



## Film Capacitors – Power Factor Correction

PFC DeltaCap X Black premium capacitors

|                       |                         |
|-----------------------|-------------------------|
| <b>Series/Type:</b>   | <b>MKD525-D- 25.0-X</b> |
| <b>Ordering code:</b> | <b>B32305A5252B025</b>  |
| <b>Date:</b>          | <b>02-12-2018</b>       |
| <b>Version:</b>       | <b>1</b>                |

## Preliminary data

### Construction

- Dielectric: Polypropylene film
- Non-PCB, biodegradable soft resin
- Stacked winding
- Extruded round black painted aluminum can with stud
- Provided with integrated discharge resistors

### Features

- Three-phase, internal delta connection
- Double safety system:
  - overpressure disconnecter,
  - self-healing technology
- Naturally air cooled (or forced air cooling)
- Indoor mounting

### Typical applications

- For Power Factor Correction

### Terminals

- Screw clamps terminals M6
- Max. torque: 3.5 Nm

### Mounting

- Threaded stud at bottom of can  
(max. torque for M12 = 10 Nm)



## Technical data and specifications

| Characteristics         |                |           |
|-------------------------|----------------|-----------|
| Rated capacitance $C_R$ | 3 • 96 $\mu$ F |           |
| Tolerance               | -5 / +5%       |           |
| Connection              | D (Delta)      |           |
| Rated voltage $V_R$     | 525 V AC       |           |
| Rated frequency $f_R$   | 50 Hz          | 60 Hz     |
| Output                  | 25.0 kvar      | 30.0 kvar |
| Rated current $I_R$     | 27.5 A         | 33 A      |

**Preliminary data**

| <b>Maximum ratings</b> |                                                                                                                                          |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{\max}$             | $V_R + 10\%$ (up to 8 h daily) / $V_R + 15\%$ (up to 30 min daily) / $V_R + 20\%$ (up to 5 min daily) / $V_R + 30\%$ (up to 1 min daily) |
| $I_{\max}$             | Up to $1.5 \cdot I_R$ (A) (including combined effects of harmonics, over voltages and capacitance tolerance)                             |
| $I_S$                  | Up to $500 \cdot I_R$ (A) Detail refer to capacitor operation condition below                                                            |

| <b>Capacitor operation condition</b> |                           |                                        |
|--------------------------------------|---------------------------|----------------------------------------|
| $I_S$                                | Switching operation/ year | Total switching operation of capacitor |
| $500 I_R$                            | 1000                      | 35 000                                 |
| $400 I_R$                            | 6200                      | 211 000                                |
| $300 I_R$                            | 62 000                    | 2 100 000                              |

|                                                 |                                                              |
|-------------------------------------------------|--------------------------------------------------------------|
| Power dissipation (without discharge resistors) | $\leq 0.2$ W/kvar (dielectric) and $\leq 0.5$ W/kvar (total) |
|-------------------------------------------------|--------------------------------------------------------------|

| <b>Test data</b>                        |                          |                              |
|-----------------------------------------|--------------------------|------------------------------|
| $V_{TT}$                                | $2.15 \cdot V_R$ , 2 s   | With tolerance $\pm 50$ V AC |
| $V_{TC}$                                | 3000 V AC, 10 s          |                              |
| * $\tan \delta$ (50 Hz at rate voltage) | $\leq 0.7 \cdot 10^{-3}$ |                              |
| * $\tan \delta$ at 1KHZ                 | $\leq 5.0 \cdot 10^{-3}$ |                              |

\* Without discharge resistor

| <b>Climatic category –40/D</b> |                                       |
|--------------------------------|---------------------------------------|
| $T_{\min}$                     | –40 °C                                |
| $T_{\max}$                     | +65 °C                                |
| $T_{\max \text{ Hotspot}}$     | +85 °C                                |
| Storage temperature            | –40 °C ... +85 °C                     |
| Humidity                       | Av. rel. < 95%                        |
| Maximum altitude               | 4000 m Detail refer to derating chart |

| <b>Mean life expectancy</b>                                    |
|----------------------------------------------------------------|
| Up to 300 000 hours at temperature class -40/55 <sup>(1)</sup> |
| Up to 200 000 hours at temperature class -40/60 <sup>(1)</sup> |
| Up to 100 000 hours at temperature class -40/65 <sup>(1)</sup> |

**Preliminary data**

| Temperature class <sup>(1)</sup> | Ambient temperature |                                 |        |
|----------------------------------|---------------------|---------------------------------|--------|
|                                  | Maximum             | Highest mean over any period of |        |
|                                  |                     | 24h                             | 1 year |
| -40/55                           | 55 °C               | 45 °C                           | 35 °C  |
| -40/60                           | 60 °C               | 50 °C                           | 40 °C  |
| -40/65                           | 65 °C               | 55 °C                           | 45 °C  |

**Design data**

|                           |                                                                                                                                  |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Dimensions (d × h)        | 136 × 230 mm                                                                                                                     |
| Weight approx             | 3.9 kg                                                                                                                           |
| Impregnation              | Non PCB, resin filling: soft polyurethane resin                                                                                  |
| Fixing                    | Threaded bolt M12                                                                                                                |
| Max. torque (Al can stud) | 10 Nm                                                                                                                            |
| Mounting position         | Preferably in vertical position, horizontal position possible.<br>See "Maintenance and Installation Manual" for further details. |

**Terminals**

|                          |                    |
|--------------------------|--------------------|
| Protection degree        | IP20               |
| Terminal cross section   | 35 mm <sup>2</sup> |
| Maximum terminal current | 100 A              |
| Creepage distance (min)  | 19.1 mm            |
| Clearance distance (min) | 19.1 mm            |

**Safety**

|                            |                                                        |
|----------------------------|--------------------------------------------------------|
| Mechanical safety          | Overpressure disconnecter                              |
| Max. short circuit current | (AFC: 10 kA according UL 810 standard) UL file E489229 |
| Discharge resistor time    | ≤ 60 s to 75 V or less                                 |

**Reference standards**

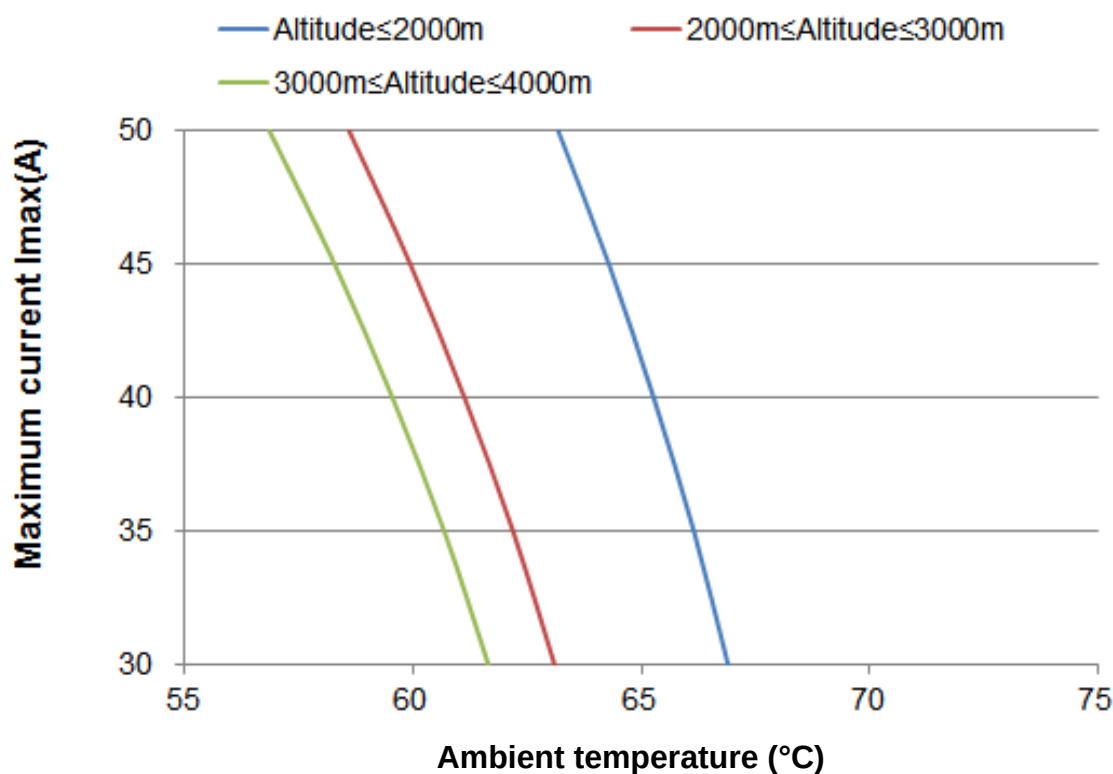
IEC 60831–1/2(2014) and UL 810 5<sup>th</sup> edition

Preliminary data

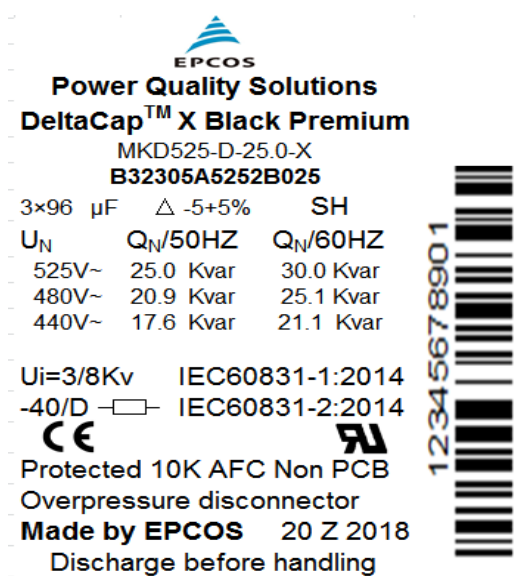
### Current derating curve

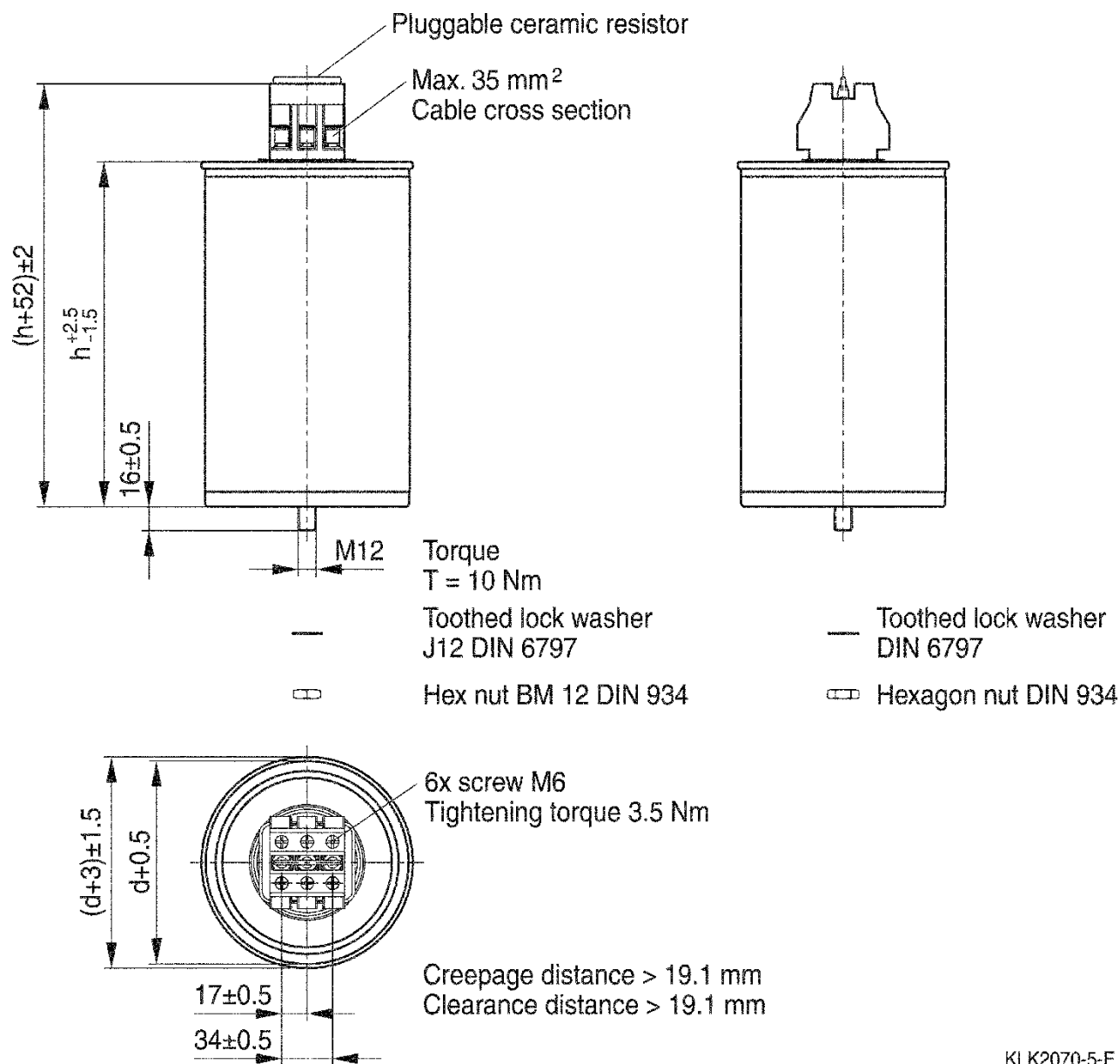
Current derating according maximum altitudes

$\Theta_{hs}=85^{\circ}\text{C}$  / Natural convection



### Label design



**Preliminary data**
**Dimensional drawings B32305A series**

**Specification table**

| Type                                               | 50 Hz       |                  | 60 Hz       |                  | C <sub>R</sub> | D × H     | Weight | Ordering code   | Packing unit pcs |
|----------------------------------------------------|-------------|------------------|-------------|------------------|----------------|-----------|--------|-----------------|------------------|
|                                                    | Output kvar | I <sub>R</sub> A | Output kvar | I <sub>R</sub> A | μF             | mm        | kg     |                 |                  |
| Rated voltage 525 V AC, 50/60 Hz, delta connection |             |                  |             |                  |                |           |        |                 |                  |
| MKD525-D-25.0-X                                    | 25.0        | 27.5             | 30          | 33               | 3 x 96         | 136 x 230 | 3.9    | B32305A5252B025 | 4                |

## Preliminary data

### Cautions and warnings

- In case of dents of more than 1 mm depth or any other mechanical damage, capacitors must not be used at all.
- This applies also in cases of oil leakages.
- To ensure the full functionality of the overpressure disconnecter, elastic elements must not be hindered and a minimum space of 12 mm has to be kept above each capacitor.
- Do not handle the capacitor before it is discharged.
- Resonance cases must be avoided by appropriate application design in any case.
- 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.

### Discharging

Capacitors must be discharged to a maximum of 10% of rated voltage before they are switched in again. This prevents an electric impulse discharge in the application, influences the capacitor's service life and protects against electric shock. The capacitor must be discharged to 75 V or less within 3 minutes. There must be not any switch, fuse or any other disconnecting device in the circuit between the power capacitor and the discharging device. DeltaCap capacitors are delivered with discharge resistor included; alternatively discharge reactors are available from TDK. Discharge and short circuit capacitor before handling!

### Service life expectancy

Electrical components do not have an unlimited service life expectancy; this applies to self-healing capacitors too. The maximum service life expectancy may vary depending on the application the capacitor is used in.

### Safety

Electrical or mechanical misapplication of capacitors may be hazardous. Personal injury or property damage may result from bursting of the capacitor or from expulsion of oil or melted material due to mechanical disruption of the capacitor.

- Ensure good, effective grounding for capacitor enclosures.
- Provide means of disconnecting and insulating a faulty component/bank.
- The terminals of capacitors, connected bus bars and cables as well as other devices may also be energized.
- Follow good engineering practice.

### Thermal load/over-temperature

After installation of the capacitor it is necessary to verify that maximum hot-spot temperature is not exceeded at extreme service conditions.

### Preliminary data

#### Overpressure disconnecter

To ensure full functionality of an overpressure disconnecter, the following must be observed:

1. The elastic elements must not be hindered, i.e.
  - Connecting lines must be flexible leads (cables).
  - There must be sufficient space (min. 12 mm) for expansion above the connections. This will enable a longitudinal extension of the can to secure the overpressure disconnecter work.
  - Folding beads must not be retained by clamps.
2. The maximum allowed fault current of 10000 A in accordance with UL 810 standard must be assured by the application.
3. Stress parameters of the capacitor must be within the IEC60831 specification.

#### Overcurrent and short circuit protection

- Use HRC fuses or MCCBs for short circuit protection. Short circuit protection and connecting cables should be selected so that 1.5 times the rated capacitor current can be permanently handled.
- HRC fuses do not protect a capacitor against overload – they are only for short circuit protection.
- The HRC fuse rating should be 1.6 to 1.8 times rated capacitor current.
- Do not use HRC fuses to switch capacitors (risk of arcing).
- Use thermal magnetic over current relays for overload protection.

#### Resonance cases

Resonance cases must be avoided by appropriate application design in any case. Maximum total RMS capacitor current (incl. fundamental harmonic current) specified in technical data must not be exceeded.

#### Re-switching vs. phase-opposition

In case of voltage interruption, a sufficient discharge time has to be ensured to avoid phase-opposition and resulting high inrush currents.

#### Vibration resistance

The resistance to vibration of capacitors corresponds to IEC 68, part 2–6.

Max. test conditions:

|                        |               |
|------------------------|---------------|
| Test duration          | 6 h*          |
| Frequency range 1      | 10 ... 55 Hz* |
| Displacement amplitude | 0.75 mm*      |

\*corresponding to max. 98.1 m/s or 10 g



### Preliminary data

These figures apply to the capacitor alone. Because the fixing and the terminals may influence the vibration properties, it is necessary to check stability when a capacitor is built in and exposed to vibration. Irrespective of this, you are advised not to locate capacitors where vibration amplitude reaches the maximum in strongly vibrating equipment.

### Mechanical protection

The capacitor has to be installed in a way that mechanical damages and dents in the aluminium can are avoided.

### Grounding

The threaded bottom stud of the capacitor has to be used for grounding. In case grounding is done via metal chassis that the capacitor is mounted to, the layer of varnish beneath the washer and nut should be removed. The maximum tightening torque is 12 Nm.

### Maintenance

- Check tightness of the connections/terminals periodically.
- Take current reading twice a year and compare with nominal current. Use a harmonic analyser or true effective RMS-meter.
- In case of current above the nominal current check your application for modifications.
- If a significant increase in the amount of non-linear loads has been detected, then a consultant has to be called in for a harmonic study.
- In case of the presence of harmonics installation of a de-tuned capacitor bank (reactors) must be considered.
- Check the discharge resistors/reactors and in case of doubt, check their function:
  - (1) Power the capacitor up and down.
  - (2) After  $\leq 60$  seconds the voltage between the terminals must decline to less than 75 V.
- Check the temperature of capacitors directly after operation for a longer period, but make sure that the capacitors have been switched off. In case of excessive temperature of individual capacitors, it is recommended to replace these capacitors, as this should be an indication for loss factor increase, which is a sign for reaching end of life.

### Storage and operating conditions

Do not use or store capacitors in corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. In dusty environments regular maintenance and cleaning especially of the terminals is required to avoid conductive path between phases and/or phases and ground.

### Note

For detailed information about PFC capacitors and cautions, refer to the latest version of the PFC Product Profile.

## Preliminary data

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## Important notes

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