

COAXIAL CABLE UNIT, CABLE TERMINAL AND FIXTURE BOARD

This patent application claims priority based on Japanese patent application H11-34740 filed on February 12, 1999, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

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This invention relates to a cable terminal and a coaxial cable unit using the cable terminal, and a fixture board using the coaxial cable. A fixture board is often called as a Hi-Fix. More particularly, the present invention relates to a cable terminal, a coaxial cable, and a fixture board through which an input signal may be transmitted correctly.

2. Description of the Related Art

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The conventional coaxial cable is installed in a circuit board by soldering a ground portion and a signal line portion respectively on the wiring pattern of the circuit board. Further, in another method, a jig for screwing the ground portion and the signal line portion respectively is installed on the circuit board, and the coaxial cable is then fixed to the circuit board by screwing onto the jig.

According to the conventional method of soldering, however, the connection strength between the coaxial cable and the circuit board is weak, so there is a problem where the coaxial cable is easily broken away when the coaxial cable is pulled. Further, in the case of using a jig, there is another problem where the production cost using the coaxial cable is high, since additional costs for the jig and for screwing the coaxial cable

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onto the jig are generated.

Further, in a semiconductor testing apparatus used for testing a semiconductor device, for example, it is required that a high speed signal should be transmitted with high precision. Thus, it is preferable that the coaxial cable used for transmitting such a signal should not allow noise into the coaxial cable, should always have constant line impedance, and have low stray capacitance. However, in the conventional method, stray capacitance can easily become large since the installation area of the coaxial cable on a circuit board is large. Further, a signal line in an installation portion is uncovered, thus noise from the outside can easily intrude.

Accordingly, the object of the present invention is to provide a cable terminal, a coaxial cable unit, and a fixture board which can solve the above-described problems. This object is achieved by combinations described in the independent claims. The dependent claims define further advantageous and exemplary combinations of the present invention.

SUMMARY OF THE INVENTION

In the first preferred embodiment, a fixture board is provided including a socket board in which a socket of a semiconductor device is installed, a performance board connected to a testing apparatus for testing a semiconductor device, and plural coaxial cable units for connecting the socket board and the performance board. The coaxial cable unit includes a coaxial cable having a ground layer, a signal line enclosed by the ground layer, at least one end part and a cable terminal having an enclosure enclosing an outer circumference of the ground layer in the end part of the coaxial cable, and a fitting part connected electrically to the enclosure and extending towards an axial

direction of the coaxial cable in a suitable direction from the signal line. When the coaxial cable includes two end parts, the cable terminals may be provided in the two end parts respectively.

5 In the second preferred embodiment, the cable terminal further includes a shoulder part that is connected to the enclosure and extends in the radial direction of the coaxial cable. A fitting part is connected to the shoulder part and extends in the axial direction from the shoulder part. Here it is preferable
10 that the maximum width of the fitting part should be different from the diameter of the signal line. Further, it is preferable that the enclosure encloses greater than $3/4$ and less than the complete outer circumference of the coaxial cable. It is preferable that a top position of the fitting part in the axial
15 direction should be almost equal to the top position of the signal line in the coaxial direction.

 Here, the above-described summary of the invention does not itemize all of the necessary characteristics of the present
20 invention. Sub-combinations of these characteristics are also able to be included in the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

25 The present invention will be understood more fully from the detailed description given below, in conjunction with the accompanying drawings:

 FIG. 1 is a front view of a fixture board in accordance with
30 one aspect of the present invention;

 FIGS. 2A to 2C are three-side views to show in detail, structures of a coaxial cable unit 20 shown in FIG. 1; and

FIGS. 3A to 3B are three-side views to show in detail, structures of a cable terminal 40 shown in FIGS. 2A to 2C.

DETAILED DESCRIPTION OF THE INVENTION

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The invention will now be described based on the preferred embodiments. This does not intend to limit the scope of the present invention, but exemplify the invention. All of the features and the combinations thereof described in the
10 embodiments are not necessarily essential to the invention.

FIG. 1 is a front view of a fixture board with regard to an aspect of the preferred embodiment of the present invention. The fixture board includes a socket board 10 into which a socket
15 70 of a semiconductor device 90 is installed, a performance board 30 that is connected to a testing apparatus main body 80 for testing a semiconductor device 90, and plural coaxial cable units 20 that connect the socket board 10 and the performance board 30.

20 In the socket board 10, a through-hole 14 is provided for inserting and soldering the signal line of the coaxial cable unit 20 and a through-hole 16 for connection to the ground line of the coaxial cable unit 20. In the performance board 30, a through-hole 34 is provided for inserting and soldering the signal line of the
25 coaxial cable unit 20 and a through-hole 36 for connection to the ground line of the coaxial cable unit 20. The through-holes 36 of the socket board 10 and the performance board 30 are connected to ground patterns provided inside the socket board 10 and performance board 30 respectively.

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A high speed signal is transmitted to the performance board 30 from the testing apparatus main body 80 for testing the semiconductor device 90. The test signal transmitted from the testing apparatus main body 80 to the performance board 30 is

provided through the coaxial cable unit 20 and the socket board 10 to a socket wiring pattern 12 formed on the socket board. In the same way, the output signal output from the semiconductor device 90 is provided to the testing apparatus main body 80 through the socket 70, the socket board 10, the coaxial cable unit 20, and the performance board 30 when testing the semiconductor device 90.

In order to test the semiconductor device 90 correctly, it is preferable that external noise interfering with the test signal should be negligible. Further, in order to avoid test signal reflection or edge rounding, it is desirable that characteristic impedance on a transmission line of the test signal be continually constant, and stray capacitance on the transmission line be as small as possible.

FIGS. 2A to 2C are three-side views to show in detail the structure of the coaxial cable unit 20 shown in FIG. 1. The coaxial cable unit 20 includes a coaxial cable 60 and a cable terminal 40. The coaxial cable 60 includes a ground layer 66, a ground leader line 64 guided from the ground layer 66, a signal line 62 enclosed by the ground layer 66, and at least one end part 68.

The cable terminal 40 and the ground layer 66 of the coaxial cable 60 are soldered together in the end part 68 of the coaxial cable 60. Further, the ground leader line 64 and the cable terminal 40 are soldered together by being folded in the outward direction of the cable terminal 40. An insulation layer is provided between the ground layer 66 and a signal line 62. In the end part, the insulation layer projects in the direction towards the top of the coaxial cable unit 20. In FIGS. 2B and 2C, the cable terminals 40 are installed in the two end parts 68 of the coaxial cable 60 respectively, but it is possible that the cable terminal 40 is installed only in one of the end parts 68 as an additional

preferred embodiment.

FIGS. 3A to 3C are three-side views to show in detail the cable terminal 40 shown in FIGS. 2A to 2C. The cable terminal 40 includes an enclosure 42 for enclosing the ground layer 66 of the coaxial cable 60 and a fitting part 46 extending towards the axial direction of the coaxial cable 60 with a suitable distance from the signal line 62 of the coaxial cable 60 and being electrically insulated from the enclosure 42. In the socket board 10, a through-hole 14 is provided for inserting and soldering the signal line 62 and a through-hole 16 is provided for inserting and soldering the fitting part 46. In the performance board 30, a through-hole 34 is provided for inserting and soldering the signal line 62 and a through-hole 36 is provided for inserting and soldering the fitting part 46.

Since the enclosure 42 encloses more than $3/4$ of the periphery of the coaxial cable 60, the coaxial cable 60 and the cable terminal 40 securely contact electrically with each other and it is possible to suppress impedance change in the connecting portion. Since the circumference length of the enclosure 42 is smaller than the length necessary for covering the whole circumference of the ground layer 66, a gap 52 is generated between both ends of the enclosure 42. Because of this, solder may be easily poured from the gap 52, and the cable terminal 40 and the coaxial cable 60 may be soldered together.

Due to this, the electrical connection between the cable terminal 40 and the coaxial cable 60 is not only secure, but mechanical strength may also be improved. A shoulder part 44 connected to the enclosure 42 and extending in the radial direction is provided in the cable terminal 40. Since the fitting part 46 is connected to the shoulder part 44 and extends in the axial direction from the shoulder part 44, a suitable distance

may be retained between the fitting part 46 and the signal line 62. Because of this, incorrect contact of the signal line 62 with the enclosure 42 is avoidable.

5 Since a cut-out portion 48 is provided in the side of the fitting part 46 in the axial direction of the enclosure 42, when the ground leader line 64 is folded outward from the inside of the enclosure 42, projection of the folding portion out of the cut-out portion 48 may be avoided. Because of this, it is possible
10 that the cable terminal 40 contacts with the socket board 10 and the performance board 30, thus connection strength of the cable terminal 40 to the socket board 10 and the performance board 30 may be improved, and further it is possible to make the connection impedance small.

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 In order to prevent the cable terminal 40 from short-circuiting with other cables and also improve the strength of the bond, it is preferable that the end parts 68 of the cable terminal 40 and the coaxial cable 60 be covered by end tubes, not shown
20 in the figure. Since a small projecting part 50 is provided in the end portion opposite from the fitting part 46 in the axial direction of the enclosure 42, it is possible to avoid movement of the end tubes covering the cable terminal 40 and the end part 68 of the coaxial cable 60. Because of this, it is possible to
25 prevent exposure of the cable terminal 40.

 Since the signal line 62 is inserted into the through-holes 14 and 34 provided in the socket board 10 and the performance board 30, the section of the signal line 62 that is exposed is extremely
30 small. Because of this, it is possible to prevent external noise from entering the signal line 62. The ground layer 66 of the coaxial cable 60 is connected to the ground layer of the performance board 30 and the socket board 10 in the close vicinity of the signal line 62. Because of this, it is possible to suppress

and keep low the signal line impedance of the connecting portion among the coaxial cable 60, the socket board 10, and the performance board 30, and reflection of the signal in the connecting portion may also be suppressed.

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Further, since the cable terminal 40 may be soldered in the connection between the socket board 10 and the coaxial cable 60 and the connection between the performance board 30 and the coaxial cable 60, it is possible that the connection strength
10 among the socket board 10, performance board 30, and the coaxial cable 60 is increased. Further, since the signal line 62 and the ground layer 66 are soldered together with the board using a through-hole, soldering strength is increased rather than in the case in which soldering is performed on the board surface. Also,
15 the soldering area is small, and thus it is possible that stray line capacitance is reduced.

When the maximum width of the fitting part 46 is nearly equal to the diameter of the signal line 62, it is preferable that
20 the size of the through-holes 14 and 34 of the signal line 62 are almost equal to the size of the through-holes 16 and 36 of the fitting part 46 in the socket board 10 and the performance board 30. However, if the size of the through-holes 14 and 34 of the signal line 62 are almost equal to the through-holes 16 and 36
25 of the fitting part 46, there is a possibility that the signal line 62 and the fitting part 46 will be installed into the incorrect through-holes respectively.

In order to avoid this, it is preferable that the diameter
30 of the signal line 62 be different from the width of the fitting part 46 and also the inner diameters of the through-holes 14 and 34 for the signal line 62 be different from the through-holes 16 and 36 for the fitting part 46.

The signal line 62 and the fitting part 46 inserted into the socket board 10 or the performance board 30 projects through the back side of the socket board 10 and the performance board 30. In order to prevent the projecting fitting part 46 and signal
5 line 62 from contacting with each other, it is preferable to have a short projection length to the back side. Thus, the position at the top portion of the fitting part 46 in the horizontal direction of the coaxial cable 60 is almost equal to the position at the top portion of the signal line 62 in advance.

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Here, the invention is described based on the preferred embodiment. The scope of the art is not limited to the scope of the preferred embodiment. It is obvious to a person with ordinary skill in the art that various modifications or improvements may
15 be added to the preferred embodiment. It is obvious from the scope of the patent claims that the embodiments added by such modifications or improvements are included in the scope of the art of the present invention.

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As obviously explained in the above, according to the present invention, it is possible to provide a fixture board using a cable unit, a coaxial cable unit, and a cable terminal in which the connection strength between the coaxial cable and the circuit
board is strong and a jig or screw is not required. Further,
25 according to the present embodiment, it is possible to provide a fixture board and a coaxial cable unit in which noise does not easily penetrate and stray capacitance on the line and impedance of the connecting portion between the coaxial cable and the circuit board are small.

What is claimed is:

1. A coaxial cable unit for transmitting a signal, comprising:

a coaxial cable [unit] including at least one end part with a ground layer and a signal line enclosed by said ground layer; and

a cable terminal including an enclosure enclosing a periphery of said ground layer in said end part of said coaxial cable, and a fitting part connected electrically to said enclosure and extending in an axial direction of said coaxial cable at a suitable distance from said signal line;

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line; and

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction.

2. A coaxial cable unit as recited in claim 1, wherein said cable terminal further includes a shoulder part connecting to said enclosure and extending in a radial direction of said coaxial cable from said enclosure, and said fitting part is connected to said shoulder part and extends in the axial direction from said shoulder part.

3. A coaxial cable unit as recited in claim 1, wherein said enclosure encloses more than $3/4$ and less than the complete outer periphery of said ground layer.

4. A coaxial cable unit as recited in claim 1, wherein an insulation layer is further included between said ground layer and said signal line and said insulation layer projects towards a top direction of said coaxial cable unit from ground layer in said end part.

5. A coaxial cable unit as recited in claim 1, wherein said coaxial cable has two end parts wherein a said cable terminal is provided at each of said two end parts.

6. A cable terminal in which an end part having a ground layer and a signal line enclosed by said ground layer is installed in a circuit board, comprising:

an enclosure having an adequate length for enclosing an outer periphery of said ground layer;

a fitting part connected to said enclosure electrically and capable of extending in an axial direction of a coaxial cable with a suitable distance from said signal line when said enclosure encloses an outer periphery of said ground layer; and

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line; and

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction.

7. A cable terminal as recited in claim 6, wherein a shoulder part is connected to said enclosure and is capable of extending in a radial direction of said coaxial cable, and said fitting part is connected to said shoulder part and extends towards the axial direction from said shoulder part.

8. A cable terminal as recited in claim 6, wherein a length of a circumference of said enclosure is shorter than a length of an outer circumference of said ground layer.

9. A fixture board including a socket board in which a socket of a semiconductor device is installed, a performance board connected to a testing apparatus for testing said semiconductor device, and plural coaxial cable units for connecting said socket board and said performance board;

wherein said each of said coaxial cable units includes a coaxial cable having a ground layer, a signal line enclosed by said ground layer, at least one end part and a cable terminal having an enclosure enclosing an outer circumference of said ground layer in said end part of said coaxial cable, and a fitting part being connected electrically to said enclosure and extending towards to an axial direction of said coaxial cable in a suitable direction from said signal line;

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line; and

wherein a top position of said fitting part in the axial direction is almost equal to a top position of said signal line in the coaxial direction.

10. A fixture board as recited in claim 9, wherein said cable terminal further includes a shoulder part being connected to said enclosure and extending in the radial direction of a coaxial cable and said fitting part is connected to said shoulder part and extends towards the axial direction from said shoulder part.

11. A fixture board as recited in claim 9, wherein said enclosures encloses more than $3/4$ and less than the complete outer circumference of said ground layer.

12. A fixture board as recited in claim 9, wherein an insulation layer is further included between said ground layer and said signal line and said insulation layer projects towards the top direction of said coaxial cable unit from said ground layer in said end part.

13. A coaxial cable unit for transmitting a signal, comprising:

a coaxial cable unit including at least one end part with a ground layer and a signal line enclosed by said ground layer;

a cable terminal including an enclosure enclosing a periphery of said ground layer in said end part of said coaxial cable, and a fitting part connected electrically to said enclosure and extending

in an axial direction of said coaxial cable with a suitable distance from said signal line;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.

14. A cable terminal in which an end part having a ground layer and a signal line enclosed by said ground layer is installed in a circuit board, comprising:

an enclosure having an adequate length for enclosing an outer periphery of said ground layer;
a fitting part connected to said enclosure electrically and capable of extending in an axial direction of a coaxial cable with a suitable distance from said signal line when said enclosure encloses an outer periphery of said ground layer;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.

15. A fixture board including a socket board in which a socket of a semiconductor device is installed, a performance board connected to a testing apparatus for testing said semiconductor device, and plural coaxial cable units for connecting said socket board and said performance board;

wherein said coaxial cable unit includes a coaxial cable having a ground layer, a signal line enclosed by said ground layer, at least one end part and a cable terminal having an enclosure enclosing an outer circumference of said ground layer in said end part of said coaxial cable, and a fitting part being connected electrically to said enclosure and extending towards to an axial direction of said coaxial cable in a suitable direction from said signal line;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.

16. A coaxial cable unit for transmitting a signal, comprising:

a coaxial cable unit including at least one end part with a ground layer and a signal line enclosed by said ground layer; and

a cable terminal including an enclosure enclosing a periphery of said ground layer in said end part of said coaxial cable, and a fitting part connected electrically to said enclosure and extending in an axial direction of said coaxial cable with a suitable distance from said signal line;

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.

17. A cable terminal in which an end part having a ground layer and a signal line enclosed by said ground layer is installed in a circuit board, comprising:

an enclosure having an adequate length for enclosing an outer periphery of said ground layer;

a fitting part connected to said enclosure electrically and capable of extending in an axial direction of a coaxial cable with a suitable distance from said signal line when said enclosure encloses an outer periphery of said ground layer; and

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.

18. A fixture board including a socket board in which a socket of a semiconductor device is installed, a performance board connected to a testing apparatus for testing said semiconductor device, and plural coaxial cable units for connecting said socket board and said performance board;

wherein said coaxial cable unit includes a coaxial cable having a ground layer, a signal line enclosed by said ground layer, at least one end part and a cable terminal having an enclosure enclosing an outer circumference of said ground layer in said end part of said coaxial cable, and a fitting part being connected electrically to said enclosure and extending towards to an axial direction of said coaxial cable in a suitable direction from said signal line;

wherein the fitting part is of a width being transverse to the axial direction, its maximum width is different from the diameter of said signal line;

wherein a top end position of said fitting part in the axial direction is almost equal to a top end position of said signal line in the axial direction; and

wherein said ground layer is provided in the vicinity of said signal line.