

# Conductive Polymer Tantalum Solid Capacitors

## Surface Mount Type

### TPE series      B size

### Features

- Small size (L 3.5 × W 2.8 × H 1.9 mm)
- Low ESR (15 mΩ max.)
- RoHS compliance, Halogen free

### Specifications

Size code	B2	
Category temp. range	-55 °C to +105 °C	
Rated volt. range	2.0 V to 10 V	
Category volt. range	1.8 V to 8 V	
Rated cap. range	47 μF to 470 μF	
Capacitance tolerance	±20 % (120 Hz / +20 °C)	
Leakage current	Please see the attached characteristics list	
Dissipation factor(tan δ)	Please see the attached characteristics list	
Surge voltage (V)	Rated voltage × 1.15	
Endurance	+105 °C 1000 h rated voltage applied	
	Rated temp, +85 °C Products : +85 °C 1000 h, rated voltage applied	
	Capacitance change	Within ±20 % of the initial value
	Dissipation factor(tan δ)	≤ 1.5 times of the initial limit
Damp heat (Steady State)	+60 °C, 90 % to 95 % RH, 500 h, No-applied voltage	
	Capacitance change	Within +50 %, -20 % of the initial value (2R5TPE220MAZB (MAPB, MAFB), 2R5TPE330MAZB, 2TPE470MAJGB (MAFB))
		Within +40 %, -20 % of the initial value (Except for above model)
	Dissipation factor(tan δ)	≤ 1.5 times of the initial limit
	Leakage current	≤ 3 times of the initial limit

### Marking

Rated capacitance code

Polarity marking (+)

Rated voltage code

Lot No.

R. voltage code		Unit : V	
d	2.0	g	4.0
e	2.5	j	6.3
		k	8.0
		A	10

R. capacitance code		Unit : μF	
S7	47	E8	150
A8	100	J8	220
C8	120	N8	330
		S8	470

### Dimensions (not to scale)

Size code	L±0.2	W±0.2	H±0.1	S±0.2	W1±0.1
B2	3.5	2.8	1.9	0.8	2.2

Unit : mm

\* Externals of figure are the reference.

**Characteristics list**

Rated voltage (V)	Rated temperature (°C)	Category voltage (V)	Category temperature (°C)	Rated capacitance (µF)	Case size (mm)			Size code	Specifications				Standard		Floor life level		
					L	W	H		Ripple current (mA rms)	ESR <sup>*2</sup> (mΩ max.)	tan δ <sup>*3</sup>	LC <sup>*4</sup> (µA)	Part number	Min. packaging q'ty (pcs)	Reflow temp ≤260°C	Reflow temp ≤250°C	
2.0	85	1.8	105	470	3.5	2.8	1.9	B2	2300	15	0.10	188.0	2TPE470MAFB	2000	3	3	
	85	1.8	105		3.5	2.8	1.9		2300	11/300kHz	0.08	188.0	2TPE470MAJGB	2000			
2.5	85	2.0	105	220	3.5	2.8	1.9		2000	15	0.08	110.0	2R5TPE220MAFB	2000			
	105	2.5	105		3.5	2.8	1.9		1800	15/300kHz	0.08	110.0	2R5TPE220MFGB	2000			
	105	2.5	105		3.5	2.8	1.9		1700	21	0.08	55.0	2R5TPE220MLB	2000			
	85	2.0	105		3.5	2.8	1.9		1600	25	0.08	55.0	2R5TPE220MAPB	2000			
	105	2.5	105		3.5	2.8	1.9		1400	35	0.08	55.0	2R5TPE220MZB	2000			
	85	2.0	105		3.5	2.8	1.9		1400	35	0.08	55.0	2R5TPE220MAZB	2000			
	105	2.5	105		3.5	2.8	1.9		1400	30	0.08	55.0	2R5TPE220MUB	2000			
	85	2.0	105		330	3.5	2.8		1.9	1400	35	0.08	82.5	2R5TPE330MAZB			2000
	85	2.0	105			3.5	2.8		1.9	3200	9/300kHz	0.08	165.0	ETPE330MA9GB			2000
	105	2.5	105			3.5	2.8		1.9	3200	9/300kHz	0.08	165.0	ETPE330M9GB			2000
105	2.5	105	3.5	2.8		1.9	2700		15	0.08	165.0	ETPE330MFB	2000				
4.0	105	2.5	105	100	3.5	2.8	1.9		2450	18	0.08	165.0	ETPE330MIB	2000			
	105	4.0	105		3.5	2.8	1.9		1400	35	0.08	40.0	4TPE100MZB	2000			
	105	4.0	105		3.5	2.8	1.9		950	70	0.08	40.0	4TPE100MBB	2000			
	85	3.2	105		150	3.5	2.8		1.9	1300	40	0.08	40.0	4TPE100MWB			2000
	85	3.2	105		220	3.5	2.8		1.9	1400	35	0.08	60.0	4TPE150MAZB			2000
	105	4.0	105			3.5	2.8		1.9	1400	35	0.08	88.0	4TPE220MAZB			2000
	105	4.0	105			3.5	2.8		1.9	1350	35	0.10	88.0	4TPE220MZB			2000
	105	4.0	105			3.5	2.8	1.9	1150	45	0.10	88.0	4TPE220MVB	2000			
	6.3	105	4.0		105	100	3.5	2.8	1.9	950	70	0.10	88.0	4TPE220MBB	2000		
		105	6.3		105		3.5	2.8	1.9	1600	25	0.08	63.0	6TPE100MPB	2000		
85		5.0	105	3.5	2.8		1.9	1400	35	0.08	63.0	6TPE100MAZB	2000				
105		6.3	105	3.5	2.8		1.9	1400	35	0.08	63.0	6TPE100MZB	2000				
105		6.3	105	3.5	2.8		1.9	950	70	0.08	63.0	6TPE100MBB	2000				
105		6.3	105	3.5	2.8		1.9	1300	40	0.08	63.0	6TPE100MWB	2000				
105		6.3	105	3.5	2.8		1.9	1200	45	0.08	63.0	6TPE100MVB	2000				
85		5.0	105	120	3.5		2.8	1.9	1400	35	0.08	75.6	6TPE120MAZB	2000			
85		5.0	105	150	3.5		2.8	1.9	1600	25	0.08	94.5	6TPE150MAPB	2000			
85		5.0	105		3.5		2.8	1.9	1400	35	0.08	94.5	6TPE150MAZB	2000			
8.0		85	5.0	105	220		3.5	2.8	1.9	1400	35	0.10	138.6	6TPE220MAZB	2000		
		85	5.0	105			3.5	2.8	1.9	1600	25	0.10	138.6	6TPE220MAPB	2000		
		105	6.3	105			3.5	2.8	1.9	1150	45	0.10	138.6	6TPE220MVB	2000		
		105	6.3	105			3.5	2.8	1.9	950	70	0.10	138.6	6TPE220MBB	2000		
	105	6.3	105	3.5		2.8	1.9	1350	35	0.10	138.6	6TPE220MZB	2000				
	8.0	85	6.3	105		100	3.5	2.8	1.9	1400	35	0.08	80.0	8TPE100MAZB	2000		
	10	85	8.0	105		47	3.5	2.8	1.9	1400	35	0.08	47.0	10TPE47MAZB	2000		

\*1: Ripple current (100 kHz / +45 °C)

\*2: ESR (100 kHz / +20 °C)

\*3: tan δ (120 Hz / +20 °C)

\*4: After 5 minutes

◆ Please refer to each page in this catalog for "Reflow conditions", "Taping specifications" and "Floor life level".

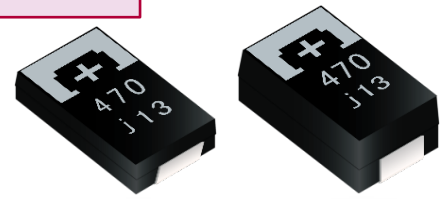
◆ Small order quantity (500 pcs/reel) is available with TPE series. Please contact our sales representative if you prefer it.



# Conductive Polymer Tantalum Solid Capacitors

## Surface Mount Type

### TPE series      D size



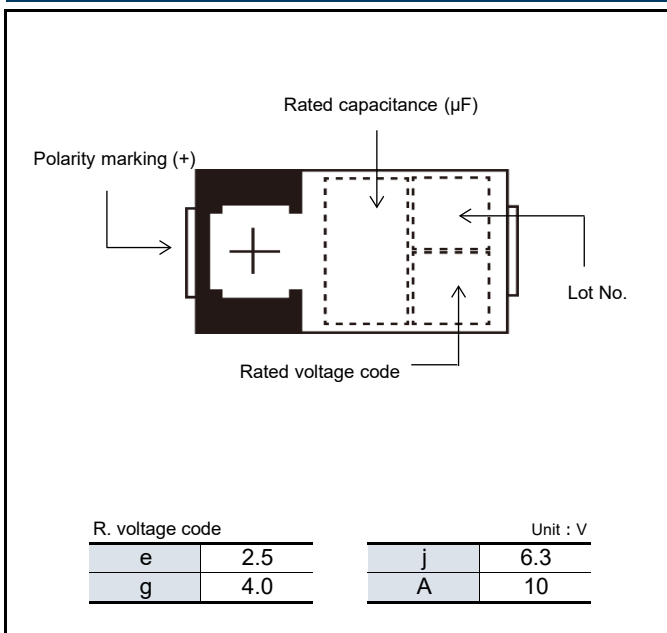
### Features

- Low profile (Height 1.5 mm max.)
- Low ESR (7 mΩ max.)
- Large capacitance (1500 μF max.)
- RoHS compliance, Halogen free

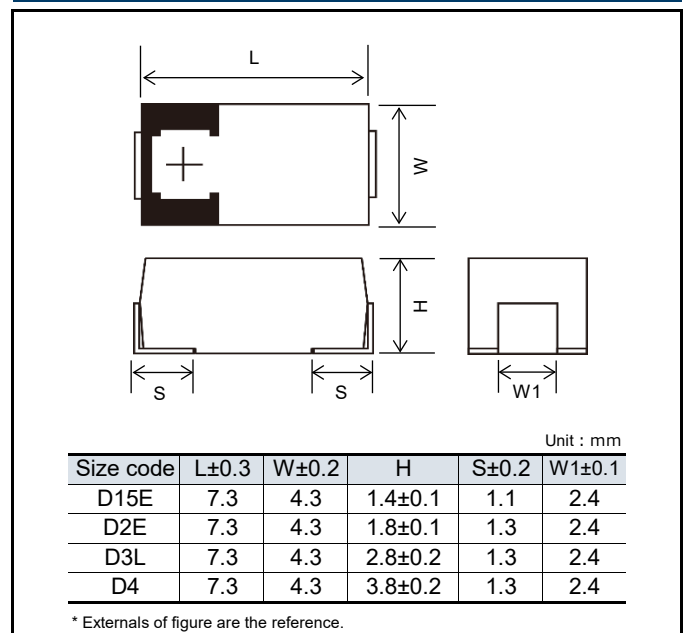
### Specifications

Size code	D15E	D2E	D3L	D4
Category temp. range	-55 °C to +105 °C			
Rated volt. range	6.3 V	2.5 V to 10 V		
Category volt. range	5.0 V	2.5 V to 10 V		
Rated cap. range	470 μF	68 μF to 470 μF	150 μF to 680 μF	330 μF to 1500 μF
Capacitance tolerance	±20 % (120 Hz / +20 °C)			
Leakage current	Please see the attached characteristics list			
Dissipation factor(tan δ)	Please see the attached characteristics list			
Surge voltage (V)	Rated voltage × 1.15			
Endurance	+105 °C 2000 h rated voltage applied			
	Rated temp, +85 °C Products : +85 °C 1000 h, rated voltage applied			
	(6TPE330MAP, 6TPE470MAZU : +85 °C 2000 h, rated voltage applied)			
	Capacitance change	Within ±20 % of the initial value		
Damp heat (Steady State)	Dissipation factor(tan δ)	≤ 1.5 times of the initial limit		
	Leakage current	Within the initial limit		
	Capacitance change	Within +50 %, -20 % of the initial value (2R5TPE220M (I, F, 9), 2R5TPE330M (I, F, C, 9, 7), 2R5TPE470M (I, F, C, 9, 7), 2R5TPE1000MF, 2R5TPE1500M (F, C))		
Damp heat (Steady State)	Dissipation factor(tan δ)	≤ 1.5 times of the initial limit		
	Leakage current	≤ 3 times of the initial limit		
	Capacitance change	Within +40 %, -20 % of the initial value (Except for above model)		

### Marking



### Dimensions (not to scale)



Characteristics list

Rated voltage (V)	Rated temperature (°C)	Category voltage (V)	Category temperature (°C)	Rated capacitance (µF)	Case size (mm)			Size code	Specifications				Standard		Floor life level			
					L	W	H		Ripple <sup>*1</sup> current (mA rms)	ESR <sup>*2</sup> (mΩ max.)	tan δ <sup>*3</sup>	LC <sup>*4</sup> (µA)	Part number	Min. packaging q'ty (pcs)	Reflow temp ≤260°C	Reflow temp ≤250°C		
2.5	105	2.5	105	220	7.3	4.3	1.8	D2E	3900	9	0.10	55.0	2R5TPE220M9	3000	3			
	105	2.5	105		7.3	4.3	1.8		3100	15	0.10	55.0	2R5TPE220MF	3000				
	105	2.5	105		7.3	4.3	1.8		2800	18	0.10	55.0	2R5TPE220MI	3000				
	NRFND 105	2.5	105		7.3	4.3	1.8		2400	25	0.10	55.0	2R5TPE220M	3000				
	105	2.5	105	330	7.3	4.3	1.8		4400	7	0.10	82.5	2R5TPE330M7	3000				
	105	2.5	105		7.3	4.3	1.8		3900	9	0.10	82.5	2R5TPE330M9	3000				
	105	2.5	105		7.3	4.3	1.8		3500	12	0.10	82.5	2R5TPE330MC	3000				
	105	2.5	105		7.3	4.3	1.8		3100	15	0.10	82.5	2R5TPE330MF	3000				
	105	2.5	105		7.3	4.3	1.8		2800	18	0.10	82.5	2R5TPE330MI	3000				
	NRFND 105	2.5	105		7.3	4.3	1.8		2400	25	0.10	82.5	2R5TPE330M	3000				
	105	2.5	105		7.3	4.3	1.8		4400	7	0.10	117.5	2R5TPE470M7	3000				
	105	2.5	105		7.3	4.3	1.8		3900	9	0.10	117.5	2R5TPE470M9	3000				
	105	2.5	105	470	7.3	4.3	1.8		3500	12	0.10	117.5	2R5TPE470MC	3000				
	105	2.5	105		7.3	4.3	1.8		3100	15	0.10	117.5	2R5TPE470MF	3000				
	105	2.5	105		7.3	4.3	1.8		2800	18	0.10	117.5	2R5TPE470MI	3000				
	105	2.5	105		7.3	4.3	2.8		3500	12	0.10	170.0	2R5TPE680MCL	2500				
	105	2.5	105	680	7.3	4.3	2.8		3100	15	0.10	170.0	2R5TPE680MFL	2500				
	105	2.5	105		7.3	4.3	2.8		1850	40	0.10	170.0	2R5TPE680MWL	2500				
	105	2.5	105		7.3	4.3	3.8		3900	15	0.15	250.0	2R5TPE1000MF	2000				
	105	2.5	105	1500	7.3	4.3	3.8		4400	12	0.15	375.0	2R5TPE1500MC	2000				
105	2.5	105	7.3		4.3	3.8	3900	15	0.15	375.0	2R5TPE1500MF	2000						
4.0	105	4.0	105	150	7.3	4.3	1.8	D2E	2800	18	0.10	60.0	4TPE150MI	3000	2a			
	105	4.0	105	220	7.3	4.3	1.8		3100	15	0.10	88.0	4TPE220MF	3000				
	105	4.0	105		7.3	4.3	1.8		2800	18	0.10	88.0	4TPE220MI	3000				
	105	4.0	105		7.3	4.3	1.8		2400	25	0.10	88.0	4TPE220M	3000				
	105	4.0	105		7.3	4.3	1.8		1750	45	0.10	88.0	4TPE220MV	3000				
	105	4.0	105	330	7.3	4.3	1.8		2800	18	0.10	132.0	4TPE330MI	3000				
	105	4.0	105		7.3	4.3	1.8		2400	25	0.10	132.0	4TPE330M	3000				
	105	4.0	105		7.3	4.3	1.8		1850	40	0.10	132.0	4TPE330MW	3000				
	105	4.0	105		7.3	4.3	2.8		3500	12	0.10	188.0	4TPE470MCL	2500				
	105	4.0	105	470	7.3	4.3	2.8		3100	15	0.10	188.0	4TPE470MFL	2500				
	105	4.0	105		7.3	4.3	2.8		2800	18	0.10	188.0	4TPE470MIL	2500				
	105	4.0	105		7.3	4.3	2.8		2400	25	0.10	188.0	4TPE470ML	2500				
	105	4.0	105		7.3	4.3	2.8		1850	40	0.10	188.0	4TPE470MWL	2500				
	6.3	105	6.3	105	100	7.3	4.3		1.8	D2E	2800	18	0.10	63.0	6TPE100MI	3000	3	
		105	6.3	105		7.3	4.3		1.8		2400	25	0.10	63.0	6TPE100M	3000		
		105	6.3	105		7.3	4.3		1.8		1850	40	0.10	63.0	6TPE100MW	3000		
105		6.3	105	7.3		4.3	1.8	3100	15		0.10	94.5	6TPE150MF	3000				
105		6.3	105	150	7.3	4.3	1.8	2800	18		0.10	94.5	6TPE150MI	3000				
105		6.3	105		7.3	4.3	1.8	2400	25		0.10	94.5	6TPE150M	3000				
105		6.3	105		7.3	4.3	1.8	2800	18		0.10	138.6	6TPE220MI	3000				
105		6.3	105		7.3	4.3	1.8	2400	25		0.10	138.6	6TPE220M	3000				
105		6.3	105	220	7.3	4.3	1.8	2400	25		0.10	138.6	6TPE220MAP	3000				
85		5.0	105		7.3	4.3	1.8	2400	25		0.10	138.6	6TPE220MW	3000				
105		6.3	105		7.3	4.3	2.8	1850	40		0.10	138.6	6TPE220MW	3000				
105		6.3	105		7.3	4.3	2.8	D3L 2800	18		0.10	138.6	6TPE220MIL	2500				
85		5.0	105	330	D2E 2400	25	0.10	207.9	6TPE330MAP		3000							
NRFND 85		5.0	105	330	7.3	4.3	2.8	D3L	3900		9/500kHz	0.10	207.9	6TPE330MA9EL	2500			
105		6.3	105		7.3	4.3	2.8		3100		15	0.10	207.9	6TPE330MFL	2500			
105		6.3	105		7.3	4.3	2.8		2800		18	0.10	207.9	6TPE330MIL	2500			
105	6.3	105	7.3		4.3	2.8	2400		25	0.10	207.9	6TPE330ML	2500					
NRFND 85	5.0	105	7.3	4.3	3.8	D4 4400	10	0.10	207.9	6TPE330MAA	2000							
105	6.3	105	470	7.3	4.3	1.4	D15E	1700	35	0.10	296.1	6TPE470MAZU	4000					
105	6.3	105		7.3	4.3	3.8		3500	18	0.15	296.1	6TPE470MI	2000					
105	6.3	105		7.3	4.3	3.8		3000	25	0.15	296.1	6TPE470M	2000					
105	6.3	105		7.3	4.3	3.8		2500	35	0.15	296.1	6TPE470MZ	2000					
105	6.3	105	680	7.3	4.3	3.8	D4	2350	40	0.15	296.1	6TPE470MW	2000					
105	6.3	105		7.3	4.3	3.8		3500	18	0.15	428.4	6TPE680MI	2000					
105	6.3	105		7.3	4.3	3.8		3000	25	0.15	428.4	6TPE680M	2000					
105	6.3	105		7.3	4.3	3.8		2400	25	0.10	68.0	10TPE68M	3000					
10	105	10	105	68	7.3	4.3	1.8	D2E	1850	40	0.10	68.0	10TPE68MW	3000	3			
	105	10	105		7.3	4.3	1.8		2400	25	0.10	150.0	10TPE150MPL	2500				
	105	10	105	150	7.3	4.3	2.8	D3L	2800	18	0.10	220.0	10TPE220MIL	2500				
	105	10	105		7.3	4.3	2.8		2400	25	0.10	220.0	10TPE220ML	2500				
	105	10	105		7.3	4.3	2.8		2400	25	0.10	220.0	10TPE220ML	2500				
	105	10	105		7.3	4.3	3.8		D4 3000	25	0.10	330.0	10TPE330M	2000				

\*1: Ripple current (100 kHz / +45 °C)      \*2: ESR (100 kHz / +20 °C)      \*3: tan δ (120 Hz / +20 °C)      \*4: After 5 minutes

◆ Please refer to each page in this catalog for "Reflow conditions", "Taping specifications" and "Floor life level".

◆ Small order quantity (500 pcs/reel) is available with TPE series. Please contact our sales representative if you prefer it.

NRFND Not recommended for new design

## Safety and Legal Matters to Be Observed

### Product specifications and applications

- Please be advised that this product and product specifications are subject to change without notice for improvement purposes. Therefore, please request and confirm the latest delivery specifications that explain the specifications in detail before the final design, or purchase or use of the product, regardless of the application. In addition, do not use this product in any way that deviates from the contents of the company's delivery specifications.
- Unless otherwise specified in this catalog or the delivery specifications, this product is intended for use in general electronic equipment (AV products, home appliances, commercial equipment, office equipment, information and communication equipment, etc.).  
When this product is used for the following special cases, please separately discuss the delivery specifications suited to each application with the company. These include applications requiring special quality and reliability, wherein their failures or malfunctions may directly threaten human life or cause harm to the human body (e.g.: space/aircraft equipment, transportation/traffic equipment, combustion equipment, medical equipment, disaster prevention/crime prevention equipment, safety equipment, etc.).

### Safety design and product evaluation

- Please ensure safety through protection circuits, redundant circuits, etc., in the customer's system design so that a defect in our company's product will not endanger human life or cause other serious damage.
- This catalog shows the quality and performance of individual parts. The durability of parts varies depending on the usage environment and conditions. Therefore, please ensure to evaluate and confirm the state of each part after it has been mounted in your product in the actual operating environment before use.  
If you have any doubts about the safety of this product, then please notify us immediately, and be sure to conduct a technical review including the above protection circuits and redundant circuits at your company.

### Laws / Regulations / Intellectual property

- The transportation of dangerous goods as designated by UN numbers, UN classifications, etc., does not apply to this product. In addition, when exporting products, product specifications, and technical information described in this catalog, please comply with the laws and regulations of the countries to which the products are exported, especially those concerning security export control.
- Each model of this product complies with the RoHS Directive (Restriction of the use of hazardous substances in electrical and electronic equipment) (2011/65/EU and (EU) 2015/863). The date of compliance with the RoHS Directive and REACH Regulation varies depending on the product model.  
Further, if you are using product models in stock and are not sure whether or not they comply with the RoHS Directive or REACH Regulation, please contact us by selecting "Sales Inquiry" from the inquiry form.
- During the manufacturing process of this product and any of its components and materials to be used, Panasonic does not intentionally use ozone-depleting substances stipulated in the Montreal Protocol and specific bromine-based flame retardants such as PBBs (Poly-Brominated Biphenyls) / PBDEs (Poly-Brominated Diphenyl Ethers). In addition, the materials used in this product are all listed as existing chemical substances based on the Act on the Regulation of Manufacture and Evaluation of Chemical Substances.
- With regard to the disposal of this product, please confirm the disposal method in each country and region where it is incorporated into your company's product and used.
- The technical information contained in this catalog is intended to show only typical operation and application circuit examples of this product. This catalog does not guarantee that such information does not infringe upon the intellectual property rights of Panasonic or any third party, nor imply that the license of such rights has been granted.

**Panasonic Industry will assume no liability whatsoever if the use of our company's products deviates from the contents of this catalog or does not comply with the precautions. Please be advised of these restrictions.**

## Matters to Be Observed When Using This Product (Conductive Polymer Tantalum Solid Capacitors / POSCAP)

### Use environments and cleaning conditions

- This product (capacitor) is intended for standard general-purpose use in electronic equipment, and is not designed for use in the specific environments described below. Using the product in such specific environments or service conditions, therefore, may affect the performance of the product.

Please check with us about the performance and reliability of the product first before using the product.

- (1) Used in liquid, such as water, oil, chemicals, and organic solvents.
  - (2) Used in a place exposed to direct sunlight, an outdoor place with no shielding, or a dusty place.
  - (3) Used in a wet place (dew concentration on a resistor, water leakage, etc.), a place exposed to sea breeze, or a place filled with a 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) Used in an environment where static electricity and electromagnetic waves are strong.
  - (5) The product is located close to a heating component or a flammable material, such as a vinyl cable, is placed near the product.
  - (6) The product is used sealed with a resin, etc.
  - (7) Solder flux of the soldered product is cleansed with a solvent, water, and a water-soluble cleaner.  
(Be careful with water soluble solder flux.)
  - (8) Used in an environment where an acidic or alkali atmosphere is present.
  - (9) Used in an environment where excessive vibration or impact is applied to the product.
  - (10) Used under a low atmospheric pressure condition or depressurized condition.
- When the capacitor is used in a circuit where an impact voltage is applied or a high voltage is applied in a short period (transient phenomenon) or a high pulse voltage is applied, make sure to use the capacitor at a voltage equal to or lower than its rated voltage.

### Response to anomalies and handling conditions

- A short mode is a major failure mode in a capacitor. A short mode is caused by thermal stress created by soldering or a high service temperature, electric stress, mechanical stress, etc. When the capacitor has shorted, take the following steps to ensure your safety.
  - (1) When you see smoke coming out of the shorted product, turn off the main power supply to stop using the capacitor.  
Do not place your face or hand near to the smoldering capacitor.
  - (2) The time a shorted capacitor takes to generate smoke ranges from a few seconds to a few minutes, depending on service conditions. If you incorporate a protective circuit, design the circuit to activate in the time preceding the smoke generation.
  - (3) In case smoke gets into your eyes or comes into your mouth, wash the eyes with water or rinse out the mouth immediately.
  - (4) When a current value after the short of the product is extremely large, the shorted capacitor may spark out, which, in the worst scenario, may result in ignition. Ensure the safety of the circuit by, for example, giving it a redundant circuit structure or providing it with a protective circuit.

### Reliability and product life

The failure rate of the capacitor is specified based on 0.5%\*/1000 h (reliability level 60%), a failure rate conforming to JIS C 5003 (failure rate level). This indicates that the possibility of occurrence of a failure is by no means zero. One of the failure modes is a wear out failure. This happens when the period of guaranteeing the durability and high-temperature/high-humidity resistance of the capacitor is over, changes in the electrical characteristics of the capacitor (product) get larger and its electrolyte gradually deteriorates into an insulating material to create an open mode. Another failure mode is a random failure in which a short mode results mainly because of thermal, electrical, or mechanical stress, etc.

\* The failure rate of a small POSCAP of a B2 size or smaller is 1.0%.



## Circuit design and circuit board design

- Do not use this capacitor in a high-impedance voltage holding circuit, a coupling circuit, a time constant circuit, or a circuit widely affected by leak current.
- The capacitor is incorporated and used in a circuit where the capacitor operates within a rating range specified in the specifications. Set a service temperature within a specified category temperature range. Do not let a current larger than the allowable ripple current flow in the circuit. Reduce a ripple current to the extent at which the surface temperature of the capacitor's top does not exceed the rated temperature.  
(For information about TQC series, please contact us separately.)
- Electrical characteristics values listed in a characteristics table, such as a capacitance and an ESR, are values specified at shipment of the capacitor. These values may change when departing from the specified values in the table under certain electrical or mechanical performance condition. Be careful in choosing a capacitor with the intended electrical characteristics in your design work. Besides, temperature/frequency fluctuations can cause the capacitor's electrical characteristics to change. Confirm such changes in the electrical characteristics and then proceed with your circuit design.
- A leak current may increase even when soldering conditions are within a specified range. The leak current may increase also in a high-temperature non-load test or humidity-resistance non-load test, in which no voltage is applied, a temperature cycle test, etc. In such cases, applying a voltage at a temperature equal to or lower than the highest service temperature of the capacitor reduces the leak current gradually.
- A flow of excessively large rush current created by rapid charge/discharge may result in short circuit or an increase in leak current. When a rush current value exceeds 20 A\*, apply a protective circuit to the product.  
Note that at leak current measurement, a protective resistance of about 1 kΩ is put in the circuit before the capacitance is charged or discharges.

## Mounting and storage conditions

- Set soldering conditions within a specified range. Stricter soldering conditions outside the specified range will cause the deterioration of the electrical characteristics and service life characteristics.
- The capacitor must be kept in storage in an environment that avoids dropping soldering performance or caused trouble with soldering because of moisture absorption by an exterior resin. Store the capacitor, which is put together with a reel in an airtight moisture-proof bag, in a place where a normal temperature and humidity (15 °C to 35 °C and 45%RH to 75%RH) are maintained and direct sunlight is blocked. The storage period is 18 months or less after shipment from the factory.
- Unseal the bag to take out the capacitor right before mounting it on a circuit. Once you take out the capacitor, make sure to use it up. Storage periods for capacitors taken out of bags are as follows.  
\* These products do not conform to the entire requirements defined in JEDEC J-STD-020 and J-STD-033.  

(1) Level 2a	: four weeks at a temperature and a humidity equal to or lower than 30 °C and 60 %RH
(2) Level 3	: 168 hours at a temperature and a humidity equal to or lower than 30 °C and 60 %RH
(3) Level 5	: 48 hours at a temperature and a humidity equal to or lower than 30 °C and 60 %RH

## Reference information

### Intellectual property

Panasonic Group provides customers with safe products and services. We are also making great efforts to protect our intellectual property rights for Panasonic Group products. Typical patents related to this product are as follows.

[U.S. patent]

USP Nos. 6508800, 6891717, 7158368, 7326260, 8081421, 8149569, 8456804, and 8559167