TO: DIGIKEY, USA

Issue No.	:	**EA-04-01-16-01S**
Date of Issue	:	**16th. January, 2004**
Classification	:	■ New ☐ Changed ☐ Revised

PRODUCT SPECIFICATION

Product Description	:	Aluminium Electrolytic Capacitor
Product Part Number	:	**ECA1CKS470U**
		( )
Country of Origin	:	Malaysia / Japan
Marking of the Origin	:	Printed on the packaging label
Classification of Spec.	:	Product specification
Applications	:	**Distribution**
		For other application, contact our person signed below.
Term of Validity	:	**15th. January, 2009 from the date of issue**

CUSTOMER USE ONLY	Receipt Record # :
This was certainly received by us. One copy is being returned to the manufacturer within 2 months from the date of issue. If not, it shall be considered as accepted.	Date of Receipt Received by :

- This capacitor is designed to be used for electronics circuits of, such as, audio/visual equipment, home appliances, computers and other office equipment, optical equipment, measuring equipment and industrial robots.
- No Ozone Depleting Chemicals (ODC's), controlled under the Montreal Protocol Agreement, are used in producing this product.
- This product does not contain PBBOs or PBBs.
- All the materials that are used for this product are registered as "Known Chemicals" in the Japanese act "Law Concerning the Examination and Regulation of Manufacture, etc. of Chemical Substances".
- This product is not subject to the control under Foreign Exchange and Foreign Trade Control Law of Japan as one of the strategic products.

Matsushita Electronic Devices (M) Sdn. Bhd.
No.1 Jalan Pelaga 16/13, 40000 Shah Alam,
Selangor Darul Ehsan, MALAYSIA.
(P.O. Box 7720, Pejabat Pos Besar Shah Alam,
40724 Shah Alam, Selangor Darul Ehsan.)

Prepared by: Customer Engineering, R&D Center		
Approved	Checked	Prepared
YAMADA	S.C.LEE	H.L.LEE

Contents

Remark

MINIATURE ALUMINIUM ELECTROLYTIC CAPACITOR SPECIFICATION SHEET

Customer Part No.		
Matsushita Part No.	ECA1CKS470U	
Based on Specification	Unless otherwise mentioned below, It shall be based on JIS-5141 Characteristic (W) Grade (Y)	Operating Temperature Range: -40 ~ +85 °C

Rated Capacitance	47	μF a 120 Hz +20°C
Capacitance Tolerance	-20 ~+ 20	% at +20°C
Rated Working Voltage	16	V.D.C.
Surge Voltage	20	V.D.C.
Tan δ	0.16	max. at 120Hz +20°C
Leakage Current	7.52	μA max. after 2 minutes
Ripple Current	39	mA max. r.m.s. at 120 Hz +85 °C

Endurance

The capacitor shall be subjected to application of the D.C. voltage with full rated ripple current in an ambient temperature of +85°C±2°C for a period of 1000 hours. After stability at +20°C, the capacitor shall not exceed the specified values listed below. (The sum of D.C. voltage and ripple peak voltage shall not exceed the rated working voltage).

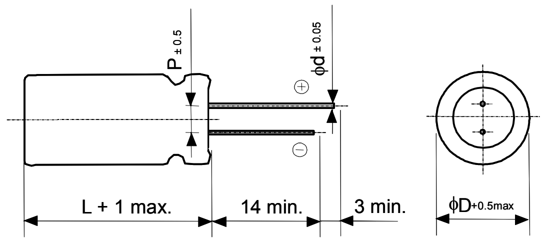
Capacitance Change	Within - 20 ~ + 20 % of the initial measured value
Tan δ	Less than 200 % of the initial specified value
D.C. Leakage Current	Less than initial specified value

Shelf Life Test

The capacitor shall be held at +85°C ±2°C for 1000 hours with no voltage applied. After stability at +20°C, the capacitor shall not exceed the specified values listed in Endurance (with voltage treatment).

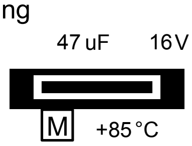
Dimension (unit:mm)

Fig. 1



ϕD	5
L	5
P	2
ϕd	0.45

Marking



Note

Remark/ Revision

Issue Date	31-Oct-03	MATSUSHITA ELECTRONIC DEVICES (M) SDN. BHD. No.1,Jalan Pelaga 16/13, 40000 Shah Alam, Selangor D.E.
Revision Date		

1. Circuit design

1.1 Operating Temperature and Frequency

Electrolyte capacitor electrical parameters are normally specified at 20°C temperature and 120Hz frequency. These parameters vary with changes in temperature and frequency. Circuit designers should take these changes into consideration.

(1) Effects of operating temperature on electrical parameters

a) At higher temperatures, leakage current and capacitance increase while equivalent series resistance (ESR) decreases.

b) At lower temperatures, leakage current and capacitance decrease while equivalent series resistance (ESR) increases.

(2) Effects of frequency on electrical parameters

a) At higher frequencies, capacitance and impedance decrease while tan δ increases.

b) At lower frequencies, ripple current generated heat will rise due to an increase in equivalent series resistance (ESR).

1.2 Operating Temperature and Life Expectancy

(1) Expected life is affected by operating temperature. Generally, each 10°C reduction in temperature will double the expected life. Use capacitors at the lowest possible temperature below maximum guaranteed temperature.

(2) If operating temperatures exceed the maximum guaranteed limit, rapid electrical parameter deterioration will occur, and irreversible damage will result.
Check for maximum capacitor operating temperatures including ambient temperature, internal capacitor temperature rise caused by ripple current, and the effects of radiated heat from power transistors, IC's or resistors.

(3) The formula for calculating expected life at lower operating temperatures is as follows :

$$L2 = L1 \times 2^{\frac{T1-T2}{10}}$$

L1 : Guaranteed life (h) at temperature, T1 °C
L2 : Expected life (h) at temperature, T2 °C
T1 : Maximum operating temperature (°C)
T2 : Actual operating temperature, ambient temperature + temperature rise due to ripple current heating (°C)

1.3 Common Application Condition To Avoid

The following misapplication load conditions will cause rapid deterioration to capacitor electrical parameters. In addition, rapid heating and gas generation within the capacitor may occur causing the pressure relief vent to operate and resulting leakage of electrolyte. Under extreme conditions, explosion and fire may result.

Leaking electrolyte is combustible and electrically conductive.

(1) Reverse voltage
DC capacitors have polarity. Verify correct polarity before insertion. For circuits with changing or uncertain polarity, use DC bi-polar capacitors. DC bi-polar capacitors are not suitable for use in AC circuits.

(2) Charge/Discharge Applications
Standard capacitors are not suitable for use in repeating charge/discharge applications. For charge/discharge application, consult us and advise actual conditions.

(3) Overvoltage
Do not apply voltages exceeding the maximum specified rated voltage. Voltages within the surge voltage rating are acceptable for short periods of time. Ensure that the sum of the DC voltage and the superimposed AC ripple voltage does not exceed the maximum specified rated voltage.

(4) Ripple Current
Do not apply ripple currents exceeding the maximum specified value. For high ripple current applications, use a capacitor designed for high ripple currents or contact us with your requirements. Ensure that allowable ripple currents superimposed on low DC bias voltage do not cause reverse voltage conditions.

1.4 Using Two or More Capacitor in Series or Parallel

(1) Capacitors Connected in Parallel
The circuit resistance can closely approximate the series resistance of the capacitor causing an imbalance of ripple current loads within the capacitors. Careful design of wiring methods can minimize the possibility of excessive ripple currents applied to a capacitor.

(2) Capacitor Connected in Series
Normal DC leakage current differences among capacitors can cause voltage imbalances. The use of voltage divider shunt resistors with consideration to leakage currents, can prevent capacitor voltage imbalances.

1.5 Capacitor Mounting Considerations

(1) Double-sided Circuit Boards
Avoid wiring pattern runs which pass between the mounted capacitor and the circuit board. When dipping into a solder bath, excess solder may collect under the capacitor by capillary action and short-circuit the anode and cathode terminals.

(2) Circuit Board Hole Positioning
The vinyl sleeve of the capacitor can be damaged if solder passes through a lead hole for subsequently processed parts. Special care when locating hole positions in proximity to capacitors is recommended.

(3) Circuit Board Hole Spacing
The circuit board hole spacing should match the capacitor lead wire spacing within the specified tolerances. Incorrect spacing can cause excessive lead wire stress during the insertion process. This may result the premature capacitor failure doe to short or open circuit, increased leakage current, or electrolyte leakage.

(4) Clearance for Case Mounted Pressure Relief Vents
Capacitor with case mounted pressure relief vents requires sufficient clearance to allow for proper vent operation. The minimum clearances are dependent on capacitor diameters as follows :
ϕ6.3 ~ ϕ16mm : 2mm minimum, ϕ18 mm : 3mm minimum

(5) Clearance for Seal Mounted Pressure Relief Vents
A hole in the circuit board directly under the seal vent location is required to allow proper release of pressure.

(6) Wiring Near the Pressure Relief Vent
Avoid locating high voltage or high current wiring or circuit board paths above the pressure relief vent.
Flammable, high temperature gas exceeding 100°C may be released which could dissolve the wire insulation and ignite.

(7) Circuit Board Patterns Under the Capacitor
Avoid circuit board runs under the capacitor as electrolyte leakage could cause an electrical short.

(8) Screw Terminal Capacitor Mounting
Do not orient the capacitor with the screw terminal side of the capacitor facing downwards. Tighten the terminal and mounting bracket screws within the torque range specified in the specification.

1.6 Electrical Isolation of the Capacitor

Completely isolate the capacitor as follows :
(1) Between the cathode and the case (except for axially leaded B types) and between the anode terminal and other circuit paths.
(2) Between the extra mounting terminals (on T types) and the anode terminal, cathode terminal, and other circuit paths.

1.7 Capacitor Sleeve

The vinyl sleeve or laminate coating is intended for marking and identification purposes and is not meant to electrically insulate the capacitor.
The sleeving may split or crack if immersed into solvents such as toluene or xylene, and then exposed to high temperature.

CAUTION!!!!
Always consider safety when designing equipment and circuits. Plan for worst case failure modes such short circuits and open circuits which could occur during use.
(1) Provide protection circuits and protection devices to allow safe failure modes.
(2) Design redundant or secondary circuits where possible to assure continued operation in case of main circuit failure.

2. Capacitor Handling Techniques

2.1 Consideration Before Using
(1) Capacitors have a finite life. Do not reuse or recycle capacitors from used equipment.
(2) 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.
(3) Capacitors stored for long periods of time may exhibit an increase in leakage current. This can be connected by gradually applying rated voltage in series with a resistor of approximately 1 kΩ.
(4) If capacitors are dropped, they can be damaged mechanically or electrically. Avoid using dropped capacitors.
(5) Dented or crushed capacitors should not be used. The seal integrity can be compromised and loss of electrolyte/shortened life can result.

2.2 Capacitor Insertion

(1) Verify the correct capacitance and rated voltage of the capacitors.
(2) Verify the correct polarity of the capacitor before inserting.
(3) Verify the correct pole spacing before insertion (land pattern size in chip type) to avoid stress on the terminals.
(4) Ensure that the auto insertion equipment lead clinching operation does not stress the capacitor leads where they enter the seal of the capacitors. For chip type capacitors, excessive mounting pressure can cause high leakage current, short circuit, or disconnection.

2.3 Manual Soldering

(1) Observe temperature and time soldering specifications and do not exceed temperatures of 350°C for 3 seconds or less.
(2) If lead wires must be formed to meet terminal board hole spacing, avoid stress on the lead wire where it enters the capacitor seal.
(3) If a soldered capacitor must be removed and reinserted, avoid excessive stress to the capacitor leads.
(4) Avoid touching the tip of the soldering iron to the capacitor, to prevent melting of the vinyl sleeve.

2.4 Flow Soldering

(1) Do not immerse the capacitor body into the solder bath as excessive internal pressure could result.
(2) Observe proper soldering conditions (temperature, time, etc.). Do not exceed the specified limits.
(3) Do not allow other parts or components to touch the capacitor during soldering.

2.5 Other Soldering Consideration

Rapid temperature rises during the preheat operation and resin bonding operation can cause cracking of the capacitor vinyl sleeve.
For heat curing, do not exceed 150°C for a maximum time of 2 minutes.

2.6 Capacitor Handling after Soldering

(1) Avoid movement of the capacitor after soldering to prevent excessive stress on the lead wires where they enter the seal.
(2) Do not use the capacitor as a handle when moving the circuit board assembly.
(3) Avoid striking the capacitor after assembly to prevent failure due to excessive shock.

2.7 Circuit Board Cleaning

(1) Circuit boards can be immersed or ultrasonically cleaned using suitable cleaning solvents for up to 5 minutes and up to 60°C maximum temperatures. The boards should be thoroughly rinsed and dried.
The use of ozone depleting cleaning agents are not recommended in the interest of protecting the environment.
(2) Avoid using following solvent groups unless specifically allowed for in the specification :
Halogenated cleaning solvent except for solvent resistant capacitor types, halogenated solvents can permeate the seal and cause internal capacitor corrosion and failure. For solvent resistant capacitors, carefully follow the temperature and time requirements for the specification. 1-1-1 trichloroethane should never be used on any aluminium electrolytic capacitor.
- Alkali solvent : could attack and dissolve aluminium case.
- Petroleum based solvent : deterioration of the rubber seal could result.
- Xylene : deterioration of the rubber seal could result.
- Acetone : removal of the ink markings on the vinyl sleeve could result.

(3) A thorough drying after cleaning is required to remove residual cleaning solvents which maybe trapped between the capacitor and the circuit board. Avoid drying temperatures which exceed the maximum rated temperature of the capacitor.
(4) Monitor the contamination levels of the cleaning solvents during use by electrical conductivity, pH, specific gravity, or water content. Chlorine levels can rise with contamination and adversely affect the performance of the capacitor.

2.8 Mounting Adhesives and Coating Agents

When using mounting adhesives or coating agents to control humidity, avoid using materials containing halogenated solvents. Also, avoid the use of chloroprene base polymers.
After applying adhesives or coatings, dry thoroughly to prevent residual solvents from being trapped between the capacitor and the circuit board.

3.0 Precaution for using Capacitors

3.1 Environmental Conditions

Capacitors should not be stored or used in the following environments.
(1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitors.

(2) Direct contact with water, salt water, or oil.
(3) High humidity condition where water could condense on the capacitor.
(4) Exposure to toxic gases such as hydrogen sulphide, sulphuric acid, nitric acid, chlorine, or ammonia.
(5) Exposure to ozone, radiation, or ultraviolet rays.
(6) Vibration and shock conditions exceeding specified requirements.

3.2 Electrical Precaution

(1) Avoid touching the terminals of the capacitor as possible electric shock could result. The exposed aluminium case is not insulated and could also cause electric shock if touched.
(2) Avoid short circuiting the area between the capacitor terminals with conductive materials including liquids such as acids and alkaline solutions.

4.0 Emergency Procedures

(1) If the pressure relief vent of the capacitor operates, immediately turn off the equipment and disconnect from the power source. This will minimize additional damage caused by the vaporizing electrolyte.
(2) Avoid contact with the escaping electrolyte gas which exceeds 100°C temperatures. If electrolyte or gas enters the eye, immediately flush the eye with large amount of water. If electrolyte or gas is ingested by mouth, gargle with water. If electrolyte contacts the skin, wash with soap and water.

5.0 Long Term Storage

Leakage current of a capacitor increases with long storage times. The aluminium 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 current surge could cause the circuit or the capacitor to fail. In-order to keep the capacitor life, we recommend the capacitor store in-doors and temperature between 5°C ~ 35°C. Expiry date of capacitor shall be according to product model or type. Please consult us concerning the product life model by model. After storing exceeding the expiry date of the product, a capacitor should be reconditioned by applying rated voltage in series with a 1000Ω, current limiting resistor for a time period of 30 minutes.

5.1 Environmental Conditions

(1) Temperature exposure above the maximum rated or below the minimum rated 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 sulphide, sulphuric acid, nitric acid, chlorine, or ammonia.
(5) Exposure to ozone, radiation, or ultraviolet rays.
(6) Vibration and shock conditions exceeding specified requirements.

6.0 Capacitor Disposal

When disposing of capacitors, use on of the following methods :
(1) Incinerate after crushing the capacitor or puncturing the can wall (to prevent explosion due to internal pressure rise). Capacitors should be incinerated at high temperature to prevent the release of toxic gases such as chlorine from the polyvinyl chloride sleeve, etc.
(2) Disposal of solid waste.

NOTE : Local laws may have specific disposal requirements which must be followed.