

# How To Select a Heat Sink

## Example A

Find a space saving heat sink to keep a TO-220 device below the maximum 150°C junction temperature in natural convection. Device will be screw mounted with an electrically conductive interface.

Given:

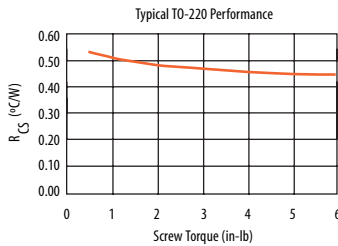
$$P_D = 6 \text{ watts}$$

$$R_{\theta JC} = 3^\circ\text{C/W (from semiconductor manufacturer)}$$

$$T_J \text{ max} = 150^\circ\text{C (from semiconductor manufacturer)}$$

$$T_A \text{ max} = 65^\circ\text{C}$$

A Kondux™ pad is a good choice for electrically conductive applications. Thermal resistance for Kondux™ can be determined from the following graph.



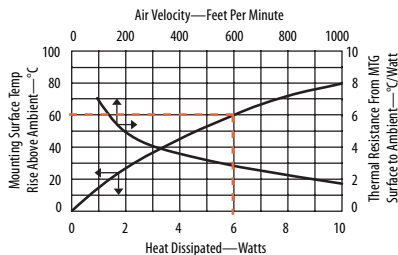
At 2 in-lb of torque the thermal resistance is approximately  $R_{\theta CS} = 0.5^\circ\text{C/W}$

Using equation 1, solve for  $R_{\theta SA}$

$$R_{\theta SA} = \frac{150 - 65}{6} - (3 + 0.5) = 10.7^\circ\text{C/W}$$

The Index by Heat Sink Style on page 8 lists space saving heat sinks. Several models are in the 10 °C/W range. Choose the one that best fits the application and verify thermal resistance from graph.

Part number 593202B03500G shows a 60 °C temperature rise at 6 watts.



$$R_{\theta SA} = \frac{60}{6} = 10.0^\circ\text{C/W}$$

Which meets the above requirement in natural convection.

## Example B

Find a heat sink to keep a TO-220 device below the maximum 150 °C junction temperature in forced convection at 400 ft/min. Device must be electrically insulated and mounted with a labor saving clip.

Given:

$$P_D = 12 \text{ watts}$$

$$R_{\theta JC} = 2.5^\circ\text{C/W (from semiconductor manufacturer)}$$

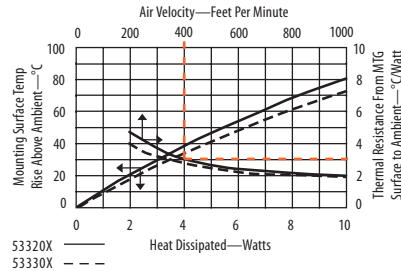
$$T_J \text{ max} = 140^\circ\text{C (from semiconductor manufacturer)}$$

$$T_A \text{ max} = 50^\circ\text{C}$$

A Hi-Flow® pad works great with clip mounting and provides the necessary electrical insulation. Thermal resistance for Hi-Flow® at low pressure is 1.15°C/W (from page 87). Using equation 1, solve for  $R_{\theta SA}$

$$R_{\theta SA} = \frac{140 - 50}{12} - (2.5 + 1.15) = 3.85^\circ\text{C/W}$$

Many styles are available. If board space is a concern, 533202B02551G (pg 55) meets the requirements.

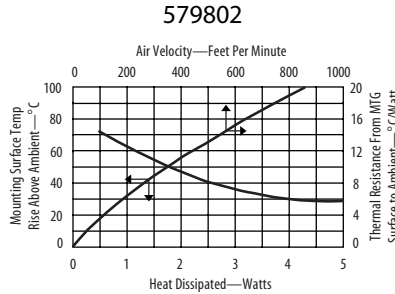


According to the above graph, an airflow of 400 ft/min results in a thermal resistance of 3°C/W. This is less than the required thermal resistance of 3.85°C/W and is therefore acceptable under these airflow conditions.

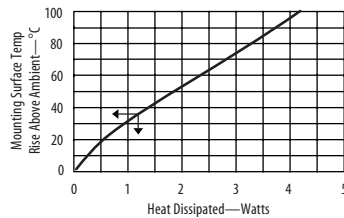
If height is a concern, 533702B02552G would meet the requirements and is only 1.0" tall

Hi-Flow® is a trademark of the Bergquist Company

The performance graphs you will see in this catalog (see graph 579802) are actually a composite of two separate graphs which have been combined to save space. The small arrows on each curve indicate to which axis the curve corresponds. Thermal graphs are published assuming the device to be cooled is properly mounted and the heat sink is in its recommended mounting position.



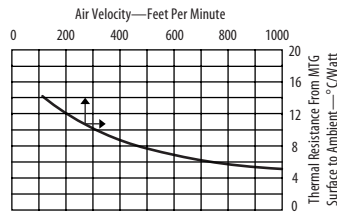
GRAPH A



**GRAPH A** is used to show heat sink performance when used in a natural convection environment (i.e. without forced air). This graph starts in the lower left hand corner with the horizontal axis representing the heat dissipation (watts) and the vertical left hand axis representing the rise in heat sink mounting surface temperature above ambient (°C). By knowing the power to be dissipated, the temperature rise of the mounting surface can be predicted. Thermal resistance in natural convection is determined by dividing this temperature rise by the power input (°C/W).

**EXAMPLE A:** Aavid Thermalloy part number 579802 is to be used to dissipate 3 watts of power in natural convection. Because we are dealing with natural convection, we refer to graph "A". Knowing that 3 watts are to be dissipated, follow the grid line to the curve and find that at 3 watts there is a temperature rise of 75°C. To get the thermal resistance, divide the temperature rise by the power dissipated, which yields 25°C/W.

GRAPH B



**GRAPH B** is used to show heat sink performance when used in a forced convection environment (i.e. with forced air flow through the heat sink). This graph has its origin in the top right hand corner with the horizontal axis representing air velocity over the heat sink LFM\* and the vertical axis representing the thermal resistance of the heat sink (°C/W). Air velocity is calculated by dividing the output volumetric flow rate of the fan by the cross-sectional area of the outflow air passage.

$$\text{Velocity (LFM)}^* = \frac{\text{Volume (CFM)}^{**}}{\text{area (ft}^2\text{)}}$$

**EXAMPLE B:** For the same application we add a fan which blows air over the heat sink at a velocity of 400 LFM. The addition of a fan indicates the use of forced convection and therefore we refer to graph "B". This resistance of 9.50°C/W is then multiplied by the power to be dissipated, 3 watts. This yields a temperature rise of 28.5°C.

## CONVERTING VOLUME TO VELOCITY

Although most fans are normally rated and compared at their free air delivery at zero back pressure, this is rarely the case in most applications. For accuracy, the volume of output must be derated 60%–80% for the anticipation of back pressure.

**EXAMPLE:** The output air volume of a fan is given as 80 CFM. The output area is 6 inches by 6 inches or 36 in<sup>2</sup> or 25 ft<sup>2</sup>. To find velocity:

$$\text{Velocity (LFM)} = \frac{\text{Volume (CFM)}}{\text{area (ft}^2\text{)}}$$

$$\text{Velocity} = \frac{80}{0.25} = 320$$

Velocity is 320 LFM, which at 80%, derates to 256 LFM.

## DESIGN ASSISTANCE

Aavid Thermalloy can assist in the design of heat sinks for both forced and natural convection applications. Contact us for help with your next thermal challenge. For more information, visit our web site at: [www.aavidthermalloy.com](http://www.aavidthermalloy.com)

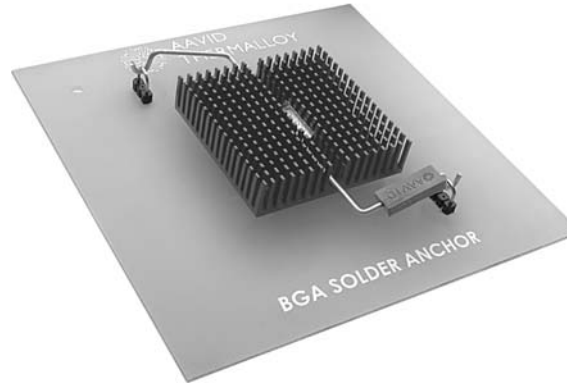
\* Linear feet per minute

\*\* Cubic feet per minute

## Solder anchor attachment

Aavid's unique Solder anchor attachment method uses two or four small Solder anchors attached to the circuit card and a wire spring clip to securely fasten the heat sink to the device. This method is rugged, compact and allows for easy removal in case of rework.

All products include a phase change pad suitable for most IC package styles to optimize thermal performance. Models are available with a single or dual spring clips for additional thermal interface pressure. Solder anchors are ordered separately.

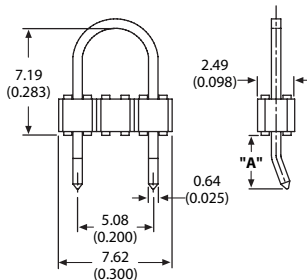


## ORDERING INFORMATION

IC Pkg Size (mm)	IC Pkg Style	Part Number	"W" (mm)	"L" (mm)	"H" (mm)	"A" (mm)	Øn <sup>1</sup>	Øt <sup>2</sup>	Finish	Fig. <sup>4</sup>	PCB Fig. <sup>4</sup>	#Anchors <sup>3</sup>
23 x 23	All	374024B60023G	23.00	23.00	10.00	49.70	40.00	11.69	Black anodize	1	A	2
23 x 23	All	374124B60023G	23.00	23.00	18.00	49.70	23.40	7.39	Black anodize	1	A	2
23 x 23	All	374224B60023G	23.00	23.00	25.00	49.70	19.70	6.37	Black anodize	1	A	2
27 x 27	All	374324B60023G	27.00	27.00	10.00	49.70	30.60	9.35	Black anodize	1	A	2
27 x 27	All	374424B60023G	27.00	27.00	18.00	49.70	20.30	6.46	Black anodize	1	A	2
27 x 27	All	374524B60023G	27.00	27.00	25.00	49.70	16.50	5.47	Black anodize	1	A	2
35 x 35	Flip chip	10-5634-01G	31.00	34.90	23.00		11.50	4.20	Black anodize	2	C	2
35 x 35	Flip chip	10-THMA-01G	31.00	34.90	35.00		10.70	3.95	Black anodize	2	C	2
35 x 35	All	374624B60024G	35.00	35.00	10.00	62.30	23.40	7.55	Black anodize	1	B	2
35 x 35	All	374724B60024G	35.00	35.00	18.00	62.30	15.30	5.15	Black anodize	1	B	2
35 x 35	All	374824B60024G	35.00	35.00	25.00	62.30	12.00	4.27	Black anodize	1	B	2
37.5 x 37.5	Flip chip	10-BRD2-01G	35.70	37.30	23.00		11.50	4.20	Clear anodize	2	B	2
37.5 x 37.5	Flip chip	10-BRD1-01G	37.50	37.50	23.00		10.10	3.83	Black anodize	2	B	2
37.5 x 37.5	Flip chip	10-BRD1-03G	37.50	37.50	23.00		10.10	3.83	Black anodize	3	D	4
37.5 x 37.5	Flip chip	10-BRD1-04G	37.50	37.50	23.00		10.10	3.83	Black anodize	2	B	2
37.5 x 37.5	Flip chip	10-BRD1-05G	37.50	37.50	23.00		10.10	3.83	Clear anodize	3	D	4
37.5 x 37.5	Flip chip	10-BRD1-07G	37.50	37.50	23.00		10.10	3.83	Clear anodize	2	B	2
40 x 40	All	374924B60024G	40.00	40.00	10.00	62.30	20.30	6.46	Black anodize	1	B	2
40 x 40	All	375024B60024G	40.00	40.00	18.00	62.30	12.20	4.34	Black anodize	1	B	2
42 x 40	All	375124B60024G	40.00	40.00	25.00	62.30	10.30	3.83	Black anodize	1	B	2
42.5 x 42.5	Flip chip	10-CLS1-01G	42.30	42.30	23.00		8.80	3.51	Black anodize	2	E	2
42.5 x 42.5	Flip chip	10-CLS2-01G	42.30	42.30	35.00		8.30	3.44	Black anodize	2	E	2

## SOLDER ANCHOR

Part Number	PCB Thickness (mm)	"A" Dim (mm)
125700D00000G	1.60	3.61
125800D00000G	2.54-2.79	4.70



1. Natural convection thermal resistance based on a 75° C heat sink temperature rise.
2. Force convection thermal resistance based on an entering 1.0 m/s (200LFM) airflow.
3. Solder anchors are sold separately refer to drawing above.
4. Solder anchor mechanical drawings and board mounting drawings see page 13.

## Solder anchor heat sinks mechanical drawings

FIGURE 1

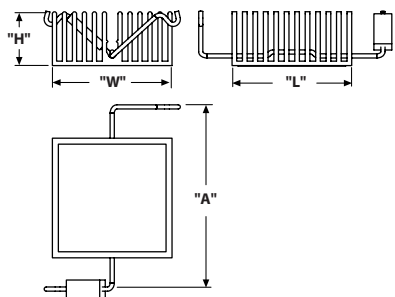


FIGURE 2

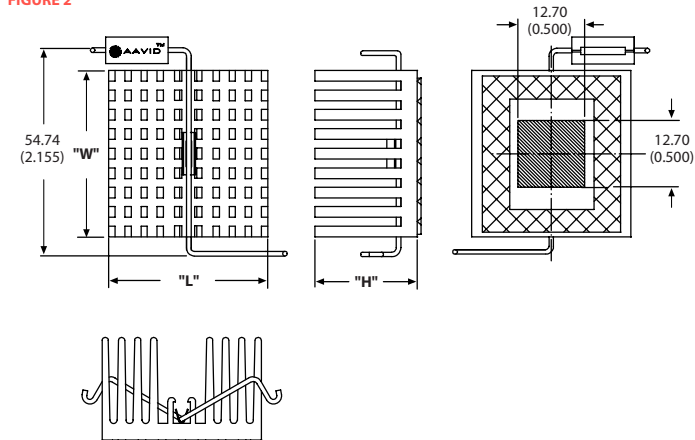
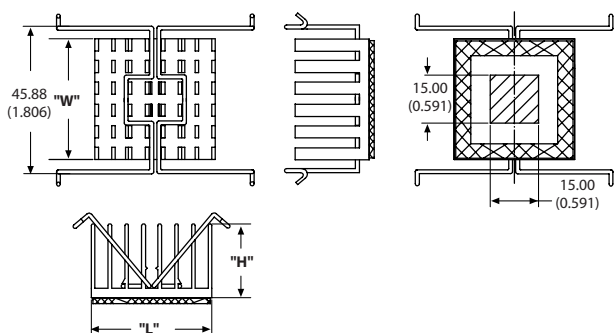


FIGURE 3



## Board mounting pattern information for solder anchor heat sinks

FIGURE A

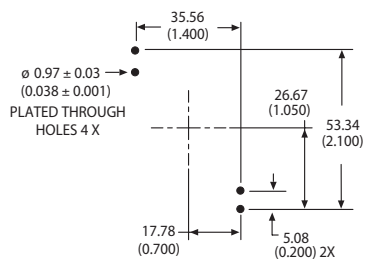


FIGURE B

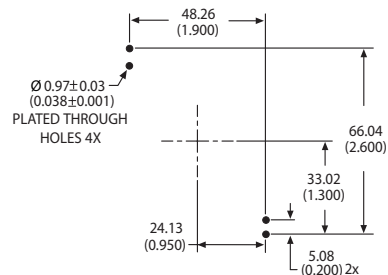


FIGURE C

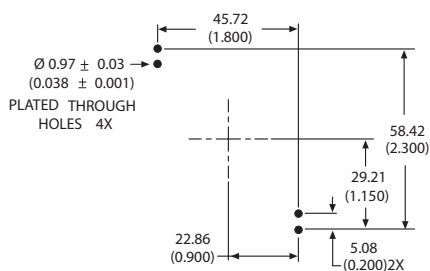


FIGURE D

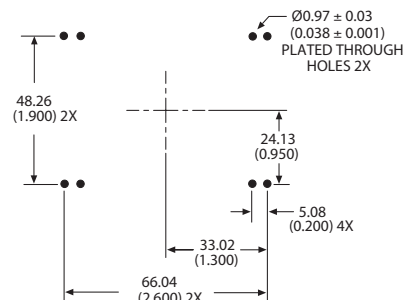


FIGURE E

