



HPN3 SERIES

POWER FACTOR CORRECTION CAPACITOR

METALLIZED POLYPROPYLENE CAPACITOR ▲ THT type

Low noise

AEC-Q200 on request, contact MGT for more details

Self-healing property

Standard size ▲ Pitch 15mm

Temperature range -40°C to +125°C with voltage derating

SPECIFICATION

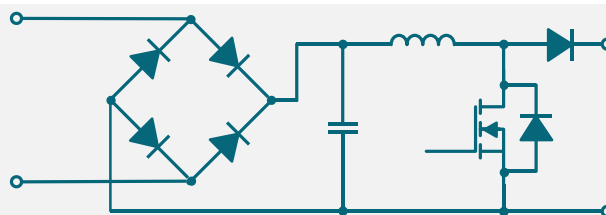
Item		Characteristics		
Related Documents		IEC 60384-16		
Rated Temperature Range		-40°C to +85°C		
Usable Temperature Range ^{Note 1}		-40°C to +125°C		
Capacitance Range	C _R	0.22μF to 2.2μF		
Capacitance Tolerance	ΔC	±5% ▲ ±10%		
Rated DC Voltage	V _{R DC}	450V _{DC} ▲ 520V _{DC} ▲ 630V _{DC}		
Rated AC Voltage	V _{R AC}	160V _{AC} ▲ 200V _{AC} ▲ 200V _{AC}		
Dissipation Factor	tan δ	f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF
		1	≤ 0.1%	≤ 0.15%
		100	≤ 1.5%	≤ 2.5%
Insulation Resistance ^{Note 2}	R _{INS}	C _R ≤ 0.33μF		C _R > 0.33μF
		≥ 20GΩ		≥ 9GΩ x μF
Withstand Voltage ^{Note 3}	V _W	1.4 x V _R applied for 2 sec. (cut off current 10mA)		
Maximum Pulse Rise Slope dV/dt	Pitch (mm)	450V _{DC}	520V _{DC}	630V _{DC}
	15	80V/μs	120V/μs	150V/μs

Notes:

- Derating ratio of rated voltage +85°C to +125°C 1.5% per °C for rated DC voltage
- Terminal to terminal at 20°C ± 5°C Voltage charge time: 1minute; Voltage charge: 100V_{DC}
- Terminal to terminal at 20°C ± 5°C Slow-up voltage speed: C ≤ 10μF: 5sec / C > 10μF: 10sec

APPLICATIONS

Power Factor Correction Circuits

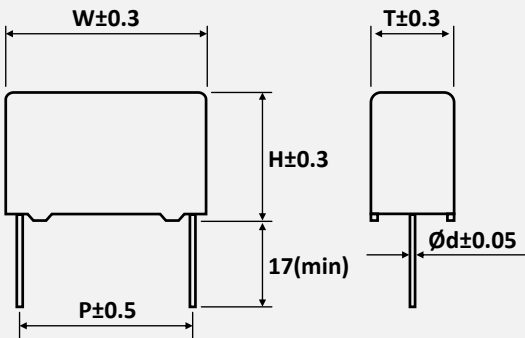
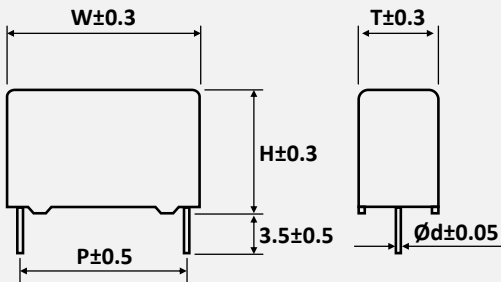


ELECTRICAL CHARACTERISTICS

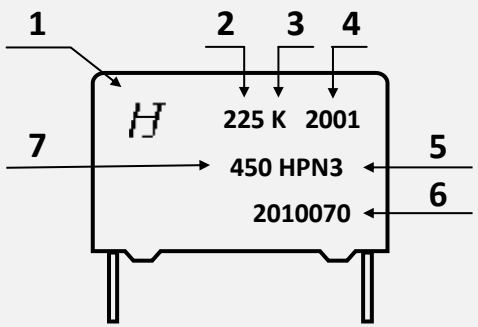
V_R	C_R (μF)	Dimensions (mm)			P (mm)	$\phi d \pm 0.05$ (mm)	Part Number ^{Note}
		W ± 0.3	H ± 0.3	T ± 0.3			
450V _{DC} ▲ 160V _{AC}	0.47	18	11	5	15	0.8	HPN3474□0450DB□15□
	0.68	18	12	6	15	0.8	HPN3684□0450DB□15□
	1	18	13	7	15	0.8	HPN3105□0450DB□15□
	1.5	18	17	8	15	0.8	HPN3155□0450DB□15□
	2	18	18	9	15	0.8	HPN3205□0450DB□15□
	2.2	18	18	10	15	0.8	HPN3225□0450DB□15□
520V _{DC} ▲ 200V _{AC}	0.33	18	12	6	15	0.8	HPN3334□0520DB□15□
	0.47	18	13	7	15	0.8	HPN3474□0520DB□15□
	0.68	18	14.5	8.5	15	0.8	HPN3684□0520DB□15□
	1	18	18	9	15	0.8	HPN3105□0520DB□15□
	1.5	18	19	11	15	0.8	HPN3155□0520DB□15□
630V _{DC} ▲ 200V _{AC}	0.22	18	12	6	15	0.8	HPN3224□0630DB□15□
	0.33	18	13	7	15	0.8	HPN3334□0630DB□15□
	0.47	18	14	8	15	0.8	HPN3474□0630DB□15□
	0.68	18	18	9	15	0.8	HPN3684□0630DB□15□
	1	18	19	11	15	0.8	HPN3105□0630DB□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 dimensions for Long Leads: W± 0.3, H± 0.3, T± 0.3, P± 0.5, $\phi d \pm 0.05$, and 17(min).</p>	 <p>Diagram showing dimensions for Short Leads: W± 0.3, H± 0.3, T± 0.3, P± 0.5, 3.5± 0.5, and $\phi d \pm 0.05$.</p>

PRODUCT MARKING

Marking					Details	
					No.	Description
					1	Manufacturer Logo *
					2	Nominal capacitance in μF
					3	Capacitance tolerance
					4	Date code
					5	Series name
					6	Production no.
					7	DC rated voltage
$P \leq 10\text{mm}$	H	P 15 to 27.5mm	H	$P > 27.5\text{mm}$	HJC	

DATE CODE & APPLICATION CATEGORY

Example:

Date code

2001: 2001 = 1st 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 st
20	2020	02	2 nd
21	2021	03	3 rd
22	2022	04	4 th
23	2023	05	5 th
...
30	2030	53	53 rd

PRODUCT CODE

Example: HPN3 series ▲ 2.2 μF ▲ 450V_{DC} ▲ $\pm 10\%$ ▲ P=15mm ▲ Bulk ▲ Straight leads ▲ 17mm lead length

HPN3		225		K		0450		D		B		1		15		1	
Series		Capacitance Code ^{Note1} (pF)		Capacitance Tolerance (%)		Rated Voltage (V _{DC})		Voltage Type		Packaging Type		Lead Configuration ^{Note2}		Pitch (mm)		Lead Length (mm)	
Code	Series	Code	μF	Code	Tol.	Code	VDC	Code	Type	Code	Type	Code	Style	Code	mm	Code	mm
HPN3	HPN3	154	0.22	J	± 5	0450	450	D	DC	B	Bulk	1	SL	15	15.0	1	17.0
		684	0.68	K	± 10	0520	520									2	3.5
		105	1.0			0630	630										
		225	2.2														

Note:

- Capacitance code expressed in pF. 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

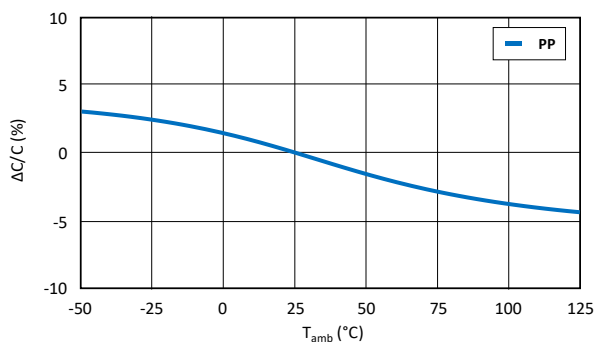


Fig. 2 • Insulation Resistance vs. Ambient Temperature

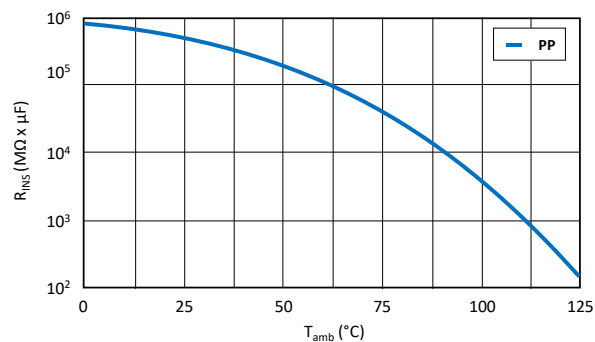


Fig. 3 • Dissipation Factor vs. Ambient Temperature

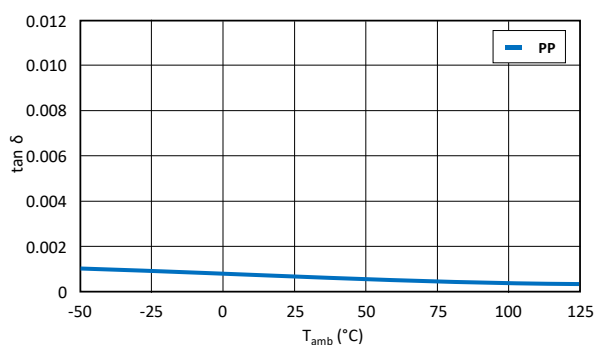


Fig. 4 • Dissipation Factor vs. Frequency

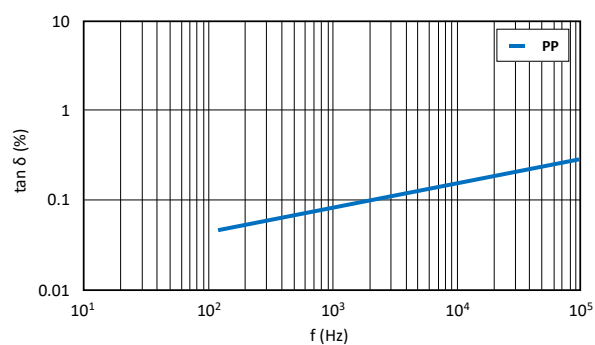


Fig. 5 • Capacitance Drift vs. Frequency

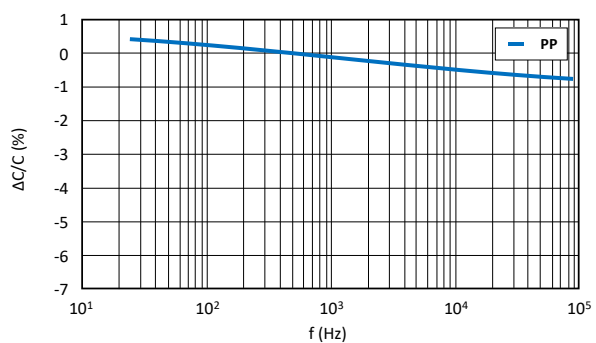


Fig. 6 • Impedance vs. Frequency - Typical Curve

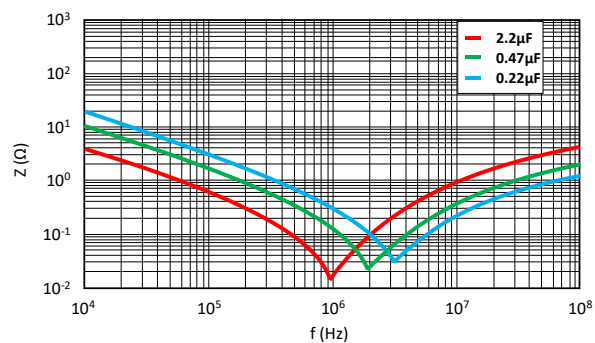


Fig. 7 • Max. RMS Voltage vs. Frequency - 450V_{DC}/160V_{AC}

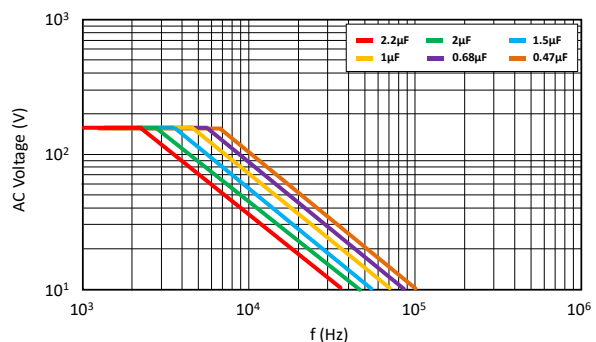
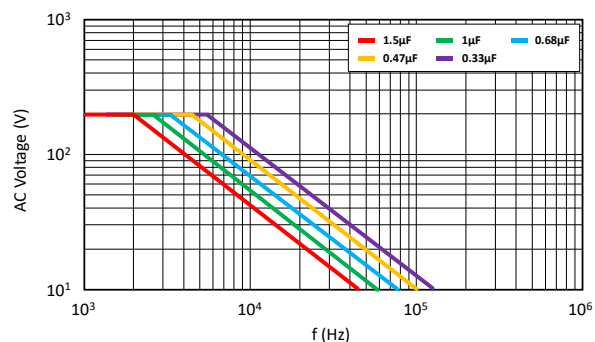


Fig. 8 • Max. RMS Voltage vs. Frequency - 520V_{DC}/200V_{AC}



REFERENCE DATA

Fig. 9 • Max. RMS Voltage vs. Frequency • 630V_{DC}/200V_{AC}

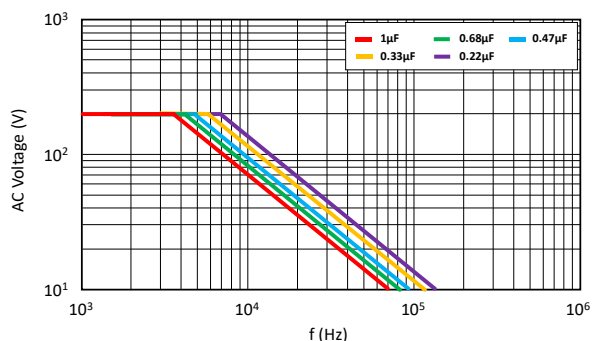


Fig. 10 • Max. DC Voltage vs. Temperature

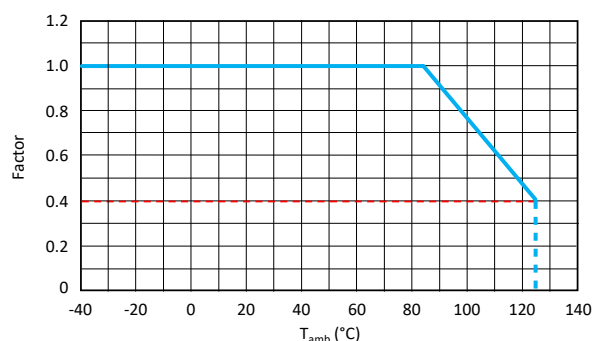


Fig. 11 • Permissible Current Derating by Temperature

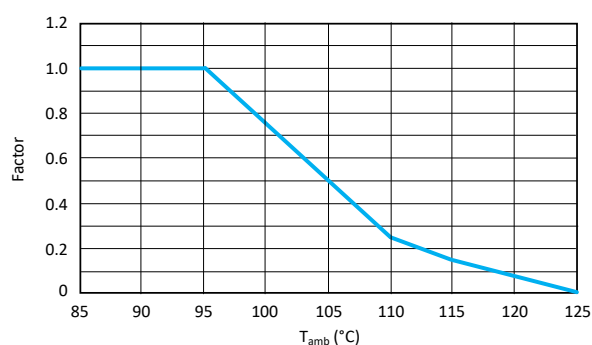


Fig. 12 • Voltage Wave Form

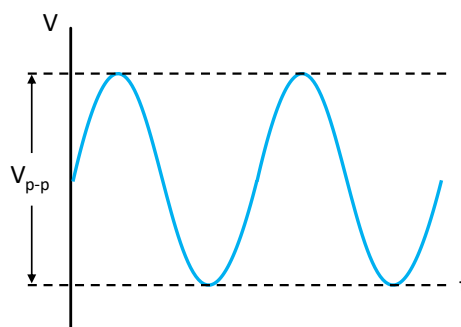
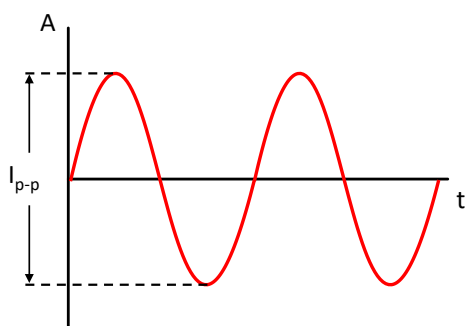


Fig. 13 • Max. RMS Current - Wave Form



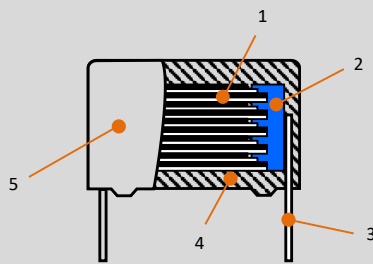
MAXIMUM RMS CURRENT

V_R	C_R (μF)	P (mm)	I_{RMS} (A) at f							
			15.75kHz	35kHz	45kHz	65kHz	80kHz	100kHz	130kHz	200kHz
450V _{DC} ▲ 160V _{AC}	0.47	15	2.30	2.45	2.55	2.60	2.65	2.70	2.75	2.80
	0.68	15	3.40	3.65	3.70	3.80	3.90	4.00	4.05	4.20
	1	15	4.10	4.30	4.45	4.55	4.65	4.75	4.90	5.00
	1.5	15	4.25	4.45	4.55	4.65	4.75	4.90	5.00	5.10
	2	15	4.30	4.55	4.70	4.85	5.00	5.05	5.15	5.20
	2.2	15	4.45	4.80	4.90	5.00	5.15	5.20	5.30	5.25
520V _{DC} ▲ 200V _{AC}	0.33	15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.60
	0.47	15	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
	0.68	15	2.80	2.90	2.95	3.00	3.05	3.10	3.15	3.20
	1	15	3.20	3.30	3.35	3.40	3.45	3.50	3.55	3.60
	1.5	15	3.60	3.75	3.80	3.85	3.90	3.95	4.00	4.10
630V _{DC} ▲ 200V _{AC}	0.22	15	1.70	1.85	1.90	1.95	2.00	2.05	2.10	2.20
	0.33	15	2.25	2.35	2.40	2.50	2.55	2.60	2.65	2.75
	0.47	15	2.60	2.80	2.85	2.90	2.95	3.00	3.05	3.15
	0.68	15	3.10	3.30	3.40	3.45	3.50	3.60	3.70	3.80
	1	15	3.85	4.10	4.20	4.30	4.40	4.50	4.60	4.70

Note: Maximum capacitor surface temperature $T_s \leq 125^\circ\text{C}$; Maximum body temperature rise $\Delta T \leq 10^\circ\text{C}$

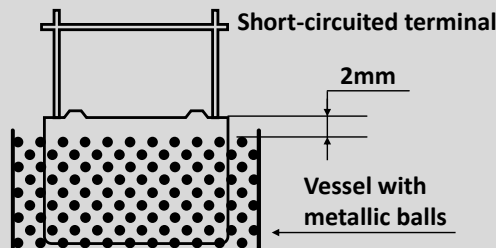
$$I_{RMS} = \frac{I_{p-p}}{2 \cdot \sqrt{2}}$$

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 HPN3					
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 = Inner coating		Epoxy resin filled. (UL-94V-0 Standard)			
5 = Outer coating		Plastic case. (UL-94V-0 Standard)					
4	Atmospheric and Temperature Characteristics	Standard atmospheric conditions. 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			
		If there may be any doubt on the results, measurements shall be made within the following limits.					
		Ambient temperature:		20°C ± 5°C			
		Relative humidity:		60 to 70%			
		Operating temperature range					
		Lowest operating temperature:		-40°C			
		Maximum operating temperature:		+125°C (case-temperature) with specified voltage-derating			
5	Electrical Characteristics	The capacitor can be operated up to 125°C case-temperature (according to the power to be dissipated). Derating ratio of rated voltage +85°C to +125°C: 1.5% 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.					
		Rated voltage:		V _R at 85°C	450V _{DC}	520V _{DC}	630V _{DC}
		Category voltage:		Up to 85°C V _C = V _R			
		Rated upper limit temperature:		+85°C			
		Usable upper limit temperature:		+125°C			

5	Electrical Characteristics	Capacitance range:	0.22μF to 2.2μF			
		Capacitance tolerance:	±5% (J), ±10% (K)			Measured at 1kHz, 1V

TECHNICAL SPECIFICATION

No.	Category	Specification																				
5	Electrical Characteristics	Dissipation factor tanδ (%): LCR meter: HP-4284A, at 20°C ± 5°C																				
		f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF	1	≤ 0.10%	≤ 0.15%	100	≤ 1.50%	≤ 2.50%												
		f (kHz)	C ≤ 1μF	1μF < C ≤ 2.2μF																		
		1	≤ 0.10%	≤ 0.15%																		
		100	≤ 1.50%	≤ 2.50%																		
		Insulation resistance between terminals																				
		Test conditions:																				
		Temperature:	20°C ± 5°C																			
		Voltage charge:	100V _{DC}																			
		Performance:	C ≤ 0.33μF	C > 0.33μF																		
			After voltage charge 1 minute > 20GΩ	After voltage charge 1 minute > 9GΩ x μF																		
		Test voltage between terminals																				
		1.4 × V _{RDC} 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																			
		Dielectric strength between terminal and enclosure																				
		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. Distance of the metallic balls and the terminals shall be kept about 2 mm as shown in fig. 1. The test voltage shall be applied between the short-circuited terminals and the 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></th></tr><tr><td>1</td><td>-40 ± 3°C</td><td>30 ± 3 min</td><td rowspan="4">Capacitance change ΔC/C ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value</td></tr><tr><td>2</td><td>Ordinary</td><td>3 min or less</td></tr><tr><td>3</td><td>+125 ± 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		1	-40 ± 3°C	30 ± 3 min	Capacitance change ΔC/C ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value	2	Ordinary	3 min or less	3	+125 ± 2°C	30 ± 3 min
Conditions			Performance																			
Step	Temperature	Time																				
1	-40 ± 3°C	30 ± 3 min	Capacitance change ΔC/C ≤ ± 10% tan δ change ≤ 0.1% at 1kHz R insulation ≥ 50 % of limit value																			
2	Ordinary	3 min or less																				
3	+125 ± 2°C	30 ± 3 min																				
4	Ordinary	3 min or less																				

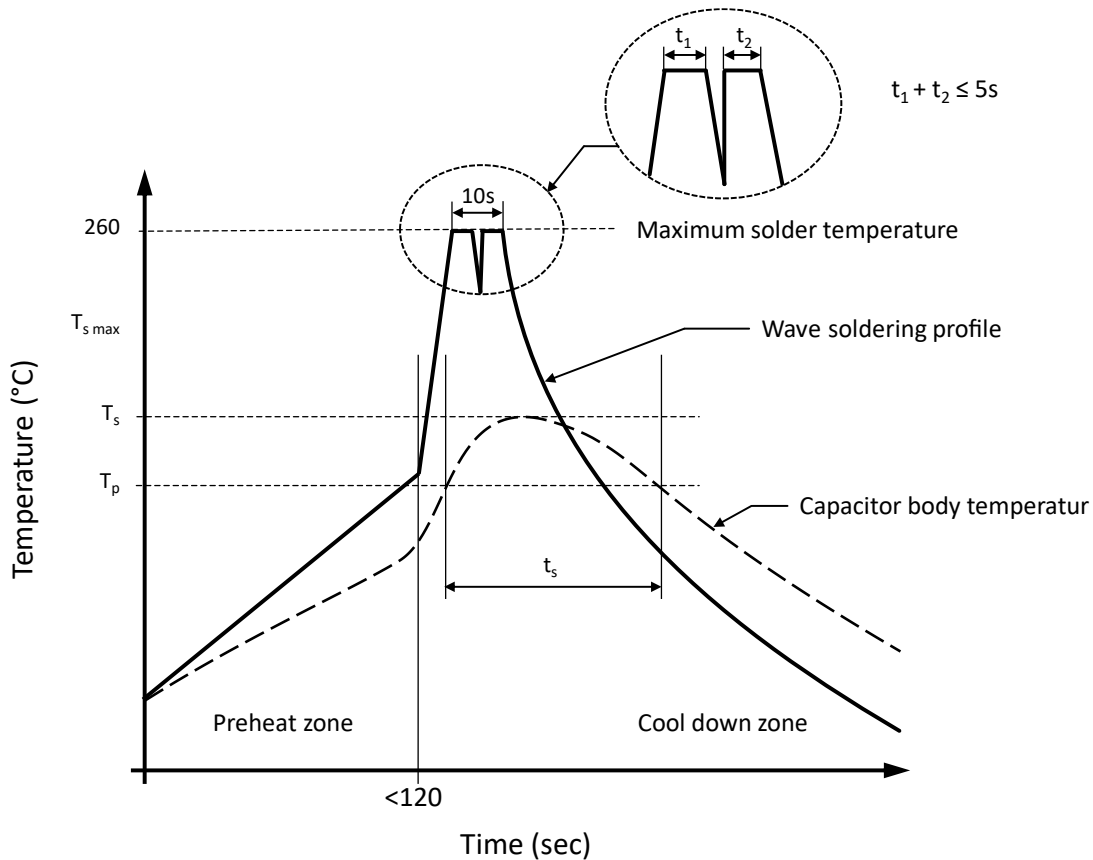
TECHNICAL SPECIFICATION

No.	Category	Specification		
6	Mechanical Characteristics	Test Item	Conditions	Performance
		Robustness of terminations (IEC68-2-21)	<p>Tensile Ua1</p> <p>A load of 10 N (1.0kg) shall be gradually applied to the terminal in the axial direction and held thus for 10 sec</p> <p>Bending Ub methode 1</p> <p>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.</p> <p>Then the body shall be bent 90° at the same speed in the opposite direction and returned to the original position</p>	There shall be no such mechanical damage as terminal damage etc.
7	Endurance Characteristics	Solderability (IEC68-2-20 Ta)	<p>Solder bath: 245°C ± 5°C</p> <p>Immersion time: 2.5±0.5sec</p> <p>Visual examination</p>	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)	<p>Solder bath: 260 °C ± 5 °C</p> <p>Immersion time: 10±1sec</p> <p>Thickness of heat shunt (Printed wiring board): 1.6mm</p> <p>Capacitance at 1kHz</p> <p>tan δ at 1kHz</p>	<p>Capacitance change</p> <p>$\Delta C/C \leq \pm 3\%$</p> <p>tan δ change</p> <p>$\leq 0.1\%$ at 1kHz</p>
		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	<p>Bending strength:</p> <p>There shall be no open or short-circuiting and the connections must be stabilized.</p>
		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	<p>Capacitance change</p> <p>$\Delta C/C \leq \pm 5\%$</p> <p>tan δ change</p> <p>$\leq 0.1\%$ at 1kHz</p> <p>R insulation $\geq 50\%$ of limit value</p>
		Electrical endurance (IEC 60384-2)	<p>125% of category voltage shall be applied to the capacitor at a temperature of 125 ± 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.</p> <p>The load resistor in series with the capacitor shall be 20Ω to 1kΩ.</p>	<p>Capacitance change</p> <p>$\Delta C/C \leq \pm 10\%$</p> <p>tan δ change</p> <p>$\leq 0.4\%$ at 1kHz</p> <p>R insulation $\geq 50\%$ of limit value</p>

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.

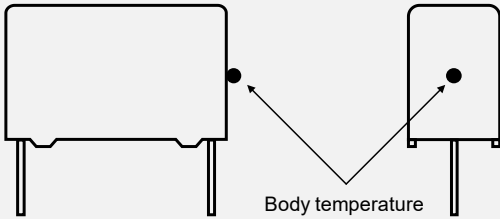
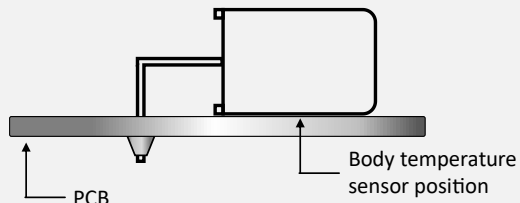
RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



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 in 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

Except for the written expressed warranties, MGT does not implicitly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any MGT product.

All information and technical specifications made available by MGT are for guidance only and we reserve the right to change or modify them without prior notice. Unless expressly stated in writing by MGT, we reject any guarantees, obligations, or warranties.

All MGT products with the technical specifications described are suitable for use in certain applications. Operating, production, storage and environmental conditions can have a massive influence on the parameters mentioned in the data sheets, which cause the performance to vary over time.

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.

MGT components are not designed or rated for use in life support, rescue, safety critical, military, or aerospace applications where failure or malfunction could result in property or environmental damage, serious injury or death. In the aforementioned cases, please contact us before using MGT products.

In principle, we reserve all rights and MGT's general terms and conditions apply. You can find them on our website www.mgt.co.com.