FAN ATTACHMENT CLIP FOR HEAT SINK

Related Applications

This application is a continuation-in-part of Serial No. 08/482,011, filed June 7, 1995, Donald Clemens, "Fan Attachment Clip For Heat Sink" now U.S. Patent No. 5,590,025 issued December 31, 1996.

Background of the Invention

This invention relates to a clip for attaching a fan to a heat dissipating heat sink.

Many semiconductor devices generate heat during operation which must be dissipated to avoid damage to the device. Some such devices have power-handling limitations which are largely determined by their ability to expel internally-generated heat and thereby avoid general or localized thermal degradations or failures within them.

In some semiconductor devices, the internally-generated heat is dissipated sufficiently by the enclosure, header or leads of the device. In many semiconductor devices, however, it is necessary to aid the dissipation of internally-generated heat by the use of heat sinks. A wide variety of heat sink designs have been employed for dissipation of internally-generated heat from electronic device packages which house semiconductor devices. For the purposes of the present invention, a heat sink is a body of metal or like material which is placed in contact with an electronic device package for transferring internally-generated heat from the semiconductor device contained in the electronic device

package and for rapid dissipation of the internally-generated heat to the atmosphere by conduction, convection and/or radiation.

U.S. Patent 4,884,331-Hinshaw shows a widely used heat sink commonly referred to as a pin fin heat sink. The heat sink has rows and columns of upstanding parallel fins. The heat sinks are formed by first extruding rows of upstanding fins and then cross-cutting the fins to form rows and columns of pin fins.

These devices are frequently adequate to cool electronic devices by themselves. However, in many applications, it is desirable to add a fan which blows cooling air over the fins of the heat sink. The prior art technique of securing a fan to a heat sink is by inserting a screw, or like fastener, through the mounting holes of the fan into the space between upstanding pin fins. This is not satisfactory, because often a space between pin fins does not line up with all of the mounting holes on the fan. The clip of the present invention obviates this problem.

It is an object of the present invention to provide a clip which makes the assembly of the fan to a heat sink much easier.

Summary of the Invention

In accordance with the present invention, a clip includes a frame having a width which can be wedged between the fins of the heat sink. The clip has means to secure the fan to the frame. The frame is wedged between the fins of the heat sink and then locked in place. The rectangular shape of the frame fits between rows and columns of fins on the heat sink.

The frame is formed from a sheet of resilient metal. The blades extend downwardly from the frame. Blades are inserted between the columns of pin fins in the space formed by cross-cutting.

The clip of the present invention has important advantages when assembled with the blade between columns of pin fins formed by cross-cutting. The cross-cut gap between columns of pin fins is narrow and of a constant dimension. Because of this, the clip of the present invention will always provide good engagement and locking in the heat sink. On the other hand, the gap between the extruded rows of pin fins varies depending upon the size of the heat sink. One size clip will not wedge in the extruded rows of all heat sinks.

The insertion of the clip of the present invention into cross-cut gaps between columns of pin fins has another important advantage. The fins often have better strength in the extruded direction and this is the direction against which the locking force of the clip is applied.

The clip of the present invention is adaptable to different sizes of heat sinks and it is adaptable to different types of fans. The clip of the present invention can be inserted into heat sinks having relatively long or relatively short pin fins. In the longer pin fin heat sinks, the clip does not bottom out at the base, but the clip is securely locked in place.

The clip can be used to mount fans of various types. These include fans which have slots or holes at the corners.

In accordance with the invention, the blades of the frame have arcuate cut-outs. The arcuate cut-out traps a Z clip in the heat sink. This aids in the assembly of a heat sink with a socket wherein the Z clip secures the heat sink to an electronic device.

Further in accordance with the invention, the extruded fins of the heat sink have a ridge or a notch to hold the frame in place in the heat sink. This prevents the fan assembly from pulling off the heat sink. The ridge or notch is extruded into the extrusion before it is cross-cut to make a pin fin heat sink, but the invention can also be used on an extruded heat sink.

In accordance with another modification of the invention, the fins of the heat sink are serrated to form a series of notches and ridges. The fan clip is pushed to a desired, appropriate depth. The clip fits into the notch at this depth. Instead of being latched into a specific notch or ridge, some flexibility in positioning the clip on the heat sink is provided.

Further in accordance with the invention, a nub on the clip prevents the clip and fan from sliding sideways in the heat sink. The nub fits between two pins in a pin fin heat sink to prevent sideways motion.

The foregoing and other objects, features and advantages of the invention will be better understood from the following more detailed description and appended claims.

Short Description of the Drawings

Fig. 1 is an exploded view of a fan, a heat sink and the clip of the present invention;

Fig. 2 is a top view of the clip;

Fig. 2A is a view of the clip on the line 2-2 of Fig. 2;

Fig. 3 is a front view of the clip;

Fig. 4 is a side view of the clip;

Fig. 5 is an exploded view of a fan, the clip of the present invention, a Z-spring retainer, a pin fin heat sink, an electronic device, and a socket;

Fig. 6 shows a modification of the heat sink with a notch for holding the clip in place;

Fig. 7 is an enlarged view of the notch of Figure 6;

Fig. 8 shows the clip in place on the heat sink;

Fig. 9 is another modification wherein a notch on the fins of the heat sink holds the clip in place;

Fig. 10 shows a modification in which the fins are serrated to form a series of notches and ridges to hold the clip in place at a desired depth of the heat sink;

Fig. 11 is an enlarged view of a fin of Figure 10; and

Fig. 12 shows a modification in which the blade of the clip has a nub to prevent sideways movement of the clip.

Description of the Preferred Embodiment

The clip of the prevent invention includes a frame 10 having a width which can be wedged between the fins of the heat sink 12. Heat sink 12 is of the type made in accordance with the aforementioned '331 Hinshaw patent. It has pin fins 14, 16, ... 18 in one row and similar fins in parallel rows. These rows of fins are extruded during the manufacturing process. Then, the rows of fins are cross-cut to form columns of pin fins. For example, pin fins 18, 20 ... 22 are in a first column and there are successive parallel columns of pin fins.

The clip has a width which can be wedged between parallel columns of pin fins. Blades 24 and 26 extend downwardly from the frame. (Hereinafter the words "upwardly" and "downwardly" will be used to describe elements as viewed in

the drawings, but it will be understood that these are relative terms which depend upon the direction from which those elements are viewed.) Blades 24 and 26 bear against the fins to secure the frame in the heat sink after it has been inserted therein. Sides 23 and 25 of the frame fit between adjacent columns of pin fins and sides 27 and 28 fit between adjacent rows of pin fins.

Tabs 30, 32, 34 and 36 lock the frame in the heat sink after it has been inserted. Tab 34 extends upwardly and outwardly from a bend line 38 (Fig. 4) along which the tab is bent out of the plane of the blade. The tab lockingly engages a fin against movement in the direction out of the heat sink. The tabs bite into the metal of the pin fins when upward pressure is exerted so that the frame is locked in the heat sink.

The clip is made of resilient metal such as stainless or plated steel. The clip is formed from a sheet of this resilient metal such that the width of the sheet forms the blades 24 and 26 which fit between the columns of the pin fins. Each of the blades spans one or more rows of the pin fins.

Upstanding corner posts 40-43 engage the fan 11 to secure it to the frame 10. As best shown in Fig. 2A, each corner post is bifurcated so that it compresses as it is pushed into the slots 44 of the fan. The corner posts may also be pushed into mounting holes in the fan. Each corner post has barbs 47, 48. These barbs snap over the top lip of the slots 44-46 to lock the fan to the clip. Alternatively, when a fan has holes, instead of slots, the barbs dig into the hole to lock the fan to the clip.

Two edges 49 of the frame are turned upwardly to form a strengthening rib. This provides stability to the frame.

Each of the blades has an arcuate cut-out 50.

Arcuate cut-out 50 accommodates a wire clip 52 (Fig. 5) which secures the heat sink to a socket. Pages 15-29 of the Thermalloy catalog 90-HS-11, Thermalloy Semiconductor Accessories, show clips for attaching heat sinks to electronic devices. Z-clip 52 is trapped by the arcuate cut-outs 50 in the blades of the clip 10. The Z clip is engaged by the protrusion 53 on socket 54. In this manner, the assembly of socket 54. electronic device 55, heat sink 12, clip 10 and fan 11 are held together.

Figures 6 and 7 show a modification in which the heat sink fin 20 has a ridge 58 which holds the clip in place on the heat sink. The ridge 58 is formed during the extrusion of the fins 18, 20, . . . 22. The ridge 58 holds the fan assembly including the frame on the heat sink so that the frame cannot be pulled off the heat sink. The ridge 58 is extruded on the fin before the heat sink is cross-cut to make a pin fin heat sink.

Figure 8 shows the frame 10 in place on the heat sink with the tabs 32, 34 securely locked under ridge, or projection, 58.

Figure 9 shows another modification in which a notch 59 is formed in at least one extruded fin to hold the clip, and fan assembly, on the heat sink. In similar manner, the tabs 30, 32, 34, and 36 snap into a notch on the fins to hold the clip in place.

Figures 10 and 11 show a modification in which the fins of the heat sink are serrated to form a series of ridges and notches, the projection of which hold the frame at a desired depth in the heat sink. The frame is pushed to an appropriate depth in the heat sink rather than hooking onto a specific notch. This allows flexibility in assembling the heat sink, frame and fan into an assembly.

As shown in Figure 12, the blade has a nub 60 which fits between two rows of fins. This prevents sideways motion of the frame. The nub 60 is bent out of the plane of the blade to form a notch in the blade. This notch can be used to secure a wire clip in the same manner as the cut-out 50 of Figures 1 and 4.

Other embodiments are within the true spirit and scope of the invention. The appended claims, are therefore, intended to cover all such embodiments.

WHAT IS CLAIMED IS:

1. The heat sink recited in claim 21 wherein said projection on said fins of said heat sink includes a ridge for holding said frame in said heat sink.

2. The heat sink recited in claim 21 wherein said projection on said fins of said heat sink includes a notch for holding said frame in said heat sink.

3. The heat sink recited in claim 1 wherein said heat sink is extruded and said ridge is formed during extrusion.

4. The heat sink recited in claim 2 wherein said heat sink is extruded and said notch is formed during extrusion.

5. The clip recited in claim 25 wherein said nub is bent out of the plane of said blade to form a notch in said blade.

6. The clip recited in claim 5 wherein said notch accommodates a wire clip for securing said heat sink to a socket.

7. The clip recited in claim 25 further comprising:
means for locking said frame between the fins of said sink.

8. The clip recited in claim 7, wherein said means for locking includes tabs extending from said blade, said tabs extending upwardly and outwardly from a bend line along which said tabs are bent out of the plane of said blade to lockingly engage said fins against movement in the upward direction.

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9. The clip recited in claim 25, wherein said frame is resilient metal.

10. The clip recited in claim 9 wherein said frame is formed from a sheet of said resilient metal.

11. The clip recited in claim 10 wherein the width of said sheet forms said blades which fit between said columns of pin fins.

12. The clip recited in claim 13 wherein said blade spans at least two of said rows of pin fins.

13. The clip recited in claim 25, wherein said blade has a downwardly facing arcuate cut-out which accommodates a wire clip for securing said heat sink to a socket.

14. The clip recited in claim 25, wherein said means for securing said fan to said frame includes upstanding corner posts which engage said fan to secure it to said frame.

15. The clip recited in claim 14 wherein each corner post is bifurcated.

16. The clip recited in claim 15 wherein each corner post has a barb at the top thereof.

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17. The clip recited in claim 25, wherein at least one edge of said frame is turned upwardly to form a strengthening rib to provide stability to said frame.

18. An assembly including:

a pin fin heat sink having upstanding parallel fins;

a fan for cooling said heat sink; and

a clip for securing said heat sink to said fan comprising:

a frame having a width which can be wedged between said fins of said heat sink; a blade extending downwardly from said frame, a nub on said blade preventing movement of said frame from side to side in said heat sink; and means on said frame for securing said fan to said frame.

19. The assembly recited in claim 18 further including:

a socket;

an electronic device between said socket and said heat sink; and

a wire clip for securing said heat sink to said socket.

20. The assembly recited in claim 18, wherein said blade has a downwardly facing arcuate cut-out which accommodates said wire clip to trap said wire clip in said heat sink.

21. A heat sink having upstanding parallel fins which can be secured to a fan for cooling said heat sink with a rectangular frame having a width which can be wedged between said fins of said heat sink, said rectangular frame spanning rows and columns of said fins, said frame having a blade

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extending downwardly and bearing against said fins to secure said frame to said heat sink, said heat sink comprising:

rows and columns of upstanding fins, a plurality of said rows being within one rectangular dimension of said frame and a plurality of said columns of fins being within the other rectangular dimension of said frame, and

a projection on said fins of said heat sink for holding said frame in said heat sink.

22. The combination of a heat sink and a clip for securing said heat sink to a fan for cooling said heat sink comprising:

a clip having:

a rectangular frame, adjacent sides of said frame fitting between rows and columns of fins on said heat sink;

said frame having a width which can be wedged between said fins of said heat sink; and

a heat sink having upstanding parallel fins in rows and columns; said heat sink having:

means for securing said fan to said frame; and

said fins of said heat sink being serrated to form a plurality of projections on said fins to hold said frame at a desired depth in said heat sink, said frame being lodged in a projection at said desired depth.

23. The combination recited in claim 22 wherein said projections are a plurality of ridges on said fins.

24. The combination recited in claim 22, wherein said projections are formed by notches in said extruded heat sink.

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25. A clip for securing a heat sink having rows and columns of parallel fins to a fan for cooling said heat sink;

a rectangular frame, adjacent sides of said frame fitting between rows and columns of fins on said heat sink;

a blade extending downwardly from said frame, and

a nub on said blade preventing movement of said frame from side to side in said heat sink.

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