Pulse capacitor
A pulse capacitor is a capacitor designed primarily for applications with intermittent charges and/or discharges at high values of the charge/discharge current.

Pulse operation
Capacitors subjected to pulses with fast rise or fall times (high \(\frac{dU}{dt}\)) will be exposed to high current pulses \(i = C \times \frac{dU}{dt}\). In order not to overload the internal connections the current must be limited. The current limits for a specific type of capacitor are dependent upon:

- Amplitude and form of the pulse
- Rated voltage of the capacitor
- Capacitance

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The power dissipation in a capacitor is approximately:

\[ P = 2\pi f \times C \times \tan\delta \times U_{\text{rms}}^2 \]  
(1)

or

\[ P = \tan\delta/(2\pi f \times C) \times I_{\text{rms}}^2 \]  
(2)

\(\tan\delta\) = dissipation factor.

Typical values can be estimated from the diagram on page 15.

The power dissipation in a capacitor is approximately:

\[ P = P_1 + P_2 + \ldots + P_n \]

\(\Delta T = (T_s - T_a) = P \times R_{\text{thha}} °C\)  
(3)

Temperature increase between hot spot \((T_s)\) of the capacitor and ambient \((T_a)\).

\(R_{\text{thha}} = \text{Thermal resistance (°C/W)}\) between hot spot and ambient.

Maximum permissible hot spot temperature for polypropylene is +105 °C and maximum \(\Delta T = 10 °C\) at +85 °C \(T_a\).

For lower \(T_s\), a higher \(\Delta T\) can be allowed.

This is implemented in PCCAD software package below.

In order to make it easy to select pulse capacitors Evox Rifa has developed a software for Windows™ with the following main options:

- To get general technical information about pulse capacitors
- To get complete data sheets of all Evox Rifa pulse capacitors
- To select a Part Number and then get diagrams of ESR, DF, max \(I_{\text{rms}}\) and \(U_{\text{rms}}\) vs frequency and ambient temperature. This means that it is easy
  - To check if a certain capacitor is suitable for a certain application.
  - To make Fourier analysis of an arbitrary waveform.
  - To make print-outs of data files and diagrams from simulations.

This is normally all the information needed to select the right pulse capacitor.

Free download is available at www.kemet.com.
### QUALITY TESTS AND REQUIREMENTS

The details are valid for all types of pulse capacitors unless specific remark is made in each detail specification.

All tests are made at +23°C unless otherwise specified.

<table>
<thead>
<tr>
<th>Test</th>
<th>IEC Publication</th>
<th>Procedure</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage proof</strong></td>
<td>60384-1 clause 4.6</td>
<td>1.6 x U&lt;sub&gt;r&lt;/sub&gt; after 60 s</td>
<td>The capacitors must withstand the voltage without breakdowns or flashovers and without decreased insulation resistance below the value in each detail specification. No visible damage.</td>
</tr>
<tr>
<td></td>
<td>2 x U&lt;sub&gt;r&lt;/sub&gt; (min 400 VDC to case) after 60 s</td>
<td></td>
<td>As above</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td>60068-2-6 Test Fc</td>
<td>6 h with 10 – 500 Hz and 0.75 mm amplitude or 98 m/s² depending on frequency</td>
<td>No visible damage, tanδ ≤ 1.2 x stated value at 100 kHz ΔC/C ≤ ± 0.5%</td>
</tr>
<tr>
<td><strong>Bump</strong></td>
<td>60068-2-29 Test Eb</td>
<td>4000 bumps with 390m/s² mounted on PCB</td>
<td>ΔC/C ≤ ± 0.5% tanδ ≤ 1.2 x stated value at 100 kHz Insulation resistance: ≥ 100000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; ≤ 0.33 µF ≥ 30000 s for C&lt;sub&gt;n&lt;/sub&gt; &gt; 0.33 µF</td>
</tr>
<tr>
<td><strong>Resistance to soldering heat</strong></td>
<td>60068-2-20 Method 1A</td>
<td>Solder bath at + 260°C ± 5°C with screening</td>
<td>Immersion of the terminations into the solder bath shall be completed in a time not exceeding 1 s and the terminations shall remain immersed to the specified depth for 10 ± 1 s and then be withdrawn. ΔC/C ≤ ± 0.5% tanδ ≤ 1.2 x stated value at 100 kHz No visible damage.</td>
</tr>
<tr>
<td><strong>Climatic sequence</strong></td>
<td>60384-1 para 4:21</td>
<td>IEC 60068-2-2 dry heat 16 h IEC 60068-2-34 damp heat, one cycle, IEC 60068-2-1 Test Aa 2 h</td>
<td>Insulation resistance: ≥ 100000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; ≤ 0.33 µF ≥ 30000 s for C&lt;sub&gt;n&lt;/sub&gt; &gt; 0.33 µF ΔC/C ≤ ± 0.5% tanδ ≤ 1.2 x stated value at 100 kHz</td>
</tr>
<tr>
<td><strong>Damp heat steady state</strong></td>
<td>IEC 60068-2-3 Test Ca</td>
<td>+ 40°C and 90 – 95% RH</td>
<td>56 days No visible damage. Insulation resistance: ≥ 50000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; ≤ 0.33 µF ≥ 15000 s for C&lt;sub&gt;n&lt;/sub&gt; &gt; 0.33 µF ΔC/C ≤ ± 1% tanδ ≤ 1.2 x stated value at 100 kHz</td>
</tr>
<tr>
<td><strong>Endurance, AC</strong></td>
<td>60384-17 para 4.13</td>
<td>10000 pulses and with (2 x) dU/dt according to detail specification</td>
<td>No visible damage. ΔC/C ≤ ± 5% tanδ ≤ 1.5 x stated value at 100 kHz Insulation resistance: ≥ 100000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; ≤ 0.33 µF ≥ 30000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; &gt; 0.33 µF</td>
</tr>
<tr>
<td><strong>Charge and discharge</strong></td>
<td>10000 pulses and with (2 x) dU/dt according to detail specification</td>
<td>tanδ (100 kHz) ≤ 2 x stated value (100 kHz) ΔC/C ≤ ± 0.5% Insulation resistance: ≥ 50000 MΩ for C&lt;sub&gt;n&lt;/sub&gt; ≤ 0.33 µF ≥ 15000 s for C&lt;sub&gt;n&lt;/sub&gt; &gt; 0.33 µF</td>
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* Note: Generally, all small polypropylene capacitors are sensitive to the soldering heat due to the relatively low melting point of polypropylene material (160°C - 170°C). This is why the suitability of the soldering process should be checked before the use of especially PHE426 in 5 and 7.5 mm pitches. Consult KEMET for recommended temperature profiles.