When a current flows through a circuit, energy is dissipated in the circuit at a rate given by:—

$$\text{Power} \quad = P = V \times I \quad \text{Watts}$$

For resistive circuits, application of Ohms law $V = I \times R$ gives:—

$$\text{Power} \quad = P = V \times I = I^2 \times R = \frac{V^2}{R} \quad \text{Watts}$$

Specify resistors with three parameters

- The resistance in Ohms
- The tolerance on the resistance
- The maximum permissible power dissipation

The power rating relates to the physical size of the resistor, to its ability to withstand heating without damage and to its ability to dissipate heat to the surroundings.

Example 1

A torch bulb operates from a $6V$ battery and draws a current of $0.5A$.

Calculate the total charge which flows around the circuit in 2 minutes operation.

Calculate the Power rating for the bulb.

$$\begin{aligned} \text{Charge in 2 min.} &= 0.5A \times 2 \times 60s \\ &= 60 \text{ Coulomb} \\ \text{Power Dissipation} &= V \times I \quad \text{Watts} \\ &= 6V \times 0.5A \\ &= 3.0 \quad \text{Watts} \end{aligned}$$

Example 2 Calculate the current flowing in a $12V$, $60W$ car head lamp bulb.
Which of the following wire conductor cross sections is used for the connection to the head lamp to prevent any significant heating of the wire;
($0.1mm^2$), ($0.5mm^2$), ($1.5mm^2$), ($5mm^2$), ($12mm^2$)?
Is single strand or multistrand conductor used in this application?
Why?

$$\text{Current} \quad = \frac{60W}{12V} = 5\,\text{Amps}$$