TERMS AND DEFINITIONS

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 dU/dt) will be exposed to high current pulses (i = C x 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
- Geometrical configuration of the winding

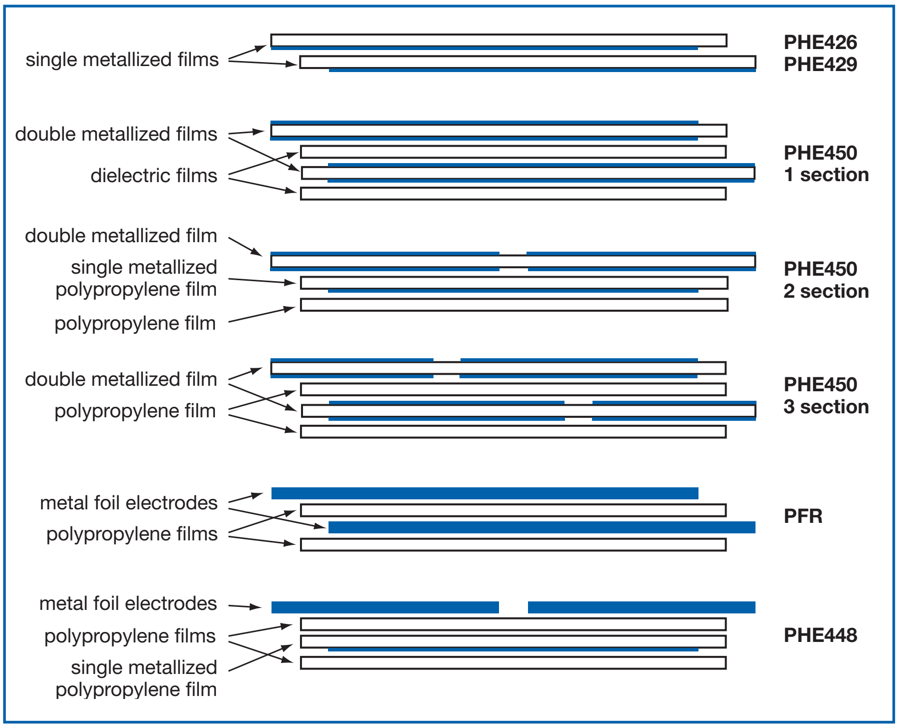
At repeated pulse operation, self-heating, ambient temperature and cooling set the load limit.
Pulse current limits are commonly expressed in the form of maximum permitted dU/dt in volts per microsecond. The figures stated in the data sheets refer to an unlimited number of pulses charging or discharging to or from the rated voltage U_R.

TYPICAL APPLICATIONS

Pulse capacitors are intended for coupling, bypass, filtering, snubbering or pulse operation in SMPS at low as well as at high AC voltage of high frequency where there is a need for high pulse rise time and high ionization level, e.g. fly-back circuits in TV-sets.

CONSTRUCTION

In a metallized film capacitor the electrodes are deposited under vacuum on the plastic film. Contact to the metallized layers is achieved by spraying the ends of the windings with a special metal alloy. This method results in low inductance and a low series resistance capacitor. There are three main types of metallized film compositions. In film/foil types of capacitors metal foils are used as electrodes.



THERMAL DISSIPATION

The power dissipation in a capacitor is approximately:

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

or

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

$\tan\delta$ = dissipation factor.
Typical values can be estimated from the diagram on page 15.
f = frequency (Hz)
This is valid for sine wave signals. For wide band signals, the power dissipation values for each frequency have to be added, i.e.

$P_{tot} = P1 + P2 + ... + Pn$

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

Temperature increase between hot spot (T_h) of the capacitor and ambient (T_a).
R_{thha} = Thermal resistance (°C/W) between hot spot and ambient.
Maximum permissible hot spot temperature for polypropylene is +105 °C and maximum ΔT=10 °C at +85 °C T_a.
For lower T_a, a higher ΔT can be allowed. This is implemented in PCCAD software package below.

The diagrams for derated AC voltage vs. frequency for the pulse capacitors in this catalogue are calculated with T_a = +85 °C and ΔT = 10 °C.
Example:
PHE450SB4680JR06 6.8 nF 2000 VDC
f = 100 kHz, U_{rms} = 200 VAC, DF = 0.03%, R_{thha} = 98 °C/W
With formula (1) and (3) above:
P = 0.05 W and ΔT = 5 °C
If T_a = 85 °C then T_h = 90 °C

PULSE CAPACITOR CAD (PCCAD) - UNIQUE SOFTWARE

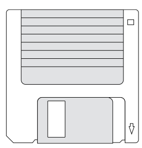
In order to make it easy to select pulse capacitors Evox Rifa has developed a software for Windows™ with the following main options:

- 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_{rms} and U_{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.

Test	IEC Publication	Procedure	Requirements
Voltage proof	60384-1 clause 4.6	1.6 x U_R after 60 s	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.
	clause 4.6 2.3	2 x U_R (min 400 VDC to case) after 60s	As above
Vibration	60068-2-6 Test Fc	6 h with 10 – 500 Hz and 0.75 mm amplitude or 98 m/s² depending on frequency	No visible damage. tanδ ≤ 1.2 x stated value at 100 kHz ΔC/C ≤ ± 0.5 %
Bump	60068-2-29 Test Eb	4000 bumps with 390m/s² mounted on PCB	ΔC/C ≤ ± 0.5% tanδ ≤ 1.2 x stated value at 100 kHz Insulation resistance: ≥ 100000 MΩ for C_R ≤ 0.33 µF ≥ 30000 s for C_R > 0.33 µF
Resistance to soldering heat *	60068-2-20 Method 1A	Solder bath at + 260°C ± 5°C with screening	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.
Climatic sequence	60384-1 para 4:21	IEC 60068-2.2 dry heat 16 h IEC 60068-2-34 damp heat, one cycle, IEC 60068-2-1 Test Aa 2 h	Insulation resistance: ≥ 100000 MΩ for C_R ≤ 0.33 µF ≥ 30000 s for C_R > 0.33 µF ΔC/C ≤ ± 0.5 % tanδ ≤ 1.2 x stated value at 100 kHz
Damp heat steady state	IEC 60068-2-3 Test Ca	+ 40°C and 90 – 95% RH	56 days No visible damage. Insulation resistance: ≥ 50000 MΩ for C_R ≤ 0.33 µF ≥ 15000 s for C_R > 0.33 µF ΔC/C ≤ ± 1% tanδ ≤ 1.2 x stated value at 100 kHz
Endurance, AC		1000 h at +85°C and 1.25 x U_R AC	No visible damage. ΔC/C ≤ ± 3% tanδ ≤ 1.5 x stated value at 100 kHz Insulation resistance: ≥ 100000 MΩ for C_R ≤ 0.33 µF ≥ 30000 MΩ for C_R > 0.33 µF
Charge and discharge	60384-17 para 4.13	10000 pulses and with (2 x) dU/dt according to detail specification	tanδ (100 kHz) ≤ 2 x stated value (100 kHz) ΔC/C ≤ ± 0.5% Insulation resistance: ≥ 50000 MΩ for C_R ≤ 0.33 µF ≥ 15000 s for C_R > 0.33 µF

* 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.