

The application of aluminum electrolytic capacitor and the matters needing attention

Good application in electrical and electronic devices to aluminum electrolytic capacitor is dealing with the performance of the aluminum electrolytic capacitor has more fully understand, in front of each section has been compared most performance of aluminum electrolytic capacitor are introduced in detail. In the application Best or better aluminum electrolytic capacitor can stand about how much of a ripple current, the ESR is roughly how many, 220 v / 110 v direct rectification in a filter capacitor how big ripple current, when after the transformer step-down rectifier filter capacitor of ripple current, the frequency converter rectifier directly with three-phase 380 v when the ripple current on the filter capacitor, switch power supply have much high frequency transformation on the filter capacitor current, frequency converter and will have much high frequency transformation on the filter capacitor current, the filter capacitor in switching power supply and frequency converter to the bottom will suffer much ripple current, the ripple current to the filter with the practical application of aluminum electrolytic capacitor will have much effect, should choose what type of filter aluminum electrolytic capacitors, if filter with aluminum electrolytic capacitor can not meet the requirements and what to do, is best when applications are given, so as to ensure the excellent properties of the product. One of the main parameters influencing the performances of electrolytic capacitor is ripple current.

Aluminum electrolytic capacitor ESR, ripple current

The influence of ripple current of aluminium electrolytic capacitor

Ripple current to the influence of aluminum electrolytic capacitor is mainly resulted from power consumption on the ESR aluminium electrolytic capacitor fever, in turn, shorten service life.

Ripple current caused by the temperature rise

Rated ripple current rating is defined as the temperature when the expectations of the temperature increase. Most of 85 ° C rated capacitor type allowed 10 ° C temperature rise. 105 ° C rated general type allows 5 ° C temperature rise, 110 ° C for maximum core temperature. Actual maximum core temperature varies with the type and production change, can from the manufacturers data book of life and the characteristics of temperature and ripple current curve. Ripple current on the ESR produce the loss and the ripple current is proportional to the square of the RMS, and with the increase of ripple current, hour life curve is similar to parabola function curve. In the rated ripple current flow, the temperature rise is approximately 3 ° C; And under the condition of 2 times the rated ripple current, the temperature will rise to nearly 15 ° C; When ripple current rise to three times the rated ripple current, the temperature rise will be close to 40 ° C. Reduce the core package

Temperature and the methods to reduce temperature rise

One of the ways to lower the temperature in the core package is trying to reduce the ripple current in the aluminum electrolytic capacitor (actually reduce the actual ripple current coefficient), which is the application of aluminum electrolytic capacitor must pay attention to the problem. Selection method is to adopt large capacity of aluminum electrolytic capacitor, after all, the large capacity of aluminum electrolytic capacitor affordable ripple current is larger than small capacity of aluminum electrolytic capacitor; Also can use more than small capacity of aluminum electrolytic capacitor in parallel manner, such as two 47 uF electrolytic capacitors can withstand the ripple current is greater than 1 only 100uF aluminum electrolytic capacitor, and 3 only 33 uF is greater than 1 100uF only; Can also choose low ripple current of the circuit topology, such as inductance input rectifier filter wave method can greatly reduce the ripple current filter capacitor, when conditions permit multi converter split phase parallel circuit topology can greatly reduce the switch transform current. Even if the condition does not allow, also should adopt bridge or push-pull circuit topology, and the best choice as far as possible

big duty ratio, in general, the flyback converter switch transform current relative maximum.

Another approach to reduce the core temperature is trying to reduce the surface temperature of aluminum electrolytic capacitors, in this way, even if there is higher temperature rise, due to the low surface temperature, nor is the core package transition temperature increases.

Under the condition of natural cooling, heat to the environment through the shell, aluminum electrolytic capacitors with plastic casing thermal resistance between the shell and the environment for the surface area per square inch per 1°C for 0.006 W . This means that under the condition of natural cooling, power dissipation is equal to the ripple current square multiplied by ESR. Usually in the 100/120 Hz and 25°C under the condition of room temperature, by ESR and the ripple current can be used to calculate the power dissipation, again through the thermal resistance calculated surface temperature of the aluminum electrolytic capacitor and core temperature, then hours service life.

For example, suppose that $4700\text{ pf} / 450\text{ v}$, rated the highest temperature of 85°C capacitor, in $W\text{Smm} \times \text{SSmm}$ shell, the biggest ESR at 25°C , 120 Hz is $30\text{ m}\Omega$. Shell area (not including terminal terminal) for 338 cm^2 , thermal resistance of $0.36\text{ W} / 2^{\circ}\text{C}$ or 78 C/W , assuming that the core temperature is equal to the shell temperature, the ambient temperature for 85°C ; Ripple current should be permission is 11 A . If the ESR of 85°C was 35% lower, the maximum ripple current can reach 13.6 A .

Core packages usually wave dissipation per watt power needs to be higher than the shell temperature $3 \sim 5^{\circ}\text{C}$, while the core package to the environment temperature rises High in the rated ripple current and the largest when the ESR can reach 10 t , both will vary more than twice. Usually assume that core covering the temperature in less than 25 mm below the diameter of the capacitor shell temperature in lieu of the core package temperature is safe. Bigger shells with large ripple current flow of large aluminum electrolytic capacitor often use a low thermal resistance in internal design, can effectively reduce the core covering the temperature to the temperature rise.

To reduce heat loss, between winding and case, some of the aluminum electrolytic capacitor manufacturers, production of large-scale aluminum electrolytic capacitor used for electrolytic capacitor core package cooling measures, such as SHANGHAI JINPEI production of capacitor in the capacitor core between the bottom of the bag and a cylindrical heat bridge. As most of the heat loose from the shell of the base, the bottom of a capacitor on the use of heat absorption is one of the most useful cooling method. Therefore, common screw will be fixed in a capacitor

On the radiato

Forced cooling is a good way to lower the temperature in the core packages. The service life of the value given in the table is suitable for the aluminum electrolytic capacitor on the condition of natural cooling, for example, the heat generated by the winding under the condition of natural transformation wasted by device. By increasing the permissible ripple current and/or through additional heat absorption, water or forced ventilation method to prolong the service life of the cold. On the contrary, the improper cooling methods (such as capacitor set too close, thermal isolation seal packaging and vacuum) will reduce the service life.

If a screw terminal is cooling at the bottom of high voltage capacitor to keep a certain temperature, and the correspondingly high rated current can be applied to the bottom of the cooling kR (B) rather than rated current $J \sim R$ for natural cooling.

Ripple current and frequency

The loss factor of aluminum electrolytic capacitor (associated with the equivalent series resistance) varies with the frequency of the applied voltage. Therefore, the ripple current also related to the frequency. Usually in the product data given in the table of capacitor ripple current sexual frequency of 100 hz and 20 KHZ. All kinds of different working frequency conversion factor in product data is given in tabular form.

Ripple current and temperature

All kinds of capacitor models of ambient temperature of 40 ° C and the maximum permissible ripple current value scope of high temperature In products (hereinafter referred to as the data in the data table) data table is given. For all temperature high at 85 ° C types of containers, they at 85 ° C of ripple current are also given for comparison. Each type of capacitor data in the table Also includes a capacitor continuous work in other environmental temperature and ripple current limit value under the circumstance of the illustration. Also gives the solution of this figure is expected service life of the capacitor under different working conditions.

Air pressure

Must be limits on atmospheric conditions on the application of the aluminum electrolytic capacitor. Therefore, observation of IEC climate are presented in the form the password to the scope of the maximum and minimum allowed temperature and humidity conditions is very important. The scope of IEC for each type provides the corresponding data table.

Maximum allowable working temperature range (high temperature)

High temperature range refers to the maximum allowable allows capacitor continuous working environment temperature. It depends on the design of the condenser, and given the scope of their respective IEC climate. If beyond this range, the capacitor will be early damage. However, for some types of capacitor, a short period of time allowed to work in higher than the temperature of UCT, capacitor See their data sheets.

Service life and reliability to a great extent, depends on the temperature of the condenser. Work in the minimum allowed temperature will increase the service life and reliability, and therefore be advised to use. By the same token, when using aluminum electrolytic capacitor is to place it in the position of possible the coldest is very wise.

The minimum allowed working temperature (low temperature range)

With lower temperature, the electrolyte is reduced, so that the electrolyte resistance increases, resulting in number of impedance and dissipation (or the equivalent series resistance). For most applications, the increase would have maximum. These temperature limits are referred to as "low temperature range", they are also part of the scope of IEC climate.

It should be stressed that working temperature below this limit will not damage the capacitor. Especially when a ripple current flows through the device, heat dissipation through the increase of equivalent series resistance will increase the temperature of the capacitor to the high out of the environment temperature is very much, so the capacity must be appropriate to maintain the operation of equipment.

Charge and discharge

Generally aluminum electrolytic capacitor cannot be used for frequent fast charging and discharging, the application of this might damage the container. Overheating due to excessive charge and discharge current and overvoltage, or cause series failure breakdown caused by open, short circuit, damage the electrolytic capacitor. Capacitor used in rapid charge and discharge, the discharge rate not more than manufacturers suggest.

Reverse polarity voltage

Check each capacitor in the circuit design and installation of polarity. Polarity marking on the capacitor. Capacitor can even continue to endure below 1.5 V the application of the reverse voltage, over due to overheating, over-voltage, damaged capacitor dielectric breakdown. This will cause the corresponding open circuit and short circuit failure and capacitor dielectric breakdown.

The combustibility of aluminum electrolytic capacitor

Large aluminum electrolytic capacitors are widely used in inverter, ups system and other inverter. However, at present most of aluminum electrolytic capacitor with flammable organic acid of electrolyte and combustibility of problem. Among them, the high pressure great type aluminium electrolytic capacitors for work to gather electrostatic energy is very high, and with the amount of electrolyte is very much also, so bring to the more flammable, explosive and other security issues. According to some appliances class market quality feedback data of the machine, according to incomplete statistics, aluminum electrolytic capacitor fueled engine fires events accounted for about 38%. Obviously, this kind of problem has reached quite serious degree.

The burning of aluminum electrolytic capacitor model

The study found that the aluminum electrolytic capacitor can happen "combustion" also can cause the secondary combustion.

Active combustibility: capacitor to ignite a direct result of combustion, hereafter called "combustion" at a time.

Passive combustibility: capacitor itself is not "a burning" is caused by the influence of other factors and indirect burning bodies around, known as "secondary combustion" below.

(1) a combustion model

"Burning" refers to the aluminum electrolytic capacitor burn in certain conditions on their own, the so-called "active combustion". The sex ".

The formation of the fire

Electrostatic energy accumulation within the capacitor under certain conditions can be 'directly by arcing between electrodes to spark discharge. The spark is "fire". Electrostatic energy formula: $W = jCV$

Among them, the C for electrostatic capacity, V for charging voltage. It is directly proportional to the square of the charging voltage, therefore, will greatly increase the high voltage capacitor electrodes on the accumulation of electrostatic energy. Generally speaking, the power input capacitor electric high pressure for their work, and easy to cause internal spark discharge, which directly caused the eruption electrolyte burning. Output power electricity container however because usually can not meet the internal of the electrostatic spark discharge energy and rare burning at a time.

Around the fire because there is the electrolyte, isolation lining paper and produces hydrogen fuel, it is easy to catch fire Burning.

The supply of oxygen

Capacitor with fever as well as the impact of arcing between the electrode and the internal pressure will rise sharply until the relief valve to open. At this time, the fuel into contact with the outside air will be lit up and continue to burn. The open area of the relief valve The more oxygen supply, combustion will be fierce. On the other hand, the open area is small that fuel failed to fly out of contact with the outside air, at this time, the combustion will not continue, up to leave a little trace of burning in flying arc part.

The secondary combustion mode

"Secondary combustion" refers to the aluminum electrolytic capacitor by external fire lit, or electrolyte spewing fly high electric field near to cause short circuit, arc, in turn, a fire, the so-called "passive combustibility".

The electrolyte leakage or eruption

Sealing the air tightness of the bad or the relief valve to open the case, the electrolyte from condenser leakage or outside introversion eruption and follow the road to the high energy region (e.g., high energy part of the circuit board), cause a short circuit, arc, result in electrolyte on fire and causing the electrolyte fuel combustion.

External fire

Capacitor around fuel burning to become fire, fire or capacitor capacitor sealing materials for external heat source heating the relief valve opens, electrolyte leakage was lit.'

The combustion application countermeasures

Prevent capacitor "burning" the application of countermeasures: avoid using high-voltage aluminum electrolytic capacitor. For example, power input capacitors in the original design to choose 400 v - 22 (VF aluminum electrolytic capacitor, in order to significantly reduce the capacitor electrodes on the accumulation of electrostatic energy, you can change to both 200 v - 47 pf capacitor in series.

Prevent capacitor "secondary combustion application countermeasures:" around the high voltage aluminum electrolytic capacitor, trying to partition fluid leak electricity solution possible pathways of courses and to the high energy region. For example, as far as possible don't punch on the circuit boards around, so as to avoid the electrolyte flow to printed circuit cause short circuit, electric arcing.

The selection of capacitor specification: generally speaking, appropriate selection of the specifications of the large electric capacity to improve the impact of the capacitor current resistance ability.