

Product Profile 2025

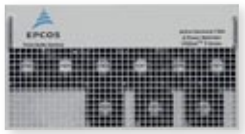
Power Quality Solutions

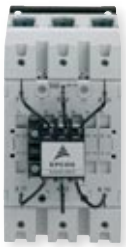












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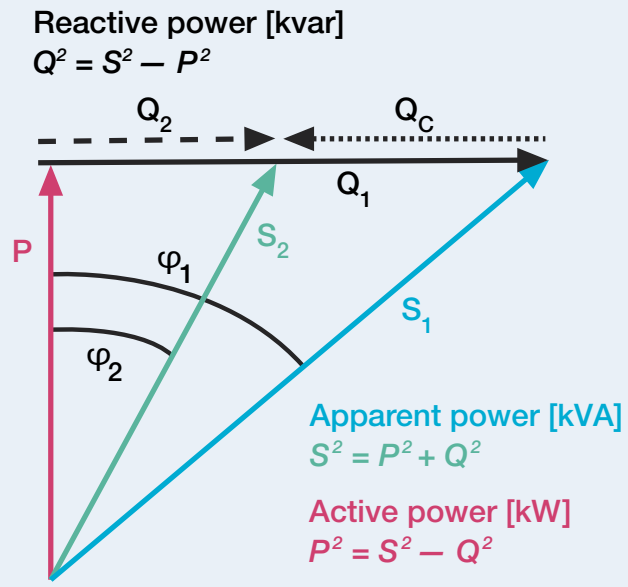
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Power Quality Solutions Preview

Reactive power



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

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

General

The growing demand for electrical power, combined with increasing awareness of energy conservation, has made power quality a priority. As a result, power factor correction (PFC) and harmonic mitigation are being adopted more widely. Power factor improvement frees up the capacity of the electrical distribution systems, reduces transmission losses, and enhances the overall efficiency of power delivery. It also enables better voltage regulation at the low voltage distribution level.

Harmonic mitigation is key to ensure safe, reliable and efficient operation of the system. Higher frequency harmonics components (multiples of 50/60 Hz) are responsible for heating of the busbars, cables, transformers and all other devices through which these currents are flowing. They are also responsible for reverse torque in induction motors, nuisance tripping of the protection relays and frequent failures of the power/control cards in the rectifiers, inverters, and other non-linear loads.

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.

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Preview

Power quality solutions



Power factor
Low power factor (cos φ)

Low cos ϕ 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

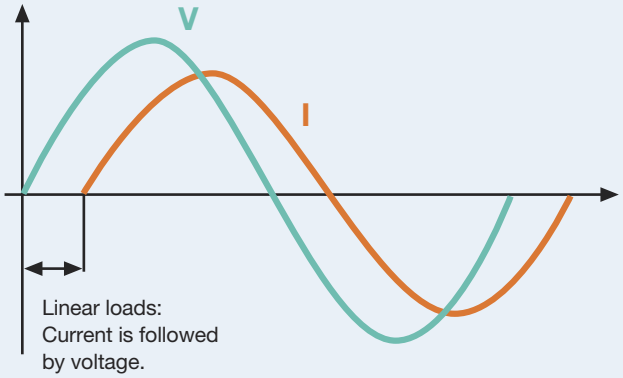
Power factor improvement can be achieved by

- compensation of reactive power with capacitors,
- active compensation – using semiconductors,
- overexcited synchronous machine (motor/generator).

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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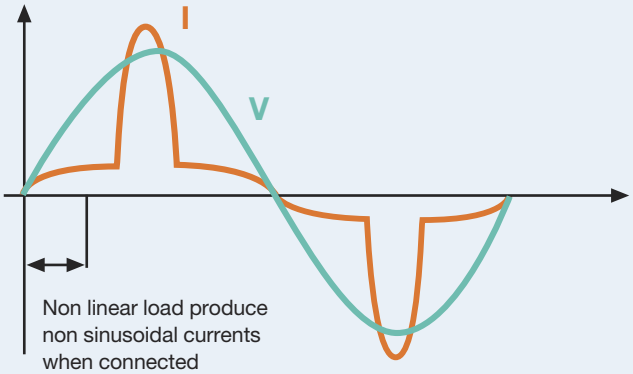
Preview

Linear loads



Linear loads:
Current is followed
by voltage.

Non linear loads



Non linear load produce
non sinusoidal currents
when connected
to sinusoidal voltage.

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.

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PFC Capacitor Series Overview

PFC capacitor series for power factor correction and detuned filter

Parameter		PhaseCap Energy Plus (Resin)	PhaseCap Energy Plus (Gas)	PhiCap Extra Heavy Duty (Gas)
Reactive power	Q_N	5.0 … 60.0 kvar	5.0 … 33.1 kvar	6.3 … 33.1 kvar
Rated voltage	V_N	230 … 1000 V AC	230 … 690 V AC	415 … 525 V AC
Inrush current	I_S	Up to 500 I_N <33.1 kvar Up to 400 I_N >33.1 kvar	Up to 500 · I_N	Up to 300 · I_N
Temperature class		**–40/+60 °C ≤33.1 kvar:** Max. temp. +60 °C Max. mean 24 h = +50 °C Max. mean 1 year = +40 °C Lowest temperature = –40 °C **–40/+60 °C >33.1 kvar:** Max. temp. +55 °C Max. mean 24 h = +45 °C Max. mean 1 year = +35 °C Lowest temperature = –40 °C	**–40/+60 °C:** Max. temp. +60 °C Max. mean 24 h = +50 °C Max. mean 1 year = +40 °C Lowest temperature = –40 °C	**–40/D:** Max. short time: +55 °C Max. mean 24 h: +45 °C Max mean 1 year: +35 °C Lowest temperature: –40 °C
Losses: **– Dielectric** **– Total**[1]	 Q_L Q_L	 <0.2 W/kvar Approx. 0.35 to 0.45 W/kvar	 <0.2 W/kvar Approx. 0.35 to 0.45 W/kvar	 <0.2 W/kvar <0.45 W/kvar
Max. humidity	H_{rel}	95% (non condensing)	95% (non condensing)	95% (non condensing)
Safety		Self-healing, three-phase overpressure disconnector, touch proof safety terminal	Self-healing, three-phase overpressure disconnector, dry technology, touch proof safety terminal	Self-healing, three-phase overpressure disconnector, dry technology, touch proof safety terminal
Impregnation		Semi-dry biodegradable resin	Non-flammable inert gas	Non-flammable inert gas
Mean life expectancy	t_{LD}	<33.1 kvar: Up to 240 000 h (temp. class –40/D) Up to 220 000 h (temp. class –40/60) >33.1 kvar: Up to 150 000 h (temp. class –40/D)	Up to 220 000 h (temp. class –40/D) Up to 200 000 h (temp. class –40/60)	Up to 180 000 h (temp. class –40/D)
Connection		Optimized isolated capacitor safety terminals, IP20, (VDE 0106 part 100), for current and connection cable details and terminal type association see terminal and capacitor type list	Optimized isolated capacitor safety terminals (IP20), (VDE 0106 part 100), for current and connection cable details and terminal type association see terminal and capacitor type list	Optimized isolated capacitor safety terminals, IP20, (VDE 0106 part 100), for current and connection cable details and terminal type association see terminal and capacitor type list
Cooling		Natural or forced	Natural or forced	Natural or forced
Case/shape		Aluminum/cylindrical	Aluminum/cylindrical	Aluminum/cylindrical
Enclosure		IP20, indoor mounting, optionally with terminal cap for IP54 (for diameter 116 and 136 mm)	IP20, indoor mounting, optionally with terminal cap for IP54 (for diameter 116 and 136 mm)	IP20, indoor mounting
Standard		IEC 60831-1,2, edition 3.0 (2014), UL 810 5th edition cUL file # E238746	IEC 60831-1,2, edition 3.0 (2014), UL 810 5th edition cUL file # E238746	IEC 60831-1
Ordering code		B25675C	B25674C	B32474G
Page		18	26	34
				

[1] Without discharge resistor

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PFC Capacitor Series Overview

PFC capacitor series for power factor correction and detuned filter

Parameter		DeltaCap	PhiCap	PoleCap
Reactive power	Q_N	0.5 … 50.0 kvar	0.5 ... 40.0 kvar	0.5 ... 36.0 kvar
Rated voltage	V_N	230 … 525 V AC	230 ... 525 V AC	400 ... 525 V AC
Inrush current	I_S	Up to 200 · I_N Up to 200 · I_N	Up to 200 · I_N	Up to 300 · I_N
Temperature class		**–40/D:** Max. temp. +55 °C Max. mean 24 h = +45 °C Max. mean 1 year = +35 °C Lowest temperature = –40 °C **–40/C:** Max. temp. +50 °C Max. mean 24 h = +40 °C Max. mean 1 year = +30 °C Lowest temperature = –40 °C	**–40/D:** Max. temp. +55 °C Max. mean 24 h = +45 °C Max. mean 1 year = +35 °C Lowest temperature = –40 °C	**–40/D:** Max. short time: +55 °C Max. mean 24 h: +40 °C Max mean 1 year: +35 °C Lowest temperature: –40 °C
Losses: **– Dielectric** **– Total**[1]	 Q_L Q_L	 <0.20 W/kvar <0.45 W/kvar	 <0.20 W/kvar <0.45 W/kvar	 <0.2 W/kvar <0.6 W/kvar
Max. humidity	H_{rel}	95% (non condensing)	95% (non condensing)	95% (non condensing)
Safety		Self-healing technology – Overpressure disconnector – Isolated terminal (IP20) for B32304 series	Dual (self-healing, overpressure disconnector)	Three-phase overpressure disconnector, self healing, shock proof, dry type (gas impregnated) or resin (impregnated with biodegradable resin)
Impregnation		Biodegradable soft resin, semi-dry	Biodegradable soft resin, semi-dry	Non-flammable inert gas Biodegradable soft resin, semi-dry
Mean life expectancy	t_{LD}	Up to 150 000 h (temp. class –40/C) Up to 115 000 h (temp. class –40/D)	Up to 135 000 h (temp. class –40/C) Up to 100 000 h (temp. class –40/D)	Up to 100 000 h (temp. class –40/D)
Connection		**B32300/B32303 series:** Fast-on terminals **B32301/B32304 series:** Screw terminals, max. 25 mm² cable cross-section	**B32340/B32343 series:** Fast-on terminals **B32344 series:** Optimized capacitor safety terminal, block-type	Touch proof IP20 safety terminals
Cooling		Natural or forced	Natural or forced	Natural or forced
Case/shape		Aluminum/cylindrical	Aluminum/cylindrical	Extruded aluminum can
Enclosure		P00 for B32300 and B32303 IP20 for B32301 and B32304	IP00 for B32340/B32343 series; optionally IP54 for B32344 series with terminal cap	IP54 or IP65, outdoor mounting
Standard		IEC 60831-1,2, EN60831-1,2, VDE approval [2]	IEC 60831-1,2, UL 810 5th edition cUL file # E106388 CSA file # C22.2 N°190 MC # 236094, (up to ø 85 mm), GOST	IEC 60831-1
Ordering code		B32300, B32301 B32303 B32304	B32340C B32343C B32344E	B25671A
Page		39	46	54
				

[2] For most of the types. For detailed information please contact our local sales office.

PFC Key Components Overview

PF controllers					
Parameter	**BR7000-I BR7000-I/S485**	**BR7000-I-TH BR7000-I-TH/S485**	**BR7000/BR7000-HD BR7000-T**	**BR6000-R BR6000-T**	
Supply voltage	110 … 440 V AC ±15%			110 … 230 V AC ±15%	
Measurement voltage range	30 … 440 V AC (L-N), 50 … 760 V AC (L-L)	30 … 440 V AC (L-N) 50 … 760 V AC (L-L)	3 · 30 … 440 V AC (L-N), 3 · 50 … 760 V AC (L-L)	30 … 525 V AC (L-N) or (L-L)	
Measurement current	X:5 A/X:1 A Selectable	X:5 A/X:1 A Selectable	3 x X:5 A/X:1 A Selectable	X/5 or X:1 A Selectable	
Frequency	50/60 Hz				
Sensivity	50 mA/10 mA				

Output stages	**Relay outputs**	**Transistor outputs**	**Interface**	**Dynamic PFC**	**Ordering code**
BR7000-I	12+1	–	–	no	B44066R7012E230
BR7000-I/S485	12+1	–	RS485	no	B44066R7112E230
BR7000-I-TH	12	12	–	Yes	B44066R7412E230
BR7000-I-TH/S485	12	12	RS485	Yes	B44066R7612E230
BR7000	15	–	2× RS485	no	B44066R7415E230
BR7000-T	–	15	2× RS485	Yes	B44066R7615E230
BR6000-R6	6	–	–	no	B44066R6006E230
BR6000-R12	12	–	–	no	B44066R6012E230
BR6000-T6	–	6	–	Yes	B44066R6106E230
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BR7000



BR6000

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PFC Key Components Overview

Switching devices			
Parameter	**Capacitor contactors**	**Thyristor modules**	**Reactors – antiresonance harmonic filter**
Operating voltage	230 … 690 V	TSM-LC-I: 230 … 525 V TSM-LC[1]: 380 … 440 V TSM-LC-S: 200 … 440 V TSM-LC-N690: 380 … 690 V	400 and 440 V
Output range	12.5 … 100 kvar	TSM-LC-I: 10 … 22 kvar, depending on voltage TSM-LC[1]: 10 … 200 kvar, depending on the voltage	10 … 100 kvar
Frequency	50 /60 Hz	50/60 Hz	50 or 60 Hz
De-tuning		Suitable for detuned and conventional systems	Factor: 5.67%, 7%, 14%
Ordering code	B44066S…J230/J110 for all PFC systems	TSM-LC-I: B44066T1022E520 TSM-LC[1]: B44066T…E402 TSM-LC-N480: B44066T3850E408 TSM-LC-N690: B44066T3050E690	B44066D…
Page	70	70	74
		 	 

[1] Available in three versions with 10, 100 or 200 kvar

PQSine Ultima Overview

PQSine Ultima Active Harmonic Filter			
Parameter			
Rated voltage (range)	200 V (176 … 263 V)	400 V (228 … 456 V)	480 V (384 … 528 V)
Individiual module capacity	25, 35, 50, 60, 100, 150 A		
Mains frequency	50/60 Hz, auto sensing (range : 45 Hz~62.5 Hz)		
Neutral filtering capability	Up to 3 times of the rated filter current >97%		
Harmonic current compensation range	2^{nd} to 51^{st} harmonic order and selectable for each order		
Rate of harmonic reduction	>97% (for both odd and even harmonic)		
Efficiency	≈ 99%		
Target power factor	Adjustable from –1 to 1		
Reaction time	<50 µs		
Overall response time	<15 ms		
Display	4.3-inch HMI (module), 7-inch HMI (central monitor) and LED		
Communication ports	RS485 and network port (RJ45)		
Communication protocols	Modbus RTU, TCP/IP (Ethernet)		
Protection functions	Overvoltage protection, undervoltage protection, inverter bridge inverse protection, overcompensation protection		
Operating temperature	–10 to +50 °C (will derate capacity if ambient temperature exceeds +40 °C)		
Protection class	IP20 (IP grade can be customizable)		
Ordering code	B44066F…S…		
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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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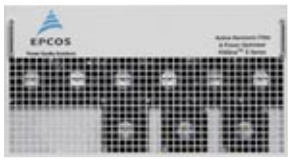
PQvar Ultima Overview

PQvar Ultima Static Var Generator			
Parameter			
Rated voltage (range)	200 V (176 … 263 V)	400 V (228 … 456 V)	480 V (384 … 528 V)
Individiual module capacity	30, 50, 75, 100 kvar		
Mains frequency	50/60 Hz (range: 45 … 62.5 Hz)		
Parallel operation	Unlimited		
Response time	<15 ms		
Overall efficiency	≈ 99%		
Power grid structure	3P3W/ 3P4W		
Current transformers	150/5 … 10 000/5		
Circuit topology	Silicon Carbide (SiC) MOSFET		
Target power factor	Adjustable from –1 to +1		
Cabinet mounting	Wall-mounted, rack-mounted and cabinet		
Display	4.3-inch HMI (module), 7-inch HMI (central monitor) and LED		
Communication ports	RS485 and ethernet port (RJ45)		
Communication protocols	Modbus RTU, TCP/IP		
Protection functions	Overvoltage protection, undervoltage protection, inverter bridge inverse protection, overcompensation protection		
Operating temperature	–10 to +50 °C (will derate capacity if ambient temperature exceeds +40 °C)		
Protection class	IP20 (IP grade can be customizable)		
Ordering code	B44066F*Q/ B44066F*K		
Page	105		



PQSine S Series Overview

PQSine S series Active Harmonic Filter		
Parameter		
Rated voltage (range)	200 V (173 … 263 V); 400 V (228 … 456 V)	480 V (384 … 552 V); 600 V (420 … 690 V); 690 V (483 … 793 V)
Individual module capacity	25, 35, 50, 60, 100, 150 A	50, 75, 100 A
Neutral filtering capability	3 times the rated filter current (in case of four-wire device)	
Harmonic current compensation range	Up to 51st harmonic order	
Rate of harmonic reduction	>97%[1)]	
Typical power losses	<3%, depending on the load	
Target power factor	Adjustable from –1 to 1	
Reaction time	Approx. 50 µs	
Overall response time	<15 ms	
Display	All systems include a 7" TFT color control / display unit (touch screen)	
Communication ports	RS485 and network port (RJ45)	
Communication protocols	Modbus RTU, TCP/IP (Ethernet)	
Fault alarm	Available, max. 500 alarm records	
Operating temperature	–10 to +40 °C (higher temperatures with derating)	
Protection class	IP 20 according to IEC 529 (other IP classes are customizable)	
Ordering code	B44066F…S…	
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[1)] For typical harmonic order distortions

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PQvar S Series Overview

PQvar S series Static Var Generator					
Parameter					
Rated voltage (range)	240 V (176 … 263 V)	400 V (228 … 456 V)	480 V (384 … 552 V)	600 V (420 … 690 V)	690 V (483 … 793 V)
Individiual module capacity	15, 30, 50 kvar	30, 50, 100 kvar	40, 80 kvar	50, 100 kvar	60, 120 kvar
Mains frequency	50/60 Hz (range: 45 … 62 Hz)				
Parallel operation	Unlimited				
Response time	<15 ms				
Overall efficiency	>97%				
Power grid structure	3P3W/ 3P4W				
Current transformers	150/5 … 10 000/5				
Circuit topology	3-level				
Target power factor	Adjustable from –1 to +1				
Cabinet mounting	Floor-mounted, wall-mounted				
Communication ports	RS485, TCP/IP				
Communication protocols	Modbus				
Noise level	<65 dB (depending on the model)				
Protection functions	Overvoltage, undervoltage, short-circuit, inverter bridge inverse, overcompensation				
Operating temperature	–10 to +40 °C (higher temperatures with derating)				
Protection class	IP20 (other IP classes are customizable)				
Ordering code	B44066F…V…				
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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 we are 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 a 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.tdk-electronics.tdk.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 our General Terms and Conditions of Supply.**
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.
8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, FilterCap, FormFit, InsuGate, LeaXield, MediPlas, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PiezoBrush, PlasmaBrush, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SurfIND, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

Release 2024-02

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PFC Capacitors

PhaseCap Energy Plus (Resin)

PhaseCap Energy Plus (Gas)

PhiCap Extra Heavy Duty (Gas) NEW

DeltaCap

PhiCap

PoleCap

PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V



General

The PhaseCap Energy Plus Resin represents the premium range of capacitors for power factor correction (PFC).

PhaseCap Energy Plus Resin offers expected service life of up to 240 000 hours, an increased inrush current capability of up to 500 · I_N and optimized can dimensions make the PhaseCap Energy Plus Resin the ideal capacitor for industrial applications that call for high reliability.

PhaseCap Energy Plus resin developed with sustainable material called biodegradable soft resin. PhaseCap Energy Plus is equipped with self- healing properties and three-phase overpressure disconnector.

A voltage range from 230 to 1000 V outputs of 5.0 to 60.0 kvar and four different terminal types allow the selection of the customized capacitor type.

Applications

- Electro-intensive applications (e.g. steel, cement, textile, automobile)
- Automatic PFC equipment, capacitor banks
- Individual fixed PFC (e.g. motors, transformers, lighting)
- Group fixed PFC
- Tuned and detuned capacitor banks
- Dynamic PFC

Features

- Robust, reliable and compact design
- Most comprehensive range of superior capacitors
- MKK-technology with wavy cut and heavy edge
- Voltage range 230 … 1000 V
- Output range 5.0 … 60 kvar
- Ultra long life expectancy up to 240 000 hours at temperature class –40/D
- Very high inrush current capability of up to 500 · I_N
- High pulse current withstand capability
- High long-term stability
- Reduced mounting costs
- Maintenance-free (except for the recommended periodic checks).
- Highest packing density thanks to compact dimensions

Safety

- Self-healing
- Three-phase overpressure disconnector
- Touch proof IP20 safety terminal
- Safe discharging: Pre-mounted ceramic base discharge resistor or discharge resistor module (depending upon the type)
- cUL approval
- Biodegradable semi dry resin impregnation

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Technical data and specifications

Standards IEC 60831-1,2, UL 810		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min daily)
Overcurrent	I_{max}	Up to 2.0 · I_N <33.1 kvar Up to 1.6 · I_N >33.1 kvar (depending on the particular type) including combined effects of harmonics, overvoltages and capacitance tolerance
Inrush current	I_S	Up to 500 · I_N <33.1 kvar Up to 400 · I_N >33.1 kvar
Losses: **– Dielectric** **– Total** [1]		 <0.2 W/kvar Approx. 0.35 to 0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		–5% / +5%
Test voltage, terminal / terminal	V_{TT}	2.15 · V_N, AC, 2 s
Test voltage, terminal / case	V_{TC}	3600 V AC / 50 Hz, 2 s up to V_N = 525 V, 6000 V AC / 50 Hz, 2 s above V_N = 525 V
Mean life expectancy	t_{LD}	<33.1 kvar: Up to 240 000 h (temp. class –40/D) up to 220 000 h (temp. class –40/60) >33.1 kvar: Up to 150 000 h (temp. class –40/D)
Ambient temperature		Up to 33.1 kvar: –40/60; max. temp. +60 °C; max. mean 24 h = +50 °C; max. mean 1 year = +40 °C; lowest temperature = –40 °C Above 33.1 kvar: –40/D; max. temp. +55 °C; max. mean 24 h = +45 °C; max. mean 1 year = +35 °C; lowest temperature = –40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Upright / horizontal (depending on the particular type)
Mounting and grounding		Threaded M12 stud on bottom of case
Safety		Three-phase overpressure disconnector, self-healing, maximum allowed fault current 10 000 A in accordance with UL 810 standard
Discharge device		Ceramic discharge module or discharge module block (depending on the particular type)
Case		Extruded aluminum can
Enclosure		IP20, indoor mounting (optionally with terminal cap for IP54)
Dielectric		Polypropylene film
Impregnation		B25675C: Semi-dry biodegradable resin
Terminals		Optimized capacitor safety terminal with electric shock protection (IP20), (VDE 0106 part 100), max. 25 mm^2 cable cross-section, max. current 80 A
Certification		cUL file # E238746 (up to 33.1 kvar, 600 V ratings)
Number of switching operations		Up to 15 000 switchings per year (depending on the particular type)

[1] Without discharge resistor

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Resin filled capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 230 V AC, delta connection										
MKK230-D-5.0-04	5.0	12.6[5)]	6.0	15.1[2)]	3 x 100.3	A	75 x 218	1.1	B25675C2052J030	9
MKK230-D-7.5-04	7.5	18.8[5)]	9.0	22.6[2)]	3 x 150.4	B	100 x 192	1.8	B25675C2072J530	6
MKK230-D-10.0-04	10.0	25.1[4)]	12.0	30.1[2)]	3 x 200.5	B	100 x 224	2.1	B25675C2102J030	4
MKK230-D-12.5-04	12.5	31.4[2)]	15.0	37.7	3 x 250.7	B	116 x 207	2.6	B25675C2122J530	4
MKK230-D-15.0-04	15.0	37.7[1)]	–	–	3 x 300.8	B	125 x 207	3.0	B25675C2152J030	4
Rated voltage 400 V AC, delta connection										
MKK400-D-5.0-04	5.0	7.2[5)]	6.0	8.7[2)]	3 x 33.2	A	75 x 164	0.9	B25675C4052J000	6
MKK400-D-6.3-04	6.3	9.1[5)]	7.6	11.0[2)]	3 x 41.8	A	75 x 164	0.9	B25675C4062J300	6
MKK400-D-7.5-04	7.5	10.8[5)]	9.0	13.0[2)]	3 x 49.7	A	75 x 200	1.1	B25675C4072J500	6
MKK400-D-8.3-04	8.3	12.0[5)]	10.0	14.4[2)]	3 x 55.0	A	75 x 200	1.1	B25675C4082J300	6
MKK400-D-10.4-04	10.4	15.0[4)]	12.5	18.0[1)]	3 x 69.0	A	75 x 218	1.1	B25675C4102J400	9
MKK400-D-12.5-04	12.5	18.0[4)]	15.0	21.7[1)]	3 x 82.9	A	85 x 200	1.3	B25675C4122J500	9
MKK400-D-15.0-04	15.0	21.7[3)]	18.0	26.0[1)]	3 x 99.5	A	85 x 218	1.5	B25675C4152J000	4
MKK400-D-16.7-04	16.7	24.1[2)]	20.0	28.9[1)]	3 x 110.7	B	100 x 207	1.9	B25675C4162J700	6
MKK400-D-20.0-04	20.0	28.9[1)]	24.0	34.6[1)]	3 x 132.6	B	100 x 224	2.1	B25675C4202J000	4
MKK400-D-25.0-04	25.0	36.1[1)]	30.0	43.3[1)]	3 x 165.8	B	116 x 192	2.4	B25675C4252J000	4
MKK400-D-28.1-04	28.1	40.6[1)]	–	–	3 x 186.3	B	125 x 192	2.8	B25675C4282J100	4
MKK400-D-30.0-04	30.0	43.3[1)]	–	–	3 x 198.9	B	116 x 224	2.8	B25675C4302J000	4
MKK400-D-33.0-04	33.0	47.6[1)]	–	–	3 x 218.8	B	125 x 207	3.0	B25675C4332J000	4
MKK400-D-40.0-04	40.0	57.7[1)]	48.0	69.3[1)]	3 x 265.2	F	136 x 233	3.7	B25675C4402J000	4
MKK400-D-50.0-04	50.0	72.2[1)]	60.0	86.6[1)]	3 x 331.5	F	136 x 312	5.0	B25675C4502J000	2
Rated voltage 415 V AC, delta connection										
MKK415-D-5.0-04	5.0	7.0[5)]	6.0	8.3[2)]	3 x 30.8	A	75 x 164	0.9	B25675C4052J015	6
MKK415-D-6.3-04	6.3	8.8[5)]	7.6	10.6[2)]	3 x 38.8	A	75 x 164	0.9	B25675C4062J315	6
MKK415-D-7.5-04	7.5	10.4[5)]	9.0	12.5[2)]	3 x 46.2	A	75 x 200	1.1	B25675C4072J515	6
MKK415-D-8.3-04	8.3	11.5[5)]	10.0	13.9[2)]	3 x 51.1	A	75 x 200	1.1	B25675C4082J315	6
MKK415-D-10.4-04	10.4	14.5[5)]	12.5	17.4[2)]	3 x 64.1	A	75 x 200	1.1	B25675C4102J415	6
MKK415-D-12.5-04	12.5	17.4[4)]	15.0	20.9[1)]	3 x 77.0	A	85 x 200	1.3	B25675C4122J515	9
MKK415-D-15.0-04	15.0	20.9[3)]	18.0	25.0[1)]	3 x 92.4	A	85 x 200	1.3	B25675C4152J015	9
MKK415-D-16.7-04	16.7	23.2[2)]	20.0	27.8[1)]	3 x 102.9	B	100 x 207	1.9	B25675C4162J715	6
MKK415-D-20.0-04	20.0	27.8[1)]	24.0	33.4[1)]	3 x 123.2	B	100 x 207	1.9	B25675C4202J015	6
MKK415-D-25.0-04	25.0	34.8[1)]	30.0	41.7[1)]	3 x 154.0	B	116 x 192	2.4	B25675C4252J015	4
MKK415-D-28.1-04	28.1	39.1[1)]	–	–	3 x 173.1	B	116 x 207	2.6	B25675C4282J115	4
MKK415-D-30.0-04	30.0	41.7[1)]	–	–	3 x 184.8	B	116 x 207	2.6	B25675C4302J015	4
MKK415-D-33.0-04	33.0	45.9[1)]	–	–	3 x 203.3	B	116 x 224	2.8	B25675C4332J015	4
MKK415-D-40.0-04	40.0	55.6[1)]	48.0	66.8[1)]	3 x 246.4	F	136 x 217	3.7	B25675C4402J015	4
MKK415-D-50.0-04	50.0	69.6[1)]	60.0	83.5[1)]	3 x 308.0	F	136 x 279	4.5	B25675C4502J015	2

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Resin filled capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 440 V AC, delta connection										
MKK440-D-5.0-04	5.0	6.6[5)]	6.0	7.9[2)]	3 x 27.4	A	75 x 164	0.9	B25675C4052J040	6
MKK440-D-6.0-04	6.0	7.9[5)]	7.2	9.4[2)]	3 x 32.9	A	75 x 164	0.9	B25675C4062J040	6
MKK440-D-6.3-04	6.3	8.3[5)]	7.6	10.0[2)]	3 x 34.5	A	75 x 164	0.9	B25675C4062J340	6
MKK440-D-7.0-04	7.0	9.2[5)]	8.4	11.0[2)]	3 x 38.4	A	75 x 200	1.1	B25675C4072J040	6
MKK440-D-7.5-04	7.5	9.8[5)]	9.0	11.8[2)]	3 x 41.1	A	75 x 200	1.1	B25675C4072J540	6
MKK440-D-8.0-04	8.0	10.5[5)]	9.6	12.6[2)]	3 x 43.8	A	75 x 200	1.1	B25675C4082J040	6
MKK440-D-8.3-04	8.3	10.9[5)]	10.0	13.1[2)]	3 x 45.5	A	75 x 200	1.1	B25675C4082J340	6
MKK440-D-9.0-04	9.0	11.8[5)]	10.8	14.2[2)]	3 x 49.3	A	75 x 200	1.1	B25675C4092J040	6
MKK440-D-10.0-04	10.0	13.1[4)]	12.0	15.7[1)]	3 x 54.8	A	75 x 200	1.1	B25675C4102J040	6
MKK440-D-10.4-04	10.4	13.6[4)]	12.5	16.4[1)]	3 x 57.0	A	85 x 200	1.3	B25675C4102J440	9
MKK440-D-12.0-04	12.0	15.7[4)]	14.4	18.9[1)]	3 x 65.8	A	85 x 200	1.3	B25675C4122J040	9
MKK440-D-12.5-04	12.5	16.4[4)]	15.0	19.7[1)]	3 x 68.5	A	85 x 200	1.3	B25675C4122J540	9
MKK440-D-14.2-04	14.2	18.6[4)]	17.0	22.3[1)]	3 x 77.8	A	85 x 200	1.3	B25675C4142J240	9
MKK440-D-15.0-04	15.0	19.7[3)]	18.0	23.6[1)]	3 x 82.2	A	85 x 218	1.5	B25675C4152J040	4
MKK440-D-16.7-04	16.7	21.9[2)]	20.0	26.2[1)]	3 x 91.5	B	100 x 207	1.9	B25675C4162J740	6
MKK440-D-18.8-04	18.8	24.7[2)]	22.6	29.7[1)]	3 x 103.0	B	100 x 207	1.9	B25675C4182J840	6
MKK440-D-20.0-04	20.0	26.2[1)]	24.0	31.5[1)]	3 x 109.6	B	100 x 207	1.9	B25675C4202J040	6
MKK440-D-25.0-04	25.0	32.8[1)]	30.0	39.4[1)]	3 x 137.0	B	116 x 192	2.4	B25675C4252J040	4
MKK440-D-28.1-04	28.1	36.9[1)]	–	–	3 x 154.0	B	116 x 207	2.6	B25675C4282J140	4
MKK440-D-30.0-04	30.0	39.4[1)]	–	–	3 x 164.4	B	125 x 192	2.8	B25675C4302J040	4
MKK440-D-33.1-04	33.1	43.4[1)]	–	–	3 x 181.4	B	116 x 224	2.8	B25675C4332J140	4
MKK440-D-40.0-04	40.0	52.5[1)]	48.0	63.0[1)]	3 x 219.2	F	136 x 217	3.7	B25675C4402J040	4
MKK440-D-50.0-04	50.0	65.6[1)]	60.0	78.7[1)]	3 x 274.0	F	136 x 279	4.5	B25675C4502J040	2
MKK440-D-56.0-04	56.0	73.5[1)]	–	–	3 x 306.9	F	136 x 312	5.0	B25675C4562J040	2
MKK440-D-60.0-04	60.0	78.7[1)]	–	–	3 x 328.8	F	136 x 312	5.0	B25675C4602J040	2
Rated voltage 480 V AC, delta connection										
MKK480-D-5.0-04	5.0	6.0[5)]	6.0	7.2[2)]	3 x 23.0	A	75 x 164	0.9	B25675C4052J080	6
MKK480-D-6.3-04	6.3	7.6[5)]	7.6	9.1[2)]	3 x 29.0	A	75 x 164	0.9	B25675C4062J380	6
MKK480-D-7.5-04	7.5	9.0[5)]	9.0	10.8[2)]	3 x 34.5	A	75 x 200	1.1	B25675C4072J580	6
MKK480-D-8.3-04	8.3	10.0[5)]	10.0	12.0[2)]	3 x 38.2	A	75 x 200	1.1	B25675C4082J380	6
MKK480-D-10.4-04	10.4	12.5[5)]	12.5	15.0[2)]	3 x 47.9	A	75 x 200	1.1	B25675C4102J480	6
MKK480-D-11.0-04	11.0	13.2[5)]	13.2	15.9[2)]	3 x 50.7	A	85 x 200	1.3	B25675C4112J080	9
MKK480-D-12.5-04	12.5	15.0[4)]	15.0	18.0[1)]	3 x 57.6	A	85 x 200	1.3	B25675C4122J580	9
MKK480-D-13.8-04	13.8	16.6[4)]	16.6	20.0[1)]	3 x 63.5	A	85 x 200	1.3	B25675C4132J880	9
MKK480-D-15.0-04	15.0	18.0[3)]	18.0	21.7[1)]	3 x 69.1	B	100 x 207	1.9	B25675C4152J080	6
MKK480-D-16.7-04	16.7	20.1[2)]	20.0	24.1[1)]	3 x 76.9	B	100 x 207	1.9	B25675C4162J780	6
MKK480-D-20.0-04	20.0	24.1[2)]	24.0	28.9[1)]	3 x 92.1	B	100 x 207	1.9	B25675C4202J080	6
MKK480-D-20.8-04	20.8	25.0[1)]	25.0	30.1[1)]	3 x 95.8	B	116 x 207	2.6	B25675C4202J880	4
MKK480-D-22.0-04	22.0	26.5[1)]	26.4	31.8[1)]	3 x 101.3	B	116 x 207	2.6	B25675C4222J080	4
MKK480-D-25.0-04	25.0	30.1[1)]	30.0	36.1[1)]	3 x 115.1	B	116 x 192	2.4	B25675C4252J080	4
MKK480-D-28.1-04	28.1	33.8[1)]	–	–	3 x 129.4	B	116 x 207	2.6	B25675C4282J180	4
MKK480-D-30.0-04	30.0	36.1[1)]	–	–	3 x 138.1	B	125 x 192	2.8	B25675C4302J080	4
MKK480-D-31.0-04	31.0	37.3[1)]	–	–	3 x 142.7	B	125 x 192	2.8	B25675C4312J080	4
MKK480-D-33.0-04	33.0	39.7[1)]	–	–	3 x 154.0	B	116 x 224	2.8	B25675C4332J080	4
MKK480-D-40.0-04	40.0	48.1[1)]	48.0	57.7[1)]	3 x 184.2	F	136 x 217	3.7	B25675C4402J080	4
MKK480-D-50.0-04	50.0	60.1[1)]	60.0	72.2[1)]	3 x 230.2	F	136 x 279	4.5	B25675C4502J080	2
MKK480-D-56.0-04	56.0	67.4[1)]	–	–	3 x 257.9	F	136 x 312	5.0	B25675C4562J080	2
MKK480-D-60.0-04	60.0	72.2[1)]	–	–	3 x 276.3	F	136 x 312	5.0	B25675C4602J080	2

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PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Resin filled capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 525 V AC, delta connection										
MKK525-D-5.0-04	5.0	5.5[5)]	6.0	6.6[2)]	3 x 19.2	A	75 x 164	0.9	B25675C5052J025	6
MKK525-D-6.3-04	6.3	6.9[5)]	7.6	8.4[2)]	3 x 24.2	A	75 x 164	0.9	B25675C5062J325	6
MKK525-D-7.5-04	7.5	8.2[5)]	9.0	9.9[2)]	3 x 28.9	A	75 x 185	1.0	B25675C5072J525	6
MKK525-D-8.3-04	8.3	9.1[5)]	10.0	11.0[2)]	3 x 31.9	A	75 x 200	1.1	B25675C5082J325	6
MKK525-D-10.4-04	10.4	11.4[5)]	12.5	13.7[2)]	3 x 40.0	A	85 x 185	1.2	B25675C5102J425	9
MKK525-D-12.5-04	12.5	13.7[5)]	15.0	16.5[2)]	3 x 48.1	A	85 x 200	1.3	B25675C5122J525	9
MKK525-D-13.2-04	13.2	14.5[5)]	15.8	17.4[2)]	3 x 50.8	A	85 x 200	1.3	B25675C5132J225	9
MKK525-D-15.0-04	15.0	16.5[4)]	18.0	19.8[1)]	3 x 57.7	A	85 x 218	1.5	B25675C5152J025	4
MKK525-D-16.7-04	16.7	18.4[3)]	20.0	22.0[1)]	3 x 64.3	B	100 x 207	1.9	B25675C5162J725	6
MKK525-D-20.0-04	20.0	22.0[2)]	24.0	26.4[1)]	3 x 77.0	B	100 x 224	2.1	B25675C5202J025	4
MKK525-D-20.8-04	20.8	22.9[2)]	25.0	27.5[1)]	3 x 80.1	B	100 x 224	2.1	B25675C5202J825	4
MKK525-D-25.0-04	25.0	27.5[1)]	30.0	33.0[1)]	3 x 96.2	B	116 x 207	2.6	B25675C5252J025	4
MKK525-D-26.5-04	26.5	29.1[1)]	31.8	35.0[1)]	3 x 102.0	B	116 x 207	2.6	B25675C5262J525	4
MKK525-D-28.1-04	28.1	30.9[1)]	–	–	3 x 108.2	B	125 x 192	2.8	B25675C5282J125	4
MKK525-D-30.0-04	30.0	33.0[1)]	–	–	3 x 115.5	B	125 x 207	3.0	B25675C5302J025	4
MKK525-D-33.1-04	33.1	36.4[1)]	–	–	3 x 127.4	B	136 x 192	3.3	B25675C5332J125	4
MKK525-D-34.4-04	34.4	37.8[1)]	–	–	3 x 132.4	B	136 x 192	3.3	B25675C5342J425	4
MKK525-D-40.0-04	40.0	44.0[1)]	48.0	52.8[1)]	3 x 154.0	F	136 x 233	3.7	B25675C5402J025	4
MKK525-D-50.0-04	50.0	55.0[1)]	60.0	66.0[1)]	3 x 192.5	F	136 x 312	5.0	B25675C5502J025	2
MKK525-D-60.0-04	60.0	66.0[1)]	–	–	3 x 230.9	F	136 x 351	5.7	B25675C5602J025	2
Rated voltage 600 V AC, delta connection										
MKK600-D-5.3-04	5.3	5.1[5)]	6.4	6.2[2)]	3 x 15.6	C	75 x 185	1.0	B25675C6052J300	6
MKK600-D-6.2-04	6.2	6.0[5)]	7.4	7.1[2)]	3 x 18.3	C	75 x 185	1.0	B25675C6062J200	6
MKK600-D-6.9-04	6.9	6.6[5)]	8.3	8.0[2)]	3 x 20.3	C	75 x 200	1.1	B25675C6062J900	6
MKK600-D-8.3-04	8.3	8.0[4)]	10.0	9.6[1)]	3 x 24.5	C	75 x 218	1.1	B25675C6082J300	9
MKK600-D-10.4-04	10.4	10.0[4)]	12.5	12.0[1)]	3 x 30.6	C	85 x 200	1.3	B25675C6102J400	9
MKK600-D-12.5-04	12.5	12.0[4)]	15.0	14.4[1)]	3 x 36.8	D	100 x 192	1.8	B25675C6122J500	6
MKK600-D-13.9-04	13.9	13.4[4)]	16.7	16.1[1)]	3 x 41.0	D	100 x 207	1.9	B25675C6132J900	6
MKK600-D-14.6-04	14.6	14.0[4)]	17.5	16.8[1)]	3 x 43.0	D	100 x 207	1.9	B25675C6142J600	6
MKK600-D-16.7-04	16.7	16.1[3)]	20.0	19.2[1)]	3 x 49.2	D	100 x 224	2.1	B25675C6162J700	4
MKK600-D-20.0-04	20.0	19.2[2)]	24.0	23.1[1)]	3 x 58.9	D	116 x 207	2.6	B25675C6202J000	4
MKK600-D-20.8-04	20.8	20.0[2)]	25.0	24.1[1)]	3 x 61.3	D	116 x 207	2.6	B25675C6202J800	4
MKK600-D-25.0-04	25.0	24.1[1)]	30.0	28.9[1)]	3 x 73.7	D	125 x 207	3.0	B25675C6252J000	4
MKK600-D-28.0-04	28.0	26.9[1)]	–	–	3 x 82.5	D	136 x 192	3.3	B25675C6282J000	4
MKK600-D-30.0-04	30.0	28.9[1)]	–	–	3 x 88.4	D	136 x 207	3.6	B25675C6302J000	4

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Resin) PFC Capacitors

Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Resin filled capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 690 V AC, delta connection										
MKK690-D-5.3-04	5.3	4.4[5)]	6.4	5.4[2)]	3 x 11.8	C	75 x 185	1.0	B25675C6052J390	6
MKK690-D-6.2-04	6.2	5.2[5)]	7.4	6.2[2)]	3 x 13.8	C	75 x 200	1.1	B25675C6062J290	6
MKK690-D-6.9-04	6.9	5.8[5)]	8.3	6.9[2)]	3 x 15.4	C	75 x 200	1.1	B25675C6062J990	6
MKK690-D-8.3-04	8.3	6.9[5)]	10.0	8.4[2)]	3 x 18.5	C	75 x 200	1.1	B25675C6082J390	6
MKK690-D-10.4-04	10.4	8.7[4)]	12.5	10.5[1)]	3 x 23.2	C	75 x 200	1.1	B25675C6102J490	6
MKK690-D-12.5-04	12.5	10.5[4)]	15.0	12.6[1)]	3 x 27.9	C	85 x 200	1.3	B25675C6122J590	9
MKK690-D-13.9-04	13.9	11.6[4)]	16.7	14.0[1)]	3 x 31.0	C	85 x 200	1.3	B25675C6132J990	9
MKK690-D-14.6-04	14.6	12.2[4)]	17.5	14.6[1)]	3 x 32.5	D	100 x 207	1.9	B25675C6142J690	6
MKK690-D-16.7-04	16.7	14.0[4)]	20.0	16.7[1)]	3 x 37.2	D	100 x 192	1.8	B25675C6162J790	6
MKK690-D-20.0-04	20.0	16.7[3)]	24.0	20.1[1)]	3 x 44.6	D	100 x 207	1.9	B25675C6202J090	6
MKK690-D-20.8-04	20.8	17.4[3)]	25.0	20.9[1)]	3 x 46.3	D	100 x 224	2.1	B25675C6202J890	4
MKK690-D-25.0-04	25.0	20.9[2)]	30.0	25.1[1)]	3 x 55.7	D	116 x 192	2.4	B25675C6252J090	4
MKK690-D-28.0-04	28.0	23.4[1)]	–	–	3 x 62.4	D	116 x 207	2.6	B25675C6282J090	4
MKK690-D-30.0-04	30.0	25.1[1)]	–	–	3 x 66.8	D	125 x 192	2.8	B25675C6302J090	4
Rated voltage 800 V AC, delta connection										
MKK800-D-15.0-04	15.0	10.8[3)]	18.0	13.0[1)]	3 x 24.9	E	100 x 224	2.1	B25675C8152J000	6
MKK800-D-20.0-04	20.0	14.4[2)]	24.0	17.3[1)]	3 x 33.2	E	116 x 224	2.8	B25675C8202J000	4
MKK800-D-25.0-04	25.0	18.0[1)]	30.0	21.7[1)]	3 x 41.4	E	116 x 224	2.8	B25675C8252J000	4
MKK800-D-28.0-04	28.0	20.2[1)]	–	–	3 x 46.4	E	116 x 248	3.1	B25675C8282J000	4
MKK800-D-30.0-04	30.0	21.7[1)]	–	–	3 x 49.7	E	116 x 248	3.1	B25675C8302J000	4
Rated voltage 900 V AC, delta connection										
MKK900-D-15.0-04	15.0	9.6[3)]	18.0	11.5[1)]	3 x 19.6	E	100 x 224	2.1	B25675C9152J000	6
MKK900-D-20.0-04	20.0	12.8[2)]	24.0	15.4[1)]	3 x 26.2	E	116 x 224	2.8	B25675C9202J000	4
MKK900-D-25.0-04	25.0	16.0[1)]	30.0	19.2[1)]	3 x 32.7	E	116 x 224	2.8	B25675C9252J000	4
MKK900-D-30.0-04	30.0	19.2[1)]	–	–	3 x 39.3	E	116 x 248	3.1	B25675C9302J000	4
Rated voltage 1000 V AC, delta connection										
MKK1000-D-15.0-04	15.0	8.7[4)]	18.0	10.4[1)]	3 x 15.9	E	100 x 224	2.1	B25675C0152J000	6
MKK1000-D-20.0-04	20.0	11.5[2)]	24.0	13.9[1)]	3 x 21.2	E	116 x 224	2.8	B25675C0202J000	4
MKK1000-D-25.0-04	25.0	14.4[1)]	30.0	17.3[1)]	3 x 26.5	E	116 x 248	3.1	B25675C0252J000	4
MKK1000-D-30.0-04	30.0	17.3[1)]	–	–	3 x 31.8	E	116 x 282	3.5	B25675C0302J000	2

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

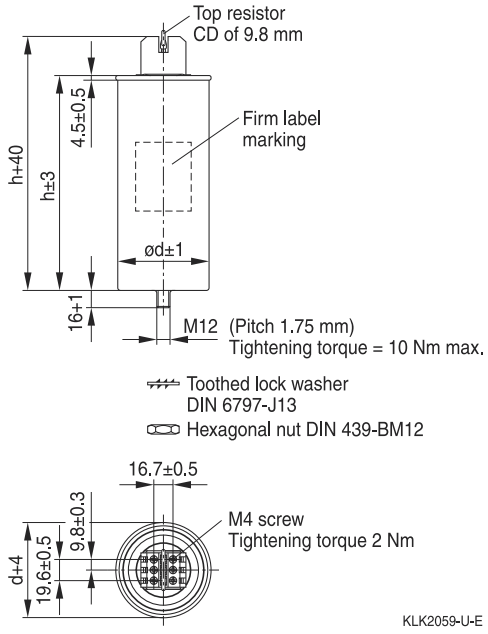
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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PhaseCap Energy Plus (Resin) PFC Capacitors

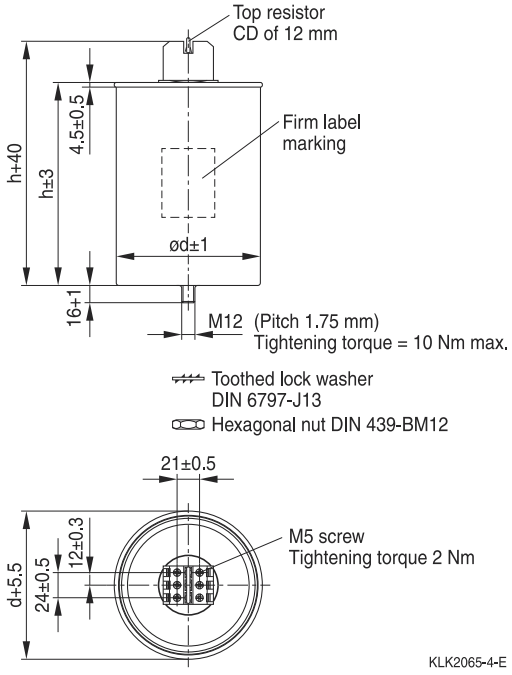
Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Dimensional drawings

Terminal type A

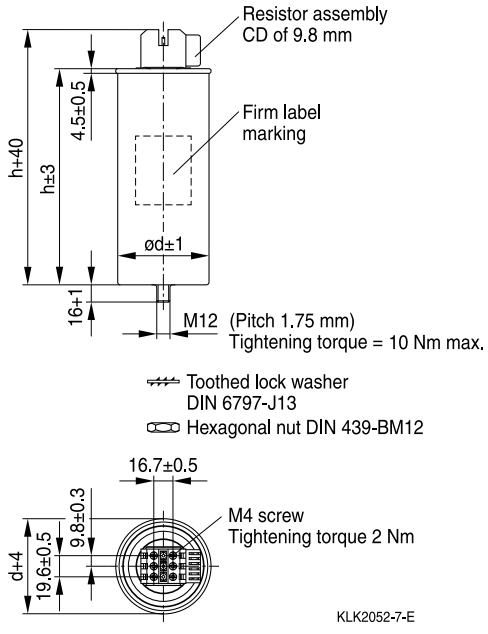


Terminal type B

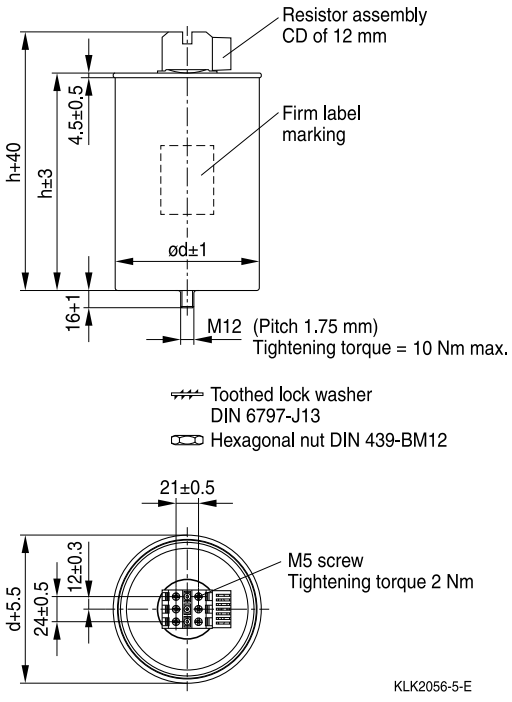


Dimensional drawings

Terminal type C



Terminal type D



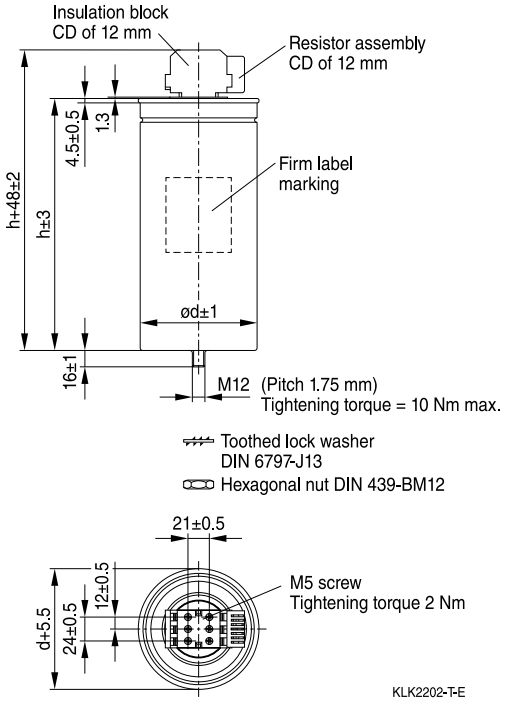
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PhaseCap Energy Plus (Resin) PFC Capacitors

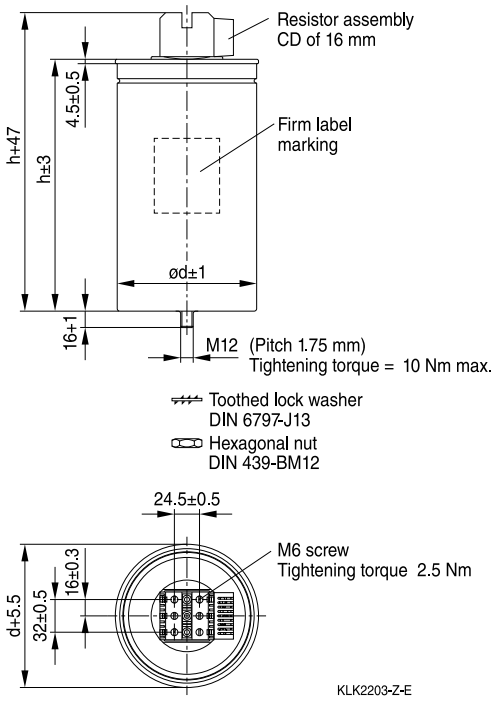
Most comprehensive range • Superior PFC capacitor series • Up to 60 kvar • Up to 1000 V

Dimensional drawings

Terminal type E

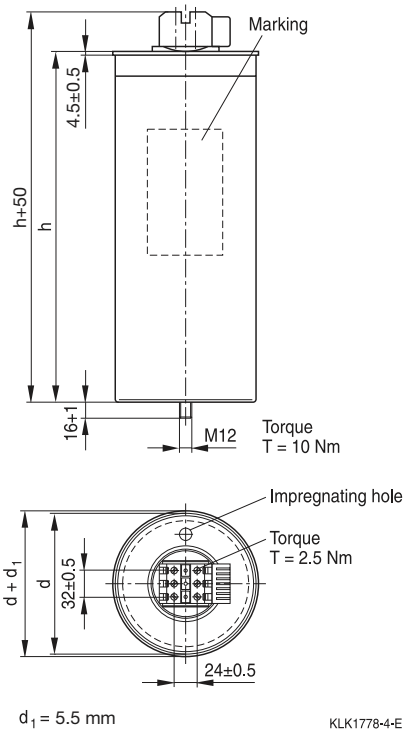


Terminal type F



Dimensional drawings

Capacitor



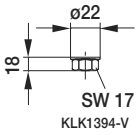
Mounting

Toothed washer J 12.5 DIN 6797

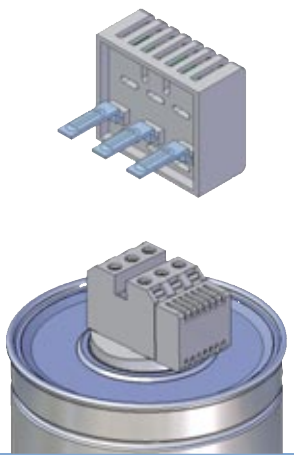
Hex nut BM12 DIN 439

or

nut C61010-A415-C15



Discharge resistor



PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V



General

The PhaseCap Energy Plus (Gas) series represents the premium range of capacitors for power factor correction (PFC).

This series has an expected service life of up to 220 000 hours, an increased inrush current capability of up to 500 · I_N, and optimized can dimensions making the PhaseCap Energy Plus (Gas) filled a great capacitor for electro-sensitive applications that call for high reliability. PhaseCap Energy Plus is gas-impregnated with self-healing properties and an overpressure disconnector for all three phases. They are specified with a voltage range from 230 to 690 V and can deliver 5.0 to 33.1 kvar.

Applications

- Electro-sensitive applications (e.g. oil & gas, healthcare, data centres, pharma)
- Automatic PFC equipment, capacitor banks
- Individual fixed PFC (e.g., motors, transformers, lighting)
- Group fixed PFC
- Tuned and detuned capacitor banks
- Dynamic PFC

Features

- Robust, reliable and compact design
- Most comprehensive range of superior capacitors
- MKK-technology with wave cut and heavy edge
- Voltage range 230 … 690 V
- Output power range 5.0 … 33.1 kvar
- Ultra long-life expectancy up to 220 000 hours at temperature class –40/D
- Very high inrush current capabilityof up to 500 · I_N
- High pulse current withstand capability
- High long-term stability
- Reduced mounting costs
- Maintenance-free (except for the recommended periodic checks).
- Highest packing density thanks to compact dimensions

Safety

- Self healing technology
- Three-phase overpressure disconnector for all three phases
- Touch proof IP20 safety terminal
- Safe discharging: Pre-mounted ceramic base discharge resistor or discharge resistor module (depending upon the type)
- cUL approval
- Gas Impregnated, dry type

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Technical data and specifications		
Standards IEC 60831-1,2, UL 810		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min. daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min. daily)
Overcurrent	I_{max}	Up to 2.0 · I_N (depending on the particular type) including combined effects of harmonics, overvoltages and capacitance tolerance
Inrush current	I_S	Up to 500 · I_N
Losses: **– Dielectric** **– Total** [1]		<0.2 W/kvar Approx. 0.35 to 0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		-5% / +5%
Test voltage, terminal to terminal	V_{TT}	2.15 · V_N, AC, 2 s
Test voltage, terminal to case	V_{TC}	3600 V/50 Hz, 2 s up to V_N = 525 V, 6000 V AC / 50 Hz, 2 s above V_N = 525 V
Mean life expectancy	t_{LD}	Up to 220 000 h (temp. class -40/D) up to 200 000 h (temp. class –40/60)
Ambient temperature		-40/60; max. temp. +60 °C; max. mean 24 h = +50 °C; max. mean 1 year = +40 °C; lowest temperature = -40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Upright/horizontal (depending on the particular type)
Mounting and grounding		Threaded M12 stud on the bottom of the case
Safety		Three-phase overpressure disconnector, self-healing, maximum allowed fault current 10 000 A acc. UL 810 standard
Discharge device		Ceramic discharge module or discharge module block (depending on the particular type)
Case		Extruded aluminum can
Enclosure		IP20, indoor mounting (optionally with terminal cap for IP54)
Dielectric		Polypropylene film
Impregnation		Non-flammable inert gas
Terminals		Optimized capacitor safety terminal with electric shock protection (IP20), (VDE 0106 part 100), max. 25 mm^2 cable cross-section, max. current 80 A
Certification		cUL file # E238746 (up to 600 V ratings)
Number of switching operations		Up to 15 000 switchings per year (depending on the particular type)

[1] Without discharge resistor

PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 230 V AC, delta connection										
MMKK230-D-5.0-03	5.0	12.6[5)]	6.0	15.1[2)]	3 x 100.3	A	75 x 218	0.9	B25674C2052J030	9
MKK230-D-7.5-03	7.5	18.8[5)]	9.0	22.6[2)]	3 x 150.4	B	100 x 192	1.4	B25674C2072J530	6
MKK230-D-10.0-03	10.0	25.1[4)]	12.0	30.1[2)]	3 x 200.5	B	100 x 224	1.7	B25674C2102J030	4
MKK230-D-12.5-03	12.5	31.4[2)]	15.0	37.7[1)]	3 x 250.7	B	116 x 207	2.1	B25674C2122J530	4
MKK230-D-15.0-03	15.0	37.7[1)]	–	–	3 x 300.8	B	125 x 207	2.4	B25674C2152J030	4
Rated voltage 400 V AC, delta connection										
MMKK400-D-5.0-03	5.0	7.2[5)]	6.0	8.7[2)]	3 x 33.2	A	75 x 164	0.7	B25674C4052J000	6
MKK400-D-6.3-03	6.3	9.1[5)]	7.6	11.0[2)]	3 x 41.8	A	75 x 164	0.7	B25674C4062J300	6
MKK400-D-7.5-03	7.5	10.8[5)]	9.0	13.0[2)]	3 x 49.7	A	75 x 200	0.8	B25674C4072J500	6
MKK400-D-8.3-03	8.3	12.0[5)]	10.0	14.4[2)]	3 x 55.0	A	75 x 200	0.8	B25674C4082J300	6
MKK400-D-10.4-03	10.4	15.0[4)]	12.5	18.0[1)]	3 x 69.0	A	75 x 218	0.9	B25674C4102J400	9
MKK400-D-12.5-03	12.5	18.0[4)]	15.0	21.7[1)]	3 x 82.9	A	85 x 200	1.1	B25674C4122J500	9
MKK400-D-15.0-03	15.0	21.7[3)]	18.0	26.0[1)]	3 x 99.5	A	85 x 218	1.2	B25674C4152J000	4
MKK400-D-16.7-03	16.7	24.1[2)]	20.0	28.9[1)]	3 x 110.7	B	100 x 207	1.6	B25674C4162J700	6
MKK400-D-20.0-03	20.0	28.9[1)]	24.0	34.6[1)]	3 x 132.6	B	100 x 224	1.7	B25674C4202J000	4
MKK400-D-25.0-03	25.0	36.1[1)]	30.0	43.3[1)]	3 x 165.8	B	116 x 192	1.9	B25674C4252J000	4
MKK400-D-28.1-03	28.1	40.6[1)]	–	–	3 x 186.3	B	125 x 192	2.3	B25674C4282J100	4
MKK400-D-30.0-03	30.0	43.3[1)]	–	–	3 x 198.9	B	116 x 224	2.3	B25674C4302J000	4
MKK400-D-33.0-03	33.0	47.6[1)]	–	–	3 x 218.8	B	125 x 207	2.4	B25674C4332J000	4
Rated voltage 415 V AC, delta connection										
MKK415-D-5.0-03	5.0	7.0[5)]	6.0	8.3[2)]	3 x 30.8	A	75 x 164	0.7	B25674C4052J015	6
MKK415-D-6.3-03	6.3	8.8[5)]	7.6	10.6[2)]	3 x 38.8	A	75 x 164	0.7	B25674C4062J315	6
MKK415-D-7.5-03	7.5	10.4[5)]	9.0	12.5[2)]	3 x 46.2	A	75 x 200	0.8	B25674C4072J515	6
MKK415-D-8.3-03	8.3	11.5[5)]	10.0	13.9[2)]	3 x 51.1	A	75 x 200	0.8	B25674C4082J315	6
MKK415-D-10.4-03	10.4	14.5[5)]	12.5	17.4[2)]	3 x 64.1	A	75 x 200	0.8	B25674C4102J415	6
MKK415-D-12.5-03	12.5	17.4[4)]	15.0	20.9[1)]	3 x 77.0	A	85 x 200	1.1	B25674C4122J515	9
MKK415-D-15.0-03	15.0	20.9[3)]	18.0	25.0[1)]	3 x 92.4	A	85 x 200	1.1	B25674C4152J015	9
MKK415-D-16.7-03	16.7	23.2[2)]	20.0	27.8[1)]	3 x 102.9	B	100 x 207	1.6	B25674C4162J715	6
MKK415-D-20.0-03	20.0	27.8[1)]	24.0	33.4[1)]	3 x 123.2	B	100 x 207	1.6	B25674C4202J015	6
MKK415-D-25.0-03	25.0	34.8[1)]	30.0	41.7[1)]	3 x 154.0	B	116 x 192	1.9	B25674C4252J015	4
MKK415-D-28.1-03	28.1	39.1[1)]	–	–	3 x 173.1	B	116 x 207	2.1	B25674C4282J115	4
MKK415-D-30.0-03	30.0	41.7[1)]	–	–	3 x 184.8	B	116 x 207	2.1	B25674C4302J015	4
MKK415-D-33.0-03	33.0	45.9[1)]	–	–	3 x 203.3	B	116 x 224	2.3	B25674C4332J015	4

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 440 V AC, delta connection										
MKK440-D-5.0-03	5.0	6.6[5)]	6.0	7.9[2)]	3 x 27.4	A	75 x 164	0.7	B25674C4052J040	6
MKK440-D-6.0-03	6.0	7.9[5)]	7.2	9.4[2)]	3 x 32.9	A	75 x 164	0.7	B25674C4062J040	6
MKK440-D-6.3-03	6.3	8.3[5)]	7.6	10.0[2)]	3 x 34.5	A	75 x 164	0.7	B25674C4062J340	6
MKK440-D-7.0-03	7.0	9.2[5)]	8.4	11.0[2)]	3 x 38.4	A	75 x 200	0.8	B25674C4072J040	6
MKK440-D-7.5-03	7.5	9.8[5)]	9.0	11.8[2)]	3 x 41.1	A	75 x 200	0.8	B25674C4072J540	6
MKK440-D-8.0-03	8.0	10.5[5)]	9.6	12.6[2)]	3 x 43.8	A	75 x 200	0.8	B25674C4082J040	6
MKK440-D-8.3-03	8.3	10.9[5)]	10.0	13.1[2)]	3 x 45.5	A	75 x 200	0.8	B25674C4082J340	6
MKK440-D-9.0-03	9.0	11.8[5)]	10.8	14.2[2)]	3 x 49.3	A	75 x 200	0.8	B25674C4092J040	6
MKK440-D-10.0-03	10.0	13.1[4)]	12.0	15.7[1)]	3 x 54.8	A	75 x 200	0.8	B25674C4102J040	6
MKK440-D-10.4-03	10.4	13.6[4)]	12.5	16.4[1)]	3 x 57.0	A	85 x 200	1.1	B25674C4102J440	9
MKK440-D-12.0-03	12.0	15.7[4)]	14.4	18.9[1)]	3 x 65.8	A	85 x 200	1.1	B25674C4122J040	9
MKK440-D-12.5-03	12.5	16.4[4)]	15.0	19.7[1)]	3 x 68.5	A	85 x 200	1.1	B25674C4122J540	9
MKK440-D-14.2-03	14.2	18.6[4)]	17.0	22.3[1)]	3 x 77.8	A	85 x 200	1.1	B25674C4142J240	9
MKK440-D-15.0-03	15.0	19.7[3)]	18.0	23.6[1)]	3 x 82.2	A	85 x 218	1.2	B25674C4152J040	4
MKK440-D-16.7-03	16.7	21.9[2)]	20.0	26.2[1)]	3 x 91.5	B	100 x 207	1.6	B25674C4162J740	6
MKK440-D-18.8-03	18.8	24.7[2)]	22.6	29.7[1)]	3 x 103.0	B	100 x 207	1.6	B25674C4182J840	6
MKK440-D-20.0-03	20.0	26.2[1)]	24.0	31.5[1)]	3 x 109.6	B	100 x 207	1.6	B25674C4202J040	6
MKK440-D-25.0-03	25.0	32.8[1)]	30.0	39.4[1)]	3 x 137.0	B	116 x 192	1.9	B25674C4252J040	4
MKK440-D-28.1-03	28.1	36.9[1)]	–	–	3 x 154.0	B	116 x 207	2.1	B25674C4282J140	4
MKK440-D-30.0-03	30.0	39.4[1)]	–	–	3 x 164.4	B	125 x 192	2.3	B25674C4302J040	4
MKK440-D-33.1-03	33.1	43.4[1)]	–	–	3 x 181.4	B	116 x 224	2.3	B25674C4332J140	4
Rated voltage 480 V AC, delta connection										
MKK480-D-5.0-03	5.0	6.0[5)]	6.0	7.2[2)]	3 x 23.0	A	75 x 164	0.7	B25674C4052J080	6
MKK480-D-6.3-03	6.3	7.6[5)]	7.6	9.1[2)]	3 x 29.0	A	75 x 164	0.7	B25674C4062J380	6
MKK480-D-7.5-03	7.5	9.0[5)]	9.0	10.8[2)]	3 x 34.5	A	75 x 200	0.8	B25674C4072J580	6
MKK480-D-8.3-03	8.3	10.0[5)]	10.0	12.0[2)]	3 x 38.2	A	75 x 200	0.8	B25674C4082J380	6
MKK480-D-10.4-03	10.4	12.5[5)]	12.5	15.0[2)]	3 x 47.9	A	75 x 200	0.8	B25674C4102J480	6
MKK480-D-11.0-03	11.0	13.2[5)]	13.2	15.9[2)]	3 x 50.7	A	85 x 200	1.1	B25674C4112J080	9
MKK480-D-12.5-03	12.5	15.0[4)]	15.0	18.0[1)]	3 x 57.6	A	85 x 200	1.1	B25674C4122J580	9
MKK480-D-13.8-03	13.8	16.6[4)]	16.6	20.0[1)]	3 x 63.5	A	85 x 200	1.1	B25674C4132J880	9
MKK480-D-15.0-03	15.0	18.0[3)]	18.0	21.7[1)]	3 x 69.1	B	100 x 207	1.6	B25674C4152J080	6
MKK480-D-16.7-03	16.7	20.1[2)]	20.0	24.1[1)]	3 x 76.9	B	100 x 207	1.6	B25674C4162J780	6
MKK480-D-20.0-03	20.0	24.1[2)]	24.0	28.9[1)]	3 x 92.1	B	100 x 207	1.6	B25674C4202J080	6
MKK480-D-20.8-03	20.8	25.0[1)]	25.0	30.1[1)]	3 x 95.8	B	116 x 207	2.1	B25674C4202J880	4
MKK480-D-22.0-03	22.0	26.5[1)]	26.4	31.8[1)]	3 x 101.3	B	116 x 207	2.1	B25674C4222J080	4
MKK480-D-25.0-03	25.0	30.1[1)]	30.0	36.1[1)]	3 x 115.1	B	116 x 192	1.9	B25674C4252J080	4
MKK480-D-28.1-03	28.1	33.8[1)]	–	–	3 x 129.4	B	116 x 207	2.1	B25674C4282J180	4
MKK480-D-30.0-03	30.0	36.1[1)]	–	–	3 x 138.1	B	125 x 192	2.3	B25674C4302J080	4
MKK480-D-31.0-03	31.0	37.3[1)]	–	–	3 x 142.7	B	125 x 192	2.3	B25674C4312J080	4
MKK480-D-33.0-03	33.0	39.7[1)]	–	–	3 x 154.0	B	116 x 224	2.3	B25674C4332J080	4

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

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PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 525 V AC, delta connection										
MKK525-D-5.0-03	5.0	5.5[5)]	6.0	6.6[2)]	3 x 19.2	A	75 x 164	0.7	B25674C5052J025	6
MKK525-D-6.3-03	6.3	6.9[5)]	7.6	8.4[2)]	3 x 24.2	A	75 x 164	0.7	B25674C5062J325	6
MKK525-D-7.5-03	7.5	8.2[5)]	9.0	9.9[2)]	3 x 28.9	A	75 x 185	0.8	B25674C5072J525	6
MKK525-D-8.3-03	8.3	9.1[5)]	10.0	11.0[2)]	3 x 31.9	A	75 x 200	0.8	B25674C5082J325	6
MKK525-D-10.4-03	10.4	11.4[5)]	12.5	13.7[2)]	3 x 40.0	A	85 x 185	1.0	B25674C5102J425	9
MKK525-D-12.5-03	12.5	13.7[5)]	15.0	16.5[2)]	3 x 48.1	A	85 x 200	1.1	B25674C5122J525	9
MKK525-D-13.2-03	13.2	14.5[5)]	15.8	17.4[2)]	3 x 50.8	A	85 x 200	1.1	B25674C5132J225	9
MKK525-D-15.0-03	15.0	16.5[4)]	18.0	19.8[1)]	3 x 57.7	A	85 x 218	1.2	B25674C5152J025	4
MKK525-D-16.7-03	16.7	18.4[3)]	20.0	22.0[1)]	3 x 64.3	B	100 x 207	1.6	B25674C5162J725	6
MKK525-D-20.0-03	20.0	22.0[2)]	24.0	26.4[1)]	3 x 77.0	B	100 x 224	1.7	B25674C5202J025	4
MKK525-D-20.8-03	20.8	22.9[2)]	25.0	27.5[1)]	3 x 80.1	B	100 x 224	1.7	B25674C5202J825	4
MKK525-D-25.0-03	25.0	27.5[1)]	30.0	33.0[1)]	3 x 96.2	B	116 x 207	2.1	B25674C5252J025	4
MKK525-D-26.5-03	26.5	29.1[1)]	31.8	35.0[1)]	3 x 102.0	B	116 x 207	2.1	B25674C5262J525	4
MKK525-D-28.1-03	28.1	30.9[1)]	–	–	3 x 108.2	B	125 x 192	2.3	B25674C5282J125	4
MKK525-D-30.0-03	30.0	33.0[1)]	–	–	3 x 115.5	B	125 x 207	2.4	B25674C5302J025	4
MKK525-D-33.1-03	33.1	36.4[1)]	–	–	3 x 127.4	B	136 x 192	2.7	B25674C5332J125	4
Rated voltage 600 V AC, delta connection										
MKK600-D-5.3-03	5.3	5.1[5)]	6.4	6.2[2)]	3 x 15.6	C	75 x 185	0.8	B25674C6052J300	6
MKK600-D-6.2-03	6.2	6.0[5)]	7.4	7.1[2)]	3 x 18.3	C	75 x 185	0.8	B25674C6062J200	6
MKK600-D-6.9-03	6.9	6.6[5)]	8.3	8.0[2)]	3 x 20.3	C	75 x 200	0.8	B25674C6062J900	6
MKK600-D-8.3-03	8.3	8.0[4)]	10.0	9.6[1)]	3 x 24.5	C	75 x 218	0.9	B25674C6082J300	9
MKK600-D-10.4-03	10.4	10.0[4)]	12.5	12.0[1)]	3 x 30.6	C	85 x 200	1.1	B25674C6102J400	9
MKK600-D-12.5-03	12.5	12.0[4)]	15.0	14.4[1)]	3 x 36.8	D	100 x 192	1.4	B25674C6122J500	6
MKK600-D-13.9-03	13.9	13.4[4)]	16.7	16.1[1)]	3 x 41.0	D	100 x 207	1.6	B25674C6132J900	6
MKK600-D-14.6-03	14.6	14.0[4)]	17.5	16.8[1)]	3 x 43.0	D	100 x 207	1.6	B25674C6142J600	6
MKK600-D-16.7-03	16.7	16.1[3)]	20.0	19.2[1)]	3 x 49.2	D	100 x 224	1.7	B25674C6162J700	4
MKK600-D-20.0-03	20.0	19.2[2)]	24.0	23.1[1)]	3 x 58.9	D	116 x 207	2.1	B25674C6202J000	4
MKK600-D-20.8-03	20.8	20.0[2)]	25.0	24.1[1)]	3 x 61.3	D	116 x 207	2.1	B25674C6202J800	4
MKK600-D-25.0-03	25.0	24.1[1)]	30.0	28.9[1)]	3 x 73.7	D	125 x 207	2.4	B25674C6252J000	4
MKK600-D-28.0-03	28.0	26.9[1)]	–	–	3 x 82.5	D	136 x 192	2.7	B25674C6282J000	4
MKK600-D-30.0-03	30.0	28.9[1)]	–	–	3 x 88.4	D	136 x 207	2.9	B25674C6302J000	4

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhaseCap Energy Plus (Gas) PFC Capacitors

Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	Terminal type	d x h	Weight	Ordering code	Packing unit*
	Output kvar	I_N A	Output kvar	I_N A	µF		mm	kg		
Rated voltage 690 V AC, delta connection										
MKK690-D-5.3-03	5.3	4.4[5)]	6.4	5.4[2)]	3 x 11.8	C	75 x 185	0.8	B25674C6052J390	6
MKK690-D-6.2-03	6.2	5.2[5)]	7.4	6.2[2)]	3 x 13.8	C	75 x 200	0.8	B25674C6062J290	6
MKK690-D-6.9-03	6.9	5.8[5)]	8.3	6.9[2)]	3 x 15.4	C	75 x 200	0.8	B25674C6062J990	6
MKK690-D-8.3-03	8.3	6.9[5)]	10.0	8.4[2)]	3 x 18.5	C	75 x 200	0.8	B25674C6082J390	6
MKK690-D-10.4-03	10.4	8.7[4)]	12.5	10.5[1)]	3 x 23.2	C	75 x 200	0.8	B25674C6102J490	6
MKK690-D-12.5-03	12.5	10.5[4)]	15.0	12.6[1)]	3 x 27.9	C	85 x 200	1.1	B25674C6122J590	9
MKK690-D-13.9-03	13.9	11.6[4)]	16.7	14.0[1)]	3 x 31.0	C	85 x 200	1.1	B25674C6132J990	9
MKK690-D-14.6-03	14.6	12.2[4)]	17.5	14.6[1)]	3 x 32.5	D	100 x 207	1.6	B25674C6142J690	6
MKK690-D-16.7-03	16.7	14.0[4)]	20.0	16.7[1)]	3 x 37.2	D	100 x 192	1.4	B25674C6162J790	6
MKK690-D-20.0-03	20.0	16.7[3)]	24.0	20.1[1)]	3 x 44.6	D	100 x 207	1.6	B25674C6202J090	6
MKK690-D-20.8-03	20.8	17.4[3)]	25.0	20.9[1)]	3 x 46.3	D	100 x 224	1.7	B25674C6202J890	4
MKK690-D-25.0-03	25.0	20.9[2)]	30.0	25.1[1)]	3 x 55.7	D	116 x 192	1.9	B25674C6252J090	4
MKK690-D-28.0-03	28.0	23.4[1)]	–	–	3 x 62.4	D	116 x 207	2.1	B25674C6282J090	4
MKK690-D-30.0-03	30.0	25.1[1)]	–	–	3 x 66.8	D	125 x 192	2.3	B25674C6302J090	4

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

[1)] … max. current 1.6 · I_N
[2)] … max. current 1.7 · I_N
[3)] … max. current 1.8 · I_N
[4)] … max. current 1.9 · I_N
[5)] … max. current 2.0 · I_N

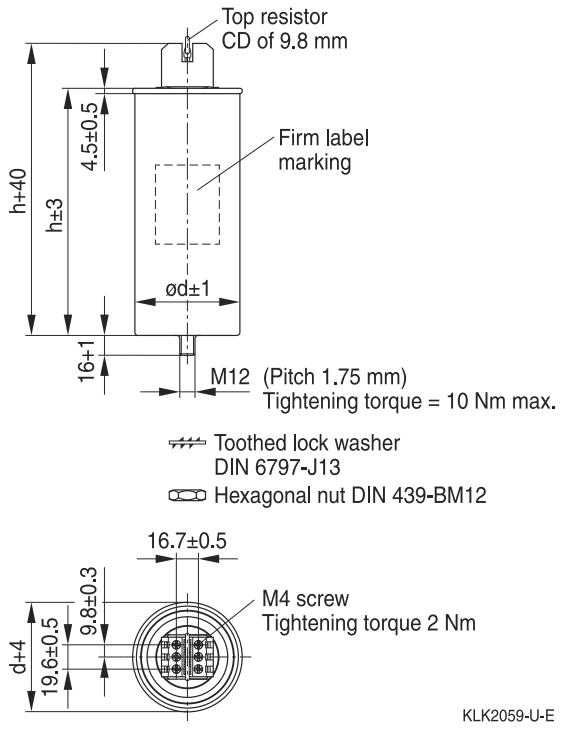
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PhaseCap Energy Plus (Gas) PFC Capacitors

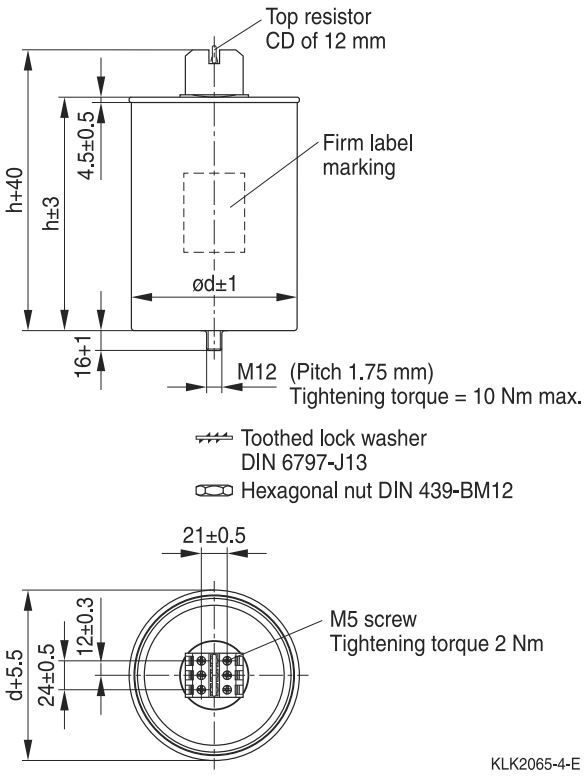
Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Dimensional drawings

Terminal type A



Terminal type B



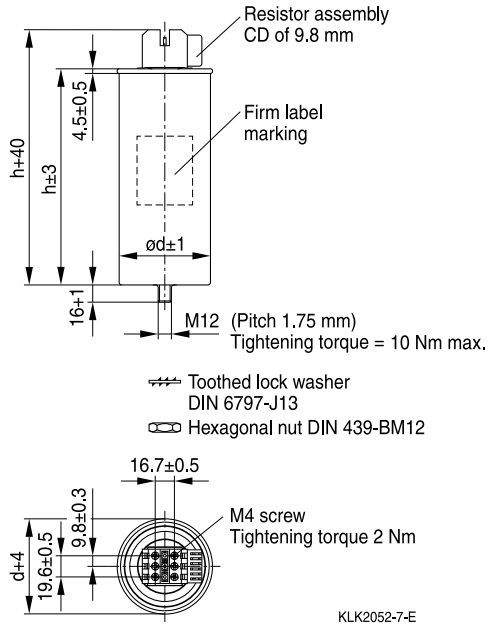
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PhaseCap Energy Plus (Gas) PFC Capacitors

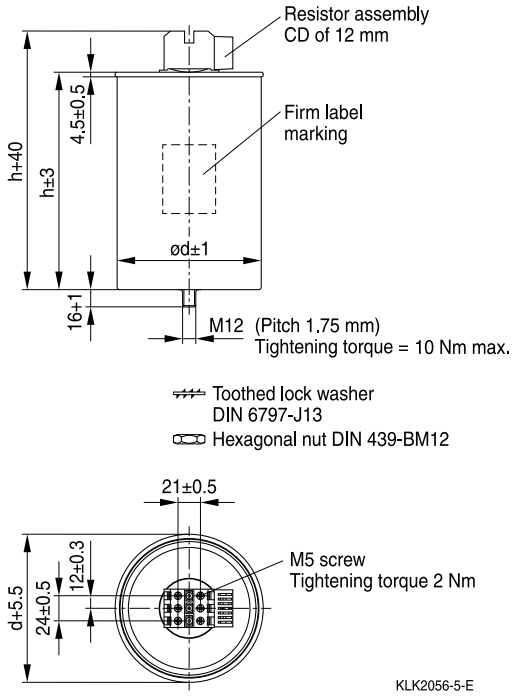
Comprehensive range • 5.0 to 33.1 kvar • 230 to 690 V

Dimensional drawings

Terminal type C



Terminal type D







NEW

PhiCap Extra Heavy Duty (Gas)

- Non-flammable dry type inert gas as impregnant
- Reinforced design:
  – Over current: 2 · I_N
  – Inrush current: 300 · I_N
- Electro-sensitive applications:
  – Oil & gas
  – Hospitals
  – Data centers
  – Pharma
  – Automobile



PhiCap Extra Heavy Duty (Gas) PFC Capacitors

Most comprehensive range • True dry-type design • 6.3 to 33.1 kvar • 415 to 525 V



General

PhiCap Extra Heavy Duty (Gas) is the latest addition to the PhiCap family with a true dry-type gas-impregnated design with enhanced performance through better electrical and thermal design.

PhiCap Extra Heavy Duty (Gas) comes with a reinforced design with an expected service life of up to 180 000 hours, an inrush current handling up to 300 · I_N, and a maximum permissible current (I_{max}) of 2 · I_N. PhiCap Extra Heavy Duty (Gas) is the ideal choice for electro-sensitive applications like oil & gas, hospitals, data centers, pharma, and automobile applications which demand high reliability and fire safety.

PhiCap Extra Heavy Duty (Gas) comes with power ranges of 6.3 to 33.1 kvar and can handle up to 10 000 switchings per year to meet continuous operation.

Applications

- Electro-sensitive applications (e.g. oil & gas, healthcare, data centres, pharma)
- Power factor correction in automatic capacitor banks
- Fixed PFC applications
- Tuned and detuned PFC systems
- Dynamic PFC systems

Features

- Power: 6.3 … 33.1 kvar
- Rated voltage: 415 … 525 V
- Frequency: 50 Hz
- Max. transient peak current 300 · I_N
- Max. permissible current (I_{max}) 2 · I_N
- Life expectancy: up to 180 000 hours
- No. of switchings: max. 10 000 per year
- Terminal Type: safety terminal with M4 screws
- Reference standards: IEC 60831-1,2

Safety

- Non-flammable dry type inert gas as impregnation
- Self-healing technology
- Overpressure disconnector for all 3 phases
- SIGUT terminal

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PhiCap Extra Heavy Duty (Gas) PFC Capacitors

Most comprehensive range • True dry-type design • 6.3 to 33.1 kvar • 415 to 525 V

Technical data and specifcations		
Standards IEC 60831-1,2, UL 810		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min daily)
Overcurrent	I_{max}	Up to 2.0 · I_N including combined effects of harmonics, overvoltages, and capacitance tolerance
Inrush current	I_S	Up to 300 · I_N
Losses: **– Dielectric** **– Total**[1)]		 <0.2 W/kvar <0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		–5% / +10%
Test voltage, terminal / terminal	V_{TT}	2.15 · V_N, 2 s
Test voltage, terminal / case	V_{TC}	3600 V, 50 Hz
Mean life expectancy	t_{LD}	Up to 180 000 h (temperature class –40/D); ϴHS <+70 °C (max. mean ambient temperature per year = +35 °C)
Ambient temperature		Class –40/D: Max. short time: +55 °C, max. mean 24 h: 45 °C; max mean 1 year: +35 °C; lowest temperature: –40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Vertical upright
Mounting and grounding		Threaded M12 stud on the bottom of the case
Safety		Three-phase overpressure disconnector, self-healing, maximum allowed fault current 10 000 A acc. UL 810 standard
Discharge device		Ceramic discharge module or discharge module block (depending on the particular type)
Case		Extruded aluminum can
Enclosure		IP20, indoor mounting (optionally with terminal cap for IP54)
Dielectric		Polypropylene film
Impregnation		Non-flammable inert gas
Terminals		Touchproof IP20 safety terminals
Number of switching operations		Up to 10 000 switchings per year (depending on the particular type)

[1)] Without discharge resistor

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhiCap Extra Heavy Duty (Gas) PFC Capacitors

Most comprehensive range • True dry-type design • 6.3 to 33.1 kvar • 415 to 525 V

Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated Voltage 415 V AC, delta connection									
MKP415-D-7.5	7.5	10.4	9	12.5	3 x 46.2	75 x 172	0.7	B32474G4072E515	6
MKP415-D-8.0	8	11.1	9.6	13.4	3 x 49.3	75 x 172	0.7	B32474G4082E015	6
MKP415-D-9.0	9	12.5	10.8	15	3 x 55.4	75 x 172	0.7	B32474G4092E015	6
MKP415-D-10.0	10	13.9	12	16.7	3 x 61.6	75 x 208	0.9	B32474G4102E015	6
MKP415-D-12.5	12.5	17.4	15	20.9	3 x 77.0	75 x 208	0.9	B32474G4122E515	6
MKP415-D-15.0	15	20.9	18	25	3 x 92.4	75 x 283	0.9	B32474G4152E015	6
MKP415-D-20.0	20	27.8	24	33.4	3 x 123.2	75 x 283	1.2	B32474G4202E015	6
MKP415-D-25.0	25	34.8	30	41.7	3 x 154.0	85 x 283	1.5	B32474G4252E015	4
Rated Voltage 440 V AC, delta connection									
MKP440-D-7.5	7.5	9.8	9	11.8	3 x 41.1	75 x 172	0.7	B32474G4072E540	6
MKP440-D-8.3	8.3	10.9	10	13.1	3 x 45.5	75 x 172	0.7	B32474G4082E340	6
MKP440-D-9.0	9	11.8	10.8	14.2	3 x 49.3	75 x 172	0.7	B32474G4092E040	6
MKP440-D-10.0	10	13.1	12	15.7	3 x 54.8	75 x 208	0.9	B32474G4102E040	6
MKP440-D-12.5	12.5	16.4	15	19.7	3 x 68.5	75 x 208	0.9	B32474G4122E540	6
MKP440-D-15.0	15	19.7	18	23.6	3 x 82.2	85 x 208	1.1	B32474G4152E040	4
MKP440-D-20.0	20	26.2	24	31.5	3 x 109.6	75 x 283	1.2	B32474G4202E040	6
MKP440-D-25.0	25	32.8	30	39.4	3 x 137.0	85 x 283	1.5	B32474G4252E040	4
MKP440-D-28.1	28.1	36.9	-	-	3 x 154.0	90 x 283	1.7	B32474G4282E140	4
MKP440-D-30.0	30	39.4	-	-	3 x 164.4	90 x 283	1.7	B32474G4302E040	4
Rated Voltage 480 V AC, delta connection									
MKP480-D-8.3	8.3	10	10	12	3 x 38.2	75 x 172	0.7	B32474G4082E380	6
MKP480-D-10.4	10.4	12.5	12.5	15	3 x 47.9	75 x 208	0.9	B32474G4102E480	6
MKP480-D-11.1	11.1	13.4	13.3	16	3 x 51.1	75 x 208	0.9	B32474G4112E180	6
MKP480-D-12.5	12.5	15	15	18	3 x 57.6	75 x 208	0.9	B32474G4122E580	6
MKP480-D-13.8	13.8	16.6	16.6	20	3 x 63.5	85 x 208	1.1	B32474G4132E880	4
MKP480-D-15.0	15	18	18	21.7	3 x 69.1	85 x 208	1.1	B32474G4152E080	4
MKP480-D-16.7	16.7	20.1	20	24.1	3 x 76.9	85 x 208	1.1	B32474G4162E780	4
MKP480-D-18.7	18.7	22.5	22.4	26.9	3 x 86.1	75 x 283	1.2	B32474G4182E780	6
MKP480-D-20.0	20	24.1	24	28.9	3 x 92.1	75 x 283	1.2	B32474G4202E080	6
MKP480-D-22.0	22	26.5	26.4	31.8	3 x 101.3	85 x 283	1.5	B32474G4222E080	4
MKP480-D-25.0	25	30.1	30	36.1	3 x 115.1	85 x 283	1.5	B32474G4252E080	4
MKP480-D-27.7	27.7	33.3	-	-	3 x 127.5	90 x 283	1.7	B32474G4272E780	4
MKP480-D-28.1	28.1	33.8	-	-	3 x 129.4	90 x 283	1.7	B32474G4282E180	4
MKP480-D-30.0	30	36.1	-	-	3 x 138.1	90 x 283	1.7	B32474G4302E080	4
MKP480-D-31.0	31	37.3	-	-	3 x 142.7	90 x 283	1.7	B32474G4312E080	4

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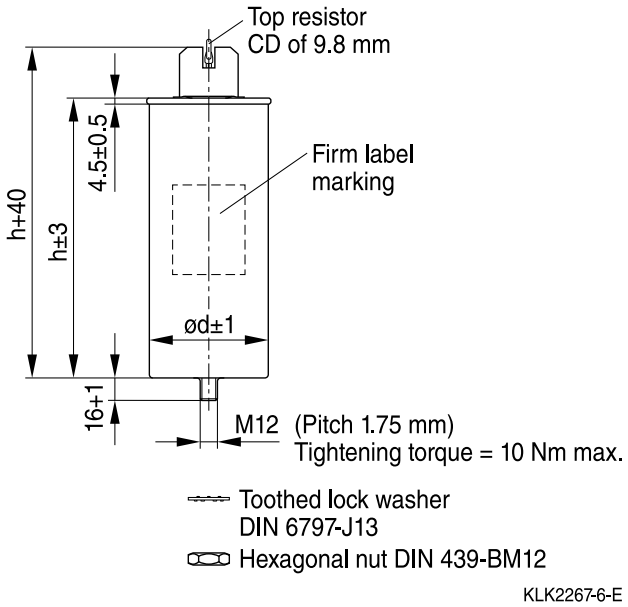
PhiCap Extra Heavy Duty (Gas) PFC Capacitors

Most comprehensive range • True dry-type design • 6.3 to 33.1 kvar • 415 to 525 V

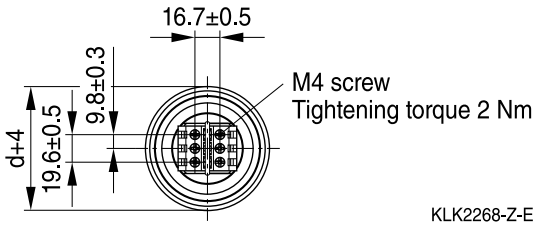
Gas impregnated capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated Voltage 525 V AC, delta connection									
MKP525-D-6.3	6.3	6.9	7.6	8.4	3 x 24.2	75 x 172	0.7	B32474G5062E325	6
MKP525-D-6.6	6.6	7.3	7.9	8.7	3 x 25.4	75 x 172	0.7	B32474G5062E625	6
MKP525-D-7.5	7.5	8.2	9	9.9	3 x 28.9	75 x 172	0.7	B32474G5072E525	6
MKP525-D-8.3	8.3	9.1	10	11	3 x 31.9	75 x 172	0.7	B32474G5082E325	6
MKP525-D-10.4	10.4	11.4	12.5	13.7	3 x 40.0	75 x 208	0.9	B32474G5102E425	6
MKP525-D-12.5	12.5	13.7	15	16.5	3 x 48.1	85 x 208	1.1	B32474G5122E525	4
MKP525-D-13.2	13.2	14.5	15.8	17.4	3 x 50.8	85 x 208	1.1	B32474G5132E225	4
MKP525-D-15.0	15	16.5	18	19.8	3 x 57.7	85 x 208	1.1	B32474G5152E025	4
MKP525-D-16.7	16.7	18.4	20	22	3 x 64.3	75 x 283	1.2	B32474G5162E725	6
MKP525-D-20.0	20	22	24	26.4	3 x 77.0	85 x 283	1.5	B32474G5202E025	4
MKP525-D-25.0	25	27.5	30	33	3 x 96.2	85 x 283	1.5	B32474G5252E025	4
MKP525-D-26.5	26.5	29.1	-	-	3 x 102.0	90 x 283	1.7	B32474G5262E525	4
MKP525-D-30.0	30	33	-	-	3 x 115.5	85 x 358	2	B32474G5302E025	4
MKP525-D-33.1	33.1	36.4	-	-	3 x 127.4	85 x 358	2	B32474G5332E125	4

Dimensional drawings: PhiCap Extra Heavy Duty (Gas)



KLK2267-6-E



KLK2268-Z-E

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system



General

Based on the well-proven MKP technology with stacked windings, DeltaCap capacitors are especially developed for low voltage PFC applications in industrial installations. The cost-effective design offers an output range from 0.5 to 33.0 kvar. The voltage range covers from 230 to 525 V.

Applications

- Power Factor Correction
- Automatic capacitor banks
- Fixed PFC applications, e.g. motor compensation
- AC power electronics
- Tuned and detuned PFC systems

Features

- Compact design in cylindrical aluminum can with stud
- MKD technology with stacked windings
- Output range 0.5 … 50.0 kvar
- Voltage range 230 … 525 V

Safety

- Self-healing technology
- Overpressure disconnector
- Isolated terminal (IP20) for B32301 and B32304 series

Electrical

- Up to 33 kvar per capacitor for three-phase applications
- Long life expectancy up to 150 000 hours (at temperature class –40/C)
- High inrush current withstand ability (up to 200 · I_N)

Mechanical and maintenance

- Reduced mounting costs, easy installation and connection
- Low weight and compact volume
- Maintenance-free

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DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system

Technical data and specifications

Standards IEC 60831-1,2		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min daily)
Overcurrent	I_{max}	Up to 1.3 · I_N (up to 1.5 · I_N including combined effects of harmonics, overvoltages and capacitance)
Inrush current	I_S	Up to 200 · I_N
Losses: **– Dielectric** **– Total**[1)]		 <0.2 W/kvar <0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		–5% / +10%
Test voltage, terminal / terminal	V_{TT}	2.15 · V_N, AC, 2 s
Test voltage, terminal / case	V_{TC}	3000 V AC, 10 s
Mean life expectancy	t_{LD}	Up to 150 000 h (temperature class –40/C) Up to 115 000 h (temperature class –40/D)
Ambient temperature		–40/D; max. temp. +55 °C; max. mean 24 h = +45 °C; max. mean 1 year = +35 °C; lowest temperature = –40 °C –40/C; max. temp. +50 °C; max. mean 24 h = +40 °C; max. mean 1 year = +30 °C; lowest temperature = –40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Upright
Mounting and grounding		Threaded M12 (10 Nm) for case size diameter ≥50 mm
Safety		Self-healing technology, overpressure disconnector, max. allowed fault current 10 000 A in accordance with UL 810 standard
Discharge resistor		Discharge resistor included in the delivery for B32300/B32303, pre-mounted for B32301 and B32304
Case		Extruded aluminum can
Enclosure		IP00 for B32300 and B32303 IP20 for B32301 and B32304
Dielectric		Polypropylene film
Impregnation		Biodegradable soft resin, semi-dry
Terminals		Screw terminal for B32304 series, max. 25 mm^2 cable cross-section; fast-on terminals for B32300, B32301 and B32303 series
Number of switching operations		Max. 5000 switchings per year according to IEC 60831-1,2

[1)] Without discharge resistor

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 230 V AC, 50/60 Hz, delta connection									
MKD230-D-0.5	0.5	1.3	0.6	1.6	3 x 10	50 x 150	0.4	B32303A2002A530	50
MKD230-D-0.7	0.7	1.8	0.8	2.2	3 x 14	50 x 150	0.4	B32303A2002A730	50
MKD230-D-1.0	1.0	2.5	1.2	3.0	3 x 20	50 x 150	0.4	B32303A2012A030	50
MKD230-D-1.5	1.5	3.8	1.8	4.6	3 x 30	63.5 x 150	0.6	B32303A2012A530	12
MKD230-D-2.0	2.0	5.0	2.4	6.0	3 x 40	63.5 x 150	0.6	B32303A2022A030	12
MKD230-D-2.5	2.5	6.3	3.0	7.6	3 x 50	63.5 x 150	0.8	B32303A2022A530	12
MKD230-D-5.0	5.0	12.6	6.0	15.1	3 x 100	75 x 200	1.1	B32304A2052#030[1)]	6
MKD230-D-7.5	7.5	18.8	9.0	22.6	3 x 151	75 x 275	1.4	B32304A2072#530[1)]	6
MKD230-D-10.0	10.0	25.1	12.0	30.1	3 x 201	85 x 275	1.7	B32304A2102#030[1)]	4
MKD230-D-12.5	12.5	31.4	15.0	37.7	3 x 251	85 x 350	2.2	B32304A2122#530[1)]	4
MKD230-D-15.0	15.0	37.7	18.0	45.2	3 x 301	85 x 350	2.2	B32304A2152#030[1)]	4
Rated voltage 400 V AC, 50/60 Hz, delta connection									
MKD400-D-1.0	1.0	1.4	1.2	1.7	3 x 6.6	50 x 150	0.4	B32303A4012A000	50
MKD400-D-1.5	1.5	2.2	1.8	2.6	3 x 10	50 x 150	0.4	B32303A4012A500	50
MKD400-D-2.0	2.0	2.9	2.4	3.5	3 x 13	50 x 150	0.4	B32303A4022A000	50
MKD400-D-2.5	2.5	3.6	3.0	4.3	3 x 17	50 x 150	0.4	B32303A4022A500	50
MKD400-D-5.0	5.0	7.2	6.0	8.6	3 x 33	63.5 x 150	0.6	B32303A4052A000	12
MKD400-D-6.3	6.3	9.1	7.6	10.9	3 x 42	75 x 163	0.8	B32304A4071#500[1)]	6
MKD400-D-7.5	7.5	10.8	9.0	13.0	3 x 50	75 x 163	0.9	B32304A4072#500[1)]	6
MKD400-D-8.3	8.3	12.0	10.0	14.4	3 x 55	75 x 200	1.1	B32304A4101#000[1)]	6
MKD400-D-10.0	10.0	14.4	12.0	17.3	3 x 66	75 x 200	1.1	B32304A4102#000[1)]	6
MKD400-D-12.5	12.5	18.0	15.0	21.6	3 x 83	75 x 275	1.4	B32304A4122#500[1)]	6
MKD400-D-15.0	15.0	21.7	18.0	26.0	3 x 100	75 x 275	1.4	B32304A4152#000[1)]	6
MKD400-D-16.7	16.7	24.1	20.0	28.9	3 x 111	85 x 275	1.8	B32304A4201#000[1)]	4
MKD400-D-20.0	20.0	28.9	24.0	34.7	3 x 133	85 x 275	1.8	B32304A4202#000[1)]	4
MKD400-D-25.0	25.0	36.1	30.0	43.3	3 x 166	85 x 350	2.2	B32304A4252#000[1)]	4
MKD400-D-30.0	30.0	43.3	–	–	3 x 199	96 x 275	2.4	B32304A4302#000[1)]	4
MKD400-D-50.0	50.0	72.1	60.0	86.6	3 x 331.7	136 x 275	4.3	B32304A4502#000[1)]	4
Rated voltage 415 V AC, 50/60 Hz, delta connection									
MKD415-D-1.0	1.0	1.4	1.2	1.7	3 x 6.2	50 x 150	0.4	B32303A4012A010	50
MKD415-D-1.5	1.5	2.1	1.8	2.5	3 x 9.2	50 x 150	0.4	B32303A4012A510	50
MKD415-D-2.0	2.0	2.8	2.4	3.4	3 x 12	50 x 150	0.4	B32303A4022A010	50
MKD415-D-2.5	2.5	3.5	3.0	4.2	3 x 15	63.5 x 150	0.6	B32303A4022A510	12
MKD415-D-5.0	5.0	7.0	6.0	8.4	3 x 31	63.5 x 150	0.8	B32303A4052A010	12
MKD415-D-6.3	6.3	8.8	7.6	10.6	3 x 39	75 x 200	1.0	B32304A4071#510[1)]	6
MKD415-D-7.5	7.5	10.4	9.0	12.5	3 x 46	75 x 200	1.1	B32304A4072#510[1)]	6
MKD415-D-10.0	10.0	13.9	12.0	16.7	3 x 62	75 x 275	1.4	B32304A4102#010[1)]	6
MKD415-D-12.5	12.5	17.4	15.0	20.9	3 x 77	75 x 275	1.4	B32304A4122#510[1)]	6
MKD415-D-15.0	15.0	20.9	18.0	25.1	3 x 93	85 x 275	1.7	B32304A4152#010[1)]	4
MKD415-D-20.0	20.0	27.8	24.0	33.4	3 x 123	85 x 275	2.2	B32304A4202#010[1)]	4
MKD415-D-20.8	20.8	28.9	25.0	34.7	3 x 128	85 x 350	2.4	B32304A4251#010[1)]	4
MKD415-D-25.0	25.0	34.8	30.0	41.8	3 x 154	85 x 350	2.4	B32304A4252#010[1)]	4
MKD415-D-30.0	30.0	41.7	36.0	50.0	3 x 185	96 x 350	2.7	B32304A4302#010[1)]	4

[1)] Available either as B32304A****A*** series (3-terminal design, integrated resistor) or B32304A****B*** series (6-terminal design, pluggable ceramic resistor).
Please replace # with the right character before ordering.

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DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 440 V AC, 50/60 Hz, delta connection									
MKD440-D-0.9	0.9	1.2	1.1	1.4	3 x 5.2	50 x 127	0.4	B32303A4011A040	50
MKD440-D-1.0	1.0	1.3	1.2	1.6	3 x 5.5	50 x 127	0.4	B32303A4012A040	50
MKD440-D-1.2	1.2	1.6	1.4	1.9	3 x 6.6	50 x 127	0.4	B32303A4011A540	50
MKD440-D-1.5	1.5	2.0	1.8	2.4	3 x 8.8	50 x 127	0.4	B32303A4012A540	50
MKD440-D-2.0	2.0	2.6	2.4	3.1	3 x 11	50 x 150	0.5	B32303A4022A040	50
MKD440-D-2.1	2.1	2.8	2.5	3.4	3 x 12	50 x 150	0.5	B32303A4021A540	50
MKD440-D-2.5	2.5	3.3	3.0	4.0	3 x 14	63.5 x 150	0.7	B32303A4022A540	12
MKD440-D-4.2	4.2	5.5	5.0	6.6	3 x 23	63.5 x 150	0.7	B32303A4051A040	12
MKD440-D-5.0	5.0	6.6	6.0	7.9	3 x 27	63.5 x 150	0.8	B32303A4052A040	12
MKD440-D-6.3	6.3	8.3	7.6	10.0	3 x 35	75 x 163	0.8	B32304A4071#540[1)]	6
MKD440-D-7.5	7.5	9.8	9.0	11.8	3 x 41	75 x 200	1.1	B32304A4072#540[1)]	6
MKD440-D-8.3	8.3	10.9	10.0	13.1	3 x 46	75 x 200	1.1	B32304A4101#040[1)]	6
MKD440-D-10.0	10.0	13.1	12.0	15.7	3 x 55	75 x 275	1.4	B32304A4102#040[1)]	6
MKD440-D-10.4	10.4	13.6	12.5	16.3	3 x 57	75 x 275	1.4	B32304A4121#540[1)]	6
MKD440-D-12.5	12.5	16.4	15.0	19.7	3 x 69	75 x 275	1.4	B32304A4151#040[1)]	6
MKD440-D-15.0	15.0	19.7	18.0	23.6	3 x 82	85 x 275	1.7	B32304A4152#040[1)]	4
MKD440-D-16.7	16.7	21.9	20.0	26.3	3 x 92	85 x 275	1.7	B32304A4201#040[1)]	4
MKD440-D-20.0	20.0	26.2	24.0	31.5	3 x 110	85 x 275	1.9	B32304A4202#040[1)]	4
MKD440-D-20.8	20.8	27.3	25.0	32.8	3 x 114	85 x 350	2.2	B32304A4251#040[1)]	4
MKD440-D-25.0	25.0	32.8	30.0	39.4	3 x 137	85 x 350	2.2	B32304A4252#040[1)]	4
MKD440-D-28.0	28.0	36.7	33.6	44.0	3 x 154	85 x 350	2.2	B32304A4282#040[1)]	4
MKD440-D-30.0	30.0	39.0	–	–	3 x 164	96 x 350	2.7	B32304A4302#040[1)]	4
MKD440-D-33.0	33.0	43.3	–	–	3 x 181	96 x 350	2.7	B32304A4332#040[1)]	4
MKD440-D-33.8	33.8	44.4	–	–	3 x 185	96 x 350	2.7	B32304A4332#840[1)]	4
Rated voltage 480 V AC, 50/60 Hz, delta connection									
MKD480-D-1.5	1.5	1.8	1.8	2.2	3 x 6.9	50 x 127	0.4	B32303A4012A580	50
MKD480-D-2.0	2.0	2.4	2.4	2.9	3 x 9.2	50 x 150	0.5	B32303A4022A080	50
MKD480-D-2.5	2.5	3.0	3.0	3.6	3 x 12	63.5 x 150	0.7	B32303A4022A580	12
MKD480-D-5.0	5.0	6.0	6.0	7.2	3 x 23	75 x 163	0.8	B32304A4052#080[1)]	6
MKD480-D-6.3	6.3	7.6	7.6	9.1	3 x 29	75 x 163	0.8	B32304A4071#580[1)]	6
MKD480-D-7.5	7.5	9.0	9.0	10.8	3 x 35	75 x 200	1.1	B32304A4072#580[1)]	6
MKD480-D-8.3	8.3	10.0	10.0	12.0	3 x 38	75 x 200	1.1	B32304A4101#080[1)]	6
MKD480-D-10.4	10.4	12.5	12.5	15.0	3 x 48	75 x 275	1.4	B32304A4121#580[1)]	6
MKD480-D-12.5	12.5	15.0	15.0	18.0	3 x 58	75 x 275	1.4	B32304A4151#080[1)]	6
MKD480-D-15.0	15.0	18.0	18.0	21.6	3 x 69	85 x 275	1.7	B32304A4152#080[1)]	6
MKD480-D-16.7	16.7	20.1	20.0	24.1	3 x 77	85 x 275	1.8	B32304A4162#780[1)]	6
MKD480-D-20.0	20.0	24.1	24.0	28.9	3 x 92	85 x 350	2.2	B32304A4201#080[1)]	4
MKD480-D-20.8	20.8	25.0	25.0	30.0	3 x 96	85 x 350	2.2	B32304A4202#080[1)]	4
MKD480-D-25.0	25.0	30.1	30.0	36.1	3 x 115	85 x 350	2.2	B32304A4252#080[1)]	4
MKD480-D-30.0	30.0	36.0	36.0	43.0	3 x 138	96 x 350	2.7	B32304A4302#080[1)]	4
MKD480-D-33.0	33	39.7	–	–	3 x 152	96 x 350	2.7	B32304A4332#080[1)]	4

[1)] Available either as B32304A****A*** series (3-terminal design, integrated resistor) or B32304A****B*** series (6-terminal design, pluggable ceramic resistor).
Please replace # with the right character before ordering.

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 525 V AC, 50/60 Hz, delta connection									
MKD525-D-1.0	1.0	1.1	1.2	1.3	3 x 3.9	50 x 150	0.4	B32303A5012A020	50
MKD525-D-1.5	1.5	1.6	1.8	1.9	3 x 5.8	50 x 150	0.4	B32303A5012A520	50
MKD525-D-2.0	2.0	2.2	2.4	2.6	3 x 7.7	63.5 x 150	0.6	B32303A5022A020	12
MKD525-D-2.5	2.5	2.7	3.0	3.2	3 x 9.6	63.5 x 150	0.6	B32303A5022A520	12
MKD525-D-5.0	5.0	5.5	6.0	6.6	3 x 19	75 x 163	0.8	B32304A5061#020[1)]	6
MKD525-D-6.3	6.3	6.9	7.6	8.3	3 x 24	75 x 200	1.0	B32304A5071#520[1)]	6
MKD525-D-8.3	8.3	9.1	10.0	10.9	3 x 32	75 x 275	1.4	B32304A5101#020[1)]	6
MKD525-D-10.4	10.4	11.4	12.5	13.7	3 x 40	75 x 275	1.4	B32304A5121#520[1)]	6
MKD525-D-12.5	12.5	13.7	15.0	16.4	3 x 48	75 x 275	1.4	B32304A5151#020[1)]	6
MKD525-D-16.7	16.7	18.4	20.0	22.1	3 x 64	85 x 275	1.8	B32304A5201#020[1)]	4
MKD525-D-20.8	20.8	22.9	25.0	27.5	3 x 80	85 x 350	2.2	B32304A5202#020[1)]	4
MKD525-D-25.0	25.0	27.5	30.0	33.0	3 x 96	85 x 350	2.2	B32304A5252#020[1)]	4
MKD525-D-30.0	30.0	33.0	36.0	39.0	3 x 115	96 x 350	2.7	B32304A5302#020[1)]	4
MKD525-D-40.0	40.0	44.0	48.0	52.8	3 x 150	136 x 255	4.2	B32304A5402B025	4

[1)] Available either as B32304A****A*** series (3-terminal design, integrated resistor) or B32304A****B*** series (6-terminal design, pluggable ceramic resistor).
Please replace # with the right character before ordering.

DeltaCap PFC Capacitors

Low voltage (LV)-PFC in industrial applications • Stacked winding • Dual safety system

Single-phase capacitors

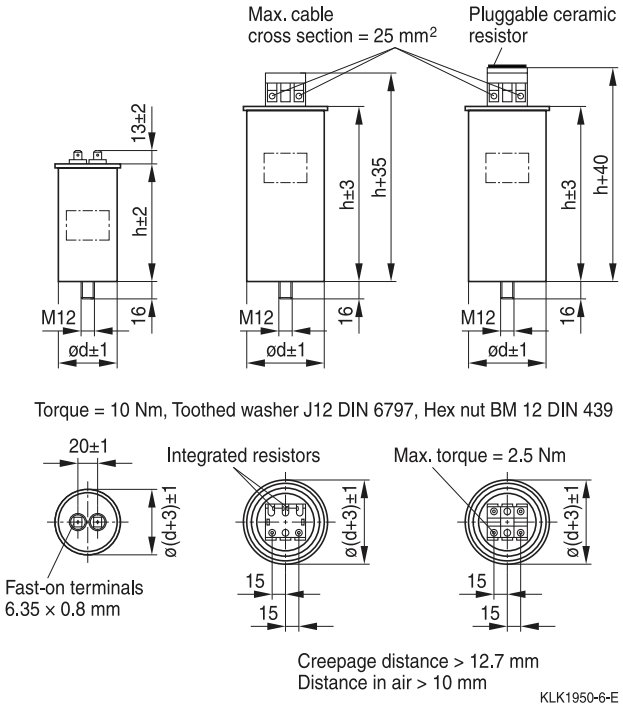
Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 230 V AC, 50/60 Hz, single-phase									
MKD230-I-0.8	0.8	3.5	1.0	4.2	48	63.5 x 64.5	0.3	B32300A2002A830	12
MKD230-I-1.7	1.7	7.4	2.0	8.9	102	63.5 x 102	0.4	B32300A2012A730	12
MKD230-I-2.5	2.5	10.9	3.0	13.1	151	63.5 x 127	0.5	B32300A2022A530	12
Rated voltage 250 V AC, 50/60 Hz, single-phase									
MKD250-I-0.8	0.8	3.2	1.0	3.8	41	50 x 77	0.2	B32300A2002A850	50
MKD250-I-1.7	1.7	6.8	2.0	8.2	87	63.5 x 92	0.4	B32300A2012A750	12
MKD250-I-2.0	2.0	7.8	2.4	9.4	100	63.5 x 92	0.4	B32300A2022A050	12
MKD250-I-2.5	2.5	10.0	3.0	12.0	127	63.5 x 102	0.5	B32300A2022A550	12
MKD250-I-5.0	5.0	20.0	6.0	24.0	255	75 x 166	0.7	B32301A2052#050[1)]	6
MKD250-I-7.5	7.5	30.0	9.0	36.0	382	85 x 196	1.1	B32301A2072#550[1)]	4
MKD250-I-10	10	40.0	12	48.0	510	85 x 216	1.2	B32301A2102#050[1)]	4
Rated voltage 400 V AC, 50/60 Hz, single-phase									
MKD400-I-0.8	0.8	2.0	1.0	2.4	16	50 x 64.5	0.2	B32300A4002A800	50
MKD400-I-1.7	1.7	4.3	2.0	5.2	34	63.5 x 62.5	0.3	B32300A4012A700	12
MKD400-I-2.5	2.5	6.3	3.0	7.6	50	63.5 x 77	0.3	B32300A4022A500	12
MKD400-I-3.3	3.3	8.3	4.0	10.0	66	63.5 x 102	0.4	B32300A4032A300	12
MKD400-I-4.2	4.2	10.5	5.0	12.6	84	63.5 x 102	0.4	B32300A4051A000	12
MKD400-I-5.0	5.0	12.5	6.0	15.0	100	63.5 x 127	0.5	B32300A4052A000	12
Rated voltage 415 V AC, 50/60 Hz, delta connection									
MKD415-I-0.8	0.8	1.9	1.0	2.3	15	50 x 64.5	0.2	B32300A4082A310	50
MKD415-I-1.7	1.7	4.0	2.0	4.8	31	63.5 x 64.5	0.3	B32300A4012A710	12
MKD415-I-2.5	2.5	6.0	3.0	7.2	46	63.5 x 102	0.4	B32300A4022A510	12
MKD415-I-3.3	3.3	8.0	4.0	9.6	61	63.5 x 102	0.4	B32300A4032A310	12
MKD415-I-5.0	5.0	12.0	6.0	14.4	92	63.5 x 127	0.6	B32300A4052A010	12
Rated voltage 440 V AC, 50/60 Hz, single-phase									
MKD440-I-0.7	0.7	1.6	0.8	1.9	12	50 x 64.5	0.2	B32300A4001A840	50
MKD440-I-1.4	1.4	3.2	1.7	3.8	23	63.5 x 64.5	0.3	B32300A4011A740	12
MKD440-I-2.1	2.1	4.8	2.5	5.8	35	63.5 x 77	0.3	B32300A4021A540	12
MKD440-I-2.8	2.8	6.4	3.4	7.7	46	63.5 x 102	0.4	B32300A4031A340	12
MKD440-I-3.3	3.3	7.5	4.0	9.0	54	63.5 x 102	0.4	B32300A4032A340	12
MKD440-I-4.2	4.2	9.5	5.0	11.4	69	63.5 x 127	0.5	B32300A4051A040	12
MKD440-I-5.0	5.0	11.4	6.0	13.7	82	63.5 x 127	0.5	B32300A4052A040	12
Rated voltage 480 V AC, 50/60 Hz, single-phase									
MKD480-I-0.7	0.7	1.5	0.8	1.8	10	50 x 64.5	0.2	B32300A4001A880	50
MKD480-I-1.4	1.4	2.9	1.7	3.5	19	63.5 x 64.5	0.3	B32300A4011A780	12
MKD480-I-2.1	2.1	4.4	2.5	5.3	29	63.5 x 77	0.3	B32300A4021A580	12
MKD480-I-2.8	2.8	5.8	3.4	7.0	39	63.5 x 102	0.4	B32300A4031A380	12
Rated voltage 525 V AC, 50/60 Hz, single-phase									
MKD525-I-1.4	1.4	2.7	1.7	3.2	16	63.5 x 64.5	0.3	B32300A5011A730	12
MKD525-I-2.8	2.8	5.3	3.4	6.4	32	63.5 x 102	0.4	B32300A5031A320	12
MKD525-I-3.3	3.3	6.3	4.0	7.6	38	63.5 x 102	0.4	B32300A5032A320	12
MKD525-I-4.2	4.2	8.0	5.0	9.6	49	63.5 x 127	0.5	B32300A5051A020	12
MKD525-I-25.0	25.0	47.6	30.0	57.1	289	116 x 200	1.9	B32301A5252#025[1)]	4

[1)] Available either as B32301A****A*** series (2-terminal design, integrated resistor) or B32301A****B*** series (4-terminal design, pluggable ceramic resistor).
Please replace # with the right character before ordering.

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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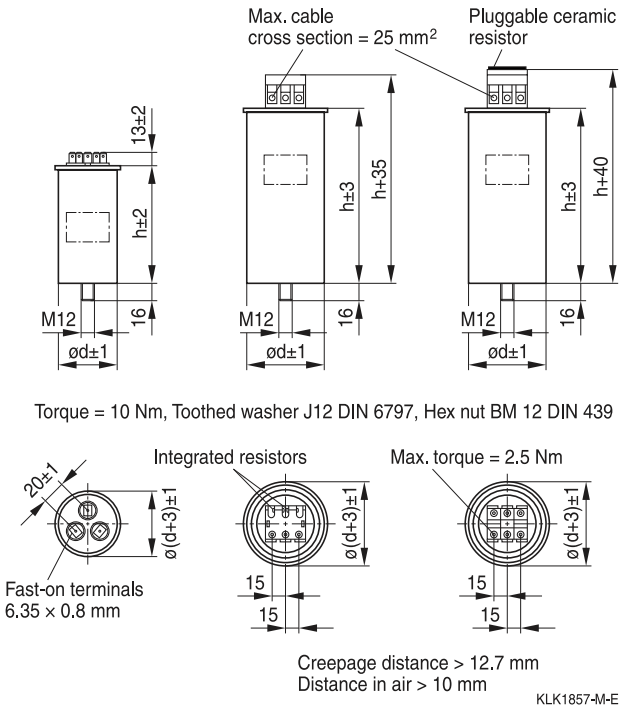
Dimensional drawings: Single-phase capacitors

B32300A/B32301A****A***/B32301A****B***



Dimensional drawings: Three-phase capacitors

B32303A****A***/B32304A****A***/B32304A****B***



PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system



General

PhiCap capacitors is a legacy product line within well-established series of MKP (metallized polypropylene), capacitors from TDK, used in PFC applications for over 15 years.

The reactive power range varies from 0.5 to 30.0 kvar and 0.7 to 6.4 kvar per single capacitor can, depending on a three-phase or single-phase capacitor design.

The PhiCap capacitor is especially intended for power factor correction in industrial applications.

The capacitors are manufactured using metalized polypropylene film as the dielectric and housed in a cylindrical aluminum case.

Applications

- Power Factor Correction (PFC)
- Automatic capacitor banks
- Fixed PFC applications, e.g. motor compensation
- Detuned PFC systems
- Dynamic PFC systems

Features

- Compact design in cylindrical aluminum can with stud
- Stacked winding
- MKP technology
- Voltage range 230 … 525 V
- Output range 0.5 … 30 kvar

Electrical

- Up to 30 kvar per case for three-phase applications
- Up to 6 kvar per case for single-phase applications
- Long life expectancy of up to 130 000 hours
- High pulse current withstand capability (up to 200 · I_N)

Mechanical and maintenance

- Reduced mounting costs, easy installation and connection
- Low weight and compact volume
- Maintenance-free

Safety

- Self-healing
- Overpressure disconnector
- Shock hazard protected optimized capacitor safety terminal for B32344 series

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Technical data and specifications

Standards IEC 60831-1,2		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min daily)
Overcurrent	I_{max}	Up to 1.5 · I_N including combined effects of harmonics, overvoltages and capacitance
Inrush current	I_S	Up to 200 · I_N
Losses: **– Dielectric** **– Total**[1)]		 <0.2 W/kvar <0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		–5% / 10%
Test voltage, terminal / terminal	V_{TT}	2.15 · V_N, AC, 2 s
Test voltage, terminal / case	V_{TC}	3000 V AC, 10 s
Mean life expectancy	t_{LD}	Up to 130 000 h (temperature class –40/C) Up to 100 000 h (temperature class –40/D)
Ambient temperature		–40/D; max. temp. +55 °C; max. mean 24 h = +45 °C; max. mean 1 year = +35 °C; lowest temperature = –40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Upright
Mounting and grounding		Threaded M12 (10 Nm) for case size diam. >53 mm M8 (4 Nm) for case size diam. ≤53 mm
Safety		Self-healing technology, overpressure disconnector, maximum allowed fault current 10 000 A in accordance with UL 810 standard
Discharge device		Discharge resistor included; pre-mounted for B32344 series
Case		Extruded aluminum can
Enclosure		IP00 for B32340/B32343, indoor mounting (IP54 for B32344 with plastic terminal cap; for other series please refer to page 53)
Dielectric		Polypropylene film
Impregnation		Biodegradable soft resin, semi-dry
Terminals		Optimized capacitor safety terminals for B32344 series, max. current 50 A, max. 16 mm² cable cross section, fast-on terminals for B32340 and B32343 series
Number of switching operations		Max. 5000 switchings per year according to IEC 60831-1,2

[1)] Without discharge resistor

PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 230 V AC, 50 / 60 Hz, delta connection									
MKP230-D-0.5	0.5	1.3	0.6	1.5	3 x 10	53 x 114	0.3	B32343C2002A530	12
MKP230-D-0.7	0.7	1.8	0.9	2.0	3 x 14	53 x 114	0.3	B32343C2002A730	12
MKP230-D-1.0	1.0	2.5	1.2	3.0	3 x 20.1	63.5 x 129	0.5	B32343C2012A030	12
MKP230-D-1.5	1.5	3.8	1.8	4.5	3 x 30.1	63.5 x 129	0.5	B32343C2012A530	12
MKP230-D-2.0	2.0	5.0	2.4	6.0	3 x 40	75 x 138	0.7	B32344E2022A030	6
MKP230-D-2.5	2.5	6.3	3.0	7.5	3 x 50	75 x 138	0.7	B32344E2022A530	6
MKP230-D-5.0	5.0	12.6	6.0	15.1	3 x 100.5	75 x 198	1.2	B32344E2052A030	4
MKP230-D-7.5	7.5	18.8	9.0	22.6	3 x 150	85 x 198	1.3	B32344E2072A530	4
MKP230-D-10.0	10.0	25.1	12.0	30.1	3 x 201	85 x 273	1.8	B32344E2102A030	4
MKP230-D-12.5	12.5	31.4	15.0	37.7	3 x 251	85 x 348	2.2	B32344E2122A530	4
MKP230-D-15.0	15.0	37.7	–	–	3 x 300	85 x 348	2.2	B32344E2152A030	4
Rated voltage 400 V AC, 50 / 60 Hz, delta connection									
MKP400-D-1.0	1.0	1.4	1.2	1.7	3 x 6.6	53 x 114	0.3	B32343C4012A000	12
MKP400-D-1.5	1.5	2.2	1.8	2.6	3 x 10	53 x 114	0.3	B32343C4012A500	12
MKP400-D-2.0	2.0	2.9	2.4	3.5	3 x 13.3	63.5 x 129	0.5	B32343C4022A000	12
MKP400-D-2.5	2.5	3.6	3.0	4.3	3 x 16.6	63.5 x 129	0.5	B32343C4022A500	12
MKP400-D-4.2	4.2	6.1	5.0	7.3	3 x 27.8	63.5 x 129	0.5	B32343C4042B200	12
MKP400-D-5.0	5.0	7.2	6.0	8.7	3 x 33.2	63.5 x 129	0.5	B32343C4052A000	12
MKP400-D-6.3	6.3	9.1	7.5	10.9	3 x 42	75 x 160	0.9	B32344E4071A500	6
MKP400-D-7.5	7.5	10.8	9.0	13.0	3 x 50	75 x 160	0.9	B32344E4072A500	6
MKP400-D-8.3	8.3	12.0	10.0	14.4	3 x 55	75 x 160	0.9	B32344E4101A000	6
MKP400-D-10.0	10.0	14.4	12.0	17.3	3 x 66.5	75 x 198	1.2	B32344E4102A000	4
MKP400-D-12.5	12.5	18.1	15.0	21.7	3 x 83	85 x 198	1.3	B32344E4122A500	4
MKP400-D-15.0	15.0	21.7	18.0	26.0	3 x 99.5	85 x 198	1.3	B32344E4152A000	4
MKP400-D-16.7	16.7	24.1	20.0	28.9	3 x 111	85 x 198	1.3	B32344E4201A000	4
MKP400-D-20.0	20.0	28.9	24.0	34.7	3 x 133	85 x 273	1.8	B32344E4202A000	4
MKP400-D-25.0	25.0	36.1	–	–	3 x 166	85 x 273	1.8	B32344E4252A000	4
MKP400-D-30.0	30.0	43.3	–	–	3 x 199	85 x 348	2.2	B32344E4302B000	4
Rated voltage 415 V AC, 50 / 60 Hz, delta connection									
MKP415-D-1.0	1.0	1.4	1.2	1.7	3 x 6.2	53 x 114	0.3	B32343C4012A010	12
MKP415-D-1.5	1.5	2.1	1.8	2.5	3 x 9.2	53 x 114	0.3	B32343C4012A510	12
MKP415-D-2.0	2.0	2.8	2.4	3.3	3 x 12.3	53 x 114	0.3	B32343C4022A010	12
MKP415-D-2.5	2.5	3.5	3.0	4.2	3 x 15.4	53 x 114	0.3	B32343C4022B510	12
MKP415-D-3.0	3.0	4.2	3.6	5.0	3 x 18.5	53 x 152	0.4	B32343C4032B010	12
MKP415-D-4.0	4.0	5.6	4.8	6.7	3 x 24.7	53 x 152	0.4	B32343C4032B010	12
MKP415-D-5.0	5.0	7.0	6.0	8.3	3 x 30.8	63.5 x 129	0.5	B32343C4052B010	12
MKP415-D-6.3	6.3	8.8	7.5	10.5	3 x 39	75 x 160	0.9	B32344E4071A510	6
MKP415-D-7.5	7.5	10.4	9.0	12.5	3 x 46.2	75 x 160	0.9	B32344E4072B510	4
MKP415-D-10.0	10.0	13.9	12.0	16.7	3 x 62	75 x 198	1.2	B32344E4102A010	4
MKP415-D-12.5	12.5	17.4	15.0	20.9	3 x 77	75 x 198	1.2	B32344E4122B510	4
MKP415-D-15.0	15.0	20.9	18.0	25.0	3 x 92.4	75 x 273	1.4	B32344E4152B010	4
MKP415-D-20.0	20.0	27.8	24.0	33.4	3 x 123.2	75 x 273	1.4	B32344E4202B010	4
MKP415-D-25.0	25.0	34.8	–	–	3 x 154	85 x 273	1.8	B32344E4252B010	4

Types for voltages 220, 240, 480, 600, 660 V and other kvar-values available upon request.

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 440 V AC, 50 / 60 Hz, delta connection									
MKP440-D-0.9	0.9	1.2	1.1	1.4	3 x 4.9	53 x 114	0.3	B32343C4011A040	12
MKP440-D-1.0	1.0	1.3	1.2	1.6	3 x 5.5	53 x 114	0.3	B32343C4012A040	12
MKP440-D-1.2	1.2	1.6	1.5	1.8	3 x 6.6	53 x 114	0.3	B32343C4011A540	12
Rated voltage 440 V AC, 50 / 60 Hz, delta connection									
MKP440-D-1.5	1.5	2.0	1.7	2.3	3 x 8.2	53 x 114	0.3	B32343C4012A540	12
MKP440-D-2.1	2.1	2.8	2.5	3.3	3 x 11.5	53 x 114	0.3	B32343C4021A540	12
MKP440-D-2.5	2.5	3.3	3.0	3.9	3 x 13.7	53 x 114	0.3	B32343C4022B540	12
MKP440-D-2.8	2.8	3.7	3.3	4.5	3 x 15.4	53 x 114	0.3	B32343C4022B840	12
MKP440-D-3.0	3.0	3.9	3.6	4.7	3 x 16.4	53 x 114	0.3	B32343C4032B040	12
MKP440-D-4.2	4.2	5.5	5.0	6.6	3 x 23	53 x 152	0.4	B32343C4051B040	12
MKP440-D-5.0	5.0	6.6	6.0	7.9	3 x 27.4	53 x 152	0.4	B32343C4052B040	12
MKP440-D-5.6	5.6	7.3	6.7	8.8	3 x 30.7	63.5 x 152	0.6	B32343C4052B640	12
MKP440-D-6.0	6.0	7.9	7.2	9.4	3 x 32.9	63.5 x 152	0.6	B32343C4062B040	12
MKP440-D-6.3	6.3	8.3	7.6	10.0	3 x 34.5	63.5 x 152	0.6	B32343C4071B540	6
MKP440-D-7.5	7.5	9.8	9.0	10.8	3 x 41	75 x 160	0.9	B32344E4072A540	6
MKP440-D-8.3	8.3	10.9	10.0	13.1	3 x 45.5	75 x 160	0.9	B32344E4101B040	4
MKP440-D-10.0	10.0	13.1	12.0	15.8	3 x 55	75 x 198	1.2	B32344E4102A040	4
MKP440-D-10.4	10.4	13.7	12.5	16.4	3 x 57	75 x 198	1.2	B32344E4121A540	4
MKP440-D-12.5	12.5	16.4	15.0	19.7	3 x 68.5	75 x 198	1.2	B32344E4151B040	4
MKP440-D-15.0	15.0	19.7	18.0	23.6	3 x 82.2	75 x 273	1.4	B32344E4152B040	4
MKP440-D-16.7	16.7	21.9	20.0	26.3	3 x 92	85 x 273	1.8	B32344E4201A040	4
MKP440-D-20.8	20.8	27.3	25.0	32.7	3 x 114	85 x 273	1.8	B32344E4251A040	4
MKP440-D-25.0	25.0	32.8	30.0	39.4	3 x 137.5	85 x 348	2.2	B32344E4252A040	4
MKP440-D-28.0	28.0	36.7	–	–	3 x 153.5	85 x 348	2.2	B32344E4282A040	4
MKP440-D-30.0	30.0	39.4	–	–	3 x 164.5	85 x 348	2.2	B32344E4302A040	4
Rated voltage 480 V AC, 50 / 60 Hz, delta connection									
MKP480-D-1.5	1.5	1.8	1.8	2.2	3 x 6.9	53 x 114	0.3	B32343C4012B580	12
MKP480-D-2.0	2.0	2.4	2.4	2.9	3 x 9.2	53 x 114	0.3	B32343C4022B080	12
MKP480-D-2.5	2.5	3.0	3.0	3.6	3 x 11.5	53 x 114	0.3	B32343C4022B580	12
MKP480-D-4.2	4.2	5.1	5.0	6.0	3 x 19.3	53 x 152	0.4	B32343C4051B080	12
MKP480-D-5.0	5.0	6.0	6.0	7.2	3 x 23	63.5 x 152	0.6	B32343C4052B080	12
MKP480-D-6.3	6.3	7.6	7.5	9.1	3 x 29	63.5 x 152	0.6	B32343C4071A580	12
MKP480-D-7.5	7.5	9.0	9.0	10.8	3 x 34.5	75 x 160	0.9	B32344E4072B580	4
MKP480-D-8.3	8.3	10.0	10.0	12.0	3 x 38.2	75 x 160	0.9	B32344E4101B080	4
MKP480-D-10.4	10.4	12.5	12.5	15.0	3 x 47.9	75 x 198	1.2	B32344E4121B580	4
MKP480-D-12.5	12.5	15.0	15.0	18.0	3 x 57.6	75 x 198	1.2	B32344E4151B080	4
MKP480-D-15.0	15.0	18.0	18.0	21.7	3 x 69.1	75 x 273	1.4	B32344E4152B080	4
MKP480-D-16.7	16.7	20.1	20.0	24.1	3 x 77	85 x 273	1.8	B32344E4162A780	4
MKP480-D-20.8	20.8	25.0	25.0	30.1	3 x 96	85 x 273	1.8	B32344E4202A080	4
MKP480-D-25.0	25.0	30.1	30.0	36.1	3 x 115.5	85 x 348	2.2	B32344E4252A080	4
MKP480-D-30.0	30.0	36.1	–	–	3 x 138.5	90 x 348	2.5	B32344E4302A080	4

Types for voltages 220, 240, 480, 600, 660 V and other kvar-values available upon request.

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PhiCap PFC Capacitors

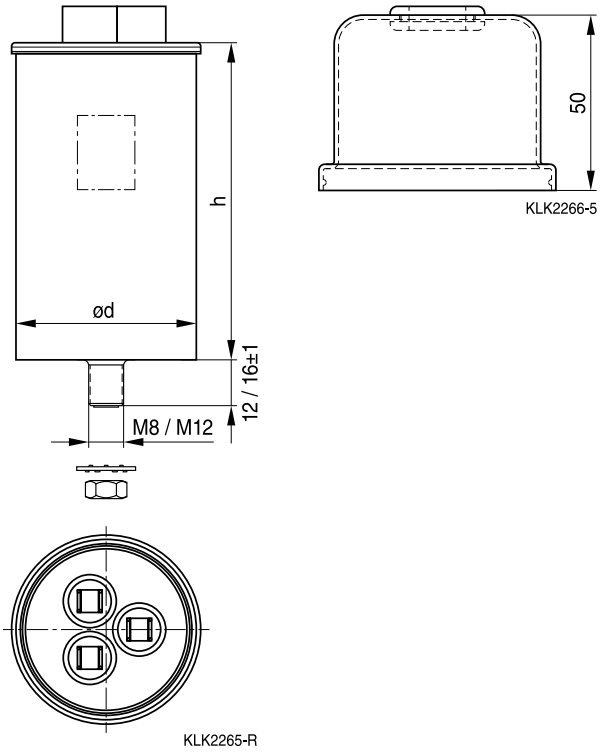
Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Three-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 525 V AC, 50 / 60 Hz, delta connection									
MKP525-D-1.0	1.0	1.1	1.2	1.3	3 x 3.9	53 x 114	0.3	B32343C5012A020	12
MKP525-D-1.5	1.5	1.6	1.8	2.0	3 x 5.8	53 x 114	0.3	B32343C5012A520	12
MKP525-D-2.0	2.0	2.2	2.4	2.6	3 x 7.7	63.5 x 129	0.5	B32343C5022A020	12
MKP525-D-2.5	2.5	2.7	3.0	3.3	3 x 9.6	63.5 x 129	0.5	B32343C5022A520	12
MKP525-D-5.0	5.0	5.5	6.0	6.6	3 x 19.2	63.5 x 152	0.6	B32343C5061B020	12
MKP525-D-6.3	6.3	6.9	7.5	8.3	3 x 24.5	75 x 160	0.9	B32344E5071A520	6
MKP525-D-8.3	8.3	9.1	10.0	11.0	3 x 31.9	75 x 160	0.9	B32344E5101B020	4
MKP525-D-10.4	10.4	11.4	12.5	13.7	3 x 40	75 x 198	1.2	B32344E5121B520	4
MKP525-D-12.5	12.5	13.8	15.0	16.5	3 x 48.1	85 x 198	1.3	B32344E5151B020	4
MKP525-D-16.7	16.7	18.4	20.0	22.0	3 x 64.5	85 x 273	1.8	B32344E5201A020	4
MKP525-D-20.8	20.8	22.9	25.0	27.5	3 x 80.1	85 x 348	2.2	B32344E5202A020	4
MKP525-D-25.0	25.0	27.5	30.0	33.0	3 x 96.5	85 x 348	2.2	B32344E5252A020	4

Dimensional drawings: Three-phase capacitors

Terminal type A



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)
Diameter (ø)	53.0 mm 63.5 mm
Expansion α	max. 12 mm

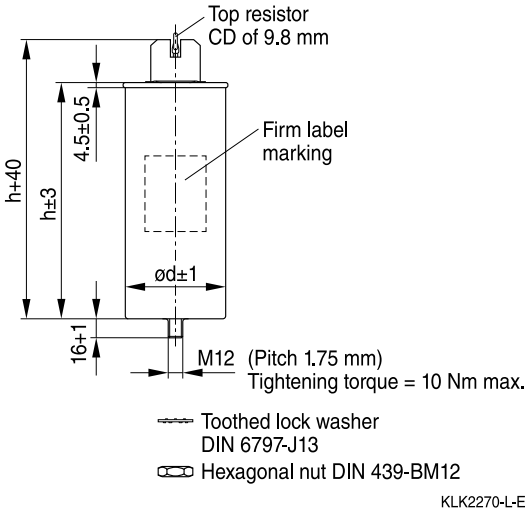
Mounting

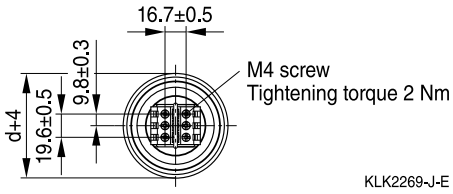
	M12 (ø 63.5 mm)	M8 (ø 53.0 mm)
Torque	T = 10 Nm	T = 4 Nm
Toothed washer	J12.5 DIN 6797	J8.0 DIN 6797
Hex nut	BM12 DIN 439	BM 8 DIN 439

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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Dimensional drawings: Three-phase capacitors

Terminal type B, sigut terminal





Creepage distance	9.6 mm
Clearance	12.7 mm
Diameter d (ø)	75.0 mm / 85.0 mm
Expansion α	max. 13 mm

Mounting

	M12
Torque	T = 10 Nm
Toothed washer	J12.5 DIN 6797
Hex nut	BM12 DIN 439

PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Single-phase capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code	Packing unit
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg		
Rated voltage 230 V AC, 50 / 60 Hz									
MKP230-I-0.8	0.8	3.6	1.0	4.3	50	63.5 x 105	0.30	B32340C2002A830	12
MKP230-I-1.7	1.7	7.2	2.0	8.7	100	63.5 x 142	0.40	B32340C2012A730	12
MKP230-I-2.5	2.5	10.9	3.0	13.1	150	63.5 x 142	0.50	B32340C2022A530	12
Rated voltage 400 V AC, 50 / 60 Hz									
MKP400-I-0.8	0.8	2.0	1.0	2.3	15	63.5 x 68	0.30	B32340C3001A880	12
MKP400-I-1.7	1.7	4.2	2.0	5.0	33	63.5 x 68	0.30	B32340C4012A700	12
MKP400-I-2.5	2.5	6.3	3.0	7.5	50	63.5 x 105	0.40	B32340C4022A500	12
MKP400-I-3.3	3.3	8.4	4.0	10.0	66	63.5 x 105	0.40	B32340C4032A300	12
MKP400-I-4.2	4.2	10.4	5.0	12.5	84	63.5 x 142	0.40	B32340C4051A000	12
MKP400-I-5.0	5.0	12.4	6.0	15.0	99	63.5 x 142	0.50	B32340C4052A000	12
Rated voltage 415 V AC, 50 / 60 Hz									
MKP415-I-0.8	0.8	2.0	1.0	2.4	15	63.5 x 68	0.35	B32340C4082A810	12
MKP415-I-1.7	1.7	4.0	2.0	4.8	31	63.5 x 105	0.45	B32340C4012A710	12
MKP415-I-2.5	2.5	6.0	3.0	7.2	46	63.5 x 105	0.50	B32340C4022A510	12
MKP415-I-3.3	3.3	8.0	4.0	9.7	62	63.5 x 142	0.50	B32340C4032A310	12
MKP415-I-5.0	5.0	12.0	6.0	14.5	91	63.5 x 142	0.60	B32340C4052A010	12
Rated voltage 440 V AC, 50 / 60 Hz									
MKP440-I-0.7	0.7	1.6	0.8	1.9	11	63.5 x 68	0.30	B32340C4001A840	12
MKP440-I-1.4	1.4	3.2	1.7	3.8	23	63.5 x 68	0.30	B32340C4011A740	12
MKP440-I-2.1	2.1	4.7	2.5	5.7	34	63.5 x 105	0.40	B32340C4021A540	12
MKP440-I-2.8	2.8	6.4	3.3	7.6	46	63.5 x 105	0.40	B32340C4031A340	12
MKP440-I-3.3	3.3	7.6	4.0	9.1	55	63.5 x 142	0.50	B32340C4032A340	12
MKP440-I-4.2	4.2	9.5	5.0	11.4	68	63.5 x 142	0.50	B32340C4051A040	12
MKP440-I-5.0	5.0	11.4	6.0	13.6	82	63.5 x 142	0.60	B32340C4052A040	12
Rated voltage 480 V AC, 50 / 60 Hz									
MKP480-I-0.7	0.7	1.5	0.8	1.7	10	63.5 x 105	0.30	B32340C4001A880	12
MKP480-I-1.4	1.4	2.9	1.7	3.5	19	63.5 x 105	0.30	B32340C4011A780	12
MKP480-I-2.1	2.1	4.3	2.5	5.2	29	63.5 x 105	0.50	B32340C4021A580	12
MKP480-I-2.8	2.8	5.8	3.3	6.9	38	63.5 x 142	0.50	B32340C4031A380	12
Rated voltage 525 V AC, 50 / 60 Hz									
MKP525-I-1.4	1.4	2.6	1.7	3.1	16	63.5 x 105	0.30	B32340C5011A720	12
MKP525-I-2.8	2.8	5.2	3.3	6.2	31	63.5 x 142	0.50	B32340C5031A330	12
MKP525-I-3.3	3.3	6.3	4.0	7.6	38	63.5 x 142	0.60	B32340C5032A320	12
MKP525-I-4.2	4.2	8.0	5.0	9.5	48	63.5 x 142	0.70	B32340C5051A020	12

Types for voltages 220, 240, 600, 660 V and other kvar-values available upon request.

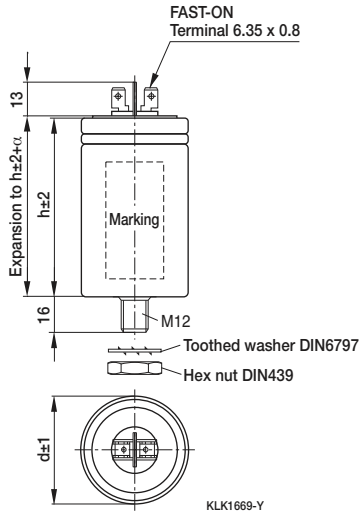
Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PhiCap PFC Capacitors

Biodegradable soft resin impregnated • Stacked winding • Dual safety system

Dimensional drawings: Single-phase capacitors

Capacitor B32340 series

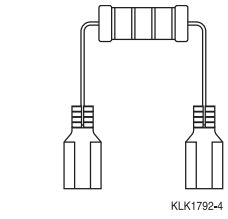


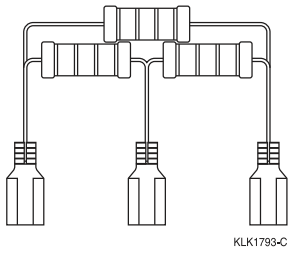
Creepage distance	10.0 mm
Clearance	16.5 mm
Diameter (ø)	63.5 mm
Expansion α	max. 12 mm

Mounting

	M12
Torque	T = 10 Nm
Toothed washer	J12.5 DIN 6797
Hex nut	BM12 DIN 439

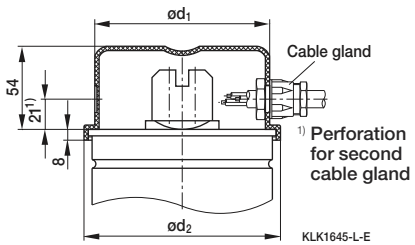
Discharge resistors for B32340 and B32343 series





Discharge resistor for B32344 series refer to page 25.

Protective cover for terminal, protection class IP54



Ø in mm	Ordering code
53.0	B44066K0530A000[1)]
63.5	B44066K0635A000[1)]
75	B44066K0795A000
85	B44066K0895A000

[1)] For B32340 and B32343 series (diameter 53.0 and 63.5 mm), terminal covers with cable entry on top

For IP54 additional cable gland at cable entry required.



NEW

PoleCap PFC Capacitor

- Best suited for harsh environmental applications
  – Mining & Metal
  – Cement
  – Stone & Wood cutting units
  – Flour mills

- Ingress protection IP54/IP65
- UV & weather resistant
- Available with dry type (gas impregnated) & resin impregnated



PoleCap PFC Capacitors

Suitable for outdoor application • Harsh environmental conditions • 0.5 to 36 kvar • 400 to 525 V



General

PoleCap PFC Capacitors are an add-on design to the well-established PhaseCap (MKK) and PhiCap (MKP) capacitors to address the specific challenges of customers to improve the power factor in outdoor applications and harsh environmental conditions.

Its IP54/65 enclosure has been designed and developed with pure aluminum to achieve corrosion-free operation, and the cable gland, terminal cover, and cables are weather and UV-radiation resistant.

PoleCap design comes with a power range of 0.5 kvar to 36 kvar with the option of true dry type design (gas impregnated) and biodegradable resin (resin impregnated). Additionally, it offers a life expectancy up to 100 000 hours, maximum switchings up to 5000 per year, inrush current handling up to 200 · I_N. Therefore, PoleCap is a great choice to manage and meet both performance and operational challenges for outdoor and harsh environmental conditions?

Applications

- Outdoor use
- Harsh environmental conditions
- Mining & Metal
- Cement, textile
- Stone & Wood-cutting units
- Flour mills
- Pole-mounted
- LV distribution transformers

Features

- Power: 0.5 … 36 kvar
- Rated voltage: 400 V, 440 V, 525 V
- Frequency: 50/60 Hz
- Ingress protection: IP54/IP65
- Low dissipation factor
- Reduction of labor costs
- Long Life Expectancy of up to 100 000 hours
- Corrosion-optimized housing (pure aluminum)
- Optimum cooling due to the single housing concept
- High insulation resistance to IEC 60831, 15 kV

Safety

- Dry type (gas impregnated) or resin (impregnated with biodegradable resin)
- Double housing of terminals to protect against ingress of dust or water
- Shock-proof
- Terminal cover, cable gland, and connection cable resistant to weather, UV radiation, and aging
- Self-healing
- Overpressure disconnector

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PoleCap PFC Capacitors

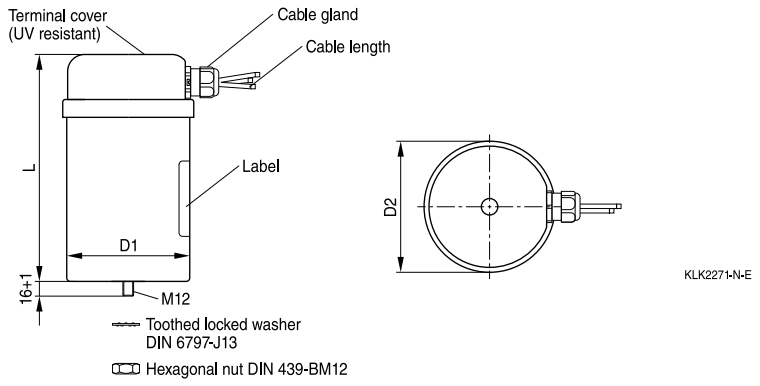
Suitable for outdoor application • Harsh environmental conditions • 0.5 to 36 kvar • 400 to 525 V

Technical data and specifications

Standards IEC 60831-1+2		
Overvoltage	V_{max}	V_N + 10% (up to 8 h daily) / V_N + 15% (up to 30 min daily) / V_N + 20% (up to 5 min daily) / V_N + 30% (up to 1 min daily)
Overcurrent	I_{max}	Up to 1.3 · I_N including combined effects of harmonics, overvoltages and capacitance tolerance
Inrush current	I_S	Up to 300 · I_N
Losses: **– Dielectric** **– Total**[1)]		 <0.2 W/kvar <0.6 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		–5% / 10%
Test voltage, terminal / terminal	V_{TT}	2.15 · V_N, 2 s
Test voltage, terminal / case	V_{TC}	3600 V/50 Hz,
Mean life expectancy	t_{LD}	Up to 100 000 hours (temperature class –40/D); ΘHS <+70° C (Max. mean ambient temperature per year = +35 °C)
Ambient temperature		Class –40/D: Max. short time: +55 °C, max. mean 24 h: +40 °C; max. mean 1 year: +35 °C; lowest temperature: –40 °C
Cooling		Natural or forced
Relative humidity	RH	Max. 95% (non condensing)
Altitude		Max. 4000 m above sea level
Mounting position		Vertical upright
Mounting and grounding		Threaded M12 stud on the bottom of the case
Safety		Three-phase overpressure disconnector, self-healing
Discharge device		Ceramic discharge module or discharge module block (depending on the particular type)
Case		Extruded aluminum can
Enclosure		IP54 or IP65
Dielectric		Polypropylene film
Impregnation		Dry type (gas impregnated) or resin (impregnated with biodegradable resin)
Terminals		Touch-proof IP20 safety terminals
Number of switching operations		Up to 5000 switchings per year (depending on the particular type)

[1)] Without discharge resistor

Dimensional drawings: PoleCap



Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PoleCap PFC Capacitors

Suitable for outdoor application • Harsh environmental conditions • 0.5 to 36 kvar • 400 to 525 V

PoleCap capacitors

Type	50 Hz		60 Hz		C_R	d x h	Weight	Ordering code
	Output kvar	I_N A	Output kvar	I_N A	µF	mm	kg	
Rated voltage 400 V AC, delta connection								
MKP400-D-0.5-P	0.5	0.7	0.6	0.83	3 x 3.5	82 x 210	0.4	B25671A4002A500
MKP400-D-1-P	1	1.44	1.2	1.73	3 x 6.5	82 x 210	0.5	B25671A4012A000
MKP400-D-2-P	2	2.89	2.4	3.46	3 x 13.5	82 x 210	0.5	B25671A4022A000
MKP400-D-3-P	3	4.33	3.6	5.2	3 x 20	82 x 210	0.6	B25671A4032A000
MKP400-D-4-P	4	5.77	4.8	6.97	3 x 26.5	82 x 210	0.6	B25671A4042A000
MKK400-D-5-P	5	7	6	9	3 x 33	125 x 217	1.5	B25671A3996A375
MKK400-D-7.5-P	7.5	11	9	13	3 x 50	125 x 217	1.5	B25671A3147A375
MKK400-D-10-P	10	15	12	18	3 x 69	125 x 217	1.7	B25671A3207A375
MKK400-D-12.5-P	12.5	18	15	22	3 x 83	125 x 217	1.8	B25671A3247A375
MKK400-D-15-P	15	22	18	26	3 x 100	125 x 217	2.0	B25671A3297A375
MKK400-D-20-P	20.8	30	25	36	3 x 138	145 x 253	2.3	B25671A3417A375
MKK400-D-25-P	25	36	-	-	3 x 166	145 x 253	2.9	B25671A3497A375
Rated voltage 440 V AC, delta connection								
MKP440-D-0.5-P	0.5	0.66	0.6	0.79	3 x 2.8	82 x 210	0.4	B25671A4002A540
MKP440-D-1-P	1	1.37	1.2	1.57	3 x 5.5	82 x 210	0.5	B25671A4012A040
MKP440-D-2-P	2	2.62	2.4	3.15	3 x 11	82 x 210	0.5	B25671A4032A040
MKP440-D-3-P	3	3.94	3.6	4.72	3 x 16.5	82 x 210	0.6	B25671A4032A040
MKP440-D-4-P	4	5.25	4.8	6.3	3 x 22	82 x 210	0.6	B25671A4042A040
MKK440-D-5-P	5	7	6	8	3 x 27	125 x 217	1.5	B25671A4826A375
MKK440-D-7.5-P	7.5	10	9	12	3 x 41	125 x 217	1.5	B25671A4127A375
MKK440-D-10.4-P	10.4	14	12.5	16	3 x 57	125 x 217	1.7	B25671A4177A375
MKK440-D-11.2-P	11.2	15	13.4	18	3 x 61	125 x 217	1.8	B25671A4187A375
MKK440-D-12.5-P	12.5	16	15	20	3 x 69	125 x 217	1.9	B25671A4207A375
MKK440-D-14.2-P	14.2	19	17	22	3 x 78	125 x 217	2.0	B25671A4237A365
MKK440-D-15-P	15	20	18	24	3 x 82	125 x 217	2.1	B25671A4247A375
MKK440-D-18.8-P	18.8	25	22.6	30	3 x 103	145 x 253	2.7	B25671A4307A375
MKK440-D-20-P	20.8	27	25	33	3 x 114	145 x 253	2.8	B25671A4347A375
MKK440-D-25-P	25	27	-	-	3 x 137	145 x 253	3.0	B25671A4417A375
Rated Voltage 525 V AC, delta connection								
MKP525-D-0.5-P	0.5	0.55	0.6	0.66	3 x 2	82 x 210	0.4	B25671A5002A520
MKP525-D-1-P	1	1.1	1.2	1.32	3 x 4	82 x 210	0.5	B25671A5012A020
MKP525-D-2-P	2	2.2	2.4	2.64	3 x 8	82 x 210	0.5	B25671A5022A020
MKP525-D-3-P	3	3.3	3.6	3.9	3 x 12	82 x 210	0.5	B25671A5032A020
MKP525-D-4-P	4	4.4	4.8	5.28	3 x 16	82 x 210	0.6	B25671A5042A020
MKP525-D-5-P	5	5.5	6	6.6	3 x 19.5	82 x 210	0.6	B25671A5052A020
MKK525-D-6.3-P	6.3	7	7.5	8	3 x 24	125 x 217	1.4	B25671A5726A375
MKK525-D-8.3-P	8.3	9	10	11	3 x 32	125 x 217	1.5	B25671A5996A375
MKK525-D-10-P	10.4	11	12.5	14	3 x 40	125 x 217	1.8	B25671A5127A375
MKK525-D-12.5-P	12.5	14	15	17	3 x 48	125 x 217	2.0	B25671A5147A375
MKK525-D-15-P	15	17	18	20	3 x 58	125 x 253	2.2	B25671A5177A375
MKK525-D-16.7-P	16.7	18	20	22	3 x 64	125 x 253	2.3	B25671A5197A375
MKK525-D-20-P	20.8	22	25	28	3 x 80	145 x 253	2.9	B25671A5247A375
MKK525-D-25-P	25	28	30	33	3 x 96	145 x 253	3.2	B25671A5287A375
MKK525-D-30-P	30	33	-	-	3 x 115	145 x 253	3.1	B25671A5347A375

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PF Controllers BR6000 & BR7000 Series

Various types of PF controllers • User-friendly • Customized solutions



BR7000-I



BR6000



BR7000

General

Controllers for PFC are of major importance in the compensation system. They measure the actual power factor and connect or disconnect capacitor stages to achieve specific desired values (cos φ).

All types of the BR6000 and BR7000 series feature menu-driven handling in plain language, various languages available. They are all panel-mounted types with an illuminated full graphic display.

Nowadays, controllers feature a microprocessor that analyzes the signal from a current transformer and delivers a command to switch the contactor or – in dynamic PFC – the thyristor to add or remove capacitor steps. This ensures a well-balanced utilization of the capacitor steps, reduces the number of switchings and in the long run will extent the service life of the PFC system.

The number of steps is determined by the required capacitor output to select the particular PF controller. In general, the number of steps depends on the number of loads. The higher the quantity of small loads, the higher the number of controller-steps should be.

The range of PF controllers offers a broad variety of types that allow to select the perfect device for the customer's requirements. Starting with 15 relay outputs in the version of BR6000-series up to 15 outputs for the BR7000-series, a tailor made solution can satisfy customer's demands.

TDK is offering PF controllers for standard applications with slowly changing loads and for dynamic PFC for applications with rapidly changing loads, such as elevators, welding machines, cranes or presses. The dynamic types are designed to switch thyristor modules of the TSM series, also available from TDK (see page 70). Particular types are suited for hybrid applications, e.g. standard and dynamic.

Overview of series

- **BR6000-R6:** 6 relay outputs, standard compensation
- **BR6000-R12:** 12 relay outputs, standard compensation
- **BR6000-T6:** 6 transistor outputs for dynamic compensation
- **BR7000-I:** 12 relay outputs for standard compensation
- **BR7000-I/S485:** 12 relay outputs for standard compensation plus interface RS485
- **BR7000-I-TH:** 12 relay and 12 transistor outputs for standard, mixed and dynamic compensation
- **BR7000-I-/TH/S485:** 12 relay and 12 transistor outputs for standard, mixed and dynamic compensation plus interface RS485
- **BR7000:** 15 relay outputs for standard compensation with two independent RS485-interfaces
- **BR7000-T:** 15 transistor outputs for dynamic PFC with two independent RS485-interfaces

Types featuring a RS85-interface can be connected to a PC for an easy and comfortable evaluation with Windows-based software BR7000-SOFT, included in the delivery. More accessories for PF controllers please see page 64.

Technical details, measured values, dimensions and other features please see tables on page 60.

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PF Controllers BR6000 & BR7000 Series

Various types of PF controllers • User-friendly • Customized solutions

Features

- Display
  - Multifunctional LCD
  - Graphic and alphanumeric
  - LCD illumination
- Intelligent control
- Menu-driven handling (plain language)
- Self-optimizing control capability
- Recall function of recorded values
- Four-quadrant operation (e.g. stand-by generator)
- Large measuring voltage range
- Powerful alarm output
- Display of numerous of system parameters
  - System voltage (V AC)
  - Reactive power (kvar)
  - Active power (kW)
  - Frequency
  - Energy
  - THD-V, THD-I
  - Individual harmonics up to 19th
  - Monitoring of individual capacitor currents
  - Apparent power (kVA)
  - Apparent current (A)
  - Temperature (°C)
  - Real-time cos φ
  - Target cos φ
  - kvar value to target cos φ
- Alarm output
  - Insufficient compensation
  - Overcompensation
  - Undercurrent
  - Overcurrent
  - Overtemperature
  - Harmonics exceeded
  - Threshold value programmable
  - Internal error storage
  - Programming of 2nd signal relay random
- Recall recorded values
  - Number of contactor switching operations
  - Maximum voltage V (V_{max})
  - Maximum reactive power, Q (kvar)
  - Maximum value of harmonic
  - Maximum active power, P (kW)
  - Maximum apparent power, S (kVA)
  - Maximum temperature (°C)
  - Operation time of all capacitors
- Automatic initialization
- Dynamic PFC (transistor output)[1)]
  - Thyristor switching

⚠ Cautions

- 1. Discharge time: Make sure that the discharge time set in controller matches the capacitor discharge time. See page 147.
- 2. Number of switchings: LV PFC capacitors according to standard IEC 60831 are designed for up to 5000 switching operations. Make sure that 5000 switching operations per year are not exceeded.
- 3. Controller hunting must be avoided at any case (see page 150)!

[1)] Only for T-types

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PF Controllers BR6000 Series

Various types of PF controllers • User-friendly • Customized solutions

Technical data and specifications

	BR6000-R6	BR6000-R12	BR6000-T6
Ordering code	B44066R6006E230	B44066R6012E230	B44066R6106E230
Supply voltage	110 … 230 V~ 50/60 Hz	110 … 230 V~ 50/60 Hz	110 … 230 V~ 50/60 Hz
Measurement voltage	30 … 525 V~ (L-N) or (L-L)	30 … 525 V~ (L-N) or (L-L)	30 … 525 V~ (L-N) or (L-L)
Power consumption	<5 VA	<5 VA	<5 VA
Operating temperature	–20 … +60 °C	–20 … +60 °C	–20 … +60 °C
Display	Illuminated display 2 x 16 characters	Illuminated display 2 x 16 characters	Illuminated display 2 x 16 characters
Plain language	CZ/E/ES/F/GER/ NL/PL/PT/RU/TR	CZ/E/ES/F/GER/ NL/PL/PT/RU/TR	CZ/E/ES/F/GER/ NL/PL/PT/RU/TR
Number of relay outputs	6	12	–
Number of transistor outputs	–	–	6
Alarm/Message relay	1/0	1/1	1/0
Additional separate fan relay	–	–	–
Interface	–	–	–
Input 2nd parameter set switchover target PF	–	–	–
Measuring	Single-phase	Single-phase	Single-phase
Controlling	Three-phase	Three-phase	Three-phase
Automatic initialization	Yes	Yes	–
Test run of complete PFC-system	Yes	Yes	–
Number of control series	20 series pre-set	20 series pre-set	20 series pre-set
Control series editor for free programming	Yes	Yes	Yes

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PF Controllers BR6000 Series

Various types of PF controllers • User-friendly • Customized solutions

Technical data and specifications			
	BR6000-R6	**BR6000-R12**	**BR6000-T6**
Ordering code	B44066R6006E230	B44066R6012E230	B44066R6106E230
Parameters displayed			
Voltage (V)	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Apparent current (A)	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Reactive power (kvar)	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Active power (kW)	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Apparent power (kVA)	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
kvar-value to targt cos-φ	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Energy	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Frequency	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Temperature	Alphanumeric: Real value °C/°F	Alphanumeric: Real value °C/°F	Alphanumeric: Real value °C/°F
Real-time cos-φ	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Target cos-φ	Alphanumeric: Real value	Alphanumeric: Real value	Alphanumeric: Real value
Individual harmonics up to	19^{th}	19^{th}	–
TDV-THD-I	Yes	Yes	–
Recall recorded values			
Min. and max. voltage	Yes	Yes	Yes
Maximum active power	Yes	Yes	Yes
Maximum reactive power	Yes	Yes	Yes
Maximum apparent power	Yes	Yes	Yes
Maximum value THD-V, THD-I	Yes	Yes	–
Maximum temperature (°C)	Yes	Yes	Yes
Operation time of all capacitors	Yes	Yes	–
Number of contactor switching operations	Yes	Yes	–
Others			
Switching time	1 … 1200 s	1 … 1200 s	20 … 1000 ms
Weight	1 kg	1 kg	1 kg
Dimensions	144 x 144 x 55 mm	144 x 144 x 55 mm	144 x 144 x 55 mm
Suitable for dynamic PFC	No	No	Yes

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PF Controllers BR7000 Series

Various types of PF controllers • User-friendly • Customized solutions

Technical data and specifications

	BR7000	**BR7000-I**	**BR7000-I-TH**
Ordering code	B44066R7415E230	B44066R7012E230	B44066R7412E230
	BR7000-T	**BR7000-I/S485**	**BR7000-I-TH/S485**
Ordering code	B44066R7615E230	B44066R7112E230	B44066R7612E230
Supply voltage	110 … 440 V~ 50/60 Hz	110 … 440 V~ 50/60 Hz	110 … 230 V~ 50/60 Hz
Measurement voltage	3 x 30 … 440 V AC (L-N) 3 x 50 … 760 V AC (L-L)	30 … 440 V AC (L-N) 50 … 760 V AC (L-L)	30 … 440 V AC (L-N) 50 … 760 V AC (L-L)
Power consumption	<3 W	<5 W	<5 W
Operating temperature	–20 … +70 °C,	–20 … +70 °C	–20 … +70 °C
Display	Illuminated graphic display, 128 x 64 dots;	Illuminated graphic display, 128 x 64 dots	Illuminated graphic display, 128 x 64 dots
Large display of 3 grid parameters	Selection in display editor	Selection in display editor	Selection in display editor
Plain language	GER/E/ES/F/RU/TR	CZ/E/ES/F/GER/ NL/PL/PT/RU/TR	CZ/E/ES/F/GER/ NL/PL/PT/RU/TR
Number of relay outputs	BR7000: 15 relay outputs, freely programmable for switching of single- or three-phase capacitors	12 … 13 switching outputs	12
Number of transistor outputs	BR7000-T: 15 transistor outputs, freely programmable for switching of single- or three-phase capacitors	–	12
Alarm/Message relay	1/1	1 alarm 1 message (version with interface)	1 alarm 1 message (version with interface)
Additional separate fan relay	Yes	–	–
Interface	2 independent isolated RS485	RS485 with version BR7000-I/S485	RS485 with version BR7000-I-TH/S485
Input 2nd parameter set switchover target PF	Yes	Version /S only	Version /S only
Measuring	Three-phase	Single-phase	Single-phase
Controlling	Single-phase, three-phase, mixed mode	Three-phase	Three-phase
Automatic initialization	–	Yes	–
Test run of complete PFC-system	Only BR7000	Yes	–
Internal timers	Yes	–	–
Oscilloscope (graphical display) mode	Yes	–	–
Display editor	Yes	Yes	Yes
Backward navigation ESCAPE button	Yes	Yes	Yes
HELP button for interactive help text	Yes	Yes	Yes
Number of control series	23 series pre-set	20 series pre-set	20 series pre-set
Control series editor for free programming	Yes	Yes	Yes

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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PF Controllers BR7000 Series

Various types of PF controllers • User-friendly • Customized solutions

Technical data and specifications

	BR7000	**BR7000-I**	**BR7000-I-TH**
Ordering code	B44066R7415E230	B44066R7012E230	B44066R7412E230
	HD-version	**BR7000-I/S485**	**BR7000-I-TH/S485**
Ordering code	B44066R7515E230	B44066R7112E230	B44066R7612E230
	BR7000-T		
Ordering code	B44066R7615E230		
Parameters displayed			
Voltage (V)	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Apparent current (A)	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Reactive power (kvar)	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Active power (kW)	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Apparent power (kVA)	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
kvar-value to targt cos-φ	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Energy	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Frequency	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display	Alphanumeric: Real value / large display
Temperature	Real value / large display °C/°F	Real value / large display °C/°F	Real value / large display °C/°F
Real-time cos-φ	Real value / large display	Real value / large display	Real value / large display
Target cos-φ	Real value / large display	Real value / large display	Real value / large display
Individual harmonics up to	Up to 31st/ real value / in % / bar graph	Odd up to 33rd/ even and odd up to 17th; real value / in % / bar graph	Odd up to 33rd/ even and odd up to 17th; real value / in % / bar graph
TDV-THD-I	Real value / in % / bar graph	Real value / in % / bar graph	Real value / in % / bar graph
Time/date	Yes	Only BR7000-I/S485	Only BR7000-I-TH/S485
Recall recorded values			
Min. and max. voltage	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum current	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum active power	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum reactive power	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum apparent power	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum value THD-V, THD-I	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Maximum temperature (°C)	Yes, with time stamp	Yes, version /S with time stamp	Yes, version /S with time stamp
Operation time of all capacitors	Only BR7000 and BR7000-HD	Yes	–
Number of contactor switching operations	Only BR7000 and BR7000-HD	Yes	–
Others			
Switching time	20 … 1000 ms (version T) 1 … 1200 s (standard)	1 … 1200 s	Dynamic part: 20 … 1000 ms relay part: 1 … 1200 s
Weight	1 kg	1 kg	1 kg
Dimensions	144 x 144 x 50 mm	144 x 144 x 55 mm	144 x 144 x 55 mm
PC-software included	Yes	Only version BR7000-I/S485	Only version BR7000-I-TH/S485
Suitable for dynamic PFC	Only BR7000-T	No	Yes
Suitable for TSM-LC-S via interface	No	No	Only version BR7000-I-TH/S485

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Accessories for PF Controller Series BR6000 and BR7000

Accessories for PF controller series



BR7000-SOFT



IF8000 Interface-Module



USB to RS485 converter



DataLogSD

BR7000-SOFT Windows-based software

This program offers the possibility for a comfortable parameterization, recording, analysis and visualization of grid parameters in online operation via a PC. It is compatible with PF controller series BR7000. The software allows the recording and a graphical evaluation of all values including export- and print function. The spectrum of harmonics can be displayed as bar chart. The configuration manager is used for a complete read out, editing, storing and writing of all parameters of the PF controller via PC. All data can be stored in a configuration file.

Features

- Connection to RS485-bus
- Administration of several PF controllers possible
- Convenient analysis of recorded values
- Direct connection to USB port of a PC via USB adapter
- CD-ROM included in the delivery of PF controller BR7000

IF8000 Interface-Module for BR7000-I (Version 4 onwards) for devices with service interface to add an additional interface (RS485 – Modbus-RTU). The PF controller BR7000-I will automatically identify the second interface and will extend the internal menus. Remote read-out of grid parameters. Storage and display via PC-software in online operation. Potential free, for alignment of up to 255 devices. Control LED Tx and Rx. Power supply via basic devices (no external feed-in required). Integrated switchable termination.
Ordering code: B44066R7013E230

USB to RS485 converter to connect the PF controllers BR7000, BR7000-I/S485 and BR7000-I-TH/S485 or other devices with interface RS485 to a PC with USB interface. Connection of several devices at RS485 possible.
Ordering code: B44066R3333E230

DataLogSD in compact plastic casing for recording, visualisation and evaluation for grid parameters. Comfortable evaluation of accquired data (recorded on SD-card) via Windows-based software.
Ordering code: B44066R1311E230

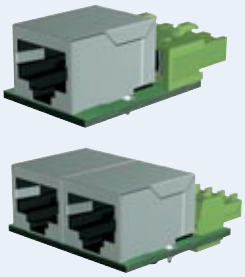
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Accessories for PF Controller Series BR6000 and BR7000

Accessories for PF controller series



NET 8000 web server for BR 7000



RJ45 adapter

The "NET8000" web server is available as an accessory for the reactive power controller BR7000-I designed. It enables remote access to the controller via an existing network.

The following functions can be implemented:

- Display of all measured values and the level status
- Display of the individual harmonics of the current and voltage
- Detailed information on the individual levels
- Display of the controller settings
- Display of the error memory
- Remote access/parameterization
- Changing the parameterization of the controller
- Display and reset of the maximum values
- Deleting the fault memory
- E-mail functionality
- Parameterization of any warning and error messages
- For notification via e-mail
- Setting up several e-mail addresses possible

RJ45 adapter, connectors for PF controller series BR7000 and BR7000-I-TH/S485. Three different versions of the adapter connectors enable the following configurations:

- Terminal to RJ45 converter
- To connect the interface terminal of BR7000 and BR7000-I-TH/S485 via a RJ45-standard cable (1:1)
- Connection of several devices at the RS485 bus with simple connection (one click)
- Example:
  Connection of several BR7000, BR7000-I/S485 and BR7000-I-TH/S485 to a PC with BR7000-SOFT, coupling of several BR7000-I/S485 with each other

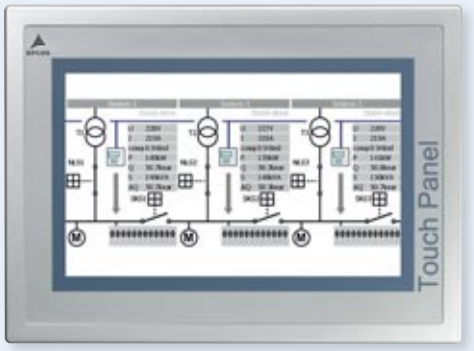
Variants

- 1 x RJ45 for BR7000, BR7000-I/S485 and BR7000-I-TH/S485
  Ordering code: B44066R1611E230
- 2 x RJ45 for BR7000, BR7000-I/S485 and BR7000-I-TH/S485
  Ordering code: B44066R1711E230
- 2 x RJ45 for MMI6000
  Ordering code: B44066R1811E230

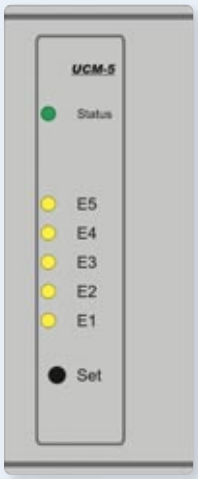
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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Accessories for PF Controller Series BR6000 and BR7000

Accessories for PF controller series



Touch panel VIP-X-TP



UCM-5

Touch panel VIP-X-TP, comfortable control device for intelligent coupling of 3 to 5 compensation systems. Enables operation of compensation systems in parallel for 3 to 5 coupled feeding transformers without any retroactivity. The control device VIP-X-TP realizes the coupling with PF controllers BR7000-I/S485 and at the same time offers a comfortable visualization of the measured values, switching states and of the actual system state. To achieve this, the device is connected to the PF controllers via patch-cables only (RS485-interface). All possibilities of coupling are supported:

- Coupling with coupling switches
- Ring coupling
- Coupling via separate coupling bus bars

Variants

- VIP-3-TP
  Coupling of 3 compensation systems
  Ordering code: B44066R1703E230
- VIP-4-TP
  Coupling of 4 compensation systems
  Ordering code: B44066R1704E230
- VIP-5-TP
  Coupling of 5 compensation systems
  Ordering code: B44066R1705E230

UCM-5, bus compatible S0-impulse module for software MMI-energy for conversion of counter impulses (Q+, Q–, P+, P–, synchronic) on RS485 (Modbus RTU protocol)

- Accessory for processing of counter values in PF controller (controlling of reactive power related to counter impulses instead of current transformer)
- Allows processing of counter values via Windows-software MMI-energy (included in the delivery): cost center management, visualization and evaluation
- Cross-linking of up to 32 devices (UCM-5, BR7000) at Modbus
- Compact design in plastic case
- Mounting on DIN-rail possible
- Evaluation software included in the delivery

Ordering code: B44066R1411E230

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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Switching Devices – Capacitor Contactors

Specially designed for damping of inrush current in LV PFC systems



General

When a capacitor is switched to an AC voltage, the result is a resonant circuit damped to a greater or lesser degree. The switching of capacitors can cause high inrush currents, particularly when they are switched in parallel to others already activated in the power line, and if high short-circuit powers are present on the line.

Capacitor contactors with damping resistors make use of pre-switching auxiliary contacts. They close before the main contacts and pre-load the capacitor thus avoiding current peak values.

This influences positively the life expectancy of the capacitor significantly in addition to the positive impact on the power quality (avoiding transients and voltage sags that otherwise may be caused by switching in capacitors).

Applications

- Damping of inrush current in low-voltage PFC systems
- For PFC systems with and without reactors

Approvals

- cUL file 224924

Features

- Excellent damping of inrush current
- Improved power quality (e.g. avoidance of voltage sags)
- Longer useful service life of main contacts of capacitor contactor
- Soft switching of capacitor and thus longer useful service life
- Enhanced mean life expectancy of PFC system
- Reduced ohmic losses
- Leading contacts with wiper function
- Tamper-proof and protected resistors
- Easy access for cable connection
- Voltage range: 400 … 690 V
- Output range: 12.5 … 100 kvar
- AC6b utilization category

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Switching Devices – Capacitor Contactors

Specially designed for damping of inrush current in LV PFC systems

Technical data and specifications

Type Main contacts		B44066*****J230/J110 S1810	S2410	S3210	S5010	S6210	S7410	S9010	S9910
Rated insulation voltage V	[V AC]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]	1,000[1)]	1,000[1)]
Max. frequency of operation	1/h	120	120	120	120	120	80	80	80
Contact life	million operations	0.25	0.15	0.15	0.15	0.15	0.12	0.12	0.12
Cable cross section Solid or standard	[mm^2]	1.5–6	2.5–25	2.5–25	4–50	4–50	4–50	0.5–95/10–120	0.5–95/10–120
Flexible	[mm^2]	1.5–4	2.5–16	2.5–16	10–35	10–35	10–35	0.5–70/10–95	0.5–70/10–95
Flexible with multicore cable end	[mm^2]	1.5–4	2.5–16	2.5–16	6–35	6–35	6–35	0.5–70/10–95	0.5–70/10–95
Cables per clamp		2	1	1	1	1	1	2	2
Operating range of magnet coils in multiples of control voltage V_S		0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1
Auxiliary contacts[1)] **Rated insulation voltage V**	[V AC]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]	690[1)]
Rated current I_{th} at ambient temperature $T_{A,max.}$ = 40 °C	I_{coth} [A]	16	10	10	10	10	10	10	10
$T_{A,max.}$ = 60 °C	I_{coth} [A]	12	6	6	6	6	6	6	6
Utilization category AC15 220 to 240 V	I_{coth} [A]	12	3	3	3	3	3	3	3
380 to 440 V	I_{coth} [A]	4	2	2	2	2	2	2	2
Short circuit protection Highest fuse rating slow, gL (gG) Auxiliary contacts	I_{coth} [A] NO / NC	25 1 / 0	20 1 / 0	20 1 / 0	20 1 / 0	20 1 / 0	20 1 / 0	20 1 / 0	20 1 / 0

IEC 947-4-1, IEC 947-5-1, EN 60947-4-1, EN 60947-5-1, VDE 0660. Dimensional drawing: see datasheet

[1)] Applies to networks with grounded star point, overvoltage category I to IV, pollution severity 3 (industrial standard), V_{imp} = 8 kV. Values for other conditions on request.

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Switching Devices – Capacitor Contactors

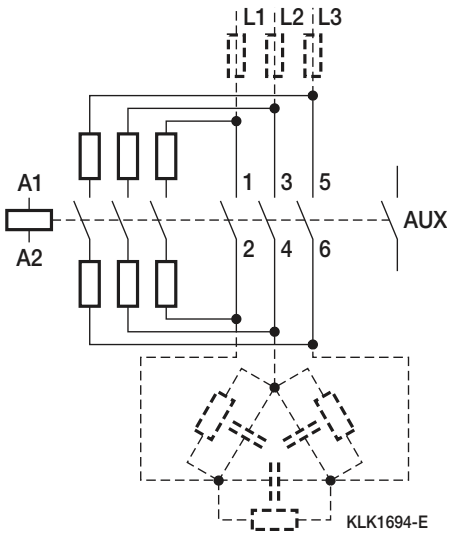
Specially designed for damping of inrush current in LV PFC systems

Characteristics and ordering codes

Capacitor reactive power at ambient temp., voltage, 50/60 Hz 380 … 400 V		415 … 440 V		660 … 690 V		Rated current		Weight	Ordering code
+50 °C kvar	+60 °C kvar	+50 °C kvar	+60 °C kvar	+50 °C kvar	+60 °C kvar	+50 °C A	+60 °C A	kg	
110 V coil									
0–12.5	0–12.5	0–13	0–13	0–20	0–20	18	18	0.34	B44066S1810J110
10–20	10–20	10.5–22	10.5–22	17–33	17–33	28	28	0.60	B44066S2410J110
10–25	10–25	10.5–27	10.5–27	17–41	17–41	36	36	0.60	B44066S3210J110
20–50	20–50	23–53	23–53	36–82	36–82	72	72	1.10	B44066S6210J110
20–75	20–60	23–75	23–64	36–120	36–100	108	87	1.10	B44066S7410J110
33–80	33–75	36–82	36–77	57–120	57–120	115	108	2.30	B44066S9010J110
33–100	33–90	36–103	36–93	57–148	57–148	144	130	2.30	B44066S9910J110
230 V coil									
0–12.5	0–12.5	0–13	0–13	0–20	0–20	18	18	0.34	B44066S1810J230
10–20	10–20	10.5–22	10.5–22	17–33	17–33	28	28	0.60	B44066S2410J230
10–25	10–25	10.5–27	10.5–27	17–41	17–41	36	36	0.60	B44066S3210J230
20–33.3	20–33.3	23–36	23–36	36–55	36–55	48	48	1.10	B44066S5010J230
20–50	20–50	23–53	23–53	36–82	36–82	72	72	1.10	B44066S6210J230
20–75	20–60	23–75	23–64	36–120	36–100	108	87	1.10	B44066S7410J230
33–80	33–75	36–82	36–77	57–120	57–120	115	108	2.30	B44066S9010J230
33–100	33–90	36–103	36–93	57–148	57–148	144	130	2.30	B44066S9910J230

Connection diagrams

All types B44066S**J*** (with preload resistors), B44066S1810J230 and B44066S1810J110 with wires on the bottom, B44066S9010J230 and B44066S9910J230 with resistors inside housing**



Switching Devices – Thyristor Modules for Dynamic PFC, TSM-Series



General

Conventional systems for power factor correction are used to optimize the power factor and reduce the level of harmonics in the grid. The usage of new technologies in modern industry has negative impacts on electric power quality of the main supply networks, e.g. frequent high load fluctuations and harmonic oscillation.

Excessive currents, increased losses and flickering will not only influence the supply capacity but will also have a significant impact on the operation of sensitive electronic devices.

The solution for this are dynamic power factor correction systems.

With the thyristor module series TSM-LC, we provide the main component – "the electronic switch" – for dynamic power factor correction.

The TSM module series offers fast electronically controlled, self-observing thyristor switches for capacitive loads up to 100 kvar, that are capable to switch PFC capacitors within a few milliseconds nearly without a limitation to the number of switchings during the capacitor lifetime.

Applications

- Main supply networks with high load fluctuations for dynamic PFC systems
- Presses
- Welding machines
- Elevators
- Cranes
- Wind turbines

Features

- Easy installation: it can be used similar to a contactor
- All the intelligence needed is offered within the thyristor module itself
- Reaction time: 5 milliseconds only
- Permanent self-controlling of:
  - Voltage parameter
  - Phase sequence
  - Capacitor output
- Display of
  - Operation
  - Faults
  - Activation
- TSM-LC-S: Triggering of the module via system bus (patch cable) from PF-controller BR7000-I-TH/S485
  - Up to 32 devices at supported by controller
  - Display and monitoring of V, I, Q, temperature, switching state
  - Error display and evaluation via bus directly at PF-controller
  - Direct monitoring of temperature switch of filter reactor
- Voltage range:
  - TSM-LC*: 380 … 440 V AC
  - TSM-LC-S: 200 … 440 V AC
  - TSM-LC-N480: 380 … 480 V AC
  - TSM-LC-N690: 380 … 690 V AC
- Output range: TSM-LC-I: 10 … 22 kvar, depending on the voltage TSM-LC: 10, 25, 50, 100 kvar, depending on the voltage

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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Switching Devices – Thyristor Modules for Dynamic PFC, TSM-Series

Technical data and specifications

	TSM-LC10	TSM-LC-N1	TSM-LC-N480
Ordering code	B44066T0010E402	B44066T3850E402	B44066T3850E408
Rated voltage	380 … 400 V AC	380 … 440 V AC	380 … 480 V AC
Max. grid voltage: In conventional PFC systems (without reactors)	440 V AC	440 V AC	480 V AC
In detuned PFC system (7% detuning)	440 V AC	440 V AC	480 V AC
In detuned PFC system (14% detuning)	400 V AC	max. 440 V AC	480 V AC
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum power / at nominal voltage	12.5 kvar	25 to 50 kvar depending on the voltage	50 kvar depending on the voltage
Power circuit	Direct connection 4 pole via terminal clamps (D = 6 mm^2 resp. 4 mm^2)	Direct connection 4-pole via high-current clamps (cable lug 35 mm^2). Connection from bottom	Direct connection 4-pole via high-current clamps (cable lug 35 mm^2). Connection from bottom
Neutral required	No	No	No
Aux. supply voltage required	No	No	230 V AC/10 VA
Connection	From bottom	From bottom	From bottom
Losses (PD in W)	Pv (W) = 2.0 · I (in A); at 400 V/12.5 kvar approx. 35 W (thermal)	Pv (W) = 2.0 · I (in A); at 400 V/50 kvar typically 150 W	Pv (W) = 2.0 · I (in A); at 400 V/50 kvar typically 150 W
Recommended fuses "superfast"	3× electronic fuse (NH00 AC 690 V) 35 A	3× electronic fuse (NH00 AC 690 V) 50 kvar: 125 A 25 kvar: 63 A	3× electronic fuse (NH AC 690 V) 50 kvar: 125 A 25 kvar: 63 A
Dimensions in mm (w x h x d)	163 x 152 x 75	157 x 200 x 180	157 x 200 x 180
Weight	1.75 kg	Approx. 4.8 kg	Approx. 4.8 kg
Display per phase	2 LED	2 LED	2 LED
Ambient temperature	–10 … +55 °C	–10 … +55 °C	–10 … +55 °C
Discharge resistors EW-22 needed	1	1	1
Current limitation reactor BD…needed[1)]	2	2 x BD100	2 x BD100

[1)] For PFC systems without detuning reactors mandatory.

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Switching Devices – Thyristor Modules for Dynamic PFC, TSM-Series

Technical data and specifications

	TSM-LC-N690	TSM-LC100
Ordering code	B44066T3050E690	B44066T0100E402
Rated voltage	380 … 690 V AC	380 … 400 V AC
Max. grid voltage: In conventional PFC systems (without reactors)	690 V AC	440 V AC
In detuned PFC system (7% detuning)	690 V AC	440 V AC
In detuned PFC system (14% detuning)	max. 690 V AC	400 V AC
Frequency	50/60 Hz	50/60 Hz
Maximum power / at nominal voltage	40 to 75 kvar depending on the voltage	100 kvar
Power circuit	Direct connection via high current plug; connection from the bottom	Direct connection 4 pole via busbar (cable lug 70 mm^2, D = 10 mm)
Neutral required	No	No
Aux. supply voltage required	230 V AC/10 VA	230 V AC (needed for fan) via terminal clamp
Connection	From bottom	From bottom
Losses (PD in W)	Pv (in W) = 2.4 · I (in A); approx. 150 W thermal at nominal current	Pv (in W) = 2.0 · I (in A); typical 300 W (thermal)
Recommended fuses “superfast”	3× electronic fuse (NH00 AC 690 V) 50 kvar: 125 A	3× NH1 (AC 690 V) 250 A 125 A
Dimensions in mm (w x h x d)	157 x 200 x 190	157 x 240 x 195
Weight	Approx. 4.8 kg	5.5 kg
Display per phase	2 LED	2 LED
Ambient temperature	–10 … +55 °C	–10 … +55 °C
Discharge resistors EW-22 needed	2	1–2 in parallel
Current limitation reactor BD… needed[1)]	2 x BD100	Standard applications require a special current limitation reactor

[1)] For PFC systems without detuning reactors mandatory.

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Switching Devices – Thyristor Modules for Dynamic PFC, TSM-Series

Accessories for TSM modules

	BD050[1]	BD100
Ordering code	B44066T0050L400	B44066T0100L400
Nominal voltage	400/480 V	400/480 V
Nominal current	50 A	85 A
Frequency	50/60 Hz	50/60 Hz
Dimensions (w x d x h)	55 x 60 x 70 mm	70 x 77 x 86 mm
Weight	Approx. 1.5 kg	Approx. 2.3 kg

[1] Production only after ordering. [2] Only suitable for TSM-LC100.

Accessories for TSM modules

Type / description
Discharge resistors EW-22 at least 1 piece per step to be used for all types of TSM if fast re-switching time is required.[1] For higher rated steps please contact our local sales office.

EW-22 and EW-33: Dimensions (w x d x h):	90 x 50 x 100 mm
Weight (approx.):	0.3 kg
Design panel:	for mounting on heat sink/fitting
Connection:	screw terminal, ready for three-phase connection to the capacitor

Ordering code
B44066T0022E400

[1] Consisting of two single resistors of 22 kΩ each



EW-22



BD100

BD series:
Single-phase current limitation reactor for thyristor modules

TSM series in conventional dynamic PFC systems without reactor

- Used for limitation of the pace of current increase dI/dT in the thyristors to the maximum permissible value
- Protection of thyristor modules series TSM-LC

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Detuned Reactors – Antiresonance Harmonic Filter





General

The increasing use of modern power electronic apparatus (drives, uninterruptible power supplies, etc) produces nonlinear current and thus influences and loads the network with harmonics (line pollution).

The power factor correction or capacitance of the power capacitor forms a resonant circuit in conjunction with the feeding transformer. Experience shows that the self-resonant frequency of this circuit is typically between 250 and 500 Hz, i.e. in the region of the 5th and 7th harmonics.

Such a resonance can lead to the following undesirable effects:

- Overloading of capacitors
- Overloading of transformers and transmission equipment
- Interference with metering and control systems, computers and electrical gear
- Resonance elevation, i.e. amplification of harmonics
- Voltage distortion

These resonance phenomena can be avoided by connecting capacitors in series with filter reactors in the PFC system. These so called “detuned” PFC systems are scaled in a way that the self-resonant frequency is below the lowest line harmonic. The detuned PFC system is purely inductive seen by harmonics above this frequency. For the base line frequency (50 or 60 Hz usually), the detuned system on the other hand acts purely capacitive, thus correcting the reactive power.

Applications

- Avoidance of resonance conditions
- Tuned and detuned harmonic filters
- Reduction of harmonic distortion (network clearing)
- Reduction of power losses

Features

- High harmonic loading capability
- Very low losses
- High linearity to avoid choke tilt
- Low noise
- Convenient mounting
- Long expected life time
- Temperature protection (NC contact)

Technical data and limit values

Filter reactors	
Harmonics[1)]	V_3 = 0.5% V_R (duty cycle = 100%) V_5 = 6.0% V_R (duty cycle = 100%) V_7 = 5.0% V_R (duty cycle = 100%) V_{11} = 3.5% V_R (duty cycle = 100%) V_{13} = 3.0% V_R (duty cycle = 100%)
Effective current	$I_{RMS} = \sqrt{(I_1^2+I_3^2 \ldots I_{13}^2)}$
Fundamental current	$I_1 = 1.06 \cdot I_R$ (50 Hz or 60 Hz current of capacitor)
Temperature protection	Microswitch (NC)
Dimensional drawings and terminals	See specific datasheets

Three-phase filter reactors to VDE 0532 / EN 60289	
Frequency	50 Hz or 60 Hz
Voltage	400, 440
Output	10 … 100 kvar
Detuning	5.67%, 7%, 14%
Cooling	Natural
Ambient temperature	+40 °C
Class of protection	I
Enclosure	IP00

[1)] According to DIN ENV VV61000-2-2

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Detuned Reactors – Antiresonance Harmonic Filter

Characteristics and ordering codes

Power	Δ Capacitance	Inductance	I_{RMS} (I_{eff})	Losses[1)]	Weight	Terminal	Ordering code
kvar	µF	mH	A	W	kg		
Rated voltage V = 400 V, f = 50 Hz, p = 5.67% (f_r = 210 Hz) / Linearity: L ≥0.95 · L_R for current up to 2.08 · I1							
10	3 x 62	3.06	18.5	95	6.4	10 mm² Kl.	B44066D5010*400
12.5	3 x 78	2.45	23.0	120	8.4	10 mm² Kl.	B44066D5012*400
20	3 x 125	1.53	36.9	100	13	16 mm² Kl.	B44066D5020*400
25	3 x 156	1.23	46.1	135	17	16 mm² Kl.	B44066D5025*400
40	3 x 250	0.77	73.7	150	23	M6 Al-flat	B44066D5040*400
50	3 x 312	0.61	92.1	240	31	M6 Al-flat	B44066D5050*400
75	3 x 496	0.41	138.2	260	35	M8 Al-flat	B44066D5075*400
100	3 x 625	0.31	183.8	360	47	M8 Al-flat	B44066D5100*400
Rated voltage V = 400 V, f = 50 Hz, p = 7% (f_r = 189 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.73 · I1							
10	3 x 61	3.84	16.4	70	5.9	10 mm² Kl.	B44066D7010*400
12.5	3 x 77	3.01	20.5	75	8.6	10 mm² Kl.	B44066D7012*400
20	3 x 123	1.92	32.7	120	18	Cu bars Ø 9 mm	B44066D7020*400
25	3 x 154	1.53	40.9	180	18	Cu bars Ø 9 mm	B44066D7025*400
40	3 x 246	0.96	65.4	230	26	Cu bars Ø 9 mm	B44066D7040*400
50	3 x 308	0.77	81.8	270	27	Cu bars Ø 9 mm	B44066D7050*400
75	3 x 462	0.51	122.7	330	39	Cu bars Ø 9 mm	B44066D7075*400
100	3 x 617	0.38	163.3	390	50	Cu bars Ø 11 mm	B44066D7100*400
Rated voltage V = 400 V, f = 50 Hz, p = 14% (f_r = 135 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.37 · I1							
10	3 x 57	8.29	15.4	80	9.4	10 mm² Kl.	B44066D1410*400
12.5	3 x 71	6.64	19.2	95	12	10 mm² Kl.	B44066D1412*400
20	3 x 114	4.15	30.8	150	22	Cu bars Ø 9 mm	B44066D1420*400
25	3 x 142	3.32	38.5	200	26	Cu bars Ø 9 mm	B44066D1425*400
40	3 x 228	2.07	61.6	270	38	Cu bars Ø 9 mm	B44066D1440*400
50	3 x 285	1.66	77	290	40	Cu bars Ø 9 mm	B44066D1450*400
75	3 x 427	1.11	115.5	380	58	Cu bars Ø 9 mm	B44066D1475*400
100	3 x 570	0.83	153.9	470	66	Cu bars Ø 11 mm	B44066D1499*400
Rated voltage V = 440 V, f = 50 Hz, p = 5.67% (f_r = 210 Hz) / Linearity: L ≥0.95 · L_R for current up to 2.08 · I1							
10	3 x 51	3.71	16.8	100	7	10 mm² Kl.	B44066D5010*440
12.5	3 x 64	2.97	21.0	120	9	10 mm² Kl.	B44066D5012*440
25	3 x 129	1.48	42.0	110	16.5	16 mm² Kl.	B44066D5025*440
50	3 x 258	0.74	83.8	200	25	M6 Al-flat	B44066D5050*440
75	3 x 387	0.49	125.6	370	36	M8 Al-flat	B44066D5075*440
100	3 x 517	0.37	168.0	320	50	M8 Al-flat	B44066D5100*440

[1)] Total max. losses, considering max. specified overvoltage and harmonic currents

* TDK offers reactors with slightly different specifications (e.g. dimensions) that can be used for the same application although sometimes with slightly different resulting performances. These types are distinguished by different letters at digit 12 of the product code. Thus this digit is not specified here.

Other voltages upon request

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Detuned Reactors – Antiresonance Harmonic Filter

Characteristics and ordering codes

Power	Δ Capacitance	Inductance	I_{RMS} (I_{eff})	Losses[1)]	Weight	Terminal	Ordering code
kvar	µF	mH	A	W	kg		
Rated voltage V = 440 V, f = 50 Hz, p = 7% (f_r = 189 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.73 · I1							
10	3 x 50	4.64	14.9	70	6.5	10 mm² Kl.	B44066D7010*440
12.5	3 x 63	3.71	18.7	65	8.5	10 mm² Kl.	B44066D7012*440
25	3 x 127	1.87	37.2	170	18	Cu bars Ø 9 mm	B44066D7025*440
50	3 x 254	0.93	74.3	250	33	Cu bars Ø 9 mm	B44066D7050*440
75	3 x 382	0.62	111.4	340	43	Cu bars Ø 9 mm	B44066D7075*440
100	3 x 509	0.46	148.7	410	49	Cu bars Ø 9 mm	B44066D7100*440
Rated voltage V = 440 V, f = 50 Hz, p = 14% (f_r = 135 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.37 · I1							
10	3 x 47	10.04	14.0	90	10	10 mm² Kl.	B44066D1410*440
12.5	3 x 58	8.03	17.5	100	13	10 mm² Kl.	B44066D1412*440
25	3 x 117	4.02	35.0	160	27	Cu bars Ø 9 mm	B44066D1425*440
50	3 x 235	2.01	70.0	300	40	Cu bars Ø 9 mm	B44066D1450*440
75	3 x 353	1.34	105.0	440	53	Cu bars Ø 9 mm	B44066D1475*440
100	3 x 471	1.00	140.0	490	65	Cu bars Ø 9 mm	B44066D1499*440
Rated voltage V = 440 V, f = 60 Hz, p = 5.67% (f_r = 252 Hz) / Linearity: L ≥0.95 · L_R for current up to 2.08 · I1							
25	3 x 107	1.24	42.0	140	16	16 mm² Kl.	B44066D5025*441
50	3 x 215	0.62	83.8	210	25	M6 Al-flat	B44066D5050*441
75	3 x 323	0.41	126.0	340	33	M8 Al-flat	B44066D5075*441
100	3 x 431	0.31	167.4	310	47	M8 Al-flat	B44066D5100*441
Rated voltage V = 440 V, f = 60 Hz, p = 7% (f_r = 227 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.73 · I1							
25	3 x 106	1.55	37.2	130	18	Cu bars Ø 9 mm	B44066D7025*441
50	3 x 212	0.77	74.4	250	27	Cu bars Ø 9 mm	B44066D7050*441
75	3 x 318	0.52	111.4	320	39	Cu bars Ø 9 mm	B44066D7075*441
100	3 x 424	0.39	148.6	380	44	Cu bars Ø 9 mm	B44066D7100*441
Rated voltage V = 440 V, f = 60 Hz, p = 14% (f_r = 162 Hz) / Linearity: L ≥0.95 · L_R for current up to 1.37 · I1							
25	3 x 98	3.35	34.8	180	22	Cu bars Ø 9 mm	B44066D1425*441
50	3 x 196	1.67	69.5	290	34	Cu bars Ø 9 mm	B44066D1450*441
75	3 x 294	1.12	104.3	380	45	Cu bars Ø 9 mm	B44066D1475*441
100	3 x 392	0.84	139.1	480	54	Cu bars Ø 9 mm	B44066D1499*441

[1)] Total max. losses, considering max. specified overvoltage and harmonic currents

* TDK offers reactors with slightly different specifications (e.g. dimensions) that can be used for the same application although sometimes with slightly different resulting performances. These types are distinguished by different letters at digit 12 of the product code. Thus this digit is not specified here.

Other voltages upon request

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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NEW

High VTHD Detuned Reactors

- Voltage harmonics withstand: 12%, 16%, 20% VTHD
- Aluminum foil design to
  – minimize skin effect
  – improved short circuit withstand capability
- Linearity: Up to 250% of rated current
- Designed to work for most demanding applications



High VTHD Detuned Reactors (12% to 20%)



General

High VTHD Detuned Reactors are designed to mitigate the impacts of harmonic distortion, particularly in environments with high levels of voltage distortion, ensuring stable and reliable power quality.

The offer includes ratings from 12.5 to 100 kvar, specifically designed to operate in environments with high voltage distortion (12 to 20% VTHD), ensuring optimal performance even in demanding conditions. Its design offers linearity up to 250 · I_N, high overload handling, low noise, temperature control, and a built-in micro switch making it a great choice for non-linear loads that cause high harmonics in electrical networks.

Applications

- High harmonic (VTHD) environment
- Textile
- Steel
- Offshore Oil & Gas
- Captive power plants with High source impedance

Features

- Power: 12.5 … 50 kvar
- Operating voltages: 400 … 440 V
- Frequency: 50 /60 Hz
- Operating temperature: –5 … +55 °C
- Integrated cooling – AN
- RoHS compatible
- CE marking

Safety

- Linearity up to 250 · I_N
- Temperature control via micro-switch in the inner coil
- Aluminum foil winding
- Low noise
- Low losses (120 … 330 W)
- Robust construction

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High VTHD Detuned Reactors (12% to 20%)

Technical data and limit values

Filter reactors			
Ordering codes	B44066D7025E412	B44066D7050E412	B44066D7050E416
Harmonics	V_3 = 0.5% V_R (duty cycle = 100%) V_5 = 9% V_R (duty cycle = 100%) V_7 = 6.5% V_R (duty cycle = 100%) V_{11} = 3.9% V_R (duty cycle = 100%) V_{13} = 2.2% V_R (duty cycle = 100%)	V_3 = 0.5% V_R (duty cycle = 100%) V_5 = 9% V_R (duty cycle = 100%) V_7 = 6.5% V_R (duty cycle = 100%) V_{11} = 3.9% V_R (duty cycle = 100%) V_{13} = 2.2% V_R (duty cycle = 100%)	V_3 = 0.63% V_R (duty cycle = 100%) V_5 = 12% V_R (duty cycle = 100%) V_7 = 9% V_R (duty cycle = 100%) V_{11} = 4.88% V_R (duty cycle = 100%) V_{13} = 2.75% V_R (duty cycle = 100%)
Effective current	I_{RMS} = 43.80 A	I_{RMS} = 87.50 A	I_{RMS} = 95.30 A
Fundamental current	I_1 = 38.25 A	I_1 = 76.50 A	I_1 = 76.50 A
Temperature protection	Microswitch (NC)	Microswitch (NC)	Microswitch (NC)
Dimensional drawings and terminals	See specific datasheets	See specific datasheets	See specific datasheets
Three-phase filter reactors to IEC 60076-6			
Frequency	50 Hz	50 Hz	50 Hz
Voltage	400 V	400 V	400 V
Output	25 kvar	50 kvar	50 kvar
Detuning	7%	7%	7%
VTHD withstand	12%	12%	16%
Cooling	Natural	Natural	Natural
Ambient temperature	+40 °C	+40 °C	+40 °C
Class of protection	H	H	H
Enclosure	IP00	IP00	IP00

Filter reactors			
Ordering codes	B44066D7050E420	B44066D1450E412	B44066D7025E452
Harmonics	V_3 = 1.4% V_R (duty cycle = 100%) V_5 = 14% V_R (duty cycle = 100%) V_7 = 10% V_R (duty cycle = 100%) V_{11} = 6.36% V_R (duty cycle = 100%) V_{13} = 5.38% V_R (duty cycle = 100%)	V_3 = 0.5% V_R (duty cycle = 100%) V_5 = 9% V_R (duty cycle = 100%) V_7 = 6.5% V_R (duty cycle = 100%) V_{11} = 3.9% V_R (duty cycle = 100%) V_{13} = 2.2% V_R (duty cycle = 100%)	V_3 = 0.5% V_R (duty cycle = 100%) V_5 = 9% V_R (duty cycle = 100%) V_7 = 6.5% V_R (duty cycle = 100%) V_{11} = 3.9% V_R (duty cycle = 100%) V_{13} = 2.2% V_R (duty cycle = 100%)
Effective current	I_{RMS} = 101.5 A	I_{RMS} = 81.40 A	I_{RMS} = 39.80 A
Fundamental current	I_1 = 76.50 A	I_1 = 76.50 A	I_1 = 34.77 A
Temperature protection	Microswitch (NC)	Microswitch (NC)	Microswitch (NC)
Dimensional drawings and terminals	See specific datasheets	See specific datasheets	See specific datasheets
Three-phase filter reactors to IEC 60076-6			
Frequency	50 Hz	50 Hz	50 Hz
Voltage	400 V	400 V	440 V
Output	50 kvar	50 kvar	25 kvar
Detuning	7%	14%	7%
VTHD withstand	20%	12%	12%
Cooling	Natural	Natural	Natural
Ambient temperature	+40 °C	+40 °C	+40 °C
Class of protection	H	H	H
Enclosure	IP00	IP00	IP00

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

High VTHD Detuned Reactors (12% to 20%)

Characteristics and ordering codes

Power kvar	Δ capacitance µF	Inductance mH	I_{RMS} (I_{eff}) A	Losses W	Weight kg	Ordering code
Rated voltage V = 400 V, f = 50 Hz, p = 7%						
25	462.5	3 x 1.533	43.8	120	19	B44066D7025E412
50	925.1	3 x 0.767	87.5	180	31	B44066D7050E412
50	925.1	3 x 0.767	95.3	250	36	B44066D7050E416
50	925.1	3 x 0.767	101.5	300	40	B44066D7050E420
Rated voltage V = 400 V, f = 50 Hz, p = 14%						
50	855.46	3 x 1.660	81.4	330	60	B44066D1450E412
Rated voltage V = 440 V, f = 50 Hz, p = 7%						
25	382.27	3 x 1.860	39.8	120	90	B44066D7025E452

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NEW

600/690 V Power Factor Improvement Solution

- 800 V capacitors
- 690 V TSM or 690 V CDC
- 690 V 7% detuned reactors
- Controller BR6000







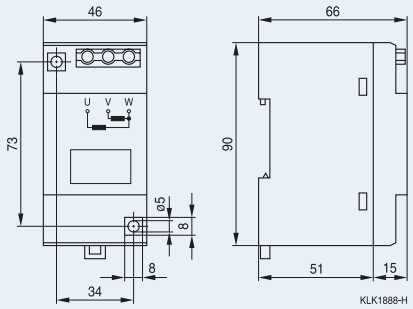




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Discharge Reactor





Dimensions in mm

General

The losses of discharge reactors are substantially lower than those of discharging resistors. They satisfy the requirement for permanently connected discharging device and for a discharge time of a few seconds. Fast discharging allows a fast re-switching in automatic PFC equipment. However, max. 5000 switching operations (according to IEC 60831) should not be exceeded.

Features and dimensional drawings

- Fast discharge for fast reconnection of capacitors
- Reduced losses
- Shockproof case for DIN rail mounting

Technical data

Ordering code		**B44066E9900L001**
Voltage	V_R	230 ... 690 V
Frequency	f	50 / 60 Hz
Internal configuration		2 windings in V arrangement
Resistance	R	7.5 kΩ
Discharge time	t	230 V Up to 25 kvar <10 s / up to 50 kvar <20 s / Up to 100 kvar <40 s 400 ... 525 V Up to 25 kvar <5 s / up to 50 kvar <10 s / Up to 100 kvar <20 s 525 ... 690 V Up to 25 kvar <3 s / up to 50 kvar <6 s / Up to 100 kvar <12 s
Power loss	P_{LOSS}	<1.6 W
Free-wheeling current	I	<3.4 mA
Accepted discharge number		1× / minute and 100 kvar
Insulation class	R_{INS}	Ta = +40 °C/B
Cable diameter	ø	0.75 ... 2 x 2.5 mm²
Terminals		Fixing torque 0.5 Nm
Installation location		Indoor
Ambient temperature		–25 ... +55 °C
Cooling		Natural
Dimensions	h x w x d	90 x 46 x 66 mm
Weight		0.5 kg

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NEW

PQSine Ultima



- Higher efficiency: ≈ 99%
- Truly modular design allows parallel modules of varying ratings
- 3C2 conformal coating (designed to work in harsh environment)
- Compact size – lesser weight – lesser heat generation
- High power density
- Leverage benefits of “Silicon Carbide MOSFET”
- Ultimate design to meet new challenges

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PQSine Ultima Active Harmonic Filter

SiC MOSFET technology | Higher efficiency | Compact design



NEW

General

The PQSine Ultima series is a new generation active harmonic filter designed and developed with the innovative silicon carbide (SiC) MOSFET technology. This offers exceptional overall energy efficiency of up to 99%, a more compact form factor, and a lightweight design to achieve more power density inside the same cabinet. It will help users mitigate harmonics, enhance power availability, and reduce power consumption to minimize the life cycle cost of the infrastructure.

Due to the use of SiC MOSFETs technology with its higher switching frequency, PQSine Ultima enables harmonic attenuation beyond 97% for both odd & even harmonics and up to 3 times neutral compensation of rated capacity and allows users to set up to the 51st harmonic order for mitigation purposes.

Applications

- Data center
- EV charging infrastructure
- Renewables
- Pharma
- Food & beverage
- Oil & gas
- Commercial & residential tower

Features

- Rating: 25, 35, 50, 60, 75, 100, 150 A
- Innovative SiC MOSFET technology
- Overall efficiency ≈ 99%
- Compensation rate >97% for both odd and even harmonic
- Up to 51st harmonic order mitigation (selectable as per need)
- Truly modular electrical and mechanical architecture
- Compact design and footprint
- Neutral filtering capacity up to 3 times the rated filter capacity
- 3C2 conformal coating by default (optional 3C3 coating available)

Safety

- Overvoltage protection
- Undervoltage protection
- Inverter bridge inverse protection
- Overcompensation protection
- Overtemperature protection
- Short circuit protection
- Ground fault protection
- Harmonic overload protection
- Phase loss protection
- Anti resonance protection

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PQSine Ultima Active Harmonic Filter

SiC MOSFET technology | Higher efficiency | Compact design

Technical data and specifications

Function	Harmonic, reactive power and three-phase unbalance compensation
Features	Ultimate performance, very compact design, higher efficiency of up to 99%, SiC MOSFET technology, truly modular in construction, low noise
Nominal voltage	220 V (176 … 264 V) / 400 V (228 … 456 V) / 480V (384 … 528 V)
Nominal frequency	50/60 Hz, auto-sensing (range: 45 … 62.5 Hz)
Filter current	25/35/50/60/75/100/150 A
Neutral filtering capability	Up to 3 times of the rated filter current, >97%
Parallel quantities	Unlimited
Efficiency	≈ 99%
Connection type	Three-phase three-wire / three-phase four-wire
CT location	Load/supply side
Control algorithm	FFT, intelligent FFT, and instantaneous reactive power
Compensation order	2nd to 51st, selectable for each order
Advanced control algorithm	Resonance suppression, compensation performance software auto-tuning
Compensation rate	>97% (for both odd and even harmonic)
Reaction time	<50 µs
Response time	<15 ms
Target power factor	Adjustable from -1 to +1
Switching frequency	Average 40 kHz, designed to operate up to 95 kHz
Cooling air requirement	Fan cooled
Noise level	<64 dB (Full load)
Communications ports	RS-485 and Ethernet port (RJ45)
Communications protocols	Modbus RTU, TCP/IP
Module display interface	4.3-inch HMI (module), 7-inch HMI (central monitor) and LED
Protection functions	Overvoltage protection, undervoltage protection, inverter bridge inverse protection, overcompensation protection
Mounting type	Wall-mounted, rack-mounted, and cabinet
Operating ambient temperature	-10 … +50 °C (will derate capacity if ambient temperature exceeds +40 °C)
Relative humidity	5 … 95%, non-condensing
Altitude	≤1500 m, 1500 … 4000 m, capacity is derating 1% for every 100 m altitude increased
Panel color	RAL 7035 light grey
Protection class	IP20 (IP grade can be customizable)
Electro-sensitive applications	EMI / EMC filter available (optional)

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PQSine Ultima
Active Harmonic Filter

220 V PQSine Ultima – 3P3W systems							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1)]							
PQSM3025H200	25	176	264	Rack	18	530 x 551 x 88	B44066F3025H200
PQSM3035H200	35	176	264	Rack	18	530 x 551 x 88	B44066F3035H200
PQSM3050H200	50	176	264	Rack	18	530 x 551 x 88	B44066F3050H200
PQSM3060H200	60	176	264	Rack	18	530 x 551 x 88	B44066F3060H200
PQSM3075H200	75	176	264	Rack	18	530 x 551 x 88	B44066F3075H200
PQSM3100H200	100	176	264	Rack	25	530 x 605 x 88	B44066F3100H200
PQSM3150H200	150	176	264	Rack	30	500 x 612 x 100	B44066F3150H200
Wall-mounted units[2)]							
PQSW3025H244	25	176	264	Wall	18	504 x 97 x 540	B44066F3025H244
PQSW3035H244	35	176	264	Wall	18	504 x 97 x 540	B44066F3035H244
PQSW3050H244	50	176	264	Wall	18	504 x 97 x 540	B44066F3050H244
PQSW3060H244	60	176	264	Wall	18	504 x 97 x 540	B44066F3060H244
PQSW3075H244	75	176	264	Wall	18	504 x 97 x 540	B44066F3075H244
PQSW3100H244	100	176	264	Wall	25	504 x 98 x 594	B44066F3100H244
PQSW3150H244	150	176	264	Wall	30	504 x 109 x 601	B44066F3150H244
Floor mounted units[3)]							
PQSF3200H215	200	176	264	Floor	440	600 x 1000 x 2200	B44066F3200H215
PQSF3250H215	250	176	264	Floor	445	600 x 1000 x 2200	B44066F3250H215
PQSF3300H215	300	176	264	Floor	450	600 x 1000 x 2200	B44066F3300H215
PQSF3350H215	350	176	264	Floor	470	600 x 1000 x 2200	B44066F3350H215
PQSF3400H215	400	176	264	Floor	475	600 x 1000 x 2200	B44066F3400H215
PQSF3450H215	450	176	264	Floor	480	600 x 1000 x 2200	B44066F3450H215
PQSF3500H215	500	176	264	Floor	500	600 x 1000 x 2200	B44066F3500H215
PQSF3550H215	550	176	264	Floor	505	600 x 1000 x 2200	B44066F3550H215
PQSF3600H215	600	176	264	Floor	510	600 x 1000 x 2200	B44066F3600H215

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

220 V PQSine Ultima – 3P4W systems							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1)]							
PQSM4025H200	25	176	264	Rack	18	530 x 551 x 88	B44066F4025H200
PQSM4035H200	35	176	264	Rack	18	530 x 551 x 88	B44066F4035H200
PQSM4050H200	50	176	264	Rack	18	530 x 551 x 88	B44066F4050H200
PQSM4060H200	60	176	264	Rack	18	530 x 551 x 88	B44066F4060H200
PQSM4075H200	75	176	264	Rack	18	530 x 551 x 88	B44066F4075H200
PQSM4100H200	100	176	264	Rack	25	530 x 605 x 88	B44066F4100H200
PQSM4150H200	150	176	264	Rack	30	500 x 612 x 100	B44066F4150H200
Wall-mounted units[2)]							
PQSW4025H244	25	176	264	Wall	18	504 x 97 x 540	B44066F4025H244
PQSW4035H244	35	176	264	Wall	18	504 x 97 x 540	B44066F4035H244
PQSW4050H244	50	176	264	Wall	18	504 x 97 x 540	B44066F4050H244
PQSW4060H244	60	176	264	Wall	18	504 x 97 x 540	B44066F4060H244
PQSW4075H244	75	176	264	Wall	18	504 x 97 x 540	B44066F4075H244
PQSW4100H244	100	176	264	Wall	25	504 x 98 x 594	B44066F4100H244
PQSW4150H244	150	176	264	Wall	30	504 x 109 x 601	B44066F4150H244
Floor mounted units[3)]							
PQSF4200H215	200	176	264	Floor	440	600 x 1000 x 2200	B44066F4200H215
PQSF4250H215	250	176	264	Floor	445	600 x 1000 x 2200	B44066F4250H215
PQSF4300H215	300	176	264	Floor	450	600 x 1000 x 2200	B44066F4300H215
PQSF4350H215	350	176	264	Floor	470	600 x 1000 x 2200	B44066F4350H215
PQSF4400H215	400	176	264	Floor	475	600 x 1000 x 2200	B44066F4400H215
PQSF4450H215	450	176	264	Floor	480	600 x 1000 x 2200	B44066F4450H215
PQSF4500H215	500	176	264	Floor	500	600 x 1000 x 2200	B44066F4500H215
PQSF4550H215	550	176	264	Floor	505	600 x 1000 x 2200	B44066F4550H215
PQSF4600H215	600	176	264	Floor	510	600 x 1000 x 2200	B44066F4600H215

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

400 V PQSine Ultima – 3P3W systems							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1)]							
PQSM3025H300	25	228	456	Rack	18	530 x 551 x 88	B44066F3025H300
PQSM3035H300	35	228	456	Rack	18	530 x 551 x 88	B44066F3035H300
PQSM3050H300	50	228	456	Rack	18	530 x 551 x 88	B44066F3050H300
PQSM3060H300	60	228	456	Rack	18	530 x 551 x 88	B44066F3060H300
PQSM3075H300	75	228	456	Rack	18	530 x 551 x 88	B44066F3075H300
PQSM3100H300	100	228	456	Rack	25	530 x 605 x 88	B44066F3100H300
PQSM3150H300	150	228	456	Rack	30	500 x 612 x 100	B44066F3150H300
Wall-mounted units[2)]							
PQSW3025H344	25	228	456	Wall	18	504 x 97 x 540	B44066F3025H344
PQSW3035H344	35	228	456	Wall	18	504 x 97 x 540	B44066F3035H344
PQSW3050H344	50	228	456	Wall	18	504 x 97 x 540	B44066F3050H344
PQSW3060H344	60	228	456	Wall	18	504 x 97 x 540	B44066F3060H344
PQSW3075H344	75	228	456	Wall	18	504 x 97 x 540	B44066F3075H344
PQSW3100H344	100	228	456	Wall	25	504 x 98 x 594	B44066F3100H344
PQSW3150H344	150	228	456	Wall	30	504 x 109 x 601	B44066F3150H344
Floor mounted units[3)]							
PQSF3200H315	200	228	456	Floor	440	600 x 1000 x 2200	B44066F3200H315
PQSF3250H315	250	228	456	Floor	445	600 x 1000 x 2200	B44066F3250H315
PQSF3300H315	300	228	456	Floor	450	600 x 1000 x 2200	B44066F3300H315
PQSF3350H315	350	228	456	Floor	470	600 x 1000 x 2200	B44066F3350H315
PQSF3400H315	400	228	456	Floor	475	600 x 1000 x 2200	B44066F3400H315
PQSF3450H315	450	228	456	Floor	480	600 x 1000 x 2200	B44066F3450H315
PQSF3500H315	500	228	456	Floor	500	600 x 1000 x 2200	B44066F3500H315
PQSF3550H315	550	228	456	Floor	505	600 x 1000 x 2200	B44066F3550H315
PQSF3600H315	600	228	456	Floor	510	600 x 1000 x 2200	B44066F3600H315

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

400 V PQSine Ultima – 3P4W systems							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1)]							
PQSM4025H344	25	228	456	Rack	18	530 x 551 x 88	B44066F4025H344
PQSM4035H344	35	228	456	Rack	18	530 x 551 x 88	B44066F4035H344
PQSM4050H344	50	228	456	Rack	18	530 x 551 x 88	B44066F4050H344
PQSM4060H344	60	228	456	Rack	18	530 x 551 x 88	B44066F4060H344
PQSM4075H344	75	228	456	Rack	18	530 x 551 x 88	B44066F4075H344
PQSM4100H344	100	228	456	Rack	25	530 x 605 x 88	B44066F4100H344
PQSM4150H344	150	228	456	Rack	30	500 x 612 x 100	B44066F4150H344
Wall-mounted units[2)]							
PQSW4025H344	25	228	456	Wall	18	504 x 97 x 540	B44066F4025H344
PQSW4035H344	35	228	456	Wall	18	504 x 97 x 540	B44066F4035H344
PQSW4050H344	50	228	456	Wall	18	504 x 97 x 540	B44066F4050H344
PQSW4060H344	60	228	456	Wall	18	504 x 97 x 540	B44066F4060H344
PQSW4075H344	75	228	456	Wall	18	504 x 97 x 540	B44066F4075H344
PQSW4100H344	100	228	456	Wall	25	504 x 98 x 594	B44066F4100H344
PQSW4150H344	150	228	456	Wall	30	504 x 109 x 601	B44066F4150H344
Floor mounted units[3)]							
PQSF4200H315	200	228	456	Floor	440	600 x 1000 x 2200	B44066F4200H315
PQSF4250H315	250	228	456	Floor	445	600 x 1000 x 2200	B44066F4250H315
PQSF4300H315	300	228	456	Floor	450	600 x 1000 x 2200	B44066F4300H315
PQSF4350H315	350	228	456	Floor	470	600 x 1000 x 2200	B44066F4350H315
PQSF4400H315	400	228	456	Floor	475	600 x 1000 x 2200	B44066F4400H315
PQSF4450H315	450	228	456	Floor	480	600 x 1000 x 2200	B44066F4450H315
PQSF4500H315	500	228	456	Floor	500	600 x 1000 x 2200	B44066F4500H315
PQSF4550H315	550	228	456	Floor	505	600 x 1000 x 2200	B44066F4550H315
PQSF4600H315	600	228	456	Floor	510	600 x 1000 x 2200	B44066F4600H315

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

480 V PQSine Ultima – 3P3W systems							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1]							
PQSM3025H400	25	384	528	Rack	18	530 x 551 x 88	B44066F3025H400
PQSM3035H400	35	384	528	Rack	18	530 x 551 x 88	B44066F3035H400
PQSM3050H400	50	384	528	Rack	18	530 x 551 x 88	B44066F3050H400
PQSM3060H400	60	384	528	Rack	18	530 x 551 x 88	B44066F3060H400
PQSM3075H400	75	384	528	Rack	18	530 x 551 x 88	B44066F3075H400
PQSM3100H400	100	384	528	Rack	25	530 x 605 x 88	B44066F3100H400
PQSM3150H400	150	384	528	Rack	30	500 x 612 x 100	B44066F3150H400
Wall-mounted units[2]							
PQSW3025H444	25	384	528	Wall	18	504 x 97 x 540	B44066F3025H444
PQSW3035H444	35	384	528	Wall	18	504 x 97 x 540	B44066F3035H444
PQSW3050H444	50	384	528	Wall	18	504 x 97 x 540	B44066F3050H444
PQSW3060H444	60	384	528	Wall	18	504 x 97 x 540	B44066F3060H444
PQSW3075H444	75	384	528	Wall	18	504 x 97 x 540	B44066F3075H444
PQSW3100H444	100	384	528	Wall	25	504 x 98 x 594	B44066F3100H444
PQSW3150H444	150	384	528	Wall	30	504 x 109 x 601	B44066F3150H444
Floor mounted units[3]							
PQSF3200H415	200	384	528	Floor	440	600 x 1000 x 2200	B44066F3200H415
PQSF3250H415	250	384	528	Floor	445	600 x 1000 x 2200	B44066F3250H415
PQSF3300H415	300	384	528	Floor	450	600 x 1000 x 2200	B44066F3300H415
PQSF3350H415	350	384	528	Floor	470	600 x 1000 x 2200	B44066F3350H415
PQSF3400H415	400	384	528	Floor	475	600 x 1000 x 2200	B44066F3400H415
PQSF3450H415	450	384	528	Floor	480	600 x 1000 x 2200	B44066F3450H415
PQSF3500H415	500	384	528	Floor	500	600 x 1000 x 2200	B44066F3500H415
PQSF3550H415	550	384	528	Floor	505	600 x 1000 x 2200	B44066F3550H415
PQSF3600H415	600	384	528	Floor	510	600 x 1000 x 2200	B44066F3600H415

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

400 V PQSine Ultima – 3P3W systems EMC compliant							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM3050C300	50	228	456	Rack	21	530 x 611 x 88	B44066F4050C300
PQSM3075C300	75	228	456	Rack	21	530 x 611 x 88	B44066F4075C300
PQSM3100C300	100	228	456	Rack	34	530 x 712 x 100	B44066F4100C300
PQSM3150C300	150	228	456	Rack	34	530 x 712 x 100	B44066F4150C300
Wall-mounted units[2]							
PQSW4050C344	50	228	456	Wall	21	504 x 97 x 540	B44066F4050C344
PQSW4075C344	75	228	456	Wall	21	504 x 97 x 540	B44066F4075C344
PQSW4100C344	100	228	456	Wall	34	504 x 97 x 540	B44066F4100C344
PQSW4150C344	150	228	456	Wall	34	504 x 97 x 540	B44066F4150C344
Floor mounted units[3]							
PQSF3200C315	200	228	456	Floor	440	600 x 1000 x 2200	B44066F3200C315
PQSF3250C315	250	228	456	Floor	445	600 x 1000 x 2200	B44066F3250C315
PQSF3300C315	300	228	456	Floor	450	600 x 1000 x 2200	B44066F3300C315
PQSF3350C315	350	228	456	Floor	470	600 x 1000 x 2200	B44066F3350C315
PQSF3400C315	400	228	456	Floor	475	600 x 1000 x 2200	B44066F3400C315
PQSF3450C315	450	228	456	Floor	480	600 x 1000 x 2200	B44066F3450C315
PQSF3500C315	500	228	456	Floor	500	600 x 1000 x 2200	B44066F3500C315
PQSF3550C315	550	228	456	Floor	505	600 x 1000 x 2200	B44066F3550C315
PQSF3600C315	600	228	456	Floor	510	600 x 1000 x 2200	B44066F3600C315

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine Ultima
Active Harmonic Filter

400 V PQSine Ultima – 3P4W systems EMC compliant							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM4050C300	25	228	456	Rack	18	530 x 551 x 88	B44066F4050C300
PQSM4075C300	35	228	456	Rack	18	530 x 551 x 88	B44066F4075C300
PQSM4100C300	50	228	456	Rack	18	530 x 551 x 88	B44066F4100C300
PQSM4150C300	60	228	456	Rack	18	530 x 551 x 88	B44066F4150C300
Wall-mounted units[2]							
PQSW4050C344	25	228	456	Wall	18	504 x 97 x 540	B44066F4050C344
PQSW4075C344	35	228	456	Wall	18	504 x 97 x 540	B44066F4075C344
PQSW4100C344	50	228	456	Wall	18	504 x 97 x 540	B44066F4100C344
PQSW4150C344	60	228	456	Wall	18	504 x 97 x 540	B44066F4150C344
Floor mounted units[3]							
PQSF4200C315	200	228	456	Floor	440	600 x 1000 x 2200	B44066F4200C315
PQSF4250C315	250	228	456	Floor	445	600 x 1000 x 2200	B44066F4250C315
PQSF4300C315	300	228	456	Floor	450	600 x 1000 x 2200	B44066F4300C315
PQSF4350C315	350	228	456	Floor	470	600 x 1000 x 2200	B44066F4350C315
PQSF4400C315	400	228	456	Floor	475	600 x 1000 x 2200	B44066F4400C315
PQSF4450C315	450	228	456	Floor	480	600 x 1000 x 2200	B44066F4450C315
PQSF4500C315	500	228	456	Floor	500	600 x 1000 x 2200	B44066F4500C315
PQSF4550C315	550	228	456	Floor	505	600 x 1000 x 2200	B44066F4550C315
PQSF4600C315	600	228	456	Floor	510	600 x 1000 x 2200	B44066F4600C315

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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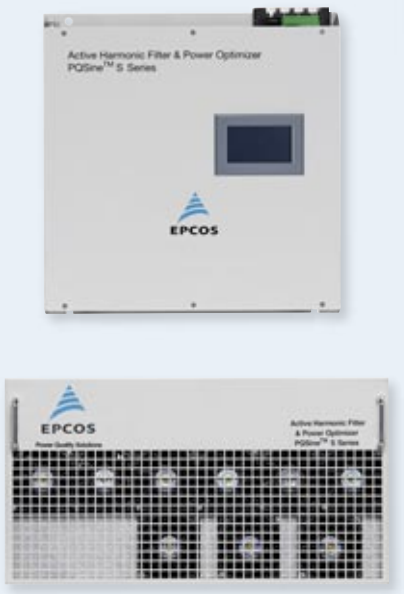
PQSine Ultima
Active Harmonic Filter

480 V PQSine Ultima – 3P4W systems EMC compliant							
Type	**Rated filter current A**	**System min./max. voltage V**		**Mounting variant**	**Approx. weight kg**	**Approx. dimensions (w x d x h) mm**	**Ordering code**
Rack mounted units[1)]							
PQSM3050C400	50	384	528	Rack	21	530 x 611 x 88	B44066F3050C400
PQSM3075C400	75	384	528	Rack	21	530 x 611 x 88	B44066F3075C400
PQSM3100C400	100	384	528	Rack	34	530 x 712 x 100	B44066F3100C400
PQSM3150C400	150	384	528	Rack	34	530 x 712 x 100	B44066F3150C400
Wall-mounted units[2)]							
PQSW3050C444	50	384	528	Wall	18	509 x 97 x 674	B44066F3050C444
PQSW3075C444	75	384	528	Wall	18	509 x 97 x 674	B44066F3075C444
PQSW3100C444	100	384	528	Wall	18	504 x 109 x 701	B44066F3100C444
PQSW3150C444	150	384	528	Wall	18	504 x 109 x 701	B44066F3150C444
Floor mounted units[3)]							
PQSF3200C415	200	384	528	Floor	440	600 x 1000 x 2200	B44066F3200C415
PQSF3250C415	250	384	528	Floor	445	600 x 1000 x 2200	B44066F3250C415
PQSF3300C415	300	384	528	Floor	450	600 x 1000 x 2200	B44066F3300C415
PQSF3350C415	350	384	528	Floor	470	600 x 1000 x 2200	B44066F3350C415
PQSF3400C415	400	384	528	Floor	475	600 x 1000 x 2200	B44066F3400C415
PQSF3450C415	450	384	528	Floor	480	600 x 1000 x 2200	B44066F3450C415
PQSF3500C415	500	384	528	Floor	500	600 x 1000 x 2200	B44066F3500C415
PQSF3550C415	550	384	528	Floor	505	600 x 1000 x 2200	B44066F3550C415
PQSF3600C415	600	384	528	Floor	510	600 x 1000 x 2200	B44066F3600C415

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter



General

The PQSine S series is an active harmonic filter system designed to eliminate harmonic oscillations and consequently reduce costs. AHF PQSine S series monitors the current signal and compensates the unwanted elements of the measured current. Thus, the filter ensures harmonic suppression independently of the number of loads. It also corrects the power factor, improving the system efficiency while reducing harmonic pollution.

Features

- Harmonic compensation up to 51st harmonic (individually selectable)
- Ultra-fast reactive power compensation (inductive and capacitive)
- Load balancing between phases and unloaded neutral wire
- Compact design, three level topology
- Modular system extendable
- Grid resonance detection
- Digital Control of FFT algorithm, intelligent FFT algorithm, instantaneous reactive algorithm
- Ethernet system for interconnection
- User-friendly menu operation
- High performance and reliability
- Insensitive to network conditions

Typical applications

Fast current harmonics and reactive power suppression e.g. for:

- Data centers
- UPS systems
- Green power generation (e.g. photovoltaics and wind turbines)
- Sensitive equipment manufacturing (e.g. silicon wafer production, semiconductor production)
- Industrial production machines
- Electrical welding systems
- Plastic industry machinery (extruders, injection molders)
- Office buildings and shopping centers (3rd and triple harmonic cancellation and neutral conductor unloading)

Safety

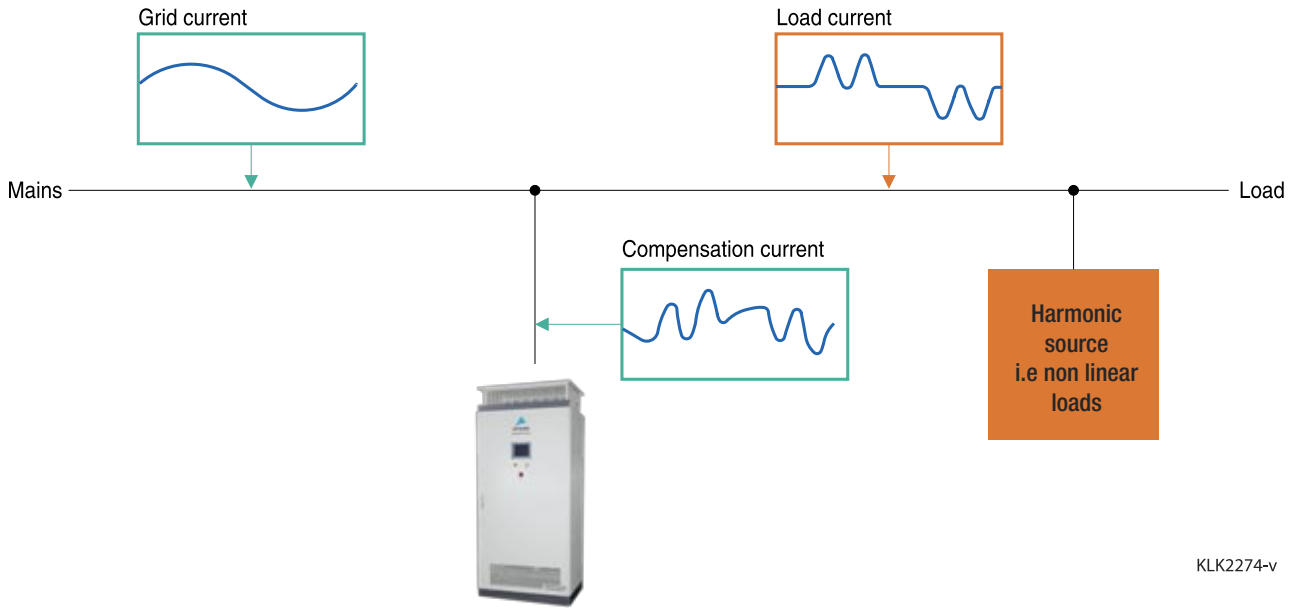
- Highest safety and reliability
- Overload protection
- Internal short-circuit protection
- Overheating protection
- Overvoltage and undervoltage protection
- Inverter bridge protection
- Resonance protection
- Fan fault alarm

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PQSine S Series
Active Harmonic Filter

Active harmonic filter

Figure 1: Principle of an active filter



Active harmonic filter

Figure 2: Total harmonic current distortion without active filter

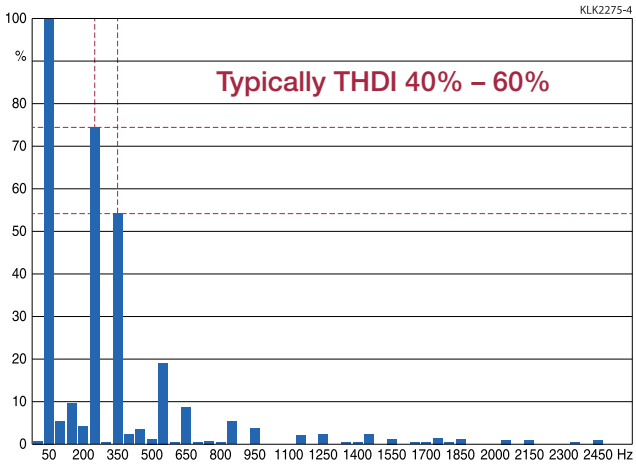
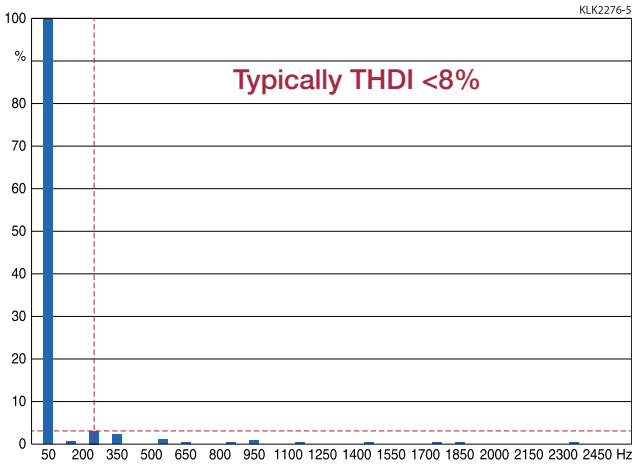


Figure 3: Total harmonic current distortion with activated active filter



PQSine S Series
Active Harmonic Filter

Technical data and specifications

Rated voltage (range)	200 V (176 … 263 V)	400 V (228 … 456 V)	480 V (384 … 552 V)	600 V (420 … 690 V)	690 V (483 … 793 V)
Individiual module capacity	25, 35, 50, 60, 75, 100, 150 A		50, 75, 90, 100 A		
Mains frequency	50/60 Hz (range: 45 … 62 Hz)				
Neutral filtering capability	3 times the rated filter current (in case of four-wire device)				
Harmonic current compensation range	Up to 51st harmonic order				
Rate of harmonic reduction	>97%[1)]				
Typical power losses	<3% (depending of the load)				
Target power factor	Adjustable from –1 to 1				
Switching/control frequency	20 kHz/20 kHz				
Reaction time	Approx. 50 µs				
Overall response time	<15 ms				
Harmonic compensation	Available				
Reactive power compensation	Available				
Unbalance compensation	Available				
Display	All systems include a 7" TFT color control / display unit (touch screen)				
Communication ports	RS485 and network port (RJ45)				
Communication protocols	Modbus RTU, TCP/IP (Ethernet)				
Fault alarm	Available, max. 500 alarm records				
Noise level	<56 dB upto 100 A, <65 dB for 150 A		<65 dB (depending on the model)		
Protection functions	Overvoltage, undervoltage, short-circuit, inverter bridge inverse, overcompensation				
Operating temperature	–10 to +40 °C (higher temperatures with derating)				
Relative humidity	5 to 95%, non-condensation				
Cooling	75,115,222, 336,360 L/sec (25-35,50-60,75-100, 150 A)		359 L/sec		
Protection class	IP 20 according to IEC 529 (customizable)				
Panel color	RAL7035 light grey				
Altitude	1500. Between 1500 to 4000 m the power decreases by 1% for every additional 100 m, according to GB/T3859.2				
Qualifications	CE, IEEE 61000		CE, ETL (UL 508 and CSA C22.2 # 2014), IEEE 61000		
Compliance with standards	IEEE 519, ER G5/4				

[1)] For typical harmonic order distortions

Wall-mounted panel



Floor-mounted panel



Horizontal module



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PQSine S Series
Active Harmonic Filter

200 V PQSine S series – 3P3W systems							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM3025S200	25	176	263	Rack	18	440 x 470 x 150	B44066F3025S200
PQSM3035S200	35	176	263	Rack	18	440 x 470 x 150	B44066F3035S200
PQSM3050S200	50	176	263	Rack	23	500 x 515 x 180	B44066F3050S200
PQSM3060S200	60	176	263	Rack	23	500 x 515 x 180	B44066F3060S200
PQSM3075S200	75	176	263	Rack	28	500 x 546 x 190	B44066F3075S200
PQSM3100S200	100	176	263	Rack	35	500 x 575 x 285	B44066F3100S200
PQSM3150S200	150	176	263	Rack	44	500 x 605 x 270	B44066F3150S200
Wall-mounted units[2]							
PQSW3025S244	25	176	263	Wall	18	440 x 150 x 485	B44066F3025S244
PQSW3035S244	35	176	263	Wall	18	440 x 150 x 485	B44066F3035S244
PQSW3050S244	50	176	263	Wall	23	500 x 180 x 540	B44066F3050S244
PQSW3060S244	60	176	263	Wall	23	500 x 180 x 540	B44066F3060S244
PQSW3075S244	75	176	263	Wall	28	500 x 190 x 585	B44066F3075S244
PQSW3100S244	100	176	263	Wall	35	500 x 200 x 599	B44066F3100S244
PQSW3150S244	150	176	263	Wall	44	500 x 273 x 638	B44066F3150S244
Floor mounted units[3]							
PQSF3100S215	100	176	263	Floor	285	600 x 1000 x 2200	B44066F3100S215
PQSF3150S215	150	176	263	Floor	294	600 x 1000 x 2200	B44066F3150S215
PQSF3200S215	200	176	263	Floor	320	600 x 1000 x 2200	B44066F3200S215
PQSF3250S215	250	176	263	Floor	329	600 x 1000 x 2200	B44066F3250S215
PQSF3300S215	300	176	263	Floor	338	600 x 1000 x 2200	B44066F3300S215
PQSF3350S215	350	176	263	Floor	364	600 x 1000 x 2200	B44066F3350S215
PQSF3400S215	400	176	263	Floor	373	600 x 1000 x 2200	B44066F3400S215
PQSF3450S215	450	176	263	Floor	382	600 x 1000 x 2200	B44066F3450S215
PQSF3500S215	500	176	263	Floor	408	600 x 1000 x 2200	B44066F3500S215
PQSF3550S215	550	176	263	Floor	417	600 x 1000 x 2200	B44066F3550S215
PQSF3600S215	600	176	263	Floor	426	600 x 1000 x 2200	B44066F3600S215
PQSF3750S225	750	176	263	Floor	720	1200 x 1000 x 2200	B44066F3750S225
PQSF3900S225	900	176	263	Floor	764	1200 x 1000 x 2200	B44066F3900S225
PQSF3115S225	1150	176	263	Floor	843	1200 x 1000 x 2200	B44066F3115S225
PQSF3120S225	1200	176	263	Floor	852	1200 x 1000 x 2200	B44066F3120S225

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

200 V PQSine S series – 3P4W systems							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM4025S200	25	176	263	Rack	18	440 x 470 x 150	B44066F4025S200
PQSM4035S200	35	176	263	Rack	18	440 x 470 x 150	B44066F4035S200
PQSM4050S200	50	176	263	Rack	23	500 x 515 x 180	B44066F4050S200
PQSM4060S200	60	176	263	Rack	23	500 x 515 x 180	B44066F4060S200
PQSM4075S200	75	176	263	Rack	28	500 x 546 x 190	B44066F4075S200
PQSM4100S200	100	176	263	Rack	35	500 x 575 x 200	B44066F4100S200
PQSM4150S200	150	176	263	Rack	44	500 x 605 x 270	B44066F4150S200
Wall-mounted units[2]							
PQSW4025S244	25	176	263	Wall	18	440 x 150 x 485	B44066F4025S244
PQSW4035S244	35	176	263	Wall	18	440 x 150 x 485	B44066F4035S244
PQSW4050S244	50	176	263	Wall	23	500 x 180 x 540	B44066F4050S244
PQSW4060S244	60	176	263	Wall	23	500 x 180 x 540	B44066F4060S244
PQSW4075S244	75	176	263	Wall	28	500 x 190 x 585	B44066F4075S244
PQSW4100S244	100	176	263	Wall	35	500 x 200 x 599	B44066F4100S244
PQSW4150S244	150	176	263	Wall	44	500 x 273 x 638	B44066F4150S244
Floor mounted units[3]							
PQSF4100S215	100	176	263	Floor	285	600 x 1000 x 2200	B44066F4100S215
PQSF4150S215	150	176	263	Floor	294	600 x 1000 x 2200	B44066F4150S215
PQSF4200S215	200	176	263	Floor	320	600 x 1000 x 2200	B44066F4200S215
PQSF4250S215	250	176	263	Floor	329	600 x 1000 x 2200	B44066F4250S215
PQSF4300S215	300	176	263	Floor	338	600 x 1000 x 2200	B44066F4300S215
PQSF4350S215	350	176	263	Floor	364	600 x 1000 x 2200	B44066F4350S215
PQSF4400S215	400	176	263	Floor	373	600 x 1000 x 2200	B44066F4400S215
PQSF4450S215	450	176	263	Floor	382	600 x 1000 x 2200	B44066F4450S215
PQSF4500S215	500	176	263	Floor	408	600 x 1000 x 2200	B44066F4500S215
PQSF4550S215	550	176	263	Floor	417	600 x 1000 x 2200	B44066F4550S215
PQSF4600S215	600	176	263	Floor	426	600 x 1000 x 2200	B44066F4600S215
PQSF4750S225	750	176	263	Floor	720	1200 x 1000 x 2200	B44066F4750S225
PQSF4900S225	900	176	263	Floor	764	1200 x 1000 x 2200	B44066F4900S225
PQSF4115S225	1150	176	263	Floor	843	1200 x 1000 x 2200	B44066F4115S225
PQSF4120S225	1200	176	263	Floor	852	1200 x 1000 x 2200	B44066F4120S225

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

400 V PQSine S series – 3P3W systems							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM3025S300	25	228	456	Rack	18	440 x 470 x 150	B44066F3025S300
PQSM3035S300	35	228	456	Rack	18	440 x 470 x 150	B44066F3035S300
PQSM3050S300	50	228	456	Rack	23	500 x 515 x 180	B44066F3050S300
PQSM3060S300	60	228	456	Rack	23	500 x 515 x 180	B44066F3060S300
PQSM3075S300	75	228	456	Rack	28	500 x 546 x 190	B44066F3075S300
PQSM3100S300	100	228	456	Rack	35	500 x 575 x 200	B44066F3100S300
PQSM3150S300	150	228	456	Rack	44	500 x 605 x 270	B44066F3150S300
Wall-mounted units[2]							
PQSW3025S344	25	228	456	Wall	18	440 x 150 x 485	B44066F3025S344
PQSW3035S344	35	228	456	Wall	18	440 x 150 x 485	B44066F3035S344
PQSW3050S344	50	228	456	Wall	23	500 x 180 x 540	B44066F3050S344
PQSW3060S344	60	228	456	Wall	23	500 x 180 x 540	B44066F3060S344
PQSW3075S344	75	228	456	Wall	28	500 x 190 x 585	B44066F3075S344
PQSW3100S344	100	228	456	Wall	35	500 x 200 x 599	B44066F3100S344
PQSW3150S344	150	228	456	Wall	44	500 x 273 x 638	B44066F3150S344
Floor mounted units[3]							
PQSF3100S315	100	228	456	Floor	285	600 x 1000 x 2200	B44066F3100S315
PQSF3150S315	150	228	456	Floor	294	600 x 1000 x 2200	B44066F3150S315
PQSF3200S315	200	228	456	Floor	320	600 x 1000 x 2200	B44066F3200S315
PQSF3250S315	250	228	456	Floor	329	600 x 1000 x 2200	B44066F3250S315
PQSF3300S315	300	228	456	Floor	338	600 x 1000 x 2200	B44066F3300S315
PQSF3350S315	350	228	456	Floor	364	600 x 1000 x 2200	B44066F3350S315
PQSF3400S315	400	228	456	Floor	373	600 x 1000 x 2200	B44066F3400S315
PQSF3450S315	450	228	456	Floor	382	600 x 1000 x 2200	B44066F3450S315
PQSF3500S315	500	228	456	Floor	408	600 x 1000 x 2200	B44066F3500S315
PQSF3550S315	550	228	456	Floor	417	600 x 1000 x 2200	B44066F3550S315
PQSF3600S315	600	228	456	Floor	426	600 x 1000 x 2200	B44066F3600S315
PQSF3750S325	750	228	456	Floor	720	1200 x 1000 x 2200	B44066F3750S325
PQSF3900S325	900	228	456	Floor	764	1200 x 1000 x 2200	B44066F3900S325
PQSF3115S325	1150	228	456	Floor	843	1200 x 1000 x 2200	B44066F3115S325
PQSF3120S325	1200	228	456	Floor	852	1200 x 1000 x 2200	B44066F3120S325

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

400 V PQSine S series – 3P4W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM4025S300	25	228	456	Rack	18	440 x 470 x 150	B44066F4025S300
PQSM4035S300	35	228	456	Rack	18	440 x 470 x 150	B44066F4035S300
PQSM4050S300	50	228	456	Rack	23	500 x 515 x 180	B44066F4050S300
PQSM4060S300	60	228	456	Rack	23	500 x 515 x 180	B44066F4060S300
PQSM4075S300	75	228	456	Rack	28	500 x 546 x 190	B44066F4075S300
PQSM4100S300	100	228	456	Rack	35	500 x 575 x 200	B44066F4100S300
PQSM4150S300	150	228	456	Rack	44	500 x 605 x 270	B44066F4150S300
Wall-mounted units[2)]							
PQSW4025S344	25	228	456	Wall	18	440 x 150 x 485	B44066F4025S344
PQSW4035S344	35	228	456	Wall	18	440 x 150 x 485	B44066F4035S344
PQSW4050S344	50	228	456	Wall	23	500 x 180 x 540	B44066F4050S344
PQSW4060S344	60	228	456	Wall	23	500 x 180 x 540	B44066F4060S344
PQSW4075S344	75	228	456	Wall	28	500 x 190 x 585	B44066F4075S344
PQSW4100S344	100	228	456	Wall	35	500 x 200 x 599	B44066F4100S344
PQSW4150S344	150	228	456	Wall	44	500 x 273 x 638	B44066F4150S344
Floor mounted units[3)]							
PQSF4100S315	100	228	456	Floor	285	600 x 1000 x 2200	B44066F4100S315
PQSF4150S315	150	228	456	Floor	294	600 x 1000 x 2200	B44066F4150S315
PQSF4200S315	200	228	456	Floor	320	600 x 1000 x 2200	B44066F4200S315
PQSF4250S315	250	228	456	Floor	329	600 x 1000 x 2200	B44066F4250S315
PQSF4300S315	300	228	456	Floor	338	600 x 1000 x 2200	B44066F4300S315
PQSF4350S315	350	228	456	Floor	364	600 x 1000 x 2200	B44066F4350S315
PQSF4400S315	400	228	456	Floor	373	600 x 1000 x 2200	B44066F4400S315
PQSF4450S315	450	228	456	Floor	382	600 x 1000 x 2200	B44066F4450S315
PQSF4500S315	500	228	456	Floor	408	600 x 1000 x 2200	B44066F4500S315
PQSF4550S315	550	228	456	Floor	417	600 x 1000 x 2200	B44066F4550S315
PQSF4600S315	600	228	456	Floor	426	600 x 1000 x 2200	B44066F4600S315
PQSF4750S325	750	228	456	Floor	720	1200 x 1000 x 2200	B44066F4750S325
PQSF4900S325	900	228	456	Floor	764	1200 x 1000 x 2200	B44066F4900S325
PQSF4115S325	1150	228	456	Floor	843	1200 x 1000 x 2200	B44066F4115S325
PQSF4120S325	1200	228	456	Floor	852	1200 x 1000 x 2200	B44066F4120S325

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

Accessories ordering codes

Product description	Ordering code
7" TFT HMI Color control/Display unit, touch screen	B44066F9999S230
Optional Internet/ Dry Contact I/O Unit	B44066F8900S230

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PQSine S Series
Active Harmonic Filter

480 V PQSine S series – 3P3W systems (based on 400 V design)							
Type	**Rated filter current** **A**	**System min./max. voltage** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PPQSM9025S400	25	372	526	Rack	18	440 x 470 x 150	B44066F9025S400
PQSM9035S400	35	372	526	Rack	18	440 x 470 x 150	B44066F9035S400
PQSM9050S400	50	372	526	Rack	23	500 x 515 x 180	B44066F9050S400
PQSM9060S400	60	372	526	Rack	23	500 x 515 x 180	B44066F9060S400
PQSM9075S400	75	372	526	Rack	28	500 x 546 x 190	B44066F9075S400
PQSM9100S400	100	372	526	Rack	35	500 x 575 x 200	B44066F9100S400
PQSM9150S400	150	372	526	Rack	44	500 x 605 x 270	B44066F9150S400
Wall-mounted units[2]							
PQSW9025S444	25	372	526	Wall	18	440 x 150 x 485	B44066F9025S444
PQSW9035S444	35	372	526	Wall	18	440 x 150 x 485	B44066F9035S444
PQSW9050S444	50	372	526	Wall	23	500 x 180 x 540	B44066F9050S444
PQSW9060S444	60	372	526	Wall	23	500 x 180 x 540	B44066F9060S444
PQSW9075S444	75	372	526	Wall	28	500 x 190 x 585	B44066F9075S444
PQSW9100S444	100	372	526	Wall	35	500 x 200 x 599	B44066F9100S444
PQSW9150S444	150	372	526	Wall	44	500 x 273 x 638	B44066F9150S444
Floor mounted units[3]							
PQSF9100S415	100	372	526	Floor	285	600 x 1000 x 2200	B44066F9100S415
PQSF9150S415	150	372	526	Floor	294	600 x 1000 x 2200	B44066F9150S415
PQSF9200S415	200	372	526	Floor	320	600 x 1000 x 2200	B44066F9200S415
PQSF9250S415	250	372	526	Floor	320	600 x 1000 x 2200	B44066F9250S415
PQSF9300S415	300	372	526	Floor	329	600 x 1000 x 2200	B44066F9300S415
PQSF9350S415	350	372	526	Floor	364	600 x 1000 x 2200	B44066F9350S415
PQSF9400S415	400	372	526	Floor	373	600 x 1000 x 2200	B44066F9400S415
PQSF9450S415	450	372	526	Floor	382	600 x 1000 x 2200	B44066F9450S415
PQSF9500S415	500	372	526	Floor	408	600 x 1000 x 2200	B44066F9500S415
PQSF9550S415	550	372	526	Floor	417	600 x 1000 x 2200	B44066F9550S415
PQSF9600S415	600	372	526	Floor	426	600 x 1000 x 2200	B44066F9600S415
PQSF9750S425	750	372	526	Floor	720	1200 x 1000 x 2200	B44066F9750S425
PQSF9900S425	900	372	526	Floor	764	1200 x 1000 x 2200	B44066F9900S425
PQSF9115S425	1150	372	526	Floor	843	1200 x 1000 x 2200	B44066F9115S425
PQSF9120S425	1200	372	526	Floor	852	1200 x 1000 x 2200	B44066F9120S425

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

480 V PQSine S series based on UL design – 3P3W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM3050S400	50	384	552	Rack	40	500 x 540 x 180	B44066F3050S400
PQSM3075S400	75	384	552	Rack	70	500 x 675 x 250	B44066F3075S400
PQSM3100S400	100	384	552	Rack	70	500 x 675 x 250	B44066F3100S400
Wall-mounted units[2)]							
PQSW3050S444	50	384	552	Wall	40	500 x 184 x 627	B44066F3050S444
PQSW3075S444	75	384	552	Wall	70	500 x 250 x 723	B44066F3075S444
PQSW3100S444	100	384	552	Wall	70	500 x 250 x 723	B44066F3100S444
Floor mounted units[3)]							
PQSF3100S435	100	384	552	Floor	320	800 x 1000 x 2200	B44066F3100S435
PQSF3150S435	150	384	552	Floor	360	800 x 1000 x 2200	B44066F3150S435
PQSF3200S435	200	384	552	Floor	390	800 x 1000 x 2200	B44066F3200S435
PQSF3250S435	250	384	552	Floor	430	800 x 1000 x 2200	B44066F3250S435
PQSF3300S435	300	384	552	Floor	460	800 x 1000 x 2200	B44066F3300S435
PQSF3350S435	350	384	552	Floor	500	800 x 1000 x 2200	B44066F3350S435
PQSF3400S435	400	384	552	Floor	530	800 x 1000 x 2200	B44066F3400S435

480 V PQSine S series based on UL design – 3P4W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM4050S400	50	384	552	Rack	40	500 x 540 x 180	B44066F4050S400
PQSM4075S400	75	384	552	Rack	70	500 x 675 x 250	B44066F4075S400
PQSM4100S400	100	384	552	Rack	70	500 x 675 x 250	B44066F4100S400
Wall-mounted units[2)]							
PQSW4050S444	50	384	552	Wall	40	500 x 184 x 627	B44066F4050S444
PQSW4075S444	75	384	552	Wall	70	500 x 250 x 723	B44066F4075S444
PQSW4100S444	100	384	552	Wall	70	500 x 250 x 723	B44066F4100S444
Floor mounted units[3)]							
PQSF4100S435	100	384	552	Floor	320	800 x 1000 x 2200	B44066F4100S435
PQSF4150S435	150	384	552	Floor	360	800 x 1000 x 2200	B44066F4150S435
PQSF4200S435	200	384	552	Floor	390	800 x 1000 x 2200	B44066F4200S435
PQSF4250S435	250	384	552	Floor	430	800 x 1000 x 2200	B44066F4250S435
PQSF4300S435	300	384	552	Floor	460	800 x 1000 x 2200	B44066F4300S435
PQSF4350S435	350	384	552	Floor	500	800 x 1000 x 2200	B44066F4350S435
PQSF4400S435	400	384	552	Floor	530	800 x 1000 x 2200	B44066F4400S435

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

600 V PQSine S series based on UL design – 3P3W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM3050S600	50	420	690	Rack	40	500 x 540 x 180	B44066F3050S600
PQSM3075S600	75	420	690	Rack	70	500 x 675 x 250	B44066F3075S600
PQSM3100S600	100	420	690	Rack	70	500 x 675 x 250	B44066F3100S600
Wall-mounted units[2)]							
PQSW3050S644	50	420	690	Wall	40	500 x 184 x 627	B44066F3050S644
PQSW3075S644	75	420	690	Wall	70	500 x 250 x 723	B44066F3075S644
PQSW3100S644	100	420	690	Wall	70	500 x 250 x 723	B44066F3100S644
Floor mounted units[3)]							
PQSF3100S635	100	420	690	Floor	320	800 x 1000 x 2200	B44066F3100S635
PQSF3150S635	150	420	690	Floor	360	800 x 1000 x 2200	B44066F3150S635
PQSF3200S635	200	420	690	Floor	390	800 x 1000 x 2200	B44066F3200S635
PQSF3250S635	250	420	690	Floor	430	800 x 1000 x 2200	B44066F3250S635
PQSF3300S635	300	420	690	Floor	460	800 x 1000 x 2200	B44066F3300S635
PQSF3350S635	350	420	690	Floor	500	800 x 1000 x 2200	B44066F3350S635
PQSF3400S635	400	420	690	Floor	530	800 x 1000 x 2200	B44066F3400S635

600 V PQSine S series based on UL design – 3P4W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM4050S600	50	420	690	Rack	40	500 x 540 x 180	B44066F4050S600
PQSM4075S600	75	420	690	Rack	70	500 x 675 x 250	B44066F4075S600
PQSM4100S600	100	420	690	Rack	70	500 x 675 x 250	B44066F4100S600
Wall-mounted units[2)]							
PQSW4050S644	50	420	690	Wall	40	500 x 184 x 627	B44066F4050S644
PQSW4075S644	75	420	690	Wall	70	500 x 250 x 723	B44066F4075S644
PQSW4100S644	100	420	690	Wall	70	500 x 250 x 723	B44066F4100S644
Floor mounted units[3)]							
PQSF4100S635	100	420	690	Floor	320	800 x 1000 x 2200	B44066F4100S635
PQSF4150S635	150	420	690	Floor	360	800 x 1000 x 2200	B44066F4150S635
PQSF4200S635	200	420	690	Floor	390	800 x 1000 x 2200	B44066F4200S635
PQSF4250S635	250	420	690	Floor	430	800 x 1000 x 2200	B44066F4250S635
PQSF4300S635	300	420	690	Floor	460	800 x 1000 x 2200	B44066F4300S635
PQSF4350S635	350	420	690	Floor	500	800 x 1000 x 2200	B44066F4350S635
PQSF4400S635	400	420	690	Floor	530	800 x 1000 x 2200	B44066F4400S635

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQSine S Series
Active Harmonic Filter

690 V PQSine S series based on UL design – 3P3W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM3050S700	50	483	793	Rack	40	500 x 540 x 180	B44066F3050S700
PQSM3075S700	75	483	793	Rack	70	500 x 675 x 250	B44066F3075S700
PQSM3100S700	100	483	793	Rack	70	500 x 675 x 250	B44066F3100S700
Wall-mounted units[2)]							
PQSW3050S744	50	483	793	Wall	40	500 x 184 x 627	B44066F3050S744
PQSW3075S744	75	483	793	Wall	70	500 x 250 x 723	B44066F3075S744
PQSW3100S744	100	483	793	Wall	70	500 x 250 x 723	B44066F3100S744
Floor mounted units[3)]							
PQSF3100S735	100	483	793	Floor	320	800 x 1000 x 2200	B44066F3100S735
PQSF3150S735	150	483	793	Floor	360	800 x 1000 x 2200	B44066F3150S735
PQSF3200S735	200	483	793	Floor	390	800 x 1000 x 2200	B44066F3200S735
PQSF3250S735	250	483	793	Floor	430	800 x 1000 x 2200	B44066F3250S735
PQSF3300S735	300	483	793	Floor	460	800 x 1000 x 2200	B44066F3300S735
PQSF3350S735	350	483	793	Floor	500	800 x 1000 x 2200	B44066F3350S735
PQSF3400S735	400	483	793	Floor	530	800 x 1000 x 2200	B44066F3400S735

690 V PQSine S series based on UL design – 3P4W systems

Type	Rated filter current A	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM4050S700	50	483	793	Rack	40	500 x 540 x 180	B44066F4050S700
PQSM4075S700	75	483	793	Rack	70	500 x 675 x 250	B44066F4075S700
PQSM4100S700	100	483	793	Rack	70	500 x 675 x 250	B44066F4100S700
Wall-mounted units[2)]							
PQSW4050S744	50	483	793	Wall	40	500 x 184 x 627	B44066F4050S744
PQSW4075S744	75	483	793	Wall	70	500 x 250 x 723	B44066F4075S744
PQSW4100S744	100	483	793	Wall	70	500 x 250 x 723	B44066F4100S744
Floor mounted units[3)]							
PQSF4100S735	100	483	793	Floor	320	800 x 1000 x 2200	B44066F4100S735
PQSF4150S735	150	483	793	Floor	360	800 x 1000 x 2200	B44066F4150S735
PQSF4200S735	200	483	793	Floor	390	800 x 1000 x 2200	B44066F4200S735
PQSF4250S735	250	483	793	Floor	430	800 x 1000 x 2200	B44066F4250S735
PQSF4300S735	300	483	793	Floor	460	800 x 1000 x 2200	B44066F4300S735
PQSF4350S735	350	483	793	Floor	500	800 x 1000 x 2200	B44066F4350S735
PQSF4400S735	400	483	793	Floor	530	800 x 1000 x 2200	B44066F4400S735

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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NEW

PQvar Ultima



- Higher efficiency: ≈ 99%
- Truly modular design allows parallel modules of varying ratings
- 3C2 conformal coating (designed to work in harsh environment)
- Compact size – lesser weight – lesser heat generation
- High power density
- Leverage benefits of “Silicon Carbide MOSFET”
- Ultimate design to meet new challenges

PQvar Ultima Static Var Generator

SiC MOSFET technology



NEW

General

The PQvar Ultima series is a new generation static var generator designed and developed using the innovative silicon carbide (SiC) MOSFET technology. This offers exceptional overall energy efficiency of up to 99%, a very compact form factor, and a lightweight design. It helps users with an infinite step compensation to improve the power factor (PF) by injecting leading and lagging reactive power (var) into the system.

The SiC MOSFETs technology enables to achieve a higher power density inside the same cabinet without impacting thermal performance of the product.

Applications

- Data center
- EV charging infrastructure
- Renewables
- Pharma
- Food & beverage
- Oil & gas
- Commercial & residential tower

Features

- Power: 30, 50, 75, 100 kvar
- Innovative SiC MOSFET technology
- Overall efficiency ≈ 99%
- Truly modular electrical and mechanical architecture
- Compact design and footprint
- Better thermal efficiency
- 3C2 conformal coating by default (optional 3C3 coating available)

Safety

- Overvoltage protection
- Undervoltage protection
- Inverter bridge inverse protection
- Overcompensation protection
- Overtemperature protection
- Short circuit protection
- Ground fault protection
- Harmonic overload protection
- Phase loss protection
- Anti resonance protection

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PQvar Ultima Static Var Generator

SiC MOSFET technology | Higher efficiency | Compact design

Technical data and specifications

Function	Reactive power and three-phase unbalance compensation
Features	Ultimate performance, very compact design, Higher efficiency of up to 99%, SiC MOSFET technology, truly modular in construction, low noise
Nominal voltage	220 V (176 … 264 V) / 400 V (228 … 456 V) / 480V (384 … 528 V)
Nominal frequency	50/60 Hz, auto-sensing (range: 45 … 62.5 Hz)
Individual module capacity	30/50/75/100 kvar
Parallel quantities	Unlimited
Efficiency	≈ 99%
Connection type	Three-phase three-wire / three-phase four-wire
CT location	Load/supply side
Control algorithm	FFT, intelligent FFT, and instantaneous reactive power
Compensation rate	>97% (for both odd and even harmonic)
Reaction time	<50 µs
Response time	<15 ms
Target power factor	Adjustable from -1 to +1
Switching frequency	Average 40 kHz, designed to operate up to 95 kHz
Cooling air requirement	Fan cooled
Noise level	<64 dB (Full load)
Communications ports	RS-485 and Ethernet port (RJ45)
Communications protocols	Modbus RTU, TCP/IP
Module display interface	4.3-inch HMI (module), 7-inch HMI (central monitor) and LED
Protection functions	Overvoltage protection, undervoltage protection, inverter bridge inverse protection, overcompensation protection
Mounting type	Wall-mounted, rack-mounted, and cabinet
Operating ambient temperature	-10 … +50 °C (will derate capacity if ambient temperature exceeds +40 °C)
Relative humidity	5 … 95%, non-condensing
Altitude	≤1500 m, 1500 … 4000 m, capacity is derating 1% for every 100 m altitude increased
Panel color	RAL 7035 light grey
Protection class	IP20 (IP grade can be customizable)
Electro-sensitive applications	EMI / EMC filter available (optional)

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PQvar Ultima
Static Var Generator

220 V PQvar Ultima – 3P3W systems

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6015Q200	15	176	264	Rack	18	530 x 551 x 88	B44066F6015Q200
PQSM6030Q200	30	176	264	Rack	25	530 x 605 x 88	B44066F6030Q200
PQSM6050Q200	50	176	264	Rack	30	530 x 612 x 100	B44066F6050Q200
Wall-mounted units[2)]							
PQSW6015Q244	15	176	264	Wall	18	504 x 97 x 540	B44066F6015Q244
PQSW6030Q244	30	176	264	Wall	25	504 x 98 x 594	B44066F6030Q244
PQSW6050Q244	50	176	264	Wall	30	504 x 109 x 601	B44066F6050Q244
Floor mounted units[3)]							
PQSF6060Q215	60	176	264	Floor	440	600 x 1000 x 2200	B44066F6060Q215
PQSF6080Q215	80	176	264	Floor	445	600 x 1000 x 2200	B44066F6080Q215
PQSF6100Q215	100	176	264	Floor	450	600 x 1000 x 2200	B44066F6100Q215
PQSF6150Q215	150	176	264	Floor	480	600 x 1000 x 2200	B44066F6150Q215
PQSF6200Q215	200	176	264	Floor	510	600 x 1000 x 2200	B44066F6200Q215

220 V PQvar Ultima – 3P4W systems

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM8015Q200	15	176	264	Rack	18	530 x 551 x 88	B44066F8015Q200
PQSM8030Q200	30	176	264	Rack	25	530 x 605 x 88	B44066F8030Q200
PQSM8050Q200	50	176	264	Rack	30	530 x 612 x 100	B44066F8050Q200
Wall-mounted units[2)]							
PQSW8015Q244	15	176	264	Wall	18	504 x 97 x 540	B44066F8015Q244
PQSW8030Q244	30	176	264	Wall	25	504 x 98 x 594	B44066F8030Q244
PQSW8050Q244	50	176	264	Wall	30	504 x 109 x 601	B44066F8050Q244
Floor mounted units[3)]							
PQSF8060Q215	60	176	264	Floor	440	600 x 1000 x 2200	B44066F8060Q215
PQSF8080Q215	80	176	264	Floor	445	600 x 1000 x 2200	B44066F8080Q215
PQSF8100Q215	100	176	264	Floor	450	600 x 1000 x 2200	B44066F8100Q215
PQSF8150Q215	150	176	264	Floor	480	600 x 1000 x 2200	B44066F8150Q215
PQSF8200Q215	200	176	264	Floor	510	600 x 1000 x 2200	B44066F8200Q215

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQvar Ultima
Static Var Generator

400 V PQvar Ultima – 3P3W systems

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6030Q300	30	228	456	Rack	18	530 x 551 x 88	B44066F6030Q300
PQSM6050Q300	50	228	456	Rack	18	530 x 551 x 88	B44066F6050Q300
PQSM6100Q300	100	228	456	Rack	30	530 x 612 x 100	B44066F6100Q300
Wall-mounted units[2)]							
PQSW6030Q344	30	228	456	Wall	18	504 x 97 x 540	B44066F6030Q344
PQSW6050Q344	50	228	456	Wall	18	504 x 97 x 540	B44066F6050Q344
PQSW6100Q344	100	228	456	Wall	30	504 x 109 x 601	B44066F6100Q344
Floor mounted units[3)]							
PQSF6150Q315	150	228	456	Floor	438	600 x 1000 x 2200	B44066F6150Q315
PQSF6200Q315	200	228	456	Floor	450	600 x 1000 x 2200	B44066F6200Q315
PQSF6250Q315	250	228	456	Floor	468	600 x 1000 x 2200	B44066F6250Q315
PQSF6300Q315	300	228	456	Floor	480	600 x 1000 x 2200	B44066F6300Q315
PQSF6350Q315	350	228	456	Floor	498	600 x 1000 x 2200	B44066F6350Q315
PQSF6400Q315	400	228	456	Floor	510	600 x 1000 x 2200	B44066F6400Q315

400 V PQvar Ultima – 3P4W systems

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM8030Q300	30	228	456	Rack	18	530 x 551 x 88	B44066F8030Q300
PQSM8050Q300	50	228	456	Rack	18	530 x 551 x 88	B44066F8050Q300
PQSM8100Q300	100	228	456	Rack	30	530 x 612 x 100	B44066F8100Q300
Wall-mounted units[2)]							
PQSW8030Q344	30	228	456	Wall	18	504 x 97 x 540	B44066F8030Q344
PQSW8050Q344	50	228	456	Wall	18	504 x 97 x 540	B44066F8050Q344
PQSW8100Q344	100	228	456	Wall	30	504 x 109 x 601	B44066F8100Q344
Floor mounted units[3)]							
PQSF8150Q315	150	228	456	Floor	438	600 x 1000 x 2200	B44066F8150Q315
PQSF8200Q315	200	228	456	Floor	450	600 x 1000 x 2200	B44066F8200Q315
PQSF8250Q315	250	228	456	Floor	468	600 x 1000 x 2200	B44066F8250Q315
PQSF8300Q315	300	228	456	Floor	480	600 x 1000 x 2200	B44066F8300Q315
PQSF8350Q315	350	228	456	Floor	498	600 x 1000 x 2200	B44066F8350Q315
PQSF8400Q315	400	228	456	Floor	510	600 x 1000 x 2200	B44066F8400Q315

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQvar Ultima
Static Var Generator

480 V PQvar Ultima – 3P3W systems

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6040Q400	40	384	528	Rack	18	530 x 551 x 88	B44066F6040Q400
PQSM6060Q400	60	384	528	Rack	18	530 x 551 x 88	B44066F6060Q400
PQSM6120Q400	120	384	528	Rack	30	530 x 612 x 100	B44066F6120Q400
Wall-mounted units[2)]							
PQSW6040Q444	40	384	528	Wall	18	504 x 97 x 540	B44066F6040Q444
PQSW6060Q444	60	384	528	Wall	18	504 x 97 x 540	B44066F6060Q444
PQSW6120Q444	120	384	528	Wall	30	504 x 109 x 601	B44066F6120Q444
Floor mounted units[3)]							
PQSF6180Q415	180	384	528	Floor	438	600 x 1000 x 2200	B44066F6180Q415
PQSF6240Q415	240	384	528	Floor	450	600 x 1000 x 2200	B44066F6240Q415
PQSF6300Q415	300	384	528	Floor	468	600 x 1000 x 2200	B44066F6300Q415
PQSF6360Q415	360	384	528	Floor	480	600 x 1000 x 2200	B44066F6360Q415
PQSF6420Q415	420	384	528	Floor	498	600 x 1000 x 2200	B44066F6420Q415
PQSF6480Q415	480	384	528	Floor	510	600 x 1000 x 2200	B44066F6480Q415

400 V PQvar Ultima – 3P3W systems EMC compliant

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6030K300	30	228	456	Rack	21	530 x 611 x 88	B44066F6030K300
PQSM6050K300	50	228	456	Rack	21	530 x 611 x 88	B44066F6050K300
PQSM6100K300	100	228	456	Rack	34	530 x 712 x 100	B44066F6100K300
Wall-mounted units[2)]							
PQSW6030K344	30	228	456	Wall	21	530 x 611 x 88	B44066F6030K344
PQSW6050K344	50	228	456	Wall	21	530 x 611 x 88	B44066F6050K344
PQSW6100K344	100	228	456	Wall	34	530 x 712 x 100	B44066F6100K344
Floor mounted units[3)]							
PQSF6150K315	150	228	456	Floor	445	600 x 1000 x 2200	B44066F6150K315
PQSF6200K315	200	228	456	Floor	458	600 x 1000 x 2200	B44066F6200K315
PQSF6250K315	250	228	456	Floor	479	600 x 1000 x 2200	B44066F6250K315
PQSF6300K315	300	228	456	Floor	492	600 x 1000 x 2200	B44066F6300K315
PQSF6350K315	350	228	456	Floor	513	600 x 1000 x 2200	B44066F6350K315
PQSF6400K315	400	228	456	Floor	526	600 x 1000 x 2200	B44066F6400K315

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQvar Ultima
Static Var Generator

400 V PQvar Ultima – 3P4W systems EMC compliant

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM8030K300	30	228	456	Rack	21	530 x 611 x 88	B44066F8030K300
PQSM8050K300	50	228	456	Rack	21	530 x 611 x 88	B44066F8050K300
PQSM8100K300	100	228	456	Rack	34	530 x 712 x 100	B44066F8100K300
Wall-mounted units[2)]							
PQSW8030K344	30	228	456	Wall	21	530 x 611 x 88	B44066F8030K344
PQSW8050K344	50	228	456	Wall	21	530 x 611 x 88	B44066F8050K344
PQSW8100K344	100	228	456	Wall	34	530 x 712 x 100	B44066F8100K344
Floor mounted units[3)]							
PQSF8150K315	150	228	456	Floor	445	600 x 1000 x 2200	B44066F8150K315
PQSF8200K315	200	228	456	Floor	458	600 x 1000 x 2200	B44066F8200K315
PQSF8250K315	250	228	456	Floor	479	600 x 1000 x 2200	B44066F8250K315
PQSF8300K315	300	228	456	Floor	492	600 x 1000 x 2200	B44066F8300K315
PQSF8350K315	350	228	456	Floor	513	600 x 1000 x 2200	B44066F8350K315
PQSF8400K315	400	228	456	Floor	526	600 x 1000 x 2200	B44066F8400K315

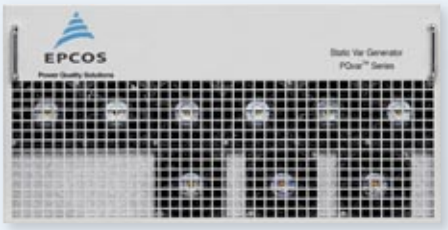
480 V PQvar Ultima – 3P3W systems EMC compliant

Type	Reactive power kvar	System min./max. voltage V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6040K400	40	384	528	Rack	18	530 x 551 x 88	B44066F6040K400
PQSM6060K400	60	384	528	Rack	18	530 x 551 x 88	B44066F6060K400
PQSM6120K400	120	384	528	Rack	30	530 x 612 x 100	B44066F6120K400
Wall-mounted units[2)]							
PQSW6040K444	40	384	528	Wall	18	504 x 97 x 540	B44066F6040K444
PQSW6060K444	60	384	528	Wall	18	504 x 97 x 540	B44066F6060K444
PQSW6120K444	120	384	528	Wall	30	504 x 109 x 601	B44066F6120K444
Floor mounted units[3)]							
PQSF6180K415	180	384	528	Floor	438	600 x 1000 x 2200	B44066F6180K415
PQSF6240K415	240	384	528	Floor	450	600 x 1000 x 2200	B44066F6240K415
PQSF6300K415	300	384	528	Floor	468	600 x 1000 x 2200	B44066F6300K415
PQSF6360K415	360	384	528	Floor	480	600 x 1000 x 2200	B44066F6360K415
PQSF6420K415	420	384	528	Floor	498	600 x 1000 x 2200	B44066F6420K415
PQSF6480K415	480	384	528	Floor	510	600 x 1000 x 2200	B44066F6480K415

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

PQvar S Series
Static Var Generator (SVG)



General

SVG PQvar series is a product which has rewritten the conventional approach of power factor correction. It is designed to compensate the rapid reactive power requirement, thereby improving the power factor and consequently reducing the costs. SVG PQvar series monitors the current signal and utilizes three levels inverter topology which generate the reactive part of the measured current to compensate dynamically in order to improve the power factor. It can dynamically compensate power factor from –1 to 1.

Features

- SVG PQvar series can be considered as a controllable reactive current source, which helps to improve the system power factor to a target value of more than >0.99 without any over or under compensation.
- SVG PQvar series has extremely rapid dynamic compensation reaction time, which is less than 50 µs and a state response time of less than 15 ms.
- SVG PQvar series is an active compensation device, which doesn't need capacitor or reactor for reactive power compensation which will avoid the condition of resonance caused by the traditional capacitor banks.
- SVG PQvar series can compensate both inductive and capacitive reactive power and also provide load balancing.
- SVG PQvar series can compensate reactive power in any scope and can be installed together with traditional capacitor banks.
- The grid voltage has no influence on the SVG PQvar series compensation capacity. So even if the system voltage drops down, the required reactive power can be compensated by monitoring its requirement.
- SVG PQvar series can compensate for the same capacity equivalent to the installed capacity, therefore it requires 20 to 30% lower capacity in comparison with the conventional capacitor banks.
- SVG PQvar series has been designed to show high safety and reliability features.

Typical applications

Some typical applications which require rapid reactive power compensation includes the following:

- Data centers
- UPS systems
- Renewable power generation (e.g. photovoltaics and wind turbines)
- Sensitive equipment manufacturing (e.g. silicon wafer production, semiconductor production)
- Industrial production machines
- Electrical welding systems
- Plastic industry machinery (e.g. extruders, injection molders)

Safety

- Overload protection
- Internal short-circuit protection
- Overheating protection
- Overvoltage and undervoltage protection
- Inverter bridge protection
- Fan fault alarm

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PQvar S Series
Static Var Generator (SVG)

Wall-mounted panel



Floor-mounted panel



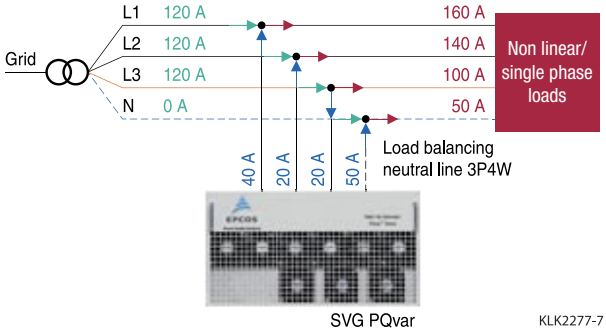
Horizontal module



Depending on the customer needs, TDK offers either complete panels, wall mounted cabinets or even modules.

The state of the art modular design of SVG PQvar series offers the advantage of having a minimum downtime in case of a service or maintenance requirement.

SVG PQvar series load balancing for 3P3W and 3P4W



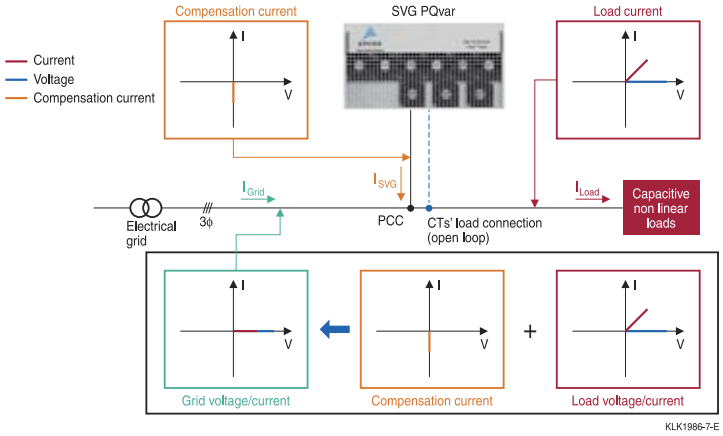
SVG PQvar series can balance load between phases and unloaded neutral wire for input voltage connection systems such as three-phase three-wires (3P3W) and three-phase four-wires (3P4W). Therefore, it will be a perfect solution with applications having reactive power requirements along with unbalanced loads, which is the case with the electricity distribution in rural areas, some industrial applications and much more.

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PQvar S Series
Static Var Generator (SVG)

Static Var Generator (SVG) PQvar series

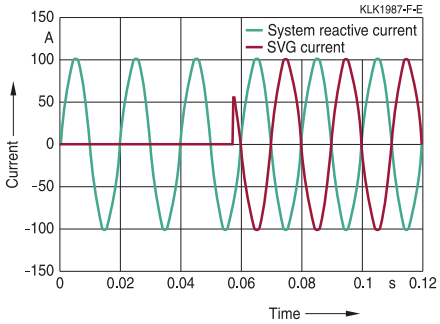
Compensation of reactive power with SVG PQvar series



SVG PQvar series compensation performance

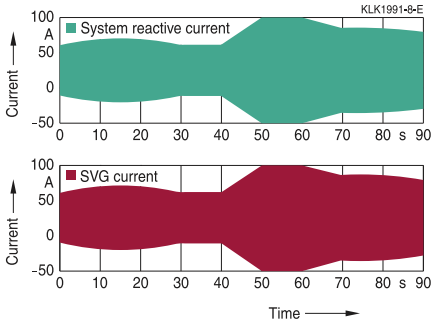
Fast reaction

Extremely rapid reactive power generation, in order to achieve target PF, right at the SVG PQvar series switch on.



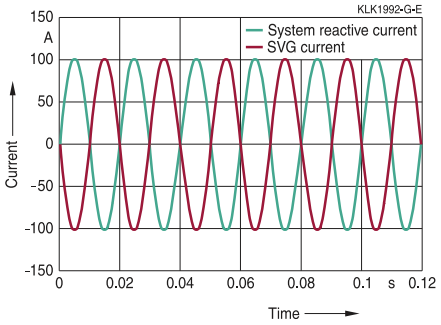
Real-time tracking

While system reactive current changes, SVG PQvar series also can generate dynamic real time compensation current to satisfy the changing power system requirement.



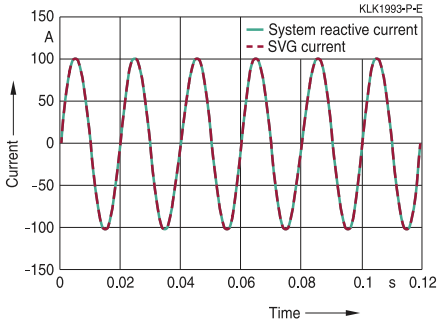
Perfect compensation

SVG PQvar series identifies the system reactive power requirement and generates a reactive current same in magnitude but opposite in phase to ensure perfect compensation result.



Reverse and overlapping

The reversed waveform of reactive current generated by SVG PQvar series overlaps with the power system reactive current.



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PQvar S Series
Static Var Generator (SVG)

Technical data and specifications of low-voltage SVG PQvar series

Rated voltage (range)	240 V (176 … 263 V)	400 V (228 … 456 V)	480 V (384 … 552 V)	600 V (420 … 690 V)	690 V (483 … 793 V)
Individiual module capacity (kvar)	30, 60, 120	30, 50, 100, 200	40, 80	50, 100	60, 120
Mains frequency	50/60 Hz (range: 45 … 62 Hz)				
Parallel operation	Unlimited				
Response time	<15 ms				
Overall efficiency	>97%				
Power grid structure	3P3W / 3P4W				
Current transformers	150/5 … 10 000/5				
Circuit topology	3 level				
Cooling mode	Smart air cooling: 110 L/sec to 500 L/sec, depending upon the models				
Target power factor	Adjustable from –1 … +1				
Cabinet mounting	Floor-mounted, wall-mounted				
Communication ports	RS485, TCP/IP				
Communication protocols	Modbus				
Noise level	<65 dB (depending on the model)				
Protection functions	Overvoltage, undervoltage, short-circuit, inverter bridge inverse, overcompensation				
Operating temperature	–10 … +40 °C (higher temperatures with derating)				
Relative humidity	5 … 95%, non-condensing				
Protection class	IP20 (other IP classes are customizable)				
Panel color	RAL7035 light grey				
Altitude	1500 m, 1% derating per 100 m plus				
EMC requirements	EN 61000_6_2(2005)/ EN55011, GROUP1, CLASS A IEC 61000_6_2(1999)/ CISPR11, GROUP1, CLASS A				
Compliance with standards	EN 50178:1997/ IEC 50178:1997, EN 50091-3/ IEC 62040-3/ AS 62040-3(VFI SS 111)				

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PQvar S Series
Static Var Generator (SVG)

240 V PQvar series – 3P3W systems

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6018V200	18	176	263	Rack	23	500 x 515 x 180	B44066F6018V200
PQSM6030V200	30	176	263	Rack	28	500 x 546 x 190	B44066F6030V200
PQSM6060V200	60	176	263	Rack	44	500 x 605 x 269	B44066F6060V200
PQSM6120V200	120	176	263	Rack	110	500 x 722 x 370	B44066F6120V200
Wall-mounted units[2)]							
PQSW6018V244	18	176	263	Wall	23	500 x 180 x 540	B44066F6018V244
PQSW6030V244	30	176	263	Wall	28	500 x 190 x 585	B44066F6030V244
PQSW6060V244	60	176	263	Wall	44	500 x 273 x 638	B44066F6060V244
PQSW6120V244	120	176	263	Wall	110	500 x 370 x 722	B44066F6120V244
Floor mounted cabinets[3)]							
PQSF6060V215	60	176	263	Floor	294	600 x 1000 x 2200	B44066F6060V215
PQSF6120V215	120	176	263	Floor	338	600 x 1000 x 2200	B44066F6120V215
PQSF6180V215	180	176	263	Floor	382	600 x 1000 x 2200	B44066F6180V215
PQSF6240V215	240	176	263	Floor	426	600 x 1000 x 2200	B44066F6240V215

240 V PQvar series – 3P4W systems

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM8018V200	18	176	263	Rack	23	500 x 515 x 180	B44066F8018V200
PQSM8030V200	30	176	263	Rack	28	500 x 546 x 190	B44066F8030V200
PQSM8060V200	60	176	263	Rack	44	500 x 605 x 269	B44066F8060V200
PQSM8120V200	120	176	263	Rack	110	500 x 722 x 370	B44066F8120V200
Wall-mounted units[2)]							
PQSW8018V244	18	176	263	Wall	23	500 x 180 x 540	B44066F8018V244
PQSW8030V244	30	176	263	Wall	28	500 x 190 x 585	B44066F8030V244
PQSW8060V244	60	176	263	Wall	44	500 x 273 x 638	B44066F8060V244
PQSW8120V244	120	176	263	Wall	110	500 x 370 x 722	B44066F8120V244
Floor mounted cabinets[3)]							
PQSF8060V215	60	176	263	Floor	294	600 x 1000 x 2200	B44066F8060V215
PQSF8120V215	120	176	263	Floor	338	600 x 1000 x 2200	B44066F8120V215
PQSF8180V215	180	176	263	Floor	382	600 x 1000 x 2200	B44066F8180V215
PQSF8240V215	240	176	263	Floor	426	600 x 1000 x 2200	B44066F8240V215

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

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PQvar S Series
Static Var Generator (SVG)

400 V PQvar series – 3P3W systems

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM6030V300	30	228	456	Rack	23	500 x 515 x 180	B44066F6030V300
PQSM6050V300	50	228	456	Rack	28	500 x 546 x 190	B44066F6050V300
PQSM6100V300	100	228	456	Rack	44	500 x 605 x 269	B44066F6100V300
PQSM6200V300	200	228	456	Rack	110	500 x 722 x 370	B44066F6200V300
Wall-mounted units[2]							
PQSW6030V344	30	228	456	Wall	23	500 x 180 x 540	B44066F6030V344
PQSW6050V344	50	228	456	Wall	28	500 x 190 x 585	B44066F6050V344
PQSW6100V344	100	228	456	Wall	44	500 x 273 x 638	B44066F6100V344
PQSW6200V344	200	228	456	Wall	110	500 x 370 x 722	B44066F6200V344
Floor mounted cabinets[3)]							
PQSF6100V315	100	228	456	Floor	294	600 x 1000 x 2200	B44066F6100V315
PQSF6150V315	150	228	456	Floor	322	600 x 1000 x 2200	B44066F6150V315
PQSF6200V315	200	228	456	Floor	338	600 x 1000 x 2200	B44066F6200V315
PQSF6250V315	250	228	456	Floor	366	600 x 1000 x 2200	B44066F6250V315
PQSF6300V315	300	228	456	Floor	382	600 x 1000 x 2200	B44066F6300V315
PQSF6350V315	350	228	456	Floor	410	600 x 1000 x 2200	B44066F6350V315
PQSF6400V315	400	228	456	Floor	426	600 x 1000 x 2200	B44066F6400V315

400 V PQvar series – 3P4W systems

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1)]							
PQSM8030V300	30	228	456	Rack	23	500 x 515 x 180	B44066F8030V300
PQSM8050V300	50	228	456	Rack	28	500 x 546 x 190	B44066F8050V300
PQSM8100V300	100	228	456	Rack	44	500 x 605 x 269	B44066F8100V300
PQSM8200V300	200	228	456	Rack	110	500 x 722 x 370	B44066F8200V300
Wall-mounted units[2)]							
PQSW8030V344	30	228	456	Wall	23	500 x 180 x 540	B44066F8030V344
PQSW8050V344	50	228	456	Wall	28	500 x 190 x 585	B44066F8050V344
PQSW8100V344	100	228	456	Wall	44	500 x 273 x 638	B44066F8100V344
PQSW8200V344	200	228	456	Wall	110	500 x 722 x 690	B44066F8200V344
Floor mounted cabinets[3)]							
PQSF8100V315	100	228	456	Floor	294	600 x 1000 x 2200	B44066F8100V315
PQSF8150V315	150	228	456	Floor	322	600 x 1000 x 2200	B44066F8150V315
PQSF8200V315	200	228	456	Floor	338	600 x 1000 x 2200	B44066F8200V315
PQSF8250V315	250	228	456	Floor	366	600 x 1000 x 2200	B44066F8250V315
PQSF8300V315	300	228	456	Floor	382	600 x 1000 x 2200	B44066F8300V315
PQSF8350V315	350	228	456	Floor	410	600 x 1000 x 2200	B44066F8350V315
PQSF8400V315	400	228	456	Floor	426	600 x 1000 x 2200	B44066F8400V315

[1)] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2)] Wall mounted units include a built-in 4.3-inch HMI display
[3)] Floor mounted cabinets include a 7-inch HMI display

PQvar S Series
Static Var Generator (SVG)

480 V PQvar series - 3P3W systems (based on 400 V design)							
Type	**Reactive power** **kvar**	**System voltage min./max.** **V**		**Mounting variant**	**Approx. weight** **kg**	**Approx. dimensions (w x d x h)** **mm**	**Ordering code**
Rack mounted units[1]							
PQSM9040V400[1]	40	372	526	Rack	23	500 x 515 x 180	B44066F9040V400
PQSM9060V400	60	372	526	Rack	28	500 x 546 x 190	B44066F9060V400
PQSM9120V400	120	372	526	Rack	44	500 x 605 x 269	B44066F9120V400
PQSM9250V400	250	372	526	Rack	110	500 x 722 x 370	B44066F9250V400
Wall-mounted units[2]							
PQSW9040V444	40	372	526	Wall	23	500 x 180 x 540	B44066F9040V444
PQSW9060V444	60	372	526	Wall	28	500 x 190 x 585	B44066F9060V444
PQSW9120V444	120	372	526	Wall	44	500 x 273 x 638	B44066F9120V444
PQSW9250V444	250	372	526	Wall	110	500 x 722 x 690	B44066F9250V444
Floor mounted cabinets[3]							
PQSF9120V415	120	372	526	Floor	294	600 x 1000 x 2200	B44066F9120V415
PQSF9180V415	180	372	526	Floor	322	600 x 1000 x 2200	B44066F9180V415
PQSF9240V415	240	372	526	Floor	338	600 x 1000 x 2200	B44066F9240V415
PQSF9300V415	300	372	526	Floor	366	600 x 1000 x 2200	B44066F9300V415
PQSF9360V415	360	372	526	Floor	382	600 x 1000 x 2200	B44066F9360V415
PQSF9420V415	420	372	526	Floor	410	600 x 1000 x 2200	B44066F9420V415
PQSF9480V415	480	372	526	Floor	426	600 x 1000 x 2200	B44066F9480V415

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display

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PQvar S Series
Static Var Generator (SVG)

480 V PQvar series – 3P3W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM6040V400	40	384	552	Rack	40	500 x 540 x 180	B44066F6040V400
PQSM6080V400	80	384	552	Rack	70	500 x 675 x 250	B44066F6080V400
Wall-mounted units[2]							
PQSW6040V444	40	384	552	Wall	40	500 x 184 x 627	B44066F6040V444
PQSW6080V444	80	384	552	Wall	70	500 x 250 x 723	B44066F6080V444
Floor mounted cabinets[3]							
PQSF6080V435	80	384	552	Floor	320	800 x 1000 x 2200	B44066F6080V435
PQSF6120V435	120	384	552	Floor	360	800 x 1000 x 2200	B44066F6120V435
PQSF6160V435	160	384	552	Floor	390	800 x 1000 x 2200	B44066F6160V435
PQSF6200V435	200	384	552	Floor	430	800 x 1000 x 2200	B44066F6200V435
PQSF6240V435	240	384	552	Floor	460	800 x 1000 x 2200	B44066F6240V435
PQSF6280V435	280	384	552	Floor	500	800 x 1000 x 2200	B44066F6280V435
PQSF6320V435	320	384	552	Floor	530	800 x 1000 x 2200	B44066F6320V435

480 V PQvar series – 3P4W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM8040V400	40	384	552	Rack	40	500 x 540 x 180	B44066F8040V400
PQSM8080V400	80	384	552	Rack	70	500 x 675 x 250	B44066F8080V400
Wall-mounted units[2]							
PQSW8040V444	40	384	552	Wall	40	500 x 184 x 627	B44066F8040V444
PQSW8080V444	80	384	552	Wall	70	500 x 250 x 723	B44066F8080V444
Floor mounted cabinets[3]							
PQSF8080V435	80	384	552	Floor	320	800 x 1000 x 2200	B44066F8080V435
PQSF8120V435	120	384	552	Floor	360	800 x 1000 x 2200	B44066F8120V435
PQSF8160V435	160	384	552	Floor	390	800 x 1000 x 2200	B44066F8160V435
PQSF8200V435	200	384	552	Floor	430	800 x 1000 x 2200	B44066F8200V435
PQSF8240V435	240	384	552	Floor	460	800 x 1000 x 2200	B44066F8240V435
PQSF8280V435	280	384	552	Floor	500	800 x 1000 x 2200	B44066F8280V435
PQSF8320V435	320	384	552	Floor	530	800 x 1000 x 2200	B44066F8320V435

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display
[4] UL approval pending

PQvar S Series
Static Var Generator (SVG)

600 V PQvar series – 3P3W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM6050V600	50	420	690	Rack	40	500 x 540 x 180	B44066F6050V600
PQSM6100V600	100	420	690	Rack	70	500 x 675 x 250	B44066F6100V600
Wall-mounted units[2]							
PQSW6050V644	50	420	690	Wall	40	500 x 184 x 627	B44066F6050V644
PQSW6100V644	100	420	690	Wall	70	500 x 250 x 723	B44066F6100V644
Floor mounted cabinets[3]							
PQSF6100V635	100	420	690	Floor	320	800 x 1000 x 2200	B44066F6100V635
PQSF6150V635	150	420	690	Floor	360	800 x 1000 x 2200	B44066F6150V635
PQSF6200V635	200	420	690	Floor	390	800 x 1000 x 2200	B44066F6200V635
PQSF6250V635	250	420	690	Floor	430	800 x 1000 x 2200	B44066F6250V635
PQSF6300V635	300	420	690	Floor	460	800 x 1000 x 2200	B44066F6300V635
PQSF6350V635	350	420	690	Floor	500	800 x 1000 x 2200	B44066F6350V635
PQSF6400V635	400	420	690	Floor	530	800 x 1000 x 2200	B44066F6400V635

600 V PQvar series – 3P4W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM8050V600	50	420	690	Rack	40	500 x 540 x 180	B44066F8050V600
PQSM8100V600	100	420	690	Rack	70	500 x 675 x 250	B44066F8100V600
Wall-mounted units[2]							
PQSW8050V644	50	420	690	Wall	40	500 x 184 x 627	B44066F8050V644
PQSW8100V644	100	420	690	Wall	70	500 x 250 x 723	B44066F8100V644
Floor mounted cabinets[3]							
PQSF8100V635	100	420	690	Floor	320	800 x 1000 x 2200	B44066F8100V635
PQSF8150V635	150	420	690	Floor	360	800 x 1000 x 2200	B44066F8150V635
PQSF8200V635	200	420	690	Floor	390	800 x 1000 x 2200	B44066F8200V635
PQSF8250V635	250	420	690	Floor	430	800 x 1000 x 2200	B44066F8250V635
PQSF8300V635	300	420	690	Floor	460	800 x 1000 x 2200	B44066F8300V635
PQSF8350V635	350	420	690	Floor	500	800 x 1000 x 2200	B44066F8350V635
PQSF8400V635	400	420	690	Floor	530	800 x 1000 x 2200	B44066F8400V635

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display
[4] UL approval pending

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PQvar S Series
Static Var Generator (SVG)

690 V PQvar series – 3P3W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM6060V700	60	483	793	Rack	40	500 x 540 x 180	B44066F6060V700
PQSM6120V700	120	483	793	Rack	70	500 x 675 x 250	B44066F6120V700
Wall-mounted units[2]							
PQSW6060V744	60	483	793	Wall	40	500 x 184 x 627	B44066F6060V744
PQSW6120V744	120	483	793	Wall	70	500 x 250 x 723	B44066F6120V744
Floor mounted cabinets[3]							
PQSF6120V735	120	483	793	Floor	320	800 x 1000 x 2200	B44066F6120V735
PQSF6180V735	180	483	793	Floor	360	800 x 1000 x 2200	B44066F6180V735
PQSF6240V735	240	483	793	Floor	390	800 x 1000 x 2200	B44066F6240V735
PQSF6300V735	300	483	793	Floor	430	800 x 1000 x 2200	B44066F6300V735
PQSF6360V735	360	483	793	Floor	460	800 x 1000 x 2200	B44066F6360V735
PQSF6420V735	420	483	793	Floor	500	800 x 1000 x 2200	B44066F6420V735
PQSF6480V735	480	483	793	Floor	530	800 x 1000 x 2200	B44066F6480V735

690 V PQvar series – 3P4W systems (based on UL design[4])

Type	Reactive power kvar	System voltage min./max. V		Mounting variant	Approx. weight kg	Approx. dimensions (w x d x h) mm	Ordering code
Rack mounted units[1]							
PQSM8060V700	60	483	793	Rack	40	500 x 540 x 180	B44066F8060V700
PQSM8120V700	120	483	793	Rack	70	500 x 675 x 250	B44066F8120V700
Wall-mounted units[2]							
PQSW8060V744	60	483	793	Wall	40	500 x 184 x 627	B44066F8060V744
PQSW8120V744	120	483	793	Wall	70	500 x 250 x 723	B44066F8120V744
Floor mounted cabinets[3]							
PQSF8120V735	120	483	793	Floor	320	800 x 1000 x 2200	B44066F8120V735
PQSF8180V735	180	483	793	Floor	360	800 x 1000 x 2200	B44066F8180V735
PQSF8240V735	240	483	793	Floor	390	800 x 1000 x 2200	B44066F8240V735
PQSF8300V735	300	483	793	Floor	430	800 x 1000 x 2200	B44066F8300V735
PQSF8360V735	360	483	793	Floor	460	800 x 1000 x 2200	B44066F8360V735
PQSF8420V735	420	483	793	Floor	500	800 x 1000 x 2200	B44066F8420V735
PQSF8480V735	480	483	793	Floor	530	800 x 1000 x 2200	B44066F8480V735

Accessories ordering codes

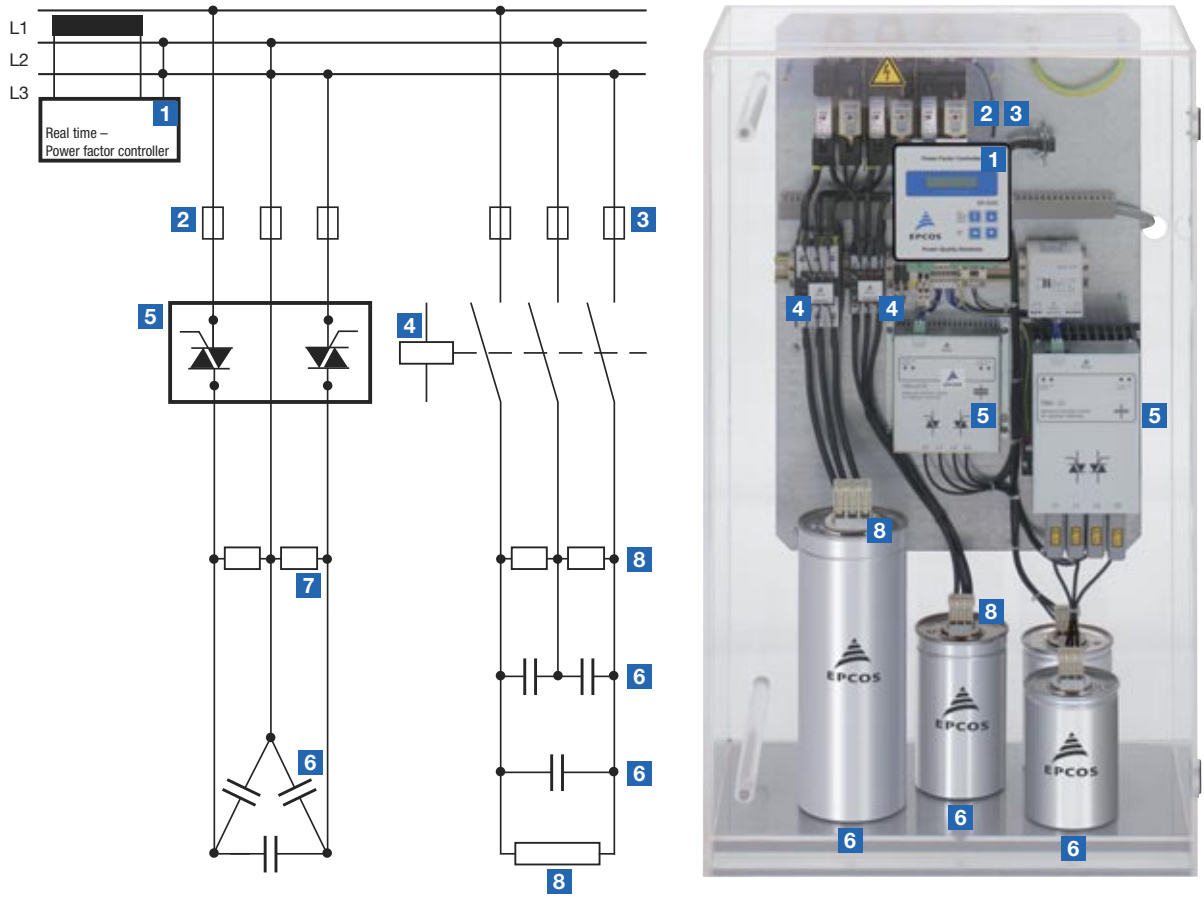
Product description	Ordering code
7" TFT HMI Color control/Display unit, touch screen	B44066F9999V230
Optional Internet/ Dry Contact I/O Unit	B44066F8900V230

[1] Rack mounted units do not include a built-in display. An additional 7-inch HMI display is necessary
[2] Wall mounted units include a built-in 4.3-inch HMI display
[3] Floor mounted cabinets include a 7-inch HMI display
[4] UL approval pending

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Fundamentals of Power Factor Correction

Application example



1 Power factor controller
2 Semiconductor fuses
3 Fuses
4 Contactor
5 Thyrisor module
6 Capacitor
7 Discharge resistor
8 Discharge resistor (plug in)

The rational use of electrical energy calls for cost effective generation, transmission and distribution with little losses. That means restricting all factors in electrical networks that cause losses. One of these factors is lagging reactive power. Loads in industrial and public power grids are primarily of an ohmic-inductive nature. The purpose of systems for power factor correction in networks is to compensate the generated lagging reactive power by leading reactive power at defined nodes. This also serves to avoid impermissibly high voltage drops and additional ohmic losses. The necessary leading power is produced by capacitors parallel to the supply network, as close as possible to the inductive load. Static capacitive compensation devices reduce the lagging reactive power component transmitted over the network. If grid conditions change, the required leading reactive power can be matched in steps by adding or taking out single power capacitors (automatic PFC) to compensate the lagging reactive power.

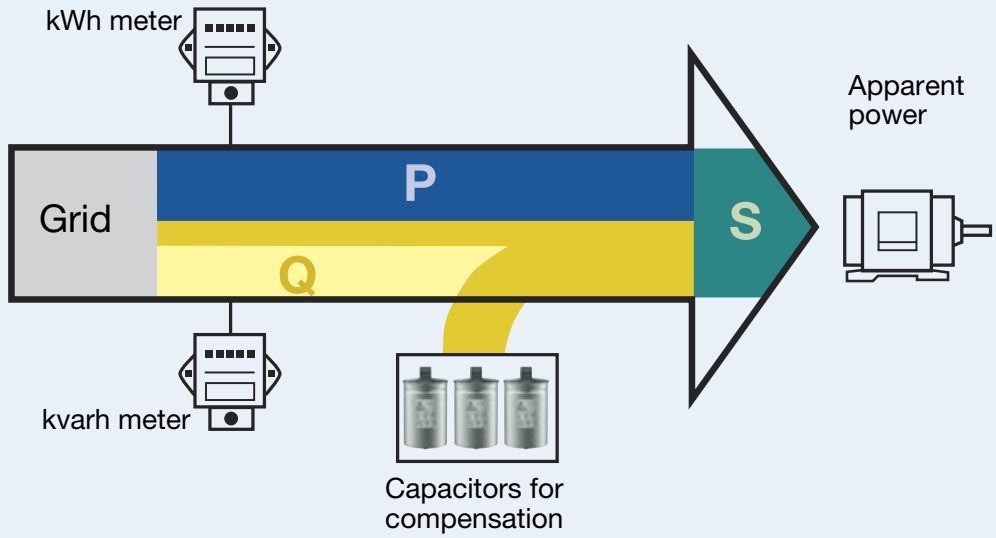
Benefits of power factor correction

- Fast return on investment through lower power costs
  - Power factor correction reduces the reactive power in a system.
  - Power consumption and thus power costs drop in proportion.
- Effective use of installation
  - An improved power factor means that an electrical installation operates more economically (higher effective power for the same apparent power).
- Improved voltage quality
- Reduced voltage drops
- Optimum cable design
  - Cable cross-sections can be reduced with improvement of power factor (less current). In existing installations for instance, extra or higher power can be transmitted.
- Reduced transmission losses
  - The transmission and switching devices carry less current, i.e. only the effective power, meaning that the ohmic losses in the leads are reduced.

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Components for Power Factor Correction

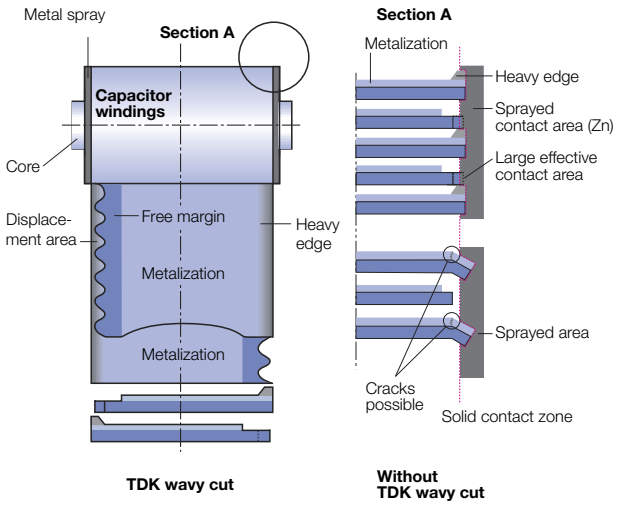
Conventional power factor correction



1. Capacitor

Power factor correction (PFC) capacitors produce the necessary leading reactive power to compensate the lagging reactive power. They should be capable of withstanding high inrush currents caused by switching operations (>100 · I_N). If they are connected in parallel, i.e. as banks, the inrush current will increase (≥150 · I_N) because the charging current comes from the power line as well as from other capacitors connected in parallel.

Wavy cut design



Design of capacitors

MKK/MKP/MKD technology

Metalized plastic compact capacitors with self-healing properties and a polypropylene dielectric. Film metallization with zinc/aluminum alloy results in high performance and a low film thickness allowing significantly more compact dimensions and a lower weight.

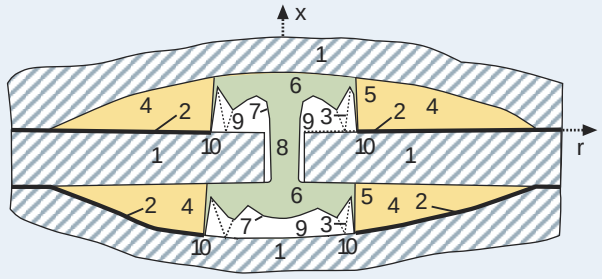
A heavy edge and special film-cutting technique (optimized combination of wavy and smooth cuts) produces a maximum effective surface for the metal spraying or contacting process.

- Series PhaseCap Energy – with gas impregnation (dry technology) or with semi-dry biodegradable soft resin.
- Series PhaseCap and PhaseCap HD dry technology – impregnation with a non-flammable inert gas (nitrogen N2).
- Series PhaseCap Compact – semi-dry biodegradable resin.
- Series DeltaCap – impregnation with semi-dry biodegradable soft resin.
- Series PhiCap – impregnation with semi-dry biodegradable soft resin.

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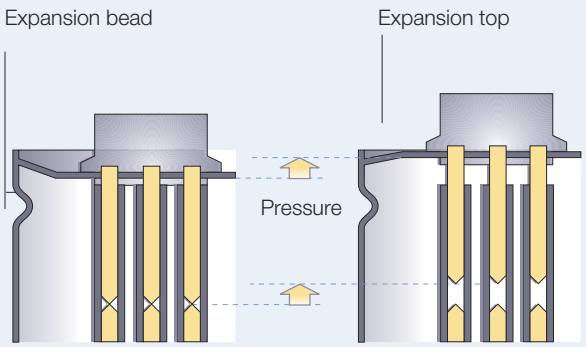
Components for Power Factor Correction

Self-healing



1 Dielectric
2 Metalized electrodes
3 Material displacing shock wave
4 Air gap with metal vapor
5, 6 Plasma zone
7 Boundary layer between gas phase dielectric and plasma
8 Breakdown channel
9 Gas phase dielectric
10 Zone of displaced metalization and dielectric (isolating region)

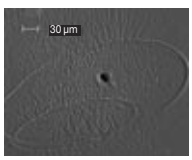
Overpressure disconnector

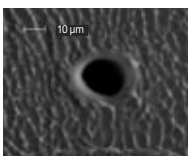


Safety

Self-healing properties

In the event of thermal or electrical overload, an electric breakdown occurs. The dielectric in the breakdown channel is broken down into highly compressed plasma that explodes out of the breakdown channel and pushes the dielectric layers apart. The discharge continues within the spreading plasma via the metal layers so that the metal surrounding the faulty area is completely burnt out. This produces perfect isolation of the faulty area within microseconds. The self-healing process results in negligible capacitance loss – less than 100 pF per event. The capacitor remains fully functional during the entire process.





Overpressure disconnector

At the end of the capacitor's service life or when a high pressure forms inside the can, the overpressure disconnector is activated.

The specially designed cover with
an expansion bead moves upwards. Expansion beyond a certain degree will separate the wires and disconnect the capacitor safely from the line. The disconnector is separated at its break point (small notch) and the flow of current to the capacitor windings is interrupted.

⚠ Cautions

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

1. The elastic elements must not be hindered, i.e.
   – connecting lines must be flexible leads (cables),
   – there must be sufficient space (at least 20 mm) for expansion above the connections (specified for the different models),
   – folding beads must not be retained by clamps.
2. The maximum permissible fault current of 10 000 A to the UL 810 standard must not be exceeded.
3. Stress parameters of the capacitor must be within the IEC 60831 specification.

Dry technology/vacuum impregnation

The active winding elements are heated and then dried for a defined period. Impregnation is performed under vacuum. In this way, air and moisture are extracted from the inner capacitor, and oxidation of the electrodes as well as partial discharges
are avoided. Afterwards, the capacitor elements are hermetically sealed in cases (e.g. aluminum). This elaborate process ensures excellent capacitance stability and long useful life.

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Components for Power Factor Correction

2. Power factor controller

Modern PF controllers are microprocessor-based. The microprocessor analyzes the signal from a current transformer and produces switching commands to control the contactors that add or remove capacitor stages.

Intelligent control by microprocessor-based PF controllers ensures even utilization of capacitor stages, a minimized number of switching operations and an optimized life cycle of the capacitor bank.

After the required capacitor output has been determined, the number of steps should be defined. The broad product range of controllers from TDK allows customized solutions: The BR6000 series is available for conventional, dynamic and mixed compensation with six and twelve steps for medium and large systems respectively; BR6000-T6 for dynamic compensation with 6 steps.

The PF controller BR7000 with its 15 outputs offers a broad range of applications, e.g. 15 conventional steps (each for one three-phase capacitor), 15 steps for single-phase capacitors or mixed operation (see page 60).

Version BR7000-T with 15 transistor outputs is suitable for dynamic PFC. Series BR7000-I is designed for single-phase controlling.

BR7000-I/TH and BR7000-I/TH/S485 are designed for dynamic and mixed systems, each with 12 relays and 12 transistor outputs.

Rule of thumb: the number of steps depends on the number of loads, i.e. the more small inductive loads, the higher the number of steps should be. The switching time is also of major importance here: the more frequently a capacitor is switched, the more stress is placed on it and its contactors.

3. Switching devices

Two types of switching devices are available from TDK: capacitor contactors and thyristor modules. Before choosing a switching device for a PFC system, the user must consider the number of switching operations.

Capacitor contactor

Contactors are electromechanical switching elements used to switch capacitors or reactors and capacitors in standard or detuned PFC systems. The pre-switching auxiliary contacts of TDK Electronics capacitor contactors close before the main contact and avoid peak current values by pre-loading the capacitor. Note: Even when using capacitor contactors, it is important not to exceed the annual switching capability of the particular capacitor series.

Thyristor modules

Fast-changing loads of any kind require technologies that act in real time. In dynamic PFC systems, thyristor modules replace slow-acting electromechanical switches. This not only allows them to react within a few milliseconds, but also increases the life expectancy of all components without any mechanical wear out of the thyristor module.

Note:

A dynamic PF controller is required, e.g. of the BR6000-T or BR7000-T series.

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Components for Power Factor Correction

4. Reactors (compensation and filtering)

Power distribution networks are increasingly subjected to harmonic pollution from modern power electronics devices, known as non-linear loads, e.g. drives, uninterruptible power supplies and electronic ballasts. Harmonics are dangerous for capacitors connected in the PFC circuit, especially if they operate at a resonant frequency. The series connection of a reactor and capacitor to detune the series resonant frequency (the capacitor's resonant frequency) helps to prevent capacitor damage. The most critical frequencies are the 5th and 7th harmonics (250 and 350 Hz at 50 Hz grid frequency). Detuned capacitor banks also help to reduce the harmonic distortion level and clean the network.

5. Active Filter PQSine

Active harmonic filters and power optimizers of the PQSine help to reduce harmonic pollution in the grid. By offering dynamic VAR compensation, active load balancing and elimination of harmonics power quality can be optimized, leading to a more efficient and reliable usage of energy. Depending on the customer needs or application, TDK offers complete panels, wall mounted cabinets and modules with voltages 200 V, 400 V, 480 V, 600 V and 690 V. Based on the latest state of the art technology, the AHF are installed in parallel to the polluting loads. They analyze the line current and the related harmonics. By generating a compensation current, the harmonic currents are neutralized, leading to an almost sinusoidal waveform.

6. PQvar

PQvar is a modular static var generator (SVG) for active stepless power factor correction and load balancing e.g. in industrial grids and large commercial buildings. With a fast response time of less than 15 ms and a dynamic reaction time of less than 50 µs, PQvar offers significantly faster compensation than conventional systems.

7. Discharge devices

Discharge resistors

- Discharge resistors are required to discharge capacitors and help protect human beings against electric shock hazards as well as to switch capacitors in automatic PFC equipment (opposing phase).
- TDK Electronics discharge resistors are designed to discharge capacitors to 75 V or less within 60 seconds. Specific types <75 V in 90 seconds; please refer to table of ordering codes.
- Before switching on again, capacitors must be discharged to 10% or less of their nominal voltage.
- Discharge resistors are included in the scope of delivery, pre-mounted for the PhaseCap Premium, PhaseCap Compact, PhaseCap HD, DeltaCap and PhiCap B32344 series.

⚠ Cautions

Discharge and short-circuit the capacitor before handling it!

Discharge reactor

Whenever fast discharge of a capacitor is required, a discharge resistor is not sufficient. Discharge reactors must be used to allow a discharge of within a few seconds. Also, the various steps in a PFC system can then be switched much faster, minimizing losses at the same time.

8. Protection

An HRC fuse or MCCB acts as a safety device for short-circuit protection.

- HRC fuses do not protect a capacitor against overload – they are designed for short-circuit protection only.
- The HRC fuse rating should be 1.6 to 1.8 times the nominal capacitor current.

⚠ Cautions

Do not use HRC fuses for switching (risk of arcing!).

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Standard Values:
Selection Table for Cable and Fuses

Selection table			
Power kvar	**Current A**	**Section mm²**	**Fuse A**
Rated voltage 230 V, 60 Hz			
2.5	6.3	1.5	10
5.0	12.6	4.0	25
7.5	18.8	6.0	35
10.0	25.1	10.0	50
12.5	31.4	16.0	50
15.0	37.7	16.0	63
Rated voltage 400 V, 50 Hz			
2.5	3.6	1.5	10
5.0	7.2	2.5	16
7.5	10.8	2.5	16
10.0	14.4	4.0	25
12.5	18.0	6.0	35
15.0	21.6	6.0	35
20.0	28.8	10.0	50
25.0	36.0	16.0	63
30.0	43.2	25.0	80
40.0	57.6	35.0	100
50.0	72.0	50.0	125
75.0	108.3	70.0	160
Rated voltage 440 V, 60 Hz			
2.5	3.3	1.5	10
5.0	6.6	2.5	16
7.5	10.0	2.5	16
10.0	13.2	4.0	25
12.5	16.8	4.0	25
15.0	19.8	6.0	35
20.0	26.4	10.0	50
25.0	33.0	16.0	63
30.0	39.6	25.0	80
40.0	52.8	35.0	100
50.0	66.0	50.0	125
75.0	99.0	70.0	160

The above mentioned values are guidelines for operation in normal conditions at ambient temperatures up to +35 °C.
Upgrade accordingly if conditions differ, e.g. temperature or hamonics differ. The internal wiring of a capacitor bank is sometimes possible with a smaller cross section. Various parameters such as temperature inside the cabinet, cable quality, maximum cable insulation temperature, single or multi core cable, cable length and laying system have to be considered for a proper selection. The local panelbuilder/installer is responsible for a proper selection of the cable sizes and fuses according to the valid regulations and standards in the specific country where the PFC panels are installed.

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Standard Values:
Selection Table for Cable and Fuses

Selection table			
Power kvar	**Current A**	**Section mm²**	**Fuse A**
Rated voltage 480 V, 60 Hz			
2.5	3.0	1.5	10
5.0	6.0	2.5	16
7.5	9.0	2.5	16
10.0	12.0	4.0	25
12.5	18.0	6.0	35
15.0	21.0	6.0	35
20.0	24.0	10.0	50
25.0	30.0	10.0	50
30.0	36.0	16.0	63
40.0	48.0	25.0	80
50.0	60.0	35.0	100
75.0	90.0	70.0	160
Rated voltage 525 V, 50 Hz			
2.5	2.7	1.5	10
5.0	5.5	1.5	10
7.5	6.9	2.5	16
10.0	11.0	2.5	16
12.5	13.7	4.0	25
15.0	16.5	4.0	25
20.0	22.0	6.0	35
25.0	27.5	10.0	50
30.0	33.0	16.0	63
40.0	44.0	25.0	80
50.0	55.0	35.0	100
75.0	82.5	70.0	160
Rated voltage 690 V, 50 Hz			
2.5	2.1	1.5	10
5.0	4.2	1.5	10
7.5	6.3	1.5	10
10.0	8.4	2.5	16
12.5	10.5	2.5	16
15.0	12.6	4.0	25
20.0	16.7	4.0	25
25.0	20.9	6.0	35
30.0	25.1	10.0	50
40.0	33.5	16.0	63
50.0	41.8	25.0	80
75.0	62.8	50.0	125

The above mentioned values are guidelines for operation in normal conditions at ambient temperatures up to +35 °C.
Upgrade accordingly if conditions differ, e.g. temperature or hamonics differ. The internal wiring of a capacitor bank is sometimes possible with a smaller cross section. Various parameters such as temperature inside the cabinet, cable quality, maximum cable insulation temperature, single or multi core cable, cable length and laying system have to be considered for a proper selection. The local panelbuilder/installer is responsible for a proper selection of the cable sizes and fuses according to the valid regulations and standards in the specific country where the PFC panels are installed.

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Calculation Table for Reactive Power Demand (Qc)

Current (ACTUAL) tan φ	cos φ	Achievable (TARGET) cos φ 0.80	0.82	0.85	0.88	0.90	0.92	0.94	Qc	TARGET cos φ = 0.96 cos φ ≤1 $Q_c = P_{mot} \cdot F$ (0.96) = … [kvar] 100 · 1.01 = 101.0 kvar 0.96	0.98	1.00
		Factor F										
3.18	0.30	2.43	2.48	2.56	2.64	2.70	2.75	2.82		2.89	2.98	3.18
2.96	0.32	2.21	2.26	2.34	2.42	2.48	2.53	2.60		2.67	2.76	2.96
2.77	0.34	2.02	2.07	2.15	2.23	2.28	2.34	2.41		2.48	2.56	2.77
2.59	0.36	1.84	1.89	1.97	2.05	2.10	2.17	2.23		2.30	2.39	2.59
2.43	0.38	1.68	1.73	1.81	1.89	1.95	2.01	2.07		2.14	2.23	2.43
2.29	0.40	1.54	1.59	1.67	1.75	1.81	1.87	1.93		2.00	2.09	2.29
2.16	0.42	1.41	1.46	1.54	1.62	1.68	1.73	1.80		1.87	1.96	2.16
2.04	0.44	1.29	1.34	1.42	1.50	1.56	1.61	1.68		1.75	1.84	2.04
1.93	0.46	1.18	1.23	1.31	1.39	1.45	1.50	1.57		1.64	1.73	1.93
1.83	0.48	1.08	1.13	1.21	1.29	1.34	1.40	1.47		1.54	1.62	1.83
1.73	0.50	0.98	1.03	1.11	1.19	1.25	1.31	1.37		1.45	1.63	1.73
1.64	0.52	0.89	0.94	1.02	1.10	1.16	1.22	1.28		1.35	1.44	1.64
1.56	0.54	0.81	0.86	0.94	1.02	1.07	1.13	1.20		1.27	1.36	1.56
1.48	0.56	0.73	0.78	0.86	0.94	1.00	1.05	1.12		1.19	1.28	1.48
1.40	0.58	0.65	0.70	0.78	0.86	0.92	0.98	1.04		1.11	1.20	1.40
1.33	0.60	0.58	0.63	0.71	0.79	0.85	0.91	0.97		1.04	1.13	1.33
1.30	0.61	0.55	0.60	0.68	0.76	0.81	0.87	0.94		1.01	1.10	1.30
1.27	0.62	0.52	0.57	0.65	0.73	0.78	0.84	0.91		0.99	1.06	1.27
1.23	0.63	0.48	0.53	0.61	0.69	0.75	0.81	0.87		0.94	1.03	1.23
1.20	0.64	0.45	0.50	0.58	0.66	0.72	0.77	0.84		0.91	1.00	1.20
1.17	0.65	0.42	0.47	0.55	0.63	0.68	0.74	0.81		0.88	0.97	1.17
1.14	0.66	0.39	0.44	0.52	0.60	0.65	0.71	0.78		0.85	0.94	1.14
1.11	0.67	0.36	0.41	0.49	0.57	0.63	0.68	0.75		0.82	0.90	1.11
1.08	0.68	0.33	0.38	0.46	0.54	0.59	0.65	0.72		0.79	0.88	1.08
1.05	0.69	0.30	0.35	0.43	0.51	0.56	0.62	0.69		0.76	0.85	1.05
1.02	0.70	0.27	0.32	0.40	0.48	0.54	0.59	0.66		0.73	0.82	1.02
0.99	0.71	0.24	0.29	0.37	0.45	0.51	0.57	0.63		0.70	0.79	0.99
0.96	0.72	0.21	0.26	0.34	0.42	0.48	0.54	0.60		0.67	0.76	0.96
0.94	0.73	0.19	0.24	0.32	0.40	0.45	0.51	0.58		0.65	0.73	0.94
0.91	0.74	0.16	0.21	0.29	0.37	0.42	0.48	0.55		0.62	0.71	0.91
0.88	0.75	0.13	0.18	0.26	0.34	0.40	0.46	0.52		0.59	0.68	0.88
0.86	0.76	0.11	0.16	0.24	0.32	0.37	0.43	0.50		0.57	0.65	0.86
0.83	0.77	0.08	0.13	0.21	0.29	0.34	0.40	0.47		0.54	0.63	0.83
0.80	0.78	0.05	0.10	0.18	0.26	0.32	0.38	0.44		0.51	0.60	0.80
0.78	0.79	0.03	0.08	0.16	0.24	0.29	0.35	0.42		0.49	0.57	0.78
0.75	0.80		0.05	0.13	0.21	0.27	0.32	0.39		0.46	0.55	0.75
0.72	0.81			0.10	0.18	0.24	0.30	0.36		0.43	0.52	0.72
0.70	0.82			0.08	0.16	0.21	0.27	0.34		0.41	0.49	0.70
0.67	0.83			0.05	0.13	0.19	0.25	0.31		0.38	0.47	0.67
0.65	0.84			0.03	0.11	0.16	0.22	0.29		0.36	0.44	0.65
0.62	0.85				0.08	0.14	0.19	0.26		0.33	0.42	0.62
0.59	0.86				0.05	0.11	0.17	0.23		0.30	0.39	0.59
0.57	0.87					0.08	0.14	0.21		0.28	0.36	0.57
0.54	0.88					0.06	0.11	0.18		0.25	0.34	0.54
0.51	0.89					0.03	0.09	0.15		0.22	0.31	0.51
0.48	0.90						0.06	0.12		0.19	0.28	0.48
0.46	0.91						0.03	0.10		0.17	0.25	0.46
0.43	0.92							0.07		0.14	0.22	0.43
0.40	0.93							0.04		0.11	0.19	0.40
0.36	0.94									0.07	0.16	0.36
0.33	0.95										0.13	0.33

$Q_C = P_A \cdot (\tan \varphi 1 - \tan \varphi 2)$
Q_C [kvar] = P_A · F = active power [kW] · factor "F"
$P_A = S \cdot \cos \varphi$ = apparent power · cos φ
tan φ1 + φ2 according to cos φ values ref. table

Example:

Actual motor power	P = 100 kW
ACTUAL cos φ	0.61
TARGET cos φ	0.96
Factor F from table	1.01
Capacitor reactive power Q_C	
$Q_C = 100 \cdot 1.01 = 101.0$ kvar	

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Detuned PFC in General

When installing capacitors for PFC purpose, the problem of dealing with harmonics has to be faced. They have to be taken into account when designing the PFC system in order to prevent parallel and / or series resonance conditions that would damage the whole electrical system.

When PFC capacitors are connected, the inductance of the transformer together with the capacitors forms a resonant circuit that could be excited by a harmonic current generated by the load. This resonant circuit has a resonance frequency, and if a harmonic current of this frequency (or close to it) exists, it will lead the circuit into a resonance condition where high current will flow through the branches (L: the transformer, and C: the capacitor bank), overloading them and raising the voltage across them and across the whole electrical system that is connected in parallel.

PFC detuned filtering is a technique to correct the power factor avoiding the risk of resonance condition performed by shifting the resonance frequency to lower values where no harmonic currents are present.

This is achieved by modifying the basic LC circuit formed by the transformer and the capacitor bank, introducing a filter reactor in series with the capacitors, making this way a more complex resonant circuit but with the desired feature of having a resonance frequency below the first existing harmonic. This way it's not possible to have a real resonance condition.

Besides this main objective, the reactor connected in series with capacitors form a series resonant circuit with a certain tuning frequency at which the branch will offer a low impedance path. Filtering of harmonic currents and "cleaning" of the grid will be achieved.

Components for PFC detuned filters must be carefully selected according to the desired PFC purpose, to the harmonics present in the system, to some features of the system like short circuit power and impedances, to the desired filtering effect and to the characteristics of the resonant circuit configured.

For example, the voltage across the capacitors will be higher than the nominal grid voltage when they have a reactor connected in series.

The reactors must be selected in line with the inductance value to obtain the desired tuning frequency and current capability high enough for the harmonic current absorption that can be expected. The tuning frequency is usually indirectly referred to as the detuning factor p and expressed as a percentage.

$$p = 100 \cdot \frac{X_L}{X_C} = \left(\frac{f}{f_{RES}}\right)^2 \cdot 100$$

PFC detuned filtering is an engineering speciality that takes experienced know-how to implement it in a satisfying and safe way.

The design-instructions for detuned PFC systems on page 131 have to be followed to ensure an optimum performance of the PFC system.

Note: The recommendations given in the selection tables are meant as a support tool. TDK does not take over any responsibility for the design as apart from the theoretical conditions the prevailing circumstances in the application have to be taken into account.

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Detuned PFC: Important Facts and Instructions

Important design instructions to be followed for detuned PFC Systems

1. Determine the necessary effective power (kvar) of the capacitor bank in order to obtain the desired PF.
2. Design the capacitor stages in such a way that the sensibility of the bank is around 15–20% of the total available power. It's not useful to have a more sensitive bank that reacts with a 5 or 10% of the total power because this would lead to a high amount of switching operations, wasting the equipment unnecessarily when the real objective is to have a high average PF.
3. Try to design the bank with standard kvar values of effective power steps, preferably multiples of 25 kvar.
4. Measure the presence of harmonic currents in the main feeder cable of the system without capacitors at all possible load conditions. Determine frequency and maximum amplitude for every harmonic that could exist.
   Calculate the Total Harmonic Distortion of Current
   $THD\text{-}I = 100 \cdot SQR\,[(I_3)^2 + (I_5)^2 + \ldots + (I_R)^2]/I_I$
   Calculate every existing value for $THD\text{-}I_R = 100 \cdot I_R/I_I$
5. Measure the presence of harmonic voltages that might come from outside your system, if possible measure the HV side.
   Calculate the Total Harmonic Distortion of Voltage $THD\text{-}V = 100 \cdot SQR\,[(V_3)^2 + (V_5)^2 + \ldots + (V_N)^2]/V_I$
6. Are there harmonics such as
   THD-I >10% or THD-V >3%
   (measured without capacitors)?
   If YES ➞ use PFC-DF and go to consideration 7.
   If NO ➞ use standard PFC
   and skip considerations 7, 8 and 9.
7. Is there 3rd harmonic content,
   $I_3 > 0.2 \cdot I_5$?
   If YES ➞ use PFC-DF with p = 14%
   and skip consideration 8.
   If NO ➞ use PFC-DF with p = 7% or 5.67%
   and go to consideration 8.
8. THD-V is:
   3–7% ➞ use PFC-DF with p = 7%
   >7% ➞ use PFC-DF with p = 5.67%
   >10% ➞ ask for special filter design
9. Select the proper components using TDK tables for PFC-DF and standard values for effective power, the voltage and frequency of your grid, and the determined detuned factor p.
10. Always use genuine TDK application-specific designed components for PFC-DF. Please observe that reactors are specified for their effective power at grid voltage and frequency. This power will be the real effective power of the whole LC set at fundamental frequency. Capacitors for PFC-DF must be selected for a higher rated voltage than the grid's because of the overvoltage caused by the series connection with the reactor. Contactors for capacitors are designed as application-specific to reduce inrush capacitors currents and to handle capacitive loads in a reliable way.

Note:

These are general instructions. Conditions may differ depending on the application.
In case of doubts, please contact our local sales-office.

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Component Selection Tables for Detuned PFC

Selection table

Detuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Contactor ordering code	Cable cross-section mm²	Fuse rating A
400 V – 50 Hz						
5.67	10	1× B25675C4132J880	B44066D5010*400	B44066S1810J230	4	25
5.67	12.5	1× B25675C4142J240	B44066D5012*400	B44066S1810J230	6	35
5.67	20	1× B25675C4282J180	B44066D5020*400	B44066S2410J230	10	50
5.67	25	1× B25675C4282J140	B44066D5025*400	B44066S3210J230	16	63
5.67	40	1× B25675C4202J040 1× B25675C4252J040	B44066D5040*400	B44066S6210J230	35	100
5.67	50	2× B25675C4282J140	B44066D5050*400	B44066S6210J230	50	125
5.67	75	3× B25675C4282J140	B44066D5075*400	B44066S7410J230	70	160
5.67	100	4× B25675C4282J140	B44066D5100*400	B44066S9910J230	120	250
7	10	1× B25675C4132J880	B44066D7010*400	B44066S1810J230	4	25
7	12.5	1× B25675C4142J240	B44066D7012*400	B44066S1810J230	6	35
7	20	1× B25675C4282J180	B44066D7020*400	B44066S2410J230	10	50
7	25	1× B25675C4282J140	B44066D7025*400	B44066S3210J230	16	63
7	40	1× B25675C4202J040 1× B25675C4252J040	B44066D7040*400	B44066S6210J230	35	100
7	50	2× B25675C4282J140	B44066D7050*400	B44066S6210J230	50	125
7	75	3× B25675C4282J140	B44066D7075*400	B44066S7410J230	70	160
7	100	4× B25675C4282J140	B44066D7100*400	B44066S9910J230	125	250
14	10	1× B25675C4122J580	B44066D1410*400	B44066S1810J230	4	25
14	12.5	1× B25675C4152J080	B44066D1412*400	B44066S1810J230	6	35
14	20	1× B25675C4252J080	B44066D1420*400	B44066S2410J230	10	50
14	25	1× B25675C4312J080	B44066D1425*400	B44066S3210J230	16	63
14	40	2× B25675C4252J080	B44066D1440*400	B44066S6210J230	35	100
14	50	2× B25675C4312J080	B44066D1450*400	B44066S6210J230	50	125
14	75	3× B25675C4312J080	B44066D1475*400	B44066S7410J230	70	160
14	100	4× B25675C4312J080	B44066D1499*400	B44066S9910J230	125	250
400 V – 60 Hz						
5.67	10	1× B25675C4112J080	B44066D5010*401	B44066S1810J230	4	25
5.67	12.5	1× B25675C4122J040	B44066D5012*401	B44066S1810J230	6	35
5.67	20	1× B25675C4182J840	B44066D5020*401	B44066S2410J230	10	50
5.67	25	1× B25675C4102J040 1× B25675C4142J240	B44066D5025*401	B44066S3210J230	16	63
5.67	40	2× B25675C4182J840	B44066D5040*401	B44066S6210J230	35	100
5.67	50	2× B25675C4142J240 1× B25675C4182J840	B44066D5050*401	B44066S6210J230	50	125
5.67	75	1× B25675C4202J040 2× B25675C4252J040	B44066D5075*401	B44066S7410J230	70	160
5.67	100	1× B25675C4202J040 3× B25675C4252J040	B44066D5100*401	B44066S9910J230	120	250
7	10	1× B25675C4092J040	B44066D7010*401	B44066S1810J230	4	25
7	12.5	1× B25675C4122J040	B44066D7012*401	B44066S1810J230	6	35
7	20	1× B25675C4182J840	B44066D7020*401	B44066S2410J230	10	50
7	25	2× B25675C4122J040	B44066D7025*401	B44066S3210J230	16	63
7	40	2× B25675C4182J840	B44066D7040*401	B44066S6210J230	35	100
7	50	2× B25675C4142J240 1× B25675C4182J840	B44066D7050*401	B44066S6210J230	50	125
7	75	1× B25675C4202J040 2× B25675C4252J040	B44066D7075*401	B44066S7410J230	70	160
7	100	1× B25675C4182J840 3× B25675C4252J040	B44066D7100*401	B44066S9910J230	120	250

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Component Selection Tables for Detuned PFC

Selection table

Detuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Contactor ordering code	Cable cross-section mm²	Fuse rating A
400 V – 60 Hz						
14	10	1× B25675C4102J480	B44066D1410*401	B44066S1810J230	4	25
14	12.5	1× B25675C4122J580	B44066D1412*401	B44066S1810J230	6	35
14	20	1× B25675C4202J880	B44066D1420*401	B44066S2410J230	10	50
14	25	1× B25675C4252J080	B44066D1425*401	B44066S3210J230	16	63
14	40	2× B25675C4202J880	B44066D1440*401	B44066S6210J230	35	100
14	50	2× B25675C4252J080	B44066D1450*401	B44066S6210J230	50	125
14	75	3× B25675C4252J080	B44066D1475*401	B44066S7410J230	70	160
14	100	4× B25675C4252J080	B44066D1499*401	B44066S9910J230	120	250
440 V – 50 Hz						
5.67	10	1× B25675C4112J080	B44066D5010*440	B44066S1810J230	4	25
5.67	12.5	1× B25675C4132J880	B44066D5012*440	B44066S1810J230	4	35
5.67	20	1× B25675C4222J080	B44066D5020*440	B44066S2410J230	10	50
5.67	25	1× B25675C4282J180	B44066D5025*440	B44066S3210J230	16	63
5.67	40	2× B25675C4222J080	B44066D5040*440	B44066S6210J230	35	100
5.67	50	2× B25675C4282J180	B44066D5050*440	B44066S6210J230	50	125
5.67	75	3× B25675C4282J180	B44066D5075*440	B44066S7410J230	70	160
5.67	100	4× B25675C4282J180	B44066D5100*440	B44066S9910J230	95	200
7	10	1× B25765C4112J080	B44066D7010*440	B44066S1810J230	4	25
7	12.5	1× B25675C4132J880	B44066D7012*440	B44066S1810J230	4	25
7	20	1× B25675C4222J080	B44066D7020*440	B44066S2410J230	10	50
7	25	1× B25675C4282J180	B44066D7025*440	B44066S3210J230	16	63
7	40	2× B25675C4222J080	B44066D7040*440	B44066S6210J230	35	100
7	50	2× B25675C4282J180	B44066D7050*440	B44066S6210J230	50	125
7	75	3× B25675C4282J180	B44066D7075*440	B44066S7410J230	70	160
7	100	4× B25675C4282J180	B44066D7100*440	B44066S9910J230	95	200
14	10	1× B25675C5122J525	B44066D1410*440	B44066S1810J230	4	25
14	12.5	1× B25675C5152J025	B44066D1412*440	B44066S1810J230	4	25
14	20	1× B25675C5252J025	B44066D1420*440	B44066S2410J230	10	50
14	25	1× B25675C5302J025	B44066D1425*440	B44066S3210J230	16	63
14	40	2× B25675C5252J025	B44066D1440*440	B44066S6210J230	35	100
14	50	2× B25675C5302J025	B44066D1450*440	B44066S6210J230	50	125
14	75	3× B25675C5302J025	B44066D1475*440	B44066S7410J230	70	160
14	100	4× B25675C5302J025	B44066D1499*440	B44066S9910J230	95	200
440 V – 60 Hz						
5.67	10	1× B25675C6142J200	B44066D5010*441	B44066S1810J230	4	25
5.67	12.5	1× B25675C4112J080	B44066D5012*441	B44066S1810J230	4	25
5.67	20	1× B25675C4082J380 1× B25675C4102J480	B44066D5020*441	B44066S2410J230	10	50
5.67	25	1× B25675C4112J080 1× B25675C4122J580	B44066D5025*441	B44066S3210J230	16	63
5.67	40	1× B25675C4162J780 1× B25675C4202J880	B44066D5040*441	B44066S6210J230	35	100
5.67	50	1× B25675C4222J080 1× B25675C4252J080	B44066D5050*441	B44066S6210J230	50	125
5.67	75	1× B25675C4202J880 2× B25675C4252J080	B44066D5075*441	B44066S7410J230	70	160
5.67	100	1× B25675C4202J080 3× B25675C4252J080	B44066D5100*441	B44066S9910J230	95	200

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Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.

Component Selection Tables for Detuned PFC

Selection table

Detuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Contactor ordering code	Cable cross-section mm²	Fuse rating A
440 V – 60 Hz						
7	10	1× B25675C5102J425	B44066D7010*441	B44066S1810J230	4	25
7	12.5	1× B25675C5132J225	B44066D7012*441	B44066S1810J230	4	25
7	20	1× B25675C4082J380 1× B25675C4102J480	B44066D7020*441	B44066S2410J230	10	50
7	25	1× B25675C4222J080	B44066D7025*441	B44066S3210J230	16	63
7	40	1× B25675C4162J780 1× B25675C4202J080	B44066D7040*441	B44066S6210J230	35	100
7	50	1× B25675C4202J880 1× B25675C4252J080	B44066D7050*441	B44066S6210J230	50	125
7	75	2× B25675C4222J080 1× B25675C4252J080	B44066D7075*441	B44066S7410J230	70	160
7	100	3× B25675C4222J080 1× B25675C4252J080	B44066D7100*441	B44066S9910J230	95	200
14	10	1× B25675C5102J425	B44066D1410*441	B44066S1810J230	4	25
14	12.5	1× B25675C5122J525	B44066D1412*441	B44066S1810J230	4	25
14	20	1× B25675C5202J825	B44066D1420*441	B44066S2410J230	10	50
14	25	1× B25675C5262J525	B44066D1425*441	B44066S3210J230	16	63
14	40	1× B25675C5202J025 1× B25675C5202J825	B44066D1440*441	B44066S6210J230	35	100
14	50	1× B25675C5252J025 1× B25675C5262J525	B44066D1450*441	B44066S6210J230	50	125
14	75	2× B25675C5252J025 1× B25675C5262J525	B44066D1475*441	B44066S7410J230	70	160
14	100	3× B25675C5252J025 1× B25675C5262J525	B44066D1499*441	B44066S9910J230	95	200
480 V – 60 Hz						
5.67	10	1× B25675C6122J500	B44066D5010*481	B44066S1810J230	4	25
5.67	12.5	1× B25675C6142J200	B44066D5012*481	B44066S1810J230	4	25
5.67	20	1× B25675C6252J000	B44066D5020*481	B44066S2410J230	10	50
5.67	25	1× B25675C5082J325 1× B25675C5152J025	B44066D5025*481	B44066S3210J230	16	63
5.67	40	1× B25675C5162J725 1× B25675C5202J825	B44066D5040*481	B44066S6210J230	35	100
5.67	50	1× B25675C5202J825 1× B25675C5252J025	B44066D5050*481	B44066S6210J230	50	125
5.67	75	1× B25675C5202J825 2× B25675C5252J025	B44066D5075*481	B44066S7410J230	70	160
5.67	100	1× B25675C5202J025 3× B25675C5252J025	B44066D5100*481	B44066S9910J230	95	200
7	10	1× B25675C6122J500	B44066D7010*481	B44066S1810J230	4	25
7	12.5	1× B25675C6142J200	B44066D7012*481	B44066S1810J230	4	25
7	20	1× B25675C6252J000	B44066D7020*481	B44066S2410J230	10	50
7	25	1× B25675C5082J325 1× B25675C5152J025	B44066D7025*481	B44066S3210J230	16	63
7	40	1× B25675C5162J725 1× B25675C5202J025	B44066D7040*481	B44066S6210J230	35	100
7	50	1× B25675C5202J825 1× B25675C5252J025	B44066D7050*481	B44066S6210J230	50	125
7	75	1× B25675C5202J025 2× B25675C5252J025	B44066D7075*481	B44066S7410J230	70	160
7	100	1× B25675C5162J725 3× B25675C5252J025	B44066D7100*481	B44066S9910J230	95	200

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Component Selection Tables for Detuned PFC

Selection table

Detuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Contactor ordering code	Cable cross-section mm²	Fuse rating A
480 V – 60 Hz						
14	10	1× B25675C6142J690	B44066D1410*481	B44066S1810J230	4	25
14	12.5	1× B25675C6132J900	B44066D1412*481	B44066S1810J230	4	25
14	20	1× B25675C6102J400 1× B25675C6122J500	B44066D1420*481	B44066S2410J230	10	50
14	25	2× B25675C6132J900	B44066D1425*481	B44066S3210J230	16	63
14	40	1× B25675C6202J000 1× B25675C6252J000	B44066D1440*481	B44066S6210J230	35	100
14	50	1× B25675C6142J200 2× B25675C6202J800	B44066D1450*481	B44066S6210J230	50	125
14	75	1× B25675C6082J300 3× B25675C6252J000	B44066D1475*481	B44066S7410J230	70	160
14	100	1× B25675C6122J500 4× B25675C6252J000	B44066D1499*481	B44066S9910J230	95	200
690 V – 50 Hz						
5.67	12.5	1× B25675C8152J000	B44066D5012*690	B44066S1810J230	4	25
5.67	20	1× B25675C8252J000	B44066D5020*690	B44066S1810J230	10	50
5.67	25	1× B25675C8302J000	B44066D5025*690	B44066S2410J230	16	63
5.67	40	2× B25675C8252J000	B44066D5040*690	B44066S3210J230	35	100
5.67	50	2× B25675C8302J000	B44066D5050*690	B44066S5010J230	50	125
5.67	75	3× B25675C8302J000	B44066D5075*690	B44066S6210J230	70	160
5.67	100	4× B25675C8302J000	B44066D5100*690	B44066S7410J230	95	200
7	12.5	1× B25675C8152J000	B44066D7012*690	B44066S1810J230	4	25
7	20	1× B25675C8252J000	B44066D7020*690	B44066S1810J230	10	50
7	25	1× B25675C8302J000	B44066D7025*690	B44066S2410J230	16	63
7	40	2× B25675C8252J000	B44066D7040*690	B44066S3210J230	35	100
7	50	2× B25675C8302J000	B44066D7050*690	B44066S5010J230	50	125
7	75	3× B25675C8302J000	B44066D7075*690	B44066S6210J230	70	160
7	100	4× B25675C8302J000	B44066D7100*690	B44066S7410J230	95	200
14	12.5	1× B25675C9202J000	B44066D1412*690	B44066S1810J230	4	25
14	20	1× B25675C9302J000	B44066D1420*690	B44066S1810J230	10	50
14	25	1× B25675C0202J000 1× B25675C0252J000	B44066D1425*690	B44066S2410J230	16	63
14	40	2× B25675C9302J000	B44066D1440*690	B44066S3210J230	35	100
14	50	3× B25675C0302J000	B44066D1450*690	B44066S5010J230	50	125
14	75	1× B25675C9202J000 3× B25675C9302J000	B44066D1475*690	B44066S6210J230	70	160
14	100	6× B25675C0302J000	B44066D1499*690	B44066S7410J230	95	200

Component Selection Tables for Detuned PFC

Selection table

Detuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Contactor ordering code	Cable cross-section mm²	Fuse rating A
690 V – 60 Hz						
5.67	12.5	1× B25675C0202J000	B44066D5012*691	B44066S1810J230	4	25
5.67	20	1× B25675C9252J000 1× B25674A8122A500	B44066D5020*691	B44066S1810J230	10	50
5.67	25	2× B25675C0202J000	B44066D5025*691	B44066S2410J230	16	63
5.67	40	2× B25675C8202J000	B44066D5040*691	B44066S3210J230	35	100
5.67	50	1× B25675C8152J000 1× B25675C8252J000	B44066D5050*691	B44066S5010J230	50	125
5.67	75	4× B25675C8202J000	B44066D5075*691	B44066S6210J230	70	160
5.67	100	4× B25675C8202J000 1× B25675C8252J000	B44066D5100*691	B44066S7410J230	95	200
7	12.5	1× B25675C0202J000	B44066D5012*691	B44066S1810J230	4	25
7	20	1× B25675C9252J000 1× B25674A8122A500	B44066D5020*691	B44066S1810J230	10	50
7	25	2× B25675C0202J000	B44066D5025*691	B44066S2410J230	16	63
7	40	2× B25675C8202J000	B44066D5040*691	B44066S3210J230	35	100
7	50	1× B25675C8152J000 1× B25675C8252J000	B44066D5050*691	B44066S5010J230	50	125
7	75	4× B25675C8202J000	B44066D5075*691	B44066S6210J230	70	160
7	100	4× B25675C8202J000 1× B25675C8252J000	B44066D5100*691	B44066S7410J230	95	200
14	12.5	1× B25675C9152J000	B44066D5012*691	B44066S1810J230	4	25
14	20	1× B25675C9252J000	B44066D5020*691	B44066S1810J230	10	50
14	25	2× B25675C9152J000	B44066D5025*691	B44066S2410J230	16	63
14	40	2× B25675C9252J000	B44066D5040*691	B44066S3210J230	35	100
14	50	4× B25675C9152J000	B44066D5050*691	B44066S5010J230	50	125
14	75	1× B25675C0152J000 4× B25675C0252J000	B44066D5075*691	B44066S6210J230	70	160
14	100	6× B25675C0252J000	B44066D5100*691	B44066S7410J230	95	200

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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Dynamic PFC: Important Facts and Instructions

General

Conventional PFC systems quickly reach their limits when they have to deal with fast changing loads. Applications like rolling mills, steel presses, wind turbines, container cranes and large buildings include a huge amount of electric consumers that require a reactive power adjustment on the ms scale. Production equipment, elevators, chillers, and other electric devices not only require such dynamic reactions of the power factor compensation equipment, they also lead very soon to a total number of switchings that exceeds the specifications of standard electromechanical contactors by far.

In conventional PFC systems, standard capacitor contactors are used to switch capacitor steps on and off. These electromechanical devices offer between 100 000 and 200 000 switching operations in total during their life time which means that in such an application they reach their life expectancy after 1 to 2 years already. It has to be mentioned that capacitors are much stricter limited with regard to the permitted annual number of switching operations (IEC 60831). This typically results in destruction of their inrush current damping capability and may also damage the contacts in the main power circuit. Burnt main contacts may produce oscillation or “unclean” (re-bouncing) switching operations. This massive overload not only shortens the life expectancy of the capacitor, but also increases the risk of premature failure and in the worst case represents a potential safety risk.

But furthermore the capacitor itself is specified for a limited number of switching operations per year. The standard IEC 60831 gives an acceptable value of 5000 switching operations per year, a value far below switching numbers up to 100 000 that may be required per year in dynamic applications. Such large switching numbers and the respective overvoltages and overcurrents during each switching operation are likely to damage the capacitor and may lead to a very early capacitor failure.

In dynamic PFC systems, the capacitor contactors are replaced by thyristor modules that are suitable for a nearby unlimited number of switching operations as there is no mechanical wear-off. Thyristor modules feature electronic semiconductor switches that are able to react to a changing reactive power demand on the ms scale and that can switch capacitors without additional stress. The TSM-thyristor switches keep the capacitors at the peak value of the grid voltage and connect them only when the grid reaches this peak voltage value. Thus the capacitors are switched current free and inrush currents that can reach values of 200 times the nominal current for conventional contactors are avoided. Additionally, capacitor discharge times up to 75 s as necessary for conventional PFC are not required here.

In summary dynamic PFC does not only prevent wear-off of the capacitors and the switches and increases thus the lifetime of a PFC system and its safety. It also increases the power quality in the grid essentially as it can almost react in real time to reactive power demands. Fast enough for example, to take care of motor start up effects or spot welding requirements.

TDK offers all necessary key components to set up a dynamic PFC systems as the thyristor modules (TSM, see page 70), the required fast transistor output controllers (BR6000-T, page 58ff), standard reactor (page 74) and of course capacitor series (page 17ff). A further help to compose such a system for a large number of situations is given by the dynamic PFC selection tables on page 132ff.

Note:

The recommendations given in the selection tables are meant as a support tool. TDK does not take over any responsibility for the design as apart from the theoretical conditions the prevailing circumstances in the application have to be taken into account.

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Component Selection Tables for Dynamic PFC

Component selection table for dynamic LV PFC antiresonance filter circuits

De-tuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Thyristor module ordering code	Discharge resistor ordering code	Cable cross-section mm²	Fuse rating A
400 V – 50 Hz							
5.67	10	1× B25675C5162J725	1× B44066D5010*400	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	12.5	1× B25675C5202J025	1× B44066D5012*400	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	20	1× B25675C5332J125	1× B44066D5020*400	1× B44066T3850E402	1× B44066T0022E400	10	50
5.67	25	2× B25675C5202J025	1× B44066D5025*400	1× B44066T3850E402	1× B44066T0022E400	16	63
5.67	40	2× B25675C5332J125	1× B44066D5040*400	1× B44066T3850E402	1× B44066T0022E400	35	100
5.67	50	3× B25675C5282J125	1× B44066D5050*400	1× B44066T3850E402	1× B44066T0022E400	50	125
5.67	75	4× B25675C5302J025	1× B44066D5075*400	1× B44066T0100E402	1× B44066T0022E400	70	160
5.67	100	5× B25675C5332J125	1× B44066D5100*400	1× B44066T0100E402	1× B44066T0022E400	120	250
7	10	1× B25675C5162J725	1× B44066D7010*400	1× B44066T0010E402	1× B44066T0022E400	10	35
7	12.5	1× B25675C5202J025	1× B44066D7012*400	1× B44066T0010E402	1× B44066T0022E400	10	35
7	20	1× B25675C5332J125	1× B44066D7020*400	1× B44066T3850E402	1× B44066T0022E400	10	50
7	25	2× B25675C5202J025	1× B44066D7025*400	1× B44066T3850E402	1× B44066T0022E400	16	63
7	40	2× B25675C5332J125	1× B44066D7040*400	1× B44066T3850E402	1× B44066T0022E400	35	100
7	50	3× B25675C5262J525	1× B44066D7050*400	1× B44066T3850E402	1× B44066T0022E400	50	125
7	75	4× B25675C5302J025	1× B44066D7075*400	1× B44066T0100E402	1× B44066T0022E400	70	160
7	100	5× B25675C5332J125	1× B44066D7100*400	1× B44066T0100E402	1× B44066T0022E400	125	250
14	10	1× B25675C5152J025	1× B44066D1410*400	1× B44066T0010E402	1× B44066T0022E400	10	35
14	12.5	1× B25675C6252J000	1× B44066D1412*400	1× B44066T0010E402	1× B44066T0022E400	10	35
14	20	1× B25675C5302J025	1× B44066D1420*400	1× B44066T3850E402	1× B44066T0022E400	10	50
14	25	1× B25675C5162J725 1× B25675C5202J025	1× B44066D1425*400	1× B44066T3850E402	1× B44066T0022E400	16	63
14	40	2× B25675C5302J025	1× B44066D1440*400	1× B44066T3850E402	1× B44066T0022E400	35	100
14	50	3× B25675C5252J025	1× B44066D1450*400	1× B44066T3850E402	1× B44066T0022E400	50	125
14	75	4× B25675C5282J125	1× B44066D1475*400	1× B44066T0100E402	1× B44066T0022E400	70	160
14	100	5× B25675C5302J025	1× B44066D1499*400	1× B44066T0100E402	1× B44066T0022E400	125	250
400 V – 60 Hz							
5.67	10	1× B25675C5132J225	1× B44066D5010*401	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	12.5	1× B25675C5162J725	1× B44066D5012*401	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	20	1× B25675C5262J525	1× B44066D5020*401	1× B44066T3850E402	1× B44066T0022E400	10	50
5.67	25	2× B25675C5162J725	1× B44066D5025*401	1× B44066T3850E402	1× B44066T0022E400	16	63
5.67	40	2× B25675C5262J525	1× B44066D5040*401	1× B44066T3850E402	1× B44066T0022E400	35	100
5.67	50	2× B25675C5202J825 1× B25675C5252J025	1× B44066D5050*401	1× B44066T3850E402	1× B44066T0022E400	50	125
5.67	75	4× B25675C5252J025	1× B44066D5075*401	1× B44066T0100E402	1× B44066T0022E400	70	160
5.67	100	5× B25675C5262J525	1× B44066D5100*401	1× B44066T0100E402	2× B44066T0022E400	120	250
7	10	1× B25675C5132J225	1× B44066D7010*401	1× B44066T0010E402	1× B44066T0022E400	10	35
7	12.5	1× B25675C5162J725	1× B44066D7012*401	1× B44066T0010E402	1× B44066T0022E400	10	35
7	20	1× B25675C5262J525	1× B44066D7020*401	1× B44066T3850E402	1× B44066T0022E400	10	50
7	25	2× B25675C5162J725	1× B44066D7025*401	1× B44066T3850E402	1× B44066T0022E400	16	63
7	40	2× B25675C5262J525	1× B44066D7040*401	1× B44066T3850E402	1× B44066T0022E400	35	100
7	50	2× B25675C5202J825 1× B25675C5252J025	1× B44066D7050*401	1× B44066T3850E402	1× B44066T0022E400	50	125
7	75	4× B25675C5252J025	1× B44066D7075*401	1× B44066T0100E402	1× B44066T0022E400	70	160
7	100	5× B25675C5262J525	1× B44066D7100*401	1× B44066T0100E402	2× B44066T0022E400	120	250

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Component Selection Tables for Dynamic PFC

Component selection table for dynamic LV PFC antiresonance filter circuits

De-tuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Thyristor module ordering code	Discharge resistor ordering code	Cable cross-section mm²	Fuse rating A
400 V – 60 Hz							
14	10	1× B25675C5122J525	1× B44066D1410*401	1× B44066T0010E402	1× B44066T0022E400	10	35
14	12.5	1× B25675C5152J025	1× B44066D1412*401	1× B44066T0010E402	1× B44066T0022E400	10	35
14	20	1× B25675C5252J025	1× B44066D1420*401	1× B44066T3850E402	1× B44066T0022E400	10	50
14	25	2× B25675C5152J025	1× B44066D1425*401	1× B44066T3850E402	1× B44066T0022E400	16	63
14	40	2× B25675C5252J025	1× B44066D1440*401	1× B44066T3850E402	1× B44066T0022E400	35	100
14	50	3× B25675C5202J825	1× B44066D1450*401	1× B44066T3850E402	1× B44066T0022E400	50	125
14	75	2× B25675C5202J825 2× B25675C5252J025	1× B44066D1475*401	1× B44066T0100E402	1× B44066T0022E400	70	160
14	100	5× B25675C5252J025	1× B44066D1499*401	1× B44066T0100E402	1× B44066T0022E400	120	250
440 V – 50 Hz							
5.67	10	1× B25675C5132J225	1× B44066D5010*440	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	12.5	1× B25675C5162J725	1× B44066D5012*440	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	20	1× B25675C5262J525	1× B44066D5020*440	1× B44066T3850E402	1× B44066T0022E400	10	50
5.67	25	1× B25675C5332J125	1× B44066D5025*440	1× B44066T3850E402	1× B44066T0022E400	16	63
5.67	40	2× B25675C5262J525	1× B44066D5040*440	1× B44066T3850E402	1× B44066T0022E400	35	100
5.67	50	2× B25675C5332J125	1× B44066D5050*440	1× B44066T3850E402	1× B44066T0022E400	50	125
5.67	75	3× B25675C5332J125	1× B44066D5075*440	1× B44066T0100E402	1× B44066T0022E400	70	160
5.67	100	4× B25675C5332J125	1× B44066D5100*440	1× B44066T0100E402	1× B44066T0022E400	120	250
7	10	1× B25675C5132J225	1× B44066D7010*440	1× B44066T0010E402	1× B44066T0022E400	10	35
7	12.5	1× B25675C5162J725	1× B44066D7012*440	1× B44066T0010E402	1× B44066T0022E400	10	35
7	20	1× B25675C5262J525	1× B44066D7020*440	1× B44066T3850E402	1× B44066T0022E400	10	50
7	25	1× B25675C5332J125	1× B44066D7025*440	1× B44066T3850E402	1× B44066T0022E400	16	63
7	40	2× B25675C5262J525	1× B44066D7040*440	1× B44066T3850E402	1× B44066T0022E400	35	100
7	50	2× B25675C5332J125	1× B44066D7050*440	1× B44066T3850E402	1× B44066T0022E400	50	125
7	75	3× B25675C5332J125	1× B44066D7075*440	1× B44066T0100E402	1× B44066T0022E400	70	160
7	100	4× B25675C5332J125	1× B44066D7100*440	1× B44066T0100E402	1× B44066T0022E400	120	250
440 V – 60 Hz							
5.67	10	1× B25675C6132J900	1× B44066D5010*441	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	12.5	1× B25675C5132J225	1× B44066D5012*441	1× B44066T0010E402	1× B44066T0022E400	10	35
5.67	20	1× B25675C5102J425 1× B25675C5122J525	1× B44066D5020*441	1× B44066T3850E402	1× B44066T0022E400	10	50
5.67	25	1× B25675C5122J525 1× B25675C5152J025	1× B44066D5025*441	1× B44066T3850E402	1× B44066T0022E400	16	63
5.67	40	1× B25675C5202J825 1× B25675C5252J025	1× B44066D5040*441	1× B44066T3850E402	1× B44066T0022E400	35	100
5.67	50	1× B25675C5162J725 2× B25675C5202J025	1× B44066D5050*441	1× B44066T3850E402	1× B44066T0022E400	50	125
5.67	75	4× B25675C5202J825	1× B44066D5075*441	1× B44066T0100E402	1× B44066T0022E400	70	160
5.67	100	1× B25675C5122J525 4× B25675C5252J025	1× B44066D5100*441	1× B44066T0100E402	1× B44066T0022E400	120	250
7	10	1× B25675C6132J900	1× B44066D7010*441	1× B44066T0010E402	1× B44066T0022E400	10	35
7	12.5	1× B25675C5132J225	1× B44066D7012*441	1× B44066T0010E402	1× B44066T0022E400	10	35
7	20	1× B25675C5102J425 1× B25675C5122J525	1× B44066D7020*441	1× B44066T3850E402	1× B44066T0022E400	10	50
7	25	1× B25675C5262J525	1× B44066D7025*441	1× B44066T3850E402	1× B44066T0022E400	16	63
7	40	1× B25675C5202J025 1× B25675C5252J025	1× B44066D7040*441	1× B44066T3850E402	1× B44066T0022E400	35	100
7	50	2× B25675C5262J525	1× B44066D7050*441	1× B44066T3850E402	1× B44066T0022E400	50	125
7	75	4× B25675C5202J825	1× B44066D7075*441	1× B44066T0100E402	1× B44066T0022E400	70	160
7	100	4× B25675C5262J525	1× B44066D7100*441	1× B44066T0100E402	1× B44066T0022E400	120	250

Component Selection Tables for Dynamic PFC

Component selection table for dynamic LV PFC antiresonance filter circuits

De-tuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Thyristor module ordering code	Discharge resistor ordering code	Cable cross-section mm²	Fuse rating A
690 V – 50 Hz							
5.67	12.5	1× B25675C8152J000	1× B44066D5012*690	1× B44066T3050E690	2× B44066T0022E400	2.5	16
5.67	20	1× B25675C8252J000	1× B44066D5020*690	1× B44066T3050E690	2× B44066T0022E400	4	25
5.67	25	1× B25675C8302J000	1× B44066D5025*690	1× B44066T3050E690	2× B44066T0022E400	6	35
5.67	40	2× B25675C8252J000	1× B44066D5040*690	1× B44066T3050E690	2× B44066T0022E400	16	63
5.67	50	2× B25675C8302J000	1× B44066D5050*690	1× B44066T3050E690	2× B44066T0022E400	25	80
5.67	75	3× B25675C8302J000	1× B44066D5075*690	1× B44066T3050E690	2× B44066T0022E400	50	125
5.67	100	4× B25675C8302J000	2× B44066D5050*690	2× B44066T3050E690	4× B44066T0022E400	25	80
7	12.5	1× B25675C8152J000	1× B44066D7012*690	1× B44066T3050E690	2× B44066T0022E400	2.5	16
7	20	1× B25675C8252J000	1× B44066D7020*690	1× B44066T3050E690	2× B44066T0022E400	4	25
7	25	1× B25675C8302J000	1× B44066D7025*690	1× B44066T3050E690	2× B44066T0022E400	6	35
7	40	2× B25675C8252J000	1× B44066D7040*690	1× B44066T3050E690	2× B44066T0022E400	16	63
7	50	2× B25675C8302J000	1× B44066D7050*690	1× B44066T3050E690	2× B44066T0022E400	25	80
7	75	3× B25675C8302J000	1× B44066D7075*690	1× B44066T3050E690	2× B44066T0022E400	50	125
7	100	4× B25675C8302J000	2× B44066D7050*690	2× B44066T3050E690	4× B44066T0022E400	25	80
14	12.5	1× B25675C9202J000	1× B44066D1412*690	1× B44066T3050E690	2× B44066T0022E400	2.5	16
14	20	1× B25675C9302J000	1× B44066D1420*690	1× B44066T3050E690	2× B44066T0022E400	4	25
14	25	1× B25675C0202J000 1× B25675C0252J000	1× B44066D1425*690	1× B44066T3050E690	2× B44066T0022E400	6	35
14	40	2× B25675C9302J000	1× B44066D1440*690	1× B44066T3050E690	2× B44066T0022E400	16	63
14	50	3× B25675C0302J000	1× B44066D1450*690	1× B44066T3050E690	2× B44066T0022E400	25	80
14	75	1× B25675C9202J000 3× B25675C9302J000	1× B44066D1475*690	1× B44066T3050E690	2× B44066T0022E400	50	125
14	100	6× B25675C0302J000	2× B44066D1450*690	2× B44066T3050E690	4× B44066T0022E400	25	80

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Component Selection Tables for Dynamic PFC

Component selection table for dynamic LV PFC antiresonance filter circuits

De-tuning factor %	Effective filter output kvar	Capacitor ordering code	Reactor ordering code	Thyristor module ordering code	Discharge resistor ordering code	Cable cross-section mm²	Fuse rating A
690 V – 60 Hz							
5.67	12.5	1× B25675C0202J000	1× B44066D5012*691	1× B44066T3050E690	2× B44066T0022E400	2.5	16
5.67	20	1× B25675C9252J000 1× B25674A8122A500	1× B44066D5020*691	1× B44066T3050E690	2× B44066T0022E400	4	25
5.67	25	2× B25675C0202J000	1× B44066D5025*691	1× B44066T3050E690	2× B44066T0022E400	6	35
5.67	40	2× B25675C8202J000	1× B44066D5040*691	1× B44066T3050E690	2× B44066T0022E400	16	63
5.67	50	1× B25675C8152J000 1× B25675C8252J000	1× B44066D5050*691	1× B44066T3050E690	2× B44066T0022E400	25	80
5.67	75	4× B25675C8202J000	1× B44066D5075*691	1× B44066T3050E690	2× B44066T0022E400	50	125
5.67	100	4× B25675C8202J000 1× B25675C8252J000	2× B44066D5050*691	2× B44066T3050E690	4× B44066T0022E400	25	80
7	12.5	1× B25675C0202J000	1× B44066D7012*691	1× B44066T3050E690	2× B44066T0022E400	2.5	16
7	20	1× B25675C9252J000 1× B25674A8122A500	1× B44066D7020*691	1× B44066T3050E690	2× B44066T0022E400	4	25
7	25	2× B25675C0202J000	1× B44066D7025*691	1× B44066T3050E690	2× B44066T0022E400	6	35
7	40	2× B25675C8202J000	1× B44066D7040*691	1× B44066T3050E690	2× B44066T0022E400	16	63
7	50	1× B25675C8152J000 1× B25675C8252J000	1× B44066D7050*691	1× B44066T3050E690	2× B44066T0022E400	25	80
7	75	4× B25675C8202J000	1× B44066D7075*691	1× B44066T3050E690	2× B44066T0022E400	50	125
7	100	4× B25675C8202J000 1× B25675C8252J000	2× B44066D7050*691	2× B44066T3050E690	4× B44066T0022E400	25	80
14	12.5	1× B25675C9152J000	1× B44066D1412*691	1× B44066T3050E690	2× B44066T0022E400	2.5	16
14	20	1× B25675C9252J000	1× B44066D1420*691	1× B44066T3050E690	2× B44066T0022E400	4	25
14	25	2× B25675C9152J000	1× B44066D1425*691	1× B44066T3050E690	2× B44066T0022E400	6	35
14	40	2× B25675C9252J000	1× B44066D1440*691	1× B44066T3050E690	2× B44066T0022E400	16	63
14	50	4× B25675C9152J000	1× B44066D1450*691	1× B44066T3050E690	2× B44066T0022E400	25	80
14	75	1× B25675C0152J000 4× B25675C0252J000	1× B44066D1475*691	1× B44066T3050E690	2× B44066T0022E400	50	125
14	100	6× B25675C0252J000	2× B44066D1450*691	2× B44066T3050E690	4× B44066T0022E400	25	80

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PFC Basic Formulas

The following electrical formulas may be used to calculate basic PFC values.

Active power

The amount of input power converted to output power is the active power.

$$P = \sqrt{3} \cdot V \cdot I \cdot \cos \varphi \quad [W]$$

Formula 1

Reactive power

The reactive power is the power consumed in an AC circuit due to the expansion and collapse of magnetic (inductive) and electrostatic (capacitive) fields.

$$Q = \sqrt{3} \cdot V \cdot I \cdot \sin \varphi \quad [var]$$

Formula 2

Apparent Power

The apparent power is the power delivered to an electric circuit.

$$S = \sqrt{3} \cdot V \cdot I \quad [VA]$$

Formula 3

Power factor

The power factor of an AC electrical power system is defined as the ratio of the real (active) power to the apparent power.

$$\text{Power factor} = \frac{\text{Active power}}{\text{Apparent power}} = \frac{P}{S}$$

Formula 4

Power Factor Correction

When the AC load is partly capacitive or inductive, the current waveform is out of phase with the voltage. This requires additional AC current to be generated that is not consumed by the load, creating I^2R losses in power cables. Capacitors are used to supply reactive energy to inductive loads. Reactive energy must be produced as closely as possible to the loads to prevent unnecessary flow of current in the network. This is known as power factor correction.

$$Q_C = P \cdot (\tan \varphi_1 - \tan \varphi_2) \quad [var]$$

Formula 5

Q_C: reactive power needed
P: total active power
φ_1: actual angle of cos φ actual
φ_2: target angle of cos φ target

Connection and rating of capacitors

The reactive power of the capacitor is a function of its rated voltage and current.

$$Q_C = V_C \cdot I_C \quad [var]$$

Formula 6

$$Q_C = \frac{V_C \cdot V_C}{X_C} = \frac{(V_C)^2}{X_C}$$

Formula 7

$$X_C = \frac{1}{\omega \cdot C} = \frac{1}{2\pi \cdot f \cdot C}$$

Formula 8

f: frequency of network
X_C: impedance of capacitor
C: capacitance value

Formula (7) and (8) together

$$Q_C = (V_C)^2 \cdot \omega \cdot C = (V_C)^2 \cdot 2\pi \cdot f \cdot C$$

Formula 9

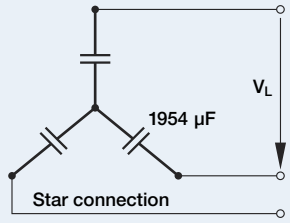
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PFC Basic Formulas

Capacitor in three-phase PFC application

Three-phase PFC applications have two types of capacitor connections: star and delta.

- STAR connection



$$Q_{TOT} = 3 \cdot Q_C$$

Formula 10

$$V_C = V_L / \sqrt{3}$$

Formula 11

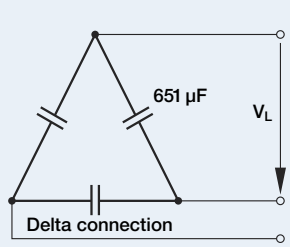
From formulas (9), (10) and (11)

$$Q_{TOT} = 3 \cdot \frac{(V_L)^2}{(\sqrt{3})^2} \cdot \omega \cdot C_{STAR}$$

$$C_{STAR} = \frac{Q_{TOT}}{(V_L)^2 \cdot \omega} = \frac{Q_{TOT}}{(V_L)^2 \cdot 2\pi \cdot f}$$

Formula 12

- DELTA connection



$$V_C = V_L$$

Formula 13

From formulas (9), (10) and (13)

$$Q_{TOT} = 3 \cdot (V_L)^2 \cdot \omega \cdot C_{DELTA}$$

$$C_{DELTA} = \frac{Q_{TOT}}{3 \cdot (V_L)^2 \cdot \omega} = \frac{Q_{TOT}}{3 \cdot (V_L)^2 \cdot 2\pi \cdot f}$$

Formula 14

As a conclusion formula (12) and (14)

$$C_{DELTA} = \frac{C_{STAR}}{3}$$

Formula 15

Capacitor output kvar:

From the formula (9), if we find the Q_{new} with ratio:
C will be constant

$$Q_{New} = \left(\frac{V_{New}}{V_C}\right)^2 \cdot \frac{f_{New}}{f_R} \cdot Q_C$$

Formula 16

These values are operating conditions:

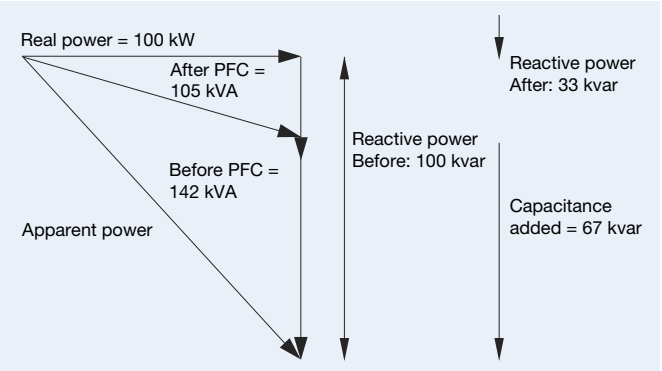
Q_{new}: new reactive power
V_{new}: new voltage
f_{new}: new frequency

These values are the values capacitor is designed:
Q_C: rated capacitor reactive power
V_C: rated capacitor voltage
f_R: rated frequency

Calculation examples

Example 1:
The relationship between active, reactive and real power and cos φ.

In the diagram below, the power triangle shows an initial power factor of 0.70 for a 100 kW (real power) inductive load. The reactive power required by the load is 100 kvar. By installing a 67-kvar capacitor, the apparent power is reduced from 142 to 105 kvar, resulting in a 26% reduction in current. The power factor is improved to 0.95.



Formulas used (1), (2), (3) and (4).

Power factor calculations:
Before PFC: 100/142 = 0.70 or 70%
After PFC: 100/105 = 0.95 or 95%

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PFC Basic Formulas

Example 2:
Calculation of capacitor rating for industrial installation

- Given parameters:

Induction motor	220 kW
Network (line delta)	440 V AC, three-phase
Frequency	50 Hz
Power factor	
– Current cos φ	0.7
– Target cos φ	0.9

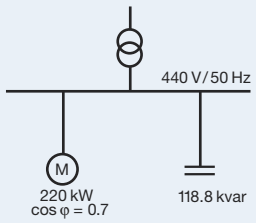
Target to correct the power factor to 0.9:

$\cos \varphi 1 = 0.7 \qquad \tan \varphi 1 = 1.02$

$\cos \varphi 2 = 0.9 \qquad \tan \varphi 2 = 0.48$

$Q_C = P (\tan \varphi 1 - \tan \varphi 2)$

$= 220 \cdot 1000 (1.02 - 0.48) = 118.8 \text{ kvar}$



Example 3:
Calculating capacitor ratings for DELTA and STAR connections in example 2

- STAR connection:

$$V_C = \frac{V_L}{\sqrt{3}} = \frac{440}{\sqrt{3}} = 254 \text{ V}$$

$$C_{STAR} = \frac{Q_{TOT}}{(V_L)^2 \cdot \omega} = \frac{Q_{TOT}}{(V_L)^2 \cdot 2\pi \cdot f}$$

$$C_{STAR} = \frac{118.8 \cdot 1000}{(440)^2 \cdot 2\pi \cdot 50} = 1\,954 \text{ µF / Line (phase)}$$

$C_{TOT} = 5862$ µF

- DELTA connection:

$V_C = V_L = 440$ V

$$C_{DELTA} = \frac{Q_{TOT}}{3 \cdot (V_L)^2 \cdot \omega} = \frac{Q_{TOT}}{3 \cdot (V_L)^2 \cdot 2\pi \cdot f}$$

$$C_{DELTA} = \frac{118.8 \cdot 1000}{3 \cdot (440)^2 \cdot 2\pi \cdot 50} = 651 \text{ µF / Line (phase)}$$

$C_{TOT} = 1954$ µF

Example 4:
Calculating apparent power reduction (S1–S2) in example 2

$S_1 = P / \cos \varphi 1 = 220 / 0.7$
$= 314$ kVA

$S_2 = P / \cos \varphi 2 = 220 / 0.9$
$= 244$ kVA

$S_1 - S_2 = 70$ kVA

Thus, additional power of
$70 \cdot (0.9) = 63$ kW can be supplied and transferred via the existing network.

Cable cross section calculation

Line current drawn by the motor:

I_1 uncompensated load (0.7):

$$I_1 = \frac{220 \cdot 1000}{\sqrt{3} \cdot 440 \cdot (0.7)} = 412 \text{ A}$$

I_2 compensated load (0.9):

$$I_2 = \frac{220 \cdot 1000}{\sqrt{3} \cdot 440 \cdot (0.9)} = 320 \text{ A}$$

Thus, the cable can carry an additional load of 92 A, or the designer can reduce the cable cross section.

Please read *Important notes* on page 16 and *Cautions* on page 145 – 150.
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Cautions

Temperature class of capacitors (according IEC 60831-1)			
Temperature class	**Temperature of capacitor surrounding air**		
	Maximum	**Maximum mean for 24 h**	**Maximum mean for 1 year**
B	+45 °C	+35 °C	+25 °C
C	+50 °C	+40 °C	+30 °C
D	+55 °C	+45 °C	+35 °C

Enclosure of capacitors (IPxx)		
Enclosure	**First digit**	**Second digit**
IP00	No protection against finger touch and ingress of solid foreign bodies	No protection against ingress of water
IP20	Protection against finger touch and solid foreign bodies ≥12.5 mm diameter	No protection against ingress of water
IP41	Protection against tool touch and solid foreign bodies ≥1 mm diameter	Drip-water protection
IP54	Protection against tool touch and solid foreign bodies ≥1 mm diameter, protection against dust deposit	Splash water protection

Maximum admissible overvoltage			
Frequency (50 / 60 Hz)	**Max. voltage (V_{RMS})**	**Max. duration**	**Remarks**
Line frequency	1.00 · V_N	Continuous duty	Highest mean during entire operating time of capacitor; exceptions (see below) are admissible for times of <24 h
Line frequency	1.10 · V_N	8 h daily	Line voltage fluctuations
Line frequency	1.15 · V_N	30 min daily	Line voltage fluctuations
Line frequency	1.20 · V_N	5 min daily	Line voltage fluctuations
Line frequency	1.30 · V_N	1 min daily	Line voltage fluctuations
Line frequency with harmonics	Such that current does not exceed maximum admissible figure ($I_{max.}$ = 1.3 · I_N)		

Temperature class of capacitors to standard IEC 60831-1

Capacitors are divided into temperature classes. Each class is represented by a number followed by a letter, e.g. –40/D. The number is the lowest ambient temperature at which a capacitor may operate. The upper limit temperature is indicated by the letter (see table above).

The useful life of a capacitor depends very much on temperature. Proper cooling of a capacitor must ensure that the maximum temperature is not exceeded, otherwise useful life is degraded. When configuring a circuit, one should make sure that capacitors are not subjected to heat from adjacent components (reactors, bus bars, etc). Forced cooling is preferable for compact designs. And it is highly inadvisable to arrange capacitors directly above reactors. Exceeding specified temperature limits may set in worst case the safety device out of operation.

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Cautions

Enclosure of capacitors (IPxx)

For different models there are different types of enclosure. The type of enclosure is indicated by a designation consisting of the two letters IP followed by two digits.

Current rating / maximum admissible overcurrent

The rated current (I_N) is the current resulting for rated voltage (V_N) and frequency (in Hz), excluding transients. Maximum permitted RMS current for each particular capacitor is specified in the data sheet. Continuously exceeding of the nominal current will lead to increased self-heating of the capacitor and reduce life time. The maximum admissible overcurrent (I_{max}) of 1.3 · I_N to IEC 60831 standard is maintained or overachieved by all capacitors in this catalog. The figures for overcurrent allow for the combined effects of harmonics, overvoltage and capacitance tolerance.

Maximum admissible overvoltage

Capacitors from TDK are suitable for operation on overvoltages quoted by IEC 60831 (see table). Overvoltages higher than 1.15 · V_N reduce life time of the capacitor and must not occur more than 200 times during life time of capacitor. Overvoltages above 1.3 · V_N must not occur at all, appropriate overvoltage protection (e.g. against lightning strikes) must be ensured.

Mean life expectancy

The mean life expectancy of power capacitors is mainly governed by the following factors:

- duration of overload,
- ambient temperature and the resulting case temperature,
- maximum RMS current and the resulting case temperature,
- voltage height and duration.

The calculated life expectancy of the various series is stated for nominal operating conditions. If components are stressed less than the IEC 60831 factors, longer useful life can be expected, and a correspondingly shorter one or increased failure rate if nominal parameters are exceeded.

Fuse protection

Power capacitors have to be protected against short circuits by fuses or thermal magnetic overcurrent relays. Slow-blow, low-voltage high-breaking-capacity fuses (HRC) are preferable. The fuse rating should be 1.6 to 1.8 times the rated current of the capacitor. Magnetic short circuit relays should be set to between 9 and 12 times rated current to prevent them responding to high inrush currents. Maximum allowed fault current of 10 000 A in accordance with UL 810 standard must be ensured by the application design.

⚠ HRC fuses must not be used for switching.

Resulting electric arcing can cause death!
It may also cause capacitor failures, and result, worst case, in capacitor bursting and fire.

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Cautions

Switching of capacitors

When a capacitor is switched to an AC system, the result is a resonant circuit damped to a greater or lesser degree. In addition to the rated current, the capacitor accepts a transient current that is a multiple of (up to 200 times) its rated current. Fast switching, low-bounce contactors should be used, and have the switching capacity for capacitive currents stated by the producer. Special capacitor contactors with leading contacts that feature precharging resistors to damp inrush currents are recommended. As per IEC 60831 standard, a maximum of 5000 switching operations per year is acceptable. Before considering a higher number of switching operations, please contact our sales office.

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 useful life in PFC systems, and protects against electric shock. The capacitor must be discharged to 75 V or less within 3 min. There must not be any switch, fuse or any other disconnecting device in the circuit between the power capacitor and the discharging device. TDK supplies capacitor discharge resistors to all series, alternatively discharge reactors are available.

⚠ Caution:

Discharge and short circuit capacitor before handling!

Capacitors in networks with harmonics

Harmonics are produced in the operation of electric loads with a nonlinear voltage / current characteristic (e.g. rectifiers and inverters for drives, welding apparatus and uninterruptible power supplies). Harmonics are sinusoidal voltages and currents with higher frequencies of a multiple of the 50 or 60 Hz line frequency. In low-voltage three-phase systems the 5^{th} and 7^{th} harmonics are especially troublesome. Detuned PFC should be used in systems subject to harmonics. This represents a series resonant circuit of power capacitor and reactor. The circuit is tuned so that the series resonant frequency is below the lowest harmonics appearing in the system. This produces an inductive response to all frequencies above the series resonant frequency, avoiding resonances with system inductances. Depending on the selected series resonant frequency, part of the harmonic current is taken up by the detuned PFC system. The remainder of the harmonic current flows into the superordinate system. The use of detuned PFC thus contributes to reducing voltage distortion through harmonics and lessens the disturbing effect on proper operation of other electric loads.

Most international standards limit THD-V on LV side to 5%. However it has to be noted that in many grids these levels are exceeded and even lower distortion, e.g. 3 to 4% THD-V can generate extreme overcurrents in case of resonance condition.

Maximum overcurrents as specified under technical data of each series must not be exceeded.

Resonance must be avoided by appropriate panel design. Resonance may cause very high overcurrents which can lead to capacitor failures, and worst case, to explosion and fire.

Cautions

Mechanical damage

In case of dents or any other mechanical damage, capacitors must not be used at all.

Vibration resistance

The resistance to vibration of capacitors corresponds to IEC 68, part 2 to 6.

Max. test conditions:

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

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.

Connection

Make sure connection cables are of flexible type or flexible copper bands are used. This is mandatory to allow the overpressure disconnector work and avoid mechanical stress on the terminals and feedthroughs.

The connection cables to the capacitor should be designed for a current of at least 1.5 times the rated current so that no heat is conducted into the capacitor. If reactors are used in an application, the distance between reactor and capacitor must be great enough so that no heat of the reactors, which are operating at a much higher temperature level, is conducted via connection cable to the capacitors.

Avoid bending cable lugs, cables or other mechanical force on the terminals. Otherwise leakages may set the safety device out of operation.

Ensure firm fixing of terminals, fixing torque to be applied as per individual specification.

Maximum specified terminal current (please refer to technical data of specific series) must not be exceeded at any case.

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.

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.

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Cautions

Installation

Specifications like IEC 61921, VDE 0100, VDE 0101, VDE 0560 part 4 and 46, EN 60831 and IEC 60831 apply to the installation and operation of power capacitors. Capacitors should be sited in cool and well ventilated locations away from other heat-radiating elements. Natural heat dissipation is generally sufficient for cooling purposes if enough air is able to flow to and away from them and the capacitors are spaced at least 20 mm apart. Otherwise, in a less well ventilated environment, forced cooling (fans) will be necessary, scaled so that the maximum admissible ambient temperature is not exceeded.

Useful life of capacitors strongly depends on the operating temperature (refer to page 145, temperature classes of capacitors).

Exceeding maximum allowed temperature may set the safety device out of operation.

Please read the *Installation and Maintenance Instructions* on the Internet at www.tdk-electronics.tdk.com/pfc.

Note

Products shown in this catalog reflect typical specifications. You are kindly requested to approve our product specifications before ordering.

Reactors – Antiresonance harmonic filter

During operation, all electrically active parts of this equipment such as windings, electronic components, leads, fuses and terminals carry a dangerous voltage which can lead to burns or electric shock.

Covers which protect these electrically active parts from being touched must not be opened or removed during operation.

Before any assembly or maintenance work is started, all installations and equipment must be disconnected from the power source.

Noncompliance with these instructions may lead to death, serious injury or major damage to equipment.

In order to exclude impermissible temperatures and thus overload of the insulation system, the following directions must additionally be observed:

1. Only those protective devices specified on the type plates, such as fuses and motor protection switches, may be used. It is mandatory to observe the set values specified for the motor protection switches. Any temperature-sensitive protective devices such as temperature switches and temperature sensors must be connected in accordance with the installation instructions.
2. High temperatures are permissible for the surfaces under rated operating conditions, and especially in the event of overload. Depending on the temperature class and type of loading, these may attain values of up to 260 °C and may also affect adjacent components which have been packed too densely.
3. The insertion position should be selected so that any cooling ducts present within the winding are arranged vertically and that the current of cooling air is not impeded by adjacent components, connecting leads etc.
4. The maximum voltage of the insulating system specified on the type plate must not be exceeded.

Noncompliance with these instructions may lead to considerable damage to equipment or fire due to impermissibly high temperatures.

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Cautions

Thyristor modules (TSM-series)

- Live parts in the PFC equipment must not be touched!
- Warning signs in the PFC systems are required!
- Wait 10 minutes after the main switch is turned off – until the voltage in the system has dropped to an uncritical value.
- In non-detuned systems (400 V grid) capacitors with a higher voltage rating (e.g. 440 V) are needed.
- In detuned systems (400 V grid) capacitors with a voltage of 525 V are needed.
- For discharging the capacitors, special high-voltage resistors type EW-22 are required. Standard resistors cannot be used!
- In dynamic PFC systems discharge reactors cannot be used (this would be a short circuit of the highvoltage DC)!
- In PFC systems without filter circuit reactors current limiting reactors are required (e.g. BD-series) for the TSM.
- For short circuit protection, superfast electronic fuses for protection of the thyristor are required, standard HRC fuses are not suitable. See selection table on pages 127 and 128.
- Failure to follow cautions may result, worst case, in premature failures or physical injury.

Capacitor contactors

In case auxiliary contacts are used for switching of discharge resistors (not in accordance with IEC 60831 standard), make sure that the current of the discharge resistors is not higher than the rated current of the auxiliary contacts.

Only flame-resistant and self-extinguishing materials may be used in the proximity of capacitor contactors because abnormal temperatures cannot be ruled out in the area near the resistance spirals.

PF controllers (BR6000 and BR7000 series)

Controller hunting: When putting the capacitor bank into operation, it is required to avoid needless switching cycles (means permanent switching on and off of steps without significant change of consumer loads). This so called “controller hunting” would increase the number of switching operations of the connected contactors and capacitors, decrease the expected life cycle (wear out) and even result in bursting or fires in the worst case. This can be avoided by a proper programming of the PF controllers with the actual system parameters (current transformer prim. and sec., first kvar step, control series, switching time).

The “ZVEI General safety recommendations for power capacitors” must be observed in addition to the safety instructions given in this catalogue and in the particular data-sheets. They are available on the TDK website in the various product groups. They may also be called up from the ZVEI website.

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