

2-3. Precautions guidelines for aluminum electrolytic capacitors

1. Circuit design

- 1) Please make sure the application and mounting conditions to which the capacitor will be exposed to the conditions are within specified in catalog or alternate product specification.
- 2) Appropriate capacitors which comply with the life requirement of the products should be selected when designing the circuit.
- 3) Operating temperature and applied ripple currents shall be within the specification.
 - (1) The capacitor shall not be used in an ambient temperature which exceeds the operating temperature specified value in the specification.
 - (2) Do not apply excessive current which exceeds the allowable ripple current.
- 4) The most of the aluminum electrolytic capacitors are polarized. Make sure that no reverse voltage or AC voltage is applied to the capacitors. Please use bi-polar capacitors for a circuit that can possibly see reversed polarity.

Note : Even bi-polar capacitors can not be used for AC voltage application.

- 5) The surge voltage rating is the maximum DC overvoltage to which the capacitor may be subjected for short periods nor exceeding approximately 30 seconds at infrequent intervals not more than six minutes. Unless otherwise specified, the surge voltages are as follows:

WV	4	6.3	10	16	25	35	50	63	80	100	160	200	250	315	350	400	420	450	500	550	600
SV	5	8	13	20	32	44	63	79	100	125	200	250	300	365	400	450	470	500	550	600	650

WV : Rated voltage, SV : Surge voltage

- 6) For a circuit that repeats rapid charging & discharging of electricity, an appropriate capacitor that is capable of enduring such a condition must be used.
Welding machines and photo flash are a few examples of products that contain such a circuit. In addition rapid charging & discharging may be repeated in control servo-motors, in which the circuit voltage fluctuates substantially.
For appropriate choice of capacitors for circuit that repeat rapid charging & discharging, please contact MEC-CON.
- 7) Make sure that no excess voltage (that is, higher than the rated voltage) is applied to the capacitor.
 - (1) Please make attention so that the peak voltage, which is DC voltage overlapped by ripple current, will not exceed the rated voltage.
 - (2) In the case where more than 2 aluminum electrolytic capacitors are used in series, please make sure that applied voltage will be lower than rated voltage and the voltage will be applied to each capacitor equally using a balancing resistor in parallel with the capacitors.
- 8) Aluminum electrolytic capacitors must be electrically isolated as follows;

The aluminum case and the cathode foil are connected by the unstable resistance of naturally formed oxide layer inside the aluminum case and the electrolyte.

 - (1) Case and negative terminal
 - (2) Case and positive terminal
 - (3) Case and circuit pattern
 - (4) Case and both terminals of a bi-polarized capacitor.
- 9) Outer sleeve of the capacitor is not guaranteed as an electrical insulator. Do not use a standard sleeve on a capacitor in applications that require the electrical insulation. When the application requires special insulation, please contact our sales office for details.
- 10) Capacitors may fail if they are used under the following conditions.
 - (1) Environment conditions (climatic)
 - ① Being exposed to water, high temperature & high humidity atmosphere, or condensation of moisture.

- ② Being exposed to oil or an atmosphere that is filled with particles of oil.
- ③ Being exposed to salty water or an atmosphere that is filled with particles of salt.
- ④ In an atmosphere filled with toxic gasses (such as hydrogen sulfide, sulfurous acid, nitrous acid, chloride bromine, methyl bromide, ammonia, etc)
- ⑤ Being exposed to direct sunlight, ozone, ultraviolet ray or radiation.
- ⑥ Being exposed to acidic or alkaline solutions.

(2) Under severe conditions when vibration and mechanical shock exceed the applicable ranges of the specifications.

11) When designing a P.C board, please pay attention to the following:

- (1) Have the hole spacing on the P.C board match the lead spacing of the capacitor.
- (2) Any circuit pattern or circuit wire should not be above the capacitor pressure relief vent.
- (3) Unless otherwise specified, following clearance should be made as follows:

Case diameter	Clearance required
∅6.3 to ∅16	2mm or more
∅18 to ∅35	3mm or more
∅40 or more	5mm or more

- (4) In case the vent side is placed toward P.C board (such as end seal vented parts), make a corresponding hole on the P.C board to release the gas when vent is operated. The hole should be made to match the capacitor vent position.
- (5) Screw terminal type capacitors must be insulated with their end seal side facing up. When you install a screw terminal type capacitor lying down, the upper side must be the pressure relief vent or a positive terminal.

12) The main chemical solution of the electrolyte and the separator paper used in capacitors are combustible. The electrolyte is conductive. When it comes in contact with the P.C board, there is a possibility of pattern corrosion or short circuit between the circuit pattern which could result in smoking or catching fire.

Do not locate any circuit pattern beneath the capacitor end seal.

13) Do not design a circuit board so that heat generating components are placed near an aluminum electrolytic capacitor or reverse side of P.C board (under the capacitor).

14) Electrical characteristics may vary depending on changes in temperature and frequency. Please consider this variation when you design circuit.

15) The torque for terminal screw or brackets screws shall be within the specified value on MEC-CON's drawings.

16) When you install more than 2 capacitors in parallel, consider the balance of current flowing through the capacitors.

17) If more than 2 aluminum electrolytic capacitors are used in series, make sure the applied voltage will be lower than the rated voltage and that voltage will be applied to each capacitor equally using a balancing resistor in parallel with each capacitor.

2. Mounting

- 1) Once a capacitor has been assembled in the set and power applied. Even if a capacitor is discharged, an electric potential may exist between the terminals.
- 2) Electrical potential between positive and negative terminal may exist as a result of returned electromotive force, so please discharge the capacitor using a 1kΩ resistor.
- 3) Leakage current of the parts that have been stored for more than 2 years may increase. If leakage current has increased, please perform a voltage treatment using 1kΩ resistor.
- 4) Please confirm ratings before installing capacitors on the P.C board.
- 5) Please confirm polarity before installing capacitors on the P.C board.

- 6) Do not drop capacitors on the floor, nor use a capacitor that was dropped.
- 7) Do not damage the capacitor while installing.
- 8) Please confirm that the lead spacing of the capacitor matches the hole spacing of the P.C board prior to installation.
- 9) Snap-In can type capacitor such as JIS style symbol 692, 693, 694 and 695 type should be installed tightly to the P.C board (allow no gap between the P.C. board and bottom of the capacitor).
- 10) Please pay attention that the clinch force is not too strong when capacitors are placed and fixed by an automatic insertion machine.
- 11) Please pay attention to that the mechanical shock to the capacitor by suction nozzle of the automatic insertion machine or automatic mounter, or by product checker, or by mechanism.
- 12) Hand soldering
 - (1) Soldering condition shall be confirmed to be within the specification.
 - (2) If it is necessary that the leads must be formed due to a mismatch of the lead space the hole space on the board, bend the lead prior to soldering without applying too much stress to the capacitor.
 - (3) If you need to remove parts which were soldered, please melt the solder enough so that stress is not applied to lead.
 - (4) Please pay attention so that solder iron does not touch any portion of capacitor body.
- 13) Flow soldering (Wave solder)
 - (1) Aluminum capacitor body must not be submerged into the solder bath. Aluminum capacitors must be mounted on the "top side" of the P.C. board and only allow the bottom side of the P.C. board to come in contact with the solder.
 - (2) Soldering condition must be confirmed to be within MEC-CON specification.
 - Soldering temperature: $260 \pm 5^{\circ}\text{C}$
 - Immersing lead time: 10 ± 1 second
 - Thickness of P.C. board: 1.6mm
 - (3) Please avoid having flux adhere to any portion except the terminal.
 - (4) Please avoid contact between other components and the aluminum capacitor.
- 14) Soldering flux

There are non-halogen types of flux that do not contain ionic halides, but contain many non-ionic halides. When these non-ionic halides infiltrate the capacitor, they cause a chemical reaction that is just as harmful as the use of cleaning agents. Use soldering flux that does not contain non-ionic halides.
- 15) Shrinkage, bulging and/or cracking could be seen on the outer sleeve of the capacitor when capacitors are kept in for more than 2minutes at 150°C ambient temperature during soldering at reflow process or resin curing process. Applying high temperature gas or heat ray to capacitor can cause the same phenomenon.
- 16) Do not tilt lay down or twist the capacitor body after the capacitor are soldered to the P.C. board.
- 17) Do not carry the P.C. board by grasping the soldered capacitor.
- 18) Please do allow anything to touch the capacitor after soldering. If P.C. board are stored in a stack, please make sure P.C. board or the other components do not touch the capacitor.

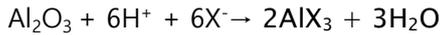
The capacitors shall not be effected by any radiated heat from the soldered P.C. board or other components after soldering.
- 19) Influence of cleaning solvent for aluminum electrolytic capacitors
 - (1) Aluminum electrolytic capacitors are easily affected by halogen ions, particularly by chloride ions. Excessive amounts of halogen ions, if happened to enter the inside of the capacitors, will be take corrosion accidents and then capacitance drop and vent open. The extent of corrosion accidents varies with kinds of electrolytes and sealing materials.
 - (2) The prevention of halogen ion contamination is the most important check point for quality lines.

At present, the organic solvent contained halogenated hydro-carbon such as Trichloroethylene, 1,1,1-Trichloroethane, and Freon are used to remove flux from circuit board. However, if general types aluminum electrolytic capacitors which seal constructions are not solvent-proof, are cleaning by such solvents, the solvents may be gradually penetrate the seal portion and electrode.

- (3) The corrosion mechanism of aluminum electrolytic capacitors by halogen ions will be exceed as follow steps. Halides(RX) are absorbed and diffused into the seal portion and electrode. The halides transfer into capacitors contact with electrolyte, and then halogen ions are made free by a hydrolysis with water in the electrolyte.



The halgen ions(x⁻) react with the dielectric substance (Al₂O₃) of aluminum electrolytic capacitors.



AlX₃ is dissociated with water.



- (4) Aluminum electrolytic capacitors have been exposed to halogenated hydrocarbon cleaning and removing of flux solvents are susceptible to attack by these solvents, this exposure can result l solvent penetration into the capacitors, leading to internal corrosion and potential failure.

- (5) Common type of halogenated cleaning agents are listed below.

Chemical Name	Structural Formula	Representative brand name
Trichlorotrifluoro ethane	C ₂ Cl ₃ F ₃	Freon TF, Daiflon S-3
Fluorotrichloro methane	CCl ₃ F	Freon-11, Daiflon S-1
1,1,1-Trichloro ethane	C ₂ H ₃ Cl ₃	Chloethane
Trichloro ethylene	C ₂ HCl ₃	Trichene
Methyl Chloride	CH ₃ Cl	MC

- (6) Recommended agents

- Based Alcohol solvent cleaning agent : Isopropyl alcohol
- Based water solvent cleaning agent
- Surfactant type cleaning agent
- Alkaline saponification agent

Note : Do not use AK225AES

- (7) Cleaning condition

Total cleaning time shall be no greater than 5minutes by immersion, ultrasonic or other method. (Temperature of the cleaning agent shall be 60°C maximum)

After the board cleaning has been completed, the capacitors should be dried using hot air for a minimum of 10 minutes. If the cleaning solution is infiltrated between the case and the sleeve, the sleeve might soften and swell when hot air temperature should not exceed softening temperature(80°C) of the sleeve.

Insufficient dries after water rinse may cause appearance problems, such as sleeve shrinking, bottom-plate bulging.

- The use of hydro-chlorofluorocarbon (HCFC) is expected to be banned in the future and MEC-CON does not recommend the use of HCFC as a cleaning agent considering its impact on the environment. When it is absolutely necessary to use HCFC, cleaning is possible under the following conditions for solvent-proof capacitors;
Within 5 minutes, total cleaning time by immersion, vapor spray, or ultrasonic.
The temperature of agent 40°C or below.

- (8) Standard aluminum electrolytic capacitors should be free halogenated solvents during P.C. board cleaning after soldering. Use solvent-proof capacitor and follow the specified cleaning condition when halogenated solvents are used.

- (9) Solvents have to well control to conductivity, pH, specific gravity, and water contents during the cleaning of solvent-proof capacitors. Chlorine levels can rise with contamination and adversely

affect the performance of the capacitor.

20) Fixing Materials and Coating Material

- (1) Do not use any affixing or coating materials, which contain halide substance.
- (2) Remove flux and any contamination, which remains in the gap between the end seal and P.C. board.
- (3) Please dry the cleaning agent on the P.C. board before using affixing or coating materials.
- (4) Please do not apply any material all around the end seal when using affixing or coating materials.

21) Others

Wooden package material may be subjected to fumigation by a halogen (methyl bromide) before they are expected in order to protect them against pests. If devices with aluminum electrolytic capacitors or capacitors themselves are directly fumigated or packed with the pallet that is fumigated, the capacitors may internally corrode due to the halogen contents of fumigation agents.

3. In the equipment

- 1) Do not directly touch terminal by hand.
- 2) Do not short between terminals with conductor, nor spill conductible liquid such as alkaline or acidic solution on or near the capacitor.
- 3) Please make sure that the ambient conditions where the set is installed not have any of the following conditions;
 - (1) Where capacitors are exposed to water, high temperature & high humidity atmosphere, or condensation of moisture.
 - (2) Where capacitors are exposed to oil or an atmosphere that is filled with particles of oil.
 - (3) Where capacitors are exposed to salty water, high temperature & high humidity atmosphere, or condensation of moisture.
 - (4) The atmosphere is filled with toxic acid gasses (ex. Hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, bromine, methyl bromide, etc)
 - (5) The atmosphere is filled with toxic alkaline gasses (ex. Ammonia)
 - (6) Where capacitors are exposed to acidic or alkaline solutions.

4. Maintenance Inspection

- 1) Please periodically inspect the aluminum capacitors that are installed in industrial equipment. The following items should be checked:
 - (1) Appearance: Remarkable abnormality such as vent operation, leaking electrolyte etc.
 - (2) Electrical characteristic: Capacitance, $\text{Tan}\delta$, leakage current, and items specified in the specification.

5. Emergency

- 1) If you see smoke due to operation of safety vent, turn off the main switch or pull out the plug from the outlet.
- 2) Do not bring your face near the capacitor when the pressure relief vent operates. The gasses emitted from that are over 100°C.
If the gas get into your eyes, please flush your eyes immediately by pure water.
If you breathe the gas, immediately wash out your mouth and throat with water.

Do not ingest electrolyte. If your skin is exposed to electrolyte, please wash it away using soap and water.

6. Storage & Use

- 1) It is recommended to keep capacitors between the ambient temperature of 5°C to 35°C and a relative humidity 75% or below.
- 2) Please make sure the ambient storage conditions will be free from the conditions that are listed in clause. 3 " In the equipment" at 3).

- 3) If the aluminum electrolytic capacitor is allowed to stand for a long time, its withstand voltage is able to drop, resulting in increase leakage current.

If the rated voltage is applied to such a capacitor, a large leakage current occurs and then generated internal heat which damaged the capacitor.

For the capacitor is allowed to stand for a long time, therefore, use it after aging voltage treatment. It is recommended to apply DC rated voltage to the capacitor for a minimum of 30minutes through 1k Ω of protective series resistor.

7. Disposal

- 1) Take either of the following methods in disposing of capacitors.
 - (1) Make a hole in the capacitor body or crush capacitors and incinerate them.
 - (2) If incineration is not applicable, hand them over to a waste disposal agent and have them buried in a landfill.
- 2) When removing a capacitor from the circuit board or when disposing of capacitor please ensure that the capacitor is properly discharged.