The Film Cap. Tech. For DC Link

Xiamen Faratronic Co. Ltd.
201812

APEC Booth 1226
Anvy Chen
Deputy manager of R&D department, Xiamen Faratronic CO., LTD.
Senior engineer, focus on development of DC-Link film capacitor
More than 12 years.

Address: No.99 Xinyuan Road, Xiamen, China.
Postcode: 361022
Tel: 86 592 2338263
Fax: 86 592 6208550
E-Mail: cyw@faratronic.com.cn
The film capacitors technology for DC link:

- DC link film capacitors become one of the key components in the EV/HEV except IGBT.
- PP film capacitors have the advantages:
  - low losses, high voltage, stability, acceptable volume and price comparing with other dielectric.
- As the EV/HEV market rapidly growing recently, it requires the DC link film capacitors:
  - Reducing size
  - Higher energy density
  - Higher temperature
The film capacitors technology for DC link:

- Faratronic focuses on:
  - Improving the properties of OPP film
  - Researching and finding new materials *(Higher temperature film dielectric)*

1) Thinner films
2) Higher dielectric strength
3) Higher dielectric constant (3~11)
4) Higher temperature (125 °C ~ 150 °C)

1) Increased stored energy density, reduced size
2) Improved reliability
3) Reduced cooling requirements
# DC-Link Capacitors roadmap

<table>
<thead>
<tr>
<th>Time</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
</tbody>
</table>

**Target**

<table>
<thead>
<tr>
<th>Rated Voltage</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>200–240 V/um</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>210–240 V/um</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>220–250 V/um</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.T. materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **200–240 V/um:** 125 °C  ～ 150 °C
- **210–240 V/um:** 125 °C  ～ 150 °C
- **220–250 V/um:** 125 °C  ～ 150 °C

**Film application researching**

- **Film application researching**
- **Samples**
- **Pilot products**

**Target Dates**

- **2018:** Q1
- **2019:** Q2
- **2020:** Q3
- **2021:** Q4
- **2022:** Q1
- **2023:** Q2

**Rated Voltages**

- **≤105 °C:**
- **≤115 °C:**
- **≤120 °C:**
125 °C or 150 °C high temperature capacitors

New H.T. Film dielectric

- PP film: lower 125 °C (short time)
- New H.T. Film dielectric: 125 °C ~ 150 °C

<table>
<thead>
<tr>
<th>Time type</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Film application researching</td>
<td>Film application researching</td>
<td>Film application researching</td>
<td>Film application researching</td>
<td></td>
</tr>
<tr>
<td>Samples</td>
<td>Samples</td>
<td>Samples</td>
<td>Samples</td>
<td></td>
</tr>
<tr>
<td>Pilot products</td>
<td>Pilot products</td>
<td>Pilot products</td>
<td>Pilot products</td>
<td></td>
</tr>
</tbody>
</table>

Note: 2018 Q4 125 °C Samples
Smoothing capacitor for EV/HEV power electronics at 125 °C.

- Segment metallized film design
- High heat resistance [continuously 125 °C, short time 150 °C].
- Higher allowable ripple current under higher temperature environment than PP film capacitor (105 °C).
- High frequency range.
Smoothing capacitor for EV/HEV power electronics at 125 °C.

- Material characteristics:

<table>
<thead>
<tr>
<th>Material</th>
<th>OPP</th>
<th>High heat resistant thermoplastic resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>85°C~105°C</td>
<td>125°C~150°C</td>
</tr>
<tr>
<td>Dielectric constant ((\varepsilon_r))</td>
<td>2.1~2.2</td>
<td>&gt;3.0</td>
</tr>
</tbody>
</table>
Smoothing capacitor for EV/HEV power electronics at 125 °C.

- Specifications:
  - Ratings
    - Rate Voltage: 450V
    - Typical Rate capacitance: 10,15uF
  - Reliability
    - Endurance: 125°C/450V,2000h; 150°C/310V,300h
    - Humidity heat test with loading: 85°C/85%RH/450Vdc, 1000 hours
    - Temperature shock: -40°C←→125°C 1000 cycles
Thank You
Faratronic, your trusty partner
APEC Booth 1226

Faratronic Contact China
Chris Zhuang
M: 011-861-360-601-8583
chris@Faratronic.com.cn
www.Faratronic.com

Faratronic Contact USA
Michael Dombrow
M: 847-212-2413
mc@dombrowinc.com