■ Cautions for Using Aluminum Electrolytic Capacitors

Please read the specification before using ELNA products.

The following cautions should be observed when using our aluminum electrolytic capacitors to assure their maximum stability and performance. When your application design conditions or operating conditions exceed the limit of the product specification, please contact us. If used under conditions beyond the limit of our specifications, it may cause defects such as short circuit, open circuit, leakage, explosion or combustion.

■ Cautions for usage

1. DC electrolytic capacitors are polarized.

- If used with a wrong polarity, it creates an abnormal current resulting in a short circuit or damage to itself.
- Cannot use for the circuit to which the polarity reverses by ripple voltage.

2. About use in power supply circuit.

- While aluminum electrolytic capacitors are operated electrolyte liquid inside dries up and E.S.R. (Equivalent Series Resistance) of the capacitor increases. In case operated longer than rated life time, the capacitance much decreases, tangent of loss angle and E.S.R. much increases. Therefore for some case the sum of bias direct voltage and the peak of ripple voltage is over the rated voltage of the capacitor.
- For any type of circuit, in case the sum of bias direct voltage and the peak of ripple voltage is over the rated voltage of the capacitors or in case the minimum voltage is lower than 0 (zero) volt, the voltage control for the capacitors shall be provided.

3. About applied voltage.

- Do not apply a voltage that exceeds the rated voltage because the leakage current will increase significantly, causing characteristic deterioration and short-circuit failure.
  When applying ripple current, the peak value of the ripple voltage must not exceed the rated voltage.
  Surge voltage exceeding the rated voltage is not guaranteed to be used for a long time due to limited conditions.
- Do not apply reverse voltage
  (DC bias + ripple voltage peak sum ≦ 0V).

4. About use in circuits with rapid charging and discharging.

- Please do not use in circuits that repeatedly charge and discharge rapidly. This may result in deterioration of characteristics, short circuits, or destruction. Please consult us separately if you are considering using the capacitor in a circuit that repeatedly charges and discharges.
  In addition, we recommend using a protection circuit if the usage method causes a rush current of more than 10A to flow into the capacitor.

5. Use within the rated ripple current.

- If applied ripple current exceeds rated ripple current, the life of the capacitor may be shortened, or in an extreme case it gets destroyed due to its internal heat. Use high-ripple type capacitors for such circuits.

6. Changes in characteristics due to operating temperature.

- The characteristics of an electrolytic capacitor will change with a change in the temperature. Such changes are temporary and the original characteristics will be restored at the original temperature (if the characteristics are not deteriorated by remaining at a high temperature for a long time). If used at a temperature exceeding the guaranteed temperature range, the capacitor may be damaged due to the increased leakage current. Pay attention to the capacitor temperature being affected by the ambient temperature of the unit, the temperature inside the appliance, the heat radiated by another hot component in the unit and the heat inside the capacitor itself due to the ripple current.
  (1)The rated capacitance is normally shown as the value at 20°C-120Hz. It increases as the temperature raises and decreases as it lowers.
  (2)The tangent of loss angle (tanδ) is normally shown as the value at 20°C-120Hz. It decreases as the ambient temperature gets high and increases as it gets low.
  (3)The equivalent series resistance (ESR) and Impedance is normally shown as the value at 20°C-100kHz. It decreases as the ambient temperature gets high and increases as it gets low.
  (4)The leakage current increases as the temperature gets high and decreases as it gets low.

7. Changes in the characteristics due to frequency.

- The characteristics of an electrolytic capacitor will change according to the change in the operating frequency.
  (1)The rated capacitance is normally shown as the value at 20°C-120Hz. It decreases as the frequency increases.
  (2)The tangent of loss angle (tanδ) is normally shown as the value at 20°C-120Hz. It increases as the frequency gets high.
  (3)The equivalent series resistance (ESR) and Impedance is normally shown as the value at 100kHz 20°C. It increases as the frequency lowers.

8. Capacitor life

- The life of the capacitor terminates when it fails due to the deterioration in its electronic characteristics. Temperature and the ripple current since they especially affect the life on technical note “2. About the Life of an Aluminum Electrolytic Capacitor” of this catalog.

9. Restrictions on the using environment

- Do not use capacitors in an environment directly exposed to water, saltwater spray, oil spill or condensation.

- Do not use capacitors in an environment filled with toxic gas such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, ammonia, etc.
- Do not use capacitors in a place exposed to ozone, ultraviolet rays, or radiation.
- Do not use the product in harsh environments where the vibration or shock conditions exceed the range specified in the technical specifications.
  Even within the specified range, resonance can add a large load, which may cause changes in characteristics or the product to fall off. Be sure to check for resonance after mounting the product.

10. Fumigation Process

- When exporting electronic equipment abroad, fumigation process may be performed on wooden packaging material with a halogen (compound) gas such as methyl bromide. Exercise care as this halogen gas may corrode capacitors. Also, use caution to epidemic preventive agent as corrosive component such as halogen may be contained.

11. Insulation between the capacitor case and the cathode terminal.

- The case and the cathode terminal are not insulated as being connected through inconstant resistance.

12. Double-sided PCB's

- When you use electrolytic capacitors on a double sided PCB, be careful not to have the circuit pattern run under where the capacitor is mounted. Otherwise it may cause a short circuit on the PCB depending on the condition of mounting.

13. Short time leakage current

The leakage current of the capacitor varies depending on the temperature, applied voltage, and applied time.
Particularly, Short-term leakage currents of less than the specified time tend to be larger than the specified value.
For short-term leakage current less than the specified time, please contact us.

14. Regarding to connection of capacitors

- Aluminum electrolytic capacitor has electrolyte liquid so that the most portion of electric loss characteristics came from E.S.R(Equivalent Series Resistance) of electrolyte liquid. Therefore the capacitor is an electronic devise which can flow high ripple current in case the temperature increases and it decreases E.S.R.
  In case connecting two capacitors or more, E.S.R. of the capacitors is close to the resistance of the circuit. Therefore in case current is unbalanced and some capacitors has high ripple current, temperature increase, it makes more high current and finally it is over the rated ripple current.
  For parallel connection of capacitors the proper design of electric circuit such as balancing of each capacitors resistance or control of total ripple current shall be provided to avoid excess ripple current and voltage.
- When connecting two or more capacitors in series, take into consideration the balance of the voltage applied to the capacitors and place a partial pressure resistor in parallel with each capacitor so that the voltage applied to each capacitor is below the rated voltage.

15. Use at a high altitude

- The use of capacitors at high altitudes such as on an airplane causes a large difference between the internal pressure of the capacitors and the atmospheric pressure. However, there is no problem in use under atmospheric pressure up to about an altitude of 10,000 meters. Please check the operation of electronic equipment at the operating environmental temperature because the temperature lowers with increased altitude.
  If the condition is severe like space, please contact us.

16. Hole pitch adjustment of the PCB to the capacitors.

- Set the hole pitch of the PCB to the lead pitch (the "F" distance in this catalog) of the capacitor. Be careful since a short circuit, a cut or an increase in the leakage current etc. may be caused by the stress given to the lead wire terminals due to the difference between the hole pitch and the lead pitch.

17. Capacitors with pressure valves.

- A part of the capacitor case is made thin to have the function as the pressure valve in order to pre vent explosion due to the rise of inside pressure when a reverse or excessive voltage is applied to the capacitor. Once it has worked as a valve, the whole capacitor needs to be replaced since the valve will not restore.
- When you use a capacitor with pressure valve, provide certain space above the pressure valve as below to prevent an interference when it works as a valve.

Diameter of the capacitor (mm)	18 or less
Required space above the valve (mm)	2.0 or more

18. NC terminal (the supplemental terminal) (series RPK)

- Since NC terminal is not insulated. It should be mounted at a position electronically independent from all other parts of the circuit.

19. External sleeve

- During a preheating or a hardening of mounting adhesive may cause a sleeve cracked. The capacitors are usually sleeved with poly vinyl chloride or poly ethylene terephthalate for the indication purpose only. Please do not consider it as an insulation.

■ Cautions for Mounting usage

1. Cautions for mounting.

- Do not reuse capacitors that have been assembled in a set and energized. Capacitors cannot be reused except for those which have been measured on electrical performance during periodic inspection.
- Check the ratings (electrostatic capacitance and rated voltage) of the capacitor before mounting.
- Transient recovery voltage may be generated in the capacitor due to dielectric absorption. If required, this voltage can be discharged with a resistor with a value of about 1 kΩ.
- Check the polarity of the capacitor to the chassis.
- Do not drop the capacitor to the floor. Do not use the dropped capacitor.
- Do not deform the capacitor for mounting.
- Do not mount heating parts around capacitors and on the back of the PCB (under or back of capacitors).

2. Do not apply excessive pressure to the capacitor, its terminals or lead wires.

- Make sure that the contact path of the capacitor meets the hole pitch of the PCB before mounting.• Do not set the automatic insertion machine to clinch the capacitor lead wires too strong.
- Pay attention to the impact given by the component receptacles of the automatic insertion/mounting machines and the product checker, and from the centering operation.

3. Soldering.

- Do not dip the capacitor into melted solder.
- The soldering conditions.
  About detail conditions are described in this catalog “Soldering conditions” page or the technical specifications.
- Do not flux other part than the terminals.
- If there is a direct contact between the sleeve of the capacitor and the printed circuit pattern or a metal part of another component such as a lead wire, it may cause shrinkage of crack.
- When you use the capacitor with its sleeve touching directly to the PCB, excessive solder temperature or excessive soldering time may cause the sleeve to shrink or crack during the heat.
- If the application is for extended use, understand and manage the soldering characteristics to avoid abnormal current caused by a contact failure between the capacitor and the PCB.
- Reflow soldering
  Reflow the capacitors within recommended reflow soldering conditions. Verify there is no temperature stress to the capacitors because the following differences might degrade capacitors electrically and mechanically.
- Caution for reflow soldering
  1)Location of components : Temperature increases at the edge of PC board more than the center.
  2)Population of PC board : The lower the component population is, the more temperature rises.
  3)Material of PC board : A ceramic-made board needs more heat than a glass epoxy-made board. The heat increase may cause damage to the capacitors.
  4)Thickness of PC board : A thicker board needs more heat than a thinner board. The heat may damage the capacitors.
  5)Size of PC board : A larger board needs more heat than a smaller board. The heat may damage the capacitors.
  6)Solder paste thickness
  If thin solder paste is to be used compared recommend solder paste thickness, please consult with us.
  7)Location of infrared ray lamps : IR reflow as well as hot plate reflow heats only on the reverse side of the PC board to lessen heat stress to the capacitors.
  8)Case leakage current will increase (about several mA at the maximum) after the reflow process, the leakage current which rose gradually decreases when voltage is applied.
  9)Please consult us about vapor phase soldering (VPS).
- Rework of soldering
  Use a soldering iron for rework. Do not exceed an iron tip temperature of 400±5°C and an exposure time of 3^{+1}_{0} seconds.

4. Handling after soldering

- After soldering, applying mechanical stress to the capacitor may cause it to fail. Do not tilt, twist or push down the capacitor body, and do not bending the PC board.
- After soldering, do not hold the capacitor as a handle to carry the PCB.
- After soldering, do not hit the capacitor with any obstacle. If PCB’s are piled up for storage, the capacitor should not touch another PCB or component.

5. Cleaning after Soldering

- Recommended cleaning method
  (1)cleaning solutions:
  (a) CLEANTHROUGH 710M, 750H, 750L
  (b) PINEALPHA ST-100S
  (2)Cleaning conditions:
  (a) The temperature of cleaning solution shall be less than 60°C.
  (b) Use immersion or ultrasonic waves within two minutes.
  (c) After cleaning, capacitors and PCB’s shall thoroughly be rinsed and dried with hot blast for more than 10 minutes. The temperature of such breeze should be less than the upper category temperature.
  (d) After cleaning, do not keep capacitors in cleaning solution atmosphere or airtight containers.
- During cleaning, control the cleaning solution against contamination.

6. Fixing adhesives and coating materials.

- Do not use fixing adhesive or coating material containing halogen-based solvent.
- Before applying the fixing adhesive or the coating material, make sure that there is no remaining flux or stains between the PCB and the sealed part of the capacitor.
- Before applying the fixing adhesive or the coating material, make sure that the detergent etc. has dried up.
- Do not cover the whole surface of the sealed part (terminal side) of the capacitor with the fixing adhesive or the coating material.
- Observe the description in this catalog or the technical specifications concerning the thermal stiffening conditions of the fixing adhesive or the coating material. (If there is no such description, contact us.) When both discrete and SMT components are on the same PCB, the fixing material for the SMT components may cause crack, tear or shrinkage on the external sleeve depending on the thermal stiffening condition.
- Recommended fixing adhesives and coating materials
  Fixing adhesives : Cemedine 1500
  Diabond DN83K
  Bond G103
  Coating materials : HumiSeal 1B66NS, 1A27NS

■ Other Cautions

1. Do not touch capacitor terminals with bare hands.

- You may get electric shock or your hand may be burnt. Discharge it with a 1 KΩ resistance before use if necessary.

2. Do not short the capacitor terminals with a conductor.

- Do not spill conductive solution including acid or alkaline solution on the capacitor.

3. Periodic inspection should be performed on the capacitors for the Industrial equipment application.

- The following items should be checked:
  (1)Appearance : Check if there is any open valve or leakage.
  (2)Electronic performance: Check the leakage current, the electrostatic capacitance, the tangent of loss angle, the equivalent series resistance (ESR), Impedance and other items described in this catalog or the technical specifications.

4. Take the following measures in case of emergency.

- If you see gas coming out of the capacitor valve when the set is in operation, turn off the power switch of the unit or unplug the power cord from the outlet.
- In case of a short, producing gas, it may take a few seconds to a few minutes depending on the conditions. Therefore, ensure that the protective circuit of the power supply works during this time.
- Keep your face away from the capacitor pressure valve, since the high temperature gas at over 100°C bursts out when the valve works. If the gas gets into your eyes or your mouth, wash your eyes or your mouth. Do not ingest the capacitor electrolyte. If the electrolyte gets on your skin, wash it out with soap.

5. Storing conditions.

- Avoid high temperature, high humidity and direct rays when storing capacitors. Keep the storing temperature at 5˚C to 35˚C and the relative humidity not more than 75%. (Recommended storage term: 2year or less after delivery)
- There may have increased leakage current when unused or stored for a long time after mounted on equipment. This phenomenon often occurs at high ambient temperatures; however, leakage current will decrease through voltage treatment.
  If necessary, treatment by voltage application should be made on the capacitors which have been stored for a long period (more than 2 years after production).
  Recommended voltage treatment conditions are provided for each series (According to JIS C5101-4 4.1 described in Shelf life).
  If anything is unclear, please contact us.
  And also, in design of equipment, consider the effect of increase in initial current, and install protective circuits as needed.
- Do not store capacitors in an environment directly exposed to water, saltwater spray, oil spill or condensation. JEDEC-J-STD-020 regulations are not applicable.
- Do not store capacitors in an environment exposed to the air contains dense hazardous gas. (hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, ozone, ammonia, etc.)
- Do not store capacitors at a place where it gets ultraviolet or radioactive rays.
- Fumigation treatment with toxic gas covering the whole wooden container frames as moth proofing during shipment may leave residual toxic gas.

6. Please take the following actions when disposing of capacitors.

- Entrust to specialists of industrial waste treatment for incineration.

7. Other notes.

- Please refer to the following literature for anything not described in this catalog and the technical specifications.

  Technical Report of Japan Electronics and Information Technology Industries Association
  EIAJ RCR-2367
  Guideline of notabilia for fixed aluminum electrolytic capacitors for use in electronic equipment