

POWER COMPONENT HEAT SINK ARRANGEMENT

5 TECHNICAL FIELD

This invention relates to electronic circuits and components or any system with heat generating / high power components, e.g. MOSFET / IGBT packages and there assemblies.

10 BACKGROUND OF THE INVENTION

Typically, electronic components which need to dissipate heat are connected to a heat exchanger / heat sink by a thermal interface material (TIM). The TIM is prone to flowing out over time, particularly at increased temperature and
 15 vibration. Moreover, when it is vertically applied, there is a big concern about its pressed-out material causing shorts if it contains electrically conducting fillers / ingredients over the life of the product. So there is a problem of TIM flowing-out: it is difficult to retain TIM during thermal cycling and vibration, causing reliability failure.

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Further problems of today's thermal dissipation solutions is that the total thermal performance is limited by TIM bulk thermal conductivity, TIM bondline thickness and wetting at contact surfaces

It is an object of the invention to overcome such problems and to reduce overall
 25 thermal resistance of such systems/components and assemblies and prevent TIM from flowing-out / pumping-out over time.

SUMMARY OF THE INVENTION

30 In one aspect of the invention is provided an assembly comprising an electronic package having a contact surface, and a heatsink having a contact surface, said heatsink being attached to said electronic package via a thermal interface material

(TIM) layer sandwiched between said contact surfaces, and including a plurality of protrusions emanating from either of said contact surfaces.

All or some of said protrusions may be embedded or protrude into said TIM layer.

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All or some of said protrusions may surround said TIM layer

Said protrusions may be compliant, compressible, bendable or collapsible.

10 Said protrusions may be in the form of pins or elongate fins.

Either or both of said contact surfaces may be non-planar.

One or both contact surfaces may be concave.

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Said one or both contact surfaces may be convex

Said protrusions may emanate from a concave contact surface formed within a generally convex contact surface.

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At least one of said contact surfaces may be formed on a pedestal raised from the body of the main package or heat sink body.

Said pedestal may include a convex or contact surface.

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Said protrusions may be embedded in said TIM layer and surround said TIM layer.

30 Said TIM layer and contact surfaces may be generally matching shape of component and said protrusion surround said TIM layer on at least two sides.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is now described by way of example with reference to the accompanying drawings in which:

- Figure 1 shows a typical schematic arrangement of an electrical / electronic component attaching to a heat sink;
- 5 - Figures 2 to 11 show further embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a typical schematic arrangement of an electrical electronic component 1 (high power package) having a heat sink 2. The heat sink is bonded to the component by a TIM layer 3.

Figure 2a shows a simple embodiment of the invention. In between the heat sink 2 and the component 1, there are a plurality of compliant i.e. pressible / collapsible, bendable protrusions 4; thus these may be regarded as compliant features, pins/fins etc. These may be formed on either on the heat exchanger or power package/electronic component contact surfaces and thus in the assembled product are embedded in the TIM.

Figure 2b and 2c show an example of the protrusions which are in the form of pins 6 or elongate thin fins 7 respectively on either of the contact surfaces 5 of the heat sink or component. Thus these protrusion are formed/embedded into the intermediate TIM layer material in the final product.

Preferably these protrusions are formed such that for example they penetrate into the TIM layer during assembly. They are preferably located on the contact surface of the heat sink before assembly. This results in increase effective thermal conductivity of given TIM with given bondline of the TIM , assist in retaining TIM and hinder its out flow or pumping-out.

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The protrusions may be pressed, shortened or bent to compensate and fit into surface morphology / topology of both bonding surfaces when pressed during TIM assembly.

The protrusions may be made of either the same material as part of heat exchanger or power package surface or totally different material. Preferably the protrusions are formed from a material with good thermal conductivity, such as an appropriate metal. The embodiment may be applicable to any thermal system with any TIM.

Thus in an example the protruded pins / fins may be created on a heat-rail / heatsink or on component / power package substrate e.g. DBC/DBA within TIM coverage. They may be the same material as part of heat-rail, and may be formed of copper, aluminium or an alloy thereof or from the same material as the power package substrate. Other material with good thermal conductivity properties can be used. Preferably the pins are formed from a material or are of a thickness such that they are pressable or bendable to compensate and fit into surface morphology of both bonding surfaces when being pressed during bonding assembly.

Figure 3a shows the formation of the assembly where protrusion 4 in the heat sink 2 are used which penetrate the TIM, and figure 3b shows formation of the assembly according to one embodiment where compressible/bendable or compliant protrusions 4 are formed between uneven contact surfaces of either or both the heat sink/component. In both examples the subfigure on the right shows the final assembled product, which has no voids.

Figure 4a shows how assembly may be performed using compressible protrusions 7 (pins/fins) protrusions. Reference numerals are as in the previous figure and figure 4b shows how the assembly may be form from bendable pins /fins 8 (protrusions). In both examples the subfigure on the right shows the final assembled product, which has no voids.

Figure 5 shows how assembly may be formed by protrusions on a concave (dome shaped) base 9 of the contact surface of the heatsink 2 to eliminate air entrapment. The lower figure shows the final assembled product.

Figure 6 show protrusions are provided inside a convex shaped base 10a (i.e. within a cavity/indent 10b thereof) of the heat sink the hint sink. Such a indent along with the protrusions can further assist retaining TIM to prevent its flowing-out. The lower figure shows the final assembled product.

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Figure 7 shows how protrusions are formed on a concave (dome- shaped) base 11 of the heat sink contact surface which is formed within a convex cavity (indent) 12 of the base to further reduce air entrapment. The lower figure shows the final assembled product.

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According to some examples pedestals may be provided on the contact surface of the component or heat sink in the case of certain designs with space or height constraints or/and greater gap between heat-rails and the electronic package/component. Protrusions such as pins can be created on such pedestals.

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Figure 8a shows assembly where protrusions such as pins or fins 4 are provided on a flat pedestal 13 on the heat sink contact surface. Figure 8b shows assembly where protrusions such a pins or fins are provided on a dome shaped (convex) pedestal 14 on the heat sink contact surface. The sub-figures on the right are finished product.

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Figure 9 shows assembly where extra protrusions are created outside the component/package coverage, these pins further retain excessive TIM and its flowing-out. In other word the protrusions extend further and flank the area of the final contact region of the contact surfaces.

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In figure 10 shows how the protrusions 4 are created only outside the package coverage to retain excessive TIM and hinder its flowing-out.

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Figure 11 further shows a further example of how protrusions 4a are formed outside the contact surface area (flanking the component /package and heatsink contact region), as well protrusions 4b provided inside a cavity indent surface 15

such as a concave shaped indent formed in the contact surface (base) of the heat sink.

CLAIMS:

1. An assembly comprising an electronic package having a contact surface, and a heatsink having a contact surface, said heatsink being attached to said electronic package via a thermal interface material (TIM) layer sandwiched between said contact surfaces, and including a plurality of protrusions emanating from either of said contact surfaces..
2. An assembly as claimed in claim 1 where all or some of said protrusions are embedded or protrude into said TIM layer.
3. An assembly as claimed in claims 1 or 2 where said all or some of said protrusion surround said TIM layer
4. An assembly as claimed in claims 1 to 3 wherein said protrusions are compliant, , compressible, bendable or collapsible.
5. An assembly as claimed in claim 1 to 4 wherein said protrusions are in the form of pins or elongate fins.
6. An assembly as claimed in claims 1 to 5 wherein either or both of said contact surfaces are non-planar.
7. An assembly as claimed in claim 6 wherein said one or both contact surfaces are concave.
8. An assembly as claimed in claims 6 or 7 wherein said one or both contact surfaces are convex
9. An assembly as claimed in claims 1 to 8 wherein said protrusion emanate from a concave contact surface formed within a generally convex contact surface.

10. An assembly as claimed in claim 1 to 9 wherein at least one of said contact surfaces are formed on a pedestal raised from the body of the main package or heat sink body.

5 11. An assembly as claimed in claim 10 wherein said pedestal includes a convex or contact surface.

12. An assembly as claimed in claim 1 to 11 where said protrusions are both embedded in said TIM layer and surround said TIM layer.

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13. An assembly as claimed in claim 1 to 12 where said TIM layer and contact surfaces are generally matching shape of component and said protrusion surround said TIM layer on at least two sides.

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