Thermal Management Products

Thermshield

Company Background

Founded in 1990, Thermshield has transitioned to focus on its core competency, thermal design, production, and supply of heat sinks and cooling products for electronics. Thermshield melds together a unique combination of capabilities including:

- world class thermal design
- broadest manufacturing technology
- global support of design, sales and logistics
- lowest cost provider

Thermshield's goal is to be the low cost, global, total thermal solutions provider. This means we are committed to delighting customers from start to finish in our dealings, including:

1. Quick and complete thermal design support, if required, from the start of a project
2. Rapid delivery of prototypes or samples to prove performance in customer application
3. Prompt, quality-conscious delivery of production lots.
4. All steps follow our ISO 9001-2000 process from start to finish in order to minimize errors and defects.

Thermshield will continue to push the design and technology envelopes in order to remove more heat from ever smaller, heat generating, components. Our customers in the global marketplace demand this and we will continue to deliver.

We welcome new customers to challenge us with leading edge design problems, request a quote for an existing custom design or compare Thermshield industry standard product offering from inventory or through distribution. We believe you will have made the right choice!


PERRY JOHNSON REGISTRARS, INC.

Certificate of Registration

Perry Johnson Registrars, Inc., has assessed the Quality Management System of:

Thermshield LLC

36 Country Club Road, Gilford Village West II, 2D & E, Gilford, NH 03249 United States

(Hereinafter called the Organization) and hereby declares that Organization is in conformance with:

ISO 9001:2000

This Registration is in respect to the following scope of supply:

Design, Sale, Support and Delivery of Thermal Management and Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Products

Such products shall be manufactured by the Organization at, or such processes or services shall be offered at or from, only the address given above. This Registration is granted subject to the system rules governing the Registration referred to above, and the Organization hereby covenants with the Assessment body duty to observe and comply with the said rules.

For PJR:

Terry Boboige, President

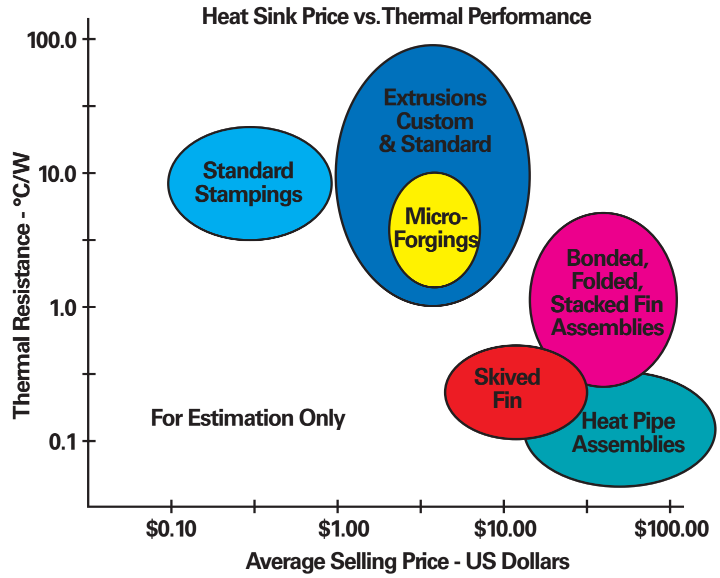
Perry Johnson Registrars, Inc. (PJR)
26555 Evergreen, Suite 1340
Southfield, Michigan 48076
(248) 358-3388

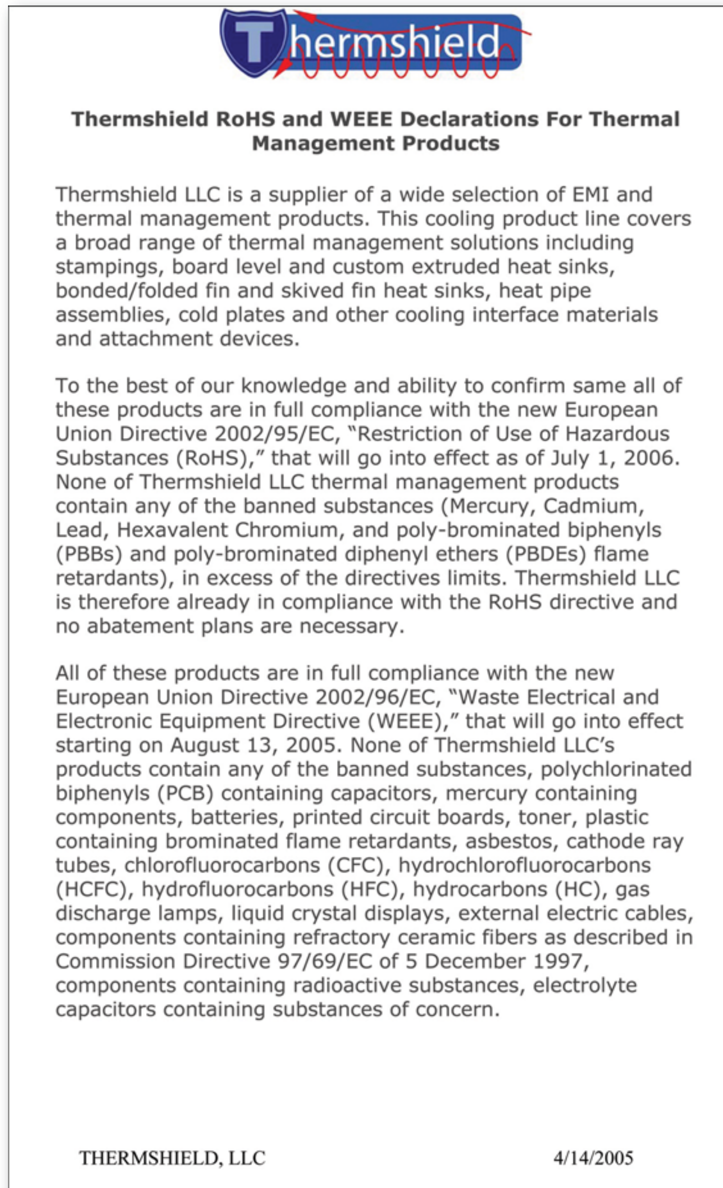
ANAB ACCREDITED

PERRY JOHNSON REGISTRARS, INC.

The validity of this certificate is mandated through ongoing surveillance.

Issue Date:	Expiration Date:	Certificate No:
July 06, 2005	July 05, 2008	C2005-01364

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Thermshield RoHS and WEEE Declarations For Thermal Management Products

Thermshield LLC is a supplier of a wide selection of EMI and thermal management products. This cooling product line covers a broad range of thermal management solutions including stampings, board level and custom extruded heat sinks, bonded/folded fin and skived fin heat sinks, heat pipe assemblies, cold plates and other cooling interface materials and attachment devices.

To the best of our knowledge and ability to confirm same all of these products are in full compliance with the new European Union Directive 2002/95/EC, "Restriction of Use of Hazardous Substances (RoHS)," that will go into effect as of July 1, 2006. None of Thermshield LLC thermal management products contain any of the banned substances (Mercury, Cadmium, Lead, Hexavalent Chromium, and poly-brominated biphenyls (PBBs) and poly-brominated diphenyl ethers (PBDEs) flame retardants), in excess of the directives limits. Thermshield LLC is therefore already in compliance with the RoHS directive and no abatement plans are necessary.

All of these products are in full compliance with the new European Union Directive 2002/96/EC, "Waste Electrical and Electronic Equipment Directive (WEEE)," that will go into effect starting on August 13, 2005. None of Thermshield LLC's products contain any of the banned substances, polychlorinated biphenyls (PCB) containing capacitors, mercury containing components, batteries, printed circuit boards, toner, plastic containing brominated flame retardants, asbestos, cathode ray tubes, chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), hydrofluorocarbons (HFC), hydrocarbons (HC), gas discharge lamps, liquid crystal displays, external electric cables, components containing refractory ceramic fibers as described in Commission Directive 97/69/EC of 5 December 1997, components containing radioactive substances, electrolyte capacitors containing substances of concern.

THERMSHIELD, LLC 4/14/2005

RoHS Compliant

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Basic Electronics Cooling

The basis of cooling electronics is the study of thermodynamics or the movement (removal) of heat. This is the set of rules and laws associated with the transfer of heat from one point to another. In everyday terms these laws are expressed:

1. *You can't win the game* – You will never have more energy than you start with.
2. *You can't break even* – Every time heat is moved from one place to another there is always a loss.
3. *You can't get out of the game* – There is no way to change Rules 1 and 2.

More scientifically stated the basic laws of thermodynamics are:

1. Whenever a closed system executes a cycle, the net work output of the system is equal to the heat input. Heat is neither created nor destroyed only transferred from one place to another.

2. It is impossible for any device to operate in such a manner that it produces no effect other than the transfer of heat from one body to another body at a higher temperature. Another way of saying this is – "In all cases heat transfer from a higher temperature object to a lower temperature object. In that transfer there is always a loss of heat, some residual heat is left behind.

In general electronic cooling terms a hot component such as a processor generating heat must have an efficient thermal path or suitable low resistance to allow heat to be removed. The temperature of the heat generating component will always be higher than it's surroundings. The lower the temperature difference is between the component and the cooling environment the more difficult it is to cool. As the temperature difference approaches zero the difficulty (surface area, heat sink volume/size, increase in air flow velocity) of cooling becomes exponential.

Basic Heat Transfer

The basic heat transfer equation for a heat sink is as follows:

$$Q = h\,A\,(T1 - T2)$$

In this equation:

Q is the amount of heat to be removed at steady state condition – typically in Watts

"h" is heat transfer coefficient typically expressed in Watts per sqr. Meter of cooling surface per °C of temperature rise above ambient. "h' is typically expressed as a low, single digit number (2 – 9) for natural convection conditions and as double digit number (10 – 35) for forced air conditions. The higher the number the greater the cooling and the higher the fluid flow velocity.

"A" is the amount of surface area expressed in square meters. This relates directly to the number of fins or extended surfaces conductively attached to a heat spreading base. Other factors, such as the conductivity of the fin material and its surface finish have an effect on the overall thermal resistance of the heat sink.

"T1-T2" is commonly referred to as the differential temperature or "delta T" written as "ΔT". Just as in the voltage difference in an electrical circuit this is what drives the heat removal process. In most electronics applications T1 is the temperature of the electronics component and T2 is the temperature of the cooling air or water.

Most important to remember is:

- Heat is neither created nor destroyed. It can only be moved from one place to another. There are always losses (temperature rises) in the process.
- A difference in temperature causes heat to flow from the heat temperature source to the low temperature sink. The closer these two temperatures are the slower the rate of heat transfer.
- Resistance to heat transfer or heat flow causes heat sources to remain at a higher temperature. Also known as insulation a high resistance heat sink is more of an insulator than a conductor.
- There are no perfect heat conductors or insulators. There is always some gain or lose despite all of our best engineering attempts to hold or remove heat.

What Does a Heat Sink Really Do?

Not all heat generating components need heat sinks. Why? Because in many cases the cooling provided by the package or the system provides sufficient heat removal. In many cases engineers and designers strive to create designs that do not need heat sinks. Reduced heat output circuits and systems are done by good, efficient designs or lower power components. As sizes get smaller and clock speeds increase the need for augmented cooling methods increase.

But what does a heat sink really do? Basically a heat sink removes heat from a semiconductor by providing a cooler temperature outlet for the heat to move toward. This low resistance path provides a place for the waste energy to drain off. The heat sink must be at and be maintained at a lower temperature than the heat source. Remember, if the heat sink is the same temperature as the semiconductor or the ambient cooling air no heat will be removed. Ultimately all heat removed from a semiconductor system will reside in the atmosphere.

The actual function of a heat sink is broken down into three phases. These are:

- Absorption of heat from the semiconductor into the sink
- Transfer of heat through the heat sink material
- Dissipation or release of the heat from the finned surface

The thermodynamic properties of the heat sink's operation can be broken down into the three basic modes of heat transfer — **Conduction, Convection and Radiation**.

Conduction is the process of heat transfer through a solid material. Individual molecules pass the heat from one to another forming a path of contacting (or close proximity) molecules. The thermal conductivity is key to conduction and the amount of heat that can pass through a given section of material with a given temperature rise

Convection is heat removal from an object by intimate contact between air (or fluid) molecules and the heat sink cooling surface. Natural convection uses the buoyancy of air as it is heated to create a flow velocity and remove heat. Forced air of active cooling requires an external air mover to add energy and create a flow velocity past the cooling surfaces. These convection layers or boundary layers are difficult to predict numerically and have a given thickness dictating optimum fin spacing or pressure head required to overcome.

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Radiation is the transfer of heat through the electromagnetic light wave spectrum. The wave lengths used to carry energy at usable electronics cooling temperatures are primarily above the visible light spectrum. In most cases radiation plays a very small role in electronics cooling depending on surface finish (emissivity) and whether the cooling is active or passive air flow.

The functions of a heat sink or heat dissipater are:

- To keep the temperature of the semiconductor junction below it's maximum recommended value.
- To maintain a sufficiently long functional life for the semiconductor
- To allow an increase to output (switching speed, clock frequency) while controlling temperature rise.

Reading Thermal Graphs

Thermal graphs in this catalog show the average thermal performance for a specific heat sink when cooling the size and style semiconductor the parts were designed to accept. This typically includes a black anodized finish on the heat sink surface, a light application of thermal grease and the part held in an optimal position for air flow in both natural and forced convection.

The majority of graphs shown are for stamped heat sinks. Each graph shows thermal performance in both forced convection, using an external air mover and natural convection, no additional air movement other than heat air buoyancy.

Natural Convection

The bottom horizontal axis (X) and the left hand vertical (Y) axis are used together to show thermal performance in natural convection. These combined with the curve that starts at the origin of the axis (0,0) can be read as °C temperature rise at a given number of Watts power input.

In natural convection the θ (°C/ W) is not read directly from the graph because the efficiency of the heat sink increases as the temperature above ambient increases. To determine the θ of the heat sink divide the temperature rise by the number Watts.

For example, at 5 Watts of power dissipation the temperature rise of this heat sink is shown to be 49 °C. This gives a thermal resistance of 49 °C/ 5 Watts = 9.8 °C/W. Please refer to Figure 1.

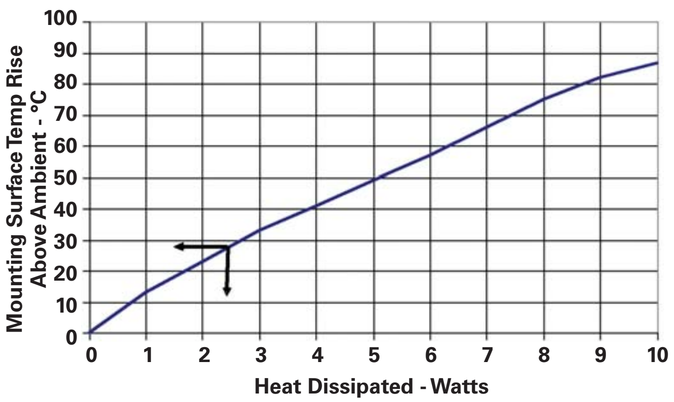


Figure 1. Natural Convection

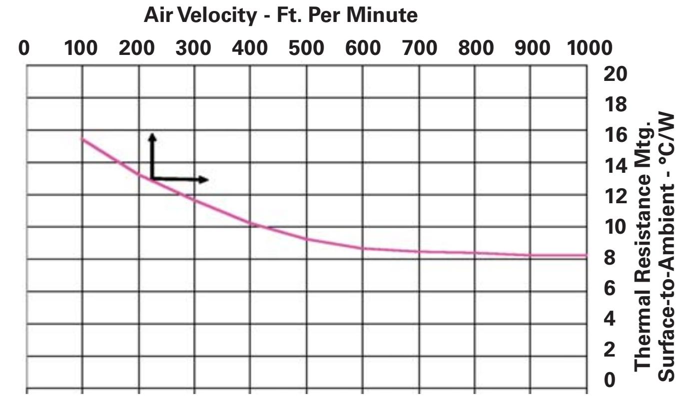


Figure 2. Forced Convection

Forced Convection

The same type of graph is used to show thermal resistance in forced cooling however, in forced air this resistance can be read directly from the right hand Y axis.

For example, at an air velocity of 400 linear feet per minute (LFM) the chart shows a resistance of ~5.1 °C/W. This means that with 10 Watts of power dissipation the temperature rise at the mounting surface of the heat sink will be 51 °C (i.e. 10 W x 5.1 °C/W) above ambient temperature. Please refer to Figure 2.

Extrusion Profile Details

Thermal extrusions, as with most aluminum extrusions, are formed as two-dimensional parts along a length. The process of extrusion makes parts that come from the extrusion press at upwards of 100 feet in length. Typically stocked in 8 foot or 3 meter "stick" lengths these parts are raw material used as the basis of custom machined heat sinks. The process of transforming them into usable heat sinks requires that the parts be cut to length, assembly holes be added to attach power dissipating devices, and mounting holes added for mounting. All raw material shapes have data used for comparison. These items are:

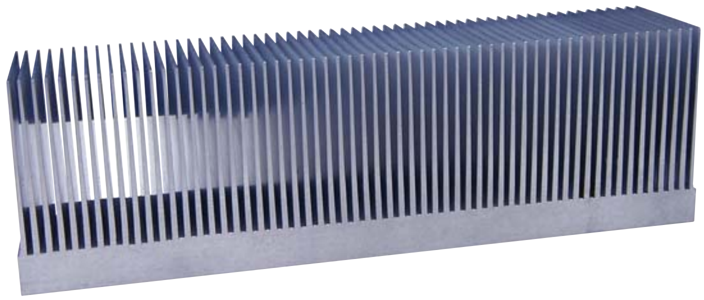
1. Weight per unit length – typically pounds per foot in US.
2. Surface area per unit length – square inches per inch.

Thermal resistance in natural convection at 3.0 inch (76 mm) length – °C / Watt. This includes a black anodize finish.

Custom Thermal Management Technologies Available From Thermshield

Technology Review

The key to high performance cooling, in fact any cooling involving convective heat transfer, is surface area exposed to the ambient air flow. The greater the surface area a heat sink has the greater the cooling. Combine this dissipation surface with high heat transfer number for each square centimeter and the overall thermal resistance of a heat sink goes down. This increases heat dissipated at a given temperature rise. This is true for all heat sinks especially those that are cooled by air. The objective of different manufacturing styles is to offer the greatest cooling area at the smallest volume at the lowest cost. Optimization of all three of these parameters results in a best fit design for any given application. This is our goal at Thermshield.



Ultra-High Ratio Heat Sink

1. Ultra High Ratio Extrusions

Ultra High ratio extrusions provide typical features of:

- up to 23:1 in 5.0 inch diameter tool
- up to 20:1 in 8.0 inch diameter tool
- Replaces bonded fin at lower cost
- Fin thicknesses down to 0.040"

Advantages of Ultra High ratio extrusions:

- Single piece construction
- Fin thickness' down to 0.50 mm depending on fin height
- Typically 6063-T5 (high conductivity) alum alloy
- More cooling surface area in equal volume
- Lighter weight – lower cost to buy and ship
- Increased thermal performance in forced air

Thermshield Ultra High ratio extrusions offer an increase in fins per inch of width providing more cooling surface in a smaller volume when compared to conventional extrusions. By definition a heat sink extrusion ratio is the height of the open air gap between fins divided by the width of that gap. Example – 40 mm tall fins with 3 mm average air gap = 13.3:1. This ratio applies to all extruded aluminum heat sinks and is limited by the tooling using to make extrusion dies. Typically made of very strong tool steel these circular dies must hold back tons of force at elevated temperature during the extrusion process. Many extrusion presses place more than 1000 tons of force against the die during processing. The key importance of Ultra High fin ratios is that the technology used to increase cooling is done at extremely reasonable costs, not much more than conventional extrusions.

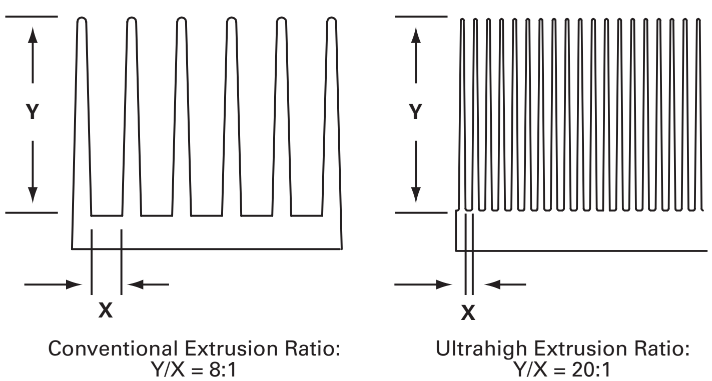


Figure 3. Conventional versus Ultra-High Extrusion Ratio

In years past extrusion ratios were limited to roughly 10:1 within an 8.0 inch diameter tool and roughly 8:1 in 12 inch diameter tool. Today Thermshield has refined this process and offers "ultra high ratios" up to 23:1. Most of these high ratio shapes will require forced convection cooling i.e; fan cooling, to achieve maximum heat dissipation and thermal performance. Natural convection seldom will be used with closely spaced fins.

Again, higher ratios means an increase in cooling area which decreases temperature rise in a given heat sink volume. The good news for heat sink customers is that extrusion costs for both tooling and part prices are the minimum in the industry. Typical costs are lower than any of the other technologies mentioned in the next few pages.

2. Skived Fin Heat Sink

Skived fin heat sinks are a relatively new method of increasing heat dissipation in a small space.

Advantages of Skived Fin:

- Single piece construction
- Thin fins – down to 0.4 mm thick
- Uses either Aluminum or Copper as the base material
- Fins pitch densities comparable to folded fin; down to 15 fins per inch depending on height
- Fin heights up to 72 mm in Aluminum, 50 mm in Copper
- Minimal tooling costs
- Short turn prototypes

The skived fin process is actually shaving of the fins (refer to Figure 4, Page 5) , removing fin material by cutting at a slight angle, from the base plate. Fins are formed from the base plate but are not removed. They are deliberately cut from the surface and straightened to stand perpendicular to the base. Fins will have slight curve at base contact area and may have a slight curve to their height. The base is rectangular in cross section at the start of the manufacturing process. In process a steel cutting, similar to a wood-workers block plane, is brought into the base at an angle. With high force and NC controlled travel this tool form fins one by one in a step-and-repeat process. After forming the part is cus-

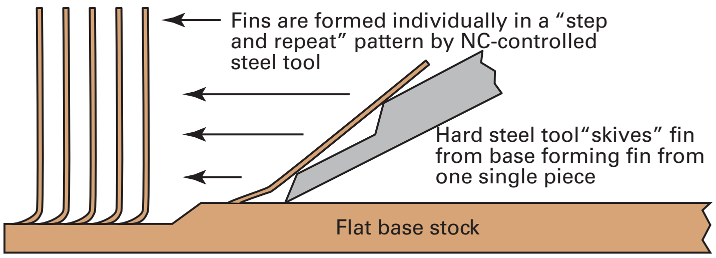
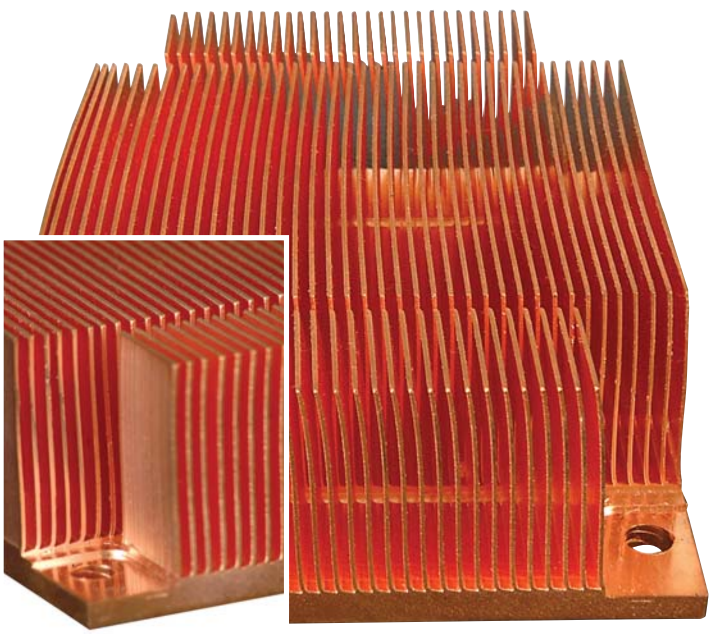


Figure 4. Skived Fin Details

tom machined just as an extrusion to add machined surfaces and attachment points.

Skived fin parts offer an excellent value from a proven manufacturing technology. In either copper or aluminum these parts skived fins parts are robust and a lower cost alternative to folded or bonded fin assemblies. Fin thickness, height and pitch are all interrelated and limited. Please consult Thermshield Engineering for details.



Typical Skived Fin Heat Sink

3. Bonded Fin Heat Sinks

Thermshield bonded fin come in many different styles:

- Mixed materials with copper fins and/or base
- Epoxy bonded or solder attachment
- Metal-to-metal swaged attachment

Advantages of Bonded Fin:

- Uniform thickness fins
- Mix of copper or aluminum in base or fins
- Equivalent extrusion ratios of > 50:1
- Fins can be cut to size or other fabrication before attachment

The bonded fin heat sink uses a grooved base plate designed to attach flat fin in set fin pitch or position. Grooves in the base are sized to accept set thickness of fin and provide a high level of heat transfer from the base to the fins for dissipation to air. Good groove design and assembly adds very little added temperature rise to the overall heat sink performance. Some designs use extruded fins that are swaged or cold-formed in place by deforming the base material over the fins in their grooves.

Developed in the 1970s bonded fin originally gave engineers the advantage of eliminating the problem of extrusion ratio limitation. A bonded fin heat sink offered extrusion ratios of >50:1 and above at a time that extrusions could only achieve 10:1. This gave the additional cooling surface needed to cool early generation IGBT power modules and Thermoelectric coolers when there were few alternatives.

Today bonded fin heat sinks are used for very high power air cooling where water cooling may be the only alternative. Bonded fin technology traditionally employs an extruded aluminum base plate with high conductivity aluminum fins. A two-part, high conductivity epoxy adhesive was used to hold fins in place. More recently lead-free solders for RoHS compliance are employed to attach fins to the base and the material of either fins or base (or both) can change to match the thermal demands of the application. More costly to tool and manufacture bonded fin heat sinks are used on an as needed basis to solve high heat load problems in a wide variety of applications.

Typical Bonded Fin Heat Sinks

4. Folded Fin Heat Sinks

Folded fins are the next step up in part cost and tight volume cooling efficiency.

Advantages of Folded Fin:

- Very thin fins down to 0.2 mm thick
- Fin pitches to 16 fins per inch or higher
- Height limits to 50 mm depending of pitch and fin thickness
- Mixed materials (copper or aluminum) between fins and base
- Alternative fin styles other than flat and straight

Folded fin technology was originally developed by the US military for use in airborne applications. Due to very thin materials these parts can be light weight and still offer significant cooling for avionics and radar applications. Over the past 30+ years these technologies have become mainstream cooling techniques for commercial applications.

Folded fin typically employs a solid metal base plate with sheet metal fins bent or corrugated in a square wave pattern. When

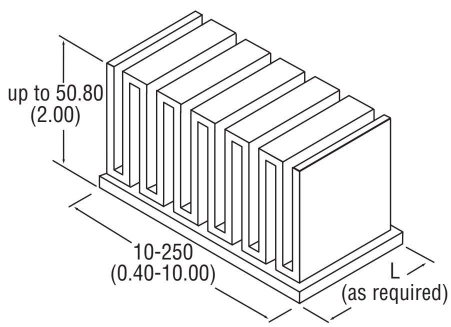
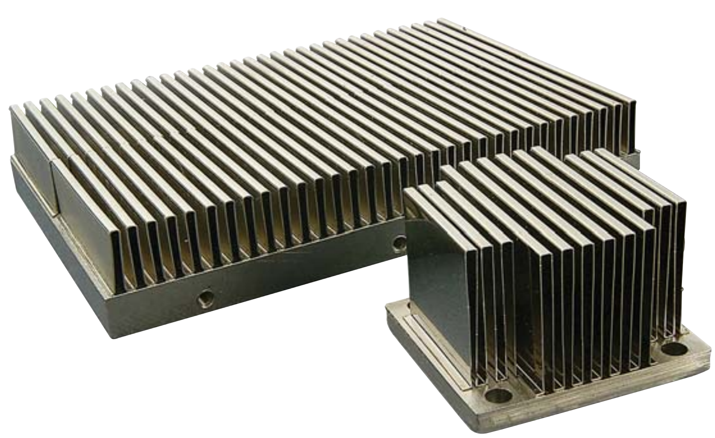


Figure 5. Folded Fin Details

brazed or soldered together these parts resemble small extrusions but with tighter tolerances. The fin's height, thickness and pitch must be carefully engineered to match the pressure drop, mass flow and required thermal resistance of a given application. Typically nonstandard parts, folded fin heat sink are virtually all custom designed. Part and tooling cost is higher than extrusions or skived fin but this style of part can solve problems no other cooling technology can approach.



Typical Folded Fin Heat Sink

5. Stacked Fin Heat Sinks

Advantages of Stacked fins:

- Thin fins – down to 0.2 mm
- Able to mix materials is base and fins
- Large sizes of both fin and base are easily accommodated
- Reduced cost from folded fins due to assembled punch press fins

Stacked fin heat sinks are similar to folded fin in that sets of fins are attached to a solid base plate through a bonding process. Stacked fins differ in their manufacturing in that the fin sets are produced on a high speed punch press with an interlock feature which holds individual fins together in a chain. The number of fins in each of these chains is set by the manufacturing tooling. The interlock feature allows the assembler manufacturing the part to handle only two pieces during assembly; the base and the interlocked set of fins. This reduces handling time and increases through-put. The fin to fin interlock holds the fins in close pitch eliminating the need to fixture or control fin spacing common with folded fin parts. Sample parts can be made by hand for thermal testing but typically are not cosmetically perfect.

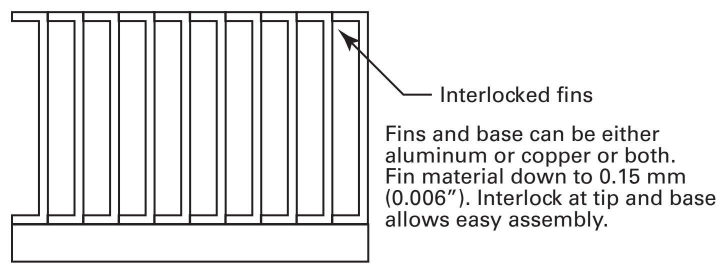
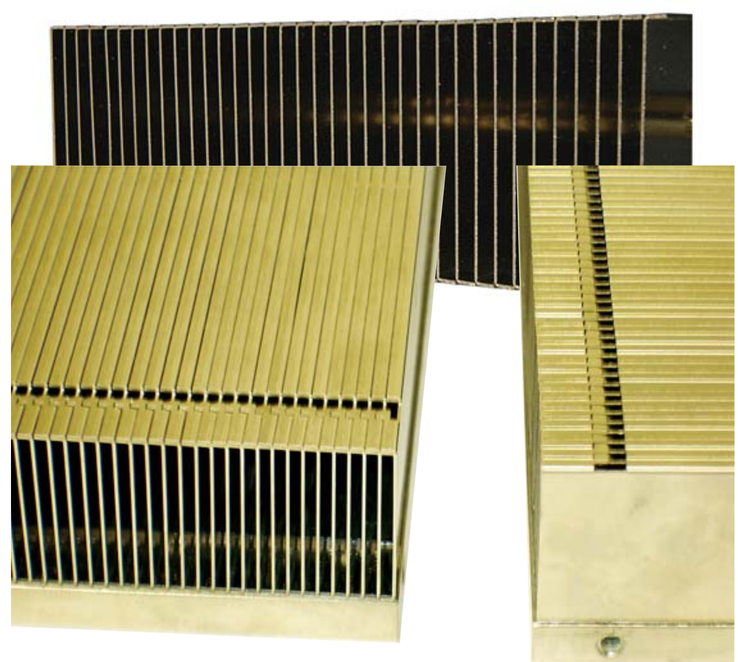


Figure 6. Stacked Fin Details



Typical Stacked Fin Heat Sink

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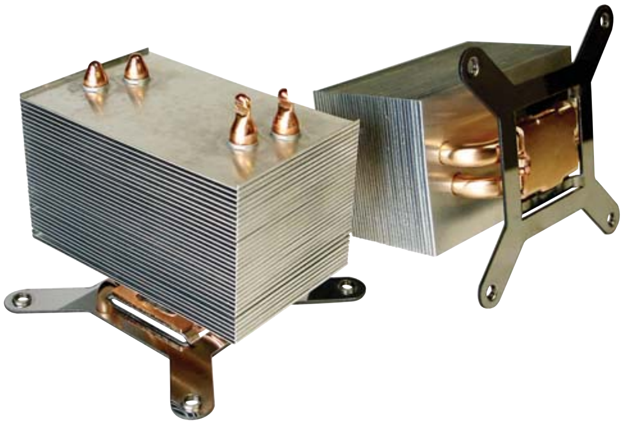
6. Heat Pipe Assemblies

Heat pipes have only recently come into use in high volume applications due mostly to their use in virtually every notebook computer manufactured in the past few years. Small diameter heat pipes are currently made by the millions every month. Significant capital investments in high production facilities has helped reduce cost substantially.



Advantages of heat pipe assemblies:

- Heat dissipation surface can be placed at a remote location from heat generation.
- Heat can be moved significant distances without large temperature rise.
- High heat flux densities can be averaged to help reduce temperature rise at the heat generator
- Correctly manufactured heat pipes have long life, typically >100K hrs.

A heat pipe by itself will not dissipate heat. It is only a conduit moving heat from one place to another. Heat input, called the evaporator, and heat removal, called condenser, must have controlled contact with the heat pipe to insure low temperature rise.

Heat pipes use a closed, phase change system to help move heat from one end to another. Liquid inside the heat pipe changes to vapor which absorbs heat in the phase-change process. The vapor moves very quickly (~speed of sound) to the cooler end of the heat pipe where it condenses back to liquid. The cooled liquid returns to the evaporator area by the porous structure (wick) on the inside diameter of the pipe. Finned surfaces and forced air are normally needed for heat removal.

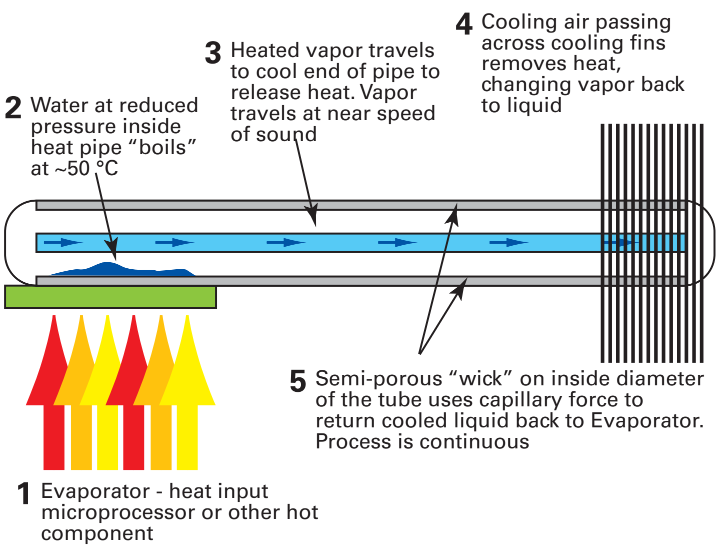
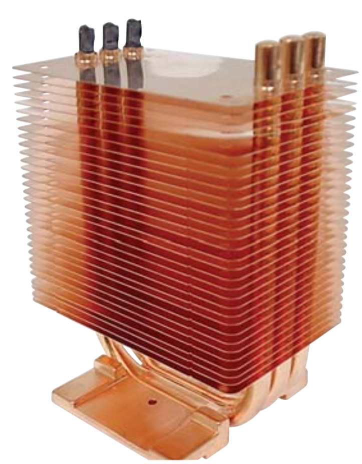


Figure 7. Heat Pipe Details



Typical Heat Pipe Heat Sink

7. Z-Axis cooler

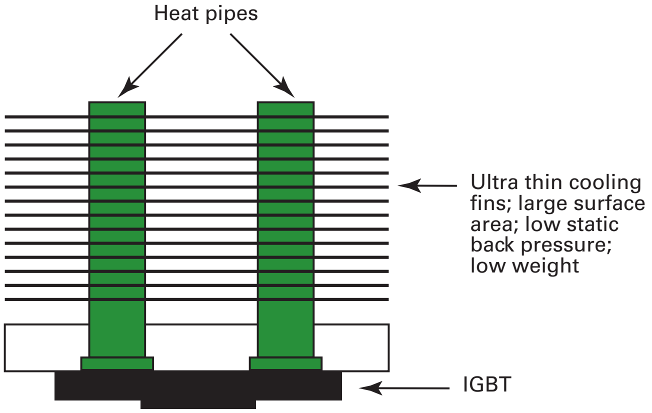
Recently developed to cool multikilowatt heat loads from IGBT power modules Z-axis heat sinks also use heat pipe technology but in a different way.

Advantages of Z-Axis cooler:

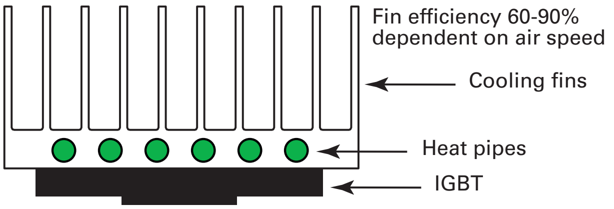
- Large diameter heat pipes (25 and 33 mm) carry multi-hundred Watt loads with minimal temperature rise.
- Due to heat pipe technology all fins operate at the same efficiency.
- Customer design positions heat pipes in direct contact with power module base at highest heat flux locations.
- Equivalent cooling capacity to water cooled cold plates
- Small volume requirements offer reduced cabinet / enclosure size
- Heat pipe efficiency >96% independent of air speed

Heat generated inside the power module is concentrated in a few local areas. Large diameter heat pipes mounted perpendicular to the base mounting surface are located directly underneath these hot spots. This minimizes the distance the heat must travel to leave the module base. A shorter distance for heat travel results in lower temperature rise through the heat sink base. The large diameter heat pipes also operate at high efficiency carrying many hundreds of Watts to the fin area. Many thin fins are used to provide significant heat removal area; forced air cooling is required.

Overall the combination of moving heat away from the base, positioning of the tower heat pipes and high number of high efficiency fins results in a significant weapon in cooling multikilowatt heat loads.



Large diameter heat pipes with flat fins: New Z-axis design



Extrusion with optional heat pipes: Conventional design

Figure 8. Z-Axis Cooler Details

Typical Z-Axis Cooler Heat Sinks

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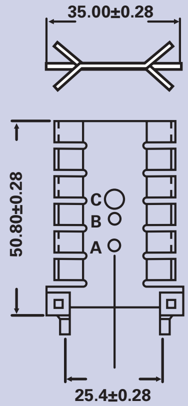
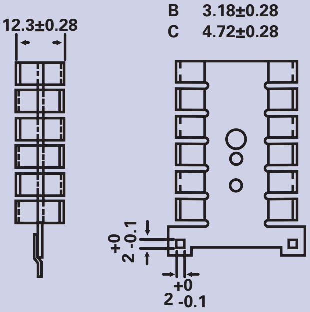
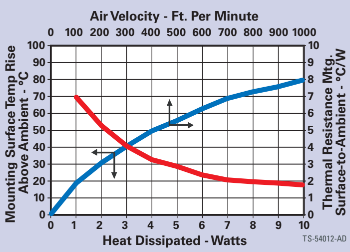
TS-54012-AD

- Material: Stamped Aluminum
- Vert. Mounting solderable tabs
- Black Anodized Finish
- Thickness is 0.50 [1.27mm]
- TO-220 and others



Hole	Diameter
A	3.18±0.28
B	3.18±0.28
C	4.72±0.28

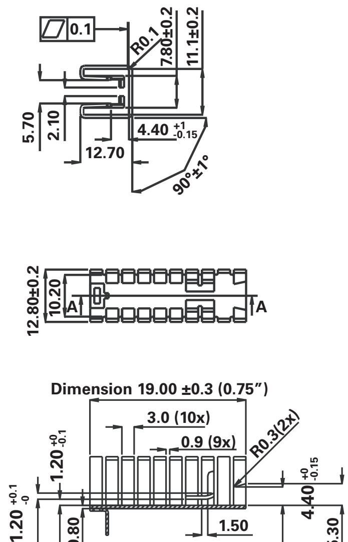




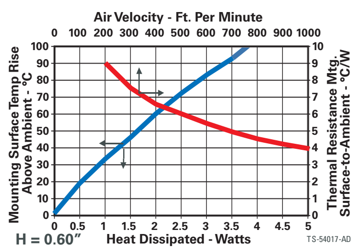
TS-54017/18/19

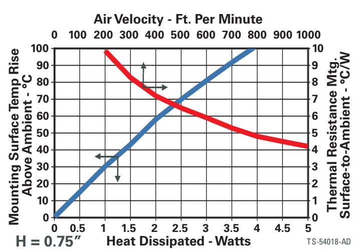
TS-54017-AD (H = 0.60"/ 15.24)
TS-54018-AD (H = 0.75" / 19.00)
TS-54019-AD (H = 1.50" / 38.10)

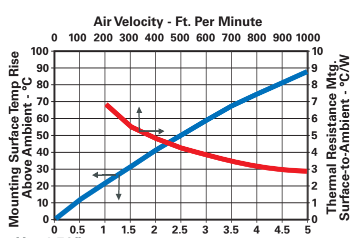
- Finish: Black Anodize
- Material: 0.032" thick H1100 Aluminum
- Options: Horz. or Vert. solder tab
- TO-220



SECTION AA
HORIZONTAL TAB SHOWN
UNITS IN MILLIMETERS



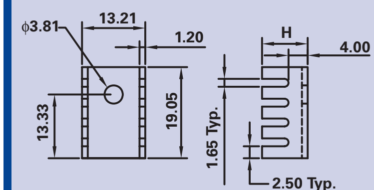


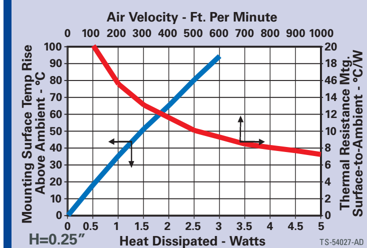


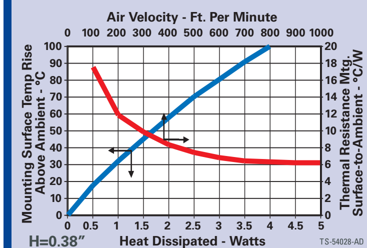
TS-54027/28/29

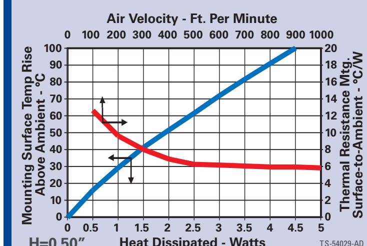
TS-54027-AD (H = 0.25"/ 6.35)
TS-54028-AD (H = 0.38" / 9.56)
TS-54029-AD (H = 0.50" / 12.70)

- Finish: Black Anodize
- Material: H1100 Aluminum
- Options: Horz. or Vert. solder tab 0.032" thick /0.051" wide
- TO-220



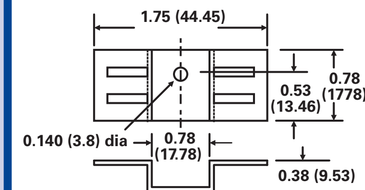


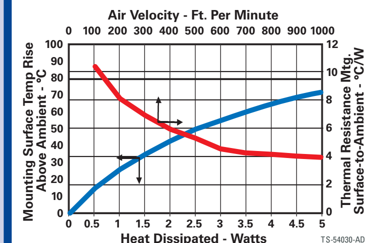




TS-54030-AD

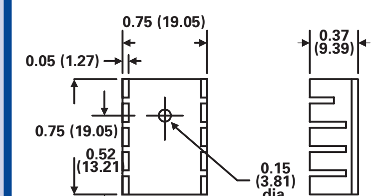
- Material: H100 Aluminum; .039 (1.0) thick
- Black Anodized Finish
- Refer to TS-541354, which nests inside for added cooling; see Page 14
- TO-220

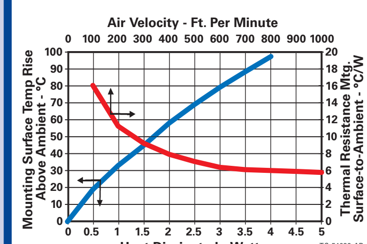




TS-54032-AD

- Material: H1100 Aluminum
- Finish: Black Anodize
- TO-220



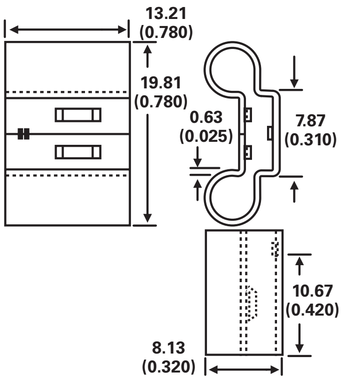


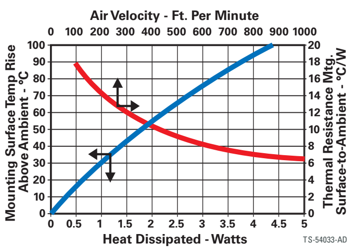
For a complete data sheet on these standard products, please visit www.thermshield.com
Any of our standard products can be used as the basis for a custom solution.

TS-54033-AD

Heat sink with NO ADDED hardware

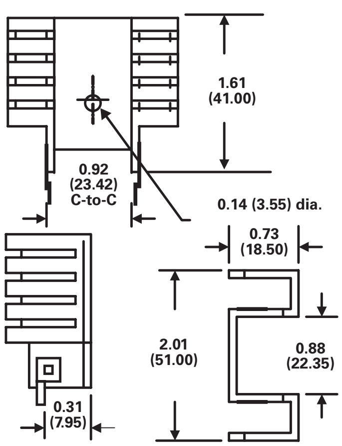
- Material: H1100 Aluminum
- Finish: Black Anodize
- Description: Board Level TO-126 Stamping

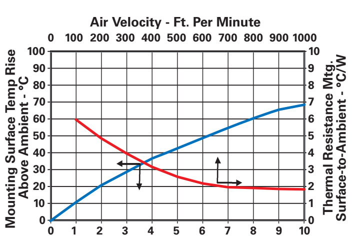




TS-54035-AD

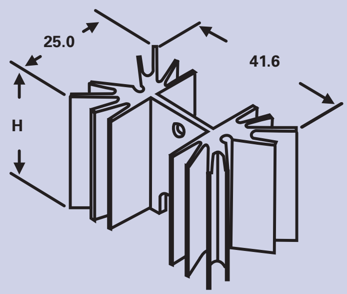
- Finish: Black Anodize
- Material: 0.05" H1100 aluminum
- Tinned solder tabs 0.032" thick
- TO-220 and others

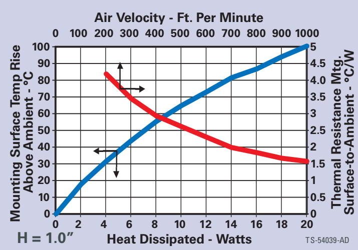


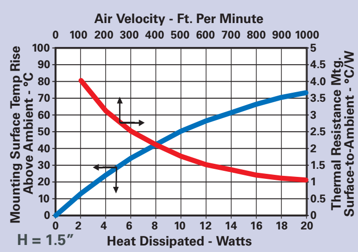


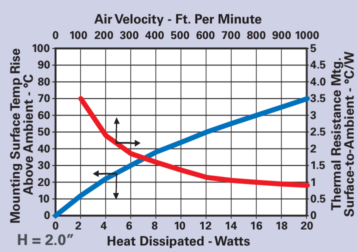
TS-54039-AD

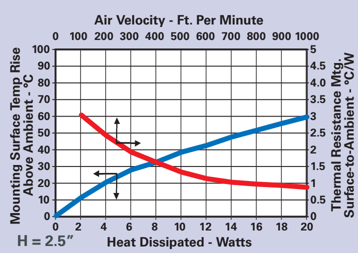
- Finish: Black Anodize
- Material: 6063-T5 aluminum
- PC board attachment: 0.090" dia. Pretinned pins
- Semi. Attachment: 0.125" dia. Mounting holes (3)
- TO-220
- Add H dimension to order
  i.e. TS-54039-AD-1.5 for 1.5 inch height; custom heights available





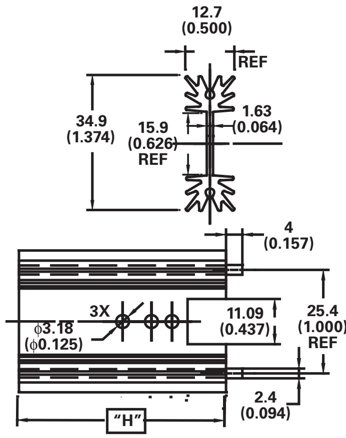




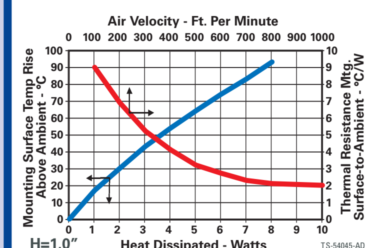


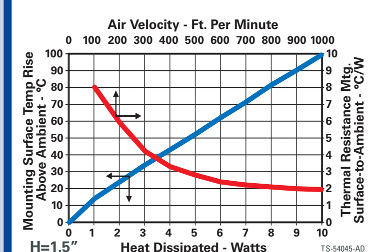
TS-54045-AD

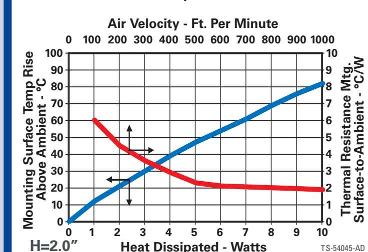
- Finish: Black Anodize
- Material: 6063-T5 aluminum
- PC board attachment: 0.090" dia. Pretinned pins
- Semi. Attachment: 0.125" dia. Mounting holes (3)
- TO-220
- Add H dimension to order

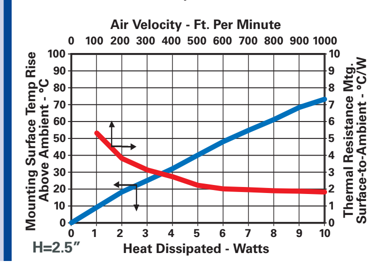


Part number suffix determines cut extrusion length "H", in inches



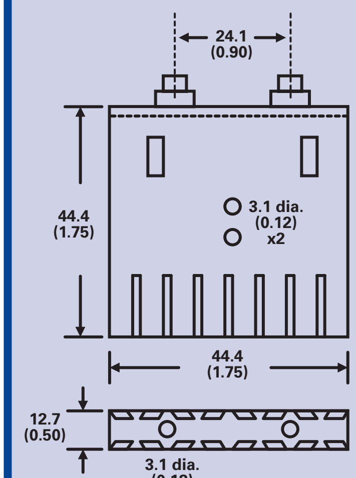


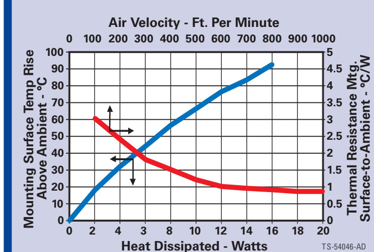


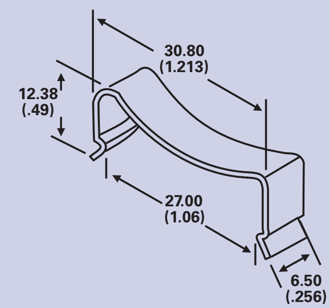


TS-54046-AD

- Finish: Black Anodize
- Material: H1100 Alloy – 0.062" thick
- PC board attachment: 0.169 dia stand-offs (2X)
- Semi. Attachment: Clip # TS-55007-AD or #4 hardware
- TO-220, TO-218, TO-247, and others





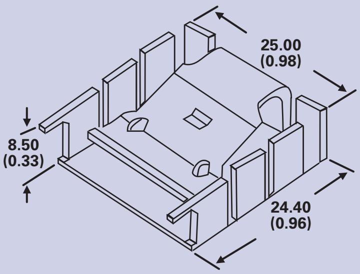


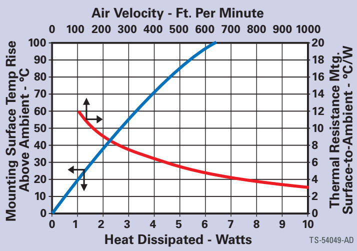
Clip #TS-55007-AD; order separately

Thermshield, LLC PO Box 1641, Laconia, NH 03247 USA
Ph: 603-524-3714 Fax: 603-524-6602 Web: www.thermshield.com

TS-54049-AD

- Material: Aluminum
- Finish: Black Anodize
- TO-220

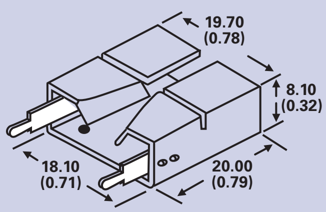


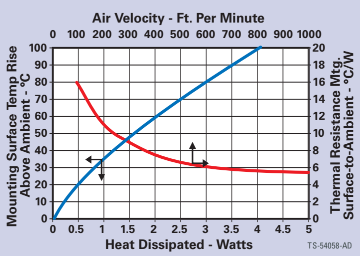


TS-54058-AD

For vertical mounting with solderable pins

- Material: Aluminum
- Finish: Black Anodize
- TO-220



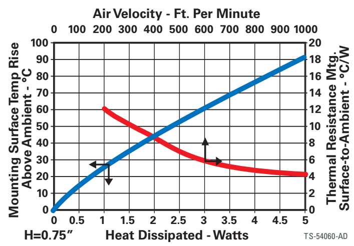


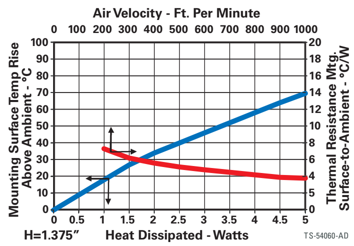
TS-54060-AD/-ADVT
TS-54453-UTVT

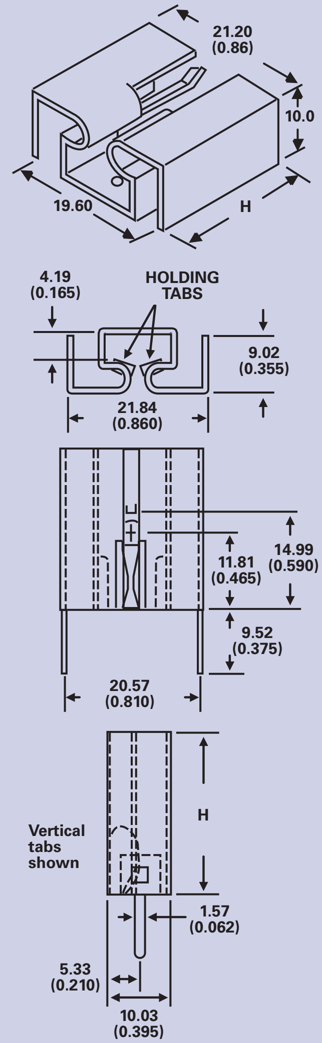
Heatsink with NO ADDED hardware

- Material: Aluminum
- Finish: Black Anodize
  Also available w/solderable vertical tabs (-XXVT)
- TO-220

TS-54060; H = 0.75” / 19.0
TS-54453-UTVT; H = 1.375” / 34.9



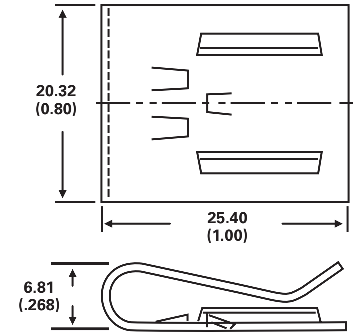


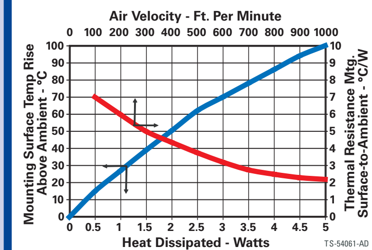


TS-54061-AD

Heatsink with NO ADDED hardware

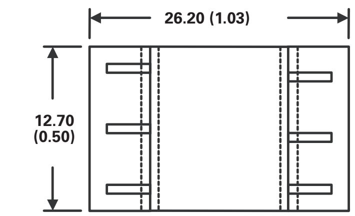
- Material: Aluminum
- Finish: Black Anodize
- TO-220

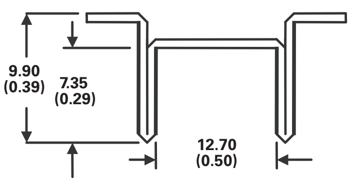


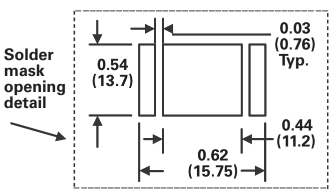


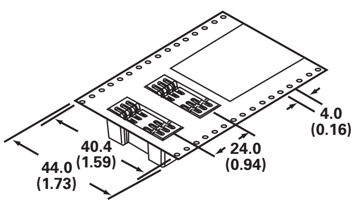
TS-54081-AD

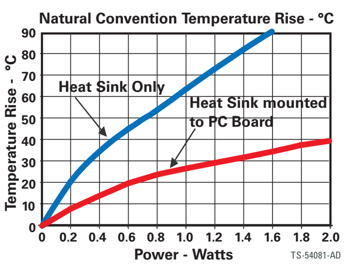
- Material is tin plated copper – 0.025” / 0.63 mm thick.
- Part is solder mounted to PC board over D2 device on solder pads
- Available in bulk packing or tape and reel format (44 mm width /24 mm pitch)
- TO-263; SMT Heat Sink for D2 Power Packages

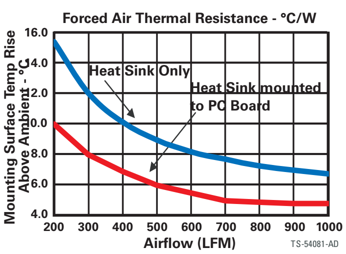






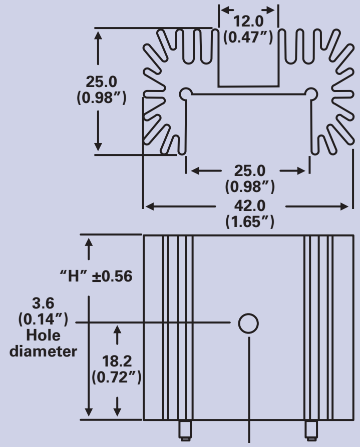


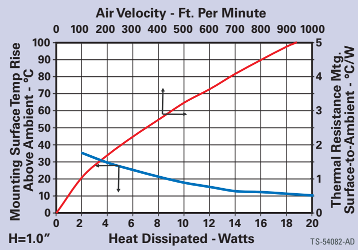


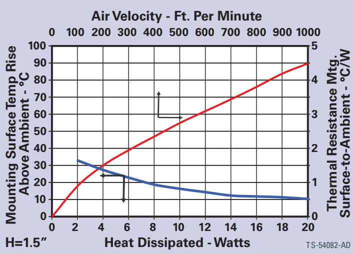


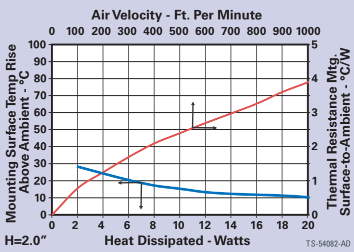
TS-54082-AD

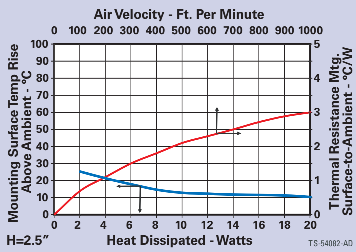
- For vertical mounting with solderable pins
- Material: Aluminum Extrusion
- Finish: Black Anodize
- TO-220, TO-218, TO-247, and others
- Add H dimension to order
  i.e. TS-54082-AD-1.5 for 1.5 inch height; custom heights available





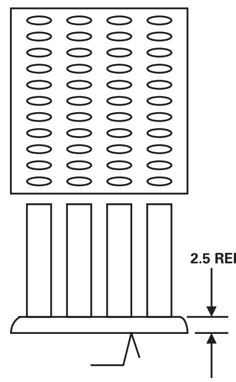


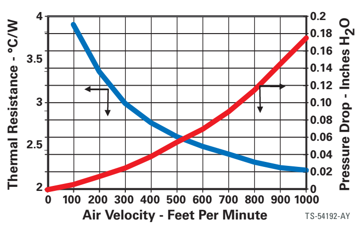




TS-54192-AY

- Micro-Forged Heat Sink for 35X35 BGAs
- Material: 6063-T5 aluminum
- Finish: Black anodize
- Overall dimensions: 37.5 X 37.5 X 21 mm
- Plastic retainer clip not shown. Available to attach 3 different thickness BGA packages —
  0.50 to 1.1mm
  1.40 to 2.00
  3.00 to 3.60 mm.

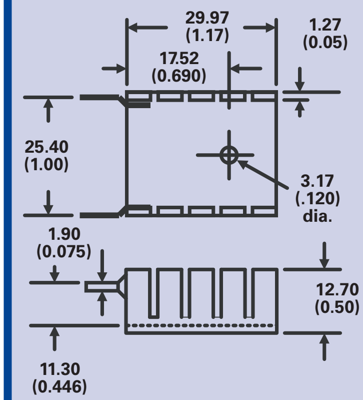


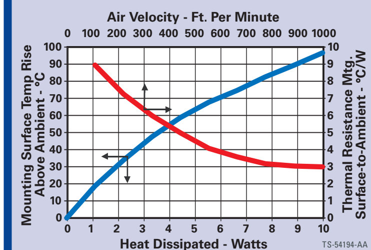


TS-54194-AD
TS-54194-ADVT

Pre-tinned solder mounting tabs
TS-54194-AD (no tabs)
TS-54194-ADVT (with solderable tabs)

- Material: Aluminum
- Finish: Black anodize
- Straight Fins
- TO-220





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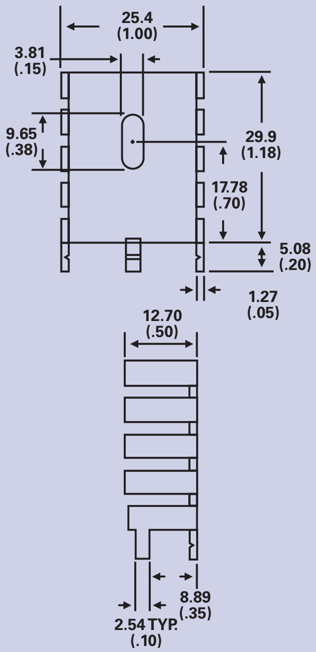
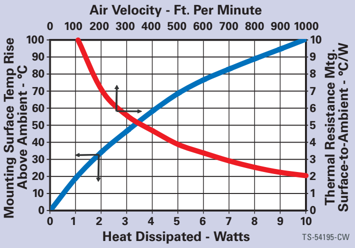
TS-54195-CW

Heat sink with NO ADDED hardware

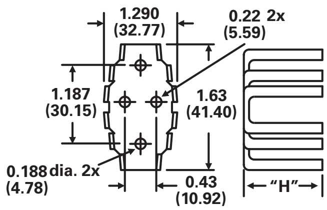
- Material: Aluminum
- Finish: Black anodize
- TO-220

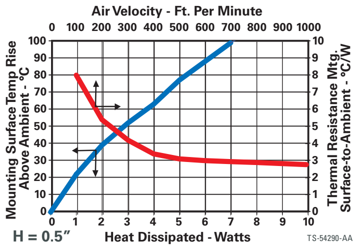


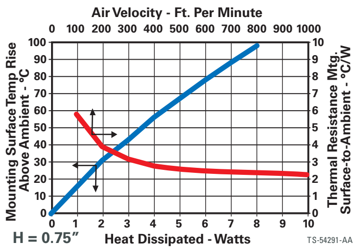


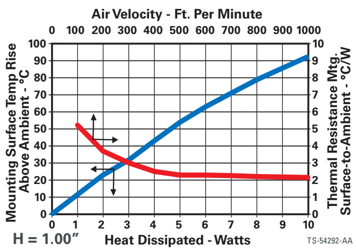
TS-54290-AA
TS-54291-AA
TS-54292-AA
TS-54293-AA

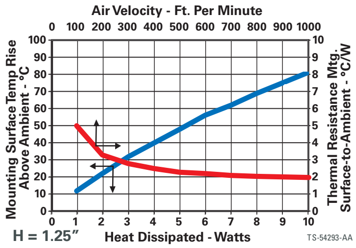
- Material: Aluminum; 0.090 (2.29) thick
- Finish: Black anodize
- TO-3







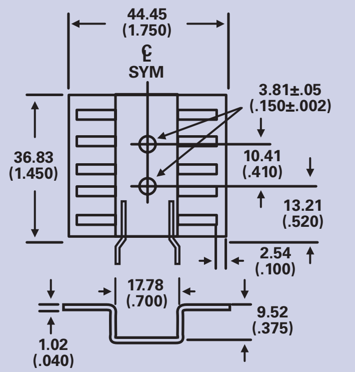


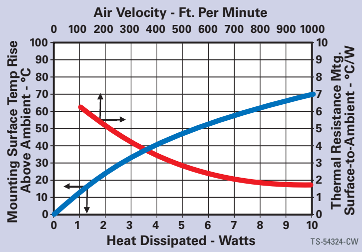


TS-54324-CW
TS-54324-CWVT

Heat sink with NO ADDED hardware

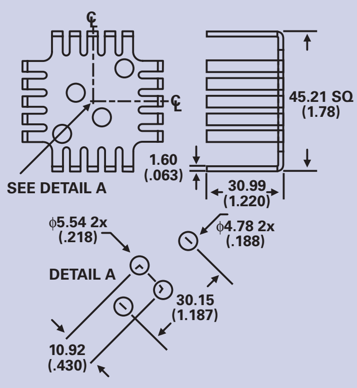
- Material: Aluminum
- Finish: Black Anodize
- TO-220

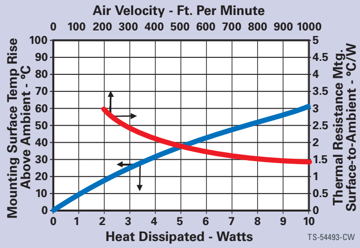




TS-54493-CW

- Material: Stamped Aluminum
- Finish: Black Anodize
- TO-3 Package

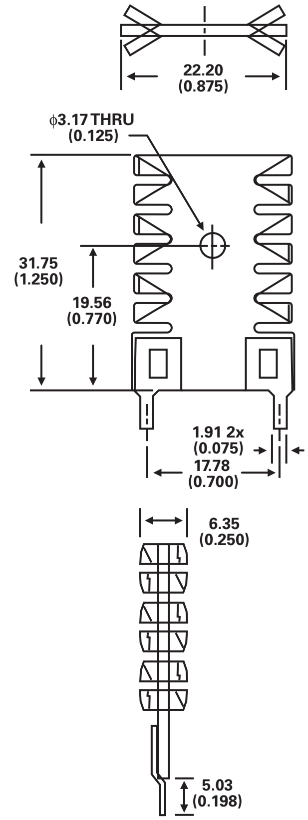


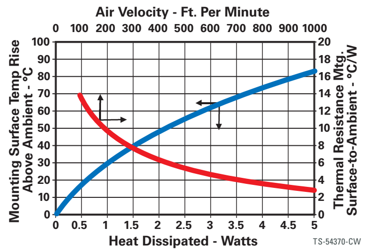


TS-54370-CW

For vertical mounting with solderable pins

- Material: Aluminum
- Finish: Black Anodize
- TO-220





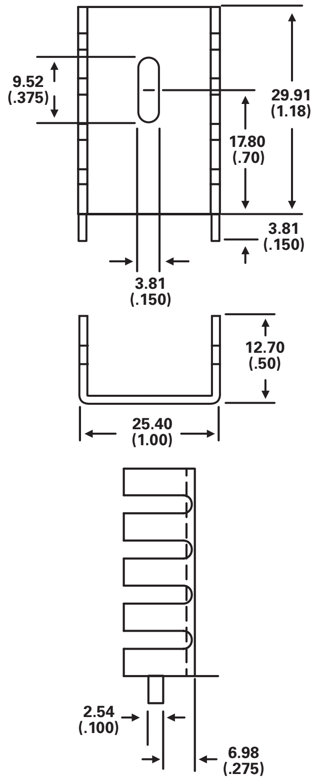
Standard Heat Sink Products

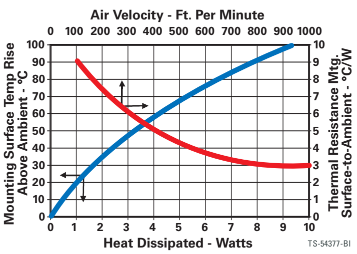
Standard Heat Sink Products

TS-54377-BI

Heat sink with NO ADDED hardware

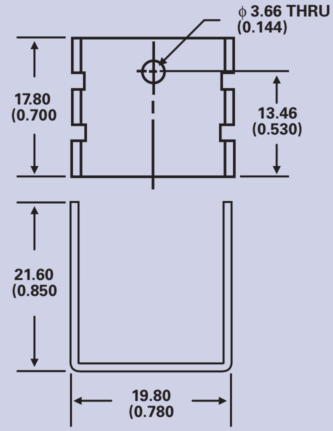
- Material: Aluminum
- Finish: Black Anodize
- TO-220

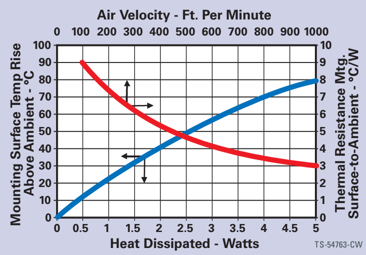




TS-54763-CW

- TO-220 Package
- Material: Stamped Aluminum
- Finish: Black Anodize
- TO-220

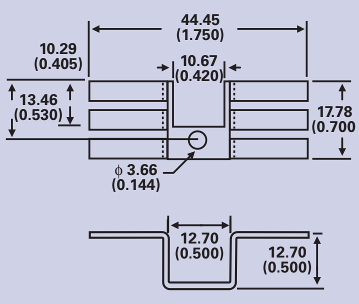


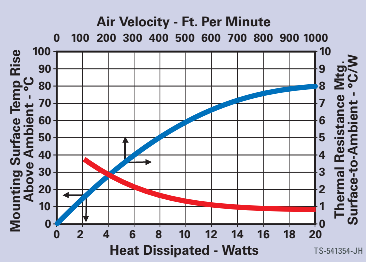


TS-541354-JH

Heat sink with no ADDED hardware

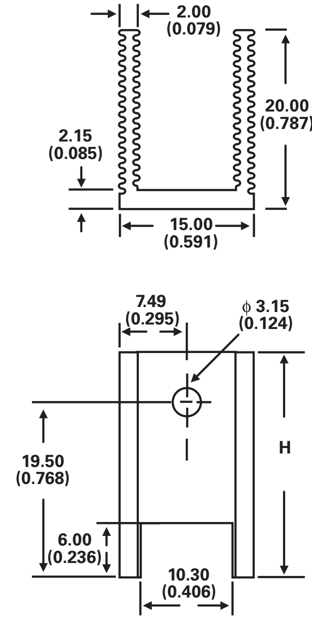
- Material: Aluminum Extrusion
- Finish: Black Anodize
- Nests in TS-54030-AD; see Page 9
- TO-220

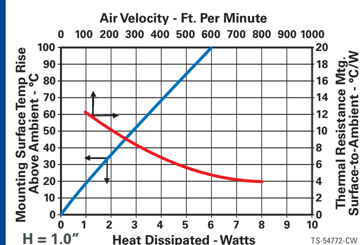


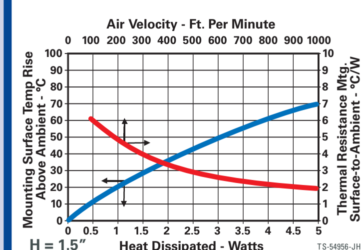


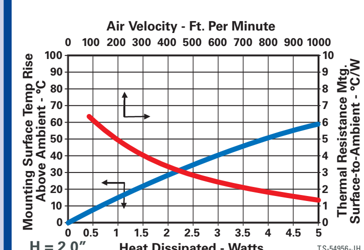
TS-54772-CW

- TO-220 Package
- Material: Aluminum Channel Extrusion with serrated fins
- Finish: Black Anodize
- TO-220





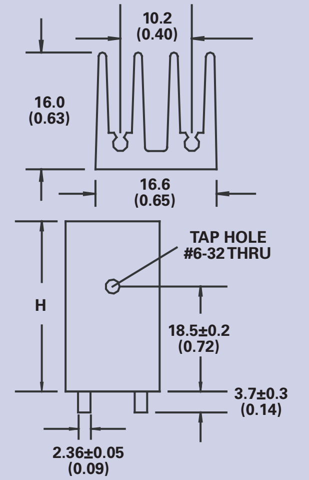


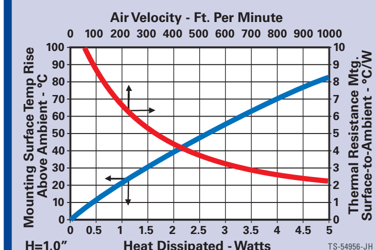


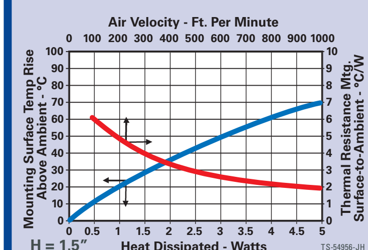
TS-54956-JH

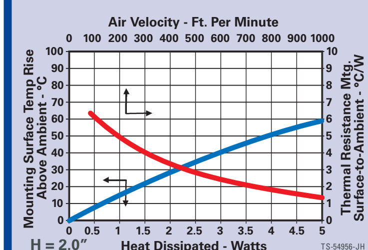
For vertical mounting with solderable pins

- Material: Aluminum Extrusion
- Finish: Black Anodize
- TO-220









Thermshield, LLC PO Box 1641, Laconia, NH 03247 USA
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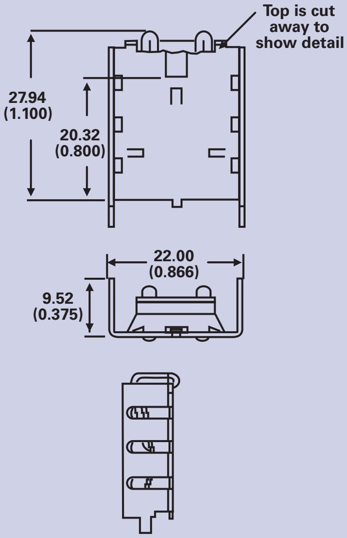
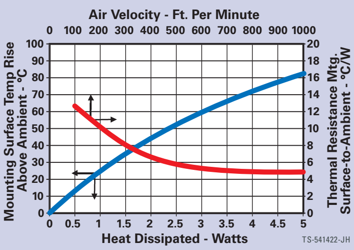
For a complete data sheet on these standard products, please visit www.thermshield.com

Any of our standard products can be used as the basis for a custom solution.

TS-541422-JH

- Material: Copper base
- Finish: solderable
- TO-220

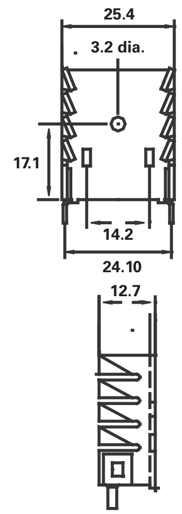


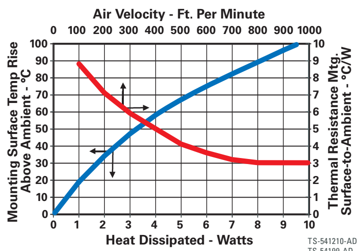


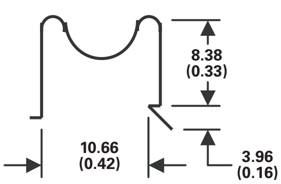
TS-541210-AD
TS-54199-AD

TS-54199-AD - without hole
TS-541210-AD - with 0.120” hole
Pre-tinned solder mounting tabs
Order TS-55056-JH clip separately; see Page 17

- Material: Aluminum; 1.2 mm (0.048”) thick
- Finish: Black Anodize
- TO-220







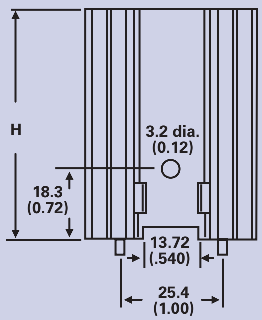
Clip #TS-55056=JH; order separately

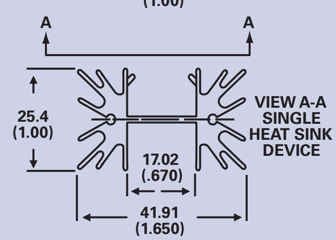
TS-541427-JH
TS-541428-JH
TS-541429-JH
TS-541430-JH

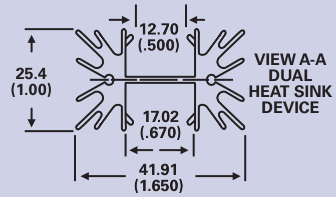
For vertical mounting with solderable pins and one (1) TS-55006-AD clip; see Page 17

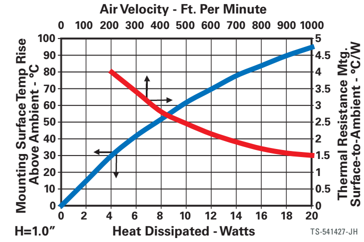
- Material: Aluminum Extrusion
- Finish: Black Anodize
- TO-220

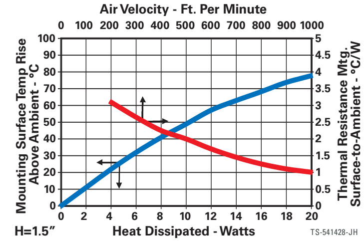
Length “H”:
TS-541427-JH; H = 25.4 (1.00)
TS-541428-JH; H = 38.1 (1.50)
TS-541429-JH; H = 50.8 (2.00)
TS-541430-JH; H = 63.5 (2.50)

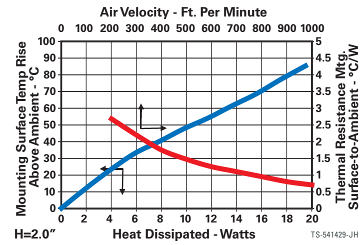


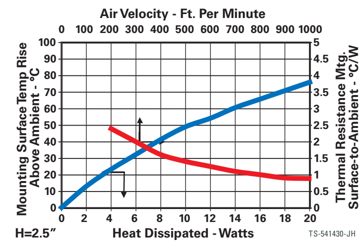


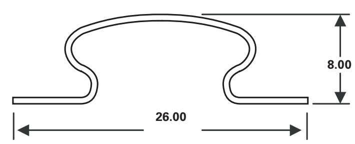










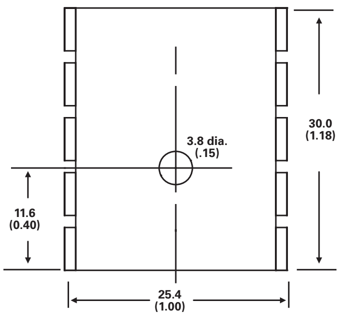


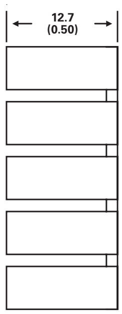
Clip #TS-55006-AD; order separately

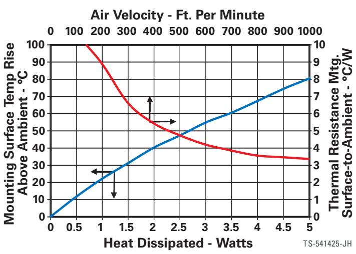
TS-541425-JH

Heat sink with no ADDED hardware

- Material: Aluminum
- Finish: Black Anodize
- TO-220 and others





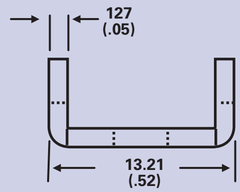


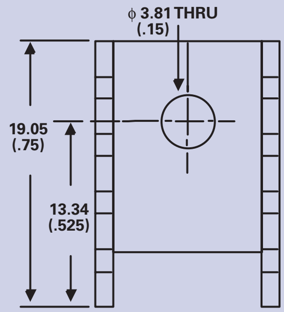
TS-541431-JH
TS-541432-JH

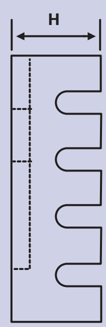
Heat sink with NO ADDED hardware

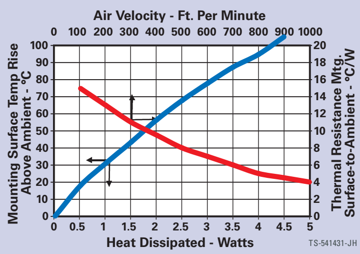
- Material: Aluminum Extrusion
- Finish: Black Anodize
- TO-220

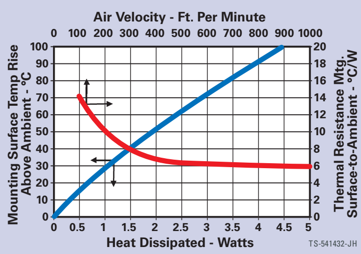
Length "H":
TS-541431-JH; H = 9.5 (0.37)
TS-541432-JH; H = 12.7 (0.50)







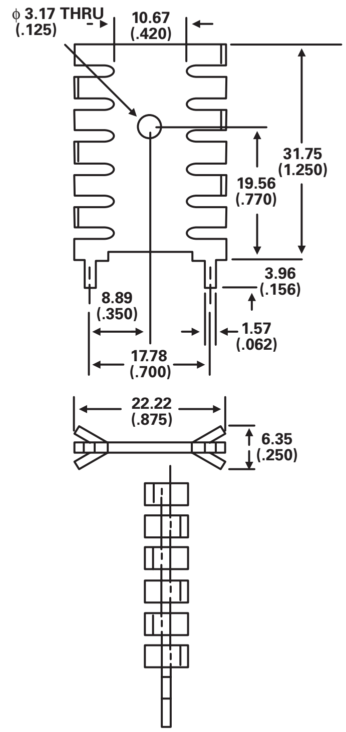


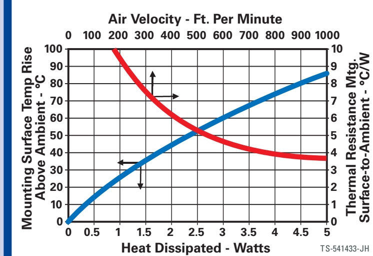


TS-541433-JH

Heat sink with NO ADDED hardware

- Material: Copper
- Finish: Black Paint w/Solderable Tabs
- TO-220

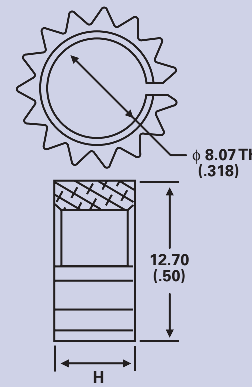


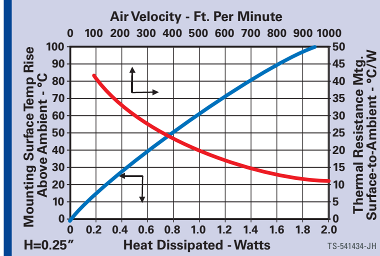


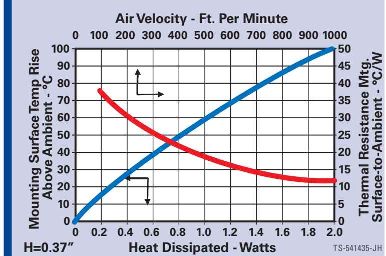
TS-541434-JH
TS-541435-JH

- Material: Aluminum Extrusion with radial fins
- Finish: Black Anodize
- TO-5

Length "H":
TS-541434-JH; H = 6.3 (0.25)
TS-541435-JH; H = 9.3 (0.37)







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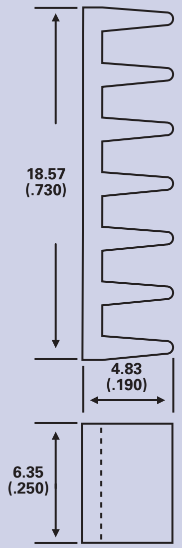
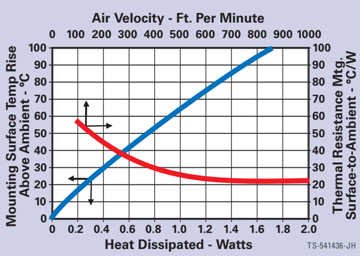
TS-541436-JH

Heat Sink for 14 or 16 Pin dip

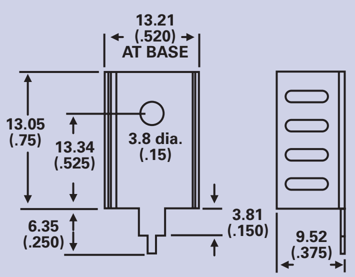
- Material: Aluminum
- Finish: Black Anodize
- TO-220

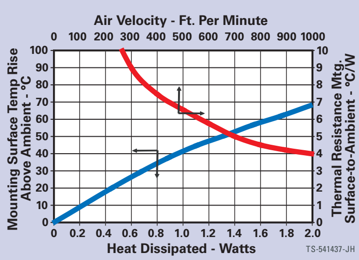




TS-541437-JH

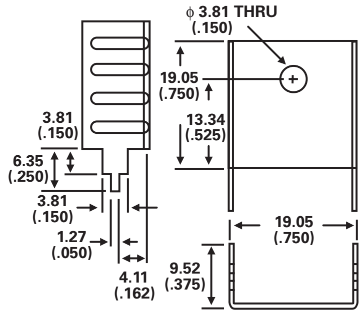
- Material: Copper base
- Finish: Solderable finish
- TO-220

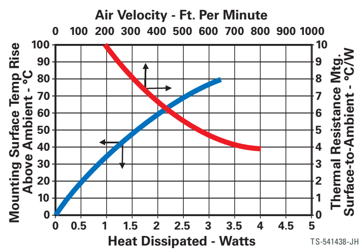




TS-541438-JH

- Material: Copper base
- Finish: Solderable finish
- TO-220 and others

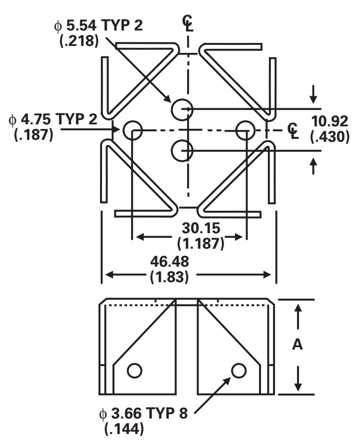


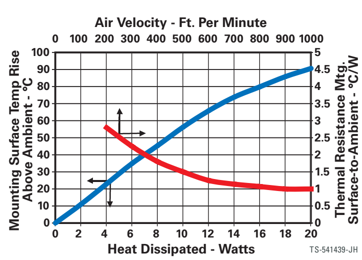


TS-541439-JH

Heat sink with NO ADDED hardware

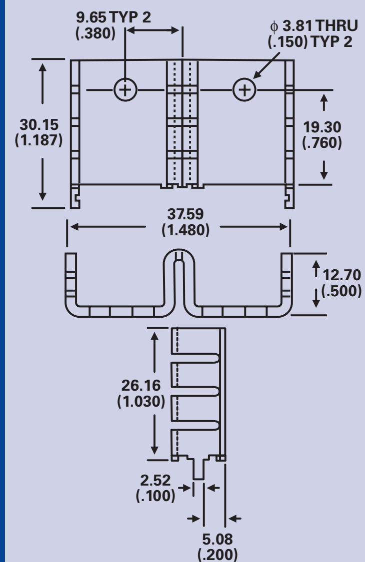
- Material: Aluminum
- Finish: Black Anodize
- TO-3

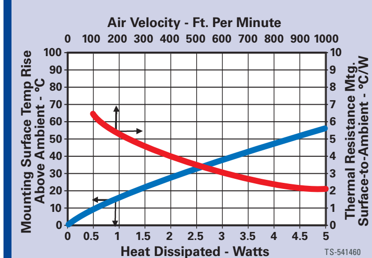




TS-541460

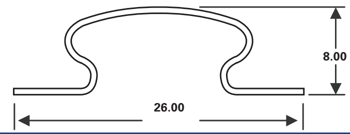
- Material: Stamped Aluminum; non-solderable, notched tabs
- Finish: Black Anodize
- Dual TO-220 Package





TS-55006

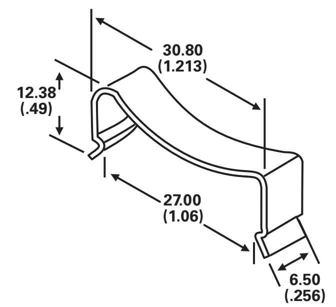
- Stainless steel spring clip for TO-220 packages.
- Use with TS-541427 thru TS-541430; see Page 16



TS-55007-AD

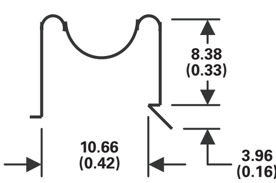
Spring Clip

- Use with Thermshield heat sink #TS-54046-AD; see Page 10
- Material: Stainless Steel – Spring Temper; 0.013” thick



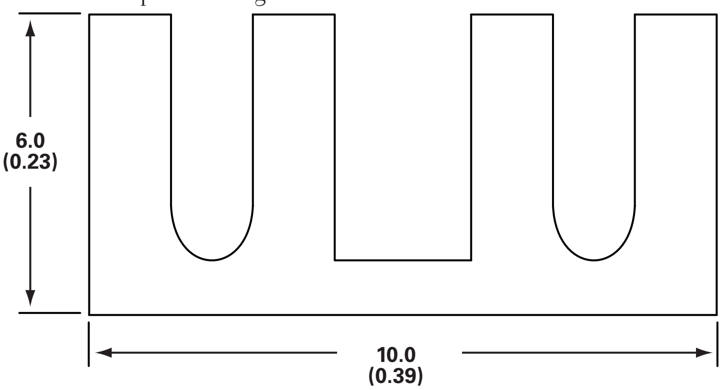
TS-55056-JH

- Stainless steel spring clip for TO-220 packages.
- Use with TS-54199-AD & TS-541210-AD; see Page 15



TS-67410-NT

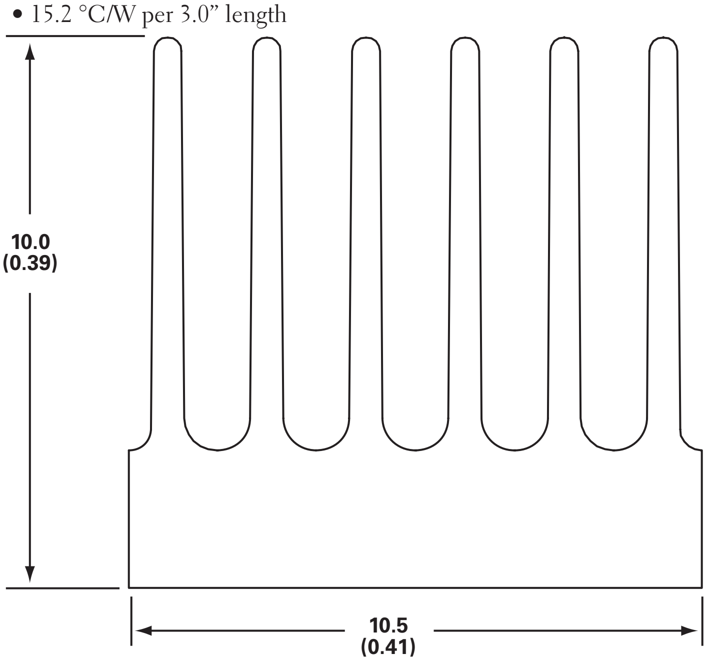
- 2.3 in^2/inch
- 0.05 pounds/foot
- 30.4 °C/W per 3.0" length



TS-67410-NT

TS-67444-AW

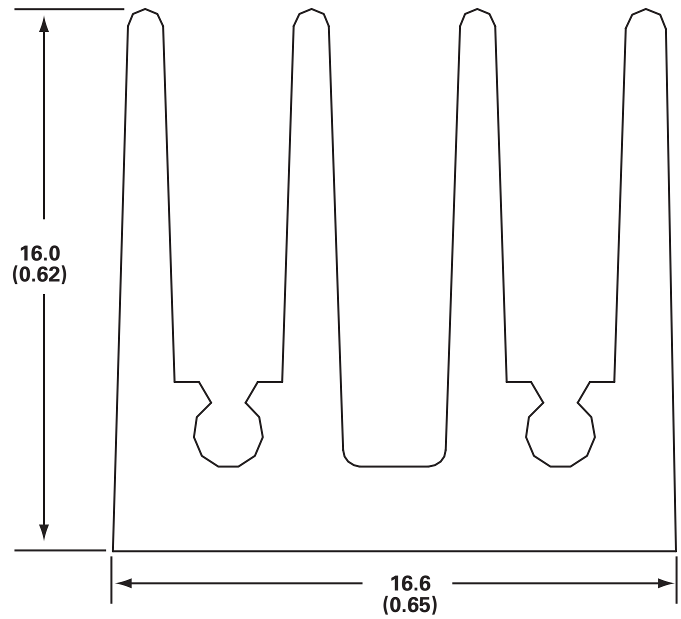
- 4.6 in^2/inch
- 0.09 pounds/foot
- 15.2 °C/W per 3.0" length



TS-67444-AW

TS-67414-JH

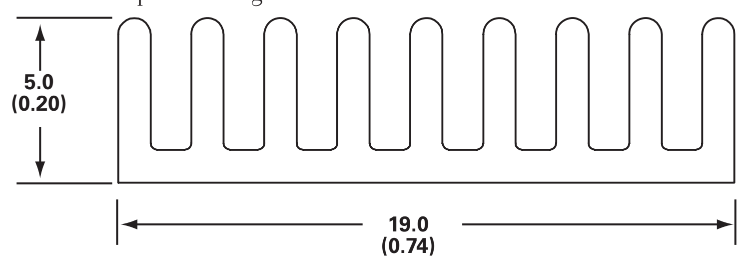
- 5.5 in^2/inch
- 0.2 pounds/foot
- 12.6 °C/W per 3.0" length



TS-67414-JH

TS-67397-BE

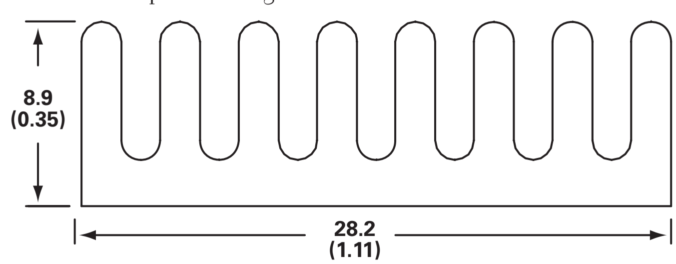
- 7.5 in^2/inch
- 0.22 pounds/foot
- 9.3 °C/W per 3.0" length



TS-67397-BE

TS-67395-AW

- 6.3 in^2/inch
- 0.32 pounds/foot
- 11.1 °C/W per 3.0" length



TS-67395-AW

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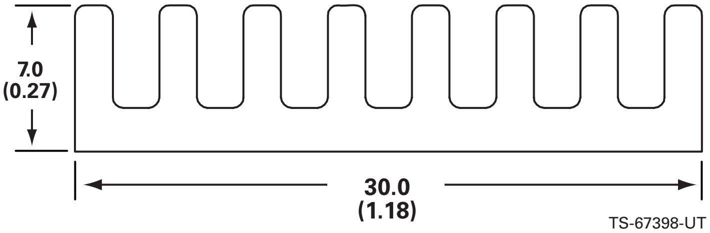
TS-67398-UT

- 4.5 in2/inch
- 0.11 pounds/foot
- 15.6 °C/W per 3.0" length

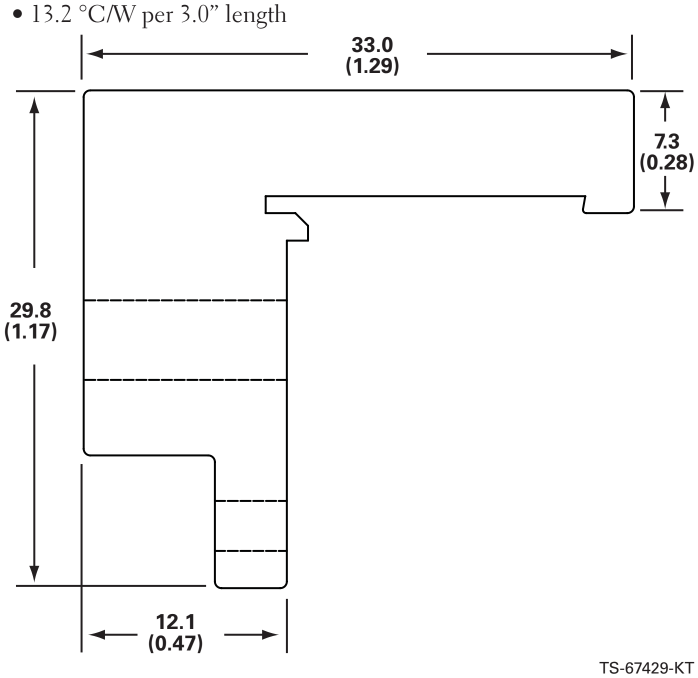


TS-67403-BE

- 8.3 in2/inch
- 0.33 pounds/foot
- 8.4 °C/W per 3.0" length

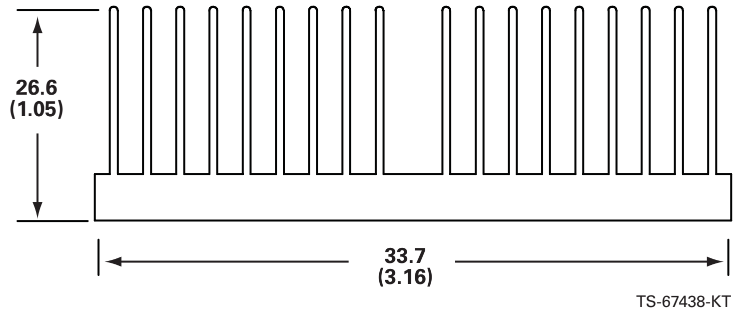
TS-67429-KT

- 5.3 in2/inch
- 0.95 pounds/foot
- 13.2 °C/W per 3.0" length



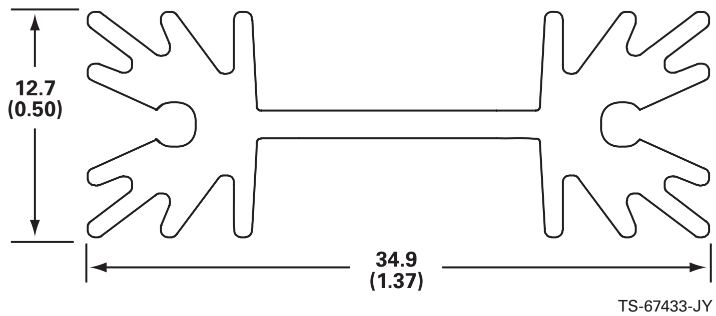
TS-67438-KT

- 36.1 in2/inch
- 1.56 pounds/foot
- 1.9 °C/W per 3.0" length



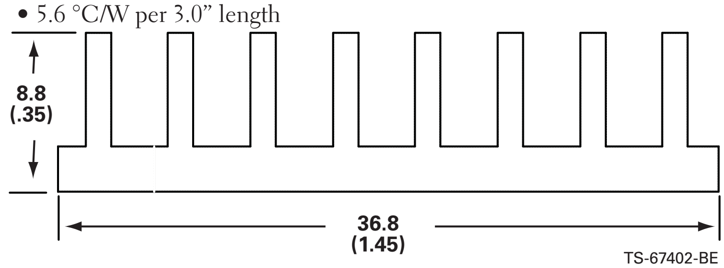
TS-67433-JY

- 7.6 in2/inch
- 0.3 pounds/foot
- 9.2 °C/W per 3.0" length



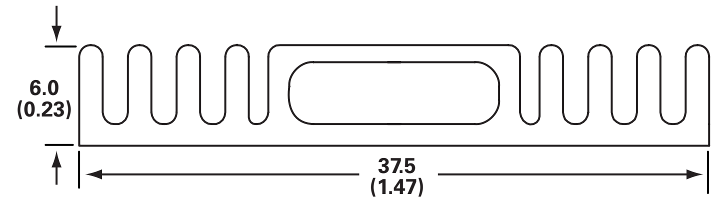
TS-67402-BE

- 12.6 in2/inch
- 0.31 pounds/foot
- 5.6 °C/W per 3.0" length



TS-67396-AW

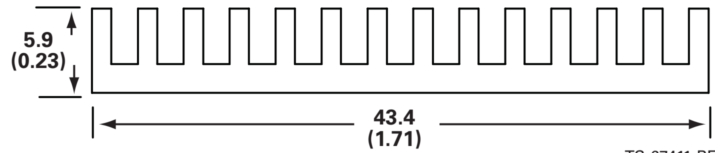
- 6.3 in2/inch
- 0.32 pounds/foot
- 11.1 °C/W per 3.0” length



TS-67396-AW

TS-67411-BE

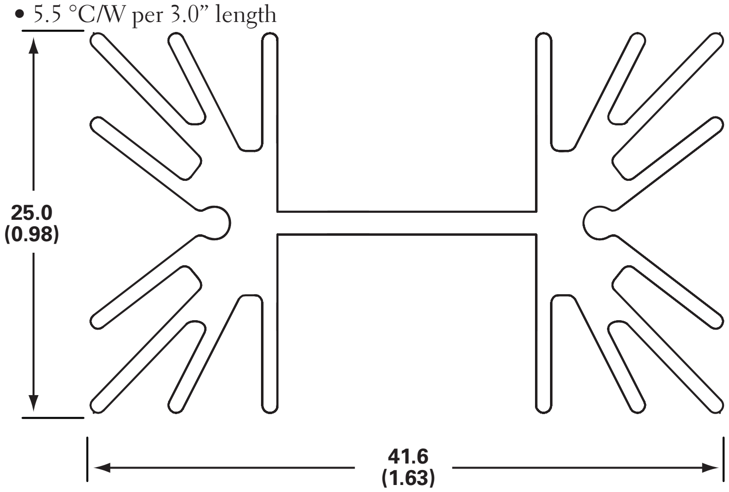
- 7.7 in2/inch
- 0.36 pounds/foot
- 9.1 °C/W per 3.0” length



TS-67411-BE

TS-67412-JH

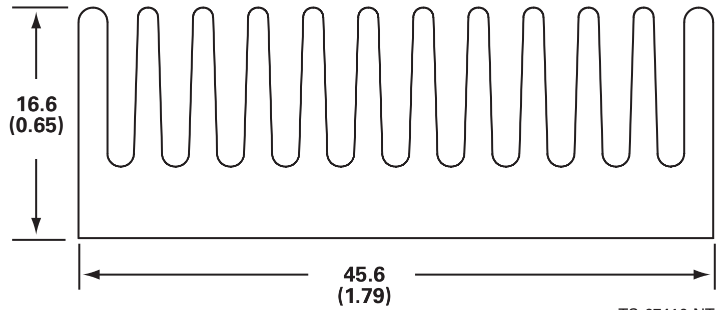
- 12.6 in2/inch
- 0.6 pounds/foot
- 5.5 °C/W per 3.0” length



TS-67412-JH

TS-67416-NT

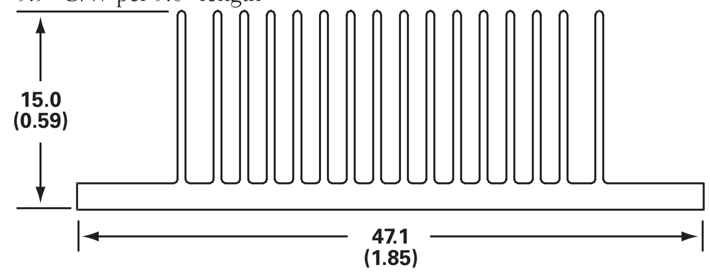
- 14.3 in2/inch
- 0.87 pounds/foot
- 4.9 °C/W per 3.0” length



TS-67416-NT

TS-67421-BE

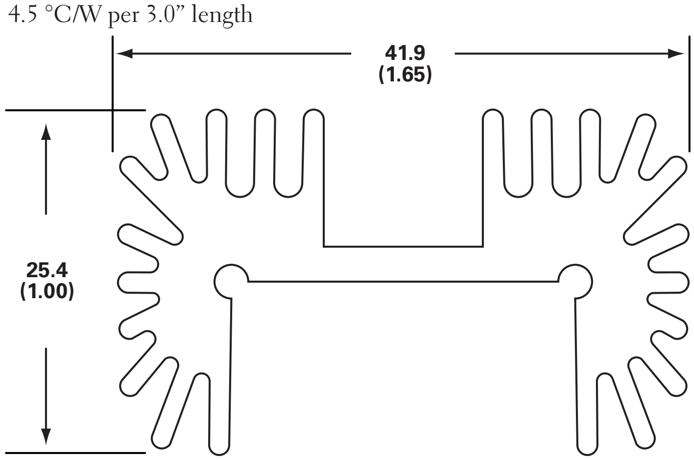
- 20.1 in2/inch
- 0.67 pounds/foot
- 3.5 °C/W per 3.0” length



TS-67421-BE

TS-67450-AD

- 15.4 in2/inch
- 0.8 pounds/foot
- 4.5 °C/W per 3.0” length



TS-67450-AD

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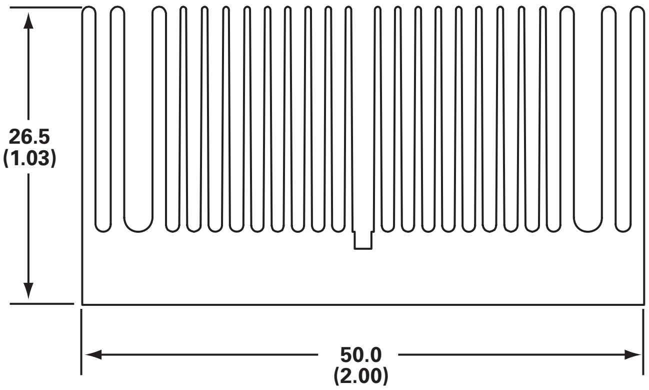
TS-67393-BE

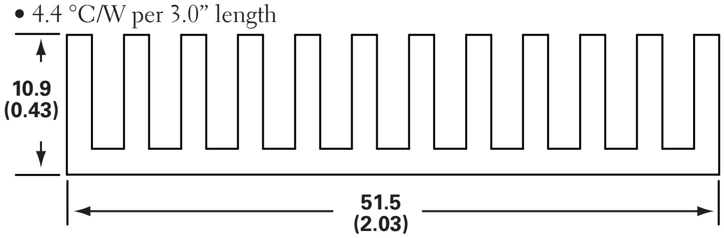
- 41.6 in2/inch
- 2.7 pounds/foot
- 1.7 °C/W per 3.0" length



TS-67393-BE

TS-67401-BE

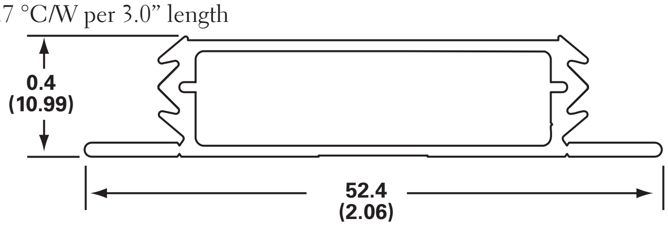
- 15.9 in2/inch
- 0.59 pounds/foot
- 4.4 °C/W per 3.0" length



TS-67401-BE

TS-67435-CS

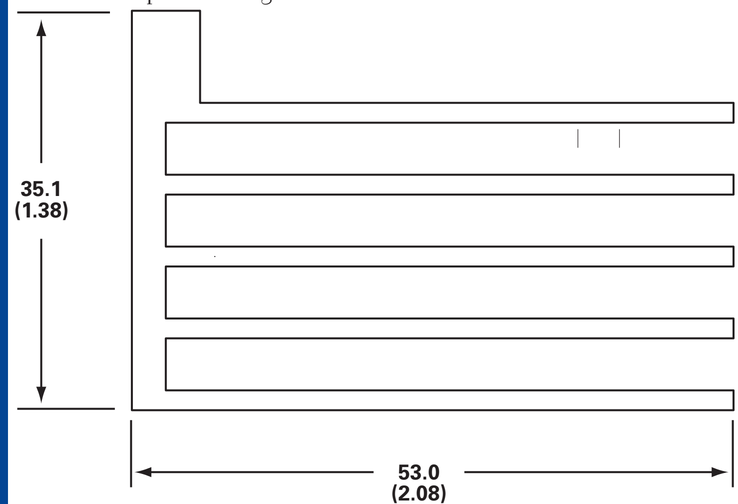
- 9.1 in2/inch
- 0.28 pounds/foot
- 7.7 °C/W per 3.0" length



TS-67435-CS

TS-67446-VS

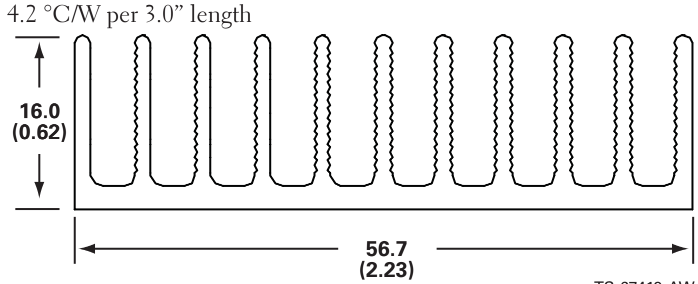
- 9.1 in2/inch
- 0.28 pounds/foot
- 7.7 °C/W per 3.0" length



TS-67446-VS

TS-67419-AW

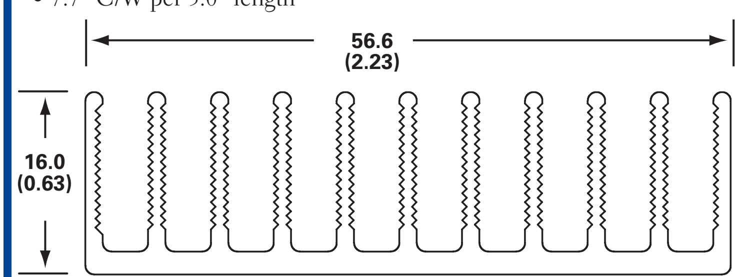
- 16.5 in2/inch
- 0.67 pounds/foot
- 4.2 °C/W per 3.0" length



TS-67419-AW

TS-67437-SS

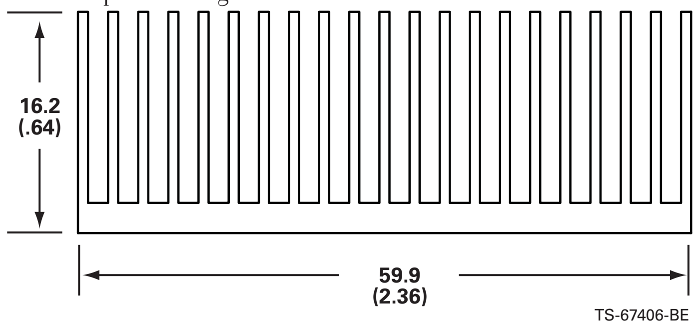
- 9.1 in2/inch
- 0.28 pounds/foot
- 7.7 °C/W per 3.0" length



TS-67437-SS

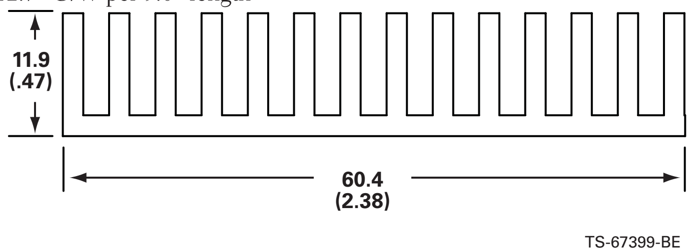
TS-67406-BE

- 25.4 in2/inch
- 0.95 pounds/foot
- 2.8 °C/W per 3.0" length



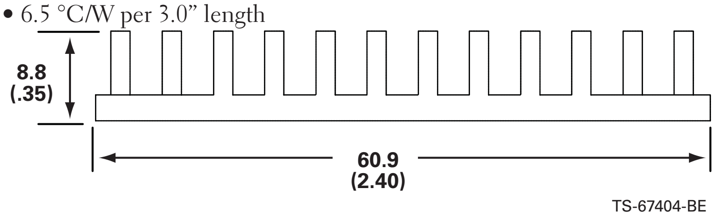
TS-67399-BE

- 5.5 in2/inch
- 0.29 pounds/foot
- 12.7 °C/W per 3.0" length



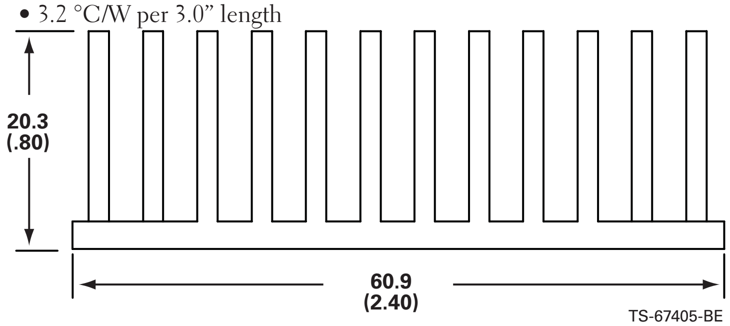
TS-67404-BE

- 10.8 in2/inch
- 0.56 pounds/foot
- 6.5 °C/W per 3.0" length



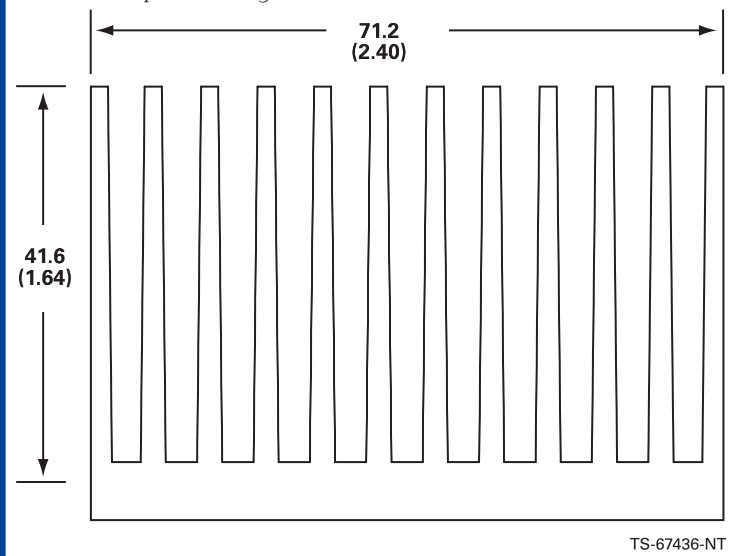
TS-67405-BE

- 21.6 in2/inch
- 0.95 pounds/foot
- 3.2 °C/W per 3.0" length



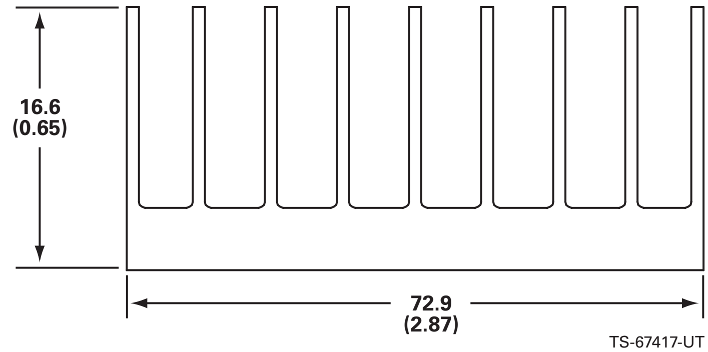
TS-67436-NT

- 38.3 in2/inch
- 2.1 pounds/foot
- 1.8 °C/W per 3.0" length



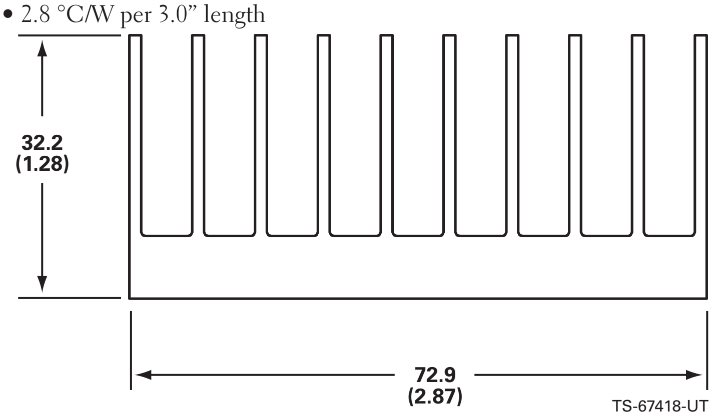
TS-67417-UT

- 12.3 in2/inch
- 1.3 pounds/foot
- 5.7 °C/W per 3.0" length



TS-67418-UT

- 25.0 in2/inch
- 1.78 pounds/foot
- 2.8 °C/W per 3.0" length



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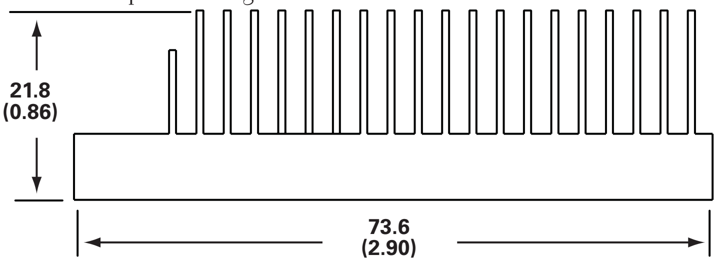
TS-67423-BE

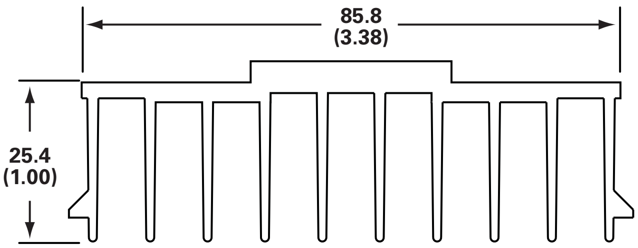
- 28.1 in²/inch
- 1.4 pounds/foot
- 2.5 °C/W per 3.0" length



TS-67423-BE

TS-67382-VS

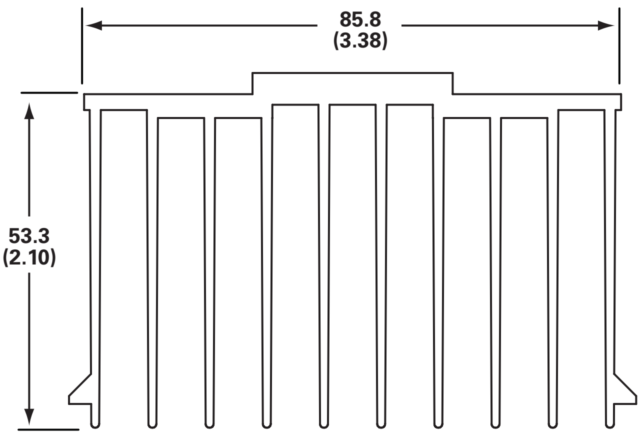
- 37.5 in²/inch
- 1.4 pounds/foot
- 1.9 °C/W per 3.0" length



TS-67382-VS

TS-67383-VS

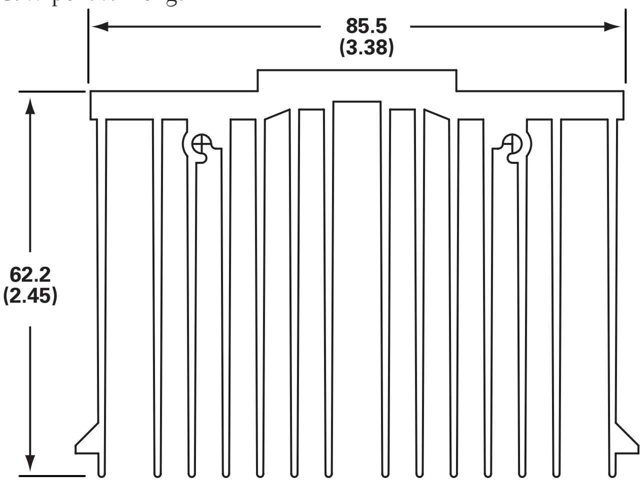
- 59.5 in²/inch
- 2.3 pounds/foot
- 1.2 °C/W per 3.0" length



TS-67383-VS

TS-67384-VS

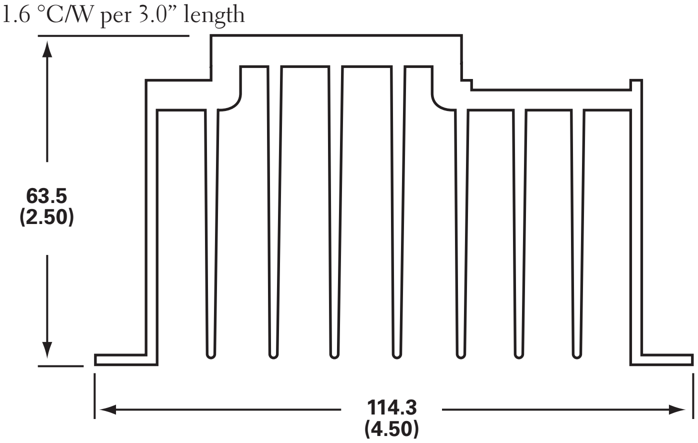
- 73.3 in²/inch
- 3.7 pounds/foot
- 1.0 °C/W per 3.0" length



TS-67384-VS

TS-67387-CS

- 44.1 in²/inch
- 3.8 pounds/foot
- 1.6 °C/W per 3.0" length

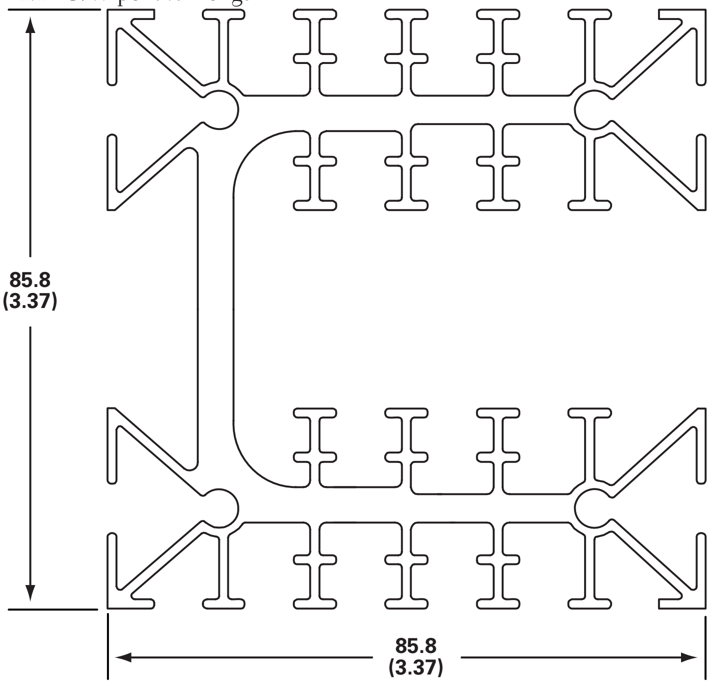


TS-67387-CS

For a complete data sheet on these standard products, please visit www.thermshield.com
Any of our standard products can be used as the basis for a custom solution.

TS-67407-UT

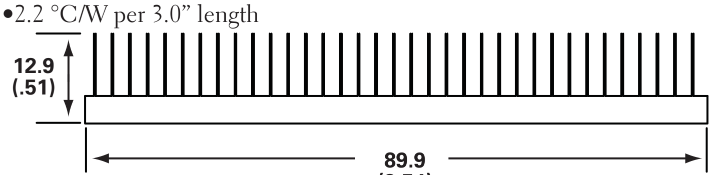
- 61.0 in2/inch
- 4.2 pounds/foot
- 1.1 °C/W per 3.0" length



TS-67407-UT

TS-67409-NT

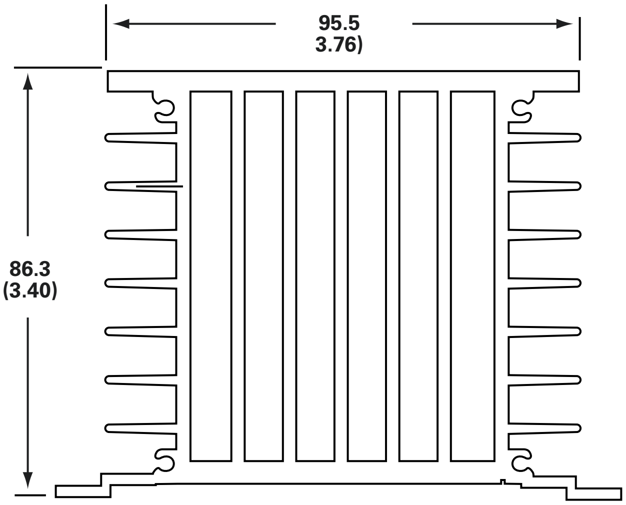
- 32.2 in2/inch
- 0.91 pounds/foot
- 2.2 °C/W per 3.0" length



TS-67409-NT

TS-67388-VS

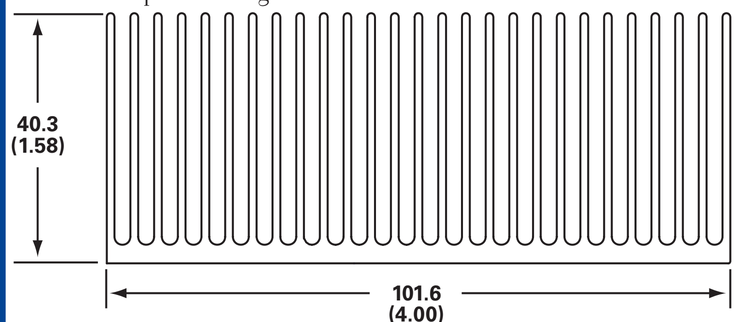
- 73.8 in2/inch
- 5.6 pounds/foot
- 0.9 °C/W per 3.0" length



TS-67388-VS

TS-67431-BE

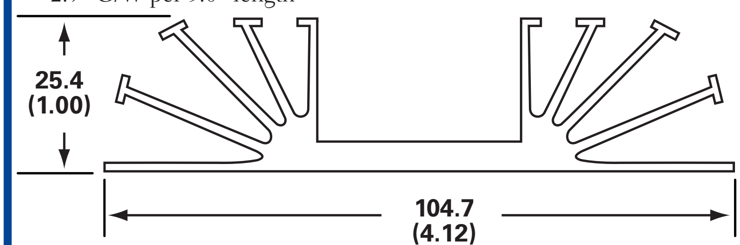
- 87.3 in2/inch
- 3.0 pounds/foot
- 0.8 °C/W per 3.0" length



TS-67431-BE

TS-67009-AD

- 23.6 in2/inch
- 1.2 pounds/foot
- 2.9 °C/W per 3.0" length



TS-67009-AD

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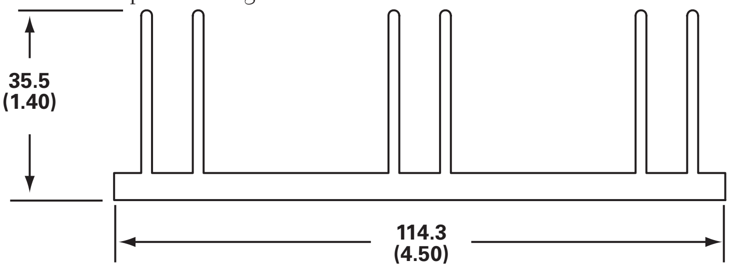
TS-67447-VS

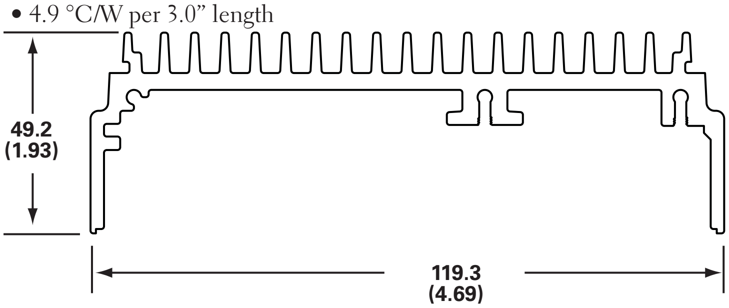
- 23.4 in2/inch
- 1.8 pounds/foot
- 3.0 °C/W per 3.0" length



TS-67447-VS

TS-67426-KT

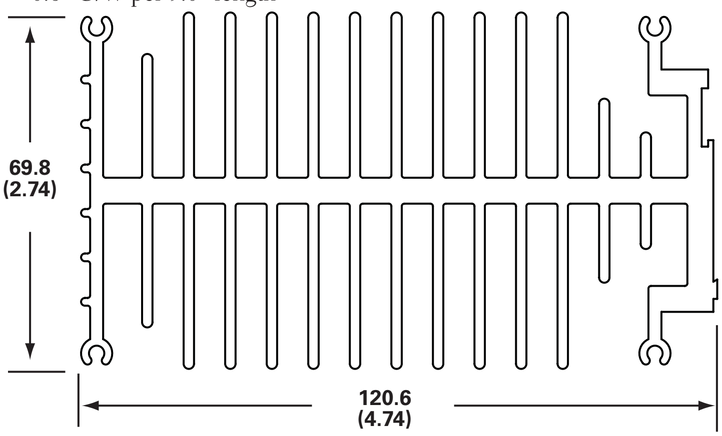
- 14.3 in2/inch
- 1.5 pounds/foot
- 4.9 °C/W per 3.0" length



TS-67426-KT

TS-67428-KT

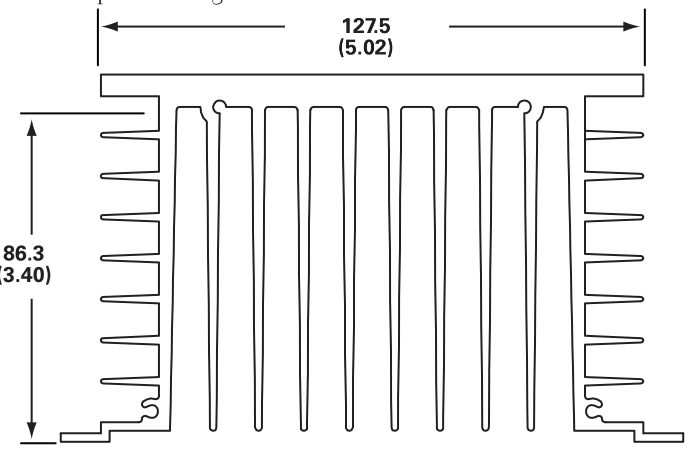
- 86.0 in2/inch
- 5.1 pounds/foot
- 0.8 °C/W per 3.0" length



TS-67428-KT

TS-67386-UT

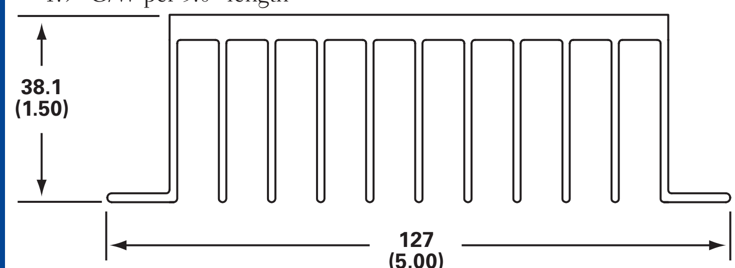
- 80.5 in2/inch
- 5.3 pounds/foot
- 0.9 °C/W per 3.0" length



TS-67386-UT

TS-67441-AW

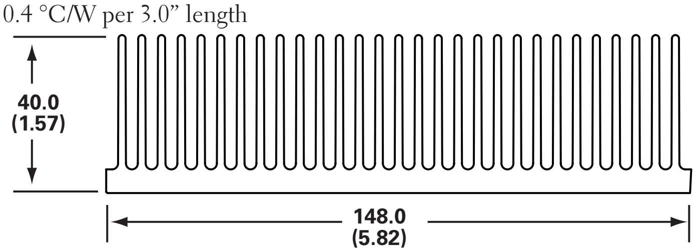
- 37.6 in2/inch
- 2.0 pounds/foot
- 1.9 °C/W per 3.0" length



TS-67441-AW

TS-67425-KT

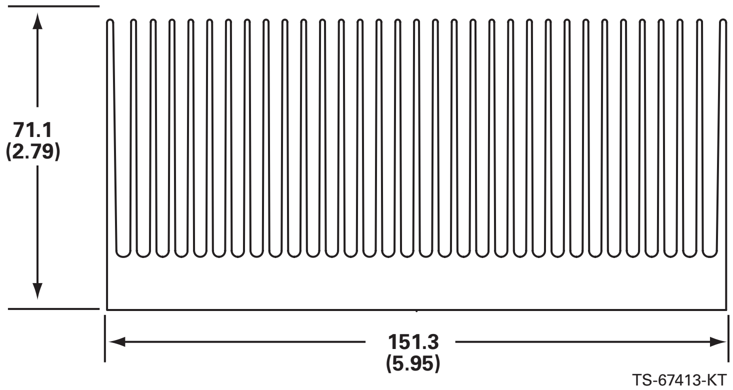
- 159.7 in2/inch
- 9.7 pounds/foot
- 0.4 °C/W per 3.0" length



TS-67425-KT

TS-67413-KT

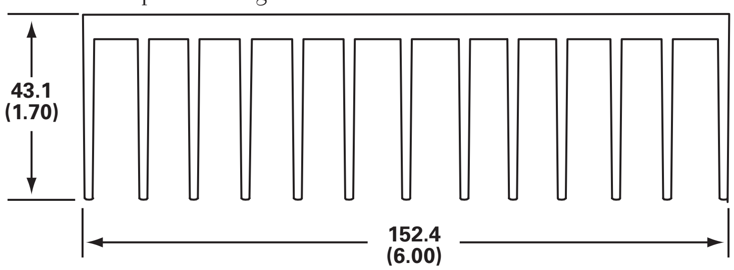
- 89.0 in2/inch
- 4.9 pounds/foot
- 0.8 °C/W per 3.0" length



TS-67413-KT

TS-67442-VS

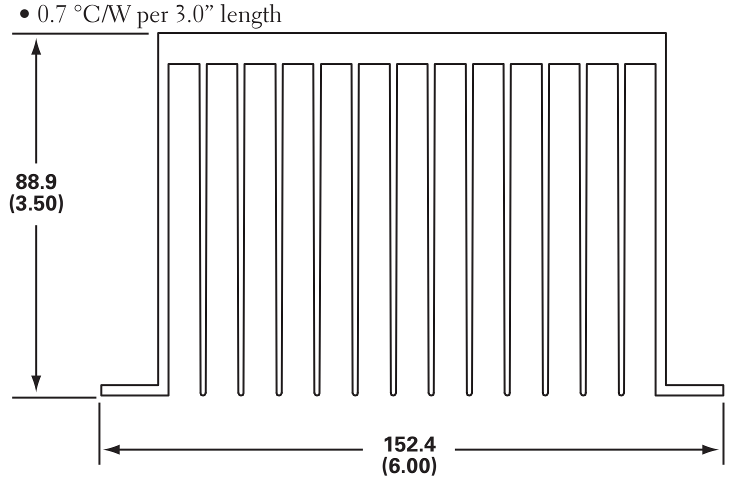
- 51.0 in2/inch
- 2.7 pounds/foot
- 1.4 °C/W per 3.0" length



TS-67442-VS

TS-67440-UT

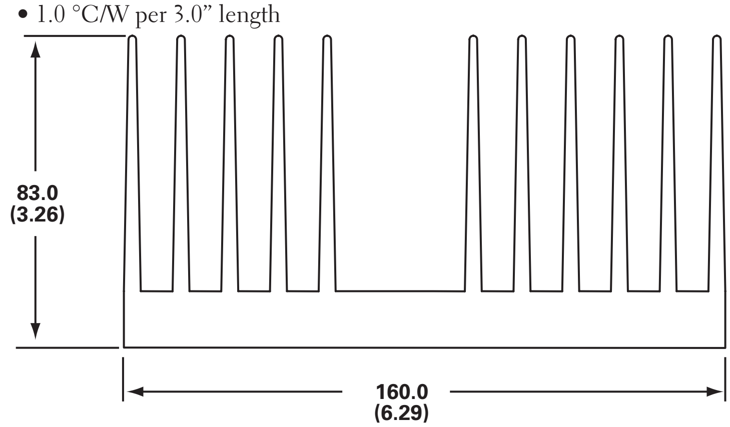
- 99.6 in2/inch
- 4.6 pounds/foot
- 0.7 °C/W per 3.0" length



TS-67440-UT

TS-67445-KT

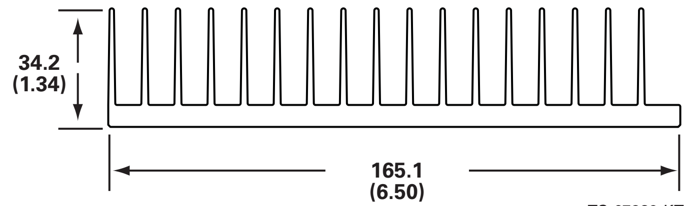
- 69.2 in2/inch
- 10.3 pounds/foot
- 1.0 °C/W per 3.0" length



TS-67445-KT

TS-67389-KT

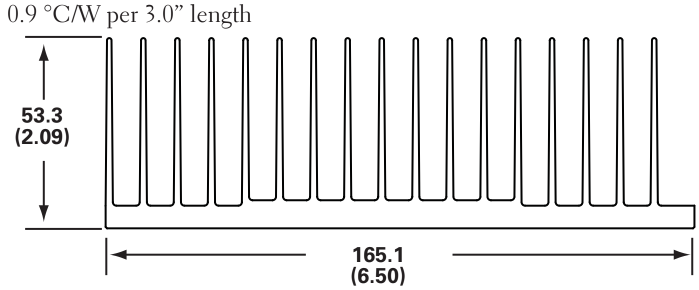
- 50.4 in2/inch
- 3.4 pounds/foot
- 1.4 °C/W per 3.0" length



TS-67389-KT

TS-67390-KT

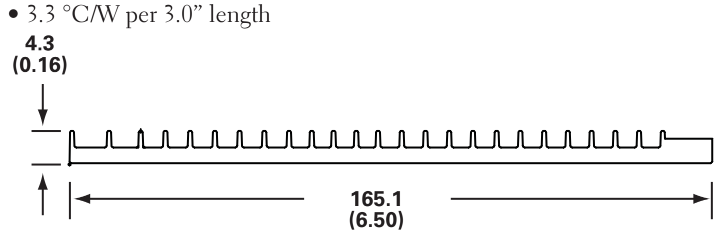
- 74.9 in2/inch
- 5.6 pounds/foot
- 0.9 °C/W per 3.0" length



TS-67390-KT

TS-67391-KT

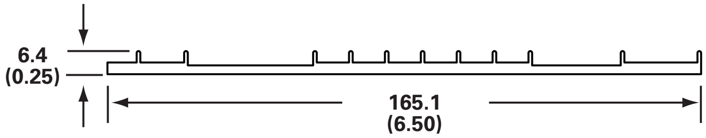
- 21.5 in2/inch
- 1.6 pounds/foot
- 3.3 °C/W per 3.0" length



TS-67391-KT

TS-67392-KT

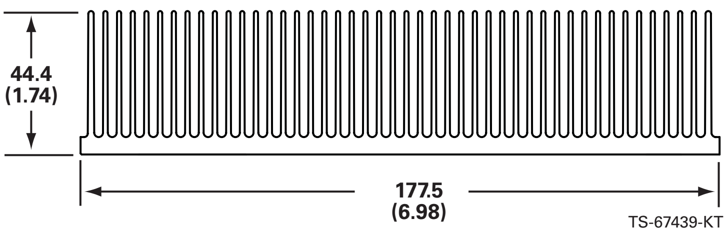
- 14.8 in2/inch
- 0.94 pounds/foot
- 4.7 °C/W per 3.0" length



TS-67392-KT

TS-67439-KT

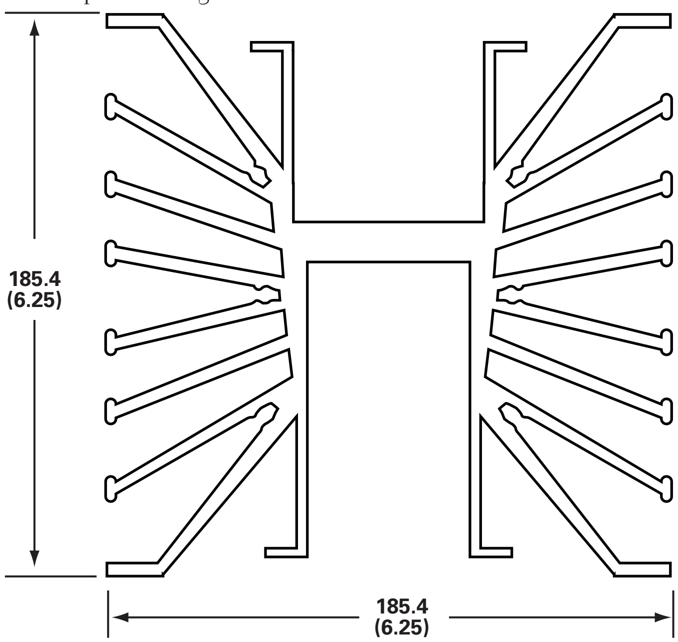
- 146.3 in2/inch
- 6.3 pounds/foot
- 0.5 °C/W per 3.0" length



TS-67439-KT

TS-67415-NT

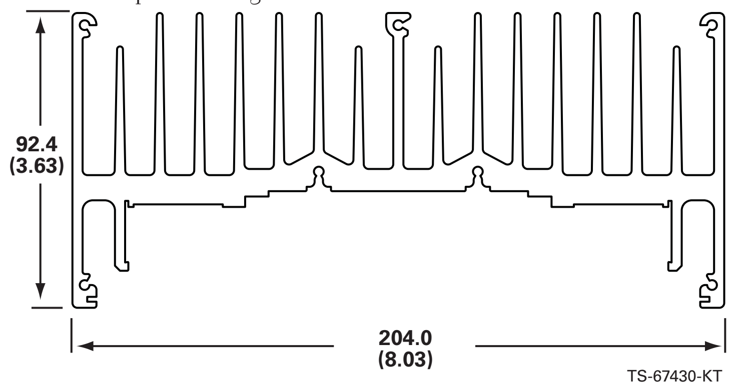
- 104.0 in2/inch
- 7.7 pounds/foot
- 0.7 °C/W per 3.0" length



TS-67415-NT

TS-67430-KT

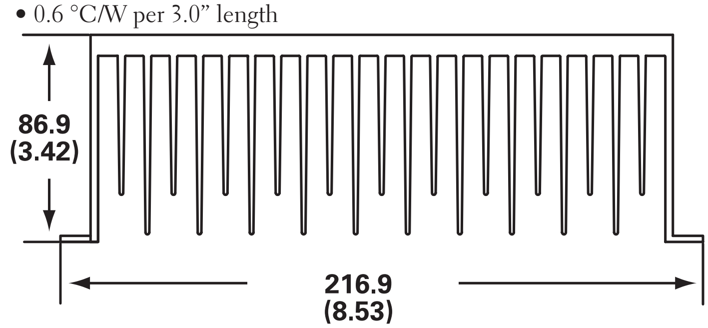
- 91.6 in2/inch
- 6.8 pounds/foot
- 0.8 °C/W per 3.0" length



TS-67430-KT

TS-67385-UT

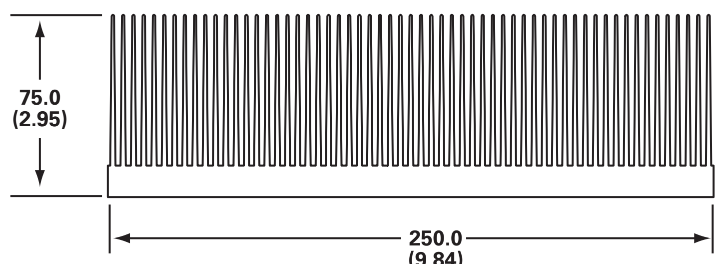
- 123.5 in2/inch
- 6.9 pounds/foot
- 0.6 °C/W per 3.0" length



TS-67385-UT

TS-67376-UT

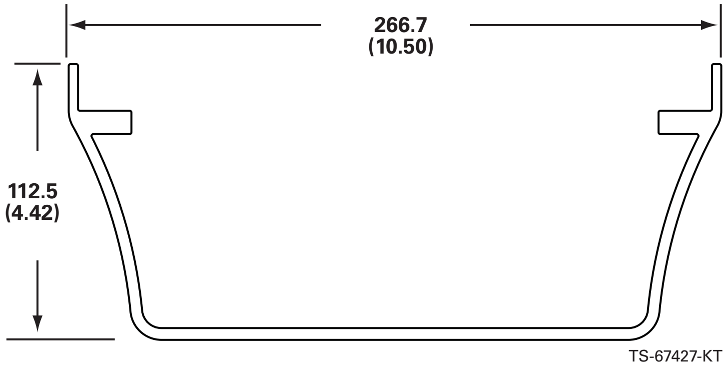
- 311.5 in2/inch
- 18.4 pounds/foot
- 0.2 °C/W per 3.0" length



TS-67376-UT

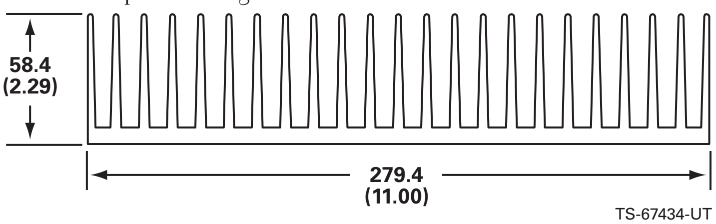
TS-67427-KT

- 38.1 in2/inch
- 2.5 pounds/foot
- 1.8 °C/W per 3.0” length



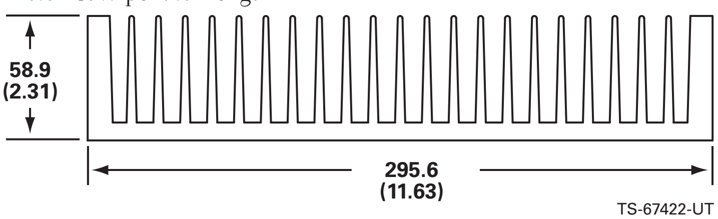
TS-67434-UT

- 114.2 in2/inch
- 9.4 pounds/foot
- 0.6 °C/W per 3.0” length



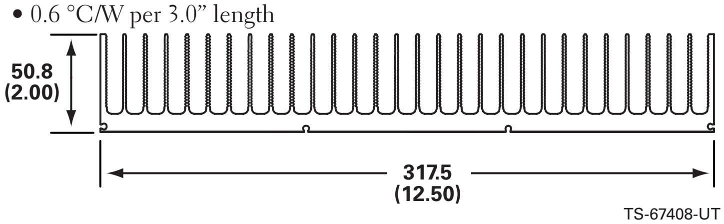
TS-67422-UT

- 115.2 in2/inch
- 10.9 pounds/foot
- 0.6 °C/W per 3.0” length



TS-67408-UT

- 122.8 in2/inch
- 10.3 pounds/foot
- 0.6 °C/W per 3.0” length



Bonded Fin Heat Sinks

Bonded fin heat sinks can provide significant cooling surface increase over conventional extrusions without increasing system volume. This increased surface area, thinner fins, higher conductivity fin material and fin heights that cannot be extruded are all benefits of this technology.

Aluminum extrusions are limited in surface area due to the strength of the tooling used in the manufacturing process. The relationship between fin height, thickness and spacing is called the extrusion ratio. This limit of fin height to air gap, typically 12:1 or 18:1 in small size parts, controls the number of fins available at a certain fin height with a certain width of profile. Due to the immense pressure used to create extrusion shapes during manufacturing the tool steel used in conventional extrusion dies can move or fracture during processing. This results in parts that will not be the correct size or have flaws making them unusable.

Bonded fin technology removes this process limit completely. An extruded base and separate fins, attached using either high conductivity epoxy or low melt temperature solder, can be used for increased cooling, reduction in heat sink volume or higher power outputs.

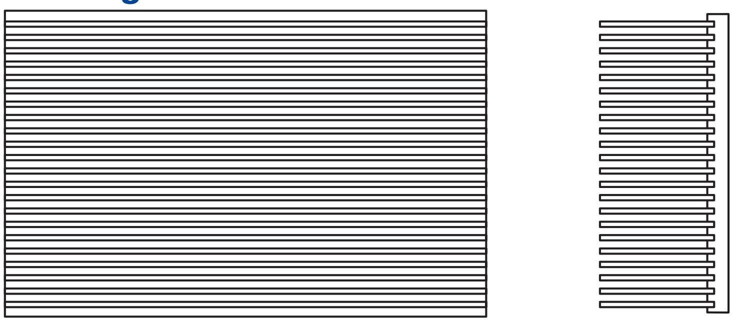
Advantages:

- More cooling surface than single piece extrusions – up to 2X increase in given volume
- Fin heights down the length of a part can be varied without machining
- Mixtures of copper and aluminum can be used for either base of fins
- Attachment of fins to base can be either high conductivity thermal epoxy or solder attachment.
- Fin spacing and thicknesses that cannot be achieved with extrusions.

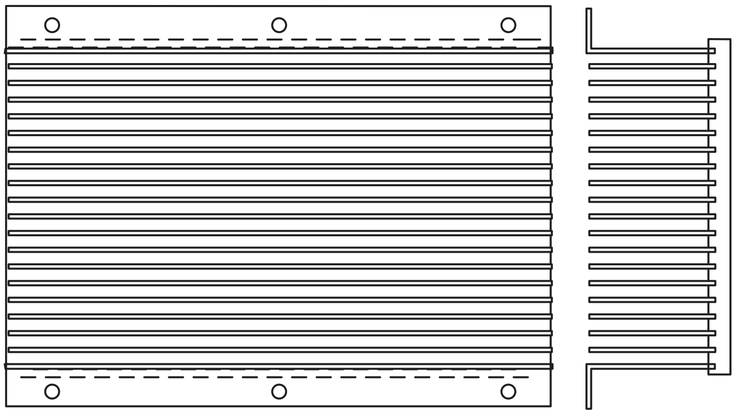
Thermshield, LLC PO Box 1641, Laconia, NH 03247 USA
Ph: 603-524-3714 Fax: 603-524-6602 Web: www.thermshield.com

Basic Bonded Fin Configurations

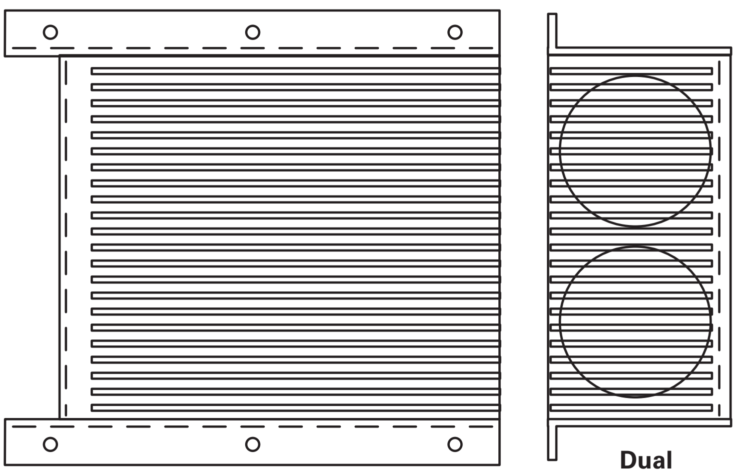
Un-flanged



Flanged

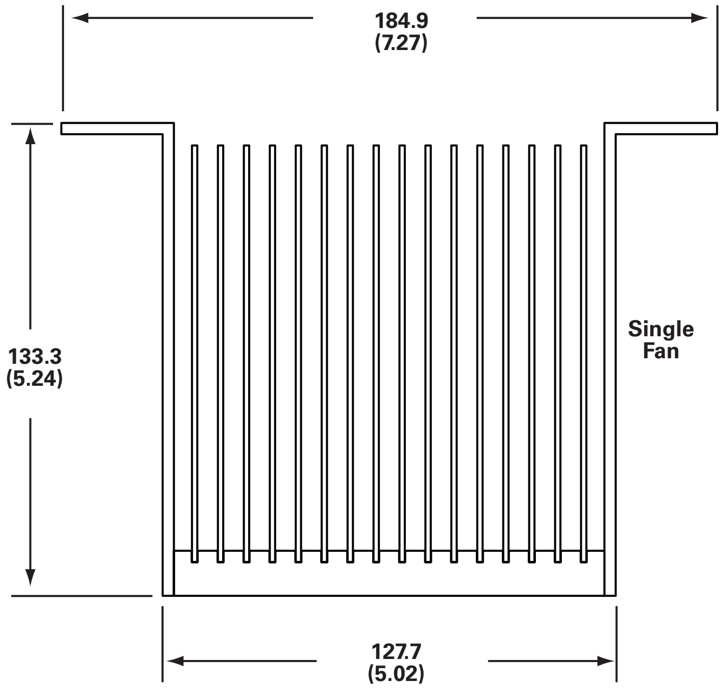


Fan-Cooled

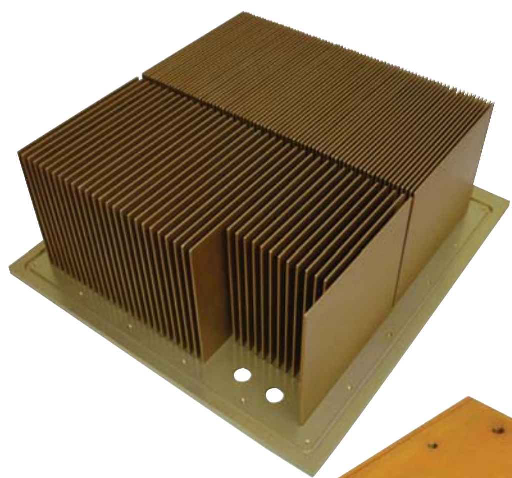


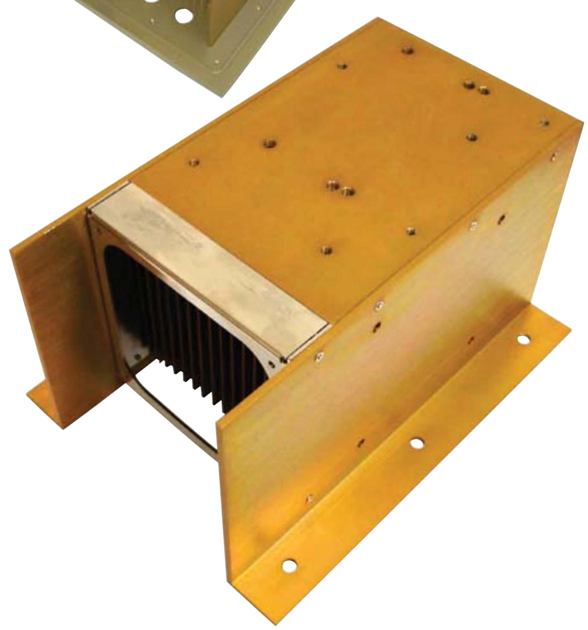
Dual Fan

TS-70012-AP



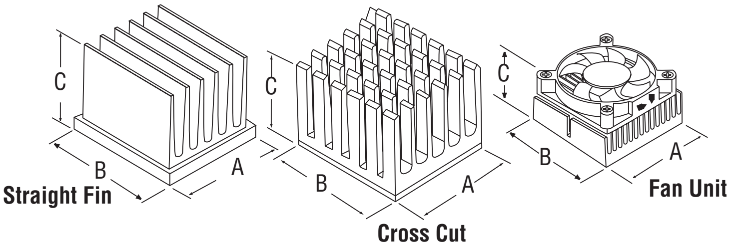
TS-70012-AP

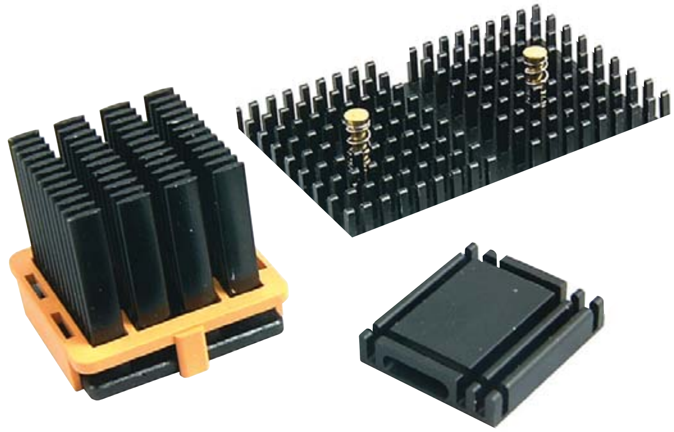




BGA Heat Sinks

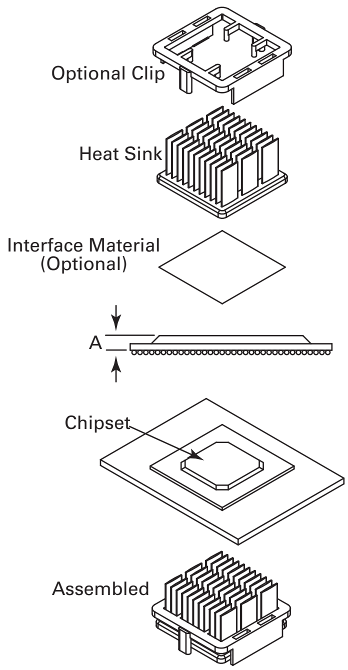
- Available in standard (check stock) and custom sizes
- Rectangular fins (extrusions), round or elliptical fins (forgings)
- Fin density and count varies with size
- Tape, Push Pin, or Plastic Clip attach
- Many other sizes, some with fans, available





Plastic Clip Attach

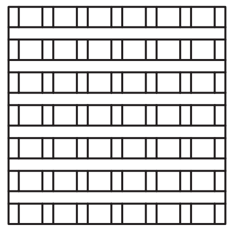
Chipset thickness "A" = Compatible clip color
3.3 ±0.3 mm = Yellow
1.7 ±0.3 mm = Blue
0.9 ±0.3 mm = Orange



Standard Examples

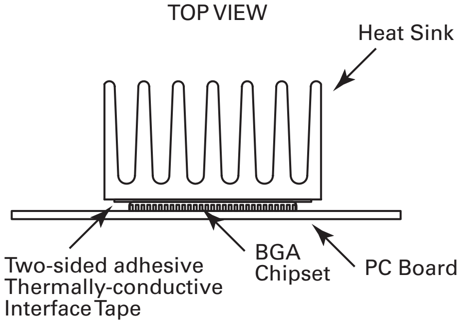
Part Number	L	W (mm)	H
TS-65102	21	21	23
TS-541063	25	25	23
TS-541064	35	35	23
TS-65092	40	40	18
TS-54191	45	45	10

Tape Attach



Cross-cut, Omni-directional airflow

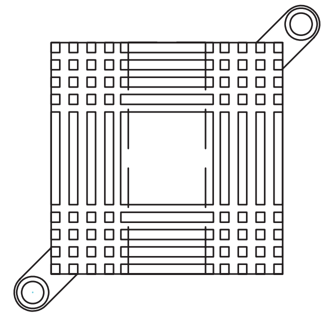
TOP VIEW



Standard Examples

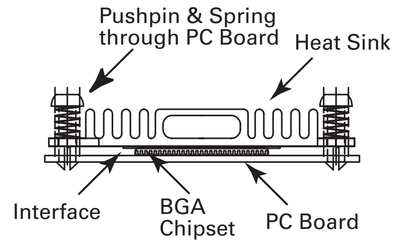
Part Number	L	W (mm)	H
TS-65082	20	20	6.5
TS-541272	28	28	8.9
TS-541271	28	28	15
TS-65134	35	35	14.8
With fan			
TS-65030	40	40	10.3

Push Pin Attach



Pushpins - can be Brass or Plastic

TOP VIEW



Standard Examples

Part Number	L	W (mm)	H
TS-54173; plastic	28	28	6
TS-541120; plastic	37.8	37.8	9.8
TS-65162; brass	37.8	37.8	25
TS-54329; brass	41.4	41.4	11.7
With fan and pins			
TS-65158; brass	40	40	10.2

May other sizes available; Please consult Thermshield Engineering for custom designs

TS- D 50 10 B 12 M

Series

A: AC fan
D: DC fan
Options:
B: Auto restart and alarm
C: Speed sensor
E: Thermal control
F: Auto restart and speed sensor

Dimensions

25: 25x25 mm
30: 30x30 mm
35: 35x35 mm
40: 40x40 mm
45: 45x45 mm
50: 50x50 mm
60: 60x60 mm
80: 80x80 mm
90: 92x92 mm
12: 120x120 mm

Thickness

05: 5 mm
07: 7.5 mm
10: 10 mm
15: 15 mm
20: 20 mm
25: 25 mm
38: 38 mm

Bearing Type

B: Two ball bearing
S: Sleeve bearing
T: One ball, one sleeve
O: Other

Input Voltage

05: 5 V
12: 12 V
24: 24 V
48: 48 V

Fan Speed

U: Ultra-high speed
H: High speed
M: Medium speed
L: Low speed
E: Extra-low speed

Thermshield offers a full line of AC and DC fans. Use the Part Number matrix to select your fan. Fan configurations may use multiple options, as needed.

Example:

TS-DCE-50-20-B-12-M

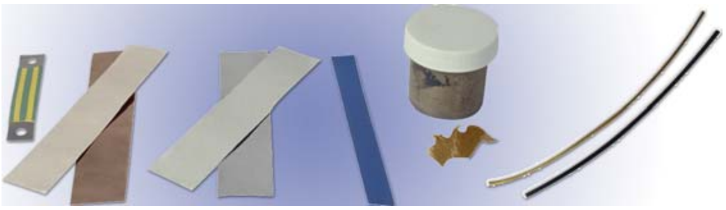
This is a DC fan, with speed sensor and thermal control options; 50x50 mm, 20 mm thick; two ball bearing; 12 V operation; medium speed

Interface Materials

Thermal pad and interface materials are used to reduce thermal resistance between a heat source and heat sink. The elimination of dead air pockets found in all interfaces is the key to reducing temperature rise in assemblies.

Interface pads and materials can be used to perform a number of functions. Some of these are:

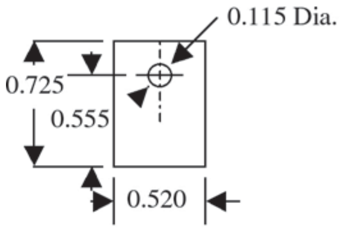
- Thermal conductivity
- Permanent bond attachment
- Temporary bond attachment
- Electrical isolation
- Filling wide spaces up to 6 mm air gaps
- Phase change materials for maximum heat transfer
- Thermal greases for maximum conformability



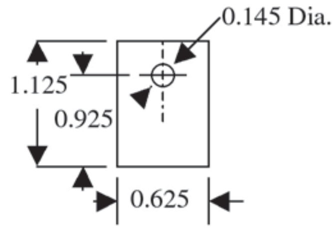
Typical Interface Products

Thermshield brings years of pad selection experience to design engineers. We make recommendations of the best material for the application based not only on the program, but also on price and availability. The advantage is we supply specific materials from a wide variety of suppliers, without prejudice or vested interest. The end result is an optimum thermal/cost solution of heat sink and interface pad that is purchased as a single part. This reduces order cost and inventory volume for production.

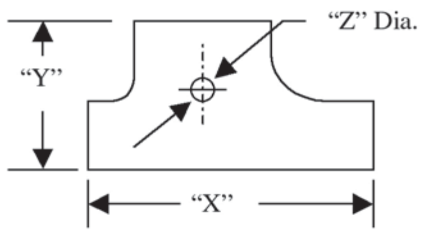
Typical Standards:



Typical T0-220



Typical T0-247 / TO-218



Custom sizes available quickly on request.

Some of the suppliers** products recommended are:

- 3M
- Fujipoly
- Laird (Thermagon)
- Sekisui Chemical
- St. Gobain
- Bergquist
- Henkel Loctite (Power Devices)
- Parker (Chomerics)
- Shin Etsu

** Trade names listed are the sole property of the companies noted.

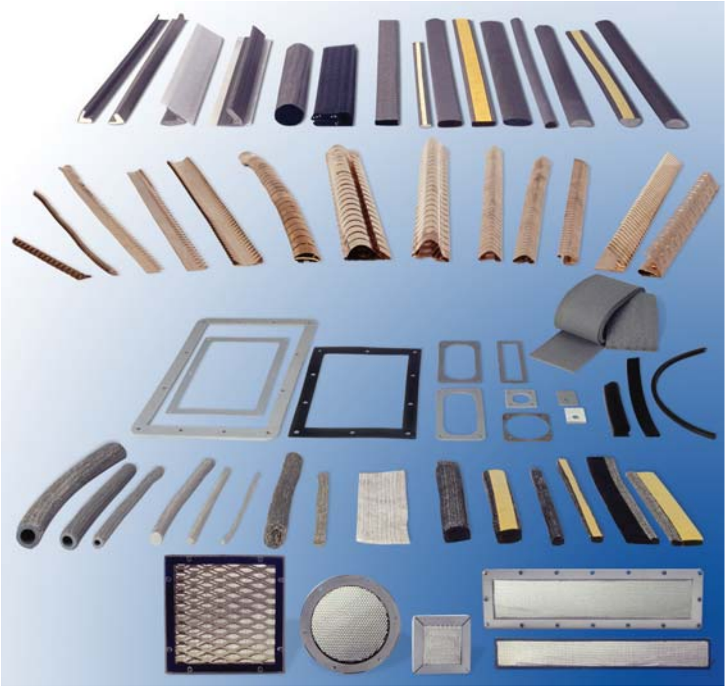
Data for specific materials is available upon request. Please contact us at:

603-524-3714
info@thermshield.com
www.thermshield.com

EMI/RFI Shielding Products

As a complement to Thermshield's thermal management solutions, we offer a complete line of EMI/RFI shielding products to the industry. From the mature beryllium copper finger strips to the more exotic fabrics over foam, Thermshield offers the broadest line of shielding products for the most demanding EMI challenges.

Data for specific materials is available upon request. Please contact us at:
603-524-3714
info@thermshield.com
www.thermshield.com



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