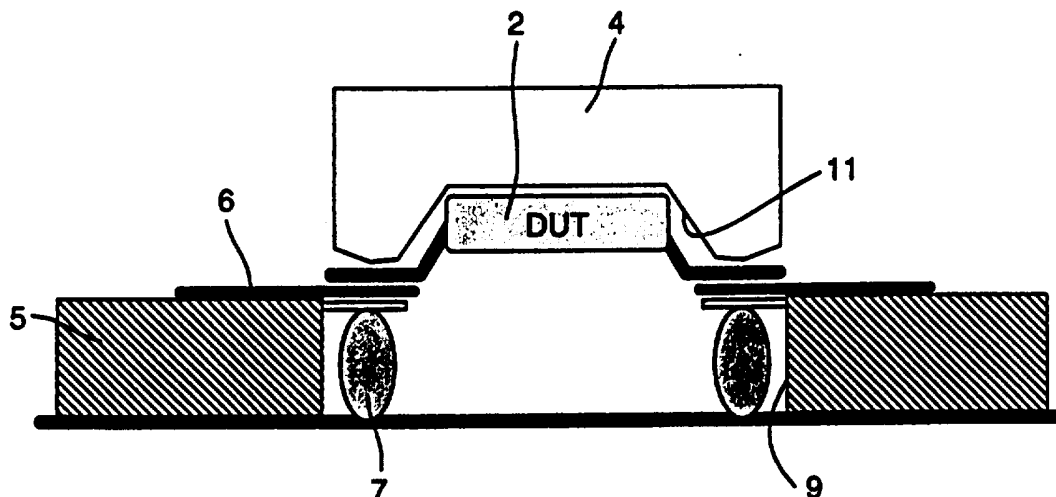




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE95/01407 (22) International Filing Date: 24 November 1995 (24.11.95) (30) Priority Data: 9404083-9 24 November 1994 (24.11.94) SE (71) Applicant (for all designated States except US): TELEFONAKTIEBOLAGET LM ERICSSON [SE/SE]; S-126 25 Stockholm (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): GUSTAFSON, Åke [SE/SE]; Tuvstarrvägen 7, S-741 42 Knivsta (SE). (74) Agents: BOHLIN, Björn et al.; Telefonaktiebolaget LM Ericsson, Patent Dept., S-126 25 Stockholm (SE).		(81) Designated States: AL, AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).  Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments. In English translation (filed in Swedish).

(54) Title: METHOD AND DEVICE FOR TESTING OF ELECTRONIC COMPONENTS



## (57) Abstract

A test assembly for use in testing electronic components, preferably surface mount IC-circuit components, includes a carrier (4) by means of which a component (2) is picked-up and brought to and held against the conductors (6) on a printed circuit board (5). The printed circuit board (5) includes at least one cavity (9) underneath the contact conductors (6) in the region where the component (2) is to be held, such as to render the conductors resilient. Pressure pads (7) are placed in the cavity (9) between the bottom of the cavity and the contact conductors (6) such as to regulate the resilience of the conductors (6).

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## Method and device for testing of electronic components

## TECHNICAL FIELD

5     The present invention relates to a method, a device and a circuit card for testing electronic components, such as IC-circuits and particularly surface mount components.

## BACKGROUND ART

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Electronic components, such as IC-circuits are at present tested electrically with the aid of specially designed contactor into which the IC-circuits are placed temporarily during the electric test without being soldered. The development of test basis for small quick-surface mounted components has not increased in keeping with the new requirements, resulting in a greater degree of uncertainty in testing the components. This leads to an unnecessarily large number of components being scrapped in the production line. When measuring dynamic parameters, for instance quick function test, transit delays or high frequency oscillations, the true performance of the components is often negated by the mechanical construction of the test socket. Occurrent deviations in the measuring results are most often due to stray capacitancies of the test socket in a measuring loop. The internal resistance and contact resistance of the test socket are also the result of incorrect measuring results when measuring static parameters.

30

US-patent 4 754 555 describes apparatus for inspecting the coplanarity of an IC-capsule. More specifically, the apparatus is intended to ascertain that the legs of the IC-capsule have the same length. An IC-capsule is placed under pressure in a socket assembly included in the apparatus. The socket assembly includes resilient devices which correspond to the legs of the IC-circuit and each of which is brought into contact with a leg when pressure is exerted on the IC-circuit, provided that the leg has sufficient length. The

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resilient device is in contact with a so-called PC-card that contains control logic. The apparatus indicates when contact is made between a leg and the PC-card. The apparatus is not used to electrically test the functions of the circuit. The apparatus is also relatively complicated and expensive due to its many components.

US-patent 4 866 374 describes a so-called contactor assembly. This contactor is mounted on a circuit card and connects a surface mounted circuit device under test (DUT) with the circuit card. This assembly is also relatively complicated and expensive because of the number of components included.

Test sockets constructed similarly to the test socket shown in Figure 1 can be obtained at present from several different suppliers. The requisite contact pressure against conductors 1 on a component 2 is often achieved with the aid of spring segments 3 similar to those shown in Figure 1. The segments are punched, cut or etched from a resilient metal material, for instance phosphorus bronze, beryllium copper or some like material. In order to obtain an effective attachment and a suitable contact pressure, it is necessary for the construction to be relatively extended geometrically. The segments are then placed adjacent one another at a spacing corresponding to the connections on the component. Because of the decreasing dimensions of such components, the segments are placed progressively closer together, resulting in the occurrence of undesirable stray capacitances between the conductors.

None of the aforesaid publications teach the testing of circuit components directly on a circuit card.

DE-C1-3 636 361 describes a device for testing the functions of surface mounted circuits directly on a circuit card. The device is intended for insertion into a heating cabinet and includes a circuit card, a receiving plate having recesses

corresponding to the circuits, and a press plate having spring elements corresponding to the circuits. The card and the plates include appropriate guide and latching means for guiding and fastening the card and plates together. In  
5 testing the circuits, it is necessary to collect the circuits and place the same in the recesses, whereafter the circuit card, the circuit accommodating plate and the press plate are brought together, mutually aligned and locked together with the accommodating plate between the circuit card and the  
10 press plate, such that the circuits will be pressed against the circuit card by the spring elements. Although this device is constructionally simple and inexpensive, it nevertheless unnecessarily includes a large number of components. A test method that is applied outside a heating cabinet would also  
15 unnecessarily include a large number of method steps.

None of the known literature relevant to this art describes a circuit card that is especially designed for testing purposes and which obviates the need of a socket for the  
20 component to be tested. Neither is there described a method by which a component can be tested quickly and simply directly on a circuit card.

#### SUMMARY OF THE INVENTION

25 The object of the present invention is to improve measurement accuracy in testing electronic components on a circuit card to be tested, in comparison with known techniques.

30 A further object is to provide an electronic component testing device which includes relatively few parts.

These object are achieved with a device which includes a component carrier which receives the component and holds said  
35 component against a circuit card to be tested, said card including a cavity underneath the contact conductors in the area where the component is held.

A further object is to provide for the testing of electronic components a circuit card which does not require contact sockets.

- 5 This object is achieved with a test circuit card which includes a cavity underneath the contact conductors in an area where the conductors are to be held.

- 10 Still another object of the invention is to provide a test method for inspecting electronic components on a printed circuit card to be tested simply and quickly.

- 15 This object is achieved with a method in which a component is collected, passed to a printed circuit card for testing and held directly against the card during the test.

- These and other objects of the invention and advantages afforded thereby will be apparent from the following description of preferred embodiments of the invention.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1 is a cross-sectional view of a known test socket described in the foregoing.

- 25 Figure 2 is a front cross-sectional view of an inventive device according to a first preferred embodiment.

Figure 3 is a front cross-sectional view of a second preferred embodiment of the inventive device.

- 30 Figure 4 is a cross-sectional view of the device shown in Figure 3.

Figure 5 shows a part of the device in Figure 4 from above.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

- 35 Figure 2 illustrates a first preferred embodiment of the invention for testing electronic components 2, preferably surface mount IC-components, comprising a carrier 4 and a

circuit card 5 used in the test, i.e. a so-called printed circuit board (PCB) or mother board. The figure shows only that part of the mother board 5 where a component under test (DUT) 2 is to be placed. Conductors 6 are drawn on the mother board 5 (only parts of two conductors being shown), these conductors 6 normally being comprised of a copper pattern on the mother board. A cavity 9 is disposed in the region on the mother board 5 where the component 2 is to be placed. The surface of the cavity 9 is configured in accordance with the component 2 to be tested, including its legs. That part of the conductor 6 to which the legs of the component 2 are to be connected extends over the edges of the cavity 9. A part of the circuit board material remains underneath the conductor 6 to be contacted. In the case of the preferred embodiment, two pressure pads 7 are each placed along a respective opposing edge of the cavity 9, wherein each pad is placed between the bottom of the cavity 9 and a conductor 6.

The cavity 9 is provided in the mother board 5 to render the conductors 6 resilient. The pressure pads 7 may be made of rubber, plastic, insulated metal or the like, and function to enable the tension in the conductor 6 to be controlled, and can be omitted if desired.

The construction of the mother board 5 enables the component 2 to be placed directly on the mother board 5 when testing the component. In testing a component, the carrier 4 collects the component 2 from a component store (not shown), moves the component 2 to the mother board 5 and holds the component pressed against the board 5 over the cavity 9, with the legs of the component 2 in direct contact with the conductors 6. This is possible by virtue of the resiliency of the conductors 6.

The carrier 4 includes a cavity 11 which is adapted to the body of the component 2, and a circumferential part which lies in abutment with the legs of the component 2, such as

to be able to press the component 2 against the mother board 5 with a uniform pressure.

5 The construction of the mother board 5 provides for greater measuring accuracy in testing a component 2 in comparison with tests carried out in a test socket. The problems encountered in a test socket with regard to stray capacitances are avoided, and the number of electrical connections are fewer, which leads to fewer components being scrapped and  
10 in improved HF-properties when testing.

Figure 3 shows another embodiment of the device, in which the carrier 4 is provided with a suction cup 8 which functions to pick-up, move and hold the component. Naturally, the  
15 carrier 4 can be provided with some other form of device which will perform the same function, for instance a pneumatic device or some form of gripping device.

Figure 4 illustrates the second embodiment of the test  
20 assembly, in which the printed circuit board includes slots 10 across the cavity 9 on each side of each conductor 6, such that the conductors will be individually resilient.

Finally, Figure 5 illustrates a carrier 4 which is held over  
25 a part of the printed circuit board 5 where said board 5 is provided with several conductors on two sides of the cavity 9. The component 2 and its legs are also depicted in this figure, even though the legs are covered by the carrier 4. Naturally, the board 5 may be constructed for circuits with  
30 legs on all four sides and the shape defined by the surface of the cavity 9 is dependent solely on the shape of the component 2.

The preferred embodiment includes a large cavity 9 having a  
35 surface which covers the whole of the component 2 to be tested. However, the cavity can be varied in several ways other than with regard to different types of components. For



instance, an individual cavity may be provided for one leg underneath each conductor or for one group of legs underneath several mutually parallel conductors. An essential feature is that cavities are provided underneath each conductor for  
5 one leg of the component so as to afford the desired resiliency.

The carrier is suitably mounted on a robot, preferably a pick and place robot, so as to enable the test procedure to be  
10 carried out quickly and effectively.

## CLAIMS

1. A method for testing electronic components preferably surface mount components, **characterized** by picking a component (2) to be tested, for instance from a component store, bringing the component to a printed circuit board (5) and holding the component in direct contact with said board for testing of the component.
2. A method according to Claim 1, **characterized** by holding the component (2) under test against resilient conductors (6) on the printed circuit board (5).
3. A method according to any one of the preceding claims, **characterized** by picking-up the component (2), moving the component (2) and holding said component against the printed circuit board with the aid of a carrier (4).
4. An electronic component test assembly, particularly for testing surface mount components, **characterized** by a component carrier (4) which functions to receive the component (2) and place and hold said component against a printed circuit board (5), wherein the printed circuit board (5) includes at least one cavity (9) underneath the contact conductors (6) in the region where the component (2) is to be held under test.
5. A test assembly according to Claim 4, **characterized** by a pressure pad (7) between the bottom of the cavity (9) and one or more contact conductors (6), said pressure pad functioning to regulate the resiliency of the conductors.
6. A test assembly according to any one of Claims 4-5, **characterized** in that slots (10) are provided on both sides of each contact conductor (6) across said cavity (9), such as to render said conductors individually resilient.

7. A test assembly according to any one of Claims 4-6, **characterized** in that the carrier (4) includes a suction cup (8) for receiving, positioning and holding the component (2).

5 8. A test assembly according to any one of Claims 4-7, **characterized** in that the carrier (4) includes a circuit-adapted cavity (11).

10 9. A test assembly according to any one of Claims 4-8, **characterized** in that the carrier (4) is mounted on a robot.

15 10. A printed circuit board (5) for testing electronic components, particularly surface mount components, **characterized** by at least one cavity (9) underneath contact conductors (6) in the circuit board in a region where an electric component (2) to be tested shall be placed.

20 11. A printed circuit board (5) according to Claim 10, **characterized** by a pressure pad (7) placed between the bottom of the cavity (9) and one or more contact conductors (6), such as to regulate the resiliency of said conductors.

25 12. A printed circuit board according to Claim 10 or Claim 11, **characterized** in that slots (10) are provided on both sides of each conductor (6) across the cavity (9), such as to render each conductor individually resilient.

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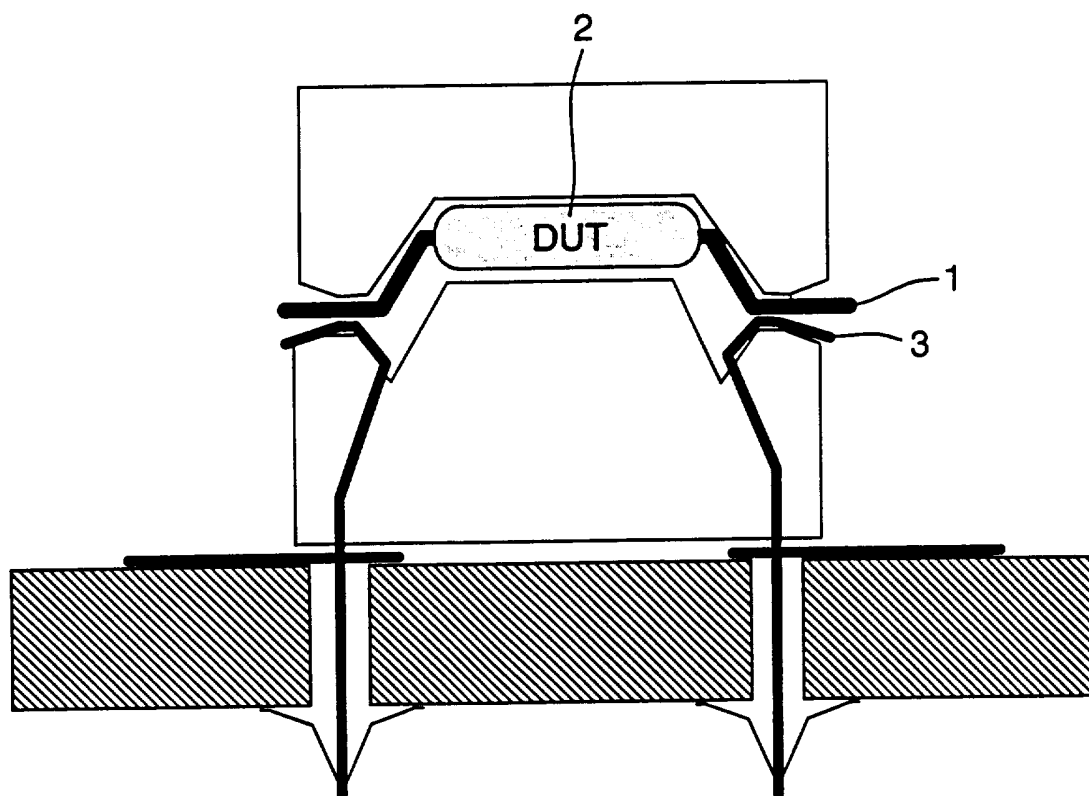


Fig. 1

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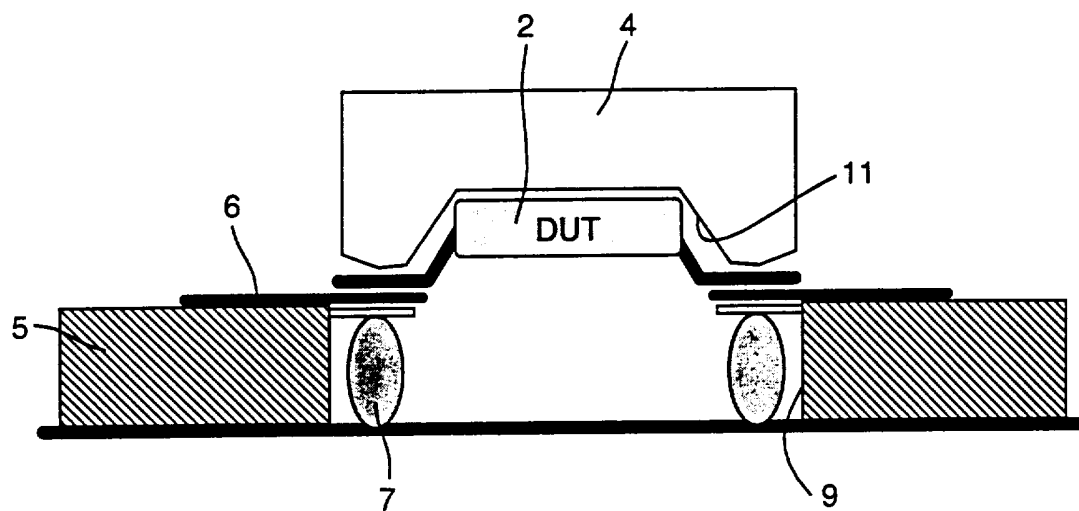


Fig. 2

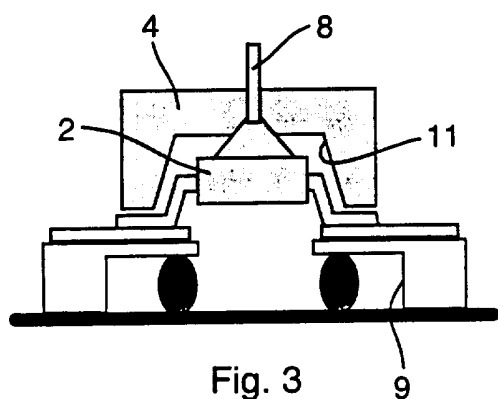


Fig. 3

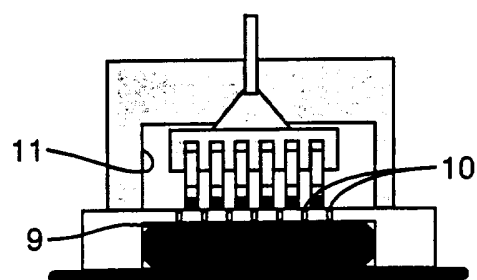


Fig. 4

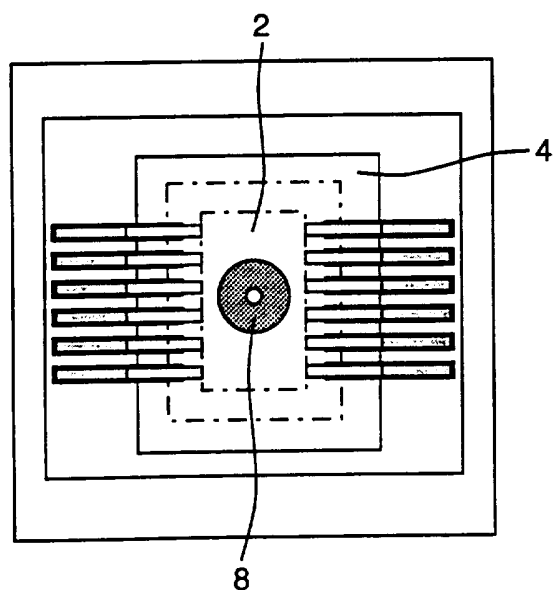


Fig. 5

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 95/01407

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01R 31/02, G01R 31/28

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4754555 A (BEN S. STILLMAN), 5 July 1988 (05.07.88), figures 1 and 9 --	1-4
A	US 4866374 A (NICHOLAS J. CEDRONE), 12 Sept 1989 (12.09.89), figure 3 --	1-4
A	DE 3636361 C1 (W.C. HERAEUS GMBH), 14 April 1988 (14.04.88), figure 1 -- -----	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4754555	05/07/88	NONE	
US-A- 4866374	12/09/89	DE-A- 3716240	17/12/87
		DE-A- 3536124	17/04/86
		JP-A- 61095259	14/05/86
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		JP-A- 63026579	04/02/88
		US-A- 4747784	31/05/88
DE-C1- 3636361	14/04/88	NONE	