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**SOCKET, CIRCUIT BOARD, AND SUB-CIRCUIT BOARD FOR
SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE** ✓

BACKGROUND OF THE INVENTION

5 **1. Field of the Invention**

The present invention generally relates to a socket, a circuit board, and a sub-circuit board for a semiconductor integrated circuit device, and more particularly to a socket having mechanical connection means for easily connecting and disconnecting the socket to and from a circuit board, the circuit
10 board, and a sub-circuit board.

2. Description of the Related Arts

After the manufacturing process, the semiconductor integrated circuit(IC) device is tested by various methods in order to inspect its reliability. These tests
15 include an Electrical Characteristic Test and a Burn-In Test. The electrical characteristic test inspects whether the semiconductor chip normally operates or is open- or short-circuited, by electrically connecting all the I/O pins of the semiconductor chip to a test signal generating circuit. And, in the burn-in test, severe stresses of high temperature, voltage, and/or operation signal, which are
20 beyond the normal operating condition, are applied to the semiconductor integrated device by electrically connecting several I/O pins of the semiconductor chip such as the power source input terminal to the test signal generating circuit. Thereby, the failures of the semiconductor integrated circuit devices are initially detected, and their longevity and defects are tested.

25 Generally, the test process of the semiconductor integrated circuit device

is accomplished after mounting the semiconductor integrated circuit device on a socket and electrically connecting the socket to a test circuit board. The methods for electrically connecting the socket to the test circuit board in order to test the semiconductor integrated circuit device may be classified three ways.

5 FIG.1 through FIG. 3 are cross-sectional views showing conventional connection methods between a socket and a circuit board for testing a semiconductor integrated circuit device. With reference to FIG. 1 through FIG. 3, the conventional sockets and the conventional circuit boards will be described hereinafter.

10 With reference to FIG. 1, a first electrical connection between a socket 70 and a circuit board 80 for testing a semiconductor integrated circuit device 20 uses a soldering method. This method is mainly employed in the Burn-In Test, and one of plural connection leads 75 of the socket 70 is electrically connected to a corresponding one of plural through connection portions 82 of the circuit
15 board 80 by soldering, in order to fix the socket 70 on which the integrated circuit device 20 is mounted to the circuit board 80.

 Since a solder 66 is applied in the soldering process, this connection method between the socket 70 and the circuit board 80 using soldering may cause the industrial accident such as the lead poisoning of the worker. And, it is
20 difficult for the worker to remove the socket 70 from the circuit board 80, when there is a failure in either of the socket 70 or the circuit board 80. That is, in order to separate the socket 70 from the circuit board 80, a process for removing the solder 66 from the respective connection leads 75 is needed. Since the heat of high temperature is applied to remove the solder 66, wiring patterns which are
25 used as passages of the electrical signals on the circuit board 80 may be damaged. Further, if the socket 70 and the circuit board 80 are used for a long time, the bonding force of the solder 66 becomes weak and thereby, the socket 70 is electrically disconnected from the circuit board 80, possibly causing a test failure.

With reference to FIG. 2, a second electrical connection between the socket 70 and the circuit board 80 for the semiconductor integrated circuit device 20 is mainly employed on the test handler and electrically connects the socket 70 to the circuit board 80 by receptacles 87. At this time, the receptacles 87 serve as an
5 intermediation to connect and disconnect the socket 70 to and from the circuit board 80. The receptacle 87 is inserted into a through hole of a through connection portion 82 of the circuit board 80 and fixed to the circuit board 80 by soldering. Then, the connection lead 75 of the socket 70 is inserted into the corresponding receptacle 87 and thereby, the socket 70 is electrically connected
10 to the circuit board 80.

For the above-described connection method using the receptacles 87, it is difficult to insert the receptacles 87 into the circuit board 80 during the manufacturing process of the circuit board 80. Further, for the fine pitch between the connection leads 75, when the receptacles 87 are fixed by soldering,
15 the respective neighboring receptacles 87 may be connected to each other by the solder 66 and thereby, it causes the electrical short-circuit or the leakage current.

Still further, since the receptacles 87 are additionally provided, it increases the production cost due to the manufacturing of the receptacles 87, and since a separate process for inserting the receptacles 87 into the circuit board 80 is
20 additionally necessary during the manufacturing process of the circuit board 80, it increases the number of the steps of the semiconductor manufacturing process.

With reference to FIG. 3, a third electrical connection method between a socket 50 and the circuit board 80 for a semiconductor integrated circuit device(not shown) uses a sub-circuit board 90 as well as the receptacles 87. The
25 receptacles 87 are fixed to the circuit board 80 by soldering, and the socket 50 is mounted on the sub-circuit board 90. Then, one of plural connection leads 95 is fixed to the corresponding one of plural through connection portions 92 of the sub-circuit board 90 by soldering. Herein, the through connection portions 92

of the sub-circuit board 90 are correspondingly aligned on the through connection portions 82 of the circuit board 80. For the fine pitch between external terminals of the socket 50, the sub-circuit board 90 makes the pitch between the external terminals to coincide with the pitch between the through connection portions 82 of the circuit board 80. Accordingly, the socket 50 is electrically connected to the circuit board 80 by inserting the connection lead 95 of the sub-circuit board 90 into the corresponding receptacle 87 of the circuit board 80.

These methods using the receptacles 87 have some drawbacks that they increase the production cost of the semiconductor integrated circuit device, for the receptacles 87 are additionally prepared.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a socket, and a circuit board, and a sub-circuit board for semiconductor integrated circuit device, which have a structure of easily connecting and disconnecting the socket to and from the circuit board without soldering and/or using the receptacles.

In order to achieve the foregoing and other objects, a socket according to the present invention electrically connects a semiconductor integrated circuit device to through connection portions of a circuit board and comprises a plurality of inner connection portions, which are electrically connected to external terminals of the semiconductor integrated circuit device, and a plurality of outer connection portions, which are integrated with the inner connection portions and mechanically contact the through connection portions of the circuit board, the through connection portion having through hole. The outer connection portions have the self-elasticity and mechanically contact the through connection portions of the circuit board by using the self-elasticity.

In another aspect of the present invention, a circuit board electrically connects the semiconductor integrated circuit device and mounts the socket having the outer connection portions with the self-elasticity so that the outer connection portions of the socket mechanically contact the through connection portions of the circuit board by the self-elasticity.

In still another aspect of the present invention, a sub-circuit board for electrically connecting the socket to the through connection portions of the circuit board, comprises wiring patterns which define predetermined circuits, through connection portions which are electrically connected to the wiring patterns and have through holes, and a plurality of connection leads, each connection lead having a terminal which is fixed to the through hole, and another terminal which has the self-elasticity and mechanically contacts the through connection portion of the circuit board.

The outer connection portions of the socket or the connection leads of the sub-circuit board are bent plural times, and thereby have the self-elasticity. It is preferable that the outer connection portions of the socket or the connection leads of the sub-circuit board are diamond-shaped. Since the width is reduced from the central portion to the upper or the lower portion, that is, the lower half portion of the outer connection portion is "V" shaped and the upper half portion of the outer connection portion is inverse "V" shaped, when the outer connection portions or the connection leads are inserted or removed to or from the through connection portions of the circuit board, the damage by the friction with the through holes can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

These and various other features and advantages of the present invention

will be readily understood with reference to the following detailed description taken in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and, in which:

FIG. 1 is a cross-sectional view showing a conventional connection method
5 between a socket and a circuit board for testing a semiconductor integrated circuit device;

FIG. 2 is a cross-sectional view showing another conventional connection method between the socket and the circuit board for testing the semiconductor integrated circuit device;

10 FIG. 3 is a cross-sectional view showing still another conventional connection method between the socket and the circuit board for testing the semiconductor integrated circuit device;

FIG. 4 is a perspective view showing an embodiment of a socket for testing a semiconductor integrated circuit device according to the present invention;

15 FIG. 5 is a cross-sectional view showing a connection method between the socket of FIG. 4 and a circuit board;

FIG. 6 is an enlarged view showing an outer connection portion of the socket of FIG. 4;

20 FIG. 7a is a schematic cross-sectional view showing the outer connection portion of the socket before inserted to the circuit board;

FIG. 7b is a schematic cross-sectional view showing the outer connection portion of the socket after inserted to the circuit board;

25 FIG. 8 is a cross-sectional view showing another embodiment of the outer connection portion of the socket for testing the semiconductor integrated circuit device according to the present invention; and

FIG. 9 is a cross-sectional view showing another connection method between the socket and the circuit board using a sub-circuit board according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described below
5 with reference to the accompanying drawings.

FIG. 4 is a perspective view showing an embodiment of a socket for testing
a semiconductor integrated circuit device according to the present invention, and
FIG. 5 is a cross-sectional view showing a connection between the socket of FIG.
4 and a circuit board. FIG. 6 is an enlarged view showing an outer connection
10 portion of the socket of FIG. 4. Herein, the socket 10 and the circuit board 30
are apparatuses for the burn-in test of an SOP(Small Outline Package) 20, which
is a kind of the semiconductor integrated circuit devices.

As shown in FIG. 4, a socket 10 of the present invention comprises a
socket body 11 consisting of an upper body 12 and a lower body 13, and a
15 plurality of socket leads 15 for electrically connecting the socket 10 to a circuit
board(30 in FIG. 5). The upper body 12 has a cavity for loading the SOP 20 at
a central portion, and the SOP 20 is mounted on the lower body 13 through the
cavity of the upper body 12. The upper body 12 is coupled with the lower body
13 by a plurality of guide bars 19. And, the upper body 12 vertically moves up
20 and down along the guide bars 19 by the external force and controls the electrical
connection with the SOP 20. The socket leads 15, which are formed on the lower
body 13 of the socket body 11, have inner connection portions 15a and outer
connection portions 15c in integration with the inner connection portions 15a.
The inner connection portions 15a touch and thereby are electrically connected
25 to the outer leads 22 of the SOP 20. The outer connection portions 15c extend
from the lower body 13 and are diamond-shaped to have the self-elasticity.

Described in detail with reference to FIG. 5, the socket leads 15, which are
formed on the lower body 13 of the socket body 11, electrically connect the SOP

20 to the circuit board 30. One socket lead 15 comprises an inner connection portion 15a, an elastic portion 15b, and an outer connection portion 15c. As described above, the inner connection portions 15a are electrically connected to the outer leads 22 of the SOP 20 and the outer connection portions 15c are electrically connected to the circuit board 30. The elastic portions 15b are bent so that the inner connection portions 15a may be connected or disconnected to or from the SOP 20 by the vertical movement of the upper body 12 of the socket body 11. At this time, the inner connection portions 15a are vertically moves up and down by the vertical movement of the upper body 12 of the socket body 11.

As shown in FIG. 6, the outer connection portion 15c has a hook form having a diamond shape so as to be easily inserted and removed into and from a through connection portion 32 having a through hole 33. That is, the outer connection portion 15c is bent plural times so that the width d1 of the central portion is greater than that of the upper or the lower portion of the outer connection portion 15c. The above-described outer connection portions 15c have the elasticity in the direction of an arrow "A", toward the outer side. That is, when the external force is applied to the central portion of the outer connection portion 15c in the direction of an arrow "B", the corresponding elasticity of the central portion of the outer connection portion 15c acts in the direction of an arrow "A".

FIG. 7a and FIG. 7b are schematic cross-sectional views respectively showing the socket before and after inserted to the circuit board, respectively. With reference to FIG. 7a and FIG. 7b, the outer connection portions 15c of the socket leads 15 will be described in detail hereinafter.

With reference to FIG. 7a, the width d1 of the central portion of the outer connection portion 15c is determined by the diameter d2 of the through hole 33 of the circuit board 30. Generally, the width d1 of the central portion of the outer connection portion 15c is greater than the diameter d2 of the through hole 33 by

a predetermined degree. Preferably, it is effective to have the difference of approximately 0.1 mm, the difference between the width $d1$ of the central portion of the outer connection portion 15c and the diameter $d2$ of the through hole 33, in order to have the constant elasticity of the outer connection portion 15c without the deformation of its shape.

As shown in FIG. 7b, when the outer connection portions 15c are inserted into the through holes 33 of the through connection portion 32 of the circuit board 30, since the diameter $d2$ of the through hole 33 is smaller than the width $d1$ of the central portion of the outer connection portion 15c, the outer connection portion 15c mechanically contacts the inner wall of the through hole 33 at a contact point C and a contact point D and thereby, the electrical connections between the outer connection portions 15c and the through holes 33 are carried out. At this time, since the outer connection portion 15c applies the elastic force to the through connection portions 32, the electrical connections between the outer connection portions 15c and the through holes 33 may be continuously maintained by the self-elasticity of the outer connection portion 15c without soldering. Further, since the outer connection portion 15c mechanically contacts the through holes 33 at plural contact points, that is, at least two contact points, the electrical contact is improved. Herein, the dimension of the contact points between the outer connection portions 15c and the through holes 33 may be variously controlled by changing the shape and the degree of the bent portion of the outer connection portion 15c.

Particularly, since the lower half portion of the outer connection portion 15c has a "V" shape, it is possible to minimize the friction which is caused when inserting the outer connection portion 15c into the through hole 33 of the circuit board 30. That is to say, from the lower portion to the central portion of the outer connection portion 15c, the width of the outer connection portion 15c increases and thereby it is easy to insert the outer connection portion 15c into the

through hole 33 of the circuit board 30. Further, since the upper half portion of the outer connection portion 15c has an inverse "V" shape, it is possible to minimize the friction which is caused when removing the outer connection portion 15c from the through hole 33 of the circuit board 30. That is to say, from the upper portion to the central portion of the outer connection portion 15c, the width of the outer connection portion 15c increases and thereby it is easy to remove the outer connection portion 15c from the through hole 33 of the circuit board 30.

Herein, the outer connection portion 15c extending from the lower body 13 has a designated height, so that the outer connection portion 15c does not protrude from the lower surface of the circuit board 30, when the outer connection portions 15c are inserted into the through holes 33 of the circuit board 30. For the conventional socket, since the outer connection portions of the socket leads should be connected to the circuit board by soldering, the outer connection portions protrude from the lower surface of the circuit board and thereby, the total height of the circuit board 30 considerably increases. However, for the socket according to the present invention, since it is not necessary to be soldered, the outer connection portions 15c do not protrude from the lower surface of the circuit board 30. Therefore, the total height of the circuit board 30 can be reduced. Further, since the lower surface of the circuit board 30 of the present invention is flat and even, the operation of an apparatus which is employed in loading and unloading the socket may be improved.

The inner walls of the through holes 33 of the circuit board 30 are made of conductive metals having an excellent abrasion-proof, such as gold(Au). At this time, a gold layer may be deposited on the inner walls of the through connection portions 32 by the plating method. The reason is to protect the through holes of the through connection portions 32 from the scratch caused when inserting and removing the outer connection portions 15c of the socket 10 into and from the

through holes 33. For the conventional socket, connection terminals of the circuit board 10 were made of materials, which have excellent cohesion with solder for soldering, for example, Pb or Sn. On the other hand, the inner walls on the through holes 33 of the through connection portions 32 of the circuit board 30 are made of Au having the conductivity with the excellent abrasion-proof. Therefore, the present invention improves the longevity and the electrical conductivity of the circuit board 30.

The socket and the circuit board according to the present invention are not limited to those which are used for the burn-in test in the above-described embodiment. That is, the present invention may be adapted to a socket and a circuit board with any structure of mounting the integrated circuit device on the socket and inserting the outer connection portions of the socket into the through holes of the circuit board.

FIG. 8 is a cross-sectional view showing another embodiment of the outer connection portion of the socket for the semiconductor integrated circuit device according to the present invention.

With reference to FIG. 8, an outer connection portion 16c of a socket lead 16 has an "S" shape. The outer connection portion 16c mechanically contacts the inner wall of the through hole 33 at a contact point E and a contact point F. When the socket 10 is loaded on the circuit board 30, the end of the outer connection portion 16c of the socket lead 16 is inserted into the through hole 33. And then, if the external force pushes the socket 10 from the upper, bent portions of the outer connection portion 16c become somewhat flat and thereby, the outer connection portion 16c is totally inserted into the through hole 33 with decreasing the total width of the outer connection portion 16c. After inserting the outer connection portion 16c, the corresponding elasticity of the outer connection portion 16c is applied to the inner wall of the through hole 33 at the contact points E and F. Therefore, the electrical connections between the outer

connection portions 16c and the through holes 33 may be stably maintained.

Herein, the outer connection portion of the socket according to the present invention is not limited to a diamond shape or an "S" shape. That is, the outer connection portion of the socket can be formed in any shapes, for example, a circle or an ellipse shape, so as to have the self-elasticity and contact the inner wall of the through hole at plural contact points when inserted into the through hole. That is, the outer portion may be in a closed shape like a diamond shape, or in an open shape like an "S" shape.

Further, although the above-described embodiments of the present invention divide the socket leads into the inner connection portions, the elastic portions, and the outer connection portions, the present invention is not limited to them. According to the embodiments of the present invention, the inner connection portions have various shape by the type of the device. And, there is a socket which does not comprise the inner connection portions, depending on the kind of the semiconductor integrated circuit devices. For example, since the CSP(Chip Scale Package) or the FPBGA(Fine Pitch Ball Grid Array) has external connection terminals which differ from the outer leads of the general semiconductor integrated circuit device, the socket for the CSP or the FPBGA does not comprise the inner connection portions.

Next, an embodiment of a sub-circuit board according to the present invention will be described hereinafter.

FIG. 9 is a cross-sectional view showing another connection method between the socket and the circuit board using a sub-circuit board according to the present invention. With reference to FIG. 9, the sub-circuit board 60 according to the present invention electrically connects a socket 50 for the BGA, which uses solder balls as the external terminals, to a circuit board 30, and is suitable for a semiconductor integrated circuit board having the fine pitch between the external terminals.

Wiring patterns 68, which are made of conductive metal, are formed on the sub-circuit board 60. The wiring patterns 68 are electrically connected to through connection portion 62 of the sub-circuit board 60 and a terminal of connection lead 65 is inserted into the through hole 63 and fixed to the sub-circuit board 60 by soldering. A reference numeral 66 indicates lead(Pb) applied. And then, one of the connection leads 65 of the sub-circuit board 60 is inserted into the corresponding one of the through holes 33 of the circuit board 30 and thereby, the socket 50 is electrically connected to the circuit board 30. Herein, the respective connection lead 65 has a diamond shape, similarly to the socket lead of the socket of the present invention. Since the connection lead 65 has the lower half portion in a "V" shape and the upper half portion in an inverse "V" shape, the connection leads 65 are easily inserted and removed into and from the through holes 33 of the circuit board 30. The sub-circuit board 60 is effectively employed, in the case that the socket 50 has the fine pitch between the external terminals and so cannot be connected directly to the circuit board 30.

With the above-described socket according to an embodiment of the present invention, an experiment was carried out. The experiment tested whether the shape of the outer connection portion of the socket lead was changed by repeatedly inserting and removing the outer connection portion into and from the circuit board under the burn-in test. Herein, the outer connection portion of the socket was designated to have the width of about 0.86 ± 0.03 mm and the diameter of the through hole of the circuit board was smaller than the width of the outer connection portion by about 0.1 mm. Hereinafter, the width of the outer connection portion of the socket refers to the width of the central portion of the outer connection portion. Four(4) sockets were repeatedly inserted and removed into and from the different through holes at twenty(20) times respectively, and then the widths of the outer connection portions of the respective socket were measured. After the experiment, the widths of the outer connection portions of

the sockets became smaller than those of the outer connection portions of the socket prior to the experiment, by only about 0.017~0.029 mm. Accordingly, it was proved that the repetitive insertion and removal of the outer connection portion of the socket up to twenty times or more does not affect the change of the width of the outer connection portion.

And, another experiment for measuring the change of the contact resistance of the socket leads was accomplished. Table 1 shows the measured values of the contact resistances after repeatedly inserting and removing six sockets into and from the through holes of the same circuit board.

Table 1

times	5	10	15	20	25	30
average	18.86mΩ	18.64mΩ	18.79mΩ	18.63mΩ	19.07mΩ	19.29mΩ

As known from the results of Table 1, although the socket was inserted and removed into and from the circuit board 30 times, the through holes of the through connection portions were little scratched and damaged, and the variation of the contact resistance is only about 0.43 mΩ. That is, the electrical connection between the socket and the circuit board is not affected, even if the socket is repeatedly inserted and removed into and from the circuit board more than 30 times.

Since the socket of the present invention maintains the electrical connection with the circuit board by inserting its elastic outer connection portions into the through holes of the circuit board, the adhesive materials such as lead which are employed in the soldering step, and/or the receptacles are unnecessary.

Accordingly, the present invention has some advantages in that it prevents the industrial accident such as the lead poisoning of the worker and reduces the production cost. And, the present invention reduces the manufacturing steps and

consequently, improves the productivity.

Further, the socket according to the present invention is easily substituted. For example, if the socket is damaged by the integrated circuit device burnt during the test process, for the conventional case, a process for melting lead(Pb) of the outer connection portions by applying the heat of the high temperature to the socket was used, in order to remove the socket from the circuit board. However, for the present invention, this melting process is not necessary. Accordingly, the present invention protects the wiring patterns which are formed on the circuit board from the damage and lengthens the longevity of the circuit board. And, the present invention more improves the productivity by the prompt and swift replacement of the socket.

Although preferred embodiments of the present invention have been described in detail hereinabove, it should be clearly understood that many variations and/or modifications of the basic inventive concepts herein taught which may appear to those skilled in the art will still fall within the spirit and scope of the present invention as defined in the appended claims.

WHAT IS CLAIMED IS :

1. A socket for electrically connecting a semiconductor integrated circuit device to through connection portions of a circuit board, the socket comprising:
5 a plurality of inner connection portions, which are electrically connected to external terminals of the semiconductor integrated circuit device; and
a plurality of outer connection portions, which are integrated with the inner connection portions and mechanically contact the through connection portions of the circuit board, said through connection portion having through hole,
10 wherein the outer connection portions have the self-elasticity and thereby mechanically contact the through connection portions of the circuit board.
2. The socket of claim 1, wherein the outer connection portions are bent to provide friction contact.
- 15 3. The socket of claim 1, wherein a central portion of the outer connection portion has greater width than that of a lower portion and an upper portion of the outer connection portion.
- 20 4. The socket of claim 1, wherein the outer connection portion is in a close shape.
5. The socket of claim 4, wherein a lower half portion of the outer connection portion is substantially "V" shaped.
- 25 6. The socket of claim 4, wherein an upper half portion of the outer connection portion is substantially inverse "V" shaped.



7. The socket of claim 4, wherein the outer connection portion is substantially diamond-shaped.
- 5 8. The socket of claim 1, wherein the outer connection portion is in an open shape.
9. The socket of claim 8, wherein the outer connection portion is substantially "S" shaped.
- 10 10. The socket of claim 1, wherein width of the central portion of the outer connection portion is greater than the diameter of the through hole.
11. The socket of claim 10, wherein the width of the central portion of the outer connection portion is greater than the diameter of the through hole by about
15 0.1 mm.
12. The socket of claim 1, wherein the circuit board is a test circuit board.
13. The socket of claim 1, wherein the inner connection portions of the socket
20 are electrically connected to the external terminals of the semiconductor integrated circuit device by the mechanical contact.
14. The socket of claim 1, wherein the external terminals of the semiconductor integrated circuit device are outer leads of a semiconductor device package.
- 25 15. The socket of claim 1, wherein the external terminals of the semiconductor integrated circuit device are solder balls of a semiconductor device package.



16. The socket of claim 1, wherein the outer connection portion contacts the inner wall of the through hole at plural points.

5 17. A circuit board for electrically testing a semiconductor integrated circuit device, the circuit board comprising:

wiring patterns which define predetermined circuits; and

a plurality of through connection portions, which are electrically connected to the wiring patterns and have through holes,

10 wherein said circuit board is connected to a socket comprising inner connection portions electrically connected to external terminals of the semiconductor integrated circuit device, and outer connection portions integrated with the inner connection portions and having the self-elasticity, and thereby the through connection portions of the circuit board mechanically contact the outer connection portions of the socket.

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18. The circuit board of claim 17, which is a burn-in test circuit board.

19. The circuit board of claim 17, wherein the outer connection portions are bent to provide friction contact.

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20. The circuit board of claim 17, wherein a central portion of the outer connection portion has greater width than that of a lower portion and an upper portion of the outer connection portion.

25

21. The circuit board of claim 17, wherein the outer connection portion is in a close shape.

22. The circuit board of claim 21, wherein a lower half portion of the outer



connection portion is substantially "V" shaped.

23. The circuit board of claim 21, wherein an upper half portion of the outer connection portion is substantially inverse "V" shaped.

5

24. The circuit board of claim 21, wherein the outer connection portion is substantially diamond-shaped.

10

25. The circuit board of claim 17, wherein the outer connection portion is in an open shape.

26. The circuit board of claim 25, wherein the outer connection portion is substantially "S" shaped.

15

27. The circuit board of claim 17, wherein width of the central portion of the outer connection portion is greater than the diameter of the through hole.

20

28. The circuit board of claim 27, wherein the width of the central portion of the outer connection portion is greater than the diameter of the through hole by about 0.1 mm.

25

29. The circuit board of claim 17, wherein the inner connection portions of the socket are electrically connected to the external terminals of the semiconductor integrated circuit device by the mechanical contact.

30. The circuit board of claim 17, wherein the external terminals of the semiconductor integrated circuit device are outer leads of a semiconductor device package.



31. The circuit board of claim 17, wherein the external terminals of the semiconductor integrated circuit device are solder balls of a semiconductor device package.

5 32. The circuit board of claim 17, wherein the outer connection portion contacts the inner wall of the through hole at plural points.

33. The circuit board of claim 17, wherein the inner wall of the through hole is made of conductive metal having the excellent abrasion-proof.

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34. The circuit board of claim 17, wherein conductive metal having the excellent abrasion-proof is deposited on the inner wall of the through hole.

35. The circuit board of claim 33, wherein the conductive metal is gold(Au).

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36. The circuit board of claim 34, wherein the conductive metal is gold(Au).

37. A sub-circuit board for electrically connecting a socket, on which a semiconductor integrated circuit device is mounted, to through connection portions of a circuit board, the sub-circuit board comprising:

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wiring patterns which define predetermined circuits;

through connection portions, which are electrically connected to the wiring patterns and have through holes; and

25 a plurality of connection leads, each connection lead having a terminal which is fixed to the through hole, and another terminal which has the self-elasticity and thereby mechanically contacts the through connection portion of the circuit board.



38. The sub-circuit board of claim 37, wherein external terminals of the semiconductor integrated circuit device are solder balls of a semiconductor device package.

