

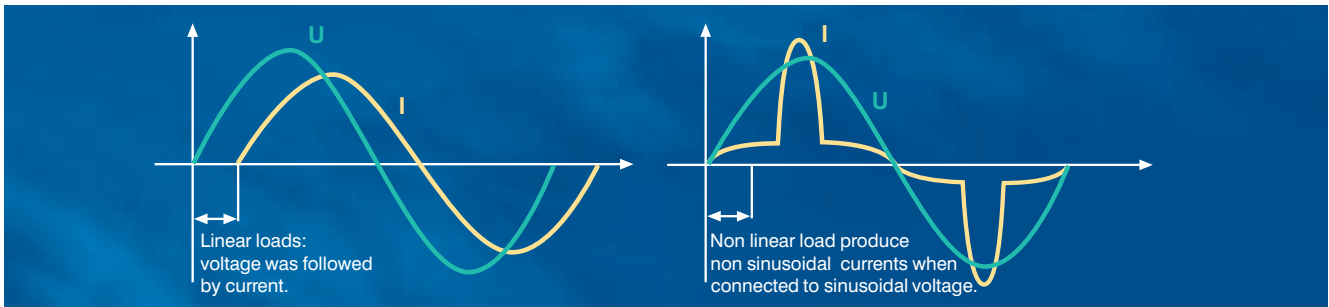
EPCOS Product Profile (India) 2013

Power Factor Correction

Power Quality Solutions



Preview



General

The increasing demand of electrical power and the awareness of the necessity of energy saving is very up to date these days. Also the awareness of power quality is increasing, and power factor correction (PFC) and harmonic filtering will be implemented on a growing scale. Enhancing power quality – improvement of power factor – saves costs and ensures a fast return on investment. In power distribution, in low- and medium-voltage networks, PFC focuses on the power flow ($\cos \varphi$) and the optimization of voltage stability by generating reactive power – to improve voltage quality and reliability at distribution level.

How reactive power is generated

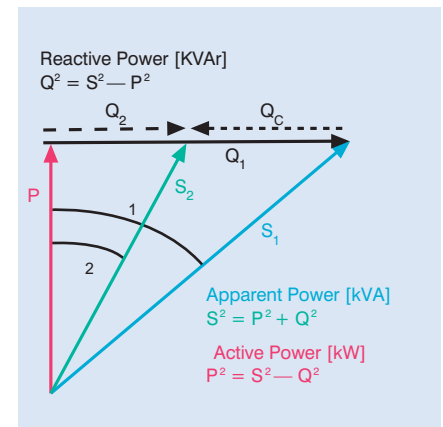
Every electric load that works with magnetic fields (motors, chokes, transformers, inductive heating, arc welding, generators) produces a varying degree of electrical lag, which is called inductance. This lag of inductive loads maintains the current sense (e.g. positive) for a time even though the negative-going voltage tries to reverse it. This phase shift between current and voltage is maintained, current and voltage having opposite signs. During this time, negative power or energy is produced and fed back into the network. When current and voltage have the same sign again, the same amount of energy is again needed to build up the magnetic fields in inductive loads. This magnetic reversal energy is called reactive power.

In AC networks (50/60 Hz) such a process is repeated 50 or 60 times a second. So an obvious solution is to briefly store the magnetic reversal energy in capacitors and relieve the network (supply line) of this reactive energy. For this reason, automatic

reactive power compensation systems (detuned /conventional) are installed for larger loads like industrial machinery. Such systems consist of a group of capacitor units that can be cut in and cut out and which are driven and switched by a power factor controller.

$$\begin{aligned} \text{Apparent power } S &= \sqrt{P^2 + Q^2} \\ \text{Active power } P &= S \cdot \cos \varphi \\ \text{Reactive power } Q &= S \cdot \sin \varphi \end{aligned}$$

With power factor correction the apparent power S can be decreased by reducing the reactive power Q.



Power factor

Low power factor ($\cos \varphi$)

Low $\cos \varphi$ results in

- Higher energy consumption and costs,
- Less power distributed via the network,
- Power loss in the network,
- Higher transformer losses,
- Increased voltage drop in power distribution networks.

Power factor improvement

Power factor improvement can be achieved by

- Compensation of reactive power with capacitors,
- Active compensation – using semiconductors,
- Overexcited synchronous machine (motor /generator).

Types of PFC

(detuned or conventional)

- individual or fixed compensation (each reactive power producer is individually compensated),
- group compensation (reactive power producers connected as a group and compensated as a whole),
- central or automatic compensation (by a PFC system at a central point),
- mixed compensation.

Preview



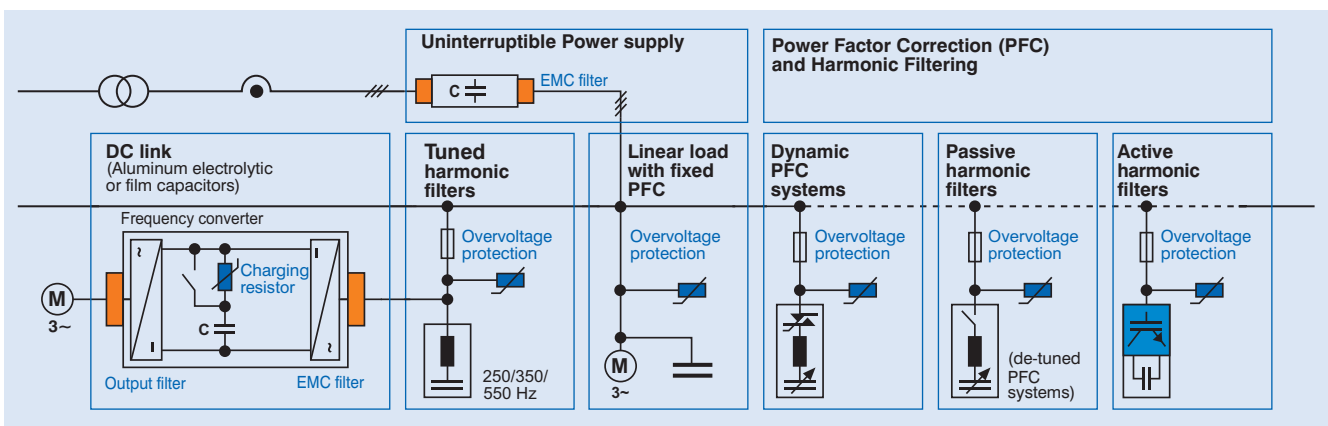
Power Quality Solution strategy

Along with the emerging demand for power quality and a growing awareness of the need for environmental protection, the complexity in the energy market is increasing: users and decision-makers are consequently finding it increasingly difficult to locate the best product on the market and to make objective decisions. It is in most cases not fruitful to compare catalogs and data sheets, as many of their parameters are identical in line with the relevant standards. Thus operating times are specified on the basis of

tests under laboratory conditions that may differ significantly from the reality in the field. In addition, load structures have changed from being mainly linear in the past to non-linear today. All this produces a clear trend: the market is calling increasingly for customized solutions rather than off-the-shelf products. This is where Power Quality Solutions come into the picture. It offers all key components for an effective PFC system from a single source, together with:

- Application know-how
- Technical skills
- Extensive experience in the field of power quality improvement
- A worldwide network of partners
- Continuous development
- Sharing of information

These are the cornerstones on which Power Quality Solutions are built. On the basis of this strategy, EPCOS is not only the leading manufacturer of power capacitors for PFC applications but also a PQS supplier with a century of field experience, reputation and reliability.



PFC Capacitor Series Overview



| PFC Capacitor series for power factor correction capacitors | | | |
|---|------|---|---|
| PhaseCap Premium | | B25667L . . . |  |
| Power | KVAr | 5...31 | |
| Voltage range | V | 415...800 V* | |
| Frequency | Hz | 50Hz | |
| Impregnation | | Gas-impregnated, dry type, Non-PCB | |
| Life expectancy | Hrs | Up to 130 000 h for -40/D Up to 180 000 h for -40/C | |
| Inrush current | A | $300 \bullet I_R$ | |
| PhaseCap Super Heavy Duty | | B25673L . . . |  |
| Power | KVAr | 5...33 | |
| Voltage range | V | 415...1000 V* | |
| Frequency | Hz | 50 Hz | |
| Impregnation | | Non-PCB, semi-dry biodegradable resin | |
| Life expectancy | Hrs | Up to 200 000 h for -40/C Up to 150 000 h for -40/60 | |
| Inrush current | A | $400 \bullet I_R$ | |
| PhiCap ND | | B32343L . . . /B32344B . . . |  |
| Power | KVAr | 5...30 | |
| Voltage range | V | 230...525 V* | |
| Frequency | Hz | 50 Hz | |
| Impregnation | | Non-PCB, semi-dry biodegradable resin | |
| Life expectancy | Hrs | Up to 100 000 hours | |
| Inrush current | A | $200 \bullet I_R$ | |
| PhiCap HD | | B32447A . . . /B32448A . . . |  |
| Power | KVAr | 1...30 | |
| Voltage range | V | 415...480 V* | |
| Frequency | Hz | 50 Hz | |
| Impregnation | | Non-PCB, semi-dry biodegradable resin | |
| Life expectancy | Hrs | Up to 115 000 hours | |
| Inrush current | A | $250 \bullet I_R$ | |

*Other voltages on request.

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. The trade names EPCOS, BAOKE, Alu-X, CeraDiode, CSMP, CSSP, CTVS, DeltaCap, DigiSiMic, DSSP, FormFit, MiniBlue, MiniCell, MKD, MKK, SquareCap, AgriCap, PoleCap, MLSC, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SIP5D, SIP5K, 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.

PhaseCap Super Heavy Duty PFC Capacitors

Semi-dry biodegradable resin • Concentric winding • Wavy cut • Dual safety system



General

The new PhaseCap Super Heavy Duty (SHD) PFC capacitor is based on the EPCOS MKK technology known for many years from the successful PhaseCap series with its unique concentric windings . Based on years of experience in PFC and millions of sold capacitors ,EPCOS presents the next step in PFC capacitor evolution . Using polypropylene as dielectric and semi dry biodegradable resin as impregnation agent ,the PhaseCap Super Heavy Duty (SHD)

offers higher inrush current capability (up to $400 \cdot I_R$) and over current capability (up to $2 \cdot I_R$) even compared to PhaseCap .With an output of up to 33 KVAR at very small height it meets the dimensional requirements of panel builders .Its new enhanced terminals permit the connection of a broader variety of cables and cable sizes .Depending on the operating conditions PhaseCap Compact provides a life expectancy of up to 200 000 hours ,more than any other capacitor in the EPCOS PFC capacitor portfolio besides MKV .



Applications

- Automatic PFC equipment, capacitor banks
- Individual fixed PFC (e.g. motors, transformers, lighting)
- Group fixed PFC
- Detuned capacitor banks
- Filter applications
- Dynamic PFC

Features

- Compact design in cylindrical aluminum can with stud
- Concentric winding
- MKK-technology with wavy cut and heavy edge
- Voltage range: 230 ... 1000 V
- Output range: 5.0 ... 33.0 KVAR

Electrical features

- Very high life expectancy
- High inrush current capability (up to $400 \cdot I_R$)
- High overcurrent capability (up to $2.0 \cdot I_R$)

Mechanical and maintenance

- Reduced mounting costs
- Maintenance-free
- Compact dimensions
- Mounting position upright

Safety

- Self healing
- Overpressure disconnecter
- Shock hazard protected terminals
- Pre-mounted ceramic discharge resistor

PhaseCap Super Heavy Duty PFC Capacitors

Semi-dry biodegradable resin • Concentric winding • Wavy cut • Dual safety system



| Technical data : PhaseCap Super Heavy Duty PFC Capacitors | |
|---|---|
| Series type | B25673L |
| Power-KVAr | 5...33KVAr |
| Rated voltage-V (AC) | 415...1000 V* |
| Frequency | 50 Hz |
| Transient peak current maximum permissible | $400 \cdot I_R$ |
| Maximum permissible temperature category | -40°C to 60°C |
| Losses (without discharge resistors) | 0.45W/KVAr |
| Maximum permissible voltage | $V_R + 10\%$ (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 | Up to $1.6 \cdot I_R$ *** |
| Safety | Self-healing, overpressure disconnecter |
| Impregnation | Non-PCB, semi-dry biodegradable resin |
| Life expectancy | Up to 200 000 h for -40/C Up to 150 000 h for -40/60 |
| Cooling | Natural or forced |
| Case shape/finish | Extruded round aluminium can with stud |
| Terminal | Optimized capacitor safety terminals |
| Mounting and grounding | Threaded stud at bottom of can (max. torque for M12=Nm) |
| Enclosure | IP 20, indoor mounting (optionally with terminal cap for IP54) |
| Discharge resistor | Provided with discharge resistor |
| Connection | Delta |
| Casing of capacitor cell | Extruded round aluminium can with stud |
| Dielectric | Polypropylene film (metallised) |
| No. of switching per annum | Max. 10 000 switching |
| Reference standard | IEC60831-1/2, UL 810-5th edition |

* Other voltages available on request

** V_R : rated voltage

*** I_R : RMS line current that occurs at rated sinusoidal voltage and rated frequency, excluding transients.

Note : for capacitors with different features/parameters than above, please check with our nearest sales office

PhaseCap Super Heavy Duty PFC Capacitors

Semi-dry biodegradable resin • Concentric winding • Wavy cut • Dual safety system



| PhaseCap Super Heavy Duty PFC Capacitors - 3 Phase | | | | | | | | |
|--|-------------------|-----------------|---------------------|---------------------|-------------|------------------|-----|----------------------|
| Rating KVA _r | Voltage V (AC) | Material code | I _r A | C _N F | d x h mm | Packing units | MOQ | Approx. weight Kg |
| PhaseCap Super Heavy Duty - 415 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 5 | 415 | B25673L4052A 10 | 7 | 3 x 30.8 | 85 x 125 | 1 | 1 | 0.7 |
| 6.2 | 415 | B25673L4062A 10 | 8.6 | 3 x 38.2 | 85 x 162 | 1 | 1 | 1.0 |
| 7.5 | 415 | B25673L4072A510 | 10.4 | 3 x 46.2 | 85 x 162 | 1 | 1 | 1.0 |
| 10.4 | 415 | B25673L4102A 10 | 14.5 | 3 x 64.1 | 100 x 162 | 1 | 1 | 1.4 |
| 12.5 | 415 | B25673L4122A510 | 17.4 | 3 x 77 | 100 x 200 | 1 | 1 | 1.7 |
| 15 | 415 | B25673L4152A 10 | 20.9 | 3 x 92.5 | 100 x 200 | 1 | 1 | 1.7 |
| 20.8 | 415 | B25673L4202A810 | 28.9 | 3 x 128.2 | 116 x 200 | 1 | 1 | 2.2 |
| 25 | 415 | B25673L4252A 11 | 35 | 3 x 154 | 136 x 200 | 1 | 1 | 3.2 |
| PhaseCap Super Heavy Duty - 440 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 5 | 440 | B25673L4052A 40 | 6.6 | 3 x 27.4 | 85 x 125 | 1 | 1 | 0.8 |
| 7.5 | 440 | B25673L4072A540 | 9.8 | 3 x 41.1 | 85 x 162 | 1 | 1 | 1.0 |
| 10.4 | 440 | B25673L4102A 40 | 13.6 | 3 x 57 | 100 x 162 | 1 | 1 | 1.4 |
| 12.5 | 440 | B25673L4122A540 | 16.4 | 3 x 68.5 | 100 x 162 | 1 | 1 | 1.4 |
| 15 | 440 | B25673L4152A 40 | 19.7 | 3 x 82.2 | 100 x 200 | 1 | 1 | 1.7 |
| 20 | 440 | B25673L4202A 40 | 26.3 | 3 x 109.7 | 116 x 200 | 1 | 1 | 2.2 |
| 25 | 440 | B25673L4252A 40 | 32.8 | 3 x 137.1 | 116 x 200 | 1 | 1 | 2.2 |
| 30 | 440 | B25673L4302A 41 | 39.2 | 3 x 164 | 136 x 200 | 1 | 1 | 3.2 |
| 33 | 440 | B25673L4332A 41 | 43.3 | 3 x 181 | 136 x 200 | 1 | 1 | 3.2 |
| PhaseCap Super Heavy Duty - 480 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 5.5 | 480 | B25673L4052A580 | 6.6 | 3 x 25.3 | 85 x 125 | 1 | 1 | 0.7 |
| 6.3 | 480 | B25673L4062A380 | 7.6 | 3 x 29 | 85 x 162 | 1 | 1 | 1.0 |
| 8.3 | 480 | B25673L4082A380 | 10 | 3 x 38.2 | 85 x 162 | 1 | 1 | 1.0 |
| 11 | 480 | B25673L4112A 80 | 13.2 | 3 x 50.7 | 100 x 162 | 1 | 1 | 1.7 |
| 13.8 | 480 | B25673L4132A880 | 16.6 | 3 x 63.6 | 100 x 200 | 1 | 1 | 1.7 |
| 16.7 | 480 | B25673L4162A780 | 20.1 | 3 x 76.9 | 100 x 200 | 1 | 1 | 1.7 |
| 22 | 480 | B25673L4222A 80 | 26.5 | 3 x 101.4 | 116 x 200 | 1 | 1 | 2.2 |
| 28 | 480 | B25673L4282A 81 | 33.4 | 3 x 128 | 136 x 200 | 1 | 1 | 3.2 |
| PhaseCap Super Heavy Duty - 525 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 6.6 | 525 | B25673L5062A620 | 7.3 | 3 x 25.4 | 85 x 162 | 1 | 1 | 1.0 |
| 10 | 525 | B25673L5102A 20 | 11 | 3 x 38.5 | 100 x 162 | 1 | 1 | 1.7 |
| 13.2 | 525 | B25673L5132A220 | 14.5 | 3 x 50.8 | 100 x 200 | 1 | 1 | 1.7 |
| 16.7 | 525 | B25673L5162A720 | 18.4 | 3 x 64.3 | 116 x 200 | 1 | 1 | 2.2 |
| 20 | 525 | B25673L5202A 20 | 22 | 3 x 77 | 116 x 200 | 1 | 1 | 2.2 |
| 26.5 | 525 | B25673L4262A581 | 29.2 | 3 x 102.1 | 136 x 200 | 1 | 1 | 3.2 |

PhaseCap Super Heavy Duty PFC Capacitors

Semi-dry biodegradable resin • Concentric winding • Wavy cut • Dual safety system



| PhaseCap Super Heavy Duty PFC Capacitors - 3 Phase | | | | | | | | |
|---|-------------------|-----------------|---------------------|---------------------|-------------|------------------|-----|----------------------|
| Rating KVA _r | Voltage V (AC) | Material code | I _R A | C _N F | d x h mm | Packing units | MOQ | Approx. weight Kg |
| PhaseCap Super Heavy Duty - 690 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 5 | 690 | B25673L6052A 90 | 4.2 | 3 x 11.2 | 116 x 164 | 1 | 1 | 2.1 |
| 7.5 | 690 | B25673L6072A590 | 6.3 | 3 x 16.7 | 116 x 164 | 1 | 1 | 2.1 |
| 10 | 690 | B25673L6102A 90 | 8.4 | 3 x 22.5 | 116 x 164 | 1 | 1 | 2.1 |
| 12.5 | 690 | B25673L6122A590 | 10.5 | 3 x 27.9 | 116 x 164 | 1 | 1 | 2.1 |
| 15 | 690 | B25673L6152A 90 | 12.6 | 3 x 33.5 | 116 x 164 | 1 | 1 | 2.2 |
| 20.8 | 690 | B25673L6202A890 | 17.4 | 3 x 46.5 | 136 x 200 | 1 | 1 | 3.2 |
| 25 | 690 | B25673L6252A 90 | 20.9 | 3 x 55.7 | 136 x 200 | 1 | 1 | 3.2 |
| PhaseCap Super Heavy Duty - 800 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 5 | 800 | B25673L8052A000 | 3.6 | 3 x 8.3 | 116 x 164 | 1 | 1 | 2.1 |
| 7.5 | 800 | B25673L8072A500 | 5.4 | 3 x 12.4 | 116 x 164 | 1 | 1 | 2.1 |
| 10.0 | 800 | B25673L8102A000 | 7.2 | 3 x 16.6 | 116 x 164 | 1 | 1 | 2.1 |
| 12.5 | 800 | B25673L8122A500 | 9 | 3 x 20.7 | 116 x 164 | 1 | 1 | 2.1 |
| 15 | 800 | B25673L8152A000 | 10.8 | 3 x 24.9 | 116 x 164 | 1 | 1 | 2.1 |
| 20 | 800 | B25673L8202A000 | 15 | 3 x 33.2 | 136 x 200 | 1 | 1 | 3.2 |
| 25 | 800 | B25673L8252A000 | 18 | 3 x 41.4 | 136 x 200 | 1 | 1 | 3.2 |
| 28 | 800 | B25673L8252A000 | 20.2 | 3 x 46.4 | 136 x 200 | 1 | 1 | 3.2 |
| PhaseCap Super Heavy Duty - 900 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 10.4 | 900 | B25673L9102A400 | 6.7 | 3 x 13.6 | 116 x 164 | 1 | 1 | 2.0 |
| 12.5 | 900 | B25673L9122A500 | 8 | 3 x 16.4 | 116 x 164 | 1 | 1 | 2.0 |
| 15 | 900 | B25673L9152A000 | 9.6 | 3 x 19.7 | 116 x 200 | 1 | 1 | 2.4 |
| 20 | 900 | B25673L9202A000 | 12.8 | 3 x 26.2 | 136 x 200 | 1 | 1 | 3.1 |
| 25 | 900 | B25673L9252A000 | 16 | 3 x 32.7 | 136 x 200 | 1 | 1 | 3.1 |
| PhaseCap Super Heavy Duty - 1000 V(AC) 3PH, 50Hz (Series B25673) | | | | | | | | |
| 10.4 | 1000 | B25673L0102A400 | 6 | 3 x 11.0 | 116 x 164 | 1 | 1 | 2.0 |
| 12.5 | 1000 | B25673L0122A500 | 7.2 | 3 x 13.3 | 116 x 164 | 1 | 1 | 2.0 |
| 15 | 1000 | B25673L0152A000 | 8.7 | 3 x 15.9 | 116 x 200 | 1 | 1 | 2.4 |
| 20 | 1000 | B25673L0202A000 | 11.6 | 3 x 21.2 | 136 x 200 | 1 | 1 | 3.1 |
| 25 | 1000 | B25673L0252A000 | 14.4 | 3 x 26.5 | 136 x 200 | 1 | 1 | 3.1 |

Packing units for capacitors equal minimum order quantity. Orders will be rounded up to packing unit or multiple thereof.

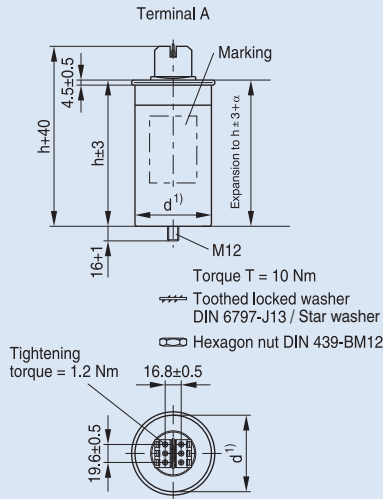
PhaseCap Super Heavy Duty PFC Capacitors

Semi-dry biodegradable resin • Concentric winding • Wavy cut • Dual safety system



Dimensional drawings

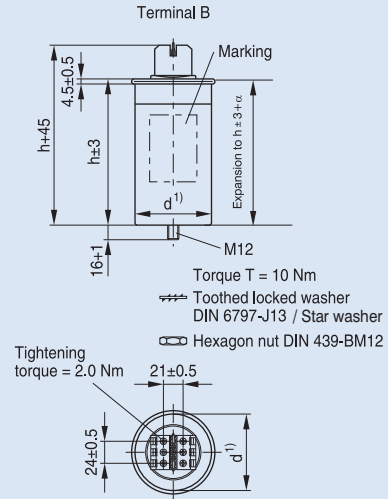
Terminal type A, current up to 50 A
Terminal cross section 16 mm² (without cable end lug)



- 1) Seaming adds 5.5 mm in diameter
- 2) Expansion α max. 15 mm

KLK1829-H-E

Terminal type B, current up to 80 A
Terminal cross section 25 mm² (without cable end lug)



- 1) Seaming adds 5.5 mm in diameter
- 2) Expansion α max. 15 mm

KLK1833-A-E