

Usage Precautions and Guidelines (Conductive Polymer Solid Type)

The M/P series product are a Conductive Polymer Solid Aluminum Capacitor that uses highly conductive polymer electrolytic material. Please read the following carefully in order to get the most out of your M & P series capacitor.

1 Designing Device Circuits

1) Types of circuit where the capacitors are not to be Used

The leakage current in conductive polymer solid aluminum capacitors may vary depending on thermal stresses that results from soldering. Avoid the use of capacitors in the following types of circuits:

- ① High-impedance circuits that are to sustain voltages.
- ② Coupling circuits
- ③ Time constant circuits

Because the capacitance varies depending on the environment the capacitors are used in, there is a possibility that the capacitor can affect a time constant circuit where sensitivity to variation in capacitance is required.

- ④ Other circuits that are significantly affected by leakage current

2) Circuit design

Verify the following before designing the circuit:

- ① The electrical characteristics of the capacitor will vary depending on differences in temperature and frequency. These factors should be considered when preparing the design.
- ② When connecting two or more capacitors in parallel, ensure that the design takes current balancing into account.
- ③ When two or more capacitors are connected in series, variability in applied voltage may cause over-voltage conditions.
Please contact us before using capacitors connected in series.
- ④ Avoid putting heat generating parts either around the capacitor or on the reverse of the circuit board.

3) Use in high reliable and Critical applications

Consult with us before using these capacitors in applications involving human life: Aviation/aerospace equipment, Nuclear power equipment, Medical equipment and Automotive equipment, or in applications where capacitor failure could have a major impact.

4) Polarity

The P series product is a polarized solid aluminum electrolytic capacitor. Do not apply either reverse voltages or AC voltages to the polarized capacitors, using reversed polarity may cause a short circuit. Refer to the catalog, product specifications or capacitor body to confirm the polarity prior to use.

5) Operating voltage

Do not apply a greater than rated voltage. If a voltage greater than the rated voltage is suddenly applied, the leakage current will increase and cause shorting. The peak voltage of superimposed AC voltages (ripple voltages) on DC voltages must not exceed the full rated voltage. While there are specifications for surge voltages exceeding the rated voltage, usage conditions apply, and continuous operation for extended periods of time under such conditions cannot be guaranteed.

6) Ripple current

Do not apply currents in excess of the rated ripple current. The superimposition of a large ripple current increases the heating rate inside the capacitor. When excessive ripple current is imposed, the increase in internal temperature can shorten life and also cause shorting.

7) Operating temperature

Use within the stated category temperature range. If used outside this range, characteristics can deteriorate and lead to potential problems.

8) Charging and Discharging the capacitor

Do not use the capacitor in circuits where the capacitor is repeatedly charged and discharged rapidly. Repeated rapid charging and discharging may reduce the capacitance or may cause damage from internal heating. The use of a protective circuit to ensure reliability is recommended when rush currents exceed 20A.

9) Leakage current

The leakage current may increase when the capacitors are subjected to the conditions below. After that, however, the leakage current will gradually decrease by self-healing action of the dielectric oxide layer when the capacitors are applied with a voltage less than the rated voltage within the Category Temperature range. As the voltage is closer to the rated voltage and the temperature is closer to the upper limit of Category Temperature range, the leakage current decreases faster.

The leakage current will increase by the following factors,

- ① Soldering
- ② Testing of high temperature exposure with no voltage applied, high temperature/humidity storage, temperature cycles, etc.

10) Failures and Service life

Based on the JIS C 5003 Standard, the failure rate for the P series capacitors (with a 60% reliability standard) is as follows:
0.5%/1,000 hours (with voltage applied at the upper limit of the Temperature Category range)

(1) Failure Modes

- ① The principal failure mode is wear-out failure, which means, capacitance decreases and ESR increases, and eventually the capacitors suffer open circuit failure. In addition, short circuit failure may happen with over-voltage and if excessive current is applied to the capacitor.
- ② The failure rate is reduced by lower ambient temperatures, ripple current and applied voltage.
- ③ If a short-circuited capacitor, the result of over-voltage (higher than the rated voltage) or other conditions, passes a large amount of current, the aluminium can of the capacitor might bulge and also expel gas.
- ④ The product contains flammable material and if the short also causes a spark it may ignite.

Please be careful with the design layout and when installing and positioning the product.

- Increase safety by using it with a protective circuit or protective equipment.
- Take measures such as the installation of redundant circuitry so that the failure of one part of the equipment will not cause unstable operation.

(2) Service Life

The P series capacitor uses rubber as the sealing material, so the service life depends on the thermal integrity of this rubber. Consequently, it is recommended the capacitor be used at a lower temperature than the maximum temperature for the category.

11) Capacitor insulation

Insulation of the capacitor's case is not guaranteed. Electrical insulation between the capacitor case, negative electrode, positive electrode and circuit tracks should be ensured.

12) Capacitor usage environment

Do not use/expose capacitors to the following conditions.

- ① Oil, water, salty water, take care to avoid storage in damp locations.
- ② Direct sunlight
- ③ Toxic gases such as hydrogen, sulfide, sulfurous acids, nitrous acids, chlorine and chlorine compounds, bromine and bromine compounds, ammonia, etc.
- ④ Ozone, ultraviolet rays and radiation.
- ⑤ Severe vibration or mechanical shock conditions beyond the limits advised in the product specification section of the catalog.

13) Capacitor mounting

- ① For the surface mount capacitor, design the solder land on the PC board in accordance with the catalog or the product specification.
- ② For radial capacitors, design the terminal holes on the PC board to fit the terminal dimension of the capacitor.
- ③ Do not pass any circuit traces beneath the seal side of a capacitor.
The trace must pass 1 to 2mm to the side of the capacitor.
- ④ Do not pass any via holes underneath a capacitor on double sided PC board
- ⑤ In designing double-sided PC boards, do not locate any copper trace under the seal side of a capacitor

2 Installing Capacitors

1) Installing

- ① Do not reuse capacitors already assembled in equipment that have been exposed to power.
- ② The capacitor may have self-charge. If this happens, discharge the capacitor through a resistor of approximately 1k before use.
- ③ If capacitors are stored at a temperature of 35°C or more and more than 75%RH, the leakage current may increase. This may also occur if the capacitors are stored for a longer period than the period which is specified in the catalog or the product specification. In this case, they can be reformed by the voltage treatment through a resistor of approximately 1k.
- ④ Verify the rated capacitance and voltage of the capacitors when installing.
- ⑤ Verify the polarity of the capacitors.
- ⑥ Do not use the capacitors if they have been dropped on the floor.
- ⑦ Do not deform the case of the capacitors.
- ⑧ Verify that the lead spacing of the capacitor fits the hole spacing in the PC board before installing the capacitors.
- ⑨ Do not apply any mechanical force in excess of the limits prescribed in the catalog or the product specification of the capacitors. Avoid subjecting the capacitor to strong forces, as this may break the electrode terminals, bend or deform the capacitor, or damage the packaging, and may also cause short/open circuits, increased leakage current, or damage the appearance. Also, note the capacitors may be damaged by mechanical shocks caused by cut the lead wire, the vacuum/insertion head, component checker or centering operation of an automatic mounting or insertion machine.

2) Heat Resistance during soldering

Ensure that the soldering conditions meet the specifications recommended by FSD-con. Note that the leakage current may increase or capacitance may decrease due to thermal stresses that occur during soldering, etc. Furthermore, the leakage current which rose gradually decreases, when voltage is applied at below the category upper limit temperature. Additionally the self-repairing action is faster when voltage near the rated voltage rather than at a higher voltage is applied at below the category's upper temperature limit.

- ① Verify the following before using a soldering iron:
 - That the soldering conditions (temperature and time) are within the ranges specified in the catalog or product specifications.
 - That the tip of the soldering iron does not come into contact with the capacitor itself.
- ② Verify the following when flow soldering:
 - Do not dip the body of a capacitor into the solder bath only dip the terminals in. The soldering must be done on the reverse side of PC board.
 - Soldering conditions (preheat, solder temperature and dipping time) should be within the limits prescribed in the catalog or the product specifications.
 - Do not apply flux to any part of capacitors other than their terminals.
 - Make sure the capacitors do not come into contact with any other components while soldering.
- ③ Verify the following when reflow soldering:
 - Soldering conditions (preheat, solder temperature and soldering time) should be within the limits prescribed in the catalogs or the product specification.
 - The heat level should be appropriate. (Note that the thermal stress on the capacitor varies depending on the type and position of the heater in the reflow oven, and the color and material of the capacitor.)
 - Please consult us about Vapor phase soldering (VPS).
 - Except for the surface mount type, reflow soldering must not be used for the capacitors.
- ④ Do not reuse a capacitor that has already been soldered to PC board and then removed. When using a new capacitor in the same location, remove the flux, etc. first, and then use a soldering iron to solder on the new capacitor in accordance with the specifications.
- ⑤ Confirm before running into soldering that the capacitors are SMD for reflow soldering.

3) Handling after soldering

Do not apply any mechanical stress to the capacitor after soldering onto the PC board.

- ① Do not lean or twist the body of the capacitor after soldering the capacitors onto the PC board.
- ② Do not use the capacitors for lifting or carrying the assembly board.
- ③ Do not hit or poke the capacitor after soldering to PC board. When stacking the assembly board, be careful that other components do not touch the aluminum electrolytic capacitors.
- ④ Do not drop the assembled board.

4) Cleaning PC board

- ① Do not wash capacitors by using the following cleaning agents. Solvent resistant capacitors are only suitable for washing using the cleaning conditions prescribed in the catalog or the product specification. In particular, ultrasonic cleaning will accelerate damage to capacitors.
 - Halogenated solvents; cause capacitors to fail due to corrosion.
 - Alkali system solvents; corrode (dissolve) an aluminum case.
 - Petroleum system solvents; cause the rubber seal material to deteriorate.
 - Xylene; causes the rubber seal material to deteriorate.
 - Acetone; erases the markings.
 CFC alternatives or the other cleaners above; please consult with us
- ② Verify the following points when washing capacitors.
 - Monitor conductivity, pH, specific gravity and the water content of cleaning agents. Contamination adversely affects these characteristics.
 - Be sure not to expose the capacitors under solvent rich conditions or keep capacitors inside a closed container. In addition, please dry the solvent sufficiently on the PC board and the capacitor with an air knife (temperature should be less than the maximum rated category temperature of the capacitor) for 10 minutes. Aluminum electrolytic capacitors can be characteristically and catastrophically damaged by halogen ions, particularly by chlorine ions, though the degree of the damage mainly depends upon the characteristics of the electrolyte and rubber seal material. When halogen ions come into contact with the capacitors, the foil corrodes when a voltage is applied. This corrosion causes an extremely high leakage current which results venting and an open circuit.
 If the new types of cleaning agents mentioned below are used, the following are recommended as cleaning conditions for some of new cleaning agents.

-Higher alcohol cleaning agents

Pine Alpha ST-100S

Clean Through 750 H, 750K, 750L, and 710M

Technocare FRW-14 through 17 (Momentive performance material)

Cleaning Conditions:

Using these cleaning agents, capacitors are capable of withstanding immersion or ultrasonic cleaning for 10 minutes at a maximum liquid temperature of 60°C. Find optimum condition for washing, rinsing, and drying. Be sure not to rub the marking off the capacitor which can be caused by contact with other components or the PC board. Note that shower cleaning adversely affects the markings on the sleeve.

-Non-Halogenated Solvent Cleaning

AK225AES (Asahi Glass)

Cleaning Conditions:

Immersion, ultrasonic or vapor cleaning for 5 minutes. However, from an environmental point of view, these types of solvent will be banned in near future. We would recommend not using them if at all possible.

-Isopropyl Alcohol (IPA)

IPA (Isopropyl Alcohol) is one of the most acceptable cleaning agents; it is necessary to maintain a flux content in the cleaning liquid at a maximum limit of 2 Wt.%.

5) Precautions for using adhesives and coating materials

- ① Do not use any adhesive and coating materials containing halogenated solvent.
- ② Verify the following before using adhesive and coating material.
 - Remove flux and dust left over between the rubber seal and the PC board before applying adhesive or coating materials to the capacitor.
 - Dry and remove any residual cleaning agents before applying adhesive and coating materials to the capacitors. Do not cover over the whole surface of the rubber seal with the adhesive or coating materials.
 - For permissible heat conditions for curing adhesives or coating materials, please consult with us.
 - Covering over the whole surface of the capacitor rubber seal with resin may result in a hazardous condition because the inside pressure cannot be completely released.
 - Also, a large amount of halogen ions in resins will cause the capacitors to fail because the halogen ions penetrate into the rubber seal and the inside of the capacitor.
 - Some coating materials, it cannot be implemented to the capacitor.
 Please note change on the surface might be caused according to the kind of solvents used for mounting adhesives and coating agents.

6) Fumigation

In many cases, wooden packaging is used when exporting or importing electronic devices, such as capacitors. It may become necessary to fumigate the shipment in order to control insects.

Precautions during "Fumigation" using halogenated chemical such as Methyl Bromide must be taken. Halogen gas can penetrate packaging materials such as cardboard boxes and vinyl bags. Penetration of the halogenated gas can cause corrosion of Electrolytic capacitors. FSD-con gives consideration to the use of packaging materials that do not require fumigation. Verify whether the assembled PC board, products and capacitors themselves will be subjected to Fumigation during shipment.

3 The Operation of Devices

- 1) Do not touch the capacitor terminals directly.
- 2) Do not short-circuit the terminal of a capacitor by letting it come into contact with any conductive object. Also, do not spill electric-conductive liquid such as acid or alkaline solution over the capacitor.
- 3) Do not use capacitors in circumstances where they would be subject to exposure to the following materials
 - . Oil, water, salty water or damp location.
 - . Direct sunlight.
 - . Ozone, ultraviolet rays or radiation.
 - . Toxic gases such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine or its compounds, and ammonium.
 - . Severe vibration or mechanical shock conditions beyond the limits prescribed in the catalog or product specification.

4 Maintenance Inspection

- 1) Make periodic inspections of capacitors that have been used in industrial applications. Turn off the power supply and carefully discharge the electricity in the capacitors before inspection. Verify the polarity when measuring the capacitors with a volt-ohm meter. Do not apply any mechanical stress to the terminals of the capacitors.
- 2) The following should be checked during periodic inspections.
 - ① Significant damage to appearance
 - ② Electrical characteristics: leakage current, capacitance, tan δ and other characteristics prescribed in the catalogue or product specification.

We recommend replacing the capacitors if the parts are out of specification.

5 Contingencies

- 1) If gas has vented from the capacitor during use, there is a short circuit and burning, or the capacitor emits an odour or smoke, turn off the main power supply to the equipment and unplug the power cord.
- 2) If there is a problem with the capacitor or a fire breaks out, the capacitor may produce a burning gas or reactive gas from the outer resin, etc. If this happens, keep your hands and face away from the gas. If vented gas comes into contact with your eyes or is inhaled, flush your eyes immediately with water and/or gargle. If vented gas comes into contact with the skin, wash the affected area(s) thoroughly with soap and water.

6 Storage

We recommend the following conditions for storage.

- 1) Store capacitors in a cool, dry place. Store at a temperature between 5 and 35°C, with a humidity of 75% or less.

	Before the bag is opened	After the bag is opened
SMD	Within 1 years after manufacturing	Within 6 months after the bag is opened
Radial	Within 2 years after manufacturing	---

SMD products are sealed in a special laminated aluminum bag. Use all capacitors once the bag is opened. Return unused capacitors to the bag, and seal it with a zipper. Please refer to above table for storage conditions. Be sure to follow our recommendations for reflow soldering.

- 2) Store the capacitors in a location free from direct contact with water, salt water, and oil.
- 3) Store in a location where the capacitor is not exposed to toxic gas, such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine or chlorine compounds, bromine or other halogen gases, methyl bromide or other halogen compounds, ammonia, or similar.
- 4) Store in a location where the capacitor is not exposed to ozone, ultraviolet radiation, or other radiation.
- 5) It is recommended to store capacitors in their original packaging wherever possible.
- 6) The JEDEC J-STD-020 standard does not apply.

7 Disposal

Please consult with a local industrial waste disposal specialist when disposing of aluminum electrolytic capacitors.

8 About AEC-Q200

The Automotive Electronics Council (AEC) was originally established by American major automotive manufactures. Today, the committees are composed of representatives from the sustaining Members of manufacturing companies in automotive electrical components. It has standardized the criteria for "stress test qualification" and "reliability test" for the electronic components. AEC-Q200 is the reliability test standard for approval of passive components, it has been specified test subjects and quantity etc. for each components. Criteria of reliability tests for Aluminum Electrolytic Capacitors are also described in this. As customer requirement, we have submitted the test results according to AEC-Q200 for the Aluminum Electrolytic Capacitors used in automotive applications. Please contact us for more information.

9 Regarding compliance for EUREACH Regulation

- 1) According to the content of REACH handbook (Guidance on requirements for substances in articles which is published on May 2008) our electronic components are "articles without any intended release". Therefore they are not applicable for "Registration" for EUREACH Regulation Article 7 (1). Reference: Electrolytic Condenser Investigation Society "Study of REACH Regulation in EU about Electrolytic Capacitor" (Publicized on 13 March 2008)
- 2) FSD-CON develops the products without substance of very high concern (SVHC). DEHP (CAS No.117-81-7), was contained as some covering material, FSD-CON abolished use of DEHP totally at June 2015.

10 Catalogs

Specifications in the catalogs are subject to change without notice. Test data shown in the catalogs are not assured as the whole performance values, but typical values. For more details, refer to JEITA/EIAJ RCR-2367B (March 2002) with the title of "Safety Application Guide for fixed aluminum electrolytic capacitors for use in electronic equipment".