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MEMS Intellect Multiprobes Contacting Devices for Electrical Checking-up of Multilayers Commutative Boards and BGA/CSP Electronic Components

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Abstract

The aim of this paper is to introduce a new method of multilayer commutative boards (printed, thick or thin film) and BGA components testing. Four types of test fixtures for connecting some thousands test points on unit under test to automatic test equipment are presented.

Probes in proposed MEMS devices fulfilled as ball grid arrays on flexible film with aluminum microwires. Such test fixtures give opportunity for self-monitoring contact of each probe to test point on board. The simplified devices can be used for BGA components testing before soldering in electronic modules.

1. Introduction

Checking-up electrical parameters of multilayers commutative boards (MCB) is an important operation in manufacturing printed boards (PB), thick- and thin film hybrids. It eliminates damaged MCB from next manufacturing stages and ensures reliability of electronic devices.

As usually integrity (continuity) of each wire and absence of connecting between different wires (short circuits) are tested. Quantity of tested points on complex boards grows and achieves some thousands.

Connecting devices, that commonly used in checking-up of MCB (test fixture – a device that interfaces between test equipment and the unit under test [1]), have the appearance of «bed of nails», pointed and pivots, «flying probes» (fig.1-2) and others [2-3]. Test fixtures are complicated and expensive devices.

So our first task was to find nontraditional form for probes and method it pressing to contact lands on boards and connecting to matrix leads electronic components BGA/CSP. Several versions of such test fixtures were created and patented by authors [4, 8-10].

Figure 1. Dual test fixture

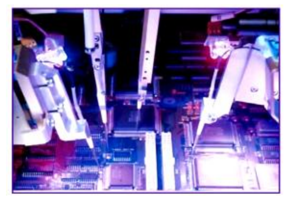


Figure 2. Flying probes

2. MEMS Test Fixture

It was solved to use ball grid array (BGA) as matrix probes [4]. Balls of BGA are sufficiently precise, manufactured with group methods and balls can be placed on flexible base [5]. It is possible to apply different film materials for making test fixture.

Conductive pattern with high precision can be fabricated with methods of printing, lithography or others [6].

At last, flexible film-base can cave-in under pressure air and make necessary and the same tension in different points of board.

There are example of multilayer thick film board with dimensions 48×60 mm shown in fig.3. 80 microschemes may be placed on it. Total quantity of testing points equals 2400. Discrete of wires is 0.625 mm (0.400 mm – land and 0.225 mm – space).

Constructed test fixture for checking-up this board consist of four-layer flexible polyimidic board with aluminum conductive layers (FDI-A-35) and external layer with ball grid array probes manufacturing with thick film screen printing [6, 7]. Pattern of internal layers was made with lithography.

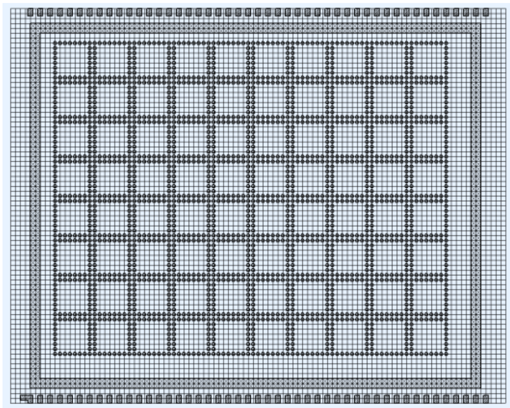


Figure 3. Multilayer thick film board 48×60 mm

The first internal layer is shown in fig.4. It connected with leads of two extreme rows microschemes on testing board. Others inner layers are like the first. Other leads of test fixture directed in opposite sides. Diameter of ball-probe 0.25 mm, wire width – 0.07…0.1 mm.

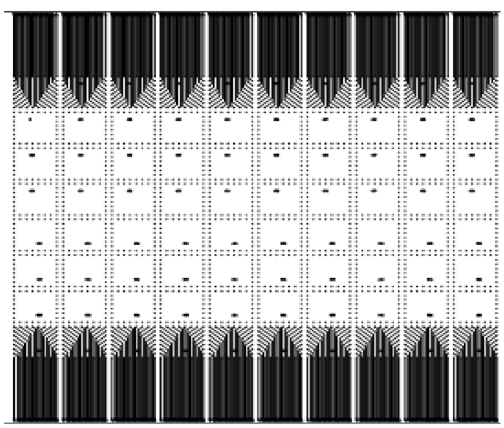


Figure 4. The first inner wire layer of fixture

Probes are situated in knots of coordinate system or arbitrary, if it's need.

Complexity of print boards grows. It is known multilayers with number points of checking-up 16 000. Manufacturing, repairing and testing such units are expensive.

It is possible two types of errors in process of automation checking-up with «bed of nails», pointed and curved pivots, «flying probes»:

Fault Masking [1], when one fault conceals the existence another, i. e. absence contact one of the two probes to land in verification short circuit between electrically separated circuits. In this case short circuit passed as valid;

False Alarm – intact wire may be reject, if the first or the second probe breaks contact with wire.
Such errors especially dangerous in complex PB.

It is need to find means for elimination it.

Such means we found in doubling or multitudinous probes to each testing point on board [8].

Developed test fixture with probes is divided on some separated parts (in fig.5 on four parts) for checking-up boards gives possibility self-monitoring contact of each probe to according land on board before it checking-up or in case of need.

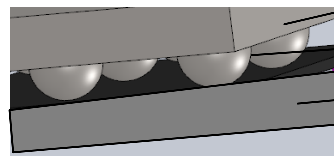


Figure 5. Contact group

Four balls on separated lands are connected crosswise in different layers in pairs (fig.6). The pairs are connected to outer leads with its own wires. Only in case, when pairs of balls will be pressed to according land of board, electrical circuit between them closes. This fact confirms presence of contact probe and testing land. On opposite sides of test fixture wires are joined with ZIF connectors.

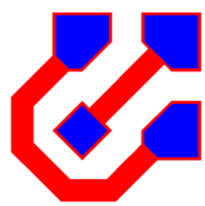


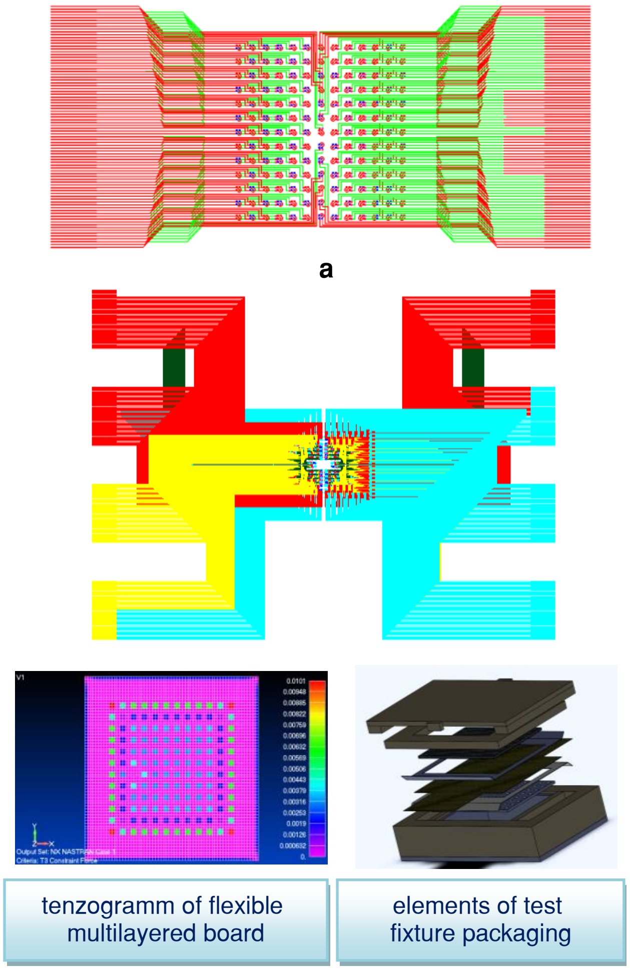
Figure 6. Crosswise connecting parts of probe

Possibility of receive information about short circuit may be interpreted as an element of intellect test fixture.

Like it test fixture without balls on separated flat lands of probe can be used for testing electronic components with matrix ball leads (type BGA/CSP) [9]. Examples of such test fixture are presented in fig.7.

All versions of test fixture placed in specific packaging according to units under test and air cushion press devices.

A good deal of outer leads in examined test fixtures requests their treatment and this procedure some bulky.



b

Figure 7. Test fixture for leads matrix 13×13 (a) and integrated circuit in FG 320 packaging (b)

Three disconnections take place in test fixtures: the first, between unit under test and probes; the second, between transfer fixture-cable to tester; the third, in entrance testing equipment.

Patent [10] solves this problem by way elimination two disconnection from three by using whole test fixture from probes of fixture to automate testing equipment.

Conclusion

Described MEMS multiprobes connecting devices can be used as intellect interface between multilayers commutative boards and testing equipment.

The main advantage of proposed working out is that probes of these devices with dividing them on two or more parts give to test fixture the possibility of self-monitoring presence of contact each probe and testing points of board, that eliminates errors the first and second types, increases contacts reliability by way doubling it different pieces. Also developed method of testing effectively provides the necessary contact pressure between test fixture and unit under test without hazard of its deformation which can appear in similar devices.

The basic technical parameters achieved for our test fixtures are:

- density of the probes arrangement – 0,5 mm;
- transitive resistance – 0,25 Ohm;
- quantity of simultaneously controllable elements – to several thousand depending on density of their placing.

These connecting devices are made with synthesis of known technologies flexibility multilayers printed boards, matrix leads BGA/CSP components and air cushion press. Such test fixtures are more simple and cheap in comparison with analogues.

Directions of practical application – at the enterprises-manufacturers of electronic means; replacement of the old or expensive equipment with the offered working out.

Researched technical decisions have positive ecological influence that consist in expenses reduction of raw materials, power inputs decreasing and reduction of the workplace area.

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