

## How to Specify Polypropylene Film Capacitors in AC or Pulse Applications

By Andy Bellavia

When specifying a capacitor for AC or pulse applications two considerations must be made. First, the instantaneous current in the capacitor must be evaluated. Excessive instantaneous current can destroy the contact area between the capacitor leads and the attachments to the leads. Second, the RMS current must be checked. Excessive RMS current will cause the capacitor to overheat.

### Evaluating the instantaneous current

The instantaneous current in a capacitor is often expressed by the rate of voltage change, or  $dV/dt$ . They are related according to the formula  $I = C * dV/dt$ , or  $dV/dt = I/C$ . So, for example, if a capacitor has the value  $0.001\mu F$  and the instantaneous current is 1A for  $1\mu S$ , the rate of voltage change is  $1000V/\mu S$  ( $1A/0.001\mu F = 1000V/\mu S$ ). Since the instantaneous current exists for  $1\mu S$ , the voltage change is 1000V ( $1000V/\mu S * 1\mu S = 1000V$ ).

The Evox-Rifa catalog lists maximum  $dV/dt$  values for most capacitor series. These are only guideline figures because the  $dV/dt$  capability of a capacitor cannot be directly measured, only determined by experiment. The values in the catalog are accurate only under the specific test conditions used by Evox-Rifa. In other cases the catalog value is conservative. To properly evaluate a capacitor in an application follow these steps:

1. Obtain voltage and current waveforms on the capacitor itself.
2. Determine the  $dV/dt$  of the pulse. This can be done by making estimated measurements on the voltage waveform or by calculating from the known value of capacitance and instantaneous peak current (from the current waveform) using  $dV/dt = I/C$ .
3. Obtain the value of the voltage change from the voltage waveform. In other words, if the voltage rises from 250 to 750 volts the voltage change is 500 volts.

4. Divide the rated voltage of the capacitor by the voltage change to obtain the multiplication factor. For example, if the capacitor rated voltage is 1,000 volts and the voltage change is 500 volts, the multiplication factor is 2.
5. Multiply the catalog value of  $dV/dt$  by the multiplication factor. *This is the allowed maximum  $dV/dt$  in the specific application.*
6. If the allowed maximum  $dV/dt$  is lower than the actual  $dV/dt$  in the application the capacitor may still be usable, especially if the current waveform is not a square wave. In these cases one should submit the voltage and current waveforms to Evox-Rifa for a specific evaluation.

### Checking the RMS current

In the past the procedure for checking RMS current was difficult to perform accurately. Now the process is made easy by using a new software package called PulseCAD, available at no charge from Evox-Rifa. After selecting a capacitor and entering the maximum ambient temperature, PulseCAD graphically shows the allowed RMS current across any desired frequency range.

PulseCAD can be obtained on disk by contacting Evox-Rifa, or downloaded directly from the Evox-Rifa Web site: <http://www.evov-rifa.com>.

### A final note...

If one evaluates a capacitor according to these guidelines with positive results then one may be assured of the capacitor's performance. However if one cannot match a capacitor to the application then it is strongly recommended the Evox-Rifa be contacted. Evox-Rifa can evaluate the specific application and make a suggestion. It is especially true with complex waveforms that the capacitor may be usable even if negative results are obtained by following the above procedures.