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技术中心 制定

Signature:

Life Estimation Formula for the Capacitors

SUIT TYPE : Chip and other type, general use capacitors

适用范围: 贴片型, 一般品, 及其他系列

$$L_x = L_o \times 2^{(T_o - T_x)/10} \times 2^{(\Delta T_o - \Delta T_x)/5}$$

SUIT TYPE : SNAP-IN

适用范围: 牛角型

$$L_x = L_o \times 2^{(T_o - T_x)/10} \times 2^{(\Delta T_o - \Delta T_x)/5} \times (V_o/V_x)^{4.4}$$

L_x = Expected life time (hours) of the capacitor

计算公式得出的寿命值

L_o = Rated life time (hours) of the capacitor

保证寿命值

T_o = Rated operating temperature (°C)

最高额定工作温度 (85°C, 105°C, 125°C, 130°C)

T_x = Actual ambient temperature of the capacitor within device

(this is not the environment temperature of the device, but the environment temperature of the capacitor that has been placed within the device, details as note 2)

实际环境温度, 即装置内的电容器实际环境温度 (非装置的环境温度, 而是装置内电容器的温度, 详见备注2)

ΔT_o = Rise in core temperature of the capacitor due to rated ripple current.

允许中心温升, 即纹波电流升到额定值时测得的电容器芯子温升。

Type	Radial	Snap-in	Low ESR
85°C	10	10	/
105°C	5	5	5
105°C (RG系列)	/	/	3
125°C	5	/	/
130°C	5	/	/

ΔT_x = Actual rise in the core temperature of the capacitor due to actual ripple current at device operating conditions.

实际中心温升, 即在整机工作条件下, 施加纹波电流而引起的电容器芯子温升。

To calculate the ΔT_x from the surface temperature of the capacitor, refer to the formula below.

已知电容表面温度 T_s 时, 请用下面的公式计算 ΔT_x

When " T_s " and " T_x " is known, refer to the table below

即: 当已知 " T_s " 和 " T_x " 时可用下面公式计算出 ΔT_x

$$\Delta T_x = (T_s - T_x) \times K_c$$

Where: T_s = Surface temperature of the aluminum case

铝壳的表面温度

Tx = Actual ambient temperature of the capacitor

电容器的实际环境温度

Kc = The ratio of ΔT_x to $(T_s - T_x)$, refer to the table below

ΔT_x 与 $(T_s - T_x)$ 的比值，请参考下表

ΦD (mm)	$\Phi 5 - \Phi 8$	$\Phi 10$	$\Phi 12.5$	$\Phi 16$	$\Phi 18$	$\Phi 22$	$\Phi 25$	$\Phi 30$	$\Phi 35$	$\Phi 40$
Kc	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.50	1.65	1.75

To calculate the ΔT_x from the actual rms ripple of the capacitor, refer to the table below.

已知实际纹波电流Ix时，请用下面的公式计算出 ΔT_x

When "Ix" is known, use the following equation to estimate ΔT_x

即:当已知实际纹波电流"Ix"时， ΔT_x 可用下面计算公式

$$\Delta T_x = \Delta T_o \times (I_x / I_o)^2$$

Where: **I_o** = rated rms ripple

额定纹波电流

I_x = Actual rms ripple

实际纹波电流

The actual and rated rms ripple current shall be equaled in frequency by using frequency multipliers prescribed for each product series in the catalog.

实际纹波电流和额定纹波电流需用产品目录提供的频率系数转换成相同频率。

Guide Limits of Maximum ΔT_x

中心温升 ΔT_x 最大极限值

125°C & 130°C max. capacitors

Capacitor ambient temperature	电容器环境温度	105°C以下	115°C	125°C
Guide limit of max. ΔT_x	中心温升 ΔT_x 最大极限值	15°C	10°C	5°C
Temperature coefficient (Actual rms ripple / Rated rms max. ripple)	温度系数(实际纹波值/额定最大纹波值)	1.73	1.41	1.00

105°C max. capacitors

Capacitor ambient temperature	电容器环境温度	85°C以下	95°C	105°C
Guide limit of max. ΔT_x	中心温升 ΔT_x 最大极限值	15°C	10°C	5°C
Temperature coefficient (Actual rms ripple / Rated rms max. ripple)	温度系数(实际纹波值/额定最大纹波值)	1.73	1.41	1.00

105°C (RG series) max. capacitors

Capacitor ambient temperature	电容器环境温度	85°C以下	95°C	105°C
Guide limit of max. ΔT_x	中心温升 ΔT_x 最大极限值	13°C	8°C	3°C
Temperature coefficient (Actual rms ripple / Rated rms max. ripple)	温度系数(实际纹波值/额定最大纹波值)	1.73	1.41	1.00

85°C max. capacitors

Capacitor ambient temperature	电容器环境温度	65°C以下	75°C	85°C
Guide limit of max. ΔT_x	中心温升 ΔT_x 最大极限值	20°C	15°C	10°C
Temperature coefficient (Actual rms ripple / Rated rms max. ripple)	温度系数(实际纹波值/额定最大纹波值)	1.41	1.22	1.00

NOTE: Temperature coefficient can not used in Life formula but reference only.

注：温度系数不使用在寿命计算公式中。

$$(V_o / V_x)^{4.4}$$

V_o: Rated Voltage (V)

V_o: 额定电压

V_x: Actual Input Voltage (V)

Vx:实际输入电压

NOTE: If $V_o=400$ and $V_x=300$, V_o/V_x should not be $400/300$, but be $400/340$ ($V_x=400 \times 85\%$)

注意: 假如 $V_o:400$ $V_x:300$, 则 V_o/V_x 不能用 $400/300$ 计算, 必须使用 $400/340(V_x=400 \times 85\%)$

Note:

备注:

for the expected life time(L_x),the maximum lifetime is 15years .

L_x 的最大寿命值为15年。

when the ambient temperature T_x less than 40°C and calculation with 40°C

环境温度 T_x 不足 40°C 时,以 40°C 为计算基准

1. The actual and rated rms ripple current shall be equaled in frequency by using frequency multipliers prescribed for each product series in the catalog.

实际纹波电流与最大额定纹波电流对照使用产品目录中每一系列的频率系数转换成相同频率.

2. How to measure the temperatures of the T_x and T_s

怎样测得 T_x 和 T_s 的温度。

Measuring the actual ambient temperature (T_x) and surface temperature(T_s)shall follow the following ways respectively

分别使用以下方法测量实际环境温度 T_x 和表面温度 T_s 。

T_x (actual ambient temperature of capacitor)

The T_x should be measured at the place 20-30mm away from the surface of the aluminum case ,at least10mm if the space less than 20mm, and any part adjacent to the capacitor produces heat and causes the temperature(T_x) to be inconstant with places around the capacitor,more than 4 places around the capacitor are preferable to be measured for temperature and then the average value of the temperatures shall be used as the temperature(T_x)

测量 T_x 时, 热电偶需放置在离铝壳表面20-30毫米的地方, 如果空间小于20毫米, 则测量距离保持最小10毫米, 如果有靠近热量或使得电容器上的部件产生电容器的温度不稳定, 使用模拟电容进行测试。需选择4个以上不同的地方进行测量, 再取平均值。

T_s (surface temperature of capacitor aluminum case)

The T_s shall be measured on the surface to the capacitor body,at the half-height of the body(aluminous part),if any part adjacent to the capacitor produces heat and causes the temperature(T_s) to be inconstant with places around the capacitor, more than 4 places around the capacitor are preferable to be measured for temperature and then the average value of the temperatures shall be used as the temperature(T_s)

测量 T_s 时, 测量电容器的表面温度, 需在电容器侧面的中间位置(铝质部分)进行, 如果靠近电容器的部件产生热量并导致电容器表面温度不稳定, 需要测量电容器表面4个点的温度, 再取平均值, 即: 电容器表面温度 (T_s)。