



## MPN4 SERIES

### POWER FACTOR CORRECTION CAPACITOR

**METALLIZED POLYPROPYLENE CAPACITOR ▲ THT type**

Low noise

Flame retardant epoxy resin, UL 94V-0

Self-healing property

Ultra-miniature size ▲ Smaller version of MPN2 series

**Especially for Power Factor Correction (PFC) circuits**

### SPECIFICATION

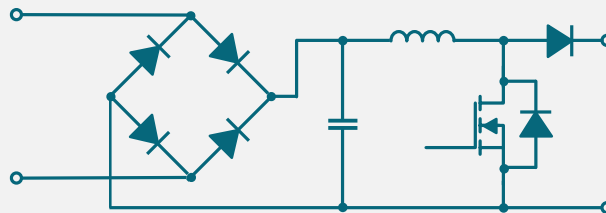
Item		Characteristics		
Related Documents		IEC 60384-16		
Rated Temperature Range		-40°C to +85°C		
Usable Temperature Range <sup>Note 1</sup>		-40°C to +110°C		
Capacitance Range	C <sub>R</sub>	0.47μF to 2.2μF		
Capacitance Tolerance	ΔC	±5% ▲ ±10% ▲ ±20%		
Rated DC Voltage	V <sub>R DC</sub>	450V <sub>DC</sub>		
Rated AC Voltage	V <sub>R AC</sub>	160V <sub>AC</sub>		
Dissipation Factor	tan δ	f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF
		1	≤ 0.1%	≤ 0.1%
		100	≤ 2%	≤ 3%
Insulation Resistance <sup>Note 2</sup>	R <sub>INS</sub>	≥ 7.5GΩ x μF		
Withstand Voltage <sup>Note 3</sup>	V <sub>W</sub>	1.6 x V <sub>R</sub> applied for 2 sec. (cut off current 10mA)		
Maximum Pulse Rise Slope dV/dt	Pitch (mm)	450V <sub>DC</sub>		
	10	60V/μs		
	15	40V/μs		

#### Notes:

- Derating ratio of rated voltage +85°C to +110°C 0.62% per °C for rated DC voltage
- Terminal to terminal at 20°C ± 5°C Voltage charge time: 1minute; Voltage charge: 100V<sub>DC</sub>
- Terminal to terminal at 20°C ± 5°C Slow-up voltage speed: C ≤ 10μF: 5sec / C > 10μF: 10sec

### APPLICATIONS

#### Power Factor Correction Circuits

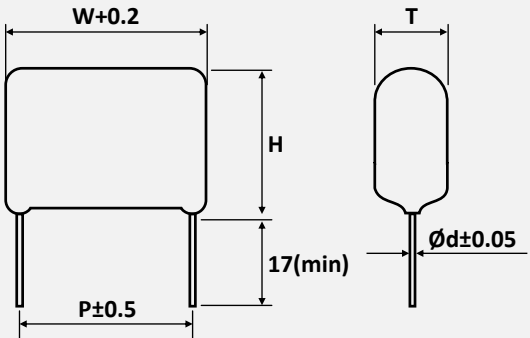
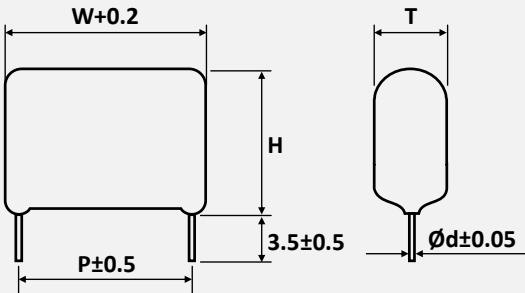


## ELECTRICAL CHARACTERISTICS

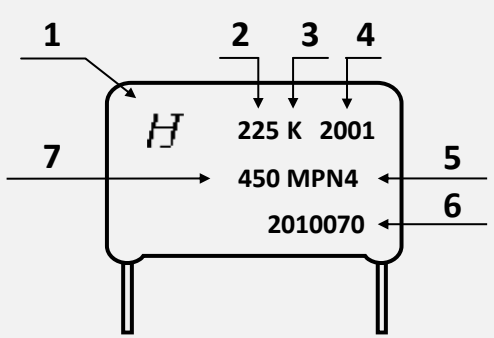

$V_R$	$C_R$ ( $\mu F$ )	Dimensions (mm)			P (mm)	$\phi d \pm 0.05$ (mm)	Part Number <sup>Note</sup>
		W + 0.2	H	T			
450V <sub>DC</sub> ▲ 160V <sub>AC</sub>	0.47	12.5	11.7	4.6	10	0.6	MPN4474□0450DB□10□
	0.68	12.5	13.2	5.3	10	0.6	MPN4684□0450DB□10□
	1	12.5	14.8	6.2	10	0.6	MPN4105□0450DB□10□
	1	12.5	13.3	8	10	0.6	MPN4105□0450DB□10□
	1	12.5	12	8.3	10	0.6	MPN4105□0450DB□10□
	1.5	12.5	17.5	7.8	10	0.8	MPN4155□0450DB□10□
	2.2	12.5	18.4	10.2	10	0.8	MPN4225□0450DB□10□
	1	18	11	6.5	15	0.8	MPN4105□0450DB□15□
	1.5	18	12.2	7.3	15	0.8	MPN4105□0450DB□15□
	2.2	18	13.5	9	15	0.8	MPN4225□0450DB□15□

Note: Enter the appropriate tolerance lead length code and lead configuration □ from the product code table

## PACKAGE OUTLINE ▲ All dimensions in mm

Long Leads	Short Leads
 <p>Diagram showing the package outline for long leads. Dimensions include: W+0.2 (width), H (height), T (lead thickness), P±0.5 (lead pitch), and 17(min) (minimum lead length). The lead diameter is specified as <math>\phi d \pm 0.05</math>.</p>	 <p>Diagram showing the package outline for short leads. Dimensions include: W+0.2 (width), H (height), T (lead thickness), P±0.5 (lead pitch), and 3.5±0.5 (lead length). The lead diameter is specified as <math>\phi d \pm 0.05</math>.</p>

## PRODUCT MARKING

Marking					Details	
 <p> <math>P \leq 10\text{mm}</math>   <b>H</b>   <math>P \text{ 15 to 27.5mm}</math>   <b>H</b>   <math>P &gt; 27.5\text{mm}</math>    </p>					No.	Description
					1	Manufacturer Logo *
					2	Nominal capacitance in $\mu\text{F}$
					3	Capacitance tolerance
					4	Date code
					5	Series name
					6	Production no.
					7	DC rated voltage

## DATE CODE & APPLICATION CATEGORY

Example:

### Date code

2001:                      2001 = 1<sup>st</sup> week of 2020

### Lot number

2010070:                      20 = Year, here 2020  
                                          1 = Month, here January  
                                          0001 to XXXX = Serial number

20		01	
Year		Week	
19	2019	01	1 <sup>st</sup>
20	2020	02	2 <sup>nd</sup>
21	2021	03	3 <sup>rd</sup>
22	2022	04	4 <sup>th</sup>
23	2023	05	5 <sup>th</sup>
...	...	...	...
30	2030	53	53 <sup>rd</sup>

## PRODUCT CODE

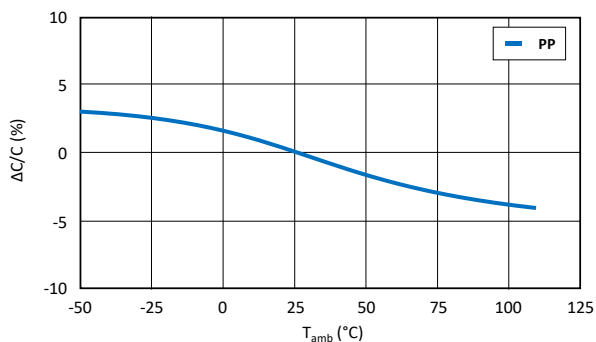
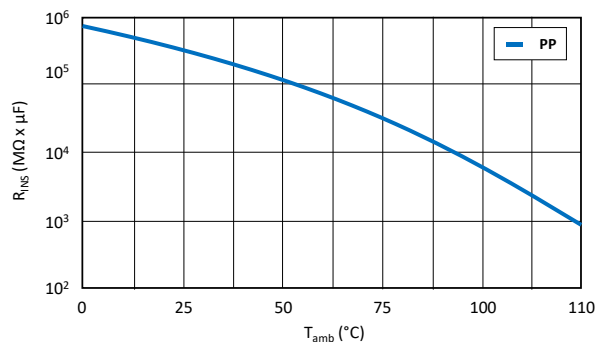
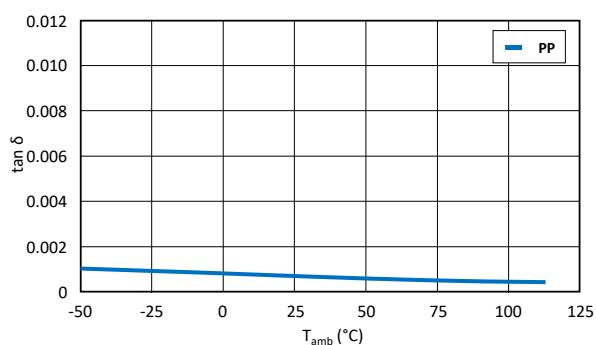
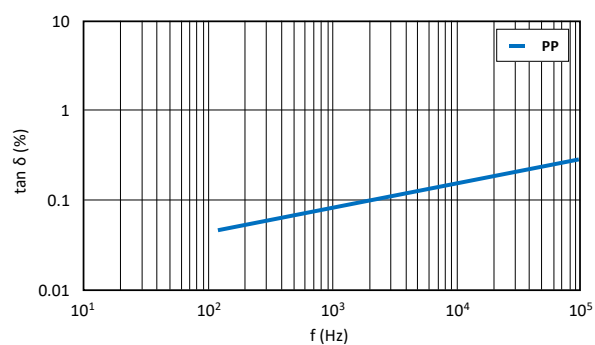
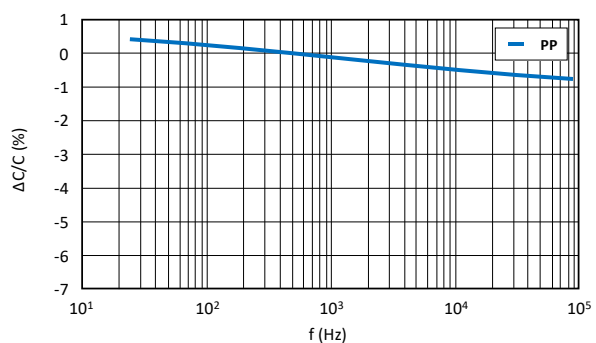
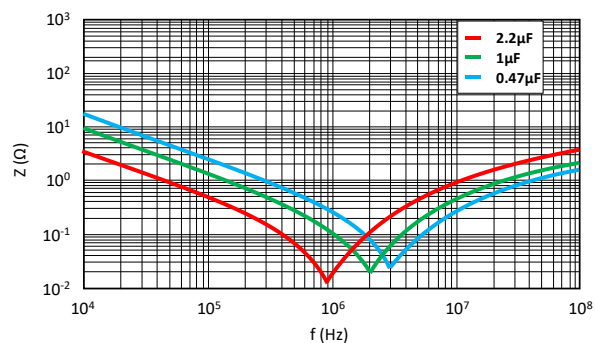
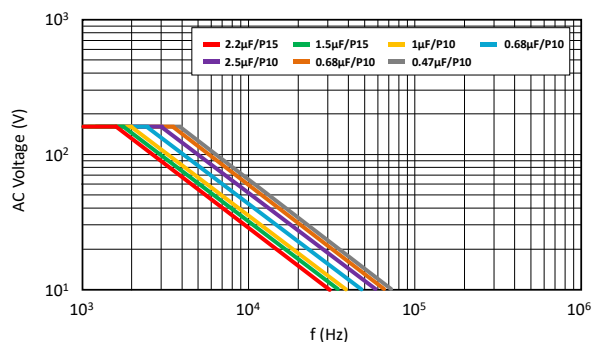
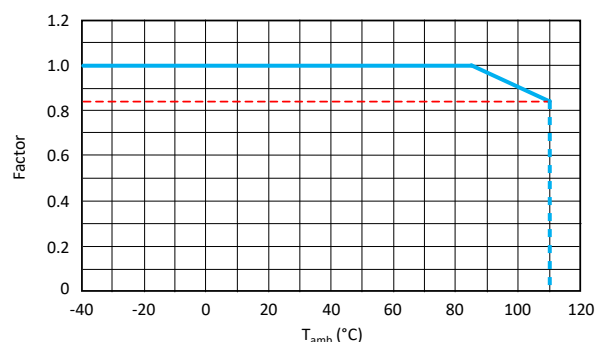
Example: MPN4 series ▲ 2.2 $\mu\text{F}$  ▲ 450V<sub>DC</sub> ▲  $\pm 10\%$  ▲ P=15mm ▲ Bulk ▲ Straight leads ▲ 17mm lead length

MPN4		225		K		0450		D		B		1		15		1	
Series		Capacitance Code <small>Note1</small> ( $\mu\text{F}$ )		Capacitance Tolerance (%)		Rated Voltage (V <sub>DC</sub> )		Voltage Type		Packaging Type		Lead Configuration <small>Note2</small>		Pitch (mm)		Lead Length (mm)	
Code	Series	Code	$\mu\text{F}$	Code	Tol.	Code	VDC	Code	Type	Code	Type	Code	Style	Code	mm	Code	mm
MPN4	MPN4	474	0.47	J	$\pm 5$	0450	450	D	DC	B	Bulk	1	SL	10	10.0	1	17.0
		105	1	K	$\pm 10$									15	15.0	2	3.5
		155	1.5	M	$\pm 20$												
		225	2.2														

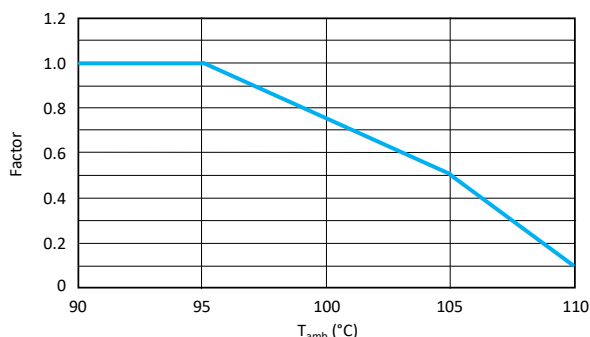
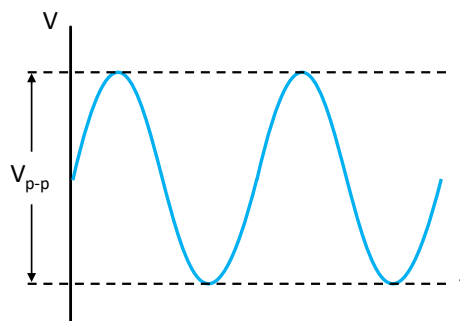
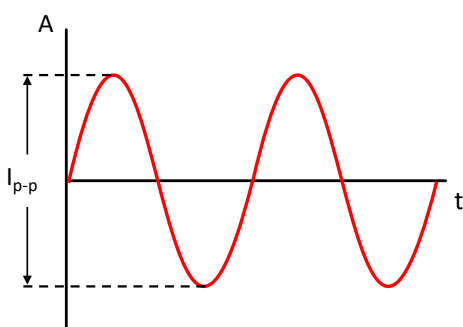
Note:

- Capacitance code expressed in  $\mu\text{F}$ . The first two digits represent significant figures. The last digit specifies the total number of zeros to be added.
- SL = Straight leads

## REFERENCE DATA

**Fig. 1 • Capacitance Drift vs. Ambient Temperature**

**Fig. 2 • Insulation Resistance vs. Ambient Temperature**

**Fig. 3 • Dissipation Factor vs. Ambient Temperature**

**Fig. 4 • Dissipation Factor vs. Frequency**

**Fig. 5 • Capacitance Drift vs. Frequency**

**Fig. 6 • Impedance vs. Frequency • Typical Curve**

**Fig. 7 • Max. RMS Voltage vs. Frequency • 450V<sub>DC</sub>/160V<sub>AC</sub>**

**Fig. 8 • Max. DC Voltage vs. Temperature**


## REFERENCE DATA

**Fig. 9 - Permissible Current Derating by Temperature**

**Fig. 10 - Voltage Wave Form**

**Fig. 11 - Max. RMS Current - Wave Form**


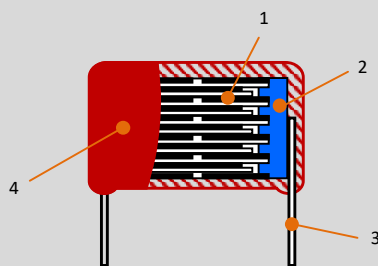
## MAXIMUM RMS CURRENT

V <sub>R</sub>	C <sub>R</sub> (μF)	P (mm)	I <sub>RMS</sub> (A) at f							
			15.75kHz	35kHz	45kHz	65kHz	80kHz	100kHz	130kHz	200kHz
450V <sub>DC</sub> ▲ 160V <sub>AC</sub>	0.47	10	1.75	1.90	1.95	2.00	2.03	2.05	2.10	2.20
	0.68	10	2.35	2.50	2.55	2.65	2.70	2.80	2.85	3.00
	1	10	2.90	3.10	3.20	3.30	3.40	3.43	3.50	3.65
	1.5	10	3.40	3.65	3.70	3.80	3.90	4.00	4.10	4.20
	2.2	10	4.10	4.40	4.50	4.60	4.70	4.80	4.90	4.85
	0.68	15	2.32	2.39	2.40	2.50	2.53	2.56	2.61	2.69
	1	15	2.77	2.92	2.97	3.06	3.07	3.14	3.19	3.27
	1.5	15	3.49	3.63	3.73	3.85	3.86	3.96	3.98	4.10
	2.2	15	4.46	4.60	4.73	4.85	4.87	4.98	5.12	5.00

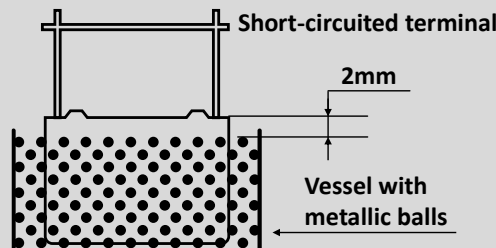
Note: Maximum capacitor surface temperature T<sub>s</sub> ≤ 110°C; Maximum body temperature rise ΔT ≤ 10°C

$$I_{RMS} = \frac{I_{p-p}}{2 \cdot \sqrt{2}}$$

## TECHNICAL SPECIFICATION

No.	Category	Specification			
1	Scope	This specification applies to capacitors for electronics applications, especially PFC circuits. Reference standards: IEC 60384-16			
2	Product Name	Metallized polypropylene film capacitor, Type MPN4			
3	Construction	Dimensions:		Refer to dimensions drawing	
					
		1 = Element		Metallized Polypropylene film	
		2 = Metal spray		Special solder. (Lead Free) compliant to RoHS directive	
		3 = Lead wire		Tinned wire (Cu wire) or tinned copper clad-steel wire (CP wire). (Lead Free) compliant to RoHS directive	
		4 = Coating		Epoxy resin. (UL-94V-0 Standard)	
4	Atmospheric and Temperature Characteristics	<b>Standard atmospheric conditions.</b> Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests is as follows:			
		Ambient temperature:		15 to 35°C	
		Relative humidity		45% to 85%	
		Air pressure		86 to 106 kPa	
		<b>If there may be any doubt on the results, measurements shall be made within the following limits.</b>			
		Ambient temperature:		20°C ± 5°C	
		Relative humidity:		60 to 70%	
		<b>Operating temperature range</b>			
		Lowest operating temperature:		-40°C	
		Maximum operating temperature:		+110°C (case-temperature) with specified voltage-derating	
		The capacitor can be operated up to 110°C case-temperature (according to the power to be dissipated). Derating ratio of rated voltage +85°C to +110°C: 0.62% per °C for $V_{RDC}$ The temperature is measured at the hottest point of the case when the capacitor has reached its thermal equilibrium.			
		Rated temperature range		-40°C to +85°C	
Rated temperature range is the range of ambient temperature for which the capacitor can be operated continuously at rated voltage.					
5	Electrical Characteristics	Rated voltage:		$V_R$ at 85°C	450V <sub>DC</sub>
		Category voltage:		Up to 85°C	$V_C = V_R$
		Rated upper limit temperature:		+85°C	
		Usable upper limit temperature:		+110°C	
		Capacitance range:		0.33μF to 2.2μF	
		Capacitance tolerance:		±5% (J), ±10% (K), ±20% (M)	Measured at 1kHz, 1V

# TECHNICAL SPECIFICATION

No.	Category	Specification																			
5	Electrical Characteristics	<b>Dissipation factor tanδ (%):</b> LCR meter: HP-4284A, at 20°C ± 5°C																			
		f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF	1	≤ 0.10%	≤ 0.10%	100	≤ 2.00%	≤ 3.00%											
		f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF																	
		1	≤ 0.10%	≤ 0.10%																	
		100	≤ 2.00%	≤ 3.00%																	
		<b>Insulation resistance between terminals</b>																			
		Test conditions:																			
		Temperature:	20°C ± 5°C																		
		Voltage charge:	100V <sub>DC</sub>																		
		Performance:	C > 0.33μF																		
			After voltage charge																		
			1 minute > 7.5GΩ x μF																		
		<b>Test voltage between terminals</b>																			
		1.6 × V <sub>RDC</sub> applied for 2 sec, at 20°C ±5°C																			
		Cut off current:	10mA																		
		Ramp/rise time:	C ≤ 10μF: 5 sec	C > 10μF: 10 sec																	
		Performance:	There shall be no dielectric breakdown or other damage																		
		<b>Dielectric strength between terminal and enclosure</b>																			
		Apply 200% of rated voltage between terminals and enclosure for 2 to 5 sec																			
		Method of the test described as below																			
		<p>Put the small metallic balls with 1 mm diameter in a vessel. The test capacitor shall be submerged with the small metallic balls.</p> <p>Distance of the metallic balls and the terminals shall be kept about 2 mm as shown in fig. 1.</p> <p>The test voltage shall be applied between the short-circuited terminals and the metallic balls</p>		 <p>Short-circuited terminal</p> <p>2mm</p> <p>Vessel with metallic balls</p> <p>Fig. 1</p>																	
		Performance:	There shall be no dielectric breakdown or other damage																		
		Test Item	The test capacitor shall be kept in the testing oven and kept at condition of following table, and it shall be repeated for 5 cycles successively. After the test, the capacitor shall be let alone at the ordinary condition for 2 hours																		
<table><tr><th colspan="3">Conditions</th><th>Performance</th></tr><tr><th>Step</th><th>Temperature</th><th>Time</th><th rowspan="5">Capacitance change  ΔC/C  ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value</th></tr><tr><td>1</td><td>-40 ± 3°C</td><td>30 ± 3 min</td></tr><tr><td>2</td><td>Ordinary</td><td>3 min or less</td></tr><tr><td>3</td><td>+110 ± 2°C</td><td>30 ± 3 min</td></tr><tr><td>4</td><td>Ordinary</td><td>3 min or less</td></tr></table>			Conditions			Performance	Step	Temperature	Time	Capacitance change  ΔC/C  ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value	1	-40 ± 3°C	30 ± 3 min	2	Ordinary	3 min or less	3	+110 ± 2°C	30 ± 3 min	4	Ordinary
Conditions			Performance																		
Step	Temperature	Time	Capacitance change  ΔC/C  ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value																		
1	-40 ± 3°C	30 ± 3 min																			
2	Ordinary	3 min or less																			
3	+110 ± 2°C	30 ± 3 min																			
4	Ordinary	3 min or less																			
Rapid change of temperature (IEC68-2-14 Na)																					

## TECHNICAL SPECIFICATION

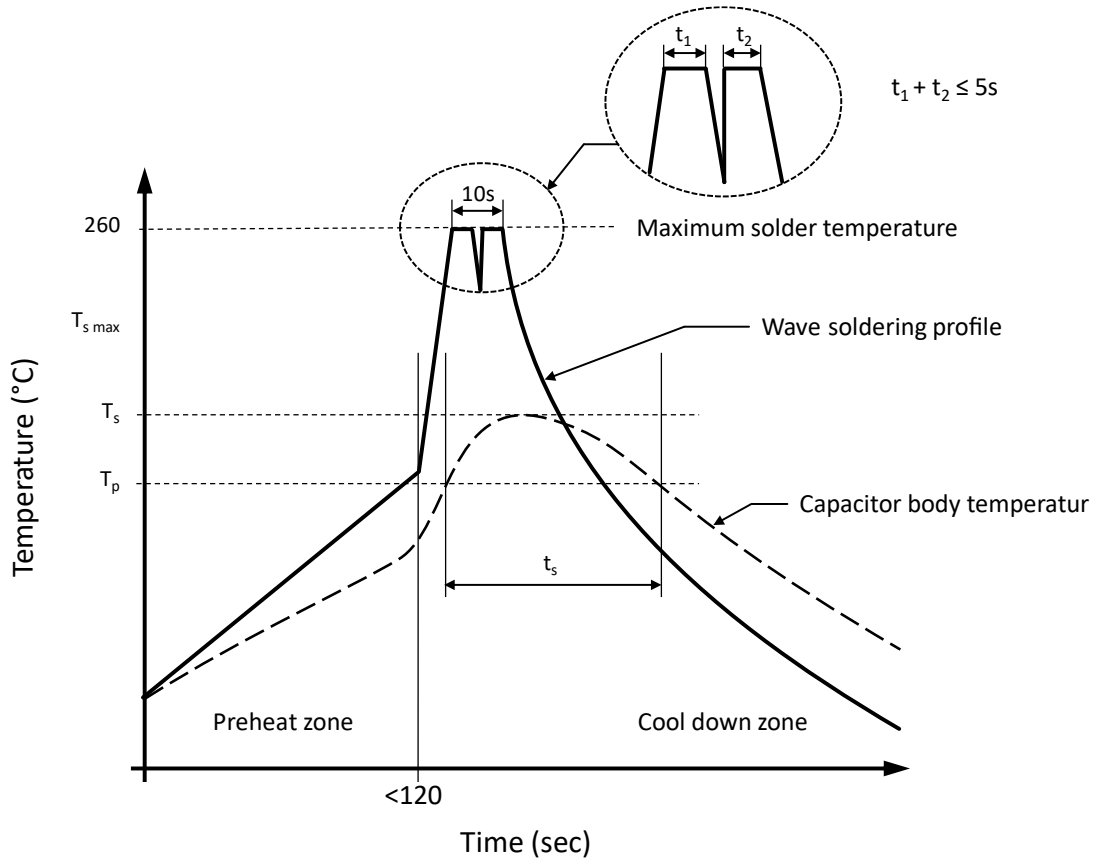
No.	Category	Specification		
		Test Item	Conditions	Performance
6	Mechanical Characteristics	Robustness of terminations (IEC68-2-21)	Tensile Ua1	There shall be no such mechanical damage as terminal damage etc.
			A load of 10 N (1.0kg) shall be gradually applied to the terminal in the axial direction and held thus for 10 sec	
			Bending Ub methode 1	
			While a load of 500g applied to the lead wire, the body of the capacitor shall be bent 90° and returned to the original position. This operation shall be conducted in a few seconds. Then the body shall be bent 90° at the same speed in the opposite direction and returned to the original position	
7	Endurance Characteristics	Solderability (IEC68-2-20 Ta)	Solder bath: 245°C ± 5°C Immersion time: 2.5±0.5sec Visual examination	At least 95% of the circumferential face of lead wire up to immersed level shall be covered with new solder
		Resistance to soldering heat (IEC 68-2-20 Tb)	Solder bath: 260 °C ± 5 °C Immersion time: 10±1sec Thickness of heat shunt (Printed wiring board): 1.6mm Capacitance at 1kHz tan δ at 1kHz	Capacitance change  ΔC/C  ≤ ± 3% tan δ change ≤ 0.1% at 1kHz
		Vibration proof (IEC68-2-6 Fc)	The frequency shall be varied form from 10Hz to 55Hz at 1.5mm amplitude and back to 10Hz in approximately 1-minute intervals. This motion shall be applied for a period of 2 hours in each of 3 mutually perpendicular directions. During the last 30 min of vibration in each direction, checks shall be made for open or short-circuit and interruption	Bending strength: There shall be no open or short-circuiting and the connections must be stabilized.
				Appearance: There shall be no such mechanical damage as terminal damage etc.
		Damp heat steady state (IEC68-2-3 Ca)	The capacitor shall be stored at a temperature of 40 ± 2°C and relative humidity of 90% to 95% for 1000 hours. And then the capacitor shall be subjected to standard atmospheric conditions for 1 to 2 hours, after which measurement shall be made	Capacitance change  ΔC/C  ≤ ± 5% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value
		Electrical endurance (IEC 60384-2)	125% of category voltage shall be applied to the capacitor at a temperature of 110 ± 2°C for 1000 hours. Then the capacitor shall be subjected to standard atmospheric conditions for 1 to 2 hours, after which measurement shall be made. The load resistor in series with the capacitor shall be 20Ω to 1kΩ.	Capacitance change  ΔC/C  ≤ ± 10% tan δ change ≤ 0.4% at 1kHz R insulation ≥ 50 % of limit value



## TECHNICAL SPECIFICATION

No.	Category	Specification
8	Storage conditions	It should be noted that the solderability of the terminals may be deteriorated when stored barely in an atmosphere for a long period.
		It should not be located in particularly high temperature and high humidity, it must submit to the following conditions (Keeping in the original package) Temperature: 5°C to 35°C Relative humidity: ≤ 70% Storage period: ≤ 12 months (Following the manufacturing date marked on the label in package bag)
		Avoid wetting the capacitor by water, oil, salt and/or poisonous gas.
		If used the capacitor that overdue the storage time, it should be test, the characteristics of the capacitor or contact with our technical engineer.

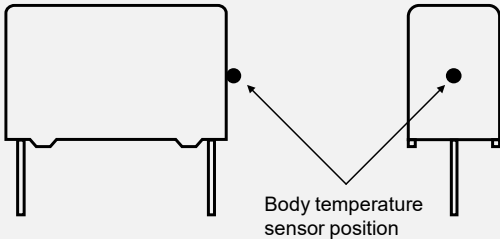
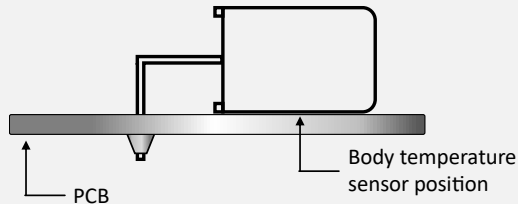
## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



Capacitor body temperature should follow the description below:

Profile Features		Polypropylene Film Capacitor	Polyester Film Capacitor
Capacitor body maximum temperature at preheating	$T_p$	$\leq 110^\circ\text{C} / 120 \text{ seconds}$	$\leq 125^\circ\text{C} / 120 \text{ seconds}$
Capacitor body maximum temperature at wave soldering	$T_s$	$\leq 120^\circ\text{C} / t_s \leq 45 \text{ seconds}$	$\leq 150^\circ\text{C} / t_s \leq 45 \text{ seconds}$

## DETERMINING THE CAPACITOR BODY TEMPERATURE

Vertical Mounting	Horizontal Mounting
 <p>Body temperature sensor position</p> <p>The body temperature sensor position is defined as the highest temperature point around the capacitor body.</p>	 <p>PCB</p> <p>Body temperature sensor position</p> <p>If there is 90 degree bending product, the sensor position shall be between product and PCB</p>

## SOLDERING SUGGESTIONS

When solder a capacitor, heat in soldering is conducted to the element of the capacitor from wire lead and an enclosure, and hence it should be noted that soldering under high temperature and a long period may cause deterioration of breakdown of capacitors. Be sure to solder within the recommended temperature condition range.

### HAND SOLDERING

- a.) Soldering iron top temperature:  $\leq 350^{\circ}\text{C}$
- b.) Soldering time:  $\leq 3\text{sec}$

If re-work or dipping twice is necessary, it should be done after the capacitor returned to the normal temperature. Suggestion time is 24 hours.

THT film capacitors are not suitable for reflow soldering.

When SMD components are used together with film capacitor, the film capacitor should not pass into the SMD adhesive curing oven. The film capacitor should be assembled after the SMD process.

In order to ensure proper conditions for manual or selective soldering, the body (surface) temperature of the film capacitor ( $T_s$ ) must be  $\leq 120^{\circ}\text{C}$ .

## REVISION TABLE

Revision	Date	Status	Notes
001	01/10/2021	Initial release	Initial publication

## DISCLAIMER

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It is subject to the user's duty of care to design and validate his products in such a way that appropriate measures are taken, such as protective circuits or redundant systems to ensure the safety standards required in the application.

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