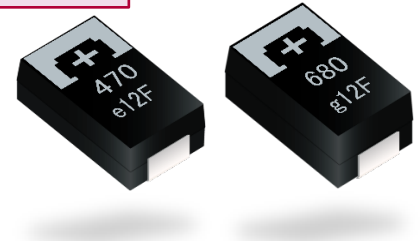


**Conductive Polymer Tantalum  
Solid Capacitors**  
Surface Mount Type  
**TPF series**



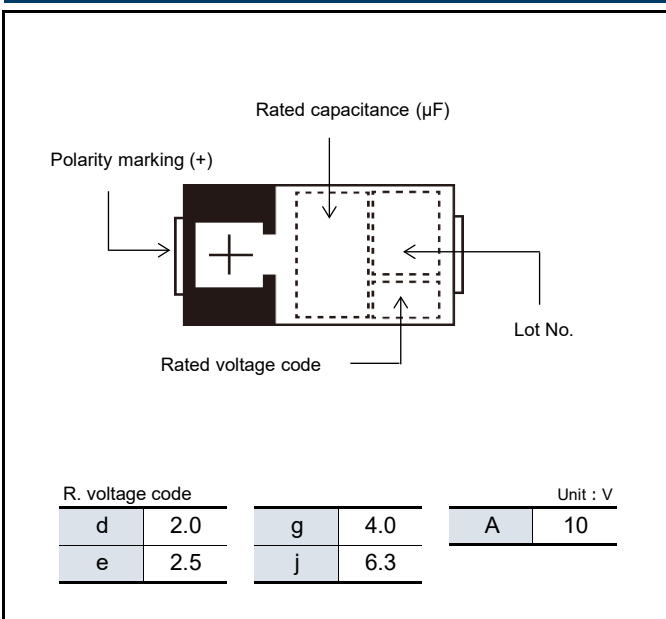
**Features**

- Super low ESR (5 mΩ max.)
- Large capacitance (1000 μF max.)
- RoHS compliance, Halogen free

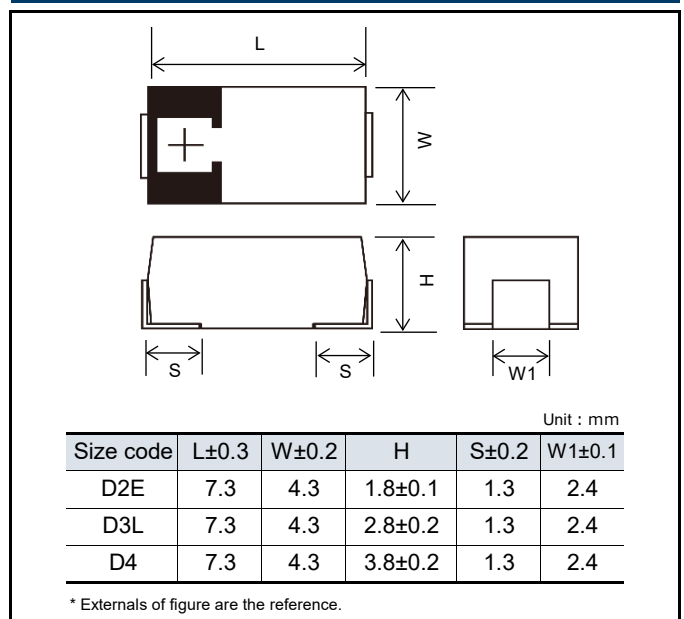
**Specifications**

Size code	D2E	D3L	D4
Category temp. range	-55 °C to +105 °C		
Rated volt. range	2.0 V	2.5 V to 10 V	2.5 V to 6.3 V
Category volt. range	2.0 V	2.5 V to 10 V	2.5 V to 6.3 V
Rated cap. range	220 μF to 330 μF	150 μF to 680 μF	470 μF to 1000 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		
	Capacitance change	Within ±20 % of the initial value	
	Dissipation factor(tan δ)	≤ 1.5 times of the initial limit	
	Leakage current	Within 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 (2TPF220M6, 2TPF330M6, ETPF1000M6H (5H))	
		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**



**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 qty (pcs)	Reflow temp ≤260°C	Reflow temp ≤250°C	
NRFND 2.0	105	2.0	105	220	7.3	4.3	1.8	D2E	4700	6	0.10	88.0	2TPF220M6	3000	-		
	105	2.0	105	330	7.3	4.3	1.8		4700	6	0.10	132.0	2TPF330M6	3000			
2.5	105	2.5	105	470	7.3	4.3	2.8	D4	4400	6	0.10	117.5	2R5TPF470M6L	2500	2a		
	105	2.5	105		7.3	4.3	2.8		4400	7	0.10	117.5	2R5TPF470M7L	2500			
	105	2.5	105		7.3	4.3	2.8		4400	10	0.10	117.5	2R5TPF470ML	2500			
	105	2.5	105	680	7.3	4.3	3.8	D3L	6100	5	0.10	117.5	ETPF470M5H	2000			
	105	2.5	105		7.3	4.3	2.8		3850	9	0.10	117.5	2R5TPF470M9L	2500			
	105	2.5	105		7.3	4.3	2.8		4400	6	0.10	170.0	2R5TPF680M6L	2500			
	105	2.5	105	1000	7.3	4.3	2.8	D4	4400	7	0.10	170.0	2R5TPF680M7L	2500			
	105	2.5	105		7.3	4.3	2.8		4400	10	0.10	170.0	2R5TPF680ML	2500			
	105	2.5	105		7.3	4.3	3.8		6100	5	0.10	170.0	ETPF680M5H	2000			
	105	2.5	105	470	7.3	4.3	3.8	D4	2700	25	0.10	170.0	ETPF680MPH	2000			
	105	2.5	105		7.3	4.3	3.8		6100	5	0.10	250.0	ETPF1000M5H	2000			
	105	2.5	105		7.3	4.3	3.8		5600	6	0.10	250.0	ETPF1000M6H	2000			
4.0	105	4.0	105	330	7.3	4.3	2.8	D3L	3900	9	0.10	132.0	4TPF330M9L	2500	2a		
	105	4.0	105		7.3	4.3	2.8		4000	12	0.10	132.0	4TPF330ML	2500			
	105	4.0	105		7.3	4.3	2.8		3550	15	0.10	132.0	4TPF330MFL	2500			
	105	4.0	105	680	7.3	4.3	2.8	D4	4400	10	0.10	188.0	4TPF470ML	2500			
	105	4.0	105		7.3	4.3	3.8		4400	10	0.10	272.0	4TPF680MAH	2000			
	105	4.0	105		7.3	4.3	3.8		3550	15	0.10	272.0	4TPF680MFH	2000			
	105	4.0	105		7.3	4.3	3.8		2350	35	0.10	272.0	4TPF680MZH	2000			
NRFND 6.3	105	6.3	105	150	7.3	4.3	2.8	D3L	2750	25	0.10	94.5	6TPF150MPL	2500	3		
	105	6.3	105	220	7.3	4.3	2.8		6100	5	0.10	138.6	6TPF220M5L	2500			
	105	6.3	105		7.3	4.3	2.8		5550	6	0.10	138.6	6TPF220M6L	2500			
	105	6.3	105		7.3	4.3	2.8		4600	9	0.10	138.6	6TPF220M9L	2500			
	105	6.3	105	330	7.3	4.3	2.8		4000	12	0.10	138.6	6TPF220ML	2500			
	105	6.3	105		7.3	4.3	2.8		3550	15	0.10	138.6	6TPF220MFL	2500			
	105	6.3	105		7.3	4.3	2.8		2750	25	0.10	138.6	6TPF220MPL	2500			
	105	6.3	105		7.3	4.3	2.8		3900	9	0.10	207.9	6TPF330M9L	2500			
	105	6.3	105	470	7.3	4.3	2.8		D4	3650	10	0.10	207.9	6TPF330MAL			2500
	105	6.3	105		7.3	4.3	3.8			4400	10	0.10	296.1	6TPF470MAH			2000
105	6.3	105	7.3		4.3	3.8	3550	15		0.10	296.1	6TPF470MFH	2000				
10	105	10	105	150	7.3	4.3	2.8	D3L	3600	15	0.10	150.0	10TPF150ML	2500	-		

\*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 TPF 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 product 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, the specification document suited to each application shall be signed/sealed (with Panasonic and the user) in advance..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  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ , or  $\text{NO}_x$ .
  - (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  $0.5\% \cdot 1000 \text{ h}$  (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

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