

53rd IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE
ACTIVITIES (D5)

Quality and Safety, always a beginning! (1)

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WHISKERS RISK ASSESSMENT METHODOLOGY FOR LEAD-FREE INTERCONNECTION OF
COTS COMPONENT FOR SPACE MISSION

Abstract

Due to the low cost, high performance and advanced technology, the application of COTS (commercial off the shelf) components is growing obviously in aerospace industry, especially in the LEO and short term space missions, such as small satellites launched for scientific experiments. Considering the lead-free process of majority of COTS components, the risk of short circuit between the outlines of COTS components caused by tin whisker has to be evaluated carefully before the usage in space mission. When selecting lead-free COTS components for aerospace models and evaluating risks, it is necessary to analyze the temperature, size and other relevant factors of tin whisker growth. Based on these factors, the decision model becomes to an urgent need to be established to guide engineering practice in space mission. In this paper, the Sn-3Ag-0.5Cu soldered structure of lead-free COTS devices is studied in terms of the risk of tin whisker contact. For Sn-3Ag-0.5Cu, test samples are designed to carry out the growth test of tin whisker under various temperature conditions. Considering the diversity of growth forms of tin whiskers, a method of characterization of the length, angle and density of tin whiskers is proposed to evaluate the risk of contact. The growth length, angle and density of tin whisker observed in the experiment are calculated and the tin whisker growth model was established. Based on this effort, the methodology of tin whisker touch risk evaluation is carried out to analyze the potential risk with different space between pins, different time and temperature conditions. By measuring the length of tin whiskers at different test times, the data and fitting results are obtained. Consequently, the mathematic relationship between tin whisker short circuit risk, space between pins and time is formed. When Sn-3Ag-0.5Cu COTS components are selected for low orbit, short term and scientific exploration space missions, the space application risks of different package lead-free COTS component can be evaluated according to the results of this paper, as well as the environment control requirement of operating temperature.