PEC MKP Capacitors

Aluminum & Film Capacitors
Business Group

TDK Electronics AG
Munich, Germany
October 2020
# Aluminum & Film Capacitors Business Group

## at a glance

<table>
<thead>
<tr>
<th>Key data</th>
<th>Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Headquarters</strong></td>
<td><strong>Aluminum electrolytic capacitors</strong></td>
</tr>
<tr>
<td>Munich, Germany</td>
<td>with the following terminals</td>
</tr>
<tr>
<td><strong>Number of plants</strong></td>
<td>• Screw</td>
</tr>
<tr>
<td>9</td>
<td>• Snap-in/solder pins</td>
</tr>
<tr>
<td><strong>Employees total</strong></td>
<td>• Axial-lead/soldering star</td>
</tr>
<tr>
<td>5600</td>
<td>• Single-ended</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td><strong>Film capacitors for industrial and automotive</strong></td>
</tr>
<tr>
<td>Bernhard Koch, CEO</td>
<td>• DC capacitors</td>
</tr>
<tr>
<td>Karl Stoll, Deputy General Manager</td>
<td>• AC capacitors</td>
</tr>
<tr>
<td>Helmut Schilling, CFO</td>
<td>• Power capacitor chips (PCC) for low power</td>
</tr>
<tr>
<td></td>
<td>• Power electronic capacitors (MKP)</td>
</tr>
<tr>
<td></td>
<td><strong>Film capacitors for energy</strong></td>
</tr>
<tr>
<td></td>
<td>• Power electronic capacitors high power (HP)</td>
</tr>
<tr>
<td></td>
<td>• Power factor correction (PFC) capacitors and key components (LV, MV)</td>
</tr>
<tr>
<td></td>
<td>• Power quality solutions (PQS)</td>
</tr>
</tbody>
</table>
Comprehensive portfolio of aluminum electrolytic & film capacitors

- **Aluminum electrolytic capacitors**
  - Screw terminals
  - Snap-in/solder pins
  - Axial-lead/soldering star
  - Single-ended

- **Film capacitors for industrial and automotive**
  - DC capacitors
  - AC capacitors
  - Power capacitor chips (PCC) for low power
  - **Power electronic capacitors (MKP)**

- **Film capacitors for energy**
  - Power electronic capacitors high power (HP)
  - Power factor correction (PFC) capacitors and key components (LV, MV)
  - Power quality solutions (PQS)
Global manufacturing presence of Aluminum & Film Capacitors Business Group

- Brazil
  - Gravataí
- Germany
  - Heidenheim
- Hungary
  - Szombathely
- Iceland
  - Akureyri
- India
  - Nashik
- China
  - Xiamen
  - Zhuhai
- Spain
  - Málaga
- Italy
  - Milan

- Aluminum electrolytic capacitors only
- Film capacitors only
- Both capacitor technologies
- TDK Foil
Plant in Zhuhai, China

Product range

Film capacitors
- DC capacitors
- Power electronic capacitors (MKP, HP)
  - Power factor correction (PFC) capacitors and key components (LV)
  - Power quality solutions (PQS)

Piezo & Protection Devices Business Group
- Disk, energy, strap and block varistors
- SMD disc varistors (CU)
- Inrush current limiters (ICLs)
- PTC thermistors

Temperature & Pressure Sensors Business Group
- NTC sensor systems for automotive and household

Certification
- ISO 9001
- ISO 14001
- IATF 16949
- IRIS (ISO/TS 22163)
- ISO 3834

Plant in Zhuhai, China

- 67,000 m²
- Founded in 1998
### PEC MKP Capacitors Portfolio

<table>
<thead>
<tr>
<th>MKD AC</th>
<th>MKP DC</th>
<th>HVDC-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input / Output filter</td>
<td>DC-link</td>
<td>Power transmission filter</td>
</tr>
</tbody>
</table>

**MKD AC**
- Input / Output filter

**MKP DC**
- DC-link

**HVDC-C**
- Power transmission filter
Power capacitors for wide area of applications

Solar  Wind  Drives  Traction  UPS  EV-Charger
### AC filter capacitors for industrial applications

#### Features
- Capacity range 5 µF to 600 µF, 250 V\textsubscript{RMS} to 1000 V\textsubscript{RMS}
- IEC 61071, GB/T17702 and UL 810 compliant
- Temperature range up to 85 °C hotspot
- Single phase (1 Ph) and three phase (3 Ph) capacitors

#### Applications
- Capacitor for AC input/output filtering for industrial applications, converters, UPS, drives and wind/solar inverters

#### Benefits
- Hermetically sealed
- Self-healing properties
- Safety mechanism, tear-off fuse overpressure disconnector

<table>
<thead>
<tr>
<th>Series</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B32370*</td>
<td></td>
</tr>
<tr>
<td>B32371*</td>
<td></td>
</tr>
<tr>
<td>B32373*</td>
<td></td>
</tr>
<tr>
<td>B32374*</td>
<td></td>
</tr>
<tr>
<td>B32375*</td>
<td>NEW</td>
</tr>
<tr>
<td>B32376*</td>
<td>NEW</td>
</tr>
<tr>
<td>B32377*</td>
<td></td>
</tr>
<tr>
<td>B32378*</td>
<td></td>
</tr>
</tbody>
</table>
## MKD AC Filter Capacitors Product Range

### Single Phase (1P2W)

<table>
<thead>
<tr>
<th>Rated AC VRMS [V]</th>
<th>( C_R ) [( \mu F )]</th>
<th>Diameter [mm]</th>
<th>Height [mm]</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>5</td>
<td>50</td>
<td>64.5</td>
<td>B3237* series</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Overpressure disconnector</td>
</tr>
<tr>
<td>1000</td>
<td>600</td>
<td>136</td>
<td>245</td>
<td>Available with fast-on terminals, screw terminals (M6 and M10) and clamp terminals</td>
</tr>
</tbody>
</table>

**Delta Connection:**
- B32375* series (fast on terminal), B32376* series (screw terminal), B32377* series (clamp on terminal)

**Star Connection:** B32378* series (only in the market)
- Overpressure disconnector

### Three Phase (3P3W & 3P4W)

<table>
<thead>
<tr>
<th>Rated AC VRMS [V]</th>
<th>( C_R ) [( \mu F )]</th>
<th>Diameter [mm]</th>
<th>Height [mm]</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>3 x 5</td>
<td>50</td>
<td>163</td>
<td>Delta connection: B32375* series (fast on terminal), B32376* series (screw terminal), B32377* series (clamp on terminal)</td>
</tr>
<tr>
<td>1000</td>
<td>3 x 600</td>
<td>136</td>
<td>350</td>
<td>Star connection: B32378* series (only in the market)</td>
</tr>
</tbody>
</table>

**New Product Brief**

[Link MKD-AC Product Brief]
New series MKD AC filter capacitors

Series MKD-AC B32375*  NEW

- Delta capacitor for small AC filters
- Fast-on terminals
- $C_R$: 3 x 5 to 50 μF (Ø: 50 mm & 63.5 mm)
- **Voltage:** 250 to 600 $V_{RMS}$
- RoHS, UL approval pending

Series MKD-AC B32376*  NEW

- Delta capacitor for big AC filters
- Screw terminals (more safety connection)
- $C_R$: 3 x 15 to 400 μF (Ø: 116 mm & 136 mm)
- **Voltage:** 250 to 1000 $V_{RMS}$
- RoHS, UL approval pending
- Upon request: mechanical shock >20 g
MKD AC filter capacitors: Improved design B3237x series

- **Hermetically sealed** → no humidity can enter, no resin leakage
- **Improved internal heat dissipation** → flat copper strip outside of windings transfers the heat and in order to reduce the hot spot temperature of the winding
- **Improved safety mechanism** → no notch-wire necessary anymore (reduction of possible vibration transport damages)
- New metallization profile → **improved performance for AC filtering frequency spectrum**

**Improved safety device**

- Overpressure disconnector closed
- Overpressure disconnector activated

With increasing pressure inside the capacitor, the metal cover will bulge and both terminals disconnect from copper band

**Better thermal dissipation**

Flat copper stripe connections routed to the outside of the windings close to the aluminum can: **Better heat dissipation**
DC-link filter capacitors for industrial applications

Series
B2568* New
B2569* New
B2562*
B2563xB*
B2563xE* New

Features
● Capacity range 40 µF to 4000 µF, 500 VDC to 3000 VDC
● Low ESR <1 mΩ & low ESL <12 nH (B2563*E series, ultra low ESL design)
● Temperature range up to 85 °C hotspot
● IEC 61071, RoHS compliant and UL 810 compliant

Applications
● DC-link for renewable energy inverters, industrial drives, e-mobility, medical and traction

Benefits
● Hermetically sealed (B2568* series)
● Self-healing properties
● 85 °C/85% RH Un1000 h (B2568*/B2569* series)
● Life time 100,000 hours at hot spot temperature +75 °C
MKP DC filter capacitors product range

<table>
<thead>
<tr>
<th></th>
<th>Rated DC VR DC [V]</th>
<th>CR [µF] [tol. +/- 10%]</th>
<th>Diameter [mm]</th>
<th>Height HC [mm]</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 700            | 40                 | 85                      | 70            |               | B2562* series  
• DC-link for renewable energies, industrial drives and traction |
| ...            | ...                | ...                     | ...           | ...           |          |
| 3000           | 4000               | 116                     | 345           |               |          |
| **Low LSI ULSI HF** |       |                         |               |               |          |
| 500            | 50                 | 85                      | 50            |               | B2563* series  
• Ls <13 nH  
• DC link for e-mobility |
| ...            | ...                | ...                     | ...           | ...           |          |
| 2000           | 400                | 85                      | 65            |               |          |
| **Heavy duty** |                    |                         |               |               |          |
| 900            | 60                 | 85                      | 99            |               | B2568* series  
• Metal top, hermetically sealed  
• LS<14nH with 4T |
| ...            | ...                | ...                     | ...           | ...           |          |
| 3000           | 4000               | 136                     | 368           |               |          |
| **High PD**    |                    |                         |               |               |          |
| 700            | 45                 | 75                      | 95            |               | B2569* series  
• Resin top, high humidity resistance and partial discharge |
| ...            | ...                | ...                     | ...           | ...           |          |
| 3000           | 5500               | 136                     | 370           |               |          |

**New**

- Hermetically closed for operations in harsh environment
- Fire and smoke classification according to EN 45545
- Ultra Low ESL (4 terminals upon request)
- Customized designs (high frequency and segmented film) upon request

**B2569* series**

- Resin top with improved partial discharge capabilities
- High humidity resistance 1.3 UN, 85 °C/85%/500 hours
- Improved high Partial Discharge (PD) extinction voltage >1.6 kVac (10 pC)

© TDK Electronics AG • 2020  
PEC MKP Capacitors • Aluminum & Film Capacitors Business Group
MKP DC ultra low inductance (ULSI) series B2563*E

DC link capacitor with very low ESL and ESR for high frequency applications

Main industrial applications
DC fast charging
Solar string inverters
Induction soldering, induction heating
High speed switching applications with SiC and latest generation of IGBT

Product description
Capacitance: 20 µF to 270 µF, U: 700 V to 2 KV
For use as DC link and snubber capacitor
Tested in full SiC applications
ESL <13 nH
High current capability
Plastic case
M6 and M8 screw terminals
Customized types upon request
Suitable for a hot spot temperature of 85 °C
$T_{HS}$: 105 °C available in samples/ Series from Q1 2021
MKP DC metal top

Hermetically sealed MKP DC series with metal top disk (B2568*)

- **Range:** 900 V to 3 kV, 50 µF to 4 mF
- **Main DC link voltage for traction:** 1 kV for 1.7 kV IGBTs and 2 kV for 3.3 kV IGBTs
- **Target applications:**
  - Traction inverters
  - Commercial agricultural vehicles (CAV)
  - Medium-voltage drives (MVD)
- **Humidity:** 85 °C/85% RH 1000 hours, condensation possible
- **Fire & smoke classification acc. to EN 45545:** R22: HL3 R23,: HL2
- **Dimensions:** D85 and D116 and D136
- **Light weight** (aluminum)
- **Good cooling** (normally stacked 2 windings)
- **Ultra low ESL with 4 Terminals design** (<14nH, in some cases <10nH possible)

Standard datasheet available under: www.tdk-electronics.tdk.com/en/power_capacitors

For harsh operating conditions especially traction applications
New series MKP DC metal top capacitors for high frequency applications

- Upon request: Special types available with internal busbars in order to achieve an homogenous current distribution between the windings
- For harmonic content with high frequency

Example of an harmonic content for wind application with \(f_{sw} = 5\) kHz (switching frequency) using HF design

<table>
<thead>
<tr>
<th>(F [Hz]) where (f_{sw} = 2 – 5) kHz</th>
<th>(I [%])</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1 \times f_{sw})</td>
<td>15</td>
</tr>
<tr>
<td>(2 – 4 \times f_{sw})</td>
<td>30</td>
</tr>
<tr>
<td>(5 – 10 \times f_{sw})</td>
<td>30</td>
</tr>
<tr>
<td>(10 – 12 \times f_{sw})</td>
<td>15</td>
</tr>
<tr>
<td>(&gt;12 \times f_{sw})</td>
<td>10</td>
</tr>
</tbody>
</table>
MKP DC high frequency vs MKP DC standard

**Current Distribution MKP DC Standard**

- Operation above its resonance frequency
- Homogeneous current distribution
- Internal resonance avoidance

**Solution:** Same impedance vs frequency for all the internal capacitance elements

- Operative capacitor up to 200 kHz
- Reduced inductance

**Current Distribution MKP DC HF**

- New
MKP DC high frequency vs MKP DC standard (ESR as a function of frequency)

\[ f_r = \frac{1}{2\pi \sqrt{L_{self} \cdot C_R}} \]
## HVDC-C filter capacitors product range

<table>
<thead>
<tr>
<th>Rated AC VRMS [V]</th>
<th>$C_R$ [µF] tolerance +/- 3%</th>
<th>Diameter [mm]</th>
<th>Height [mm]</th>
<th>Others</th>
</tr>
</thead>
</table>
| 1000              | 1000                        | 85            | 190         | Custom specific designs  
                   |                             |               |             | Gas-filled with SF$_6$ |
|                   |                             |               |             | SF$_6$ free design under development |
| ...               | ...                         | ...           | ...         |        |
| 4000              | 4000                        | 116           | 371         |        |

**High peak current capability, back-to-back transmission for long-distances in HVDC**