

PATENT SPECIFICATION

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(72) Inventors WILLIAM VITO PAUZA
EDWARD MICHAEL POLTONAVAGE



(54) SUBSTRATE CONNECTOR

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electrical connector for interconnecting conductors on a first panel with conductors on a second panel, and is particularly applicable where the first panel is a ceramic substrate and the second panel is a printed circuit board.

Co-pending Patent Appln. 41052/72 (Serial No. 1 373 986) describes an electrical connector capable of electrically interconnecting a printed circuit board and a ceramic substrate of the kind which has contact pads located on its edges rather than of the more conventional kind which has contact pads on its large faces.

The present invention is a modification of the connector disclosed in the earlier application and involves, in particular, a pre-loading feature.

The present invention is an electrical connector for interconnecting conductors on a first panel to conductors on a second panel, comprising an insulating housing having a first side forming a support surface for the first panel, a second side, and a plurality of cavities located in a pre-determined pattern at least partially defining the peripheral shape of the first panel, the cavities extending through the housing from the first side to the second side, an individual elongate electrical terminal mounted in each cavity and comprising a spring contact arm disposed at the first housing side and a contact portion projecting from the cavity at the second

housing side, the contact arm having a contact surface disposed perpendicularly with respect to and proximate the support surface and facing generally inwardly of the housing for engagement with a respective conductor on the first panel, the contact portion being adapted for connection to a respective conductor on the second panel, the spring contact arms being self-biased inwardly of the housing into engagement with respective shoulders of the housing which shoulders hold the spring contact arms in pre-loaded condition, and the spring contact arms being resiliently deformable such that the contact surfaces are movable generally parallel to the support surface outwardly of the housing on insertion of the first panel between the contact surfaces.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a perspective exploded view of an electrical connector according to the invention and showing a ceramic substrate which is to be terminated;

Figure 2 is a perspective view of the connector of Figure 1 showing the substrate supported in the connector and the connector mounted on a printed circuit board;

Figure 3 is a cross sectional view taken on line 3-3 of Figure 2;

Figure 4 is a cross-sectional view similar to that of Figure 3 but showing the substrate aligned with the connector prior to insertion of the substrate into the connector;

Figure 5 is an enlarged fragmentary perspective view of the connector showing one of the connector terminals prior to insertion in the connector housing;

Figure 6 is a fragmentary sectional view illustrating the position of the terminal

after partial insertion within the housing; and

Figure 7 is a view similar to that of Figure 6 but showing the terminal fully inserted within the housing.

The connector 10 of the present invention is intended to connect the terminal contact pads 12 of a ceramic substrate 14 with external electrical circuitry such as the conductors 16 on one side of a printed circuit board 18 as shown in Figure 3. The substrate 14 comprises a generally rectangular ceramic body 20 having parallel faces 22, 24, side surfaces 26, and end surfaces 28. Conductors (not shown) contained in the ceramic body 20 extend from the terminal pads 12 on the side surfaces 26 of the substrate 14 to an integrated circuit device (not shown) contained at a central location within the substrate 14.

The connector 10 comprises an insulating housing 32 and a plurality of electrical terminals 34 arranged in two opposing rows in the housing 32. The housing may be manufactured by conventional injection moulding methods from any suitable dielectric material, such as polycarbonate or a glass filled nylon.

The housing 32 is generally rectangular having a base wall 38 at a forward side 40 of the housing and a pair of parallel spaced side walls 42, 44 and a pair of relatively shorter, parallel spaced end walls 46, 48 extending from the base wall 38 toward a rearward side 50 of the housing 32. The base wall 38 of the housing 32 has an exterior surface 52 which is engageable with the printed circuit board 18 when the housing is mounted on the printed circuit board. The base wall 38 of the housing 32 has two openings 54 extending therethrough to facilitate dissipation of the heat generated within the housing 32 and to minimise the amount of material in the housing.

A central substrate-receiving cavity 56 is defined within the housing 32 by the interior defined within the housing 32 by the interior surfaces 58, 60, 62, 64, 66 of the walls 38, 42, 44, 46, 48 of the housing 32. The interior surface 58 of the base wall 38 is capable of supporting the substrate 14 in generally parallel relationship to, and spaced from, the circuit board 18 when the substrate 14 is received within the central cavity 56 and when the housing 32 is mounted on the board 18.

As more clearly shown in Figures 3, 4 and 5, a row of spaced apart cavities 68 extend through each of the side walls 42, 44 of the housing 32 from the forward side 40 to the rearward side 50 of the housing 32. The cavities 68 open into the central cavity 56 at the interior surfaces 60, 62 of the side walls 42, 44. The two rows of

cavities 68 are spaced apart by a distance which is greater than the distance between the rows of contact pads 12 of the substrate 14. A pair of opposing recessed shelves 70, is defined within the side walls 42, 44 of the housing 32 and respectively extend laterally from two opposing sides 72, 74 of each of the cavities 68 at a location along each cavity 68 intermediate the forward and rearward sides 40, 50 of the housing 32. Each of the shelves 70 faces in a direction generally toward the rearward side 50 of the housing 32.

Still referring to Figures 3, 4, and 5, a row of spaced apart recesses 76, is formed in the interior surface 58 of the base wall 38 of the housing 32 along each of a pair of opposing longitudinal edge portions 78 of the base wall 38 which edge portions 78 are respectively located adjacent to the interior surfaces 60, 62 of the side walls 42, 44 of the housing 32. Each of the recesses 76 corresponds to, and opens into, one of the cavities 68. Each of the recesses 76 has a floor 80 at a location therein which is remote from the interior surface 58 of the base wall 38 of the housing 32. Further, each of the recesses 76 has a shoulder 82 at a location therein which is remote from the corresponding cavity 68 and which adjoins the floor 80 of the recess 76 and faces in a direction generally toward the corresponding cavity 68. The shoulders 82 in one of the rows of recesses 76 are spaced apart from the shoulders 82 in the other of the rows of recesses 76 by a distance which is slightly less than the distance between the rows of contact pads 12 respectively disposed on the opposing side surfaces 26 of the substrate 14.

A row of spaced apart channels 84 is formed in the exterior surface 52 of the base wall 38 of the housing 32 adjacent to the locations at which each of the rows of terminal-receiving cavities 68 extend through the forward side 40 of the housing 32. Each of the channels 84 opens into one of the terminal-receiving cavities 68 and extends therefrom in a direction generally toward the opposite row of channels 84.

As shown in Figure 5, the centre-to-centre spacing between adjacent terminal-receiving cavities 68, between adjacent recesses 76, and between adjacent channels 84 within each of the respective rows are substantially the same. Further, the centre-to-centre spacing substantially corresponds, and is equal, to the centre-to-centre spacing between adjacent contact pads 12.

Figure 5 best illustrates the electrical terminal 34 used in conjunction with the housing. The terminal 34 may be fabricated by a conventional stamping and forming operation from any suitable metal, such as a pre-tin plated stainless steel.

The terminal 34 comprises a flat, central post portion 86 and a spring portion 88 which extends at an acute angle from an end of the flat post portion 86.

- 5 A pair of opposing tabs 90 extend laterally from the post portion 86 inwardly of the free end of the post portion 86. One terminal 34 is inserted into each of the cavities 68 from the rearward side 50 of the housing 32 until the forward edges 92 of the tabs 90 respectively seat on the recessed shelves 70 of the cavity 68. However, prior to full insertion of the terminal 34, the spring portion 88 of the terminal 34 must be flexed or deflected toward the cavity 68, i.e. towards the post portion 86, as shown in Figure 6, in order that a free end 94 of the spring portion 88 may be inserted into the recess 76 of the base wall 38 simultaneously as the tabs 90 of the flat post portion 86 are brought to their seated position on the recessed shelves 70.

- After the terminal 34 has been inserted into its respective cavity 68, a forward portion of the flat post portion 86 extends from the cavity 68 at the forward side 40 of the housing 32. Each of the cavities 68 includes a forward cavity portion 93 which is offset from the remainder of the cavity 68 at the rearward side 50 of the housing 32 and communicates with one of the channels 84 and the exterior of the housing 32. The forward cavity portion 93 further communicates with the remainder of cavity 68 through an opening 95 having cross-sectional dimensions which provide sufficient clearance for passage of the post portion 86 of the terminal 34 but which are substantially less than the cross-sectional dimensions of the cavity 68 proximate to the rearward side 50 of the housing 32. The cross-sectional dimensions of the forward cavity portion 93 are substantially greater than the cross-sectional dimensions of the opening 95 since, in the preferred embodiment, the cavity portion 93 is intended to provide, in addition to the clearance for the terminal 34, adequate space for a back-up tool to be applied against the exposed portion of the terminal 34 within the cavity portion 93 during the bending operations to be described below.

- The forward portion of the post portion 86 is bent by conventional forming tools (not shown) in the manner shown in Figure 7 to provide a bent portion 96 which extends perpendicularly to the longitudinal axis of the post portion 86, along one of the channels 84 formed in the exterior surface 52 of the base wall 38 which opens into the cavity portion 93 of the cavity 68. The channel 84 has a ceiling 98 which faces in a direction generally toward the forward side 40 of the housing 32 and which is engageable with the bent portion

96. This engagement together with the engagement of the tabs 90 and the shelves 70 ensures retention of the terminal 34 within the cavity 68.

The forward portion of the post portion 70 86 is further bent to now provide a terminal portion 100 which extends outwardly from the forward side 40 of the housing 32 at a location along the channel 84 which is offset from the opening 95 of the cavity 75 86. The terminal portion 100 is capable of electrical and mechanical connection to the conductor 16 of the circuit board 18 when the housing 32 is mounted on the board 18 preferably by insertion of the terminal portion 100 through an aperture 102 formed through the circuit board 18. When electrical connection of the terminal portion 100 of the terminal 34 to the conductor 16 of the board 18 is achieved by a soldering operation, the offset spaced location of the terminal portion 100 from the opening 95 of the corresponding cavity 68 prevents the flow of solder 104 through the cavity 68 to the rearward side 50 of the housing 32, 90 which, if not prevented, would allow the solder 104 to render the desired flexing action of the spring portion 88 of the terminal 34 ineffective.

With the terminal in its fully inserted 95 position and desired configuration as shown in Figures 3, 4 and 7, the flexible spring portion 88 extends from its respective cavity 68 proximate the rearward side 50 of the housing 32 in an overlying relationship to the plane of the interior surface 58 of the base wall 38 and in a direction generally toward the corresponding one of the recesses 76 formed in the interior surface 58 of the base wall 38. As stated above, during insertion of the terminal 34 the spring portion 88 was partially flexed or deflected in a direction generally toward its respective cavity 68 so that the terminating free end 94 of the spring portion 88 would extend into the corresponding one recess 76 upon continued insertion of the terminal 34. Upon extension into the one recess 76, the free end 94 of the spring portion 88 is designed to abut the shoulder 82 of the one recess 76 at a location along the shoulder 82 which is spaced from the floor 80 of the one recess 76 to pre-load the spring portion 88 of the terminal 34 and also to avoid any tendency for the free end 94 to drag on the floor 80 of the recess 76 upon further deflection of the spring portion 88 toward its respective cavity 68. It will be noted in Figure 5, also, that the post portion 86 is much wider than the spring portion 88 at their junction. Therefore, the pivotal axis of the spring portion tends to be centred approximately at area 105 adjacent to the merger location.

The spring portion 88 of each terminal 34 has a camming surface 106 thereon located remote from the free end 94 of the spring portion 88. The leading opposing longitudinal edges of the substrate 14 engage the camming surfaces 106 during insertion of the substrate 14 into the housing 32 and cause further flexing or deflection of each of the spring portions 88 toward its respective one of the cavities 68 until each of the spring portions 88 has deflected to its respective desired fully loaded condition at which time the substrate 14 is positioned upon the interior surface 58 of the base wall 38 between the rows of terminals 34.

The spring portion 88 of each terminal 34 has a contact surface 108 thereon located adjacent to the free end 94 of the spring portion 88. When the terminal 34 is in its fully inserted position as shown in Figure 4, the contact surface 108 of the spring portion 88 is disposed adjacent to, and in an overlying relationship to the plane of, the interior surface 58 of the base wall 38 and in a facing relationship toward the opposing row of terminals 34. In the preferred embodiment, the contact surface 108 is disposed generally perpendicular to the plane of the interior surface 58. The contact surfaces 108 on the terminals 34 in one of the rows of terminals 34 are spaced apart from the contact surfaces 108 on the terminals 34 in the other of the rows of terminals 34 by a distance which is slightly less than the distance between the rows of contact pads 16 respectively disposed on the opposing side surfaces 30, 32 of the substrate 14. The contact surface 108 preferably is on an embossment on the spring portion 88 as shown at 110 in order to define a precise contact area on the spring portion 88.

Referring again to Figure 1, there is illustrated a slot 112 formed through each of the end walls 46, 48 of the housing 32 at the forward side 40 of the housing 32 and also through each of a pair of opposite edge portions 114 of the base wall 38 respectively adjacent to the end walls 46, 48. These slots 112 provide access by a convention prying tool (not shown) to the face 24 of the substrate 14 on which face 24 of the substrate 14 is mounted on the interior surface 58 of the base wall 38 in order to facilitate one manner of removal of substrate 14 from the housing 32.

Also shown in Figure 1, a strap 116 is provided for assembly to the housing 32 in an overlying relationship to the substrate 14 when the substrate is supported on the interior surface 58 of the base wall 38. An interengaging means in the form of a slot 118 is provided in each of the end walls 46, 48 of the housing 32 for securing the

strap 116 to the housing as best shown in Figure 2. Although the terminal spring portion 88 provides adequate retention of the substrate 14 therebetween under most conditions, the strap 116 is an optional feature of the connector 10 which may be beneficial if the circuit board 18 on which the connector 10 and substrate 14 are mounted is disposed in a vertical position or an inverted position instead of the horizontal position as shown in Figure 2. Also, the strap 116 may be of benefit when the connector 10 is used in an environment wherein severe vibrations may be encountered.

The strap 116 has a central recess 120 on its forward facing surface into which a prying tool or the like (not shown) may be inserted in order to flex the strap 116 and thereby disengage opposing end tabs 122 of the strap 116 from slots 118 of the end walls 46, 48 of the housing 32 and thereby achieve disassembly of the strap 116 from the housing 32.

It is apparent that the overall dimensions of the connector 10 are only slightly greater than the overall dimensions of the substrate 14 so that several substrates can be mounted very close to each other on a printed circuit board and so that a number of boards having connectors thereon may be stacked closely together. A further advantage of the connector 10 is that the connector can be serviced from its rearward side; that is it can be assembled to the board and the individual ceramic substrates in an array of connectors can be removed from, or assembled to, the connectors from their rearward sides. Also, the contacts of the connector may be electrically tested from its rearward side both before and after the substrate is inserted in the connector. An additional advantage of the connector is that the contacts in the housing are protected during shipment and handling.

WHAT WE CLAIM IS:

1. An electrical connector for interconnecting conductors on a first panel to conductors on a second panel, comprising an insulating housing having a first side forming a support surface for the first panel, a second side, and a plurality of cavities located in a predetermined pattern at least partially defining the peripheral shape of the first panel, the cavities extending through the housing from the first side to the second side, an individual elongate electrical terminal mounted in each cavity and comprising a spring contact arm disposed at the first housing side and a contact portion projecting from the cavity at the second housing side, the contact arm having a contact surface disposed



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WHAT WE CLAIM IS:

1. An electrical connector for interconnecting conductors on a first panel to conductors on a second panel, comprising an insulating housing having a first side forming a support surface for the first panel, a second side, and a plurality of cavities located in a predetermined pattern at least partially defining the peripheral shape of the first panel, the cavities extending through the housing from the first side to the second side, an individual elongate electrical terminal mounted in each cavity and comprising a spring contact arm disposed at the first housing side and a contact portion projecting from the cavity at the second housing side, the contact arm having a contact surface disposed



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perpendicularly with respect to and proximate the support surface and facing generally inwardly of the housing for engagement with a respective conductor on the first panel, the contact portion being adapted for connection to a respective conductor on the second panel, the spring contact arms being self-biased inwardly of the housing into engagement with respective shoulders of the housing which shoulders hold the spring contact arms in pre-loaded condition, and the spring contact arms being resiliently deformable such that the contact surfaces are movable generally parallel to the support surface outwardly of the housing on insertion of the first panel between the contact surfaces.

2. An electrical connector as claimed in claim 1, in which each spring contact arm is bent back on a main post portion of the terminal to extend at an acute angle with

respect to the main post portion, each main post portion projecting from a respective cavity at the first housing side, and the free end portion of the spring contact arm abutting the shoulder, the contact surface being disposed between the free end portion and the junction of the spring contact arm with the main post portion.

3. An electrical connector as claimed in claim 2, in which the shoulders against which the respective free end portions of the spring contact arms abut are defined by recesses communicating respectively with the terminal receiving cavities.

4. An electrical connector substantially as described with reference to the accompanying drawings.

For the Applicants:
R. G. STUART-PRINCE,
Chartered Patent Agent.