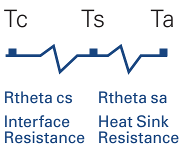
Selecting a Heat Sink

1. Thermal Resistance Basics



Tc: device case temperature (°C)
Ts: heat sink temperature (°C)
Ta: ambient temperature (°C)
Q: heat dissipated (watts)
Rtheta: thermal resistance (°C / W)

Basic thermal resistance equation
Rtheta ca = Rtheta cs + Rtheta sa = (Tc – Ta) / Q

Solving for the heat sink thermal resistance
Rtheta sa = ((Tc – Ta) / Q) – Rtheta cs

Or solving for heatsink temperature rise over ambient
(Ts – Ta) = (Tc – Ta) – (Rtheta cs x Q)

2. Calculating the Heat Sink Requirement

Example
Q = 10 watts
Tc = 150° C max
Ta = 40° C max
Rtheta cs = 1.0° C / W
(Varies with device package and interface material, such as thermal grease, silicone pad, Kapton, phase-change material, etc. Contact the factory for more details.)

Therefore, the thermal resistance required will be:
Rtheta sa = ((150-40) / 10) – 1 = 10° C / W
or lower value will be acceptable

Or, calculating the heat sink temperature rise:
(Ts –Ta) = (150 – 40) / (1 x 10) = 100° C
or lower value will be acceptable (at 10 W power)

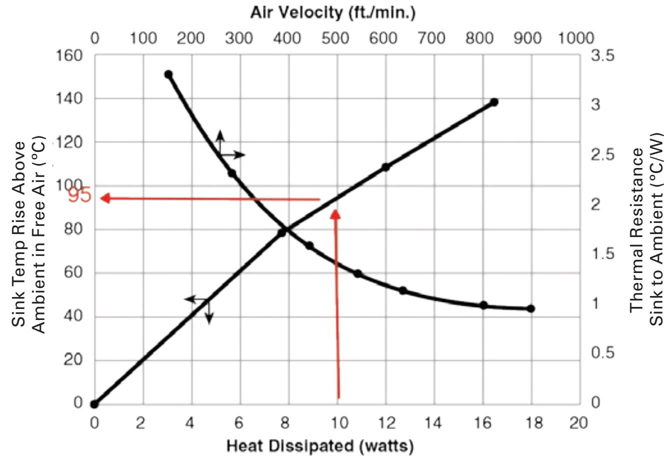
3. Selecting the Heat Sink

3a. Board Mounted Heat Sink

If it is a board (PCB) mounted heat sink, there will be a graph for the specific heat sink.

For the natural convection curve: power dissipation (watts) vs. heat sink temperature rise above ambient (Ts – Ta).

For the forced-convection curve: thermal resistance from mounting surface to ambient (Rtheta sa (°C / W) vs. air velocity (ft. / min.)



For the specific example, (Ts – Ta) = 95° C at 10 watts power, so this heat sink would satisfy the thermal requirement in natural convection.

If the heat sink has a clip to hold the device, then the heat sink thermal data will be given in terms of case temperature, not sink temperature. Therefore, in natural convection the case temperature rise above ambient (Tc – Ta) will be plotted vs. heat dissipation. With known values of Tc max, Ta max, and Q (watts), one can go right to the graph for natural convection and determine whether the heat sink will work.

For forced convection, calculate the Rtheta from the equation and go to the graph to determine the airspeed requirement.
Rtheta ca = (Tc - Ta) / Q

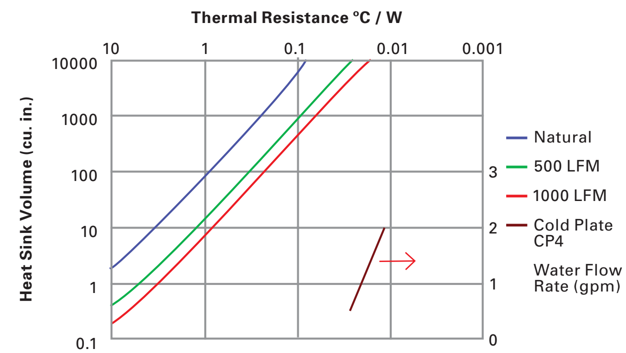
3b. Extrusion Heat Sink

If the device has higher power dissipation and an extrusion is needed, use this quick sizing guide to find the approximate size (volume) of the heat sink to satisfy the thermal requirements. Then, using the data sheet of available Ohmite extrusions, one can select potential shapes and lengths that will meet or exceed this volume.

Example:
If the Rtheta sa calculation requirement is 1.0° C / W, then from the chart the heat sink volume would be: For natural convection approximately 90 cubic inches or greater. For 500 ft./min. airspeed approximately 15 cubic inches or greater. 90 cubic inches could be satisfied by 9.5" length of extrusion AH13070 (6 x 1.75 x 9.5). 15 cubic inches could be satisfied by 3.6" length of extrusion AH12153 (3.6 x 1.15 x 3.6).

So, 9.5 inches of AH13070 is a starting point to select a heat sink for natural convection. 3.6 inches of AH12153 will work for 500 ft./min. of air flow. Interpolate for other air speeds. Other selections can be made based on available geometry of the space and any mounting considerations. However, this tool is only intended to be a first draft for selecting an extruded heat sink. For further thermal calculations and selection assistance contact the Ohmite Applications Engineering Desk.

The available Ohmite extrusions are found at www/Ohmite.com/cat/sink_ah.pdf.



Thermal Resistance vs Volume

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