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(54) **VERTICALLY MOUNTABLE HEAT SINK WITH SOLDERABLE TAB**

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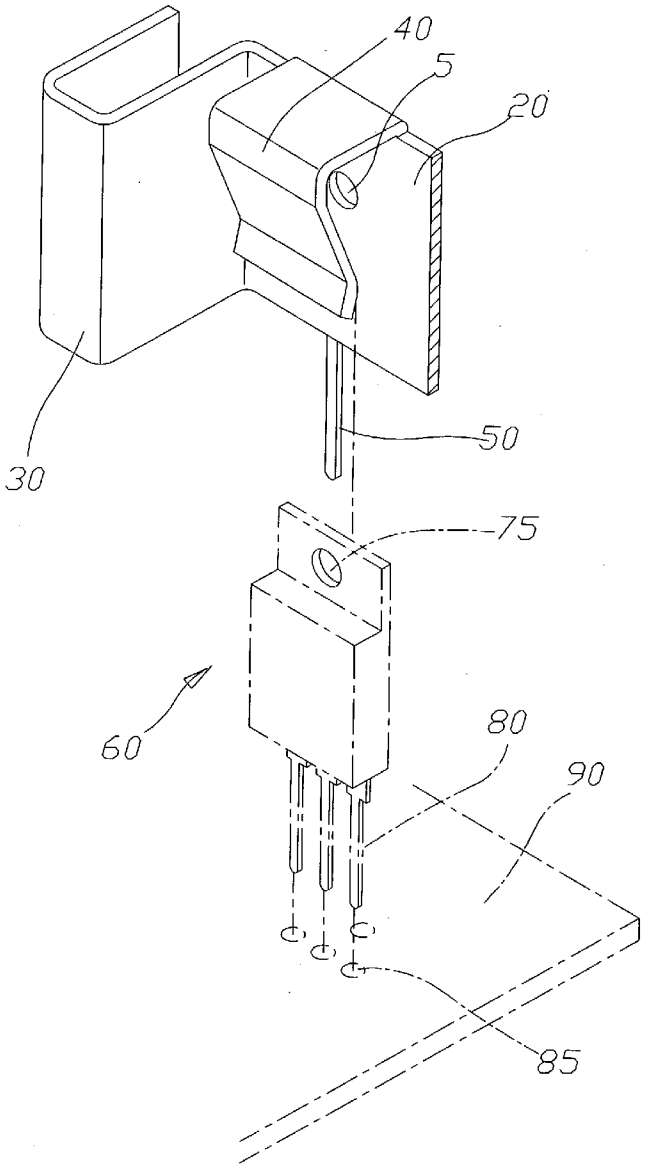
(57) **ABSTRACT**

A vertically mountable heat sink comprising a back, a pair of heat dissipation wings, a retaining clip, and a solderable tab. The retaining clip acts as a pressure clip to firmly hold the associated integrated circuit and the heat sink together and allows for easy assembly of the heat sink to the integrated circuit by simply sliding the heat sink onto the integrated circuit and the retaining clip will automatically grasp and hold the heat sink to the integrated circuit. The pair of dissipation wings allows heat from the integrated circuit to be transferred to the pair of dissipation wings where the heat will be dissipated into the surrounding environment. The solderable tab is inserted into a mating hole in the printed circuit board and then soldered to the circuit board which ensures that the heat sink is mounted and remains mounted in the correct position and placement.



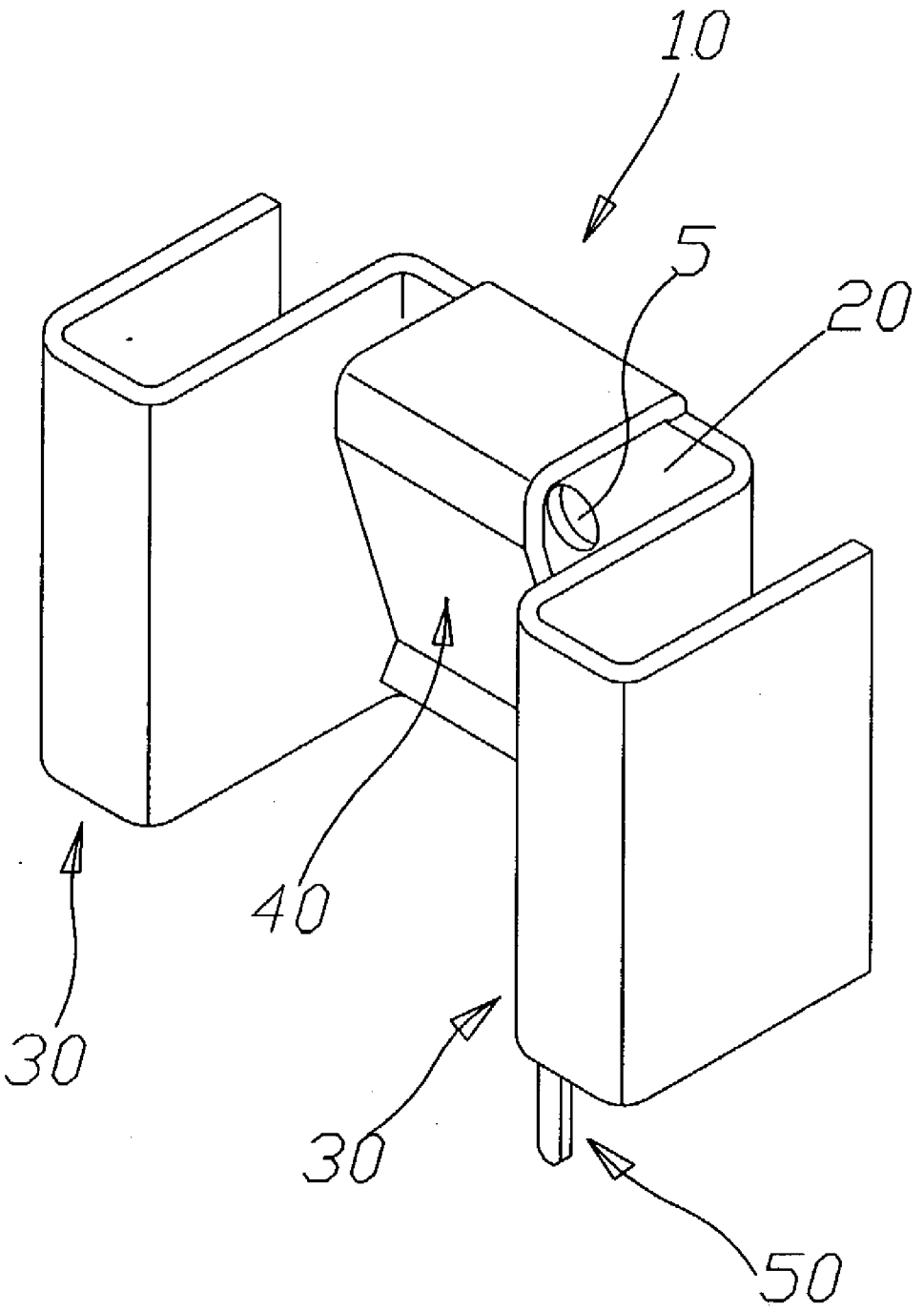


FIG. 1

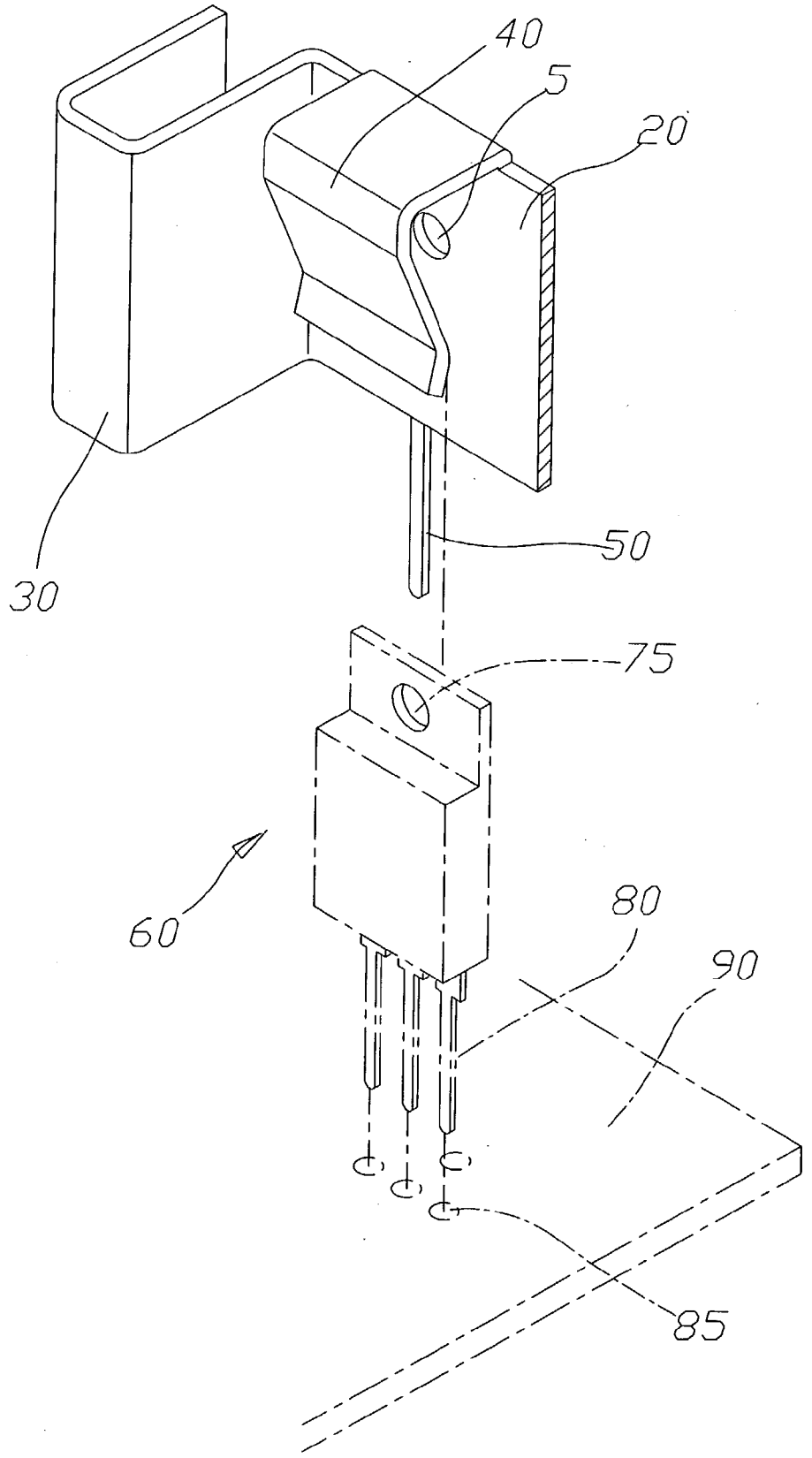


FIG. 2

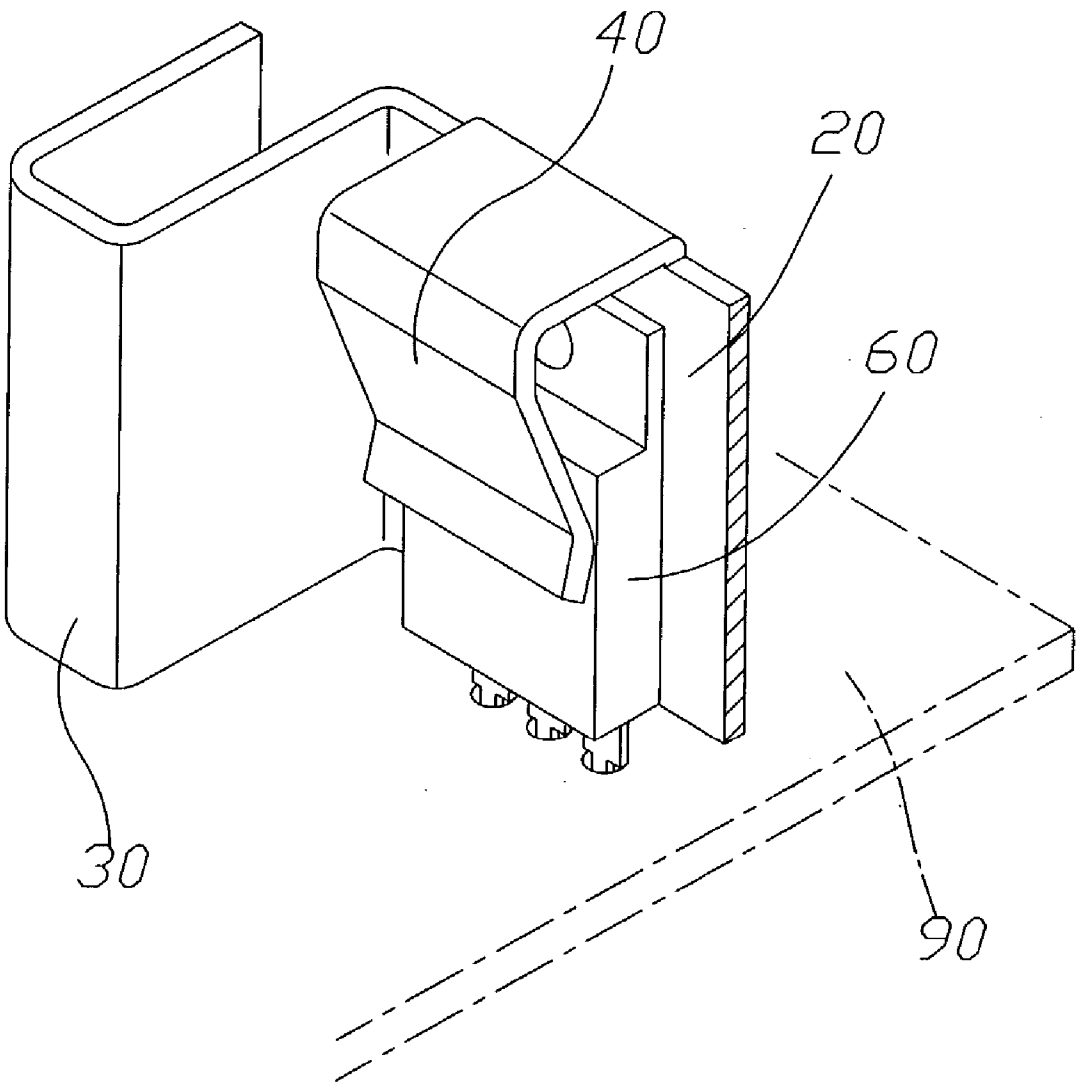


FIG. 3

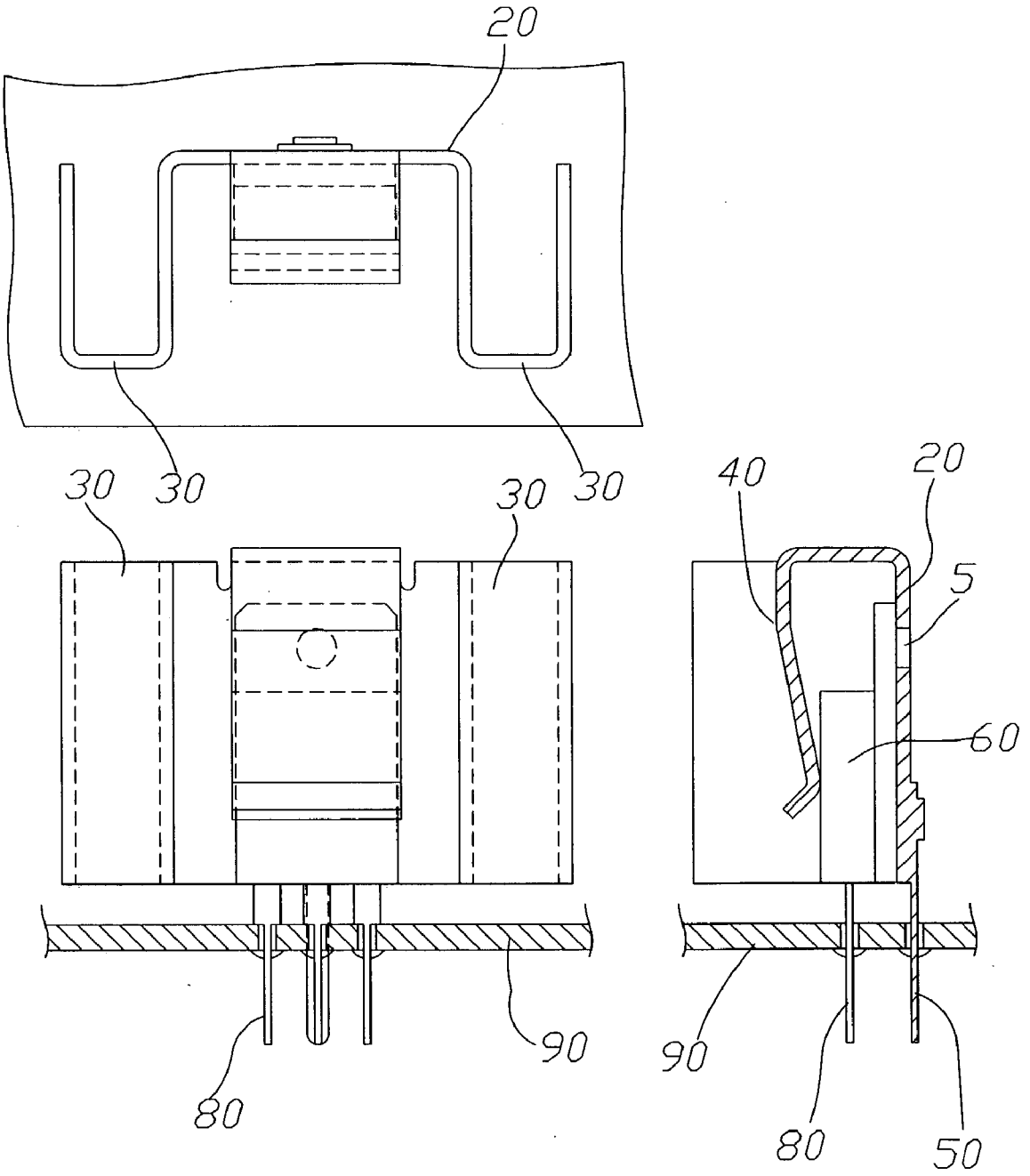


FIG. 4

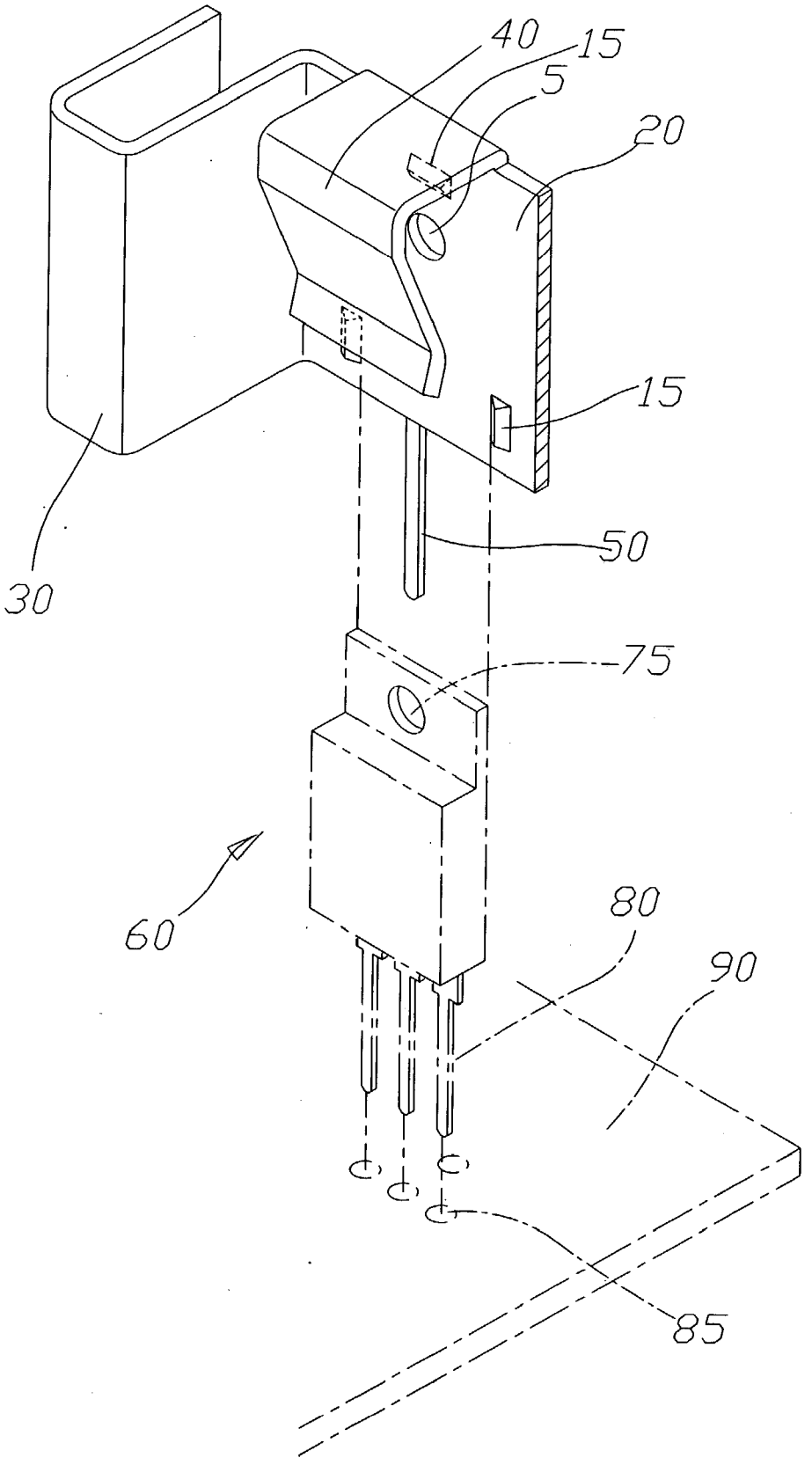


FIG. 5

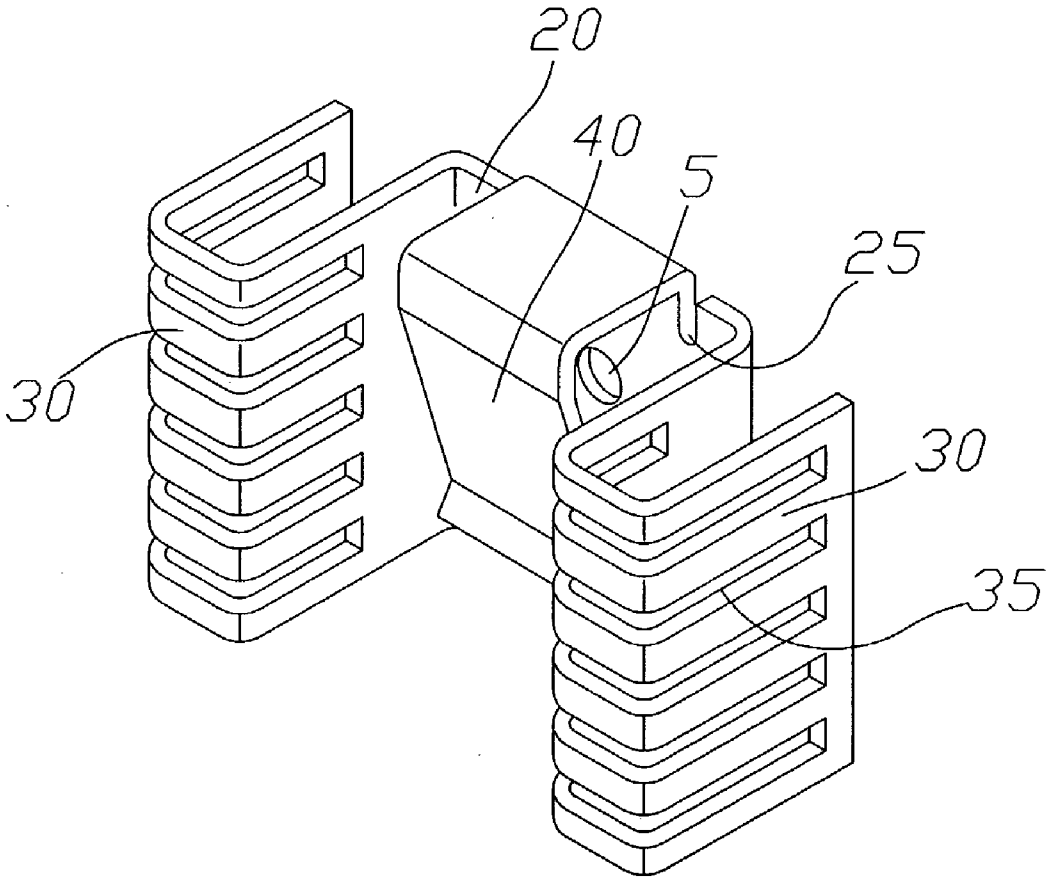


FIG. 6

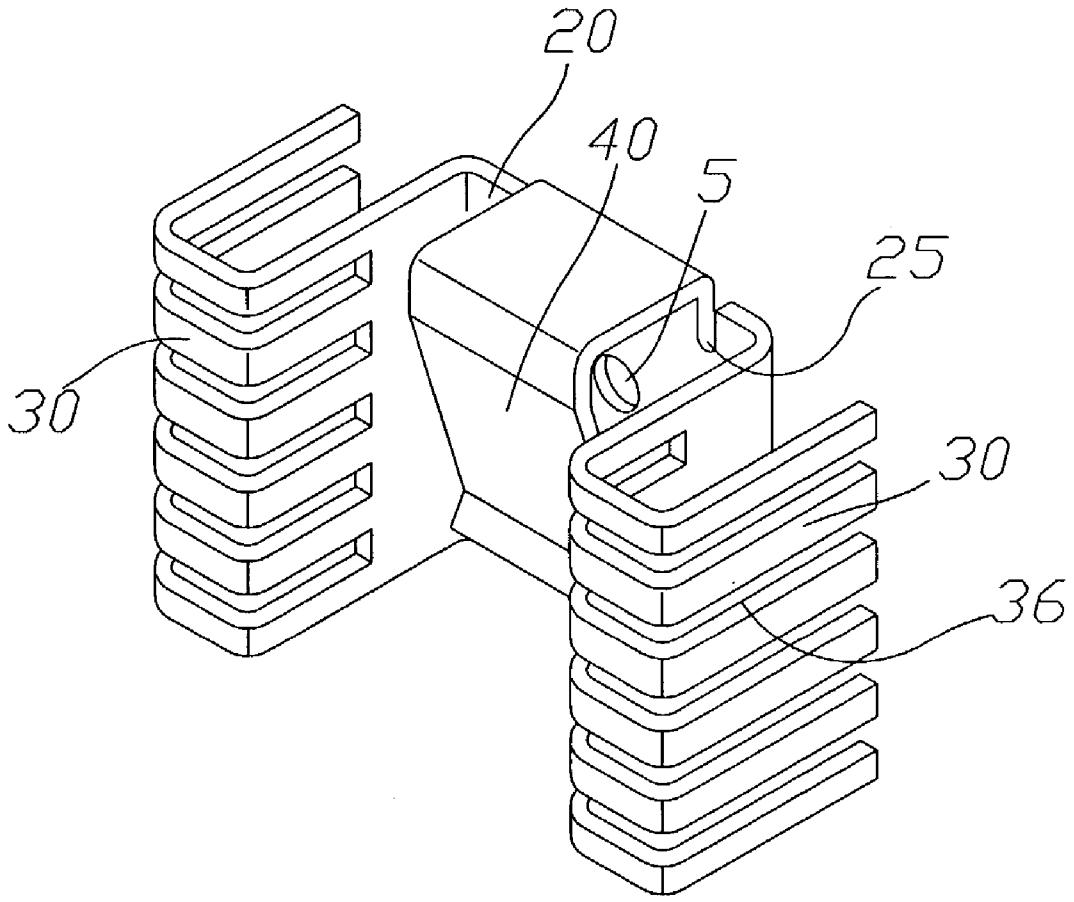


FIG. 7

VERTICALLY MOUNTABLE HEAT SINK WITH SOLDERABLE TAB

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat sink. More specifically, the present invention discloses a heat sink that can be mounted vertically with a solderable tab.

[0003] 2. Description of the Prior Art

[0004] Electrical components such as integrated circuits generate a relatively high amount of heat during operation. This heat can cause damage to the integrated circuit which may result in, at best decreased performance of the integrated circuit, or at worst failure of the integrated circuit device.

[0005] As a result, heat sinks are commonly used to dissipate heat from electrical components. Basically heat sinks are formed piece of metal that dissipate the heat generated by an integrated circuit. By attaching a heat sink to an integrated circuit, heat can be transferred from the integrated circuit to the heat sink, where the heat sink can dissipate the heat by radiation or convection.

[0006] In some cases fans are used in addition to the heat sink in order to force the heat to be dissipated by forced convection. However, this is costly and not practical in most cases for inexpensive integrated circuit components.

[0007] Conventional heat sinks, while providing some level of heat dissipation capabilities, are often troublesome during assembly. Often times, the heat sinks are simple metal pieces that are glued or screwed to the integrated circuit. However, gluing does not provide any positioning characteristics. As a result, placement of the heat sink is often arbitrary and varies between parts. In addition, the adhesion characteristics are relatively poor and the heat sink may easily detach from the integrated circuit. When the heat sink is attached by screw, the adhesion characteristics are improved but the assembly procedure is made more complex and time consuming. Additional assembly steps are required which increases costs.

[0008] Therefore, there is a need for an improved heat sink that makes mounting more efficient, accurate, and effective, while at the same time being easy to manufacture at a low price.

SUMMARY OF THE INVENTION

[0009] To achieve these and other advantages and in order to overcome the disadvantages of the conventional method in accordance with the purpose of the invention as embodied and broadly described herein, the present invention provides a vertically mounted heat sink with solderable tab that increases the ease and efficiency of mounting and assembly procedures.

[0010] As shown above, heat sinks are effective in providing thermal protection to integrated circuits. However, conventional heat sinks have numerous shortcomings or disadvantages that result in inefficient assembly and manufacture and increased price.

[0011] Some integrated circuit packages, for example a TO-220 package, are mounted vertically to a printed circuit board. This type of package has an encapsulate material surrounding the integrated circuit with leads or pins extending from the encapsulate material. With this type of package, attaching a heat sink is a relatively inefficient assembly procedure requiring a screw attachment.

[0012] Therefore, the present invention discloses a heat sink which provides effective and efficient heat dissipation characteristics to an associated integrated circuit while at the same time improving assembly and manufacturing procedures as well as lowering costs.

[0013] The heat sink basically comprises a back, a pair of heat dissipation wings, a retaining clip, and a solderable tab. The back provides a base for the heat sink. It also provides a rear support for the integrated circuit so that the retaining clip may apply an appropriate force to firmly hold the associated integrated circuit. The retaining clip acts as a pressure clip to firmly hold the associated integrated circuit and the heat sink together. The retaining clip is particularly useful during assembly. Without the retaining clip, the heat sink would have to be manually attached to the integrated circuit by means of a screw or bold. However, the retaining clip of the present invention, allows for easy assembly of the heat sink to the integrated circuit by simply sliding the heat sink onto the integrated circuit and the retaining clip will automatically grasp and hold the heat sink to the integrated circuit. The pair of dissipation wings allows heat from the integrated circuit to be transferred through the back and to the pair of dissipation wings where the heat will be dissipated into the surrounding environment. In this way, the temperature of the integrated circuit can be maintained at an acceptable level. Therefore, the integrated circuit may perform as required without overheating. The solderable tab allows for an improved ease during assembly. The solderable tab extends from the back and projects in the same direction as the pins of the integrated circuit. During assembly, the solderable tab is inserted into a mating hole in the printed circuit board and then soldered to the circuit board. This ensures that the heat sink is mounted and remains mounted in the correct position and placement. The solderable tab further provides extra support for the integrated circuit so that pressure applied to the pins of the integrated circuit will be shared by the solderable tab. Without the solderable tab, all force or pressure would be put on the pins of the integrated circuit which can easily cause damage to the integrated circuit.

[0014] Regarding production, during manufacture of the heat sink, the back, pair of heat dissipation wings, and retaining clip are stamped out of a single piece of metal. Subsequently, the retaining clip is bent in a perpendicular direction to the back. At an appropriate distance, the retaining clip is bent at approximately 90 degrees to bring it into a parallel position with the back. The remaining portion of the retaining clip is bent in a sloping V direction. The V nature of the front of the retaining clip allows the integrated circuit to easily enter the retaining clip. Since the retaining clip is at an appropriate distance from the back, the associated integrated circuit and heat sink are held firmly together with an appropriate pressure, without the need for excessive force to be applied during assembly. Depending upon the thickness of the integrated circuit, the retaining clip can be selectively made to be an appropriate distance from the back of the heat sink. In this way, the heat sink of the present invention can be easily modified without re-design, to accept

various sizes of integrated circuits. Additionally, the flexible nature of the retaining clip allows for a certain tolerance in thicknesses of integrated circuits to be used without modifying the heat sink. That is to say, integrated circuits that are slightly thicker or thinner than standard can still be utilized by using the heat sink of the present invention.

[0015] The pair of dissipation wings are formed in an upside-down U-shaped direction from the base. The dissipation wings are bent in a perpendicular, then parallel, and finally a returning perpendicular direction from the base. Typically, the dissipation wings are formed so that the ends of the dissipation wings are flush with the back. However, depending upon the application, the length of the dissipation wings and the position of the ends of the dissipation wings may be selectively adjusted.

[0016] Thus, the body of the heat sink comprising the back, retaining clip, and dissipation wings is formed from a single piece of metal. The metal, for example, aluminium, is selected from a group of any metals that are flexible enough to allow bending and still provide the retaining clip function, and have proper thermal characteristics.

[0017] The body of the heat sink is then given a protective coating, for example, anodizing, powder coating, painting, etc., which provides anti-corrosion protection and an improved appearance. After protective coating, the solderable tab is attached to the back of the heat sink. The solderable tab is attached by, for example, riveting or welding. The solderable tab may be finished with, for example, plating or electroplating, to provide anti-corrosion properties while maintaining solderability. The solderable tab extends from the back of the heat sink in the same direction as the pins of the associated integrated circuit. The length of the solderable tab is selected so that it extends an appropriate length in order to penetrate the mating hole in the printed circuit board and be soldered to the printed circuit board.

[0018] Regarding mounting, during assembly, the pins of the associated integrated circuit are inserted into mating holes of the printed circuit board. The heat sink is then positioned over the integrated circuit with the solderable tab of the heat sink penetrating a mating hole in the printed circuit board. The retaining clip of the heat sink firmly holds the heat sink and the integrated circuit together. Then, the pins of the integrated circuit and the solderable tab of the heat sink are soldered to contacts on the printed circuit board.

[0019] Furthermore, the heat sink may comprise various additional features. For example, the heat sink may further comprise dimples. The dimples are raised in relation to the back. The dimples are formed in the back of the heat sink to provide additional friction between the heat sink and the integrated circuit. This additional friction provides further retention abilities to the heat sink so that the heat sink will grab and hold the integrated circuit more effectively. The number of dimples is variable upon need. The heat sink may further comprise dissipation fins in the dissipation wings. This provides additional heat dissipation characteristics to the heat sink. The dissipation fins may be formed within the dissipation wings or may extend through the dissipation wings so that the dissipation fins are fork-like tines in the dissipation wings. The heat sink may further comprise slots in the back of the heat sink. These slots are positioned on both sides of the retaining clip. The slots allow the retaining clip to have an increased spring-like tension. Therefore, the retaining clip can adjust more easily to the body of the associated integrated circuit while maintaining a firmly held grasp.

[0020] As described, the vertically mounted heat sink comprises dissipation wings for efficiently dissipating heat from an integrated circuit so that the integrated circuit will not overheat and will be able to function properly. Additionally, the heat sink provides a retaining clip for effectively holding the heat sink and the integrated circuit together which improves the ease of assembly. By utilizing a single piece of metal to form the back, dissipation wings and retaining clip, the heat sink of the present invention is manufactured at a lower cost. Furthermore, the heat sink of the present invention further provides a solderable tab for improving the ease of assembly and for sharing the pressure load put on the pins of the integrated circuit.

[0021] These and other objectives of the present invention will become obvious to those of ordinary skill in the art after reading the following detailed description of preferred embodiments.

[0022] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRITPION OF THE DRAWINGS

[0023] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

[0024] **FIG. 1** is a drawing illustrating a vertically mounted heat sink with solderable tab according to an embodiment of the present invention;

[0025] **FIG. 2** is an assembly drawing illustrating a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention;

[0026] **FIG. 3** is an assembled drawing illustrating a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention;

[0027] **FIG. 4** is a plan view drawing showing top, side, and front views of a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention;

[0028] **FIG. 5** is an assembly drawing illustrating a vertically mounted heat sink with solderable tab and dimples and associated integrated circuit according to an embodiment of the present invention;

[0029] **FIG. 6** is a drawing illustrating a vertically mounted heat sink with solderable tab and dissipation fins according to an embodiment of the present invention; and

[0030] **FIG. 7** is a drawing illustrating a vertically mounted heat sink with solderable tab and dissipation fins according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0032] As shown above, the present invention discloses a vertically mounted heat sink with dissipation wings, a solderable tab, and a retaining clip, which provides effective and efficient heat dissipation characteristics to an associated integrated circuit.

[0033] Refer to **FIG. 1**, which is a drawing illustrating a vertically mounted heat sink with solderable tab according to an embodiment of the present invention.

[0034] The heat sink **10** basically comprises a back **20**, a pair of heat dissipation wings **30**, a retaining clip **40**, and a solderable tab **50**.

[0035] The back **20** provides a base for the heat sink **10**. It also provides a rear support for the integrated circuit so that the retaining clip **40** may apply an appropriate force to firmly hold the associated integrated circuit.

[0036] The retaining clip **40** acts as a pressure clip to firmly hold the associated integrated circuit and the heat sink together. The retaining clip **40** is particularly useful during assembly. Without the retaining clip **40**, the heat sink would have to be manually attached to the integrated circuit by means of a screw or bold. However, the retaining clip **40** of the present invention, allows for easy assembly of the heat sink to the integrated circuit by simply sliding the heat sink onto the integrated circuit and the retaining clip **40** will automatically grasp and hold the heat sink to the integrated circuit.

[0037] The pair of dissipation wings **30** allow heat from the integrated circuit to be transferred through the back **20** and to the pair of dissipation wings **30** where the heat will be dissipated into the surrounding environment. In this way, the temperature of the integrated circuit can be maintained at an acceptable level. Therefore, the integrated circuit may perform as required without overheating.

[0038] The solderable tab **50** allows for an improved ease during assembly. The solderable tab **50** extends from the back **20** and projects in the same direction as the pins of the integrated circuit. During assembly, the solderable tab **50** is inserted into a mating hole in the printed circuit board and then soldered to the circuit board. This ensures that the heat sink is mounted and remains mounted in the correct position and placement.

[0039] The solderable tab **50** further provides extra support for the integrated circuit so that pressure applied to the pins of the integrated circuit will be shared by the solderable tab. Without the solderable tab, all force or pressure would be put on the pins of the integrated circuit which can easily cause damage to the integrated circuit.

[0040] During manufacture of the heat sink **10**, the back **20**, pair of heat dissipation wings **30**, and retaining clip **40** are stamped out of a single piece of metal. Subsequently, the retaining clip **40** is bent in a perpendicular direction to the back **20**. At an appropriate distance, the retaining clip **40** is bent at approximately 90 degrees to bring it into a parallel position with the back **20**. The remaining portion of the retaining clip **40** is bent in a sloping V direction.

[0041] The V nature of the front of the retaining clip **40** allows the integrated circuit to easily enter the retaining clip **40**. Since the retaining clip **40** is at an appropriate distance from the back **20**, the associated integrated circuit and heat sink are held firmly together with an appropriate pressure, without the need for excessive force to be applied during assembly. Depending upon the thickness of the integrated circuit, the retaining clip can be selectively made to be an appropriate distance from the back **20** of the heat sink. In this way, the heat sink of the present invention can be easily modified without re-design, to accept various sizes of integrated circuits. Additionally, the flexible nature of the retaining clip allows for a certain tolerance in thicknesses of integrated circuits to be used without modifying the heat sink. That is to say, integrated circuits that are slightly thicker or thinner than standard can still be utilized by using the heat sink of the present invention.

[0042] Similarly, the pair of dissipation wings **30** are formed in an upside-down U-shaped direction from the base. The dissipation wings **30** are bent in a perpendicular, then parallel, and finally a returning perpendicular direction from the base.

[0043] Typically, the dissipation wings **30** are formed so that the ends of the dissipation wings **30** are flush with the back **20**. However, depending upon the application, the length of the dissipation wings and the position of the ends of the dissipation wings may be selectively adjusted.

[0044] Thus, the body of the heat sink comprising the back, retaining clip, and dissipation wings is formed from a single piece of metal. The metal, for example, aluminium, is selected from a group of any metals that are flexible enough to allow bending and still provide the retaining clip function, and have proper thermal characteristics.

[0045] The body of the heat sink is then given a protective coating, for example, anodizing, powder coating, painting, etc., which provides anti-corrosion protection and an improved appearance.

[0046] After protective coating, the solderable tab **50** is attached to the back **20** of the heat sink. The solderable tab **50** is attached by, for example, riveting or welding. The solderable tab may be finished with, for example, plating or electro-plating, to provide anti-corrosion properties while maintaining solderability.

[0047] The solderable tab **50** extends from the back **20** of the heat sink in the same direction as the pins of the associated integrated circuit. The length of the solderable tab **50** is selected so that it extends an appropriate length in order to penetrate the mating hole in the printed circuit board and be soldered to the printed circuit board.

[0048] Refer to **FIG. 2**, which is an assembly drawing illustrating a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention; **FIG. 3**, which is an assembled drawing illustrating a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention; and **FIG. 4**, which

is a plan view drawing showing top, side, and front views of a vertically mounted heat sink with solderable tab and associated integrated circuit according to an embodiment of the present invention.

[0049] Note that in some drawings, the dissipation wings are not shown in order to improve the clarity of the drawing.

[0050] During assembly, the pins **80** of the associated integrated circuit **60** are inserted into mating holes **85** of the printed circuit board **90**. The heat sink **10** is then positioned over the integrated circuit **60** with the solderable tab **50** of the heat sink **10** penetrating a mating hole in the printed circuit board **90**. The retaining clip **40** of the heat sink **10** firmly holds the heat sink **10** and the integrated circuit **60** together. Then, the pins **80** of the integrated circuit **60** and the solderable tab **50** of the heat sink **10** are soldered to contacts on the printed circuit board **90**.

[0051] Note, depending on factors such as assembly ease, the heat sink **10** can be attached to the integrated circuit **60** before attaching to the printed circuit board **90** or after.

[0052] Additionally, in embodiments of the present invention, the heat sink **10** further comprises a hole **5**. The hole **5** allows the heat sink **10** to be additionally fixed to the integrated circuit **60** by means of for example, a screw or bolt, through the hole **5** and a matching hole **75** on the integrated circuit. In other embodiments of the present invention, the hole **5** is not required and therefore not provided.

[0053] Refer to **FIG. 5**, which is an assembly drawing illustrating a vertically mounted heat sink with solderable tab and dimples and associated integrated circuit according to an embodiment of the present invention.

[0054] In embodiments of the heat sink of the present invention, the heat sink **10** further comprises dimples **15**. The dimples **15** are raised in relation to the back **20**. The dimples **15** are formed in the back **20** of the heat sink **10** to provide additional positioning assistance between the heat sink **10** and the integrated circuit **60**. This additional positioning assistance provides further aid in locating the proper positioning of the integrated circuit **60** and the heat sink **10** so that the integrated circuit will slide into position in the heat sink **10**. The number of dimples **15** is variable upon need. For example, in an embodiment of the present invention, three dimples **15** are provided. One is positioned slightly above the hole **5** where the top of the integrated circuit is and two are positioned on either side of where the solderable tab **50** is attached to the back **20** at a proper width slightly greater than the width of the integrated circuit. Therefore, when the integrated circuit **60** is inserted into the heat sink **10**, the dimples **15** will act as guides on each side of the integrated circuit **60**.

[0055] Refer to **FIGS. 6 and 7**, which are drawings illustrating a vertically mounted heat sink with solderable tab and dissipation fins according to an embodiment of the present invention.

[0056] In embodiments of the present invention, the heat sink **10** further comprises dissipation fins **35** in the dissipation wings **30**. This provides additional heat dissipation characteristics to the heat sink **10**. The dissipation fins **35** may be formed within the dissipation wings **30** as shown in **FIG. 6** or may extend through the dissipation wings **30** so that the dissipation fins **36** are fork-like tines in the dissipation wings **30**.

[0057] Also, as shown in **FIGS. 6 and 7**, in embodiments of the present invention, the heat sink **10** further comprises slots **25** in the back **20** of the heat sink **10**. These slots **25** are positioned on both sides of the retaining clip **40**. The slots **25** allow the retaining clip **40** to have an increased spring-like tension. Therefore, the retaining clip **40** can adjust more easily to the body of the associated integrated circuit while maintaining a firmly held grasp.

[0058] It should be noted that various elements, for example, the hole, dimples, slots, or dissipation fins may be omitted without deviating from the scope of the invention. For example, in embodiments of the present invention, the heat sink comprises all, some, or none of these elements.

[0059] Therefore, as described above, the present invention provides a vertically mounted heat sink with dissipation wings for efficiently dissipating heat from an integrated circuit so that the integrated circuit will not overheat and will be able to function properly.

[0060] Additionally, the heat sink of the present invention further provides a retaining clip for effectively holding the heat sink and the integrated circuit together which improves the ease of assembly.

[0061] Also, by utilizing a single piece of metal to form the back, dissipation wings and retaining clip, the heat sink of the present invention is manufactured at a lower cost.

[0062] Furthermore, the heat sink of the present invention further provides a solderable tab for improving the ease of assembly and for sharing the pressure load put on the pins of the integrated circuit.

[0063] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the invention and its equivalent.

What is claimed is:

1. A heat sink for dissipating heat from an integrated circuit comprising:

a main body formed from a single piece of metal, the main body comprising;

a back;

a pair of wings for dissipating heat extending from edges of the back; and

a retaining clip for grasping the integrated circuit, extending from a top of the back and over a front of the back; and

a solderable tab extending from the back in a same direction as pins of the integrated circuit.

2. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the solderable tab is attached to the main body by riveting.

3. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the solderable tab is attached to the main body by welding.

4. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the pair of wings further comprise heat dissipating fins.

5. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the pair of wings further comprise heat dissipating fork-like tines.

6. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the main body is aluminium.

7. The heat sink for dissipating heat from an integrated circuit of claim 1, whereby the main body is anodized.

8. A heat sink for dissipating heat from an integrated circuit comprising:

a back;

a pair of wings for dissipating heat extending from edges of the back; and

a retaining clip for grasping the integrated circuit, extending from a top of the back and over a front of the back; and

a solderable tab extending from the back in a same direction as pins of the integrated circuit.

9. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the solderable tab is attached to the back by riveting.

10. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the solderable tab is attached to the back by welding.

11. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the pair of wings further comprise heat dissipating fins.

12. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the pair of wings further comprise heat dissipating fork-like tines.

13. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the back, the pair of wings and the retaining clip are aluminium.

14. The heat sink for dissipating heat from an integrated circuit of claim 8, whereby the back, the pair of wings and the retaining clip are anodized.

15. A heat sink for dissipating heat from an integrated circuit comprising:

a main body formed from a single piece of metal, the main body comprising;

a back further comprising:

a plurality of raised dimples for assisting in holding the integrated circuit; and

a hole for attaching the heat sink to the integrated circuit;

a pair of wings for dissipating heat extending from edges of the back; and

a retaining clip for grasping the integrated circuit, extending from a top of the back and over a front of the back;

whereby the retaining clip has spring-like tension to firmly hold the integrated circuit between the retaining clip and the back; and

a pair of slots, one on each side of the retaining clip to improve the flexibility of the retaining clip; and

a solderable tab extending from the back in a same direction as pins of the integrated circuit.

16. The heat sink for dissipating heat from an integrated circuit of claim 15, whereby the solderable tab is attached to the main body by riveting.

17. The heat sink for dissipating heat from an integrated circuit of claim 15, whereby the pair of wings further comprise heat dissipating fins.

18. The heat sink for dissipating heat from an integrated circuit of claim 15, whereby the pair of wings further comprise heat dissipating fork-like tines.

19. The heat sink for dissipating heat from an integrated circuit of claim 15, whereby the main body is aluminium.

20. The heat sink for dissipating heat from an integrated circuit of claim 15, whereby the main body is anodized.

* * * * *