

Project Summary:

Physics of Failure Assessment and Test Results of Pb-Free Circuit Board

A major teledatacom manufacturer requested a physics of failure assessment of a new lead-free circuit board design. The review included virtual qualification, design for reliability assessment, accelerated testing, and construction analysis. Virtual qualification showed that SnAgCu had more than double the fatigue life of SnPb. Accelerated testing also showed no failures and construction analysis showed no significant voiding or other abnormalities of the solder joints. The design for reliability assessment showed that several capacitors were too close to the board edge or mounting points and should be moved. The SMT connectors should also have their gold plating thickness increased to 20 micro-inches. This product will easily meet its desired lifetime of 15 years.

Keywords: physics of failure, PoF, high-cycle fatigue, low-cycle fatigue, MTTF, mean time to failure, Weibull analysis, cross-sectioning, solder fillet angles, wetting, solder balls, shrinkage cracks, phase coarsening, failure mechanisms, intrinsic durability, design capture, life-cycle load characterization, load transmission, failure risk assessment, transport vibration, thermal cycling, solder fatigue life prediction, modal frequencies, strain range, fatigue coefficient, SAC, creep, fatigue exponent, Engelmaier, thermo-mechanical fatigue, ceramic capacitors, rotated, moved away from flexure points, low skew fan-out buffer, gold plating thickness, surface mount connectors, polymeric capacitors, aluminum organic capacitors, popcorning, degassing, latent defects, tin whiskers, nickel underplate, Norris-Landzberg, grain coarsening, micro-cracking, PBGA, voiding, PQFP, tin copper intermetallics, ceramic crystal oscillator