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FROM: NIC Technical Product Marketing Group

RE: Life expectancy of aluminum electrolytic capacitors (rev.1).

The following is provided in hopes of eliminating confusion or concern with regards to the operational life expectancy of aluminum electrolytic capacitors.

This information applies to all liquid based electrolyte aluminum electrolytic capacitors, both leaded and surface mount styles.

- The life expectancy of aluminum electrolytic capacitors is typically specified in thousands of hours (ie..1000, 2000, 4000, 5000, ..etc) at the maximum rated temperature (ie..+85°C, +105°C, +125°C...etc.).
- These life expectancies are conservative, and reflect an expected time period where the electrical characteristics of the component will still be within the following industry standard limits...
 - ✓ Capacitance change will be within $\pm 25\%$ of initial measured value or
 - ✓ Dissipation Factor will not exceed 200% of specification value or
 - ✓ Leakage Current will not exceed the specification value.
- The aluminum electrolytic capacitor industry uses these limits as gauge to the life expectancy of a component. It's important to note that at this point in the life of the capacitor it still behaves as a capacitor... it still does it's job, although not as efficiently as a new, unused component.
- The life expectancy estimations are mainly governed by the rate of electrolyte dissipation, which is effected chiefly by the temperature of operation. When operating at temperatures below the maximum rated temperature, the life expectancy of the component will double for every ten degrees Celsius lower than the rated temperature. This is supported by extended life test results.

For example: 1000 hours at +105°C

A 1000 hours at +105°C rated part will be within load life testing limits after:

- ~ 1000 hours @ +105°C
- ~ 2000 hours @ +95°C
- ~ 4000 hours @ +85°C
- ~ 8000 hours @ +75°C
- ~ 16,000 hours @ +65°C
- ~ 32,000 hours @ +55°C
- ~ 64,000 hours (about 7.3 years continuous operation) @ +45°C
- ~ 128,000 hours (about 14.6 years continuous operation) @ +35°C.

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Aluminum electrolytic capacitor life expectancy continued.

- Attached is life de-rating over temperature curves (page 3) for estimating operational life expectancy when operating at lower than maximum rated temperature.

These figures are very conservative with most components typically exceeding 2 ~ 4 times these figures. In most applications (operation @ <55°C) the capacitor will never wear out.

- Any initial circuit failures due to construction or material defects are eliminated during the production *reforming – aging* operation. During this operation the forming voltage is applied to every part (100%) in order to:
 - ✓ repair any damaged done to the dielectric film during the capacitor assembly operation.
 - ✓ to confirm the withstand voltage.
 - ✓ screen for defective products.
 - ✓ stabilize the electrical characteristics.

Reliability Prediction:

The value of reliability prediction is impacted by the unique conditions associated with each application and usage. Reliability predictions for aluminum electrolytic capacitors can be calculated using section 10.14 of military handbook MIL-HDBK-217F. Failure rate will be effected by temperature rating, operating temperature, voltage stress, capacitance value and environmental factors.

Example: +105°C rated, 330uF, 25VDC component used at +70°C at 12VDC used in benign environment:

Base failure rate = 0.12

Capacitor factor = 0.97

Quality factor = 10

Environmental factor = 1.0

Failure rate prediction = $(0.12) \cdot (0.97) \cdot (10) \cdot (1) = 1.164 \text{ failures/1,000,000 hours}$

If you have any questions, or need any further information, please do not hesitate to contact NIC's Technical Product Marketing Group at phone 516/396-7500, fax. 516/396-7575 or e-mail: info@niccomp.com

ALUMINUM ELECTROLYTIC CAPACITOR LIFE TEST DERATING (OPERATIONAL LIFE EXPECTANCY)

