National Aeronautics and Space Administration

EEE Parts Bulletin

Electrical, Electronic, and Electromechanical

A periodic newsletter of the JPL/OSMS Assurance Technology Program Office (ATPO), NASA EEE Parts Assurance Group (NEPAG), and Section 514, of the Jet Propulsion Laboratory.

June/July 2010 • Volume 2 • Issue 4

A Look at Failure: Electrical Overstress

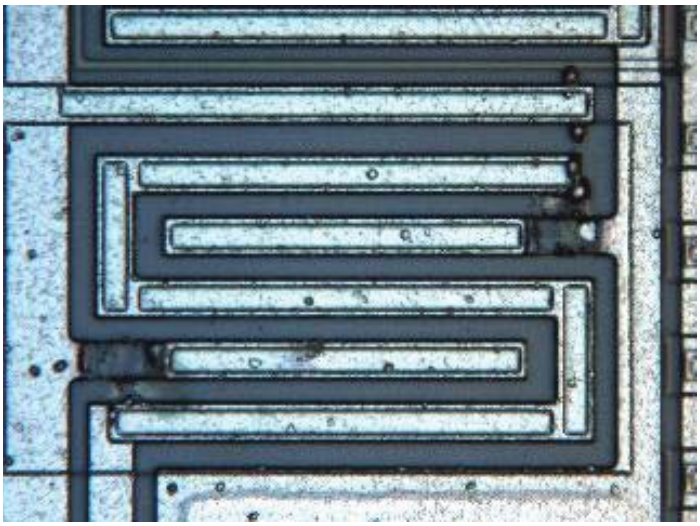

Photo Emission Microscope reveals damaged metallization. [Credit: JPL Failure Analysis Lab.]

GIDEP Alerts/Advisories

Contact your GIDEP Representative for a copy of:

Suspect Counterfeit	**M3-A-10-01** Suspect Counterfeit, Electronic Components; **HQ6-P-10-01** Suspect Counterfeit, Teledyne Electromechanical Relays **E5Z-P-10-01** Suspect Counterfeit, Microcircuit, High Speed Buffer **AHA-A-10-03** Suspect Counterfeit Electronic Components
Misc.	**E4-A-10-02** 60V N-Channel Power MOSFET **WV9-P-10-01** Plating Anomaly on US (Square End Cap) Devices of Silfos Construction and Quality Levels JAN through JANTXV **GB4-P-10-01** Microcircuit, Memory, Digital, CMOS, 512K x 32-Bit, Radiation Hardened SRAM, Multichip Module **RS2-P-10-02B** Omission of BV Verification Test at Steps 11 and 13 of MIL-PRF-19500, Table E-IV **UV5-P-10-01** Microcircuit, Digital, CMOS, UV Erasable Programmable Logic Array, Monolithic Silicon **SC7-P-10-02** Actel New Guidelines for RTAX-S/SL Devices at Power Down **FV5-P-09-01B** Linear Mode Application, Power MOSFET

Space Parts Working Group Meeting

Close to 300 people attended the May SPWG meeting in Torrance, CA. SPWG is a joint government-industry working group sponsored by The Aerospace Corporation and the Air Force Space and Missile Systems Center.

Panels and presentations included the challenges of using heritage hardware, the standardization program for SMDs and slash sheets, and supplier updates. Contact Larry Harzstark at 310-336-5883.

Ceramic Capacitor Aging Effects

Ceramic capacitors exhibit aging, that is a decrease in capacitance logarithmically over time usually specified as a certain percent per hour decade.

High dielectric constant (BaTiO3) ceramic capacitors, military type BX, BR, BQ and industrial type X7R used in the space industry exhibit anywhere from 1.5 to 4% drop in capacitance per hour decade, while types BP and BG are considered stable with no aging characteristic (although it may be approximately 0.05% per hour decade).

There are no requirements in any military standard or capacitor specification to measure or specify aging. Consequently, a user should expect an unspecified drop in capacitance value over time.

The aging process is a function of dielectric formulation that can vary among manufacturers. It could even vary among the different part types within a given manufacturer's production line. The aging process can be reset, de-aged, when a part's temperature exceeds the ceramic Curie point, which is about 125 °C.

Manufacturers try to reduce the chance parts are out of tolerance as a result of aging upon receipt by the customer. They do this by monitoring the time since the last heat, that is, when the part last saw a temperature above the Curie point and adjusting their initial capacitance tolerance to compensate for aging effects.

Because capacitance changes rapidly, the basic capacitance measurements normally refer to a time period following the de-aging process. Manufacturers use different time bases, but the most popular one is twenty-four hours after cooling through their Curie temperature.

This aging phenomenon is a basic characteristic of high dielectric constant type (BaTiO3) ceramic capacitors, and the degree of capacitance change from aging varies depending on the type of ceramic material used. Also, the degree of capacitance aging varies depending on the level of DC bias voltage applied on an actual circuit.

Therefore, when using high dielectric constant ceramic capacitors, type BX, BR, BQ and X7R, change in capacitance due to aging should be taken into consideration, especially when the stability of capacitance is important, it should be verified on the actual circuit.

Soldering is the most common way to de-age a capacitor since temperatures exceed 183 °C. Surface mount chip capacitors are particularly sensitive to this phenomenon.

Ceramic Capacitor Voltage-Temp. Effects

The combination of applied voltage and temperature can cause a significant capacitance drop in military ceramic types BX, BR, BQ and industrial type X7R. For example the combined effects of rated voltage and -55 °C can produce a drop in capacitance of 25% for BX, 40% for BR and 50% for BQ. Voltage-temperature limits are specified and controlled for military parts.

Capacitors produced with ceramic type X7R, a common ceramic designation often used as an alternate to BX, only specify a temperature coefficient. Manufacturers can use this high dielectric constant to get more capacitance in a given size. The increased dielectric constant will produce an even greater voltage coefficient effect that will be much more than the temperature effect.

Voltage-temperature limits for type X7R are not controlled by military specification and vary from manufacturer to manufacturer even for seemingly identical parts. The change in capacitance for type X7R with rated voltage and temperature can be greater than 50%. To mitigate these effects, use a more stable ceramic type such as BX or BP. To eliminate them with a ceramic part, use military type BP, BG or industrial type NPO or COG. Contact Mike Sampson at 301-614-6233.

Upcoming Meetings

- JEDEC / G11 / G12 Meeting Oct. 4-7, 2010, Columbus, OH http://www.jedec.org/events-meetings
- ReSpace / MAPLD 2010 Conference, Nov. 1-4, 2010 Albuquerque, NM http://www.cosmiac.org/ReSpace2010

NASA parts specialists recently supported DSCC Audits of:

AVX Olean Advanced Products, Vishay Thin Film, Kyocera America, DDC Corporation, Natel Engineering Co., Solitron Devices, Inc. and Honeywell Aerospace.

Task Group Update: G-12 TG10-01 Class Y for MIL-PRF-38535

Eighty people from manufacturers, NASA centers, and contractors attended May's JEDEC meeting of this task group developing requirements for non-hermetic devices for space (e.g. Virtex-4 FPGA).

MIL-PRF-38535 Appendix B, marked up for Class Y, has been distributed for comments. If you wish to receive email surveys and updates, please contact Shri Agarwal at 818-354-5598.

Contacts

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