Variable Pitch SMT Assembly: A Method for Enhancing Fatigue Life of Ceramic Column Grid
Technology #15549

Applications

This invention can be used in electronic assemblies for the automotive, military, aerospace, downhole oil and mineral prospecting, wireless communications, video games, and computer industries.

Problem Addressed

Repetitive thermal cycles, which are inevitable with many electronic applications, cause solder joints between large electronic components and printed circuit boards to fail due to strains in the joints that result from coefficient of thermal expansion (CTE) mismatch between the component body and the board. Though this is improved by use of conductive columns between the part and the board, which introduce compliance, there is a need to further increase fatigue life in certain critical applications.

Technology

This invention takes advantage of the facts that 1) interconnect columns are attached to lands on the bottom face of the part using standard eutectic solder; 2) that this solder melts at approximately the same temperature as the solder used to attach the part to the board; 3) that surface tension of liquid solder will center the ends of each column on the pads, top and bottom; and 4) that by tilting columns outward by a calculated amount in the highest strain regions of the part, fatigue life can be enhanced because compression/tension cycles are reduced by half compared to keeping those columns vertical at assembly.

To effect this, the printed circuit board is designed such that solder pads in the highest strain regions of the part, in particular the corner regions, are skewed outward from the rectilinear grid and radially from the center of the part. The board is then assembled using a conventional paste-place-reflow surface mount assembly process. When the assembly is heated to reflow (melt) the solder, the surface tension of the liquid solder causes the columns to realign themselves out of the rectilinear grid and onto the desired pattern.

The patent application describes one recommended approach to assembly that involves increasing pad thickness (by approximately 0.005”) in the central area of the device, while keeping the columns vertical in that region to provide stability during reflow; this provides clearance for columns in high stress regions to realign the desired tilted configuration.

Advantages

• This invention improves reliability of interconnects between large ceramic devices and printed circuit boards, particularly for large devices used in applications with large temperature swings
The approach uses standard commercial column grid array parts, vs. other solutions that require special column architectures and critical alignments. This design can be assembled using any conventional surface mount assembly process that is suitable for assembly of large ceramic column grid arrays.

Categories For This Invention:
Electronics & Circuits
Semiconductors & Integrated Circuits
Design & Fabrication
Lincoln Laboratory

Intellectual Property:
Grid arrays with enhanced fatigue life
US Patent Pending
2017-0013725
Grid arrays with enhanced fatigue life
Issued US Patent
9,491,859

Inventors:
Dmitry Tolpin
James Kelly
Roger Maurais

External Links:
Lincoln Laboratory
https://www.ll.mit.edu/

Image Gallery: