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Solder Joints Reliability for Electronics Components in Thermal Cycling Tests

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Abstract: The reliability of solder joints in a Printed Circuit Board Assembly (PCBA) is a critical factor in determining the lifetime of the product as solder joints are one of the earliest parts to fail. Investigating solder joints, using both non-destructive and destructive tests, gives a good indication about solder joint reliability, overall product reliability and potential life of the product. As SnAgCu lead-free alloy has become more widely used for class 2 and 3 PCBAs due to the poisonous nature of lead, it is important to examine the microstructure to monitor for the propagation of cracks, voids and IMC growth.

For this study, PCBA samples were taken directly from the production line and then were examined in the reliability lab before sending for thermal cycling. Different soldering profiles were investigated to ensure both compliance with both the IPC-A-610 standard and the reliability requirements of the solder joints. The main focus of this study was about issues related to the production process such as problems with wave soldering and reflow profiles. Thermal fatigue is one of the main sources of solder joint failure; a thermal cycling test (100 Cycles from -20 C° to +85 C°, dwell time 30 minutes) was performed for a number of boards to verify the reliability of solder joints under the service conditions and compare it with the boards without thermal cycling.

Optical microscope images were used for the final examinations of the cross-sectioned surfaces. Common issues including voids, cracks, insufficient barrel fill, and defects in the solder alloy were identified; thermal fatigue was one of the main sources of the noted defects.

Overall, few solder joints had any defects noted in the IPC-A-610 standard; failures that occurred were found to mainly occur during the manufacturing process. Products will continue to be monitored with a Weibull analysis by performing severe thermal cycling to monitor the propagation of voids, cracks and IMC growth over.

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