PKC

PARTO KHAZEN Co.

www.pkc-capacitor.com

- Power Factor Correction (PFC) Capacitors
- Automatic & Fixed Bank Capacitors
- Motor run & Lighting Capacitors
- Capacitor Duty Contactor & Digital PFC Controller
- Harmonic Filter Reactor
- Metallized PP Film For Capacitors
- Panel Accessories

VDE TÜV CERT ISO 9001 :2008 TUV NORD CE

Certificate

VDE-REG.-NR.4000316-B

ISO 9001 :2008
44 100 115764

TUV NORD

PKC

PKC Products

PKC Parto Khazen Co.

Parto Khazen Co. PKC

Preface

The Energy is so valuable and we must carry out culturally oriented tasks to fairly consume and save it.

The electrical power, as one of the main sources of energy consumed by the human being, has an especial place to care about. Considering the huge costs of efficient generation and transmission of this type of energy, we must aim to rightly improve and optimize the quality and quantity of our distribution networks.
In this regard, the Reactive power compensation is a very important issue in the electrical power systems considering the operational, economical and quality aspects of the services rendered.
Reactive power must be compensated to guarantee an efficient delivery of active power to loads, thus releasing system capacity, reducing system losses, and improving the power factor of electrical networks.

Parto Khazen Co. (PKC) in manufacturing top quality PFC capacitors in variant models and types based on customer-oriented policy and backed up by high level technical staff and equipments, is there to accompany you in achieving the above improvement goals. Nowadays, PKC Capacitors and other products are being used in many local and international electrical projects.

Introduction :

Parto Khazen Co. (PKC), Private Joint Stock Company was founded in Year 1996. The factory was built up in an area of 10,000 m² located near to Tehran. The company activity was started by Aluminum Metalizing of Polypropylene Film and manufacturing Lighting, Motor Run and Power Factor Correction (PFC) Capacitors . Later on; in the year 2003 the Zinc Alloy Metallization plant was built up and started in the factory.

PKC had a normal grow up and has got bigger and bigger over the years and is currently providing a broad range of products and services including variant models of PFC , Motor Run and Lighting Capacitors, Fixed & automatic capacitor banks that are manufactured according to latest IEC standards and based on the latest technology concepts and developments.

The annual capacity of PKC production lines is 4'000'000 Pcs. of Motor Run and Lighting Capacitors and 5000 MVAR of PFC Capacitors. PKC has the potentiality of Designing & Manufacturing other in-the-field especial products ordered in feasible volume and quantity.

PKC has already employed about 80 qualified engineers and skilled workers up to now. During the past years the company has been widely expanded and showed remarkable progress. Years of collecting experiences, good reputation & diversified resources and talents all together with continual development in the product's variety and quality made of PKC one of the greatest and most efficient and reliable manufacturer of AC capacitors in the Middle East.

PKC in possessing technological know-how and in employing highly skilled specialists, succeeded in obtaining the "VDE" product's quality type test certificate (VDE is the German most reliable certification body in the world in the electricity field); this certificate proves the high quality of PKC PFC Capacitors.

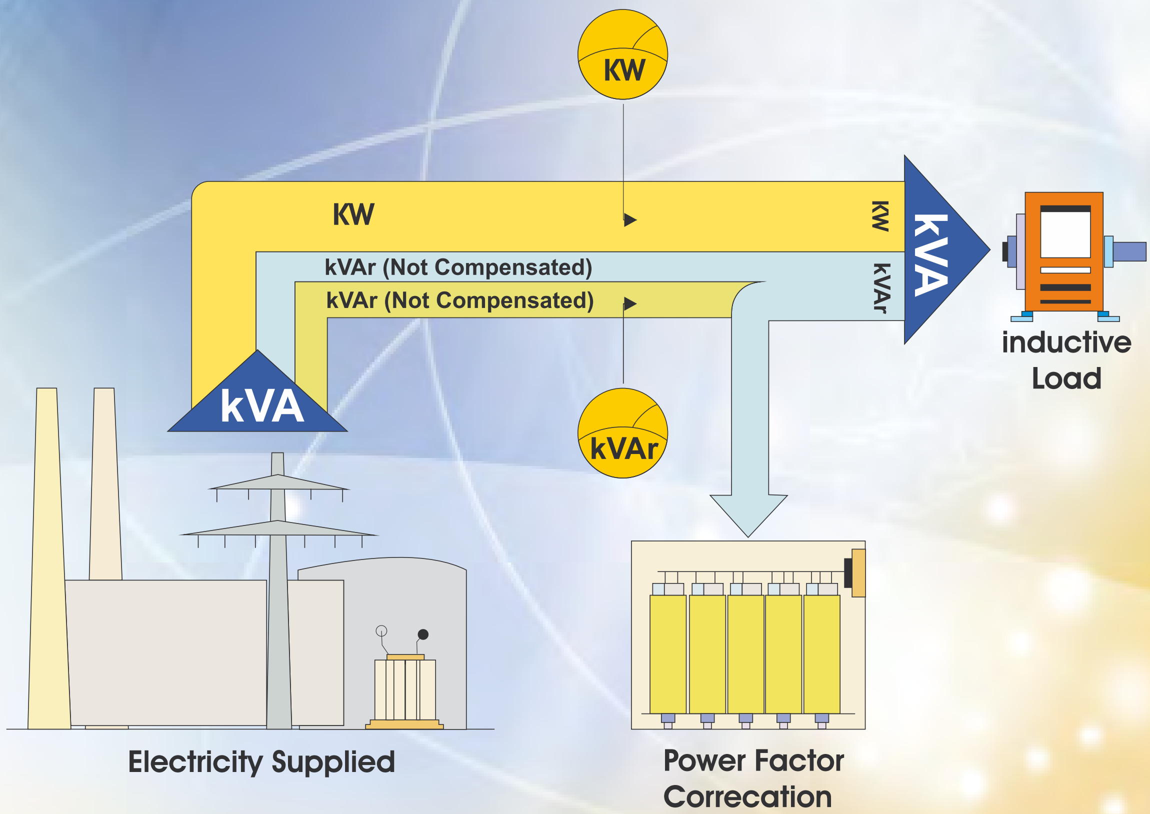
Also, PKC could obtain the ISO 9001-2008 certificate from TÜV Germany for the management quality assurance. PKC was dedicated different standard quality certificates from the Iranian important authorities like; the University of Science & Industry, Iran Power Researches Institute etc...

PKC name is listed now in the vendor lists of many Iranian organizations like Tehran Regional Electricity Company, Tabriz Electricity Distribution Company, the Fuel Consumption Optimization Company and the Petroleum Products Procurement company etc...as one of the most reliable manufacturer of LV power capacitors.

High quality with competitive prices made of PKC having a major share of the domestic market as well as an attractive reputation in some foreign markets where its products have been exported to. Based on the above, PKC could export its capacitors to more than 15 foreign countries in Europe and Asia - Middle East countries.

Competition has not affected PKC quality or attraction and its reputation is spread out by everyone using its capacitors. PKC capacitors are recommended by word of mouth to different companies and customers nation & worldwide .

PKC



Power Factor Correction (PFC)

Power Factor Correction (PFC)

Active Power (P)

In an electrical circuit, the active power P is the real power transmitted to loads. The electrical active power is transformed into heat, mechanical power, rotation and light etc…and the real work is then performed. In the active power loads, the current is in phase with the voltage. The Active Power (P) is measured in Watt (W).

All of what is measured by the single and three phase electricity counters is actually the consumed electrical energy (Active Power).

Reactive Power (Q)

Reactive power (Q) is present when voltage and current are not in phase. The reactive power is not effective working energy and causes the generation of electrical and electromagnetic fields.

In the reactive powers, the current & voltage are in Phase difference.

In the pure inductive loads, the current is 90° lagging behind the voltage. These kind of loads are called Lags;

(Explanation: Electrical equipments requiring the creation of a magnetic field to operate, for example: Motors & motor driven machines, Induction heaters, Fluorescent lighting will all draw a current which is said to 'lag' behind the voltage thus, producing a "lagging" Power Factor If Capacitors are connected to a circuit that operates at a nominally lagging power factor, the extent that the circuit lags is reduced proportionately.)

In the pure capacitive loads, the current is 90°leading in front of the voltage. These kinds of loads are called Leads; (Explanation: Capacitors contained in most Power Factor Correction Equipment draw current that is said to 'lead' the voltage, thus producing a "leading" Power Factor.)

The Reactive Power (Q) is measured in Volt Ampere Reactive (VAR). The electrical energy consumed by the reactive power is measured and registered by the reactive counters.

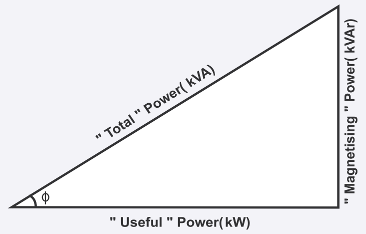
Circuits having no resultant leading or lagging component are said to operate at a "unity" (1) power factor, and the total energy consumed is equal to the useful energy.

The Apparent Power (S)

The Apparent Power (S) is the vector summation of the Active Power (P) & the Reactive power (Q). The apparent power is actually obtained in multiplying the voltage value into the current value S=VI. The Apparent Power (S) is measured in Volt Ampere (VA).

The apparent power is therefore, the basis for the electrical equipment rating; meaning that the choice/definition of capacitance for the network equipments like the generators, transformers, switches, fuses, transmitting cables and etc…is rated according to the apparent power value.

The triangle of the power is well defining the relationship between the apparent power with the other powers:



It is resulted from the above triangle the below formulas:

$S=\sqrt{P^2+Q^2}$

$P=VI\cos\varphi$

$Q=VI\sin\varphi$

The Losses due to the network Conductors

The losses due to the conductors in the network are occurred because of the ohmic resistance of the current conducting components (Cables, Switching connections,) and appears in the form of heat. The losses related to the conductors have two main forms:

- ☒ Losses due to the active power which are inevitable.
- ☒ Losses due to the reactive power which can be mostly managed and reduced, if reducing the reactive load.

Power Factor (PF)

Power Factor is the ratio of active power to apparent power in the electrical grid.

PF=P/S

Then we conclude from the previous formulas and express:

$PF=\cos\varphi$

The Power Factor is a good measure to learn how efficiently the electrical power is consumed in the electrical network.

High PF is the sign of right & efficient usage of the network and on the contrary low PF is showing the weak usage of the network. For example, the PF 85% means that 85% of the network power is in effective use.

To correct the Power Factor of your electrical network* , is our specialty.

Leave your system to us and we will offer you the best compensation solutions.

Power Factor Correction (PFC)

The main goal of correcting the power factor (Power Factor Correction) is to compensate the lagging inductive reactive power by injecting the equivalent capacitive leading reactive power… The necessary capacitive load is supplied by using capacitors in parallel with the electrical distribution network.

(Explanation: Power Factor Correction can considerably reduce the reactive power of electrical loads. As the reactive power must be supplied by power utilities via the power network, power factor correction systems can decrease the load on Industrial network, power utility installations, power lines and transmission equipment. As a result, power customers can save energy and reduce their costs.)

The smaller is the PF the bigger will be the cost in production investment, distribution, and maintenance of the electrical network equipments…Therefore in case of having a low PF from the expected/standard level…the consumed reactive power fee is also calculated and included in the bill and received from the client.

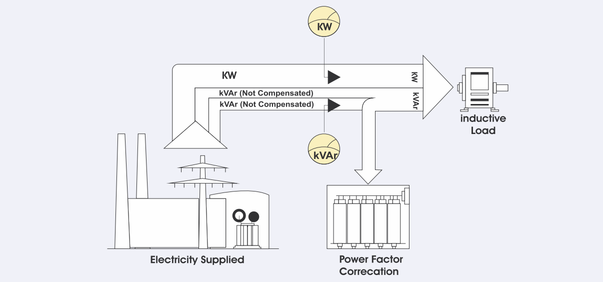


Diagram indicating the composition and usage of industrial energy

The advantages of improving the Power Factor ?
Using capacitors in the electrical network in different forms, will reduce the total power consumed by an electrical installation and will provide the following benefits:

- ☒ The Power Factor Correction will help you not paying or significantly reducing the reactive power consumption fee. Depending on the tariff and consumption conditions, the initial investment of PFC Capacitor banks is amortized between 6 to 24 months...
- ☒ Deleting the reactive power will avoid the voltage drop in the electrical network.
- ☒ Deleting the reactive power will cause reduction in current and a consequent reduction therefore in the diameter of the cables, in the capacity of the transformers and their related switches etc...
- ☒ The reduction in the current will cause the reduction on the Resistance losses of the transmission lines and the switches.
- ☒ The reduction in the current will cause the reduction of the heat in the switches, transformers and the transmission lines and will lower down the maintenance costs of the electrical accessories...
- ☒ In connection with fixed apparent powers (example: the already designed and installed networks), we can consume more active power when reducing the reactive power.
- ☒ Reduction in the voltage drop will cause the increase in the running torque of the motors...
- ☒ Financial saving - By reducing power consumed, electricity investment and daily costs are reduced.
- ☒ Increase load capacity – provide additional capacity for other loads to be connected.
- ☒ Environmental benefit - Reduced power consumption means less “Greenhouse” gas emissions and fossil fuel depletion by power stations.

The different ways of Correcting the Power Factor

For correcting the power factor we use 3 main solutions:

Individual or Static Compensation

This solution is mostly applied for the transformers, equipments with long cables and the running motors.

In this style, we calculate and use capacitor (s) for each individual electrical consumer.
The advantages of this solution are the non usage of PFC regulators, accurate compensation, discharging the network from the reactive power loads and reducing the KVAR costs...but the main disadvantage of this style is not being able to take into account the simultaneity coefficient of applying few different electrical consumers in the same time, which will cause the usage of more qty. of capacitors in the network.

Group compensation

In this style, we calculate and use one big capacitor for a group of electrical consumers. As this type of compensation is indeed another especial form of the individual compensation, then the advantages of this solution is also the non usage of PFC regulators, accurate compensation, discharging the network from the reactive power loads and reducing the KVAR costs...and it is more economical as the number of applied capacitors and the installation processes are less...but apart the total high costs, the main disadvantage of this style is the possible false compensation and the appearance of the capacitive reactive load in the circuit which happens when the consumers are not working together and in the same time...

Central Compensation

In this style, the capacitor is basically installed at the input side of the system and is divided into smaller steps. The power factor of the network is controlled by a PFC controller and the right needed capacitor is calculated and inserted into the network.

This style is applicable in almost all places. The advantages of such compensation style are: the easy installation, easy control, optimal usage of the installed capacitors and flexibility against the changes in the load. And the major disadvantage of this solution is the non-compensation inside the network itself.

Calculations and Formulas:

The Apparent power in the 3 phase network:
$S = \sqrt{3} \times U \times I$
Active Power in the 3 phase network:
$P = \sqrt{3} \times U \times I \cos \varphi$
The Reactive Power in the 3 phase network:
$Q = \sqrt{3} \times U \times I \sin \varphi$
Single phase capacitor current:
$I_C = 2 \times \pi \times f \times U_C \times C$
Three phase capacitor current:
$I_C = Qc / (\sqrt{3} \times U_C)$
Single phase capacitor power:
$Q_C = 2 \times \pi \times f \times C \times (U_C)^2$
Three phase capacitor power:
$Q_C = 6 \times \pi \times f \times C \times (U_C)^2$

How to calculate and choose the necessary capacitors for the electrical network

For calculating the right needed capacitors for the network, we will need to have the active power value and the network PF. Then the capacitor power will be obtained through the below formula:

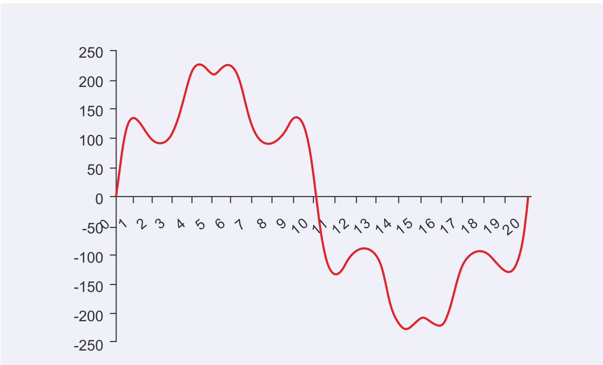
$$Q_C = (tg\,\varphi_1 - tg\,\varphi_2) \times P = K \times P$$

The value of K can be obtained from the enclosed table. For using the table and obtaining the K value we have to go for the crossing point of the row values showing the existing PF of the grid ($Cos\phi_1$) and the column values showing the expected PF ($Cos\phi_2$).

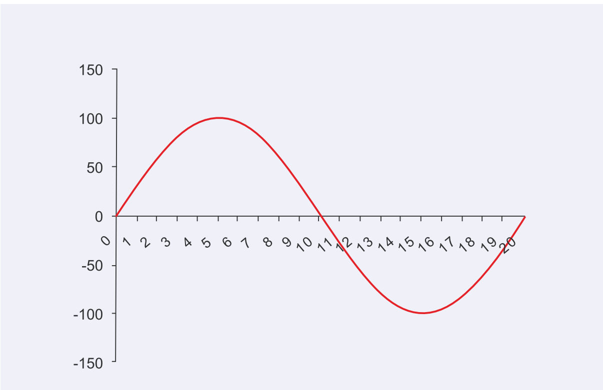
Harmonics

Our today's' world is in increasing need of automatic processes which are more quick and more flexible in application. To realize this, we will need to install and use more controlling circuits in the equipments. The old circuits were being controlled with relays and contactors, while today almost all controls are being done by semi-conductors.

Also the need of continuous power supplying in the important places like banks, hospitals, security centers...etc. caused the increasing use of UPS. The main feature of semi-conductor products (diodes/thyristors or SCR/transistors/IGBT/GTO...etc) is to change the current shape. The below diagram is well showing two types of current; with and without distortion .As you can see, if the consuming power is equal in both loads then the effective current in the distorted load is significantly more than the one without distortion.



(Curve A)



(Curve B)

The mathematical calculations Fourie * Series are proving that a non-sinusoidal alternative wave (complex wave) can be divided into many sinusoidal waves with frequencies that are a multiplier of the main (fundamental) wave frequency coefficient. Meaning that every non-sinusoidal alternative wave is the result of the summation of few sinusoidal waves with the coefficient of the main wave frequencies and their related multipliers.

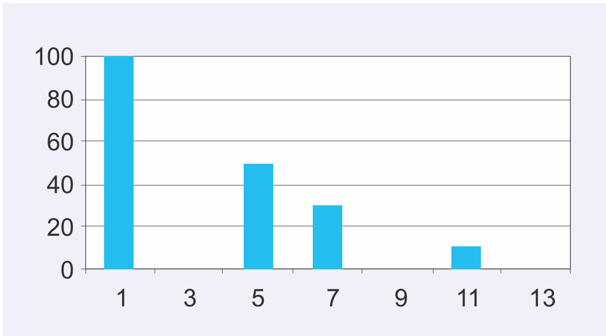
The amplitude of the main wave is conventionally considered 100% as pre-requisite and the rest wave is calculated in % and according to that.

The form of the distorted wave is not giving any information about the harmonics by itself. All of what helping the designer in analyzing the harmonics, is the harmonics spectrum diagram.

The ordinary measurement devices can not measure the harmonics. The measurement in the harmonic systems is done by True RMS devices. In such measurement process, the harmonics spectrum is measured by specialists and by using power analyzing equipments.

The main parameter of measuring the harmonics is the THD. THD is expressed in % and is the ratio of the all harmonic currents to the main current: see the below formula:

$$THD\ \% = \frac{\sqrt{\sum_{n=2}^{\infty} In^2}}{I_1} \times 100$$



The diagram of the harmonics spectrum of a system with distortion.

The main producer of harmonic in the systems:

As mentioned, the non-linear loads are producing harmonics. Below listed equipments are the most famous harmonic producer.

- ☒ UPS
- ☒ DC Servo motors
- ☒ AC Servo motors
- ☒ Frequency convertors
- ☒ Lighting Dimmers
- ☒ Invertors
- ☒ Battery chargers
- ☒ Electrical arc furnaces
- ☒ Electrical arc welding machine
- ☒ Resistance welding machine
- ☒ Electronic ballast
- ☒ Switching regulated power supply
- ☒ Induction furnaces
- ☒ Compact Fluorescent Lamps

The problems caused by harmonics:

Industries depending on the type and amplitude and value of harmonics they generate, will face different problems .

The general problems caused by harmonics in the networks are :

The fluorescent lamps' light is strengthening and weakening.

Damages on the capacitors

Damage or excessive heat on the transformers, conductors, switches, etc.

Blinking in the gas lamps

Automatic fuses functioning

Fuses burning out without apparent reason

Excessive heat or damage on the motors

Interference in long distance telecommunications

Disturbance in telephone lines

Damage on the measurement equipments

Computers hanging and lock outs

Nowadays, the main concern in the electrical network is how to avoid and control harmonics and their bad effects.

What dangers harmonics have for capacitors? and how solving them?

Considering the capacitors current formula ($I_c = 2 \times \pi \times f \times C \times U_C$) we can learn that in equal voltage circumstances, increasing the frequency will lead current increase in capacitor in turn. Example: if the voltage amplitude of the fifth harmonic is 5% of the main wave amplitude then the passing current from the capacitor due to harmonics will be 25% of the main current amplitude. Therefore having harmonics in the network will seriously damage the capacitor. The best way to avoid damages to the capacitors in harmonic systems is installing reactor in series with the capacitor will decrease the resonance frequency of each phase of the capacitor to come to the expected value.

This frequency depending on the type of harmonics and the size will be put in a place to give the best filtering.

How to choose the series resonance frequency and the capacitor voltage in the different harmonic network

In the networks where THD of the current is higher than 10% and/or THD of the voltage is more than 3% (without capacitors)then the reactor installation is mandatory. If the third harmonic amplitude of the current is more than 20% of the fifth harmonic then we use the third harmonic reactors(P=14%);otherwise we will use fifth harmonic reactor(p=7% or 5.67%)

If using fifth harmonic reactors and, if THD of the voltage is less than 7% we will use 7% harmonic reactors and if the voltage is more we will use 5.67% reactors. When using the capacitors in serial with the reactors, then the applicable voltage to the capacitor will be:

$$U_C = \frac{U}{1-p}$$

Therefore we have to pay attention that the nominal voltage of the capacitor used in the circuits with harmonic reactors must be more than the nominal voltage of the network .For achieving the needed resonance frequency we must absolutely use the capacitor which the capacitance is identified by reactor manufacture.

PKC

Cylindrical Power Factor Correction Capacitors

Technology of producing capacitors with metalized polypropylene(PP) films

The usage of plastic films with very thin thicknesses (4-12micron) as the electrical insulator was a big promotion in the LV capacitors manufacturing, technically and economically speaking. The very low thickness of these films create the significant reduction in raw material consumption, volume, weight and manufacturing cost of capacitors.

Metalized films

PKC Zinc alloy three layers metalized PP film is produced under the latest methods and world technology.

The base film is biaxial oriented polypropylene (BOPP) in micron thickness which will be then quoted with very thin layer of Zinc (approximately 95%) and aluminum (approximately 5%) in vacuum evaporation process. The zinc metal will keep the capacitance and capacitor specifications to be fixed over the time and aluminum metal will protect the film surface to be oxidized. Meantime Silver is coated on the film initially for preparation.

The combination of two metals together will result on a high stability of the electrical and chemical specifications of the capacitors. In one side the edge of the film has more metal coating and the other side edge is without metal coating. We call the non coated edge the free margin and the coated edge is called heavy edge. For producing capacitor two layers of film are put on each other and winded over a core.

Self-healing phenomena

The most important feature of Capacitors made with this type of film is self – healing.

Self- Healing process means if during the capacitor working status, the insulation between two electrodes is damaged for any reason and is broken down to cause short circuit in the MPP Film surface, then the huge current passing through the broken down point will create high heat and the metal layer will evaporate and that point will be an isolated non-conductive area without metalized layer and the capacitor continue working normally. This isolation area is so small that cannot affecting the capacity of the capacitor and is very little...to say that only 10000 self healing may lead to 1 Mfd. drop on the capacitance.

The plastic films are functioning as insulator and the metalized side is functioning as electrode.

The advantages of self-healing capacitors:

The most important advantages of using self-healing capacitor comparing with old generation of capacitors are :

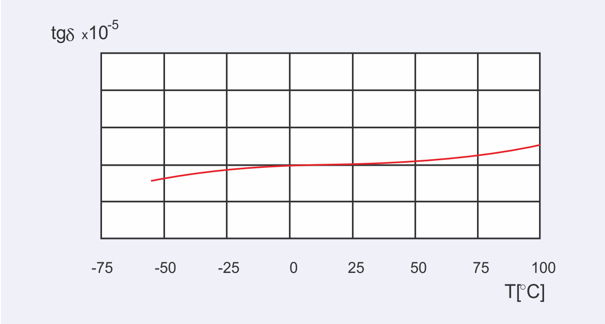
1- The lower weight and volume in comparison with the similar capacitors capacitances.

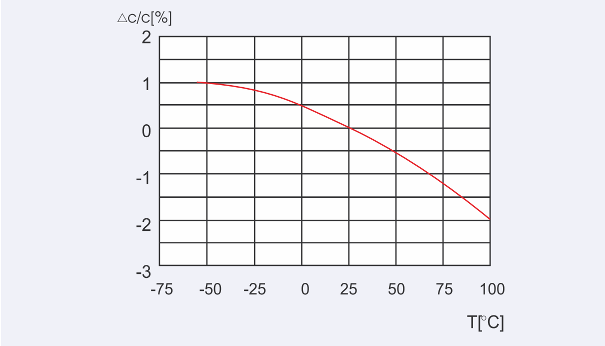
2- The self healing feature which causes the lowest drop in the capacitance if the electrical breakdown happens for the capacitor.

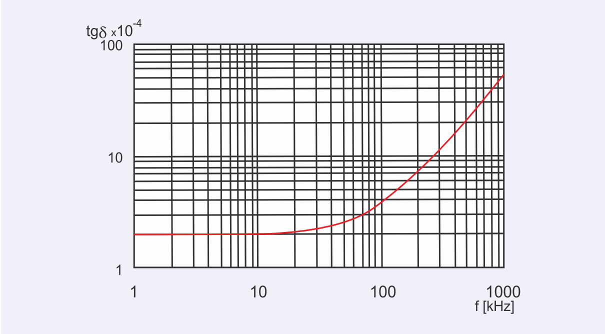
3- Due to the simple structure and low raw material the capacitors produced by this technology are economically feasible.

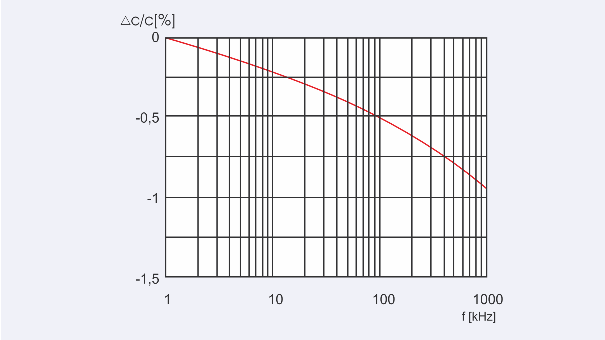
4- The lower losses of dielectric and capacitor will cause less heat and consequently more life time for the capacitors.

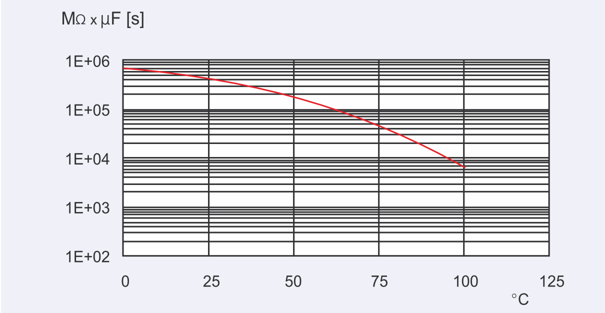
The diagrams are showing the electrical features of the capacitor produces with metalized film.











The general definitions according to the capacitor standards:

- ☒ Nominal Voltage (U_N): Is the suitable and effective alternative voltage (r.m.s) that the capacitor is designed for working under it.
- ☒ Nominal Capacitance (C_N): Is the suitable and effective capacitance that the capacitor is designed for.
- ☒ Nominal current (I_N): Is the suitable and effective alternative current (r.m.s) in the nominal voltage and frequency.
- ☒ Nominal frequency (f_N): Is the highest frequency that the capacitor is designed for working in.
- ☒ Capacitor losses: The active power consumed by the capacitor.

Overpressure disconnection system:

The capacitors like all other electrical products, have efficient life time.

Considering that the self healing capacitors will rarely face short-circuits, using only one HRC fuse cannot guarantee the safety of the capacitor and we have to use safety mechanism in the capacitor for timely overpressure disconnection.

In this system, in order to prevent the capacitor from exploding or bursting because of rising inside pressure, the safety mechanism is provided by a folded crimp. Also the wires connecting the elements to the terminals are weakened in one point.

After that the gases produced due to the electrical breakdowns are appeared and cause the rising of pressure inside the capacitor, the lid is pushed upwards and the folded area will be open and the internal connections are broken and the current flow stops consequently.

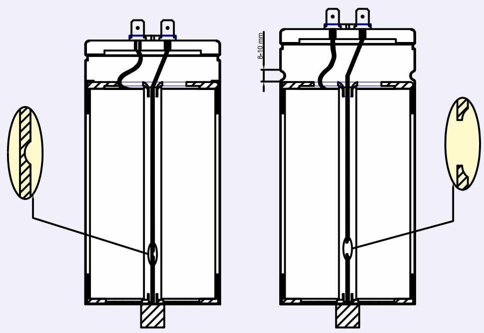
Few points to consider Overpressure disconnection system for better function:

1- Enough space above the capacitor to allow it having at least 2 cm.
increase in height.

2- Absolutely using Flexible wire or cable.

3- Making sure that The folded area of the capacitor is free to function.

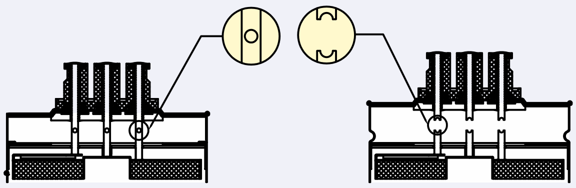
To inform that the safety mechanism of PKC Capacitors are designed and applied according to the BS 7631 and EN/IEC60593.



Normal Situation

After Disconnection

Internal disconnection System for Single Phase Capacitors



Normal Situation

After Disconnection

Internal disconnection System for Three Phase Capacitors

PFC Cylindrical Capacitors/ Model PAC

Applications

- Low Voltage distribution networks.
- Fixed & Automatic capacitor banks for centralized compensation.
- Installing on electric motors, transformers & lighting circuits and...Individual or group compensation.
- Installing in the networks with harmonic makers equipments like UPS, Convertors, and three phase servo motors in considering all technical parameters...

Technical Data & Specification

Rated Power (KVAR) Rated Voltage (V) Rated Capacitance (μF)	According to Specification Table
Capacitance Tolerance %	-5/+10
Rated Frequency (Hz)	50 (60 Hz on request)
Mean life expectancy	Up to 100.000 operating hours
Permitted Overload * - Max. permissible overvoltage (Vmax) - Max. permissible overcurrent (Imax)	Rated Voltage +10% (8 h. in every 24 h.) Rated Voltage +15% (30 min. in every 24 h.) Rated Voltage +20% (5 min.) Rated Voltage +30% (1 min.) 1.3 x Rated current
Permitted ambient temperature	-25 °C to 55 °C Max. temp. 55°C Max. mean 24 h = 45°C Max. mean 1 year = 35°C
Number of switching operations	Max. 5000 switching per year according to EN/IEC 60831/1&2
Dielectric loss Total loss	< 0.2 Watt / KVAR < 0.5 Watt / KVAR
Max. transient Inrush current	100 x Rated current
Max. discharge time	1 min. (from rated voltage to 75 V)
Internal connection	Delta (Δ)
Voltage Test - Between terminals - Terminal to Can (Case)	 2.15 Rated voltage, 2 Sec. 3 KVAC, 10 Sec.

Insulation level	3/8 KV AC
Safety Mechanism	- Self-healing technology - Overpressure disconnector
Protection **	IP 20
Can/Shape	Aluminum / Cylindrical
Max. permissible humidity	95%
Mounting - Position - Installation - Expansion space	 Vertical / Horizontal Indoor 2 cm (it is necessary to leave free space above the terminals to enable the overpressure protection device operates effectively.)
Max. permissible altitude	2000 m above sea level
Fixing/Grounding	By threaded stude M8 (for can diameter 45) / 5Nm M12 (for can diameter 50 mm and more) / 12 Nm
Filling Material	Non PCB
Terminal type	6.3 mm Tag. ST, MT & BT
Standard	EN/IEC 60831-1 & 2

* 200 times of over voltages higher than 15% can happen during the capacitor life time.

** Tag terminal Capacitors have plastic top cover(IP20)

Max. withstanding temperature according to the working class:

Temp. class	Max. ambient temp. (˚C)	Average temp. in 24 Hours (˚C)	Average temp. in 365 hours (˚C)
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Dimension & technical spec. of the Single Phase Capacitors

Single Phase 250V , 50Hz

Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	42.3	3.3	Single Tag 6.3 mm	45×109	0.20
1	50.9	4.0	Single Tag 6.3 mm	45×139	0.21
1.5	76.4	6.0	Single Tag 6.3 mm	50×139	0.32
1.67	85.1	6.7	Single Tag 6.3 mm	55×139	0.35
2.5	127.4	10.0	Double Tag 6.3 mm	65×139	0.47

Single Phase 400V , 50Hz

Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	16.5	2.1	Single Tag 6.3 mm	45×85	0.20
1	19.9	2.5	Single Tag 6.3 mm	45×85	0.20
1.5	29.9	3.8	Single Tag 6.3 mm	45×109	0.20
1.67	33.2	4.2	Single Tag 6.3 mm	45×139	0.24
2.5	50	6.3	Single Tag 6.3 mm	50×139	0.32
3.33	66.3	8.3	Single Tag 6.3 mm	55×139	0.34
4.17	83	10.4	Double Tag 6.3 mm	60×139	0.48
5	100	12.5	Double Tag 6.3 mm	65×139	0.54

Single Phase 440V , 50Hz

Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	13.7	1.9	Single Tag 6.3 mm	45×85	0.20
1	16.4	2.3	Single Tag 6.3 mm	45×85	0.20
1.5	24.7	3.4	Single Tag 6.3 mm	45×109	0.20
1.67	27.5	3.8	Single Tag 6.3 mm	45×139	0.24
2.5	41.1	5.7	Single Tag 6.3 mm	50×139	0.32
3.33	54.8	7.6	Single Tag 6.3 mm	55×139	0.34
4.17	68.6	9.5	Double Tag 6.3 mm	65×139	0.48
5	82.2	11.4	Double Tag 6.3 mm	70×139	0.54

Single Phase 525V , 50Hz

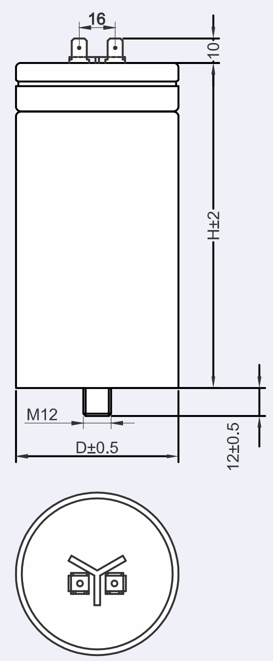
Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	9.6	1.6	Single Tag 6.3 mm	45×85	0.20
1	11.6	1.9	Single Tag 6.3 mm	45×109	0.20
1.5	17.3	2.9	Single Tag 6.3 mm	45×139	0.21
1.67	19.3	3.2	Single Tag 6.3 mm	45×139	0.24
2.5	28.9	4.8	Single Tag 6.3 mm	55×139	0.34
3.33	38.5	6.3	Double Tag 6.3 mm	60×139	0.40
4.17	48.2	7.9	Double Tag 6.3 mm	65×139	0.48
5	57.8	9.5	Double Tag 6.3 mm	70×139	0.54

Single Phase 660V , 50Hz

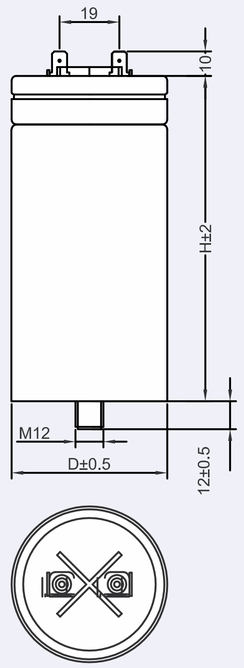
Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	6.1	1.3	Single Tag 6.3 mm	45×85	0.20
1	7.3	1.5	Single Tag 6.3 mm	45×85	0.20
1.5	11.0	2.3	Single Tag 6.3 mm	45×109	0.20
1.67	12.2	2.5	Single Tag 6.3 mm	45×139	0.24
2.5	18.3	3.8	Single Tag 6.3 mm	50×139	0.32
3.33	24.3	5.0	Single Tag 6.3 mm	55×139	0.34
4.17	30.5	6.3	Double Tag 6.3 mm	65×139	0.48
5	36.6	7.6	Double Tag 6.3 mm	70×139	0.53

Single Phase 690V , 50Hz

Nominal Power (Kvar)	Capacitance (μF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
0.83	5.6	1.2	Single Tag 6.3 mm	45×85	0.20
1	6.7	1.4	Single Tag 6.3 mm	45×85	0.20
1.5	10.0	2.2	Single Tag 6.3 mm	45×109	0.20
1.67	11.2	2.4	Single Tag 6.3 mm	45×139	0.21
2.5	16.7	3.6	Single Tag 6.3 mm	50×139	0.32
3.33	22.3	4.8	Single Tag 6.3 mm	55×139	0.34
4.17	27.9	6.0	Double Tag 6.3 mm	60×139	0.40
5	33.4	7.2	Double Tag 6.3 mm	65×139	0.48



Single Tag Terminal
Dia. 60mm up to 70mm



Single Tag Terminal
Up to Dia. of 55mm

Dimension & technical specification of the Three Phase Capacitors

Three Phase 400V , 50Hz

Nominal Power (Kvar)	Capacitance (µF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
1	6.6	1.4	Single Tag 6.3 mm	45×129	0.2
1.5	10.0	2.2	Single Tag 6.3 mm	45×129	0.2
2.5	16.6	3.6	Single Tag 6.3 mm	55×129	0.4
5	33.2	7.2	ST	70×150	0.7
7.5	49.8	10.8	ST	70×205	0.9
10	66.3	14.4	ST	70×230	1
12.5	82.9	18.0	ST	70×270	1.1
15	99.5	21.7	MT	85×280	1.8
20	132.7	28.9	MT	95×280	2.2
25	165.9	36.1	MT	100×280	2.4
30	199.0	43.3	MT	116×280	3.1
40	265	57.6	BT	116×370	4.1
50	331	72	BT	116×370	4.2

Three Phase 440V , 50Hz

Nominal Power (Kvar)	Capacitance (µF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
1	5.5	1.3	Single Tag 6.3 mm	45×129	0.2
1.5	8.2	2.0	Single Tag 6.3 mm	45×129	0.2
2.5	13.7	3.3	Single Tag 6.3 mm	55×129	0.4
5	27.4	6.6	ST	70×150	0.7
7.5	41.1	9.8	ST	70×205	0.9
10	54.8	13.1	ST	70×230	1
12.5	68.5	16.4	ST	70×270	1.2
15	82.2	19.7	MT	85×280	1.8
20	109.7	26.2	MT	95×280	2.2
25	137.1	32.8	MT	100×280	2.3
30	164.5	39.4	MT	116×280	3
40	219	52.4	BT	116×370	4.1
50	274	65.6	BT	116×370	4.2

Three Phase 525V , 50Hz

Nominal Power (Kvar)	Capacitance (µF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
1	3.9	1.1	Single Tag 6.3 mm	45×129	0.20
1.5	5.8	1.6	Single Tag 6.3 mm	55×129	0.35
2.5	9.6	2.7	Single Tag 6.3 mm	60×129	0.4
5	19.3	5.5	ST	70×150	0.7
7.5	28.9	8.2	ST	70×205	0.90
10	38.5	11.0	ST	70×270	1.2
12.5	48.1	13.7	MT	85×280	1.8
15	57.8	16.5	MT	85×280	1.8
20	77.0	22.0	MT	95×280	2.2
25	96.3	27.5	MT	116×280	3.2
30	115.5	33.0	MT	116×280	3.1
40	154	44	BT	116×370	4.1
50	192	55	BT	116×370	4.2

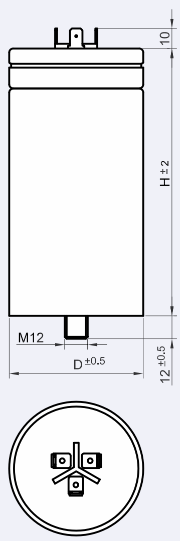
Three Phase 660V , 50Hz

Nominal Power (Kvar)	Capacitance (µF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
1	2.4	0.9	Single Tag 6.3 mm	45×129	0.2
1.5	3.7	1.3	Single Tag 6.3 mm	45×129	0.2
2.5	6.1	2.2	Single Tag 6.3 mm	55×129	0.4
5	12.2	4.4	ST	70×150	0.7
7.5	18.3	6.6	ST	70×205	0.9
10	24.4	8.7	ST	70×230	1
12.5	30.5	10.9	ST	70×270	1.2
15	36.6	13.1	MT	85×280	1.8
20	48.7	17.5	MT	95×280	2.2
25	60.9	21.9	MT	100×280	2.5
30	73.1	26.2	MT	116×280	3.2
40	97	35	BT	116×370	4.1
50	121	43.8	BT	116×370	4.2

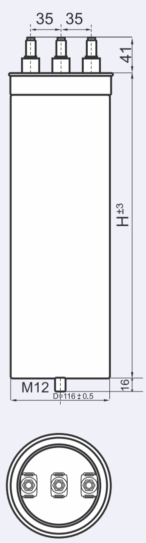
Three Phase 690V , 50Hz

Nominal Power (Kvar)	Capacitance (µF)	Current (A)	Terminal	Dimension (D×H) (mm)	Net Weight (kg)
1	2.2	0.8	Single Tag 6.3 mm	45×129	0.2
1.5	3.3	1.3	Single Tag 6.3 mm	45×129	0.2
2.5	5.6	2.1	Single Tag 6.3 mm	55×129	0.4
5	11.1	4.2	ST	70×150	0.7
7.5	16.7	6.3	ST	70×205	0.9
10	22.3	8.4	ST	70×230	1
12.5	27.9	10.5	ST	70×270	1.2
15	33.4	12.6	MT	85×280	1.8
20	44.6	16.7	MT	95×280	2.2
25	55.7	20.9	MT	100×280	2.5
30	66.9	25.1	MT	116×280	3.2
40	89	33	BT	116×370	4.1
50	111	41	BT	116×370	4.2

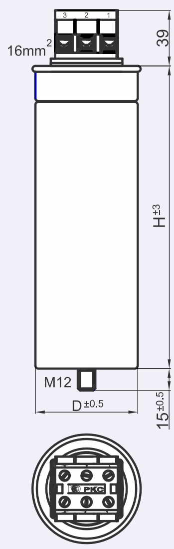
All capacitors with ST terminal can be produced with MT terminals at request.



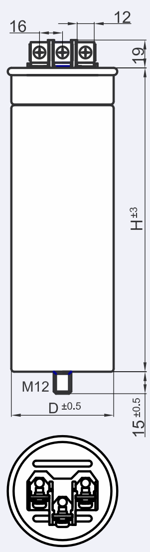
Tag Terminal



BT Terminal



MT Terminal



ST Terminal

Fixed Bank Capacitors (Box Type)

Fixed Bank Capacitors (Box Type), PFB Model

Applications

Three Phase fixed bank capacitors are used to correct the power factor and compensate the reactive power in LV systems like:

- Automatic Capacitor Banks
- Installed in the fixed consumers like electromotors, transformers, pumps used in agricultural wells, in industrial areas & etc. in individual or group forms...

Technical Data & Specification

Rated Power (KVAR) Rated Voltage (V) Rated Capacitance (µF)	According to Table Specification
Capacitance Tolerance (%)	- 5/+10
Rated Frequency (Hz)	50 (60 Hz on request)
Max permissible * Overvoltage (V max)	Rated Voltage + 10% (8h.in every 24) Rated Voltage + 15% (30 min in every 24) Rated Voltage + 20% (5min) Rated Voltage + 30% (1min)
Max permissible Overcurrent (I max)	1.3 × Rated current
Dielectric loss (W/KVAR) Total loss (W/KVAR)	< 0.2 Watt / KVAR < 0.5 Watt / KVAR
Max discharge time	1min. (from rated voltage to 75V)
Internal connection	Delta (Δ)
Voltage Test - Between terminals -Terminal to Can (Case)	2.15 Rated voltage, 2 Sec. 3 KVAC, 10 Sec.

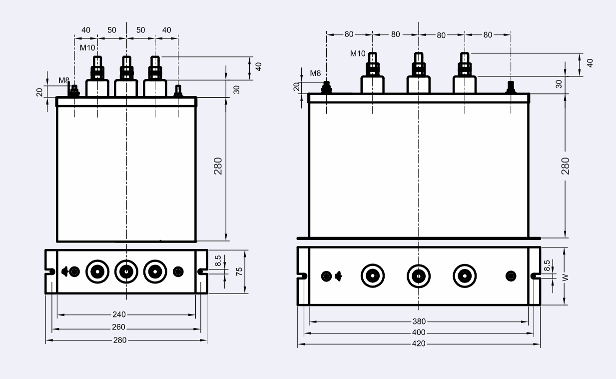
Insulation level	3/8 KVAC
Safety Mechanism	Self healing
Protection	IP00
Case & Shape	Metal Case in cubic rectangular
Case Color	RAL7032
-Mounting Position -Installation	Vertical / Horizontal Indoor
Fixing/Grounding	M8 Screw
Filling Material	Non-PCB
Terminal Type	Ceramic Bushing With M10 Metal Screw Max. Torque allowed15N.m
Standard	EN/IEC 60831-1&2

* 200 Times of over voltage higher than 15% can happen during the life time.

Dimensional Table 400V , 50 Hz

Power (Kvar)	Current (A)	Dimension (Height×Length×Width) (mm)	Net Weight (kg)
5	7.2	280×240×75	3.6
7.5	10.8	280×240×75	4.2
10	14.4	280×240×75	4.3
12.5	18	280×240×75	4.6
15	21.7	280×240×75	5
20	28.8	280×380×75	7
25	36	280×380×75	7.8
30	43.2	280×380×95	8.3
40	57.6	280×380×160	10.5
50	72	280×380×160	12
60	86.4	280×380×180	14.5

Dimensional Drawings



7.5-15 KVAR 20-60 KVAR

Q KVAR	W mm
20	75
25	75
30	95
40	160
50	160
60	180

Automatic Capacitor Banks

The working principals of the Automatic Capacitor Banks

The automatic capacitor banks are equipped with a PFC regulator. This regulator measure the altitude and form of the voltage and current waves and their phase difference and after doing the right calculations, will define the necessary capacitor power and inserts the capacitor in the network. In the low voltage networks, the voltage sample is connected to the regulator directly from the line, but the current sample is connected to the regulator by a current transformer (CT).

The capacitors switching is done by few contactors that are controlled by a PFC Regulator. Also for each capacitor's step, there are few separate fuses.

The main components of an Automatic Capacitor Bank

- Capacitor
- Capacitor duty contactor
- Fuses
- PFC Regulator
- Main switch
- Push-Button series
- Signal Lamp
- Cooling fan
- Reactor
- Measurement device

Every accessorial component (Push-Button, Signal Lamp, Cooling Fan, Measurement device etc...) and even the main switch can be omitted form the bank depending to their design, application and installation places. Also it may happen that for some capacitor banks we will add some other components.

PFC Regulator

The PFC regulator is the decision making center and actually the brain of the automatic capacitor banks. The success of a regulator in correcting the power factor is depending on 6 factors:

- Accurate Hardware design
- Using quality components
- Suitable Soft ware with suitable control algorithm
- Using accurate sampling tools for voltage and current samples
- Correct installation
- Correct adjustments

Now according to our European partner experiences and production capability, the three first factors are present in design and production of PKC regulators and the rest three factors will be furnished to the products after selling the regulator and rendering the after sales servicing and through the instructions given to the customer during the installation and start-up.

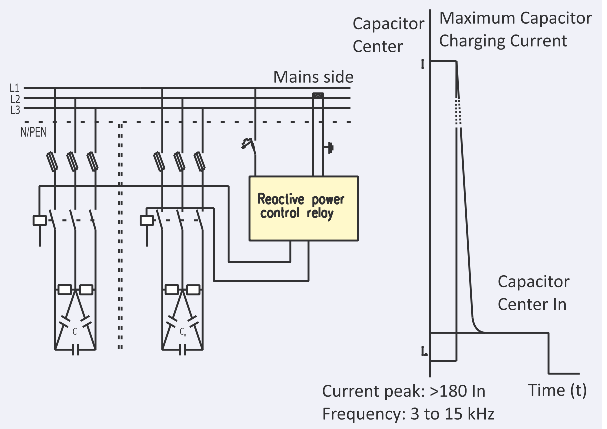
Capacitor duty contactor

Every capacitor at every switching process shows a behavior like short circuit. Meaning that, in connecting the contactor to the network a huge inrush current passes through it .This inrush current will leave damaging effects on the capacitor and also cause the contactors' contacts burning and sometimes spot welding together. Any failure in the contactors' platins will have more damaging effects on the capacitors again.

Also when connecting a new capacitor to the network, the other capacitors already connected, will be suddenly discharged into it and create a big instant current.

To avoid such event, there are different solutions, which the most common, cheapest and simplest way is using capacitor duty contactors.

The contactors have on them serial auxiliary contacts which are linked to the main contacts with resistant wires. The mechanical design of the contactors is as such, that the auxiliary contacts are closed earlier than the main contacts and the initial charge of the capacitor is done and limited through the resistors. After that the main contacts are connected the auxiliary ones will be off line and the capacitor feeding will be done by the main contacts.



Multi Stepped Capacitor Bank

Determining needed Capacitor Bank Power

Concerning the power factor of network ($Cos\phi_1$), knowing the installed power in the network (P) and by using following table it is possible to calculate needed capacitor power through confluence of the line of $Cos\phi_1$ and the column of desired $Cos\phi_2$.
Needed capacitor power is calculated by ϕ_c=K×P formula.
For example : $Cos\phi_1$=0.69 & $Cos\phi_2$=0.92
K is 0.623

Determining K coefficient table

$tg\phi_1$	$Cos\phi_1$	$Cos\phi_2$										
		0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.00
1.73	0.50	1.248	1.276	1.306	1.337	1.369	1.403	1.440	1.481	1.529	1.590	1.732
1.69	0.51	1.202	1.231	1.261	1.291	1.324	1.358	1.395	1.436	1.484	1.544	1.687
1.64	0.52	1.158	1.187	1.217	1.247	1.280	1.314	1.351	1.392	1.440	1.500	1.643
1.60	0.53	1.116	1.144	1.174	1.205	1.237	1.271	1.308	1.349	1.397	1.458	1.600
1.56	0.54	1.074	1.103	1.133	1.163	1.196	1.230	1.267	1.308	1.356	1.416	1.559
1.52	0.55	1.034	1.063	1.092	1.123	1.156	1.190	1.227	1.268	1.315	1.376	1.518
1.48	0.56	0.995	1.024	1.053	1.084	1.116	1.151	1.188	1.229	1.276	1.337	1.479
1.44	0.57	0.957	0.986	1.015	1.046	1.079	1.113	1.150	1.191	1.238	1.299	1.441
1.40	0.58	0.920	0.949	0.979	1.009	1.042	1.076	1.113	1.154	1.201	1.262	1.405
1.37	0.59	0.884	0.913	0.942	0.973	1.006	1.040	1.077	1.118	1.165	1.226	1.368
1.33	0.60	0.849	0.878	0.907	0.938	0.970	1.005	1.042	1.083	1.130	1.191	1.333
1.30	0.61	0.815	0.843	0.873	0.904	0.936	0.970	1.007	1.048	1.096	1.157	1.299
1.27	0.62	0.781	0.810	0.839	0.870	0.903	0.937	0.974	1.015	1.062	1.123	1.265
1.23	0.63	0.748	0.777	0.807	0.837	0.870	0.904	0.941	0.982	1.030	1.090	1.233
1.20	0.64	0.716	0.745	0.775	0.805	0.838	0.872	0.909	0.950	0.998	1.058	1.201
1.17	0.65	0.685	0.714	0.743	0.774	0.806	0.840	0.877	0.919	0.966	1.027	1.169
1.14	0.66	0.654	0.683	0.712	0.743	0.775	0.810	0.847	0.888	0.935	0.996	1.138
1.11	0.67	0.624	0.652	0.682	0.713	0.745	0.779	0.816	0.857	0.905	0.966	1.108
1.08	0.68	0.594	0.623	0.652	0.683	0.715	0.750	0.787	0.828	0.875	0.936	1.078
1.05	0.69	0.565	0.593	0.623	0.654	0.686	0.720	0.757	0.798	0.846	0.907	1.049
1.02	0.70	0.536	0.565	0.594	0.625	0.657	0.692	0.729	0.770	0.817	0.878	1.020
0.99	0.71	0.508	0.536	0.566	0.597	0.629	0.663	0.700	0.741	0.789	0.849	0.992
0.96	0.72	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821	0.964
0.94	0.73	0.452	0.481	0.510	0.541	0.573	0.608	0.645	0.686	0.733	0.794	0.936
0.91	0.74	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	0.909
0.88	0.75	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739	0.882
0.86	0.76	0.371	0.400	0.429	0.460	0.492	0.526	0.563	0.605	0.652	0.713	0.855
0.83	0.77	0.344	0.373	0.403	0.433	0.466	0.500	0.537	0.578	0.626	0.686	0.829
0.80	0.78	0.318	0.347	0.376	0.407	0.439	0.474	0.511	0.552	0.599	0.660	0.802
0.78	0.79	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.634	0.776
0.75	0.80	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.608	0.750
0.72	0.81	0.240	0.268	0.298	0.329	0.361	0.395	0.432	0.473	0.521	0.581	0.724
0.70	0.82	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.556	0.698
0.67	0.83	0.188	0.216	0.246	0.277	0.309	0.343	0.380	0.421	0.469	0.530	0.672
0.65	0.84	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503	0.646
0.62	0.85	0.135	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477	0.620
0.59	0.86	0.109	0.138	0.167	0.198	0.230	0.265	0.302	0.343	0.390	0.451	0.593
0.57	0.87	0.082	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424	0.567
0.54	0.88	0.055	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397	0.540
0.51	0.89	0.028	0.057	0.086	0.117	0.149	0.184	0.221	0.262	0.309	0.370	0.512
0.48	0.90	-	0.029	0.058	0.089	0.121	0.156	0.193	0.234	0.281	0.342	0.484
0.46	0.91	-	-	0.030	0.060	0.093	0.127	0.164	0.205	0.253	0.313	0.456
0.43	0.92	-	-	-	0.031	0.063	0.097	0.134	0.175	0.223	0.284	0.426
0.40	0.93	-	-	-	-	0.032	0.067	0.104	0.145	0.192	0.253	0.395
0.36	0.94		-	-	-	-	0.034	0.071	0.112	0.160	0.220	0.363
0.33	0.95	-	-	-	-	-	-	0.037	0.078	0.126	0.186	0.329
0.29	0.96	-	-	-	-	-	-	-	0.041	0.089	0.149	0.292
0.25	0.97	-	-	-	-	-	-	-	-	0.048	0.108	0.251
0.20	0.98	-	-	-	-	-	-	-	-	-	0.061	0.203
0.14	0.99	-	-	-	-	-	-	-	-	-	-	0.142

Automatic Capacitor Banks PAB/C1 Series

Applications

Automatic capacitor banks PAB/C1 series- made with power factor correction (PFC) capacitors (Model PAC) are designed to correct the power factor of LV electrical distribution networks in permissible range by a digital microprocessor power factor controller (PFC Regulator).

- Big factories
- Small workshops
- Stores and commercial consumers
- Hotels
- Administrative centers
- Commercial and residential complexes
- Hospitals

Advantages:

☒ Intelligent PFC Regulator distributes the load on all steps and therefore reduces the pressure on a single step.

☒ The possibility of displaying the current, voltage, power factor, first step's power, and the reactive power values on the PFC regulator's monitor.

- Alarms system for Overvoltage- under voltage / over current-undercurrent / overcompensation even when all steps are off and under compensation even when all steps are on.
- Use of capacitor duty contactor reduces inrush current of switching and therefore increases life expectancy of capacitor and contactor
- Easy installation and independent of sequence of Phases and CT poles,
- Less volume and weight in comparison with other automatic Capacitor Banks
- Guarantee of all main components like Capacitors, main switch, PFC Regulator, Capacitor Duty Contactor, Fuse basis and the enclosure.
- In higher power rates air circulation is done by a fan
- In case of harmonics more than the standard, the automatic capacitor banks will equipped with Harmonic Filter Reactors. For evaluating your network's harmonic level you should contact with PKC after sales service department.

Technical Specifications

Rated voltage	400V
Rated frequency	50Hz
PFC Regulator	Digital power factor control regulator
Capacitor Contactor	Duty Contactors Ac6
Safety	Separate protection for each step against short circuit by means of fuse
Working temperature rate	-25ºC/+50ºC
Power factor adjustment	0.85 inductive to 0.95 capacitive
Degree of switchgear protection	IP 40 (other protections are also available on request)
Max. total permissible harmonic distortion for current (THD)	10%
Max. total permissible harmonic distortion for voltage(THD)	3%
Type of the capacitors used in the Bank	PAC models

Models and Powers of Automatic Capacitor Banks

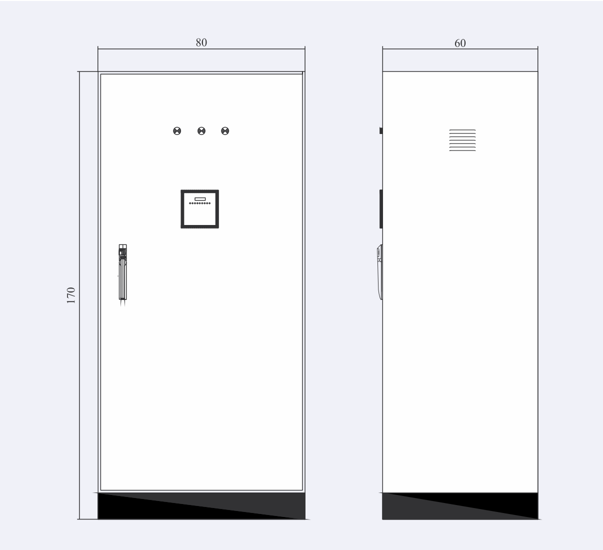
Automatic capacitor bank PAB/C1 series are made in two types;

Type 1/(Model PAB/C11)/ 440V/50 Hz/ wall mounted/ IP 42

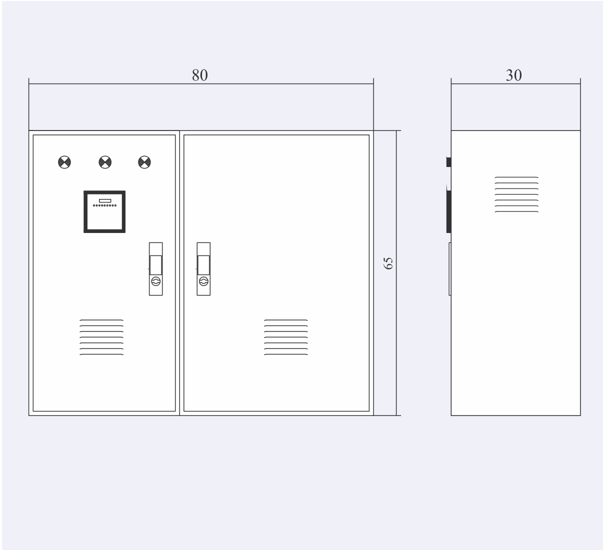
Power Q (Kvar)	Panel Dimension H×W×D (cm)	1st. Step (Kvar)	2nd. Step (Kvar)	3rd. Step (Kvar)	4th. Step (Kvar)	5th. Step (Kvar)	6th. Step (Kvar)	Power in 400 V Q (Kvar)
40	85×65×30	7.5	7.5	12.5	12.5			33
60	85×65×30	7.5	10	12.5	15	15		50
80	85×65×30	10	10	15	15	15	15	66
100	85×65×30	10	15	15	20	20	20	82

Type 2/(Model PAB/C12)/440V/50 Hz/ free stand/ IP 42

Power Q (Kvar)	Panel Dimension H×W×D (cm)	1st. Step (Kvar)	2nd. Step (Kvar)	3rd. Step (Kvar)	4th. Step (Kvar)	5th. Step (Kvar)	6th. Step (Kvar)	Power in 400 V Q (Kvar)
120	170×80×60	10	15	15	20	20	40	100
140	170×80×60	10	15	15	20	40	40	115
160	170×80×60	10	10	20	40	40	40	132
180	170×80×60	10	10	20	40	40	60	148
200	170×80×60	10	20	20	40	40	60	165



Type 2



Type 1

For calculating how many capacitors are needed for your network, refer to the section; Power Factor Correction

For producing automatic capacitor banks with higher power than 200 Kvar as well as improving the power quality, contact Parto Khazen Co.

Table of the needed Fuses and the related cables cross section according to VDE0100

Power Q (Kvar)	230 V				400 V				525 V			
	Current (A)	Fuse Current (A)	Switch Current (A)	Cable Cross section (mm²)	Current (A)	Fuse Current (A)	Switch Current (A)	Cable Cross section (mm²)	Current (A)	Fuse Current (A)	Switch Current (A)	Cable Cross section (mm²)
1	2.5	3.58	4	3x1.5	1.4	2.1	4	3x1.5	1.1	1.6	4	3x1.5
1.5	3.8	5.43	6	3x1.5	2.2	3.1	6	3x1.5	1.7	2.4	6	3x1.5
2.5	6.3	9.01	10	3x1.5	3.6	5.2	6	3x1.5	2.8	3.9	6	3x1.5
5	12.6	18	20	3x2.5	7.2	10.3	16	3x1.5	5.5	7.9	16	3x1.5
7.5	18.8	26.9	32	3x6	10.8	15.5	16	3x2.5	8.3	11.8	16	3x2.5
10	25.1	35.9	40	3x6	14.5	20.7	25	3x2.5	11.0	15.7	16	3x2.5
12.5	31.4	44.9	50	3x6	18.1	25.8	32	3x4	13.8	19.7	25	3x2.5
15	37.7	53.9	63	3x10	21.7	31.0	32	3x6	16.5	23.6	25	3x4
20	50.2	71.8	80	3x16	28.9	41.3	50	3x10	22.0	31.5	32	3x6
25	62.8	89.8	100	3x25	36.1	51.7	63	3x10	27.5	39.4	50	3x10
30	75.4	108	125	3x35	43.4	62.0	63	3x16	33.0	47.2	50	3x10
40	100.4	144	160	3x50	57.8	82.7	100	3x25	44.0	63.0	63	3x16
50	125.5	179	200	3x70	72.3	103.3	125	3x35	55.1	78.7	100	3x25
60	150.6	215	250	3x95	86.7	124.0	125	3x50	66.1	94.5	100	3x35
70	176	252	315	3x120	101.2	144.7	160	3x70	77.1	110.2	125	3x50
80	200.8	287	315	3x150	115.6	165.3	200	3x95	88.1	126.0	160	3x70
90	226.1	323	400	3x185	130.1	186.0	200	3x95	99.1	141.7	160	3x70
100	251.3	359	400	2x(3x95)	144.5	206.6	250	3x120	110.1	157.4	160	3x70
110	276.5	395	400	2x(3x95)	159.0	227.3	250	3x120	121.1	173.2	200	3x95
120	301.2	431	500	2x(3x95)	173.4	248.0	250	3x120	132.1	188.9	200	3x95
130	326.7	467	500	2x(3x120)	187.9	268.6	315	3x150	143.1	204.7	250	3x95
140	352	503	630	2x(3x120)	202.3	289.3	315	3x150	154.1	220.4	250	3x95
150	376.3	538	630	2x(3x120)	216.8	310.0	315	3x150	165.2	236.2	250	3x120
160	402	575	630	2x(3x185)	231.2	330.6	400	3x185	176.2	251.9	300	3x120
170	427.2	611	630	2x(3x185)	245.7	351.3	400	3x185	187.2	267.7	300	3x150
175	439.8	629	630	2x(3x185)	252.9	361.6	400	2x(3x95)	192.7	275.5	300	3x150
180	452.2	647	800	2x(3x185)	260.1	327.0	400	2x(3x95)	198.2	283.4	300	3x150
190	477.5	683	800	2x(3x185)	274.6	392.6	400	2x(3x95)	209.2	299.1	300	3x150
200	502	718	800	2x(3x240)	289.0	413.3	500	2x(3x120)	220.2	314.9	400	3x150
225					325.1	465.0	500	2x(3x150)	247.7	354.3	400	3x185
250					361.3	516.0	630	2x(3x185)	275.3	393.6	400	2x(3x95)
275					397.4	568.3	630	2x(3x185)	302.8	433.0	500	2x(3x120)
300					433.5	619.9	630	2x(3x185)	330.3	472.3	500	2x(3x120)
350					505.8	723.3	800	2x(3x240)	385.4	551.1	630	2x(3x185)
400					578.0	826.6	1000	2x(3x240)	440.4	629.8	630	2x(3x185)

Power Factor Correction Regulator

PFC Regulators/Model PRA

The PRA Model PFC Regulator is digitally controlling and adjusting the power factor with the highest possible accuracy and trust in reading the PF without allowing the semi conductors fault effect (Harmonics) influence and creating mistakes in the system. The especial control algorithm, will allow the system properly working even in the high harmonics areas.

Due to its high ability in calculating the reactive power, the PFC Regulator can adjust the PF properly in connecting and disconnecting different steps. Also in case of facing equality of needed power in few steps, it reduces the connection of the same Cap. and distribute to other Cap. and uses them in a equivalent manner. Regulator suitably alarms the operator of any possible failure.

Easy installation

Installation of this regulator is very easy. We have the voltage sample from the network and it is need only to install the Current Transformer (CT) on the third phase.

Simple adjustments

The PRA Model PFC Regulator needs to receive some data about the network and capacitor bank. Those data (listed in below) are transmitted to the regulator in 5 steps and through codes P01 to P05.

1- Primary current of the CT
2- Basic power for the steps
3- Capacitors' nominal voltage
4- Discharging time of each capacitor
5- Each step Coefficient according to the Basic Power (article no. 2)

Sequence of the steps

Except the high accuracy in measurement and ability of displaying the voltage, current and PF, one of the other main advantages of PRA regulator is the regularity and order of the steps. Meaning that in this regulator, there is no need for the steps to be a multiplier of the first step and be necessarily connected to the device in a respective order from small to big. But it is enough that we define a power as basis and then all steps will be a multiplier (between 1 to 16) of this basic power.

Technical Specification

Supply Circuit	144×144 MODELS
Supply Voltage	230 – 415 VAC
Operating Limits	-15%...+10% UE
Rated Frequency	50 or 60Hz
Power Consumption L/L – 400VAC	6.1 VA
Immunity time for Microbreakings	<6ms

Current Input	144×144 MODELS
Rated Current	5A
Operating Limits	0.125...5.5A
Overload Capacity	1.1le
Overload Peak	10 le for 1sec

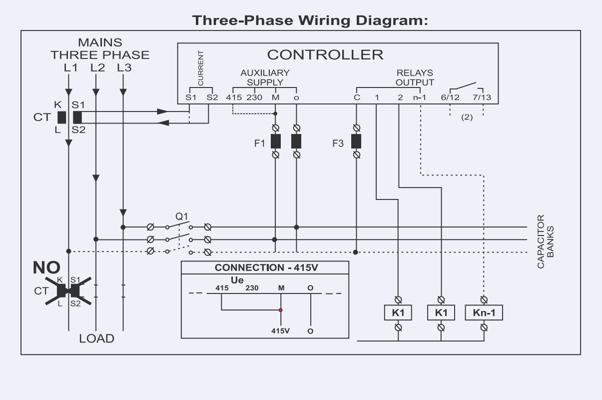
Reading and Control Range	144×144 MODELS
Voltage Reading Limits	195…460 VAC
Current Reading Limits	0.125....5.5A
Type of Current and Voltage Readings	TRMS
Cosφ Adjustment	0.85 Inductive...0.95 capacitive
Tripping Sensitivity	5...600 s/step
Re-connection Spectrum	5...240 seconds
FFT – Harmonic Spectrum	THD% - 64st

Relay Outputs	144×144 MODELS
Number of Outputs	04-06-08-12
Contact Arrangement	1NO
Contacts Capacity	8A – 250VAC (AC1)
Maximum Capacity the Common Contacts	10A
Insulating Category/Rated Voltage VDE0110	C/250-B/400
Maximum Switching Voltage	400VAC
Electrical Contact Life	20×100^{6} ops
Mechanical Contact Life	100×10^{3} ops

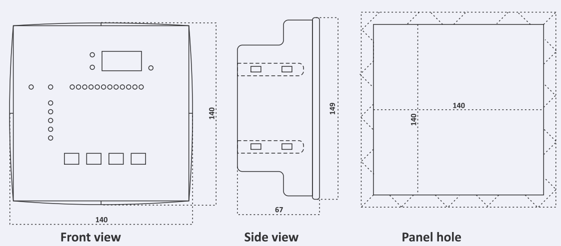
Enclosure and Connections	144×144 MODELS
Type of Terminal	Pluggable
Enclosure Version	Flush mount 144×144
Temperature Work	-10 / +50 °C
Electrical Insulation – Mains/Contact	4 k V
Protection Degree	IP41 Front – IP20 Terminals
Relative Humidity w/o Condensation	95 RH%
Conforming Norms	IEC 60255-5_IEC 60255-6 IEC 60068-2-61_IEC 60068-2-6 EN50081-1_EN50082-2
Dimensions	149 × 149 × 60mm
Weight	520g - 540g - 650g - 700g

Serial Interface	144×144 MODELS
TTL	Standard
Communication Protocol	Proprietary / MODBUS RTU
Connector Type	RJ11

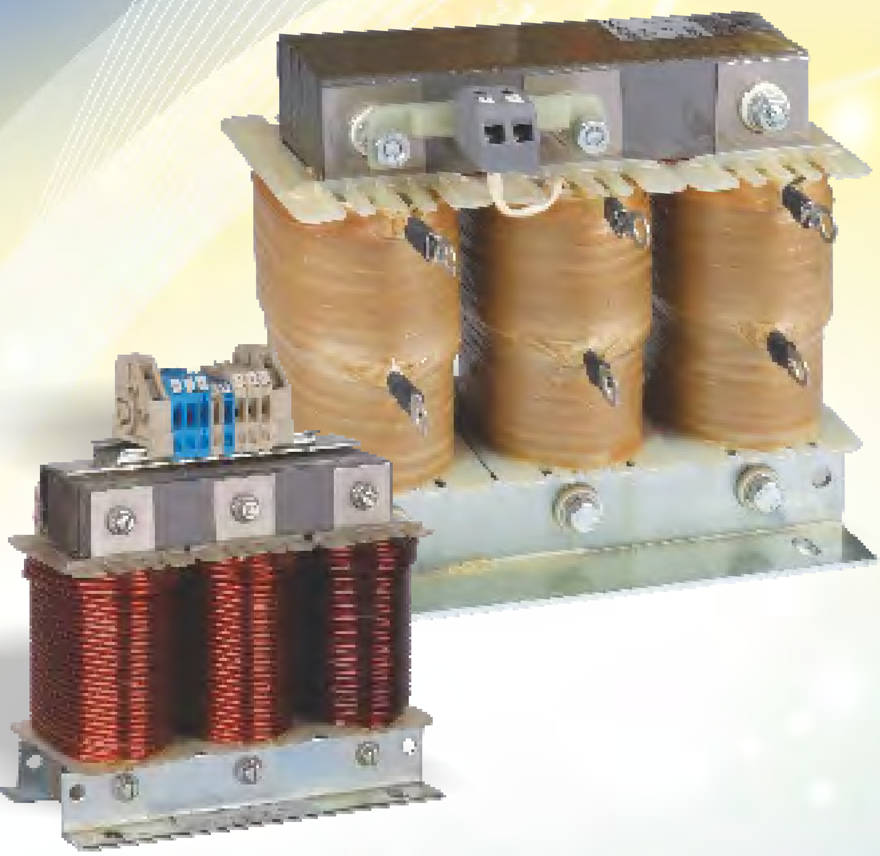
Serial Adapter TTL / USB / 485	ALL DPFC MODELS
Connector RJ11 / USB / 485	Optional order code SCUSB485



Electrical circuit drawing



Dimensional Drawing



Harmonic Filter Reactors

Harmonic Filter Reactors

Today's world is in increasing usage of automation in almost all manufacturing and servicing fields and this change caused the need of using semi-conductors in the controlling circuits instead of relays. The main feature of semi-conductors is changing the sinus wave form of the current into non sinus alternative waves .

The mathematical calculations prove that, every alternative wave is formed of few sinus waves having the main wave's frequency and its multipliers. The wave with main frequency is called the main wave and the other waves are called harmonics. We have for example 3rd and 5th and... harmonics. In other words in a network with 50 Hz frequency, the 3rd harmonic frequency is 150 Hz and the 5th harmonic is 250 Hz .

Considering that the capacitor's impedance is in opposite value with the wave's frequency, then the capacitor's impedance in harmonic areas will be lower and a higher current will pass through it and the life time of capacitor will be shortened.

In case the capacitor resonance frequency with the network is close to one of the harmonics frequency then the situation will be worse.

In order to solve such problem we use a reactor in series with the capacitor. The composition of reactor with capacitor will decrease the frequency resonance to the expected level, and such function is equal to a filter which in low frequencies has the capacitive characteristic and in high frequencies has inductive feature. Such characteristic will avoid the early damage of the capacitor.

The advantages of using Harmonic Filter Reactors

- Reducing the over current at the time of capacitor's switching
- Reducing the capacitor's overloads due to harmonics
- Better life time for the capacitor
- Reducing the overheats in the transformers
- Omitting the unexpected function in the protection circuits...
- Omitting the distortion in the voltage form

How to choose the right reactor for our system

It is very important how to choose the suitable Harmonic Filter Reactor and the qty. of necessary capacitors. For realizing this and catch the best results, we have to respect the below parameters:

- **The series resonance frequency must be chosen according to the level of harmonics analysis in the system.**
- **Because of the inductive nature of the reactor, the capacitor voltage is more than the network voltage. The choice of the capacitor voltage is done according to the resonance frequency.**

☒ **As the capacitor voltage is more than the network voltage and, as the nature of the reactor is inductive, then the created power in the series line is different from the capacitor's power. For this reason, we need to use the corrected capacitance in order to reach the desired power.**

☒ The capacitor voltage between each 2 phase is equal to:

$$Uc = \frac{U}{1 - p}$$

- After choosing the resonance frequency, the related capacitor capacity will be defined.

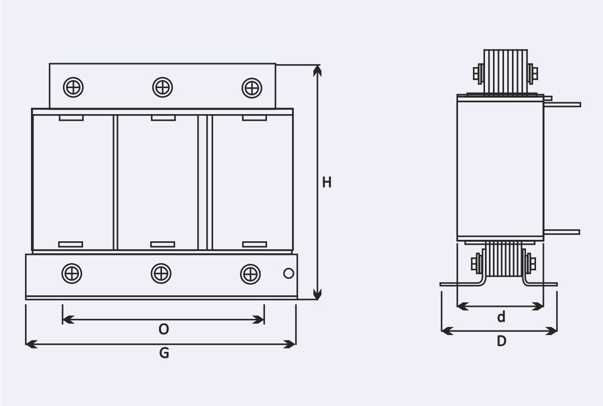
Technical Specification

Nominal Voltage of the Network	400V
Nominal Power	According to the specification tables
Network frequency	50 Hz
P coefficient	5.67%, 7%, 14%
Design	Three-Phase/Iron Core with air distance
Bobbin	Copper / Aluminum
Core	Iron with high magnetism
terminal	Terminal Block or Copper cushion
Protection degree	IP00
Thermostat	With NC Contacts for temperature protection
Air condition	Natural Air circulation
Standard	EN/IEC 61558- 2-20:

Important points to consider, when using harmonic filter reactors

- The capacitor & the reactor must be absolutely in accordance with each other. Meaning that the capacitance of the capacitor must be equal to the values mentioned in the Following tables.
- The reactors produce high heats and we must install them higher than the capacitors and in good air conditioning.
- The Min. distance between the reactors themselves and with the enclosure body must be between 5 to 7 cm.

Dimensional Drawings:



400V 50Hz Utility Voltage, 210Hz Resonance Frequency (p=%5,67)

Model	Power (kvar)	L (MH)	I rms (A)	I th (A)	I lin (A)	Dimension W x D x H (mm)	Weight (kg)	Suitable Capacitor C 3*(μf)	Suitable Capacitor Q (kvar) 440 V	Suitable Capacitor Q (kvar) 525 V
PKR- 400/5.67/5	5	6.12	7.2	8.28	12.96	180x90x175	6.00	31.2	5.69	8.1
PKR- 400/5.67/7.5	7.5	4.08	10.82	12.44	19.48	180x110x180	9.00	46.7	8.52	12.13
PKR- 400/5.67/10	10	3.06	14.43	16.59	25.97	180x105x215	10.00	62.5	11.4	16.23
PKR- 400/5.67/12.5	12.5	2.44	18.04	20.75	32.47	240x120x275	11.00	78.2	14.26	20.3
PKR- 400/5.67/25	25	1.22	36.00	41.40	64.80	260x165x180	18.00	156	28.45	40.5
PKR- 400/5.67/50	50	0.61	72.00	82.80	129.60	300x170x225	26.00	312.7	57.03	81.19
PKR- 400/5.67/75	75	0.40	108.25	124.49	194.85	300x185x260	35.00	469	85.53	121.77
PKR- 400/5.67/100	100	0.30	144.33	165.98	259.79	360x200x320	54.00	625.5	114.07	162.4

400V 50Hz Utility Voltage, 189Hz Resonance Frequency (p=%7)

Model	Power (kvar)	L (MH)	I rms (A)	I th (A)	I lin (A)	Dimension W x D x H (mm)	Weight (kg)	Suitable Capacitor C 3*(μf)	Suitable Capacitor Q (kvar) 440 V	Suitable Capacitor Q (kvar) 525 V
PKR- 400/7/5	5	7.66	7.2	8.28	11.52	180x95x175	6.00	30.8	5.62	8
PKR- 400/7/7.5	7.5	5.11	11	12.44	17.31	180x110x180	8.00	46.2	8.43	12
PKR- 400/7/10	10	3.83	14.43	16.59	23.09	240x110x235	11.00	61.6	11.23	15.99
PKR- 400/7/12.5	12.5	3.06	18.04	20.75	28.86	210x120x210	11.00	77	14.04	19.99
PKR- 400/7/25	25	1.53	36.00	41.40	57.60	260x165x180	19.00	154.18	28.12	40.03
PKR- 400/7/50	50	0.76	72.00	82.80	115.20	300x185x225	32.00	308.36	56.24	80.06
PKR- 400/7/75	75	0.51	108.25	124.49	173.20	360x190x285	41.00	462.55	84.36	120.10
PKR- 400/7/100	100	0.38	144.33	165.98	230.93	360x195x315	50.00	616	112.34	159.94

400V 50Hz Utility Voltage, 134Hz Resonance Frequency (p=%14)

Model	Power (kvar)	L (MH)	I rms (A)	I th (A)	I lin (A)	Dimension W x D x H (mm)	Weight (kg)	Suitable Capacitor C 3*(μf)	Suitable Capacitor Q (kvar) 525 V
PKR- 400/14/5	5	16.47	7.2	12.42	10.80	240x110x135	10.00	28.54	7.42
PKR- 400/14/7.5	7.5	10.98	11	18.66	16.23	200x130x210	11.00	42.81	11.12
PKR- 400/14/10	10	8.23	14.43	24.89	21.65	240x130x265	17.00	57.08	14.82
PKR- 400/14/12.5	12.5	6.59	18.04	31.12	27.06	250x160x265	19.00	71.35	18.53
PKR- 400/14/25	25	3.29	36.00	62.10	54.00	330x205x240	34.00	142.70	37.05
PKR- 400/14/50	50	1.64	72.00	124.20	108.00	330x215x270	45.00	285.40	74.10
PKR- 400/14/75	75	1.09	108.25	186.73	162.38	300x230x320	64.00	428.11	111.15
PKR- 400/14/100	100	0.82	144.33	248.97	216.50	420x235x375	77.00	570	147.99

PKC

Fan Filter, Filter, Heater and Thermostat

Electrical panels' products

1-Filter Fans

High performance and easy installation

☒ Modern Design

A positive visual impact is given by the up-to-date design of the grills and minimal external projection.
All moulded parts are made of highly resistant and self-extinguishing material. The color standard is RAL 7032.

☒ Quick Installation

Installation is fast on the enclosure panel with thickness range of 1.2 - 2.4mm by snap-in fixing system. No screws are needed.

☒ Variety in air flow rating

The range of the air flow rating in the wall mounted types is 24 to 630 m^3/h and in roof mounted ones is 600 to 1550 m^3/h. For wall mounted fans, default air flow direction is from the outside towards the inside of the enclosure and for the roof mounted is opposite.

☒ Max Outside projection

The max. projection outside the enclosure is 5mm.
This is an advantage to avoid any problem during transportation.

☒ High Performance

The best quality ball bearings are used in manufacturing the fans. They have high working performance. Their life time is about 30000h. and can work under 55^{o}C.

☒ IP Degree

The configuration of the grill, the self-adhesive gasket and the filter mat ensure an IP 54 protection degree for wall mounted fans and IP 44 for roof mounted ones.

☒ Power Supply

The fans are available in 230 VAC (Single Phase) and 400 VAC (3 Phase). In addition, 24 and 48 VDC versions are available up to 230 m^3/h.

☒ Filter Units

Filter fans are used together with filter fan units. Filter units are available in different sizes.

2-Heaters

Heaters are often necessary to prevent failures or corrosion caused by low temp. or high humidity inside the enclosure.

☒ Safety

Surface temp. is limited by a PTC or over temp. safety switch.

☒ Quick Installation

Installation is fast and mounting is possible on 35mm Din Rail.

☒ Range of Products

SHT-PTC Heaters with connection on terminals, 25-150 W
SHT/W-PTC Heaters with wire connection, 15-50 W
FSHT-Resistor heaters, fan assisted, 250-500 W
MHT-PTC mini heaters, 5-30 W
FMHT-PTC mini heaters, fan assisted, 75-230 W

3-Thermostats

Thermostats are designed for Din rail 35mm fast mounting.
They are working on the base of bimetallic junction.

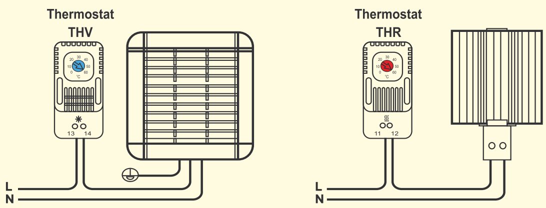
☒ Range of Products

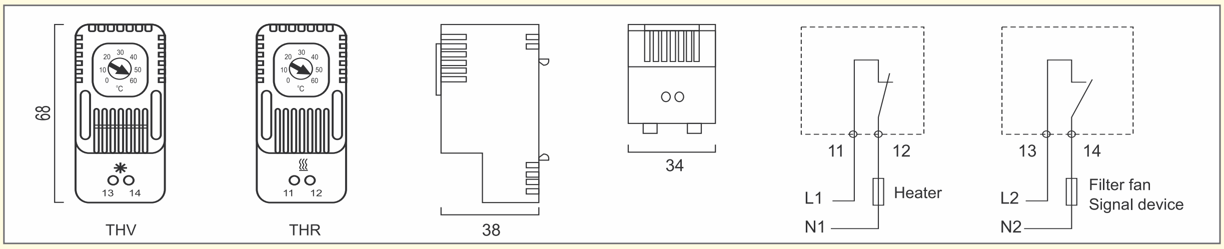
THV-Typically used for ventilation control
THR-Typically used for heating control
THRV-Typically used for ventilation and heating control

Technical Data

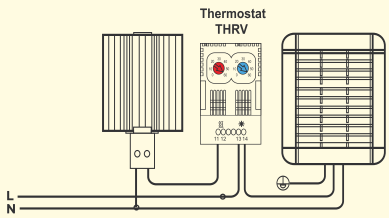
Specification	Unit	THV02	THR02	THRV22
Contact function	-	NO	NC	NC & NO
Temp. setting range	°C	0/+60	0/+60	0/+60
Max. switching current-250VAC	A	10	10	10
Temp. sensor type	-	Thermostatic bimetal	Thermostatic bimetal	Thermostatic bimetal
Life duration	cycle	> 100,000	> 100,000	> 100,000
Electrical connections	-	2-pole terminal for 2.5 mm^2 wire	2-pole terminal for 2.5 mm^2 wire	4-pole terminal for 2.5 mm^2 wire
Moulded case	-	-	-	-
Protection degree (IP)	-	IP 20	IP 20	IP 20
Operating temp.	°C	-25/+80	-25/+80	-25/+80
Mounting	-	Clip for mounting on 35mm Din rail	Clip for mounting on 35mm Din rail	Clip for mounting on 35mm Din rail
Dimension	mm	68 × 34 × 38	68 × 34 × 38	68 × 53 × 38
Weight	gr	48	48	80

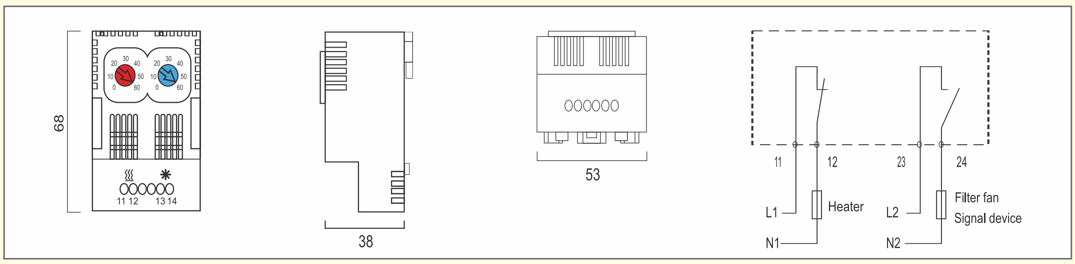
THV & THR Types





THRV Type





PKC

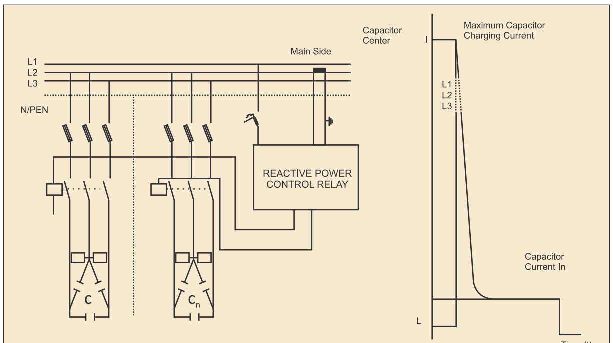
Capacitor Duty Contactors

Capacitor Duty Contactors

Why using Capacitor Duty Contactors?

During exact moment of switching, a capacitor effectively appears as short circuit. The magnitude of capacitor inrush or charging current will depend upon value of AC Voltage level at instant of switching, together with impedance of feeders cable & supply transformers. In case of individual capacitors loads, charging current peaks of up to 30 times the rated capacitor current can occur. Whereas, for multi-stage capacitor, the in-rush current greater than 180 times the rated capacitor current can occur.

Such large-current can flow through contactor since initial in-rush current is taken from both mains-supply & capacitor already connected. As in-rush current of such high magnitude is undesirable & likely to weld main contacts of Standard Duty Contactors.



Multi Stepped Capacitor Bank

Operation:

PK's Capacitor Duty Contactors are specially designed to meet Capacitor Duty application. Contactor are fitted with block of three early make auxiliary contacts in series with quick discharge damping six – resistors – 2 per phase to limit peak current to value within Contactor making capacity such that normal rated capacitor current is carries by main contacts which, after closing, effectively short out the resistors.

Product Range:

PK contactors are produced in 3 phase form with 415V from 10 to 60Kvar in eight ratings, according to the IS-13947-4-1 and IEC-947 standard.

Advantages:

- Conforms to utilization category AC 6B as per IS 13947-4-1
- Saves cots of expensive replacements
- High electrical life
- Reduced watt loss during 'ON' condition, saves energy
- High Safety
- No risk of dangerous voltage
- Switching of Capacitor bank in parallel without de-rating
- Less maintenance & down - time

Recommendation:

☒ Limit the Current Surge by inserting quick discharge series damping resistance.

- Use Special Capacitor Duty Contactors.

Specification:

KVAR ratings at 50/60 Hz t <- 55 °C (3)		Instantaneous Auxiliary Contacts (1)		Maximum Operating Rate	Electrical life at rated load	Basic reference complete with code including control cicuit voltage (4) fixing (2)
200 V 240 V	400 V 440 V	NO	NC	Operations/hour	Operations	
5.5	10.0	1 0	1 2	240	200000	PK1-D10K11 PK1-D10K02
6.7	12.5	1 0	1 2	240	200000	PK1-D12K11 PK1-D12K02
8.5	16.7	1 0	1 2	240	200000	PK1-D16K11 PK1-D16K02
10.0	20.0	1 0	1 2	240	100000	PK1-D20K11 PK1-D20K02
15.0	25.0	1 0	1 2	240	100000	PK1-D25K11 PK1-D25K02
20.0	33.3	1	2	240	100000	PK1-D33K12
25.0	40.0	1	2	100	100000	PK1-D40K12
40.0	60.0	1	2	100	100000	PK1-D60K12

Notes:

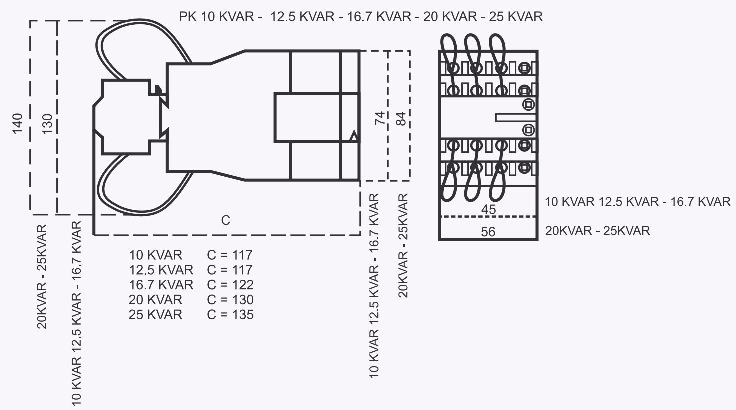
(1) Additional Auxiliary Contact block (Side mounted) type TA8DN11 or TA8DN20 can be mounted, if required
(2) Contactor Type PK1D12K-PK1D25K: Suitable type clip-on mounting into 35mm DIN rail
Contactor Type PK1D33K-PK1D60K: Suitable type clip-on mounting into 75mm DIN rail
(3) Average temperature over a 24-hour period, in accordance with IEC 70 and 831

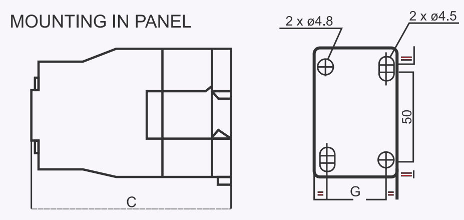
(4) Coil Reference (Standard)

Volts AC	24	48	110	120	208	220	230	240	277	380	400	415	440	480	575	600
50 Hz	B5	E5	F5			M5	P5	U5		Q5	V5	N5	R5			
60 Hz	B6	E6	F6	G6	L6	M6		U6	W6	Q6			R6	T6	S6	X6
50/60 Hz	B7	E7	F7	G7		M7	P7	U7		Q7	V7	N7	R7			

Dimensional Drawing

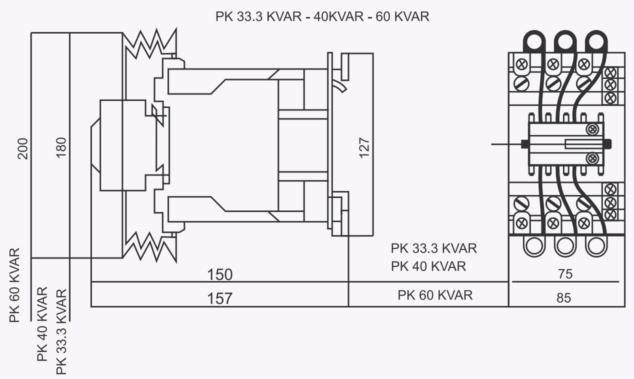
PK1-D10K, D12k, D16K, D20K, D25K

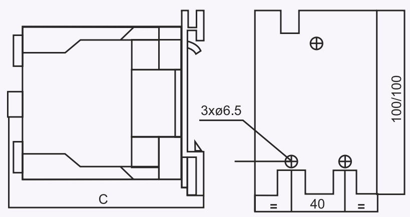




PK	10 KVAR	12.5 KVAR	16.7 KVAR	20 KVAR	25 KVAR
C	80	80	85	93	98
G	35	35	35	40	40

PK1-D33K, D40K, D60K





PK	33.3 KVAR	40 KVAR	60 KVAR
C	114	114	125

PKC

Motor Run Capacitors

Motor Run Capacitors

Motor run capacitors are produced under the latest technology and according to IEC 252 standard.
BOPP film is dielectric material and its electrode prepared by very thin metallic layer in vacuum evaporation process.
Therefore, one of the important features of these capacitors is self-healing property. After self-healing, the capacitors continue working automatically.
Due to the used technology in the production of dry capacitors, they are free from the leakage materials and pollutants of environment.

Application

Motor run capacitors are used in series to the auxiliary winding of a single phase motor allowing it to start and increase the torque while working. This type of capacitor can also be used in general AC applications.
The necessary capacitor's voltage & capacitance in single phase motors, is not only depending on obtaining the desired torque, but more is dependent on the motor's structure. Therefore there is no a specific fix way to calculate and choose the exact capacitor that is needed. It is important to study and care about the motor manufacturer instructions.
But anyway the below table (prepared considering all existing motors) which is a guide for choosing the approximate capacitance of the capacitor is useful.

The table of calculation approx. capacitance for the asynchronous single phase motors

Electromotor Power	2 Pole, 3000 RPM 220V, 50Hz	4 Pole, 1500 RPM 220V, 50Hz	6 Pole, 1000 RPM 220V, 50Hz
0.1 HP	6.3 μF	6.3 μF	-
0.25 HP	10 μF	12.5 μF	10 μF
0.5 HP	16 μF	16 μF	20 μF
0.75 HP	20 μF	20 μF	25 μF
1 HP	25 μF	25 μF	25 μF
1.5 HP	32 μF	32 μF	36 μF
2 HP	40 μF	40 μF	50 μF
3 HP	60 μF	60 μF	-

1)To remind that the mentioned capacitances in the above table are approximate and the exact values must be given by the electromotor manuf.

Technical specification of the motor running capacitors

Nominal Voltage (VAC)	400, 450, 50
Nominal Frequency (Hz)	50
Capacitance Tolerance	±5% ، ±10%
Working Temp. range (˚C)	-25˚C / +85˚C
Working Class (Life Time)	A (30000 hours) B (10000 hours) C (3000 hours) D (1000 hours)
Dissipation Factor (tg δ)	Less than 0.002 at 50 Hz
Voltage Test - Between Terminals - Between Terminal & Can	 2 Un for 2 sec. 2000 V for 2 sec.
Voltage permitted overload Current permitted overload	10% 30%
Type of Terminals	Wire, Cable, 6.3 mm Tag
Class of Safety protection	P0 or P2
Mechanical Fastening	Bottom Stud M8
Filling Material	Non PCB
Reference Standard	IEC 60252

The dimensional and packing table for MPC model Plastic Case Motor Run Capacitors

400 Vac - Class B
450 Vac - Class C

Capacitance (μF)	Dimension Dia. × Height (mm)	Packing Qty. Per Box (pcs.)	Packing Box Size (cm)
2	26 × 57	200	34 × 34 × 18.5
2.5	26 × 57	200	
3	26 × 57	200	
3.5	26 × 57	200	
4	26 × 57	200	
4.5	26 × 57	200	
5	30 × 57	200	
6	30 × 57	200	
6.3	30 × 57	200	
7	30 × 57	200	
8	34 × 57	162	
9	34 × 57	162	34 × 34 × 23.5
10	34 × 57	162	
12	34 × 76	162	
12.5	34 × 76	162	
13	34 × 76	162	
13.5	34 × 76	162	
14	34 × 76	162	
16	38 × 76	128	
18	42 × 76	98	
20	46 × 76	98	
25	46 × 96	98	34 × 34 × 27.5
30	46 × 96	98	
35	50 × 96	72	
40	50 × 96	72	

The dimensional and packing table for MAC model Aluminum Case Motor Run Capacitors

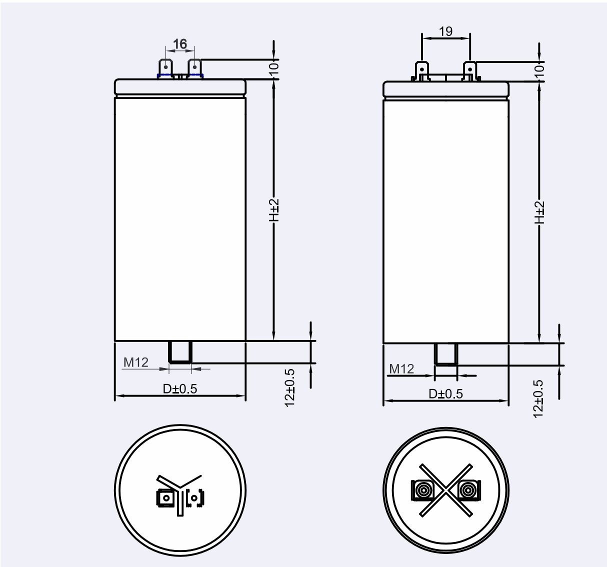
400 Vac - Class B
450 Vac - Class C

Capacitance (μF)	Dimension Dia. × Height (mm)	Packing Qty. Per Box (pcs.)	Packing Box Size (cm)
30	45 × 97	49	34 × 34 × 23.5
35	45 × 137	49	
40	45 × 137	49	
45	45 × 137	36	
50	50 × 137	36	
55	50 × 137	36	
60	55 × 137	36	
65	55 × 137	25	
70	55 × 137	25	
75	60 × 137	25	
80	60 × 137	25	
85	60 × 137	25	
90	60 × 137	25	
95	65 × 137	16	
100	65 × 137	16	

• In case of having over pressure disconnection system, the height of the capacitor will be 8mm less.

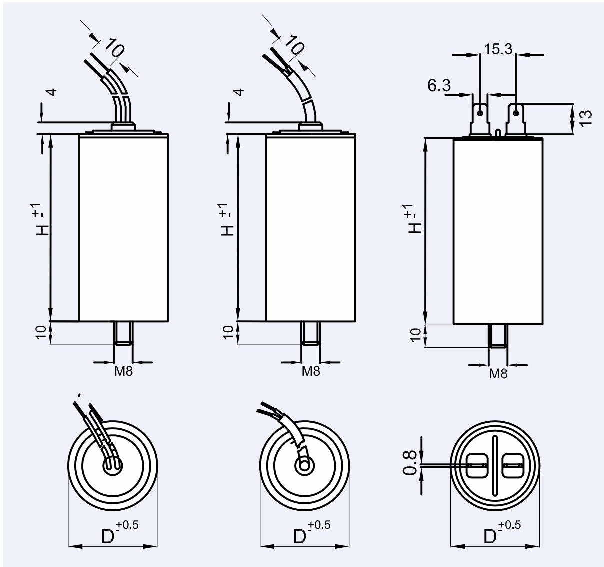
Motor Run Capacitors can be manufactured in aluminum can with or without Overpressure Disconnector.
Overpressure Disconnector is activated whenever the capacitor internal pressure is increased due to excess overload and capacitor defectiveness. While cutting off the capacitor current, it prevents firing and exploding.

MAC Model Drawing



Dia. 60mm and above | Dia. 45 to 55mm

MPC Model Drawing



Wire | Cable | Tag

PKC

Lighting Capacitors

Lighting Capacitors

Lighting capacitors are produced under the latest technology and according to IEC 1048, 1049 (international standard). BOPP film is dielectric material and its electrode prepared by very thin metallic layer in vacuum evaporation process. Therefore, one of the important features of these capacitors is self-healing property. After self-healing, the capacitors continue working automatically.
The Can of capacitors is made from flame retardant Plastic or Aluminium materials (see relevant tables).
Due to the used technology in the production of dry capacitors, they are free from the leakage materials and pollutants of environment.

Application

These type of capacitors have been designed to improve the power factor (Cosφ) and decrease the electrical currents for all gas-discharge lamps such as fluorescent tubes, mercury vapour lamps, sodium vapour lamps, etc.
Lighting capacitors with Overpressure Disconnector can be manufactured in Aluminium Cans.
This system is activated whenever the capacitors internal pressure increased due to high voltages, excess overload, overheating and capacitor defectiveness. While cutting off the capacitor current, it prevents firing and exploding.

Technical specification

Nominal Voltage (VAC)	250
Nominal Frequency (Hz)	50/60
Capacitance Tolerance	±10%
Working Temp. range (˚C)	-25˚C / +85˚C
Dissipation Factor (tg δ)	Less than 0.002 at 50 Hz
Voltage Test - Between Terminals - Between Terminal & Can	 2 Un for 2 sec. 2000 V for 2 sec.
Voltage permitted overload Current permitted overload	10% 30%
Type of Terminals	Wire, 2.8 mm & 6.3 mm Tag
Class of Safety protection	P0 or P2
Filling Material	Non PCB
Mechanical Fastening	Bottom Stud M8
Reference Standard	EN/IEC 61048 EN/IEC 61049

Capacitance of the needed capacitor

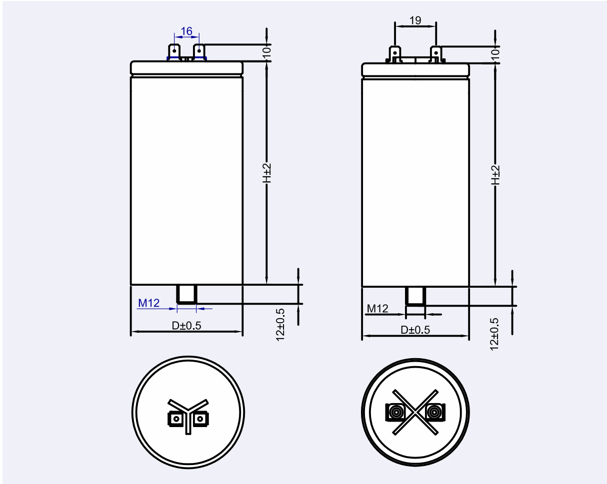
The spec. of Ballast will define the Power Factor situation and the necessary capacitance to choose.
The table given in below is prepared according to the major Ballast existing in the market and can be a guide for defining the needed capacitance.

Table of needed capacitors for power factor correction in different Lamp circuits

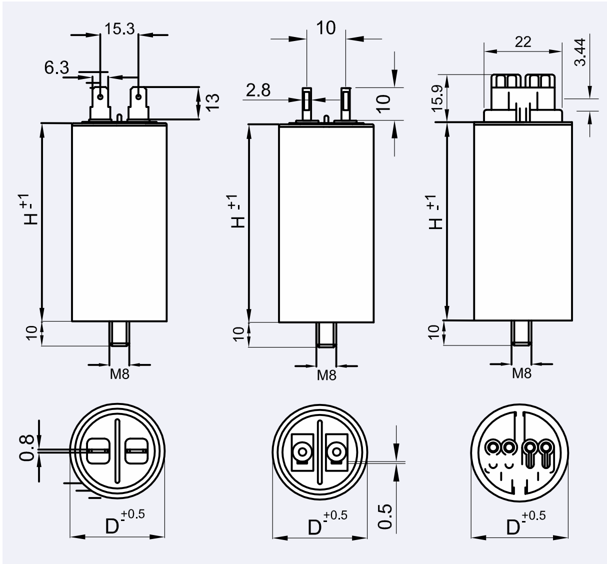
Type of Lamps	Lamp Power (W)	Capacitance (μF)
Fluorecent	4-13	2
	16	2.5
	18-20	4.5
	36-40	4.5
	58-65	7
	80	10
Mercury Vapor	50	7
	80	8
	125	10
	250	18
	400	25
	700	40
	1000	60
Low Pressure Sodium Vapor	18	5
	35	20
	55	20
	90	30
	135	45
	150	20
	180	40
	185	40
High Pressure Sodium Vapor	35	6
	50	8
	70	12
	100	12
	125	18
	150	20
	250	36
	400	45
	1000	100
Metal Halide	35	6
	70	12
	150	20
	250	32
	400	45
	1000	85
	2000/380 V	60/400 V
	3500/380 V	100/400 V

LPC Model / Plastic Case Lighting Capacitors

Capacitance (μF)	Dimension Dia. × Height (mm)	Packing	
		Box Size (cm)	Qty. Per Box (pcs.)
2	26 × 57	35 ×35 × 20	200
2.5	26 × 57	35 ×35 × 20	200
3	26 × 57	35 ×35 × 20	200
3.5	26 × 57	35 ×35 × 20	200
4	26 × 57	35 ×35 × 20	200
4.5	26 × 57	35 ×35 × 20	200
5	26 × 57	35 ×35 × 20	200
6	26 × 57	35 ×35 × 20	200
7	30 × 57	35 ×35 × 20	200
8	30 × 57	35 ×35 × 20	200
9	30 × 57	35 ×35 × 20	200
10	30 × 57	35 ×35 × 20	200
12	30 × 57	35 ×35 × 20	200
13.5	30 × 57	35 ×35 × 20	200
14	30 × 57	35 ×35 × 20	200
16	34 × 76	35 ×35 × 24	162
18	34 × 76	35 ×35 × 24	162
20	38 × 76	35 ×35 × 24	128
25	38 × 76	35 ×35 × 24	128
30	42 × 76	35 ×35 × 24	98
35	46 × 76	35 ×35 × 24	98
40	46 × 76	35 ×35 × 24	98
45	46 × 96	35 ×35 × 27	98
50	46 × 96	35 ×35 × 27	98
55	46 × 96	35 ×35 × 27	98
60	46 × 96	35 ×35 × 27	98
65	50 × 96	35 ×35 × 27	72
70	50 × 96	35 ×35 × 27	72



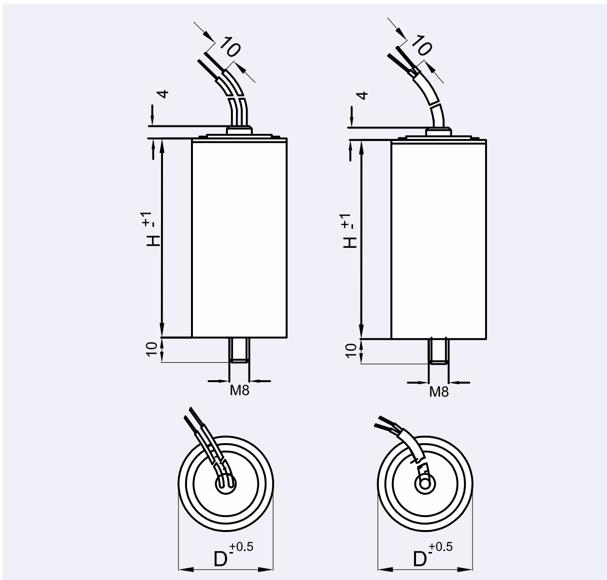
Dia. 60mm and above   Dia. 45 to 55mm



Tag-6.3mm   Tag-2.8mm   Push- in Wire

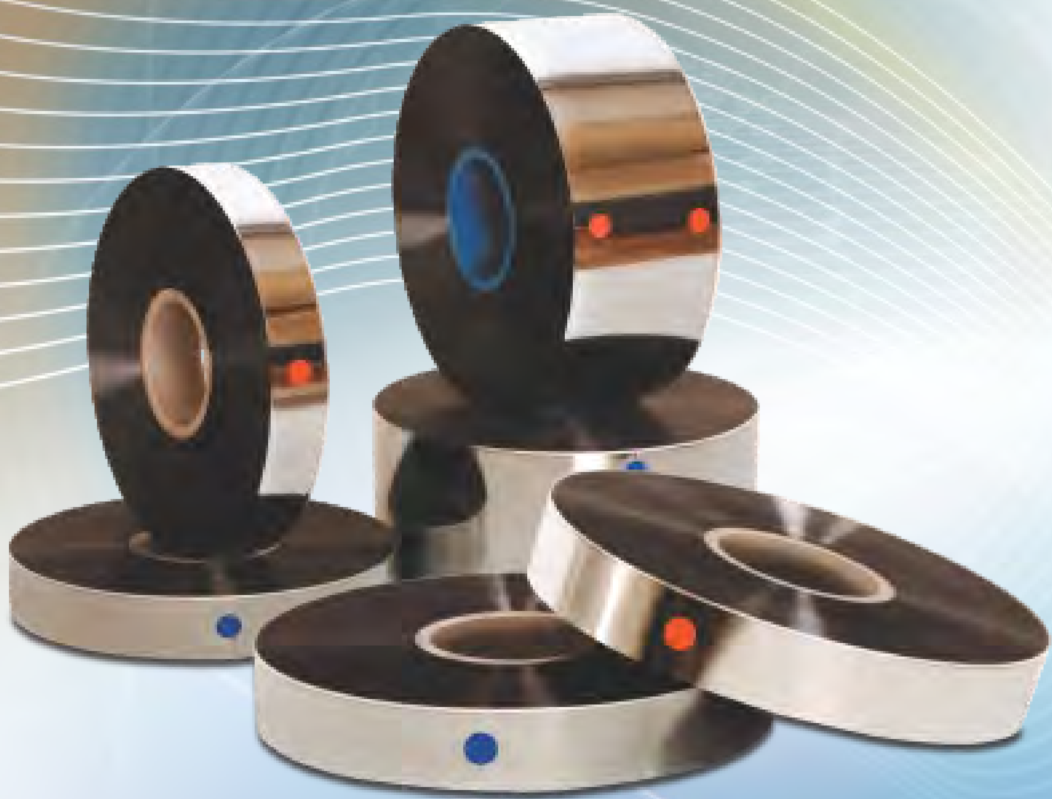
LAC Model / Aluminum Case Lighting Capacitors

Capacitance (μF)	Dimension Dia. × Height (mm)
50	45 × 137
55	45 × 137
60	50 × 137
65	50 × 137
70	50 × 137
75	50 × 137
80	55 × 137
85	55 × 137
90	55 × 137
95	55 × 137
100	60 × 137



Wire   Cable

PKC

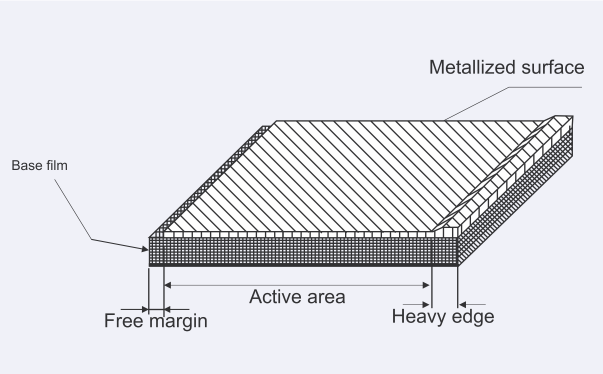


Metallized PP Film For Capacitors

Metallized PP Film

PKC capacitor grade Metallized Films are made of Polypropylene.

The base film (BOPP in micron thickness 4-12 micron) in big jumbo rolls are coated with very thin layer of Zinc and Aluminum in vacuum evaporation process. After the metallization, the films will be cut off in different widths. In order to produce high quality capacitors one edge of the film is not Metallized and the other edge is coated with more metals. The edge without meatl coating is called Free margin and the other edge with metal coating is named Heavy edge.
The most important feature of the capacitors produced by MPP is the self-healing property.



Metallized Film Structure

Advantages

- Using the best raw materials as well as BOPP film made by reputable producers.
- The adhesion of zinc layer will cause the Min. drop in the capacitance over the time.
- Aluminum layer on the surface of the film protect it from oxidation and makes it easy for long storage.
- Thin metal coating on film causes self – healing property .
- Easy and strong connection in spraying process and low losses of capacitors due to higher thickness coating of zinc at the edge of the film (heavy edge) .
- No permanent short circuit because of self – healing property .
- Economic cost because of low raw material consumption.

Electrical & Dimensional Specifications

Type of Dielectric	Polypropylene
Total Resistance (Ω/□)	7.5 ± 2
Heavy Edge Resistance (Ω/□)	3 ± 1
Constant Dielectric	2.2
Dissipation (Dielectric Loss) Factor	2×10^{-4}
Film Thickness (μm)	4 to 12 ± 0.2
Free Margin (mm)	2 , 2.5 & 3, ± 0.4
Film Width (mm)	25, 30, 37.5, 50, 55, 62.5, 75, 100, 110, 120
Film Width Tolerance (mm)	± 0.3, ± 0.5
Roll outer dia. (mm)	240^{+5}_{-10} , 340^{+10}_{-40}
Core inner dia. (mm)	$75^{+1}_{-0.5}$

PARTO KHAZEN Co.

PKC

w w w . p k c - c a p a c i t o r . c o m

- Power Factor Correction (PFC) Capacitors
- Automatic & Fixed Bank Capacitors
- Motor run & Lighting Capacitors
- Capacitor Duty Contactor & Digital PFC Controller
- Harmonic Filter Reactor
- Metallized PP Film For Capacitors
- Panel Accessories

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