September 5, 2001
RUBYCON CORPORATION
ENGINEERING DIVISION

TO: ACBEL POLYTECH INC.

LIFETME CALCULATION FORMULA OF ALUMINUM ELECTROLYTIC CAPACITORS

1. Lifetime Calculation Formula

$$L = Lb \cdot 2^{\left(\frac{Tmax - Ta}{10}\right)} \cdot 2^{\left(\frac{\Delta Tjo}{10 - 0.25 \times \Delta Tjo} - \frac{\Delta Tj}{10 - 0.25 \times \Delta Tj}\right)}$$

L : Life expectancy at the time of actual use.
Lb : Basic life at maximum operating temperature
Tmax : Maximum operating temperature
Ta : Actual ambient temperature
⊿Tjo : Internal temperature rise when maximum rated ripple current is applied.
USR, USC, USG : 10 °C
VXP : 3.5 °C
Other type : 5 °C
⊿Tj : Internal temperature rise when actual ripple current is applied.

$$\Delta Tj = \Delta Tj0 \times \left(\frac{I/F}{I_0}\right)^2$$

F : Frequency coefficient
Io : Rated ripple current at maximum operating temperature
I : Actual ripple current

2. Ambient Temperature Calculation Formula

If measuring ambient temperature (Ta) is difficult, Ta can be calculated from surface temperature of the capacitor as follows.

$$Ta = Tc - \frac{\Delta Tj}{\alpha}$$

Ta : Calculated ambient Temperature
Tc : Surface Temperature of capacitor
α : Ratio of case top and core of capacitor element

CaseϕD	≤8	10,12.5	16, 18	20, 22	25	30	35
α	1.0	1.1	1.2	1.3	1.4	1.5	1.6

3. **Ripple Current Multiplier**

(1) Temperature coefficient

Temperature coefficients are shown as below.

USR, USC, USG:

Ambient Temp.(°C)	85	≤ 65
Coefficient	1.0	1.3

Other 85°C type:

Ambient Temp.(°C)	85	70	≤ 50
Coefficient	1.0	1.6	2.0

105°C type:

Ambient Temp.(°C)	105	85	≤ 65
Coefficient	1.0	1.7	2.1

Note: Where the temperature coefficient is used, life extension cannot be expected any more because the temperature coefficient is set up on condition of the same life time at maximum operating temperature.

(2) Frequency Coefficient

Frequency coefficients for each series are shown in the catalogue or specifications.

Should you have any questions, please don't hesitate to ask us.

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