

Hands-free Measurement Device

FIELD OF INVENTION

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The present invention relates broadly to a device and method for probing connections of electronic components disposed on a circuit board.

BACKGROUND

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Presently, a probing device is generally used to probe the pins of components, for example integrated circuit packages of the flat pack type, disposed on a multi-layer printed circuit board assembly (PCBA) to measure the electrical signals between the pins when conducting a design proving test or troubleshooting of the PCBA. The components are typically disposed on the board pads on the outer surface layers on both sides of the PCBA and connections between the components are routed through the inner layers to the outer surface layers of the PCBA. Therefore it is generally required to probe the components on the outer surface layers on both sides of the PCBA. In addition, it is necessary to probe the pins of the components disposed on the PCBA while the PCBA is installed in its intended location, in the instances where the PCBA is oriented horizontally or vertically. However, existing test equipment for holding and mounting probes, such as oscilloscope probes, is suitable for taking measurements of components disposed on a PCBA that is oriented horizontally as placed on a table and not a PCBA that is oriented vertically.

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An existing method to probe the pins of components disposed on both sides of a PCBA in order to measure the electrical signals between the respective pins is to employ a hand-held testing probe. The probe is manually held in hand to make an electrical contact with a corresponding pin of the component to be tested. However, this method may necessitate an increased manpower during testing of different pins simultaneously where the testing probes have to be hand-held by two or more persons in order to probe the respective pins safely and reliably.

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An alternative method is to solder wires to the pins of the components to be tested. The exposed ends of the wires are then connected to a test equipment to probe the electrical signals between the respective pins. However, this would be impractical as individual wires are required for soldering to each of the component pins to be tested and as the amount of pins of the different components on a PCBA to be tested increases, the large amount of wires present would create confusion. There is also the possibility of accidental pulling of the wires during the testing process, thereby dislodging the components from the PCBA and damaging the board pads. Furthermore, as the pins are located near to each other, great care has to be taken to avoid the possibility of soldering two or more pins together, thereby short-circuiting the pins. Accordingly, a skilled technician has to be present during the testing of the PCBA to ensure relatively high quality soldering connections.

A need therefore exists to provide a device and method for probing connections of electronic components disposed on a circuit board that seek to address at least one of the abovementioned problems.

SUMMARY

According to a first aspect of the present invention there is provided a device for probing connections of electronic components disposed on a circuit board, the device comprising a longitudinal support structure; a pair of clamps coupled to respective opposing ends of the support structure for fastening the support structure to the circuit board; and a holder coupled to the support structure for fastening an external probe to the support structure. The holder may be moveable relative to the support structure for contacting the probe to the components mounted on the circuit board.

The support structure may comprise a mounting portion moveable along the support structure, and the holder may be coupled to the mounting portion.

The support structure may comprise a telescopic arrangement of a plurality of sections, and the mounting portion may comprise a central section of the telescopic arrangement.

- 5 Each clamp may comprise a mechanism for adjusting a height of the support structure above the circuit board.

Each clamp may comprise a plate adjustably connected to a main body of the clamp.

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The plate may have a slot formed therein, and the clamp may further comprise a screw configured to pass through the slot and may be received by another slot in the main body to adjustably connect the plate to the clamp.

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The device may further comprise a pair of elastic members, wherein respective first ends of the elastic members may be coupled to opposing ends of the support structure and each elastic member may comprise a connector for attaching the elastic member to the probe, whereby a biasing force towards the circuit board may be exerted on the probe.

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The device may comprise a plurality of the support structures coupled to the clamps, each support structure having respective holders coupled thereto.

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According to a second aspect of the present invention there is provided a method of testing electronic components on a circuit board using the device as defined in the first aspect.

BRIEF DESCRIPTION OF THE DRAWINGS

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Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

FIGURE 1 shows a schematic diagram illustrating a top view of a hands-free measurement device according to one embodiment of the present invention as attached to a PCBA.

5 FIGURE 2 shows a schematic diagram illustrating a side view of a hands-free measurement device according to the embodiment of FIGURE 1 as attached to a PCBA.

10 FIGURE 3 shows a schematic diagram illustrating a bottom view of a hands-free measurement device according to the embodiment of FIGURE 1 as attached to a PCBA.

15 FIGURE 4 shows a schematic diagram illustrating a side view of a hands-free measurement device according to the embodiment of FIGURE 1 holding a test probe, as attached to a PCBA in an operational environment.

20 FIGURES 5(a), 5(b), 5(c)-5(d) and 5(e) show a front view, a back view, a side view and a top view respectively of a G clamp according to one embodiment of the present invention.

FIGURES 6(a), 6(b), 6(c)-6(d) and 6(e) show a front view, a back view, a side view and a top view respectively of a probe holder and a back clamp according to one embodiment of the present invention.

25 FIGURES 7(a), 7(b) and 7(c) show a front view, a side view and a top view respectively of an adjustable rope stopper according to one embodiment of the present invention.

DETAILED DESCRIPTION

FIGURES 1, 2 and 3 show schematic diagrams illustrating a top view, a side view and a bottom view respectively of a hands-free measurement device 100 according to embodiments of the present invention, as attached to a multi-layer printed circuit board assembly (PCBA) 128 in an operational environment. The hands-free measurement device 100 of example embodiments are designed to hold an external probe 400 as shown in FIGURE 4 such that when in use, the hands-free measurement device 100 is capable of adjusting the position of the probe 400 and providing a relatively stable support for the probe 400 during testing and diagnostic procedures on the PCBA 128.

The hands-free measurement device 100 will now be described with reference to FIGURES 1-3. The hands-free measurement device 100 according to example embodiments comprises a pair of G clamps 101 that may be attached to opposite sides of the PCBA 128 to secure the measurement device 100 in place. Each G clamp comprises a main body 102, a groove section 103, a pressure wheel 200 and a threaded screw 202. An adjustable metal plate 104 is disposed in the groove section 103 on one side of the main body 102 of the G clamp 101, where the groove 103 acts as a guide to secure the metal plate 104 against any rotational movement when the hands-free measurement device 100 is in use. The metal plate 104 comprises a countersunk head screw 210 and a rectangular slot 208 with rounded ends disposed towards a forward extremity of the metal plate 104 substantially coinciding with the top surface of the main body 102 of the G clamp 101. The countersunk head screw 210 is fitted through the slot 208 and a corresponding rectangular slot (not shown) on the main body 102 of the G clamp 101 to securely fasten the metal plate 104 to the G clamp 101. FIGURES 5(a)-5(e) show enlarged plan views of the G clamp 101 according to example embodiments, in which each G clamp 101 comprises constituent features such as a main body 102, a groove section 103, a rectangular slot 500 disposed across the width of the main body 102 in the groove 103, a pressure wheel 200 with serrations 201 and a threaded screw 202 with a rubber pad 206 on the end surface of the threaded screw 202.

In example embodiments, the hands-free measurement device 100 further comprises a telescopic bar 108 with multiple sections. The substantially central section 109 of the telescopic bar 108 is used to support a probe holder 110 via a back clamp 112 attached to the central section 109 of the telescopic bar 108. An elastic rope 114 is attached at each extremity of the telescopic bar 108, where each elastic rope 114 is secured to each adjustable metal plate 104 by a clip 106. In example embodiments, the elastic ropes 114 attached at the extremities of the telescopic bar 108 are further connected to a substantially U-shaped probe clip 116 via two adjustable rope stoppers 118 disposed at the rear of the probe clip 116. The hands-free measurement device 100 further comprises two spring loaded storage reels 120 to supply the elastic ropes 114 or store excess length of the elastic ropes 114 when the storage reels 120 are rotated in a clockwise motion 134 or anti-clockwise motion 132 respectively. In example embodiments, the probe holder 110 as shown in FIGURES 1-2 is a ring but it should be appreciated that the probe holder 110 may be a cylinder or of other shapes and sizes. In example embodiments, the elastic ropes 114 have a diameter of 3 mm and are made of polyethylene material. This material allows the elastic ropes 114 to stretch up to 2.5 times its original length. Other materials having similar elastic characteristics as known to those of skill in the art may also be used.

The attachment and operation of the hands-free measurement device 100 according to example embodiments will now be described with reference to FIGURES 1-4. For ease of illustration, the operation of performing testing and diagnostic procedures will be described, by way of example, using a probe such as the probe 400 in FIGURE 4 to perform test on the connection pins e.g. 124 of the integrated circuit package 122 disposed on the top surface 126 of the PCBA 128. It should be appreciated that the hands-free measurement device 100 can be attached to the PCBA 128 for performing testing and diagnostic procedures via the probe 400 on other integrated circuit packages disposed on the PCBA 128, for example the integrated circuit package 130 disposed on the top surface 126 and the integrated circuit package 212 disposed on the bottom surface 214 of the PCBA 128.

In example embodiments, the G clamps 101 are attached to the PCBA 128 such that the longitudinal axis of the telescopic bar 108 is substantially parallel to the PCBA 128. The distance from the PCBA 128 to the telescopic bar 108 is adjustable thereby allowing the probe 400 to make proper contact with the pins e.g. 124 of the integrated circuit package 122 to be tested while at the same time providing sufficient clearance between the telescopic bar 108 and the various integrated circuit packages disposed on the PCBA 128.

In order to secure the hands-free measurement device 100, the G clamps 101 are positioned at either end of the PCBA 128 as shown in FIGURE 2. The pressure wheels 200 are then rotated in a clockwise motion 218 such that the threaded screws 202 move towards the PCBA 128 where the rubber pads 206 on the end surfaces of the threaded screws 202 engage part of the bottom surface 214 of the PCBA 128 to securely hold the hands-free measurement device 100 in place.

The G clamp 101 and the metal plate 104 can be operable to move a distance relative to each other as determined by the length of the slot 208. The countersunk head screw 210 is first rotated in a first predetermined motion to loosen the countersunk head screw 210. When the desired distance of the top surface of the G clamp 101 and accordingly the top surface 126 of the PCBA 128 relative to the forward extremity of the metal plate 104 has been determined, the countersunk head screw 210 is rotated in a second predetermined motion opposite to that of the first predetermined motion to tighten the countersunk head screw 210 to securely attach the metal plate 104 to the G clamp 101. Accordingly, the desired distance of the telescopic bar 108 from the PCBA 128 can be established.

Each pressure wheel 200 is typically a circular gear with serrations 201 along the circumference. The purpose of the design of the pressure wheels 200 is to prevent loosening of the G clamps 101 from the PCBA 128 before the probe 400 is removed from the PCBA 128. This helps to prevent damage to the PCBA 128 and/or the probe 400. When the probe 400 is in contact with the PCBA 128, one end of the adjustable metal plates 104 contacts with the serrations 201 of the pressure wheels 200, thereby preventing the pressure wheels 200 from turning.

The probe 400 is held by the substantially U-shaped probe clip 116 of the hands-free measurement device 100 in example embodiments with the probe 400 then inserted through the aperture 111 of the probe holder 110 attached to the central section 109 of the telescopic bar 108 to guide and secure the probe 400 in place. The probe holder 110 has a relatively strong grip to hold the probe 400 in order to provide a relatively stable support to prevent the tip of the probe 400 from slipping on the PCBA 128, thereby minimising the possibility of damage to the PCBA 128.

FIGURES 6(a)-6(e) show enlarged plan views of the probe holder 110 and the back clamp 112 according to embodiments of the present invention. With reference to FIGURES 6(c) and 6(d), the substantially circular back clamp 112 comprises a back clamp hook 600, an aperture 602 and grip protrusions 604 disposed at substantially regular intervals along the inner wall 606 of the circular back clamp 112. In the 'close' position as shown in FIGURE 6(c), the back clamp hook 600 is positioned to lock the back clamp 112. For example, when the probe holder 110 and the back clamp 112 are attached to the central section 109 of the telescopic bar 108 (FIGURE 1) whereby the protrusions 604 grip the central section 109 in the aperture 602, the back clamp hook 600 can be fastened to securely lock onto the central section 109 of the telescopic bar 108 (FIGURE 1). In order to release the back clamp 112, the back clamp hook 600 is unfastened as shown in the 'open' position in FIGURE 6(d). With reference to FIGURE 6(e), the probe holder 110 comprises an aperture 111 through which a test probe can be positioned.

In example embodiments, the probe holder 110, the back clamp 112, the back clamp hook 600 and the grip protrusions 602 are designed with the dimensions as shown in FIGURES 6(a)-6(e). It should be appreciated that other dimensions may be used for the designs of these features. In example embodiments, the probe holder 110 is made from polyoxymethylene material, also referred to as Delrin, due to the ease of machining of the material. Other similar materials suitable for machining and moulding as known to those of skill in the art may also be used.

In example embodiments and with reference to FIGURES 1, 2 and 4, the user can control the movement of the central section 109 of the telescopic bar 108

and the probe holder 110 in order to adjust the position of the probe 400 to make an electrical contact with the desired pin e.g. 124. During the adjustment of the position of the probe 400 along the longitudinal axis of the telescopic bar 108, the remaining sections on both sides of the central section 109 of the telescopic bar 108 can extend and contract accordingly. When the position of the probe 400 has been determined, appropriate tension can be provided to the respective elastic ropes 114 attached to the extremities of the telescopic bar 108 by engaging the adjustable rope stoppers 118 to control the length of the elastic ropes 114 and secure the elastic ropes 114 at the desired tension. The spring loaded storage reels 120 can be rotated in the anti-clockwise motion 132 to reduce the length of the elastic ropes 114 or rotated in the clockwise motion 134 to increase the length of the elastic ropes 114. In this way, the central section 109 of the telescopic bar 108 comprising the probe holder 110 can be controlled to adjust the position of the probe 400 across the length of the PCBA 128 as defined by the sides of the PCBA 128 held by the G clamps 101. In addition, the tension in the elastic ropes 114 apply a relatively small force to the probe clip 116 attached to the elastic ropes 114 via adjustable rope stoppers 118. This force assists the probe clip 116 to hold the probe 400 relatively firmly against the desired electrical contact with a pin, e.g. 124 to be tested.

FIGURES 7(a), 7(b) and 7(c) show the front view, the side view and the top view respectively of the adjustable rope stopper 118 attached to the hands-free measurement device 100 according to example embodiments. The adjustable rope stopper 118 comprises a push button 700 with an aperture 701 through which the elastic rope 114 can pass, a casing 702 with an aperture 704 through which the elastic rope 114 can similarly pass and a spring 706 attached to a planar back wall of the casing 702. As the push button 700 is extended in the outward direction 708, aided by the spring 706, the elastic rope 114 through the aperture 704 will be locked against the casing 702. This prevents any movement of the elastic rope 114 and the tension provided in the elastic rope 114 can assist the probe holder 110 and the probe clip 116 to hold the probe 400. As the push button 700 is pushed in the inward direction 710 against the pressure of the spring 706, the elastic rope 114 through the apertures 701, 704 will be able to move freely. Hence, by operating the push button 700 of the adjustable rope stopper 118 to lock or release the elastic ropes

114, the length of the elastic rope 114 can be adjusted to provide the appropriate tension to the elastic rope 114 in order to securely hold the probe 400.

5 The hands-free measurement device according to embodiments of the present invention can provide a probe holder capable of adjusting the position of the probe and providing a stable support for the probe during the testing and diagnostic procedures. The hands-free measurement device can hold an oscilloscope probe or other test probes firmly in place at the desired position. Furthermore, the hands-free measurement device of example embodiments can allow the user operating the
10 device to make adjustments to the height and position of the probe relatively easily during the testing and diagnostic procedures.

Example embodiments can allow the hands-free measurement device to be attached to a PCBA via the G clamps on any parallel sides of the PCBA. This allows
15 the longitudinal axis of the telescopic bar comprising the probe holder to be disposed substantially parallel to the length as defined by the parallel sides to which the G clamps are attached. A probe can then be attached to the probe holder of the device and positioned at any desired position on the PCBA. Furthermore, the distance between the PCBA and the telescopic bar is adjustable thereby allowing
20 the probe to make proper electrical contact with the pins of the components, for example integrated circuit packages, to be tested while at the same time providing sufficient clearance between the telescopic bar and the components disposed on the PCBA. Also, because the example embodiments are configured for holding external probes, the example embodiments provide versatility in being able to be
25 used with different probes depending on a specific probing application.

The probe holder in the hands-free measurement device according to example embodiments has a relatively strong grip to hold the probe in order to provide a stable support and prevent the tip of the probe from slipping during the
30 testing and diagnostic procedures. This minimises the possibility of damage to the probe, the PCBA and the components disposed on the PCBA. In addition, the elastic ropes attached to the extremities of the telescopic bar, when under applied tension, can apply a relatively small force to the probe clip attached to the elastic ropes via the adjustable rope stoppers. This force assists the probe clip to hold the

probe firmly against the desired electrical contact with a pin of the component to be tested.

The adjustable telescopic bar with multiple sections according to example
5 embodiments comprises a central section to support the probe holder which when in use, holds a probe in a relatively firm grip. The remaining sections of the telescopic bar are distributed evenly on both sides of the central section. As the central section of the telescopic bar comprising the probe holder is moved, the remaining sections on both sides of the central section can extend and contract accordingly. This allows
10 the probe to be adjusted in position across the longitudinal axis of the telescopic bar. The flexibility in adjusting the position of the probe also allows the possibility of performing tests on, for example integrated circuit packages with pins extending from all 4 sides of the integrated circuit packages.

Furthermore, the example embodiments may be used to perform testing or
15 diagnostic procedures on PCBA installed within the equipment the PCBA is intended for. Hence, the PCBA is not required to be disassembled from the equipment, thereby minimising the possibility of damage to the PCBA during disassembling, re-assembling or transfer of the PCBA. The hands-free measurement device of
20 example embodiments can also be attached to a PCBA where components are mounted on both sides of the PCBA. As the PCBA does not rest against any surface during the testing and diagnostic procedures with the hands-free measurement device, the components disposed on the surface of the PCBA not under test will not be damaged.

Additional hands-free measurement devices of example embodiments can be
25 attached to a PCBA to perform testing and diagnostic procedures simultaneously on different pins of a component or different components disposed on the same surface of the PCBA regardless of the positions of the components. Additional hands-free
30 measurement devices of example embodiments can also be attached to both sides of a PCBA to perform testing and diagnostic procedures simultaneously on components disposed on either surface of the PCBA. In alternate embodiments, a plurality of telescopic bars can be attached to the hands-free measurement device to perform testing and diagnostic procedures simultaneously on different pins of a

component or different components disposed on the PCBA regardless of the positions of the components. Furthermore, manual hand-held probes may also be used in conjunction with the hands-free measurement device of example embodiments to perform testing and diagnostic procedures. This allows secure and safe probing of component pins at multiple locations simultaneously.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A device for probing connections of electronic components disposed on a circuit board, the device comprising:

5 a longitudinal support structure;

 a pair of clamps coupled to respective opposing ends of the support structure for fastening the support structure to the circuit board; and

 a holder coupled to the support structure for fastening an external probe to the support structure;

10 wherein the holder is moveable relative to the support structure for contacting the probe to the components mounted on the circuit board.

2. The device according to claim 1, wherein the support structure comprises a mounting portion moveable along the support structure, and the holder is coupled
15 to the mounting portion.

3. The device according to claim 2, wherein the support structure comprises a telescopic arrangement of a plurality of sections, and the mounting portion comprises a central section of the telescopic arrangement.
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4. The device according to any one of the preceding claims, wherein each clamp comprises a mechanism for adjusting a height of the support structure above the circuit board.

25 5 The device according to claim 4, wherein each clamp comprises a plate adjustably connected to a main body of the clamp.

6. The device as claimed in claim 5, wherein the plate has a slot formed therein, and the clamp further comprises a screw configured to pass through the slot
30 and to be received by another slot in the main body to adjustably connect the plate to the clamp.

7. The device according to any one of the preceding claims, further comprising a pair of elastic members, wherein respective first ends of the elastic

members are coupled to opposing ends of the support structure and each elastic member comprises a connector for attaching the elastic member to the probe, whereby a biasing force towards the circuit board can be exerted on the probe.

- 5 9. The device according to any one of the preceding claims, comprising a plurality of the support structures coupled to the clamps, each support structure having respective holders coupled thereto.

- 10 10. A method of testing electronic components on a circuit board using the device according to any one of the preceding claims.