Advanced HALST Testing and Modeling on BME Ceramic Capacitors

Description:

This study represents a proposed work to address reliability issues in BME ceramic capacitors using advanced highly accelerated life stress testing (HALST) and modeling. BMEs represent a commercial processing technology for making commercial ceramic capacitors with extremely high capacitance per volume. NASA has already used BME products for some of its non-critical applications. However, there are also some concerns over the long-term reliability of BME capacitors with high capacitance and with very small dielectric thickness.

The first goal of this study is test BME capacitors from three suppliers under HALST conditions. By testing on single standardized equipment set, a more accurate comparison can be made between suppliers, and underlying performance trends can be better characterized. The second goal is to develop a more accurate HALST predictive life model that can become a practical guideline for advanced MLCCs placed in near-future high-reliability NASA applications and in high-demanding industrial conditions. The third goal is to develop a BME capacitor part selection list for NASA Parts Engineers.

Furthermore, failure analysis (FA) of selected test samples will provide evidence about the failure mechanism and also a better understanding of the reliability concerns.

FY13 Plans:

- BME capacitors with chip size 0805 and capacitances of ~0.01 μF to ~1 μF, from three (3) different suppliers, will be used for this study. All of the test capacitors will be purchased directly from distributors with an "Automotive" grading, i.e., the units were 100% tested and meet AEC-Q200 standard.
- Each part number will be tested under highly accelerated life stress conditions for both applied voltage and temperature.
- The leakage current as a function of time will be monitored for each sample being tested.
- The results will be used to modify the existing model for predicting the reliability of BME capacitors, including the verification of reverse power law relationship, and the existence of dual failure modes.
- A selection of failed capacitors will be subjected to failure analysis to better understand the failure mechanism in these capacitors.

Schedule

BME Caramic Caps	2012			2013								
Activities/Reports	O	N	D	J	F	M	A	M	J	J	A	S
Propoed HALST System Extension												
Capacitor Collection and Board Assembly												
HALST Testing												
Data Review and Modeling												
Results Analysis and Report												
Quarterly Status Report			X			X			X			X

Lead Center/PI: GSFC, David (Donhang) Liu

Deliverables:

Engineering guidelines and drawings to be used as specifications for NASA procurement of BME capacitors for high-reliability applications.

Technical papers (both refereed journal and conference) and reports regarding the performance and reliability BME capacitors

Possible reliability model that can become a practical standard for advanced MLCCs placed in demanding conditions.

NASA and Non-NASA Organizations/Procurements:

All electrical testing will be performed at Code 562 Electrical Testing Laboratory. Assistance on part assembly will be provided by the GSFC Assembly Laboratory (Sherry Warner).