

DEVICE FOR TESTING ELECTRONIC COMPONENTS

The invention relates to a device for testing electronic components according to the preamble of Claim 1.

Electronic components are usually subjected to certain tests in order to test their electrical or also their sensory functions. A number of possibilities are known for this purpose. For example, the electronic components are also tested before they are separated on the substrate. Once separated and finished, the electronic components can either be tested individually, or a support is provided, on which a number of the electronic components are fastened.

The support, the substrate or the individual electronic component is then transferred to what is known as a handler. The handler has a test head, which is normally fixed and to which a test base, which is likewise fixed, is connected. The carrier, the substrate or the individual component is moved and accurately positioned with respect to the test base. A test base may be used that simultaneously contacts and tests a number of electronic components, or each component is tested individually. If it is not possible to simultaneously test all electronic components of a support or substrate, the support or the substrate has to be repositioned after each test step.

If the electronic components are transferred individually to a handler, where they are also processed further individually, the individual components are inserted into what is known as a lead backer and are positioned in this with respect to the test base. The lead backer is adapted to the shape of the electronic component to be tested and supports said component and any provided contact legs of the component when pressing against the test base, such that the electronic component is not damaged by the effective force.

Both the excitation signals of the test head and the response signals of the electronic component have to be transmitted between the test head and the test base, which takes on the direct contacting of the electronic component. For this purpose, the test base has contact areas on its side facing away

from the electronic component. The arrangement of these contact areas is closely linked to the position of the contacts of the electronic component and to other conditions, such as necessary distance between the contacts, spatial conditions, etc. Here, the fixed arrangement of the contacts of the test head cannot normally be implemented or can be implemented only to a slight extent.

One or more hardware interfaces is/are therefore normally used and connect the contacts of the test base, said contacts facing away from the electronic component, to the contacts of the test head. Such hardware interfaces, which on one side contain contact areas adapted to the test base and on the opposite side contain contact pins adapted to the test head, are known. In order to stabilise these contact pins, they have to be cast into the hardware interface.

Since the contact pins have to be positioned very accurately, it is relatively complex and costly to cast in the contact pins. Nevertheless, the risk that these contact pins will be damaged when modified to another electronic component or during storage is very high. If only a single contact pin is damaged or broken off, the entire hardware interface is useless and has to be replaced, since it is not possible, with cast-in contact pins, to change these individually.

The object of the invention is to design a device for testing electronic components according to the preamble of Claim 1, such that signals can be exchanged between the test base and the test head with high transmission reliability, and the used hardware interfaces are easily structured, can be produced cost-effectively and are robust.

The object is solved in accordance with the invention by a device for testing electronic components having the features of Claim 1. In accordance with the invention, a device for testing electronic components including at least one test base for contacting the electronic components and including a test head, which is coupled electrically to the test base, is disclosed. In order to forward signals between the test base and test head, an adapter board is provided, which, on its side facing the test base, has contact areas which

are adapted to the position of contacts of the test base, and, on its side facing away from the test base, is provided with contact sockets which are adapted to the position of contact pins of the test

head or of a connection board, the contact areas each being electrically conductively connected to the corresponding contact sockets.

The operating costs can be considerably lowered by the use of contact sockets instead of contact pins. Since contact sockets at least do not protrude far beyond the surface of the adapter board, the risk that these will be damaged is much lower than with contact pins.

Further details and advantages of the invention will emerge from the dependent claims.

The positions of the contact areas on one side of the adapter board are advantageously arranged independently of the positions of the corresponding contact sockets on the opposite side of the adapter board. In this context, this means, independently, that the positions of corresponding *contact areas and contact sockets can be arranged directly above one another or offset in relation to one another*. The positions of the contact areas can thus be easily adapted to the positions of the contacts of the test base, and the positions of the contact sockets can be easily adapted to the positions of the contact pins of the test head or of an intermediate board.

As already mentioned above, the positions of the contact areas are arranged independently of the positions of the contact sockets, such that the contact areas or the contact sockets can be adapted to the test base or to the test head or an intermediate board. The adapter board is therefore advantageously formed as a circuit board. The electrically conductive connection between the contact areas and the contact sockets is thus achieved via a well-tested and proven technique. Due to the formation of the adapter board as a circuit board, very cost-effective production is also possible.

The contact sockets are particularly advantageously inserted in blind bores in the adapter board. A feedthrough is thus avoided, and only the contact areas for the contact pins of the test base are provided on the side of the adapter board facing the test base. The adapter board can thus be formed

as a double-layer circuit board, which can be adapted very easily to all conditions.

The contact sockets can be connected to the adapter board via an electrically conductive adhesive, or what is known as an ECA adhesive (electrically conductive adhesive). In order to design the adapter board so as to be easily repairable however, the contact sockets are advantageously soldered to the adapter board.

Contact sockets are normally formed with an open cross section, that is to say do not form a closed ring. Good adaptation to the surface of the contact pin to be contacted is thus possible, and therefore good electric contact with low transition resistance between contact pin and contact socket. The contact sockets therefore have an annular flange, wherein only the flange is soldered to the surface of the adapter board. In order to lend the contact socket the necessary stability, the flange is formed as a closed ring, wherein the inner diameter is dimensioned to be slightly larger than the outer diameter of the contact pin.

If the test head is provided with sockets in order to create the necessary conductive connection to the test base, a connection board is provided in accordance with the invention as an intermediate board between the adapter board and test head and has exchangeable contact pins, which protrude from the surface both from the side facing the adapter board and from the side facing the test head.

The positions of the contact pins on one side must not differ from the positions of the contact pins on the other side, since the adaptation of the positions to the test base or to the test head has already been taken into consideration in the design of the adapter board. Consequently, continuous contact pins can be used, which can be anchored in a very stable manner in the connection board.

Due to the exchangeability of the contact pins, the connection board can be repaired in the event of damage to one or more contact pins, and does not have to be replaced by a new connection board. The contact pins necessary

in the transmission chain between the test base and test head, yet very susceptible to failure, are thus relocated in a separate board, in which they can be exchanged easily.

So as to be able to easily exchange contact pins protruding on both sides beyond the surface, the connection board has two interconnected parts, which can be separated from one another and reconnected in order to exchange the contact pins. Damaged pins can thus be replaced very easily. To this end, only the connection between the two parts, advantageously a screw connection, has to be released, such that the two parts can be separated from one another. The damaged contact pins inserted loosely in one of the two parts are then replaced, and the two parts are interconnected again.

Electronic components often have to be tested at very low temperatures, whereas the test head with the test electronics is exposed to the ambient air, of which the temperature is set to a normal temperature. It may therefore be that moisture from the ambient air condenses out at a point of the transmission chain between the electronic component and test head. This moisture can form conductive connections between the individual contacts arranged very closely together and may thus lead to incorrect measurements and even to damage of the test electronics. In order to avoid the condensing out of moisture, the cold zone is therefore strictly separated from the zone of which the temperature is set to a normal temperature. The connection board has a temperature-insulating layer for this purpose.

A heat transfer between the cold and the warm side of the connection board can take place however via the continuous contact pins protruding on both sides beyond the surface. Condensation water on the cold contact pins can thus form on the warm side of the receiving board. In order to avoid this formation of condensation water, the connection board can be flushed with air on its side facing the test head.

Further details and advantages of the invention will emerge from the description of an exemplary embodiment, which is explained in greater detail on the basis of the drawing, in which:

- Fig. 1 shows a perspective view of an adapter board according to the invention,
Fig. 2 shows a section through the adapter board from Fig. 1,
Fig. 3 shows a perspective view of an intermediate board, formed as a connection board,
Fig. 4 shows a section through the connection board in Fig. 3,
Fig. 5 shows a section through a contact unit holder with adapter board and connection board, and
Fig. 6 shows a perspective sectional illustration of the module from Fig. 5.

The adapter board 1 according to the invention shown in Fig. 1 is designed for the testing of an approximately square electronic component, which has contacts on all four sides. A test base to be used for the testing of the component is formed accordingly. The adapter board 1 therefore has, on its upper face, a plurality of very small contact areas 2 divided into four groups, wherein the contact areas 2 are insulated from one another and each contact area is assigned to a test spring of the test base (not shown in Fig. 1).

The adapter board 1 is formed as a circuit board, such that the contact areas 2 can be electrically conductively further connected practically arbitrarily. The arrangement of the contacts as predefined by the test head can be seen on the connection board 6 illustrated in Fig. 3. Blind bores 3 are therefore provided in the adapter board 1 on the underside (see Fig. 2) and correspond to this arrangement. Contact sockets 4 are inserted into these blind bores 3. The contact sockets 4 have an annular flange 5, of which the outer diameter is larger than the inner diameter of the blind bores 3. The annular flange 5 of the contact sockets 4 is soldered to the circuit board. A reliable contact between the circuit board and contact socket 4, a durable fastening and a high stability are thus ensured. The part of the contact sockets 4 placed in the blind bore 3 is, by contrast, open and resilient and does not bear over its entire surface against the inner wall of the blind bore 3. An inserted contact pin can thus expand the

contact socket 4 within the blind bore 3, and a reliable contact between the inserted contact pin and the contact socket 4 can thus be produced.

Each contact area 2 on the upper side of the adaptor board 1 is connected to a respective contact socket 4 on the underside of the adapter board in the usual manner when the circuit board is produced. Imprinted conductive tracks or an etched conductive layer can consequently be provided on the upper side or the underside of the adapter board. The adapter board 1 may also be formed in a double-layered manner however with the corresponding conductive tracks between the two layers.

The adapter board 1 is very insensitive, since no contact pins protrude from the two opposed surfaces thereof. Damage to the adapter board 1 is therefore very unlikely. It is merely conceivable that, when modifying the test arrangement (for the testing of a different electronic component), the soldered connection between the annular flange 5 and the adapter board 1 will detach when removing contact pins from the contact sockets 4. The repair of such damage can be carried out easily however, without having to exchange the entire adaptor board 1.

Since a test head used for the testing of electronic components usually likewise comprises contact sockets, the connection board 6 shown in Fig. 3 is provided. The connection board 6 comprises a lower part 7 and an upper part 8. Both parts are interconnected via the screws 9. The connection board 6 carries contact pins 10, wherein the contact pin upper parts 11 protrude beyond the surface of the upper part 8 and the contact pin lower parts 12 protrude beyond the surface of the lower part 7. The diameter of the contact pin upper parts 11 is adapted here to the diameter of the contact sockets 4 in the adapter board 1, and the diameter of the contact pin lower parts 12 is adapted here to the diameter of the contact pins of the test head (not shown here).

The structure of the connection board 6 can be seen even more clearly from Fig. 4. Here, it is clear that the upper part 8 is provided with blind bores on the surface via which it rests on the lower part 7. The bases of these blind bores each have a central bore, of which the diameter corresponds to the

diameter of the contact pin upper parts. The contact pins 10 have a thickened region between the contact pin upper part 11 and the contact pin lower part 12, the outer diameter of said thickened region being adapted to the inner diameter of the blind bore in the upper part 8.

The contact pins 10 are thus anchored firmly in the connection board 6 and cannot be moved in the axial direction. They can, however, be easily exchanged in the event of damage. To this end, the screws 9 are released and the upper part 8 is removed. The contact pins 10 remain in the lower part 7, but are now no longer fixed in the axial direction and can be removed upwardly. Once the damaged contact pins have been exchanged, the upper part is carefully fitted on again and screwed to the lower part 7. The connection board 6 is now ready for use again, without the need for a complete exchange.

It is clear in particular from Figures 5 and 6 how the test base 13, adapter board 1 and connection board 6 cooperate. The test base 13 has a plurality of test springs 14, which are each conductively connected via their test tip 16, during the testing of an electronic component, to a contact of the electronic component. The respective spring end 15 of each test spring 14 is applied to a contact area 2 (see Fig. 1) of the adaptor board 1. The test springs 14 consequently form the connection between the contacts of an electronic component to be tested and the contact areas 2 of the adapter board 1.

An electronic component 17 to be tested is indicated schematically in Fig. 5 and is held in what is known as a lead backer 18 and is pressed against the test base 13. In the practical example shown here (see Fig. 6), a separate test base 13 is provided for each of the four sides of the electronic component 17 to be tested. Due to this arrangement, the four groups of contact areas 2 are produced on the adapter board 1 (see Fig. 1).

When moving the lead backer 18 in the direction of the test base 13, the lead backer 18 is accurately positioned by the centring plate 22, such that any contact of the electronic component 17 to be tested occurs precisely at a test tip 16 of a test spring 14.

The test bases 13 sit with the spring ends 15 of the test springs 14 on the contact areas 2 of the adapter board 1. These are in turn conductively connected to the contact sockets 4 (see Fig. 2) on the underside of the adapter board 1.

In order to then ultimately produce the connection between the contacts of the electronic component 17 to be tested and the test head (not shown here), the connection board 6 is arranged beneath the adapter board 1. The contact pin upper parts 11 protruding from the surface of the upper part 8 each plug into one of the contact sockets 4 on the underside of the adapter board 1 and form a conductive connection thereto. With connection of the test head, the contact pin lower parts 12 drive into the test head sockets provided there. The test head is centred via the locking pins 21 during the connection process.

The entire test module with the four test bases 13, the adapter board 1 and the connection board 6 is mounted in a test base holder 23, or what is known as the contact unit holder. A number of test modules can also be mounted in this contact unit holder 23, such that a plurality of electronic components can be simultaneously tested at the same time. Here, contact unit holders having four or eight test modules are usual, for example.

In some cases, electronic components have to be tested at low temperatures. To this end, the electronic components are usually cooled beforehand in a temperature-control chamber. The centring plate 22 and the test base 13 are also cooled in some circumstances. Since the test head is usually kept at room temperature, moisture must be prevented from condensing out in the transition region between the warm and the cold region, since this could lead to short circuits between the contacts. For this purpose, the connection board 6 is usually fabricated from a material that has good insulation properties. In particular, the lower part 7 can form the barrier layer between the cold and the warm region.

It is also possible however to form a cavity between the upper part 8 and the lower part 7 of the adapter board 6. This cavity, normally filled with air,

can form a temperature-insulating layer between a cold test zone and the surrounding area, wherein this surrounding area is usually at room temperature.

Nevertheless, the contact pins 10 form cold bridges, such that the contact pin lower parts 12 may cool during the test. As a result of this, it is possible for moisture in the air to condense at these parts. In order to counteract this, a ventilation chamber 20 is provided, through which hot air can be blown, such that the air around the contact pin lower parts 12 is constantly exchanged and therefore a cooling of the air and the condensing out of moisture from the cooled air is prevented. At the same time, contact pin lower parts 12 are heated slightly, such that the tendency towards an accumulation of condensation water also reduces for this reason.

The ventilation chamber 20 is delimited on its underside by a termination plate 19, which is likewise provided with bores, which also provides an additional guide for the contact pin lower parts 12 protruding far from the connection board 6. The risk of damage to the contact pin lower parts, in particular during connection between the test head and contact unit holder 23, can thus be reduced somewhat.

The termination plate 19 primarily forms the termination of the ventilation chamber 20 however. Both the contact pin lower parts 12 and the termination plate 19 are held at a temperature above the dew point via the hot air blown through the ventilation chamber 20. Water therefore cannot condensate out, either within the ventilation chamber 20, on the contact pin lower parts 12 and the inner face of the termination plate 19, or on the outer face of the termination plate 19 and the contact pin lower parts 12 protruding therefrom.

List of reference signs:

- 1 adapter board
- 2 contact areas
- 3 blind bores
- 4 contact sockets
- 5 annular flange
- 6 connection board
- 7 lower part
- 8 upper part
- 9 connection screw
- 10 contact pin
- 11 contact pin upper part
- 12 contact pin lower part
- 13 test base
- 14 test spring
- 15 spring end
- 16 test tip
- 17 electronic component
- 18 lead backer
- 19 termination plate
- 20 ventilation chamber
- 21 locking plug
- 22 centring plate
- 23 test base holder (contact unit holder)

PATENT CLAIMS

1. A device for testing electronic components, comprising at least one test base for contacting the electronic components and comprising a test head, which is coupled electrically to the test base, characterised in that, in order to forward signals between the test base and test head, an adapter board is provided, which, on its side facing the test base, has contact areas which are adapted to the position of contacts of the test base, and, on its side facing away from the test base, is provided with contact sockets which are adapted to the position of contact pins of the test head or of a connection board, the contact areas each being electrically conductively connected to corresponding contact sockets.
2. The device for testing electronic components according to Claim 1, characterised in that the positions of the contact areas on one side of the adapter board are arranged independently of the positions of the corresponding contact sockets on the opposite side of the adapter board.
3. The device for testing electronic components according to one of Claims 1 to 2, characterised in that the adapter board is formed as a circuit board.
4. The device for testing electronic components according to one of Claims 1 to 3, characterised in that the contact sockets are inserted into blind bores in the adapter board.
5. The device for testing electronic components according to one of Claims 1 to 4, characterised in that the contact sockets are soldered to the adapter board.
6. The device for testing electronic components according to Claim 5, characterised in that the contact sockets have an annular flange

and only the flange is soldered to the surface of the adapter board.

7. The device for testing electronic components according to one of Claims 1 to 6, characterised in that the connection board is provided between the adapter board and test head and comprises exchangeable contact pins which protrude from the surface both from the side facing the adapter board and from the side facing away from the test head.
8. The device for testing electronic components according to Claim 7, characterised in that the connection board has two interconnected parts which can be separated from one another and reconnected in order to exchange the contact pins.
9. The device for testing electronic components according to one of Claims 7 to 8, characterised in that the connection board has a temperature-insulating layer.
10. The device for testing electronic components according to one of Claims 7 to 9, characterised in that the connection board can be flushed with air on its side facing the test head.