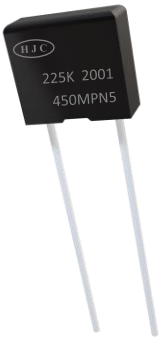



# MPN5 SERIES

## POWER FACTOR CORRECTION CAPACITOR

**METALLIZED POLYPROPYLENE CAPACITOR** ▲ THT type
Low noise
Flame retardant plastic case, epoxy resin sealed, UL 94V-0
Self-healing property
Ultra-miniature size ▲ Smaller version of MPN3 series
**Especially for Power Factor Correction (PFC) circuits**

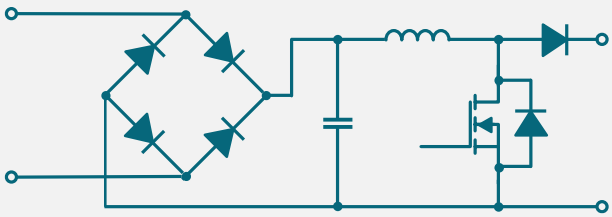
## SPECIFICATION

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

**Notes:**

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

## APPLICATIONS

| | |
|---|---|
| Power Factor Correction Circuits |  |

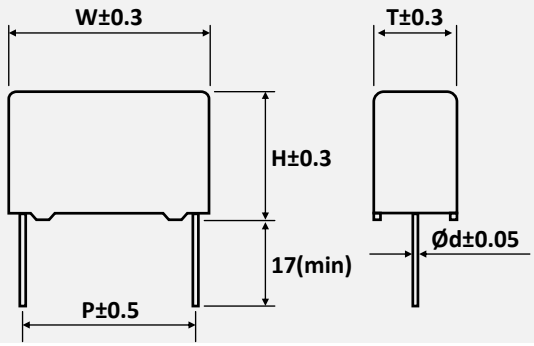
## ELECTRICAL CHARACTERISTICS

| $V_R$ | $C_R$ (µF) | Dimensions (mm) | | | P (mm) | Ød ± 0.05 (mm) | Part Number Note |
|---|---|---|---|---|---|---|---|
| | | W ± 0.3 | H ± 0.3 | T ± 0.3 | | | |
| $450V_{DC}$ ▲ $160V_{AC}$ | 0.47 | 13 | 11 | 5.5 | 10 | 0.6 | MPN5474⬚ 0450DB⬚ 10⬚ |
| | 0.68 | 13 | 13 | 6 | 10 | 0.6 | MPN5684⬚ 0450DB⬚ 10⬚ |
| | 0.68 | 13 | 12 | 7 | 10 | 0.6 | MPN5684⬚ 0450DB⬚ 10⬚ |
| | 1 | 13 | 16 | 6.4 | 10 | 0.6 | MPN5105⬚ 0450DB⬚ 10⬚ |
| | 1.5 | 13 | 17 | 8 | 10 | 0.8 | MPN5155⬚ 0450DB⬚ 10⬚ |
| | 2.2 | 13 | 21 | 10 | 10 | 0.8 | MPN5225⬚ 0450DB⬚ 10⬚ |
| | 1 | 18 | 12 | 6 | 15 | 0.8 | MPN5105⬚ 0450DB⬚ 15⬚ |
| | 1.5 | 18 | 13 | 7 | 15 | 0.8 | MPN5155⬚ 0450DB⬚ 15⬚ |
| | 2.2 | 18 | 17 | 8 | 15 | 0.8 | MPN5225⬚ 0450DB⬚ 15⬚ |

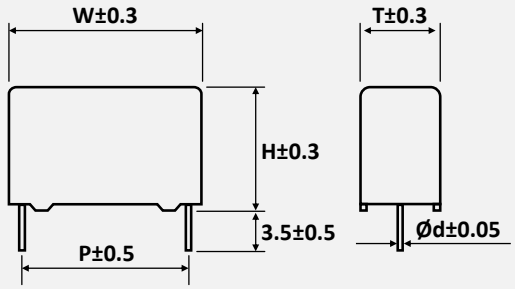
**Note:** **Enter the appropriate tolerance lead length code and lead configuration ⬚ from the product code table**

## PACKAGE OUTLINE ▲ All dimensions in mm

### Long Leads

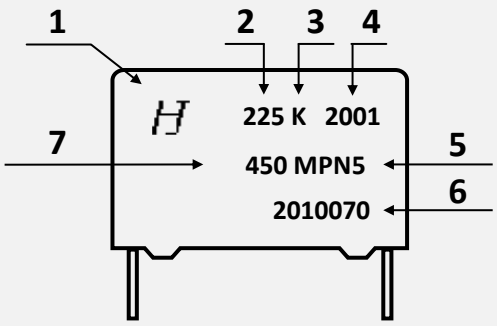



### Short Leads



## PRODUCT MARKING

| Marking | Details |
|---|---|




P ≤ 10mm H P 15 to 27.5mm P > 27.5mm HJC

| 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 |

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

## PRODUCT CODE

Example: MPN5 series ▲ 2.2µF ▲ 450$V_{DC}$ ▲ ±10% ▲ P=15mm ▲ Bulk ▲ Straight leads ▲ 17mm lead length

| MPN5 | 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 |
| MPN5 | MPN5 | 474 | 0.47 | J | ±5 | 0450 | 450 | D | DC | B | Bulk | 1 | SL | 10 | 10.0 | 1 | 17.0 |
| | | 105 | 1 | K | ±10 | | | | | | | | | 15 | 15.0 | 2 | 3.5 |
| | | 155 | 1.5 | M | ±20 | | | | | | | | | | | | |
| | | 225 | 2.2 | | | | | | | | | | | | | | |

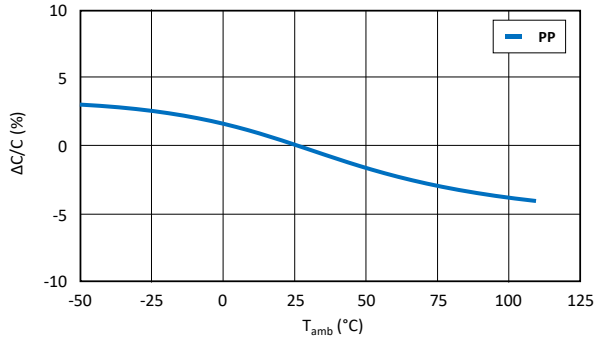
**Note:**

**1** **Capacitance code expressed in pF. The first two digits represent significant figures. The last digit specifies the total number of zeros to be added.**

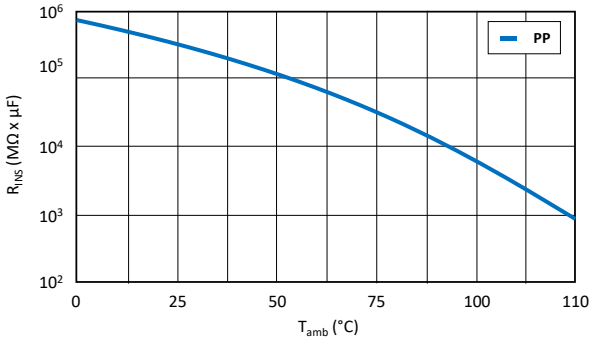
**2** **SL = Straight leads**

# REFERENCE DATA

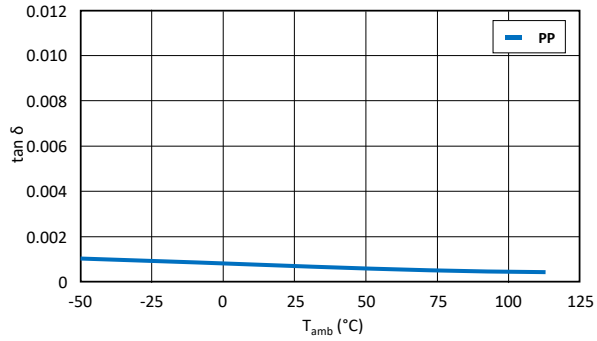
## Fig. 1 ▪ Capacitance Drift vs. Ambient Temperature



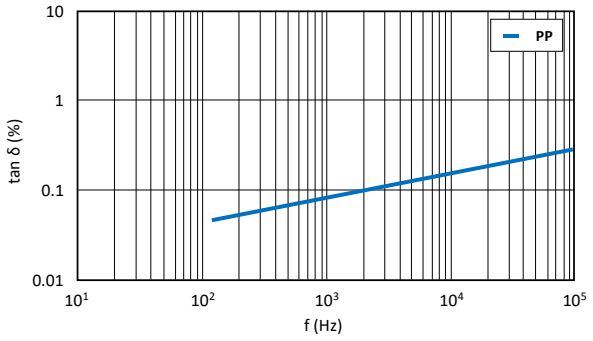

## Fig. 2 ▪ Insulation Resistance vs. Ambient Temperature



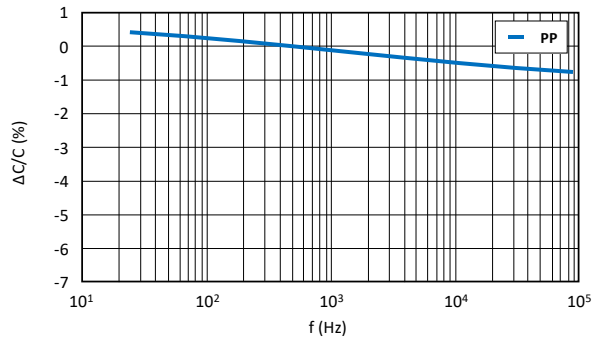

## Fig. 3 ▪ Dissipation Factor vs. Ambient Temperature



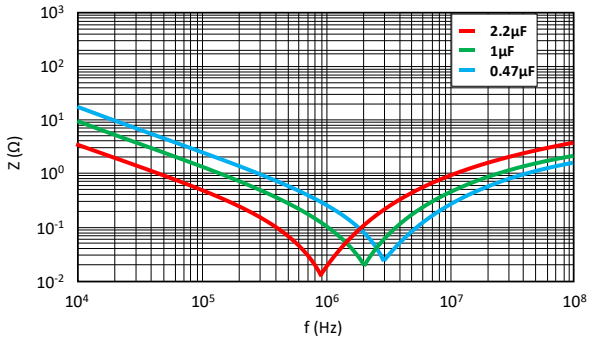

## Fig. 4 ▪ Dissipation Factor vs. Frequency



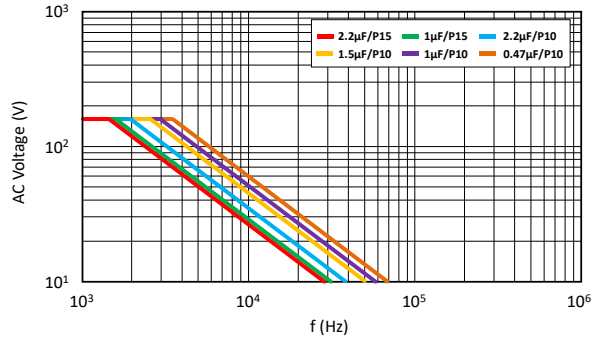

## Fig. 5 ▪ Capacitance Drift vs. Frequency



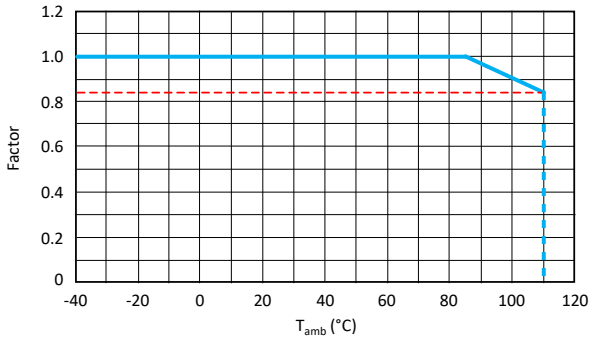

## Fig. 6 ▪ Impedance vs. Frequency ▪ Typical Curve




## Fig. 7 ▪ Max. RMS Voltage vs. Frequency ▪ 450$V_{DC}$/160$V_{AC}$




## Fig. 8 ▪ Max. DC Voltage vs. Temperature



## REFERENCE DATA

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

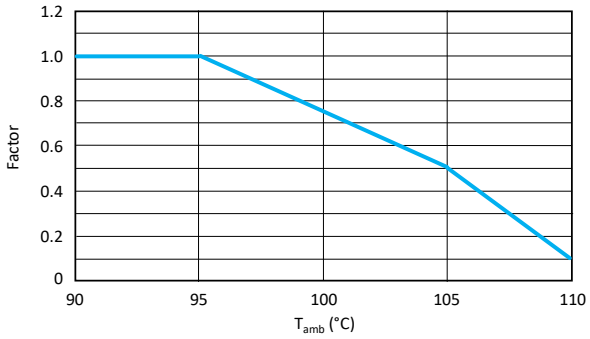



**Fig. 10 ▪ Voltage Wave Form**

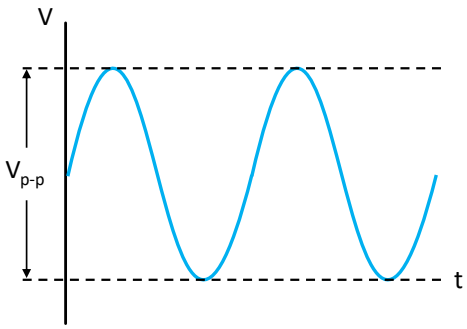
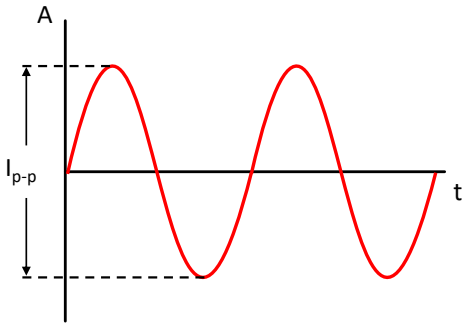



**Fig. 11 ▪ Max. RMS Current - Wave Form**



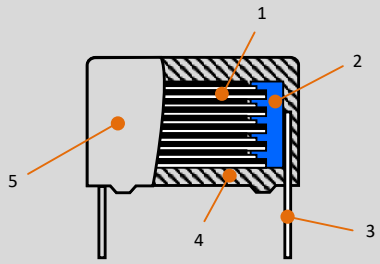

## MAXIMUM RMS CURRENT

| $V_R$ | $C_R$ (µF) | P (mm) | $I_{RMS}$ (A) at f | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 15.75kHz | 35kHz | 45kHz | 65kHz | 80kHz | 100kHz | 130kHz | 200kHz |
| 450$V_{DC}$ ▲ 160$V_{AC}$ | 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 | 2.5 | 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 |
| | 1 | 15 | 3.32 | 3.41 | 3.48 | 3.59 | 3.62 | 3.71 | 3.76 | 3.77 |
| | 1.5 | 15 | 3.50 | 3.70 | 3.80 | 3.90 | 4.00 | 4.10 | 4.20 | 4.30 |
| | 2.2 | 15 | 3.80 | 4.00 | 4.10 | 4.20 | 4.30 | 4.40 | 4.50 | 4.60 |

**Note:** **Maximum capacitor surface temperature $T_S$ ≤ 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.<br>Reference standards: IEC 60384-16 | | |
| 2 | Product Name | Metallized polypropylene film capacitor, Type MPN5 | | |
| 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.**<br>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: | +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).<br>Derating ratio of rated voltage +85°C to +110°C: 0.62% per °C for $V_{RDC}$<br>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 | 450$V_{DC}$ |
| | | Category voltage: | Up to 85°C $V_C = V_R$ | |
| | | Rated upper limit temperature: | +85°C | |
| | | Usable upper limit temperature: | +110°C | |
| | | Capacitance range: | 0.47µF to 2.2µF | |
| | | Capacitance tolerance: | ±5% (J), ±10% (K), ), ±20% (K) | Measured at 1kHz, 1V |

# TECHNICAL SPECIFICATION

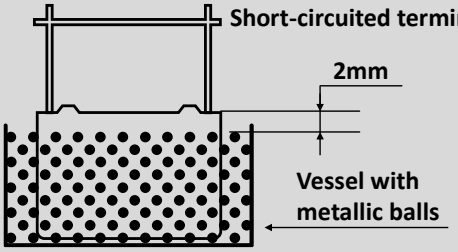
<table>
<tr><th>No.</th><th>Category</th><th>Specification</th></tr>
<tr><td rowspan="1">5</td><td rowspan="1">Electrical Characteristics</td><td>
<table>
<tr><td colspan="4">Dissipation factor tanδ (%): LCR meter: HP-4284A, at 20°C ± 5°C</td></tr>
<tr><td>f (kHz)</td><td>C ≤ 1µF</td><td colspan="2">1µF < C ≤ 2.2µF</td></tr>
<tr><td>1</td><td>≤ 0.10%</td><td colspan="2">≤ 0.10%</td></tr>
<tr><td>100</td><td>≤ 2.00%</td><td colspan="2">≤ 0.30%</td></tr>
<tr><td colspan="4">Insulation resistance between terminals</td></tr>
<tr><td colspan="4">Test conditions:</td></tr>
<tr><td>Temperature:</td><td colspan="3">20°C ± 5°C</td></tr>
<tr><td>Voltage charge:</td><td colspan="3">100$V_{DC}$</td></tr>
<tr><td rowspan="2">Performance:</td><td colspan="3">C > 0.33µF</td></tr>
<tr><td colspan="3">After voltage charge<br>1 minute > 7.5GΩ x µF</td></tr>
<tr><td colspan="4">Test voltage between terminals</td></tr>
<tr><td colspan="4">1.6 × $V_{RDC}$ applied for 2 sec, at 20°C ±5°C</td></tr>
<tr><td>Cut off current:</td><td colspan="3">10mA</td></tr>
<tr><td>Ramp/rise time:</td><td colspan="2">C ≤ 10µF: 5 sec</td><td>C > 10µF: 10 sec</td></tr>
<tr><td>Performance:</td><td colspan="3">There shall be no dielectric breakdown or other damage</td></tr>
<tr><td colspan="4">Dielectric strength between terminal and enclosure</td></tr>
<tr><td colspan="4">Apply 200% of rated voltage between terminals and enclosure for 2 to 5 sec</td></tr>
<tr><td colspan="4">Method of the test described as below</td></tr>
<tr><td colspan="2">Put the small metallic balls with 1 mm diameter in a vessel. The test capacitor shall be submerged with the small metallic balls.<br>Distance of the metallic balls and the terminals shall be kept about 2 mm as shown in fig. 1.<br>The test voltage shall be applied between the short-circuited terminals and the metallic balls</td><td colspan="2"> 

Fig. 1</td></tr>
<tr><td>Performance:</td><td colspan="3">There shall be no dielectric breakdown or other damage</td></tr>
<tr><td rowspan="2">Test Item</td><td colspan="3">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</td></tr>
<tr><td colspan="3">Conditions</td><td>Performance</td></tr>
<tr><td rowspan="5">Rapid change of temperature (IEC68-2-14 Na)</td><td>Step</td><td>Temperature</td><td>Time</td><td></td></tr>
<tr><td>1</td><td>-40 ± 3°C</td><td>30 ± 3 min</td><td rowspan="4">Capacitance change<br>|ΔC/C| ≤ ± 10%<br>tan δ change<br>≤ 0.1% at 1kHz<br>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>+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>
</td></tr>
</table>

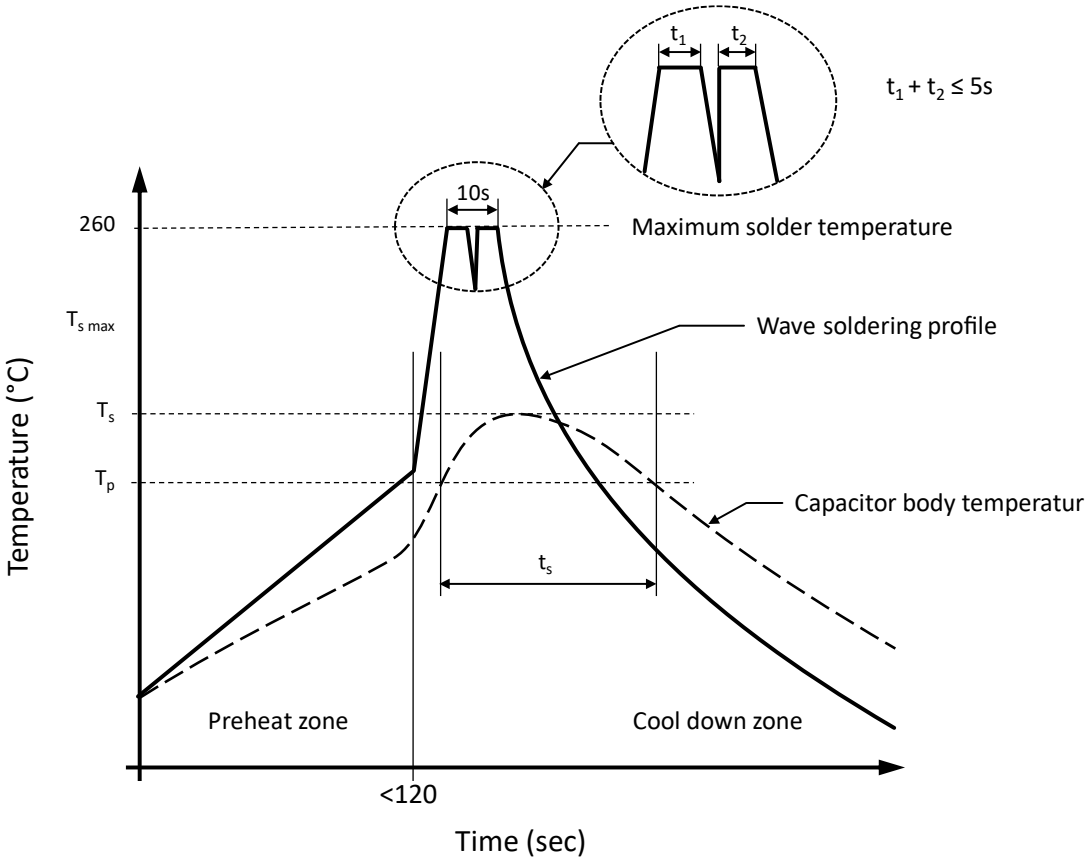
# TECHNICAL SPECIFICATION

| No. | Category | Specification | | |
|---|---|---|---|---|
| 6 | **Mechanical Characteristics** | **Test Item** | **Conditions** | **Performance** |
| | | Robustness of terminations (IEC68-2-21) | Tensile Ua1<br>A load of 10 N (1.0kg) shall be gradually applied to the terminal in the axial direction and held thus for 10 sec<br>Bending Ub methode 1<br>While a load of 500g applied to the lead wire, the body of the capacitor shall be bent 90°<br>and returned to the original position. This operation shall be conducted in a few seconds.<br>Then the body shall be bent 90° at the same speed in the opposite direction and returned to the original position | There shall be no such mechanical damage as terminal damage etc. |
| 7 | **Endurance Characteristics** | Solderability (IEC68-2-20 Ta) | Solder bath: 245°C ± 5°C<br>Immersion time:2.5±0.5sec<br>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<br>Immersion time:10±1sec<br>Thickness of heat shunt (Printed wiring board): 1.6mm<br>Capacitance at 1kHz<br>tan δ at 1kHz | Capacitance change<br>\|ΔC/C\| ≤ ± 3%<br>tan δ change<br>≤ 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:<br>There shall be no open or short-circuiting and the connections must be stabilized.<br>Appearance:<br>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.<br>And then the capacitor shall be subjected to standard atmospheric conditions for 1 to 2 hours, after which measurement shall be made | Capacitance change<br>\|ΔC/C\| ≤ ± 5%<br>tan δ change<br>≤ 0.1% at 1kHz<br>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.<br>The load resistor in series with the capacitor shall be 20Ω to 1kΩ. | Capacitance change<br>\|ΔC/C\| ≤ ± 10%<br>tan δ change<br>≤ 0.4% at 1kHz<br>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)<br>Temperature: 5°C to 35°C<br>Relative humidity: ≤ 70%<br>Storage period: ≤ 12 months<br>(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. |

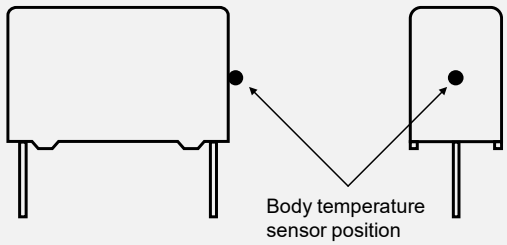
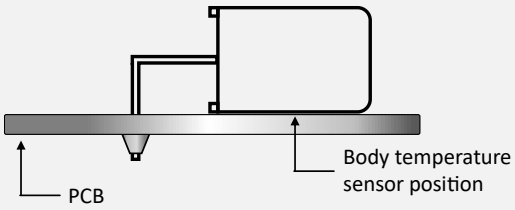
## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE




**Capacitor body temperature should follow the description below:**

| Profile Features | | Polypropylene Film Capacitor | Polyester Film Capacitor |
|---|---|---|---|
| Capacitor body maximum temperature at preheating | $T_P$ | ≤ 110°C / 120 seconds | ≤ 125°C / 120 seconds |
| Capacitor body maximum temperature at wave soldering | $T_S$ | ≤ 120°C / $t_s$ ≤ 45 seconds | ≤ 150°C / $t_s$ ≤ 45 seconds |

## DETERMINING THE CAPACITOR BODY TEMPERATURE

| Vertical Mounting | Horizontal Mounting |
|---|---|
|   |   |
| The body temperature sensor position is defined as the highest temperature point around the capacitor body. | If there is 90 degree bending product, the sensor position shall between product and PCB |

## 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: ≤ 350°C
b.) Soldering time: ≤ 3sec

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 ≤ 120°C.

## REVISION TABLE

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