

CAUTIONS FOR PROPER USE OF ALUMINUM ELECTROLYTIC CAPACITOR

To use Aluminum Electrolytic Capacitors properly, please pay attention to the points listed below.

When the following types of electrical loads indicated below are applied to Aluminum Electrolytic Capacitors, rapid deterioration of electrical property occurs :

- reverse voltage
- voltage beyond rated voltage
- ripple current beyond rated value
- severe charging/discharging

At such times, capacitors are heated very much together with gas evolution, so as to allow electrolyte leakage from sealing or to increase internal pressure enough to operate safety vent.

In some condition, capacitors may catch fire or explode to release combustibles (e.g. electrolyte, separator paper).

1.Cautions on Circuit Design

1) Operational Environment, Mounting Environment and Conditions

- Ensure that operational and mounting conditions are satisfied with the specified conditions detailed in the catalog and specification sheets.

2) Operating Temperature, Ripple Current and Load Life

- Operating temperature and applied ripple current should be within the values specified in the catalog or specification sheets.
 - ①Do not use Aluminum Electrolytic Capacitors at a temperature exceeding the specified maximum category temperature.
 - ②Do not apply excessive current exceeding the specified rated ripple current.
- The combined value of DC voltage and the peak of AC voltage must not exceed the rated voltage. Voltage application in the reverse direction is unallowable.
- Consider current balance to connect 2 or more Aluminum Electrolytic Capacitors in parallel.
- Application of ripple voltage with wide amplitude is equivalent to quick charge-discharge operation.
If ripple voltage with the amplitude over 70Vp-p is expected, please contact us.
- Expected life of capacitor calculated with "life estimation equation" based on acceleration test results aren't guaranteed, since errors and variations are included. We recommend to select a capacitor considering appropriate safety factor to the expected life. Please refer to our web-site or consult us for the detail of "life estimation equation".

3) Polarity

- Do not apply reverse voltage or AC voltage to Aluminum Electrolytic Capacitors, since they are normally polarized. Please use non-polar type capacitors to a circuit with polarity alteration. Note that such non-polar type cannot be used for AC circuit.
- Polarity is indicated as follows:
 - (1)Negative terminal is indicated with color band or arrows on capacitor body.
 - (2)On radial leaded Aluminum Electrolytic Capacitors with straight radial leads, the shorter radial lead is the negative terminal.
 - (3)On capacitors with mark on top of aluminum can, the terminal with the mark [⚡] or [⚡] is negative.
 - (4)On Snap-In and Lug Terminal type capacitors, the knurled rivet [⊗] indicates the negative terminal.
 - (5)On Screw Terminal type capacitors, polarity mark (+, -) indicates on terminal plate.

4) Charging and Discharging

- Do not use Standard Aluminum Electrolytic Capacitors to applications with rapid charge and discharge cycles. Consult us about capacitors specially designed for rapid charge-discharge cycles.

5) Applied Voltage

- Do not apply voltage beyond the rated voltage to capacitors.
- Use bleeder resistors to a circuit using 2 or more Aluminum Electrolytic Capacitors in series. In this case, the resistors should be connected parallel to the capacitors.

6) Insulation

- Electrically isolate Aluminum Electrolytic Capacitors as follows:
 - ①Among aluminum can, negative terminal, positive terminal and circuit pattern.
 - ②Among auxiliary terminals on snap-in type, positive terminal, negative terminal and circuit pattern.
- The sleeve of Aluminum Electrolytic Capacitor is not recognized as an insulator, so that standard capacitors should not be used to a circuit requiring electric insulation. Please consult us for capacitors with insulating sleeve.

7) Use Conditions

- Be sure to keep Aluminum Electrolytic Capacitors from the following environments:
 - ①Damp atmosphere where spray of water, saltwater or oil is expected, or where condensation may occur.
 - ②Atmosphere including hazardous gas/fumes such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, ammonia or bromine.
 - ③Exposure to ozone, ultraviolet rays or radiation.
 - ④Severe vibration or shock beyond the condition specified in the catalog or specification sheets.

8) Consideration for Circuit Design

•In designing a printed circuit board (PCB) with Aluminum Electrolytic Capacitors, the following matters should be ensured:

- ①Alignment of through-hole pitch on the circuit with radial lead pitch of each capacitor.
- ②Avoid wiring or circuit pattern around the capacitor's pressure relief vent.

The vent is designed to operate to release excessive hot gas including electrolyte, in case of reverse voltage or excessive voltage, or if ripple current exceeding the permissible value is applied.

- (1)The pressure relief vent bulges right before operation. Ensure enough space shown below above the vent of each capacitor, so as to prevent the capacitor from touching the cover of the set. The pressure relief vent will not open without appropriate space.

Body Dia.	Space
φ6.3—16mm	2mm MIN.
φ18—35mm	3mm MIN.
φ40mm—	5mm MIN.

- (2)In case capacitor's vent is facing the surface of PCB, make a gas release hole on the board.

- (3)Screw terminal capacitor should not be mounted sealing end down on PCB. To mount the capacitor sideways, positive terminal must be on the upper side.

- ③Do not lay copper lines or circuit patterns under capacitors.

Electrolyte is electrically conductive. In case of deposition of electrolyte on the surface of PCB, corrosion of circuit pattern, or tracking or short circuit between patterns may occur to generate smoke or fire at worst.

- ④Avoid heating parts mounting around Aluminum Electrolytic Capacitors or backside of PCB.
- ⑤Land patterns for chip capacitor should comply with the catalog or specification sheets.

9) Short time leakage current

•The leakage current of aluminum electrolytic capacitor is rather larger than other types of capacitor. This value will be influenced by temperature, applied voltage and applying time of voltage. Particularly, brief leakage current level which does not reach to specified time such as 2 minutes after applied voltage is unstable. Therefore, please pay attentions when aluminum capacitors are used for application such as timing circuit which include time constant circuit because actual leakage current level is different with simple calculation of "CR circuit".

If it is used in such a circuit, please select a capacitor with a margin for the required accuracy of the instrument.

10) Others

•Consider this variation of electric characteristics of Aluminum Electrolytic Capacitor to design circuits. The characteristics vary with operating temperature and frequency.

Extra through-holes should be avoided around or under Aluminum Electrolytic Capacitors on double sided or multilayer PCB.

•On use of Aluminum Electrolytic Capacitors to electronic equipment requiring higher safety, consider failure mode of the capacitor to ensure safety at design stage.

- ①System safety with circuit protection and protective devices.
- ②System safety with redundant circuits, etc.

•Rubycon Photo Flash Capacitors are designed, manufactured and intended solely for use in photo flash and other photographic equipment.

2. Cautions for Assembly

1) Precautions for assembly

- Do not reuse Aluminum Electrolytic Capacitors once mounted and electrified in a unit. Reuse of the capacitors is unallowable unless they are detached from PCB for the purpose of electric measurement.
- Aluminum Electrolytic Capacitors may have recurring voltage even after discharging. Please discharge capacitors through a 1k Ω resistor before use.
- Leakage current of Aluminum Electrolytic Capacitors may be increased after storage for a long time. Conduct electrification treatment for such capacitors before use.

Electrification Treatment

Connect a 1k Ω resistor in series with the subject capacitor, and apply the DC voltage as high as the Rated Voltage for 1 hour. Discharge the capacitor through a resistor of about 1 Ω /Volt after the electrification.

2) Assembly Process

- Ensure rated voltage and capacitance of each capacitor before mounting.
- Ensure polarity of each capacitor before mounting.
- Keep capacitors from falling onto the floor. Do not use capacitors if they are fallen onto a hard surface.
- Do not deform capacitors.
- Ensure that terminal pitch of each capacitor is aligned with through-hole pitch on PCB.
- For snap-in capacitors, press them to stick firmly with PCB. Lift of capacitors is unacceptable.
- Avoid excessive force to clinch lead wires in auto-insertion process.
- Avoid excessive shock to capacitors on automatic insertion machine, during mounting, parts inspection or centering operations.
- Please use supporting materials such as fixture or adhesive to mount capacitors to PCB, in case vibration or shock is expected.
- Use the value of torque within the range described in the catalog or specification sheets to tighten screw terminals.

3-1) Soldering

- Soldering should be performed with the conditions (temperatures, times) specified in the specification sheets.
- In case of requirement of lead wire reforming due to terminal pitch unaligned with through-hole pitch on PCB, capacitors should be kept from stress on body.
- In case that capacitor is required to detach from PCB due to hand rework, the detachment should be made after solder is fully melted, so as to keep the capacitor from stress on radial leads.
- Do not touch soldering iron with capacitor body.

3-2) Flow Soldering

- Do not dip capacitor body into solder bath. Dip only the opposite side of PCB.
- Soldering conditions (preheat, soldering temperature, dipping time) should conform to the specification sheets.
- Be sure to apply soldering flux only to capacitor terminals.
- Be careful that another part doesn't fall in soldering to touch capacitors.

3-3) Reflow Soldering

- Reflow soldering conditions (preheat, soldering temperature, reflow time, reflow cycle) should conform to the catalog or specification sheets.
- * Consult us for soldering beyond the specification.
- Be careful of the amount of heating with infrared heater, since infrared absorptance depends on color and material of capacitor sleeve.

4) Handling after Soldering

- Do not bend or twist capacitor body after soldering on PCB.
 - Do not hold capacitors to transfer PCB after soldering.
 - Keep capacitors from hitting something hard.
- Also keep capacitors from touching another PCB or part on stacking PCB.

5) Cleaning after Soldering

- (1) Do not clean capacitors with the following cleaning agents:
- Halogenated solvents: except for solvent resistant capacitor types, halogenated solvents can permeate the seal to corrode aluminum foil within capacitor.
 - Alkali solvents: could attack and dissolve aluminum can.
 - Petroleum based solvents: could deteriorate packing rubber.
 - Xylene: could deteriorate packing rubber.
 - Acetone: could blur print on sleeve.
- Do not use of ozone depleting agents to protect the global environment.
We don't recommend hydro-chlorofluorocarbon (HCFC) considering its impact on the environment.

(2) To clean up capacitors, select solvent-resistant capacitors.

Also use detergents and conditions stipulated in the catalog or specification sheets.

• Cleaning of solvent-resistant capacitors

Closely control cleaning solution (conductivity, pH, specific gravity, water content, etc.).

The concentration of flux (contamination) must be within 2wt% against the cleaning solution. Excessive contamination could include high content of chloride (halogen) ion, resulting in corrosion of capacitor.

• Do not keep PCB including capacitors in solvent-including environment or non-ventilated container. Be careful of drying not to leave detergent between capacitor surface and PCB. Use a circulating chamber for drying (within the maximum category temperature).

(3) Cleaning Procedure

<Subjects> Miniature Aluminum Electrolytic Capacitors 100WV or lower

<Cleaning Solvents>

Pine Alpha ST-100S

Clean-thru 750H

IPA (isopropyl alcohol)

<Cleaning Condition>

For capacitors of 100WV or lower, immerse into the solution of the solvent, put into mist atmosphere, use ultrasonic vibration, or combine them for 5 minutes (3 minutes for 5L and 7L) up to 60C.

• Please refer to specification sheets, since some products are incompatible with cleaning. Please consult us to use a solvent other than the above.

6) Adhesives and Coating Materials

• Do not use adhesives or coating materials including halogens to fix Aluminum Electrolytic Capacitors.

• Be sure to clean up soldering flux and dirt between each capacitor and the surface of PCB before using an adhesive or a coating material.

• Fully dry solvents on capacitors before using adhesive or coating material.

• Do not cover up all the sealed surface of capacitor with adhesive or coating material.

7) Fumigation, Disinfection and Halogenated Flame Retardant

• Note that treatments or environments shown below may cause corrosion inside and outside of capacitor (foils, aluminum can, terminal):

(1) Fumigation of wooden pallets to disinfect vermin before shipment.

(2) Direct deposition to capacitors of halogenated detergents or antiseptics for preventing infection of epidemic diseases contact.

(3) Coexistence of components or parts containing halogenated flame retardant agent (bromine etc.).

3. Cautions in Use on Set

• Do not touch the terminals of capacitor.

• Do not short-circuit between terminals of capacitor.

Keep capacitors from conductive solutions, such as acid and alkali.

• Ensure that operational environment is satisfied with the conditions mentioned in the catalog or specification sheets.

4.Maintenance

•Periodically inspect capacitors used for industrial equipment.
Check the following points at the inspection.

- ① Visual inspection of pressure relief vent operation and leakage of electrolyte.
- ② Electrical characteristics: leakage current, capacitance, dissipation factor and other items specified in the catalog or specification Sheets.

5.Emergency Action

•If you find pressure relief vent operation or gas evolution from a capacitor, shut off the main switch of the equipment or pull the power cable from the outlet immediately.
•Keep your face off from the capacitor with vent operation. Extremely hot gas (over 100°C) may blow out of it.
In case of eye contact or inhalation of gas, immediately flush the eye(s) with large amount of clean water or gargle the throat. Do not lick electrolyte. In case of electrolyte reach to skin, wash with soap and water.

6.Storage Condition

•Do not keep Aluminum Electrolytic Capacitors in hot and/or humid atmosphere. Recommended storage condition is 5°C-35°C in temperature and not higher than 75% in relative humidity.
•Do not keep Aluminum Electrolytic Capacitors in a condition where spray of water, saltwater or oil is expected.
•Do not store Aluminum Electrolytic Capacitors in an environment full of hazardous gas (e.g. hydrogen sulfide, sulfurous acid gas, nitrous acid, chlorine gas, ammonia, bromine gas, methyl bromide).
•Do not keep Aluminum Electrolytic Capacitors under exposure to ozone, ultraviolet rays or radiation.

7.Disposal

•Please take either of the following actions in case of disposal.
① Incineration (at high temperature over 800°C) after piercing or crushing capacitor body.
② Consignment to specialists of industrial waste.

For details:

Please refer to JEITA RCR-2367C (Safety Application Guide for fixed aluminum electrolytic capacitors for use in electronic equipment).

[Technical Report of Japan Electronics and Information Technology Industries Association (established in March 1995, Revised in March 2006)].

◆ **TYPICAL FAILURE MODES AND THEIR FACTORS**

