Hybrid Vehicles and Electric Vehicles Capacitors

General Description

DC FILTERING
The series uses a dry-wound (non-oil-filled) segmented metallized polypropylene, which features the controlled self-healing process, specially treated to have a very high dielectric strength in operating conditions up to 115°C.
For more information on how segmented metallized films and controlled self-healing works see a complete presentation.

APPLICATIONS IN ELECTRIC VEHICLES
The FHC series capacitors are specifically designed to prevent ripple currents from reaching back to the power source, and to smooth out DC bus voltage variations. Capacitors are also used to protect semiconductors - originally thyristors, but now IGBTs.

STANDARDS
IEC 61071-1, IEC 61071-2: Power electronic capacitors
AECQ 200: with specific deviation for power capacitors

The FHC1 & FHC2 range capacitor have been specially design to be use in conjunction with Hybrid & Electric vehicles IGBT modules.

LIFETIME EXPECTANCY
One unique feature of the segmented metallized technology is how the capacitor acts at the end of its lifetime. Unlike electrolytic capacitors, which are a short circuit failure mode, film capacitors only experience a parametric loss of capacitance with no catastrophic failure mode. The capacitor gradually loses capacitance over its lifetime and eventually becomes an open circuit.
Lifetime, therefore, as it is defined here, is a function of several elements:
• Decrease in capacitance limit 2-5% or to meet customer needs
• Average applied voltage (expressed as a ratio vs nominal rated voltage)
• Average hot spot temperature
By changing any of these parameters we can change the defined “lifetime” of the capacitor. The capacitor will continue to function even beyond the pre-established limit for capacitance decrease.

CONSTRUCTION
The internal construction of the FHC Series is based on several elementary wound bobbins soldered by reinforced solder point on specific bus bar offering, the benefits of which include: flexibility in internal design, current capability and repartition, reduction of thermal expansion constraints, high winding productivity, modularity in three dimensions.

PACKAGING
FHC Series capacitors are enclosed in an unpainted, rectangular, resin filled plastic case. Aluminium cases are available upon request.
Hybrid Vehicles and Electric Vehicles Capacitors

FHC1 & FHC2

HOW TO ORDER

<table>
<thead>
<tr>
<th>FHC</th>
<th>1</th>
<th>6</th>
<th>1</th>
<th>2637</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>Case Size</td>
<td>Dielectric</td>
<td>Voltage</td>
<td>Capacitance</td>
</tr>
<tr>
<td>FHC: HEV/EV DC-Link</td>
<td>1 = 170mm x 50mm single terminal</td>
<td>6 = PP (polypropylene)</td>
<td>I = 410/450 Vdc</td>
<td>-- = front facing mounting brackets</td>
</tr>
<tr>
<td>2 = 237mm x 72mm three terminal</td>
<td></td>
<td></td>
<td>C = 900 Vdc</td>
<td>JH = side facing mounting brackets</td>
</tr>
</tbody>
</table>

CHARACTERISTICS

- Voltage: 410VDC to 900Vdc (standard)
  300VDC to 1400Vdc (custom)
- Capacitance Value: 300µF - 900µF (standard)
  100µF - 1.5mF (custom)
- Working Temperature: -40°C to 105°C hot spot temperature;
  up to 115°C hot spot for low duration

ELECTRICAL CHARACTERISTICS

- Capacitance tolerance: 10%
- Tan δ: $2 \times 10^{-4}$
- Test voltage between terminals (10s): $1.5 \times U_{h} @ 25^\circ C$
- Test voltage between terminals and case (60s 50Hz): $3 \text{kV}_{rms} @ 25^\circ C$
- Hot spot max ***: 105°C / 115°C low duration
- Temp Min: -40°C
- Temp Max: +105°C
- Storage: +105°C / -40°C
- Lifetime: DC/C = -5%
- Up to 15,000h ***
- Thermal calculation**** (Q in VAR, Rs in Ohms, Rth in °C/W, T° ambient without cooling plate)
  $T^\circ \text{ Hot-spot} = T^\circ \text{ambient} + (2 \times 10^{-4} \cdot Q + R_s \cdot I_{rms}) \cdot R_{th}$
- Case: PA66 fiber reinforced 30%
- Resin: Epoxy resin
- Terminals: Flat copper tinned
- RoHS compliance: Yes
- FIT: $< 100 \text{FIT} @ 40^\circ C$

*** Max hot spot 105°C according to cooling efficiency
**** Other conditions on request
# Hybrid Vehicles and Electric Vehicles Capacitors

## FHC1 & FHC2

### RATINGS AND PART NUMBER

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Capacitance (μF)</th>
<th>Un (Vdc)</th>
<th>Imax (A) (*)</th>
<th>L parasitic inductance nH (**)</th>
<th>Rs (mΩ)</th>
<th>Rth hot spot/bottom (°C/W)</th>
<th>Tanδ 100Hz</th>
<th>Dimension LxWxH (mm)</th>
<th>Lifetime Expectancy Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHC16I0307Kxx</td>
<td>300</td>
<td>450</td>
<td>120</td>
<td>18</td>
<td>0.69</td>
<td>4.4</td>
<td>5 x 10⁻⁴</td>
<td>140 x 72 x 50</td>
<td>A</td>
</tr>
<tr>
<td>FHC16I0517Kxx</td>
<td>510</td>
<td>410</td>
<td>150</td>
<td>18</td>
<td>0.51</td>
<td>3.7</td>
<td>5 x 10⁻⁴</td>
<td>140 x 72 x 50</td>
<td>B</td>
</tr>
<tr>
<td>FHC16J0267Kxx</td>
<td>260</td>
<td>700</td>
<td>80</td>
<td>18</td>
<td>1.57</td>
<td>4</td>
<td>5 x 10⁻⁴</td>
<td>140 x 72 x 50</td>
<td>C</td>
</tr>
<tr>
<td>FHC16C0147Kxx</td>
<td>140</td>
<td>900</td>
<td>70</td>
<td>18</td>
<td>2.09</td>
<td>4</td>
<td>5 x 10⁻⁴</td>
<td>140 x 72 x 50</td>
<td>D</td>
</tr>
</tbody>
</table>

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<th>Tanδ 100Hz</th>
<th>Dimension LxWxH (mm)</th>
<th>Lifetime Expectancy Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHC26I0507Kxx</td>
<td>500</td>
<td>450</td>
<td>170</td>
<td>15</td>
<td>0.45</td>
<td>2.6</td>
<td>5 x 10⁻⁴</td>
<td>237 x 72 x 50</td>
<td>A</td>
</tr>
<tr>
<td>FHC26I0707Kxx</td>
<td>700</td>
<td>450</td>
<td>190</td>
<td>15</td>
<td>0.38</td>
<td>2.4</td>
<td>5 x 10⁻⁴</td>
<td>237 x 72 x 50</td>
<td>A</td>
</tr>
<tr>
<td>FHC26I0907Kxx</td>
<td>900</td>
<td>410</td>
<td>190</td>
<td>15</td>
<td>0.33</td>
<td>2.1</td>
<td>5 x 10⁻⁴</td>
<td>237 x 72 x 50</td>
<td>B</td>
</tr>
<tr>
<td>FHC26J0507Kxx</td>
<td>500</td>
<td>700</td>
<td>160</td>
<td>15</td>
<td>0.87</td>
<td>2.1</td>
<td>5 x 10⁻⁴</td>
<td>237 x 72 x 50</td>
<td>C</td>
</tr>
<tr>
<td>FHC26C0267Kxx</td>
<td>260</td>
<td>900</td>
<td>140</td>
<td>18</td>
<td>1.17</td>
<td>2.1</td>
<td>5 x 10⁻⁴</td>
<td>237 x 72 x 50</td>
<td>D</td>
</tr>
</tbody>
</table>

(*) Imax Max hot spot 105°C  
(**) Measurement at 1MHz  
Nb: Upon request FHC are available equipped with thermocouple for thermal measurement  
Other value or bus bar design please contact your local AVX rep
Hybrid Vehicles and Electric Vehicles Capacitors

FHC1 & FHC2

LIFETIME EXPECTANCY CURVES

**Curve A: Lifetime vs Temperature**

- Temperature (°C)
- Lifetime (hours)

**Curve B: Lifetime vs Temperature**

- Temperature (°C)
- Lifetime (hours)

**Curve C: Lifetime vs Temperature**

- Temperature (°C)
- Lifetime (hours)

**Curve D: Lifetime vs Temperature**

- Temperature (°C)
- Lifetime (hours)
Hybrid Vehicles and Electric Vehicles Capacitors

FHC1

FHC16xxxxxKJH

FHC16xxxxxK--
**Hybrid Vehicles and Electric Vehicles Capacitors**

**FHC1 & FHC2**

### FHC26xxxxKJH

- **Compression Limiter**: Ø 6.4 ± 0.5
- **Dimensions**: 287 × 237 × 48 ± 0.5

### FHC26xxxK--

- **Compression Limiter**: Ø 6.5 ± 0.2
- **Dimensions**: 237 × 79.5 ± 0.5

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<table>
<thead>
<tr>
<th>Component</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø6.1 ± 0.05</td>
<td>Compression Limiter</td>
</tr>
<tr>
<td>Ø6.4 ± 0.5</td>
<td>Compression Limiter</td>
</tr>
<tr>
<td>Ø6.5 ± 0.5</td>
<td>Compression Limiter</td>
</tr>
</tbody>
</table>

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**Notes**:
- All dimensions are in millimeters (mm).
- Values in parentheses indicate multiples of the specified dimension.
- Tolerances are ±0.5 for most dimensions, ±0.2 for smaller dimensions.
Hybrid Vehicles and Electric Vehicles Capacitors

Custom Design Sheet

### Applications

<table>
<thead>
<tr>
<th></th>
<th>DC Filtering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (μF)</td>
<td></td>
</tr>
<tr>
<td>Tolerance (%)</td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>Vpeak</td>
</tr>
<tr>
<td>Ripple Voltage (peak to peak)*</td>
<td>V</td>
</tr>
<tr>
<td>Working Frequency (Hz)</td>
<td></td>
</tr>
<tr>
<td>Operating Current*</td>
<td>Arms</td>
</tr>
<tr>
<td>Maximum Current/Duration</td>
<td>Arms s</td>
</tr>
<tr>
<td>Maximum Inductance (nH)</td>
<td></td>
</tr>
<tr>
<td>Test Voltage between Terminals (V)</td>
<td></td>
</tr>
<tr>
<td>Test Voltage between Shorted Terminals and Case (V)</td>
<td></td>
</tr>
<tr>
<td>Maximum Surge Voltage (MSV)</td>
<td></td>
</tr>
<tr>
<td>MSV Duration / Frequency</td>
<td>s /year</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>Ambient (°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>
<td></td>
</tr>
<tr>
<td>average</td>
<td>average</td>
<td>Forced Air (m/s)</td>
<td></td>
</tr>
<tr>
<td>max.</td>
<td>max.</td>
<td>Water cooling plate</td>
<td></td>
</tr>
</tbody>
</table>

*Providing Mission Profile for U, I and O°C is a must.*