

## Application Guidelines for Aluminum Electrolytic Capacitors

### ■ Designing Device Circuits

**1. Select the capacitors to suit installation and operating conditions, and use the capacitors to meet the performance limits prescribed in this catalog or the product specifications.**

#### 2. Polarity

Aluminum Electrolytic Capacitors are polarized.

Apply neither reverse voltage nor AC voltage to polarized capacitors. Using reversed polarity causes a short circuit or venting. Before use, refer to the catalog, product specifications or capacitor body to identify the polarity marking. (The shape of rubber seal does not represent the directional rule for polarity.) Use a bi-polar type of non-solid aluminum electrolytic capacitor for a circuit where the polarity is occasionally reversed. However, note that even a bi-polar aluminum electrolytic capacitor must not be used for AC voltage applications.

#### 3. Operating voltage

Do not apply a DC voltage which exceeds the full rated voltage. The peak voltage of a superimposed AC voltage (ripple voltage) on the DC voltage must not exceed the full rated voltage.

A surge voltage value, which exceeds the full rated voltage, is prescribed in the catalogs, but it is a restricted condition, for especially short periods of time.

#### 4. Ripple current

The rated ripple current has been specified at a certain ripple frequency. The rated ripple current at several frequencies must be calculated by multiplying the rated ripple current at the original frequency using the frequency multipliers for each product series.

#### 5. Category temperature

The use of a capacitor outside the maximum rated category temperature will considerably shorten the life or cause the capacitor to vent.

The relation between the lifetime of aluminum electrolytic capacitors and ambient temperature follows Arrhenius' rule that the lifetime is approximately halved with each 10°C rise in ambient temperature.

#### 6. Life expectancy

Select the capacitors to meet the service life of a device.

#### 7. Charge and discharge

Do not use capacitors in circuits where heavy charge and discharge cycles are frequently repeated. Frequent and sharp heavy discharging cycles will result in decreasing capacitance and damage to the capacitors due to generated heat. Specified capacitors can be designed to enduring such a condition. Rapid charging/discharging may be repeated in a circuit where the ripple voltage at the two terminals of the aluminum electrolytic capacitor fluctuates greatly. If the variation range of voltage exceeds 70Vp-p, please consult us.

#### 8. Failure modes of capacitors

Non-solid aluminum electrolytic capacitors, in general, have a lifetime which ends in an open circuit, the period is dependent upon temperature. Consequently, lifetime of capacitors can be extended by reducing the ambient temperature and/or ripple current.

#### 9. Insulating

- a) Electrically isolate the following parts of a capacitor from the negative terminal, the positive terminal and the circuit traces.
  - The outer can case of a non-solid aluminum electrolytic capacitors.
  - The dummy terminal of a non-solid aluminum electrolytic capacitors, which is designed for mounting stability.
- b) The outer sleeve of a capacitor is not assured as an insulator (Except for screw type). For applications that require an insulated outer sleeve, a custom-designed capacitor is recommended.

#### 10. Conditions

Do not use/expose capacitors to the following conditions.

- a) Oil, water, salty water. Avoid storage in damp locations.
- b) Direct sunlight.
- c) Toxic gases such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine or its compounds, and ammonium.
- d) Ozone, ultraviolet rays or radiation.
- e) Severe vibration or mechanical shock conditions beyond the limits prescribed in the catalogs or the product specification.

#### 11. Mounting

- a) The electrolytic paper and the electrolytic-conductive electrolyte in a non-solid aluminum electrolytic capacitor are flammable. Leaking electrolyte on a printed circuit board can gradually erode the copper traces, possibly causing smoke or burning by shortcircuiting the copper traces.

Verify the following points when designing a PC board.

- Provide the appropriate hole spacing on the PC board to match the terminal spacing of the capacitor.
- Make the following open space over the vent so that the vent can operate correctly.

Case diameter	Clearance
Ø6.3 to Ø16mm	2mm minimum
Ø18 to Ø35mm	3mm minimum
Ø40mm or more	5mm minimum

- Do not place any wires or copper traces over the vent of the capacitor.
- Installing a capacitor with the vent facing the PC board needs an appropriate ventilation hole in PC board.
- Do not pass any copper traces beneath the seal side of a capacitor. The trace must pass 1 or 2mm to the side of the capacitor.
- Avoid placing any heat-generating objects adjacent to a capacitor or even on the reverse side of the PC board.
- Do not pass anything via holes or underneath a capacitor.
- In designing double-sided PC boards, do not locate any copper trace under the seal side of a capacitor.
- b) Do not mount the terminal side of a screw mount capacitor downwards. If a screw terminal capacitor is mounted on its side, make sure the positive terminal is higher than the negative terminal.

Do not fasten the screws of the terminals and the mounting clamps over