



## Film Capacitors – Power Factor Correction

PhiCap capacitors

**Series/Type:** B32344E-series  
**Ordering code:** B32344ExxxxAxxx  
**Date:** October 2011  
**Version:** 1

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### Construction

- Dielectric: Polypropylene film
- Non PCB, semi-dry biodegradable resin
- Extruded round aluminum can with stud
- Provided with ceramic discharge module
- Dual safety system

### Features

- Three-phase, delta connected
- Self-healing technology
- Naturally air cooled (or forced air cooling)
- Indoor mounting

file # E106388

C22.2 N°190 MC # 236094

GOST  
AMS0

### Typical applications

- For Power Factor Correction

### Terminals

- Optimized capacitor safety terminals

### Mounting

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



### Technical data and specifications

Characteristics	
Rated capacitance $C_R$	According to specification table
Tolerance	-5 / +10%
Connection	D (Delta)
Rated voltage $V_R$	According to specification table
Rated frequency $f_R$	50 Hz and 60 Hz
Output	According to specification table
Rated current $I_R$	According to specification table
$\tan \delta_0$ (dielectric)	0.2 W / kvar

**Maximum ratings (according to IEC 60831)**

Maximum permissible voltage $V_{\max}$	$V_R + 10\%$ (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)
Maximum permissible current $I_{\max}$	Up to $1.5 \cdot I_R$ (A) including combined effects of harmonics, overvoltages and capacitance tolerance
$I_S$	$200 \cdot I_R$ (A)

**Test data (according to IEC 60831)**

AC test voltage terminal to terminal	$2.15 \cdot V_R$ , 2 s
Insulation voltage between terminals and container	3000 V AC, 10 s
* $\tan \delta$ (50 Hz)	$\leq 0.45$ W / kvar

\* Without discharge resistor

**Design data**

Dimensions (d x h)	According to specification table
Weight approx	According to specification table
Impregnation	Non PCB, Semi-dry biodegradable resin
Fixing	Threaded bolt M12
Max. torque (Al can stud)	10 Nm
Mounting position	Upright See "Maintenance and Installation Manual" for further details.

**Climatic category –40/D**

$\ominus$ min	–40 °C
$\ominus$ max	+55 °C
Storage temperature	–40 °C...+85 °C
$\Theta_{\text{hotspot}}$ Max.	+70 °C
Humidity	av. rel. < 95%
Degree of protection	IP 20
Maximum altitude	4000 m

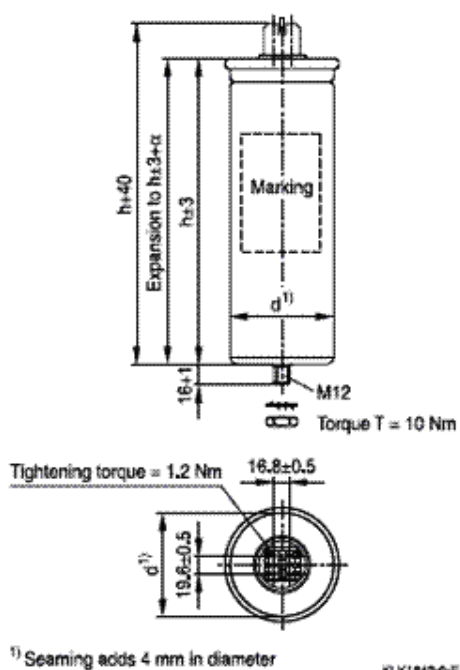
**Mean life expectancy**

$t_{LD}$	Up to 135 000 hours (temperature class –40/C) ; $\Theta_{HS} \leq +70^\circ\text{C}$ Up to 100 000 hours (temperature class –40/D) ; $\Theta_{HS} \leq +70^\circ\text{C}$
Max. 5000 switching per year	

<b>Terminals</b>	
Protection degree	Isolated terminals, IP20
Max. torque	1.2 Nm
Terminal cross section	16 mm <sup>2</sup>
Maximum terminal current	50 A
Creepage distance (min)	12.7 mm
Clearance (min)	9.6 mm

<b>Safety</b>	
Mechanical safety	Overpressure disconnecter
Max. short circuit current	(AFC: 10 kA)
Discharge resistor time	≤ 60 s to 50 V or less

<b>Reference standards</b>	
IEC 60831–1/2, UL 810-5th edition	

**Dimensional drawing**

**Label design**

**EPCOS**  
 Power Quality Solutions  
 PhiCap™  
**MKP600-D-20.8**  
 B32344E6251A000  
 3 x 61.5 μF    Δ - 5 + 10%    SH  

$U_N$	$Q_N / 50\text{Hz}$	$Q_N / 60\text{Hz}$
600 V~	20,8 kvar	25,0 kvar
525 V~	15,9 kvar	19,1 kvar
480 V~	13,2 kvar	15,9 kvar

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 **$U_i = 3/- \text{ Kv} - 40 / + 55^\circ \text{C}$  IEC 60831**  
 C22.2 N° 190    MC#236094    Non Flamable Fluid    55°C  
 "DESCHARGE AVANT DE TOUCHER"  
 AUX PIECES SOUS TENSION"  
 Overpressure Disconnecter    Non PCB  
 Protected File E106388    10K AFC  
  
 Made by EPCOS  
**DISCHARGE CAPACITOR BEFORE HANDLING**

**Three phase capacitors**
**Rated voltage 220 V, 50/60 Hz, delta connection**

Type	Ordering code	50 Hz		60 Hz		C <sub>R</sub> μF	Dimensions d x h mm	Weight kg
		Output kvar	I <sub>R</sub> A	Output kvar	I <sub>R</sub> A			
MKP220-D-1.7	B32344E2021A020	1.7	4.5	2.0	5.2	3 • 37	79.5 x 138	0.4
MKP220-D-2.1	B32344E2021A520	2.1	5.5	2.5	6.6	3 • 46	79.5 x 138	0.4
MKP220-D-4.2	B32344E2051A020	4.2	11.0	5.0	13.1	3 • 91	79.5 x 198	0.6
MKP220-D-6.3	B32344E2071A520	6.3	16.5	7.5	19.7	3 • 137	89.5 x 198	0.8
MKP220-D-8.3	B32344E2101A020	8.3	21.8	10.0	26.2	3 • 183	89.5 x 273	1.2
MKP220-D-10.4	B32344E2121A520	10.4	27.3	12.5	32.8	3 • 229	89.5 x 273	1.5
MKP220-D-12.5	B32344E2151A020	12.5	32.8	15.0	39.4	3 • 274	89.5 x 348	1.5

**Rated voltage 240 V, 50/60 Hz, delta connection**

MKP240-D-2.1	B32344E2021A540	2.1	5.1	2.5	6.0	3 • 38	79.5 x 138	0.4
MKP240-D-2.5	B32344E2031A040	2.5	6.0	3.0	7.2	3 • 46	79.5 x 138	0.4
MKP240-D-4.2	B32344E2051A040	4.2	10.1	5.0	12.0	3 • 77	79.5 x 160	0.6
MKP240-D-6.3	B32344E2071A540	6.3	15.2	7.5	18.0	3 • 115	79.5 x 198	0.6
MKP240-D-6.9	B32344E2081A340	6.9	16.6	8.3	20.0	3 • 128	89.5 x 198	1.5
MKP240-D-8.3	B32344E2101A040	8.3	20.0	10.0	24.1	3 • 154	89.5 x 198	0.9
MKP240-D-10.4	B32344E2121A540	10.4	25.0	12.5	30.1	3 • 192	89.5 x 273	1.2
MKP240-D-12.5	B32344E2151A040	12.5	30.1	15.0	36.0	3 • 230	89.5 x 273	1.2
MKP240-D-13.9	B32344E2161A740	13.9	33.4	16.7	40.2	3 • 256	89.5 x 348	1.2

**Rated voltage 380 V, 50/60 Hz, delta connection**

MKP380-D-6.2	B32344E3071A580	6.2	9.4	7.5	11.4	3 • 46	79.5 x 160	0.5
MKP380-D-8.3	B32344E3101A080	8.3	12.6	10.0	15.2	3 • 61	79.5 x 160	0.5
MKP380-D-10.4	B32344E3121A580	10.4	15.8	12.5	19.0	3 • 77	79.5 x 198	0.6
MKP380-D-12.5	B32344E3151A080	12.5	19.0	15.0	22.8	3 • 92	89.5 x 198	0.8
MKP380-D-16.7	B32344E3201A080	16.7	25.4	20.0	30.4	3 • 123	89.5 x 273	1.2
MKP380-D-20.8	B32344E3251A080	20.8	31.6	25.0	38.0	3 • 153	89.5 x 273	1.2

Type	Ordering code	50 Hz		60 Hz		C <sub>R</sub> μF	Dimensions d x h mm	Weight kg
		Output kvar	I <sub>R</sub> A	Output kvar	I <sub>R</sub> A			
<b>Rated voltage 600 V, 50/60 Hz, delta connection</b>								
MKP600-D-4.2	B32344E6051A000	4.2	4.0	5.0	4.8	3 • 12	79.5 x 198	0.5
MKP600-D-5.3	B32344E6061A300	5.3	5.1	6.3	6.1	3 • 16	79.5 x 198	0.5
MKP600-D-6.2	B32344E6071A500	6.2	6.0	7.5	7.2	3 • 18	79.5 x 198	0.5
MKP600-D-6.9	B32344E6081A300	6.9	6.6	8.3	8.0	3 • 20	79.5 x 198	0.6
MKP600-D-8.3	B32344E6101A000	8.3	8.0	10.0	9.6	3 • 25	79.5 x 198	0.6
MKP600-D-10.5	B32344E6121A500	10.4	10.0	12.5	12.0	3 • 31	89.5 x 198	0.8
MKP600-D-12.5	B32344E6151A000	12.5	12.0	15.0	14.4	3 • 37	89.5 x 273	0.8
MKP600-D-13.9	B32344E6161A700	13.9	13.4	16.7	16.1	3 • 41	89.5 x 273	1.2
MKP600-D-14.6	B32344E6171A500	14.6	14.0	17.5	16.8	3 • 43	89.5 x 273	1.2
MKP600-D-16.7	B32344E6201A000	16.7	16.1	20.0	19.2	3 • 49	89.5 x 273	1.5
MKP600-D-20.8	B32344E6251A000	20.8	20.0	25.0	24.1	3 x 61	89.5 x 348	1.5
<b>Rated voltage 660 V, 50/60 Hz, delta connection</b>								
MKP660-D-4.2	B32344E6051A060	4.2	3.7	5.0	4.4	3 • 10	79.5 x 198	0.3
MKP660-D-6.2	B32344E6071A560	6.2	5.4	7.5	6.6	3 • 15	79.5 x 198	0.3
MKP660-D-6.9	B32344E6081A360	6.9	6.0	8.3	7.3	3 • 17	89.5 x 198	0.5
MKP660-D-8.3	B32344E6101A060	8.3	7.3	10.0	8.7	3 • 20	89.5 x 198	0.6
MKP660-D-10.4	B32344E6121A560	10.4	9.1	12.5	10.9	3 • 25	89.5 x 273	0.8
MKP660-D-12.5	B32344E6151A060	12.5	10.9	15.0	13.1	3 • 31	89.5 x 273	1.1
MKP660-D-13.9	B32344E6161A760	13.9	12.2	16.7	14.6	3 • 34	89.5 x 273	1.2
MKP660-D-14.6	B32344E6171A560	14.6	12.8	17.5	15.3	3 • 36	89.5 x 348	1.5
MKP660-D-20.0	B32344E6201A060	20.0	14.6	25.0	17.5	3 • 41	89.5 x 348	1.5

### 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. PhiCap-capacitors E-series have a pre-mounted ceramic discharge module inserted from above into the middle section of the terminal; alternatively discharge reactors are available from EPCOS. 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.

### 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



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 aluminum can be 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 10 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  $\leq 90$  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 EPCOS PFC Product Profile.

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