# INDTECH®

**POWER CAPACITORS**

*The Reliable Capacitors*


*Power Quality and Power Factor Solutions*

## *Reactive Power Compensation*

IS:2993 IS:1709 IS:13340 BIS Certified CE RoHS compliant


**INDTECH CAPACITORS PVT. LTD.**

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# REACTIVE POWER COMPENSATION


## COMPANY PROFILE

*Indtech Capacitors Pvt. Ltd. one of the leading capacitors manufacturer and supplier in India. Ever since its establishment in 1998, the company has been focusing on creating high quality products that match all your capacitor needs. We take pride in our elite and customized service. Indtech Capacitors is a name that's become synonymous with supreme quality and customer satisfaction. The best part about our services is that we are open to learning. Challenges have never stopped our growth, rather we take them as a learning opportunity. Some of the main primary competitive advantages that you get with Indtech Capacitors include the following :*

- **Innovative and high quality products**
- **On time delivery**
- **Ethical business practices**
- **Reliable and dedicated teams**
- **Client centric approach**
- **Complete quality assurance**

**Create value challenge the future &**



INDTECH® POWER CAPACITORS
*The Reliable Capacitors*

## COMMITMENT TO QUALITY

"INDTECH CAPACITORS PVT. LTD. is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quality."

01

### VISION

With our targeted products and customer centric approach, we envision the organization to become one of the leading names in global market. We continuously make efforts to enhance our output and sustain the quality level to ensure we always adhere to international standards.

02

### MISSION

Our mission is to serve the power sector in the world with our esteemed products. Reaching highest level of excellence through impeccable service, dedicated after sale service, wide range of products, and customer satisfaction is what we as a team work towards. We also strive hard to maintain and uphold the quality standards and business conduct.

03

### VALUES

The values define the character and stature of an organization. For us at Indtech Capacitors, our core values are our pillars of strengths and every day we draw inspiration to do better keeping these values as base. Our core values are -

- **Customer Satisfaction**
- **On – Time Delivery**
- **Integrity**
- **Transparency**

# REACTIVE POWER COMPENSATION

## QUALITY POLICY & CERTIFICATES
with an impressive portfolio

The instruments at Indtech Capacitors pvt. ltd. are always monitored and kept fully calibrated. Calibration certificates available upon request.


**INDTECH CAPACITORS PVT. LTD.**

**QUALITY POLICY**

**WE AT INDTECH CAPACITORS PVT. LTD. ARE COMMITTED TO ACHIEVE TOTAL CUSTOMER SATISFACTION IN MANUFACTURING PLASTIC FILM POWER CAPACITORS (PFC) AND ALLIED PRODUCTS OF CONSISTENT QUALITY AT COMPETITIVE COSTS WITH ON TIME DELIVERY OF THE SAME.**

**THIS SHALL BE ACHIEVED THROUGH TRAINING, CONTINUAL IMPROVEMENT IN TECHNOLOGY SYSTEMS, SKILLS & RISK BASED THINKING.**

**Organization Quality Objectives**

- *TO INCREASE THE CUSTOMER SATISFACTION LEVEL FROM 96% - 98%.*
- *TO ENSURE 100% ON TIME DELIVERY.*
- *TO INCREASE THE TOP LINE GROWTH OF THE COMPANY BY 20% EVERY YEAR.*
- *TO MAINTAIN THE INTERNAL REJECTION LEVELS TO WELL BELOW 1%.*
- *TO MINIMIZE THE CUSTOMER COMPLAINTS TO 2 PER YEAR.*
- *TO DECREASE THE REJECTION RATE FROM 4000 PPM TO 1000 PPM.*

Place : Tronica City
Issue : 02 / Rev: 1
Date : 15.08.2018

ASIF MALIK
PARTNER

We aim at Consistent Quality Control
Customer satisfaction & Reliability

## CREATE VALUE & CHALLENGE THE FUTURE


## PRODUCTION SHOP-FLOOR

# REACTIVE POWER COMPENSATION

DURABLE
Long Lasting

ENERGY
Efficient

RELIABILITY

CONSISTENCY

QUALITY

Power Capacitors - Cylindrical Type

Filter Circuit Reactors

Reactive Power Controller

Capacitor Duty Contactor





We aim at Consistent Quality Control
Customer satisfaction & Reliability



IS:13340

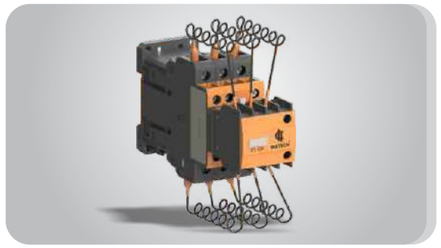
INDTECH® POWER CAPACITORS
The Reliable Capacitors

## Components For Reactive Power Compensation

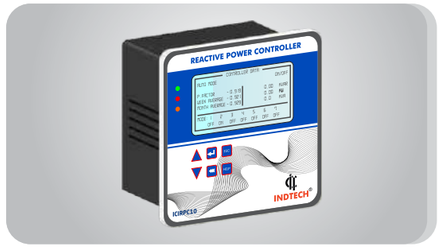
Create value
challenge the future &

## COMPONENTS FOR REACTIVE POWER COMPENSATION

**PFC CAPACITOR**



**DUTY CONTACTOR**




**APFC**


**DETUNED REACTOR**

### PFC CAPACITOR GROUP

- **Box Type (Metal/Plastic)**
  - **ND** — Normal, 1 - 25 kVAr, (Metal Body) Page : 33-34
  - **AD** — Agri, 1 - 5 kVAr, 1ϕ or 3ϕ 50Hz, (Plastic Body) Page : 33-34
  - **HD** — Heavy, 5 - 50 kVAr, (Metal Body), (Safe Device/ Oil Filled) Page : 33-34
- **Cylindrical Type (Aluminium)**
  - **ND/AD** — Normal/Agri, 1 - 25 kVAr
    - **ND/AD** — Safe Device, Burst Proof, 1ϕ(1-5kVAr) or 3ϕ, (Aluminium Body) Page : 17-20
    - **AD** — Non-Safe, Agri Duty, Epoxy Topping Page : 17-20
  - **SD** — Standard, 0.5 - 25 kVAr Page : 21-24
  - **HD** — Heavy, 0.5 - 50 kVAr Page : 25-28
  - **SHD** — Super Heavy, 1 - 30 kVAr Page : 29-32



IS:13340

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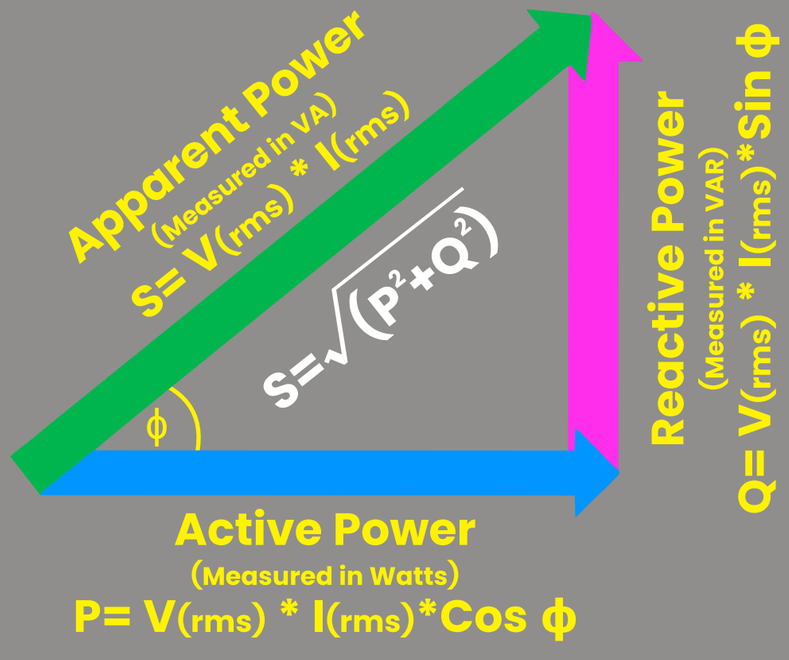
## CONTENTS

# Reactive Power Basics

Reactive power is the power required to create a magnetic field in inductive consumers like motors, transformers, ballasts, induction furnaces, etc., that is, coils of any design.

Reactive power is also known as magnetizing power. It oscillates between the consumer and the energy provider at twice the network frequency and thus loads cables, fuses and transformers.





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## POWER FACTOR CORRECTION - PFC

### ABOUT

The necessity of power quality is increasing, and power factor correction (PFC) will be implemented on a growing scale in future. Enhancing power quality – improvement of power factor – saves costs and ensures a fast return on investment. In power distribution, in low- and medium-voltage networks, PFC focuses on the power factor (cos ø) and the optimization of voltage stability by generating reactive power – to improve voltage quality and reliability at distribution level.

### POWER FACTOR (cos ø)

Low Power Factor results in

- higher energy consumption and costs.
- increased voltage drop in power distribution networks.
- less power distributed via the network,
- power loss in the network.
- higher transformer losses,

### 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.

### 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).

## BENEFITS OF REACTIVE ENERGY MANAGEMENT

- By providing proper Reactive management system the adverse effects of flow of reactive energy can be minimized

### SAVINGS ON THE ELECTRICITY BILL

- Decrease in KVA demand
- Eliminate penalties on reactive energy
- Reduce power loss in transformers
- Reduction in Line Current and hence the cable size.
- Reduction in Switchgear ratings
- Reduction in Voltage fluctuation

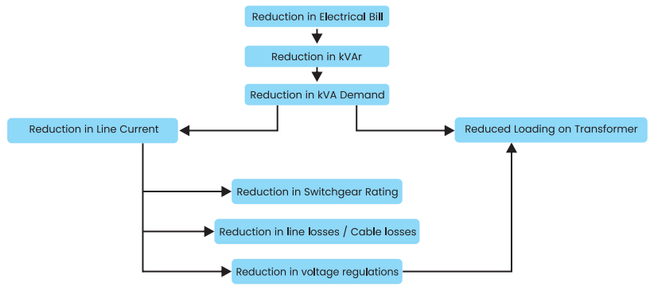

### PROPER UTILIZATION OF SYSTEM CAPACITY BY UTILITIES

- Reduction in line losses.
- Improvement in Voltage.
- Better utilization of substation capacity and thereby more revenue.
- Prevent overloading of Transformers, Transmission & Distribution lines / Cables and Switch gear.
- Resulting in significant economic savings.

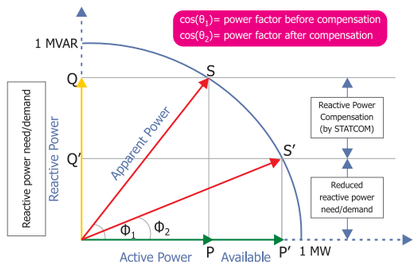
### BENEFITS TO DOMESTIC CUSTOMERS

- No benefit on billing.
- However most of the domestic equipment have capacitor as a part of it. Ex. Electric Fans, Air Conditioners, Domestic Pump Sets, Washing Machines, Television, Musical Systems etc.
- Capacitor in addition help the operation of equipments, it improves the Power Factor and thereby all benefits of improved Power Factor.

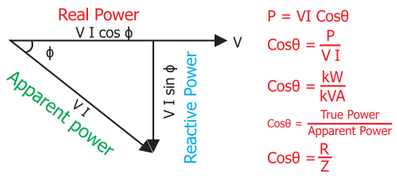
# REACTIVE POWER COMPENSATION




## PRINCIPLE OF REACTIVE ENERGY MANAGEMENT




### Power Triangle & Power Factor




$P = VI\ Cos\theta$

$Cos\theta = \frac{P}{V\,I}$

$Cos\theta = \frac{kW}{kVA}$

$Cos\theta = \frac{\text{True Power}}{\text{Apparent Power}}$

$Cos\theta = \frac{R}{Z}$

As can be seen from the power triangle, using a compensation system reduces the reactive current requirement (reactive energy costs) and thus the apparent power.

### TYPES OF COMPENSATION

1. Fixed compensation This Fixed Compensation uses one or more capacitors to provide a constant level of compensation.

Switching of Capacitor :

- Manual: by circuit-breaker or load-break switch
- Semi-automatic: by contactor
- Direct connection an appliance and switched with it

These capacitors are applied: At the terminals of inductive loads (mainly motors), at bus bars connecting numerous small motors and inductive appliances for which individual compensation would be too costly In cases where the load factor is reasonably constant.

2. Variable compensation

- APFC panels • Contactor / Thyristor based ePFC

The primary reason for Variable compensation is the variation of loads in the network. In many applications the process are not constant through out the day, hence the reactive energy required varies as per the load profile, to eliminate the risk of leading power factor and to optimize the kVA demand, the variable compensation techniques are used.

### Other reasons for reactive power compensation

Thus, the main objective of reactive power compensation is to reduce the reactive power costs billed by the energy provider to "zero."

Another reason for reactive power compensation is to reduce the current load. For this, let's take a closer look at the formula for active power:

$P = U \times I \times \cos\varphi \times \sqrt{3}$

If we apply it to the current, this results in the following formula:

$I = \frac{P}{U \times \cos\varphi \times \sqrt{3}}$

The current thus depends on the power factor cosφ. Let's calculate the current reduction using an example:

An additional consumer with a power consumption of 35 A is to be connected to a sub-distribution unit with 250 A at an outgoing line. The following values were measured:

U = 400 V

I = 238 A

cosφ = 0,72

$P = U \times I \times \cos\varphi \times \sqrt{3} = 400\ V \times 238\ A \times 0{,}72 \times \sqrt{3} = 118.700\ W$

If you increase the power factor cosφ to 0.97 by compensation, the current is reduced from 238 A to:

$I = P/(U \times \cos\varphi \times \sqrt{3}) = 118.700\ W / (400\ V \times 0{,}97 \times \sqrt{3}) = 176\ A$

By compensation of the reactive power, the current consumption was reduced by 62 A. Now, the consumer still required can be connected with 35 A.

### Why does the energy provider bill the reactive energy?

The degree of load created by network transformers, transmission lines and power plants is expressed as apparent power (S). It is calculated from the active power (P) and reactive power (Q).

$S = \sqrt{(P2 + Q2)}$

As can be seen from the formula, the transmission equipment of the network operator is additionally loaded by the reactive power. To keep the current-related losses to a minimum and to guarantee economic energy transport, network operators stipulate a minimum power factor cosϕ. This describes the ratio of active to apparent power.

$\cos\phi = P/S$

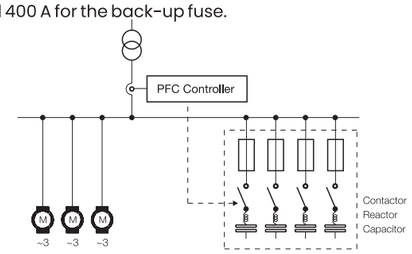
Energy meters for commercial and industrial use not only measure the active energy but also the reactive energy, which is billed in accordance with the electricity supply agreement. For most energy supply networks, a cosϕ of 0.9 is specified. Here, 50% of the consumed active energy obtained from the power supply network may be taken as reactive energy free of charge in the billing period.





### Installing reactive power compensation

Connection to the distribution is done in a similar way as for a larger consumer. The wire cross-section and back-up fuse are defined depending on the compensation selected. In our example, the 200 kVAr system consumes 288 A of current (1.44 A per kVAr). 3x240/120 mm² is chosen as the wire cross-section and 400 A for the back-up fuse.




Schematic structure of a reactive power compensation system.

To enable automatic control, the instantaneous cosϕ is needed for the controller. This is determined by way of a current and voltage measurement. The controller takes the measuring voltage from the supply voltage for compensation. With a current transformer installed in the supply line to the energy provider, the controller can now calculate the reactive power required and compensate the system of the customer.

### Disturbances in compensation systems

Consumers have changed in recent years. Motors are for example equipped with frequency converters, electronic control gears have become standard in illumination and clocked power supply units in power electronics. The current consumption of these consumers is not sinusoidal, creating a voltage drop at the network impedances. This drop is sinusoidal but has many times the fundamental frequency. These harmonic voltages occur with frequencies of 150 Hz, 250 Hz, 350 Hz, etc.

But how does a capacitor function in a network where harmonic voltage is present? The reactance Xc of a capacitor depends on the frequency.

$Xc = \frac{1}{(2 \times \pi \times f \times C)}$

Looking at the formula, it becomes clear that with higher frequencies, the reactance Xc of the capacitor decreases. What does this mean for us in practice? Depending on how much it is loaded with harmonic voltages, the amount of current a capacitor draws increases. This in turn results in a higher thermal load on the capacitor, leading to a shorter operating life. The capacitor's life span is halved when the maximum temperature is exceeded by

7 °C .

Another problem in this context is the possible resonance in low-voltage networks. In this case, the reactance of the inductance and capacitance is the same at the resulting resonance frequency. The resonance frequency fr can be calculated using the following formula:

$fr = 1/[2 \times \pi \times \sqrt{(L \times C)}]$

## FEATURES OF PFC CAPACITORS

### MPP Technology

When it comes to low-voltage power factor correction, MPP Technology (metalized plastic film/polypropylene) has demonstrated that it is currently the most suitable and most economic technology. The thickness of the dielectric differs as a function of voltage rating. The metallization (with zinc and aluminum as its major constituents) and edge enhancement with extra junctions or cross-profile metallization play a significant role in achieving high current handling and stable capacitance at high operating temperatures. Heavy- edged and special film cutting technique (optimized combination of wave and smooth cuts) produces a maximum effective surface for the metal spraying or contacting process (winding design). This results in exceptional surge current capability. The pinching effect on the film edge of the winding – the cause of contact edge problems – is demonstrably eliminated in this way.

### High Temperature Capability

The low loss of MPP film combined with the superior thermal conducting properties of polyurethane permits operation at temperatures up to 80 °C hot spot temperature.

### Triple safety system

Self-healing technology, over pressure disconnection and polyurethane impregnation technology contribute to reliable and safe PFC capacitor products.

### Polyurethane Resin

The active winding elements are heated and then dried for a defined period. 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 capacitors are filled with polyurethane hermetically sealed in cases (e.g. aluminum). The elaborate process ensures excellent capacitance stability and long service life.

# REACTIVE POWER COMPENSATION

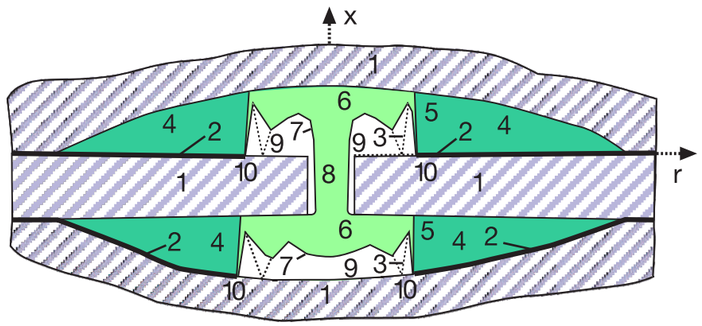
## Self Healing

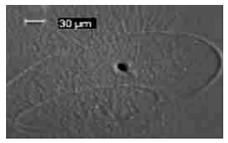
An electric breakdown is possible in the capacitor film due to electric or mechanical over stress. Due to this a small area of metallization will get evaporated and the capacitor will continue to be in service. Continuation of these phenomena will reduce the capacitance value as well as life of the capacitor over a period of time.

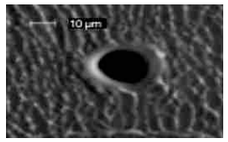
Self-healing is a process by which the capacitor restores mitself in the event of a fault in the dielectric which can happen during high overloads, voltage transients, etc.

When insulation break down, a short duration arc is formed. The intense heat generated by this arc causes the metallization in the vicinity of the arc to vaporise.

Simultaneously it re-insulates the electrodes and maintains the operation and integrity of the capacitor.




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)

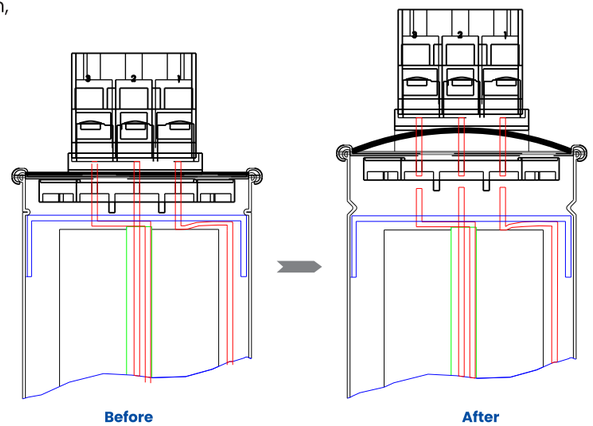
### Overpressure Sensitive Disconnector (OSD)

Electrical components do not have unlimited useful life; this applies to self-healing capacitors too. As polypropylene-type capacitors seldom produce a pronounced short-circuit, fuses do not offer reliable protection.

All capacitors featured are consequently fitted with a disconnection that responds to over pressure. If numerous electric breakdowns occur at the end of useful life or as the result of thermal or electric overload, the formation of gas produces a fast rise in pressure inside the capacitor case. With cylindrical cases this causes a change in length because of curvature of the lid or stretching of the expansion bead. Expansion beyond a certain degree will separate the internal wires and disconnect from the line. Then the capacitor receives no more energy and the development of gas stops.

To ensure full functionality of an over pressure disconnection, its elastic elements must not be hindered, i.e.

- Connecting lines must be flexible leads (cables),
- There must be sufficient space for expansion above the connections (stated for the different models),
- Folding beads must not be retained by clamps.








INDTECH® POWER CAPACITORS *The Reliable Capacitors*

## PFC CYLINDRICAL CAPACITOR

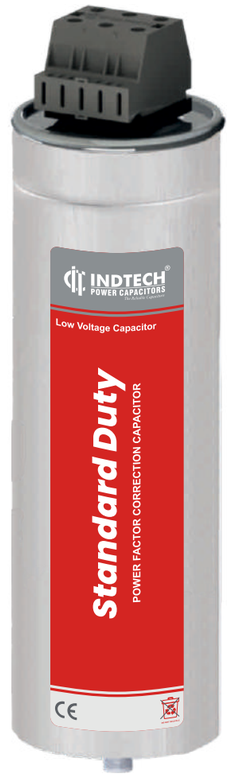
- Semi Dry Resin (Polyurethane)
- Impregnated Stacked Winding
- Dual Safety System

### General

The Indcap-C series is a well proven and reliable MPP (metalized polypropylene) capacitor series for AC current applications.

The power range varies from 0.5 to 50.0 kVAr for 3 phase capacitor and 0.5 to 10 kVAr for single phase capacitor

The Indcap-C capacitor is especially intended for power factor correction in industrial and semi-industrial applications. The capacitors are manufactured using metalized polypropylene film as dielectric and housed in a cylindrical aluminum case.




### Applications

Power factor correction (PFC) Automatic capacitor banks Fixed PFC applications, e.g. motor compensation AC power electronics Uninterruptible power supplies (UPS) Drive engineering

De-tuned PFC systems

### Features Electrical

- Up to 50 kVAr per case for three-phase applications
- Up to 6 kVAr per case for single-phase applications
- Long useful life, ≥100 000 hours
- High pulse current with- stand capability (200 * IR)

### Mechanical & Maintenance

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

### Safety

- Self-healing
- Over pressure disconnection
- Isolated terminal (Ip20)

### Environment

- Non-polluting
- Environment friendly product
- PCB-free

### Indcap-C capacitor selection

To specify and select the capacitors for PFC several factors affect the performance and the expected useful live of the capacitors:

- **Voltage, Harmonics, Temperature, Total RMS current, Inrush current, Switching operations**

Permanent over voltage shortens the useful live of a capacitor. The capacitor's rated voltage must be equal or higher than the operating voltage of the circuit to which the capacitor will be connected to.

Harmonics produce over voltage and overcorrect on the capacitors themselves. If the total harmonics distortion level for voltage (THD-V) e.g. exceeds 5%, serious damages to installation may occur by the resonance of the circuit. In such cases usage of series reactors (de-tuning) is recommended.

Operation of the capacitors above the upper category temperature level will accelerate the degradation of the dielectric and shorten the capacitor's useful live.

By keeping min. 10 mm spacing and Indcap-C capacitors mounted in upright position, better thermal conditions will ensure best performance and a longer useful live.dielectric and shorten the capacitor's useful live.

# REACTIVE POWER COMPENSATION

Residual voltage should not exceed 10% of rated voltage while re-switch- ing capacitors. During the charging period of the capacitors the current is very high – if switched in automatic capacitor banks, it is very likely that discharged capacitors are connected to charged ones already connected to the grid. In such cases the maximum permissible transient peak current is 100* IR.

During the switching process thermal and electrodynamic-stresses are developed caused by transient over-currents of high amplitude and frequency and may damage the system. Capacitor contactors with preloading resistors or series- inductance (cable twins between contactor and capacitor) will avoid excessive transient currents.

### Extended useful life of 100000 operating hours

After a long drying phase in a high vacuum to eliminate moisture from the active element, the capacitor is impregnated . The case is filled with biodegradable soft resin.

This production process helps to avoid oxidation and partial dis- charges (corona effect), promoting capacitance stability over an extremely long period, an essential in filter circuit applications.

### High inrush current withstand capability is crucial

Capacitors used for power factor correction undergo a lot of switch- ing operations.
The high inrush cur-rents that go along with this must be handled without
degrading use ful life. The pulse strength of this technology comes in
particular from the enlarged, sensitive contact area
(improved metal spraying).

### Crucial For Panels

Parallel connection of capacitors Non-detuned capacitors
Capacitor banks using standard contactors

### Discharge Resistor

A Charged Capacitor must be discharged before re-switching to prevent premature failure. Built-in discharge resistors are used for discharging the capacitor within 180 second.






INDTECH® POWER CAPACITORS The Reliable Capacitors

## PFC BOX TYPE CAPACITOR

- Semi Dry Resin (Polyurethane)
- Oil Filled
- Impregnated Stacked Winding
- Dual Safety System

### General

The IndCap-B (metalized polypropylene) capacitor series has been designed for power factor correction in low-voltage plants.

The power range is from 1 kVAr through 50 kVAr for a single capacitor container. PFC capacitor modules are available for single- or three- phase applications in normal or heavy-duty design. Modules contain the required number of single-phase capacitors in delta connection.

The capacitors are housed in a single rectangular steel case and are connected to three offset screw terminals (terminal block). This construction enables simple and inexpensive installation on site and saves inventory costs on spares.

### Applications

- Power factor correction Automatic PFC systems (capacitor banks)
- Individual fixed PFC (e.g. motors, transformers, lighting)
- Group fixed PFC Outdoor version available

### Electrical Features

- High pulse current with stand capability
- Long useful life (80 000/100 000 h)

### Mechanical & Maintenance

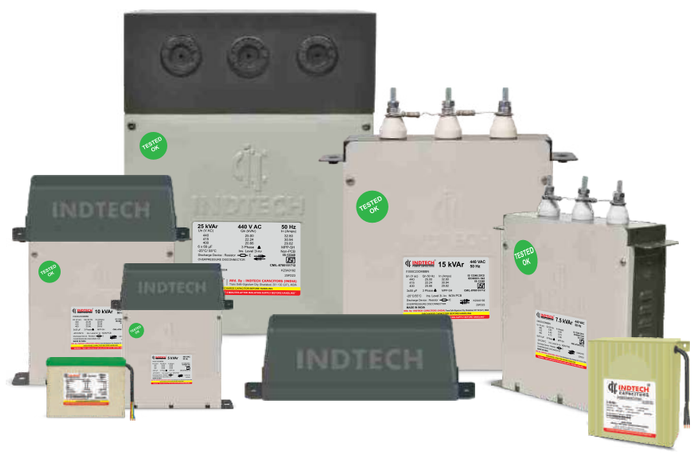
- Suitable for pole and floor mounting
- Easy installation and connection
- Easy maintenance and replacement

### Safety

- Self-healing
- Over pressure disconnection
- Polyurethane resin impregnation

### Environment

- Non-polluting
- Environment friendly product
- PCB-free



# Reactive Power Capacitors
# Agri Duty

Power capacitors for reactive current compensation in single-phase and 3-phase versions, developed for the highest requirements. Apart from a long operating life and high current and voltage load capacity, safety in case of overload (all-pole overpressure disconnector) is a crucial advantage of the compact dry technology components. Other features are good heat dissipation, low self-heating as well as reliable performance at high ambient temperatures.

**Applications**

- Power factor correction of agriculture loads
- Power factor correction of domestic & commercial air conditioners





## AGRICULTURE DUTY CAPACITOR_CYLINDRICAL

QUALITY
CONSISTENCY
RELIABILITY
ENERGY Efficient
DURABLE Long Lasting

# REACTIVE POWER COMPENSATION

## AGRI DUTY CAPACITORS (CYLINDRICAL)

**INDTECH Agri Duty Capacitors** are high grade metalized polypropylene capacitor from 1 - 25 kVAr. These capacitors come with a biodegradable soft & dry resin . These capacitors are self healing type. The capacitors come with an over pressure disconnector or dry and finger proof terminals. capacitors are light duty power factor correction capacitors. These capacitors are meant for light duty application and are mainly used for agriculture pump sets with a maximum of 5% harmonics withstand capability.


## Technical Specifications

| | |
|---|---|
| **Type** | **Cylindrical** |
| **Series** | ACS -(0.5 to 25kVAr), A6WCS - (10 kVAr & above)<br>ACWCN -(0.5 to 25 kVAr), ACPCS - (0.5 to 5 kVAr) |
| **Standard (Reference for Design)** | IS 13340:2012 -1 & 2, & IEC 60831-1 & 2 |
| **Rated Reactive Power range** | 1-25 kVAr |
| **Rated Voltage** | 230-690 Volts |
| **Rated Frequancy** | 50/60 Hz |
| **Maximum Over Voltage Un max.** | $V_R$ + 10% (up to 8 h in 24 h)<br>$V_R$ + 15% (up to 30 min in 24 h)<br>$V_R$ + 20% (up to 5 min in 24 h)<br>$V_R$ + 30% (up to 1 min in 24 h) |
| **Over Current** | Up to 1,3 x $I_R$<br>(Up to 1.5 x $I_R$ including combined effect of harmonics, over voltage and capacitance) |
| **Dielectric System** | Metallized Polypropylene Film (Heavy Edge), Self-Healing |
| **Losses** | <0.5 Watt/ kVAr |
| **Protection class** | IP20 |
| **Cooling** | Natural Air Cooled |
| **Max. above from sea level** | 4000 mtr's |
| **Case** | Aluminium Can |
| **Discharge Resistor** | Special Design International Discharge Resistance 75V in less than 180 sec. |
| **Terminal** | Max. 16mm Cable With Arc Protection Double Three day terminal |
| **Execution** | Indoor / Outdoor |
| **Incrush Current** | Upto 200 x $I_R$ |
| **Tolerance on Capacitance** | -5% to +10 % |
| **Test Voltage (Terminal to Terminal)** | 2.15 x $V_R$ AC for 10sec. |
| **Test Voltage (Terminal to Casing)** | 3000 $V_{AC}$ for 10 sec. |
| **Temperature Category** | -25°C/55°C |
| **Mounting Position** | Vertically |
| **Max. Humidity** | 95% |
| **Grounding & Mounting** | With M8/M12 Stud, Protection Type : Over pressure sensitive 3 Phase disconnector (ACS) , Self healing |
| **Impregnent** | Non PCB, Biodegradable oil Semi Soft Jelly/Dry |
| **No. of switching operation** | Imax : 5,000 switching per year (For ACS) |








## Safe Device_440V_3 Phase_50Hz_Seamtop_Wire/Screw Terminal

| UOM >> | | kVAr | µF | Amps. | — | mm | | Pc's |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Capacitance | Current | Type of Termination | Capacitor Size Ø D | H | Pack Qty. |
| 1 | I050E53ACS | 0.5 | 2.75 x 3 | 0.66 | Fig. 1 | 45 | 85 | 35 |
| 2 | I001E53ACS | 1 | 5.50 x 3 | 1.31 | Fig. 1 | 50 | 104 | 30 |
| 3 | I002E53ACS | 2 | 11.00 x 3 | 2.62 | Fig. 1 | 50 | 128 | 30 |
| 4 | I003E53ACS | 3 | 16.50 x 3 | 3.94 | Fig. 1 | 50 | 150 | 30 |
| 5 | I004E53ACS | 4 | 22.00 x 3 | 5.25 | Fig. 1 | 50 | 150 | 30 |
| 6 | I005E53ACS | 5 | 27.50 x 3 | 6.56 | Fig. 1 | 63.5 | 128 | 30 |
| 7 | I006E53ACS | 6 | 33.00 x 3 | 7.87 | Fig. 1 | 63.5 | 150 | 30 |
| 8 | I075E53ACS | 7.5 | 41.25 x 3 | 9.84 | Fig. 1 | 63.5 | 203 | 30 |
| 9 | I008E53ACS | 8 | 45.82 x 3 | 10.50 | Fig. 1 | 63.5 | 203 | 30 |
| 10 | I100E53ACS | 10 | 55.00 x 3 | 13.12 | Fig. 2 | 75 | 203 | 25 |
| 11 | I125E53ACS | 12.5 | 68.75 x 3 | 16.40 | Fig. 2 | 75 | 203 | 25 |
| 12 | I150E53ACS | 15 | 82.50 x 3 | 19.68 | Fig. 2 | 75 | 278 | 25 |
| 13 | I200E53ACS | 20 | 110.0 x 3 | 26.24 | Fig. 2 | 85 | 278 | 10 |
| 14 | I250E53ACS | 25 | 137.5 x 3 | 32.80 | Fig. 2 | 90 | 278 | 10 |

- Capacitors for Voltage Ratings 415 will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

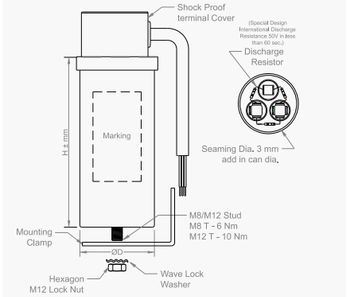


Fig. 1

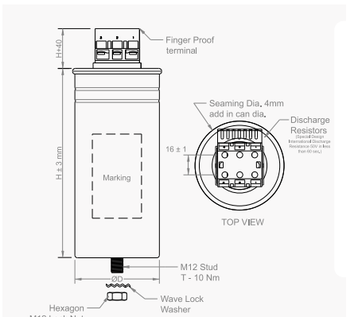


Fig. 2

## Dry Type_415V_3 Phase_50Hz_Plastic Top With Wire/Pin Terminal

| UOM >> | | kVAr | µF | Amps. | — | mm | | Pc's |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Capacitance | Current | Type of Termination | Capacitor Size Ø D | H | Pack Qty. |
| 1 | I050E53ACN | 0.5 | 2.75 x 3 | 0.66 | Fig. 3 | 45 | 85 | 35 |
| 2 | I001E53ACN | 1 | 5.50 x 3 | 1.31 | Fig. 3 | 45 | 104 | 35 |
| 3 | I002E53ACN | 2 | 11.00 x 3 | 2.62 | Fig. 3 | 50 | 140 | 35 |
| 4 | I003E53ACN | 3 | 16.50 x 3 | 3.94 | Fig .3 | 50 | 140 | 35 |
| 5 | I004E53ACN | 4 | 22.00 x 3 | 5.25 | Fig. 3 | 63.5 | 145 | 30 |
| 6 | I005E53ACN | 5 | 27.50 x 3 | 6.56 | Fig. 3 | 63.5 | 170 | 30 |
| 7 | I006E53ACN | 6 | 33.00 x 3 | 7.87 | Fig. 3 | 63.5 | 200 | 30 |
| 8 | I075E53ACN | 7.5 | 41.25 x 3 | 9.84 | Fig. 3 | 75 | 200 | 25 |
| 9 | I008E53ACN | 8 | 45.82 x 3 | 10.50 | Fig. 3 | 75 | 200 | 25 |
| 10 | I100E53ACN | 10 | 55.00 x 3 | 13.12 | Fig. 3 | 75 | 200 | 25 |
| 11 | I125E53ACN | 12.5 | 68.75 x 3 | 16.40 | Fig. 3 | 75 | 278 | 25 |
| 12 | I150E53ACN | 15 | 82.50 x 3 | 19.68 | Fig. 3 | 75 | 278 | 25 |
| 13 | I200E53ACN | 20 | 110.0 x 3 | 26.24 | Fig. 3 | 85 | 278 | 10 |
| 14 | I250E53ACN | 25 | 137.5 x 3 | 32.80 | Fig. 3 | 85 | 278 | 10 |
| 15 | I050E53ACS | 0.5 | 2.75 x 3 | 0.66 | Fig. 4 | 45 | 125 | 35 |
| 16 | I001E53ACS | 1 | 5.5 x 3 | 1.31 | Fig. 4 | 45 | 125 | 35 |
| 17 | I002E53ACS | 2 | 11 x 3 | 2.62 | Fig. 4 | 45 | 125 | 35 |
| 18 | I003E53ACS | 3 | 16.50 x 3 | 3.94 | Fig. 4 | 50 | 145 | 35 |
| 19 | I004E53ACS | 4 | 22.0 x 3 | 5.25 | Fig. 4 | 50 | 145 | 35 |
| 20 | I005E53ACS | 5 | 27.50 x 3 | 6.56 | Fig. 4 | 55 | 145 | 35 |

- Capacitors for Voltage Ratings 440 will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

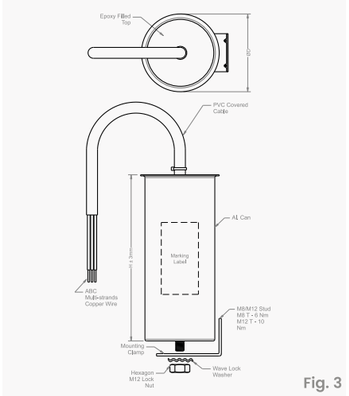


Fig. 3

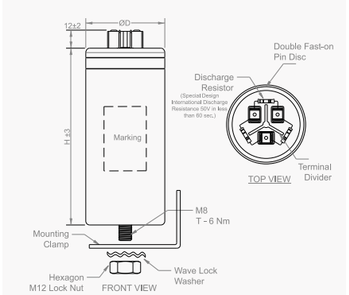


Fig. 4

# Reactive Power Capacitors

# Standard Duty

Power capacitors for reactive current compensation in single-phase and 3-phase versions, developed for the highest requirements. Apart from a long operating life and high current and voltage load capacity, safety in case of overload (all-pole overpressure disconnector) is a crucial advantage of the compact dry technology components. Other features are good heat dissipation, low self-heating as well as reliable performance at high ambient temperatures.

## Applications

***PFC - Cylindrical***

- Power Factor Correction in automatic capacitor banks
- Fixed PFC applications, e.g., motor compensation
- Dynamic PFC Systems
- Detuned PFC Systems






QUALITY

CONSISTENCY

RELIABILITY

ENERGY
Efficient

DURABLE
Long Lasting

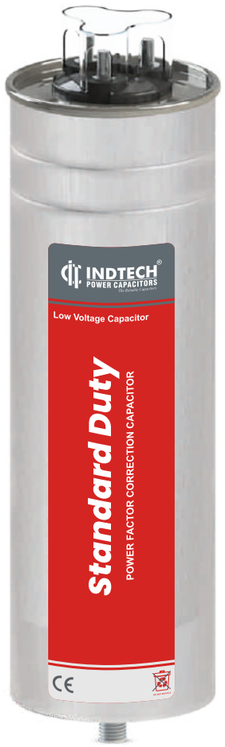
# REACTIVE POWER COMPENSATION

## STANDARD DUTY CAPACITORS_CYLINDRICAL

**INDTECH Standard Duty Capacitors** are high grade metalized polypropylene capacitor from 1 - 50 kVAr in cylindrical configuration. These capacitors come with a biodegradable soft resin. These capacitors are self healing type. The capacitors come with an over pressure disconnector and finger proof terminals. They can be used to provide effective power factor correction in industrial & semi-industrial applications.


### Technical Specifications

| | |
|---|---|
| **STANDARD DUTY** | Fig.1 - (0.5 to 6 kVAr), Fig.2 - (7.5 kVAr to 25 kVAr) |
| **Type** | Cylindrical |
| **Standard (Reference for Design)** | IS 13340:2012 (1 & 2), & IEC 60831-1&2 |
| **Rated Reactive Power range** | 0.5 - 50 kVAr |
| **Rated Voltage** | 230-690 Volts |
| **Rated Frequency** | 50/60 Hz |
| **Maximum Over Voltage U max.** | Vr + 10% (up to 8 h in 24 h)<br>Vr + 15% (up to 30 min in 24 h)<br>Vr + 20% (up to 5 min in 24 h)<br>Vr + 30% (up to 1 min in 24 h) |
| **Over Current** | Up to 1.5 x IR<br>(up to 1.8 x IR including combined effect of harmonics, over voltage and capacitance |
| **Dielectric System** | Metallized Polypropylene Film, Self-Healing |
| **Losses** | <0.5 Watt/ kVAr |
| **Protection class** | Ip20 |
| **Cooling** | Natural Air Cooled |
| **Max. above from sea level** | 4000 mtr's |
| **Case** | Aluminium Can |
| **Discharge Resistor** | Special Design International Discharge Resistance 75V in less than 180 sec. |
| **Terminal** | Max 16mm sq. Cable with Arc Protection Double Three day terminal. |
| **Execution** | Indoor / Outdoor |
| **Inrush Current** | Upto 300 x IR |
| **Test Voltage (Terminal to Terminal)** | 2.15 x Vr AC for 10 sec. |
| **Test Voltage (Terminal to Casing)** | 3600 V AC for 10 sec. |
| **Temperature Category** | -25°C/ 55°C |
| **Mounting Position** | Horizontally and Vertically<br>**Vertical use is recommended for long life.** |
| **Max. Humidity** | 95% |
| **Grounding & Mounting** | With M8/M12 Stud Over Pressure Sensitive 3 Phase Disconnector |
| **Impregnant** | Non PCB, Biodegradable Oil Semi Soft Jelly from Resin. |
| **Number of Switching** | Imax: 5,000 switching per year |








## STANDARD DUTY CAPACITORS

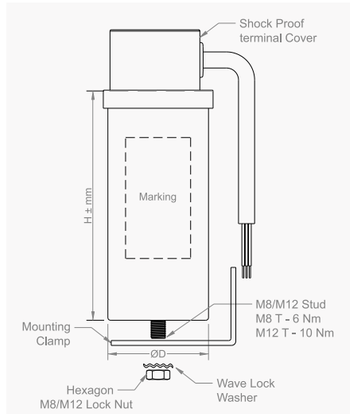


Fig. 1

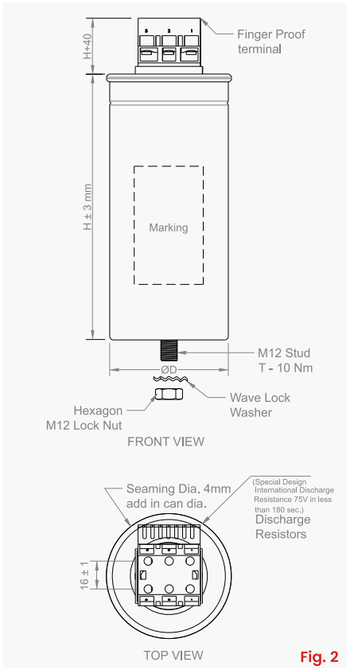


Fig. 2

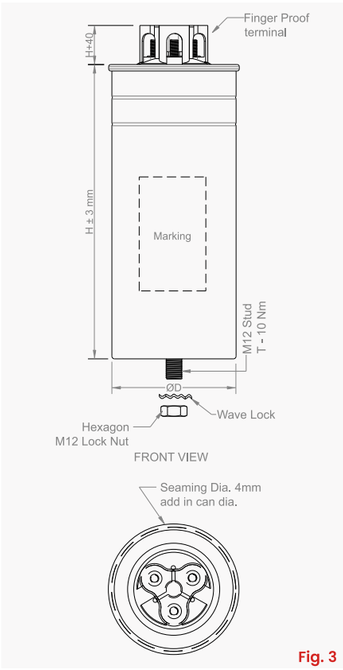


Fig. 3

### 3 Phase_50Hz_Seamtop_Wire/Screw/Stud Terminals

| UOM >> | | kVAr | Volts | µF | Amps. | µF | — | mm | | Pc's |
|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Rated Voltage | Capacitance | Current | Phase Value | Type of Termination | Capacitor Size Ø D | H | Packing Qty. |
| 1 | I050E53SCS | 0.5 | 440 | 2.75 x 3 | 0.66 | 4.11 | Fig.1 | 45 | 85 | 35 |
| 2 | I001E53SCS | 1 | 440 | 5.50 x 3 | 1.31 | 8.22 | Fig.1 | 50 | 104 | 35 |
| 3 | I002E53SCS | 2 | 440 | 11.00 x 3 | 2.62 | 16.45 | Fig.1 | 50 | 128 | 35 |
| 4 | I003E53SCS | 3 | 440 | 16.50 x 3 | 3.94 | 24.67 | Fig.1 | 50 | 150 | 35 |
| 5 | I004E53SCS | 4 | 440 | 22.00 x 3 | 5.25 | 32.90 | Fig.1 | 63.5 | 128 | 30 |
| 6 | I005E53SCS | 5 | 440 | 27.50 x 3 | 6.55 | 41.12 | Fig.1 | 63.5 | 150 | 30 |
| 7 | I006E53SCS | 6 | 440 | 33.00 x 3 | 7.87 | 49.35 | Fig.1 | 63.5 | 203 | 30 |
| 8 | I075E53SCS | 7.5 | 440 | 41.25 x 3 | 9.84 | 61.69 | Fig.2 | 75 | 203 | 25 |
| 9 | I008E53SCS | 8 | 440 | 45.82 x 3 | 10.50 | 68.27 | Fig.2 | 75 | 203 | 25 |
| 10 | I100E53SCS | 10 | 440 | 55.00 x 3 | 13.12 | 82.25 | Fig.2 | 85 | 203 | 25 |
| 11 | I125E53SCS | 12.5 | 440 | 68.75 x 3 | 16.40 | 102.81 | Fig.2 | 85 | 283 | 10 |
| 12 | I150E53SCS | 15 | 440 | 82.50 x 3 | 19.68 | 123.37 | Fig.2 | 85 | 283 | 10 |
| 13 | I200E53SCS | 20 | 440 | 110.0 x 3 | 26.24 | 164.50 | Fig.2 | 90 | 283 | 10 |
| 14 | I250E53SCS | 25 | 440 | 137.5 x 3 | 32.80 | 205.62 | Fig.2 | 95 | 283 | 10 |

- Capacitors for Voltage Ratings 415V will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

# Reactive Power Capacitors
# Heavy Duty

Power capacitors for reactive current compensation in single-phase and 3-phase versions, developed for the highest requirements. Apart from a long operating life and high current and voltage load capacity, safety in case of overload (all-pole overpressure disconnector) is a crucial advantage of the compact dry technology components. Other features are good heat dissipation, low self-heating as well as reliable performance at high ambient temperatures.

**Applications**

***PFC - Cylindrical***

- Automatic PFC Equipment, capacitor banks
- Individual Fixed PFC (e.g. motors, transformers, lighting)
- Group Fixed PFC
- Tuned & detuned capacitor banks
- Dynamic PFC





## HEAVY DUTY CAPACITOR_CYLINDRICAL


QUALITY

CONSISTENCY

RELIABILITY

ENERGY
Efficient

DURABLE
Long Lasting

# REACTIVE POWER COMPENSATION

## HEAVY DUTY CAPACITORS _CYLINDRICAL

**INDTECH Heavy Duty Capacitors** are high grade metalized polypropylene capacitor from 1 - 50 kVAr in cylindrical configuration. These capacitors have an inrush current withstand of 300 In and an overload withstand capacity of 1.8 In. These capacitor have all the features of standard capacitors like over-pressure disconnector and self healing. Compact design ensures space saving. Heavy Duty capacitors have a long life 145000 Hrs.

### Technical Specifications

| | |
|---|---|
| **HEAVY DUTY** | Fig.1-(0.5 to 5 kVAr), Fig.2-(6 kVAr to 25), Fig.3-(30 to 50kVAr) |
| **Type** | Cylindrical |
| **Standard (Reference for Design)** | IS 13340:2012 - (1 & 2) & IEC 60381 -1 & 2 |
| **Rated Reactive Power range** | 1-50 kVAr |
| **Rated Voltage** | 230-690 Volts |
| **Rated Frequency** | 50/60 Hz |
| **Maximum Over Voltage U max.** | Vr + 10% (up to 8 h in 24 h)<br>Vr + 15% (up to 30 min in 24 h)<br>Vr + 20% (up to 5 min in 24 h)<br>Vr + 30% (up to 1 min in 24 h) |
| **Over Current** | Up to 1.8 x IR |
| **Dielectric System** | Metallized Polypropylene Film, Self-Healing |
| **Losses** | <0.5 Watt/ kVAr |
| **Protection class** | Ip20 |
| **Cooling** | Natural Air Cooled |
| **Max. above from sea level** | 4000 mtr's |
| **Case** | Aluminium Can |
| **Discharge Resistor** | Special Design International Discharge Resistance 75V in less than 180 sec. |
| **Terminal** | Max 16mm Cable with Arc Protection Double Three day terminal. |
| **Execution** | Indoor / Outdoor |
| **Inrush Current** | Upto 300 x IR |
| **Test Voltage (Terminal to Terminal)** | 2.15 x Vr AC for 10 sec. |
| **Test Voltage (Terminal to Casing)** | 3000 V AC for 10 sec. |
| **Temperature Category** | -25°C/ 55°C |
| **Mounting Position** | Horizontally and Vertically<br>Vertical use is recommended for long life. |
| **Max. Humidity** | 95% |
| **Grounding & Mounting** | With M8/M12 Stud Over Pressure Sensitive 3 Phase Disconnector |
| **Impregnant** | Non PCB, Biodegradable Oil Semi Soft Jelly from Resin. |
| **Number of Switching** | Imax: 8,000 switching per year |






INDTECH® POWER CAPACITORS *The Reliable Capacitors*

## HEAVY DUTY CAPACITORS

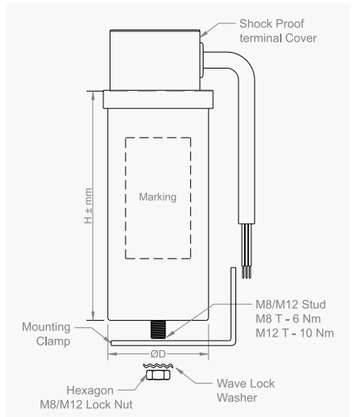



Fig. 1

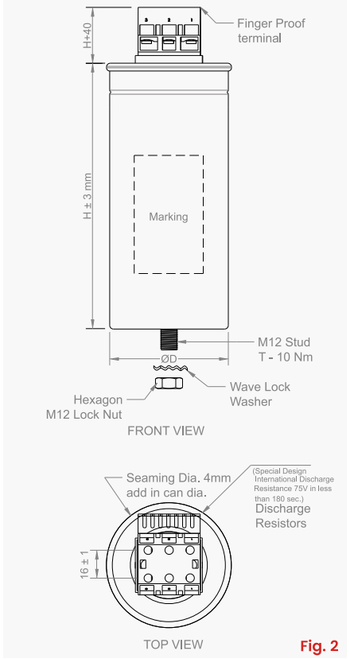



Fig. 2

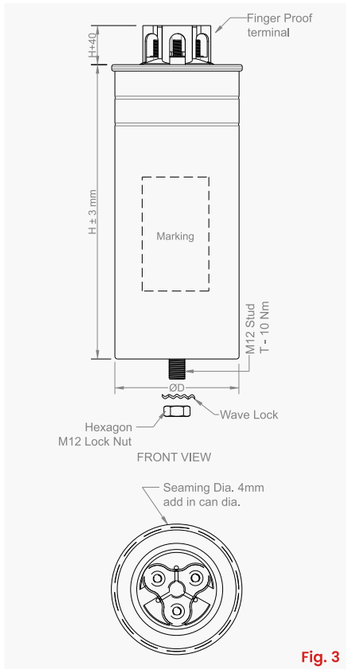



Fig. 3

### 3 Phase_50Hz_Seamtop_Wire/Screw/Stud Terminals

| UOM >> | | kVAr | Volts | µF | Amps. | µF | — | mm | | Pc's |
|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Rated Voltage | Capacitance | Current | Phase Value | Type of Termination | Capacitor Size Ø D | H | Packing Qty. |
| 1 | I050E53HCS | 0.5 | 440 | 2.75 x 3 | 0.66 | 4.11 | Fig.1 | 50 | 104 | 35 |
| 2 | I001E53HCS | 1 | 440 | 5.50 x 3 | 1.31 | 8.22 | Fig.1 | 50 | 128 | 35 |
| 3 | I002E53HCS | 2 | 440 | 11.00 x 3 | 2.62 | 16.45 | Fig.1 | 50 | 128 | 35 |
| 4 | I003E53HCS | 3 | 440 | 16.50 x 3 | 3.94 | 24.67 | Fig.1 | 63.5 | 128 | 30 |
| 5 | I004E53HCS | 4 | 440 | 22.00 x 3 | 5.25 | 32.90 | Fig.1 | 63.5 | 150 | 30 |
| 6 | I005E53HCS | 5 | 440 | 27.50 x 3 | 6.56 | 41.12 | Fig.1 | 63.5 | 170 | 30 |
| 7 | I006E53HCS | 6 | 440 | 33.00 x 3 | 7.87 | 49.35 | Fig.2 | 75 | 196 | 25 |
| 8 | I075E53HCS | 7.5 | 440 | 41.25 x 3 | 9.84 | 61.69 | Fig.2 | 75 | 243 | 25 |
| 9 | I008E53HCS | 8.3 | 440 | 45.82 x 3 | 10.91 | 68.27 | Fig.2 | 75 | 243 | 25 |
| 10 | I100E53HCS | 10 | 440 | 55.00 x 3 | 13.12 | 82.25 | Fig.2 | 85 | 243 | 10 |
| 11 | I125E53HCS | 12.5 | 440 | 68.75 x 3 | 16.40 | 102.81 | Fig.2 | 85 | 283 | 10 |
| 12 | I150E53HCS | 15 | 440 | 82.50 x 3 | 19.68 | 123.37 | Fig.2 | 90 | 283 | 10 |
| 13 | I200E53HCS | 20 | 440 | 110.0 x 3 | 26.24 | 164.50 | Fig.2 | 100 | 283 | 10 |
| 14 | I250E53HCS | 25 | 440 | 137.5 x 3 | 32.80 | 205.62 | Fig.3 | 116 | 283 | 9 |
| 15 | I300E53HCS | 30 | 440 | 164.5 x 3 | 39.37 | 246.75 | Fig.3 | 116 | 283 | 9 |
| 16 | I400E53HCS | 40 | 440 | 219.5 x 3 | 52.49 | 329.00 | Fig.3 | 136 | 283 | 4 |
| 17 | I500E53HCS | 50 | 440 | 274.5 x 3 | 65.61 | 411.25 | Fig.3 | 136 | 346 | 4 |

- Capacitors for Voltage Ratings 415V will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

# Reactive Power Capacitors

# Super Heavy Duty

Power capacitors for reactive current compensation in single-phase and 3-phase versions, developed for the highest requirements. Apart from a long operating life and high current and voltage load capacity, safety in case of overload (all-pole overpressure disconnector) is a crucial advantage of the compact dry technology components. Other features are good heat dissipation, low self-heating as well as reliable performance at high ambient temperatures.

**Applications**

***PFC - Cylindrical***

- Automatic PFC Equipment, capacitor banks
- Individual Fixed PFC (e.g. motors, transformers, lighting)
- Group Fixed PFC
- Tuned & detuned capacitor banks
- Dynamic PFC






QUALITY

CONSISTENCY

RELIABILITY

ENERGY Efficient

DURABLE Long Lasting

# REACTIVE POWER COMPENSATION

## SUPER HEAVY DUTY CAPACITORS

**INDTECH Super Heavy Duty Capacitors** are high grade metalized polypropylene Wave cut film design capacitor from 5 - 50 kVAr in cylindrical configuration. These capacitors have an inrush current withstand of 400 In and an overload withstand capacity of 2.2 In. These capacitor have all the features of standard capacitors like over-pressure disconnector and self healing. Compact design ensures space saving. Heavy Duty capacitors have a long life 1,80,000 Hrs.


### Technical Specifications

| | |
|---|---|
| **SUPER HEAVY DUTY** | – |
| **Type** | Cylindrical |
| **Standard (Reference for Design)** | IS 13340:2012 - (1 & 2) & IEC 60381 -1 & 2 |
| **Rated Reactive Power range** | 5-50 kVAr |
| **Rated Voltage** | 400-525 Volts |
| **Rated Frequency** | 50/60 Hz |
| **Maximum Over Voltage U max.** | Vr + 10% (up to 12 h in 24 h)<br>Vr + 15% (up to 30 min in 24 h)<br>Vr + 20% (up to 5 min in 24 h)<br>Vr + 30% (up to 1 min in 24 h) |
| **Over Current** | Up to 2.2 x IR |
| **Dielectric System** | Metallized Polypropylene / Wave cut Film design, Self-Healing |
| **Losses** | <0.2 Watt/ kVAr |
| **Protection class** | Ip20, on request Ip54, Outdoor mounting |
| **Cooling** | Natural Air Cooled |
| **Max. above from sea level** | 4000 mtr's |
| **Case** | Aluminium Can |
| **Discharge Resistor** | Special Design International Discharge Resistance 75V in less than 180 sec. |
| **Terminal** | Max 16mm Cable with Arc Protection Double Three day terminal. |
| **Execution** | Indoor / Outdoor |
| **Inrush Current** | Upto 400 x IR |
| **Test Voltage (Terminal to Terminal)** | 2.15 x Vr AC for 10 sec. |
| **Test Voltage (Terminal to Casing)** | 3000 V AC for 10 sec. |
| **Temperature Category** | -25°C/ 55°C |
| **Mounting Position** | Horizontally and Vertically<br>Vertical use is recommended for long life. |
| **Max. Humidity** | 95% |
| **Grounding & Mounting** | With M8/M12 Stud Over Pressure Sensitive 3 Phase Disconnector |
| **Impregnant** | Non PCB, Biodegradable Oil Semi Soft Jelly from Resin. |
| **Number of Switching** | Imax: 20,000 switching per year |






INDTECH® POWER CAPACITORS *The Reliable Capacitors*



## SUPER HEAVY DUTY CAPACITORS

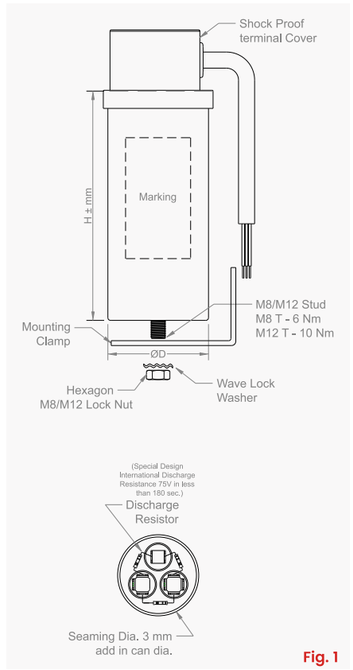



Fig. 1

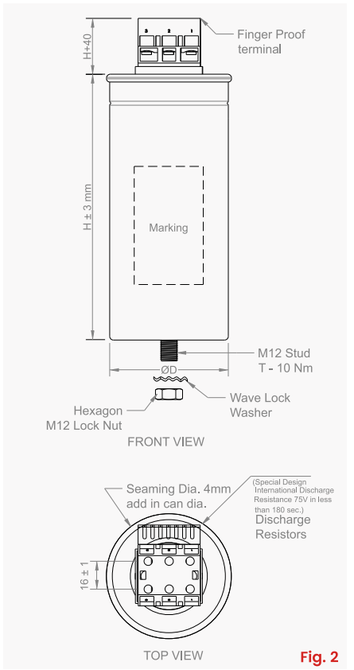



Fig. 2

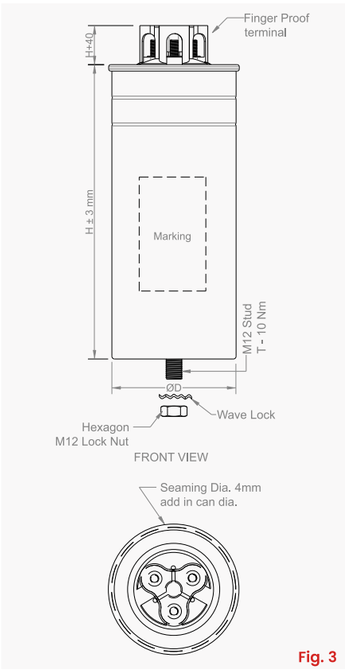



Fig. 3

### Super Heavy Duty - Cylindrical_Safe Device_440V_3 Phase_50Hz_Seamtop_Wire/Screw/Stud Terminals

| UOM >> | | kVAr | Volts | µF | Amps. | µF | – | mm | | Pc's |
|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Rated Voltage | Capacitance | Current | Phase Value | Type of Termination | Capacitor Size Ø D | Capacitor Size H | Packing Qty. |
| 1 | I005E53HCS | 5 | 440 | 27.50 x 3 | 6.56 | 41.12 | Fig.1 | 63.5 | 170 | 30 |
| 2 | I006E53HCS | 6 | 440 | 33.00 x 3 | 7.87 | 49.35 | Fig.2 | 75 | 196 | 25 |
| 3 | I075E53HCS | 7.5 | 440 | 41.25 x 3 | 9.84 | 61.69 | Fig.2 | 75 | 243 | 25 |
| 4 | I008E53HCS | 8.3 | 440 | 45.82 x 3 | 10.91 | 68.27 | Fig.2 | 75 | 243 | 25 |
| 5 | I100E53HCS | 10 | 440 | 55.00 x 3 | 13.12 | 82.25 | Fig.2 | 85 | 243 | 10 |
| 6 | I125E53HCS | 12.5 | 440 | 68.75 x 3 | 16.40 | 102.81 | Fig.2 | 85 | 283 | 10 |
| 7 | I150E53HCS | 15 | 440 | 82.50 x 3 | 19.68 | 123.37 | Fig.2 | 90 | 283 | 10 |
| 8 | I200E53HCS | 20 | 440 | 110.0 x 3 | 26.24 | 164.50 | Fig.2 | 100 | 283 | 10 |
| 9 | I250E53HCS | 25 | 440 | 137.5 x 3 | 32.80 | 205.62 | Fig.3 | 116 | 283 | 9 |
| 10 | I300E53HCS | 30 | 440 | 164.5 x 3 | 39.37 | 246.75 | Fig.3 | 116 | 283 | 9 |
| 11 | I400E53HCS | 40 | 440 | 219.5 x 3 | 52.49 | 329.00 | Fig.3 | 136 | 283 | 4 |
| 12 | I500E53HCS | 50 | 440 | 274.5 x 3 | 65.61 | 411.25 | Fig.3 | 136 | 346 | 4 |

- Capacitors for Voltage Ratings 415 will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

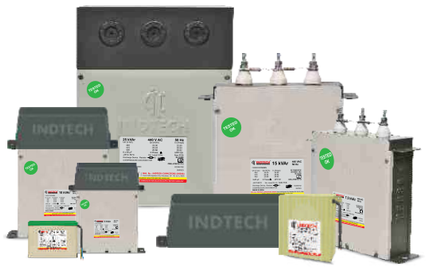
# REACTIVE POWER COMPENSATION





## BOX TYPE CAPACITORS

**INDTECH Box Type Capacitors** are high grade metalized polypropylene capacitor from 1 - 30 kVAr. These capacitors come with a biodegradable soft resin. These capacitors are self healing type. The capacitors come with an over pressure disconnector or dry and finger proof terminals. Capacitors are light duty power factor correction capacitors. These capacitors are meant for light and heavy duty application and are mainly used for industrial and heavy pump sets with a maximum of 5% harmonics withstand capability.




## Technical Specifications

| | |
|---|---|
| **Type** | **Box** |
| **Series** | AWTPL - (1 to 5 kVAr), AWBBN - (4 kVAr & above) |
| **Standard (Reference for Design)** | IS 13340:2012 -1 & 2, & IEC 60831-1 & 2 |
| **Rated Reactive Power range** | 1-50 kVAr |
| **Rated Voltage** | 415/440/550 Volts |
| **Rated Frequancy** | 50/60 Hz |
| **Maximum Over Voltage Un max.** | $V_R$ + 10% (up to 8 h in 24 h)<br>$V_R$ + 15% (up to 30 min in 24 h)<br>$V_R$ + 20% (up to 5 min in 24 h)<br>$V_R$ + 30% (up to 1 min in 24 h) |
| **Over Current** | Up to 1,3 x $I_R$<br>(Up to 1.5 x $I_R$ including combined effect of harmonics, over voltage and capacitance) |
| **Dielectric System** | Metallized Polypropylene Film (Heavy Edge), Self-Healing |
| **Losses** | <0.5 Watt/ kVAr |
| **Protection class** | IP20 |
| **Cooling** | Natural Air Cooled |
| **Max. above from sea level** | 4000 mtr's |
| **Case** | MS Box Sheet Metal |
| **Discharge Resistor** | Special Design International Discharge Resistance 50V in less than 60 sec. |
| **Terminal** | Max. 16mm Cable With Arc Protection Double Three day terminal |
| **Execution** | Indoor / Outdoor |
| **Incrush Current** | Upto 200 x $I_R$ |
| **Tolerance on Capacitance** | -5% to +10 % |
| **Test Voltage (Terminal to Terminal)** | 2.15 x $V_R$ AC for 10sec. |
| **Test Voltage (Terminal to Casing)** | 3000 $V_{AC}$ for 10 sec. |
| **Temperature Category** | -25°C/55°C |
| **Mounting Position** | Vertically |
| **Max. Humidity** | 95% |
| **Grounding & Mounting** | With M8/M12 Stud, Protection Type : Over pressure sensitive 3 Phase disconnector, Self healing |
| **Impregnent** | Non PCB, PU Resin |
| **No. of switching operation** | Imax : 5,000 switching per year (8,000 per year for HD) |


## Metal Box Type_440V_3 Phase_50Hz_Wire/Stud Terminals - Normal Duty

| UOM >> | | kVAr | µF | Amps. | — | mm | | | Pc's |
|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Capacitance | Current | Type of Termination | Capacitor Size L | W | H | Pack Qty. |
| 1 | I001E53NBN | 1 | 5.50 x 3 | 1.31 | Fig.1 | 125 | 45 | 90 | 10 |
| 2 | I002E53NBN | 2 | 11.00 x 3 | 2.62 | Fig.1 | 125 | 45 | 90 | 10 |
| 3 | I003E53NBN | 3 | 16.50 x 3 | 3.94 | Fig.1 | 125 | 45 | 90 | 10 |
| 4 | I004E53NBN | 4 | 22.00 x 3 | 5.25 | Fig.2 | 125 | 45 | 130 | 10 |
| 5 | I005E53NBN | 5 | 27.50 x 3 | 6.56 | Fig.2 | 125 | 45 | 130 | 10 |
| 6 | I006E53NBN | 6 | 33.00 x 3 | 7.87 | Fig.2 | 125 | 45 | 130 | 10 |
| 7 | I075E53NBN | 7.5 | 41.25 x 3 | 9.84 | Fig.2 | 165 | 55 | 140 | 5 |
| 8 | I008E53NBN | 8 | 45.82 x 3 | 10.50 | Fig.2 | 165 | 55 | 140 | 5 |
| 9 | I100E53NBN | 10 | 55.00 x 3 | 13.12 | Fig.2 | 165 | 55 | 140 | 5 |
| 10 | I125E53NBN | 12.5 | 68.75 x 3 | 16.40 | Fig.2 | 165 | 55 | 185 | 5 |
| 11 | I150E53NBN | 15 | 82.50 x 3 | 19.68 | Fig.2 | 165 | 55 | 185 | 5 |
| 12 | I200E53NBN | 20 | 110.0 x 3 | 26.24 | Fig.2 | 238 | 112 | 200 | 1 |
| 13 | I250E53NBN | 25 | 137.5 x 3 | 32.80 | Fig.2 | 238 | 112 | 200 | 1 |

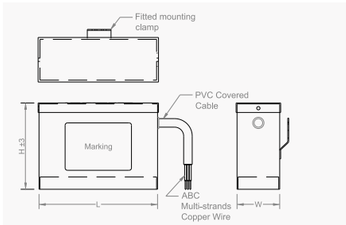


Fig. 1

## Metal Box Type_440V_3 Phase_50Hz_Wire/Stud Terminals - Heavy Duty

| UOM >> | | kVAr | µF | Amps. | — | mm | | | Pc's |
|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Capacitance | Current | Type of Termination | Capacitor Size L | W | H | Pack Qty. |
| 1 | I005E53HBS | 5 | 27.50 x 3 | 6.56 | Fig.3 | 165 | 55 | 200 | 10 |
| 2 | I006E53HBS | 6 | 33.00 x 3 | 7.87 | Fig.3 | 165 | 55 | 245 | 10 |
| 3 | I075E53HBS | 7.5 | 41.25 x 3 | 9.84 | Fig.3 | 165 | 55 | 245 | 10 |
| 4 | I008E53HBS | 8 | 45.82 x 3 | 10.50 | Fig.3 | 165 | 55 | 245 | 10 |
| 5 | I100E53HBS | 10 | 55.00 x 3 | 13.12 | Fig.3 | 165 | 55 | 245 | 10 |
| 6 | I125E53HBS | 12.5 | 68.75 x 3 | 16.40 | Fig.3 | 220 | 75 | 300 | 8 |
| 7 | I150E53HBS | 15 | 82.50 x 3 | 19.68 | Fig.3 | 220 | 75 | 300 | 8 |
| 8 | I200E53HBS | 20 | 110.0 x 3 | 26.24 | Fig.3 | 220 | 150 | 300 | 4 |
| 9 | I250E53HBS | 25 | 137.5 x 3 | 32.80 | Fig.3 | 220 | 150 | 300 | 4 |
| 10 | I300E53HBS | 30 | 164.5 x 3 | 39.37 | Fig.3 | 220 | 150 | 300 | 4 |
| 11 | I400E53HBS | 40 | 219.5 x 3 | 52.49 | Fig.3 | 330 | 220 | 300 | 1 |
| 12 | I500E53HBS | 50 | 274.5 x 3 | 65.61 | Fig.3 | 330 | 220 | 300 | 1 |

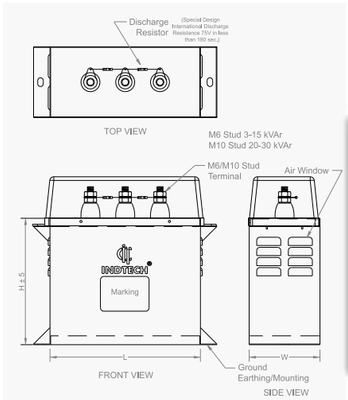


Fig. 2

## Plastic Box Type_440V_3 Phase_50Hz_Wire Terminals

| UOM >> | | kVAr | µF | Amps. | — | mm | | | Pc's |
|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Product Code | Reactive Power | Capacitance | Current | Type of Termination | Capacitor Size L | W | H | Pack Qty. |
| 1 | I001E53ABN | 1 | 5.50 x 3 | 1.31 | Fig.4 | 98 | 50 | 112 | 12 |
| 2 | I002E53ABN | 2 | 11.00 x 3 | 2.62 | Fig.4 | 98 | 50 | 112 | 12 |
| 3 | I003E53ABN | 3 | 16.50 x 3 | 3.94 | Fig.4 | 98 | 50 | 112 | 12 |
| 4 | I004E53ABN | 4 | 22.00 x 3 | 5.25 | Fig.4 | 98 | 50 | 153 | 12 |
| 5 | I005E53ABN | 5 | 27.50 x 3 | 6.56 | Fig.4 | 98 | 50 | 153 | 12 |

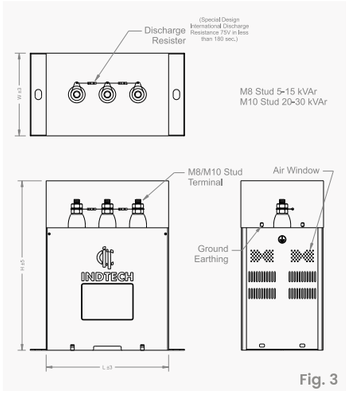


Fig. 3

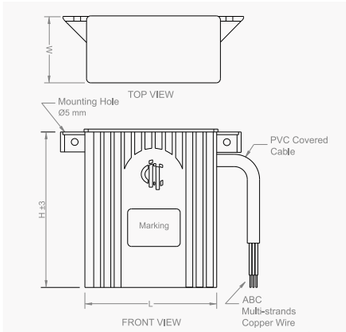
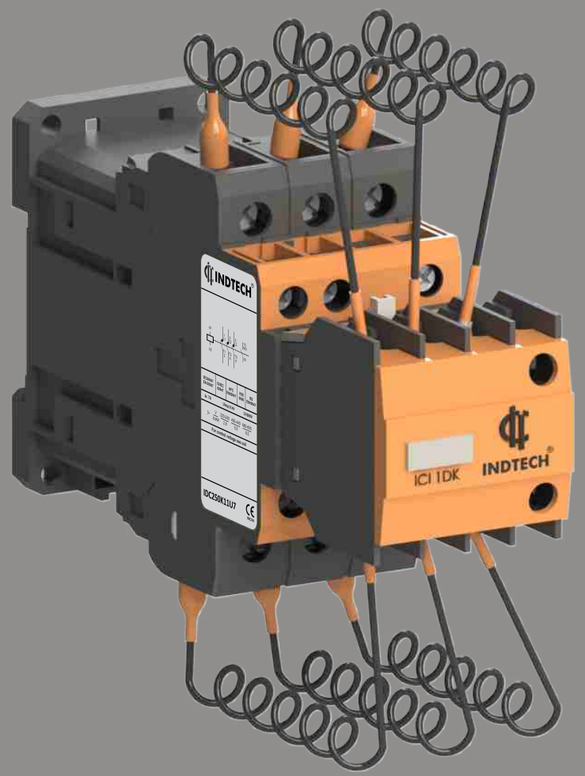


Fig. 4

- Capacitors for Voltage Ratings 415V will be manufactured as per customer demand.
- kVar Ratings other than mentioned in the above table will be manufactured as per customer demand.
- Capacitors for 60 Hz frequency will be manufactured as per customer demand.

# Capacitor Duty Contactors

QUALITY · CONSISTENCY · RELIABILITY · ENERGY Efficient · DURABLE Long Lasting




**Benifits**

- Excellent damping of inrush current
- Improved power quality (e.g. avoidance of voltage sags)
- Longer useful life of main contacts of capacitor contactors
- Soft switching of capacitor and thus longer useful life
- Enhanced mean lifetime of PFC system
- Leading contacts with wiper function
- Tamper-proof and protected resistors

**Features**

- Suitable for use with or without detuned reactors
- Largest range
- Weld resistence
- Reduce Ohmic losses
- Easy access for cable connections



INDTECH® POWER CAPACITORS The Reliable Capacitors

## CAPACITOR DUTY CONTACTOR

**•Capacitor contactors for switching detuned and conventional three-phase capacitors**

When a capacitance is switched to an AC voltage, 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 (as many as 200 times) its rated current. Fast switching, low-bounce contactors should be used. Because of the leading contacts, the inrush current spikes (reverse charging operations) are limited or damped by resistance wires.

These current spikes would lead to welding of the contactor's main contacts and they are also harmful for the capacitors. Reduction of the inrush currents also avoids transients and voltage sags. Leading contacts with a wiper function are used in these capacitor contactors, i.e. each leading contact is linked to the contactor yoke by a permanent magnet.

The leading contacts close before the main contacts and open when the main contacts are with certainty closed. This feature of the capacitor contactors guarantees effective, stable operation throughout useful life. The single controlled leading contacts also enhance resistance to soiling during operation. The capacitor contactors are suitable for direct switching of lowinductance and low-loss capacitor banks (IEC 831, VDE 0560) with or without detuning reactors.

They feature leading auxiliary switches and damping resistors to reduce peak inrush to < 70 * IR (inrush current).

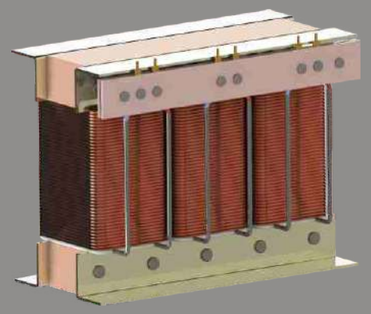
The capacitor contactors are weldresistant up to a possible peak inrush current of 200 * IR. The backup fuses gL (gG) should be scaled for 1.6 to 1.8 * IR. All capacitor contactors come with an auxiliary contact (normally open).

| Ordering Code | kVAr= Rating 50/60Hz | | | Instantaneous Auxillary Contactors | | Electric Life at Rated Load | Electric Life at Rated Load | Prospective Peak Current at Switch on (In) |
|---|---|---|---|---|---|---|---|---|
| | 200V/ 240V | 400V/ 440V | 660V/ 690V | NO | NC | Operations Hours | Operations | |
| IDC025K10U7 | 1.4 | 2.5 | 3 | 1 | 0 | 240 | 200000 | 200In |
| IDC050K10U7 | 2.8 | 5 | 6.5 | 1 | 0 | 240 | 200000 | 200In |
| IDC075K11U7 | 4 | 7.5 | 3 | 1 | 1 | 240 | 200000 | 200In |
| IDC100K11U7 | 5.5 | 10 | 12.5 | 1 | 1 | 240 | 200000 | 200In |
| IDC125K11U7 | 6.7 | 12.5 | 18 | 1 | 1 | 240 | 200000 | 200In |
| IDC167K11U7 | 8.5 | 16.7 | 24 | 1 | 1 | 240 | 200000 | 200In |
| IDC200K11U7 | 10 | 20 | 30 | 1 | 1 | 240 | 200000 | 200In |
| IDC250K11U7 | 15 | 25 | 36 | 1 | 1 | 240 | 200000 | 200In |
| IDC333K12U7 | 20 | 33.3 | 48 | 1 | 2 | 100 | 100000 | 200In |
| IDC400K12U7 | 25 | 40 | 58 | 1 | 2 | 100 | 100000 | 200In |
| IDC500K12U7 | 30 | 50 | 72 | 1 | 2 | 100 | 100000 | 200In |
| IDC600K12U7 | 40 | 60 | 92 | 1 | 2 | 100 | 100000 | 200In |
| IDC750K12U7 | 45 | 75 | 120 | 1 | 2 | 100 | 100000 | 200In |
| IDC800K12U7 | 48 | 80 | 128 | 1 | 2 | 100 | 100000 | 200In |
| IDC1000K12U7 | 60 | 100 | 143 | 1 | 2 | 100 | 100000 | 200In |

**AC COIL VOLTAGE CAPACITOR DUTY CONTACTOR**

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

# Filter Circuit/ Harmonic Reactors



- Features
- High harmonic overloading capability Very low losses
- High linearity to avoid choke tilt Low noise
- Simple mounting Long useful life
- Temperature protection (NC contact)

Electrical energy is a significant production factor for industry, and its efficient use should be a primary objective. Reducing the reactive current component by PFC correction helps to save energy. The increasing use of modern power electronic apparatus (drives, uninterruptible power supplies, etc) that produce non- linear current 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 lies typically between 250 and 500 Hz, i.e. in the region of the 5th and 7th harmonics. 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.

Detuned systems are scaled so 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 50 Hz line frequency, the detuned system acts purely capacitively, thus correcting the reactive power.

## Filter Reactors

| | |
|---|---|
| **Harmonics*** | $U_3$ = 0.5% $U_R$ (Duty Cycle = 100%)<br>$U_5$ = 6.0% $U_R$ (Duty Cycle = 100%)<br>$U_7$ = 5.0% $U_R$ (Duty Cycle = 100%)<br>$V_{11}$ = 3.5% $U_R$ (Duty Cycle=100%)<br>$V_{13}$ = 3.0% $U_R$ (Duty Cycle=100%) |
| **Effective current** | $I_{rms} = \sqrt{(I\ 1^2+I\ 3^2+...I\ 13^2)}$ |
| **Fundamental current** | I1 = 1.06* $I_R$ (50 Hz current of capacitor) |
| **Temperature protection** | Microswitch (NC) |

## Three-phase filter reactors to EN 61558

| | |
|---|---|
| **Frequency** | 50 / 60 Hz |
| **Voltage** | 400, 440, 480 V |
| **Output** | 5 .....100 kVAr |
| **Detuning** | 5.67%, 7%, 14% |
| **Cooling** | Natural |
| **Ambient temperature** | 40°C |
| **Class of protection** | I |
| **Enclosure** | IP00 |

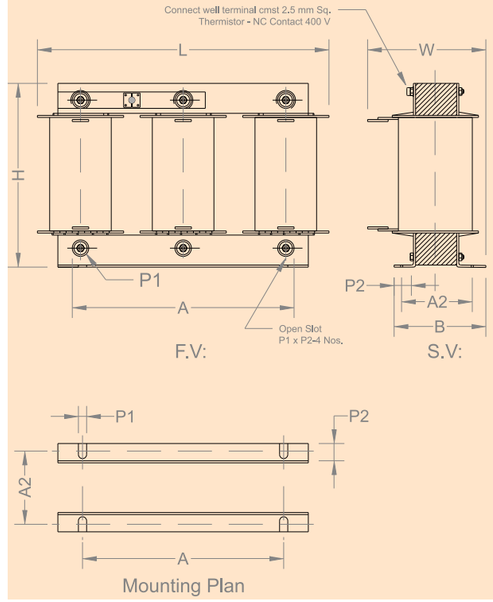




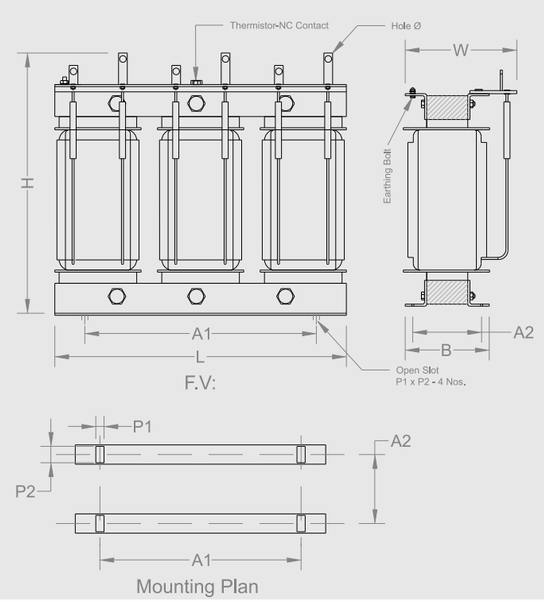
## ANTIRESONANCE HARMONIC FILTER REACTOR DETUNED SYSTEMS

### 7 & 14% Detuned Harmonics Reactors-with Thermistor switch, 415/440V, 3-ph, 50Hz

**COPPER**




**ALUMINIUM**




| 7% DETUNED REACTOR (COPPER) 440 VOLTS | kVAr | Rated Current | I rms | Inductance | Terminal Hole (ø) | All dimensions in mm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | W ±5 | H | A1 | A2 ±3 | B | P1 | P2 |
| | 5 | 6.6A | 7.5A | 9.28 mH | 6 | 175 | 96 | 157 | 100 | 55 | 73 | 10.5 | 18 |
| | 10 | 13.1A | 14.9A | 4.64 mH | 6 | 178 | 125 | 161 | 100 | 75 | 93 | 10.5 | 20 |
| | 12.5 | 16.5A | 18.7A | 3.71 mH | 6 | 178 | 125 | 161 | 100 | 75 | 93 | 10.5 | 20 |
| | 15 | 19.8A | 22.3A | 3.10 mH | 8 | 225 | 150 | 230 | 150 | 73 | 93 | 10.6 | 21.5 |
| | 20 | 26.4A | 29.8A | 2.32 mH | 8 | 226 | 152 | 205 | 150 | 96 | 109 | 10.8 | 22 |
| | 25 | 32.8A | 37.2A | 1.86 mH | 8 | 226 | 152 | 205 | 150 | 96 | 109 | 10.8 | 22 |
| | 30 | 39.6A | 44.7A | 1.55 mH | 8 | 226 | 152 | 205 | 150 | 96 | 109 | 10.8 | 22 |
| | 35 | 46.2A | 52.1A | 1.33 mH | 8 | 226 | 152 | 205 | 150 | 96 | 109 | 10.6 | 22 |
| | 50 | 65.6A | 74.4A | 0.93 mH | 8 | 260 | 207 | 240 | 150 | 167 | 185 | 10.6 | 55 |
| | 75 | 99.0A | 112.2A | 0.62 mH | 20 x 3 | 300 | 182 | 270 | 150 | 132 | 152 | 10.8 | 38 |
| | 100 | 131.2A | 148.9A | 0.46 mH | 25 x 3 | 330 | 180 | 270 | 150 | 132 | 155 | 10.8 | 15.5 |

| 7% DETUNED REACTOR (ALUMINIUM) 440 VOLTS | kVAr | Rated Current | I rms | Inductance | Terminal Hole (ø) | All dimensions in mm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | W ±5 | H | A1 | A2 ±3 | B | P1 | P2 |
| | 5 | 6.6A | 9 A | 9.28 mH | 6 | 215 | 130 | 185 | 203 | 80 | 100 | 8 | 12 |
| | 10 | 13.1A | 18 A | 4.64 mH | 6 | 215 | 155 | 185 | 203 | 92 | 110 | 8 | 12 |
| | 12.5 | 16.5A | 21 A | 3.97 mH | 6 | 215 | 170 | 185 | 203 | 105 | 123 | 8 | 12 |
| | 15 | 19.8A | 26 A | 3.21 mH | 6 | 215 | 196 | 185 | 203 | 130 | 150 | 8 | 12 |
| | 20 | 26.4A | 35 A | 2.32 mH | 6 | 250 | 170 | 225 | 150 | 110 | 140 | 12 | 20 |
| | 25 | 32.8A | 43 A | 1.85 mH | 6 | 270 | 165 | 265 | 150 | 110 | 140 | 12 | 20 |
| | 50 | 65.6A | 86 A | 0.92 mH | 10 | 270 | 210 | 375 | 150 | 110 | 140 | 12 | 20 |
| | 75 | 99.0A | 129 A | 0.62 mH | 10 | 270 | 210 | 385 | 150 | 110 | 140 | 12 | 20 |
| | 100 | 131.2A | 172 A | 0.46 mH | 10 | 370 | 205 | 305 | 180 | 145 | 185 | 12 | 20 |

# Reactive Power Controller


## Intelligent • User-Friendly • Cost Effective

**General**

This innovative PFC controller offers very intelligent control behavior and is extremely user-friendly due to menu-driven handling (plain language). The multi functional display makes installation, handling and maintenance as easy as possible. Harmonics display is standard, interface Rs232 or Rs485 optional.

QUALITY · CONSISTENCY · RELIABILITY · ENERGY Efficient · DURABLE Long Lasting

## FEATURES :

- Display
- Large and multifunctional LCD (2 x 16 characters)
- 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 (VAC)
- Reactive power (kvar)
- Active power (kW)
- Frequency
- 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 Ø
- Target cos Ø
- kvar value to target cos Ø

Alarm output
- Insufficient compensation
- Overcompensation
- Undercurrent
- Overcurrent
- Overtemperature
- Harmonics exceeded
- Treshold value programmable
- Internal error storage
- Programming of 2nd signal Relay random

Recall recorded values
- Number of contactor switching operations
- Maximum voltage, U (Vmax)
- 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

Dynamic PFC (transistor output)
- Thyristor Switching





## PFC Controller Technical Data

| | |
|---|---|
| Case | Panel-mounted instrument, 144 x 144 x 60mm |
| **Ambient conditions** | |
| Over-voltage class | III |
| Pollution degree | 2 |
| Operating temperature | -5 °C ... + 55 °C |
| Storage temperature | -20 °C ... + 65 °C |
| Mounting position | any |
| Humidity class | 15% to 95% without dew |
| Protection class :<br>Front plate<br>Rear side | Ip54 according to IEC529 / DIN 40050<br>Ip20 according to IEC529 / din 40050 |
| **Operation** | |
| Supply voltage | 230 $V_{ac,}$ 50 and 60 Hz power Lines |
| Target cos Ø | 0.8 ind. - 0.8 cap. |
| Switching and discharge time range | 1 - 1200 seconds |
| Number of control series | 20 series preset + control series editor for free programming |
| Control modes | Series switching (LIFO), circular switching (FIFO),<br>self-optimized intelligent control mode |
| **Measurement** | |
| Measurement voltage range | 30 ... 300 $V_{ac}$ phase to neutral (i.e. 50 ... 525 V phase to phase) |
| Fundamental frequency | 50Hz and 60 Hz |
| Measurement current | x/1 and x/5 Ampere possible |
| Maximum current | 40 mA |
| Zero voltage release | 5.3 A (sinusoidal) |
| Switching outputs | < 15 ms |
| Relay outputs<br>Number of relays<br>Switching voltage / power<br>Max. switching frequency<br>Expected mechanical life<br>Expected electrical life | <br>6 and 12 steps available<br>max. 250 $V_{AC,}$ max. 1000 W<br>0.25 Hz<br>> 30 x $10^5$ switching operations<br>> 5 x $10^5$ switching operations (load = 200 VA, cos Ø = 0.4) |
| Alarm relay | Potential-free contact |

# Reactive Power Compensation Selection for Solution

# Installation & Maintenance of Reactive Power Capacitors





INDTECH® POWER CAPACITORS The Reliable Capacitors

## Reactive Power Compensation Selection for Solution

### kVAr COMPENSATION FOR TRANSFORMER

Power and distribution transformers, which work on the principle of electromagnetic induction , consume reactive power for their own needs even when its secondary is not connected to any load.The power factor will be very low under such situation. To improve the power factor , it is required to connect a fixed capacitor or a capacitor bank at the LT side of the transformer. Below table gives the approximate KVAr of capacitors required.

| KVA rating of the Transformer | kVAr required for compensation |
|---|---|
| Up to and including 315 KVA | 5 % of KVA rating |
| 315 KVA - 1000 KVA | 6 % of KVA rating |
| Above 1000 KVA | 8 % of KVA rating |

It is useful to note that , in the case of APFC system , the current Transformer providing feedback to the APFC system , must be located in such a way that it does not measure this capacitor current.

### Cross Section of Connecting Cable Between Main Supply and Capacitor Bank, Fuse Rating.

| Output kVAr | Rated Voltage 230V, 50Hz | | | Rated Voltage 400V, 50Hz | | | Rated Voltage 415V, 50Hz | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rated Current A | Fuse A | Cable / mm² | Rated current A | Fuse A | Cable / mm² | Rated current A | Fuse A | Cable/ mm² |
| 2.5 | 6.3 | 16 | 2.5 | 3.6 | 10 | 1.5 | 3.5 | 10 | 1.5 |
| 5.0 | 12.6 | 25 | 4 | 7.2 | 20 | 2.5 | 7.0 | 20 | 2.5 |
| 6.67 | 16.7 | 35 | 6 | 9.6 | 20 | 2.5 | 9.3 | 20 | 2.5 |
| 7.5 | 19 | 35 | 6 | 10.80 | 20 | 2.5 | 10.4 | 20 | 2.5 |
| 8.33 | 21 | 35 | 6 | 12 | 20 | 2.5 | 11.6 | 20 | 2.5 |
| 10.0 | 25 | 50 | 10 | 14.4 | 25 | 4 | 13.9 | 25 | 4 |
| 12.5 | 31 | 63 | 16 | 18 | 35 | 6 | 17.4 | 35 | 6 |
| 15.0 | 38 | 63 | 16 | 21.7 | 35 | 6 | 20.9 | 35 | 6 |
| 16.7 | 42 | 80 | 25 | 24.1 | 50 | 10 | 23.2 | 50 | 10 |
| 20.0 | 50 | 100 | 35 | 28.9 | 50 | 10 | 27.8 | 50 | 10 |
| 25.0 | 63 | 125 | 50 | 36.1 | 63 | 16 | 34.8 | 63 | 16 |
| 30.0 | 75 | 125 | 50 | 43.3 | 80 | 25 | 41.7 | 80 | 25 |
| 33.3 | 84 | 160 | 70 | 48.1 | 80 | 25 | 46.3 | 80 | 25 |
| 40.0 | 100 | 160 | 95 | 57.7 | 100 | 35 | 55.6 | 100 | 35 |
| 50.0 | 125 | 250 | 120 | 72.2 | 125 | 50 | 69.6 | 125 | 50 |
| 60.0 | - | - | - | 86.6 | 160 | 70 | 83.5 | 160 | 70 |
| 66.7 | - | - | - | 96.3 | 160 | 70 | 92.8 | 160 | 70 |
| 70.0 | - | - | - | 101 | 160 | 70 | 97 | 160 | 70 |
| 75.0 | - | - | - | 108 | 160 | 70 | 104 | 160 | 70 |
| 83.3 | - | - | - | 120 | 200 | 95 | 116 | 200 | 95 |
| 100.0 | - | - | - | 144 | 250 | 120 | 139 | 250 | 120 |

The Cross section for connecting cable and fuse rating has to be selected in accordance with the standard practice. Guideline values for operation under normal conditions and at an ambient temperature of 40°C are given above. Higher values may have to be selected if conditions differ from normal (e.g. higher ambient temperature or high harmonic distortion.)

### FOR OTHER VOLTAGE RATINGS: (FOR NOMINAL CURRENT):

230 V: 400 V table value*1.74
480 V: 400 V table value*0.83
550 V: 400 V table value*0.73
700 V: 400 V table value*0.57
850 V: 400 V table value*0.47
1000 V: 400 V table value*0.40

415 V: 400 V table value*0.96
500 V: 400 V table value*0.80
600 V: 400 V table value*0.67
750 V: 400 V table value*0.53
900 V: 400 V table value*0.44

440 V: 400 V table value*0.91
525 V: 400 V table value*0.76
650 V: 400 V table value*0.62
800 V: 400 V table value*0.50
950 V: 400 V table value*0.42

## Reactive Power Compensation Selection for Solution

### CAPACITOR SELECTION FOR IMPROVEMENT OF POWER FACTOR

| Actual Power Factor | Target/ Desired Power Factor | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.70 | 0.75 | 0.80 | 0.85 | 0.90 | 0.92 | 0.94 | 0.96 | 0.98 | 1.00 |
| 0.40 | 1.27 | 1.41 | 1.54 | 1.67 | 1.81 | 1.87 | 1.93 | 2.00 | 2.09 | 2.29 |
| 0.45 | 0.96 | 1.10 | 1.23 | 1.36 | 1.50 | 1.56 | 1.62 | 1.69 | 1.78 | 1.98 |
| 0.50 | 0.71 | 0.85 | 0.98 | 1.11 | 1.25 | 1.31 | 1.37 | 1.44 | 1.53 | 1.73 |
| 0.55 | 0.50 | 0.64 | 0.77 | 0.90 | 1.03 | 1.09 | 1.16 | 1.23 | 1.32 | 1.52 |
| 0.60 | 0.31 | 0.45 | 0.58 | 0.71 | 0.85 | 0.91 | 0.97 | 1.04 | 1.13 | 1.33 |
| 0.65 | 0.15 | 0.29 | 0.42 | 0.55 | 0.68 | 0.74 | 0.81 | 0.88 | 0.97 | 1.17 |
| 0.70 | 0.00 | 0.14 | 0.27 | 0.40 | 0.54 | 0.59 | 0.66 | 0.73 | **0.82** | 1.02 |
| 0.75 | | 0.00 | 0.13 | 0.26 | 0.40 | 0.46 | 0.52 | 0.59 | 0.68 | 0.88 |
| 0.80 | | | 0.00 | 0.13 | 0.27 | 0.32 | 0.39 | 0.46 | 0.55 | 0.75 |
| 0.85 | | | | 0.00 | 0.14 | 0.19 | 0.26 | 0.33 | 0.42 | 0.62 |
| 0.90 | | | | | 0.00 | 0.06 | 0.12 | 0.19 | 0.28 | 0.48 |

**Example:**

**Actual Power factor 0.70, Target Power Factor = 0.98, real power (P) = 600 kW,**

**Qc = k*P = 0.82* 600 kW = 492 kVAr**

**Calculating the required capacitive reactive power**

The capacitive reactive power is calculated using the following formula:

Qc = P x (tanϕ1 - tanϕ2)

Qc = required capacitive reactive power P = active power tanϕ1 = tangent of the power factor cosϕ prior to compensation

tanϕ2 = tangent of the power factor cosϕ after compensation

When calculating central compensation, we do not have the necessary values as would be specified on a motor. In practice, the compensation power required is calculated using the most recent electricity bills or by taking long-term readings (network analysis).

In the electricity bill, the energy provider provides the following values on a monthly basis.

From this, the reactive power required can already be calculated using the formula introduced earlier.

Q = P x (tanϕ1 - tanϕ2)

P = the active power specified in the electricity bill

tanϕ1 = tangent of the power factor cosϕ before compensation

tanϕ2 = tangent of the power factor cosϕ after compensation

The power factor desired is defined by the operating technician. In most cases, it is between 0.92 and 0.97 inductive. In our case, we calculate the reactive power compensation at 0.95 inductive, as is common practice.

Q = 498 kW x (0,7025 - 0,3287) = 186 kVAr

Active power taken from the electricity bill

tanϕ1 = kVAr / kWh

= 166.023 kVAr / (78.608 + 157.716) kWh

= 0.7025 (values from the electricity bill)

tanϕ2 of the desired cosϕ 0.95

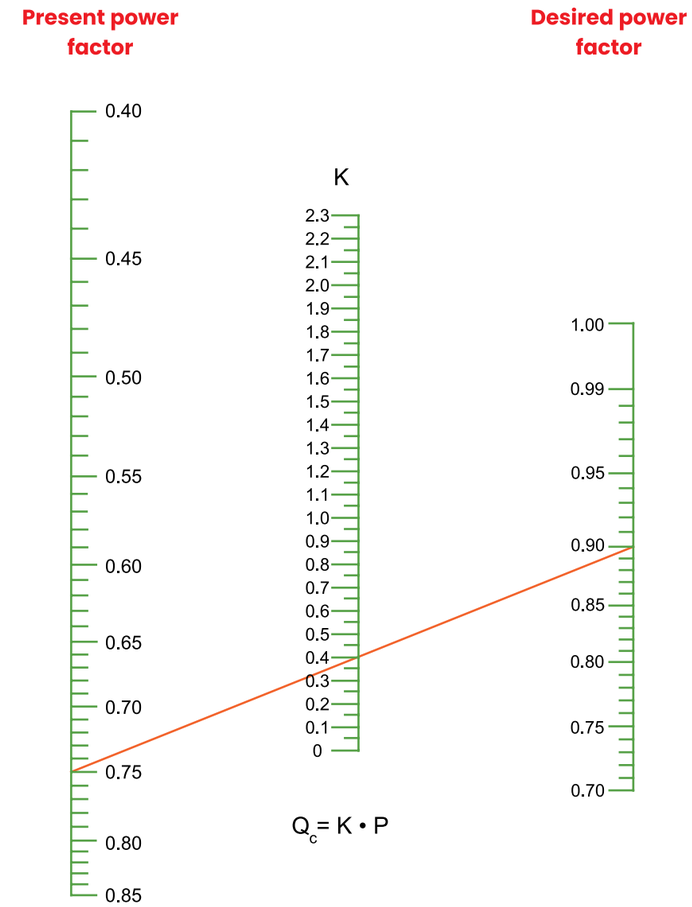
In this example, we choose the next size up for standard systems, which is 200 kVAr



## Reactive Power Compensation Selection for Solution

### Nomogram for Power Factor Correction

A capacitive kVAr required for improvement of power factor at a given load can be made from the monogram in the figure below. However, in most cases the capacitor bank rating has to be carefully selected after due consideration of rated voltage of the system, system over-voltages, harmonics in system, rating of series reactor if any, etc. Besides the correct sizing of the capacitor bank, the reliability also depends on the right selection of associated equipment such as the circuit breaker, series reactor, protective relays, etc. Above all, it is essential to check that the capacitor installation will not cause dangerous stress to the user's system due to resonance.




### NOMOGRAM

A Nomogram is used for calculating the necessary capacitor power rating Q (kVAr), required for improving the power factor of a load P (kW). For example, to calculate the capacitor power rating required to increase the power factor of an installation from 0.75 to 0.90

if the load P is 1000 kW, from the nomogram K = 0.40 and hence

**Q = 0.40 x 1000 = 400 kVAr.**

## Reactive Power Compensation Selection for Solution

### Capacitor requirement for motor selection

- The recommended capacitor rating for motor should be
- Sized to compensate upto 90 % of the motor magnetization
- Current of motor , to avoid self excitation phenomenon. The below table
- Gives the selection chart for Capacitors as per the hp rating of the motor

**Power capacitor rating for direct connection Induction Motors**
**CAPACITOR KVAr at motor speed of**

| Motor HP | 3000 rpm | 1500 rpm | 1000 rpm | 75 rpm | 600 rpm | 500 rpm |
|---|---|---|---|---|---|---|
| 5 | 2 | 2 | 2 | 3 | 3 | 3 |
| 7.5 | 2 | 2 | 3 | 3 | 3 | 3 |
| 10 | 3 | 3 | 4 | 5 | 5 | 5 |
| 15 | 3 | 4 | 5 | 7 | 7 | 7 |
| 20 | 5 | 6 | 7 | 8 | 8 | 10 |
| 25 | 6 | 7 | 8 | 9 | 9 | 12 |
| 30 | 7 | 8 | 9 | 10 | 10 | 15 |
| 40 | 9 | 10 | 12 | 15 | 16 | 20 |
| 50 | 10 | 12 | 15 | 18 | 20 | 22 |
| 60 | 12 | 14 | 15 | 20 | 25 | 25 |
| 75 | 15 | 16 | 20 | 22 | 25 | 30 |
| 100 | 20 | 22 | 25 | 26 | 32 | 35 |
| 125 | 25 | 26 | 30 | 32 | 35 | 40 |
| 150 | 30 | 32 | 35 | 40 | 45 | 50 |
| 200 | 40 | 45 | 45 | 50 | 55 | 60 |
| 250 | 45 | 50 | 55 | 60 | 65 | 70 |

**Recommended Selection Of Capacitors**

| Type of Capacitors | Harmonics Level | Application/Nature of Loads |
|---|---|---|
| Normal Duty | 15% | Small Scale Industries , Machine shops , Tool Rooms , Process Industries ,Office Buildings , Housing Societies , Consumer Goods Manufacturing. |
| Heavy Duty | 20% | Lift Cranes , Breweries , Chemical , Clothing Sewing , Auto Parts , Hotel Industries , Hospital Industries , Chemical Factories, Floor mills , Agro Product Industries , Wind Mills |
| Super Heavy Duty | 25% | Rolling Mill , Steel Industries, Cement Industries , Sugar Mill, Paper Industries, IT Software Industries , Oil Field Pumping, Forging , Foundry , Airports . |

Note : The loads such as UPS + Computer systems , Induction Furnaces , Rectifiers Welding Equipments , Drives etc are there in the plants , then the Harmonics levels are high. In that case it is recommended to at least install capacitor which can withstand higher harmonics. The normal rating capacitors will not work in that case. If the Harmonics levels are more 25 % , then it is recommended to install Detuned filters.



## Reactive Power Compensation Selection for Solution

### Required Rated Capacitor Output in Detuned Filter Circuits

**Calculation of the required rated capacitor output in Detuned Filter Circuit.**

Factors to be multiplied with the required output per step.

| **Supply Voltage : 440 V** | **Detuning Factor in 1%** | | | | | | |
|---|---|---|---|---|---|---|---|
| Rated voltage *of capacitor, V | 5 | 5.5 | 6 | 7 | 12.5 | 13 | 14 |
| 440 | 1.150 | 1.143 | 1.137 | 1.125 | - | - | - |
| 525 | 1.637 | 1.628 | 1.619 | 1.602 | 1.507 | 1.499 | 1.481 |
| **Supply Voltage : 415 V** | **Detuning Factor in %** | | | | | | |
| Rated Voltage *of capacitor, V | 5 | 5.5 | 6 | 7 | 12.5 | 13 | 14 |
| 440 | 1.068 | 1.062 | 1.057 | - | - | - | - |
| 525 | 1.520 | 1.512 | 1.504 | 1.488 | 1.400 | 1.392 | 1.376 |
| **Supply Voltage : 440 V** | **Detuning factor in %** | | | | | | |
| Rated Voltage *of capacitor, V | 5 | 5.5 | 6 | 7 | 12.54 | 13 | 14 |
| **Supply Voltage : 400 V** | **Detuning factor in %** | | | | | | |
| 525 | 1.352 | 1.345 | 1.338 | 1.324 | 1.246 | 1.239 | 1.224 |
| **Supply Voltage : 480 V** | **Detuning factor in %** | | | | | | |
| Rated Voltage *of capacitor, V | 5 | 5.5 | 6 | 7 | 12.5 | 13 | 14 |
| 525 | 1.136 | 1.130 | 1.125 | 1.113 | - | - | - |
| 660 | 1.796 | 1.787 | 1.777 | 1.758 | 1.654 | 1.645 | 1.626 |

**Example**

Required output per step at supply voltage 50 kVAr
Supply Voltage 400 V
Detuning factor 7%
Rated voltage of the capacitor 440 V
Factor of the table 1.125
Required rated output of the capacitors: 50 kVAr x 1.125 = 56.25 kVAr
* For filter circuits the capacitor rated voltage has to be chosen always higher than the supply voltage. i.e.: Fundamental voltage increased by the reactor and harmonics.

# REACTIVE POWER COMPENSATION

## TABLE OF CAPACITANCE VALUE MEASURED BETWEEN PHASE TO PHASE TERMINALS

| kVAr ▼ | Output Capacitance - Phase Value (*VAC 50Hz) (µF) | | | | | |
|---|---|---|---|---|---|---|
| | *400 V | *415 V | *440 V | *480 V | *525 V | *690 V |
| 1 | 9.95 | 9.25 | 8.22 | 6.91 | 5.78 | 3.34 |
| 2 | 19.90 | 18.49 | 16.45 | 13.82 | 11.55 | 6.69 |
| 3 | 29.86 | 27.74 | 24.67 | 20.73 | 17.33 | 10.03 |
| 4 | 39.81 | 36.98 | 32.90 | 27.64 | 23.11 | 13.38 |
| 5 | 49.76 | 46.23 | 41.12 | 34.56 | 28.89 | 16.72 |
| 6 | 59.71 | 55.47 | 49.35 | 41.47 | 34.66 | 20.07 |
| 7 | 69.67 | 64.72 | 57.57 | 48.38 | 40.44 | 23.41 |
| 7.5 | 74.64 | 69.34 | 61.69 | 51.83 | 43.33 | 25.08 |
| 8 | 79.62 | 73.97 | 65.81 | 55.29 | 46.22 | 26.76 |
| 9 | 89.57 | 83.21 | 74.02 | 62.20 | 52.00 | 30.10 |
| 10 | 99.52 | 92.46 | 82.25 | 69.11 | 57.77 | 33.45 |
| 12.5 | 124.40 | 115.57 | 102.81 | 86.39 | 72.22 | 41.81 |
| 15 | 149.28 | 138.69 | 123.37 | 103.67 | 86.66 | 50.17 |
| 20 | 199.04 | 184.92 | 164.50 | 138.22 | 115.54 | 66.89 |
| 25 | 248.80 | 231.14 | 205.62 | 172.78 | 144.43 | 83.61 |
| 30 | 298.57 | 277.37 | 246.75 | 207.34 | 173.72 | 100.34 |
| 35 | 348.33 | 323.60 | 287.87 | 241.89 | 202.20 | 117.06 |
| 40 | 398.09 | 369.83 | 329.0 | 276.45 | 231.09 | 133.78 |
| 45 | 447.85 | 416.06 | 370.12 | 311.01 | 259.98 | 150.51 |
| 50 | 497.61 | 462.29 | 411.25 | 345.56 | 288.86 | 167.23 |
| 60 | 597.13 | 554.75 | 493.50 | 414.67 | 346.63 | 200.67 |
| 80 | 796.18 | 739.66 | 658.00 | 552.90 | 462.18 | 267.57 |
| 100 | 995.22 | 924.58 | 822.49 | 691.12 | 577.72 | 334.46 |

**Note : The tolerance is -5% / +10%**

## Economic benefits of power factor correction

As an example we can take an industrial company with an average power of 500 kW, operating for 4000 hours per annum at an average cos ϕ of 0.7. The power supply tariff allows the user to draw 50% of the active energy as reactive energy at no extra charge, corresponding to a target cos ϕ of 0.9.
Without power factor correction, the company pays the power supply company 7,28,286 Rs.
annually for reactive power.
A capacitor rating of 268 kVAr is necessary to correct the power factor to 0.9. It is usual, however, to select the next largest capacity, in this case a 300 kVAr system. The payback time of less than one year illustrates the economic viability of power factor correction.

| | |
|---|---|
| Energy at normal tariff | 20000000 kWh |
| Reactive energy at normal tariff | 2040408 kVArh |
| Reactive energy at no charge | 1000000 kVArh |
| Chargeable reactive energy | 1040408 kVArh |
| * 0.7 Rs./ kVArh | 728,285.60 Rs. |

**Required kVAr Calculation formula**
**P*TAN(ACOS(pf1))-TAN(ACOS(pf2))**

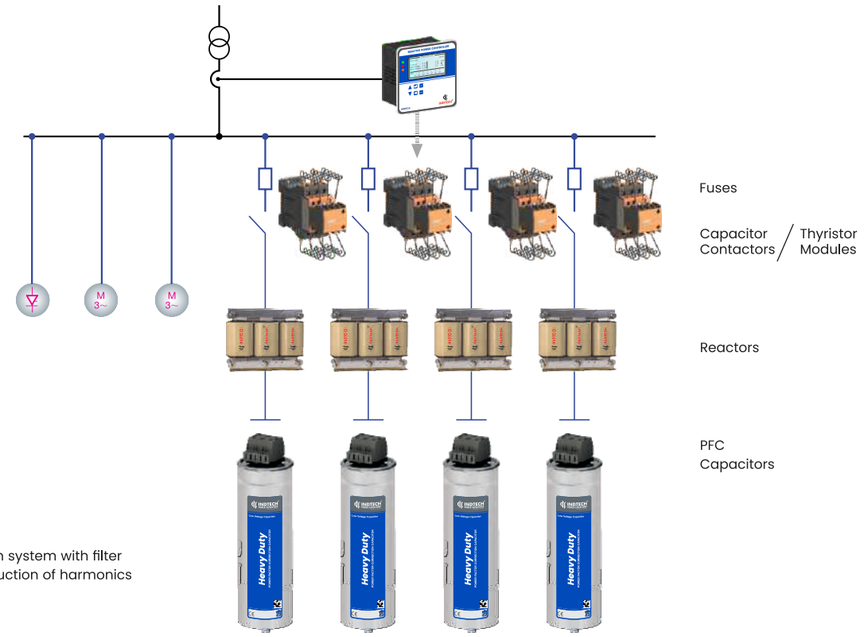
**Load (P) 500 kW**

**Total run hours = 4000 hr's/year**

**Assumption - Cost od capacitor with installation Rs./kVAr = 350 Rs.**

| Present pf1 | Target pf2 | | 0.9 | Target pf2 | | 0.92 | Target pf2 | | 0.95 | Target pf2 | | 0.98 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kVAr Required | Investment on Cap. Rs. | ROI in Day's | kVAr Required | Investment on Cap. Rs. | ROI in Day's | kVAr Required | Investment on Cap. Rs. | ROI in Day's | kVAr Required | Investment on Cap. Rs. | ROI in Day's |
| 0.4 | 904 | 3,16,400 | 157 | 933 | 3,26,550 | 162 | 982 | 3,43,700 | 170 | 1045 | 3,65,750 | 181 |
| 0.45 | 751 | 2,62,850 | 130 | 780 | 2,73,000 | 135 | 828 | 2,89,769 | 144 | 891 | 3,11,850 | 155 |
| 0.5 | 624 | 2,18,400 | 108 | 654 | 2,28,900 | 114 | 702 | 2,45,589 | 122 | 765 | 2,67,750 | 133 |
| 0.55 | 518 | 1,81,300 | 90 | 547 | 1,91,450 | 95 | 595 | 2,08,214 | 103 | 658 | 2,30,300 | 114 |
| 0.60 | 425 | 1,48,750 | 74 | 454 | 1,58,900 | 79 | 502 | 1,75,814 | 87 | 566 | 1,98,100 | 98 |
| 0.64 | 359 | 1.25.650 | 63 | 388 | 1,35,800 | 68 | 436 | 1,52,583 | 76 | 499 | 1,74,650 | 87 |
| 0.65 | 343 | 1,20,05 | 60 | 372 | 1,30,200 | 65 | 420 | 1,47,078 | 73 | 484 | 1,68,400 | 84 |
| 0.70 | 268 | 93,800 | 47 | 298 | 1,04,300 | 52 | 346 | 1,21,016 | 60 | 409 | 1,43,150 | 71 |
| 0.72 | 240 | 84,000 | 42 | 269 | 94,150 | 47 | 318 | 1,11,155 | 55 | 381 | 1,33,350 | 66 |
| 0.74 | 213 | 74,550 | 37 | 242 | 84,700 | 42 | 290 | 1,01,543 | 51 | 353 | 1,23,550 | 62 |
| 0.75 | 199 | 69,650 | 35 | 228 | 79,800 | 40 | 277 | 96,816 | 48 | 340 | 1,19,000 | 59 |
| 0.78 | 159 | 55,650 | 28 | 189 | 66,150 | 33 | 237 | 82,880 | 41 | 300 | 1,05,00 | 52 |
| 0.80 | 133 | 46,550 | 24 | 163 | 57,050 | 29 | 211 | 73,730 | 37 | 274 | 95,900 | 48 |
| 0.82 | 107 | 37,450 | 19 | 137 | 47,950 | 24 | 185 | 64,631 | 32 | 248 | 86,800 | 43 |
| 0.84 | 81 | 28,350 | 15 | 110 | 38,500 | 20 | 159 | 55,519 | 28 | 222 | 77,700 | 39 |
| 0.85 | 68 | 23,800 | 12 | 97 | 33,950 | 17 | 146 | 50,936 | 26 | 209 | 73,150 | 37 |
| 0.88 | 28 | 9,800 | 5 | 57 | 19,950 | 10 | 106 | 36,935 | 19 | 169 | 59,150 | 30 |
| 0.9 | - | - | - | 30 | 10,500 | 6 | 78 | 27,237 | 14 | 141 | 59,350 | 25 |
| 0.92 | | | | - | - | - | 49 | 17,030 | 9 | 112 | 39,200 | 20 |
| 0.94 | | | | | | | 17 | 5,997 | 3 | 80 | 28,00 | 14 |
| 0.95 | | | | | | | - | - | - | 63 | 22,050 | 11 |
| 0.98 | | | | | | | | | | - | - | - |

## Components For Reactive Power Compensation


Power factor correction system with filter circuit reactors for reduction of harmonics

## Guidelines for Capacitor Mounting & Installation

### General

- Indoor installation on firm support in a correctly ventilated local or metal enclosure.
- Ambient temperature around capacitors must not exceed 35°C over one year, 45°C over 24hours and 55°C max (according to IEC 60831 for -25/D temperature category).
- Maintain a gap of min. 20mm between capacitor units and min. 25mm between capacitors and panel enclosure for better air circulation
- Electrical clearance between phases shall be 30mm.
- For 3ph capacitors keep min. 25mm gap above the top of the capacitor
- Use capacitor duty contactor or inductor coil in series with any two phases in order to limit the inrush current when capacitors are switched in parallel with other energized capacitor units.
- Please ensure that there is no force by any means on the Pressure Sensitive Disconnector (PSD) in such a way to affect the operation of PSD when it is required to operate.

### Terminals

Double Fast-On + Cable

For lower ratings Double fast-on terminals with cables are provided ( for rating <=10kvar ) CLAMPTITE terminals

The unique finger-proof CLAMPTITE termination is fully integrated with discharge resistors and allows suitable access to tightening and ensures cable termination without any loose connections.

Once tightened, the design guarantees that the tightening torque is always maintained. (for rating >10kvar , up to 30kvar) STUD type terminals This type of terminals are used for proper current handling capabilities in capacitors of 40&50kvar

### Electrical connection

- Select the cable cross section depending on the kvar & voltage rating –see cable Selection.
- User is recommended to use a cable of minimum with stand capacity of 105°C.
- Remove conductor insulation of the cable only 10mm for connection.
- Suitable size lugs have to be used with connecting cable to capacitor terminals in order to avoid heat generation due to improper contacts.
- Use pneumatic gun to tighten the screw from top of the CLAMPTITE terminal cover. If not possible, please ensure proper tightness when a screw driver is used to avoid loose termination. Apply a torque of 2.5Nm to tighten
- For Stud type terminals use a torque of 15Nm to tighten the Terminals after connecting cable using proper sized lugs.
- For tightening the terminal studs apply a torque of
  for M6 studs - 4 Nm
  for M8 studs - 8 Nm
  for M10 studs - 12 Nm

### Mounting

- Capacitors can be mounted alone or in row.
- Position:
- Horizontally and Vertically
  Vertical use is recommended for long life
- Capacitor body shall be earthed at bottom.
- Capacitor shall be installed in dry place away from heat generating source & avoid dusty atmosphere
- Provide adequate cross ventilation for heat dissipation
- Apply a tightening torque of 8Nm to fix the capacitor on the mounting plates.
- Tightening torque of 10Nm to be applied on Hexagonal mounting nut.

# INSTALLATION AND MAINTENANCE INSTRUCTIONS
## Power Factor Correction Capacitors

**Dear Customer,**

Please follow the instructions manual carefully before installing a power capacitor for optimum and reliable performance. The information stated in this manual applies to typical, approved usage. Please refer to our product specifications, or request our approval for your own individual specifications, before installing capacitors.

### Installation : Mounting

- Power capacitors should be installed in cool and well-ventilated place.
- Power Capacitors should not be Installed within the range heat radiating objects, For e.g. Furnaces, Filter Circuit reactors, Direct sun radiation.
- Capacitors installed in a closed environment should be placed at the bottom to `ensure lowest stress temperature possible.
- **Vertical use is recommended for long life. (Refer Fig. 01 for detailed Instruction)**

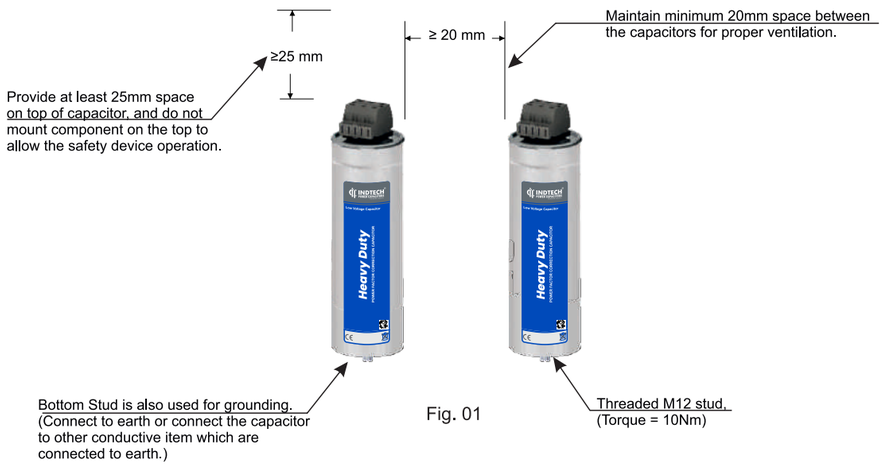



Fig. 01

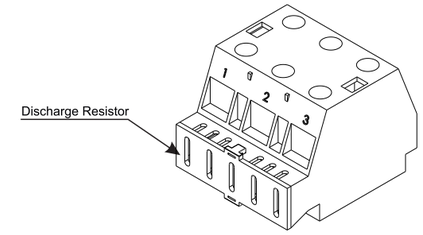
### Instructions:

- Provide Minimum 20mm space between the capacitors to have a proper cooling.
- Provide at least 25mm space above the power capacitor.
- Do not mount any component on the top or at the crimp to allow the longitudinal extension of the can in case of over-pressure disconnection.
- The threaded stud on the bottom of the capacitor is used for grounding as well.
- The connection cables should be flexible and copper material.
- Refer table 01 for max. permissible torque, while connecting the supply cable.
- For max. cable cross-section see below table and refer annex 1 for cross-section of supply copper cable according to kVAr rating.

| Center distance between two phase of terminal block | Max. Torque | Max. cable cross section |
|---|---|---|
| 9.8 mm | 1.2 Nm | 16 $mm^2$ |
| 12.0 mm | 2.0 Nm | 25 $mm^2$ |

### Discharge Resistors:

- Discharge resistors are used to discharge capacitor and protect operating personal from risk of electric shock hazard.
- Specially designed international discharge resistors to discharge the power capacitor down to 75V or below within 180 seconds.
- Before re-switching, capacitor must be discharged to 10% of the rated voltage or below.




**Caution! : Discharge the capacitor before handling.**

### Harmonics:

Harmonics are sinusoidal voltages and currents with frequencies that are multiple of a 50Hz or 60Hz power supply frequency. Harmonics are caused by loads operated with modern power electronic, such as converters, electrical drives, welding machines, and stand-by power supplies.

### Ambient Temperature:

Temperature is one of the main stress factor for polypropylene type capacitors, means it has a major influence on the life cycle of the capacitor. The ambient temperature category is -10°/D - means up to max. 5°C under forced air cooling conditions a higher ambient temperature is possible. Maximum casing temperature of 65°C must not be exceeded.

**Caution !**

Exceeding the maximum allowed temp. may set the safety device out of operation.
capacitors should not be used any longer in case of dents, mechanical or any other kind of damage!
Check the integrity of discharge resistors before installation.

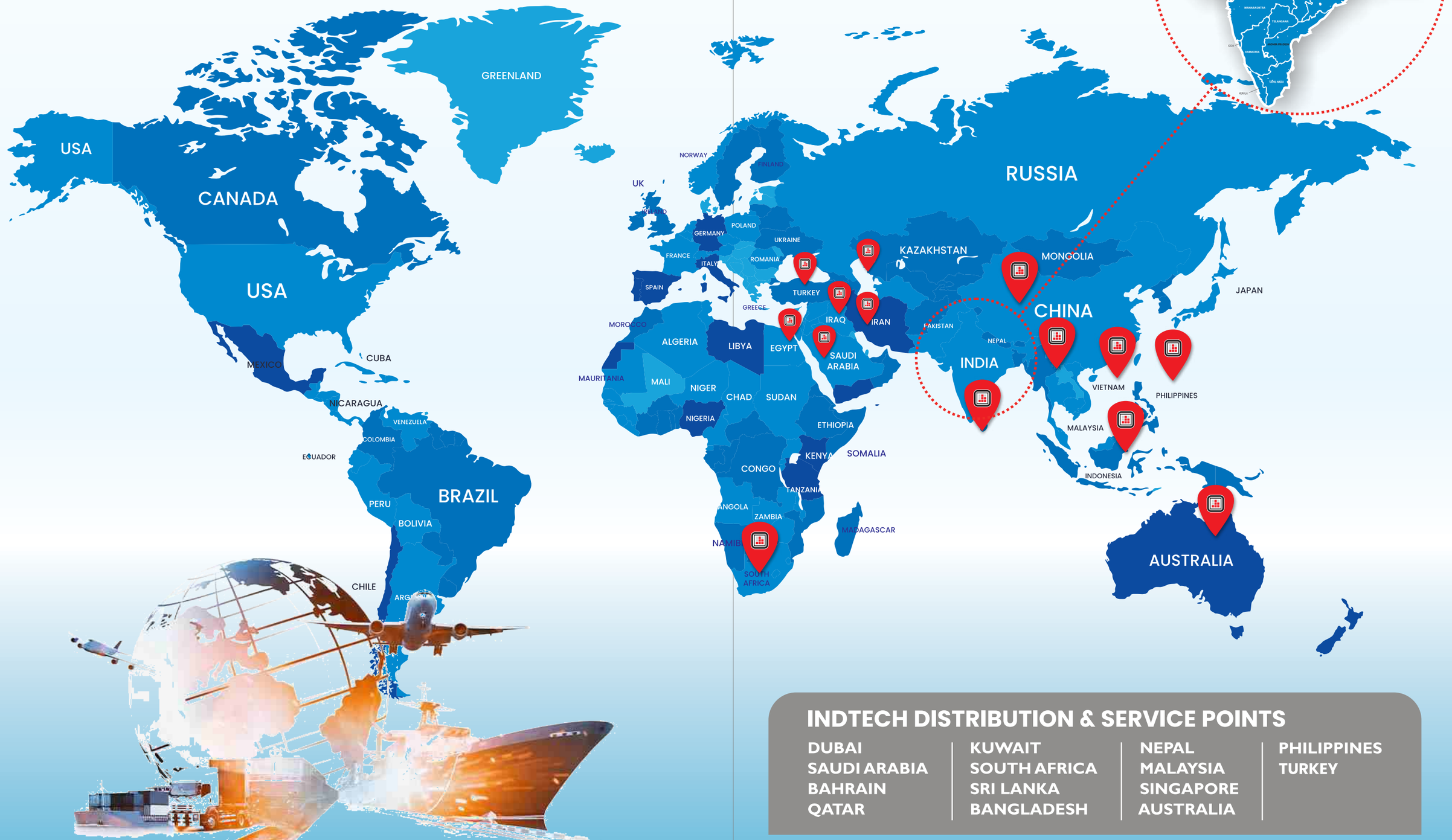
### Over current / short circuit protection:

- HRC-fuses or MCCB for short circuit protection have to be used. Short circuit protection equipment and connection cable should be selected so that the 1.5 times rated current of the capacitor can be managed permanently.
- HRC - fuses do not protect the capacitor against overload, it is only a short circuit protection.
- HRC - fuse rating has to be 1.5 to 1.8 times nominal capacitor current.
- Do not use HRC fuses for switching capacitors (lightning arc).

### Safety:

- Maintain good and effective earthing for enclosures of capacitors.
- Provide means to isolate faulty unit / bank in the system.
- Handle capacitor units carefully as they may be charged even after disconnection due to faulty discharging devices.
- Consider terminals of capacitors, connected bus bars and cables and any other devices, which are connected with them, also as energized - device under voltage.

# FOR YOU. ON SITE WORLDWIDE



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