

Title of Invention

IC Socket

Detailed Description of Invention(Field of Invention)

This invention relates to an IC socket for connecting an IC (Integrated Circuit) of pin grid array (PGA) type having pin contacts arranged in matrix form to a circuit board.

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(Prior Art)

The IC socket for connecting the IC of PGA type having the pin contacts arranged in matrix form to the circuit board usually has multiple contacts so that the socket is soldered to the circuit board by heating simultaneously solder balls attached to the contacts.

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Epoxy resin containing glass fibers is often used as resin that forms a circuit board, and insulative resin such as polybutylene terephthalate (PBT) is often used as material of a housing retaining contacts. However, since the above two resins have different thermal expansion coefficients, load may be applied to the solder balls after the IC socket is mounted on the circuit board so that solder crack may occur to cause electrical discontinuity between the IC and the circuit board.

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Furthermore, warp is inclined to occur in the connector body and the board due to the difference of the thermal expansion coefficients. When stress is applied to soldered portions due to the warp, there may be a risk that reliability of electrical conductivity deteriorates. Then, in order to solve such problems, Japanese patent laid-open No. 62-37887 discloses a technology that provides thermal expansion/constriction absorbing portions with a housing. According to the above invention, forming alternatively slits 150a extending from one wall toward the inside of the housing 120, and slits 150b extending from the other wall toward the inside of the housing 120 had having the same depth as that of the slit 150a as shown in Fig. 6(A) is proposed. The invention also proposes forming long holes 151 larger than diameter of contacts 130 between predetermined rows of the contacts 130 as shown in Fig. 6(B).

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By such a proposal, solder crack has been difficult to occur because the difference between the thermal expansion coefficients of housing and the board is absorbed to cause to reduce burden on the solder balls. Besides, warp of the connector and the board has been difficult to occur.

(Problems to be solved)

However, according to the above proposal, since the slits 150a, 150b and the longer holes 151 are formed to penetrate between upper and lower surfaces of the housing 120, strength of the housing 120 is not maintained. Moreover, it is difficult to make a desired shaped housing since it is difficult to flow synthetic resin as molding material upon molding the housing 120.

Accordingly, an object of this invention is to provide an IC socket wherein solder crack and warp can be prevented by absorbing the difference of the thermal expansion coefficients of the housing and the board without reducing the strength of the housing.

(Means to solve the problems)

In order to solve the above problems, the invention of claim 1 is directed to an IC socket in which contact press fit portion receiving holes that receive therein press fit portions of contacts for connecting an IC to a circuit board are arranged in a matrix form with said receiving holes extending to upper and lower surfaces of a housing, and in which pin contact receiving openings for receiving therein pin contacts on said IC, which are larger than said contact press fit receiving holes, are formed in upper surfaces of said contact press fit portion receiving holes, and in which solder ball receiving openings for receiving therein solder balls for connecting to said circuit board, which are larger than said contact press fit

receiving holes, are formed in upper surfaces of said contact press fit portion receiving holes, said IC socket characterized in that: first slits having bottoms and extending from said upper surface toward said lower surface of said housing are formed between predetermined rows of said pin
5 contact receiving openings, and second slits having bottoms and extending from said lower surface toward said upper surface of said housing are formed between predetermined rows of said solder ball receiving openings at locations where said first slit is not formed.

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In the invention of claim 1, by forming the first slits between the predetermined rows of the pin contact receiving openings formed in the upper surface of the housing, and the second slits between the predetermined rows of the solder ball receiving openings formed in the
15 lower surface of the housing such as not to overlap with each other, the difference between the thermal expansion coefficients of the housing and the board can be absorbed to prevent the solder crack and the warp.

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Furthermore, by providing the first and second slits having bottoms, the strength of the housing can be maintained and it is effective to make the flow of the material that forms the housing smooth upon molding the housing. And the invention of claim 2 is directed to the IC socket of
claim 1 wherein the first slits are formed shallower than the second slits.

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In the invention of claim 2, by making the first slits shallower than the second slits, it is effective to prevent the warp of the housing because the material that forms the housing at the upper portion and at the lower
30 portion of the housing is not unevenly distributed.

(Embodiments of the Invention)

One embodiment in accordance with this invention is now described

with reference to accompanied drawings. Fig. 1 shows an IC socket in accordance with this invention, (A) is a plan view, (B) is a front view, and (C) is a right side view. Fig. 2 shows a rear view of the IC socket shown in Fig. 1(A). Fig. 3 shows the IC socket in accordance with this invention, (A) is a partially enlarged plan view with a slider removed in Fig. 1(A), and (B) is a partially enlarged rear view of the IC socket shown in Fig. 2. Fig. 4 is a partially enlarged cross section taken along line 4-4 with the slider removed. Fig. 5 shows the housing used in the IC socket in accordance with this invention, (A) is a plan view, (B) is a front view, (C) is a right side view, and (D) is a rear view.

As shown in Figs. 1-4, an IC socket 1 in accordance with this invention comprises a housing 20 in which a plurality of contacts 30 connected to a circuit board (not shown) by solder balls 3 are arranged in a matrix form, a slider 40 slideable leftward and rightward (see Fig. 1(A)) over an upper surface of the housing 20 and carrying an IC (not shown), and a tool insertion hole 41 for receiving therein a tool (not shown) for driving the slider 40 leftward and rightward.

Now, as shown in Fig. 5(A)-5(D), the housing has a substantially rectangular shape formed by molding insulative resin such as PBT. On each of front and rear walls 22 of the housing 20 (see Fig. 5(A)), two projections 23 are formed with a predetermined distance leftward and rightward. On a right wall 24 of the housing 20, a gate portion 21 remains for pouring molding material. The gate portion will be removed by being broken off after the IC socket 1 is connected to the circuit board.

As shown in Fig. 4, the plurality of contacts 30 for connection to the circuit board are arranged in a matrix form with the contacts penetrating between the upper and lower surfaces of the housing 20 and being press fitted therein. In upper surfaces of contact press fit portion receiving

holes 31 for receiving press fit portions 30a of the contacts 30 therein, pin contact receiving openings 32 for receiving therein pin contacts (not shown) formed on the IC are formed wider than the contact press fit portion receiving holes 31. In lower surfaces of the contact press fit portion receiving holes 31, solder ball receiving openings 34 for receiving therein solder balls 33 for connection to the circuit board are also formed wider than the contact press fit portion receiving holes 31.

10 Furthermore, as shown in Fig. 5(A), between predetermined rows of the pin contact receiving openings 32 formed in the upper surface of the housing 20, a plurality of first slits 50a having bottoms are formed leftward and rightward at least over a region where the contacts 30 are press fitted. The first slit 50a does not extend continuously leftward and rightward but is divided into sections at places. In this embodiment, one row slit 50a is provided per four rows of the pin contact receiving openings 32 as shown in Fig. 3(A).

20 Furthermore, as shown in Fig. 5(D), between predetermined rows of the solder ball receiving openings 34 formed in the lower surface of the housing 20, a plurality of second slits 50b having bottoms are formed leftward and rightward at least over a region where the contacts 30 are press fitted. The second slit 50b does not extend continuously leftward and rightward but is divided into sections at places like the first slit 50a. In this embodiment, one row slit 50b is provided per two rows of the solder ball receiving openings 34 as shown in Fig. 3(B).

30 In other words, the first slits 50a and the second slits 50b are formed so as not to overlap with each other. Furthermore, as shown in Fig. 4, the first slits 50a provided in the upper surface of the housing 20 extend from the upper surface toward the lower surface of the housing 20. And the depth thereof is substantially the same as bottom surfaces of the pin contact

receiving openings 32, namely about 40% of thickness of the housing 20. The second slits 50b provided in the lower surface of the housing 20 extend from the upper surface toward the upper surface of the housing 20. And the depth thereof is deeper than the bottom surfaces of the pin contact receiving openings 32, namely about 70% of thickness of the housing 20. By forming the slits 50a, 50b having the bottoms and not penetrating the upper and lower surfaces of the housing 20, the strength of the housing 20 can be maintained.

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Furthermore, the depths of the first and second slits 50a, 50b are different and the depth of the first slit 50a is larger than that of the second slit 50b. This structure is intended to make the uneven distribution of material that forms the housing 20 at the upper and lower portions of the housing 20 little, so that the warp of the housing 20 can be effectively prevented.

The contact 30 is made by forming sheet metal blanked out by a press. As shown in Fig. 4, the contact 30 comprises the press fit portion 30a press fitted in the contact press fit portion receiving hole 31 in the housing 20, a resilient contact beam portion 30b that can receive therein and that can make contact with the pin contact, and a solder ball connection portion 30c connected to the solder ball. As shown in Fig. 3(A), the resilient contact beam portion 30b has a pair of resilient contact beams projecting leftward from an upper end of the press fit portion 30a. A width of the pair of resilient contact beams at the press fit portion 30a side is formed relatively large, and a left side width remote from the press fit portion 30a is formed relatively small. Accordingly, the pin contact does not make contact with the contact beams when it is located at a right side of the contact 30 (or the press fit portion 30a side) so that the IC can be inserted and extracted without any load. On the other hand, the pin contact is in contact with the resilient contact beam portion 30b when the pin contact is located at a left side of the contact 30.

Furthermore, as shown in Fig. 1(A)-1(C), the slider 40 is formed by molding insulative resin such as PBT and has a substantially rectangular shape having substantially the same dimensions as the housing 20. The slider has front and rear walls 42 (or upper and lower walls in Fig. 1(A)) extending vertically from front and rear sides. Openings 43 are formed in the front and rear walls 42 at locations corresponding to the locations of the projections 22 formed on the housing 20. The projections 22 can move leftward and rightward in only a range of the openings so that the slider 40 can slide leftward and rightward, and it functions as a stop for preventing the slider 40 from dropping off upward from the housing 20.

As shown in Fig. 1(A), the tool insertion hole 41 is formed at the left side of the housing 20 for driving the slider 40 leftward and rightward. If a tool inserted into the tool insertion hole 41 is rotated in a LOCK direction, the slider 40 moves leftward. On the other hand, if the tool is rotated in a OPEN direction, the slider 40 moves rightward. Pin contact receiving openings 44 for receiving therein the pin contacts formed on the IC are formed in a matrix form so as to correspond to the contacts 30 formed in the housing 20.

Next, manufacture of the IC socket 1 and method for connecting the IC socket 1 and the circuit board are described. First, resin as the molding material of the housing 20 that constitutes the IC socket 1 is poured from the gate portion 21 for injection molding to form the housing 20 as shown in Fig. 5(A). At this stage, the contact press fit portion receiving holes 31, the pin contact receiving openings 32, the solder ball receiving openings 34 and the first and second slits 50a, 50b are formed in the housing 20 as shown in Fig. 4. Thereafter, the press fit portions 30a of the contacts 30 are press fitted into the contact press fit portion receiving portions 31, and the solder balls 33 are formed in the solder ball receiving

openings 34 to mount the solder balls on the solder ball connection portions 30c.

5 Similarly, the slider 40 is also formed by injection molding resin as the molding material of the slider 40. At the same time, the pin contact receiving openings 44 for receiving therein the pin contacts formed on the IC are formed in a matrix form so as to correspond to the contacts 30 formed in the housing 20. Then, by mounting the slider onto the upper
10 surface of the housing 20 so that the slider can move leftward and rightward, the IC socket 1 is completed.

Then, by heating simultaneously the solder balls 33 formed on the
15 lower surface of the housing 20, the IC socket 1 is connected to the circuit board. At this time, in order to prevent the warp of the housing 20 due to heat upon soldering, the gate portion 21 used upon injection molding of the housing 20 is remained to be attached and then it is broken off after soldering.

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In order to electrically connecting the pin contacts formed on the IC to the circuit board by utilizing the IC socket 1, the tool is rotated in the LOCK direction to cause the slider 4 to move leftward from a position
25 where the slider is located at right side. Then, the pin contacts make contact with the resilient contact beams 30b of the contacts 30 to cause electrical conductivity. On the other hand, if the tool is rotated in the OPEN direction to cause the slider 40 to mover rightward from a position where the slider 40 is located at the left side, the pin contacts are
30 disconnected from the resilient contact beam portions 30b to cause electrically non-conductivity again.

In this way, by mounting the slider 40 that is movable leftward and

rightward on the upper surface of the housing 20, the pin contacts formed on the IC are connected to the circuit board. That is useful means for avoiding a problem that the IC has multiple pins and so considerable insertion force is required when the IC is directly inserted into and
5 extracted from the contacts 30 so that it makes connecting operation difficult.

In this embodiment, by means of simple structure in which the housing
10 20 is provided with the slits 50a, 50b having the bottoms for absorbing the difference of the thermal expansion coefficients, stress in the solder balls 33 due to the difference between thermal expansion coefficients of the housing 20 and the circuit board can be prevented. Accordingly, the solder crack can be ensured to be prevented after the IC socket 1 is
15 mounted on the circuit board.

Furthermore, it is advantageous that quality is easily controlled since adjustment of warp after molding is possible by changing the depth,
20 number and location of the slits 50. Moreover, as far as the slider 40 is slideable leftward and rightward, it is not limited to the tool insertion hole 41 and the tool in this embodiment, and the slider may be driven by, for example, a cam shaft that enables the slider to slide by a rotating operation.

25 In this embodiment, the IC socket 1 is described that utilizes the slider 40 for connecting the pin contacts formed on the IC to the circuit board easily. However, a similar advantage can be obtained if the pin contacts are directly connected to the housing 20 with the slider 40 removed. The
30 depth of the first and second slits 50a, 50b are not limited to this embodiment as far as molding material at the upper portion and the lower portion of the housing 20 is evenly distributed. And location and number of the slits 50 are not limited to this embodiment as far as the first and second slits 50a, 50b are formed so as not to overlap with each other.

(Advantages)

As described the above, according to the invention of claim 1, by
5 forming the first slits between the predetermined rows of the pin contact
receiving openings formed in the upper surface of the housing, and the
second slits between the predetermined rows of the solder ball receiving
openings formed in the lower surface of the housing such as not to overlap
10 with each other, the difference between the thermal expansion coefficients
of the housing and the board can be absorbed to prevent the solder crack
and the warp.

Furthermore, by providing the first and second slits having bottoms, the
15 strength of the housing can be maintained, and a housing having a desired
shape can be easily manufactured since it is effective to make the flow of
the material that forms the housing smooth upon molding the housing.
Accordingly, an IC socket that is highly reliable in electrical conductivity
can be made without causing deterioration of the strength of the housing.

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And according to the invention of claim 2, by making the first slits
shallower than the second slits, the warp of the housing can be prevented
since the material that forms the housing at the upper portion and at the
25 lower portion of the housing is not unevenly distributed.

Brief Description of Drawings

Fig. 1 shows an IC socket in accordance with this invention, (A) is a plan
view, (B) is a front view and (C) is a right side view.

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Fig. 2 shows a rear view of the IC socket shown in Fig. 1(A).

Fig. 3 shows the IC socket in accordance with this invention, (A) is a
partially enlarged plan view with a slider removed in Fig. 1(A) and (B) is a

partially enlarged rear view of the IC socket shown in Fig. 2.

Fig. 4 is a partially enlarged cross section taken along line 4-4 with the slider removed.

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Fig. 5 shows the housing used in the IC socket in accordance with this invention, (A) is a plan view, (B) is a front view, (C) is a right side view and (D) is a rear view.

10 Fig. 6 shows conventional housings, (A) is a plan view of the one example of the conventional housings, and (B) is a plan view of the other example of the conventional housings.

(Description of Reference Numerals)

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| 15 | 1 | IC socket |
| | 20 | housing |
| | 30 | contact |
| | 30a | press fit portion |
| | 31 | contact press fit portion receiving hole |
| 20 | 32 | pin contact receiving opening |
| | 33 | solder ball |
| | 34 | solder ball receiving opening |
| | 50a | first slit |
| | 50b | second slit |
| 25 | | |



CLAIMS

1. An IC socket in which contact press fit portion receiving holes that receive therein press fit portions of contacts for connecting an IC to a circuit board are arranged in a matrix form with said receiving holes extending to upper and lower surfaces of a housing, and in which pin contact receiving openings for receiving therein pin contacts on said IC, which are larger than said contact press fit receiving holes, are formed in upper surfaces of said contact press fit portion receiving holes, and in which solder ball receiving openings for receiving therein solder balls for connecting to said circuit board, which are larger than said contact press fit receiving holes, are formed in upper surfaces of said contact press fit portion receiving holes, said IC socket characterized in that:

first slits having bottoms and extending from said upper surface toward said lower surface of said housing are formed between predetermined rows of said pin contact receiving openings, and

second slits having bottoms and extending from said lower surface toward said upper surface of said housing are formed between predetermined rows of said solder ball receiving openings at locations where said first slit is not formed.

2. The IC socket of claim 1, wherein said first slits are formed shallower than said second slits.