PATENT SPECIFICATION

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(54) SOLDER CONNECTABLE ELECTRICAL COMPONENTS

(71) We, INTERNATIONAL BUSINESS MACHINES CORPORATION, a Corporation organised and existing under the laws of the State of New York in the United States of America, of Armonk, New York 10504, 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:—

The invention relates to solder connectable electrical components.

The attachment of electrical components, such as integrated modules, to circuit boards or cards is commonly done by inserting the component leads or pins into holes in the card and soldering the junctions. This mode of attachment provides component stand-off which is highly desirable since it permits circulation of cooling fluid about the components. As components and circuit cards are reduced in size by the continuing effort to miniaturize electronic packaging, lead and hole dimensions are also made smaller. The leads become less stable and there is greater difficulty in concurrently inserting the multiple leads into the respective holes. One solution to this assembly problem has been to forego lead insertion and attach the component leads to the surface of circuit lands surrounding the small through holes.

Open circuits, however, frequently occur at the lead-land junctions when components having many leads are soldered. These open circuits can be caused by failure of the solder to bridge slight gaps between some leads and their respective lands. The gaps may be due to small differences in the lengths of the leads or warpage of the circuit cards. Sometimes the solder may bridge the gaps but fail to produce fillets of adequate cross-section so that fracture of the weaker joints occurs in subsequent field usage.

The invention provides an electrical component comprising a plurality of interconnection pins or leads for solder connection to respective lands on a printed circuit card, and a plurality of sleeve connectors, one for each pin or lead, each sleeve connector slidably inter-fitting over its respective pin or lead so as to project beyond the end or lead so that when the component is fitted against the surface of a printed circuit card having a pattern of connection lands with which the pins or leads are aligned, variations in spacing between the ends of the pins or leads and the lands are accommodated by sliding movement of the sleeve connectors .

In an example of the invention to be described hereinafter sleeves of solderable, electrically conductive materials are concentrically placed on the ends of the component leads of an integrated circuit component. The sleeves extend beyond the free ends of the leads and are slideable therealong. The component is attached to a printed circuit card by bringing the sleeves or at least some of them into contact with the lands of the circuit card. The component is urged toward the lands forcing the sleeves to slide along the corresponding leads a distance determined by the separation between each lead and its land. The component is held in place on the circuit card during soldering. The solder is provided an uninterrupted flow path along the land, sleeve and lead at each junction and uniform, reliable joints are thus assured. The sleeves are preferably split so as to frictionally grip the leads and adapt to variable lead dimensions and cross-sections and to vent flux vapours from the joints.

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

FIGURE 1 is a diagrammatic elevation

view, partially in section, illustrating an integrated circuit module attached to a printed circuit card,

FIGURE 2 is a perspective view of a split sleeve connector which may be used in the embodiment shown in Figure 1.

FIGURES 3, 4, and 5 are modifications of the split sleeve shown in Figure 2 which may alternatively be used in the embodiment of Figure 1.

Referring to Figure 1, an integrated circuit module 10 having a plurality of depending, electrically conductive connecting leads or pins 11-16, is shown soldered to a circuit card 17 having electrically conductive lands 18 of thru-holes 19 corresponding to the component pins. It will be noted that the length of the pins is not uniform and that circuit card 17 has a warped surface. The result is that only certain of the pins make contact with their respective lands. The conditions illustrated, that is the variation in the length of the pins and the warpage of the card are shown somewhat exaggerated for purposes of explanation, but both of these conditions are commonly experienced either together or separately in the actual assembly of components on circuit substrates. The existence of non-uniformity of the pin length or card warpage alone are at times sufficiently severe that the pin ends do not contact the respective lands so that solder is unable to provide a structural and conductive joint. In the figure, it will be seen that the ends of pins 12, 13, 15 and 16 leave gaps of varying magnitude between corresponding land and end.

Should soldering of the pins to the lands be undertaken with such gaps, some pins would either not be connected to the lands, since the molten solder would fail to bridge the gap due to surface tension, or the bridging portion of the solder would form a connecting web too thin to sustain the vibration or stress of field usage. The illustrated module-circuit card assembly, of course, is that type in which only a surface connection is made as distinguished from the type which the pins are inserted in the thru-holes prior to soldering.

To overcome the problem of unsoldered joints or potentially weak joints, each pin end is fitted with a split sleeve 20, shown in greater detail in FIG. 2. The sleeves are preferably made with an internal diameter slightly less than the outside diameter of the leads or pins on which they are to be placed so there is a friction fit which still permits the sleeves to be pushed along the lead but remain in place upon removal of the pushing force. The sleeves are made of an electrically conductive material, preferably a hard copper, which has been pre-timed. Other materials such as brass or Kovar (Registered Trade Mark) may also be used. Wall thickness will vary according to the diameter of the pins on which the sleeves are to be placed. For example, with module leads of 0.6 mm diameter, the sleeves may be made of materials from 0.05 to 0.15 mm thickness and have an inside diameter of 0.5 mm. The width of gap 21 may vary over a wide range and needs only to allow the sleeve to retain its position and provide a solder wetting path for attachment. The sleeve length is not critical but is preferably at least twice as long as the maximum expected gap so that the sleeve will stay in position during assembly and soldering.

Referring again to FIG. 1, the ends of the pins are each fitted with a split sleeve prior to assembly, and the sleeves are positioned so that the lower edges of the respective sleeves extend well beyond or approximately halfway below the pin ends. Thereafter, the module is brought into position on circuit card 17 so that all sleeves are substantially aligned with their respective circuit lands 18. Module 10 is pressed toward the circuit card until seated in position. This process causes the unattached split sleeves 20 to move upwardly along the pins an amount dictated by the proximity of the pin ends to the circuit lands. On those pins not in contact with the lands, the sleeves will provide a bridging structure. Soldering is then done to connect the pins, sleeves, and lands. The sleeves provide a flow path for the solder from the lands to the pin ends and are soldered to form a composite junction allowing the formation of sound fillets 22.

In FIG. 3, there is shown a modified split sleeve 30 which has a plurality of integral projections on tabs 32 which are bent inwardly to form internal teeth across an end opening of the sleeve. The tabs 32 extend in a substantially orthogonal direction with respect to the axis of the sleeve 30. These projections serve as the alternative frictional elements engaging the component leads and serve to grip through any film or oxide on the lends. These inwardly projecting tabs are kept relatively short so that the clearance between the inner sleeve wall and outside surface of the lead is on the order of 0.1 to 0.2 mm. The split sleeve 30 is preferably made of the same material as the sleeve shown in FIG. 2, being a resilient, solderable metal. When internal teeth 32 are provided, the sleeve need not be split, if desired, since the sleeve and teeth can be sized so that the teeth deform sufficiently to accommodate the leads. In addition, internal tabs can be formed on both sleeve ends if desired.

The sleeve embodiments shown in FIGS. 4 and 5 are variations of the sleeve shown in FIG. 2. In FIG. 4, split sleeve 40 has a single tab 41 formed thereon which is bent inwardly beneath the sleeve proper. This modification allows the sleeve to be attached to a land which is approximately of the same or smaller area than the cross-section of the component lead. In FIG. 5, split sleeve 50 has one or more outwardly projecting tabs 51 formed integrally with the sleeve. This configuration requires a larger land area than the sleeve diameter, and provides a greater solder area on the land.

The provision of sleeves which are slidable along a component lead solves the frequently experienced problem of leads of uneven length or warped circuit substrates. The sleeves, by being slideable along the component leads, are able to readily adjust to eliminate the existing gaps between the component leads and their respective lands. The sleeves serve as compact, inexpensive lead extenders which assure reliable circuit connections in a mass-produced assembly.

Although the component leads have been shown as being of circular cross-section, leads of square, rectangular or other cross-section may be present on the components. In most cases, cylindrical sleeves on such leads provide an adequate solder flow path at the contact areas between the sleeves and leads. Exact conformance of the sleeve to the lead configuration is not necessary for reliable solder joints.

WHAT WE CLAIM IS:—

1. An electrical component comprising a plurality of interconnection pins or leads for solder connections to respective lands on a printed circuit card, and a plurality of sleeve connectors, one for each pin or lead, each sleeve connector slideably inter-fitting over its respective pin or lead so as to project beyond the end of the pin or lead so that when the component is fitted against the surface of a printed circuit card having a pattern of connection lands with which the pins or leads are aligned, variations in spacing between the ends of the pins or leads and the lands are accommodated by sliding movement of the sleeve connectors.

2. An electrical component as claimed in claim 1, in which the sleeve connectors are pre-tinned so that the solder connections between the pins, sleeve connectors and lands can be made by solder reflow techniques.

3. An electrical component as claimed in claim 1 or 2, in which said sleeve connectors each have a longitudinal slit therein throughout the length of said connector and each sleeve connector frictionally grips its respective pin.

4. An electrical component as claimed in claim 1, 2 or 3, in which each said sleeve connector is formed with at least one integral tab thereon for soldering to the respective land on the surface of said printed circuit board to which the pin is to be connected.

5. An electrical component as claimed in claim 4, in which said at least one integral tab extends in a substantially orthogonal direction with respect to the axis of said pin.

6. An electrical component as claimed in claim 1, 2 or 3, in which each said sleeve connector is formed with a plurality of inwardly bent tabs in engagement with said interconnection pin within said sleeve.

7. An electrical component as claimed in any one of claims 1 to 6, in which the sleeve connectors are each substantially as hereinbefore described with reference to and illustrated in, Figure 2 or Figure 3 or Figure 4 or Figure 5 of the accompanying drawings.

8. Electrical apparatus comprising an electrical component as claimed in any one of claims 1 to 7 having its pins and sleeve connectors solder-connected to respective lands on a printed circuit card.

9. Electrical apparatus as claimed in claim 8, which apparatus is substantially as hereinbefore described with reference to and illustrated in Figure 1 of the accompanying drawings.

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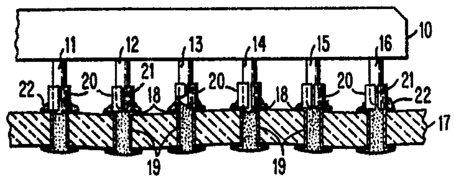

FIG. 1

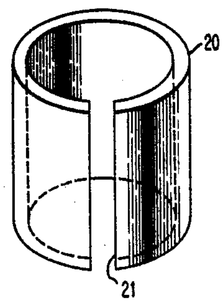

FIG. 2

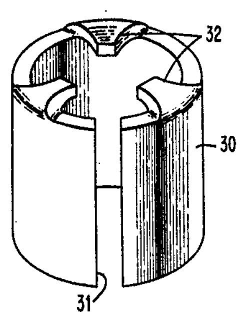

FIG. 3

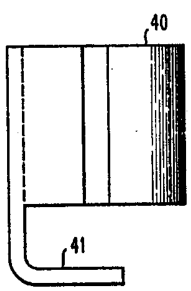

FIG. 4

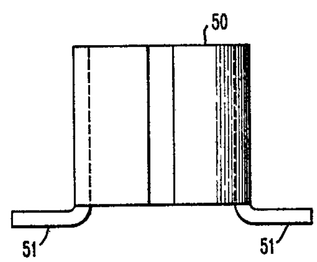

FIG. 5