

PRODUCT SPECIFICATION FOR APPROVAL

Product Description : Conductive Polymer Aluminum Electrolytic Capacitor
Customer Part Number :
Product Part Number : EEFCX0G221YR
Country of Origin : Japan, Indonesia
Printed on the packaging label
Applications : Accelerator card

※ If you approve this specification, please fill in and sign the below and return 1copy to us.

Approval No	:	
Approval Date	:	
Executed by	:	_____
		(signature)
Title	:	
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Panasonic

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Notice Matter

Law and Regulation which are Applied

- 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 use 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.

Limitation of a Use

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 and industrial robots.

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.

Country of Origin : Japan, Indonesia

Manufacturing Factory : Device Solutions Business Division
Panasonic Industry Co., Ltd.

Panasonic Industrial Devices Singapore Pte. Ltd.
(BATAM Factory) PT. Panasonic Industrial Devices Batam

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1.Scope

This specification applies to conductive polymer aluminum electrolytic capacitor (CX) for use electronic equipment.

2.Explanation of Part Numbers

E E F
2-1

O O
2-2

O O
2-3

O O O
2-4

O O
2-5

2-1 Common Code Conductive Polymer Aluminum Electrolytic Capacitor

2-2 Series and Size Code CX

2-3 Rated Voltage Code

R.V. Code	0G
R.V.(V)	4

2-4 Capacitance Code : Indicating capacitance in μF by 3 letters.
The first 2 figures are actual values and the third denotes the number of zeros.
"R" denotes the decimal point and all figures are the actual number with "R".
ex:4.7 μF ---- 4R7 10 μF ---- 100 100 μF ---- 101

2-5 Suffix Code

YR	Cap.Tol : -35 to 10%
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Parts Lists

Part Number	Rated Voltage (V)	Cap. (μF) [120Hz/20°C]	tanδ max. [120Hz/20°C]	LC (μA) max. [R.V./2min]	ESR (mΩ) max. [100kHz/20°C]	Permissible Ripple Current (A)rms max. [100kHz/45°C]
EEFCX0G221YR	4	220	0.06	88.0	15	5.1

Temperature Compensation Multipliers for Ripple Current		
$T \leq 45^{\circ}\text{C}$	$45^{\circ}\text{C} < T \leq 85^{\circ}\text{C}$	$85^{\circ}\text{C} < T \leq 105^{\circ}\text{C}$
1.0	0.7	0.25

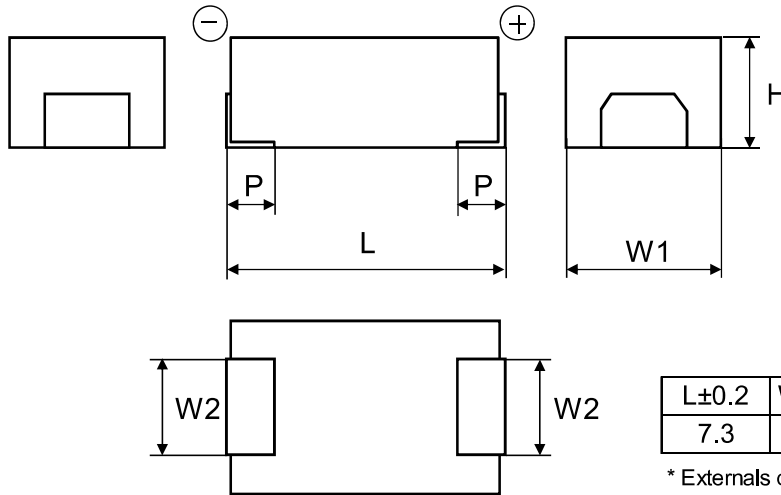
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3. Dimensions and Appearance

3.1 Appearance

By visual inspection, no deep cracks and blemishes.

3.2 Dimensions



* Externals of figure are the reference.

Surface finish of terminal : Tin(Sn)
Material of terminal : Cu or Fe

4. Marking

- (1) Rated Voltage
- (2) Capacitance
- (3) Polarity
- (4) Lot No

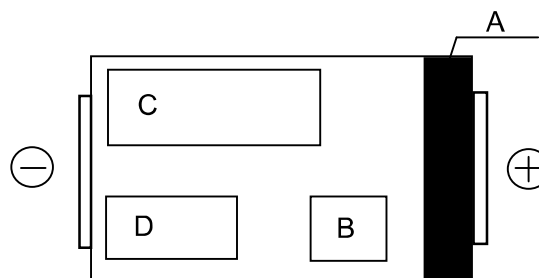
(Notes) Body Color : Black
Marking : Laser

R.V. Code

Marking Code	g
R.V.(V)	4

Code	Item
A	Polarity Bar (Positive)
B	R.V. Code
C	Cap. *
D	Lot No.

* ex:4.7μF ---- 4R7 10μF ---- 10



5. Specifications

	Item	Specifications	
1	Category Temperature Range	-55°C to 105°C	
2	Rated Voltage	4V	
3	Capacitance	220μF (120Hz/20°C)	
4	Tolerance on Capacitance	-35% to 10% (120Hz/20°C)	
5	Surge(V)	R.V.	4
		Surge	5
6	Rated Ripple Current	See attached individual specifications.(P.3)	

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6. Performance Characteristics

No	Item	Characteristics		Outline of test method
1	Leakage current	$\leq 0.1CV$		Series resistor: 1000 Ω Applied voltage: Rated Voltage Measuring: 2min If you have doubts about the measured result, please re-check after the pre-conditioning explained below. Pre-conditioning Apply rated DC voltage for 1h at 105°C through 1000 Ω series resistor: Then discharge and keep in the room temperature for 24h to 48h
2	Capacitance tolerance	-35% to 10%		Measuring temperature: 20°C Measuring frequency: 120Hz $\pm 10\%$
3	$\tan\delta$	See attached individual specification(P.3)		Measuring circuit: Equivalent series circuit Measuring voltage: +0V.DC $\leq 0.5V_{rms}$
4	ESR	See attached individual specification (P.3)		Measuring temperature: 20°C Measuring frequency: 100kHz $\pm 10\%$ Measuring voltage: +0V.DC, $\leq 0.5V_{rms}$
5	Solder-ability	More than 75% of the terminal face are covered by new solder.		Solder type: H60A or H63A Flax: About 25% rosin density melted ethanol Solder temperature: 230°C $\pm 5^\circ C$ Immersing time: 2s $\pm 0.5s$
6	Solubility resistance to marking	Appearance: No remarkable abnormal change shall be occurred.		Class of reagent: Extra grade 2-propanol (JIS K8839) or superior. Test temperature: 20°C to 25°C Immersing time: 30s $\pm 5s$
7	Solder heat resistance	Leakage current	\leq The value of item 1.	The capacitor is held on heating for reflow soldering. Reflow soldering profile: Please refer to Chapter 11 (Page 15)
		Capacitance change	$\pm 10\%$ of initial measured value.	
		$\tan\delta$	\leq The value of item 3.	
		Appearance	No remarkable abnormal change shall be occurred.	
8	Adhesion	Appearance: Without mechanical damage such as breaks after test.		Push direction: Side Force: 5.0N Holding time: 10s $\pm 0.5s$
9	Damp heat, steady state	Leakage current	\leq The value of item 1.	Test temperature: 60°C $\pm 2^\circ C$ Relative humidity: 90% Test time: 500 ⁺²⁴ ₀ h
		Capacitance change	+60%,-20% of initial measured value.	
		$\tan\delta$	$\leq 200\%$ of initial specified value.	
		Appearance	No remarkable abnormal change shall be occurred.	

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No	Item	Characteristics		Outline of test method													
10	Damp heat, steady state (Applied voltage)	Leakage current	≤The value of item 1.	Test temperature: 60°C±2°C Relative humidity: 90% Applied voltage: Rated voltage Test time: 500 ⁺²⁴ ₀ h													
		Capacitance change	+60%,-20% of initial measured value.														
		tanδ	≤200% of initial specified value.														
		Appearance	No remarkable abnormal change shall be occurred.														
11	Endurance	Leakage current	≤300% of initial specified value.	Test temperature: 105°C±2°C Applied voltage: Rated voltage Test time: 2000 ⁺⁴⁸ ₀ h													
		Capacitance change	±20% of initial measured value.														
		tanδ	≤200% of initial specified value.														
		Appearance	No remarkable abnormal change shall be occurred.														
12	Shelf life	Leakage current	≤The value of item 1.	Test temperature: 105°C±2°C Test time: 500 ⁺²⁴ ₀ h													
		Capacitance change	±10% of initial measured value.														
		tanδ	≤The value of item 3.														
		Appearance	No remarkable abnormal change shall be occurred.														
13	Characteristics at high and low temperature	Step	Item	Electrical Characteristics	Exposure the capacitor at each temperature in following order and measure characteristics at step 2,4 and 5 as described on the left. <table border="1" data-bbox="979 1220 1254 1413"> <thead> <tr> <th>Step</th> <th>Temperature</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>20°C±2°C</td> </tr> <tr> <td>2</td> <td>-55°C±3°C</td> </tr> <tr> <td>3</td> <td>20°C±2°C</td> </tr> <tr> <td>4</td> <td>105°C±2°C</td> </tr> <tr> <td>5</td> <td>20°C±2°C</td> </tr> </tbody> </table> If you have doubts about the result of its measurement, please make a re-check right after the pre-conditioning explained below. Pre-conditioning Dry the products 24h at 125°C	Step	Temperature	1	20°C±2°C	2	-55°C±3°C	3	20°C±2°C	4	105°C±2°C	5	20°C±2°C
		Step	Temperature														
		1	20°C±2°C														
		2	-55°C±3°C														
		3	20°C±2°C														
		4	105°C±2°C														
		5	20°C±2°C														
2	Capacitance	±15% of the value in step 1.															
	ESR	≤115% of the value of item 4.															
4	Capacitance	±20% of the value in step 1.															
5	Leakage current	≤The value of item 1.															
	Capacitance	±5% of the value in step 1.															
	tanδ	≤The value of item 3.															

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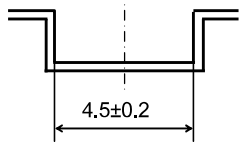
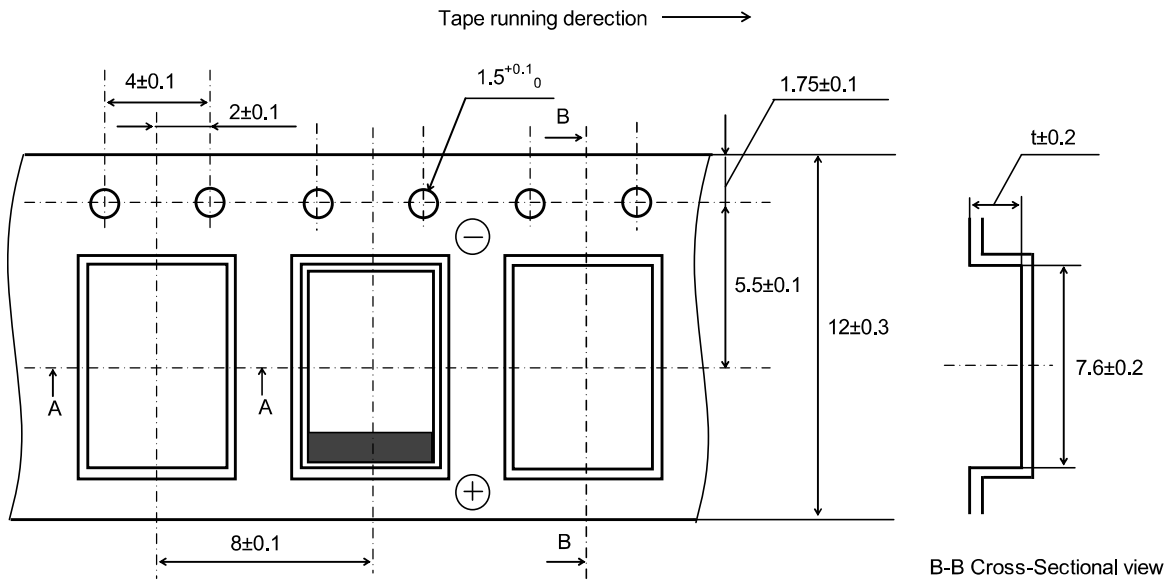
No	Item	Characteristics		Outline of test method
14	Surge	Leakage current	≤The value of item 1.	Test temperature: 15°C to 35°C Series resistor: 1000Ω Cycle: 6min±0.5min Test voltage: Surge Applied voltage: 1000 cycles of 30s±5s "ON" and 5min 30s "OFF"
		Capacitance change	±10% of initial measured value.	
		tanδ	≤The value of item 3.	
		Appearance	No remarkable abnormal change shall be occurred.	
15	Vibration	Appearance: No remarkable abnormal change shall be occurred. Capacitance: During test, measured value to be stabilized. (When measured several times within 30min before completion of test.)	Total amplitude: 1.5mm Frequency: 10Hz to 2000Hz to 10Hz (One cycle per 20min) Direction and duration of vibration: 2h each for three right-angle direction, total 6h. Mounting method: The capacitor must be soldered in place.	

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7. Carrier Tape & Reel Dimension

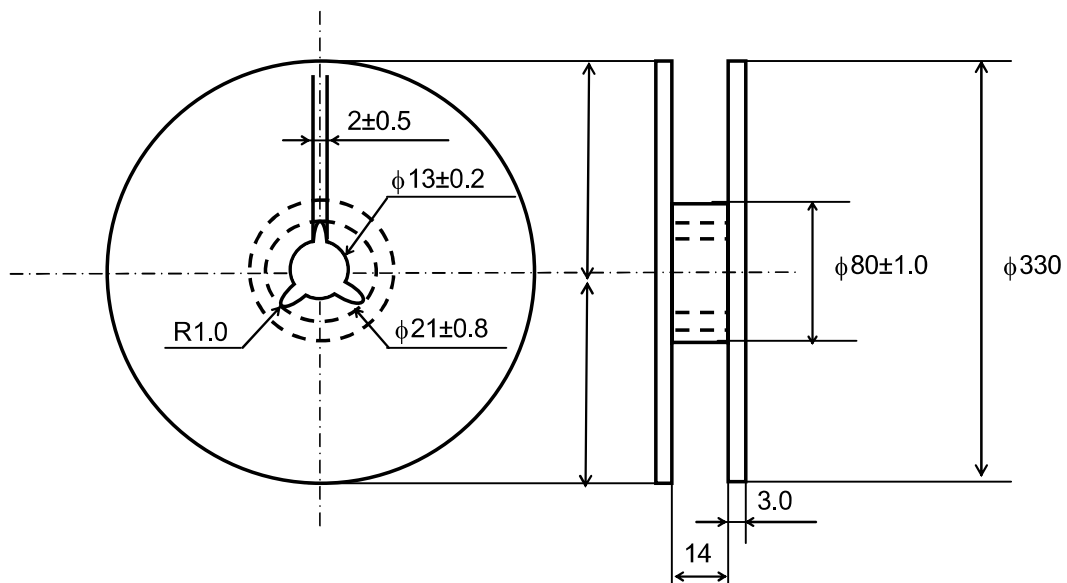
Carrier Tape

Unit : mm



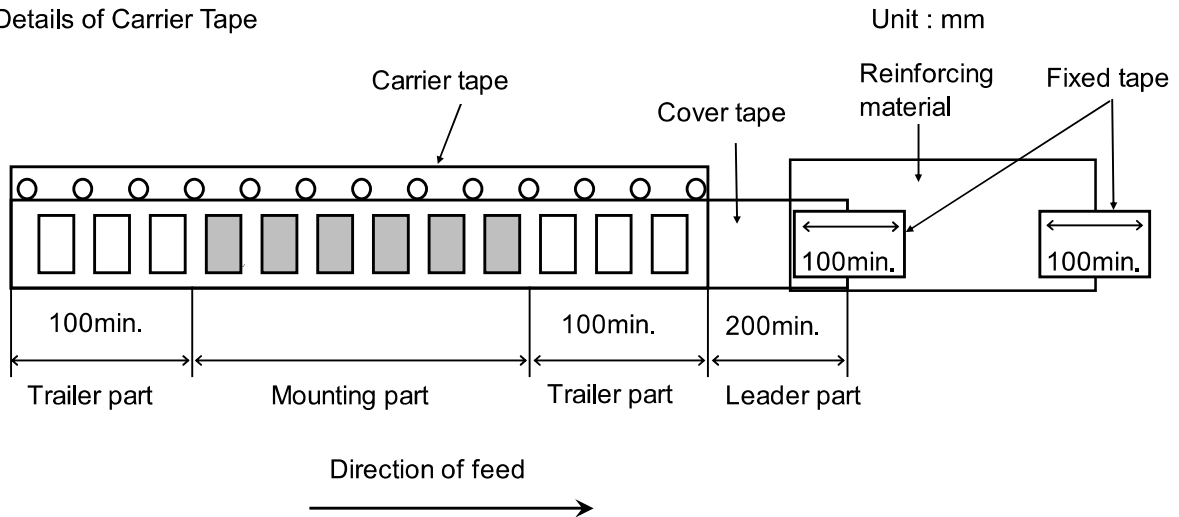
Series and Size Code	CX
t	2.4

Reel

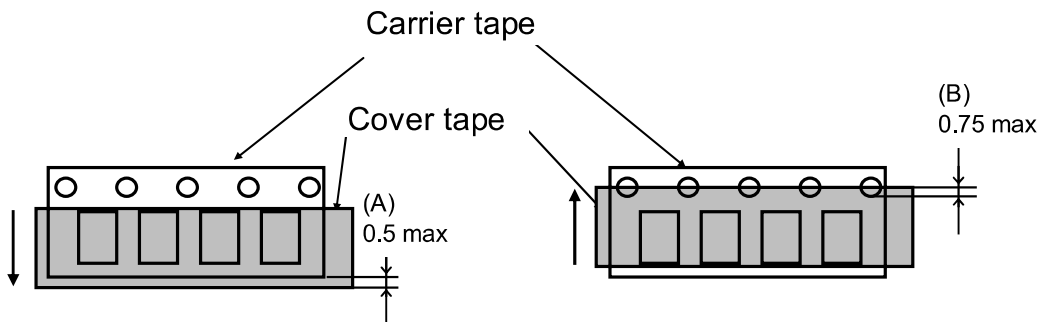


8.Package Specifications

8.1 Details of Carrier Tape



The cover tape shall not cover the sprocket holes

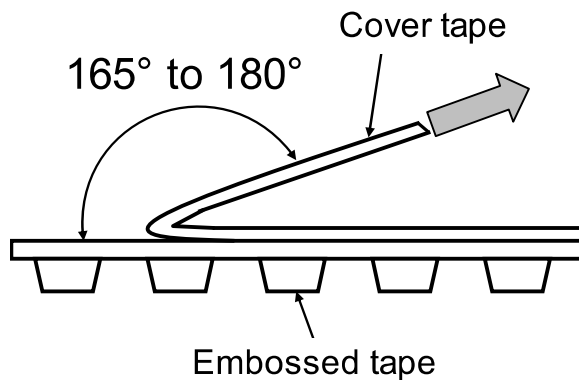


- a. Deviation between carrier tape and cover tape shall be less than 0.5mm
- b. Cover tape shall not be covered on the feeding holes more than 0.75mm

8.2 Adhesion Test

Reasonable pulling strength: 0.1N to 1.3N

Pulling speed: 0.005m/s

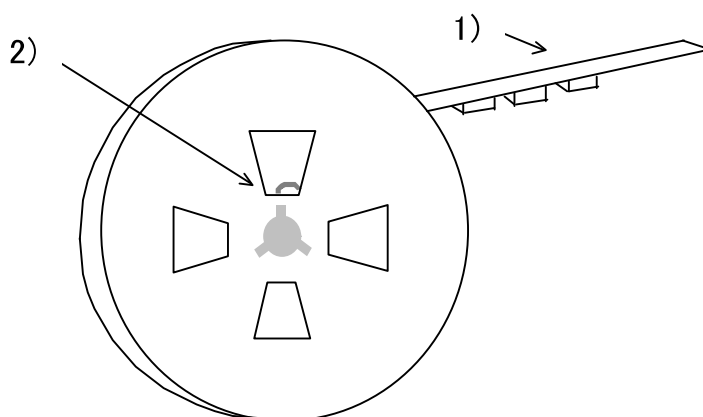


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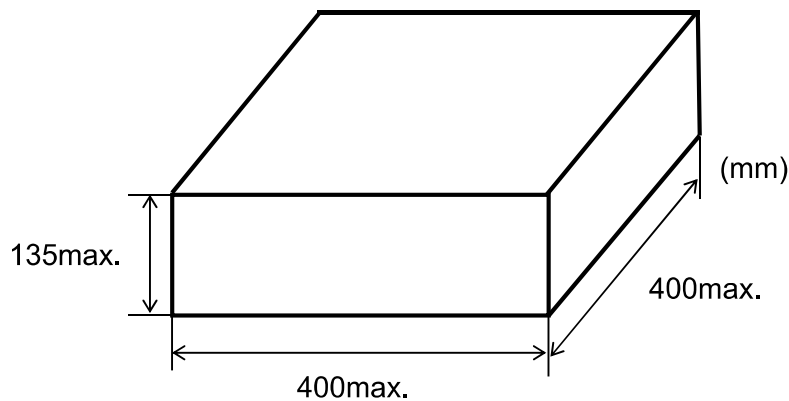
8.3 Packaging Style

- 1) Carrier tape shall be reeling inside.(seal tape shall be outside.)
- 2) First of the carrier tape shall be inserted directly to the reel as shown in the below figure and leader part of seal tape shall not be attached.



8.4 Dimensions of Outer Carton Box

Dimensions of the carton box are subject to change without notice for adjustment to reel size.



8.5 Packaging Quantity

Quantity		
1 Reel(pcs)	1 Packaging Box(reel)	Total Quantity(pcs)
3,500	1 to 5	3,500 to 17,500

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9. Items to be observed

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

When using this SP-Cap in a where safety is critical

Always consider safety when designing equipment and circuit. Plan for worst-case failure modes such as short circuits and open circuits which might occur during use.

Install the following systems for a failsafe design to ensure safety if these SP-Cap are to be used in equipment where a defect in these SP-Cap may cause the loss of human life or other signification damage, such as damage to vehicles (automobile, train, vessel), medical equipment, traffic lights, aerospace equipment, electric heating appliances, combustion/gas equipment, rotating equipment, and disaster/crime prevention equipment.

- 1) The system is equipped with a protection circuit and protection device.
- 2) 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

This SP-Cap is intended to be used in electronic equipment for general-purpose standard applications and is not designed for use in any special environments.

When this SP-Cap is used in a special environment or under special conditions, its performance may be affected.

Before use, verify the performance and reliability of the SP-Cap.

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10.Application Guidelines

10.1 Circuit design

10.1.1 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

10.1.2 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 than 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

10.1.3 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.

10.1.4 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.

10.1.5 Temperature

- 1) 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.

- 2) Specified ESR is a value at the time of shipping from factory. ESR may change upon use conditions.

10.1.6 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: 8.2Fit or less (Based on applied rated voltage at 105°C)
- 2) Market failure rate: 0.13Fit or less (Based on c=0, Reliability standard: 60%)

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10.1.7 Mounting area consideration

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

10.2 Storage and Mounting

10.2.1 Storage

SP-Cap should be stored in the moisture proof bag. Storage conditions before and after opening the moisture proof bag 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 moisture proof bag (2 years after manufactured)

Maximum storage condition after opening the moisture proof bag (7 days after opening)

SP-Cap should be all used within the storage term after opening the moisture proof bag.

10.2.2 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 moulder, 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.

10.2.3 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 "Reflow Soldering Recommended Conditions".

(b) Vapor phase reflow

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.

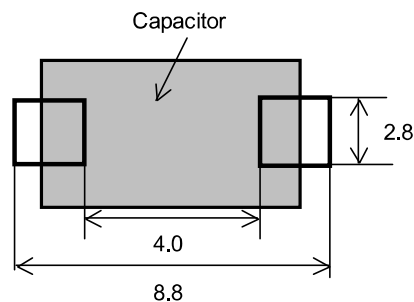
*Once removed from the printed circuit board for any reason, please do not use the SP-Cap again.

10.2.4 Land size

Refer to the land size described below figure 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.

Typical land pattern (mm)



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<p>10.2.5 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.</p> <p>10.2.6 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 (20min 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)</p> <ol style="list-style-type: none"> 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. <p>10.3 Usage environment of equipment Avoid using equipment to which SP-Cap are fitted in the following environments.</p> <ol style="list-style-type: none"> 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 Cl₂, H₂S, NH₃, SO₂, or NO₂. 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. <p>10.4 Transportation Take sufficient care during handling because excessive vibration, or shock can cause the reliability of the SP-Cap to decrease.</p> <p>10.5 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.</p> <p>10.6 Discarding Since SP-Cap are composed of various metals and resins, treat them as industrial waste when arranging for their disposal.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>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- 2367D issued by EIAJ in March 2019. Please refer to the above guidelines for details.</p> </div>	

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11.Reflow Soldering Recommended Conditions

We recommend soldering shall be done according to following maximum permissible reflow soldering temperature profile.

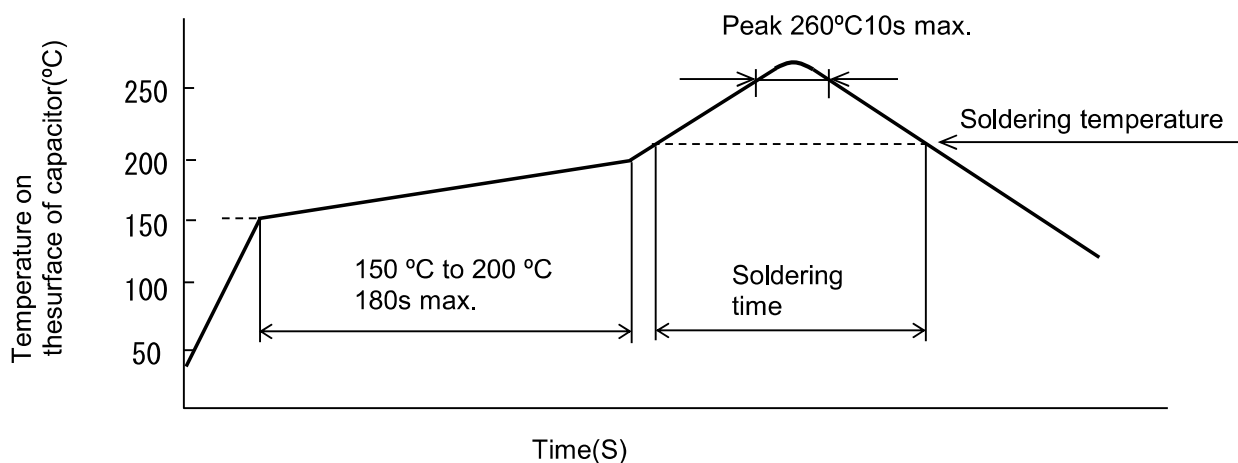
Reflow Soldering

Method: IR or Hot air.

Temperature measurement point: Top of capacitor.

Measuring method: Thermo-couple(K: $\phi 0.1\text{mm}$)

Reflow profile:



Reflow cycle: 3max.

Soldering temperature and soldering time

Temperature	Time
255°C	30s max.
230°C	130s max.
217°C	150s max.

SP-Cap recommended profile conditions of the IPC/J-STD-020D standard