Life Estimate

Life Formula

$$L_r = L_0 \times 2^{\frac{T_{0\max} - T_{r\max}}{10}} = L_0 \times 2^{\frac{T_0 + \Delta T_0 - T_r - \Delta T_r}{10}}$$

Arrhenius Equation

$$= L_0 \times 2^{\frac{T_0 - T_r}{10}} \times 2^{\frac{\Delta T_0 - \Delta T_r}{10}}$$

Ambient temperature influence factors

Ripple Current influence factors

L_r	Estimated lifetime (Hrs)
L_0	Base lifetime specified at maximum operating temperature with applied the DC voltage and the ripple current(Hrs)
T_0	Rated maximum operating temperature(℃)
T_r	Actual ambient temperature(℃)
ΔT_o	Maximum allowable temperature rise at T_0(℃)
ΔT_r	An increase in core temperature produced by internal heating due to applied ripple current(℃)

Life Formula

The Max. allowable temperature rise at different ambient temperature:

T_r Actual ambient temperature	40	60(55)	70	85	105~130
ΔT_0 Max. Allowable Temperature rise	30	20	15	10	5

Element core temperature rise estimate formula when applied ripple current

$$\Delta Tr = (Tc - Tr) / K$$

ΔT_r	Element core temperature rise when applied ripple current
T_c	Actual capacitor wall temperature
T_r	Actual ambient temperature
K	Temperature coefficient

Temperature coefficient:

ϕ (mm)	<5	6.3	8	10	12.5	16	18	20	22	25	30	35
K	1.0	1.0	0.94	0.90	0.85	0.80	0.77	0.75	0.74	0.71	0.67	0.64

Element Core Temperature Rise Test Method

Fix a thermocouple wire on the capacitor (shown as the following picture 1), then put the capacitor in the actual ambient temperature, apply the rated voltage and ripple current to the capacitor, after 1H, the temperature become stable, take the actual ambient temperature Tr and the actual capacitor wall temperature Tc.

Picture 1

Life Estimate

Remark:

1. When the actual ambient temperature (Tr) is less than 40 ℃, and estimate the lifetime, we will take Tr for 40 ℃.

2. For the SMD Type capacitor, when estimate the lifetime, the maximum allowable temperature rise ΔT0 is 0 ℃.

Example:

The base lifetime of VES 100uF/16V 6.3*5.3 L0 is 1000Hrs， the Maximum operating temperature T0 is 105 ℃, the rated ripple current is 70mA@120Hz. Put this capacitor in the actual ambient temperature of 40℃, apply rated voltage and rated ripple current, the actual temperature rise ΔTr is 3.5 ℃. The life Of VES 100uF/16V 6.3*5.3 is estimated as below:

$$Lr = L_0 * 2^{(T0-Tr)/10} * 2^{(\Delta T0-\Delta Tr)/10}$$
$$= 1000 * 2^{(105-40)/10} * 2^{(0-3.5)/10}$$
$$= 71012Hrs$$