AC and Pulse Double Metallized Polypropylene Film Capacitors
MKP Radial Potted Type

FEATURES
- 7.5 mm to 37.5 mm lead pitch; 7.5 mm bent back pitch
- Low contact resistance
- Low loss dielectric
- Small dimensions for high density packaging
- Supplied loose in box and taped on reel or ammopack
- Mounting: radial
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS
- Where steep pulses occur e.g. SMPS (switch mode power supplies)
- Electronic lighting e.g. ballast
- Motor control circuits
- S-correction
- For flyback applications please use 1400 V series

QUICK REFERENCE DATA
<table>
<thead>
<tr>
<th>Capacitance range (E24 series)</th>
<th>0.00047 μF to 4.7 μF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance tolerance</td>
<td>± 5 %</td>
</tr>
<tr>
<td>Climatic testing class according to IEC 60068-1</td>
<td>55/105/56</td>
</tr>
<tr>
<td>Rated DC temperature</td>
<td>85 °C</td>
</tr>
<tr>
<td>Rated AC temperature</td>
<td>105 °C</td>
</tr>
<tr>
<td>Maximum application temperature</td>
<td>105 °C</td>
</tr>
<tr>
<td>Reference specifications</td>
<td>IEC 60384-17</td>
</tr>
<tr>
<td>Dielectric</td>
<td>Polypropylene film</td>
</tr>
<tr>
<td>Electrodes</td>
<td>Metallized</td>
</tr>
<tr>
<td>Construction</td>
<td>Mono and internal serial construction</td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Flame retardant plastic case and epoxy resin UL-class 94 V-0</td>
</tr>
<tr>
<td>Leads</td>
<td>Tinned wire</td>
</tr>
<tr>
<td>Marking</td>
<td>C-value; tolerance; rated voltage; sub-class; manufacturer’s type; code for dielectric material; manufacturer location; manufacturer’s logo; year and week</td>
</tr>
</tbody>
</table>

Note
- For more detailed data and test requirements, contact dc-film@vishay.com

VOLTAGE RATINGS
<table>
<thead>
<tr>
<th>Rated DC voltage</th>
<th>250</th>
<th>400</th>
<th>630</th>
<th>1000</th>
<th>1400</th>
<th>1600</th>
<th>2000</th>
<th>2500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated AC voltage</td>
<td>125</td>
<td>200</td>
<td>220</td>
<td>350</td>
<td>500</td>
<td>550</td>
<td>700</td>
<td>900</td>
</tr>
<tr>
<td>Rated peak to peak voltage</td>
<td>350</td>
<td>560</td>
<td>630</td>
<td>1000</td>
<td>1400</td>
<td>1600</td>
<td>2000</td>
<td>2500</td>
</tr>
</tbody>
</table>
**COMPOSITION OF CATALOG NUMBER**

### Notes
- For detailed tape specifications refer to packaging information [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- Packaging will be bulk for all capacitors with pitch ≤ 15 mm and such with long leads (> 5 mm). Capacitors with short leads up to 5 mm and pitch > 15 mm will be in tray and asking code will be “T.”

**Voltage (V<sub>DC</sub>)**

<table>
<thead>
<tr>
<th>P&lt;sub&gt;1&lt;/sub&gt; (mm)</th>
<th>Pitch Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>025 = 250</td>
<td>5</td>
</tr>
<tr>
<td>040 = 400</td>
<td>7.5</td>
</tr>
<tr>
<td>063 = 630</td>
<td>10</td>
</tr>
<tr>
<td>100 = 1000</td>
<td>15</td>
</tr>
<tr>
<td>140 = 1400</td>
<td>22.5</td>
</tr>
<tr>
<td>160 = 1600</td>
<td>27.5</td>
</tr>
<tr>
<td>200 = 2000</td>
<td>37.5</td>
</tr>
<tr>
<td>250 = 2500</td>
<td></td>
</tr>
</tbody>
</table>

**Special Code for Terminal**

- 2 pins
- 4 pins P<sub>2</sub> = 10.2 mm
- 5 pins P<sub>2</sub> = 20.3 mm
- (§) Customized

**Multiplier (nF)**

<table>
<thead>
<tr>
<th>Multiplier (nF)</th>
<th>0.01</th>
<th>0.1</th>
<th>1</th>
<th>10</th>
<th>100</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Capacitance Code (numerically)**

<table>
<thead>
<tr>
<th>Capacitance Code (numerically)</th>
<th>147</th>
<th>210</th>
<th>310</th>
<th>410</th>
<th>510</th>
<th>610</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>470 pF</td>
<td>1 nF</td>
<td>10 nF</td>
<td>100 nF</td>
<td>1000 nF</td>
<td>10 000 nF</td>
</tr>
<tr>
<td>Tolerance</td>
<td>± 0.00047 µF</td>
<td>0.001 µF</td>
<td>0.01 µF</td>
<td>0.1 µF</td>
<td>1.0 µF</td>
<td>10.0 µF</td>
</tr>
</tbody>
</table>

**Packing Code**

<table>
<thead>
<tr>
<th>Packing Code</th>
<th>Packing Style</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/T</td>
<td>Bulk/loose</td>
<td>Excluding bent back</td>
</tr>
<tr>
<td>R</td>
<td>Tape and reel: (H; 16.0 mm; 500 mm)</td>
<td>For bent back only</td>
</tr>
<tr>
<td>Z</td>
<td>Tape and reel: (H; 16.0 mm; 356 mm)</td>
<td>For bent back only</td>
</tr>
<tr>
<td>H</td>
<td>Ammo (H; 16.0 mm)</td>
<td>For bent back only</td>
</tr>
<tr>
<td>W</td>
<td>Tape and reel (H; 18.5 mm; 500 mm)</td>
<td>Pitch 5 mm to 22.5 mm</td>
</tr>
<tr>
<td>G</td>
<td>Ammo (H; 18.5 mm)</td>
<td>Pitch ≤ 10 mm</td>
</tr>
</tbody>
</table>

**Special**

- 0 = Standard
- Other = Special
## ELECTRICAL DATA
(For Detailed Ratings go to [www.vishay.com/doc?28183](http://www.vishay.com/doc?28183))

<table>
<thead>
<tr>
<th>URDC (V)</th>
<th>CAP. (µF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>0.0068 min.</td>
</tr>
<tr>
<td></td>
<td>2.7 max.</td>
</tr>
<tr>
<td>400</td>
<td>0.0047 min.</td>
</tr>
<tr>
<td></td>
<td>1.5 max.</td>
</tr>
<tr>
<td>630</td>
<td>0.00047 min.</td>
</tr>
<tr>
<td></td>
<td>4.7 max.</td>
</tr>
<tr>
<td>1000</td>
<td>0.0043 min.</td>
</tr>
<tr>
<td></td>
<td>1.8 max.</td>
</tr>
<tr>
<td>1400</td>
<td>0.0022 min.</td>
</tr>
<tr>
<td></td>
<td>0.68 max.</td>
</tr>
<tr>
<td>1600</td>
<td>0.0027 min.</td>
</tr>
<tr>
<td></td>
<td>0.56 max.</td>
</tr>
<tr>
<td>2000</td>
<td>0.0010 min.</td>
</tr>
<tr>
<td></td>
<td>0.56 max.</td>
</tr>
<tr>
<td>2500</td>
<td>0.0010 min.</td>
</tr>
<tr>
<td></td>
<td>0.3 max.</td>
</tr>
</tbody>
</table>

## DIMENSIONS in millimeters

**Note**

(1) \(|F-F'| < 0.3\ mm  
F = 7.5 mm + 0.6 mm / - 0.1 mm  
Ø dt ± 10 % of standard diameter specified
MOUNTING

Normal Use
The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting on printed-circuit boards by means of automatic insertion machines.
For detailed tape specifications refer to packaging information www.vishay.com/doc?28139

Specific Method of Mounting to Withstand Vibration and Shock
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:
• For original pitch = 15 mm the capacitors shall be mechanically fixed by the leads
• For larger pitches the capacitors shall be mounted in the same way and the body clamped

Space Requirements on Printed-Circuit Board
The maximum space for length (l_{max}), width (w_{max}) and height (h_{max}) of film capacitors to take in account on the printed circuit board is shown in the drawings.

For products with pitch ≤ 15 mm, Δw = Δl = 0.3 mm and Δh = 0.1 mm
For products with 15 mm < pitch ≤ 27.5 mm, Δw = Δl = 0.5 mm and Δh = 0.1 mm
For products with pitch = 37.5 mm, Δw = Δl = 0.7 mm and Δh = 0.5 mm
Eccentricity as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.

SOLDERING CONDITIONS
For general soldering conditions and wave soldering profile we refer to the document “Soldering Guidelines for Film Capacitors”: www.vishay.com/doc?28171

STORAGE TEMPERATURE
T_{stg} = -25 °C to +35 °C with RH maximum 75 % without condensation

RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS
Unless otherwise specified, all electrical values apply to an ambient free temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.
For reference testing, a conditioning period shall be applied over 96 h ± 4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.
CHARACTERISTICS

Capacitance as a function of ambient temperature (typical curve) (1 kHz)

Impedance as a function of frequency (typical curve)

Max. DC and AC voltage as a function of temperature

Max. RMS voltage as a function of frequency
Max. RMS voltage as a function of frequency

Max. RMS voltage as a function of frequency

Max. RMS voltage as a function of frequency

Max. RMS voltage as a function of frequency
Max. RMS voltage as a function of frequency

- **T<sub>amb</sub> ≤ 85 °C, 1400 VDC**
  - 2.2 nF
  - 4.7 nF
  - 100 nF
  - 470 nF

- **85 °C < T<sub>amb</sub> ≤ 105 °C, 1400 VDC**
  - 2.2 nF
  - 4.7 nF
  - 22 nF
  - 470 nF

- **T<sub>amb</sub> ≤ 85 °C, 1600 VDC**
  - 4.7 nF
  - 10 nF
  - 47 nF
  - 100 nF
  - 470 nF

- **85 °C < T<sub>amb</sub> ≤ 105 °C, 1600 VDC**
  - 4.7 nF
  - 10 nF
  - 47 nF
  - 100 nF
  - 470 nF

- **T<sub>amb</sub> ≤ 85 °C, 2000 VDC**
  - 1 nF
  - 2.2 nF
  - 10 nF
  - 47 nF
  - 100 nF
  - 470 nF

- **85 °C < T<sub>amb</sub> ≤ 105 °C, 2000 VDC**
  - 1 nF
  - 2.2 nF
  - 10 nF
  - 47 nF
  - 100 nF
  - 470 nF
Max. RMS voltage as a function of frequency

Insulation resistance as a function of the ambient temperature

Maximum allowed component temperature rise ($\Delta T$) as a function of the ambient temperature ($T_{\text{amb}}$)
Tangent of loss angle as a function of frequency (typical curve)

- **250 V:**
  - $0.0068 \leq C \leq 0.091 \mu F$, curve 8
  - $0.1 < C \leq 0.15 \mu F$, curve 9
  - $0.15 < C \leq 0.22 \mu F$, curve 10
  - $0.22 < C \leq 0.27 \mu F$, curve 11
  - $0.27 < C \leq 0.33 \mu F$, curve 12
  - $0.33 < C \leq 0.56 \mu F$, curve 15
  - $0.56 < C \leq 0.82 \mu F$, curve 16
  - $0.82 < C \leq 1.2 \mu F$, curve 18
  - $1.2 < C \leq 1.6 \mu F$, curve 19
  - $1.6 < C \leq 2.7 \mu F$, curve 20

- **400 V:**
  - $0.0047 < C \leq 0.047 \mu F$, curve 5
  - $0.047 < C \leq 0.068 \mu F$, curve 6
  - $0.068 < C \leq 0.1 \mu F$, curve 7
  - $0.1 < C \leq 0.2 \mu F$, curve 8
  - $0.2 < C \leq 0.24 \mu F$, curve 12
  - $0.24 < C \leq 0.36 \mu F$, curve 13
  - $0.36 < C \leq 0.43 \mu F$, curve 14
  - $0.43 < C \leq 0.56 \mu F$, curve 16
  - $0.56 < C \leq 1.1 \mu F$, curve 17
  - $1.1 < C \leq 1.5 \mu F$, curve 18

- **630 V:**
  - $0.00047 < C \leq 0.033 \mu F$, curve 4
  - $0.033 < C \leq 0.068 \mu F$, curve 5
  - $0.068 < C \leq 0.1 \mu F$, curve 6
  - $0.1 < C \leq 0.15 \mu F$, curve 7
  - $0.15 < C \leq 0.22 \mu F$, curve 11
  - $0.22 < C \leq 0.27 \mu F$, curve 12
  - $0.27 < C \leq 0.33 \mu F$, curve 15
  - $0.33 < C \leq 0.82 \mu F$, curve 16
  - $0.82 < C \leq 1 \mu F$, curve 18
  - $1 < C \leq 4.7 \mu F$, curve 21

- **1000 V:**
  - $C \leq 0.01 \mu F$, curve 2
  - $0.011 < C \leq 0.027 \mu F$, curve 3
  - $0.027 < C \leq 0.047 \mu F$, curve 4
  - $0.047 < C \leq 0.062 \mu F$, curve 5
  - $0.062 < C \leq 0.075 \mu F$, curve 6
  - $0.075 < C \leq 0.1 \mu F$, curve 7
  - $0.1 < C \leq 0.15 \mu F$, curve 8
  - $0.15 < C \leq 0.22 \mu F$, curve 9
  - $0.22 < C \leq 0.3 \mu F$, curve 10
  - $0.3 < C \leq 1 \mu F$, curve 16
  - $1 < C \leq 1.8 \mu F$, curve 19

- **1400 V:**
  - $C \leq 0.0047 \mu F$, curve 1
  - $0.0051 < C \leq 0.016 \mu F$, curve 2
  - $0.016 < C \leq 0.033 \mu F$, curve 3
  - $0.033 < C \leq 0.051 \mu F$, curve 4
  - $0.051 < C \leq 0.068 \mu F$, curve 5
  - $0.068 < C \leq 0.082 \mu F$, curve 6
  - $0.082 < C \leq 0.2 \mu F$, curve 7
  - $0.2 < C \leq 0.68 \mu F$, curve 14

- **1600 V:**
  - $C \leq 0.0047 \mu F$, curve 3
  - $0.0051 < C \leq 0.0091 \mu F$, curve 4
  - $0.0091 < C \leq 0.068 \mu F$, curve 5
  - $0.068 < C \leq 0.01 \mu F$, curve 6
  - $0.01 < C \leq 0.16 \mu F$, curve 7
  - $0.16 < C \leq 0.56 \mu F$, curve 14

- **2000 V:**
  - $C \leq 0.0047 \mu F$, curve 2
  - $0.0051 < C \leq 0.033 \mu F$, curve 3
  - $0.033 < C \leq 0.091 \mu F$, curve 4
  - $0.091 < C \leq 0.56 \mu F$, curve 14

- **2500 V:**
  - $C \leq 0.0047 \mu F$, curve 1
  - $0.0051 < C \leq 0.015 \mu F$, curve 2
  - $0.015 < C \leq 0.091 \mu F$, curve 3
  - $0.091 < C \leq 0.33 \mu F$, curve 12
POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free air ambient temperature.

The power dissipation can be calculated according type detail specification “HQN-384-01/101: Technical information film capacitors with the typical tgd of the curves.”.

The component temperature rise ($\Delta T$) can be measured (see section “Measuring the component temperature” for more details) or calculated by $\Delta T = P/G$:

- $\Delta T$ = component temperature rise (°C)
- $P$ = power dissipation of the component (mW)
- $G$ = heat conductivity of the component (mW/°C)

MEASURING THE COMPONENT TEMPERATURE

A thermocouple must be attached to the capacitor body as in:

```
Thermocouple
```

The temperature is measured in unloaded ($T_{\text{amb}}$) and maximum loaded condition ($T_c$). The temperature rise is given by $\Delta T = T_c - T_{\text{amb}}$. To avoid radiation or convection, the capacitor should be tested in a wind-free box.
APPLICATION NOTE AND LIMITING CONDITIONS

For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: dc-film@vishay.com

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage (U_p) shall not be greater than the rated DC voltage (U_{RDC})
2. The peak-to-peak voltage (U_{p-p}) shall not be greater than the maximum (U_{p-p}) to avoid the ionization inception level
3. The voltage pulse slope (dU/dt) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{RDC} and divided by the applied voltage.
   For all other pulses following equation must be fulfilled:
   \[ \frac{2 \times \int (\frac{dU}{dt})^2 \times dt < U_{RDC} \times (\frac{dU}{dt})_{rated}}{T} \]
   T is the pulse duration
4. The maximum component surface temperature rise must be lower than the limits (see graph max. allowed component temperature rise).
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in the table: "Heat Conductivity"
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that the following conditions are fulfilled in any case (spikes and surge voltages from the mains included).

<table>
<thead>
<tr>
<th>VOLTAGE CONDITIONS FOR 6 ABOVE</th>
<th>( T_{amb} \leq 85 , ^\circ C )</th>
<th>( 85 , ^\circ C &lt; T_{amb} \leq 105 , ^\circ C )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum continuous RMS voltage</td>
<td>( U_{RAC} )</td>
<td>( U_{RAC} )</td>
</tr>
<tr>
<td>Maximum temperature RMS-over voltage (&lt; 24 h)</td>
<td>( 1.25 \times U_{RAC} )</td>
<td>( 1.25 \times U_{RAC} )</td>
</tr>
<tr>
<td>Maximum peak voltage ( (V_{p-p}) &lt; 2 , s )</td>
<td>( 1.6 \times U_{RDC} )</td>
<td>( 1.1 \times U_{RDC} )</td>
</tr>
</tbody>
</table>

**EXAMPLE**

C = 4n7 - 1600 V used for the voltage signal shown in next drawing.

\( U_{p-p} = 1000 \, V; \, U_p = 900 \, V; \, T_1 = 12 \, \mu s; \, T_2 = 64 \, \mu s; \, T_3 = 4 \, \mu s \)

The ambient temperature is 80 °C. In case of failure, the oscillation is blocked.

Checking conditions:

1. The peak voltage \( U_p = 900 \, V \) is lower than \( 1600 \, V_{DC} \)
2. The peak-to-peak voltage \( 1000 \, V \) is lower than \( 2 \times 550 \times V_{AC} = 1600 \, U_{p-p} \)
3. The voltage pulse slope (dU/dt) = 1000 V/4 \( \mu s = 250 \, V/\mu s \). This is lower than 8000 V/\( \mu s \) (see specific reference data for each version).
4. The dissipated power is 35 mW as calculated with fourier terms and typical tgd. The temperature rise for \( w_{max} = 6.0 \, mm \) and pitch = 15 mm will be 35 mW / 11 mW/°C = 3.2 °C This is lower than 10 °C temperature rise at 80 °C, according graph.
5. Oscillation is blocked
6. Not applicable
INSPECTION REQUIREMENTS

General Notes
Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-17 and Specific Reference Data”.

---

### GROUP C INSPECTION REQUIREMENTS

<table>
<thead>
<tr>
<th>SUB-CLAUSE NUMBER AND TEST</th>
<th>CONDITIONS</th>
<th>PERFORMANCE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Dimensions (detail)</td>
<td>Capacitance</td>
<td>As specified in chapters “General Data” of this specification</td>
</tr>
<tr>
<td></td>
<td>Tangent of loss angle: for C ≤ 1 μF at 100 kHz or for C &gt; 1 μF at 10 kHz</td>
<td></td>
</tr>
<tr>
<td>4.3.1 Initial measurements</td>
<td>Tensile: load 10 N; 10 s</td>
<td>No visible damage</td>
</tr>
<tr>
<td></td>
<td>Bending: load 5 N; 4 x 90°</td>
<td></td>
</tr>
<tr>
<td>4.3 Robustness of terminations</td>
<td>Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s</td>
<td>No visible damage</td>
</tr>
<tr>
<td>4.4 Resistance to soldering heat</td>
<td>Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: min. 1 h, max. 2 h</td>
<td>No visible damage Legible marking</td>
</tr>
<tr>
<td>4.4.2 Final measurements</td>
<td>Visual examination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capacitance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tangent of loss angle</td>
<td>Increase of tan δ: ≤ 0.0005 for: C ≤ 100 nF or ≤ 0.001 for: 100 nF &lt; C ≤ 470 nF or ≤ 0.0015 for: C &gt; 470 nF Compared to values measured in 4.3.1</td>
</tr>
</tbody>
</table>
### GROUP C INSPECTION REQUIREMENTS

<table>
<thead>
<tr>
<th>SUB-CLAUSE NUMBER AND TEST</th>
<th>CONDITIONS</th>
<th>PERFORMANCE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 4.6.1 Initial measurements | Capacitance  
Tangent of loss angle:  
for $C \leq 1 \mu F$ at 100 kHz or  
for $C > 1 \mu F$ at 10 kHz | |
| 4.15 Solvent resistance of the marking | Isopropylalcohol at room temperature  
Method: 1  
Rubbing material: cotton wool  
Immersion time: 5.0 min ± 0.5 min | No visible damage  
Legible marking |
| 4.6 Rapid change of temperature | $\theta_A = -55 ^\circ C$  
$\theta_B = +105 ^\circ C$  
5 cycles  
Duration $t = 30$ min | |
| 4.7 Vibration | Visual examination  
Mounting: see section “Mounting” for more information  
Procedure B4  
Frequency range: 10 Hz to 55 Hz  
Amplitude: 0.75 mm or  
Acceleration 98 m/s²  
(whichever is less severe)  
Total duration 6 h | No visible damage |
| 4.7.2 Final inspection | Visual examination | No visible damage |
| 4.9 Shock | Mounting: see section “Mounting” for more information  
Pulse shape: half sine  
Acceleration: 490 m/s²  
Duration of pulse: 11 ms | No visible damage |
| 4.9.3 Final measurements | Visual examination | |
| | Capacitance  
$|\Delta C/C| \leq 2 \%$ for pitch $< 10$ mm  
$|\Delta C/C| \leq 1 \%$ for pitch $> 10$ mm of the value measured in 4.6.1 | |
| | Tangent of loss angle  
Increase of $\tan \delta$:  
$\leq 0.0005$ for: $C \leq 100$ nF or  
$\leq 0.001$ for: $100$ nF $< C \leq 470$ nF or  
$\leq 0.0015$ for: $C > 470$ nF  
Compared to values measured in 4.6.1 | |
| | Insulation resistance | As specified in section “Insulation Resistance” of this specification |
## GROUP C INSPECTION REQUIREMENTS

<table>
<thead>
<tr>
<th>SUB-CLAUSE NUMBER AND TEST</th>
<th>CONDITIONS</th>
<th>PERFORMANCE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUB-GROUP C1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A and C1B</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.10 Climatic sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.10.2 Dry heat</td>
<td>Temperature: +105 °C Duration: 16 h</td>
<td>No breakdown or flash-over</td>
</tr>
<tr>
<td>4.10.3 Damp heat cyclic</td>
<td>Test Db, first cycle Temperature: -55 °C Duration: 2 h</td>
<td>No visible damage Legible marking</td>
</tr>
<tr>
<td>4.10.4 Cold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.10.6 Damp heat cyclic</td>
<td>Test Db, remaining cycles Voltage proof = U RDC for 1 min within 15 min after removal from testchamber</td>
<td>No breakdown or flash-over</td>
</tr>
<tr>
<td>4.10.6.2 Final measurements</td>
<td>Visual examination Capacitance</td>
<td>For original pitch = 22.5 mm and 37.5 mm: $</td>
</tr>
<tr>
<td></td>
<td>Tangent of loss angle</td>
<td>Increase of $\tan \delta$: $\leq 0.0005$ for: $C \leq 100$ nF or $\leq 0.001$ for: $100$ nF $&lt; C \leq 470$ nF or $\leq 0.0015$ for: $C &gt; 470$ nF Compared to values measured in 4.3.1 or 4.6.1</td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>$\geq 50%$ of values specified in section “Insulation Resistance” of this specification</td>
</tr>
<tr>
<td><strong>SUB-GROUP C2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.11 Damp heat steady state</td>
<td>56 days, 40 °C, 90 % to 95 % RH no load</td>
<td>No breakdown or flash-over</td>
</tr>
<tr>
<td>4.11.1 Initial measurements</td>
<td>Capacitance Tangent of loss angle at 1 kHz</td>
<td>No visible damage Legible marking</td>
</tr>
<tr>
<td>4.11.3 Final measurements</td>
<td>Voltage proof = U RDC for 1 min within 15 min after removal from testchamber</td>
<td>No breakdown or flash-over</td>
</tr>
<tr>
<td></td>
<td>Visual examination Capacitance</td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>Tangent of loss angle</td>
<td>Increase of $\tan \delta$: $\leq 0.0005$ for: $C \leq 100$ nF or $\leq 0.001$ for: $100$ nF $&lt; C \leq 470$ nF or $\leq 0.0015$ for: $C &gt; 470$ nF Compared to values measured in 4.11.1</td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>$\geq 50%$ of values specified in section “Insulation Resistance” of this specification</td>
</tr>
</tbody>
</table>
### GROUP C INSPECTION REQUIREMENTS

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<tbody>
<tr>
<td><strong>SUB-GROUP C3A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.12.1 Endurance test at 50 Hz alternating voltage</td>
<td>Duration: 2000 h</td>
<td></td>
</tr>
</tbody>
</table>
| 4.12.1.1 Initial measurements | Voltage: 1.25 x $U_{DC}$ at 105 °C  
Capacitance  
Tangent of loss angle:  
for $C \leq 1 \mu F$ at 100 kHz or  
for $C > 1 \mu F$ at 10 kHz |                          |
| 4.12.1.3 Final measurements | Visual examination | Capacitance $|\Delta C/C| \leq 5 \%$ compared to values measured in 4.12.1.1  
Tangent of loss angle Increase of $\tan \delta$:  
$\leq 0.0005$ for: $C \leq 100 \ nF$ or  
$\leq 0.001$ for: $100 \ nF < C \leq 470 \ nF$ or  
$\leq 0.0015$ for: $C > 470 \ nF$  
Compared to values measured in 4.12.1.1  
Insulation resistance $\geq 50 \%$ of values specified in section “Insulation Resistance” of this specification |
| **SUB-GROUP C4**           |            |                          |
| 4.2.6 Temperature characteristics | Capacitance  
Capacitance at -55 °C  
Capacitance at +20 °C  
Capacitance at +105 °C | For -55 °C to +20 °C:  
$+1 \% \leq |\Delta C/C| \leq 3.75 \%$ or  
for 20 °C to 105 °C:  
$-6 \% \leq |\Delta C/C| \leq 0 \%$  
Final measurements | Capacitance | As specified in section “Capacitance” of this specification.  
Insulation resistance | As specified in section “Insulation Resistance” of this specification |
| 4.13 Charge and discharge | 10 000 cycles  
Charged to $U_{DC}$  
Discharge resistance: $R = \frac{U_{DC}}{5 \times C \times (dU/dt)}$ | Capacitance  
Tangent of loss angle:  
for $C \leq 1 \mu F$ at 100 kHz or  
for $C > 1 \mu F$ at 10 kHz | Capacitance $|\Delta C/C| \leq 1 \%$ compared to values measured in 4.13.1  
Tangent of loss angle Increase of $\tan \delta$:  
$\leq 0.0005$ for: $C \leq 100 \ nF$ or  
$\leq 0.001$ for: $100 \ nF < C \leq 470 \ nF$ or  
$\leq 0.0015$ for: $C > 470 \ nF$  
Compared to values measured in 4.13.1  
Insulation resistance $\geq 50 \%$ of values specified in section “Insulation Resistance” of this specification |
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