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IPC-TM-650 TEST METHODS MANUAL

1 Scope These methods determine the physical endurance of representative coupons of printed boards to a series of high temperature excursions from ambient. The temperature excursions cause thermo-mechanical fatigue of the electrical interconnect structures.

The test coupon is resistance heated by passing DC current through the coupon to bring the temperature of the copper to a designated temperature. Switching the current on and off creates thermal cycles between room temperature and the designated temperature within the sample. The laminate and surrounding materials are heated to different extents depending on the thermal conductivity of the materials. The thermal cycling can accelerate latent interconnect anomalies to failure.

The number of cycles achieved permits a quantitative assessment of the performance.

1.1 Method A Description Method A uses a coupon with two or more independent electrical nets. The designation for these nets is either a power net (P) or a sense net (S). Each electrical net consists of plated barrels and conductors (internal and external). DC current is passed through one electrical net to heat the coupon to a designated temperature. When the electrical net is at the designated temperature, the DC current is turned off and cooling fans are turned on to cool the coupons to ambient temperature. One heating and cooling sequence represents a thermal cycle. Thermal cycling is continued to either a set number of cycles or a failure. Temperature coefficient of resistance (TCR) is estimated by proprietary algorithms.

A failure is based on a percentage change in the bulk resistance of the coupon at the designated test temperature. The percentage change is measured independently for each electrical net being tested. When the percentage change is exceeded, the test is stopped for the coupon.

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Subject DC Current Induced Thermal Cycling Test	
Date 5/14	Revision A
Originating Task Group PTV Reliability Test Methods (6-10c)	

1.2 Method B Description Method B uses a coupon with one electrical net. The net consists of via structures connected by external and/or internal circuit lines in a daisy chain. DC current is passed through the electrical net to heat the coupon to a designated temperature. When the electrical net is at the designated temperature, the DC current is turned off and a cooling fan is turned on to cool the coupons to ambient temperature. One heating and cooling sequence represents a thermal cycle. Thermal cycling is continued to either a set number of cycles or a failure. Temperature coefficient of resistance (TCR) is measured.

A failure is based on a percentage change in the bulk resistance of the coupon at the designated test temperature. The percentage change is measured independently for each electrical net being tested. When the percentage change is exceeded, the test is stopped for the coupon.

2 Applicable Documents

2.1 IPC¹

IPC-MDP-650 Method Development Packet

IPC-TM-650 Test Methods Manual²

2.1.1 Microsectioning

2.5.35 Capacitance of Printed Board Substrates After Exposure to Assembly, Rework, and/or Reliability Tests. (At the time of publication of this test method, 2.5.35 is in development.)

2.6.27 Thermal Stress, Convection Reflow Assembly Simulation

3 Test Specimens A typical daisy chain test coupon for each method is shown in Figure 3-1 and Figure 3-2.

1. www.ipc.org

2. Current and revised IPC Test Methods are available on the IPC Web site (www.ipc.org/html/testmethods.htm)

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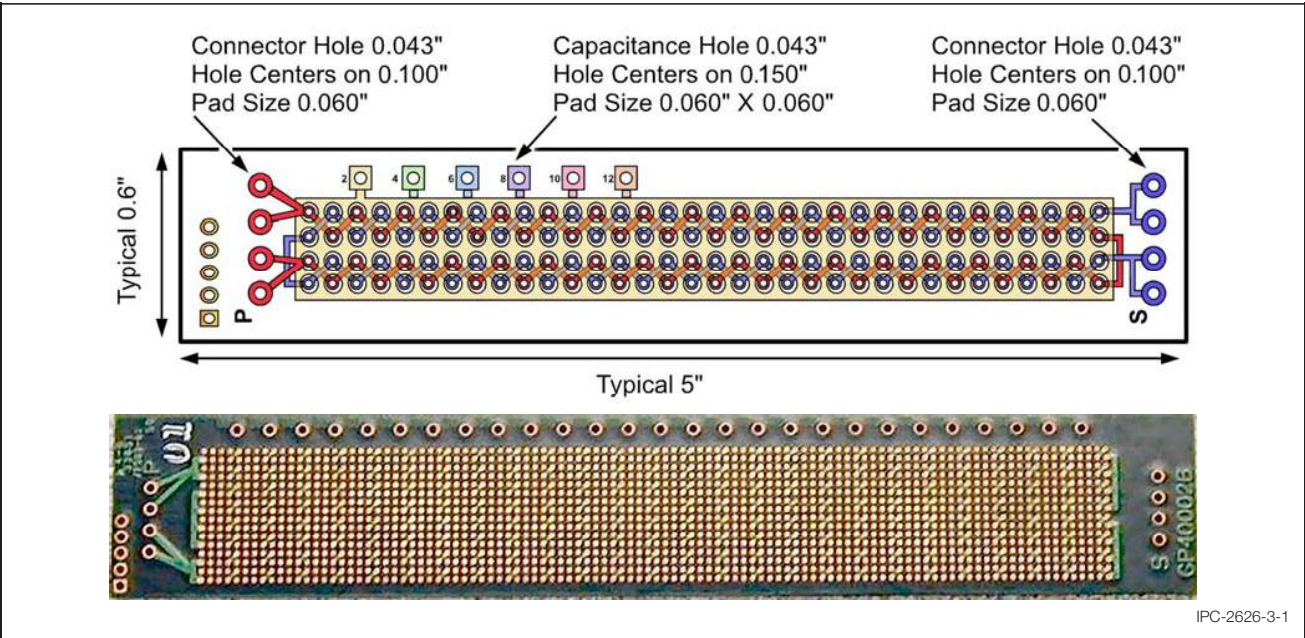


Figure 3-1 Method A Test Coupon

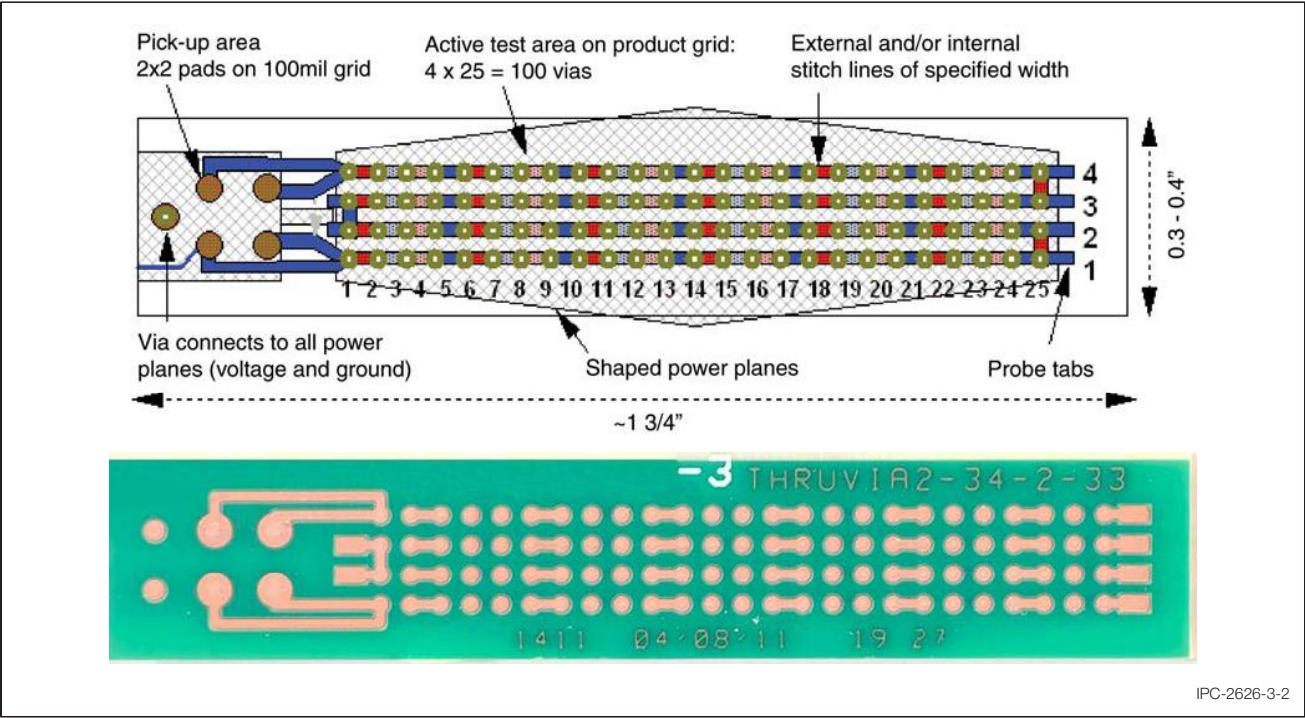


Figure 3-2 Method B Test Coupon

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3.1 Coupon Design Rules Certain design rules must be applied to achieve thermal uniformity. Electronic design files for coupon construction are available from the equipment supplier or printed board supplier. The resistance values (voltage drops) for each coupon are monitored independently for each electrical net in test, using a four wire measurement technique.

The test coupon(s) is incorporated on the panel to monitor or qualify design, materials, or processes of product and/or reliability assurance.

4 Apparatus or Material At the time of publication of this test method, 4.1 and 4.2 list the only known equipment manufacturers of this test equipment. Equivalent test systems may be used that operate on principles similar to those identified in Method A or B. IPC encourages their submission along with relevant validation test data. This test method will be revised as necessary to include these test systems as this information becomes available.

Validation of this test method was performed with the equipment listed in 4.1 and 4.2. Test conditions for the validation are provided in 6.5. If alternate test equipment is used, validation in accordance with IPC-MDP-650 and 6.5 is recommended.

4.1 Method A

4.1.1 This equipment is available from:

PWB Interconnect Solutions Inc. (Canada)
URL: www.pwbcorp.com
Equipment Type: IST

4.1.2 Two (2) four-pin, 2.54 mm [0.1 in] male connector (ITW Pancon MFSS100-4-D or equivalent).

4.1.3 Sn60Pb40, Sn63Pb37, or lead free solder.

4.1.4 Solder flux.

4.1.5 Soldering iron.

4.2 Method B

4.2.1 This equipment is available from:

i3 Electronics (USA)
(formerly Endicott Interconnect Technologies)
URL: www.i3electronics.com
Equipment Type: CITC, CITC-TCR

4.2.2 4-wire multimeter, capable of measuring milliohms

4.2.3 Thermal imaging equipment – optional

5 Procedures

5.1 Sample Selection

5.1.1 Bench top measure the resistance of each net of the coupon with a 4-wire multimeter. A net with an open cannot be tested. A net with a short must be reworked to test the coupon.

5.1.2 Coupon Selection Select coupons for evaluation based upon the test required as described in 5.1.2.1 through 5.1.2.3.

5.1.2.1 Random Sampling A sample chosen without regard to any characteristic of the individual coupons within a population, within one or more lots.

5.1.2.2 Selective Sampling A sample chosen based on the resistance measurements of the sense and power nets. Testing may include high, midrange and low resistance measurements.

5.1.2.3 Comparative Sampling A sample chosen based on the resistance measurements of the sense and power nets. Testing should include similar resistance measurements for the populations being tested.

5.2 Method A Procedure

5.2.1 Single Sense Testing Solder two four-pin male connectors in the 1.02 mm [0.040 in] holes at the left and right edges of the coupon (see Figure 3-1). A solder fillet must be apparent on both sides of the coupon.

5.2.1.1 Dual Sense Testing (Optional) When Dual Sense Testing is required, solder three four-pin male connectors in the 1.02 mm [0.040 in] holes at the edges of the coupon (see Figure 5-1). A solder fillet must be apparent on both sides of the coupon.

NOTE: Dual Sense coupons may be tested using the Single Sense Testing method.