Life Of Aluminum Electrolytic Capacitor

The life of aluminum electrolytic capacitors is mainly dependent on environmental conditions (e.g. ambient temperature, humidity etc.) and electrical factors (e.g. operating temperature, ripple current etc.). Generally, the wear-out mechanism of aluminum electrolytic capacitors is based on evaporation of electrolyte through the rubber seal. Consequently, the factor of temperature (ambient temperature and internal heating due to ripple current) is the most critical to electrolytic capacitors life. The effect of voltage on capacitor life is negligible, especially for low voltage electrolytic capacitors. The lifetime of aluminum electrolytic capacitors can be expressed as following equations:

$L_e = L_o \bullet K_t \bullet K_r$

Where:

L_e = Expected life at operating temperature T_e (h)

L_o = Specified life at temperature operating temperature T_o (h)

K_t = Ambient temperature acceleration term

K_r = Ripple current acceleration term

$K_t = L_o \bullet A^{(T_o - T_e)/10}$

Where:

T_o = Maximum rated operating temperature (°C)

T_e = Actual ambient temperature (°C)

A = Acceleration coefficient (for the range from 35°C to the maximum operating temperature, A≈2)

$K_r = 2^{(-\Delta T/5)}$

Where:

ΔT = An increase in core temperature by internal heating due to ripple current (ΔT = core temperature – ambient temperature)

ΔT can be estimated as follows:

Where: $\Delta T = (I^2 \bullet R)/(\beta \bullet S)$

I = Ripple current of the capacitor (A rms)

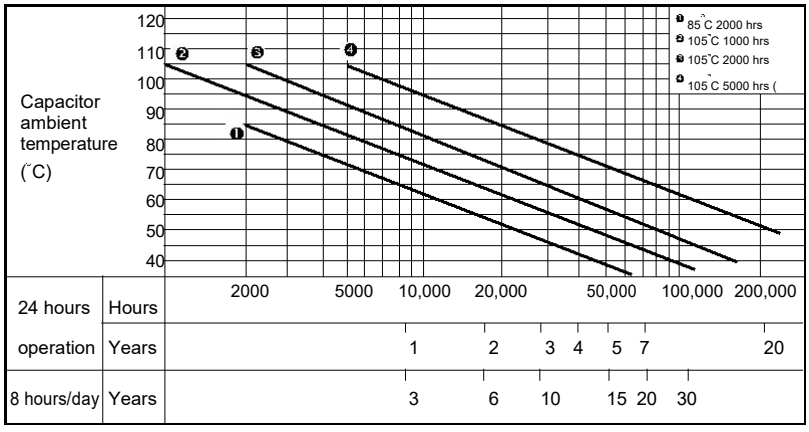
R = Equivalent series resistance of the capacitor (Ω)

β = Heat radiation coefficient of the aluminum can ($W/°C \bullet cm^2$)

S = Surface area of the capacitor (cm^2)

In neglecting ripple current effect, the expected life of the capacitors at lower temperature is shown in the following chart.

■ Quick Reference Guide of the Expected Life



Example: When a 2000 hours/105°C guaranteed product is used continuously at 60°C, it can be expected to have a life of 5 years.

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