

## **Reliability of CSP Assemblies with Underfill Subjected to 4,000 Extreme Temperature Cycles**

Reza Ghaffarian, Ph.D.  
Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California  
818-354-2059, Reza.Ghaffarian@jpl.nasa.gov

### **ABSTRACT**

The MicrotypeBGA Consortium led by the Jet Propulsion Laboratory pooled its members' resources to develop the quality and reliability of chip scale packages for a variety of projects. In the process of building the consortium's chip scale package (CSP) test vehicles, many challenges were identified regarding various aspects of technology implementation. CSPs were assembled on single- and double-sided printed circuit board (PCB) with and without underfill. The test vehicles were subjected to various environmental tests including four thermal cycling considerations. These cycles represent the extreme harsh accelerated testing in the range of 55°C to +125°C to a commercial requirement in the range of 0°C to 100°C. Thermal cycling test results to 2,000 cycles performed under different environmental conditions for single- and double-sided assemblies with and without underfill were presented previously.

Majority of CSPs failed to 2,000 cycles, even a few with underfill. However, a few CSP configurations did not failed to 2,000 cycles in the range of - 30 to 100°C. These assemblies were further thermal cycled to establish their long-life failure behavior. A few robust assemblies did not failed to 3,000 cycles in this temperature regime. The failure were accelerated by increasing the temperature regime to much higher level, i.e., -55/125°C. Additional failures to 887 cycles in this temperature regime were observed. A few that remained intact were cycled in a significantly larger temperature swing representative of Mars environment (-120 to 115°C). Reliability test results to near 4,000 cycles with X-ray and optical inspection performed at various cycles are presented.