Film Capacitors – Power Factor Correction

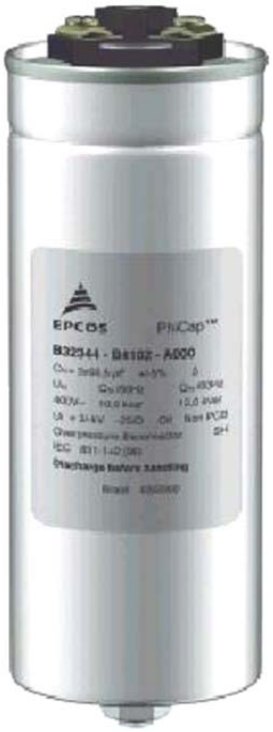
PhiCap Normal Duty Capacitors

Series/Type:	**MKP**
Ordering code:	**B32343L* / B32344B***
Date:	2018-07-10
Version:	11

EPCOS AG is a TDK Group Company.

Construction

- Dielectric: Polypropylene film
- Non PCB, Soft Polyurethane resin
- Extruded round aluminum can with stud
- Provided with discharge resistors
- Overpressure disconnector



Features

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

Typical applications

- For Power Factor Correction

Terminals

- 6.3mm fast-on terminals for plastic top -0.5 to 6.6 kvar
- Screw terminal for metal top – 5 kvar and above

Mounting parts

- Threaded stud at bottom of can
- (Max. torque = 4 Nm for M8 and 10 Nm for M12)

Technical data and specifications

Characteristics	
Rated capacitance C_R	As per table in page 6 to 8
Tolerance	-5 /+10%
Connection	D (Delta)
Rated voltage V_R	As per table in page 6 to 8
Rated frequency f_R	50 Hz
Output	As per table in page 6 to 8
Rated current I_R	As per table in page 6 to 8
Dimensions (d x h)	As per table in page 6 to 8

Maximum ratings	
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 to 1.5 • I_R (A) (including combined effects of harmonics, overvoltages and capacitance tolerance)
Maximum inrush current (I_S)	200 I_R (A) Max. 5000 switching's per year

Test data	
Voltage test between terminals (V_{TT})	2.15 • V_R V AC / 50 Hz, 2s
Voltage test between terminals and container (V_{TC})	3600 V AC / 50 Hz, 2 s

Design data	
Dielectric losses	≤ 0.2 W / kvar
* Total losses	≤ 0.5 W / kvar
Impregnation	Non PCB, soft biodegradable resin

* Without discharge resistor

Climatic category: -25/D	
T_{min}	–25 ºC
T_{max}	+55 ºC
Ambient temperature	Class -25/D: max. short time: +55 °C, max. mean 24 h: +45 °C; max. mean 1 year: +35 °C; lowest temperature: - 25 °C
Storage temperature	-25 ºC to +85 ºC
Max. hot spot temperature	+85 ºC
Humidity	Average relative < 95%

Mean life expectancy		
t_{LD}	Up to 100 000 hours (temperature class –25/D); $\Theta_{HS} \leq 70$ °C (max. mean ambient temperature per year = +35 °C) Failure rate < 3%	
Terminals		
Plastic top – 0.5 to 6.6 kvar	**6.3 mm fast-on**	
	Ø 53 mm	Ø 63.5 mm
Creepage distance	10.5 mm	10.0 mm
Clearance	13.0 mm	16.5 mm

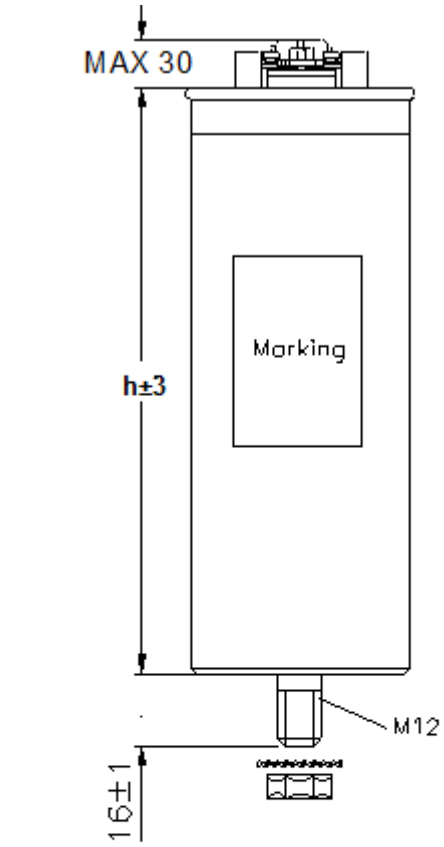
Metal top – 5 kvar and above	**Screw terminal**
Max. torque	1.2 Nm
Cable cross section	16 mm^2 (without cable and lug)
Maximum terminal current	50 A
Creepage distance (min)	12.7 mm
Clearance (min)	9.6 mm
Mounting	
Fixing	Threaded bolt M12 except M8 for d = 53 mm
Max. torque (Al can stud)	10 Nm except 4 Nm for d = 53 mm
Mounting position	Vertical upright
Maximum altitude	4000 m above sea level

Safety	
Mechanical safety	Overpressure disconnector
Max. short circuit current	AFC: 10 kA
Discharge resistor time	≤ 3 min (75 V or less)

Approvals/Reference standards		
Approval Mark	**Standard of reference**	**Certificate**
IS:13340 (Part1)/ IEC 60831-1 ISI CM/L-1432640	IS 13340 (2012) / IEC 60831 (2002)	ISI mark applicable for 400 V, 415 V, 440 V, 480 V & 525 V ratings

Dimensional drawing

B32344B



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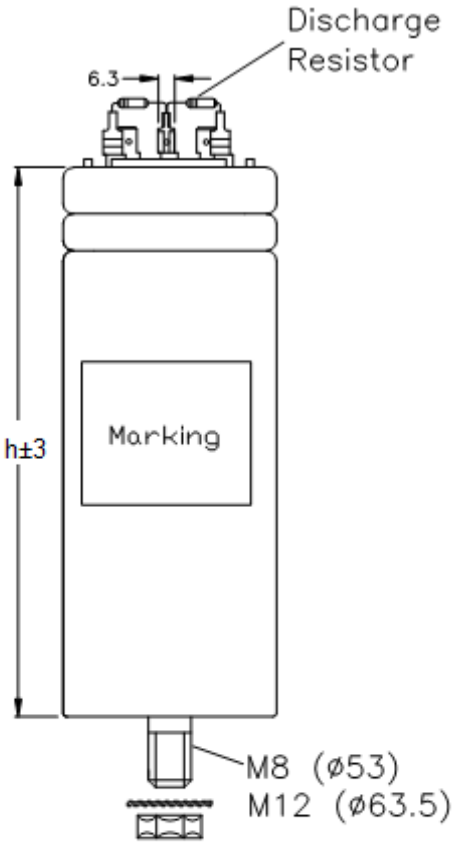

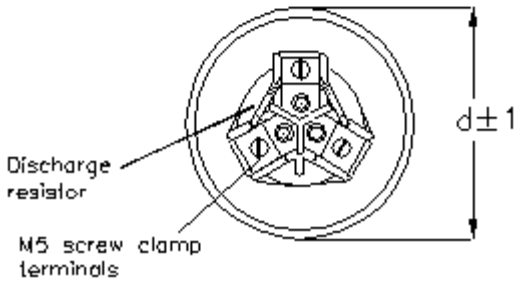

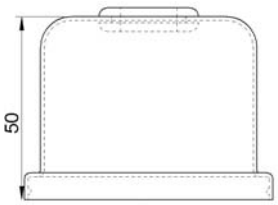

Cap

Ordering codes

Voltage V_R V	Power (Q) 50 Hz kvar	Capacitance µF	Rated current 50 Hz I_R A	Dimensions d x h mm	With or without Cap	Ordering code
400	6.3	3 x 41.8	9.1	78.4 x 195	With Cap	B32344B4071A500
	7.5	3 x 49.8	10.8	78.4 x 195	With Cap	B32344B4072A500
	10.0	3 x 66.3	14.4	88.4 x 195	With Cap	B32344B4102A000
	12.5	3 x 82.9	18.0	88.4 x 270	With Cap	B32344B4122A500
	15.0	3 x 99.5	21.7	88.4 x 270	With Cap	B32344B4152A000
	20.0	3 x 132.7	28.9	88.4 x 348	With Cap	B32344B4202A000
	25.0	3 x 165.9	36.1	88.4 x 348	With Cap	B32344B4252A000
415	0.5	3 x 3.1	0.7	53 x 117	With Cap	B32343L4002A510
	1.0	3 x 6.2	1.4	53 x 117	With Cap	B32343L4012A010
	1.5	3 x 9.2	2.1	53 x 117	With Cap	B32343L4012A510
	2.0	3 x 12.3	2.8	53 x 117	With Cap	B32343L4022A010
	2.5	3 x 15.4	3.5	63.5 x 129	With Cap	B32343L4022A510
	3.0	3 x 18.5	4.2	63.5 x 129	With Cap	B32343L4032A010
	4.0	3 x 24.7	5.6	63.5 x 152	With Cap	B32343L4042A010
	5.0	3 x 30.8	7.0	63.5 x 152	With Cap	B32343L4052A010
	6.3	3 x 38.8	8.8	78.4 x 195	With Cap	B32344B4071A510
	7.5	3 x 46.2	10.4	78.4 x 195	With Cap	B32344B4072A510
	8.3	3 x 51.2	11.5	78.4 x 195	With Cap	B32344B4082A310
	9.0	3 x 55.5	12.5	78.4 x 195	With Cap	B32344B4092A010
	10.0	3 x 61.6	13.9	88.4 x 195	With Cap	B32344B4102A010
	12.5	3 x 77.0	17.4	88.4 x 270	With Cap	B32344B4122A510
	15.0	3 x 92.5	20.9	88.4 x 270	With Cap	B32344B4152A010
	20.0	3 x 123.3	27.8	88.4 x 348	With Cap	B32344B4202A010
	25.0	3 x 154.1	34.8	88.4 x 348	With Cap	B32344B4252A010

Voltage V_R V	Power (Q) 50 Hz kvar	Capacitance µF	Rated current 50 Hz I_R A	Dimensions d x h mm	With or without Cap	Ordering code
440	0.9	3 x 4.9	1.2	53 x 117	With Cap	B32343L4011A040
	1.0	3 x 5.5	1.3	53 x 117	With Cap	B32343L4012A040
	1.2	3 x 6.6	1.6	53 x 117	With Cap	B32343L4011A540
	1.5	3 x 8.2	2.0	53 x 117	With Cap	B32343L4012A540
	2.1	3 x 11.5	2.8	53 x 117	With Cap	B32343L4021A540
	2.5	3 x 13.7	3.3	63.5 x 129	With Cap	B32343L4022A540
	2.8	3 x 15.4	3.7	63.5 x 129	With Cap	B32343L4022A840
	3.0	3 x 16.4	3.9	63.5 x 129	With Cap	B32343L4032A040
	4.2	3 x 23.0	5.5	63.5 x 129	With Cap	B32343L4051A040
	5.0	3 x 27.4	6.6	63.5 x 152	With Cap	B32343L4052A040
	5.6	3 x 30.7	7.3	63.5 x 188	With Cap	B32343L4052A640
	6.0	3 x 32.9	7.9	78.4 x 195	With Cap	B32344B4071A540
	7.0	3 x 38.4	9.2	78.4 x 195	With Cap	B32344B4072A040
	7.5	3 x 41.1	9.8	78.4 x 195	With Cap	B32344B4072A540
	8.3	3 x 45.5	10.9	78.4 x 195	With Cap	B32344B4101A040
	9.0	3 x 49.3	11.8	78.4 x 195	With Cap	B32344B4092A040
	10.0	3 x 54.8	13.1	88.4 x 195	With Cap	B32344B4102A040
	12.5	3 x 68.5	16.4	88.4 x 270	With Cap	B32344B4151A040
	15.0	3 x 82.2	19.7	88.4 x 270	With Cap	B32344B4152A040
	16.7	3 x 91.6	21.9	88.4 x 348	With Cap	B32344B4201A040
	19.0	3 x 104.2	24.9	88.4 x 348	With Cap	B32344B4192A040
	20.0	3 x 109.7	26.2	88.4 x 348	With Cap	B32344B4202A040
	20.8	3 x 114.1	27.3	88.4 x 348	With Cap	B32344B4251A040
	25.0	3 x 137.1	32.8	93.5 x 348	With Cap	B32344B4252A040
	28.0	3 x 153.5	36.7	93.5 x 348	With Cap	B32344B4282A040
	30.0	3 x 164.5	39.4	93.5 x 348	With Cap	B32344B4302A040

Voltage V_R V	Power (Q) 50 Hz kvar	Capacitance µF	Rated current 50 Hz I_R A	Dimensions d x h mm	With or without Cap	Ordering code
480	5.0	3 x 23.0	6.0	78.4 x 195	With Cap	B32344B4052A080
	5.5	3 x 25.3	6.6	63.5 x 188	With Cap	B32343L4052A580
	8.3	3 x 38.2	10.0	78.4 x 270	With Cap	B32344B4082A380
	10.4	3 x 47.9	12.5	88.4 x 270	With Cap	B32344B4121A580
	11.1	3 x 51.1	13.4	78.4 x 270	With Cap	B32344B4112A180
	12.5	3 x 57.6	15.0	88.4 x 348	With Cap	B32344B4151A080
	13.8	3 x 63.6	16.6	88.4 x 270	With Cap	B32344B4132A880
	15.0	3 x 69.1	18.0	88.4 x 348	With Cap	B32344B4152A080
	16.6	3 x 76.5	20.0	88.4 x 348	With Cap	B32344B4162A680
	20.8	3 x 95.8	25.0	88.4 x 348	With Cap	B32344B4251A080
	22.1	3 x 101.8	26.6	93.5 x 348	With Cap	B32344B4222A180
	25.0	3 x 115.2	30.1	93.5 x 348	With Cap	B32344B4252A080
	27.7	3 x 127.6	33.3	93.5 x 348	With Cap	B32344B4272A780
	30.0	3 x 138.2	36.1	93.5 x 348	With Cap	B32344B4302A080
525	5	3 x 19.3	5.5	78.4 x 195	With Cap	B32344B5052A020
	6.3	3 x 24.3	6.9	78.4 x 195	With Cap	B32344B5071A520
	6.6	3 x 25.4	7.3	63.5 x 260	With Cap	B32343L5062A620
	8.3	3 x 32.0	9.1	88.4 x 270	With Cap	B32344B5082A320
	9.9	3 x 38.1	10.9	78.4 x 270	With Cap	B32344B5092A920
	10.4	3 x 40.1	11.4	88.4 x 270	With Cap	B32344B5102A420
	12.5	3 x 48.1	13.7	88.4 x 270	With Cap	B32344B5151A020
	13.2	3 x 50.8	14.5	88.4 x 270	With Cap	B32344B5132A220
	16.6	3 x 63.9	18.3	88.4 x 348	With Cap	B32344B5162A620
	16.7	3 x 64.3	18.4	88.4 x 348	With Cap	B32344B5162A720
	19.9	3 x 76.6	21.9	88.4 x 348	With Cap	B32344B5192A920
	20.8	3 x 80.1	22.9	93.5 x 348	With Cap	B32344B5202A820
	26.5	3 x 102.1	29.1	121.5 x 325	Without Cap	B32344B5262A520
	33.1	3 x 127.5	36.4	121.5 x 325	Without Cap	B32344B5332A120

Display of ordering codes for EPCOS products

The ordering code for one and the same EPCOS product can be represented differently in data sheets, data books, other publications, on the EPCOS website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.epcos.com/orderingcodes

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. PhiCap-capacitors have a pre-mounted ceramic discharge module; 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. 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 IS 13340 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 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 4 Nm for M8 stud and 10 Nm for M12 stud.

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 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 notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to the current version of the "General Terms of Delivery for Products and Services in the Electrical Industry" published by the German Electrical and Electronics Industry Association (ZVEI)**.
7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements ("CSR") TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

Important notes

8. The trade names EPCOS, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.epcos.com/trademarks.

Release 2018-06