High Power Capacitors
Calculation Form

**DESIGN**

### Specification

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance</td>
<td>C (µF)</td>
<td></td>
</tr>
<tr>
<td>Working voltage</td>
<td>Vw (V)</td>
<td></td>
</tr>
<tr>
<td>Rms current</td>
<td>Irms (A_rms)</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>F (Hz)</td>
<td></td>
</tr>
<tr>
<td>Ripple voltage</td>
<td>Vr (V)</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>θamb (°C)</td>
<td></td>
</tr>
<tr>
<td>Lifetime @ VwIrms and θamb</td>
<td>hours</td>
<td></td>
</tr>
<tr>
<td>Parasitic inductance</td>
<td>L (nH)</td>
<td></td>
</tr>
<tr>
<td>Cooling conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Your Choice

<table>
<thead>
<tr>
<th>PN</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance</td>
<td>C (µF)</td>
<td></td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>Vn (V)</td>
<td></td>
</tr>
<tr>
<td>Serial resistance</td>
<td>Rs (mΩ)</td>
<td></td>
</tr>
<tr>
<td>Thermal resistance between hot spot and case</td>
<td>Rth1 (°C/W)</td>
<td></td>
</tr>
<tr>
<td>Thermal resistance between case and ambient air</td>
<td>Rth2 (°C/W)</td>
<td></td>
</tr>
</tbody>
</table>

### Calculations

**Maximum ripple voltage**

\[ V_{\text{max}} = 0.45V_n \]

\[ V_r = V \]

The maximum ripple voltage must be in any case lower than the ripple voltage

\[ \rho = \frac{V_w}{V_n} \]

\[ \rho = \frac{P_j}{P_d} \]

Dielectric losses

\[ P_d = Q \times \tan \delta_0 = Q \times 3 \times 10^{-4} \]

\[ P_d = W \]

Hot spot temperature

\[ \theta_{HS} = \theta_{amb} + (P_j + P_d) \times (R_{th1} + R_{th2}) \]

\[ \theta_{HS} = °C \]

The hot spot temperature must be in any case lower than 85°C

### LIFETIME EXPECTANCY VS HOT SPOT TEMPERATURE AND VOLTAGE

![Graph showing lifetime expectancy vs hot spot temperature and voltage](image)

Expected lifetime at hot spot calculated and \( V = V_w \)
DISFIM Products
For Energy Storage and Discharge Applications

Based on the CONTROLLED SELF HEALING technology, AVX offers impregnated capacitors, named DISFIM, which are ideal for discharge applications.

With the controlled self-healing technology, the capacitance of the DISFIM is divided into several million elementary capacitances. The weak points in the dielectric are insulated and the capacitor continues to work without any short-circuit or risk of explosion.

DISFIM capacitors may represent more than 10,000 square meters.
Only some square millimeters of active surface are lost for every self-healing action.
Over the life of the capacitor, the capacitance gradually decreases.
The capacitor is usually designed to lose less than 5% of its initial capacitance during its whole lifetime.

Example of design with 2 epoxide flat terminals

APPLICATIONS
- Power laser
- High voltage supplies
- Cable failure detection
- Electromagnetic and ETC guns
- Marx generators
- Welding machine

Custom design is the rule as applications and operating conditions are various.
Feel free to send your request to your local AVX representative.
Use guide for customer's specific requirement.

CHARACTERISTICS
- Voltage range from 2kV to 75kV
- Maximum energy per can 150kJ
- Specific energy up to 2000J/l
- Lifetime up to several tens millions shots
- Stray inductance from 50nH to 500nH

CONSTRUCTION
- Metal case unit
- Epoxide flat terminals or ceramic terminals
# High Power Capacitors
## Guide for Customer’s Specific Requirements

This questionnaire lists the information we require to prepare an offer according to your exact requirements.

<table>
<thead>
<tr>
<th>Applications</th>
<th>DC Filtering</th>
<th>Discharge*</th>
<th>Protection*</th>
<th>Tuning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (µF)</td>
<td>Vpeak</td>
<td>Vch</td>
<td>Vpeak</td>
<td>Vdc</td>
</tr>
<tr>
<td>Tolerance (%)</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>Arms</td>
<td>Apeak</td>
<td>Arms</td>
<td></td>
</tr>
<tr>
<td>Capacitance (µF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolerance (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ripple Voltage (peak to peak)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Current/Duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge</td>
<td></td>
<td>Aperiodic</td>
<td>Oscillatory</td>
<td></td>
</tr>
<tr>
<td>Pulse Duration (5% lpeak)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to lpeak (µs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ringing Frequency (Hz)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reversal Voltage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetition Rate</td>
<td>shots/min/hour/day</td>
<td></td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Hold Time @ Full Voltage (s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault Peak Current / nb shots</td>
<td>Apeak</td>
<td>shots</td>
<td>Apeak</td>
<td>shots</td>
</tr>
<tr>
<td>Fault Reversal Voltage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Expectancy</td>
<td>hours</td>
<td>shots</td>
<td>hours</td>
<td>hours</td>
</tr>
<tr>
<td>Maximum Inductance (nH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Voltage between Terminals (V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Voltage between Shorted Terminals and Case (V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Surge Voltage (MSV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSV Duration / Frequency</td>
<td>s/year</td>
<td>s</td>
<td>year</td>
<td></td>
</tr>
</tbody>
</table>

*Due to the particularities of varying waveforms in such application, more information on the exact nature of waveform is generally required for a full analysis.

## Thermal Characteristics

<table>
<thead>
<tr>
<th>Storage Temperature (°C)</th>
<th>Operating Temperature (°C)</th>
<th>Cooling Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>min.</td>
<td>Natural Convection</td>
</tr>
<tr>
<td>average</td>
<td>average</td>
<td>Forced Air (m/s)</td>
</tr>
<tr>
<td>max.</td>
<td>max.</td>
<td>Water</td>
</tr>
</tbody>
</table>

## Remarks
AVX Products Listing

### PASSIVES

**Capacitors**
- Multilayer Ceramic
- Film
- Glass
- Niobium Oxide* - OxiCap®
- Pulse Supercapacitors
- Tantalum

**Circuit Protection**
- Thermistors
- Fuses - Thin Film
- Transient Voltage Suppressors
- Varistors - Zinc Oxide

**Directional Couplers**
- Thin-Film

**Filters**
- Ceramic
- EMI
- Noise
- SAW
- Low Pass - Thin Film

**Inductors**
- Thin-Film

**Integrated Passive Components**
- PMC - Thin-Film Networks
- Capacitor Arrays
- Feedthru Arrays
- Low Inductance Decoupling Arrays

**Piezo Acoustic Generators**
- Ceramic

**Resistors**
- Arrays
- Miniature Axials

**Timing Devices**
- Clock Oscillators
- MHz Quartz Crystal
- Resonators
- VCO
- TCXO

### CONNECTORS

**Automotive**
- Standard, Custom

**Board to Board**
- SMD (0.4, 0.5, 1.0mm), BGA, Thru-Hole

**Card Edge**
- DIN41612
- Standard, Inverse, High Temperature

**FFC/FPC**
- 0.3, 0.5, 1.0mm

**Hand Held, Cellular**
- Battery, I/O, SIMcard, RF shield clips

**2mm Hard Metric**
- Standard, Reduced Cross-Talk

**IDC Wire to Board**
- Headers, Plugs, Assemblies

**Memory**
- PCMCIA, Compact Flash, Secure Digital, MMC,
- Smartcard, SODIMM

**Military**
- H Government, DIN41612

**Polytect™**
- Soft Molding

**Rack and Panel**
- Varicon™

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CERTIFICATE

awarded to
AVX TPC SA
Avenue colonel Prat
21850 Saint Apollinaire
France

BUREAU VERITAS CERTIFICATION

confirms, as an IRIS approved certification body, that the Management System of the above organization has been assessed and found to be in accordance with the

International Railway Industry Standard (IRIS)
Revision 01, November 2007

for the product category
Auxiliary systems

Scope of supply
Design, development and manufacturing of power capacitors

Conception, développement et fabrication de condensateurs de puissance

Date of the audit: 17.10.2008
Date of issue of the certificate: 13.01.2009 Certificate valid until: 12.01.2012

Current data: 13.01.2009
Certificate-Register-No.: FRA-IF-000 006