Film capacitors – Power Electronic Capacitors

PEC ModCap HF series (high frequency)

Series/Type: ModCap HF
Ordering code: B25647A*
Date: August 2023
Version: 3.0
Film capacitors – Power Electronic Capacitors

PEC ModCap HF series (high frequency)  ModCap HF

Rated capacitance: 640 ... 1850 µF
Rated DC Voltage: 900 ... 1600 V DC

Construction
- Dielectric: 100% Bio-based Polypropylene film
- Plastic case and cover (UL 94 V-0, Fire & smoke EN 45545-2 HL2 R22-HL3 R23)
- Non PCB, PU Resin (UL 94 V-0, Fire & smoke EN 45545-2 HL2 R22-HL3 R23)

Features
- Modular design
- High frequency performance, fully compatible with SiC semiconductors
- Self-healing technology
- Over-voltage capability
- Very low ESL
- RoHS Compliant

Typical applications
- DC link for renewable energy converters (solar, wind)
- DC link for traction applications (tramway, metro, light train inverters)
- DC link for industrial motor drive

Reference Standards
- IEC 61071:2017, International Standard Capacitors for power electronics
- IEC 61881-1:2010, International Standard Railway Applications-Rolling stock equipment-Capacitors for power electronics
- EN 45545-2 HL3 R23, Fire safety standard

Terminals
- Optimized low inductance flat female terminals M6

Certifications
- UL Recognized
- ISCC certification with 100% Bio-based PP film*

Packing
- Construction C: 4 capacitors per box

* (Mass balance approach)
## Technical data and specifications

### Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacitance $C_N$</td>
<td>Up to 1850 µF (see table)</td>
</tr>
<tr>
<td>Tolerance</td>
<td>$K$ (±10%)</td>
</tr>
<tr>
<td>Rated voltage range $U_N$</td>
<td>900 to 1600 V (see table)</td>
</tr>
<tr>
<td>Ripple voltage $U_r$</td>
<td>Up to 424 V&lt;sub&gt;peak-peak&lt;/sub&gt;</td>
</tr>
<tr>
<td>Operation bandwidth&lt;sup&gt;1,2&lt;/sup&gt;</td>
<td>Up to 100 kHz</td>
</tr>
<tr>
<td>Rated current $I_{R}$ (3 kHz)</td>
<td>(see table)</td>
</tr>
<tr>
<td>Inductance $ESL$ (1 MHz)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>8 nH</td>
</tr>
<tr>
<td>Thermal Resistance $R_{th}$&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1.4 K/°W</td>
</tr>
</tbody>
</table>

<sup>1</sup> RMS current value that corresponds to components above 100 kHz limited to 10% of total RMS. Maximum continuous losses defined for rated current at 3 kHz should not be exceed. ESR vs frequency graph available in page 5 for losses calculation according to a specific current spectrum. For more accurate thermal calculation, please ask for FEA simulation according to your specific operation conditions.

<sup>2</sup> Connecting all independent capacitances by external overlapped busbar as described in page 4.

<sup>3</sup> Calculated from $T_{an}$ to $T_{HS}$ Thol-Spot considering natural convection and no transfer of heat through the terminals.

### Maximum ratings

<table>
<thead>
<tr>
<th>Maximum permissible voltage ($U_{max}$)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N +10%$ (30% of on-load daily duration)</td>
<td>$U_N +10%$ (30% of on-load daily duration)</td>
</tr>
<tr>
<td>$U_N +15%$ (up to 30 min daily)</td>
<td>$U_N +15%$ (up to 30 min daily)</td>
</tr>
<tr>
<td>$U_N +20%$ (up to 5 min daily)</td>
<td>$U_N +20%$ (up to 5 min daily)</td>
</tr>
<tr>
<td>$U_N +30%$ (up to 1 min daily)</td>
<td>$U_N +30%$ (up to 1 min daily)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum permissible peak voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_{TC}$ (Isolation)</td>
<td>4 kV</td>
</tr>
<tr>
<td>$U_{TC}$ (Extinction)</td>
<td>2.5 kV (&lt;10pC)</td>
</tr>
</tbody>
</table>

The average applied voltage shall not be higher than the specified voltage.

It should be recognised that any significant period of operation at voltages above the rated one would reduce overall life.

### Test data

<table>
<thead>
<tr>
<th>Voltage test between terminals ($U_{TT}$)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1.5 \times U_N$, DC, 10 s (room temperature)</td>
</tr>
</tbody>
</table>

### Design data

| Weight approx.                          | 3.6 ± 0.1 kg                  |
| Fixing                                  | 4 x Ø 6.5 mm                  |

### Terminals

| Terminations                             | 8 x M6 x 25 x 30 mm, contact area 60 mm² |
| Max. torque                              | 6 Nm                           |
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**Climatic category 40/75/56**

- $\Theta_{\text{min}}$: $-40 ^\circ \text{C}$
- $\Theta_{\text{max}}$: $+75 ^\circ \text{C}$
- Storage temperature: $-40 ^\circ \text{C} ... +85 ^\circ \text{C}$
- $\Theta_{\text{hotspot max.}}$: $+90 ^\circ \text{C}$
- Humidity: av. rel. < 93% 25 g/m³ max.
- Time test: 56 days
- Maximum altitude: 2000 m, higher altitude to be requested

**Life expectancy**

- Lifetime (*): Up to 200 000 hours
- End of life criteria: C-loss: 3%

(* $U_{\text{in}}$, and 80 °C mean dielectric temperature)

**Electrical characteristics and ordering codes**

<table>
<thead>
<tr>
<th>$U_{\text{N}}$ V</th>
<th>$C_r$ µF</th>
<th>$I_n$ A</th>
<th>$I_s$ kA</th>
<th>$I$ kA</th>
<th>Dimensions LxWxH mm</th>
<th>Design / PU</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>1850</td>
<td>210</td>
<td>225</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A9198K003</td>
</tr>
<tr>
<td>1000</td>
<td>1520</td>
<td>200</td>
<td>220</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A1158K003</td>
</tr>
<tr>
<td>1100</td>
<td>1200</td>
<td>190</td>
<td>215</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A1128K003</td>
</tr>
<tr>
<td>1250</td>
<td>940</td>
<td>180</td>
<td>210</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A1947K003</td>
</tr>
<tr>
<td>1350</td>
<td>880</td>
<td>170</td>
<td>205</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A1887K003</td>
</tr>
<tr>
<td>1600</td>
<td>640</td>
<td>160</td>
<td>198</td>
<td>5</td>
<td>205x90x170</td>
<td>C / 4pcs</td>
<td>B25647A1647K003</td>
</tr>
</tbody>
</table>

**Connection via External Busbar**

The ModCap is a modular solution with four independent capacitors to be connected with an external overlapped busbar.

The customer busbar shall connect the terminals according to the appropriate polarity as shown in the electrical connection diagram below.

Note: The sketch on the label displays only the physical position of the assigned terminal numbering. The capacitor should be connected according to electric diagram on page 4. Further detail in the dimensional drawing.
ESR vs frequency
ESR up to 150 kHz
ESR up to 350 kHz

Lifetime expectancy

(*) Homogeneous dielectric temperatures
Derating vs temperature

![Graph showing Irms derating vs Ambient Temperature]

$I/I_{\text{rated}}$ vs Temperature (°C)

August 2023
Dimensional drawings

Construction C
General safety recommendations
When employed in power electronics applications, the capacitors run with high energy and high currents.

The energy stored in capacitors may be lethal. To prevent any risks of shocks, the capacitor should be discharged with adequate means by qualified people and short-circuited between terminals before handling.

The capacitor can contain dangerous residual charges even after long time without operation. For this reason, the electrical terminals must remain short-circuited until the capacitors are connected in the operating circuit.

TDK Electronics cannot predict all possible stresses that a power electronic capacitors can be subjected to. There is a remaining probability of power electronic capacitors showing malfunction due to excess temperature, overvoltage, wrong application, wrong installation, faulty maintenance, mechanical damage, operation at the limits of the specification or other reasons.

Transportation and handling
- The electrical terminals must not be used for grabbing or suspending the capacitor during transportation and handling.
- Do not handle the capacitor before it is discharged.
- Handle capacitors carefully, because they may still be charged even after disconnection due to faulty discharging devices.
- Protect the capacitor properly against over current and short circuit.
- Failure to follow cautions may result, worst case, in premature failures, bursting and fire.
- Capacitor subjected to Dual Use Category 3A201.

Fixing
- The threaded screw 4x Ø 6.5 mm in the bottom of the capacitor must be used for fixing.

Storage and operating conditions
Capacitors must never be stored outside the specified temperature and humidity ranges. Capacitors may not be stored in corrosive atmospheres, particularly not when chlorides, sulfides, acids, alkalis, salts, organic solvents, or similar substances are present.

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