

SPECIFICATIONSURFACE MOUNT CONNECTOR WITH INTEGRATED POWER LEADSBackground Of The Invention

5 The present invention relates generally to electrical connectors, and more particularly, to an improved surface mount board-to-board connector having power leads integrated with the connector.

10 Board-to-board connectors for electrically connecting a pair of parallel circuit boards or members are well known in the art. These board-to-board connectors typically utilize two opposing connector components mounted to respective opposing surfaces of the circuit boards and which project away from the circuit board mounting surfaces. One of the connector components is a male member and includes a plug member, while the other of the two connector components is a female member and includes a receptacle. The male plug member fits into the female receptacle in order to connect the two circuit boards together.

20 Board-to-board connectors further include a series of electrical terminals disposed in the two interengaging male and female connector components which contact each other when the male member is fitted into the female receptacle. These terminals have tail portions which extend out from the bottom or sides of the connector for subsequent positioning thereof either through holes in the circuit board or for engaging a like number of electrical contact pads, or traces, formed on the surfaces of the respective circuit boards and are subsequently soldered thereto. This latter mounting method is referred to in the art as surface mounting.

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The contact terminals of surface mount board-to-board connectors extend along the length of the connectors and thus, the number of circuits that a surface mount connector can accommodate is limited by the length of the connector.

5 The trend in modern electronic devices is toward miniaturization. Space on circuit boards used in electronic devices is at a premium, and whenever space is opened up on these circuit boards, the possibility of either decreasing the size of the electronic device or adding other circuitry

10 beneficially increase.

Heretofore, the power supplied to the various circuit boards in electronic devices has been accomplished through separate power leads. These power leads have utilized separate power connectors where two power leads are held

15 within connector housings and engaged together. These power leads require separate connectors, and hence take up valuable space on the circuit boards of electronic devices. In the alternative, identical terminals have been utilized for both signal and power/ground. However, due to the trend towards

20 miniaturization, many of these terminals must be utilized in order to achieve the power/ground function.

The present invention provides benefits over the prior art practice of utilizing separate circuitry and power connectors by providing a connector which has one or more

25 power-connecting portions integrated therewith, thus permitting the consolidation of power connections into a circuitry connection, and therefore resulting in a beneficial saving of space in an electronic device circuitry board. As operating voltages of electronic devices drop, such as in

30 computers, the operating current increases. The present invention permits the use of high density, close pitch signal terminals with printed circuit boards requiring high current.



Accordingly, it is a general object of the present invention to provide a new and improved board-to-board connector which incorporates power terminals in portions of the connector previously unutilized for connecting purposes.

5 Another object of the present invention to provide a new and improved board-to-board connector assembly having a male connector component and a female connector component, the male connector component having two elongated connector housing bodies interconnected at opposing ends, the female
10 connector component having two elongated connector housing bodies interconnected at their opposing ends, the interconnection being accomplished by way of interconnecting bridging members which include power connections formed therein.

15 A still further object of the present invention is to provide a board-to-board surface mount connector having male and female dual interengaging connector housings, the male and female dual connector housings being interconnected by transverse spacer members, the spacer members including at
20 least one power lead extending therefrom and at least one power receptacle disposed therein, the power lead and receptacle engaging each other in electrical contact when the male and female dual connector housings are interengaged.

Summary Of The Invention

25 The present invention is directed to a board-to-board connector which overcomes the above-mentioned shortcomings of the prior art and which offers an improvement over the prior art by integrating a power connector into a circuitry connector, thereby increasing the space available on
30 circuit boards for either additional circuitry or for a reduction in size of the circuit board



In one principal aspect of the present invention and in accordance with a first embodiment of the invention, an improved board-to-board connector assembly includes a dual plug housing assembly and a dual receptacle housing assembly.

5 The plug housing assembly has two male connector housings disposed generally parallel to each other and joined together at the opposing ends of the housings by spacers, or bridging pieces integrally formed with the male connector housings. The receptacle housing assembly has two female connector

10 housings disposed in a spaced-apart, parallel relationship and joined together at opposing ends by like integral spacer members that maintain the alignment of both the plug and receptacle housings for mounting purposes and also maintain the alignment of the terminal tails. One or more power leads

15 are disposed in one set of the spacer members and include corresponding contact blades which project therefrom. These contact blade include solder tail portions extending out from the spacer members and into contact with power circuitry as a circuit board. A like number of power receptacles are

20 disposed in the opposing spacer members and include blade-engaging contacts, also with solder tails that engage power circuitry on an opposing circuit board.

In another principal aspect of the present invention and in accordance with a second embodiment, the improved

25 board-to-board connector assembly includes a pair of opposing male and female dual connector assemblies, each of the male and female connector assemblies having two elongated housing portions arranged in a spaced-apart, parallel fashion, with each housing portion having a plurality of electrical

30 terminals disposed therein on opposing surfaces thereof. The electrical terminals of the male and female connector assemblies engage each other when the connector assemblies are interengaged with each housing portion having engagement



members disposed on opposing ends received within recesses formed in separate spacer members having engagement means that engage opposing ends of the housing. The spacer members interconnect the housings of the male and female connector assemblies together and contain complementary, interengaging power components such that, upon mating the male and female connectors, the connector assembly not only connects signal circuitry, but also power circuits of the opposing circuit boards together.

These and other objects, features and advantages of the present invention will be clearly understood through a consideration of the following detailed description.



Brief Description Of The Drawings

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

5 FIG. 1 is a perspective view of one embodiment of a connector assembly constructed in accordance with the principles of the present invention in place upon two opposing circuit boards;

10 FIG. 2 is a cross-sectional view of one of the spacer members of one connector component of the connector assembly of FIG. 1 taken along lines 2-2 thereof and illustrating the power contact blade;

15 FIG. 3 is a cross-sectional view of another spacer member of the other connector component of the connector assembly of FIG. 1 taken along lines 3-3 thereof and illustrating the power contact blade-engaging receptacle;

20 FIG. 4 is a perspective view of another embodiment of a connector assembly constructed in accordance with the principles of the present invention wherein the spacer members which carry the power leads are formed separately from the circuitry connector housings and illustrated in place on a circuit board; and,

25 FIG. 5 is a perspective exploded view of the connector assembly of FIG. 4 illustrating how the spacer members interengage with their associated connector housings.



Description Of The Preferred Embodiment

5 A board-to-board connector assembly constructed in accordance with the principles of the present invention is generally designated at 10 in FIG. 1 and, as illustrated, is shown to interconnect a first circuit board 12 with an opposing, second generally parallel circuit board 14. The two circuit boards 12, 14 may be primary circuit boards for an electronic device, or they may be modular circuit boards containing increased performance circuitry.

10 The connector assembly 10 includes a plurality of electrical terminals, generally indicated at 15, which extend out from two opposing connector component assemblies 16 and 18 and which provide a means for connecting the connector component assemblies 16, 18 to a plurality of corresponding circuit board contact pads, or traces (not shown) on
15 respective opposing circuit boards 12, 14 in order to connect the circuits on one board 12 to their corresponding counterpart circuits on the other board 14.

20 One connector component 16 is illustrated as a female connector assembly while the other connector component assembly 18 is illustrated as a male connector assembly. As is known in the art, portions of the male connector assembly 18 are received within portions of the female connector assembly 16 in order to effect a reliable connection between
25 the two connector assemblies 16, 18.

30 It can be seen that the female connector assembly 16 of the overall connector 10 of the present invention includes a pair of elongated female housing members 20 having opposing sidewalls 22, 24 and endwalls 26, 28 which cooperate to define an interior opening, or receptacle 30. Each housing member 20 preferably includes an interior pedestal 32 having generally the same height as the sidewalls 22, 24. (FIGS. 1 & 5.) The pedestal 32, as illustrated, has a generally elongated



5 rectangular, or box-like shape, and is spaced apart from the housing sidewalls 22, 24 and endwalls 26, 28 by a predetermined distance to define an interior channel, or space 36, that surrounds the pedestal 32 of each female housing member 20 and that receives plug portions of their opposing associated male housings members 60 as is known in the art.

10 Each female housing member 20 further contains a plurality of electrically conductive terminals 38 disposed therewithin and extending outwardly therefrom. The terminals 38 include contact portions 40 which are disposed along the interior surfaces 33 of the pedestal 32 and tail portions 42 which extend outwardly from the female housing member 20. The terminal tail portions 42 penetrate through bases of the female housing members 20 and extend outwardly adjacent the bottom or side surfaces thereof for engagement with contact traces (not shown) on the circuit board 14. The terminals 38 preferably are of a high density or close pitch.

15 As illustrated in FIG. 1, the dual female housing members 20 are interconnected at their opposite ends by spacer or bridging members 50 which extend for approximately the full width of the housings 20 between the outermost sidewalls 22 thereof. The spacer members 50 are preferably identical in shape with each other and preferably include mounting posts 54 which extend downwardly as shown in FIG. 3 and are received in appropriately sized openings (not shown) formed in the circuit board 14 to accurately position the connector assembly 16 on the circuit board.

20 The spacer members 50 maintain the two female housings 20 in a spaced-apart generally parallel relationship and are formed from the same material as housings 20 such as a conventional insulative, dielectric material like plastic and preferably a high-temperature material such as liquid crystal polymer (LCP).



In an important aspect of the present invention, the spacer members 50 have integrated therewith electrically conductive power terminals, illustrated in FIGS. 1 and 3 as blade-engaging contacts 52. Locating the power terminals in the spacer portions of the connector assembly allows for the use of high density, close pitch signal terminals with printed circuit board modules requiring high current. The blade-engaging contacts 52 are disposed in cavities 53 formed in the body of the spacer members 50 and include opposing contact portions 55 interconnected together at body portions 56 which terminate in tail portions 57 that extend through corresponding openings 58 formed in the circuit board 14. The openings 58 are adjacent to power circuit leads 59 formed on the circuit board and are connected thereto by conventional soldering. The contact portions 55 of the blade contacts 52 may be configured to have particular engagement surfaces 90 formed thereon which resiliently engage a mating power terminal 82 of the opposing connector assembly 18 to ensure reliable electrical contact.

The blade-engaging contacts 52 may be inserted into the spacer member cavities 53 after molding thereof as is known in the art or they may be inserted into a spacer member mold and the spacer member 50 molded around them, also as known in the art. As illustrated in the embodiment of FIGS. 1-3, the spacers 50 may be integrally formed with the housings 20 so that the resulting female connector assembly 16 constitutes a unitary structure or, as described below with respect to FIGS. 5 and 6, may be separate members.

In instances where the spacer members 50 are integrally formed with the female housing members 20, the endwalls 26, 28 of the receptacles 30 abut the spacer members 50 and may be offset as illustrated in FIG. 1 to provide a polarizing means, shown as notches 19 which receive like-shaped protrusions 17 from counterpart male housing members 60



in order to ensure a proper orientation between the circuits of the two circuit boards 12 and 14.

5 The male connector assembly 18 includes two elongated male housing members 60, each having a pair of protruding plugs, shown as elongated wall portions 62, 64 interconnected to a pair of endwalls 67, 68 at opposing ends to define an overall rectangular plug associated with each male housing member. The endwalls 67, 68 provide reinforcement to the relatively thin plug walls 62, 64 and
10 further define the polarizing means as described above.

The protruding wall portions 62, 64 of the male housing members define plugs that are received with the female housing member receptacle channels 34. In this regard, each such protruding wall portion 62, 64 contains a plurality of spaced-apart cavities 70 formed in the inner surfaces of the projecting walls 62, 64 which receive a like number of
15 electrically conductive terminals 74 therein. The terminals 74 include tail portions 75 which extend outwardly from the housings 60 for engagement with contact traces (not shown) of the circuit board 12. In order to facilitate insertion and ensure reliable contact between pairs of opposing terminals, the thickness of the protruding walls or plugs is slightly less than the width of the female housing member channels 34 so that the plug terminals will reliably engage the female
20 housing member terminals within the receptacle channels 34.

The terminals of both of the housing members are preferably formed from a highly conductive material, such as a phosphor bronze alloy and may be gold-plated. The terminals may be set in the connector housing members by insert
30 molding, i.e., positioning the terminals within a mold cavity and injecting plastic around them. In this regard, the housing members may include openings 71 in their appropriate sidewalls 62, 64 (FIG. 2) by which the terminals 74 may be



held in the mold cavity during manufacture.

5 The male housing members 60 also include spacer, or
bridging members 80, located proximate to the endwalls 67, 68
of the housings 60. The spacer members 80 extend for
approximately the width of the male connector assembly 18
(FIG. 6) and, as illustrated in FIG. 2 accommodate one or
more power terminals including contact blades 82. The
10 contact blades 82 have solid and wide body portions 83 which
are received within cavities 84 of the spacer member body
portions. Tail portions 85 extend through the base of the
spacer members 80 as shown and are received within openings 86
of the circuit board 12 where they are connected to power
circuits 59 in a customary fashion, such as by soldering. The
15 contact blades 82 preferably have a length (or height) that
corresponds to the depth of the spacer member cavities 53 and
is sufficient to project into reliable engagement with the
blade-engaging contacts 52 of the female component 20.

As shown in FIGS. 1-3, the spacer members 50, 80 may
be integrally formed with their corresponding associated
20 circuit connector housings to form two unitary assemblies 16,
18 which interengage each other. However, the spacer members
which include the power connecting components may also be
separately formed as shown in the assembly 200 of FIGS. 4 and
5. In FIGS. 4 and 5, it can be seen that the connector
25 assembly 200 includes two male or plug connector components
202, each of which contains a plurality of conductive
terminals 204 with corresponding soldering tails 206. The
connector components 202 are interconnected by separate spacer
208 which have engagement means, such as the T-shaped slots
30 210 illustrated that receive corresponding T-shaped engagement
lugs 212 extending from the endwalls of the connector
components 202. Other than the separate spacer 208,
connector assembly 200 is identical to component 18.



5 Finally, although the blades 82 of the power contacts are shown with their planes generally parallel to the axes of spacer members 80, they could be rotated 90° so that their planes are generally perpendicular to the axes of spacer members 80. Of course, the blade engaging contacts 52 would also be rotated 90°.

10 While the particular embodiments of the invention have been described above, it will be apparent to those skilled in the art that changes and modifications may be made therein without departing from the invention in its broader aspects, and, therefore, the aim of the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.



CLAIMS:

1. A connector assembly (10) for interconnecting a pair of spaced apart, generally parallel circuit members (12,14), the assembly comprising: interengageable plug connector (18) and receptacle connector (16) components, the plug connector component (18) including a pair of plug connector housings (60) arranged in a spaced-apart relationship and being interconnected at opposite ends by first bridging portions (80) of generally equal length, the receptacle connector component (16) including a pair of receptacle connector housings (20) arranged in a spaced-apart relationship and being interconnected at opposite ends by second bridging portions (50) of generally equal length, said plug and receptacle component housings each including a plurality of electrically conductive terminals (74,38) secured therein, each terminal having a corresponding tail portion (15) for interconnection to a respective circuit of one of said circuit members, the first and second bridging portions (80,50) including at least one pair of complementary interengaging power terminals (82,52), the pair of power terminals including a first power terminal (82) and a second power terminal (52), said first power terminal extending from one (80) of said first and second bridging portions and a power terminal cavity (53) disposed in another of said first and second bridging portions which opposes said one of said first and second bridging portions, the power terminal cavity (53) including said second power terminal (52) disposed therein, whereby upon mating said plug and receptacle components (18,16), said terminals (38,74) of said plug and receptacle components engage each other and said first power terminal (82) and second power terminal (52) engage each other to thereby transmit electrical power between said opposing circuit members (12,14).





5 2. The connector assembly as defined in claim 1,
 wherein said first and second bridging portions (80,50) are
 integrally formed with said plug and receptacle connector
 housings (60,20), respectively, to define respective unitary
 plug and receptacle connector components.

10 3. The connector assembly as defined in claim 1,
 wherein said first and second bridging portions (80,50) are
 formed separately from said plug and receptacle connector
 housings (60,20) and said first and second bridging pieces
 include means (210,212) for engaging said plug and receptacle
 connector housings.

15 4. The connector assembly as defined in claim 3,
 wherein said engagement means include notches (210) formed in
 said first and second bridging pieces which receive engagement
 members (212) disposed on said plug and receptacle connector
 housings.

20 5. The connector assembly as defined in claim 1,
 further including means for polarizing (17,19) said plug and
 receptacle connector components to ensure said plug connector
 housings engage said receptacle connector housings in a
 predetermined orientation and so that said first and second
 power terminals engage each other.

25 6. The connector assembly as defined in claim 5,
 wherein said polarizing means includes slots (19) formed in at
 least one of said plug and receptacle connector housings
 (60,20) which receive posts (17) extending from the other of
 said two plug and receptacle connector housings.



7. The connector assembly as defined in claim 1,
wherein said second power terminal (52) includes a pair of
spring arms (55) interconnected by a body portion (56).

5 8. The connector assembly as defined in claim 1,
wherein said first power terminal is a blade contact.

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9. A first connector (18) intermateable with a second connector (16) for interconnecting a pair of spaced apart, generally parallel circuit members (12,14), said second connector including a pair of second dielectric housings (20), each having a plurality of second electrically conductive terminals (38) associated therewith each of which have a tail portion (15) for attachment to a circuit member (14), said pair of second housings being arranged in a spaced-apart relationship and interconnected at opposite ends thereof by second bridging portions (50) of generally equal length, said second bridging portions having at least one second power terminal (52) fixed therein, said first connector comprising:

a first pair of dielectric housings (60) having a plurality of first electrically conductive terminals (74) associated therewith for mating with the plurality of second terminals (38), said plurality of first terminals each having a tail portion (15) for attachment to its respective circuit member (12), said pair of first housings (60) arranged in a spaced-apart relationship for complementary mating with said pair of second dielectric housings (20) and interconnected at opposite ends thereof by first bridging portions (80) of generally equal length, said first bridging portions including at least one first power terminal (82) for mating with said second power terminal (52), the first power terminal (82) extending from one (80) of said first and second bridging portions and a power terminal cavity (53) disposed in another (50) of said first and second bridging portions which opposes said one bridging portion (80), the power terminal cavity (53) having the second power terminal (52) disposed therein, said second power terminal including a contact portion (90), whereby when said pair of first and second dielectric housings (60,20) are interengaged, said pluralities of first and second terminals (74,38) engage each other and said first power





terminal (82) and said contact portion (90) of said second power terminal engage each other to thereby transmit electrical power between said opposing circuit members (12,14).

5 10. The first connector as defined in claim 9, wherein said first and second bridging pieces (80,50) are integrally formed with said first and second connector housings (60,20) to define respective unitary first and second connectors (18,16).

10 11. The first connector as defined in claim 9, wherein said first and second bridging pieces (80,50) are formed separately from said first and second connector housings (60,20) and said first and second bridging pieces (80,50) include means (210,212) for engaging said pair of
15 first dielectric housings (60) and said pair of second dielectric housings (20).

 12. The first connector as defined in claim 11, wherein said engagement means include notches (210) formed in said first and second bridging pieces which receive engagement
20 members (212) disposed on said pair of first dielectric housings (60) and said pair of second dielectric housings (20).

 13. The first connector as defined in claim 9, further including means for polarizing (17,19) said first and
25 second connector components (18,16) to ensure said pair of first dielectric housings (60) engage said pair of second dielectric housings (20) in a predetermined orientation and so that said first and second power terminals (82,52) engage each other.



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5 14. The first connector as defined in claim 13,
 wherein said polarizing means (17,19) includes slots (19)
 formed in at least one of said pairs of first and second
 dielectric housings (60,20) which receive posts (19) extending
 from the other of said pairs of first and second connector
 housings.

10 15. The first connector as defined in claim 9,
 wherein said second power terminal (52) includes a pair of
 spring arms (55) interconnected by a body portion (56), the
 spring arms (55) defining a slot which receives said first
 power terminal (82) therein.

