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App News



Vette Heatsink Stops a Bullet

We recently received a thank you for our ordinance absorbing heatsink design. A compliment that we did not fully understand at first until we saw the pictures where one of our bonded fin heat sinks that had been shot with the bullet coming to rest in the fins.

This will not start a new product line of impact absorbing heat sinks, but we are very glad that it was the heat sink and not anything living.

DESIGN ACTIVITY

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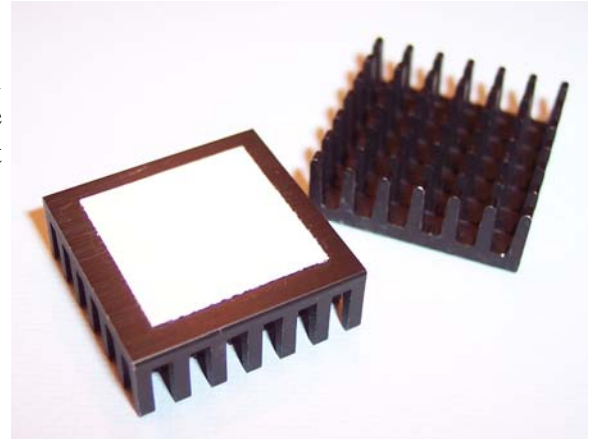
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Heatsink Attachment Methods

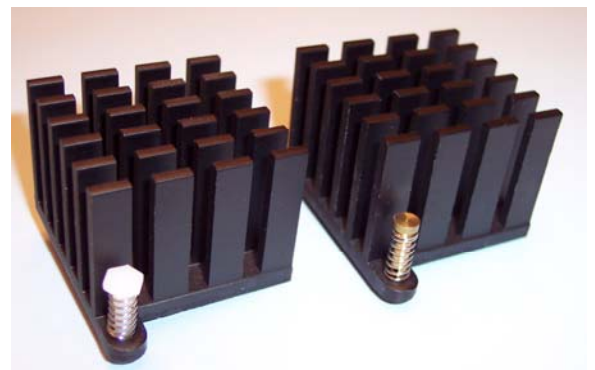
An integral part of any thermal design is the method by which the heatsink itself is to be attached to the heat source. This also affects the types of TIM (Thermal Interface Material) that can be used to fill the microscopic air gaps between the heatsink and the heat source. The following is a simple overview of some of the more common attachment methods with the associated pros and cons.

PSA Tape - Pressure Sensitive Adhesive double sided thermal tape is perhaps one of the simplest and common methods, especially for BGA applications. The adhesive type must be compatible with both the heatsink and heat source materials. Typically silicone adhesives are used for plastic packages and polyurethane adhesives for metal or ceramic packages. The use of a well known quality vendor is highly recommended, the adhesives need to hold the parts together for the life of the device. The tape should be at least 50% of the surface area of the heatsink and 1-2 mm smaller than the heat source dimensions to ensure good thermal contact in the center of the device (this particularly true for plastic packaged devices where the edges can be higher than the center of the device). Tapes run from .005 to .015 inches in thickness and typically will see about a 10C temperature drop across the tape.



Epoxy - Heatsinks can be glued down using a variety of adhesives, usually lumped into the epoxy category although they may not be true epoxies. Normally the thermal adhesive is prepared and a dab applied to either the heat sink or the heat source and the two parts are pressed together until the adhesive sets. Compounds can be the traditional two-parts epoxy, pre-mixed and frozen, cyanoacrylate (crazy glue), silicone gels (RTV), UV or air cure, etc., etc. Epoxies do a good job thermally but can be messy to use and in most cases are a one-shot, permanent application. This means that they are not re-workable which is their most common drawback.

Round Push Pins and Coil Springs - possibly the most common of all attachment methods. Plastic or metal push pins with springs are pushed through the heat sink and through the PCB. The pin heads expand on the other side of the PCB and lock the heatsink into place. Different springs material and spring rates can be used to provide the needed normal force (pressure between the heatsink and the heat source) Plastic pins can generate 0-3 lbf / pin. Higher performing TIMs like single sided PSA, PCM (Phase Change Material) and thermal grease can be used as the pin are providing the attachment, the TIM compound can be more thermally efficient. Grease joints can be as thin as .001 inch and PCM joints in the .002-004 inch range using push pins.



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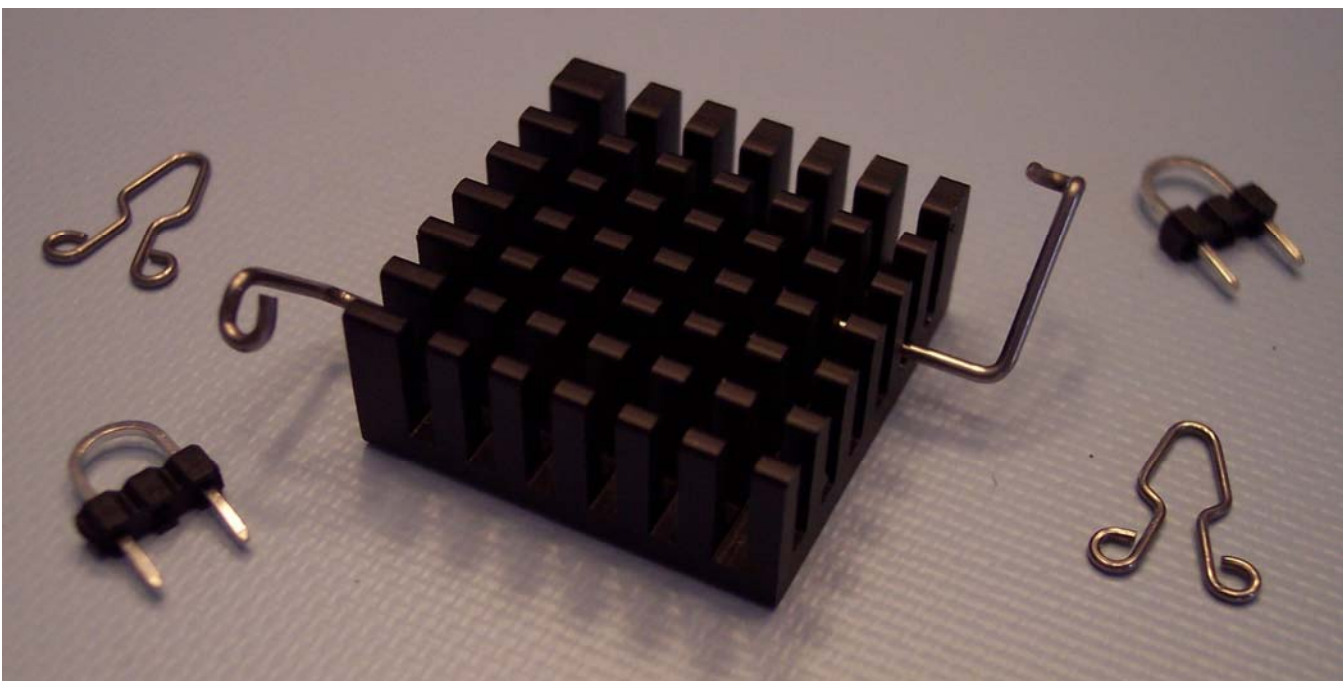
Heatsink Attachment Methods

Naturally the mating surfaces must be smooth and flat enough to take advantage of this and since flatness costs money, PCM is more commonly seen. Metal push pins can be designed with a slightly higher force (0-5 lbf / pin) and have higher side shear resistance. Side shear is important for drop tests of parts, typically a 40G test is used on commercial parts. All designs must have the sufficient number and suitable location of the push pins to provide an even pressure, Metal pins are typically 5-10 times the cost of a plastic pin. Plastic pins need to be made from high performance, temperature stabilized plastics, usually glass filled and usually with UL94 V-2 flammability rating or better.

Plastic Clips - Plastic heatsink clips usually mount directly on a BGA package and do have the benefit of being able to be added to an existing PCB as not mounting holes are needed, but all the mounting stresses are on the BGA package and it's solder joints. Industry is typically moving away from this type of mounting when it can.



Round Wire Clips - Formed wire clips, usually made of stainless steel 303/304 round wire are the fastest growing attachment method. The long term reliability of the metal spring force with its low cost being key attributes, The main drawback being that the PCB will need an anchor point of some kind, historically these have been through hole solder anchors but in the last few years the omega shaped clip is becoming increasingly popular, again due to its long term reliability. Round wire clips have the added bonus feature that they are easily re-movable, re-workable, easily adjustable for force and multiple clips can be used to increase normal force if required. Normal forces up to 7 lbf / clip are common. The round wire clips are CNC formed, so there is little to no NRE charge for a new design. Similar to plastic pins & spring, higher performing PCM thermal interfaces can be used.



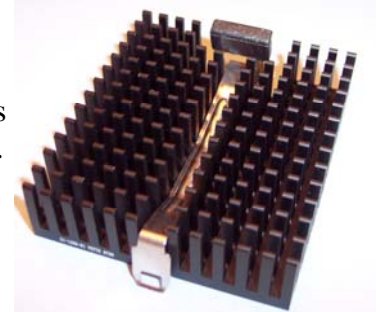
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Heatsink Attachment Methods

Flat Band Clips - Flat band clips provide high normal forces (up to 30 lbf / clip) and were commonly used on CPU's for PC's for several years as the CPU fit into a standard socket designed to accept a flat band clip. The main drawback here being that they are difficult to prototype and really need to be a hard tooled to prove out, this means NRE/tooling costs are high and so is the minimum order quantity.

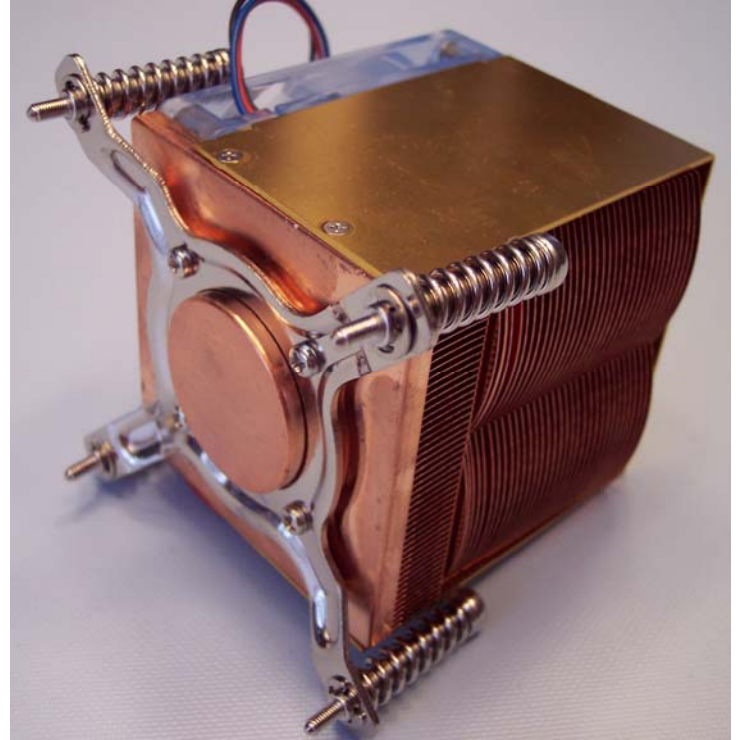


Screws Only - Most commonly used on DC/DC brick style converters and IGBT, mating parts need to be very flat. For DC/DC converter, single sided PSA tapes are usually used and this is where the highest use of a graphite tape is seen. Graphite is a good thermal performer but has limited suppliers, can be costly and is easily damaged. IGBT heatsinks are commonly machined to a tight flatness tolerance of .001 inch/inch and use high performance thermal grease as the interface.



Screws and Coil Springs - Similar to push pins and springs, this is now the most commonly used attachment method for CPU's in PC's and Server applications. The screw/spring combination provides high normal forces, excellent life and enables the use of PCM and high performance thermal grease. High normal forces of up to 15 lbf / pin are possible.

A mating threaded insert is required in the PCB for each screw and spring.



Bolts - Bolts applications are similar to screw application just with bigger threads and higher normal forces. Some heatsink designs are just so massive that they move into the bolt area by default.