Efficient cooling of electronics equipment is essential as a means of prolonging component life and improving reliability, or of allowing more power without adversely affecting life and reliability. In recognition of this need Marston offers the following products:

1. Aluminium Heat Sinks comprising both standard and specially designed Heat Sinks designed for cooling by natural convection and if appropriate for force cooling.
2. Standard force cooled Heat Sink assemblies for multi-device cooling.
3. Secondary surface air and liquid cooled assemblies specially designed to meet very high performance requirements.

All of these products are backed by Marston's unrivalled 50 years of heat transfer experience which is fully at your disposal to help in the resolution of your electronics cooling problem.

This brochure describes the range of aluminium Heat Sinks intended mainly for natural convection cooling. Separate brochures are available describing the other products and further brief information is contained elsewhere in this brochure.

Material: Aluminium alloy to BS1474 6063 (previous designation H9)
Marston Heat Sinks may be ordered in any length up to 2000mm.

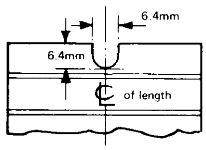
Dimensions: Tolerance on length: +/− 0.5mm on up to 300mm
+/− 1.0mm on 300 — 600mm
Other tolerances: in accordance with BS1474

Surface Finish: Marston Heat Sinks can be supplied in any of the following finishes.

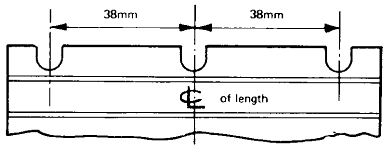
Finish No.	Description
1	Plain
2	Matt black anodised

Installation Notches: Flanged Heat Sinks can be provided with fixing points in the form of standard notches (6.4 × 6.4mm), as follows:

— in lengths from 25mm to 75mm: one notch per flange, equidistant from each end.
— in longer lengths up to 150mm: three notches per flange at a pitch of 38mm, equidistant from each end.



Single notch in each flange in lengths from 25mm to 87mm



Three notches in each flange in lengths from 88mm to 150mm

Defining the necessary Heat Sink performance

Once the maximum acceptable junction temperature of the device and the ambient temperature have been defined, it is necessary to calculate the maximum thermal resistance for the Heat Sink which is acceptable if the required junction temperature is not to be exceeded.

The basic equation for thermal equilibrium is:

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

Thus:

$$P = \frac{T_j - T_a}{\Theta_{jc} + \Theta_{cs} + \Theta_{sa}}$$

where P = Power dissipation (W)
Tj = Max. allowable junction temp. (°C), specified by manufacturer

In practice it is only the value of Θcs which can be improved (by the use of jointing compound) and of Θsa (by the use of a higher performance sink or a greater air flow rate). Θcs can vary between 0.1 and 1.5°C/W depending on the use of thermal jointing compound, and/or insulation washers: a dry mica washer could give 1.5°C/W and a similar washer using compound 0.5°C/W. If the insulating washer is eliminated and instead the whole sink assembly is electrically isolated, the use of compound between device and sink can reduce the value of Θcs to 0.1/0.2°C/W.

The maximum value for thermal resistance, sink to air (Θsa), is determined by the following equation:

$$\Theta sa = \frac{Tj - Ta}{P} - (\Theta jc + \Theta cs)$$

The result of this calculation provides a thermal resistance value which must be equalled or bettered by the Heat Sink selected for the duty.

Example: A semi-conductor is to be operated with its junction temperature not exceeding 135°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 and using an insulating washer and compound is calculated as 0.50°C/W.

Thus:

$$\Theta sa = \frac{135 - 45}{14.50} - (2.25 + 0.50)$$

$$= 3.46°C/W$$

The Heat Sink, therefore, must have a thermal resistance rating which does not exceed 3.46°C/W. Elimination of the insulating washer and isolation of the whole assembly could improve the figure to approx. 3.8°C/W.

Once the necessary Heat Sink performance has been established a suitable Heat Sink can be selected. The choice will be influenced by a number of factors of which performance, available space, mounting arrangements and cost will probably be the most important.

Performance

The performance figures shown in this brochure indicate the performance which can be expected from each Marston Heat Sink operating under natural convection conditions in the optimum mounting attitude of vertical plate and fins and in typical lengths. Unless otherwise stated, the data presented is applicable only to the condition of a 60°C rise above ambient of the Heat Sink surface in contact with the device. Data relating to other temperature rises is available on request, but the approximate effect of such a change can be established by using the following formula:

Thermal resistance at T_1 =

$$\sqrt[4]{\frac{60}{T_1}} \times \text{Thermal resistance at } 60°C$$

where T_1 = actual temperature rise above ambient.

This will give a rough guide within the range 40-80°C.

Performance of all Heat Sinks can be affected by several factors including mounting attitude, interference from other equipment, position and number of devices mounted on the sink, and a temperature rise of the sink above ambient which substantially differs from that used to establish the published data. For this reason the performance figures quoted should be regarded as indicative only and if there is any significant doubt about the suitability of a sink, we strongly recommend that its effectiveness is confirmed in the particular operating conditions to which it is subjected. In addition Marston is willing to offer advice concerning the performance to be expected in such conditions.

Size and Mounting arrangements

This information is self-evident from the illustrations and dimensional information included in the brochure.

Cost

Prices depend on Heat Sink type, the provision of holes and notches, finish and quantity. Generally the lighter the section the less expensive; and a plain finish is less expensive than an anodised. A specially designed sink may well be little more expensive than a standard.

Alternative solutions

If there is no standard sink available which adequately meets the requirements of performance and size the following alternatives must be considered:

1. A specially designed sink for natural convection cooling.
2. A force cooled sink comprising either a standard sink cooled by a separate fan, or a complete force cooled sink assembly. Force cooling of a standard sink can improve its performance by a factor of at least two.
3. A specially designed secondary surface sink. Such a sink designed for force cooling can give a performance of at least five times that of an equivalent natural convection sink, or if liquid cooled, fifty times.

Marston can help you with all of these alternatives.

SAFETY NOTICE

NOTE: (1) Heat sinks must not be used for performance duties exceeding those specified in this catalogue.
(2) In some applications heat sinks operating within their design specification will become very hot.
(3) An equipment fault condition may cause heat sinks to become very hot.

WARNING:

EXPOSED HEAT SINKS MUST BE FITTED WITH A PROTECTIVE GUARD TO PREVENT ACCIDENTAL BODY CONTACT