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IPC-TM-650
TEST METHODS MANUAL

Number	
2.6.14	
Subject	
Solder Mask - Resistance to Electrochemical Migration	
Date	Revision
03/07	**D**
Originating Task Group	
Solder Mask Performance Task Group (5-33b)	

1 Scope This test method is used to determine the ability of a polymer solder mask protective coating to withstand an environment conducive to electrochemical migration.

2 Applicable Documents

IPC-A-25A-G-KIT[1] Multipurpose One-Sided Test Pattern - Gerber Format

IPC-SM-840 Qualification and Performance of Permanent Solder Mask

IPC-TR-476 Electrochemical Migration: Electrically Induced Failures in Printed Wiring Assemblies

J-STD-004 Requirements for Soldering Fluxes

3 Test Specimens The IPC-A-25A-G-KIT artwork package provides the Gerber files necessary for the fabrication of the standard IPC-B-25A test board used with this test method.

3.1 Qualification Testing Three IPC-B-25A boards (see Figure 1) using the D comb patterns with 0.32 mm [0.0126 in] lines and spaces for both Classes T and H, coated with solder mask according to the solder mask supplier's recommendations.

3.2 Conformance Testing Three IPC-B-25A boards (see Figure 1) using the C comb pattern (''Y'' shape pattern) which should be 0.64 mm lines/0.64 mm spacing [0.025 in lines/ 0.025 in spacing] or the pattern with the minimum spacing on the production board, whichever has the smallest line spacing, coated with solder mask according to the solder mask supplier's recommendations.

4 Equipment/Apparatus

4.1 Power Supply Capable of supplying 10 ± 0.5 VDC at 1 A, maximum.

4.2 Oven Capable of maintaining up to 90 ± 1 °C [194 ± 1.8 °F].

4.3 Chamber Capable of maintaining 85 ± 2 °C [185 ± 3.6 °F] with 85%, minimum, relative humidity.

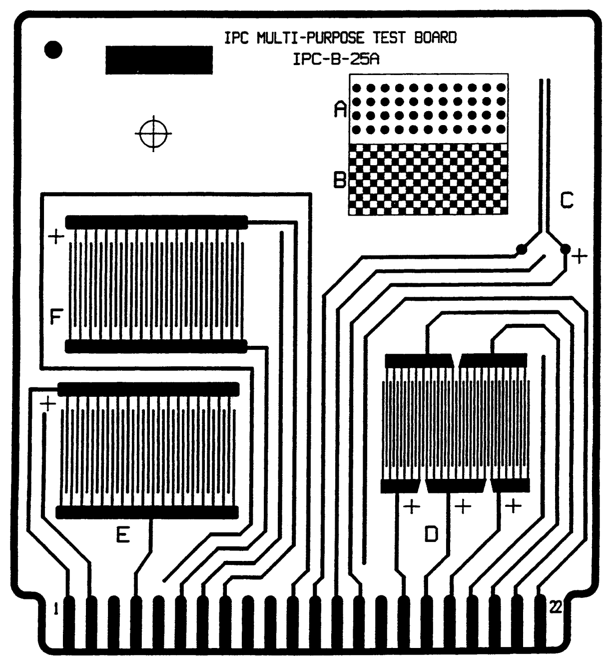

Figure 1 IPC-B-25A Test Board

4.4 Desiccator 25 cm [9.84 in] diameter minimum, with openings for the connecting wires to pass through while maintaining a hermetic seal.

4.5 Potassium Sulfate Reagent Grade potassium sulfate.

4.6 RTV Dow Corning 732 RTV potting compound or equivalent.

4.7 Resistors 10 megohm resistor for Class H testing and 1 megohm resistors for Class T testing

4.8 Magnifier Capable of supplying 10X magnification

4.9 Soldering Iron

1. www.ipc.org/onlinestore

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4.10 Flux Water white rosin (R or RMA) with halide content less than 0.5%, i.e., type Symbol A and B or ROL0 and ROL1 according to J-STD-004.

5 Test Conditions

5.1.1 Class T 85 ± 2 °C [185 ± 3.6 °F] with 85% relative humidity minimum, 10 VDC bias, for 500 hours.

5.1.2 Class H 85 ± 2 °C [185 ± 3.6 °F] with 90, +5/-0% relative humidity, 10 VDC bias for 168 hours.

5.2 Specimen Preparation

5.2.1 Positive, permanent and noncontaminating identification of the test specimens is of paramount importance.

5.2.2 Visually inspect the test specimens for any obvious defects, as described in IPC-A-600. If there is any doubt about the overall quality of any test specimen, the test specimen should be discarded.

5.3 Electrical Connections (Both Classes)

5.3.1 For qualification testing, solder single strand PTFE insulated wires or equivalent to the lands of each of the D test patterns using a noncontact shield to protect the patterns from flux splattering. These wires will be used to connect the test specimen to the bias voltage or resistance meter. Test points 1, 3 and 5 are to be connected to the positive terminal and test points 2 and 4 are to the negative terminal of resistance meter or power supply. When resistors are used, they are to be connected between test points 1, 3 and 5 and the positive terminal of power supply.

5.3.2 For conformance testing, solder single strand PTFE insulated wires or equivalent in each of the connecting points of the pattern described in 3.2 using a noncontact shield to protect the patterns from flux splattering. These wires will be used to connect the test specimen to the bias voltage or resistance meter. One side of the pattern should be connected to the positive terminal and the other side to the negative terminal of resistance meter or power supply. When resistors are used, they are to be connected between the pattern and the positive terminal of power supply.

5.3.3 The flux shall not be removed from the test specimens.

5.4 Procedures

5.4.1 Desiccator Test Method

5.4.2 Take insulation resistance measurements of the test specimens using 10 VDC, prior to testing. This step will ensure that the resistance measurements are sufficient to proceed with testing.

5.4.3 Prepare a saturated solution of distilled water and potassium sulfate (approximately 35g per 100 mL) at a temperature of 85 °C [185 °F]. Pour the solution into the desiccator just below the ceramic plate. Crystals of potassium sulfate should remain visible in the saturated solution in the oven at operating temperature.

5.4.4 Place the test specimens into the desiccator, such that they do not touch one another. Route the connecting wires to the outside of the desiccator and seal with a silicone potting compound such as Dow Corning 732 RTV or a heat resistant vacuum grease.

5.4.5 Place the desiccator into an oven maintained at 85 °C [185 °F]. For the remaining test procedures, see 5.5.4 to 5.6.2 for Class H and 5.7.4 to 5.8.4 for Class T.

5.5 Class H – Test Chamber Method

5.5.1 Prior to testing, take insulation resistance measurements of the test specimens using 10 VDC. This step will ensure that the resistance measurements are sufficient to proceed with testing.

5.5.2 Place the specimens into the test chamber and route the wires through the porthole of the test chamber and seal, if necessary.

5.5.3 Set the chamber's parameters, which is a noncondensing ramp, for 85 °C [185 °F] with 90% relative humidity. Close the chamber doors and activate the test chamber.

5.5.4 Connect the correct test points as specified in 5.3.1 and 5.3.2 to a 10-megohm resistor before the positive terminal of power supply. (See Figure 2 for configuration for qualification testing.) Apply the bias voltage of 10 VDC.

5.5.5 Allow the test specimens to remain in the test chamber for the duration of 168 hours (seven days).

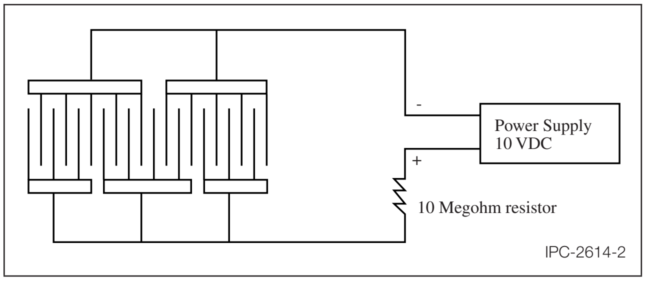

Figure 2 Configuration for Class H Qualification Testing

5.5.6 Upon completion of the 168 hours, turn off the bias and open the test chamber and allow the test specimens to return to laboratory ambient conditions.

5.6 Class H – Measurements/Evaluation

5.6.1 Upon specimen stabilization at laboratory ambient temperature, take the resistance measurements, as specified in 5.5.1, with 10 VDC and record.

5.6.2 Examine the test specimens with 10X magnification with backlighting for electrochemical migration.

5.7 Class T – Test Chamber Method

5.7.1 Prior to testing, take insulation resistance measurements of the test specimens using 45 -100 VDC. This step will ensure that the resistance measurements are sufficient to proceed with testing.

5.7.2 Place the test specimens into the test chamber and route the wires through the porthole of the test chamber and seal, if necessary.

5.7.3 Set the chamber's parameters for 85 °C [185 °F] with 85% relative humidity minimum. Close the chamber doors and activate the test chamber.

5.7.4 Allow the test specimens to stabilize at test conditions for 96 hours (four days).

5.7.5 After the 96-hour (four days) stabilization period at test conditions, take measurements of initial insulation resistance as specified in 5.7.1 with 45 -100 VDC.

5.7.6 After obtaining the measurements, connect each test point as specified in 5.3.1 and 5.3.2 to a 1-megohm resistor before the positive terminal of power supply. (See Figure 3 for configuration of qualification testing.) Apply the bias voltage of 10VDC. The test polarity shall be the same as the measurement polarity stated in 5.7.1.

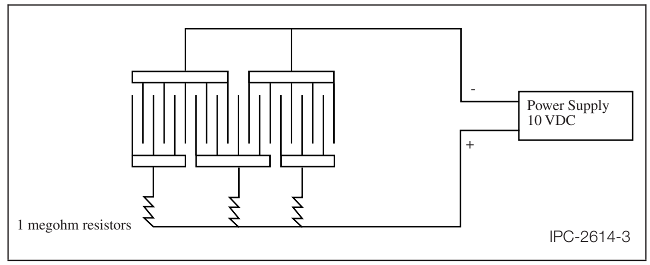

Figure 3 Test Point Connection for Class T Qualification Testing

5.7.7 Allow the specimens to remain in the test chamber an additional 404 hours (500 hours total test time).

5.8 Class T – Measurements/Evaluations

5.8.1 Upon completion of the 500 hours (21 days), disconnect the power supply and repeat the measurements as stated in 5.7.5 with the specimens under test conditions.

5.8.2 The chamber is then turned off and the specimens are removed from the test chamber and visually inspected with backlighting at 10X magnification for electrochemical migration.

5.8.3 The individual resistance measurements obtained at 96 hours and 500 hours shall be averaged using the following calculation. These initial and final average insulation resistance readings shall then be reported.

$$IR_{avg} = 10^{\left[\frac{1}{N}\sum_{1}^{N} \log IR_i\right]}$$

Where:

N = Number of test points (12 nominal)

IR_i = Individual insulation resistance measurements

5.8.4 Where an assignable cause can be found, exceptionally low insulation resistance readings can be excluded from calculating the average value, provided that 11 (of the original 12) measurements are included in the average. Such assignable causes are attributable to the laminate itself or to the process used to produce the printed board. They include:

a. Contamination on the insulating surface of the board such as lint, solder splines, or water droplets from the conditioning chamber.

b. Incompletely etched patterns that decrease the insulating space between conductors by more than the amount allowed in the appropriate design requirements drawing.

c. Scratched, cracked or obviously damaged insulation between conductors.

6 Notes

6.1 Protective coatings are helpful in preventing electrochemical migration, but there is no assurance that the protection is complete unless the coating is adequately bonded to a good clean board.