

Vibration Durability of Pb-free Soldered Assemblies
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Abstract

The vibration fatigue durability of eutectic Sn37Pb and near-eutectic Pb-free Sn3.9Ag0.6Cu solders is quantified, based on test data available from the literature [1]. The tests use random broad-band excitation (between 20Hz & 2000Hz), on selected SAC and SnPb surface mount interconnect styles. In the test, step-stress excitation was applied in the out-of-plane direction by increasing the RMS excitation levels sequentially from 10G_{rms} to 28G_{rms}, to fail most of the components on the board. The tests were conducted on five identical test vehicles for repeatability. Fatigue damage was quantified using a time-domain approach, reported in the literature [2]. The test results show SAC solder has lower fatigue durability than SnPb solder under the vibration excitation applied in this study. This result is consistent with mechanical cycling studies and repetitive mechanical shock studies, conducted earlier [3]. Power-law model constants for vibration fatigue are determined for both solders, by using least-squares fit to the test results. These fatigue models can be used to design Pb-free electronic assemblies for vibration environments.

References:

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3. Q Zhang, A Dasgupta, P Haswell, "Isothermal Mechanical Durability of Three Selected Pb-Free Solders: Sn3.9Ag0.6Cu, Sn3.5Ag and Sn0.7Cu", Transactions of the ASME, vol. 127, pp 512-522, 2005