

## Notices

### ■ Applicable Laws and Regulations

- This product complies with the RoHS Directive (Restriction of the use of certain Hazardous substances in electrical and electronic equipment (DIRECTIVE 2011/65/EU).
- No Ozone Depleting Chemicals(ODC's), controlled under the Montreal Protocol Agreement, are used in producing this product.
- We do not PBBs or PBDEs as brominated flame retardants.
- Export procedure which followed export related regulations, such as foreign exchange and a foreign trade method, on the occasion of export of this product Thank you for your consideration.

### ■ Limited applications

- This capacitor is designed to be used for electronics circuits such as audio/visual equipment, home appliances, computers and other office equipment, optical equipment, measuring equipment.
- High reliability and safety are required [ be / a possibility that incorrect operation of this product may do harm to a human life or property ] more. When use is considered by the use, the delivery specifications which suited the use separately need to be exchanged.

## Items to be observed

- This specification guarantees the quality and performance of the product as individual components. Before use, check and evaluate their compatibility with installed in your products.
- Do not use the products beyond the specifications described in this document.

### ■ For specifications

- Install the following systems for a failsafe design to ensure safety if these products are to be used in equipment where a defect in these products may cause the loss of human life or other signification damage, such as damage to vehicles (automobile, train, vessel), traffic lights, medical equipment, aerospace equipment, electric heating appliances, combustion/ gas equipment, rotating rotating equipment, and disaster/crime prevention equipment.
  - The system is equipped with a protection circuit and protection device.
  - The system is equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault.

### ■ Conditions of use

- Before using the products, carefully check the effects on their quality and performance, and determined whether or not they can be used. These products are designed and manufactured for general-purpose and standard use in general electronic equipment. These products are not intended for use in the following special conditions.
  - (1) In liquid, such as Water, Oil, Chemicals, or Organic solvent.
  - (2) In direct sunlight, outdoors, or in dust.
  - (3) In vapor, such as dew condensation water of resistive element, or water leakage, salty air, or air with a high concentration corrosive gas, such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, or NO<sub>x</sub>.
  - (4) In an environment where strong static electricity or electromagnetic waves exist.
  - (5) Mounting or placing heat-generating components or inflammables, such as vinyl-coated wires, near these products.
  - (6) Sealing or coating of these products or a printed circuit board on which these products are mounted, with resin and other material.
  - (7) Using solvent, water or water-soluble cleaner for flux cleaning agent after soldering. (In particular, when using water or a water-soluble cleaning agent, be careful not to leave water residues)
  - (8) Using in the atmosphere which strays Acid or alkaline.
  - (9) Using in the atmosphere which there are excessive vibration and shock.
- Please arrange circuit design for preventing impulse or transitional voltage. Do not apply voltage, which exceeds the full rated voltage when the capacitors receive impulse voltage, instantaneous high voltage, high pulse voltage etc.
- Our products there is a product are using an electrolyte solution. Therefore, misuse can result in rapid deterioration of characteristics and functions of each product. Electrolyte leakage damages printed circuit and affects performance, characteristics, and functions of customer system.

## ⚠ Application Guidelines (SP-Cap)

### 1. Circuit design

#### 1.1 Prohibited circuits for use

Do not use the SP-Cap with the following circuit.

- (1) Time-constant circuit
- (2) Coupling circuits
- (3) 2 or more SP-Cap connected serially
- (4) Circuit which are greatly affected by leakage current
- (5) High-impedance voltage retention circuits

#### 1.2 Voltage and polarity

The application of over-voltage and reverse voltage described below can cause increases in leakage current and short circuits.

Applied voltage, refers to the voltage value including the peak value of the transitional Instantaneous voltage and the peak value of ripple voltage, not just steady line voltage.

Design your circuit so that the peak voltage does not exceed the stipulated voltage.

[Over-Voltage]

Do not apply over-voltage in excess of the rated voltage. Do not apply voltage, which exceeds the full rated voltage when the SP-Cap receive impulse voltage, instantaneous high voltage, high pulse voltage etc.

[Reverse-Voltage]

Do not apply reverse-voltage

#### 1.3 Ripple current

Use the SP-Cap within the stipulated permitted ripple current.

When excessive ripple current is applied to the SP-Cap, it causes increases in leakage current and short circuits due to self-heating.

Even when using the SP-Cap under the permissible ripple current, reverse voltage may occur if the DC bias voltage is low.

#### 1.4 Leakage current

There is a risk of leakage current characteristics increasing even if the following use environments are within the stipulated range.

However, even if the leakage current increases, the SP-Cap self-repairing function will reduce the leakage current in most cases when a voltage is applied.

- (1) After re-flow
- (2) Shelf conditions such as high temperature with no load, high temperature high humidity with no load and sudden temperature changes.

#### 1.5 Temperature

Use at or under the rated (guaranteed) temperature.

Operation at temperatures exceeding specifications causes large changes in the SP-Cap electrical properties, and deterioration than can potentially lead to failure.

When calculating the operating temperature of the SP-Cap, be sure to include not only the ambient temperature and internal temperature of the unit, but also radiation from heat generating elements inside the unit (power transistors, resistors, etc.), and self-heating due to ripple current.

#### 1.6 Calculation of the expected life time

Expected life is affected by operating temperature.

Generally, the capacitance change ratio will be 1/10 by each 20 °C reduction in temperature, so estimated life time will be expected 10 times.

As below can be calculated the formula for expected life time  $L_x$  (h) of SP-Cap at  $T_x$  (°C) based on the capacitance change ratio by temperature reduction.

Not guaranteed is the life time which is obtained by this formula as well as upper limit of valid expected life time is 20 years.

$$L_x = L_0 \times 10^{\left(\frac{T_0 - T_x}{20}\right)}$$

$T_0$  (°C) : Upper category temperature

$T_x$  (°C) : Temperature in actual use (Temperature of SP-Cap)

$L_0$  (h) : Guaranteed life at ( $T_0$ )

$L_x$  (h) : Life expectancy in actual use ( $T_x$ )

#### 1.7 Failure rate

The majority of failure modes are short circuits or increases in leakage current.

The main factors of failure are mechanical stress, heat stress and electric stress due to re-flow and heat from the use temperature environment.

Even within the stipulated limits, it is possible to lower the failure rate by reducing use conditions such as temperature and voltage. Please be sure to have ample margin in your design.

[Expected Failure Rate]

- (1) Date based on our reliability tests: 8.2 Fit or less (Based on applied rated voltage at 105 °C)
- (2) Market failure rate: 0.13 Fit or less (Based on  $c=0$ , Reliability standard : 60 %)

#### 1.8 Mounting area consideration

Isolate the surface of PCB under the mounted SP-Cap.

## 2. Mounting

### 2.1 When mounting

- (1) Check the SP-Cap ratings (capacitance and voltage) before mounting.
- (2) Check the SP-Cap polarity before mounting.
- (3) Check the land size for the SP-Cap before mounting.
- (4) When using a mounter, if the pressure for mounting is too high, then the current leak may increase, short-circuiting may occur, or the SP-Cap may break down or come off.

### 2.2 Soldering

- (1) Reflow soldering  
Be performed by one of following methods.
  - (a) Ambient heat conduction reflow (IR / Hot-air)  
Please refer to the page of "Mounting Specifications".
  - (b) Vapor phase reflow (but only allowable for CX, CT, SX, ST, GX, LX, LT and HX series).  
Please contact Panasonic for details of allowable vapor phase reflow condition.
- (2) Wave soldering and dip soldering  
Please remind SP-Cap is NOT compatible.
- (3) Hand soldering  
Excessive force stress to the SP-Cap should be avoided  
Conditions :  
Tip temperature of soldering iron : 350 °C max.  
Exposure time : 10 s max.  
\* Once removed from the printed circuit board for any reason, please do not use the SP-Cap again.

### 2.3 Land size

Refer to the land size of "Mounting specifications" for appropriate design dimensions.  
Circuit board design requires examination of the most suitable dimensions taking conditions such as circuit board, parts and reflow into consideration.

### 2.4 Mechanical stress

Do not apply excessive force to the SP-Cap this can damage the electrodes and badly affect the SP-Cap mount ability. It can also cause the increase of leakage current, separation of the lead wire and element, and damage to the SP-Cap body, all of which can badly affect the electrical performance of the SP-Cap.

### 2.5 Circuit board cleaning

SP-Cap should be cleaned after soldering in accordance with the following conditions.

Temperature : Less than 60 °C

Time : Within 5min

Be sure to sufficiently wash and dry (20 min at 100 °C) the board afterward.

[Recommended Cleaning Solvents]

Pine Alpha ST-100S, Clean-thru 750H / 750L / 710M, Aqua Cleaner 210SEP, Sunelec B-12

DK Beclear CW-5790, Techno Cleaner 219, Cold Cleaner P3-375, Telpene Cleaner EC-7R

Technocare FRW-17 / FRW-1 / FRV-1, AXREL 32, IPA (Isopropyl alcohol)

- (1) Consult our factory when performing processes with cleaning solvents other than those listed above or deionized water.
- (2) The use of ozone depleting cleaning agents are not recommended in the interest of protecting the environment.
- (3) In the case of using ultrasonic cleaning, the terminals may be broken. Therefore, please test before using in mass production.

## 3. Usage environment of equipment

Avoid using equipment to which SP-Cap are fitted in the following environments.

- (1) In liquid, such as Water, Oil, Chemicals, or Organic solvent.
- (2) In direct sunlight, outdoors, or in dust.
- (3) In vapor, such as dew condensation water of resistive element, or water leakage, salty air, or air with a high concentration corrosive gas, such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, or NO<sub>2</sub>.
- (4) In an environment where strong static electricity or electromagnetic waves exist.
- (5) Mounting or placing heat-generating components or inflammables, such as vinyl-coated wires, near these SP-Cap.
- (6) Sealing or coating of these SP-Cap or a printed circuit board on which these SP-Cap are mounted, with resin and other material.
- (7) Acid or alkaline environments.
- (8) Environment subject to excessive vibration and shock.

#### 4. Storage

SP-Cap should be stored in a moisture proof environment. Storage conditions before and after opening the moisture proof packaging as follows.

(If these conditions are exceeded, the package may absorb moisture and there is a risk of damage to the exterior due to heat stress during mounting.)

[Environment of Storage]

Temperature: 5 °C to 30 °C without direct sunlight

Humidity : Less than 70 %

Maximum storage term before opening the package (2 years after manufactured)

Maximum storage condition after opening the package (7 days after opening)

SP-Cap should be all used within the storage term after opening the package.

#### 5. Transportation

Take sufficient care during handling because excessive vibration, or shock can cause the reliability of the SP-Cap to decrease.

#### 6. Emergency procedures

If the SP-Cap is overheated, the resin case may emit smoke. If this occurs, immediately switch off the unit's main power supply to stop operation. Keep your face and hands away from the SP-Cap the temperature may be high enough to cause the SP-Cap to ignite and burn.

#### 7. Discarding

Since SP-Cap are composed of various metals and resins, treat them as industrial waste when arranging for their disposal.

The precautions for the use of functional polymer 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.

#### ◇ Intellectual property right

We, Panasonic Group are providing the product and service that customers can use without anxiety, and are working positively on the protection of our products under intellectual property rights.

Representative patents relating to SP-Cap are as follows :

US Patent No. 7136276