

Handling Cautions

NOTES TO USERS OF ALUMINUM ELECTROLYTIC CAPACITORS

Before using the products, please read the notes for proper use.

1. Operating environment

- Water, saltwater, oil or other electrically conductive liquid on a capacitor, or using a capacitor when it is damp with dew may cause a failure. Oil on the rubber seal or safety vent may cause a decline in airtightness. Do not use any capacitor in contact with liquid. Do not use capacitors that have been immersed in rainwater or other contaminated water.
- Do not use or leave a capacitor in areas where there is halide compound gas such as hydrogen sulfide, nitrous acid, sulfurous acid, chlorine and bromine, ammonia or other hazardous gas. The ingress of any of these gases into a capacitor may corrode it.
- Do not use or leave a capacitor in an area exposed to ozone, ultraviolet light or radiation.
- Powders (dust, etc.) that settle between terminals can absorb moisture and cause corrosion and tracking of the terminal. When there is conspicuous dust between terminals, stop the current, allow the capacitor to discharge and wipe the terminals with paper or a towel lightly dampened with water or ethanol. Do not use cleaning agents or other chemicals.
- Do not use a capacitor in an area subject to excessive vibration or impact.

2. Operating conditions

2.1. Operating temperature, ripple current

- Check the operating and installation environment and use the capacitor within the range of the rated performance specified in the catalog or specifications.
- Maintain operating temperature and ripple current within the specified ranges. Base your choice of capacitors on the maximum load conditions. A capacitor will overheat under excessive current, potentially resulting in short circuit, fire or other major failure.
- A capacitor also generates the self-heating. Please bear in mind that the capacitor heats up the interior of the equipment and take appropriate precautions. Operate the unit under normal conditions and check the temperature of the area surrounding the capacitor.
- The permissible ripple current declines with the rise in ambient temperature (the temperature of the capacitor's surroundings). Consider the permissible ripple current at the maximum predictable ambient temperature.
- Electric characteristics change as frequencies change. Check frequency changes in order to choose the right capacitor.

2.2. Applied voltage and other operating conditions

- In general, capacitors have polarity. Applying reverse voltage or AC voltage to a capacitor may activate the vent or cause a short circuit, fire or other major failure.
- Use a bipolar capacitor for circuits whose polarity reverses. However, as in any other case, do not use a bipolar capacitor in an AC circuit. Use a special AC capacitor for AC voltage.
- Do not apply voltage in excess of the rated voltage. When an AC voltage is superimposed on DC voltage, prevent the peak value from exceeding the rated voltage. Excessive voltage may cause a short circuit, fire or other major failure.
- Specifications on surge voltage have restricted conditions and therefore do not guarantee long hours of operation. Voltage should never exceed the rated voltage of the capacitor, even for brief periods. Choose your capacitor accordingly.
- When connecting more than one capacitor in parallel, give proper consideration to the resistance of the wiring. Establish the connections so that the wiring resistance will be equal at every capacitor.
- When connecting more than one capacitor in series, all must be of identical rating, then the balancing resistors connected in parallel. At that time, design the circuit so that equal voltage levels are applied to all the capacitors. Ascertain that the voltage applied to each individual capacitor does not exceed its rated voltage.
- The balancing resistors are connected in parallel to each capacitor and do all have an equivalent value of resistance apart from their technical conditioned tolerance.
- The worst circumstance is given if the capacitor with the highest leakage current is applied to the most negatively tolerance attributed balancing resistor.
- Concerning the rating of balancing resistors the following points are essential:
 - number of series connected capacitors
 - Ratio of rated voltage of capacitors to bus voltage (voltage over C-battery)
 - Minimum leakage current of capacitors
 - Maximum leakage current of capacitors

- Tolerance of balancing resistors
- To use preferably high-resistance resistors, which cause smaller power losses, their tolerance has to be small ($\leq 3\%$).
- Due to the minimum leakage current of AIC tech Inc. capacitors this is defined for the series connection of two capacitors while the voltage derating is $\geq 5\%$:

T_a	$V_r \leq 450$ VDC		$V_r > 450$ VDC	
	$C \leq 8200$ μ F	$C > 8200$ μ F	$C \leq 5600$ μ F	$C > 5600$ μ F
$< 40^\circ\text{C}$	R = 82 k Ω	R = 68 k Ω	R = 68 k Ω	R = 47 k Ω
$40^\circ\text{C} - 70^\circ\text{C}$	R = 68 k Ω	R = 47 k Ω	R = 47 k Ω	R = 47 k Ω
$> 70^\circ\text{C}$	R = 47 k Ω	R = 47 k Ω	R = 47 k Ω	R = 27 k Ω

- Take into account the service life of the equipment in the use of the capacitor. Use of the capacitor beyond its service life risks such failures as safety vent activation or short circuit. Replace as necessary at regular inspection.
- Do not use a capacitor for a circuit that is quickly charged and discharged repeatedly. Use a dedicated capacitor for an application like a welding unit or photo flash charging/discharging. Consult us for selecting the proper capacitor, since the control circuits of certain rotation equipment, like servo motors, charge and discharge repeatedly.
- Even slow charging/discharging can shorten the service life of a capacitor, resulting in premature failure, where there are marked changes in voltage. Check the installation in your equipment carefully and consult us.
- General purpose capacitors should not be used for a circuit involving rapid charge and discharge or an AC circuit. Capacitors specially made for such applications should be used. Check the self-heating of the capacitor used in such a circuit in addition to the types and levels to be imposed to the capacitor of the rapid charge/discharge, rush current and voltage.

3. Installation

3.1. Before installation

- Check the specifications of the capacitors and install them within the prescribed specifications.
- Do not reverse the polarity. Do not use a capacitor where reverse voltage is applied, even if it appears problemfree. Not taking these precautions could lead to a major failure.
- Dropping or otherwise impacting a capacitor may result in a decline in its electric performance, causing a failure. Do not use any capacitor whose packaging has a noticeable abnormality on delivery.
- Do not distort the shape of the capacitor, which may lead the major failures such as liquid leakage or short circuit.

3.2. Installation method

- Do not install wiring or a circuit pattern near the vent. When the vent is activated, electrolyte may spurt out resulting in short circuit followed by fire or other secondary hazard due to tracking or migration.
- Do not lay out heat-generating components near the capacitor. Radiated heat and other partially high temperatures may shorten the life of the capacitor. PCB temperature that is higher than the internal temperatures of the capacitor markedly hinders the dissipation of heat inside the capacitor, greatly shortening its life. When designing equipment, check temperature distribution first.
- When installing the vent of the capacitor against the PCB, drill a gas bleeder hole to allow the gas to escape when the vent is activated. If the diffusion of gas is hindered while the vent is in operation, the internal pressure can rise, with danger of explosion, fire or other serious failure.

Capacitor diameter	Clearance
$\varnothing 16 \sim 35$	3 mm or more
$\varnothing 40$ or more	5 mm or more

3.2.1. Snap mount type capacitors

- Do not connect the blank terminal (reinforced terminal) of multi-terminal (3-, 4-) snap mount capacitors, as this could cause a short circuit.
- Use a completely isolated circuit between the case and the electrode terminal, and between the case and the circuit pattern.
- Do not hinder the activation of the vent. Allow for the following clearance above the vent. If dissipation of gas is inhibited while the vent is in operation, the inner pressure will rise, with danger of explosion, fire or other major failure.

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- Solder at 260°C for not more than 10 seconds (in the case of dip) or at 380°C for not more than 3 seconds (in the case of tip of iron). Exceeding these specifications may result in a decline in electrical performance, leading to trouble. Do not let the tip of the soldering iron come in contact with the capacitor body.
- If it becomes necessary to remove a capacitor after soldering, melt the solder with a soldering iron to avoid subjecting the terminals to stress.
- Flux on the rubber seal may result in corrosion. Do not flux stick to any part other than the terminals.

3.2.2. Screw-terminal type capacitors

- Following mounting positions are recommended for screw type capacitors:
 - upright (vertical), terminals side face upwards
 - on the side (horizontal), anode above cathode terminal
 - on the side (horizontal), vent faces upwards
- The upside-down position (terminals face downwards) should not be used. If a capacitor is installed sideways, please put anode terminal or vent upward.
- Screw type capacitors with stud bolt mounting must be fixed insulated.
- Please refer to "Tightening torques for terminals and mounting options" for further notes.
- If a terminal screw is loose or angled, that portion generates heat, with a danger of fire or other serious failure. Check that the screw is inserted on the perpendicular and securely tightened.
- We recommend a bar hole diameter of 6mm for M5 terminals. An excessively large hole diameter may result in poor contact between the terminal surface and the bar, causing local heat buildup, with a danger of fire or other serious failure.
- Do not apply physical stress (tightening with fixtures, etc.) to the curled portion (seal contacting the case and cap). Any such practice may cause a liquid leak or sleeve breakage.

4. About washing PCB and fixative

- In washing, please avoid using a material which destroys the ozone layer.
- For cleaning flux, we recommend an aqueous or higher alcohol detergent or isopropyl alcohol. The recommended concentration of flux with regard to the cleaning agent is 2wt% or less. Excessively high flux concentration may cause corrosion due to halide. For use of other cleaning agents, consult us.
- If you must clean the capacitor with halogen solvents, etc., we recommend that you use washable capacitors. Make sure that the cleaning conditions are within those stipulated in the specifications, and measure the cleaning agent for conductivity, pH, specific gravity and moisture content for contamination control. After cleaning, thoroughly dry the capacitors together with PCBs. Do not store the capacitors in the same atmosphere as the cleaning agent or in a sealed container. For details on washable capacitors, consult us.
- Thoroughly remove all traces of the cleaning agent from the capacitor. Even when not cleaning the flux, dry the flux itself. Cleaning agent or flux residue may cause the halide to penetrate the rubber seal, leading to corrosion.
- When fixing a PCB and capacitor with a coating agent or fixative, use a substance completely free of halide compounds. Thoroughly dry the flux or detergent before applying the coating. Do not let the coating block the entire surface of the seal. Any halide compound present in the coating may lead to corrosion.

5. Storage

- Store all capacitors indoors at a temperature of 5–35°C (primarily below 25°C) and relative humidity of not more than 75% RH (25°C), away from direct sunlight. Store capacitors in their original packaging whenever possible.
- The base shelf life of capacitors is 3 years. The useful shelf life of capacitors is 5 years under proper storing conditions.
- Capacitors which have been on the shelf for more than 3–5 years may have high leakage current. Treat them with appropriate voltage before using. As treating method, we recommend the past forming process as below at room temperature:
 1. Firstly, 80% of rated voltage applied and keep 1 hour after reaching 80% of rated voltage.
 2. Secondly, 90% of rated voltage applied and keep 1 hour after reaching 90% of rated voltage.
 3. Finally, 100% of rated voltage applied and keep 1 hour after reaching 100% of rated voltage.
- Even after discharged, capacitors may hold an electrical charge due to re-striking. Do not touch the terminals with bare hands. Touching the terminals could cause an electric shock. Discharge all capacitors with a resistor (approx. 1kΩ) or a discharge plate before use.

6. About fumigation

- To control insects during export, fumigation may be done using halide compounds such as methyl bromide. Direct fumigation of capacitors or equipment incorporating capacitors or use of fumigated timber as a pallet may cause corrosion inside a capacitor, resulting in failure. Even when covered in plastic, chemicals may penetrate through small gaps. Likewise, do not apply insecticides directly on or near the capacitors.
- When using a sterilizer against infectious diseases, do not spray it directly on or close to capacitors and equipment incorporating capacitors. Some sterilizers contain a high concentration of halide compounds. The sterilizer spray may accelerate internal corrosion, resulting in failure.

7. Miscellaneous

7.1. Maintenance and servicing

- Conduct periodic checkups on capacitors for industrial equipment. Before each periodic checkup, turn off the equipment and completely discharge the capacitor. Follow these checkpoints:
 1. Appearance: condition of the vent (open, notably swollen), liquid leaks or other considerable abnormality.
 2. Electrical performance: capacity, tangent of loss angle, leakage current, and other items specified in the delivery specifications.

The standard temperature for measuring electrical performance is 20 °C. Leave the capacitor at 20 °C and wait for the inside of the capacitor to reach the specified temperature before taking measurements.
- Please ask us the advisability of using capacitor which is inspected.
- Replace all capacitors whose service life has reached its end. When replacing one capacitor, always replace all of them. Mixing old and new capacitors may cause an imbalance in the ripple current or voltage sharing, risking failures such as activation of the vent or short circuit.

7.2. In an emergency

- If gas is detected while a product is in use, turn off the main power supply or unplug it.
- When the safety vent of a capacitor is activated, a hot gas exceeding 100 °C will escape. Do not place your face in close proximity to the vent and avoid proximity to areas exposed to the gas.
- Should the gas jet get in your eyes, wash them immediately with clean water. If you inhale the gas, gargle immediately. The gas is composed of a gaseous form of hydrogen or organic solvents.
- Should the electrolyte come in contact with your skin, wash with soap and water. Never put it into your mouth.

7.3. For scrapping

- Scrapped capacitors are classified as scrapped metal. For disposal they are handled as controllable industrial waste because of the nature of the contents (electrolyte). Most of the material is aluminum and cannot be completely burned.

7.4. Remarks

- For details, see the Guidelines on the Operation of Fixed Aluminum Electrolytic Capacitors for Electronic Equipment EIAJ RCR-2367B March, 2002 issue.
- Specifications are subject to change without prior notice for product improvement.

8. Quality and useful life

- The specification of quality data – which always refers to a fairly large number of components – does not constitute a guarantee of characteristics or properties in the legal sense. However, agreement on the specifications does not mean that the customer may not claim for replacement of individual defective capacitors within the terms of delivery. We cannot, however, assume any further liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure.
- Furthermore, it must be taken into consideration that the figures stated for useful life and failure rate refer to the average production status and are therefore to be understood as mean values (statistical expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and data obtained from preceding tests under normal conditions, or for purposes of accelerated aging – more severe conditions.
- Glossary
 - V_r** Rated voltage
 - I_r** Ripple current
 - I_L** Leakage current
 - T_a** Ambient temperature
 - ESR** Equivalent Series Resistance
 - ESL** Capacitor self-inductance
 - Z** Impedance
 - DC** Direct Current
 - RMS** Root mean square (e.g. of ripple current)