ALUMINUM ELECTROLYTIC CAPACITORS

■ TECHNICAL NOTE

Where L_0: Life at the maximum guaranteed temperature with the rated ripple current (h)
$\triangle T_0$: Temperature increase at capacitor core, at the maximum guaranteed temperature (deg.)
(3) The life equation considering the ambient temperature and the ripple current will be a conversion of the above equation (5), as below:

$$L=L_0 \times 2^{\left(\frac{T_0-T}{10}\right)} \times K^{\left[1-\left(\frac{I}{I_0}\right)^2\right] \times \frac{\triangle T_0}{10}} \quad \text{---------(6)}$$

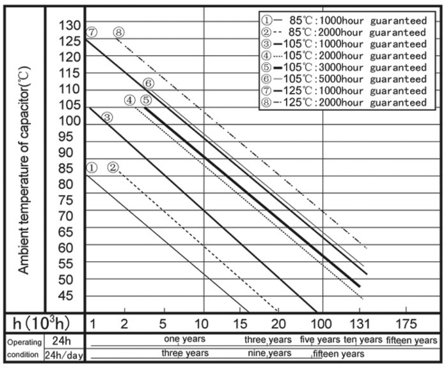
Where in I_0: Rated ripple current at the maximum guaranteed temperature (Arms)
I: Applied ripple current (Arms)
Since it is actually difficult to measure the temperature increase at the capacitor core, the following table is provided for conversion from the surface temperature increase to the core temperature increase.

Table 2-1

Case diameter	~10	12.5~16	18	22	25	30	35
Core/Surface	1.1	1.2	1.25	1.3	1.4	1.6	1.65

The life expectancy formula shall in principle be applied to the temperature range between the ambient temperature of +40℃ and maximum allowable working temperature. The expected life time shall be about fifteen years at maximum as a guide in terms of deterioration of the sealant.

(Fig 2-1Life Expectancy Chart)



3 To calculate Balance when connecting in series

3-1 Circuit layout
Circuit for connecting two capacitors (C_1, C_2) in series and equivalent circuit can be illustrated as below figure. Formula to calculate a balance resistance R_B of below figure is shown as follows.

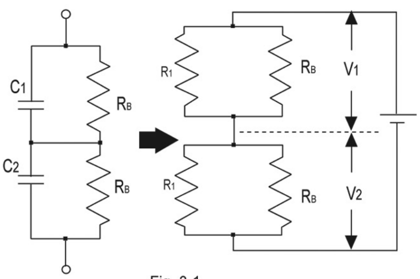


Fig. 3-1

Following are the preconditions of the circuit.
① V_2 shall be the rated voltage (=V_0).
② V shall be a times V_0x2, V=2aV_0 (a<1)
③ R_2 shall equal R_1xb (b>1) (1)

3-2 Formulas to calculate [RB]
3-2-1 Following formula can be established from balanced condition

■ TECHNICAL NOTE

$$V_1 \left[\frac{I}{R_1}+\frac{I}{R_B}\right]=V_2 \left[\frac{I}{R_2}+\frac{I}{R_B}\right] \quad (2)$$

3-2-2 Following formula can be established from preconditions.

$V_2 \leqslant V_0$ (3)
$V_1=V-V_2$ (4)
$=2aV_0-V_2$ (4')
3-2-3 Put formulas (1,), (3) and (4') in formula (2).

$$(2aV_0-V_2)\left[\frac{R_1+R_B}{R_1 \cdot R_B}\right]=V_2\left[\frac{bR_1+R_B}{bR_1 \cdot R_B}\right]$$

$2abV_0(R_1+R_B)=V2\{b(R_1+R_B)+bR_1+R_B\}$
$2ab(R_1+R_B) \leqslant 2b R_1+(1+b) R_B$
Accordingly, balance resistance Rs shall be the following formula.

$$R_B \leqslant 2b R_1 \frac{(1-a)}{(2a-1) \cdot b-1}$$

3-3 Calculation Example
Calculation the value of the balance resistance in the case of connecting two 400V 470μF (LC standard value: 1.88mA) capacitors in series.

$$R_1=\frac{400(V)}{1.88(mA)}=2.13(K\Omega)$$

If a=0.8, 400(V) x2x0.8=640(V) as an impressed voltage.
If b=2, R_2=b R_1=426(KΩ), LC=0.94(mA).
Balance resistance R_B will be:

$$R_B \leqslant 2x2x213(K\Omega)\frac{1-0.8}{(2x0.8-1)x2-1}=852(K\Omega)$$

4 Regarding Recovery Voltage

After charging and then discharging the aluminum electrolytic capacitor, and further causing short-circuit to the terminals and leave them alone, the voltage between the two terminals will rise again after some interval. Voltage caused in such case is called recovery voltage. Following is the process that causes this phenomenon:
. When the voltage is impressed on a dielectric, electrical transformation will be caused inside the dielectric due to dielectric action, and electrification will occur in positive-negative opposite to the voltage impressed on the surface of the dielectric. This phenomenon is called polarization action.
. After the voltage is impressed with this polarization action, and if the terminals are discharged till the terminal voltage reaches 0 and are left open for a while, an electric potential will arise between the two terminals and thus causes recovery voltage.
. Recovery voltage comes to a peak around 10 to 20 days after the two terminals are left open, and then gradually declines. Recovery voltage has a tendency to become bigger as the component (stand-alone base type) becomes bigger.
. If the two terminals are short-circuit after the recovery voltage as generated, a spark may scare the workers working in the assembly line, and may put low-voltage driven components (CPU, memory, etc) in danger of being destroyed. Measures to prevent this is to discharge the accumulated electric charge with resistor of about 100 to 1KΩ before using,or ship out by making the terminals in short-circuit condition by covering them with an aluminum foil at the production stage. Please consult us for adequate procedures.