

## Notices

### ■ Applicable laws and regulations

- This product satisfies the requirements of the RoHS Directive (2002/95/EC) (related to the specified hazardous substances contained in electrical and electronic equipment).
- The ozone-depleting chemicals regulated by the Montreal Protocol are not intentionally used in the materials used in our manufacturing processes.
- PBBs(Poly-Brominated Biphenyls)/PBEDs (Poly-Brominated Diphenyl ethers)  
The above specified brominated flame retardants are not intentionally used.
- The materials used in this product are all referred to as existing chemicals by the Law Concerning Examination and Regulation of Manufacture and Handling of Chemical Substances.
- When exporting this product, observe the export procedures specified in export control laws such as the Foreign Exchange and Foreign Trade Control Law.

### ■ Limited applications

- This product is intended to be used for general-purpose standard applications for general electronic equipment (such as AV equipment, household appliances, business or office equipment, information or communications equipment, etc.)
- If this product is being examined for possible use in applications where higher reliability or safety is required, in cases where a malfunction of this product may endanger life or property, then the delivery specifications meeting the application requirements must be agreed to and exchanged.

## Items to be observed

<1> The purpose of these specifications is to ensure the quality of components as individual components.  
Before use, check and evaluate their operation when mounted on your products.

<2> Do not use our components outside of the corresponding specifications.

### ■ When using this capacitor in a product where safety is critical

We take great care in the quality of this product. However, performance may deteriorate and short-circuiting or open-circuiting may occur if it will be used in transportation equipment (e.g. trains, cars, traffic lights), medical equipment, airborne equipment, aerospace equipment, electric heating appliances, combustion/gas equipment, rotating equipment, disaster/crime prevention equipment, or other equipment where a defect in this component may cause the loss of human life or other significant damage. Ensure that the target equipment has a failsafe design and is provided with the following systems to guarantee adequate safety.

- (1) \* Ensure the safety of the whole system by installing a protection circuit and a protection device.
- (2) Redundant circuits, etc. to maintain the safety of the entire system so that a single independent failure will not lead to unsafe conditions.

### ■ Conditions of use:

This product is intended to be used in electronic equipment for general-purpose standard applications and is not designed for use in any special environments.

When this capacitor is used in a special environment or under special conditions, its performance may be affected. Before use, verify the performance and reliability of the capacitor.

## ⚠ Application Guidelines

### 1. Circuit design

Verify the usage and fitting environments and make sure to observe the rated performance specified in the corresponding catalog or specifications.

#### 1.1 Operating temperature and frequency

Variations in temperature and frequency can affect the electrical characteristics of capacitors. Design circuits allowing for these variations.

- (1) At high temperatures leakage current increases.
- (2) At low temperatures the capacitance decreases and an increase in the tangent of the loss angle and impedance.
- (3) As frequency increases, capacitance decreases and the tangent of the loss angle increases, while the capacitive portion of impedance decreases till the resonant frequency is reached.
- (4) At low frequency there is temperature rise caused by ripple currents accompanying the increase in equivalent series resistance.

#### 1.2 Operating temperature and life expectancy

- (1) The capacitor life is affected by usage temperature.  
In general, the capacitor life is approximately doubled when the temperature decreases by 10 °C.  
Reduce the usage temperature as much as possible.
- (2) The use of capacitors beyond the guaranteed range may cause rapid deterioration in the characteristics and break down may occur.  
The temperature referred to here includes the ambient temperature(within equipment), including heat produced by heat generating devices (power transistors, resistors, etc.), self-heating due to ripple currents, etc. Take these factors into consideration when checking the temperature of capacitors.  
Do not place any heat generating devices, etc. on the back of capacitors.
- (3) The life acceleration can be calculated with the following equation:

$$L_2 = L_1 \times 2^{\frac{T_1 - T_2}{10}}$$

L<sub>1</sub>: Life at a temperature T<sub>1</sub> °C (h)

L<sub>2</sub>: Life at a temperature T<sub>2</sub> °C (h)

T<sub>1</sub>: Category upper limit temperature + heat generation due to ripple currents (°C)

T<sub>2</sub>: Ambient temperature to calculate the life + heat generation due to ripple currents (°C)

#### 1.3 Common application conditions to avoid

If the loads shown below are applied to a capacitor, then its characteristics may degrade rapidly or it may short-circuit. Rapid heat or gas generation may occur, which leads to the activation of the pressure valve. Electrolytes will then leak from the sealing section. In the worst case, an explosion or ignition may occur.  
When the capacitor breaks down, combustible materials (electrolytes, element fixing materials, etc.) may flow externally in all directions.

##### (1) Polarity

**Aluminum electrolytic capacitors have polarities.**

Do not apply a reversed or alternating-current voltage.

If the polarity is reversed, then short-circuiting may occur in the initial state or the pressure valve may be activated, leading to capacitor breakdown.

Check the polarity when using a polar capacitor.

If the polarity is unstable or unclear in a circuit, then use bipolar capacitors. However, bipolar capacitors cannot be used in alternating current circuits.

##### (2) Applied voltage

**Do not apply an excessive voltage (voltage exceeding the rating).**

The peak direct current voltage superposed with a ripple voltage (alternating current component) must be equal to or less than the rated voltage. A surge voltage exceeding the rated voltage is allowed and specified. However, the allowable conditions are limited and the specifications do not guarantee the application of such a surge voltage for a long time.

##### (3) Ripple current

**Do not allow an excessive current (current exceeding the rated ripple current) to pass.**

If an excessive ripple current passes through, then the amount of internally generated heat will grow, the capacitor life will be reduced, or the pressure valve will be activated, leading to breakdown.

Even if the current is equivalent to or less than the allowable level, a reversed voltage may be applied when a direct current bias voltage is low.

Use capacitors so that a reversed voltage is not applied.

(4) Charging/discharging applications

Do not use general-purpose capacitors in rapid charging/discharging circuits.

Please contact us for capacitors to be used in circuits where rapid charging/discharging is repeated.

(5) ON-OFF circuit

Do not use capacitors in circuit where ON-OFF switching is repeated more than 10000 times/per day.

In case of applying to the theses ON-OFF circuit, consult with us about circuit condition and so on.

(6) Series/parallel connection

**[Parallel connection]**

If capacitors are connected in parallel, then the balance of currents between these capacitors may be disrupted and an excessive ripple current may pass through only part of these capacitors.

Wire your circuits such that excessive ripple current does not pass through the capacitors.

**[Series connection]**

If capacitors are connected in series, then the balance of voltages between these capacitors may be disrupted and excessive voltage may be applied. Add a bleeder resistor in parallel with each capacitor. By taking leak currents into consideration the balance of voltages will not be disrupted.

(7) Electrical isolation of the capacitors

**Isolate capacitors completely in a circuit in the following cases.**

Between the housing and cathode and anode terminals and between circuit traces.

Between stand-alone non-connected terminals (for reinforcing) and cathode and anode terminals and between circuit traces.

(8) Capacitor sleeve

Exterior sleeves or lamination covering capacitors are for indication purposes only and do not guarantee electrical insulation.

#### 1.4 Capacitor mounting considerations

For aluminum electrolytic capacitors, conductive electrolysis whose main solvent is combustible organic solvent and combustible electrolytic paper is used.

If the electrolysis leaks onto a printed circuit board, then it may corrode or short-circuit the traces, leading to smoke or fire. Check the following points when designing products.

1) Double-sided circuit board

If capacitors are used in double-sided boards, then do not lay wiring traces immediately below the capacitors.

If the sealed part of a capacitor adheres to the surface of a through-hole printed circuit board, then the solder may be absorbed into the gap during dip soldering and the anode and cathode terminals may be short-circuited.

2) Circuit board hole positioning

Solder may protrude from the through-holes or holes for post-mounted component leads and damage the capacitor exterior sleeves. Be mindful of the hole positions.

3) Circuit board hole spacing

Make holes for capacitors with a gap equivalent to that of capacitor leads (terminals) during design. Otherwise, there will be stress on the capacitor leads when they are inserted into these holes, leading to current leaks, short-circuiting, or electrolysis leakage.

4) Surface-mount types

For surface-mount type capacitors, design land traces with reference to the recommended board land sizes described in the delivery specifications, etc.

5) Capacitors equipped with pressure valves

Provide a space above the pressure valve so that it can operate properly.

For capacitors equipped with a pressure valve (as per the shape and dimensional descriptions of each series), provide a space as follows. If the space is smaller than the requirements, then the pressure valve may not operate properly, leading to an explosion.

| Product diameter | Space        |
|------------------|--------------|
| φ6.3 to φ16 mm   | 2 mm or more |
| φ18 to φ35 mm    | 3 mm or more |
| φ40 mm or more   | 5 mm or more |

6) Clearance for seal mounted pressure relief vents

When the pressure valve section of a capacitor faces the printed wiring, provide a degassing hole aligned with the pressure valve position for proper operation of the valve.

7) Wiring near the pressure relief vent.

Considerations must be taken in designing circuits so that there are no traces, particularly for high-voltage or large-current wiring, above the pressure valve sections.

When a pressure valve is activated, combustible high-temperature gas exceeding 100°C will be released. Gas may condense or the wiring covers may melt and secondary accidents may occur.

8) Circuit board patterns under the capacitor.

## 2. Mounting

### 2.1 Considerations before using

- 1) Do not reuse capacitors that have been installed and energized.
- 2) Capacitors may generate transient recovery voltages. In this case, discharge them using a resistor of approx. 1 k $\Omega$ .
- 3) Capacitors stored for a long time may have a larger current leak.  
In this case, dispose the voltage using a resistor of approx. 1 k $\Omega$ .
- 4) Do not drop capacitors onto a floor, etc.  
Do not use dropped capacitors because they may be damaged mechanically or electrically.
- 5) Do not use corrupted capacitors.  
If a capacitor's seal is deteriorated, then its performance will be degraded, life reduced, and/or the electrolyte will leak.

### 2.2 Capacitor insertion

- 1) Check the capacitor ratings (capacitance and voltage) before mounting.
- 2) Check the capacitor polarity before mounting.
- 3) Check the capacitor lead and hole intervals and land size before mounting.  
If these intervals are different, then stress will be applied to the inside of the capacitor through its leads when they are inserted into the board holes, leading to short-circuiting or other failures.
- 4) When an automatic mounter is used, the force to clinch and fix capacitor leads must not be excessive.  
When capacitor leads are clinched and fixed onto a circuit board, the leads may be pulled and a large force applied to the capacitor if there are missing cogs or the gap between the clinching section and the circuit board is too small.  
If this is the case, then the capacitor may break down.  
For surface-mount type capacitors, if the mounting pressure is excessive, then current leaks may increase, short-circuiting may occur, or the capacitor may break down and come off.
- 5) Self-standing capacitors must be mounted so that they come in contact with the circuit board (do not leave it lifted).

### 2.3 Manual soldering

- 1) Solder capacitors under the soldering conditions (temperature and time) as described in the specifications or at 350 °C for three seconds or less.
- 2) If the capacitor lead terminals must be pre-processed in order to align the gaps between the terminals and holes, place them before soldering to prevent stress from being applied to the capacitor body.
- 3) If it is necessary to manually remove soldered capacitors, repair them after the solder has sufficiently melted to prevent stress from being applied to the capacitor terminals.
- 4) Do not touch the capacitor body with the soldering iron tip. Otherwise, a hole may occur on the capacitor exterior sleeve. The sleeve may break or become damaged.

### 2.4 Flow soldering

- 1) Do not immerse the capacitor body in a solder bath. The capacitor's inner pressure could increase and the capacitor will break down.
- 2) Solder capacitors under the soldering conditions (temperature and time) described in the specifications.
- 3) When soldering, do not allow other components to fall or touch the capacitors.  
When soldering, if resistors, ceramic capacitors, or other components (with a high heat conductance) fall and their lead terminals or metallic sections touch the capacitor, then local thermal stress can occur causing the capacitor's exterior sleeve to break down. This phenomenon is identical to short-circuiting.
- 4) Prevent flux from adhering to anything other than the terminals.

### 2.5 Reflow soldering for chip capacitors

- 1) Surface-mount type capacitors are exclusively for reflow soldering. When reflow solder is used an ambient heat conduction system such as the simultaneous use of infrared and hot-air is recommended (not a steam heat conduction system 'VPS').  
\* This system cannot be used for flow or dip soldering.
- 2) Soldering capacitors under the soldering conditions (pre-heating, soldering temperature and time) described in the specifications.
- 3) Reflow-solder only once.  
If you need to apply reflow soldering twice, then make sure to contact us.
- 4) Do not reuse the installed surface-mount type capacitors.
- 5) The crack on top marking might be occurred by reflow heat stress.  
But please acknowledge that it does not influence the reliability of the product.

### 2.6 Other soldering considerations

If the chip capacitor temperature becomes very high due to pre-heating or hardening of the fixing resin, then the capacitor exterior sleeve may shrink or crack. If capacitors are passed through a heat-curing furnace, then the ambient temperature must be 150°C or less and the duration must be two minutes or less.

### 2.7 Capacitor handling after soldering

- 1) Do not tilt, bring down, or twist the capacitors soldered to the printed circuit board; otherwise a torque will be generated with the capacitor circumference as the fulcrum. As a result, a large force will be applied to the inside of the element through the terminals and the capacitor may break down.
- 2) Do not hold the capacitors soldered to the printed circuit board to carry the board; otherwise the board's entire weight will be applied to the inside of the element through the terminals and the capacitor may break down.
- 3) Do not hit the capacitors soldered to the printed circuit board with foreign objects. When stacking printed circuit boards, do not hit the capacitors with circuit boards or other components (terminals, etc.)

## 2.8 Circuit board cleaning

- 1) Apply the following conditions to flux cleaning after soldering  
 Temperature: 60°C or less, duration: Five minutes or less (Ultrasonic waves may be used.)  
 However, rinse sufficiently and dry the boards (at 100°C for 20 minutes or less).  
 [Applicable solvents]  
 Pine Alpha ST-100S  
 Clean-thru 750H, 750L, or 710M  
 Aqua Cleaner 210SEP  
 Sunelec B-12  
 DK Beclear CW-5790  
 Techno Cleaner 219  
 Cold Cleaner P3-375  
 Telpen Cleaner EC-7R  
 Techno Care FRW-17, FRW-1, or FRV-1  
 Isopropyl alcohol (IPA)  
 Remarks  
 1 : If you wish to use solvents other than the above, please contact us.  
 2 : Please do not use ozone-depleting chemicals in order to protect the environment.  
 3 : Depending on the cleaning method, the marking on a capacitor may be erased or blurred.
- 2) **Avoid using the following solvent groups unless specifically allowed for in the specification**  
 Halogen solvents: Corrode the inside capacitors.  
 The solvent may enter (diffuse) inside the capacitor, decompose and cause a reaction. Then, the released chlorine ions may react with the aluminum and corrode it.  
 For capacitors for which we guarantee cleaning, use solvents under the cleaning conditions (temperature, time, etc.) described in the specifications.  
 Alkaline solvents: Corrode (melt) aluminum housings.  
 Petroleum solvents: Deteriorate sealing rubber.  
 Xylene solvents: Deteriorate sealing rubber.  
 Acetone: Erases indications.
- 3) Be sure to dry the printed circuit boards immediately after cleaning so that the solvent does not remain between the capacitor's sealed section and the circuit board.
- 4) Manage the contamination of solvents (conductance, PH, specific gravity, amount of water, etc.)  
 If the solvent is contaminated, then the chlorine concentration will become high and the inside capacitor may be corroded. Control the flux concentration against the solvent to 2 %wt or less.

## 2.9 Mounting adhesives and coating agents

- 1) If bond or coating agents are used to fix capacitors or prevent moisture, then solvents contained in these materials may corrode the capacitors. Select solvents other than halogen compounds. Do not use chloroprene-derived polymers.
- 2) If fixing or coating agents are used for capacitors, then check the following points.
  1. Do not allow flux residue or contaminants to remain between the capacitor's sealed section and the circuit board.
  2. Harden and dry bond or coating agents so that the solvents do not remain. Do not completely block the sealed section of a capacitor. (At least 1/3 of the sealed section must be exposed.)

## 2.10 Fumigation process

When electronic equipment incorporating aluminum electrolytic capacitors is exported, wooden packing materials may be fumigated using halogen compounds such as bromomethane. If drying after the fumigation process is insufficient, halogen remaining in the packing materials may be released, enter and corrode the capacitors.  
 If the fumigation process is carried out, then check carefully for remaining halogen after processing and drying.  
 Make sure not to apply the fumigation process to completely packed electronic equipment.

## 3. Precautions for Usage

- 1) This product is intended to be used for electronic equipment for general-purpose standard applications and not designed for usage in the following special environments. Therefore, when this capacitor is used in the following special environments or under special conditions, the performance may be affected. Verify the performance and reliability of the capacitor in your company before use.
  - (1) Capacitors are directly exposed to water, salt water, or oil.
  - (2) Capacitors are exposed to direct sunlight.
  - (3) Capacitors are exposed to high temperature and humidity conditions and the capacitor surface condenses.
  - (4) Capacitors are exposed to various active gases.
  - (5) Acidic or alkaline environments
  - (6) Capacitors are exposed to high-frequency induction.
  - (7) Capacitors are exposed to excessive vibrations or shocks.
- 2) A low-molecular-weight-shiroxane which is included in a silicon material shall causes abnormal electrical characteristics.
- 3) Do not touch the capacitor terminals directly.  
 If you touch the capacitor terminals, you will receive an electric shock. Do not touch the exposed aluminum sections of a capacitor, such as the pressure valve sections because they are not insulated.
- 4) Do not short-circuit the capacitor terminals.  
 Do not spill conductive solutions such as acidic or alkaline solutions on the capacitors. Otherwise, short-circuiting will occur. The circuit will malfunction and the capacitors break down.

### 4. Precautions for checks and maintenance

- 1) Periodically check the capacitors used in industrial equipment. When checking and maintaining capacitors, turn off the equipment and discharge the capacitors beforehand. In this case, do not apply stress to the capacitor lead terminals, etc.
  - 2) Periodically check the following items.
    1. Significant appearance abnormalities (deformation, electrolysis leakage, etc.)
    2. Electrical characteristics (described in the corresponding catalog or delivery specifications)
- If any abnormalities are found, then replace the capacitors or take appropriate actions.

### 5. Emergency procedures

- 1) Capacitors of a certain size or larger are equipped with a pressure valve to release excessive pressure. If the capacitor pressure valve is activated and gas becomes visible when using equipment, then turn off the equipment or unplug it. If the power is not turned off, then the short-circuited capacitors may damage the circuit or the gas may become liquefied and cause a short-circuit. In the worst case, secondary disasters such as equipment damage may occur.  
Gases released from the capacitor's pressure valve is not fume but liquefied electrolysis.
- 2) When a pressure valve is activated, a high-temperature gas exceeding 100 °C will be released. Do not place your face close to the capacitor.  
If the gas gets into your eyes or you inhale it, then immediately wash your eyes with water or gargle. If the gas comes in contact with your skin, then wash it with soap.

### 6. Long Term Storage

- 1) Leakage current of a capacitor increases with long storage times. The aluminum oxide film deteriorates as a function of temperature and time.  
If used without reconditioning, an abnormally high current will be required to restore the oxide film.  
This surge current could cause the circuit or the capacitor to fail.  
Storage period is one year. When storage period is over 12 months, a capacitor should be reconditioned by applying the rated voltage in series with a 1000  $\Omega$  current limiting resistor for a time period of 30 minutes.  
For storage condition, keep room temperature (5 °C to 35 °C) and humidity (45% to 85%) where direct sunshine doesn't reach.
- 2) Environmental Conditions
  1. Exposure to temperatures above the upper category or below the lower category temperature of the capacitor.
  2. Direct contact with water, salt water, or oil
  3. High humidity conditions where water could condense on the capacitor.
  4. Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, Chlorine compound, Bromine, Bromine compound or ammonia.
  5. Exposure to ozone, radiation, or ultraviolet rays.
  6. Vibration and shock conditions exceeding specified requirements.

### 7. Discarding

- When discarding capacitors, use either of the following procedures.
- Make holes on the capacitor or break it up completely.  
Then burn it at a temperature of 800°C or higher.  
If capacitors are burnt as is, then they may explode.
  - If you do not burn them, then ask professional waste disposer.

The precautions in using aluminum electrolytic capacitors follow the Precautionary Guidelines for the Use of Fixed Aluminum Electrolytic Capacitors for Electronic equipment, RCR-2367B issued by EIAJ in March 2002. Please refer to the above guidelines for details.