



# 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:

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

$$\text{Thus PD} = \frac{T_j - T_a}{\theta_{jc} + \theta_{cs} + \theta_{sa}} \quad (\text{equ 1})$$

Where PD = Power dissipation (W)

$T_j$  = Max. allowable junction temp ( $^{\circ}\text{C}$ )  
(specified by device manufacturer)

$T_a$  = Ambient temperature ( $^{\circ}\text{C}$ )

$\theta_{jc}$  = Thermal resistance, junction to case ( $^{\circ}\text{C}/\text{W}$ )  
(specified by manufacturer)

$\theta_{cs}$  = Thermal resistance, case to heat sink ( $^{\circ}\text{C}/\text{W}$ )

$\theta_{sa}$  = Thermal resistance, heat sink to ambient air ( $^{\circ}\text{C}/\text{W}$ )

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

$$\theta_{sa} = \frac{T_j - T_a - (\theta_{jc} + \theta_{cs}) \text{PD}}{\text{PD}} \quad (\text{equ 2})$$

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  $90^{\circ}\text{C}$  whilst dissipating 14.50 watts to ambient air at a temperature of  $45^{\circ}\text{C}$ . The thermal resistance, junction to case, is specified by the manufacturer as  $2.25^{\circ}\text{C}/\text{W}$  and the thermal resistance, case to sink (using an insulating washer and thermally conductive compound) is taken as  $0.50^{\circ}\text{C}/\text{W}$

$$\begin{aligned} \therefore \theta_{sa} &= \frac{90 - 45}{14.50} - (2.25 + 0.50) \\ &= 0.35^{\circ}\text{C}/\text{W} \end{aligned}$$

The heat sink therefore must have a thermal resistance which does not exceed  $0.35^{\circ}\text{C}/\text{W}$ .

A suitable heat sink may therefore be the  $0.3^{\circ}\text{C}/\text{W}$  type **RS** stock no. 403-112.

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