EPCOS

Series PhaseCap (B25667...), PhaseCap HD (B25669...), WindCap (B25668...) and PhiCap (B32344C...)

Installation and Maintenance Instructions

Read this first

Read the following »Installation and Maintenance Instruction« carefully before installing a capacitor into your application.

This Manual

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.

For your safety! Disregarding the guidelines in this manual could result in operational failure, bursting and fire.

In case of doubt, contact your local EPCOS sales organization or distributor for assistance.

General Safety Notes for Installation and Operation

- Maintain good, effective grounding of capacitor enclosures.
- Provide the means to isolate any faulty units/banks in the system.
- Handle capacitor units carefully, as they may be charged even after disconnection due to faulty discharging devices.
- Follow proper engineering practices.
- Do not use the HRC fuses to power up and down the capacitor (otherwise this could lead to the risk of electrical arcing!).
- 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 loaded!

Storage and Operation Conditions

Do not use or store capacitors in corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or similar substances are present.

In a dusty environment, regular maintenance and cleaning, especially of the terminals, is required to avoid a conductive path between phases and/or phases and ground.

Ambient Temperature

The ambient temperature category is for most standard types -25/D. This means up to a max. temperature of 55 °C, an average temperature over 24 hours of 45 °C, and the average temperature in one year should not exceed 35 °C. The maximum casing temperature of 60 °C must not be exceeded.

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. For higher temperature requirements, EPCOS offers MKV type capacitors for ambient temperatures of up to 70 °C (with natural cooling).

Caution! Exceeding maximum allowed temperature may set the safety device out of operation.
In case of dents, mechanical or any other kind of damage, capacitors should not be used any longer!

Installation

Mounting

The Capacitors

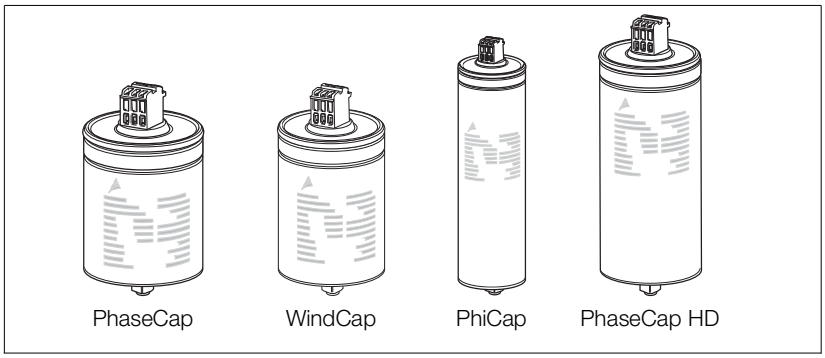

Figure 1: Capacitors WindCap, PhaseCap, PhiCap and PhaseCap HD

Mounting Positions

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

Warning! In case of dents deeper than 0.5 mm, do not install the capacitor.

PhaseCap, WindCap

Mounting the capacitors PhaseCap and WindCap is possible in the vertical **or** horizontal position:

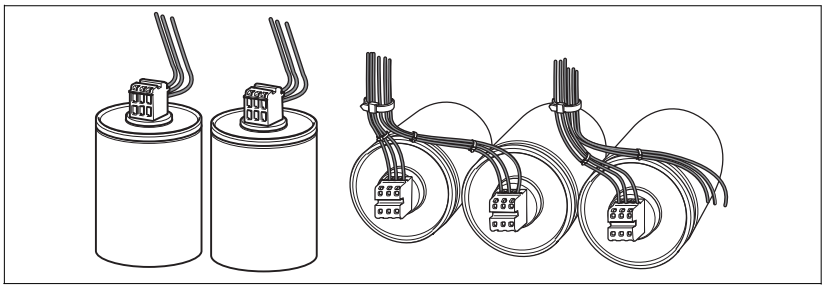

Figure 2: PhaseCap and WindCap in vertical or horizontal mounting position

PhaseCap HD, PhiCap

Mounting the capacitors PhaseCap HD and PhiCap is **only** possible in the vertical position:

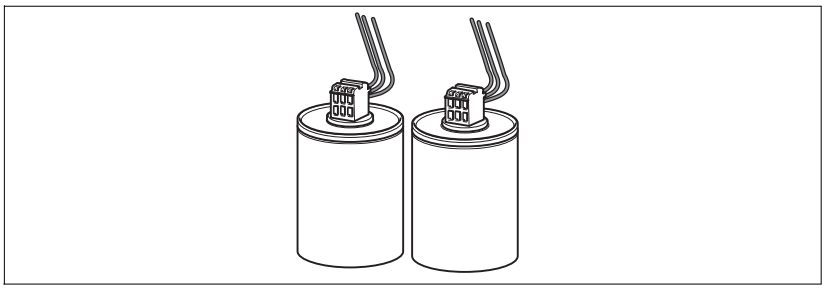

Figure 3: PhaseCap HD and PhiCap in vertical mounting position

Mounting Conditions

PFC capacitors must be installed in a cool and well ventilated place, and should not be installed close to heat radiating objects, e.g. filter circuit reactors, furnaces, direct sunlight.

Cooling Space for Capacitors

Make sure that sufficient cooling space is provided (see Figure 4):

– 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 to secure the over-pressure disconnector work.

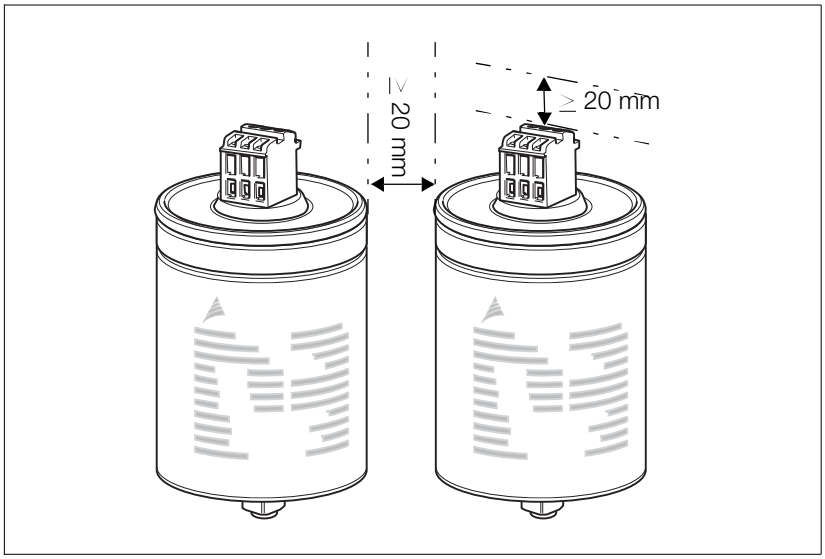

Figure 4: Minimum space over and between the capacitors

Using Reactors: Cooling Space for Cables

If reactors are used in an application, note that they operate at a much higher temperature level. The distance between the reactor and capacitor must be far enough apart so that neither the reactor heat is conducted via the connection cable to the capacitors, nor can heat radiation from the reactor to the capacitor cause overheating.

Fixing Threaded Bottom Stud and Grounding

Threaded Bottom Stud

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

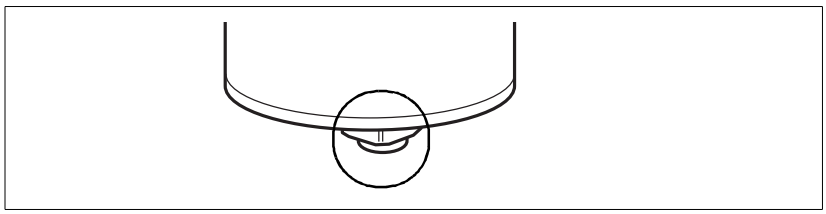

Figure 5: Threaded bottom stud for grounding the capacitor

Fixing

The threaded bottom stud has to be fastened with certain torques:

– PhaseCap, Windcap, PhaseCap HD
  M12 bottom stud torque of 10 Nm.

– PhiCap
  M12 bottom stud for diameters <53 mm: torque 10 Nm
  M 8 bottom stud for diameters 53 mm: torque 4 Nm

Grounding

The M12 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 SIGUT terminal is not recommended.

Connecting the Supply Cable

Cable Specification

The connection cable must be of flexible type, material should preferably be copper.

Note: Do not use solid core cables!

Maximum cable cross section is for

- PhaseCap, PhiCap and WindCap: 16mm^2
- PhaseCap HD: 35 mm^2.

Further information 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 maximimum allowable current:

- PhaseCap, WindCap and PhiCap: Max. 50A total RMS current
- PhaseCap HD: Max. 130 A total RMS current

Attaching the Supply Cable

Attach the supply cable only with the maximum permissible torque values:

- PhaseCap, PhiCap and WindCap: 1.2 Nm
- PhaseCap HD: 2.5 Nm.

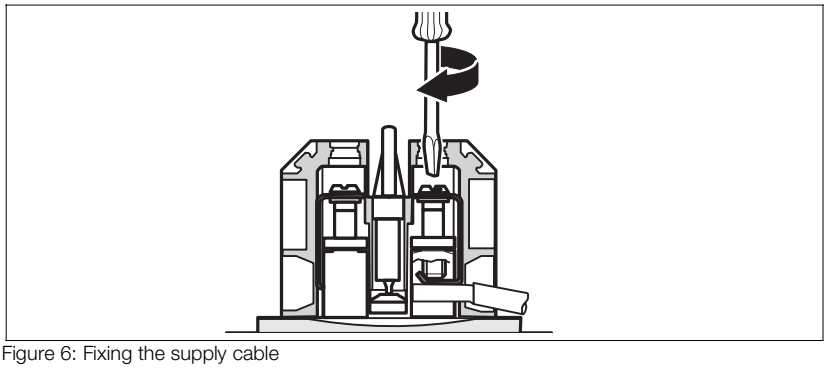

Figure 6: Fixing the supply cable

Using Discharge Resistors

Discharge resistors are included in the delivery package, premounted by the factory.

They are required for discharging of capacitors in order to protect operating personal (risk of electric shock hazard) and for re-switching capacitors in automatic PFC equipment (phase opposition!).

EPCOS discharge resistors are designed to discharge capacitors within 60 secs. down to 75 V or less.

Make sure that the correct resistor is used for replacement, e.g. Ohm-value and push-on connector diameter.

Discharge the Capacitor

Before re-switching, capacitors have to be discharged to 10% of the rated voltage or even lower.

A discharge resistor can be easily replaced by pressing it on the exposed top on the SIGUT terminal.

Caution! Discharge and short circuit the capacitor before handling!

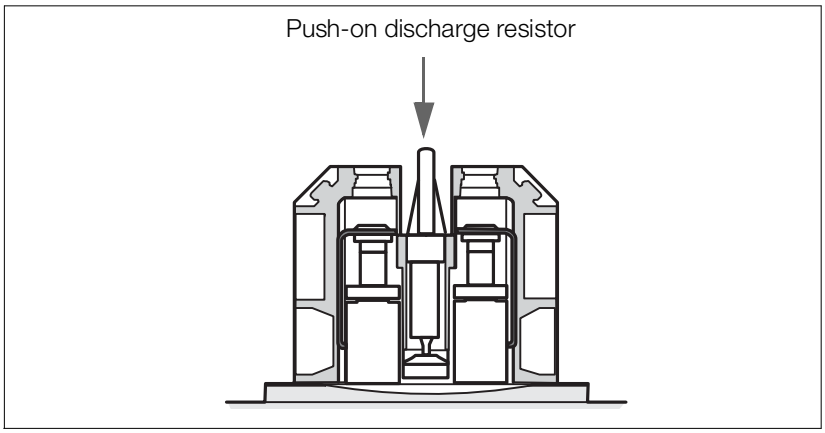

Figure 7: Push-on discharge resistor

Inrush Current Limitation

Switching LV PFC capacitors can cause high inrush currents of more than 200 times the rated current, especially when they are connected in parallel to others that are already energized. This may cause additional stress to contactors as well as to capacitors and reduce their life cycle.

Inrush currents have a negative effect on power quality, e.g. transients, voltage drop. Although the MKK AC design with its wave cut has high impulse handling capability, inrush current limitation is required, e.g.:

– contactors with pre-charging resistors for pre-loading of capacitors

  or

– serial air coils (approx. 8 turns in the connection cables between contactor and capacitor with a diameter of 10 cm)

IEC 831 Standard and Reference

According to IEC 831 standard, a maximum of 5000 switching operations per year is acceptable. Before considering higher number of switching operations, please contact EPCOS.

Please request the EPCOS application note "Damping of inrush currents in LV PFC equipment" for more details about this.

Harmonics

Harmonics are sinusoidal voltages and currents with frequencies that are multiples of a 50 Hz or 60 Hz power supply frequency.

Harmonics result from the operation of electrical loads with non-linear voltage-current characteristics.

They are mainly caused by loads operated with modern electronic devices, such as converters, electrical drives, welding machines and uninterruptible power supplies (UPS).

Attention! In applications with harmonic distortion only power capacitors with reactors, namely de-tuned capacitor banks, should be used. Depending on the chosen series resonance frequency, a part of the harmonic current will be absorbed by the power capacitor. The rest of the harmonic current will flow into the grid. The use of power capacitors with reactors reduces harmonic distortion and minimizes the disturbing effects on operation of other loads.

Avoid Resonance Conditions

The most important reason for installing de-tuned capacitor banks is to avoid resonance conditions. Resonance conditions may multiply existing harmonics and create power quality problems as well as damages to distribution equipment.

Occurrences of resonance should by all means be avoided by appropriate application design!

Total RMS capacitor current (incl. fundamental and harmonic currents) specified in the technical data of the specific series must in any case not be exceeded.

Overpressure Disconnector

Electrical components do not have unlimited life expectancy; 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 series PhaseCap, PhaseCap HD, PhiCap and WindCap are consequently fitted with a disconnector 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 831 specification), the formation of gas produces a rise in pressure inside the capacitor case.

This causes a change in length because of curvature of the lid or stretching of the expansion bead. Expansion beyond a certain degree will separate the internal wires (tear-off fuses) and disconnect the capacitor from the line.

Caution! To ensure full functionality of an overpressure disconnector, the following is required:

1) The elastic metal top must not be impaired:
   - connecting lines must be flexible leads (cables),
   - there must be sufficient space for expansion above the connections (stated for the different models),
   - folding groove must not be retained by clamps.
2) Maximum allowed fault current of 10000 A in accordance with UL 810-standard must not be exceeded.
3) Stress parameters of the capacitor must be within the IEC 831 specification.

Over Current/Short Circuit Protection

HRC fuses or MCCB for short circuit protection have to be used.

Short circuit protection equipment and connection cable should be selected so that the 1.5 times rated current of the capacitor can be managed permanently.

HRC fuses do not protect the capacitor against overload, it is only a short circuit protection!

HRC fuse rating has to be 1.6 ...1.8 times nominal capacitor current.

Do not use HRC fuses for switching capacitors (lightning arc!).

Use thermal/magnetic overcurrent relays for overload protection.

Maintenance

Caution! Disregarding the following measures may result in severe operation failures, bursting and fire.

- Check tightness of the connections/terminals periodically.
- Clean the terminals/bushings periodically to avoid short circuits due dust or other contamination.
- Check the short circuit protection fuses.
- Take current reading twice a year and compare with nominal current. Use a harmonic analyser or true effetive RMS-meter.
- In case of a 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 cases 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 60 seconds the voltage between the terminals must decline to less than 75 V.
- 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.

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

Please note again that these »Installation and Maintenance Instructions« apply to typical specifications.

Refer to our product specifications, or request our approval for your specification before installing a capacitor

Appendix

Connection Cable Cross Section, HRC Fuse Rating

Listed below are recommendations according to VDE 0100 for fusing and cable cross-sections for three phase power capacitors.

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 harmonic distortion.

kvar rating at 400 V	Nominal current (in A)	HRC fuse rating (in A)	Cross section of supply cable
5	7.4	16	1.5
6.3	9	16	2.5
7.5	10.8	20	2.5
8,3	12	20	2.5
10	14.4	25	4
12.5	18	35	4
15	21.6	35	6
20	29	50	10
25	36	63	16
30	43	80	25
40	58	100	35
50	72	125	35

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

Vibration Resistance

The capacitor resistance to vibration corresponds to IEC 68, part 2-6. The following values apply to the capacitor alone.

Tested Conditions

Max. test conditions:

Test duration	2 h	corresponding to max. 0.7 g
Frequency range	10 ... 55 Hz	
Displacement amplitude	0.75 mm	

The fastening and the terminals may influence the vibration properties. It is necessary to check the stability when an installed capacitor is exposed to vibration.

Irrespective of this, you are advised not to locate capacitors where vibration amplitude could reach maximum levels in strongly vibrating appliances.

Purchase orders are subject to the General Conditions for the Supply of Products and Services of the Electrical and Electronics Industry recommended by the ZVEI (German Electrical and Electronic Manufacturers' Association), unless otherwise agreed.

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