Film capacitors – Power Factor Correction

PhiCap capacitors

Series/Type: **B32343C / MKPxxx-D**
Ordering code: **B32343C****A*****

Date: March 2009
Version: 2

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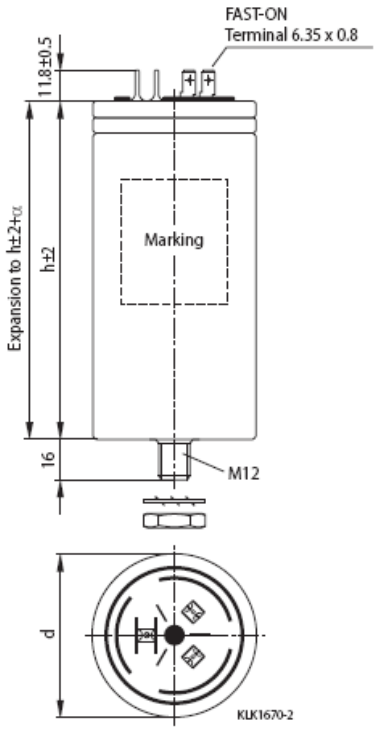
Construction

- Dielectric: metallized polypropylene film
- Semi-dry; biodegradable soft resin; non-PCB
- Case: extruded round aluminum can with stud
- Mounting and grounding: threaded stud on bottom of can
  M 8 (4 Nm/ Ø 53mm), M 12 (10 Nm/ Ø 63.5mm)
- Degree of protection: IP20 (optionally IP54 with terminal cover)
- Terminals: Fast on terminals

Dimensional drawing



Features

- Three-phase, delta-connected provided with discharge resistors
- Dual safety system: overpressure disconnector, self-healing technology
- c UL us file # E106388
- CSA C22.2 N°190 MC # 236094
- Naturally air cooled (or forced air cooling)
- Indoor mounting

Characteristics

Rated capacitance C_R and Q_R	According to specification table
Tolerance	–5/+10%
Connection	D (Delta)
Rated voltage V_R	According to specification table
Rated frequency f_R	50/60 Hz

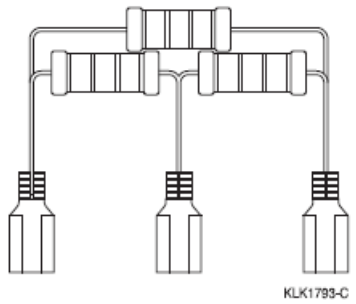
Technical data and specifications	
Maximum ratings (accord. to IEC 60831)	
Maximum permissible voltage V_{max}	V_R +10% (up to 8 h daily) V_R +15% (up to 30 min daily) V_R +20% (up to 5 min daily) V_R +30% (up to 1 min daily)
Maximum permissible current I_{max}	Up to 1.3 · I_R (up to 1.5 · I_R incl. combined effects of harmonics, over voltages and capacitance)
Maximum transient inrush current	Up to 200 · I_R
Power dissipation (dielectric)	< 0.2 W/kvar
Power dissipation (excluding discharge resistors)	< 0.45 W/kvar
Test data (accord. To IEC 60831)	
AC test voltage terminal-to-terminal	2.15 · V_R, 2 s
Insulation voltage between terminals and container	3000 V AC, 10 s
Dissipation factor tan δ at 100 Hz	$\leq 1.0 \cdot 10^{-3}$
Climatic category / -25/D (to IEC 60831)	
Ambient temperature	Max. temp.= 55 °C Max. mean 24 h = 45 °C Max. mean 1 year = 35 °C Lowest temperature = –25 °C
Maximum permissible humidity	Average relative < 95%
Maximum permissible altitude	4000 m
Mean life expectancy	
t_{LD}	Up to 100 000 operating hours
Max. 5 000 switching operations according to IEC 60831	

Design data	
Dimensions (d × l)	According to specification table
Weight approx.	According to specification table
Filling	Biodegradable soft resin
Fixing	Threaded bolt M12
Max. torque (Al can stud)	10 Nm (for Ø 63.5 mm)
Mounting position	Upright. See “Installation and maintenance instructions for PFC capacitors” for further details.
Terminals	
Degree of protection	IP20, option IP54 with plastic terminal cap; additional cable gland at cable entry required.
Creepage distance	10.5 mm (Ø 53); 10.0 mm (Ø 63.5)
Clearance	13.0 mm (Ø 53); 16.5 mm (Ø 63.5) (to UL 810)
Safety	
Mechanical safety	Tear off fuses overpressure disconnector
Max. short circuit current	(AFC: 10 kA) (to UL 810)
Discharge resistor time	≤ 1 min (75 V) , IEC 60831 specify 3 min.

Reference standards

IEC 60831–1/2. UL 810-5th edition

Three phase resistor, included in the extend of delivery



Three-phase capacitors – V_R = 220 V AC, 50/60 Hz, delta connection								
Product / Type Ordering code	50 Hz Output kvar	 I_R A	60 Hz Output kvar	 I_R A	C_R µF	Dimensions d × h mm	Weight kg	Quantity per box
MKP220-D-0.4 B32343C2001A520	0.4	1.1	0.5	1.3	3 × 9,0	53 × 114	0.30	12
MKP220-D-0.6 B32343C2001A720	0.6	1.6	0.75	2.0	3 × 13.5	53 × 114	0.30	12
MKP220-D-0.8 B32343C2011A020	0.8	2.2	1.0	2.6	3 × 18.5	53 × 114	0.30	12
MKP220-D-1.2 B32343C2011A520	1.2	3.3	1.5	4.0	3 × 27.5	63.5 × 129	0.40	12

Three-phase capacitors – V_R = 230 V AC, 50/60 Hz, delta connection								
Product / Type Ordering code	50 Hz Output kvar	 I_R A	60 Hz Output kvar	 I_R A	C_R µF	Dimensions d × h Unit	Weight kg	Quantity per box
MKP230-D-0.5 B32343C2002A530	0.5	1.3	0.6	1.6	3 × 10	53 × 114	0.30	12
MKP230-D-0.7 B32343C2002A730	0.7	1.9	0.9	2.3	3 × 15	53 × 114	0.30	12
MKP230-D-1.0 B32343C2012A030	1.0	2.5	1.2	3.0	3 × 20	63.5 × 129	0.30	12
MKP230-D-1.5 B32343C2012A530	1.5	3.8	1.8	4.6	3 × 30	63.5 × 129	0.40	12

Three-phase capacitors – V_R = 380 V AC, 50/60 Hz, delta connection								
Product / Type Ordering code	50 Hz Output kvar	 I_R A	60 Hz Output kvar	 I_R A	C_R µF	d × h Unit	Weight kg	Quantity per box
MKP380-D-0.8 B32343C3011A080	0.8	1.3	1.0	1.5	3 × 6	53 × 114	0.30	12
MKP380-D-1.3 B32343C3011A580	1.3	1.9	1.5	2.3	3 × 9	53 × 114	0.30	12
MKP380-D-1.7 B32343C3021A080	1.7	2.5	2.0	3.0	3 × 12.5	63.5 × 129	0.40	12
MKP380-D-2.1 B32343C3021A580	2.1	3.2	2.5	3.8	3 × 15.5	63.5 × 129	0.40	12
MKP380-D-4.2 B32343C3051A080	4.2	6.3	5.0	7.6	3 × 31	63.5 × 129	0.40	12

Three-phase capacitors – V_R = 400 V AC, 50/60 Hz, delta connection								
Product / Type	50 Hz		60 Hz		C_R	d × h	Weight	Quantity
Ordering code	Output kvar	I_R A	Output kvar	I_R A	µF	mm	kg	per box
MKP400-D-1.0 B32343C4012A000	1.0	1.4	1.2	1.7	3 × 7	53 × 114	0.30	12
MKP400-D-1.5 B32343C4012A500	1.5	2.2	1.8	2.6	3 × 10	53 × 114	0.30	12
MKP400-D-2.0 B32343C4022A000	2.0	2.9	2.4	3.5	3 × 13	63.5 × 129	0.40	12
MKP400-D-2.5 B32343C4022A500	2.5	3.6	3.0	4.3	3 × 17	63.5 × 129	0.40	12
MKP400-D-5.0 B32343C4052A000	5.0	7.2	6.0	8.6	3 × 33	63.5 × 129	0.40	12

Three-phase capacitors – V_R = 415 V AC, 50/60 Hz, delta connection								
Product / Type	50 Hz		60 Hz		C_R	d × h	Weight	Quantity
Ordering code	Output kvar	I_R A	Output kvar	I_R A	µF	mm	kg	per box
MKP415-D-1.0 B32343C4012A010	1.0	1.4	1.2	1.6	3 × 6	53 × 114	0.30	12
MKP415-D-1.5 B32343C4012A510	1.5	2.1	1.8	2.4	3 × 9	53 × 114	0.30	12
MKP415-D-2.0 B32343C4022A010	2.0	2.8	2.4	3.4	3 × 12	53 × 114	0.40	12
MKP415-D-2.5 B32343C4022A510	2.5	3.5	3.0	4.2	3 × 15	63.5 × 129	0.40	12
MKP415-D-5.0 B32343C4052A010	5.0	7.0	6.0	8.4	3 × 31	63.5 × 154	0.40	12

Three-phase capacitors – V_R = 440 V AC, 50/60 Hz, delta connection								
Product / Type	**50 Hz**		**60 Hz**		**C_R**	**d × h**	**Weight**	**Quantity**
Ordering code	**Output kvar**	**I_R A**	**Output kvar**	**I_R A**	**µF**	**mm**	**kg**	**per box**
MKP440-D-0.9 B32343C4011A040	0.9	1.2	1.0	1.3	3 × 5	53 × 114	0.30	12
MKP440-D-1.0 B32343C4012A040	1.0	1.3	1.2	1.6	3 × 6	53 × 114	0.30	12
MKP440-D-1.2 B32343C4011A540	1.2	1.6	1.5	2.0	3 × 7	53 × 114	0.30	12
MKP440-D-1.5 B32343C4012A540	1.5	2.0	1.8	2.3	3 × 8	53 × 114	0.30	12
MK440-D-2.1 B32343C4021A540	2.1	2.7	2.5	3.3	3 × 11	53 × 114	0.40	12
MKP440-D-2.5 B32343C4022A540	2.5	3.3	3.0	3.9	3 × 13	63.5 × 129	0.30	12
MKP440-D-4.2 B32343C4051A040	4.2	5.5	5.0	6.6	3 × 23	63.5 × 129	0.40	12
MKP440-D-5.0 B32343C4052A040	5.0	6.5	6.0	7.8	3 × 27	63.5 × 154	0.50	12

Three-phase capacitors – V_R = 480 V AC, 50/60 Hz, delta connection								
Product / Type	**50 Hz**		**60 Hz**		**C_R**	**d × h**	**Weight**	**Quantity**
Ordering code	**Output kvar**	**I_R A**	**Output kvar**	**I_R A**	**µF**	**mm**	**kg**	**per box**
MKP480-D-1.5 B32343C4012A580	1.5	1.8	1.8	2.2	3 × 7	63.5 × 129	0.40	12
MKP480-D-2.0 B32343C4022A080	2.0	2.4	2.4	2.9	3 × 9	63.5 × 129	0.40	12
MKP480-D-2.5 B32343C4022A580	2.5	3.0	3.0	3.6	3 × 11	63.5 × 129	0.40	12
MKP480-D-4.2 B32343C4051A080	4.2	5.1	5.0	6.1	3 × 19	63.5 × 154	0.50	12

Three-phase capacitors – V_R = 525 V AC, 50/60 Hz, delta connection								
Product / Type **Ordering code**	**50 Hz**		**60 Hz**		**C_R**	**d × h**	**Weight**	**Quantity per box**
	Output kvar	**I_R A**	**Output kvar**	**I_R A**	**µF**	**mm**	**kg**	
MKP525-D-1.0 B32343C5012A020	1.0	1.1	1.2	1.3	3 × 4	53 × 114	0.30	12
MKP525-D-1.5 B32343C5012A520	1.5	1.6	1.8	2.0	3 × 6	53 × 114	0.30	12
MKP525-D-2.0 B32343C5022A020	2.0	2.2	2.4	2.6	3 × 8	63.5 × 129	0.40	12
MKP525-D-2.5 B32343C5022A520	2.5	2.7	2.7	3.0	3 × 9	63.5 × 129	0.40	12

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 disconnector, 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. Discharge resistors are included in the extend of delivery; 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 disconnector

To ensure full functionality of an overpressure disconnector, 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 disconnector work.
   - folding beads must not be retained by clamps.
2. 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 IEC 60831 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 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 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 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.
Important: Please note that the „General Safety Recommendations for Power Capacitors“ by ZVEI (German Electrical and Electronic Manufacturers´ Association (ZVEI) have to be observed in addition to the caution guidelines stated in the data sheet (Internet: www.epcos.com/pfc).

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