Pulse energy calculation considerations

Most power resistor applications are 'pulse' applications, meaning that the power dissipated in the resistor is created by a series of pulses rather than a constant power dissipation.

These applications have to be looked at in some detail as although the average power may be well within the rating of an individual resistor, the peak power rating may cause the device to fail.

Pulses or transients cause instantaneous temperature rise of the resistor.

For applications with transients, pulses or surges the following must be considered:

**For pulses below 100ms.**

Do not exceed the peak voltage. For film resistors an overvoltage can cause an irreversible shift in the resistance value, which in turn can cause the resistor to fail.

In these applications the heat generated in the resistance element (film, wire or foil) does not have time to transit from the element to the environment (heatsink or chassis).

In these circumstances you need to find out, the energy rating of the resistance element. This rating will change from resistance value to resistance value in the same resistor series.

**Single pulse applications**

If it is single pulse application (i.e. the resistor has time to cool down fully before the application of the next pulse), additional heatsinking is not usually required. Again do not exceed the peak voltage rating.

Pulse shapes and energy:

\[ E = \frac{V^2 t}{R} \]

\[ E = \frac{1}{2} CV^2 \quad t = RC \]

\[ E = \frac{V^2 t}{3R} \]

Units:
- \( E \) = Energy (joules)
- \( t \) = Time (seconds)
- \( V \) = Voltage (volts)
- \( R \) = Resistance (ohms)
- \( C \) = Capacitance (farads)
Multiple pulse applications.

When pulses occur at a uniform frequency the average power can be determined and allows selection of the power resistor, and associated heatsink.

The average power dissipation for uniformly spaced pulses can be calculated from the following formula:

\[ P_{\text{average}} = \frac{E}{f} \]

\[ P_{\text{average}} = PD = \text{average power dissipation (watts)} \]

\[ E = \text{single pulse energy (Joules)} \]

\[ f = \text{frequency (pulses per second)} \]