IPC-9708

Test Methods for Characterization of Printed Board Assembly Pad Cratering

Developed by the SMT Attachment Reliability Test Methods Task Group (6-10d) of the Product Reliability Committee (6-10) of IPC

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847615.7100
Fax 847615.7105

Table of Contents

1 **SCOPE** . . . 1
1.1 Performance Classification. . . . 1
1.2 Definition of Terms. . . . 1
1.2.1 BGA. . . . 1
1.2.2 Component. . . . 1
1.2.3 Solder Joint/Ball. . . . 1
1.2.4 Pad Cratering. . . . 1
1.3 Interpretation. . . . 1

2 **APPLICABLE DOCUMENTS** . . . 1
2.1 IPC. . . . 1
2.2 Joint Electron Device Engineering Council . . . 1

3 **TEST METHODS** . . . 2
3.1 General . . . 2
3.2 Test Coupons . . . 3
3.3 Pad Cratering Test Method Comparison . . . 4
3.4 Pin-Pull Test Method . . . 4
3.4.1 Procedure Description . . . 4
3.4.2 Critical Test Variables . . . 5
3.4.3 Test Apparatus . . . 5
3.4.4 Solder Application Process . . . 5
3.4.5 Heater Calibration . . . 6
3.4.6 Test Board Fixturing . . . 6
3.4.7 Test Procedure . . . 6
3.5 Ball-Pull Test Method . . . 7
3.5.1 Test Prerequisites. . . . 7
3.5.2 Critical Test Variables . . . 7
3.5.3 Sample Preparation . . . 7
3.5.4 Equipment Setup . . . 8
3.5.5 Testing Method . . . 9
3.6 Ball-Shear Test Method. . . . 10
3.6.1 Procedure Test Method Details . . . 10
3.6.2 Critical Test Variables . . . 10
3.6.3 Test Apparatus . . . 10
3.6.4 Test Board Fixturing . . . 10
3.6.5 Test Setup and Testing Procedure . . . 10
3.7 Failure Inspection Procedure . . . 11
3.7.1 Failure Modes . . . 11
3.7.2 Test Sample Size and Results Reporting . . . 14

4 **REFERENCES** . . . 14

FIGURES

Figure 3-1 Example Failure Mode Categories Occurring in a BGA PBA Assembly . . . 2
Figure 3-2 Example of a Pad Cratering Failure . . . 2
Figure 3-3 Definition of Pad Construction . . . 3
Figure 3-4 Test Setup Schematic . . . 4
Figure 3-5 Thermocouple Locations on Panel . . . 5
Figure 3-6 Thermocouple vs. Heater Temperature Calibration . . . 6
Figure 3-7 Test Board Fixturing with Metal Plate . . . 6
Figure 3-8 Flowchart of Pin Pull Test Sequence . . . 6
Figure 3-9 Flux Application to Target Pad . . . 7
Figure 3-10 Test Pin Position . . . 7
Figure 3-11 Pull Test . . . 7
Figure 3-12 Isolated Pad Array . . . 8
Figure 3-13 Paste or Ball Fixture . . . 8
Figure 3-14 Tool Alignment . . . 9
Figure 3-15 Jaw Alignment . . . 9
Figure 3-16 Ball-Shear Test Schematic . . . 10

TABLES

Table 3-1 Benefits and Challenges for Pin-Pull, Ball-Pull, and Ball-Shear Tests. . . . 4
Table 3-2 Summary of Key Variables for Pin-Pull Test . . . 5
Table 3-3 Summary of Key Variables for Ball-Pull Test . . . 7
Table 3-4 Ball-Pull Testing Parameters . . . 9
Table 3-5 Critical Variables for Ball-Shear Test. . . . 10
Table 3-6 Ball-Shear Test Parameter Settings . . . 11
Table 3-7 Typical Failure Modes . . . 12
Table 3-8 Examples of Failure Modes . . . 13
Table 3-9 Example Results Reporting Template . . . 14

Test Methods for Characterization of Printed Board Assembly Pad Cratering

1 SCOPE

This document provides test methods to evaluate the susceptibility of printed board assembly (PBA) materials and designs to cohesive dielectric failure underneath surface mount technology (SMT) attach pads. The test methods can be used to rank order and compare different printed board materials and design parameters, but do not define acceptance criteria.

1.1 Performance Classification This test method guideline recognizes that surface mount assemblies (SMAs) will be subject to variations in performance requirements based on end use. While performance classes are defined in IPC-6011, these performance classifications are not specific as to the required reliability. As of the publication of this standard, the acceptance criteria needs to be established as agreed between user and supplier (AABUS).

1.2 Definition of Terms The definition of all terms used herein **shall** be as specified in IPC-T-50, except as otherwise specified in 1.2.1 through 1.2.4.

1.2.1 BGA Ball Grid Array package.

1.2.2 Component Packaged semiconductor device.

1.2.3 Solder Joint/Ball The solder interconnection between a component and PBA.

1.2.4 Pad Cratering The formation of a cohesive (or adhesive) dielectric crack or fracture underneath the pad of a surface mount component, most commonly BGA packages.

1.3 Interpretation **"Shall"** is used throughout this specification whenever a requirement is intended to express a provision that is mandatory; deviation may be considered if sufficient data is supplied to justify the exception.

The words "should" and "may" are used whenever it is necessary to express non-mandatory provisions. "Will" is used to express a declaration of purpose. To assist the reader, the word "**shall**" is presented in bold characters.

2 APPLICABLE DOCUMENTS

The following documents are applicable and constitute a part of this specification to the extent specified herein. Sub-sequent issues of, or amendments to, these documents will become a part of this specification. Documents are grouped under categories such as IPC, Joint Industry Standard, and others depending on the source.

2.1 IPC[1]

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-6011 Qualification and Performance Specification for Printed Boards

2.2 Joint Electron Device Engineering Council[2]

JESD22-B117A BGA Ball Shear

JESD22-B115 Solder Ball Pull

1. www.ipc.org
2. www.jedec.org