

## **ELECTRICAL CONNECTOR WITH RETENTION MEMBERS**

### **TECHNICAL FIELD**

The present disclosure relates to electrical connectors. In particular, the present invention relates to electrical connectors with retention members that provide reliable  
5 mounting of the electrical connectors to a substrate such as, e.g., a printed circuit board.

### **BACKGROUND**

It is well known to provide electrical connectors mountable to a printed circuit board, with contact terminals therein electrically coupled to respective electrical circuit traces on the board. The terminals may have solder tails projecting from the connector and inserted into  
10 holes in the board, or the terminals may have leg portions generally parallel to the board for surface mounting in electrical engagement with circuit traces on the board. In either instance, the terminals are coupled to the circuit traces on the board most commonly by solder connections, either between the solder tails and plated through-holes in the board or between the surface mounted leg portions and the circuit traces on the board surface.

15 One of the problems with electrical connectors mounted to printed circuit boards is that the electrical connections between the contact terminals and the board circuits often are subjected to stresses which can weaken or destroy the electrical connections.

Surface-mounted electrical connectors, such as, e.g., Small Form Factor (SFF) connectors, most often have some form of hold-down means for securing the connector to a  
20 surface of the printed circuit board. The hold-down means may be provided for permanent securement of the connector or for temporarily maintaining the connector on the board. Such hold-down means may be provided by mounting pegs which are integral with the connector housing or by separate hold-down devices or clips. A typical arrangement is to provide the mounting pegs or clips with a bifurcated configuration, along with outwardly projecting hooks  
25 or barbs for engaging the opposite surface of the printed circuit board, whereby the pegs or clips can be yieldingly inserted through holes in the board and snappingly engage the opposite side of the board to hold the connector onto the one surface of the board.

Other hold-down means have been provided in the form of screws, bolts or other clamping devices. However, with the ever-increasing miniaturization of electronic circuitry, along with the consequent reduction in sizes of the connectors and terminals, such clamping devices often are impractical and neither cost nor space effective. Consequently, various types of retention devices have been used which, themselves, may be secured to the surface of the printed circuit board by a substantial soldered area. Most such devices are costly due to reasons such as, e.g., material waste and high tooling cost associated with the need for connector pin count specific designs, the need for a multi-step assembly process, and limitations with respect to selective plating, to name a few. In addition, many such devices do not provide sufficient support between the connector and the printed circuit board.

## SUMMARY

An object of the invention is to provide retention members for an electrical connector mountable to a substrate such as, e.g., a printed circuit board.

In one aspect, the present invention provides an electrical connector including an insulative housing, a plurality of terminals received in the insulative housing, and a pair of retention members. The insulative housing has a top wall, a bottom wall, a back wall and a pair of side walls. The pair of retention members is inserted horizontally and from opposing ends of the insulative housing into the pair of side walls to retain the insulative housing on a circuit substrate.

In another aspect, the present invention provides a method of assembling an electrical connector. The method includes providing an insulative housing having a top wall, a bottom wall, a back wall and a pair of side walls, providing a pair of retention members, and horizontally and from opposing ends of the insulative housing inserting the pair of retention members into the pair of side walls.

The above summary of the present invention is not intended to describe each disclosed embodiment or every implementation of the present invention. The Figures and detailed description that follow below more particularly exemplify illustrative embodiments.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded top perspective view of an exemplary embodiment of an electrical connector according to an aspect of the present invention.

Fig. 2 is a top perspective view of the electrical connector of Fig. 1.

5 Fig. 3 is a bottom perspective view of the electrical connector of Fig. 1.

Fig. 4 is a top perspective view of a retention member of the electrical connector of Fig. 1.

Fig. 5 is a top perspective view of the electrical connector of Fig. 1 illustrating the retention members in an unassembled configuration.

10 Fig. 6a is a top perspective view of the electrical connector of Fig. 1 illustrating the retention members in a partially assembled configuration.

Fig. 6b is a perspective cross-sectional view of the electrical connector of Fig. 1 illustrating the retention members in a partially assembled configuration.

15 Fig. 7a is a top perspective view of the electrical connector of Fig. 1 illustrating the retention members in a fully assembled configuration.

Fig. 7b is a perspective cross-sectional view of the electrical connector of Fig. 1 illustrating the retention members in a fully assembled configuration.

## DETAILED DESCRIPTION

20 In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof. The accompanying drawings show, by way of illustration, specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is  
25 defined by the appended claims.

Referring now to the Figures, Figures 1-3 illustrate an exemplary embodiment of an electrical connector according to an aspect of the present invention. Electrical connector 2 includes an insulative housing 4 having a top wall 6, a bottom wall 8, a back wall 10, and a pair of sides walls 12a and 12b (also referred to herein as “side walls 12”). Side walls 12

interconnect with top wall 6, bottom wall 8, and back wall 10 to cooperatively define a receiving passage 16 along a horizontal direction. Receiving passage 16 is configured to receive a mating plug connector (not shown). Bottom wall 8 of insulative housing 4 may include one or more mounting posts 18 configured to position electrical connector 2 to a circuit substrate, such as, e.g., printed circuit board 20.

Electrical connector 2 further includes a plurality of terminals separated into two distinct sets 14a and 14b along a vertical direction. The first set of terminals 14a and the second set of terminals 14b extend into receiving passage 16 and provide an electrical transmission path from a mating plug connector (not shown) to a circuit substrate, such as, e.g., printed circuit board 20. The first set of terminals 14a is similar to the second set of terminals 14b in that each terminal in the two sets includes a contact portion 22 that extends into receiving passage 16 and a terminal portion 24 that extends out of insulative housing 4 for attachment to a circuit substrate, such as, e.g., printed circuit board 20. Although terminal portion 24 is illustrated in a surface mount configuration, in other embodiments, terminal portion 24 may be configured in a through-hole configuration, such as, e.g., a solder configuration or a press-fit configuration. Each terminal also includes a body portion 26 that is positioned intermediate contact portion 22 and terminal portion 24 to interconnect them together. Each terminal may further include a retention portion 28 primarily configured to retain the terminal in insulative housing 4.

The first set of terminals 14a are inserted into a plurality of top slots 30 disposed in top wall 6 of insulative housing 4. Top slots 30 include openings (not shown) that communicate with receiving passage 16 and are positioned such that contact portions 22 of the first set of terminals 14a at least partially extend into receiving passage 16. The second set of terminals 14b are inserted into a plurality of bottom slots 32 disposed in bottom wall 8 of insulative housing 4. Bottom slots 32 include openings (not shown) that communicate with receiving passage 16 and are positioned such that contact portions 22 of the second set of terminals 14b at least partially extend into receiving passage 16.

Still referring to Figures 1-3, and additionally to Figure 4, electrical connector 2 further includes a pair of retention members 34. Retention members 34 are inserted horizontally and from opposing ends of insulative housing 4 into side walls 12 of insulative

housing 4. In the illustrated embodiment, one retention member 34 is inserted horizontally into side wall 12a from a front end 4a of insulative housing 4, i.e., the end adjacent receiving passage 16, and the other retention member 34 is inserted horizontally into side wall 12b from a back end 4b of insulative housing 4, i.e., the end adjacent back wall 10. In an alternative  
5 embodiment, side walls 12 may be designed such that one retention member 34 is inserted horizontally into side wall 12a from back end 4b of insulative housing 4, and the other retention member 34 is inserted horizontally into side wall 12b from front end 4a of insulative housing 4.

Inserting retention members 34 horizontally and from opposing ends of insulative  
10 housing 4 into side walls 12 of insulative housing 4 significantly improves the strength and durability of the attachment of electrical connector 2 to a circuit substrate, such as, e.g., printed circuit board 20. If retention members 34 were both inserted from front end 4a of insulative housing 4, the retention of insulative housing 4 with respect to retention members 34 would be compromised during insertion of a mating plug connector. During insertion of a  
15 mating plug connector, insulative housing 4 would have a tendency to move in the insertion direction (as indicated by arrow A in Figure 2). Similarly, if retention members 34 were both inserted from back end 4b of insulative housing 4, the retention of insulative housing 4 with respect to retention members 34 would be compromised during extraction of a mating plug connector. During extraction of a mating plug connector, insulative housing 4 would have a  
20 tendency to move in the extraction direction (as indicated by arrow B in Figure 2). In contrast, inserting retention members 34 horizontally and from opposing ends of insulative housing 4 into side walls 12 of insulative housing 4 prevents these potential movements. During insertion of a mating plug connector, retention member 34 inserted into side wall 12b helps to prevent movement of insulative housing 4 in the insertion direction. During extraction of a  
25 mating plug connector, retention member 34 inserted into side wall 12a helps to prevent movement of insulative housing 4 in the extraction direction. Thus, cooperatively, retention members 34 help to prevent movement of insulative housing 4 during insertion and extraction of a mating plug connector. In addition, retention members 34 help to prevent forward and backward tilt (as indicated by arrows C and D, respectively, in Figure 2) and clockwise and

counterclockwise rotation (as indicated by arrows E and F, respectively, in Figure 2) of insulative housing 4 during insertion and extraction of a mating plug connector.

Further, inserting retention members 34 horizontally and from opposing ends of insulative housing 4 into side walls 12 of insulative housing 4 enables retention members 34 to have a substantially identical shape. In other words, there is no need to have a first retention member shaped specifically for insertion into side wall 12a of insulative housing 4 and a second retention member shaped specifically for insertion into side wall 12b of insulative housing 4. Having a single retention member design, compared to having two distinct retention member designs, reduces the number of distinct components and simplifies the assembly process of electrical connector 2, resulting in a lower cost of electrical connector 2.

To retain electrical connector 2 on a circuit substrate, such as, e.g., printed circuit board 20, with a balanced retention strength, retention members 34 may be positioned symmetrically with respect to insulative housing 4. An exemplary axis of symmetry  $C_L$  is illustrated in Figure 3.

Referring now to Figure 4, each retention member 34 includes a body portion 36 having a front end 38 and a back end 40. Each retention member 34 further includes a front engaging portion 42 extending from front end 38, a back engaging portion 44 extending from back end 40, and a foot portion 46 horizontally extending outward from body portion 36. In the illustrated embodiment, front engaging portion 42 is generally s-shaped, and back engaging portion 44 is generally hook-shaped. These shapes of front engaging portion 42 and back engaging portion 44 facilitate assembly of retention member 34 in insulative housing 4, as described below and illustrated in Figures 5-7b.

In a preferred embodiment, retention members 34 are made of a sheet metal by metal stamping and forming. In other embodiments, retention members 34 may be formed of a polymeric material by methods such as injection molding, extrusion, casting, machining, and the like, or may be formed of metal by methods such as molding, casting, stamping, machining, and the like, as suitable for the intended application. In one embodiment, foot portion 46 is selectively plated. This means that body portion 36, front engaging portion 42, and back engaging portion 44 may be unplated, or may be plated with a relatively lower performance/lower cost plating, such as, e.g., a layer of tin over a layer of nickel, while foot

portion 46 may be plated with a relatively higher performance/higher cost plating, such as, e.g., a layer of gold or palladium nickel over a layer of nickel. Compared to overall plating of retention member 34 with a relatively higher performance/higher cost plating, selective plating of foot portion 46 with a relatively higher performance/higher cost plating facilitates the same desired connection to a circuit substrate, such as, e.g., printed circuit board 20, but at a significantly lower cost.

Referring again to Figure 1, side walls 12 each include a first slot 48, a second slot 50, and a recessed portion 52 connecting first slot 48 to second slot 50. When electrical connector 2 is in an assembled configuration, body portion 36 of retention member 34 is positioned in recessed portion 52, front engaging portion 42 of retention member 34 is inserted into first slot 48, and back engaging portion 44 of retention member 34 is inserted into second slot 50. To facilitate insertion of retention members 34 from opposing ends of insulative housing 4, first and second slots 48, 50 in side wall 12a are positioned in an opposing orientation with respect to first and second slots 48, 50 in side wall 12b. In the embodiment illustrated in Figure 1, first slot 48 in side wall 12a is positioned adjacent back end 4b of insulative housing 4 and first slot 48 in side wall 12b is positioned adjacent front end 4a of insulative housing 4. Similarly, second slot 50 in side wall 12a is positioned adjacent front end 4a of insulative housing 4 and second slot 50 in side wall 12b is positioned adjacent back end 4b of insulative housing 4.

Figures 5-7b illustrate an exemplary method of assembling electrical connector 2. In Figure 5, insulative housing 4 and a pair of retention members 34 are provided. Retention members 34 are illustrated in an unassembled configuration. Prior to assembly, retention members 34 are positioned such that they can be moved horizontally towards side walls 12 such that body portion 36 of retention members 34 can be positioned in recessed portion 52 of side walls 12 (as indicated by arrows G and H). In Figures 6a-6b, body portion 36 of retention members 34 is positioned in recessed portion 52 of side walls 12. Retention members 34 are illustrated in a partially assembled configuration. Retention members 34 are positioned such that retention member 34 associated with side wall 12a can be moved horizontally towards back end 4b of insulative housing 4 (as indicated by arrow I) and retention member 34 associated with side wall 12b can be moved horizontally towards front end 4a of insulative

housing 4 (as indicated by arrow J). In Figures 7a-7b, retention member 34 associated with side wall 12a has been moved horizontally towards back end 4b of insulative housing 4 and retention member 34 associated with side wall 12b has been moved horizontally towards front end 4a of insulative housing 4. Retention members 34 are illustrated in a fully assembled configuration. Body portion 36 of retention member 34 is positioned in recessed portion 52 of side walls 12, front engaging portion 42 of retention member 34 is inserted into first slot 48 of side walls 12, and back engaging portion 44 of retention member 34 is inserted into second slot 50 of side walls 12. One or both of front engaging portion 42 and back engaging portion 44 function to maintain retention member 34 in a fixed relative position with respect to insulative housing 4. Front and back engaging portions 42, 44 may be retained in first and second slots 48, 50, respectively, using any suitable method/structure, including but not limited to snap fit, friction fit, press fit, mechanical clamping, and adhesive. In the embodiment illustrated in Figures 7a-7b, front engaging portion 42 is generally s-shaped and back engaging portion 44 is generally hook-shaped. This configuration enables one or both of front engaging portion 42 and back engaging portion 44 to function as a stop to limit insertion of retention member 34.

Inserting retention members 34 may occur in a single operation, which improves the efficiency of the assembly operation, resulting in a lower cost of electrical connector 2. To further improve the efficiency of the assembly operation, inserting retention members 34 and inserting one or both of the first set of terminals 14a and the second set of terminals 14b may occur in a single operation. The first set of terminals 14a and the second set of terminals 14b may be inserted from opposing ends of insulative housing 4 using any suitable method.

In each of the embodiments and implementations described herein, the various components of the electrical connector and elements thereof are formed of any suitable material. The materials are selected depending upon the intended application and may include both metals and non-metals (e.g., any one or combination of non-conductive materials including but not limited to polymers, glass, and ceramics). In one embodiment, electrically insulative components, such as, e.g., insulative housing 4, are formed of a polymeric material by methods such as injection molding, extrusion, casting, machining, and the like, while electrically conductive components, such as, e.g., the first set of terminals 14a and the second

set of terminals 14b, are formed of metal by methods such as molding, casting, stamping, machining, and the like. Material selection will depend upon factors including, but not limited to, chemical exposure conditions, environmental exposure conditions including temperature and humidity conditions, flame-retardancy requirements, material strength, and rigidity, to  
5 name a few.

Although specific embodiments have been illustrated and described herein for purposes of description of the preferred embodiment, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate and/or equivalent implementations calculated to achieve the same purposes may be substituted for the specific embodiments  
10 shown and described without departing from the scope of the present invention. Those with skill in the mechanical, electro-mechanical, and electrical arts will readily appreciate that the present invention may be implemented in a very wide variety of embodiments. This application is intended to cover any adaptations or variations of the preferred embodiments discussed herein. Therefore, it is manifestly intended that this invention be limited only by the  
15 claims and the equivalents thereof.

What is claimed is:

1. An electrical connector comprising:  
an insulative housing having a top wall, a bottom wall, a back wall and a pair of side  
walls;  
5 a plurality of terminals received in the insulative housing; and  
a pair of retention members inserted horizontally and from opposing ends of the  
insulative housing into the pair of side walls to retain the insulative housing on a  
circuit substrate.
2. The electrical connector of claim 1, wherein the side walls interconnect with the top  
10 wall, the bottom wall, and the back wall to cooperatively define a receiving passage along a  
horizontal direction.
3. The electrical connector of claim 1, wherein the terminals are separated into two  
distinct sets along a vertical direction.
4. The electrical connector of claim 1, wherein the retention members each include:  
15 a body portion having a front end and a back end;  
a front engaging portion extending from the front end of the body portion;  
a back engaging portion extending from the back end of the body portion; and  
a foot portion horizontally extending outward from the body portion.
5. The electrical connector of claim 4, wherein the side walls each include:  
20 a first slot;  
a second slot; and  
a recessed portion connecting the first slot to the second slot,  
wherein the body portion is positioned in the recessed portion, wherein the front  
engaging portion is inserted into the first slot, and wherein the back engaging  
25 portion is inserted into the second slot.

6. The electrical connector of claim 4, wherein the front engaging portion is generally s-shaped.
7. The electrical connector of claim 4, wherein the back engaging portion is generally hook-shaped.
- 5 8. The electrical connector of claim 4, wherein the retention member is made of a sheet metal.
9. The electrical connector of claim 4, wherein the foot portion is selectively plated.
10. The electrical connector of claim 1, wherein the retention members are positioned symmetrically with respect to the insulative housing.
- 10 11. A method of assembling an electrical connector comprising:  
providing an insulative housing having a top wall, a bottom wall, a back wall and a pair of side walls;  
providing a pair of retention members; and  
horizontally and from opposing ends of the insulative housing inserting the pair of  
15 retention members into the pair of side walls.
12. The method of claim 11, wherein inserting the pair of retention members occurs in a single operation.
13. The method of claim 11, wherein the retention members each include a body portion having a front end and a back end, a front engaging portion extending from the front end of  
20 the body portion, a back engaging portion extending from the back end of the body portion, and a foot portion horizontally extending outward from the body portion, wherein the side walls each include a first slot, a second slot, and a recessed portion connecting the first slot to the second slot, and wherein inserting the pair of retention members includes positioning the body portion in the recessed portion, inserting the front engaging portion into the first slot,  
25 and inserting the back engaging portion into the second slot.

14. The method of claim 11 further comprising providing a plurality of terminals and inserting the terminals into the insulative housing.

15. The method of claim 14, wherein inserting the pair of retention members and inserting the terminals occurs in a single operation.

5 16. The method of claim 14, wherein the terminals are separated into two distinct sets along a vertical direction, and wherein inserting the terminals into the insulative housing includes inserting the distinct sets from opposing ends of the insulative housing.

17. The method of claim 11, wherein providing a pair of retention members includes selectively plating a foot portion of the retention members.