Data Sheet

Heatsink performance guide

An outline guide to the selection of heatsinks with regard to their thermal performance.

Defining the necessary heat sink performance.

In order to calculate the maximum acceptable thermal resistance for the heat sink so that the device being cooled does not overheat it is first necessary to define the thermal parameters under which it is to operate.

The basic equation for thermal equilibrium is:

$$\text{Power dissipated} = \frac{\text{Temperature difference across the system}}{\text{Sum of all the thermal resistances in the heat flow path.}}$$

$$\text{Thus PD} = \frac{Tj - Ta}{\theta jc + \theta cs + \theta sa} \qquad \text{(equ 1)}$$

Where PD = Power dissipation (W)

Tj = Max. allowable junction temp (°C) (specified by device manufacturer)

Ta = Ambient temperature (°C)

θjc = Thermal resistance, junction to case (°C/W) (specified by manufacturer)

θcs = Thermal resistance, case to heat sink (°C/W)

θsa = Thermal resistance, heat sink to ambient air (°C/W)

The maximum value for thermal resistance heat sink to air (sa) is usually determined by rearranging equation 1 to the following:

$$\theta sa = \frac{Tj - Ta - (\theta jc + \theta cs)}{PD} \qquad \text{(equ 2)}$$

The result of the above equation provides a thermal resistance value which must be equalled or bettered by the heat sink selected.

Example

A semi-conductor device is to be operated with its junction temperature not exceeding 90°C whilst dissipating 14.50 watts to ambient air at a temperature of 45°C. The thermal resistance, junction to case, is specified by the manufacturer as 2.25°C/W and the thermal resistance, case to sink (using an insulating washer and thermally conductive compound) is taken as 0.50°C/W

$$\therefore \theta sa = \frac{90 - 45}{14.50} - (2.25 + 0.50)$$

$$= 0.35°C/W$$

The heat sink therefore must have a thermal resistance which does not exceed 0.35°C/W.

A suitable heat sink may therefore be the 0.3°C/W type **RS** stock no. 403-112.

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