



**SURFACE MOUNT CONNECTOR ASSEMBLY FOR
DOCKING-STYLE CONNECTOR APPLICATIONS**



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Background of the Invention

The present invention relates generally to a surface mount connector assembly for mounting to circuit boards, and more particularly relates to an improved surface mount assembly for connecting a multi-wire cable connector, such as an input/output ("I/O") connector to circuits on a circuit board along an edge portion of the circuit board.

Conventional surface mount connectors are constructed from an electrically insulative housing and have a plurality of conductive terminals loaded within the connector housing. Solder tails formed on the terminals extend out of the connector housing and are soldered to conductive pads arranged on the circuit board. The solder tails are soldered to the surface of the circuit board by the reflow or solder dipping method where the surface mount connector terminals extend through throughholes formed in the circuit board. Where a throughhole manner of mounting is used, the through holes on the opposite side of the circuit board take up valuable space on the circuit board that could otherwise be used for accommodating circuitry and components.

These surface mount connectors are matable with other connectors. The surface mount connectors are usually oriented with their engagement portions being of a straight-type engagement that is oriented upwardly or a right angle-type engagement that is oriented parallel to the circuit board. When the number of terminals is increased and the connector size remains the same, the pitch of the terminals must be decreased

accordingly. Surface soldering is frequently used in such applications, and the solder tails of the connector are arranged on two opposing sides of the connector housing.

5 In this type of structure, the right angle-type engagement portion of the surface mount connectors have terminals that extend out from the rear side of the connector. These terminals must have a longer length as compared to the terminals arranged on the front side of the connector, thereby causing a difficulty in maintaining a predetermined pitch of the solder tails
10 extending out of the front side of the connector.

Furthermore, the soldered ends of the solder tails are exposed around the engagement end of an opposing cable connector which potentially may cause difficulty in engaging the cable connector on the wire side, or the cable connector may
15 unexpectedly impact upon and cause damage to the soldered ends of the solder tails. Additionally, the coupling of a cable connector to the surface mount connector may exert forces on the soldered ends of the solder tail portions during engagement, and these forces may cause breakage of the soldered portion.

20 Additionally, where throughhole surface mount connectors are used, the throughholes formed in the circuit board prevent the use of a surface mount, or any other style connector, on the opposite side of the circuit board. Thus, this type of arrangement wastes space on the circuit board and accordingly,
25 is not good for use in docking type applications as will be found in notebook and laptop computers.

Summary of the Invention

30 The present invention is directed to a surface mount connector that overcomes the aforementioned disadvantages.

Therefore, it is a general object of the present invention to provide surface mount connector assembly for mounting near

the edge of a circuit board and a mounting method thereof, which protects the soldered ends of the solder tails of a surface mount connector from forces generated during engagement of the connector to a cable connector.

5 It is another object of the present invention to provide an improved surface mount connector assembly having a surface mount connector component for mounting on an edge of a circuit board, the assembly having a right-angle intermediate connector that is vertically aligned with the surface mount connector, and having
10 a cavity enclosing a plurality of terminals for engaging terminals of the surface mount connector, and the cavity accommodating the entire surface mount connector and its solder tails that are attached to a circuit board.

 Still another object of the present invention is to provide
15 a surface mount connector assembly for mounting to a circuit board near an edge thereof, the connector assembly having a right-angled body portion that extends above the circuit board and over the edge of the circuit board, the right-angled body portion having a plurality of terminals with contact portions
20 positioned past the edge of the circuit board and away from the circuit board for engaging with an opposing docking-style connector.

 Yet another object of the present invention is to provide a surface mount connector assembly for docking-type applications,
25 wherein the assembly includes a surface mount connector portion for mounting to the circuit board near an edge thereof and a dual row leaf connector portion that engages the surface mount connector, the dual row leaf connector portion enclosing a plurality of terminals and positioning them over the circuit
30 board past the edge thereof for engaging an opposing cable connector.

In order to accomplish these and other objects, the present invention, in one principal aspect, provides a surface mount connector assembly is provided for mounting near an edge portion of a circuit board and which is engageable with a multi-wire cable connector terminating a plurality of individual wires. The connector assembly includes a surface mount connector for mounting to a surface of the circuit board, and an intermediate connector, with the surface mount and intermediate connectors each having respective opposing engagement portions matable with each other, the intermediate connector having a dual row leaf connector portion that extends past the edge of the circuit board and having a plurality of conductive terminals arranged thereon for mating with opposing terminals of the cable connector.

In another principal aspect of the present invention, the intermediate connector is fixed to the circuit board by way of its engagement with the surface mount connector, and the dual row leaf connector portion mates with a multi-wire cable connector. The dual row leaf connector portion extends above and past the circuit board edge to maintain its terminal contacts in a horizontal plane substantially parallel to the circuit board, which differs from conventional PC card-style connectors

In another principal aspect of the present invention, the surface mount connector has an insulative housing and a plurality of terminals loaded therein, each terminal having a solder tail extending outwardly from a bottom surface of the housing for soldering to a conductive pad on the circuit board. The intermediate connector is directly fixed to the circuit board by way a mounting means such as attachment screws, and it includes a housing having a cavity that substantially encloses the surface mount connector and its terminal solder tail

soldered to the circuit board. This structure covers the solder tails and does not expose them externally.

In the preferred embodiment, the intermediate connector is fixed to the circuit board by mounting screws that extend through both the circuit board and the intermediate connector. In this manner, the surface mount connectors may be respectively mounted on opposing front and back (top and bottom) surfaces of the circuit board, and a pair of intermediate connectors respectively engage these surface mount connectors and are further fixed to the circuit board by their engagement.

Because the intermediate connector is directly fixed to the circuit board, forces developed during engagement of a cable connector to the intermediate connector are directly transmitted to the circuit board. The solder tails of the surface mount connector may be inspected after attachment to the circuit board because they extend along the sides of the surface mount connector. By accommodating the entire connector housing of the surface mount connector within an engagement cavity of the intermediate connector, and by covering the surface mount connector so that the solder tails are not externally exposed, the surface mount connector and the soldered ends of its solder tails can be protected. The subsequent engagement of the intermediate connector with the surface mount connector is completed easily.

In another principal aspect of the present invention, the intermediate connector includes a dual row leaf connector end that enclose and supports a plurality of conductive terminals in an orientation to mate with an opposing, docking-type connector. This end is positioned above the circuit board and past an edge of the circuit board so that it may be mated with a docking-style connector, such as a multi-wire connector. The dual row leaf connector end and its terminals extend horizontally past

the edge of the circuit board. The terminals each have bifurcated end portions with two spaced apart and aligned contact portions that provide a cleaning action during engagement with the opposing cable connector.

5 These and other objects, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings.

10 Brief Description of the Drawings

In the course of the following description of the detailed description, reference will be made to the attached drawings wherein like reference numerals identify like parts and wherein:

15 FIG. 1 is an exploded perspective view of a surface mount connector assembly utilizing a preferred embodiment of a surface mount connector constructed in accordance with the principles of the present invention, and which illustrates the manner of mounting of the surface mount connector on a circuit board and the manner of connection with a right-angle connector for
20 providing an I/O type of connection;

FIG. 2 is cross-sectional view of the surface mount connector illustrated in FIG. 1;

FIG. 3 is a top plan view of the surface mount connector illustrated in FIG. 1;

25 FIG. 4 is a perspective view of a pair of terminals utilized in the surface mount connector of FIGS. 1 and 2 arranged in an opposing pair of terminals;

30 FIG. 5 is a cross-sectional view of the surface mount connector of FIG. 1 mated with an opposing right-angle connector;

FIG. 6 is a top view of the opposing right-angle connector of FIG. 5;

FIG. 7 is a perspective view of a portion of a terminal contact portion of a terminal utilized in the right-angle connector of FIG. 5;

FIG. 8 is a longitudinal cross-sectional view of an exterior connector used in the connector assembly of FIG. 1 that is intended to be connected to the horizontal connection portion of the right-angle connector of FIG. 5;

FIG. 9 is a top plan view, partly in section, of the exterior connector of FIG. 8, with a portion of an upper cover portion removed for clarity; and,

FIG. 10 is a diagrammatic, top plan view illustrating a plurality of surface mount connector assemblies connected together to corresponding right-angle connectors and aligned with exterior cable connectors.

Detailed Description of the Preferred Embodiments

FIG. 1 is a perspective view of a surface mount connector assembly, generally indicated at 1 that includes a preferred embodiment of a surface mount connector 5 constructed in accordance with the principles of the present invention. The surface mount connectors of the present invention are particularly suitable for providing a connection between circuits on a circuit board 2 and a series of wires enclosed in a cable 3 and terminated to a wire connector, such as the I/O style connector 4 illustrated. An intervening right-angle connector 6 is mated to the surface mount connector 5 to provide a connector having a dual row leaf terminal arrangement that is matable with the I/O-type cable connector 4.

Two manners of mounting the surface connector assembly 1 to a printed circuit board 2, and engaging a cable connector 4 connected to one end of a wire cable 3 to the surface connector assembly 1 are illustrated. In one manner, such as that shown

in the lower right of FIG. 1, a single surface connector 5 is mounted to the circuit board and hence will only mate with a single right-angle connector 6. In the other manner, as shown in the upper left of FIG. 1, two surface connectors 5 are
5 attached to opposing surfaces of the circuit board 2, and two right-angle connectors 6 are mated thereto. Each right-angle connector 6 is matable with an opposing cable connector 4.

The surface mount connector assembly 1 includes the surface mount connector 5 mounted to a surface of the printed circuit
10 board 2 and an engaging, right-angle connector 6 that engages with the upper portion of the surface connector 5.

As shown best in FIGS. 2 & 3, the surface mount connector 5 can be seen to include a connector housing 7 formed from an electrically insulative material and a plurality of conductive
15 terminals 8 that are mounted in the connector housing 7 at a predetermined pitch P. The connector housing 7 is shown as generally rectangular that may include a pair of slots 9 formed therein and opening to the upper surface of the connector housing 7 so as to form a receptacle connector.

20 The terminals 8 are mounted in the connector housing 2 longitudinally in a predetermined pitch P with respective contact portions 10 of the terminals mutually opposing each other on opposite sides of the slots 9. (FIG. 2.) The terminals 8 are arranged in two rows having aligned terminals,
25 as shown in FIG. 4. Two sets of terminals 8 are shown in FIGS. 2 and 3 as mounted in two distinct rows 64a, 65a and 64b, 65b in each slot 9. It can be seen that the terminals 8 each have solder tail portions 11 that project along the bottom surface of the connector housing 7 in a manner such that they lie
30 substantially flush with the connector housing bottom surface.

The solder tail portions 11 of the two rows of terminals 8 arranged in one slot 9 project out from one side of the

connector housing, while the solder tail portions 11 of the rows of terminals 8 of the other slot 9 project out from the other and opposite side of the connector housing 7. In this relationship, the solder tails 11a of the terminals 8a, the contact portions 10a of which line the first of the two engagement slots 9a extend to one side (the right side as seen in FIG. 2) of the connector housing 7, while the solder tails 11b of the terminals 8b in which the contact pieces 10b thereof line the other of the two engagement slots 9b extend to the other and opposite side (shown as the left side in FIG. 2) of the connector housing 7.

Turning now to FIG. 4, a pair of opposed terminals of the connector 5 are illustrated in the position they take of two rows in each of the slots 9. Each such terminal can be seen to include a terminal body portion 12, a pair of contact portions 13a, 13b, and an associated solder tail portion 11. In order to allow the solder tails 11 to be located in the manner set forth above, the solder tails 11 of the respective terminals 8 has approximately half width of that of a corresponding opposing terminal body portion 12, such that the solder tails 11 of one row of terminals 8 in one slot 9 extend out of the connector housing 7, but underneath the terminal body portion 12 of the respective terminals 8 of the other row of terminals disposed in the same slot 9. This passing is facilitated by way of a recess, or cavity, 62 formed in the rightmost terminal body portion 12. As a result, it can be seen that the pitch of the solder tails 11 is one-half that of the pitch P of the terminals 8, i.e., $\frac{1}{2}P$.

The contact portions 10 of the terminals 8 are formed in a characteristic configuration and they each include two divided contact portions 10a, 10b that preferably extend parallel to each other. One of the divided contact portions 10a is longer

than the other of the two divided contact portions 10b, so that arc-shaped contact portions 13a, 13b that are provided at the distal ends of the respective divided contact portions 10a, 10b are aligned along the longitudinal direction of the contact portion 10, i.e., vertically. As seen in FIG. 2, these contact portions 13a, 13b protrude slightly into the connector housing engagement slots 9.

In assembling the surface mount connector assembly 1, to the edge portion of the printed circuit board 2, the surface mount connector 5 is first mounted to the surface of the circuit board 2, near an edge portion 70 of the circuit board 2 as shown near side of FIG. 1. The solder tail portions 11 of the connector 5 project outwardly from the connector housing 7 along the sides of the connector housing 7 (or what may be considered as forward and rearward when viewing FIG. 1). The solder tail portions 11 are aligned in opposition to conductive pads (not shown) formed on the surface of the circuit board 2. The solder tail portions 11 and the conductive pads are then surface soldered by any desirable manner of soldering, such as by reflow soldering, in order to fix the connector 5 to the circuit board 2. The pitch of the solder tail portions 11 is one-half of the pitch P of the terminal contact portions 10, and thereby reduces the area occupied by the connector 5 and its solder tail portions 11. Thus, a high density connection may be achieved with the circuit board 2 while using a reduced amount of space thereon.

The surface mount connector 5 is of simple construction which basically includes the connector housing 7 and the plurality of conductive terminals 8 set forth above. The solder tails 11 are also formed in a simple exterior configuration, in that they extend outwardly along the bottom surface of the connector housing 7 exterior of the connector housing 7. This

structure prevents the solder tail portions 11 from being longer, and facilitates the manufacturing of the solder tail portions 11 of the terminals 8. It is also easy to maintain the arrangement pitch of the solder tails 11 in correspondence with a predetermined pitch P, and enable the surface soldering of the solder tail portions 11 to the circuit board 2 by a normal soldering reflow method.

Furthermore, the solder tail portions 11 project on two opposing sides of the connector housing 7, so that the solder tail portions 11 and the circuit board contact pads of the circuit board lie exposed exterior of the connector housing 7. By this, it is possible to smoothly and certainly perform any inspection of the installation of the connectors 5 to the circuit board by way of video inspection or other methods, without the connector housing 7 acting as an obstruction to obstruct the view of the inspector.

Returning now to FIG. 1, it can be seen that the right-angle connector 6 is provided as part of the overall surface mount assembly 1 in order to provide an intervening connection, or an intermediate connector between the surface mount connector 5 and a counterpart cable connector that encloses a plurality of terminated wires, such as is the case with input/output ("I/O") style connectors. This right-angle, intermediate connector 6 engages on the upper portion of the surface mount connector 5 and includes a pair of plug portions 60 that are disposed within a housing engagement portion 14 that includes an interior cavity 61 dimensioned to substantially receive the entire connector housing 7 of the surface mount connector 5 therewithin.

In this manner, the bottom surface 16a of the intermediate connector 6 will substantially abut the circuit board 2 as shown in FIGS. 5 and 6. The housing body 16 of the intermediate connector 6 not only encompasses the engagement portion 14, but

also extends to one side thereof as shown in FIG. 5 where it includes a dual row leaf receptacle portion 15 as its second engagement portion that will engage the cable connector 4. This dual row leaf portion 15 receives and supports the contact portions 19 of a plurality of conductive terminals 17 and provides surfaces for the support and arrangement of the terminals 17 in two distinct sets of terminals, wherein each set has two opposing rows of terminals 17. The contact portions 19 of the terminals 17 are maintained by this structure in a position above the circuit board and past the edge 70 of the circuit board 2.

The terminals 17 of the intermediate connector 6 are mounted with the same arrangement pitch P as the contact portions 10 of the surface mount connector terminals 8, and form likewise two sets of terminals corresponding to the two rows of terminals 8 in the two engagement slots 9 of the surface mount connector 5. Other contact portions 18 are provided at ends of the terminals 17 which extend a sufficient distance to project into the first engagement portion 14 and the cavity 61 located along the bottom surface 16a of the connector housing body 16.

The contact portions 18 project along plug portions 60 of the first engagement portion 14 to define an overall plug end of the intermediate connector 6 that engages opposing contact portions 10 of the surface mount connector terminals 8 arranged in the receptacles 9 of the surface mount connector 5. Second contact portions 19 are provided at the other end of the intermediate connector terminals 17 and are is formed into their specific configuration by turning them back upon themselves within the dual row leaf engagement portion 15 as shown in FIGS. 5 & 7. These contact portions oppose each other in pairs near the dual row leaf engagement end 15 of the intermediate connector 6. These contact portions are maintained in a

position both above the plane of the circuit board 2 but also out past the edge 70 of the circuit board 2.

The housing body 16 of the intermediate connector 6 includes end blocks 20 provided at the opposite ends thereof as shown in FIGS. 1 and 6 and provide a means for mounting the intermediate connectors 6 to the circuit board 2. These end blocks 20 each include, as shown, screw holes 21 passing therethrough in a vertical direction. Each end block has a connector guide pin 22 that faces to the front of the connector housing 16. These guide pins are positioned on opposite sides of the connector housing 16 and are provided for guiding the engagement of the opposing cable connector 4 into engagement with the intermediate connector 6. The guide pins 22 may include, as shown in FIG. 6, a round shaft 24 integrally connected to the distal plug end 26 of the shaft 24 by way of a thin neck portion 25. The plug ends 26 may differ in size, with one plug end 26b being larger than the other plug end 26a to provide a polarizing feature to ensure proper orientation of the cable connector 4 with the intermediate connector 16 and the plug ends may differ in their axial extent, with one being longer than the other.

The right-angle connector 6 is fixed on the circuit board 2 by first engaging it with the upper portion of the surface mount connector 5 in order to complete the surface mount connector assembly 1. One manner of fixing these intermediate connectors 6 to the surface mount connectors 5 and the circuit board is shown in the middle of FIG. 1. The intermediate connectors 6 are engaged with two corresponding surface mount connectors 5 in a manner such that the whole connector housings 7 of the connectors 5 are received within the first engagement portion 14 of the intermediate connector housing 16. In this manner, the soldering portions of the solder tail portions 11 are also

enclosed by the cavity 61 of the first engagement portion 14, such that both the surface mount connector housing 7 and the ends (i.e., the soldering portions) of the solder tail portions 11 are covered by the connector housing 16 to avoid exposing them to the exterior environment.

This engagement of the intermediate connector 6 causes the contact portions 18 at one end of the terminals 17 to respectively engage with the opposing contact portions 10 of the surface mount connector terminals 8. Upon engaging, one contact portion 13a of the two contact portions 13a, 13b provided on the contact piece 10 of the surface mount connector 5 wipes the surface of the intermediate connector contact portion 18 and thereby to remove stains or other types of surface contaminants. Therefore, the terminal structure incorporates a self-cleaning function by which it is possible to secure a good electrical engagement.

Furthermore, the pitch of the contact portions 10 and the pitch of the contact portions 18 are twice the pitch of the solder tail portions 11 of the surface mount connector 5, so that the interval between adjacent contact portions 10, 18 is relatively wide. Therefore, this terminal structure avoids the possibility of shorting adjacent terminals in the connectors.

The intermediate connectors 6 that are engaged with the surface mount connector 5 may be directly fixed on the circuit board 2 by way of screws 28 passing through the screw hole 21 of the end blocks 20 formed at the opposite ends of the connector housing 16 and an opening 27 formed in the printed circuit board 2. By directly fixing the intermediate connector 6 to the circuit board 2, any exterior forces that are applied to the intermediate connector 6 as a result of engaging the cable connector 4 therewith, are directly transferred to the circuit board 2 without being transferred to the surface connector 5.

This structure avoids imposing forces on the soldering ends of the solder tail portions 11 of the surface connector 5.

When the intermediate connector 6 is engaged with the surface connector 5, the dual row leaf engagement portion 15 that is formed along the upper portion of the intermediate connector 6 projects from the housing 16 thereof and lies along a plane generally parallel to and beyond the edge 70 of the circuit board 2, along with guide pins 22. Therefore, the cable connector 4 may be mounted without being interfered by the edge 70 of the circuit board 2 and so facilitate the installation operation.

Upon engaging the cable connector 4 to the intermediate connector 6, the force applied to the intermediate connector 6 from the connector 4 can be directly transferred to one side of the circuit board 2 as set forth above, so that the force applied is not applied to the surface mount connector 5 in order to protect the soldering portions of the solder tail portions 11. By engaging the right-angle connector 6 with the surface connector 5 so that the contact portions 18 of the terminals 17 of the relay connector 6 are interengaged with each other in a one-to-one relationship, the conductive pads (not shown) of the circuit board 2 are placed within the dual row leaf engagement portion 15 of the right-angle connector 6 in the electrically conducting condition.

The cable connector 4 is thus engaged with the dual row leaf portion 15 to thereby effect a connection between the wires of the cable 3 and the conductive pads (and circuits) of the circuit board 2. The contact portions 19 of the intermediate connector terminals are located within the dual row leaf engagement portion 15. These terminals also include pairs of divided contact portions 19a, 19b as shown best in FIG. 7 that have short and long lengths that are aligned in a horizontal

plane that is generally parallel to the plane of the circuit board 2. The divided contact portions 19a, 19b assist in the cleaning of the opposing contact portions of the cable connector 4, in the manner discussed above with respect to the surface mount connector terminals 8. It should be noted that a metal shell 29 may be fitted onto and around the dual row leaf engagement portion 15 of the connector 16 and is adapted for contacting an opposing metal shell 31 of a counter-engaging portion 30 of the cable connector 4.

As shown in FIGS. 8 & 9, the cable connector 4 is constructed to interengage with the intermediate connector dual row leaf engagement portion 15. The cable connector 4 includes a connector housing 32 loaded with a plurality of terminals 33. The connector housing 32 is covered by a metal shielding cover 34 on the outer upper and lower sides thereof. The connector housing 32 includes an engagement portion 30 formed one end thereof that projects outwardly from the metal cover 34. The metal shell 31 is fitted on the periphery of the engaging portion 30 and projects exterior thereof.

The terminals 33 of the cable connector 4 are loaded in a parallel arrangement in the connector housing 32 with the same pitch as the pitch P, that of the terminals 8 in the surface mount connector 5. As shown in FIG. 8, the terminals 33 include contact portions 35 located on the upper and lower sides of the engagement portions 30 and respectively engage with two sets of the contact portions 19 of the intermediate connector 6 that are located within the dual row leaf engagement portion 15.

Insulation displacement contact portions 36 are formed on the terminals 33 and are located within the connector housing 32.

As is known in the art, insulated wires 37 of the cable 3 that lie within the metal cover 34 are terminated to the terminals 33

in a conventional manner by pressing them against the terminals 33.

As shown in FIG. 9, guide holes 38 are provided on the opposite sides of the cable connector metal cover 34 and receive the guide pins 22 that project from the connector housing 16 of the intermediate connector 6. Engagement hooks 40 are located within the guide holes 38 and are formed at the distal end of latch members 39. When the cable connector 4 is engaged with the intermediate connector 6, the engagement portion 30 is guided by the guide pins 22 and the guide holes 38 so as to oppose the dual row leaf engagement portion 15 of the intermediate connectors 6. Upon completing the engagement, the hooks 40 engage the guide pins neck portions 25 to thereby engage the head portions 26 thereof and maintain the connectors 4, 16 in engagement.

The latch members 39 are resilient and flex in their lateral directions. Release levers 41 are located along the latch members 39 and are actuated to force the latch members 39 to flex outwardly to release the engagement of the cable connector 4 with the intermediate connector 16. The release levers 41 are located along the side wall of the metal cover 34 and slide parallel to the engaging direction of the connector 4. The release levers 41 are biased toward the engagement portion 30 by coil springs 42, and are manually slid in the direction of the arrow 43 against the force of the coil springs 42.

By engaging the cable connector 4 with the intermediate connector 6, the contact portions 19 of the intermediate connector terminals 17 and the contact portions 35 of the cable connector terminals are engaged together. The latter terminals receive the cleaning action of the contact portions 19 and thereby connect the individual wires 37 of the cable 3 to appropriate corresponding circuits on the circuit board 2. Upon

releasing the cable connector 4 from its engagement with the intermediate connector 6, the release levers 41 are slid rearwardly in the direction of arrow 43. Actuating portions 44 at the distal end of the release levers 41 lie along the bent portions 45 formed on the bases of the latch members 39. When the release levers 41 are slid backwards as shown, the actuating portions 44 engage the bent portions 45 and flex the latch members 39 outwardly to release the engagement of the hooks 40 with the guide pins 22, thereby completing the disengagement.

The cable wire 3 may be fixed to one of the metal covers 34 via a clamp bar 46 as shown in FIG. 9. A tapered edge 47 is provided at the end of the housing and is provided to facilitate extending the cable 3 obliquely in the direction of the tapered edge 47. As shown in FIG. 10, the tapered edge 47 is provided in consideration of the case that a plurality of the surface mount connector assemblies 1 are mounted to the circuit board 2, and the space on the outside of the edge of the circuit board 2 is narrow and restricted by a wall or door 48 that serves as part of an overall casing that receives the circuit board 2, such as a housing for a portable computer. In this case, a plurality of the cables 3 respectively extend along the doors or wall 48 in the lateral direction thereof. Therefore, the cable 3 outwardly extending from the cable connector 4 facilitates bending in a direction perpendicular to the tapered edges 47 of the connector housing 32 to avoid applying the excessive force to the insulation displacement terminals 37 and the connector clamp bar 46.

FIG. 1 illustrates the surface mount connectors 5 mounted on opposite surfaces of the circuit board 2, and with intermediate connectors 6 engaged with the surface mount connectors 5. The intermediate connectors 6 provided on the opposite surfaces of the surface mount connector 5 are fixed on

the circuit board 2 by common screws 28. By mounting two such connector assemblies 1 on the opposite surfaces of the circuit board 2, the effective utilization of the opposite surfaces of the circuit board 2 is accomplished. It will be understood that the surface connector 5 may be mounted to only one surface of the circuit board 2 and engaged with one corresponding intermediate connector 6.

The fixing of the intermediate connectors 6 on the circuit board 2 is also not limited to means of mounting screws 28. It is possible to use other fixing means, such as a fixing peg provided on the intermediate connector housing body 16. With the use of screws 28, it is easy to fix and releasably mount the intermediate connector 6 from the surface mount connector 5, which is convenient for replacement and repair. The screws 28 used in FIG. 1 may engage formed openings in the opposite intermediate connector 6 so that two such intermediate connectors 6 mounted on the opposite surfaces of the circuit board may be simultaneously fixed by one common screw 28.

The preferred embodiment in which the connector housing 7 is provided with two rows of engaging slots 9. However, it will be understood that the present invention also contemplates the use of only one engagement slot 9 formed in the surface mount connector housing 7.

As set forth above, according to the present invention, because the pitch of the contact portions arranged in the engaging slot of the surface mount connector can be made relatively wider, shorting between adjacent contact portions will be successfully prevented. Also, because the pitch of the solder tail portions can be made relatively small, high density connection on the circuit board is possible.

Because the surface mounting connector assembly is mounted on an edge portion of a circuit board and engageable with a

cable connector, it is located in an area of the circuit board that facilitates assembly of the circuit board and the connector assembly.

Furthermore, by accommodating the overall connector housing of the surface mount connector within the intermediate connector engagement portion of the intermediate connector, and by covering the soldered ends of the solder tails for preventing them from being exposed externally, the surface mount connector and its solder tails are successfully protected.

While the preferred embodiments of the invention have been shown and described, it will be understood by those skilled in the art the changes or modifications may be made thereto without departing from the true spirit and scope of the invention.

As shown in FIG. 8, the cable connector 4 is constructed to interengage with the intermediate connector dual row leaf engagement portion 15. The cable connector 4 includes a connector housing 32 loaded with a plurality of terminals 33. The connector housing 32 is covered by a metal shielding cover 34 on the outer upper and lower sides thereof. The connector housing 32 includes an engagement portion 30 formed one end thereof that projects outwardly from the metal cover 34. The metal shell 31 is fitted on the periphery of the engaging portion 30 and projects exterior thereof.

The terminals 33 of the cable connector 4 are loaded in a parallel arrangement in the connector housing 32 with the same pitch as the pitch P, that of the terminals 8 in the surface mount connector 5. As shown in FIG. 8, the terminals 33 include contact portions 35 located on the upper and lower sides of the engagement portions 30 and respectively engage with two sets of the contact portions 19 of the intermediate connector 6 that are located within the dual row leaf engagement portion 15. Insulation displacement contact portions 36 are formed on the terminals 33 and are located within the connector housing 32. As is known in the art, insulated wires 37 of the cable 3 that lie within the metal cover 34 are terminated to the terminals 33 in a conventional manner by pressing them against the terminals 33. The cable connector 4 includes guide holes (not shown) that the guide pins 22 that project from the intermediate connector 6.

By engaging the cable connector 4 with the intermediate connector 6, the contact portions 19 of the intermediate connector terminals 17 and the contact portions 35 of the cable connector terminals are engaged together. Release means that include levers 44 are provided on the exterior of the cable connector 4 so as to provide a means for a user to grab and

readily disengage the cable connector 4 from the intermediate connector 6.

FIG. 1 illustrates the surface mount connectors 5 mounted on opposite surfaces of the circuit board 2, and with intermediate connectors 6 engaged with the surface mount connectors 5. The intermediate connectors 6 provided on the opposite surfaces of the surface mount connector 5 are fixed on the circuit board 2 by common screws 28. By mounting two such connector assemblies 1 on the opposite surfaces of the circuit board 2, the effective utilization of the opposite surfaces of the circuit board 2 is accomplished. It will be understood that the surface connector 5 may be mounted to only one surface of the circuit board 2 and engaged with one corresponding intermediate connector 6.

The fixing of the intermediate connectors 6 on the circuit board 2 is also not limited to means of mounting screws 28. It is possible to use other fixing means, such as a fixing peg provided on the intermediate connector housing body 16. With the use of screws 28, it is easy to fix and releasably mount the intermediate connector 6 from the surface mount connector 5, which is convenient for replacement and repair. The screws 28 used in FIG. 1 may engage formed openings in the opposite intermediate connector 6 so that two such intermediate connectors 6 mounted on the opposite surfaces of the circuit board may be simultaneously fixed by one common screw 28.

While the preferred embodiments of the invention have been shown and described, it will be understood by those skilled in the art the changes or modifications may be made thereto without departing from the true spirit and scope of the invention.

What is Claimed

1. A surface mount connector assembly for mounting to a printed circuit board along an edge portion thereof for mating with an opposing docking-style connector, the connector assembly comprising;

5 a surface mount connector having an insulative housing and at least one receptacle formed in the housing, the receptacle including a plurality of conductive terminals disposed therein, the terminals having contact portions disposed in said housing receptacle and solder tail portions extending out of said housing along sides thereof for mounting with opposing conductive traces disposed on a first surface of said circuit board near said circuit board edge portion, said circuit board first surface extending in a predetermined plane;

15 an intermediate connector having distinct first and second ends interconnected by a body portion, the first and second ends being angularly offset with respect to each other, the intermediate connector having respective first and second engagement portions disposed at said first and second ends thereof, said intermediate connector further including a plurality of conductive terminals extending through said body portion between said first and second ends, each of said intermediate connector terminals having first and second contact portions respectively disposed at said first and second engagement portions;

25 said first engagement portion being matable with said surface mount connector, and said first engagement portion including a cavity that receives substantially all of said surface mount connector and said terminal solder tail portions therein, said intermediate connector terminal first contact portions being disposed within said cavity

and extending in a plane angularly offset from said circuit board plane;

35 said intermediate connector second engagement portion including a dual row leaf connector portion that extends past said circuit board edge portion and that supports said intermediate connector terminal second contact portions in a plane substantially parallel to said plane of said circuit board and in a position past said circuit board
40 edge portion for mating with said opposing docking-style connector.

2. The surface mounting connector assembly set forth in claim 1, wherein said intermediate connector includes means for directly fixing said intermediate connector to said circuit board in order to resist forces generated during engagement
5 and disengagement of said opposing docking-style connector with said intermediate connector, said direct fixing means including at least one mounting screw and at least one mounting hole formed in said intermediate connector for receiving said mounting screw therethrough, said mounting
10 hole being oriented angularly offset from said circuit board.

3. The surface mounting connector assembly set forth in claim 2, wherein said intermediate connector mounting hole is aligned with a corresponding opposing mounting hole formed in said circuit board when said intermediate connector is mated to said surface mount connector.

4. The surface mounting connector assembly as set forth in claim 1, wherein said intermediate connector terminal second contact portions are bifurcated.

5. The surface mounting connector assembly as set forth in claim 4, wherein each of said intermediate connector terminal second contact portions include two contact heads spaced apart from each other and aligned with each other along said plane of said intermediate connector second engagement portion, and wherein said dual row leaf portion supports said contact heads in a location that is past said circuit board edge portion.
6. The surface mounting connector assembly as set forth in claim 1, wherein said intermediate connector first engagement portion is a plug portion that is received within said surface mount connector receptacle and which supports said intermediate connector terminal first contact portions in a plane that is angularly offset from said circuit board plane.
7. The surface mounting connector assembly as set forth in claim 6, wherein said dual row leaf portion supports said intermediate connector terminal second contact portions in a position that is past said circuit board edge portion.
8. The surface mounting connector assembly as set forth in claim 1, wherein said dual row leaf portion supports said intermediate connector terminal second contact portions in a position that is past said circuit board edge portion.
9. The surface mounting connector assembly as set forth in claim 3, wherein said direct fixing means includes a second mounting screw and a second mounting hole formed in said



intermediate connector, the second mounting hole receiving said second mounting screw.

10. The surface mounting connector assembly as set forth in claim 9, wherein said intermediate connector mounting and second mounting holes are disposed at opposite ends of said intermediate connector.

11. The surface mounting connector assembly as set forth in claim 1, wherein said intermediate connector first engagement portion defines a plug end of said intermediate connector and said intermediate connector second engagement portion defines a dual row leaf receptacle end of said intermediate connector.

12. A surface mount connector assembly for mounting to a printed circuit board near an edge thereof, the surface mount connector assembly extending partially beyond the circuit board edge for a preselected distance and for engaging an opposing connector at a location past said circuit board edge, the connector assembly comprising:

a surface mount connector for mounting on a surface of said circuit board near said circuit board edge, and an intermediate connector engageable with said surface mount connector for providing an engagement portion of said connector assembly that is mateable with said opposing connector and that is disposed above said circuit board and has a length that extends past said circuit board edge;

said surface mount connector having an elongated housing with a plurality of conductive terminals arranged thereon, said surface mount connector terminals having associated solder tail portions that extend outwardly from

said housing along a bottom surface thereof and which are capable of being soldered to said circuit board along the exterior of said housing, said surface mount connector terminals further having contact portions that line opposing sides of a receptacle formed in said housing;

said intermediate connector including an elongated intermediate connector body having a first engagement end with at least one plug portion that is insertable into said surface mount connector receptacle, said intermediate connector body further having a second engagement end that extends parallel to said circuit board and at an angle to said surface mount connector receptacle, the second engagement end including a dual row leaf connector portion that extends above said circuit board and projects outwardly past said circuit board edge, and a plurality of terminals extending between said intermediate connector first and second engagement ends.

13. The surface mount assembly of claim 12, further including means for fixing said intermediate connector directly to said circuit board, said fixing means including a pair of mounting holes disposed at opposite ends of said intermediate connector and a pair of mounting screws that are received within said mounting holes and within mounting holes formed in said circuit board when said connector assembly is mounted to said circuit board.

14. The surface mount assembly of claim 12, wherein said intermediate connector terminals include first and second contact portions respectively disposed at said first and second engagement ends of said intermediate connector, said second contact portions being supported by said dual row

leaf connector portion above said circuit board entirely past said circuit board edge.

15. The surface mount assembly of claim 14, wherein said second intermediate connector terminal contact portions include distinct pairs of contact heads, said contact heads being spaced apart from each other and aligned with each other horizontally.

16. The surface mount assembly of claim 12, wherein said surface mount connector includes a pair of receptacles disposed in said housing and said first intermediate connector first engagement end includes a pair of plug portions that are received within said receptacles.

17. A surface mount connector assembly for mounting to a printed circuit board near an edge thereof, the surface mount connector assembly extending partially beyond the circuit board edge for a preselected distance and for engaging an opposing connector at a location past said circuit board edge, the connector assembly comprising:

a surface mount connector for mounting on a surface of said circuit board near said circuit board edge, and an intermediate connector engageable with said surface mount connector for providing an engagement portion of said connector assembly that is mateable with said opposing connector and that is disposed above said circuit board and has a length that extends past said circuit board edge;

said surface mount connector having an elongated housing with a plurality of conductive terminals arranged thereon, said surface mount connector terminals having associated solder tail portions that extend outwardly from

said housing along a bottom surface thereof and which are capable of being soldered to said circuit board along the exterior of said housing, said surface mount connector terminals further having contact portions that line opposing sides of a receptacle formed in said housing;

said intermediate connector including an elongated intermediate connector body having a first engagement end with at least one plug portion that is insertable into said surface mount connector receptacle, said intermediate connector body further having a second engagement end that extends parallel to said circuit board and at an angle to said surface mount connector receptacle, the second engagement end including a dual row leaf connector portion that extends above said circuit board and projects outwardly past said circuit board edge, and a plurality of terminals extending between said intermediate connector first and second engagement ends; and,

means for fixing said intermediate connector directly to said circuit board in order to prevent forces generated during engagement and disengagement of said opposing connector with said connector assembly from detrimentally affecting said surface mount connector solder tail portions, said fixing means including a pair of mounting holes disposed at opposite ends of said intermediate connector, and a pair of mounting screws that are received within said mounting holes and within mounting holes formed in said circuit board when said connector assembly is mounted to said circuit board.

18. The surface mount assembly of claim 17, wherein said intermediate connector terminals include first and second contact portions respectively disposed at said first and

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second engagement ends of said intermediate connector, said second contact portions being supported by said dual row leaf connector portion above said circuit board entirely past said circuit board edge.