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**IPC/JEDEC-9704**

# **Printed Wiring Board Strain Gage Test Guideline**

Developed by the JEDEC Reliability Test Methods for Packaged Devices Committee (JC-14.1) and 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.

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# Printed Wiring Board Strain Gage Test Guideline

## 1 SCOPE

This document describes specific guidelines for strain gage testing for Printed Wiring Board (PWB) assemblies in the board manufacturing process including, assembly, test, system integration and board shipping.

The suggested procedure enables board assemblers to conduct required strain gage testing independently, and provides a quantitative method for measuring board flexure, and assessing risk levels.

The topics covered include:

- Test setup and equipment requirements
- Strain measurement
- Report format

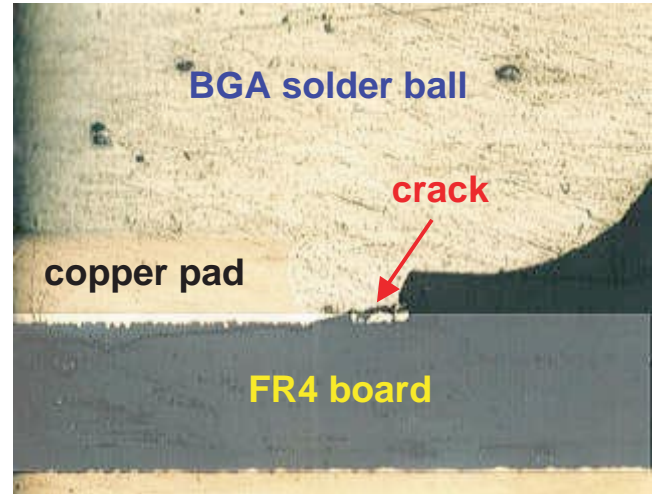
This document assumes a surface mount device; Ball Grid Array (BGA), Small Outline Package (SOP) and Chip Scale (Size) Package (CSP) are typical device examples. Discrete Surface Mount Technology (SMT) devices, (e.g., capacitors, resistors, etc.) are outside the scope of this publication.

**1.1 Purpose** Strain gage testing allows objective analysis of the strain and strain rate levels that a SMT package is subjected to during PWB assembly, test and operation.

Characterization of worst-case PWB strain is critical due to the susceptibility of component solder joints to strain-induced failures. Excessive strain can result in solder joint damage for all package substrate plating finishes. Such failures include solder ball cracking, trace damage, pad lifting (shown in Figure 1-1) and substrate cracking during board manufacturing and test processes.

**1.2 Background** Board flexure control using strain gage measurement has proven very beneficial to the electronics industry, and continues to gain acceptance as a method to identify damaging manufacturing processes. However, as interconnect densities have increased and become more fragile, the potential for flexure-induced damage has increased. Many board assemblers are now required to operate under strain levels specified by their customers or component suppliers.

As strain measurement technology has matured, different methodologies have developed. Variations in strain gage methodology inhibit reliable data collection and prevent data comparison across the industry. This document addresses variations in gage mounting, gage placement, experiment design, data acquisition system variables, and strain metrics.



**Figure 1-1** Lifted Pad

PWB strain measurement includes application of strain gages to the board at specified components, and then subjecting the instrumented board to various test and assembly operations. Test and assembly steps which exceed strain limits are deemed excessive and are identified so that corrective actions can be made. Strain limits may come from the customer, component supplier or internal best known practices. Examples of strain measurement criteria are shown in Appendix A.

By identifying areas sensitive to manufacturing variation, strain gage testing provides insight into the effects of a production ramp. Strain gage measurements become the baseline for future process improvement activities, and quantify the effectiveness of adjustments. Manufacturing steps that are typically characterized are listed below:

1. SMT assembly process:
  - Board depanelization (routing) processes
  - All manual handling processes
  - All rework and retouch processes
  - Connector installation
  - Component installation
2. Board test processes:
  - In-Circuit Test (ICT)
  - Board Functional Test (BFT), or equivalent functional test
3. Mechanical assembly:
  - Heat sink assembly
  - Board support/stiffener assembly