

# The application situation and life of electrolytic capacitors

Among various kinds of capacitors, but the aluminum electrolytic capacitor life problems. Usually of aluminium electrolytic capacitor life throughout the evaluation is based on the electric capacity drops below 80% of the rated (initial value), the electric capacity first is the direct cause of aluminum electrolytic capacitor electrodes of the actual area is reduced. Among them, the anode area in use process is not likely to reduce, reduce is the cathode. Cathode by the electrolyte is the actual size of the warranty, if the electrolyte due to volatile reduce will cause actual area of the cathode. So you can think because the end of the service life of aluminum electrolytic capacitor electrolyte waving hair, then what are the reasons cause the volatilization of the electrolyte? The main reason is the high temperature environment or heat. High temperature environment is better understanding; Make aluminum electrolytic capacitor hot aluminum electrolytic capacitor in the work is the cause of the rectifier filter (including the output of high frequency switch power supply rectifier filter) at the time of the ripple, or pulse electric current flows through the aluminum electrolytic capacitor, the loss and go into heat generated in the aluminum electrolytic capacitor ESR make it hot.

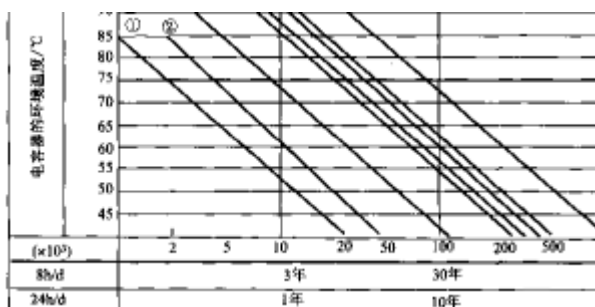
## The rated temperature

Rated temperature of the aluminum electrolytic capacitor is the allowed to work and store the highest temperature of aluminum electrolytic capacitors.

## Environment temperature and the life of the relationship

Aluminum electrolytic capacitor of the actual working environment is not necessarily at the highest temperatures, most probably at lower than the highest temperature storage or work. When the actual life of aluminum electrolytic capacitors is how many? Can be obtained by calculation. Such as the literature [26] the recommended calculation method is:

Does not contain ripple current working status of aluminum electrolytic capacitor calculation formula is calculated. Its life calculation formula for  $L = L_{0.5} \cdot XZC^{0.1}$



The life of the electrolytic capacitor with temperature diagram a-1

L and L is the life of the actual environment temperature butyl respectively and rated the most high temperature T. At the time of life. Compared with temperature, step-down use little impact on the life of the capacitor, negligible. As you can see, the drop in temperature 10 ° C, the service life of aluminum electrolytic capacitor, doubled the so-called law of 10 ° C. Therefore, whether used or stored, aluminum electrolytic capacitor shall be under the environment of low temperature as far as possible, for example, 85 ° C / 1000 h of aluminum electrolytic capacitor in 45 ° C actual life is 16000 h, or 10 months to 1 year; 29 ° C for 48000 h, or for 5 years and 6 months; The 1000 h (for 42 days). As you can see, the importance of lowering the temperature to extend the service life of aluminum electrolytic capacitor.

The relationship between life and temperature aluminum electrolytic capacitors as shown in figure 1 a. Given in figure 8 kinds of rated temperature, and the life of the relationship between the service life of aluminum electrolytic capacitor and temperature curve. Can also be seen from the figure, along with the temperature drop, all kinds of hours rated temperature and lifespan of extend the service life of aluminum electrolytic capacitor.

The above calculation method applies only to storage state and no ripple current (small ripple current) working condition (such as condenser, small signal circuit of bypass capacitors). For obvious contains ripple current working conditions, should press surface method is calculated.

#### Conditions of use and aluminum electrolytic capacitor life relationship

In many applications of chinalco will flow ripple current, electrolytic capacitor with ripple current working status of aluminum electrolytic capacitor calculation can be obtained by formula calculation, also can through the relationship between life and temperature, ripple current curve is obtained.

When considering the ripple current life, aluminum electrolytic capacitor ESR significantly greater than other types of capacitor, therefore, aluminum electrolytic capacitor when the flow ripple will be produced in the ESR obvious loss caused by fever. Excessive heat will significantly shorten the expected life of aluminum electrolytic capacitors. Therefore, in calculating flow ripple current aluminum electrolytic capacitor life expectancy can use the following calculation method:

Fever due to internal of aluminum electrolytic capacitor equivalent series resistance (ESR), its loss to produce  $P = p \cdot \text{Resr} \cdot I$  for the ripple current for equivalent series resistance (fi). Caused by the heating temperature for.  $I^2 * \text{RESR}$

A. H type of ats for the temperature rise AT the center of A capacitor (° C). J for ripple current (A), the ESR for ESR (n); A, A capacitor surface area (cm<sup>2</sup>). H as the coefficient of heat transfer [(1.5 ~ 2.0) X10<sup>-3</sup> wacm<sup>2</sup>. ° C)].

Condenser temperature rise with the square of the ripple current and the equivalent series resistance is directly proportional to the ESR, is inversely proportional to the surface area of the capacitor, therefore, the size of the ripple current determines the size of the heat, and affect the service life.

Ambient temperature and ripple current at the time of the life formula:  $L, a. X^2 = L (D XK)$

L for the actual service life; L. The service life of working for dc voltages; K ripple current coefficient (actual ripple current effective value and the ratio of the rated ripple current RMS, K = 2, ripple current in the allowed range, K = 4 when more than ripple current range). Container temperature testing capacitor upper limit of working in the rated ripple current and temperature, the life of the capacitor can be obtained through conversion type:

$$L = L_{10} \times X \quad (4.17)$$

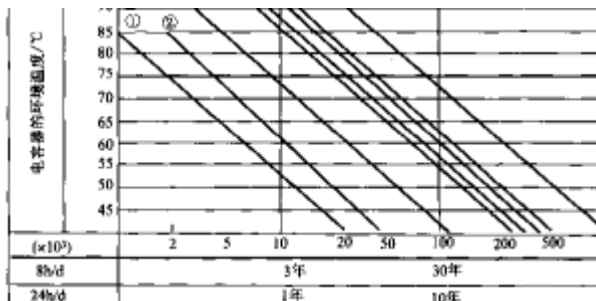
L. For working in the rated ripple current and the life of the highest working temperature (h); The AT. Work for the high temperature of condenser center permissible temperature rise..

Actually type (4. 16) with type is described by (4) 17) after the test to the temperature of the condenser shell, and do not know the size of the ripple current, if you know the size of the ripple current, can use type (4) 17) instead

$$L = L_{10} \times X^2 \times (Z^{\wedge} 1) \times X \times kC1\_2]$$

Over the life of the calculate formula, in principle, applicable to the ambient temperature is + 40 ° C in the highest working temperature range, but due to the factors such as aging of sealing materials, the actual life time generally the maximum is 15 years.

To JINPEI CD268 series specifications of the long life of aluminum electrolytic capacitor as the example (figure a - 2), it is a rated temperature of 105 ° C; 6000 h life, rated ripple current 13 a aluminum electrolytic capacitor. At 105 ° C and the ripple current for 105. (: rating, its useful life is 6000 h. Under other conditions? Figure 4. 15 Yin in the shadow part of the work area is forbidden, any conditions (including storage) are not allowed in this area; the rightmost thick curve for 6000 h curve, without a ripple current can afford about 108 ° C, high t: in 108, the electrolyte will boil; on the right side of the second curve is 10000 h characteristic curve, and so on the back of the 000 h 25, 50, 000 respectively 100 000 h and 250 h, 100 h curve. Both temperature and ripple current is how much, as long as pay on a curve, the actual life of aluminum electrolytic capacitor is this curve represents the number of hours. For different flow ripple current, aluminum electrolytic capacitor affordable ripple current value is different, table CD11GE/CD11GA series specifications of the long life of aluminum electrolytic capacitor under different frequency ripple current and ripple current conversion relations during the 100HZ



long life the life of the aluminum electrolytic capacitor, the temperature, the current diagram

Instant overtemperature of aluminum electrolytic capacitor

Aluminum electrolytic capacitor life along with the core temperature rise 10 ° C life by half. However, with the capacitor is heated to its maximum allowable core temperature, the result will also change. For I05 work ° C temperature electrolytic capacitor, the largest core temperature higher than 125 ° C, the electrolyte of ESR increase 10 times. This will lead to increased ESR produce a larger quantity of heat, make the core temperature to rise further, the electrolytic capacitor is not allowed. Therefore, to be vigilant in the possible problems of the application of high temperature and

high pulse, special attention to the cooling system.

### Load life test

Put the capacitor with air convection device, set the temperature limit at 85 ° C and 105 ° or 125 ° C, C + 3 ° C. The DC voltage and AC voltage ripple. Adjust the AC voltage causes a current is equal to the rated ripple current, adjustment RC peak voltage is equal to the rated voltage capacitor voltage causes. At rated load life test before and after the completion of the 6 h an applied voltage. When completed to allow stable capacitor at 25 ° C for 24 h or more. Capacitor can satisfy the capacitance, the lower limit of the ESR and DCL.

The EIA ripple life test, the EIA IS - 479

By the EIA standard 479 for "wear" life time test. Test points are as follows: the 120 hz pulse electric current, if another work frequency, adjustment to maintain in the same power dissipation. The DC bias is equal to the application of AC electric pressure rated voltage of the minimum peak. Environment temperature for 85 and 2 ° C, the air flow rate is less than 0.5 m/s. Test interval time < 1 a. a. h for a loop, do all the tests under this temperature. The end of a life time of 10% or more, the electric capacity is less than the initial value of the measured electrolytic capacitor 80%, the ESR is greater than the initial estimate of 200%, DCL is greater than the initial value and the electrolyte has obvious mechanism of damage or leakage. Failure short circuit or open circuit, 10% of the sample may not be counted.

### Voltage derating

Voltage derating expressed as a percentage of applied voltage is less than the rated voltage. Such as working at 400 v 450 v capacitor voltage derating 11%.

Aluminum electrolytic capacitor dielectric formed voltage at least 35% greater than the rated voltage, rated temperature of 85 ° C or higher aluminum electrolytic capacitor does not require large voltage derating. In the application, work in less than 45 C does not need derating, 10% until 75 ° C is enough. The higher temperature, high ripple current 15% or 20% is appropriate. For longer working life to beg or to continue to increase military and aerospace applications, working voltage derating amplitude can press 50% rated voltage derating.

Flash capacitors at room temperature are available in the full rated voltage. Because they are designed for this small duty cycle. When selecting a capacitor to at least 10% from voltage derating benefit, because the work continues to make them hot.