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High Temperature Printed Board Flatness Guideline

Developed by the Printed Board Coplanarity Subcommittee (6-11) 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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1 PURPOSE

1.1 Introduction During the surface mount assembly process of an electronic package to a printed board through a reflow temperature profile, the flatness behavior of both the package and printed board are critical for the integrity of solder joint formation and reliability. While the deviation of the package from planarity during this process is critical, controlling the printed board flatness is equally important for preventing subsequent assembly-related issues, including open or bridging joints, which ultimately cause product failure. Board flatness is largely driven by a change in intrinsic properties through exposure to changes in temperature, with the final flatness state becoming a function of the entire temperature history or reflow profile and support boundary conditions. It is also driven by copper symmetry stack-up and metal pattern balancing. The worst-case deviation of the printed board from flatness may be at room temperature, peak temperature during reflow, or at any temperature in between. Therefore, printed board flatness must be characterized during the entire reflow thermal cycle, and not solely at room temperature at the beginning and end of the process. This document aims to provide guidance on methods and procedures for critically evaluating printed board flatness during a simulated temperature reflow cycle.

1.2 Scope The purpose of this test method is to measure the shape and relative change in shape of a local area of interest (e.g., flip-chip ball grid array (FCBGA) land area) of printed boards through a range of temperatures typical during surface mount and through-hole builds of integrated circuit packages to printed boards. The use of shape measurements and relative changes in shape will depend on the specific application and interest of the user performing the measurement. This guideline differs from and does not supersede IPC-TM-650, Method 2.4.22, which is used for inspection of bow and/or twist of bare printed boards at room temperature.

1.3 Terms and Definitions The definition of all terms used herein **shall** be in accordance with IPC-T-50 and as defined in 1.3.1 through 1.3.15.

1.3.1 Clamped (Support Condition) Surface-mount technology (SMT) build condition where the printed board is fixed in a carrier, or pallet, which may or may not have standoff supports underneath the middle area of the printed board in addition to spring clamps that slide over the top edges of the primary surface of the printed board. The printed board is not free to rotate at the edges, and the clamps help mitigate the board warpage in either direction during a reflow cycle (see Figure 4-3 item a).

1.3.2 Concave Shape description for flatness where the center of the printed board lies lower than the corners of the printed board with respect to the local surface area of interest (e.g., FCBGA land on primary or secondary side) as shown in Figure 1-1. This aligns with JEDEC JESD22-B112.

1.3.3 Confocal Method Approach of forming an image by scanning one or more focused beams of light across a surface and using spatial filtering techniques to eliminate out-of-focus light or glare, keeping only the points that exactly coincide with the surface being measured.

1.3.4 Convex Shape description for flatness where the corners of the printed board lie lower than the center of the printed board with respect to the local surface area of interest (e.g., FCBGA land on primary or secondary side) as shown in Figure 1-1. This aligns with JEDEC JESD22-B112.

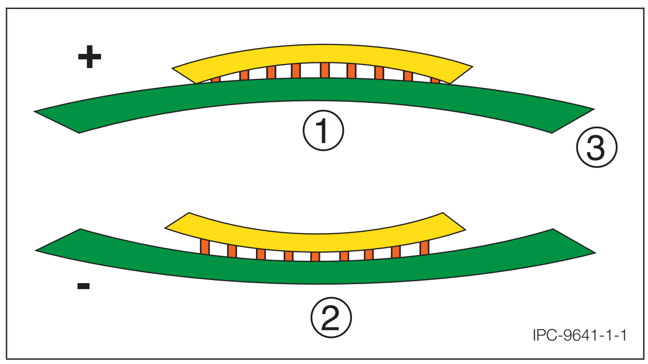

Figure 1-1 Printed Board Shape Convention with Example BGA Package
(Note: BGA package shape could be convex, flat, or concave regardless of printed board shape)
1. **Convex**
2. **Concave**
3. **Printed Board Shape**

1.3.5 Dynamic Warpage The full-field difference in flatness of a component (package, printed board, etc.) between initial ambient and reflow temperature, obtained by subtracting full-field initial ambient flatness from reflow-temperature flatness.

1.3.6 Full-Field Methods A general class of non-contact optical metrologies which measure topography and shape change over an entire (*x,y*) region or field of view during a single acquisition, rather than at a single point per acquisition.