

DEVICE, ASSEMBLY AND METHOD FOR TESTING ELECTRONIC COMPONENTS, AND CALIBRATING METHOD THEREFOR

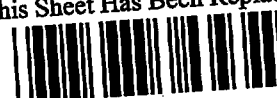
5 The invention relates to a test device for testing electronic components mounted on a carrier such as a lead frame or substrate. The invention also relates to a test assembly of which at least one such test device forms part. In addition, the invention provides a method for testing electronic components mounted on a carrier such as a lead frame and a method for calibrating a test device.

10 The testing of electronic components, particularly semiconductors, usually takes place according to the prior art after a plurality of electronic components have been placed on a carrier. The carrier is subsequently subdivided into segments on which one component is situated in each case. The separate carrier segments with electronic components mounted thereon are individually placed for testing against for instance a
15 test contact with which the measurement is performed. For testing according to this known method test devices have been developed with a gripper for engaging individual electronic components. This gripper is movable to a test contact so that an electronic component can be urged against the test contact and the gripper can then be moved back to the starting position to lay off a tested electronic component. The existing
20 methods and devices are relatively slow, unreliable and do not usually result in the desired accurate measurement results.

The present invention has for its object to provide an improved test device and method for testing electronic components with which testing can take place in
25 accurate manner at relatively high speed.

The invention provides for this purpose a test device as according to claim 1. In a preferred embodiment the transport path for supplying a carrier connects onto the transport path for discharging a carrier. In another preferred embodiment the transport
30 path for supplying a carrier runs at least partly parallel to at least a part of the transport path for discharging a carrier. Using this test device a whole carrier with a plurality of electronic components mounted thereon can be engaged in one operation. The engaged carrier and/or the electronic components mounted thereon can now be placed

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into contact, once or a number of times at different positions, with one or more test contacts. A significant advantage of the device according to the invention is that the time required for testing an electronic component can be considerably reduced. By simultaneously engaging a plurality of electronic components on a carrier the time
5 required for engaging an object for testing and for placing the object for testing close to the test contact is considerably reduced. Fewer separate objects are in any case carried into the test device. Another advantage of the test device according to the invention is that the accuracy of positioning of the component relative to the contacts increases so that the quality of contact improves and becomes more constant. The
10 carrier does after all contain the original reference points (also designated as index holes) on the basis of which previous operations have taken place. When the electronic components are separated for the test device, use must be made for later positioning of derived reference points such as for instance a moulded housing. It will be apparent that use of the original reference points on the carrier enables a more
15 precise positioning of the objects for testing. The accuracy of the measurement will hereby increase, whereby fewer products are unnecessarily rejected as a result. Yet another advantage of the test device according to the invention is that it enables testing relatively early in the production process, so that relatively quicker feedback is possible when errors are detected and whereby possibly expensive further operations
20 can be dispensed with. Because a carrier for testing is taken from a supply path and a tested carrier is placed in a discharge path, a plurality of testing devices can be deployed parallel to each other for testing a production flow of carriers. The capacity of the testing device does not therefore need to form a bottle-neck in a production process. The supply and discharge of carriers can take place via a single transport
25 path, in which case it is advisable to record which carriers have been tested and which have not been tested, but it is also possible to use different transport paths for supply and discharge of carriers. In this latter situation there is less necessity for monitoring which carriers have been tested since the presence in the discharge path already indicates that a carrier has been tested. It is however possible in both variants to
30 deploy test devices parallel to each other.

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In a preferred embodiment at least one transport path is adapted for transport in two directions. The flexibility of the test device is hereby further increased, particularly in respect of the arrangement in which it is used.

5 The manipulator is preferably provided with two substantially mutually perpendicular linear guides for displacing the manipulator in a plane. The manipulator can herein also be provided with a third linear guide which lies substantially perpendicular to the other two linear guides. Such a manipulator enables a precise positioning of the carrier relative to the test contact. It is also possible to use such a manipulator for placing
10 carrier and test contact into mutual contact a number of times, for instance at different locations on the carrier. A precise positioning of carrier relative to test contact is then also possible. An advantage already described above is the short transporting time required between two measurement on the same carrier. Yet another advantage of the manipulator with linear guiding is that it is relatively inexpensive to manufacture and
15 is easily maintained.

In yet another preferred embodiment, the test device is provided with identification means for identification of an individual carrier. The test results of determined
20 positions on the carrier can thus be linked to the individual carrier so that in optional further processing of a carrier the test results can be taken into account.

In yet another preferred embodiment, the manipulator is provided with positioning means for positioning the carrier relative to the manipulator. Using the positioning means the manipulator can be positioned on the carrier relative to the original
25 reference points.

For processing of the test data the test device preferably comprises a computer system which is connected to the test contact. In practice such a computer system is a number of times more expensive (for instance by a factor 4) than the test device itself. The
30 productivity increase of the test device according to the invention compared to the prior art also entails that the productivity of the relatively expensive computer system



also increases. Reduction of the processing time per measurement thus provides an advantage which extends beyond more optimal utilization of the test device without peripheral equipment.

5 The invention also provides a test assembly for testing electronic components mounted on a carrier such as a lead frame, as described in claim 10. Such a test assembly can operate as stand-alone unit but can also be built into a production line. In addition, one or more test devices can be incorporated in the test assembly as required.

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The invention moreover provides a method for testing components mounted on a carrier such as a lead frame, as described in claim 11. A carrier can herein be tested during step C) by placing it in contact with a test contact. It is also possible for a carrier and/or components mounted on a carrier to be tested a number of times by placing these in contact with the test contact at a plurality of positions. It is also further possible to test the carrier and/or components mounted on a carrier a number of times by placing them in contact with a plurality of test contacts. This can take place simultaneously as well as successively. By taking a whole carrier with electronic components mounted thereon out of a transport path the advantages are obtained as already described above with reference to the device according to the invention. The relatively simple method enables it to be performed with a relatively simple device. Measurements can be performed at relatively high temperatures (100-200°C) but it is also possible to perform the method at relatively low temperatures (-60 - -20°C). The device according to the invention can be used for cold as well as hot test conditions.

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Depending on the conditions in which the test is carried out, the carrier can be taken before testing out of the same transport path as, or out of a different transport path from the one in which it is placed after testing. In a stand-alone application of the method, a single transport path may for instance suffice but in a situation where the method is performed simultaneously at different positions a multiple transport path is preferred.

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Finally, the invention also provides a method for calibrating a test device as described in claim 17. In a preferred embodiment of this method, the calibration carrier is returned after the calibration process to its starting position. By making use of a calibration carrier, in practice also referred to as "golden lead frame", calibration processes can be performed without complex change-overs. When the calibration carrier has been returned to the starting position thereof, the calibration process can be repeated as desired at any chosen moment. Depending on the dimensions of the test device, this can take place with the manipulator or a return movement of a conveyor belt can be used for this purpose.

The present invention will be further elucidated with reference to the non-limitative embodiments shown in the following figures. Herein:

- figure 1 shows a schematic perspective view of a device according to the invention,
- figure 2 shows a schematic perspective view of a variant of the device shown in figure 1, and
- figure 3 shows a schematic view of a part of the device as shown in figures 1 and 2 which is coupled to a computer.

Figure 1 shows a test device 1 with a feed conveyor 2 along which a lead frame 3 for testing is supplied. When lead frame 3 has reached a determined position it will be engaged by a manipulator 6 which is provided for this purpose with movable grippers 7. Manipulator 6 is movably suspended by means of a frame 8. In this frame 8 is arranged a vertical linear guide 9 (Z-axis) with which manipulator 6 is displaceable in vertical direction. Also arranged in frame 8 are two horizontal linear guides 10, 11 which lie perpendicularly of one another. Manipulator 6 is movable by horizontal linear guides 10, 11 in a plane which lies at least partly above feed conveyor 2 for lead frame 3 and a discharge conveyor 4 for discharge of tested lead frames 5.

After a lead frame 3 for testing has been taken from feed conveyor 2, manipulator 6 is moved to above a test contact 12. This test contact 12 is provided with positioning pins 13 which co-act with index holes 25, which are arranged in lead frames 3 for testing. As an alternative it is also possible to provide the manipulator 6 with
5 positioning pins 13 cooperating with recesses in the test contact 12. When manipulator 6 is situated with a lead frame 3 for testing above test contact 12, manipulator 6 will be moved downward by the vertical linear guide 9 such that positioning pins 13 engage in the index holes of lead frame 3. When manipulator 6 is moved downward the lead frame 3, or an electronic component mounted thereon, will
10 make contact with the conducting stops 14 arranged on test contact 12. The measurement can subsequently be performed, and this will be further discussed with reference to figure 3.

After performing of the first measurement the manipulator 6 is moved a limited
15 distance upward such that lead frame 3 is released from positioning pins 13. Subject to the test programme to be run, lead frame 3 can now be displaced through a limited distance in X or Y direction to then be moved downward again so that a subsequent test can be carried out with lead frame 3. A number of tests can thus be performed on a single lead frame 3. Usually The number of tests to be carried out will usually
20 correspond with the number of electronic components arranged on lead frame 3. Because in the case of successive measurements on the same lead frame 3 the relative displacements of lead frame 3 are relatively small, the processing time per test for performing is also limited. In order to perform a number of very diverse tests on the same lead frame 3 for testing a plurality of test contacts 12 of diverse geometry can
25 also be placed in the same test device 1.

After all required tests have been carried out, manipulator 6 is displaced to a position above discharge conveyor 4 on which a tested lead frame 5 is set down by opening
grippers 7. Depending on the quantity of lead frames for testing and the complexity of
30 the tests to be performed, one or more test devices 1 can be combined. This combining of a plurality of test devices 1 can be realized relatively simply when feed

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conveyor 2 and discharge conveyor 4 are separated. However, also when only one combined feed and discharge conveyor is used it is possible to combine a plurality of test devices 1. A control system must however be used in this case which monitors which lead frame 4 lying on the conveyor has already been tested and which lead frame 3 has not yet been tested.

The test device 1 according to the invention has the advantage that very few product-dependent components form part of test device 1. Test device 1 can hereby be changed over relatively quickly for processing of different types of product. The most product-dependent component in test device 1 is the test contact 12 which can be embodied for quick replacement, for instance by means of rapid-action couplings.

Figure 2 shows a test device 15 in which, in addition to the components shown in figure 1, two transfer devices 16, 17 are also arranged for removing a lead frame 3 for testing from a transport track 26 and placing a tested lead frame 5 after testing on the transport track 26. A lead frame 3 is displaced to an infeed station 18 above which is disposed a camera 19. A first visual inspection of lead frame 3 can be performed herewith. The camera 19 can also be equipped as a data code reader for reading a code marking a lead frame and identifying it. Based on this information a link can be made relating a test result and individual components on the lead frame 3. The information can be used for selectioning of the tested components later on. Manipulator 6 engages lead frame 3 in infeed station 18 and moves it to test contact 12 where the tests as described above are carried out. After the tests have been performed the tested lead frame 5 will be placed by manipulator 6 in an outfeed station 20. In addition to camera 19 placed at the infeed station 18, it is also possible for other test equipment to be deployed close to infeed station 18 and outfeed station 20.

The test device 15 is provided with a frame 27 for carrying the manipulator 6 that is less complete than the frame 8 showed in figure 1. The frame 27 creates freedom for the manipulator 6 in only two directions, the X- and Z-axis. As freedom in the Y

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direction, as showed in test device 15 in figure 1, is superfluous because of hte transfer devices 16, 17 the frame 27 can be relatively simple.

5 The transfer devices 16, 17 increase the capacity of test device 15 in that manipulator 6 only has to displace a lead frame 3, 5 over a limited distance, since the operations by transfer devices 16, 17 and manipulator 6 can take place in parallel manner, the productivity of test device 15 is greater than that of test device 1. In addition, infeed and outfeed stations 18, 20 enable additional inspections.

10 Figure 3 shows schematically a computer 22 as visualization of a so-called test system which in practice consists of a mainframe with relatively complex test software. An individual test system 22 is used per test device 1, 15. Test system 22 is connected by means of a signal line 23 to the conducting stops 14 of test contact 12. Also shown schematically is a sensor 24 which is accommodated in manipulator 6 for
15 identification of an engaged lead frame 3. The test results of a lead frame 3 can thus be linked to the identity of lead frame 3.

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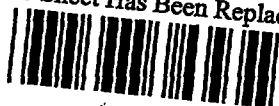




CLAIMS

1. Test device for testing electronic components mounted on a carrier such as a
5 lead frame, comprising:
- a transport path for supplying a carrier for testing,
 - a manipulator for engaging and displacing a supplied carrier,
 - a test contact with which a carrier and/or at least one component mounted on
the carrier can be placed in contact by the manipulator, and
 - 10 - a transport path for discharging a tested carrier.
2. Test device as claimed in claim 1, wherein the transport path for supplying a
carrier is connected to the transport path for discharging a carrier.
- 15 3. Test device as claimed in claim 1 or 2, wherein the transport path for
supplying a carrier runs at least partly parallel to at least a part of the transport path for
discharging a carrier.
4. Test device as claimed in any of the foregoing claims, wherein at least one
20 transport path is adapted for transport in two directions.
5. Test device as claimed in any of the foregoing claims, wherein the manipulator
is provided with two substantially mutually perpendicular linear guides for displacing
the manipulator in a plane.
- 25 6. Test device as claimed in claim 5, wherein the manipulator is provided with a
third linear guide which lies substantially perpendicular to the other two linear guides.
7. Test device as claimed in any of the foregoing claims, wherein this comprises
30 identification means for identification of an individual carrier.

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8. Test device as claimed in any of the foregoing claims, wherein the manipulator is provided with positioning means for positioning the carrier relative to the manipulator.
- 5 9. Test device as claimed in any of the foregoing claims, wherein this also comprises a computer system for processing the test data, which computer system is connected to the test contact.
- 10 10. Test assembly for testing electronic components mounted on a carrier such as a lead frame, comprising:
- an infeed station for carriers with electronic components,
 - at least one test device as claimed in any of the foregoing claims, of which the transport path for supplying a carrier for testing connects onto the infeed station,
 - 15 - an outfeed station for carriers with electronic components which connects onto the transport path for discharging tested carriers, and
 - a central control system for synchronized control of the infeed station, at least one test device and the outfeed station.
- 20 11. Method for testing electronic components mounted on a carrier such as a lead frame, wherein the steps are successively performed of:
- A) supplying a carrier for testing along a transport path,
 - B) removing the carrier for testing from the transport path,
 - C) testing at least one electronic component on the carrier removed from the transport path, and
 - 25 D) re-placing in a transport path and discharging the tested carrier.
12. Method as claimed in claim 11, wherein an electronic component and/or a carrier is tested during step C) by being placed in contact with a test contact.



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13. Method as claimed in claim 11 or 12, wherein a carrier and/or electronic components mounted on a carrier are tested a number of times by being placed in contact with the test contact at a plurality of positions.
- 5 14. Method as claimed in any of the claims 11-13, wherein a carrier and/or electronic components mounted on a carrier are tested a number of times by being placed in contact with a plurality of test contacts.
- 10 15. Method as claimed in any of the claims 11-14, wherein the carrier is taken before testing out of the same transport path as the one in which it is re-placed after testing.
- 15 16. Method as claimed in any of the claims 11-14, wherein the carrier is taken before testing out of a different transport path from the one in which it is placed after testing.
- 20 17. Method for calibrating a test device, wherein a calibration carrier is carried through a test device with a method as claimed in any of the claims 11-16 and, when a measurement result is detected which deviates from a norm, the setting of the test device is changed such that the measurement results comply with a required norm.
18. Method as claimed in claim 17, wherein the calibration carrier is returned after the calibration process to the starting position thereof.