



# Film Capacitors - Power Electronic Capacitors

Installation and maintenance instruction for capacitors

<b>Series/Type:</b>	<b>FilterCap MKD AC</b>
<b>Ordering code:</b>	<b>B3237X</b>
Date:	2018-05-07
Version:	01

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## Contents

1. Safety instructions .....	3
2. Installation.....	5
3. Maintenance .....	11
4. End of use and disposal .....	12
5. Appendix.....	13

## Figures

Figure 1: Overview of FilterCap MKD AC capacitor series .....	5
Figure 2: FilterCap Capacitors in vertical or horizontal mounting position.....	5
Figure 3: Minimum space over and between the capacitors for vertical mounting position.....	6
Figure 4: Mounting stud.....	6
Figure 5: Fixing the supply cable for B32374 / B32377 series.....	9
Figure 6: Fixing the supply cable or Bus-Bar B32371, B32372 and B32373 series .....	9
Figure 7: handling of capacitor .....	10

## Tables

Table 1: Mounting with threaded stud on the bottom of aluminum can:.....	7
Table 2: Maximum terminal currents .....	8
Table 3: Max. torque per screw .....	8
Table 4: Recommendations of multicore cable (material: copper).....	13

## 1. Safety instructions

<b>Read this first!</b>	Read the following “Installation and maintenance instructions for capacitor” carefully before installing a capacitor into your application.
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<b>About this manual</b>	The information stated in this manual applies to typical, approved usage. Please refer to our product specifications, or request our approval for your own individual specifications, before installing capacitors.
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<b>For your safety!</b>	<p>Since power capacitors are electrical energy storage devices, they must always be handled with caution. Even after being turned off for a relatively long period of time, they can still be charged with potentially lethal high voltages.</p> <p>Disregarding the guidelines in this manual can result in operational failure, bursting and fire. In case of doubt, contact your local EPCOS sales organization or distributor for assistance.</p>
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<b>General safety notes for installation and operation</b>	<ul style="list-style-type: none"> <li>■ Ensure you are using the right capacitor type for your application. Please refer to the EPCOS product catalog and application notes for proper selection of capacitors. Please contact EPCOS for any assistance required in selection.</li> <li>■ Maintain good, effective grounding of capacitor enclosures.</li> <li>■ Provide the means to isolate any faulty units/banks in the system.</li> <li>■ Handle capacitor units carefully, as they may be charged even after disconnection due to faulty discharging devices.</li> <li>■ Follow proper engineering practices.</li> <li>■ Do not use the HRC fuses to power up and down the capacitor (otherwise this could lead to the risk of electrical arcing!).</li> <li>■ Also consider terminals of capacitors, connected bus bars and cables and any other devices which are connected with them, as being energized. The device is electrically charged!</li> </ul>
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<b>Storage and operation conditions</b>	Capacitors may not be stored or operated in corrosive atmospheres, particularly not when chloride gas, sulfide gas, acid, alkali, salt or similar substances are present. In dusty and dirt-prone environments, regular maintenance and cleaning, especially of the terminals, is required to avoid a conductive path between live parts, phase to phase and/or phases to ground.
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**Ambient temperature**

FilterCap MKD AC capacitors are designed for very tough conditions: temperature class -40 to 70 °C.

Temperature of air surrounding the capacitor: max. 70 °C permanently; if the applied current is higher than its maximum specified value, please refer to the relevant current derating of datasheets.

After installation, verify that the maximum hot-spot temperature is not exceeded under extreme operating conditions: the maximum Hot-spot temperature  $T_{hs} = 85$  °C.

Temperature is one of the main stress factors for polypropylene type capacitors. Temperature has a major influence on the useful life expectancy of the capacitor.

<b>Caution!</b>	<p>Exceeding the maximum allowed temperature may cause the safety device to be inoperative, leading the capacitor burst. .</p> <p>Capacitors should not be used any longer in case of dents, mechanical or any other kind of damage!</p> <p>Existing protective devices of the capacitors may not be manipulated, removed or impaired in their function.</p>
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## 2. Installation

### Mounting the capacitors



Figure 1: Overview of FilterCap MKD AC capacitor series

### Mounting positions

Capacitors installed in a cabinet should be placed on the bottom to ensure the lowest stress temperature possible.

### Warning!

Do not install the capacitor in case of dents deeper than 0.5 mm!

FilterCap MKD AC capacitors are designed to be mounted usually with terminals upright. For horizontal position or other mounting positions please contact TDK for guidance.

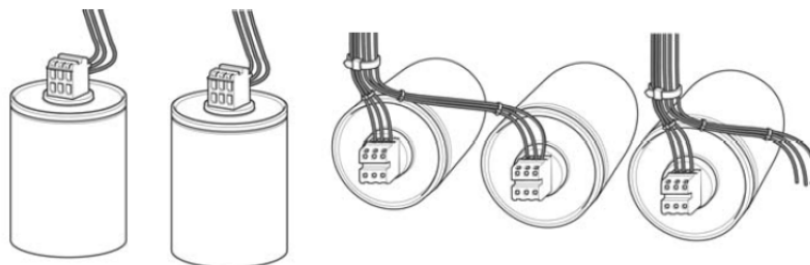


Figure 2: FilterCap Capacitors in vertical or horizontal mounting position.

**Mounting conditions**

FilterCap MKD AC capacitors must be installed in a cool and well ventilated place, and not close to objects that radiate heat, or in the direct sunlight.

Within high-power inverter systems the capacitors usually produce the smallest portion of the total losses, and the permissible operating temperatures are low compared to power semiconductors, reactors and resistors. So, the distance between capacitor and heating sources must be large enough to avoid the capacitor overheating. In case of space constraint to make the best possible use of capacitors, technically and economically, it is advisable to supply forced cooling air.

**Cooling space for capacitors**

Make sure that sufficient cooling space is provided (see Figure 3):

- A minimum distance of 20 mm between the capacitors is necessary to maintain sufficient cooling.
- Keep at least 20 mm space above the capacitor and do not attach any mounting components at the crimp or on top. This gap will allow a longitudinal extension of the can in order to ensure that the over-pressure safety device disconnecter can fully extend.

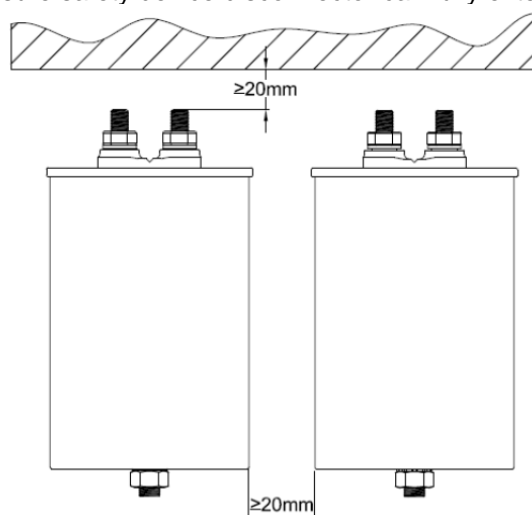


Figure 3: Minimum space over and between the capacitors for vertical mounting position.

**Mounting with threaded stud**

The threaded mounting stud is at the bottom of aluminum can of capacitor:

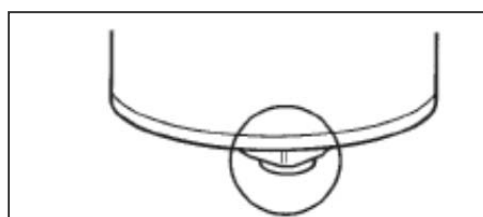


Figure 4: Mounting stud

The threaded stud on the bottom of aluminum can with a diameter less than  $\leq 63.5$  mm and a height less than  $\leq 160$  mm may be used if vibration stress does not exceed 5 g. For larger dimensions and vibration of  $> 5$  g, the capacitors should be mounted by clamps, rings, etc.

Table 1: Mounting with threaded stud on the bottom of aluminum can:

**Maximum torque**

Threaded stud	Mounting hole	Maximum torque
M12	14 mm	10 Nm

**Grounding**

The bottom stud is used for grounding. Connect it to the ground by cable, or connect the capacitor to any other conductive item which is connected to the ground.

**Note!**

Suitable connectors have to penetrate existing layers of lacquer to ensure good, constant conductivity and sufficient current carrying capabilities. If grounding is done via the metal chassis the capacitor is mounted to, then the layer of varnish beneath the washer and nut should be removed.

**Connecting**

When connecting, avoid bending cable lugs or cables, or the use of other forms of mechanical force on the terminals. Otherwise, leakage could disable the safety device!

Ensure firm fixing of terminals, fixing torque to be applied as per individual specification.

In any case, the maximum specified terminal current may not be exceeded. Please refer to the technical data of the specific series.

Parallel connection of capacitors via the terminal is not recommended.

**Connecting the supply cable**
**Cable specification**

The connection cable must be of flexible type for three phase capacitor, material should be preferably copper. For single phase capacitors, can be flexible cable or Bus-Bar, in case of using Bus-Bar for connection, it is necessary to confirm whether safety device can be operated.

**Note!**
**Do not use solid core cables!**

- Maximum cable cross section for FilterCap MKD AC series can be found in the appendix.

The connection cables to the capacitor should be dimensioned for a current of at least 1.5 times the rated current so that no heat is conducted into the capacitor.

**Maximum terminal currents**

- Do not exceed the maximum allowable current, as following:

Table 2: Maximum terminal currents

Type of capacitor	Maximum terminal Current
B32370-fast on	15 A
B32371-M6	30 A
B32373-M10	60 A
B32374-Screw clamp M5	50 A
B32377 type A- Screw clamp M5	50 A
B32377 type B- Screw clamp M5	80 A
B32377 type C- Screw clamp M6	100 A

**Attaching the supply cable**

Attach the supply cable on capacitor terminals only with the maximum permissible torque, as follow:

Table 3: Max. torque per screw

Position – Screw	Maximum Torque
Screw clamp terminal M5	2 Nm
Screw clamp terminal M6	3.5 Nm
Terminal – M6	4 Nm
Terminal – M10	10 Nm



**Screw driver**

Use an appropriate PZ2 screwdriver for the Pozidriv PZ2 screws at the terminals. Shown as follow:

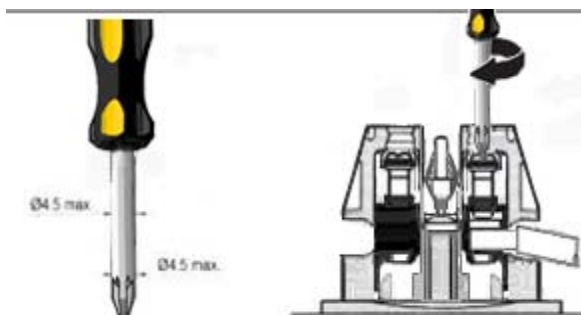


Figure 5: Fixing the supply cable for B32374 / B32377 series

Use an appropriate wrench for the screws at the terminals. It would be better to use a torque wrench for higher precision. Shown as follow:



Figure 6: Fixing the supply cable or Bus-Bar B32371 and B32373 series

<p><b>Caution!</b></p>	<p><b>Discharge and short circuit the capacitor before handling!</b>                  When handling the capacitor, do not take the capacitor from the terminal. This can cause accident in case the capacitor is charged, terminal break, leakage and capacitance loss due to capacitor is heavy. Shown as follow:</p>
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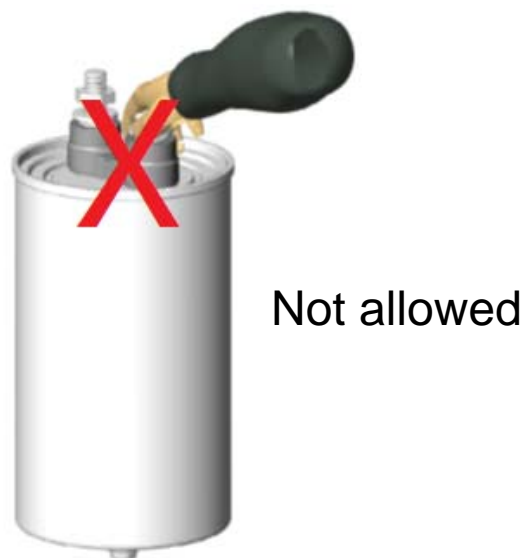


Figure 7: Handling of capacitor

**Overpressure disconnecter**

Electrical components do not have unlimited life expectancies; this also applies to self-healing capacitors. As polypropylene-type capacitors seldom produce a pronounced short circuit, HRC fuses or circuit breakers alone do not offer sufficient protection.

All capacitors of the FilterCap series are consequently fitted with a disconnecter that responds to overpressure. If numerous electric breakdowns occur at the end of life or as the result of thermal or electric overload (within IEC 61071 specification), the formation of gas increases the pressure inside the capacitor case, each is hermetically sealed.

This causes the expansion of capacitor lid (metal top cover) that beyond a certain limit; the capacitor internal connections (tear-off fuses) will be separated and disconnected from the capacitor power line. Once the safety device has operated, the capacitor will remain switched off.

<p><b>Caution!</b></p>	<p>To ensure full functionality of an overpressure disconnecter, observe the following requirements:</p> <ol style="list-style-type: none"> <li>1) The elastic metal top cover must not be impaired:             <ul style="list-style-type: none"> <li>– The connecting lines must be flexible leads (cables).</li> <li>– There must be sufficient space for expansion above the connections (stated for the different models).</li> </ul> </li> <li>2) The maximum allowed fault current of 10000 A to the UL 810-standard must not be exceeded.</li> <li>3) Stress parameters of the capacitor must be within the IEC 61071 specification.</li> </ol>
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**Note!**

The capacitor protective safety device can interrupt the voltage only within the capacitor. They are not fuses in the classical sense such as cable or device fuses which interrupt the voltage upstream from the faulty system component.

### 3. Maintenance

<b>Caution!</b>	<p>Disregarding the following measures may result in severe operation failures, bursting and fire:</p> <ul style="list-style-type: none"> <li>■ Check tightness of the connections/terminals periodically, two weeks after installation at the latest, and then once every 6 months.</li> <li>■ Clean the terminals/bushings periodically to avoid short circuits due dust or other contamination.</li> <li>■ Check the short circuit protection fuses.</li> <li>■ Take current reading twice a year and compare with nominal current. Use a harmonic analyzer or true effective RMS-meter.</li> <li>■ In case of a current above the nominal current check your application for modification.</li> <li>■ Check the temperature of energized capacitors. In case of excessive temperature of individual capacitors, it is recommended to replace this capacitor, as this could be an indication for loss factor increase which is a sign for reaching end of life.</li> <li>■ When power capacitors are used, suitable measures must always be taken to eliminate possible danger to humans, animals and property both during operation and when a failure occurs. This applies to capacitors both with and without protective devices. Regular inspection and maintenance by a competent person is therefore essential.</li> </ul>
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**Note!**

For detailed information about FilterCap capacitors and cautions, refer to the latest version of EPCOS FilterCap MKD AC datasheet.

Please note again that the "Installation and maintenance instructions for capacitor" applies to typical specifications. Refer to our product specifications, or request our approval for your specification before installing a capacitor.

## 4. End of use and disposal

The materials used in FilterCap MKD AC capacitors do not exceed the limits for chemical substances specified in the following national regulations:

- Chemicals prohibition regulation,
- CFC halogen prohibition regulation.
- RoHS Directive 2011/65/EU

Our FilterCap MKD capacitors contain no means of impregnation with PCB. The MKD series is filled with Soft Polyurethane Resin (Vegetable Castor Oil base resin). For further details of material used, refer the MSD (Material Data Sheet) of capacitor.

Capacitors without PCB for power electronics are not explicitly mentioned in the waste qualification regulations. From this it could be deduced that they do not have to be disposed of as “waste requiring special supervision”.

Because of our special commitment to and responsibility for the environment, we ask you to take every care when disposing of capacitors and to observe the relevant local regulations. We recommend that you drain the resin of capacitor and send it to an oil refuse depot. The emptied capacitor can then be disposed as grease and oil soiled item of apparatus.

In any case it is advisable to consult a waste disposal facility and to find out about the applicable regulations in force.

## 5. Appendix

**Connection cable cross section** Listed below are recommendations from VDE 0100 part 523 and 430, group 2 for cable cross sections for power capacitors.

**VDE 0100 part 523 and 430, group 2**

VDE 0100 Recommendations: Cross-section values mentioned below are guideline values valid for operation under normal conditions and at an ambient temperature of 40°C. Higher values should be selected if conditions differ from the norm, such as higher temperatures or high frequencies.

Table 4: Recommendations of multicore cable (material: copper)

Rated current (A)	Cable cross section (mm <sup>2</sup> )
12	0.75
15	1
18	1.5
26	2.5
34	4
44	6
61	10
82	16
108	25
135	35

The internal wiring of a capacitor bank can be normally done with a lower cross section. Various parameters such as temperature inside cabinet, quality of cable, maximum cable isolation temperature, single or multicore cable and length of cable have to be taken into consideration when selecting the appropriate value.

**Note:**

For detailed information about FilterCap capacitors and cautions, refer to the latest version of the EPCOS FilterCap MKD AC Datasheet.

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Release 2018-06