

**PRE-APPLICATION OF GREASE TO HEAT SINKS
WITH A PROTECTIVE COATING**

The present invention relates to electronic component assemblies, and more particularly relates to the application of a substance such as thermally conductive grease between two components.

Background of the Invention

The interface between a heat sink and the component to which it is attached creates a boundary layer of thermal insulation. This reduces the thermal transmissivity to the heat sink, and thus ultimately reduces the ability of the heat sink to dissipate heat generated by the component. In the past, it has been found that applying a film of thermal grease can diminish or substantially eliminate this problem. Thermal grease is well known in the art and can be a composition of silicone and zinc oxide, available from Dow Corning of Midland, Michigan and other sources. Another thermal grease composition, Thermalcote™ is available from Thermalloy, Inc. of Dallas, Texas; another a product sold by the same company and known as Thermalcote II™ does not contain silicone. The Thermalcote products are available in forms that are applied by brush, squeezed out of a tube, applied by a paddle, or other techniques. Unfortunately, the application of thermal grease to individual components in a production environment is laborious and inexact. Nonetheless, despite numerous

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efforts to create another interface material to replace it, thermal grease remains the most effective product for ensuring good thermal conductivity.

Thermal grease can be applied directly to an
5 insulator strip. The coated strip is supplied in a package that must be peeled away, and the insulator must then be applied to a component. This product is sold under the name Insul-Cote by Thermalloy, Inc. of Dallas, Texas. Similarly, it is known to apply a thin layer of thermal grease to both
10 sides an aluminum carrier that is 0.1 mm (0.004") thick. The coated carrier is then disposed between a heat sink and a microprocessor. This product is sold under the name Conducta-cote(TM) by Thermalloy, Inc. of Dallas, Texas. However, the use of such coated insulators or aluminum
15 carriers does not eliminate the above-mentioned problems, since handling the grease-coated insulation or carrier is nearly as difficult as applying the grease from a tube or with a brush. The insulators and carriers can be obtained in strip form and applied by a machine, which alleviates
20 some of these problems. However, this adds a production step and the capital cost of the application machine if the supplier of the pre-coated insulators or carriers does not provide one. The advantage of pre-coated insulators or carriers is that they apply a specific amount of grease, and
25 a specific quantity of grease may be purchased by ordering coated insulators or carriers on a one-to-one basis with the heat sinks. However, a disadvantage of the above-described pre-coated insulators and aluminum carriers that are pre-coated with thermal grease is that they are difficult to
30 manufacture.

As mentioned above, others in the art have attempted to create pads of material that serve as a replacement for thermal grease. Some of these products are insulating, while some more recent versions are not.
35 Although such pads reduce the waste and inaccurate application related to the use of a thermal enhancement product, they are often more expensive and do not offer the

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thermal performance of grease. Therefore, it would be desirable to provide a product in which the thermal properties of grease are advantageously available to create a better thermal connection between a heat sink and a heat-emitting component. Moreover, it would be further desirable to reduce or eliminate waste, spillage and over-application of thermal grease. It is therefore an object of the present invention to provide products and methods in which thermal grease is applied in a precise and controlled manner. It is a further object of the present invention to provide products and methods that readily adapt to production environments and that do not require significant alteration of existing production sequences or changes in production tooling.

15 Summary of the Invention

It has now been found that these and other objects of the present invention are met by pre-applying coatings and substances such as thermal grease to components such as heat sinks. The relevant area is covered with a protective sheet, e.g., a thin film or paper. The assembler removes the protective sheet, preferably using a tear off tab provided for that purpose. After the protective film is removed, the heat sink is assembled to a microprocessor or other semiconductor device, or any source of heat. Alternatively, the protective film or paper can be pre-coated and applied to the component.

The present invention therefore discloses heat sinks or proactive films that are pre-coated with a layer of a material such as thermal grease that provide several advantages over the prior art. For one, contamination and migration of the thermal grease is substantially reduced by covering the coated areas with a protective film that is removed prior to the assembly of the heat sink into a circuit board or other assembly. By providing a pre-coated heat sink, productivity is enhanced by increasing accuracy with which the thermal grease is applied, thus eliminating



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waste and clean up. The present invention is thus also directed to improved methods for pre-coating a heat sink with thermal grease in which areas of the heat sink can be either fully coated, or portions electively coated;

5 alternatively, the protective film can be pre-coated. The coating is most preferably accomplished by a silk screening process or a pad printing process. The protective film is most preferably provided with a tear off tab to facilitate the removal of the protective film. Finally, the present
10 invention also discloses improved methods of installing a heat sink using heat sinks that have an area where thermal grease is pre-applied and covered by a protective film.

Brief Description of the Drawings

FIG. 1 is a perspective view of a preferred
15 embodiment of the present invention; and

FIG. 2 is a perspective view of an alternate embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Referring now to FIG. 1, in a preferred
20 embodiment, a heat sink 10 comprises a plurality of fins 11 extending from a heat dissipation side 12 and a component facing side 14 opposite the heat dissipation side 12. The component facing side 14 is covered with a layer of material 100 and a protective film 110 overlies the layer of material
25 100. For purposes of illustration, FIG. 1 shows one corner of the protective film 110 upturned to expose the layer of material 100. It will be understood, however, that the heat sink 10 is normally delivered with a sheet of protective material overlying the layer of material 100.

30 The layer of material 100 most preferably comprises a thermal grease, the use of which is well known in the art as discussed above. It will be realized, however, that thermal grease is not the only type of material that can utilize the concepts disclosed herein.

35 Numerous other property enhancing coatings, such s



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conductive powders, gels, dispersions, etc. can be used, as well as compliant coatings that absorb shock. In FIG. 1, the layer of material 100 is shown in phantom except where the protective film 110 is again shown as being lifted up
5 for purposes of illustration.

In most embodiments, the layer of material 100 is applied over substantially the entire component facing side 14 as shown in FIG. 1. However, as seen in FIG. 2, the layer of material 100 alternatively can be applied over
10 selected portions of the component facing side 14. In certain preferred embodiments, protective film 110 is adhered to the layer of material at one or more edges of the component facing side 14. In the embodiment illustrated in FIG. 2 the areas that are coated with the material 100 are
15 shown in phantom. In either the embodiment of FIG. 1 or FIG. 2, it is preferred that the protective film 110 overlies the entire component facing side 14, although it will be understood that the present invention contemplates embodiments in which the protective film 110 is
20 discontinuous, made of several sections, slit, perforated, or otherwise does not cover the entire component facing side 14. In certain preferred embodiments, at least a portion of the protective film 110 extends beyond an edge of the heat sink 10. Most preferably, a portion of the protective film
25 110 extends beyond an edge of the heat sink 10 and forms a removal tab 112.

The present invention contemplates that the protective film 110 can be made from any suitable material. As will be readily appreciated by those of skill in the art,
30 suitable materials include those that are easily released from the component, that resist deterioration due to exposure with the thermal grease, and those that resist absorption of the thermal grease, in order to keep the external packaging free of contamination and to preserve the
35 precise quantity of grease that has been applied. In preferred embodiments, the protective film 110 comprises a

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transparent material, but may alternatively be made from a coated paper product.

In another aspect of the present invention, improved methods of applying thermal grease to a heat sink are disclosed. In a preferred embodiment, the methods of the present invention comprise the steps of identifying an area to receive thermal grease and applying thermal grease to the area. The thermal grease is then covered with a protective film. An alternative embodiment of the present invention involves applying thermal grease to pre-selected areas of the protective film, and then applying the coated thermal film to the heat sink or other component such that the grease coated side of the film comes into contact with the component.

As will be realized by those of skill in the art, there are a number of techniques for applying thermal grease to the surface of a heat sink in accordance with the present invention. One technique, which represents a preferred embodiment of the present invention is to silk screen the grease on to the surface of the heat sink. In another preferred embodiment, pad printing can also be used in place of silk screening. In this embodiment a rubber pad or other suitable carrier is coated with grease and applied to either the component or the protective film. When the pad is removed, a "printed" area of thermal grease will be deposited in the appropriate area. The determination of the thickness of the coating can be easily determined by trial and error, and will not require undue amounts of experimentation.

Whether the thermal grease is applied by silk screening or by other techniques, the present invention contemplates methods wherein discrete areas are selectively coated, as well as methods in which an entire surface of a component is coated. After the grease has been applied, the step of covering the thermal grease is undertaken, and this preferably comprises applying a plastic film, coated paper or other film over the thermal grease.

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Additionally, as explained above, although it is preferred that the component be coated with thermal grease, application are envisioned wherein the protective film will be coated first, and then the coated film applied to the component.

Another aspect of the present invention is the disclosure of improved methods for installing a heat sink. In accordance with this aspect of the present invention, a protective backing is removed from the heat sink, and the heat sink is installed. Preferably, the step of removing a protective backing comprises the step of grasping a tear off tab, which, as discussed above, is supplied with preferred embodiments of the present invention.

It will be understood that although the foregoing description of the preferred embodiments of the present invention focused upon the application of a material such as thermal grease to a heat sink, and then applying a protective film over the thermal grease, the present invention is equally applicable to and is directed to embodiments wherein the protective film is first coated, continuously or discontinuously, with a coating such as thermal grease, and then the protective film or a portion of it is applied to the back of a components such as a heat sink.

Although certain embodiments of the present invention have been disclosed and described with particularity, these embodiments are provided for the purpose of illustrating the invention and are not meant to be limiting. Upon review of the foregoing specification, those of skill in the art will immediately realize that numerous variations, modifications and adaptations of the invention are possible. Although differing in form and function, such alternate embodiments will employ the spirit of the present invention and are encompassed by the same. Accordingly, reference should be made to the appended claims in order to determine the full scope of the present invention.





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What is claimed is:

1. A The method of claim 11, wherein the step of applying thermal grease to the area comprises the step of silk screening. heat sink comprising a plurality of fins
5 extending from a heat dissipation side and a component facing side opposite the heat dissipation side, wherein the component facing side includes an area upon which a layer of material is disposed and a protective film overlies the layer of material.
- 10 2. The heat sink of claim 1, wherein the layer of material comprises thermal grease.
3. The heat sink of claim 1, wherein the area upon which the layer of material is disposed is the entire component facing side.
- 15 4. The heat sink of claim 1, wherein the area upon which the layer of material is disposed is one or more selected portions of the component facing side.
5. The heat sink of claim 1, wherein the protective film overlies the entire component facing side.
- 20 6. The heat sink of claim 1, wherein at least a portion of the protective film extends beyond an edge of the component facing side.
7. The heat sink of claim 6, wherein the portion of the protective film that extends beyond an edge of the
25 component facing side forms a removal tab.
8. The heat sink of claim 1, wherein the protective film comprises a transparent material.

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9. The heat sink of claim 1, wherein the protective film comprises a coated paper product.

10. The heat sink of claim 9, wherein the protective paper is adhered to the layer of material at an
5 edge of the component facing side.

11. A method of applying thermal grease to a heat sink, comprising the steps of:

identifying an area to receive thermal
grease;
10 applying thermal grease to the area; and
covering the thermal grease with a protective
film.

12. The method of claim 11, wherein the step of
applying thermal grease to the area comprises the step of
15 silk screening.

13. The method of claim 11, wherein the step of
applying thermal grease to the area comprises the step of
printing with a pad.

14. The method of claim 11, wherein the step of
20 applying thermal grease to the area comprises selectively
coating discrete areas of a component.

15. The method of claim 11, wherein the step of
applying thermal grease to the area comprises coating an
entire surface of a component.

25 16. The method of claim 11, wherein the step of
applying thermal grease to the area comprises the step of
applying thermal grease to a protective backing.





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17. A method of installing a heat sink comprising the steps of:

removing a protective film from the heat sink; and

5 installing the heat sink.

18. The method of claim 17, wherein the step of removing the protective film comprises the step of grasping a tear off tab.

19. A heat sink comprising a plurality of fins
10 extending from a heat dissipation side and a component facing side opposite the heat dissipation side, wherein the heat dissipation side is covered with a layer of material and a protective film overlies the layer of material.

20. The heat sink of claim 19, wherein the layer
15 of material comprises thermal grease.

21. The heat sink of claim 19, wherein the layer of material is discontinuous.

22. The heat sink of claim 19, wherein the protective film comprises a tear off tab.





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AMENDED CLAIMS

[received by the International Bureau on 21 October 1997 (21.10.97);
original claims 1 and 19-22 amended;
remaining claims unchanged (2 pages)]

1. A heat sink comprising:
a heat dissipation member; a plurality of fins
extending from a heat dissipation side of said member, said
member having a component facing side opposite the heat
dissipation side,
the component facing side of said member including an
area upon which a layer of thermal grease comprised of silicon
is disposed; and
a protective film over said layer of thermal grease.
2. Canceled.
3. The heat sink of claim 1, wherein the area upon which
the layer of material is disposed is the entire component facing
side.
4. The heat sink of claim 1, wherein the area upon which
the layer of material is disposed is one or more selected
portions of the component facing side.
5. The heat sink of claim 1, wherein the protective film
overlies the entire component facing side.
6. The heat sink of claim 1, wherein at least a portion
of the protective film extends beyond an edge of the component
facing side.
7. The heat sink of claim 6, wherein the portion of the
protective film that extends beyond an edge of the component
facing side forms a removal tab.
8. The heat sink of claim 1, wherein the protective film
comprises a transparent material.

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AMENDED SHEET (ARTICLE 19)



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17. A method of installing a heat sink comprising the steps of:

removing a protective film from the heat sink to expose a surface coated with a material; and
installing the heat sink.

18. The method of claim 17, wherein the step of removing the protective film comprises the step of grasping a tear off tab.

19. Canceled.

20. Canceled.

21. The heat sink of claim 1, wherein the layer of material is discontinuous.

22. The heat sink of claim 1, wherein the protective film includes a tear off tab.

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AMENDED SHEET (ARTICLE 19)

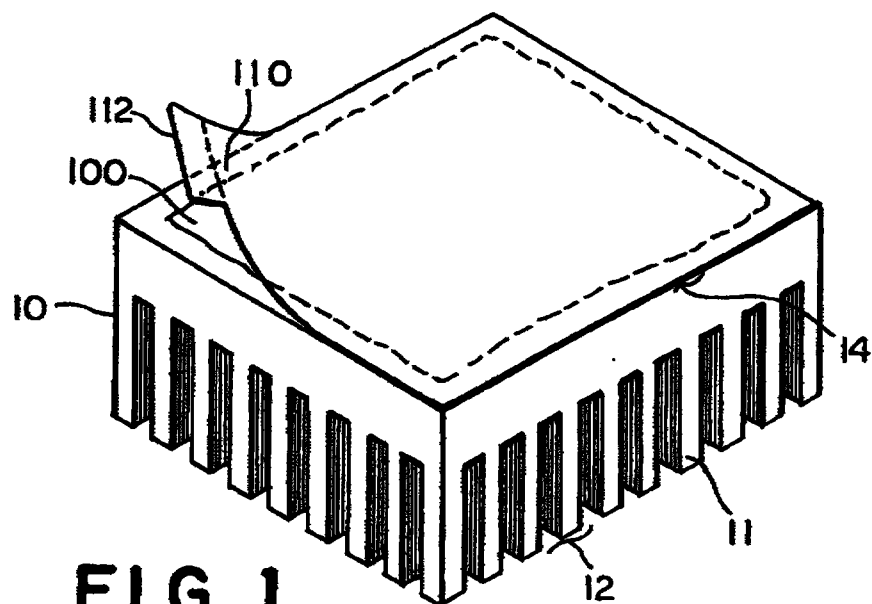


FIG. 1

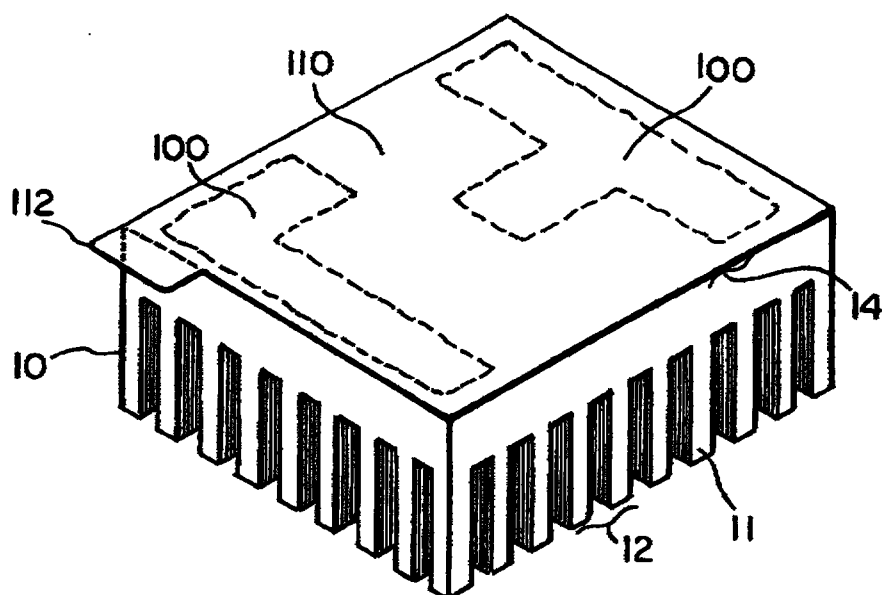


FIG. 2

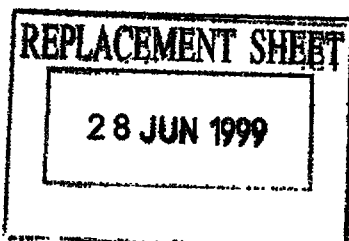
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thermal performance of grease. Therefore, it would be desirable to provide a product in which the thermal properties of grease are advantageously available to create a better thermal connection between a heat sink and a heat-emitting component. Moreover, it would be further desirable to reduce or eliminate waste, spillage and over-application of thermal grease. It is therefore an object of the present invention to provide products and methods in which thermal grease is applied in a precise and controlled manner. It is a further object of the present invention to provide products and methods that readily adapt to production environments and that do not require significant alteration of existing production sequences or changes in production tooling.

Summary of the Invention

It has now been found that these and other objects of the present invention are met by pre-applying coatings of thermal grease to components such as heat sinks. The relevant area is covered with a protective sheet, e.g., a thin film or paper. The assembler removes the protective sheet, preferably using a tear off tab provided for that purpose. After the protective film is removed, the heat sink is assembled to a microprocessor or other semiconductor device, or any source of heat. Alternatively, the protective film or paper can be pre-coated and applied to the component.

The present invention therefore discloses heat sinks or proactive films that are pre-coated with a layer of thermal grease that provide several advantages over the prior art. For one, contamination and migration of the thermal grease is substantially reduced by covering the coated areas with a protective film that is removed prior to the assembly of the heat sink into a circuit board or other assembly. By providing a pre-coated heat sink, productivity is enhanced by increasing accuracy with which the thermal grease is applied, thus eliminating



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waste and clean up. The present invention is thus also directed to improve methods for pre-coating a heat sink with thermal grease in which areas of the heat sink can be either fully coated, or portions electively coated; alternatively, the protective film can be pre-coated. The coating is most preferably accomplished by a silk screening process or a pad printing process. The protective film is most preferably provided with a tear off tab to facilitate the removal of the protective film. Finally, the present invention also discloses improved methods of installing a heat sink using heat sinks that have an area where thermal grease is pre-applied and covered by a protective film.

Brief Description of the Drawings

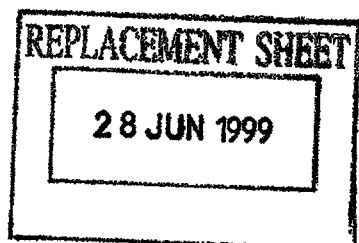
Fig. 1 is a perspective view of a preferred embodiment of the present invention; and

Fig. 2 is a perspective view of an alternate embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Referring now to Fig. 1, in a preferred embodiment, a heat sink 10 comprises a plurality of fins 11 extending from a heat dissipation side 12 and a component facing side 14 opposite the heat dissipation side 12. The component facing side 14 is covered with a layer of material 100 and a protective film 110 overlies the layer of material 100. For purposes of illustration, Fig. 1 shows one corner of the protective film 110 upturned to expose the layer of material 100. It will be understood, however, that the heat sink 10 is normally delivered with a sheet of protective material overlying the layer of material 100.

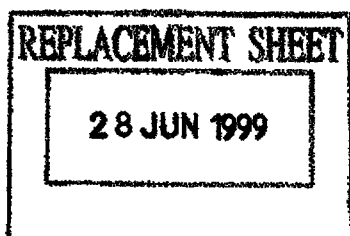
The layer of material 100 comprises a thermal grease, the use of which is well known in the art as discussed above. In Fig. 1,



the layer of material 100 is shown in phantom except where the protective film 110 is again shown as being lifted up for purposes of illustration.

In most embodiments, the layer of material 100 is applied over substantially the entire component facing side 14 as shown in Fig. 1. However, as seen in Fig. 2, the layer of material 100 alternatively can be applied over selected portions of the component facing side 14. In certain preferred embodiments, protective film 110 is adhered to the layer of material at one or more edges of the component facing side 14. In the embodiment illustrated in Fig. 2 the areas that are coated with the material 100 are shown in phantom. In either the embodiment of Fig. 1 or Fig. 2, it is preferred that the protective film 110 overlies the entire component facing side 14, although it will be understood that the present invention contemplates embodiments in which the protective film 110 is discontinuous, made of several sections, slit, perforated, or otherwise does not cover the entire component facing side 14. In certain preferred embodiments, at least a portion of the protective film 110 extends beyond an edge of the heat sink 10. Most preferably, a portion of the protective film 110 extends beyond an edge of the heat sink 10 and forms a removal tab 112.

The present invention contemplates that the protective film 110 can be made from any suitable material. As will be readily appreciated by those of skill in the art, suitable materials include those that are easily released from the component, that resist deterioration due to exposure with the thermal grease, and those that resist absorption of the thermal grease, in order to keep the external packaging free of contamination and to preserve the precise quantity of grease that has been applied. In preferred embodiments, the protective film 110 comprises a

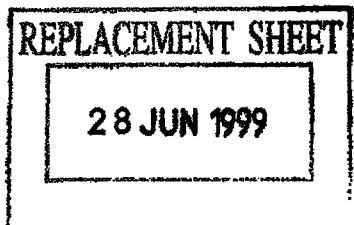


transparent material, but may alternatively be made from a coated paper product.

In another aspect of the present invention, improved methods of applying thermal grease to a heat sink are disclosed. In a preferred embodiment, the methods of the present invention comprise the steps of identifying an area to receive thermal grease and applying thermal grease to the area. The thermal grease is then covered with a protective film. An alternative embodiment of the present involves applying thermal grease to pre-selected areas of the protective film, and then applying the coated film to the heat sink or other component such that the grease coated side of the film comes into contact with the component.

As will be realized by those of skill in the art, there are a number of techniques for applying thermal grease to the surface of a heat sink in accordance with the present invention. One technique, which represents a preferred embodiment of the present invention, is to silk screen the grease on to the surface of the heat sink. In another preferred embodiment, pad printing can also be used in place of silk screening. In this embodiment a rubber pad or other suitable carrier is coated with grease and applied to either the component or the protective film. When the pad is removed, a "printed" area of thermal grease will be deposited in the appropriate area. The determination of the thickness of the coating can be easily made by trial and error, and will not require undue amounts of experimentation.

Whether the thermal grease is applied by silk screening or by other techniques, the present invention contemplates methods wherein discrete areas are selectively coated, as well as methods in which an entire surface of a component is coated. After the grease has been applied, the step of covering the thermal grease is undertaken, and this preferably comprises applying a plastic film, coated paper or other film over the thermal grease.

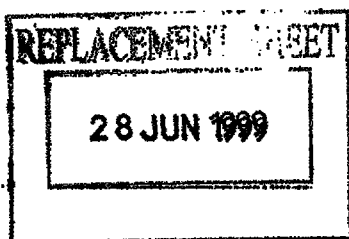


Additionally, as explained above, although it is preferred that the component be coated with thermal grease, applications are envisioned wherein the protective film will be coated first, and the coated film applied to the component.

Another aspect of the present invention resides in improved methods for installing a heat sink. In accordance with this aspect of the present invention, a protective backing is removed from the heat sink, and the heat sink is installed. Preferably, the step of removing a protective backing comprises the step of grasping a tear off tab, which, as discussed above, is supplied with preferred embodiments of the present invention.

It will be understood that although the foregoing description of the preferred embodiments of the present invention focused upon the application of a material such as thermal grease to a heat sink, and then applying a protective film over the thermal grease, the present invention is equally applicable to and is directed to embodiments wherein the protective film 110 is first coated, continuously or discontinuously, with a coating such as thermal grease, and then the protective film 110 or a portion of it is applied to the back of a component such as a heat sink.

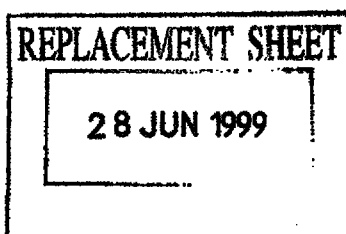
Although certain embodiments of the present invention have been disclosed and described with particularity, these embodiments are provided for the purpose of illustrating the invention and are not meant to be limiting. Upon review of the foregoing specification, those of skill in the art will immediately realize that numerous variations, modifications and adaptations of the invention are possible. Although differing in form and function, such alternate embodiments will employ the features of the present invention and are encompassed by the same. Accordingly, reference should be made to the appended claims in order to determine the full scope of the present invention.





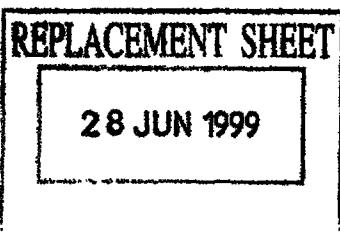
CLAIMS

1. A method of applying thermal grease to a heat sink, comprising the steps of:
 - identifying an area of the heat sink to receive thermal grease;
 - applying thermal grease to the area; and
 - covering the thermal grease with a protective film.
2. The method of claim 1, wherein the step of applying thermal grease to the area comprises the step of silk screening.
3. The method of claim 1, wherein the step of applying thermal grease to the area comprises the step of printing with a pad.
4. The method of claim 1, wherein the step of applying thermal grease to the area comprises selectively coating discrete areas of a component facing side of the heat sink.
5. The method of claim 1, wherein the step of applying thermal grease to the area comprises coating an entire surface of a component facing side of the heat sink.
6. A method of applying thermal grease to a component, comprising the steps of:
 - identifying an area of the component to receive thermal grease;
 - applying thermal grease to the area by selectively coating discrete areas of the component; and
 - covering the thermal grease with a protective film.



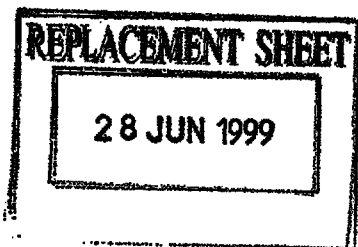


7. A method of applying thermal grease to a heat sink, comprising the steps of:
applying thermal grease to a pre-selected area on one side of a protective backing; and
applying the protective backing to the heat sink such that said one side of the backing comes into contact with the heat sink.
8. A heat sink comprising:
a heat dissipation member, a plurality of fins extending from a heat dissipation side of said member, said member having a component facing side opposite the heat dissipation side, the component facing side of said member including an area upon which a layer of thermal grease comprising silicone is disposed; and
a protective film over said layer of thermal grease.
9. The heat sink of claim 8, wherein the area upon which the layer of thermal grease is disposed is the entire component facing side.
10. The heat sink of claim 8, wherein the area upon which the layer of thermal grease is disposed is one or more selected portions of the component facing side.
11. The heat sink of claim 8, wherein the protective film overlies the entire component facing side.
12. The heat sink of claim 8, wherein at least a portion of the protective film extends beyond an edge of the component facing side.
13. The heat sink of claim 12, wherein the portion of the protective film that extends beyond an edge of the component facing side forms a removal tab.





14. The heat sink of claim 8, wherein the protective film comprises a transparent material.
15. The heat sink of claim 8, wherein the protective film comprises a coated paper product.
16. The heat sink of claim 15, wherein the protective film is adhered to the layer of thermal grease at an edge of the component facing side.
17. The heat sink of claim 8, wherein the layer of thermal grease is discontinuous.
18. The heat sink of claim 8, wherein the protective film includes a tear off tab.



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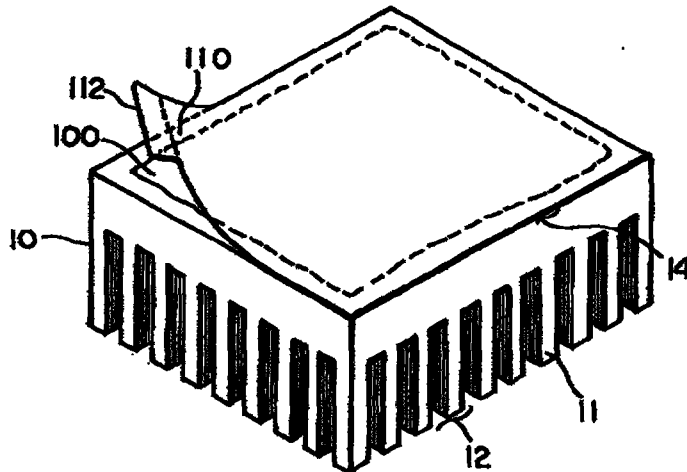
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(21) International Application Number: PCT/US96/20934 (22) International Filing Date: 30 December 1996 (30.12.96) (30) Priority Data: 08/669,875 21 June 1996 (21.06.96) US (71) Applicant: THERMALLOY, INC. [US/US]; 2021 West Valley View Lane, Dallas, TX 75234 (US). (72) Inventors: HINSHAW, Howard, G.; 5808 Preston Oaks Road #2095, Dallas, TX 75240 (US); SMITHERS, Matthew, C.; 502 Price Drive, Lewisville, TX 75067 (US). (74) Agents: KURTZ, Richard, E. et al.; Woodcock Washburn Kurtz Mackiewicz & Norris, 46th floor, One Liberty Place, Philadelphia, PA 19103 (US).		(81) Designated States: CN, JP, KR, SG. Published With international search report. With amended claims. 1 PD 1 app/n. 2 Invs.

(54) Title: PRE-APPLICATION OF GREASE TO HEAT SINKS WITH A PROTECTIVE COATING



(57) Abstract

The present invention discloses a heat sink (10) that is pre-coated with a thermal grease (100) and has a protective film (110) covering the thermal grease (100). The protective film (110) has a tab (112) so that the protective film (110) can be removed from the heat sink (10). This allows the heat sink (10) to be installed onto a circuit board or device.