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Environmental and endurance testing – Test methods for surface-mount boards of area array type packages FBGA, BGA, FLGA, LGA, SON and QFN

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL AND ENDURANCE TESTING – TEST METHODS FOR SURFACE-MOUNT BOARDS OF AREA ARRAY TYPE PACKAGES FBGA, BGA, FLGA, LGA, SON AND QFN[1]

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International Standard IEC 62137 has been prepared by IEC technical committee 91: Electronics assembly technology.

The text of this standard is based on the following documents:

FDIS	Report on voting
91/444/FDIS	91/451/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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1 FBGA fine-pitch ball grid array
BGA ball grid array
FLGA fine-pitch land grid array
LGA land grid array
SON small outline non-leaded package
QFN quad flat-pack non-leaded package

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version may be issued at a later date.

ENVIRONMENTAL AND ENDURANCE TESTING – TEST METHODS FOR SURFACE-MOUNT BOARDS OF AREA ARRAY TYPE PACKAGES FBGA, BGA, FLGA, LGA, SON AND QFN

1 Scope

This International Standard specifies the test method and guidelines for evaluating the quality and reliability of boards, solder lands, solder process and solder joints of reflow solder mounted area array type packages and peripheral terminal type packages.

This standard tests for durability against mechanical and thermal stress received during or after the mounting process of discrete semiconductor devices and of integrated circuits (hereinafter both referred to as semiconductor devices) used mainly for industrial and consumer use equipment.

The test method specified in this standard is an integrated one by including the evaluation method of mounting methods, mounting conditions, printed circuit boards, soldering materials, and so on. It does not specify the evaluation method of the individual semiconductor devices.

Mounting conditions, printed wiring boards, soldering materials, and so on significantly affect the result of the test specified in this standard. Therefore, the test specified in this standard shall not be regarded as the one to be used to guarantee the mounting reliability of the semiconductor devices.

The test method is not necessary if there is no stress (mechanical or others) from any of the tests covered in this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60191-6-2:2001, *Mechanical standardization of semiconductor devices – Part 6-2: General rules for the preparation of outline drawings of surface mounted semiconductor device packages – Design guide for 1,50 mm, 1,27 mm and 1,00 mm pitch ball and column terminal packages*

IEC 60191-6-5:2001, *Mechanical standardization of semiconductor devices – Part 6-5: General rules for the preparation of outline drawings of surface mounted semiconductor device packages – Design guide for fine-pitch ball grid array (FBGA)*

IEC 61190-1-1, *Attachment materials for electronic assemblies – Part 1-1: Requirements for soldering fluxes for high-quality interconnections in electronics assembly*

IEC 61190-1-2, *Attachment materials for electronic assemblies – Part 1-2: Requirements for solder pastes for high-quality interconnections in electronics assembly*

IEC 61190-1-3, *Attachment materials for electronic assemblies – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solders for electronic soldering applications*

JEITA[2] ETR-7001:1998, *Terms and definitions for surface mount technology*

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[2] Japan Electronics and Information Technology Industries Association.

3 Terms and definitions

For the purposes of this document, the terms and definitions for BGA, FBGA and so on, are referred to in IEC 60191-6-2 and IEC 60191-6-5.

4 Abbreviations

FBGA fine-pitch ball grid array
BGA ball grid array
FLGA fine-pitch land grid array
LGA land grid array
SON small outline non-leaded package
QFN quad flat-pack non-leaded package

5 Solder joint quality test methods

5.1 Reflow solderability test for solder joint

5.1.1 Purpose

This test method specifies the reflow solderability test for the solder joint, as part of the specification in the standard. It is used to evaluate the solderability of reflow soldering of area-array type packages and peripheral terminal type packages (QFN and SON).

5.1.2 Test specimen

The test specimen shall satisfy the following conditions:

a) test board design (see Clause A.4);
b) standard mounting process (see Annex B);
c) resistance to reflow soldering (see Clause A.1), solderability test for test board land (see Clause A.2) and peel test method for test board land (see Clause A.3).

5.1.3 Test apparatus

The test apparatus shall include the following:

a) Oven

The oven shall maintain the temperature specified in 5.1.4.2.

b) Moistening equipment

The humidifier shall maintain the temperature and humidity specified in 5.1.4.2. No reaction shall occur to the material of the oven at high temperatures. The water used for the test shall be purified water or deionized water, with pH 6,0 to pH 7,2 at 23 °C, and with a resistivity of 500 Ωm or higher.

c) Infrared reflow/air reflow furnace

The infrared reflow/air reflow furnace shall meet the heating process conditions specified in 5.1.4.4.

5.1.4 Test procedure

5.1.4.1 Initial measurement

The initial measurement shall be carried out according to the items and conditions specified in the individual standard.

5.1.4.2 Moisture treatment

The moisture treatment is desirable for the test because a soldering defect may occur with moisture. “Defect of soldering” is defined in ETR-7001 as general failure of soldering.

a) Pre-treatment

Unless otherwise specified in the individual standard, the specimen subject to the moistening reflow pre-treatment in b) shall be baked in the oven at (125 ± 5) °C for 24 h or more.

b) Moistening process (1)

The specimen shall be moistened as specified in the individual standard. If there is no such specification mentioned in the individual standard, the specimen shall be subject to the moistening condition at 30 °C, with a relative humidity of 70 % for 96 h.

c) Moistening process (2)

When the specimen is subjected to the reflow process twice, the specimen reflow soldered on the test board shall be moistened once again under the moistening condition as specified in the individual standard.

In this case, by taking into consideration the moistening reflow characteristic of the test board, it is desirable to set both the moisture soaking conditions and the moistening time for the repeat version of the test. In general, it is desirable to set the moistening condition to 30 °C, with a relative humidity of 70 %, or to 30 °C, with a relative humidity of 85 % up to 165 h maximum.

5.1.4.3 Test conditions

a) Reflow profile measurement

The infrared reflow/air reflow furnace shall meet the heating process conditions specified in Figure 3. The temperature of the specimen shall be measured at measurement Point A (the centre on the top of the package) and measurement point B (the soldered inner part of the terminal), shown in Figure 1.

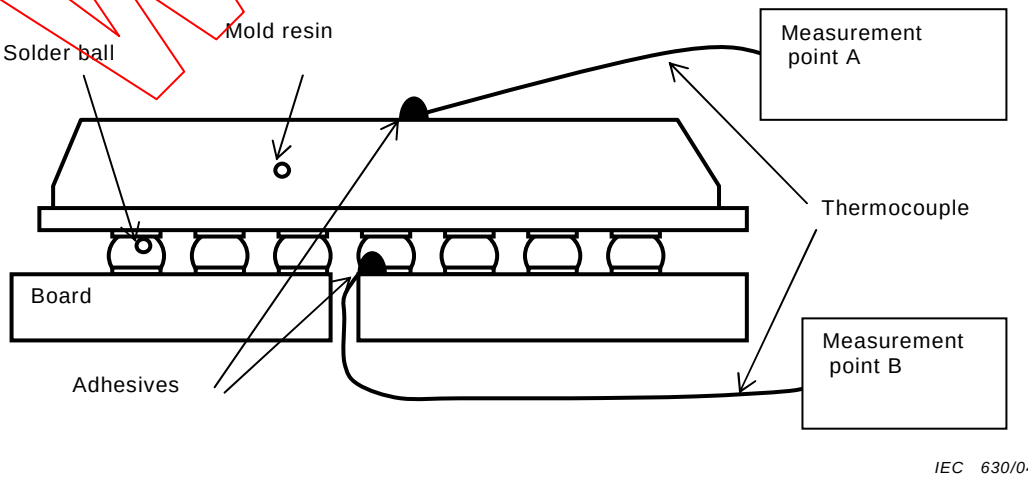

Figure 1 – Temperature measurement of the specimen using thermocouples

b) Test process.

The board to be tested shall carry out the evaluation under similar conditions to that of the actual usage of the board.

A proposal is shown in Figure 2.

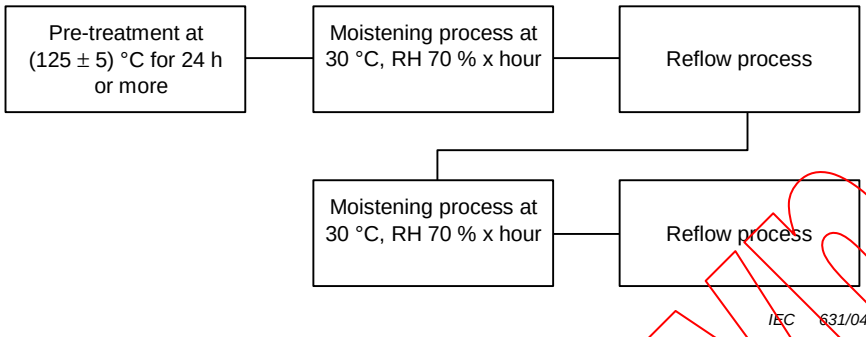

Figure 2 – Moistening/reflow process cycle proposed

5.1.4.4 Reflow heating

Mount the specimen on the mount reliability test board on which the solder paste has been printed as described in Annex B.

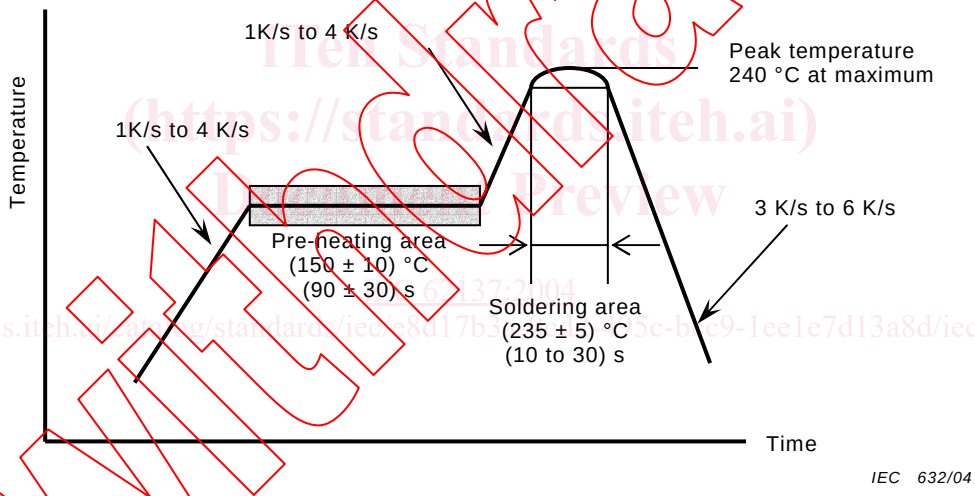

Figure 3 – Reflow profile

5.1.4.5 Post-treatment

After the test has been completed, if necessary, leave the specimen in the standard condition for the time specified in the individual standard:

- standard temperature range: 15 °C to 35 °C;
- standard relative humidity: 25 % to 75 %;
- standard atmospheric pressure: 86 kPa to 106 kPa.

Refer to IEC 60068-1.

5.1.4.6 Evaluation

Measure the electrical characteristic of the specimen according to the individual standard. Then, using soft X-ray inspection equipment, check the soldered condition. If necessary, observe the cross-sectional view after the buried process of resin.

5.2 Reserved for future use

(Vacant).

6 Mechanical test methods

6.1 Bending test for solder joint

(Under consideration)

6.2 Drop test for solder joint

(Under consideration)

7 Environment test methods

7.1 Temperature cycling test for solder joint

7.1.1 Purpose

This test method specifies the temperature cycling test for solder joints. It is an accelerated test method to measure the life expectancy of semiconductor devices and of the solder joint on the board by taking into consideration the assumed temperature increase when area array type packages and peripheral terminal type packages (QFN and SON) mounted on the board are working.

7.1.2 Test specimen

The test specimen shall satisfy the following conditions:

a) test board design (see Clause A.4);

b) standard mounting process (see Annex B);

c) reflow solderability (see 5.1), solderability test for test board land (see Clause A.2), and peel test method for test board land (see Clause A.3).

7.1.3 Test apparatus

The test apparatus shall include the following:

a) Oven

The oven shall maintain the temperature specified in 7.1.4.2.

b) Moistening equipment

The humidifier shall maintain the temperature and humidity as specified in 7.1.4.2. No reaction shall occur in the material of the oven at high temperatures. The water used for the test shall be purified water or deionized water, with pH 6,0 to pH 7,2 at 23 °C, and with a resistivity of 500 Ωm or higher.

c) Temperature cycling test oven

The temperature cycling test oven shall be of vapour phase type that meets the test conditions of the temperature cycle profile specified in 7.1.4.3.

7.1.4 Test procedure

7.1.4.1 Initial measurement

The initial measurement shall be carried out according to the items and conditions specified in the individual standard.