

ELECTRICAL TERMINAL AND CARD EDGE CONNECTOR
INCLUDING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to an electrical terminal and a card edge connector, and more particularly, to an electrical terminal including a solder tail with surfaces having different affinities for solder and a card edge connector including the same.

2. Description of the Related Art

10 Electrical terminals are provided in an electrical connector with their solder tails projecting from the bottom of the electrical connector for connection to electrical circuit traces on the printed circuit board. A plurality of designs can be applied to connect the solder tails to the electrical circuit traces on the printed circuit board, and one of these is a
15 method in which short solder tails are butt-welded onto conductive pads connecting to the electrical circuit traces on the printed circuit board.

 During soldering, molten solder is drawn onto the surfaces of the tail portions of the electrical terminals by capillary action after the tail portions are dipped into the molten solder. The tail portion usually has a simple
20 solid shape so that a limited peripheral surface can be used for soldering attachment. Because solder is peripherally adhered to the tail portion and to a limited surface, the adhesive force of the soldering connections of the tail portions may be insufficient.

 In addition, to facilitate solder wetting on the tail portion, the tail
25 portion may have a surface uniformly having an affinity for molten solder. However, such a uniformly solder-philic surface may cause too much molten solder to be wicked onto the tail portions away from the conductive pads on the printed circuit board during reflow, resulting in weak solder

connections between the tail portions and the conductive pads.

Further, conventional tail portions have large tip areas. Therefore, the tail portion can not easily penetrate molten solder to engage the corresponding conductive pad, thus resulting in poor quality of electrical connection. In addition, the large tip area may not be correctly positioned on the corresponding conductive pad, resulting in failed connection between the tail portion and the corresponding conductive pad.

Therefore, due to the soldering drawbacks of the current electrical terminals, new electrical terminals for a card edge connector are required.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide a new and improved card edge connector comprising electrical terminals each including a solder tail with surfaces having different affinities for solder so as to control the flow of the solder.

Another objective of the present invention is to provide a solder tail having an aperture configured to allow solder to form a bridge across such aperture so as to strengthen the solder joint between the solder tail and the pad on a printed circuit board.

In order to achieve the above objectives, an electrical terminal is proposed. The electrical terminal comprises a solder tail and an aperture. The solder tail includes a lower surface, an upper surface, and a boundary defined between the lower surface and the upper surface. The upper surface has a sufficiently lower affinity for solder compared to the lower surface so that the flow of molten solder is restricted. The aperture is configured to extend across the boundary.

One embodiment of the present invention provides a card edge connector, which comprises an insulating housing including a card-receiving slot for receiving a printed circuit card and a plurality of electrical

terminals arrayed in the insulating housing. Each electrical terminal comprises a contact portion, a solder tail, and an aperture. The contact portion, disposed oppositely to the solder tail, is configured to protrude into the card-receiving slot to electrically and mechanically engage the printed circuit card. The solder tail includes a lower surface, an upper surface, and a boundary defined between the lower surface and the upper surface. The upper surface has a sufficiently lower affinity for solder compared to the lower surface so that the flow of molten solder is restricted. The aperture is configured to extend across the boundary.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described according to the appended drawings in which:

FIG. 1 is a perspective view showing an assembly of a card edge connector, a printed circuit board, and a printed circuit card according to one embodiment of the present invention;

FIG. 2 is a perspective view from below of the assembly of FIG. 1;

FIG. 3 is an exploded perspective view of the assembly of FIG. 1;

FIG. 4 is a perspective view from below of the exploded assembly of FIG. 3;

FIG. 5 is an exploded perspective view showing a card edge connector according to one embodiment of the present invention;

FIG. 6 is a perspective view from below of the card edge connector of FIG. 5;

FIG. 7 is a top view showing a card edge connector according to one embodiment of the present invention;

FIG. 8 is a cross-sectional view along line W-W of FIG. 7;

FIG. 9 is a cross-sectional view along line X-X of FIG. 7;

FIG. 10 is a front view showing the arrangement of upper and lower electrical terminals according to one embodiment of the present invention;

FIG. 11 is an enlarged view of rectangle A of FIG. 10;

5 FIG. 12A is a front view showing a solder joint formed between a solder tail and a pad on a printed circuit board according to one embodiment of the present invention; and

10 FIG. 12B is a side view showing a solder joint formed between a solder tail and a pad on a printed circuit board according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, embodiments of the present invention are described in detail with reference to the attached drawings. As illustrated in FIGS. 1 to 4, a card edge connector 3 disposed on a printed circuit board 1 and
15 configured to receive a horizontally oriented printed circuit card 2 locked by two latch arms 311 is exemplarily demonstrated.

Referring to FIG. 4, the card edge connector 3 may comprise an elongated insulating housing 31 having two oppositely disposed latch arms 311, and a card-receiving slot 312 extending between the two latch arms
20 311 for receiving the printed circuit card 2, two oppositely disposed mounting members 313 respectively adjacent to the two latch arms 311, and a terminal support member 315 disposed opposite the card-receiving slot 312. The card-receiving slot 312 is unequally divided by a polarizing rib 314 for preventing the printed circuit card 2 from being improperly installed.
25 Referring to FIGS. 3 and 4, a plurality of upper grooves 317 are formed on the upper surface 319 of the terminal support member 315, and a plurality of edge grooves 318 are formed on the edge surface 320 of the terminal support member 315 with respect to the plurality of upper grooves 317. In

addition, a plurality of bottom grooves 316 are formed on the bottom surface of the insulating housing 31.

Referring to FIGS. 5 and 6, the card edge connector 3 comprises a plurality of upper electrical terminals (4a and 4b) and a plurality of lower electrical terminals (4c and 4d). The plurality of upper grooves 317 are configured to receive respectively the plurality of upper electrical terminals (4a and 4b) inserted from the back side of the insulating housing 31, and the plurality of bottom grooves 316 are configured to receive respectively the plurality of lower electrical terminals (4c and 4d). Each of the upper electrical terminals (4a and 4b) may comprise a cantilevered contact portion 42, a solder tail 45, and an interconnecting section 48 or 49 extending between the contact portion 42 and the solder tail 45. The interconnecting section 48 or 49 may include at least one retention portion 46 or 47 laterally extending and configured for fixing the respective one of the upper electrical terminals (4a and 4b) to the insulating housing 31. In the present embodiment, the interconnecting section 48 or 49 includes an elongated body portion 41 and a connecting portion 43 or 44. The cantilevered contact portion 42 extends from one end of the body portion 41, and the connecting portion 43 or 44 extends from another end of the body portion 41 and is bent to connect to the respective solder tail 45, wherein a portion of the connecting portion 43 or 44 is received by the respective edge groove 318 of the terminal support member 315 after the upper electrical terminal 4a or 4b is inserted into the respective upper groove 317. Each of the retention portions 46 and 47 may include at least one barb for retention. The retention portions 46 and 47 may extend along the insertion direction of the upper electrical terminal 4a or 4b, and may be separately disposed on the body portion 41 and the respective connecting portion 43 or 44 of the upper electrical terminals 4a or 4b as shown in FIG. 5. Each connecting portion 43 or 44 may extend obliquely and be bent transversely relative to the body portion 41. The connecting portion 43 of the upper electrical terminals 4a and the connecting portion 44 of the upper electrical terminals 4b can have different extension lengths such that the solder tails 45 of the

alternately arranged upper electrical terminals 4a and 4b can be arrayed in a staggered manner.

Similarly, each of the lower electrical terminals 4c and 4d may comprise a cantilevered contact portion 52, a solder tail 45, and an
5 interconnecting section 58 or 59 extending between the contact portion 52 and the solder tail 45. The interconnecting section 58 or 59 may include at least one retention portion 56 configured for fixing the respective one of the upper electrical terminals (4c and 4d) to the insulating housing 31. In the present embodiment, the interconnecting section 58 or 59 includes an
10 elongated body portion 51 and a connecting portion 53 or 54. The cantilevered contact portion 52 extends from one end of the body portion 51, and the connecting portion 53 or 54 extends from another end of the body portion 51 and is bent to connect to the respective solder tail 45. The lower electrical terminals 4c and 4d are inserted from the bottom of the insulating
15 housing 31, and a plurality of retention portions 56, each of which may include at least one barb, are provided on the upper edge of each of the lower electrical terminals 4c and 4d, extending along the insertion direction of the lower electrical terminals 4c and 4d for fixing the respective one of the lower electrical terminals 4c and 4d to the insulating housing 31. The
20 lower electrical terminals 4c and 4d can be alternately arranged and respectively have connecting portions 53 and 54 in different lengths such that the solder tails 45 can be arranged in a staggered manner.

Referring to FIGS. 7 to 9, each bottom groove 316 includes a plurality of cavities 321 for receiving the respective retention portions 56 of the
25 lower electrical terminal 4c. The plurality of oppositely projecting barbs are configured to interference fit with the two opposite side surfaces defining the respective cavity 321. The solder tail 45 projects downward from the insulating housing 31, and the contact portion 52 protrudes forward and upward into the lower portion of the card-receiving slot 312 for engaging
30 the respective contact pad 21 on the lower side of the printed circuit card 2.

Moreover, each upper groove 317 also comprises a plurality of cavities

322 for receiving the respective retention portions 46 and 47 of the upper electrical terminal 4b. The at least one barb projecting from each of the retention portions 46 and 47 is configured to interference fit with the respective side surface defining the cavity 322. The solder tail 45 of the upper electrical terminal 4b projects downward from the insulating housing 31, and the contact portion 42, projecting upward and then forward, is located at the upper portion of the card-receiving slot 312 for engaging the respective contact pad 21 on the upper side of the printed circuit card 2.

Referring to FIGS. 10 and 11, the solder tails 45 of the upper electrical terminals (4a and 4b) and the lower electrical terminals (4c and 4d) extend downward from the insulating housing 31 at different locations, and therefore, the solder tails 45 are arranged in a periodically staggered fashion. Each solder tail 45 comprises a lower surface 451 and an upper surface 452. The lower surface 451 is configured to have an affinity for solder, and the upper surface 452 is configured to have a lower affinity for solder than the lower surface 451. A boundary 453 is defined to separate the lower surface 451 and the upper surface 452. Specifically, the upper surface 452 has a sufficiently lower affinity for solder compared to the lower surface 451 so that the flow of the molten solder can be restricted or stopped around the boundary 453. Therefore, a proper amount of molten solder is wicked upward so as to allow sufficient amount of molten solder to form a strong solder joint. In particular, the lower surface 451 can be formed of a material having excellent solderability such as tin, gold, silver, and palladium, or a material having good solderability such as copper, lead, bronze, brass, and nickel-silver. In contrast, the upper surface 452 can be formed of a material having fair solderability such as nickel and zinc, or of a material having poor solderability such as aluminum-bronze. In another embodiment, the lower surface 451 can be a solder-philic surface, where molten metal can form a contact angle smaller than 90 degrees with respect to the lower surface 451. In contrast, the upper surface 452 can be a solder-repellent surface, where molten metal can form a contact angle larger than 90 degrees with respect to the upper surface 452.

In addition, an aperture 454 can further be formed on the solder tail 45, extending across the boundary 453 as shown in FIG. 11. The aperture 454 can further restrict upward flow of molten solder because of the reduction of the capillary force drawing molten solder. The aperture 454 causes the solid area of a cross section passing therethrough to be smaller than the area of a cross section that does not pass therethrough, or causes the peripheral length of a cross section passing therethrough to be smaller so as to reduce the capillary force.

Referring to FIGS. 12A and 12B, the disposition of the aperture 454 can increase the surface area that can be used for soldering attachment. The aperture 454 can be configured to allow molten solder to flow therethrough and to form a bridge across the aperture 454 as shown in FIG. 12A, and a mechanical joint can be formed between the solder tail 45 and a respective contact pad 11 on a printed circuit board 1. Specifically, molten solder may be drawn upward, entering the aperture 454, and accumulating, as shown in FIG. 12B, above the lower transverse portion of the solder tail 45, underneath the aperture 454 such that the lower transverse portion of the solder tail 45 can be firmly clamped. Therefore, the strength of the solder joint between the solder tail 45 and the respective contact pad 11 on the printed circuit board 1 can be increased.

Moreover, the solder tail 45 may further comprise a protrusion 455 protruding centrally from the distal tip end 4551 of the solder tail 45. The protrusion 455 is configured to be soldered on a respective contact pad 11 on the printed circuit board 1 and to allow solder paste to flow around the protrusion 455 so that a strong joint can be formed. The protrusion 455 can have a height smaller than the height H of a solder paste 6 ready to be dipped by the solder tail 45. Specifically, the protrusion 455 may include a height in a range of from 0.05 to 0.15 millimeters. Compared to the distal tip end 4551 of the solder tail 45, the protrusion 45 has a smaller tip area. Therefore, the protrusion 45 can more easily penetrate molten solder over a respective contact pad 11 and engage the respective contact pad 11 during a

soldering process such that high quality of electrical connection between the solder tail 45 and the contact pad 11 can be ensured. In addition, with small tip area, the protrusion 45 can be easily and correctly positioned on the respective contact pad 11.

5 Referring back to FIGS. 4 to 6, each mounting member 313 may comprise a plurality of holes 3131, and studs 7 are configured to be inserted into the respective holes 3131 and to engage the respective openings 12 on the printed circuit board 1 so as to secure the card edge connector 3 to the printed circuit board 1. Further, the card edge connector 3 may comprise a
10 plurality of pegs 323 extending from the bottom of the insulating housing 31 and a plurality of locating plates 8 disposed below the mounting members 313 respectively. The plurality of pegs 323 and the plurality of locating plates 8 are configured to engage the respective openings 13 and 14 for positioning the card edge connector 3.

15 In summary, the card edge connector 3 of the present invention comprises a plurality of electrical terminals each including a solder tail having a lower surface, an upper surface, and a boundary defined between the lower surface and the upper surface. The upper surface has a sufficiently lower affinity for solder compared to the lower surface so as to
20 restrict the flow of molten solder. Further, an aperture is formed on the solder tail such that the upward flow of the molten solder can further be restricted due to the reduction of capillary force. In addition, the aperture can be configured to allow molten solder to flow through the aperture and to transversely form a bridge across the aperture. Subsequently, a
25 mechanical joint can be formed between the solder tail and a respective pad on a printed circuit board.

The above-described embodiments of the present invention are intended to be illustrative only. Numerous alternative embodiments may be devised by persons skilled in the art without departing from the scope of the
30 following claims.

What is claimed is:

1. An electrical terminal, comprising:
a solder tail having a lower surface, an upper surface, and a boundary defined between the lower surface and the upper surface, wherein the upper
5 surface has a sufficiently lower affinity for solder compared to the lower surface; and
an aperture extending across the boundary.
2. The electrical terminal of Claim 1, wherein the solid area of a cross section passing through the aperture is smaller than the area of a cross
10 section that does not pass through the aperture.
3. The electrical terminal of Claim 1, wherein the solder tail further comprises a protrusion protruding centrally from a distal tip end thereof.
4. The electrical terminal of Claim 3, wherein the protrusion has
15 a height less than that of a solder paste ready to be dipped by the solder tail.
5. The electrical terminal of Claim 4, further comprising a contact portion configured for electrically engaging a printed circuit card, and an interconnecting section extending between the solder tail and the contact portion, wherein the interconnecting section includes at least one
20 retention portion laterally extending and configured for fixing the electrical terminal.
6. The electrical terminal of Claim 3, wherein the protrusion is configured to penetrate a solder paste ready to be dipped by the solder tail.
7. The electrical terminal of Claim 3, wherein the protrusion has
25 a height in a range of from 0.05 to 0.15 millimeters.

8. The electrical terminal of Claim 1, wherein the aperture is configured to allow solder to form a bridge across the aperture.

9. The electrical terminal of Claim 1, wherein the lower surface is a solder-philic surface, and the upper surface is a solder-repellent surface.

5 10. The electrical terminal of Claim 1, wherein the lower surface is formed of a material having an affinity for solder, and the material includes gold, silver, and tin.

10 11. The electrical terminal of Claim 1, wherein the upper surface is formed of a material having a lower affinity for solder, and the material includes nickel and zinc.

12. A card edge connector, comprising:

an insulating housing including a card-receiving slot for receiving a printed circuit card; and

15 a plurality of electrical terminals arrayed in the insulating housing, each electrical terminal comprising:

a contact portion configured to protrude into the card-receiving slot to electrically and mechanically engage the printed circuit card;

20 a solder tail having a lower surface, an upper surface, and a boundary defined between the lower surface and the upper surface, wherein the upper surface has a sufficiently lower affinity for solder compared to the lower surface so that the flow of molten solder is restricted; and

an aperture extending across the boundary.

25 13. The card edge connector of Claim 12, wherein the solid area of a cross section passing through the aperture is smaller than the area of a cross section that does not pass through the aperture.

14. The card edge connector of Claim 12, wherein the solder tail further comprises a protrusion protruding centrally from a distal tip end thereof.

15. The card edge connector of Claim 14, wherein the protrusion
5 has a height less than that of a solder paste ready to be dipped by the solder tail.

16. The card edge connector of Claim 15, wherein each electrical terminal further comprises a contact portion configured for electrically engaging the printed circuit card, and an interconnecting section extending
10 between the solder tail and the contact portion, wherein the interconnecting section includes at least one retention portion laterally extending and configured for fixing the electrical terminal.

17. The card edge connector of Claim 16, wherein the insulating housing comprises a terminal support member disposed opposite the card-receiving slot and having a plurality of upper grooves, and the plurality of
15 electrical terminals comprise a plurality of upper electrical terminals and a plurality of lower electrical terminals, wherein the plurality of upper grooves are configured to respectively receive the plurality of upper electrical terminals.

18. The card edge connector of Claim 17, wherein the insulating housing comprises a plurality of bottom grooves formed on the bottom of the insulating housing for respectively receiving the plurality of lower
20 electrical terminals.

19. The card edge connector of Claim 18, wherein the insulating
25 housing comprises two oppositely disposed latch arms for locking the printed circuit card.

20. The card edge connector of Claim 19, wherein the insulating

housing comprises two oppositely disposed mounting members respectively adjacent to the two latch arms, and each mounting member includes a plurality of holes for receiving a stud for securing the insulating housing to a printed circuit board.

5 21. The card edge connector of Claim 14, wherein the protrusion is configured to penetrate a solder paste ready to be dipped by the solder tail.

22. The card edge connector of Claim 14, wherein the protrusion has a height in a range of from 0.05 to 0.15 millimeters.

10 23. The card edge connector of Claim 12, wherein the aperture is configured to allow a solder paste to form a bridge across the aperture.

24. The card edge connector of Claim 12, wherein the lower surface is a solder-philic surface, and the upper surface is a solder-repellent surface.

15 25. The card edge connector of Claim 12, wherein the lower surface is formed of a material having an affinity for solder, and the material includes gold, silver, and tin.

26. The card edge connector of Claim 12, wherein the upper surface is formed of a material having a lower affinity for solder, and the material includes nickel and zinc.