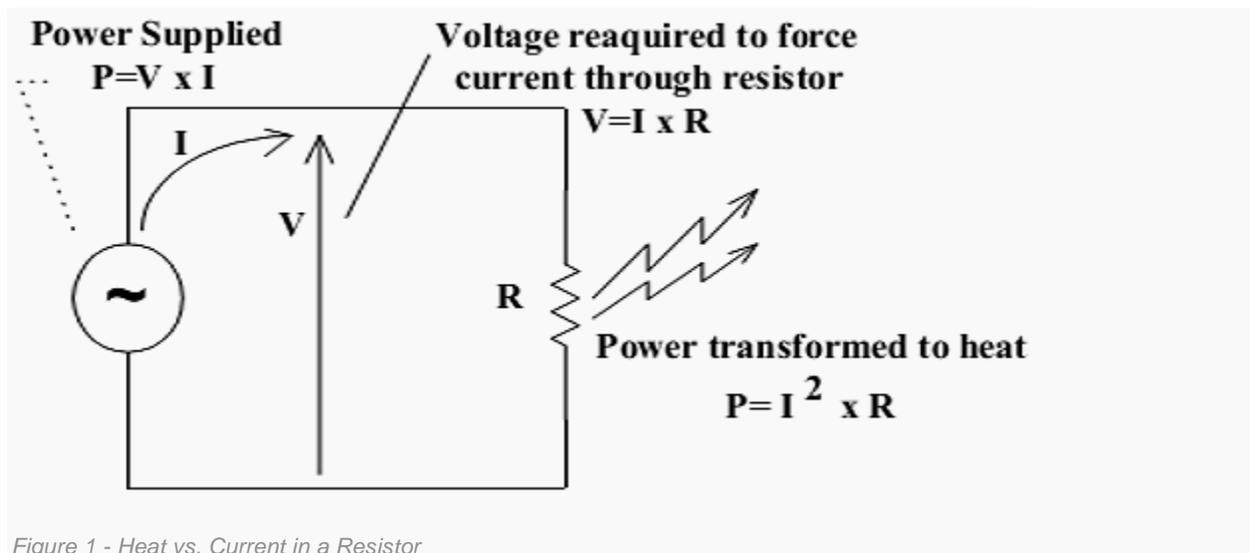Power = (Current)^2 x Resistance (P = I^2 x R)

Figure 1 - Heat vs. Current in a Resistor

Note: Real power only occurs when the magnitude of the voltage and current increase and decrease at exactly the same rate as illustrated below.

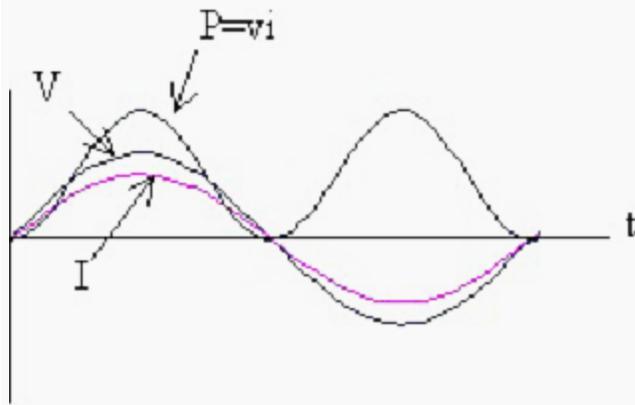This is called *being in-phase* and will only happen for a *resistive load*.

Figure 2 - Real Power Volts and Amps

At any time in an AC circuit the instantaneous power flow in the product of the voltage and the current. In **AC circuits** the power flow is not constant, but fluctuates with the voltage and current.

The integral of the power with respect to time is ***the energy delivered to the load***. In a purely resistive circuit the product of voltage and current is always positive. In the course of one complete AC cycle energy is delivered to the load.

Reference: *Science and Reactor Fundamentals – Electrical CNSC Technical Training Group*

Source: