



PRODUCT CATALOGUE
PARTS AND TRAYS
POWER FACTOR CORRECTION **LV**



ICAR: products and solutions

Founded in 1946, ICAR is a leading manufacturer of capacitors and power factor correction systems in low and medium voltage; it controls with its own companies all production phases: the polypropylene/paper film, metallization, winding, manufacturing of the finished product.

The entire process is checked in order to obtain a product of high quality level that guarantees its functioning even in the most burdensome plant configurations.

The ICAR Group has 6 plants, all located in Europe. For details on the individual families, download the full catalogs on the website, www.icar.com. Here are all equipment and the solutions ICAR proposes.



Bank for power factor correction



Capacitors and MT power factor correction systems



Power electronics capacitors



Active filters



LV voltage stabilizers



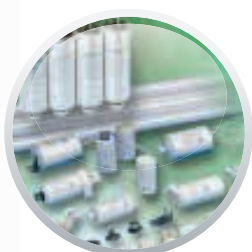
EMI RFI filters



Motor run capacitors



Capacitors for energy storage and rapid discharge



Lighting capacitors



Reactors and LV/LV special transformers

Power factor correction

An advantageous choice under the technological and ecological prospective

The proper power factor correction of an electric plant, brings to several implications far beyond the simple technical considerations. In an electric plant, the useful energy that is transformed into work is the active energy.

The electric devices that determine a low $\cos \phi$, require a quote of ("reactive") energy for their proper functioning that causes a greater load in both the manufacturing power plant and the electric lines that convey the plant up to the user plant.

The power factor correction enables to "produce" the reactive energy within the plant with clearly visible advantage for the user and the electric network behind it.

The proper power factor correction of an electric plant, has, technically, the following advantages:

- Avoid the fines applied by the energy suppliers to the users with low $\cos \phi$.
- For new plants, optimize the dimensioning of the plant depending on the actual planned production capability
- For existing plants, recover productive capability without adding/increasing the performances of what already installed (transformers, cables)
- Reduce line voltage drop (that could cause problems in motors starting or plants served by long MV power lines with low short circuit power).
- Reduce energy losses due to Joule effect in transformers and cables

The payback of a power factor correction system often occurs within a little more than a year.

Beside these technical/economical considerations, it can not be forgotten the ecological importance of the power factor correction. In fact, the growing energy demand makes necessary to:

- increase the total power installed by building new generating plants with the resulting environmental impact for pollution emission during their life cycle
- improve the performances of the transmission and distribution networks with the addition of new lines and/or the expansion of the existing ones.

A politic of power factor correction bringing the average Italian $\cos \phi$ to 0,95 would make saving, according to preventive estimates, about a million of MWh/year with evident advantage in terms of stress reduction for the power plant park and the energy transmission /distribution network, reducing, at the same time, CO2 emission of about a million tons.

Quality

ICAR has always regarded product quality and effectiveness of internal processes as key factors of corporate strategy. In ICAR we believe that compliance with international standards is a basic requirement to offer equipment that can meet the needs of our customers.

Quality System

The ICAR Quality management system is certified according to ISO 9001 since 1994.

We participate actively in international standards committees that draft regulations applicable to our production equipment, and in particular to industrial capacitors: this guarantees to be always up with changes in legislation, or rather pre-empt it.

Since 2011 the ICAR quality management system is certified by IRIS (International Railway Industry Standard). Promoted by UNIFE (Association of European companies operating



Certificato UNI EN
Iso9001:2008

in the railway sector) and supported by operators, system integrators and equipment manufacturers, IRIS integrates the ISO 9001 quality standard introducing additional requirements, specific to the railway industry.



IRIS is modeled on quality standards similar to those already in use in the automotive and aerospace industries.

Independent certification bodies and approved by the promulgators of the standard ensure objectivity and transparency in the evaluation.

IRIS certification, while being oriented in the rail system, has a positive effect on the whole ICAR quality system, with benefits for all types of produced devices.

The valid certificates can be downloaded from the website www.icar.com the section "Company - Quality"

Product quality

The equipment produced in ICAR are tested both in our laboratories and in the most important internationally recognized laboratories, in order to ensure compliance with the highest standards.

new

Power Quality in your hands with new regulators RPC 8LGA and 5LGA



Power Quality functions:

THD calculation and display of current and voltage.

Powerful.

Regulators with poor and confusing displays are a thing of the past: The 8LGA will amaze you with its 128x80 pixel LCD matrix graphic display.

The sharp detail allows intuitive navigation of the menus represented by icons and text in the 10 available languages - these include Italian, English, French, German, Russian, Spanish, Portuguese.



Better readability

of the measures and messages on the screen, thanks to the graphic display, LED and icons.

Alarms descriptions

in six available languages, for better events understanding.

Alarm preventive maintenance,

to keep the system always efficient.

Optical port

for adjustment and quick reference by PC using USB cable or WIFI dongle.

RPC 5LGA is on MICROMatic and MINImatic,
RPC 8LGA on MIDImatic.



Electronic Fast Switches

Static compensation is very often the only way to afford networks with relatively high fluctuating loads (milliseconds). The main advantages of this compensation system are:

- an immediate answer to the compensation request;
- no electromagnetic contactors: the total absence of mobile mechanic parts increase the number of switching operations and reduce the maintenance;
- the lack of transients in the capacitor switching connections minimizes disturbance such as flicker, noise, voltage drop.

Summary

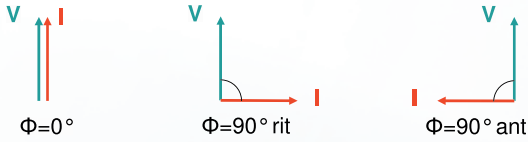
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Introductory Notes

Power factor correction: why?

In electrical circuits the current is in phase with the voltage whenever are in presence of resistors, whereas the current is lagging if the load is inductive (motors, transformers with no load conditions), and leading if the load is capacitive (capacitors).



The total absorbed current, for example, by a motor is determined by vector addition of:

1. I_R resistive current;
2. I_L inductive reactive current;

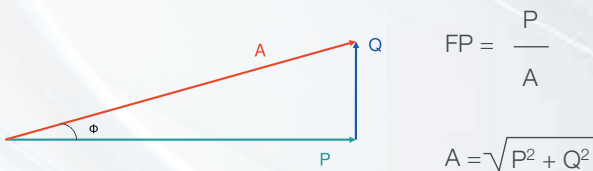


These currents are related to the following powers:

1. active power linked to I_R ;
2. reactive power linked to I_L ;

The reactive power doesn't produce mechanical work and it is an additional load for the energy supplier. The parameter that defines the consumption of reactive power is the power factor.

We define power factor the ratio between active power and apparent power:



As for as there are not harmonic currents power factor coincide to $\cos\phi$ of the angle between current and voltage vectors. $\cos\phi$ decreases as the reactive absorbed power increases.

Low $\cos\phi$, has the following disadvantages:

1. High power losses in the electrical lines
2. High voltage variation in the electrical lines
3. Over sizing of generators, electric lines and transformers.

From this we understand the importance to improve (increase) the power factor. Capacitors need to obtain this result.

Power factor correction: how?

By installing a capacitor bank it is possible to reduce the reactive power absorbed by the inductive loads in the system and consequently to improve power factor.

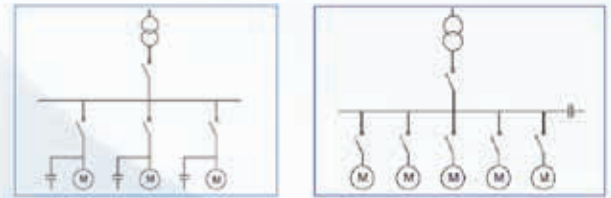
It is suitable to have $\cos\phi$ a little in excess of 0.9 to avoid paying the penalties provided for by the law. $\cos\phi$ must not be too close to unity, to avoid the leading currents in of the electrical system.

The choice of the correct power factor correction equipment depends on the type of loads present and by their way of working.

The choice is between CENTRAL COMPENSATION and INDIVIDUAL COMPENSATION.

Individual compensation: power factor correction is wired at each single load (i.e. motor terminals)

Central compensation: there is only one bank of capacitors on the main power distribution switch board or substation.



Individual Compensation

Central Compensation

The individual compensation is a simple technical solution: the capacitor and the user equipment follow the same sorts during the daily work, so the regulation of the $\cos\phi$ becomes systematic and closely linked to the load.

Another great advantage of this type of power factor correction is the simple installation with low costs.

The daily trend of the loads has a fundamental importance for the choice of most suitable power factor correction.

In many systems, not all the loads work in the same time and some of them work only a few hours per day.

It is clear that the solution of the individual compensation becomes too expensive for the high number of capacitors that have to be installed. Most of these capacitors will not be used for long period of time.

The individual compensation is more effective if the majority of the reactive power is concentrated on a few substations loads that work long period of time.

Central compensation is best suited for systems where the load fluctuates throughout the day.

If the absorption of reactive power is very variable, it is advisable the use of automatic regulation in preference to fixed capacitors.

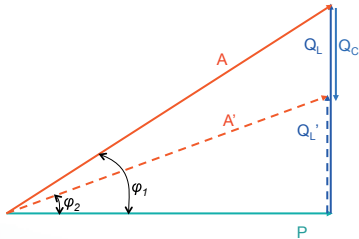
Power factor correction: How many capacitors?

The choice of capacitor bank to install in a system is closely depended from:

- $\cos\varphi_2$ value that we would obtain
- $\cos\varphi_1$ starting value
- installed active power.

By the following equation:

$$Q_c = P * (\tan\varphi_1 - \tan\varphi_2)$$



Q_c = Required Capacitors Reactive Output [kvar];

P = Active Power [kW];

Q_L, Q'_L = Inductive Reactive Output before and after the installation of the capacitor bank;

A, A' = apparent power before and after the power factor correction [kVA].

As example if we have installed a load that absorbs an active power of 300 kW having a power factor 0.7 and we want to increase it until 0.95.

From the table 1 we find: $k = 0,692$

Which means: $Q_c = 0,692 * 300 = 207,6$ kvar

Can be also written $Q_c = k * P$

Starting power factor	Final power factor					
	0,9	0,91	0,92	0,93	0,94	0,95
0,40	1,807	1,836	1,865	1,896	1,928	1,963
0,41	1,740	1,769	1,799	1,829	1,862	1,896
0,42	1,676	1,705	1,735	1,766	1,798	1,832
0,43	1,615	1,644	1,674	1,704	1,737	1,771
0,44	1,557	1,585	1,615	1,646	1,678	1,712
0,45	1,500	1,529	1,559	1,589	1,622	1,656
0,46	1,446	1,475	1,504	1,535	1,567	1,602
0,47	1,394	1,422	1,452	1,483	1,515	1,549
0,48	1,343	1,372	1,402	1,432	1,465	1,499
0,49	1,295	1,323	1,353	1,384	1,416	1,450
0,50	1,248	1,276	1,306	1,337	1,369	1,403
0,51	1,202	1,231	1,261	1,291	1,324	1,358
0,52	1,158	1,187	1,217	1,247	1,280	1,314
0,53	1,116	1,144	1,174	1,205	1,237	1,271
0,54	1,074	1,103	1,133	1,163	1,196	1,230
0,55	1,034	1,063	1,092	1,123	1,156	1,190
0,56	0,995	1,024	1,053	1,084	1,116	1,151
0,57	0,957	0,986	1,015	1,046	1,079	1,113
0,58	0,920	0,949	0,979	1,009	1,042	1,076
0,59	0,884	0,913	0,942	0,973	1,006	1,040
0,60	0,849	0,878	0,907	0,938	0,970	1,005
0,61	0,815	0,843	0,873	0,904	0,936	0,970
0,62	0,781	0,810	0,839	0,870	0,903	0,937
0,63	0,748	0,777	0,807	0,837	0,870	0,904
0,64	0,716	0,745	0,775	0,805	0,838	0,872
0,65	0,685	0,714	0,743	0,774	0,806	0,840
0,66	0,654	0,683	0,712	0,743	0,775	0,810
0,67	0,624	0,652	0,682	0,713	0,745	0,779
0,68	0,594	0,623	0,652	0,683	0,715	0,750
0,69	0,565	0,593	0,623	0,654	0,686	0,720
0,70	0,536	0,565	0,594	0,625	0,657	0,692
0,71	0,508	0,536	0,566	0,597	0,629	0,663
0,72	0,480	0,508	0,538	0,569	0,601	0,635
0,73	0,452	0,481	0,510	0,541	0,573	0,608
0,74	0,425	0,453	0,483	0,514	0,546	0,580
0,75	0,398	0,426	0,456	0,487	0,519	0,553
0,76	0,371	0,400	0,429	0,460	0,492	0,526
0,77	0,344	0,373	0,403	0,433	0,466	0,500
0,78	0,318	0,347	0,376	0,407	0,439	0,474
0,79	0,292	0,320	0,350	0,381	0,413	0,447
0,80	0,266	0,294	0,324	0,355	0,387	0,421
0,81	0,240	0,268	0,298	0,329	0,361	0,395
0,82	0,214	0,242	0,272	0,303	0,335	0,369
0,83	0,188	0,216	0,246	0,277	0,309	0,343
0,84	0,162	0,190	0,220	0,251	0,283	0,317
0,85	0,135	0,164	0,194	0,225	0,257	0,291
0,86	0,109	0,138	0,167	0,198	0,230	0,265
0,87	0,082	0,111	0,141	0,172	0,204	0,238

Table 1
See the full table in Appendix

A typical example of power factor correction, sometimes not much considered but surely important, concerns the power factor correction of transformers for the distribution of energy. It is essentially a fixed power factor correction that must compensate for the reactive power absorbed by the transformer in its no load condition (this happens often during the night). The calculation of the needed reactive output is very easy and it bases itself on this equation:

$$Q_c = I_0\% * \frac{A_N}{100}$$

where

$I_0\%$ = magnetising current of the transformer

A_N = Apparent rated power in kVA of the transformer

If we don't have these parameters, it is convenient to use the following table.

Power transformer KVA	Oil transformer kvar	Resin transformer kvar
10	1	1,5
20	2	1,7
50	4	2
75	5	2,5
100	5	2,5
160	7	4
200	7,5	5
250	8	7,5
315	10	7,5
400	12,5	8
500	15	10
630	17,5	12,5
800	20	15
1000	25	17,5
1250	30	20
1600	35	22
2000	40	25
2500	50	35
3150	60	50

Table 2

Another very important example of power factor correction concerns asynchronous three-phase motors that are individually corrected. The reactive power likely needed is reported on table 3:

Motor power		Required Reactive Power (kvar)				
HP	kW	3000 rpm	1500 rpm	1000 rpm	750 rpm	500 rpm
0,4	0,55	-	-	0,5	0,5	-
1	0,73	0,5	0,5	0,6	0,6	-
2	1,47	0,8	0,8	1	1	-
3	2,21	1	1	1,2	1,6	-
5	3,68	1,6	1,6	2	2,5	-
7	5,15	2	2	2,5	3	-
10	7,36	3	3	4	4	5
15	11	4	5	5	6	6
30	22,1	10	10	10	12	15
50	36,8	15	20	20	25	25
100	73,6	25	30	30	30	40
150	110	30	40	40	50	60
200	147	40	50	50	60	70
250	184	50	60	60	70	80

Table 3

Be careful: the capacitor output must not be dimensioned too high for individual compensated machines where the capacitor is directly connected with the motor terminals. The capacitor placed in parallel may act as a generator for the motor which will cause serious overvoltages (self-excitation phenomena). In case of wound rotor motor the reactive power of the capacitor bank must be increased by 5%.

Power factor correction: technical reasons

Recent energy market deregulation, along with new potential energy supplier rising, had lead to many and different type of invoicing which are not very clear in showing Power Factor up.

However as energy final price is steady growing, to correct power factor is becoming more and more convenient.

In most of the cases power factor improvement device prime cost is paid back in few months.

Technical-economical advantages of the installation of a capacitor bank are the following:

- decrease of the losses in the network and on the transformers caused by the lower absorbed current
- decrease of voltage drops on lines
- optimisation of the system sizing.

The current I, that flows in the system, is calculated by:

$$I = \frac{P}{\sqrt{3} * V * \cos\phi}$$

where

P= Active power

V= Nominal Voltage

While $\cos\phi$ increases, with the same absorbed power we can obtain a reduction in the value of the current and as a consequence the losses in the network and on the transformers are reduced. Therefore we have an important saving on the size of electrical equipment used on a system. The best system sizing has some consequence on the line voltage drop. We can easily see that looking at the following formula:

$$\Delta V = R * \frac{P}{V} + X * \frac{Q}{V}$$

where

P= active power on the network (kW)

Q= reactive power on the network (kvar)

while R is the cable resistance and X its reactance ($R \ll X$). The capacitor bank installation reduces Q so we have a lower voltage drop. If, for a wrong calculation of the installed capacitor bank value, the reactive part of the above equation becomes negative, instead of a reduction of the voltage drop we have an increasing of the voltage at the end of the line (Ferranti Effect) with dangerous consequence for the installed loads.

Some examples clarify the concepts set out above:

1. Power loss (kW), in function of $\cos\phi$, from a copper cable 3 x 25mm² 100m long carrying 40kW at 400Vac.
2. Supplied active power (kW) by a transformer 100kVA, in function of $\cos\phi$

$\cos\phi$	1)	2)
0,5	3,2	50
0,6	2,3	60
0,7	1,6	70
0,8	1,3	80
0,9	1	90
1		100

As we can see as the power factor increases we have fewer losses in the network and more active power from the same KVA.

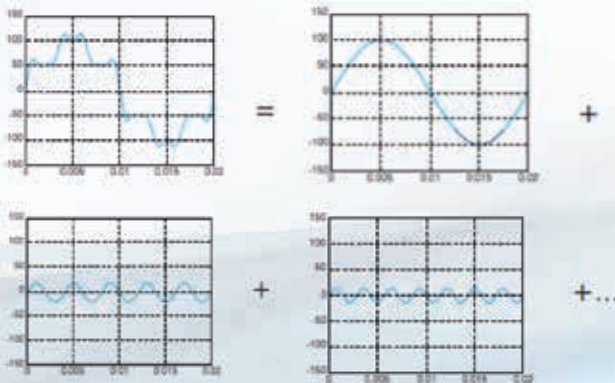
This allows us to optimise on the system sizing.

Power factor correction: Harmonics in the network

The distortions of the voltage and current waveforms are generated by non-linear loads (inverter, saturated transformers, rectifier, etc.) and produce the following problems:

- On the A.C. motors we find mechanical vibration that can reduce expected life. The increase of the losses creates overheating with consequent damaging of the insulating materials;
- In transformers they increase the copper and iron losses with possible damaging of the windings. The presence of direct voltage or current could cause the saturation of the cores with consequent increasing of the magnetising current;
- The capacitors suffer from the overheating and the increasing of the voltage that reduce their life.

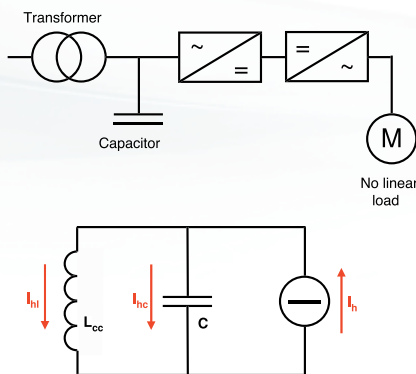
The waveform of the current (or voltage) generated by a non-linear load (fig. 1), being periodical, could be represented by the sum of many sinusoidal waves (a 50Hz component called fundamental and other components with multiple frequency of the fundamental component so called HARMONICS).



$$I = I_1 + I_2 + I_3 + I_4 + \dots + I_n$$

It is not advisable to install the power factor correction without considering the harmonic content of a system. This is because, even if we could manufacture capacitors that can withstand high overloads, capacitors produce an increase of harmonic content, with the negative effects just seen. We speak about resonance phenomena when an inductive reactance is equal to the capacitive one:

$$2\pi f L = \frac{1}{2\pi f C}$$



Ideal current generator represents motor as harmonic current components generator, these are independent from circuit inductance, while L_{CC} is obtainable by capacitor upstream short circuit power (in general it is equal to transformer short-circuit inductance) the resonance frequency is obtained as follows:

$$N = \sqrt{\frac{S_{cc}}{Q}} \cong \sqrt{\frac{A * 100}{Q * v_{cc}\%}}$$

S_{cc} = Short-circuit power of the network (MVA)

Q = Output of power factor correction bank (kvar)

A = Rated power transformer (kVA)

$v_{cc}\%$ = Short-circuit voltage %

N = Resonance harmonic order

In parallel resonance conditions the current and the voltage of the circuit $L_{CC} - C$ are heavily amplified as well as the nearby harmonic currents. Hereinafter an example:

$A = 630\text{kVA}$ (rated power transformer)

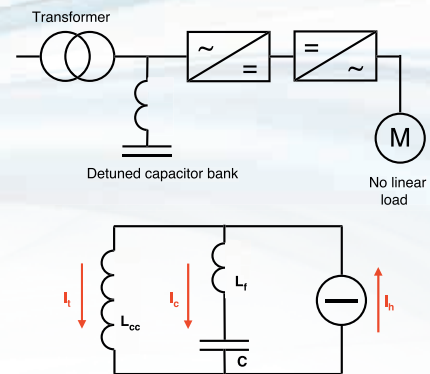
$V_{cc}\% = 6$ (short-circuit voltage %)

$Q = 300\text{kvar}$ (output of power factor correction bank)

$$N = \sqrt{\frac{A * 100}{Q * v_{cc}\%}} = \sqrt{\frac{630 * 100}{300 * 6}} \cong 6$$

The result shows that in these conditions the system transformer-capacitor bank has the parallel resonance frequency of 300Hz ($N \times 50\text{Hz}$). This means likely amplification of 5th and 7th harmonic current.

The most convenient solution to avoid this is the detuned filter, formed introducing a filter reactor in series with the capacitors, making this a more complex resonant circuit but with the desired feature of having a resonance frequency below the first existing harmonic.



With this type of solution, the parallel resonance frequency is modified from

$$f_{rp} = \frac{1}{2 * \pi * \sqrt{L_{cc} * C}}$$

to

$$f_{rp} = \frac{1}{2 * \pi * \sqrt{(L_{cc} + L_t) * C}}$$

Normally the resonance frequency between the capacitor and the series reactance is shifted lower than 250Hz and it is generally between 135Hz and 210Hz.

The lower frequencies correspond to higher harmonic loads. The installation of a reactance in series with the capacitor bank produces a series resonance frequency:

$$f_{rs} = \frac{1}{2 * \pi * \sqrt{L_f * C}}$$

If a harmonic current I_n with the same frequency of the resonance in series exists, this one will be totally absorbed by the system capacitors - reactors without any effect on the network. The realisation of a **tuned passive filter** is based on this simple principle. This application is required when we want the reduction of the total distortion in current (THD) on the system:

$$THD = \frac{\sqrt{I_3^2 + I_5^2 + I_7^2 + \dots + I_n^2}}{I_1}$$

I_1 = Component at the fundamental frequency (50Hz) of the total harmonic current

I_3, I_5, \dots = Harmonic components at the multiple frequency of the fundamental (150Hz, 250Hz, 350Hz, ...)

The dimensioning of tuned/passive filters is linked to the circuit parameter:

- impedance of the network (attenuation effect less as the short-circuit power on the network increases: in some cases could be useful to add in series with the network a reactance to increase the filtering effect);
- presence of further loads that generate harmonics linked to other nodes on the network
- capacitor types;

On this last point we have to make some considerations. It is known that the capacitors tend to decrease capacity over time: varying the capacity inevitably varies the resonance series frequency

$$f_{rs} = \frac{1}{2 * \pi * \sqrt{L_f * C}}$$

and this drawback can be very dangerous because the system could lead in parallel resonance conditions. In this case, the filter does not absorb more harmonics but even amplifies them.

In order to have a constant capacity guarantee over time we need to use another type of capacitors made in bimetalized paper and oil impregnated polypropylene. In addition to the passive absorption filter realized with capacitors and inductances is possible to eliminate the network harmonics, with another type of absorption filter: the Active Filter.

The operation principle is based on the in-line injection of the same current harmonics produced by non-linear loads, but out of phase.

Selection criteria depending on the type of plant (for EUROrack trays)

The choice of power factor correction equipment must be made by evaluating the design data of the system or, better yet, your electricity bills.

The choice of the power factor correction type must be carried out according to the following table, which shows on the ordinate the rate of harmonic distortion of the plant current (THDI_R%) and in abscissa the ratio between the reactive power Q_C (in kvar) of the PFC bank and LV/MV transformer apparent power (kVA).

In light of these data, it identifies the box with proposed families, starting from the family that ensures the proper functioning with the best quality/price ratio.

So you choose the power factor corrector series. The table was made starting from the following assumptions:

- Network voltage 400V
- Initial power factor of the plant 0.7 inductive
- Power factor target 0.95 inductive
- Non linear load with 5°-7°-11°-13° harmonics current

The hypotheses used are general and valid in the most of cases. In particular situations (harmonics coming from other branch of network, presence of rank equal to or a multiple of 3rd harmonics) previous considerations may be invalid.

In these cases, the guarantee of a correct choice of the equipment occurs only as a result of a measurement campaign of harmonic analysis of the network and/or the appropriate calculations.

ICAR disclaims any responsibility for incorrect choice of the product.

THDI_R: it is the maximum THD present in the plant without any capacitor battery installed on the basis of which to select the type of the capacitor to be installed in the plant. It 'an empirical fact, based on the construction technology used and the experience of the manufacturer.

There is no theoretical link between THDI_R and THDI_C valid for all plants. The THDI_R can also be very different, for capacitors with the same THDI_C produced by different manufacturers, depending on the risk tolerance of the manufacturer.

THDI_C: it is the harmonic overload suggested in order to satisfy the technical requirements of the components. It 'a characteristic value of each capacitor, indicative of its robustness: much higher is the THDI_C, more robust is the capacitor. The THDI_C is the most significant value to compare different capacitors, together with the maximum temperature of use.

Automatic PFC systems selection guidelines

THDI_R% > 27	HP10/HP20	FH20/FH30	FH20/FH30	FH20/FH30	FH20/FH30	FH20/FH30	FH20/FH30
20 < THDI_R% ≤ 27	HP10/HP20	FH20/FH30	FH20/FH30	HP20/HP30	HP30/FH20	FH20/FH30	FH20/FH30
12 < THDI_R% ≤ 20	HP10/HP20	FH20/FH30	FH20/FH30	HP20/HP30	HP20/HP30	FH20/FH30	FH20/FH30
THDI_R% ≤ 12	HP10/HP20	HP20/HP30	HP30/FH20	HP10/HP20	HP20/HP30	HP30/FH20	FH20/FH30
	Q_C / A_T ≤ 0,05	0,05 < Q_C / A_T ≤ 0,1	0,1 < Q_C / A_T ≤ 0,15	0,15 < Q_C / A_T ≤ 0,2	0,2 < Q_C / A_T ≤ 0,25	0,25 < Q_C / A_T ≤ 0,3	Q_C / A_T > 0,3

Application Example

For example, consider a MV connected system through a LV/MV 1000kVA transformer, and with a THDI_R% equal to 25%. Assuming that the power factor correction system to be installed has a reactive power of 220kvar, the ratio QC/AT is equal to 0.22. The recommended power factor correction is therefore that in the box identified from the abscissa 0.2 < QC/AT ≤ 0.25 and the ordinate 20 < THDI_R ≤ 27%.

You can choose an HP30 family device, or for even greater reliability of the solution, choose the FH20 family.

CRTE Power Capacitors



In its power factor correction systems, ICAR uses only capacitors entirely made within the facilities of its group. This way, ICAR guarantees the highest quality of the finished product.

The film used in the CRTE power capacitors comes directly from the ICAR experience in the high performance capacitors, in particular it is defined as “High density metalized polypropylene film”.

High density metalized polypropylene film capacitors

The main difference in comparison to standard polypropylene capacitors is the way in which the dielectric film is metalized.

In standard polypropylene capacitors the thickness of the metal layer deposited on the film surface is constant; in 1995, instead, ICAR has developed a manufacturing process that enables obtaining a metal layer with properly modulated thickness and achieving extraordinary results in the capacitors field for direct current and energy accumulation applications.

Subsequently this technology has been extended to capacitors for alternating current applications, with same remarkable results in power factor correction of industrial facilities.

The modulation of the metallization thickness, considerably betters capacitors performances (and therefore those of the power factor corrector systems of which they are the basic component) in terms of:

- increased specific power (kvar/dm³) with resulting reduction of power factor corrector systems dimension;
- improvement of the strengthens to continuous and temporaries overvoltage for a better reliability even in plants with voltage peaks due to the network or manoeuvres on the plant; CRTE capacitors are in fact tested at three times the rated voltage (type test);
- better reaction to the internal short circuit thanks to the special metallization with variable thickness.

General description

CRTE is the ICAR last generation of metallized polypropylene film capacitors to be used for power factor correction and harmonic filtering in low voltage plants.

The main features are:

- Three phase windings delta connected in a cylindrical aluminum case;
- Rated power from 2,5kvar up to 50kvar;
- Rated voltage from 230V up to 800V;
- Rated frequency 50 / 60 Hz;
- IP20 terminal board;
- Reduced mounting cost thanks terminal lid connections;
- Up to 130.000 hours service life design;
- Dry, environment friendly construction;
- Suitable for any mounting position (vertical preferable for better cooling);
- Indoor installation;
- Made under Quality System in accordance with ISO 9001 standard.

Applications

- Individual fixed Power Factor Correction for motors, low voltage transformers, etc;
- Low voltage automatic Power Factor Correction Capacitor Banks;
- Low voltage detuned/tuned Capacitor Banks.

Damping of Inrush Current

Capacitors used for power factor correction have to withstand a lot of switching operations.

The switching of a capacitor in parallel with energized capacitor banks, produces extremely high inrush currents and voltage transients.

The connection of a low voltage power factor correction capacitor without damping to an AC power supply, could lead to a reduced lifetime.

For this reason, capacitors should be protected during the switching operation by means of suitable contactors equipped with damping resistors (AC6b).

Harmonics

Harmonics are sinusoidal voltages and currents with multiple frequencies of the 50 or 60 Hz line frequency.

In presence of harmonics the resonance phenomena can be avoided by connecting capacitors in series with reactors (detuned filters). Components for detuned filter must be carefully selected (see next chapter). Particular care has to be taken for capacitors because the voltage across them will be higher than the nominal voltage when they have a reactor in series.

Discharging

Capacitors must be discharged in 3 minutes to 75V or less. There shall be no switch, fuse or any other isolating device between the capacitor unit and the discharging device. ICAR supplies capacitor discharge resistors to all series.

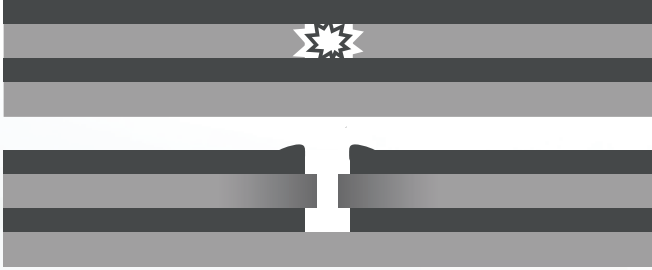
Safety features

CRTE capacitors are equipped with the most modern and reliable safety features to keep capacitor working in proper conditions and to prevent heavy breakdowns.



Self-healing metallized polypropylene

This metallized polypropylene feature is widely used in Power Capacitors as a mean to keep capacitors working even when voltage breakdown between the metal layers occurs. In case of arc, the metallized surface around is evaporated but the breakdown is kept in limited area and it does not enlarge its effects.



Over pressure safety device

In the case or fault, due to over voltage, overload or normal ageing, the self-healing process may accelerate and so to create a increasing pressure within the case. In order to prevent the case from bursting, capacitor is fitted with an over pressure device that set out of service the capacitor from the supply; two of the supply leads have reduced section, and while the pressure increases leads are strained by the top lid till breaking of cables (see figure below).



Dry technology

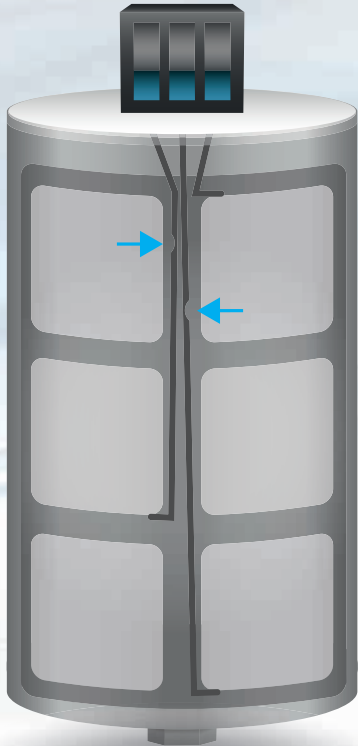
As CRTE capacitor is filled with resin, there is no risk of leaking oil or gas.



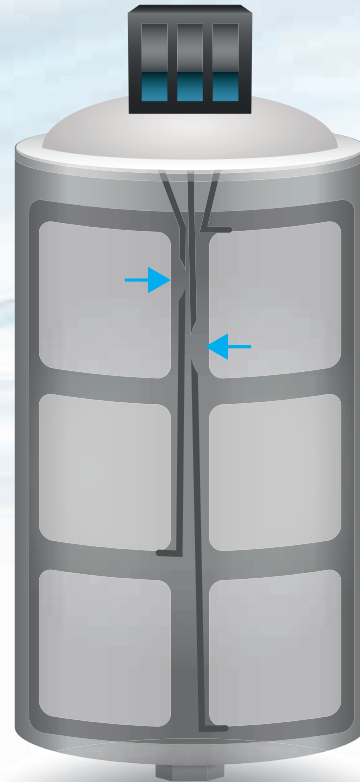
Touch proof terminals

CRTE is equipped with terminal board of IP20 protection degree (see product tables for specific feature application).

Overpressure safety device



CAPACITOR IN WORKING CONDITIONS



CAPACITOR WITH OPERATED MECHANISM

Inside layout



Metallized Polypropylene

ICAR has its own manufacturing of base polypropylene and relevant metallization: further it has developed a peculiar process that enables obtaining a metal layer with properly modulated thickness and achieving extraordinary performances in terms of voltage withstand and overall reliability.

The film is then cut and wound on high precision and fully automated winding machines, sprayed with abundant metal contact layer to reduce the contact resistance.



Wave cut film

CRTE capacitors are also fitted with wave cut film to reduce the stress between the polypropylene film layers and the contact layer. This enable capacitors to withstand higher inrush currents during the switching operations.



Environmentally friendly filler

Capacitors need filler around capacitive elements in order to protect metal layers from oxidation and to help heat dissipation.

Without this feature capacitors would cope with accelerated self healing and so a shorter service life.

ICAR filler are all PCB free.

Inside wiring

Power factor correction Capacitors for applications in nominal voltages networks of 600/660/690V (eg. Applications such as mining, highway tunnels and rail cargoes on board ship, port cranes, steel mills, paper mills and other "heavy" applications) can be realized in different ways described as follows.

Capacitors with star connection

A widely used mode embodiment, but risky, provides a capacitors star connection (fig 1): in this way capacitors are subjected to a voltage equal to the nominal plant divided by $\sqrt{3}$.

- Advantages: capacitors are smaller and cheaper, getting more compact and lightweight banks.
- Disadvantages: in case capacitor capacity degradations, the voltage across the capacitors of the star will no longer be balanced, but it will increase on the side with greater capacity degradation, till to reach values higher than the rated voltage of the capacitors themselves. In this situation, the risk of overvoltage with possible consequent capacitors explosion/fire increases dramatically.

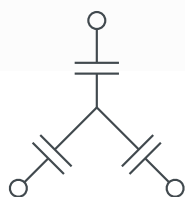


Fig 1: Capacitors star connection

Delta-connected Capacitors

This solution calls for the use of capacitor elements with a voltage rating at least equal to that of the network, as can be seen in Figure 2.

- Advantages: capacitor is electrically robust. Even in case of loss of capacity of a capacitor element, the others do not suffer any consequences: malfunctions risks and capacitors damages are reset.
- Disadvantages: capacitors bulkier and heavier, with higher costs.

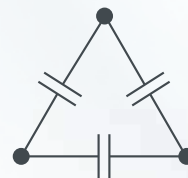


Fig 2: Capacitors delta connection

The ICAR way

CRTE for working voltages higher than 550V are made with delta connected capacitors, and so they have a nominal voltage equal or higher than the system network working voltage; this is the most sound and reliable solution.

Installation and maintenance

Handling and Storage

Capacitors shall have to be handled and stored with care in order to avoid any mechanical damage during transportation. Protection against environmental influences shall also be taken.

Installation

Capacitors are suitable for indoor installation and vertical mounting position is preferable for better cooling. Capacitors must be installed in such a way that the specified limit temperature is not overcome. Not being in compliance with the above instructions will result as a reduction of the expected service life. Installation of capacitors shall have to be performed in such a way that any dangerous resonance phenomena due to harmonics is avoided.

Automatic power factor correction banks

The switching of a capacitor bank in parallel with energized capacitor(s), produces extremely high inrush currents and voltage transients. For this reason, it is extremely important to wait for the unit discharge before a new switching.

Assembly

Capacitors shall have to be assembled by means of the threaded M12 bottom stud. The maximum applicable tightening torque is 10Nm.

The catalogue specifies the recommended cross section of the supplying cables.

The recommended tightening torque is 3Nm.

With terminals screw design two antagonist spanners shall be used.

In order to ensure a proper operation of the internal overpressure safety device, an extra minimum 15mm clearance distance between the upper part of capacitors

and assembly enclosures shall have to be provided. Capacitors shall be placed in such a way that there is an adequate dissipation by convection and radiation of the heat produced by the capacitor losses.

The ventilation of the operating room and the arrangement of the capacitor units shall provide good air circulation around each unit. A minimum 20mm distance between the units has to be maintained.

Maintenance

Periodical checks and inspections are required to ensure reliable operation of capacitors. Monitoring and recording of the electrical service parameters are also recommended to become acquainted with progressive capacitors stress conditions.

Protections

Capacitors shall have to be protected against inrush peak currents during switching operations of automatic banks by means of suitable contactors equipped with pre-making resistors.

Safety Instructions

DO NOT MISAPPLY CAPACITORS FOR POWER FACTOR CORRECTION APPLICATIONS

Capacitors according to the Standards, are equipped with a suitable discharge device such as discharge resistors, permanently connected. They are able to reduce the residual voltage so that any dangerous resonance phenomena due to harmonics is avoided.

Automatic power factor correction banks

DO NOT TOUCH ANY CAPACITOR TERMINAL IF NOT SHORT CIRCUITED AND EARTHED IN ADVANCE To prevent damage to people and goods due to improper usage and/or application of capacitors, the "RECOMMENDATION FOR THE SAFE USE OF STATIC CAPACITORS, BANKS AND EQUIPMENT FOR POWERFACTOR CORRECTION" published by ANIE shall have to be strictly respected.

ICAR is not responsible for any kind of possible damages occurred to people or things, derived from the improper installation and application of Power Factor Correction capacitors.

Most common misapplication forms

- Current, voltage, harmonics and frequency above specification;
- Working or storage temperature beyond the specified limits;
- Unusual service conditions as mechanical shock and vibrations, corrosive or abrasive conductive parts in cooling air, oil or water vapour or corrosive substances, explosive gas or dust, radioactivity, excessive and fast variations of ambient conditions, service areas higher than 2000 m above sea level...

In case of doubt in choice or in performances of the capacitors ICAR technical service MUST be contacted.

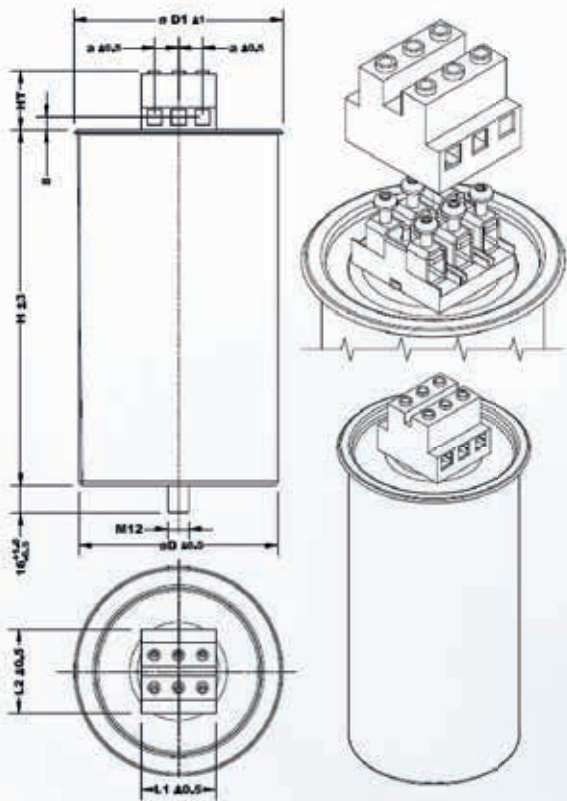
Personal Safety

Electrical or mechanical misapplications of CRTE capacitors may become hazardous. Personal injury or property damage may result from disruption of the capacitor and consequent expulsion of melted material. Before using the capacitors in any application, please read carefully the technical information contained in this catalogue.

The energy stored in a capacitor may become lethal. The capacitor should be short circuited and earthed before handling to prevent any chance of shock. Special attention must be taken to make sure the capacitors are correctly used for each application and that warnings and instructions are strictly followed. Capacitors are made with polypropylene that is a flammable material.

The risk of fire cannot be totally eliminated; therefore suitable precautions shall be taken. Reliability data have a statistical value (i.e. based on a large number of components), it is not possible to transfer automatically data from a limited quantity or even to a batch of capacitors. This applies in particular to consequential damage caused by component failure.

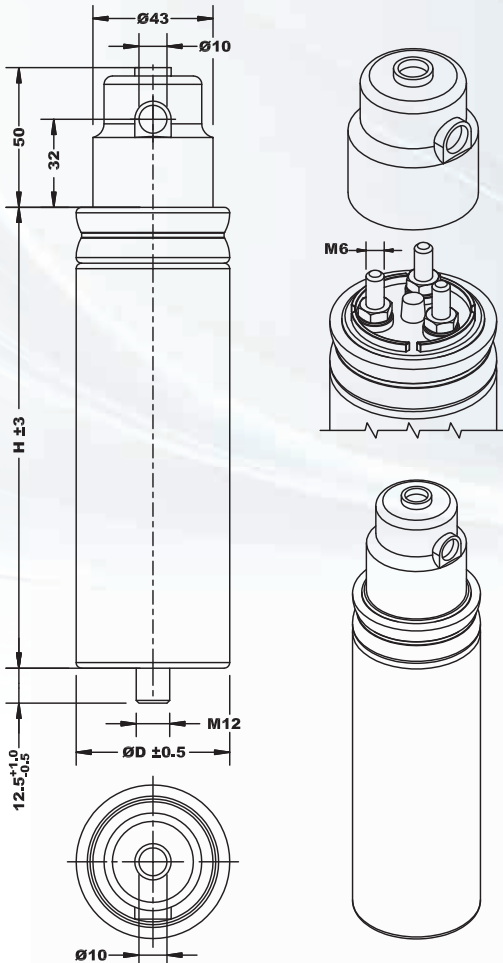
Dimensions and connecting cable cross section



- Aluminium finishing: black painted for diameter $\varnothing D 100$, $\varnothing D 116$, $\varnothing D 136$. naked for diameter $\varnothing D 75$, $\varnothing D 85$
- Terminals: 25mm^2 for $\varnothing D 85$, $\varnothing D 100$, $\varnothing D 116$, $\varnothing D 136$
 16mm^2 for $\varnothing D 75$
- Maximum continuative terminal current:
 25mm^2 60Arms
 16mm^2 35Arms
- 35mm^2 75 Arms
- Degree of protection: IP20
- Creepage 19mm
- Clearance 19mm
- Humidity class: F. Max relative humidity 75% annual on average, 95% 30 days per year, condensation not permitted.

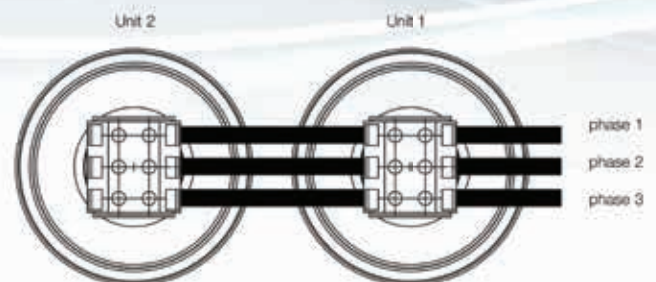
$\varnothing D1$	L1	L2	HT	a	
$\varnothing D 75$	81	39,0	45,0	32 ± 1	13
$\varnothing D 85$	91	43,5	49,0	35 ± 1	14
$\varnothing D 100$	106	43,5	49,0	35Max	14
$\varnothing D 116$	122	43,5	49,0	35Max	14
$\varnothing D 136$	142	43,5	49,0	35Max	14
$\varnothing D 136 (50 \text{ Kvar})$..	142	52	63	50Max	17

Max case elongation in case of over pressure disconnector activated $< 12,7$ mm. Below table is a guidelines for operation in normal conditions at ambient temperature up to 40°C (or 55°C capacitor surrounding air). Various parameter such us harmonics, temperature inside the cabinet, cable length have to be considered for proper selection.



Rated voltage 415V, 50 Hz	RATED POWER Q_n [kvar]	I_n [A]	CROSS SECTION mm^2 Cu
	2,5	3,5	2,5
	5	7	2,5
	7,5	10,5	4
	10	13,9	6
	12,5	17,4	6
	15	20,9	10
	20	27,8	10
	25	34,8	16
	40	55,6	25
50	72,2	35	

Limits for parallel of CRTE capacitors



The maximum number of parallel connected units should not have a total output higher than 40kvar. The cross section of cables in the Unit 1 (phase 1, 2, 3) have to be selected considering the total amount of the Unit 1 and Unit 2 output. **Leave enough space** to allow longitudinal expansion of the can for proper operation of the internal over pressure safety device (15 mm). A minimum space of 20 mm between capacitors is necessary to ensure **proper cooling**.

CRT-E 230V - 50Hz



TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	230V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 230V - 50Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT233100156V00	CRT-56V-1-230 **	1	3 x 20	3 x 2,5	55	165	0,5	30	370x370x245	Internal
CRT233150156V00	CRT-56V-1,5-230 **	1,5	3 x 30,1	3 x 3,8	55	165	0,5	30	370x370x245	Internal
CRT233200166V00	CRT-66V-2-230 **	2	3 x 40,1	3 x 5	65	205	0,7	6	370x370x106	Internal
CRT233250166V00	CRT-66V-2,5-230 **	2,5	3 x 50,1	3 x 6,3	65	205	0,7	6	370x370x106	Internal
CRE501233M50322	CRTE08520805023	5	3 x 100	3 x 12,6	85	208	1,6	4	370x370x106	External
CRE751233M50323	CRTE10020807523	7,5	3 x 150	3 x 18,9	100	208	2	3	370x370x106	External
CRE102233M50315	CRTE10020810023	10	3 x 200	3 x 25,2	100	208	2	3	370x370x106	External
CRE1D2233M50324	CRTE11620812523	12,5	3 x 250	3 x 31,5	116	208	2,6	3	370x370x125	External
CRE152233M50325	CRTE13620815023	15	3 x 300	3 x 37,6	136	208	3,2	2	370x370x161	External

* File number E99479

** Not UL approved



CRT-E 400/415V - 50Hz



TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	400V/415V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 400V (415V) - 50Hz **IEC**

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Height (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT403100156V00	CRT-56V-1-400 **	1	3 x 6,6	3 x 1,4	55	165	0,5	30	370x370x245	Internal
CRT403150156V00	CRT-56V-1,5-400 **	1,5	3 x 9,9	3 x 2,2	55	165	0,5	30	370x370x245	Internal
CRT403200156V00	CRT-56V-2-400 **	2	3 x 13,3	3 x 2,9	55	165	0,5	30	370x370x245	Internal
CRT403250156V00	CRT-56V-2,5-400 **	2,5	3 x 16,6	3 x 3,6	55	165	0,5	30	370x370x245	Internal
CRT403300166V00	CRT-66V-3-400 **	3	3 x 19,9	3 x 4,3	65	205	0,7	6	370x370x106	Internal
CRT403400166V00	CRT-66V-4-400 **	4	3 x 26,5	3 x 5,8	65	205	0,7	6	370x370x106	Internal
CRT403500166V00	CRT-66V-5-400 **	5	3 x 33,2	3 x 7,2	65	205	0,7	6	370x370x106	Internal
CRE501403M50028	CRTE07520805040	5	3 x 33,2	3 x 7,2	75	208	1,2	5	370x370x106	External
CRE751403M50033	CRTE07520807540	7,5	3 x 49,7	3 x 10,8	75	208	1,2	5	370x370x106	External
CRE102403M50053	CRTE08520810040	10	3 x 66,3	3 x 14,4	85	208	1,6	4	370x370x106	External
CRE1D2403M50036	CRTE08520812540	12,5	3 x 82,9	3 x 18	85	208	1,6	4	370x370x106	External
CRE152403M50054	CRTE10020815040	15	3 x 99,5	3 x 21,7	100	208	2	3	370x370x106	External
CRE202403M50001	CRTE10020820040	20	3 x 132,6	3 x 28,9	100	208	2	3	370x370x106	External
CRE252403M50002	CRTE11620825040	25	3 x 165,8	3 x 36,1	116	208	2,6	3	370x370x125	External
CRE302403M50003	CRTE11620830040	30	3 x 198,9	3 x 43,3	116	208	2,6	3	370x370x125	External
CRE402403M50108	CRTE13628340040 **	40	3 x 265,4	3 x 57,7	136	283	3,8	2	370x370x161	External
CRE502403M50416	CRTE13636050040 **	50	3 x 332	3 x 72,2	136	360	5,5	2	470x280x160	External

* File number E99479

** Not UL approved

CRT-E 450V - 50Hz



TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	450V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 450V - 50Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Height (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT453100156V00	CRT-56V-1-450 **	1	3 x 5,2	3 x 1,3	55	165	0,5	30	370x370x245	Internal
CRT453150156V00	CRT-56V-1,5-450 **	1,5	3 x 7,9	3 x 1,9	55	165	0,5	30	370x370x245	Internal
CRT453200156V00	CRT-56V-2-450 **	2	3 x 10,5	3 x 2,6	55	165	0,5	30	370x370x245	Internal
CRT453250156V00	CRT-56V-2,5-450 **	2,5	3 x 13,1	3 x 3,2	55	165	0,5	30	370x370x245	Internal
CRT453300166V00	CRT-66V-3-450 **	3	3 x 15,7	3 x 3,8	65	205	0,7	6	370x370x106	Internal
CRT453400166V00	CRT-66V-4-450 **	4	3 x 21	3 x 5,1	65	205	0,7	6	370x370x106	Internal
CRT453500166V00	CRT-66V-5-450 **	5	3 x 26,2	3 x 6,4	65	205	0,7	6	370x370x106	Internal
CRE501453M50015	CRTE07520805045	5	3 x 26,2	3 x 6,4	75	208	1,2	5	370x370x106	External
CRE751453M50034	CRTE07520807545	7,5	3 x 39,3	3 x 9,6	75	208	1,2	5	370x370x106	External
CRE102453M50055	CRTE08520810045	10	3 x 52,4	3 x 12,8	85	208	1,6	4	370x370x106	External
CRE1D2453M50037	CRTE08520812545	12,5	3 x 65,5	3 x 16	85	208	1,6	4	370x370x106	External
CRE152453M50056	CRTE10020815045	15	3 x 78,6	3 x 19,2	100	208	2	3	370x370x106	External
CRE202453M50010	CRTE10020820045	20	3 x 104,8	3 x 25,7	100	208	2	3	370x370x106	External
CRE252453M50004	CRTE11620825045	25	3 x 131	3 x 32,1	116	208	2,6	3	370x370x125	External
CRE302453M50009	CRTE11620830045	30	3 x 157,2	3 x 38,5	116	208	2,6	3	370x370x125	External
CRE402453M50162	CRTE13628340045 **	40	3 x 209,7	3 x 51,3	136	283	3,8	2	370x370x161	External

* File number E99479

** Not UL approved



CRT-E 525V - 50Hz



TECHNICAL CHARACTERISTICS

Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	525V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 525V - 50Hz



PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Height (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT523100156V00	CRT-56V-1-525 **	1	3 x 3,8	3 x 1,1	55	165	0,5	30	370x370x245	Internal
CRT523150156V00	CRT-56V-1,5-525 **	1,5	3 x 5,8	3 x 1,6	55	165	0,5	30	370x370x245	Internal
CRT523200156V00	CRT-56V-2-525 **	2	3 x 7,7	3 x 2,2	55	165	0,5	30	370x370x245	Internal
CRT523250156V00	CRT-56V-2,5-525 **	2,5	3 x 9,6	3 x 2,7	55	165	0,5	30	370x370x245	Internal
CRT523300166V00	CRT-66V-3-525 **	3	3 x 11,5	3 x 3,3	65	205	0,7	6	370x370x106	Internal
CRT523400166V00	CRT-66V-4-525 **	4	3 x 15,4	3 x 4,4	65	205	0,7	6	370x370x106	Internal
CRT523500166V00	CRT-66V-5-525 **	5	3 x 19,2	3 x 5,5	65	205	0,7	6	370x370x106	Internal
CRE501523M50016	CRTE07520805052	5	3 x 19,2	3 x 5,5	75	208	1,2	5	370x370x106	External
CRE751523M50035	CRTE07520807552	7,5	3 x 28,9	3 x 8,2	75	208	1,2	5	370x370x106	External
CRE102523M50057	CRTE08520810052	10	3 x 38,5	3 x 11	85	208	1,6	4	370x370x106	External
CRE1D2523M50038	CRTE08520812552	12,5	3 x 48,1	3 x 13,7	85	208	1,6	4	370x370x106	External
CRE152523M50058	CRTE10020815052	15	3 x 57,7	3 x 16,5	100	208	2	3	370x370x106	External
CRE202523M50021	CRTE10020820052	20	3 x 77	3 x 22	100	208	2	3	370x370x106	External
CRE252523M50022	CRTE11620825052	25	3 x 96,2	3 x 27,5	116	208	2,6	3	370x370x125	External
CRE302523M50023	CRTE11620830052	30	3 x 115,5	3 x 33	116	208	2,6	3	370x370x125	External
CRE402523M50079	CRTE13620840052	40	3 x 154	3 x 44	136	208	3,2	2	370x370x161	External
CRE502523M50428	CRTE13636050052 **	50	3 x 193	3 x 55	136	360	5,5	2	470x280x161	External

* File number E99479

** Not UL approved

CRT-E 690V - 50Hz



TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	690V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	6000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 690V - 50Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRE501693M50163	CRTE07520805069	5	3 x 11,1	3 x 4,2	75	208	1,2	5	370x370x106	External
CRE751693M50164	CRTE08520807569	7,5	3 x 16,7	3 x 6,3	85	208	1,6	4	370x370x106	External
CRE102693M50165	CRTE10020810069	10	3 x 22,3	3 x 8,4	100	208	2	3	370x370x106	External
CRE1D2693M50166	CRTE10020812569	12,5	3 x 27,9	3 x 10,5	100	208	2	3	370x370x106	External
CRE152693M50167	CRTE11620815069	15	3 x 33,4	3 x 12,5	116	208	2,6	3	370x370x125	External
CRE202693M50168	CRTE11620820069	20	3 x 44,6	3 x 16,7	116	208	2,6	3	370x370x125	External
CRE252693M50111	CRTE13620825069	25	3 x 55,7	3 x 20,9	136	208	3,2	2	370x370x161	External
CRE302693M50006	CRTE11628330069	30	3 x 66,9	3 x 25,1	116	283	3,2	3	370x370x125	External
CRE402693M50169	CRTE13628340069	40	3 x 89,2	3 x 33,5	136	283	3,8	2	370x370x161	External



CRT-E 750V - 50Hz



TECHNICAL CHARACTERISTICS

Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	750V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	6000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 750V - 50Hz **EAC**

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRE501753M50170	CRTE07520805075	5	3 x 9,4	3 x 3,8	75	208	1,2	5	370x370x106	External
CRE751753M50171	CRTE08520807575	7,5	3 x 14,1	3 x 5,8	85	208	1,6	4	370x370x106	External
CRE102753M50172	CRTE10020810075	10	3 x 18,9	3 x 7,7	100	208	2	3	370x370x106	External
CRE1D2753M50173	CRTE11620812575	12,5	3 x 23,6	3 x 9,6	116	208	2,6	3	370x370x125	External
CRE152753M50174	CRTE11620815075	15	3 x 28,3	3 x 11,5	116	208	2,6	3	370x370x125	External
CRE202753M50175	CRTE13620820075	20	3 x 37,7	3 x 15,4	136	208	3,2	2	370x370x161	External
CRE252753M50042	CRTE11628325075	25	3 x 47,2	3 x 19,2	116	283	3,2	3	370x370x125	External
CRE302753M50176	CRTE13628330075	30	3 x 56,6	3 x 23,1	136	283	3,8	2	370x370x161	External
CRE352753M50177	CRTE13628335075	35	3 x 66	3 x 26,9	136	283	3,8	2	370x370x161	External

CRT-E 800V - 50Hz



TECHNICAL CHARACTERISTICS

Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	800V
Rated Frequency	50 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	6000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 800V - 50Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRE501803M50178	CRTE08520805080	5	3 x 8,3	3 x 3,6	85	208	1,6	4	370x370x106	External
CRE751803M50044	CRTE10020807580	7,5	3 x 12,4	3 x 5,4	100	208	2	3	370x370x106	External
CRE102803M50179	CRTE10020810080	10	3 x 16,6	3 x 7,2	100	208	2,6	3	370x370x106	External
CRE1D2803M50180	CRTE11620812580	12,5	3 x 20,7	3 x 9	116	208	2,6	3	370x370x125	External
CRE152803M50181	CRTE13620815080	15	3 x 24,9	3 x 10,8	136	208	3,2	2	370x370x161	External
CRE202803M50182	CRTE13620820080	20	3 x 33,2	3 x 14,4	136	208	3,2	2	370x370x161	External
CRE252803M50183	CRTE13628325080	25	3 x 41,5	3 x 18	136	283	3,8	2	370x370x161	External
CRE302803M50184	CRTE13628330080	30	3 x 49,8	3 x 21,6	136	283	3,8	2	370x370x161	External



CRT-E 230V- 60Hz



TECHNICAL CHARACTERISTICS

Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	230V
Rated Frequency	60 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 230V - 60Hz



PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT233120156V60	CRT-56V-1,2-230/60 **	1,2	3 x 20	3 x 3	55	165	0,5	30	370x370x245	Internal
CRT233180156V60	CRT-56V-1,8-230/60 **	1,8	3 x 30,1	3 x 4,5	55	165	0,5	30	370x370x245	Internal
CRT133240166V60	CRT-66V-2,4-230/60 **	2,4	3 x 40,1	3 x 6	65	205	0,7	6	370x370x106	Internal
CRT233300166V60	CRT-66V-3-230/60 **	3	3 x 50,1	3 x 7,5	65	205	0,7	6	370x370x106	Internal
CRE601233M60059	CRTE08520806023/60	6	3 x 100	3 x 15	85	208	1,6	4	370x370x106	External
CRE901233M60060	CRTE10020809023/60	9	3 x 150	3 x 22,6	100	208	2	3	370x370x106	External
CRE122233M60031	CRTE10020812023/60	12	3 x 200	3 x 30	100	208	2	3	370x370x106	External
CRE152233M60032	CRTE11620815023/60	15	3 x 250	3 x 37,6	116	208	2,6	3	370x370x125	External
CRE182233M60186	CRTE13620818023/60	18	3 x 300	3 x 45,2	136	208	3,2	2	370x370x161	External

* File number E99479

** Not UL approved

CRT-E 400V - 60Hz



TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	400V
Rated Frequency	60 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 400V - 60Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRE501403M60432	CRT-E-75208-5-400 60Hz	5	3 x 27,6	3 x 7,2	75	208	1,2	5	370x370x106	External
CRE102403M60433	CRT-E-85208-10-400 60Hz	10	3 x 55,3	3 x 14,4	85	208	1,6	4	370x370x106	External
CRE1D2403M60431	CRT-E-100208-12,5-400 60Hz	12,5	3 x 69,1	3 x 18	100	208	2	3	370x370x106	External
CRE152403M60430	CRT-E-100208-15-400 60Hz	15	3 x 82,9	3 x 21,7	100	208	2	3	370x370x106	External
CRE252403M60404	CRT-E-116208-25-400 60Hz	25	3 x 138,2	3 x 36,1	116	208	2,6	3	370x370x125	External
CRE302403M60395	CRT-E-136208-30-400 60Hz	30	3 x 165,9	3 x 43,3	136	208	3,2	2	370x370x161	External



CRT-E 480V - 60Hz



TECHNICAL CHARACTERISTICS

Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	480V
Rated Frequency	60 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board /screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20 (only D ≥ 85mm)
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 480V - 60Hz



PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Height (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRT483100156V60	CRT-56V-1-480/60 **	1	3 x 3,8	3 x 1,2	55	165	0,5	30	370x370x245	Internal
CRT483150156V60	CRT-56V-1,5-480/60 **	1,5	3 x 5,8	3 x 1,8	55	165	0,5	30	370x370x245	Internal
CRT483200156V60	CRT-56V-2-480/60 **	2	3 x 7,7	3 x 2,4	55	165	0,5	30	370x370x245	Internal
CRT483250156V60	CRT-56V-2,5-480/60 **	2,5	3 x 9,6	3 x 3	55	165	0,5	30	370x370x245	Internal
CRT483300166V60	CRT-66V-3-480/60 **	3	3 x 11,5	3 x 3,6	65	205	0,7	6	370x370x106	Internal
CRT483400166V60	CRT-66V-4-480/60 **	4	3 x 15,4	3 x 4,8	65	205	0,7	6	370x370x106	Internal
CRT483500166V60	CRT-66V-5-480/60 **	5	3 x 19,2	3 x 6	65	205	0,7	6	370x370x106	Internal
CRE501483M60085	CRTE07520805048/60	5	3 x 19,2	3 x 6	75	208	1,2	5	370x370x106	External
CRE751483M60086	CRTE07520807548/60	7,5	3 x 28,9	3 x 9	75	208	1,2	5	370x370x106	External
CRE102483M60087	CRTE08520810048/60	10	3 x 38,5	3 x 12	85	208	1,6	4	370x370x106	External
CRE1D2483M60088	CRTE08520812548/60	12,5	3 x 48,1	3 x 15	85	208	1,6	4	370x370x106	External
CRE152483M60089	CRTE10020815048/60	15	3 x 57,7	3 x 18	100	208	2	3	370x370x106	External
CRE202483M60090	CRTE10020820048/60	20	3 x 77	3 x 24,1	100	208	2	3	370x370x106	External
CRE252483M60091	CRTE11620825048/60	25	3 x 96,2	3 x 30,1	116	208	2,6	3	370x370x125	External
CRE302483M60092	CRTE11620830048/60	30	3 x 115,5	3 x 36,1	116	208	2,6	3	370x370x125	External
CRE402483M60198	CRTE13620840048/60	40	3 x 154	3 x 48,1	136	208	3,2	2	370x370x161	External
CRE502483M60429	CRTE13636050048/60	50	3 x 192	3 x 60,1	136	360	5,5	2	470x280x161	External

* File number E99479

** Not UL approved

CRT-E 600V - 60Hz

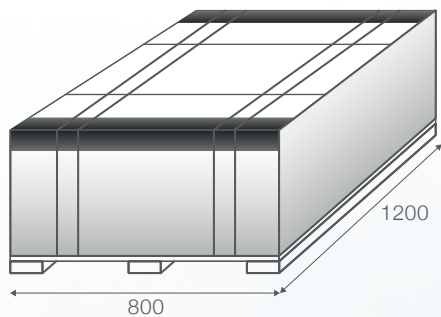


TECHNICAL CHARACTERISTICS	
Dielectric	polypropylene metallized film
Winding connection	delta
Safety device	Internal overpressure disconnecter
Capacitance tolerance	-5%, +10%
Rated Voltage	600V
Rated Frequency	60 Hz
Over voltages	According to IEC Un + 10% (up to 8 hours daily) Un + 15% (up to 30 minutes daily) Un + 20% (up to 5 minutes daily) Un + 30% (up to 1 minute daily)
Over current (not continuative)	2 In (including harmonics)
Maximum inrush current	200 In
Insulation level	3 / 12 kV
Voltage test between terminals	2,15 Un, 50Hz, 10 seconds (routine test)
Voltage test between terminals	3,00 Un, 50Hz, 60 seconds (type test)
Voltage test terminals/case	3000V, 50Hz, 10 seconds
Dielectric losses	< 0.2 W/kvar
Temperature class	-25/D
Cooling	Natural air or forced ventilation
Permissible humidity	95%
Service life	130.000 operating hours (hot spot 50°C)
Service life	100.000 operating hours (hot spot 55°C)
Altitude above sea level	2000 m
Impregnation	resin filled, PCB free
Terminals	Terminal board / screws (D ≤ 65mm)
Fixing and Ground	Threaded M12 stud on case bottom
Mounting position	vertical preferable for better cooling
Protection degree	IP20
Installation	Indoor
Discharge resistors	Included
Discharge time	< 3 minutes to 75V or less
Applicable standards	IEC 60831-1/2

Vn = 600V - 60Hz 

PART NUMBER	MODEL	Q POWER (KVar)	C Capacity (µF)	In Current (A)	D Diameter (mm)	H Heigh (mm)	Weight (Kg)	Pcs/box	Box dimensions	Discharge resistor
CRE501603M60440	CRTE07520805060/60	5	3 x 12,3	3 x 4,8	75	208	1,2	5	370x370x106	External
CRE102603M60441	CRTE10020810060/60	10	3 x 24,6	3 x 9,6	100	208	2	3	370x370x106	External
CRE152603M60442	CRTE11620815060/60	15	3 x 36,9	3 x 14,4	116	208	2,6	3	370x370x125	External
CRE202603M60443	CRTE13620820060/60	20	3 x 49,1	3 x 19,2	136	208	3,2	2	370x370x161	External
CRE252603M60444	CRTE11628325060/60	25	3 x 61,4	3 x 24,1	116	283	3,2	3	370x370x125	External
CRE302603M60445	CRTE13628330060/60	30	3 x 73,7	3 x 28,9	136	283	3,8	2	370x370x161	External

Packing details: CRTE Capacitors



WOODEN FRAME ON STANDARD EURO-PALLET
(FUMIGATED IF REQUIRED)

CRTE Capacitor diameter (mm)	Number of Capacitors per box	Number of Capacitors per pallet/box	Package height H (mm)
75	5	180	900
85	4	144	900
100	3	108	900
116	3	108	1050
136	2	60	1050
136 (50 Kvar)	2	40	1000

Harmonic blocking reactors



The growing use of power electronic devices is causing an increasing level of harmonic distortion in the electrical systems, which frequently leads to problems with capacitor installations. This is the reason why energy suppliers and actual conditions require the usage of harmonic blocking reactors.

A detuned capacitor system works out the function of power factor correction whilst preventing any amplification of harmonic currents and voltages caused by resonance between capacitor and inductance impedances of the electrical system.

By adding an appropriately rated series reactor to the power capacitor, both elements form a low-pass resonant circuit (usually below the 5th) which prevents higher order harmonics to flow into capacitors.

ICAR harmonic blocking reactors are made of high-class transformer sheets and aluminium or copper coils.

They are fully manufactured at our premises, dried and impregnated in a vacuum with environmentally-friendly, low-styrole resin which ensures high voltage withstand, low noise levels, and enjoys a long operating life.

PARAMETERS AND SELECTION

Coupling of Capacitors and Reactors

Combination of capacitors and reactors is a delicate procedure which has to be properly done. The scheme ICAR is proposing in following pages comes from its experience in the Automatic Power Factor Correction systems design and manufacturing and it considers all of the aspects involved, such as:

Voltage increase across capacitor terminals

- Allowable harmonic overload of reactors and capacitors
- Actual reactive power output

It is then warmly recommended to respect the proposed coupling of capacitance and reactance, as well as capacitor rated voltage.

Detuning frequency [f_N]

Harmonic blocking reactor choice is based on the actual harmonic current spectrum; the most relevant and lowest harmonic current determines the harmonic blocking frequency, hence the reactor selection.

In detail

- 140Hz will be used if THD in current is substantial higher than 60%,
- 189Hz or 215Hz will be used if THD in current is up to 60%.

Rated inductance [l]

Inductance rating of reactor, measured at rated current I_n, expressed in mH (Milli-Henry) is the main component feature.

Capacitance [C]

It comes from the delta connection of three single phase capacitive elements. Stated value is the multiple by three of each element and it expressed in μF (micro Farad).

Capacitor Rated voltage [v]

The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the case.

$$U_c = \frac{U_N}{\left[1 - \frac{p}{100\%}\right]}$$

where

$$p = 100\% \cdot \frac{X_L}{X_C}$$

examples:

Detung factor p	Resonance frequency Fr	
	F _N = 50 Hz	F _N = 60 Hz
5,67 %	210 Hz	227 Hz
7 %	189 Hz	252 Hz
14 %	134 Hz	160 Hz

Rated capacitor power [Q]

The rated capacitor output is defined as the power the capacitor can generate if supplied at rated voltage; it is important to follow the manufacturer recommendation in terms of voltage selection.

This parameter also makes easier the selection of proper CRTE capacitor in series to reactor.

Real output [Qc]

Actual capacitor output is increased respect to the rated value by the higher voltage at capacitor terminals.

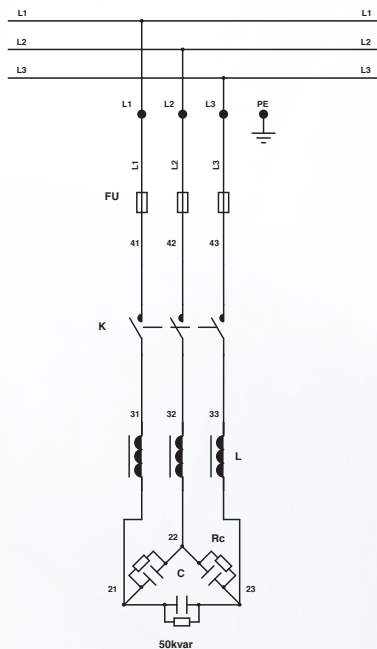
However this effect is already incorporated in the table Qc Reactive Power.

RMS Current I_{eff} [I_{rms}]

Actual load flowing on the reactor in permanent operation, it is composed by the fundamental wave plus harmonic currents. Component selections described in this catalogue are made in respect to the maximum reactor and capacitor allowed manufacturer limits.

RECOMMENDED CONNECTING SCHEME

Reactors shown in this catalogue are designed for the following scheme of wiring.



INSTALLATION AND MAINTENANCE

Handling and Storage

Reactors shall have to be handled and stored with care in order to avoid any mechanical damage during transportation. Protection against environmental influences shall also be taken.

Installation

Reactors are suitable for indoor installation and for vertical position. Reactors must be installed in such a way that the specified limit temperature is not overcome. Not being in compliance with the above instructions will result as a reduction of the expected service life.

Assembly

Total losses are sum of all iron, winding, and stray field losses at max. specified over voltage and harmonic content. Depending on the detuning factor, actual dissipation power of our reactors is between 4 and 6W/kvar. While using capacitors and reactors within a capacitor bank, suitable means for heat dissipation and cooling of components shall be taken. A minimum 20mm distance between the units has to be maintained.

Maintenance

Periodical checks and inspections are required to ensure reliable operation of reactors. Monitoring and recording of the electrical service parameters are also recommended to become acquainted with progressive reactors stress conditions.

Protections

Temperature Switch All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil. These leads shall be wired in series to contactor coils to switch off in case of over load.



SAFETY INSTRUCTIONS

DO NOT MISAPPLY REACTORS FOR POWER FACTOR CORRECTION APPLICATIONS

To prevent damage to people and goods due to improper usage and/or application of reactors, the "RECOMMENDATION FOR THE SAFE USE OF STATIC CAPACITORS, BANKS AND EQUIPMENT FOR POWERFACTOR CORRECTION". Published by ANIE shall have to be strictly respected. ICAR is not responsible for any kind of possible damages occurred to people or things, derived from the improper installation and application of Power Factor Correction capacitors and reactors.

Most common misapplication forms

Current, voltage, harmonics and frequency above specification;

- Working or storage temperature beyond the specified limits;
- Unusual service conditions as mechanical shock and vibrations, corrosive or abrasive conductive parts in cooling air, oil or water vapour or corrosive substances, explosive gas or dust, radioactivity, excessive and fast variations of ambient conditions, service areas higher than 2000 m above sea level...

In case of doubt in choice or in performances of the capacitors and reactors ICAR technical service MUST be contacted.

Personal Safety

Electrical or mechanical misapplications of Harmonic Blocking Reactors capacitors may become hazardous. Special attention must be taken to make sure the reactors are correctly used for each application and that warnings and instructions are strictly followed. Reactors are made not only but also with iron, aluminium, paper and resin that are partially flammable materials. The risk of fire cannot be totally eliminated; therefore suitable precautions shall be taken. Reliability data quoted by ICAR should be considered as statistical i.e. based on a number of components, and does not guarantee properties or performance in the legal sense. ICAR liability is limited to the replacement of defective components. This applies in particular to consequential damage caused by component failure.

5,4% 400V - 50Hz Reactors

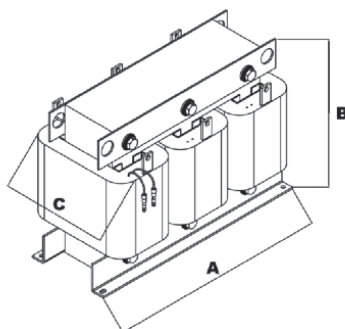
U_N	f	f_N	P
400V	50Hz	215 Hz	5,4%



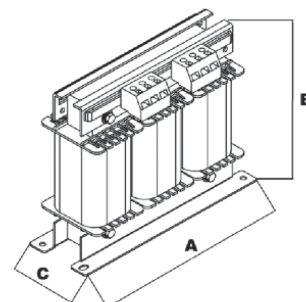
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	50 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1,8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46015810	5	5,8	8	copper	205x167x68	7	7,5	450	112,5
46012910	10	2,9	16	copper	205x164x68	8,6	12,5	450	196
46012401	12,5	2,4	19	copper	205x184x68	6	15	450	236
46011451	20	1,45	32	copper	205x184x88	9,5	25	450	393
46011452	25	1,22	39	copper	180x180x170	11,6	30	450	471
PRG0030DAB57579	40	0,73	64,3	aluminium	320x220x120	18	50	450	786
PRG0039DAB57871	50	0,6	78	aluminium	340x220x135	20	60	450	942



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7% 400V - 50Hz Reactors

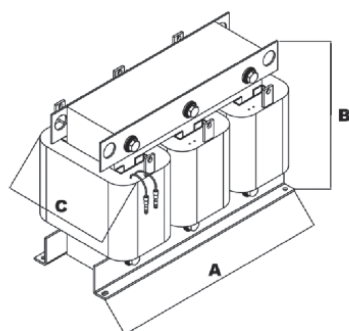
U_N	f	f_N	P
400V	50Hz	189 Hz	7%



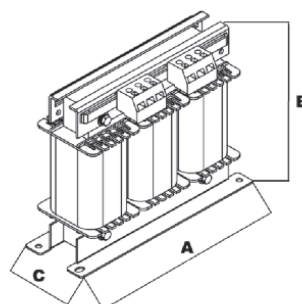
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	50 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1.8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
4618300	5	8,3	8	copper	205x170x65	6,0	7,5	450	112,5
46014200	10	4,2	17	copper	205x181x79	7,7	12,5	450	196
46014201	12,5	3,03	21	copper	180x180x150	11	15	450	236
PRG0028DAB57538	20	1,73	40	aluminium	320x220x120	17	25	450	393
PRG0025DAB57568	25	1,572	39,5	aluminium	320x220x120	17	30	450	471
PRG0056DAB57524	40	0,865	80	aluminium	320x220x145	26	50	450	786
PRG0050DAB57567	50	0,786	79	aluminium	320x220x140	26	60	450	942



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14% 400V - 50Hz Reactors

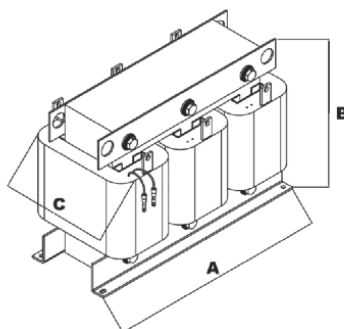
U_N	f	f_N	P
400V	50Hz	134 Hz	14%



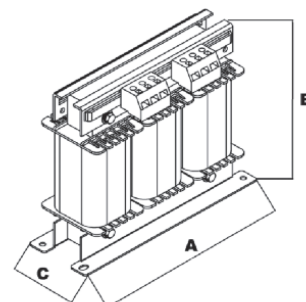
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	50 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1.8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46021480	5	14,8	9	copper	205x170x78	7,4	7,5	525	87
46017400	10	7,4	18	copper	205x180x113	12,8	15	525	173
46016300	12,5	6,3	19	copper	205x170x113	13,5	20	525	231
PRG0042DAB57551	20	3,7	35	aluminium	320x220x130	21	30	525	345
PRG0047DAB57427	25	3,13	38	aluminium	320x220x135	22	35	525	404
PRG0078DAB57592	40	2,056	63	aluminium	320x220x165	34	60	525	692
PRG0093DAB57418	50	1,57	77	aluminium	380x215x165	37	75	525	865



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7% 380V - 60Hz Reactors

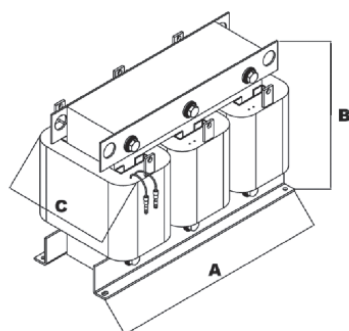
U_N	f	f_N	P
380V	60Hz	252 Hz	7%



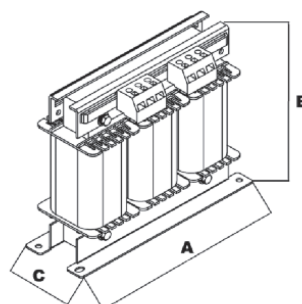
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	50 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1.8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46188300	5	8,3	8	copper	205x170x65	13,5	6	450	78
46012910	10	2,9	16	copper	205x184x68	8,6	12	450	157
46012600	12,5	2,6	27	copper	205x184x98	11	15	450	196
46011451	20	1,45	32	copper	205x184x88	9,5	24	450	314
46011452	25	1,22	39	copper	180x180x170	13,6	30	450	393
PRG0030DAB57579	40	0,73	64,3	aluminium	320x220x120	18	54	450	707
PRG0037DAB57692	50	0,6	78	aluminium	340x220x135	20	66	450	864



ALUMINIUM



COPPER

U_N	f	f_N	P
400V	60Hz	227 Hz	5,4%

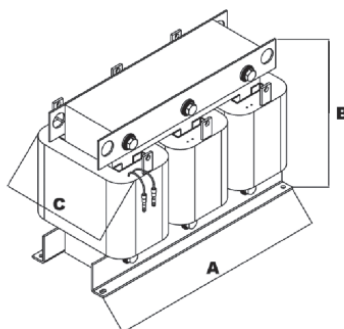
6% 400V - 60Hz Reactors



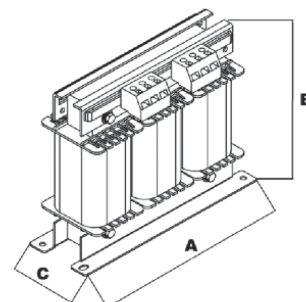
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	60 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1.8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46015810	5	5,8	8	copper	205x167x68	7	6	450	78
46012600	10	2,6	27	copper	205xx184x98	11	12	450	157
46012601	12,5	1,8	26	copper	180x180x130	8	18	450	236
46012602	20	1,31	30	copper	180x180x140	9,7	24	450	314
46012603	25	1,05	44	copper	180x180x150	11,4	30	450	393
PRG0030DAB57579	40	0,6	78	aluminium	340x220x135	20	54	450	707
PRG0035DAB57693	50	0,45	88	aluminium	320x220x130	19,5	66	450	864



ALUMINIUM



COPPER



7% 230V - 60Hz Reactors

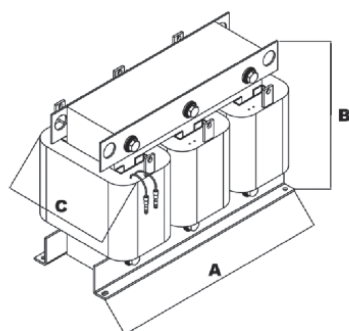
U _N	f	f _N	P
230V	60Hz	252 Hz	7%



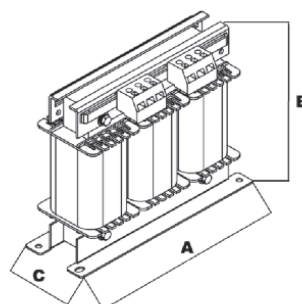
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	60 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	I _{lin} = 1.6...1.8 I _n
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Q _c at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Q _c at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46012100	5	2,1	33	copper	205x180x113	13,3	15	400	249
46012101	10	1,04	35	copper	180x180x130	7,9	30	400	497
46012102	12,5	0,82	37	copper	180x180x130	8	12	230	602
PRG0037DAB57692	20	0,6	78	aluminium	320x220x130	20	54	400	896
PRG0035DAB57693	25	0,45	88	aluminium	320x220x130	18,5	24	230	1204
PRG0033DAB57694	40	0,273	109	aluminium	320x220x120	18,5	36	230	1806
PRG0043DAB57695	50	0,2	146	aluminium	320x220x135	21,5	48	230	2408



ALUMINIUM



COPPER

U_N	f	f_N	P
230V	60Hz	227 Hz	5,67%

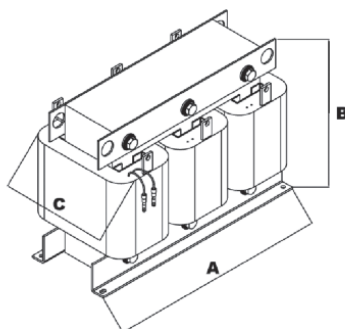
5,67% 230V - 60Hz Reactors



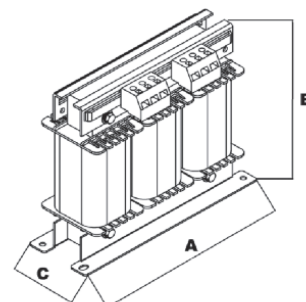
TECHNICAL CHARACTERISTICS

Applicable standards	IEC 60076-6
Rated voltages	230...690V
Rated frequencies	60 Hz
Tolerance of inductance	±5% (mean value across three phases)
Linearity	$I_{lin} = 1.6...1.8 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I _{rms} (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
460120103	5	1,6	15	copper	180x180x120	5,7	15	400	249
460120104	10	0,82	37	copper	180x180x130	8,2	30	400	497
460120105	12,5	0,66	36	copper	180x180x120	6,8	12	230	602
PRG0035DAB57693	20	0,45	88	aluminium	320x220x130	19,5	54	400	896
PRG0024DAB57696	25	0,282	86	aluminium	320x220x115	16	24	230	1204
PRG0026DAB57697	40	0,22	108	aluminium	320x220x120	16,5	36	230	1806
PRG0035DAB57698	50	0,167	144	aluminium	320x220x130	19,5	48	230	2408

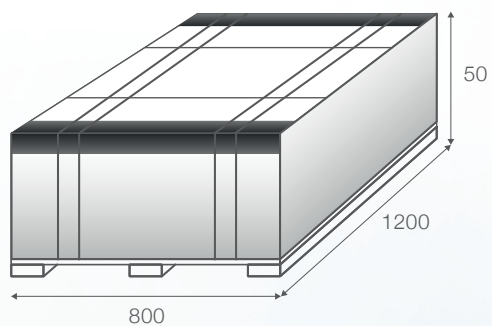


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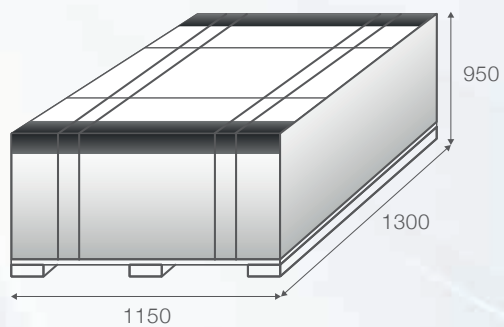
COPPER

Packing details: Reactors



PALLET

Reactor type	Reactors per package
Copper winding	20
Aluminium winding	16



WOODEN BOX

Reactor type	Reactors per package
Copper winding	90
Aluminium winding	72

Reactive power regulators and protections

The reactive power regulator is, together with the capacitors and reactors (in detuned filter cabinets), the key component of the automatic power factor correction system. It is in fact the "intelligent" element, responsible for the verification of the power factor of the load, in function of which controls the switching on and off of the capacitors batteries in order to maintain the power factor of the system beyond the target. The reactive power regulators RPC are designed to provide the desired power factor while minimizing the wearing on the banks of capacitors, accurate and reliable in measuring and control functions are simple and intuitive in installation and consultation. The flexibility of ICAR regulators allows you to modify all the parameters to customize its operation to fit the actual characteristics of the system to be corrected (threshold power factor, sensitivity of step switching, reconnecting time of the steps, presence of photovoltaics, etc.).

Reactive power regulators 5LGA RPC and RPC 8LGA

The new reactive power regulator RPC 5LGA equips Micromatic and Minimatic automatic power factor correction systems, while the new regulator RPC 8LGA equips MIDmatic. Both are managed by a microprocessor and offer many features maintaining a simple user interface locally or from a PC. They are characterized by a large LCD display with text messages (in 6 languages: ITA, ENG, FRA, SPA, POR, GER) and icons for quick and intuitive navigation.

The regulators are very flexible: they are in fact able to adjust the power factor between 0,8 inductive and 0,8 capacitive, to operating with power from 100 to 440 VAC, to run on the 4 quadrants for cogeneration installations, to accept in Input CT secondary 5A or 1A .

The regulators have standard temperature control and the ability to configure one of the available relays for activating visual alarms sound at a distance; also control the distortion of current and voltage.

Regulators RPC 5LGA-8LGA can operate in automatic or manual mode: in the first case in complete autonomy by switching batteries available up to the desired power factor; in the second case it will be the operator to force the insertion and disconnection of the battery: the regulator still oversee operations to prevent potential damage to the capacitors (for example by assessing compliance of discharge times before a subsequent insertion).

The slot allows you to add additional functions:

- OUT2NO for two additional digital outputs
- COM485 communication module for connection to network RS485 (Modbus)
- COM232 communication module for connection to network RS232 (Modbus)
- WEBETH communication module for connection to the Ethernet network (Modbus), available only for RPC 8LGA

Measurement functions

Regulators RPC 5LGA and 8LGA provide many standard measurements in order to check and monitor the correct electrical and temperature conditions of the power factor correction system. Display shows the following values: power factor, voltage, current, delta kvar (reactive power missing to reach the target power factor), average weekly power factor, total harmonic distortion of the current system (THDI_R%) with detailed harmonic for harmonic from 2nd to 15th, total harmonic distortion of the voltage (THDV%) with detail for harmonic from 2nd to 15th, total harmonic distortion in the current% (THDI%) capacitor, temperature. The controller stores and makes available for consultation the maximum value of each of these variables, to evaluate the most severe stress suffered by the automatic power factor correction since the last reset: the temperature, the voltage and the total harmonic distortion have a strong impact on the capacitors as if they hold more than the nominal values can drastically reduce the service life.



RPC 5LGA



RPC 8LGA

Alarms

Regulators RPC ICAR show many different alarms:

- Under-compensation: the alarm is activated if, with all the steps of power factor correction switched on, the power factor is lower than the desired value
- Over-compensation: the alarm is activated if, with all the steps of power factor correction switched off, the power factor is greater than the desired value.
- Minimum and maximum current: to assess the condition of the system load
- Minimum and maximum voltage: to evaluate the stresses due to the variations of the supply voltage
- Maximum THD%: to assess the pollution of network as regards to harmonic current.
- Maximum temperature in the enclosure: to monitor the capacitor climatic conditions
- Short voltage interruptions.

Alarms are programmable (enable, threshold, time on / off).

Display Indications

The LCD display icons and text provides the following information for quick identification of the state of the system:

- Operating mode automatic/manual
- Status of each battery (on / off)
- Recognition power factor inductive / capacitive
- Type of value displayed
- Active alarm code, and explanatory text (in a language of choice among the 6 available: ITA, ENG, FRA, SPA, POR, GER)

Contacts

The regulators RPC 5LGA and 8LGA have power contacts for controlling the steps, to control the eventual cooling fan and for the activation of alarms to distance; contacts are NO and have a range of 1.5A to 5A at 250Vac or 440Vac. A contact is in exchange for alarm functions (NO or NC).

Technical characteristics

- Microprocessor control
- Auxiliary supply voltage: 100 to 440 VAC
- Frequency: 50Hz / 60Hz
- Voltage measuring input : 100 to 600V
- Current measuring input : 5A (1A programmable)
- Current reading range: from 25mA to 6A (from 25mA to 1.2A)
- Automatic current way sensing: yes
- Operation in systems with cogeneration: yes
- Power consumption: 9.5 VA
- Output relay : 5A - 250Vac
- Cos ϕ adjustment: from 0.5 ind to 0.5 cap
- Step Switching Time: 1s ÷ 1000s
- Alarm relay: yes
- Degree of protection: IP54 on front and IP20 at terminals
- Operating temperature: -20 ° C to + 60 ° C
- Storage temperature: -30 ° C to + 80 ° C
- Optical port Front: for communication USB or WIFI with dedicated accessories
- Compliance with the standards: IEC EN 61010-1; IEC / EN 61000-6-2; IEC / EN 61000-6-4; UL508; CSA C22-2 n ° 14

	RPC 5LGA	RPC 8LGA
Output relays:	5 (up to 7)	8 (up to 12)
Dimensions:	96x96mm	144x144mm
Weight:	0,35kg	0,65kg

Additional modules

The regulator RPC 5LGA has the ability to accommodate, in the back slot, an additional module.

The regulator RPC 8LGA has two rear slots to accommodate up to two additional modules. Once installed an additional module, the controller recognizes and activates the menu for its programming. Additional modules can be installed even in the bank already in service.

Slots for additional module may be already used by ICAR to implement necessary functions to the context in which the controller is mounted. If you decide to add a module to an already operating, ensure that there is an available slot.

- OUT2NO two digital outputs device to control additional steps (two relays 5A 250Vac)
- COM232 interface RS232 isolated
- COM485 interface RS485 isolated
- WEBETH communication module for connection to the Ethernet network, available only for RPC 8LGA



RPC 5LGA

LCD display with icons and text

Selection keys, parameters editing and confirmation

Communication optical port
USB-WIFI



RPC 8LGA

Reactive power regulator RPC 8BGA

The RPC 8BGA reactive power regulator equips MULTImatic automatic power factor correction systems.

It is a very innovative controller, with exclusive features:

- High electrical performance
- Extended Capabilities
- Graphic display
- Advanced communication
- Upgradability, even after installation
- Powerful supervision software

More details below, referring to the following page tables and manuals for further information.

High electrical performance: The 8BGA controller is equipped with powerful hardware, which allows a considerable electrical performances: it can be connected to the CT secondary 5A or 1A, it can work on networks with voltages from 100 to 600Vac with a measuring range from 75VAC to 760VAC, it can be connected to a single CT (typical configuration of the power factor correction) or three-CTs (for a more accurate measurement of the power factor, and this fact makes the 8BGA controller to refocus and to be a multimeter as well).

Extended Capabilities: The 8BGA reactive power regulator is controlled by a powerful microprocessor that allows a set of new functions to solve problems even in complex plant.

8BGA can work master-slave functions, handles up to 10 languages simultaneously, can be used in MV systems managing the transformation ratio of the VT, it can support multiple inputs and outputs via optional modules, it can handle target cos phi from 0.5 inductive to 0.5 capacitive. 8BGA can build a network of 4 wired units (one master three slaves) to be able to handle up to 32 steps of power factor correction in a consistent and uniform way.

Graphical display with high readability: forget the regulators with small displays and difficult to read: 8BGA will amaze you with its display matrix graphic LCD 128x80 pixels.

The detail and sharpness allow intuitive navigation between the different menus, represented with text and icons.

Advanced communication: 8BGA born to be a regulator able to communicate in a manner in line with the latest technology: Ethernet, RS485, GSM / GPRS modem, USB, WIFI.

Now you can see the information of the company cos phi, without having to go in front of the regulator. It will be the controller to inform you by posting, if you wish, SMS or email. Or you can consult a tablet, a smartphone, or PC. The information about the cos phi is important, because it impacts heavily on the company's income statement.

Evolutivity: the "basic" 8BGA regulator can be enhanced with up to four additional modules "plug and play" which greatly expands its performance. And 'possible to add additional control relays (up to a total of 16), even for a static control (thyristors), digital and analog inputs, analog outputs, communication modules. Your controller can become a small PLC, and the PFC system can become a point of data aggregation, for remote communication.

Measurement functions and help to maintain

8BGA is a real evolved multimeter, thanks also to the graphic display of excellent readability and to the powerful microprocessor. The measured parameters are the basic ones (cos phi, FP, V, I, P, Q, A, Ea, Er) with the addition of the distortion of the voltage and current (THD, histogram of the value of each harmonic, waveform graphic visualization).

If 8BGA is connected to three CT, the harmonic analysis is detailed for each phase, in order to identify any anomalies of single phase loads. 8BGA measure and count values that can help in ruling the PFC (temperature, number of switching of each step). 8BGA also suggests the maintenance to be carried out by means of simple messages on the display. Keep efficient capacitor becomes much easier. 8BGA stores the maximum values of current, voltage, temperature, each associated with the date and time of the event for a better analysis of what happened.

Alarms

The set of alarms (maximum and minimum voltage, maximum and minimum current, over and under-compensation, overload of the capacitors, maximum temperature, microinterruption) associated with the readability of the messages on the display allows a better understanding of what happened.

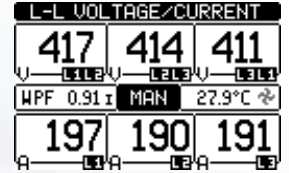
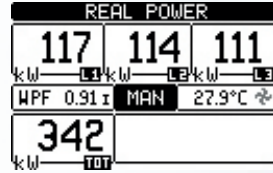
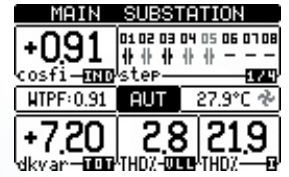
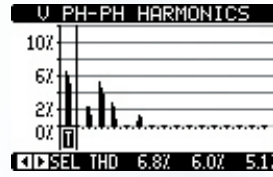
Even alarm programming (enable / disable, delay, relapse etc.) is easier and faster.



8BGA Power Factor Correction Controller: Technical parameters

Technical characteristics

- Auxiliary supply voltage: 100÷440Vac
- Frequency: 50Hz/60Hz
- Voltage Measuring range: 100÷600Vac (-15% / +10%)
- Current Measuring range: 5A (1A selectable)
- Current incoming range: from 25mA to 6A (from 10mA to 1,2A)
- Automatic phase sequence reading: yes
- Compensation in cogeneration: yes
- Burden: 9,5 VA
- Output relay current: 5A – 250Vac
- Cos ϕ range: from 0,5 ind to 0,5 cap
- Step switching time: 1s÷1000s
- Alarm relay: yes
- Degree of protection: IP54
- Working temperature range: from -20°C to 60°C
- Storage temperature range: from -30°C to + 80°C
- USB optic communication port (with COMUSB)
- Temperature Control: from -30°C to +85°C
- Standards compliance: IEC EN 61010-1; IEC/EN 61000-6-2; IEC/EN 61000-6-3; UL508; CSA C22-2 n°14
- Step output relays: 5 (expandible till 7)
- Dimensions: 96x96mm
- Weight: 0,35Kg
- Part number: A25060046411000



Graphic display 128x80 pixel

Selection, modification and enter push buttons.

USB – WIFI Optic netport

LED watchdog and alarm

RPC 8BGA Power Factor Correction Controller: additional modules

The RPC 8BGA controller accommodates up to 4 additional modules "plug & play".

Once you have added an additional module, the controller recognizes and activates the menu for its programming. Additional modules can also be installed in the rear.

Digital inputs and outputs

These modules allow you to increase the contacts funding for control of the steps contactors (OUT2NO module) or thyristors (STR4NO module) switched banks, or to add inputs and / or digital / analog acquisition of parameters and implementing simple logic.

- OUT2NO module 2 digital outputs to control additional steps (two relays 5A 250 Vac)
- STR4NO module 4 static outputs for thyristor control steps (range SPEED)
- INP4OC module 4 digital inputs
- 2IN2SO module 2 digital inputs and 2 static outputs
- INP2AN module 2 analog inputs
- OUT2AN module 2 analog outputs



Protection functions (MCP5) and data logging (DATLOG)

The control and protection module MCP5 allows a more detailed inspection of the electrical parameter that can damage the capacitors, thanks to algorithms particularly suitable for equipment consisting of capacitors and reactors (detuned filters MULTImatic FH20, FH30, FD25, FD25V, FD35, FH70, FD70).

The data logging module adds the ability to record events, for a better understanding and diagnosis of troubled plants.

- MCP5 module for protection and control for additional safety of capacitors, especially suitable in the detuned banks
- DATLOG data logger module with real time clock and battery backup for data retention

Communication functions

RPC 8BGA regulator is very powerful in terms of communication.

The modules dedicated to these functions allow multiple solutions to remotely control the power factor system and all other variables measured, calculated or obtained from the instrument.

- COM232 isolated RS232 interface
- COM485 RS485 opto-isolated
- WEBETH Ethernet interface with webserver function
- COMPRO isolated Profibus-DP interface
- COMGSM GPRS / GSM modem
- CX01 cable connection from the RPC 8BGA optical port to the USB port of the computer for programming, downloading / uploading data, diagnostics etc..
- CX02 device to connect the optical port in the PRC 8BGA via WIFI: for programming, downloading / uploading data, diagnostics etc..
- CX03 antenna quad band GSM (800/900/1800)



App¹

App available for WIFI interfacing with the RPC 8BGA controller via tablet or smartphone. For iOS and Android.

You have the following functions:

- Set up regulator
- Sending commands
- Reading information
- Download information and data residing on board

1. For availability contact us



Electronic Fast Switches



Electronic Fast Switches is the best and sometimes the sole choice when it is necessary to compensate loads over short periods of time. Examples are steel companies, lifting apparatus (cranes, quay cranes, etc), cable makers (extruders, etc), welding machines, robots, compressors, skiing lift stations, LV industrial networks (chemical plants, paper mills, automotive suppliers). Thyristor switched capacitor bank are also an ergonomic solution where noise can be problematic, like hotels, banks, offices, service infrastructures (telecommunications board, informatics 'boards, hospitals, malls).

Limits of the traditional contactor switched banks

- High inrush current and over voltages
- Risk of over voltages due to the arc breaking
- Longer reconnecting time: more than 30 sec
- More demanding maintenance compared with static switches.

General advantages of Power Factor Correction

- Reduced losses on mains and power transformers
- Increase of plant available power
- Less voltage drop in the plant

Electronic Fast Switches benefits include:

- Minimises network disturbances such as Voltage Drop and Flicker
- No moving parts therefore reduced maintenance (i.e. no Electro-magnetic contactors)
- Enhanced capacitor life expectancy.

In general there is a comprehensive PLANT EFFICIENCY; because power factor correction is fast, the power transformer and line design can be done considering only the actual load.

Therefore longer working life and reliability of plant.

Static switches allow unlimited operations.

Steps switching is also done limiting transient phenomena that inside normal plants stresses the capacitors reducing their working life.

General Characteristics

ICAR ELECTRONIC FAST SWITCHES FEATURES are described below:

- Switching speed: 20ms ON - 20ms OFF
- Electronic components: SCR
- Connectable power: up to 100kvar-400/415V
- Possibility to switch capacitors without reactor
- Fan dedicated to the cooling radiator
- Protection circuit with signalling LED

Further ADVANTAGES

1. The control technology adopted doesn't allow switching that could generate self damage.
2. Very small dimensions.
3. High temperature protection.
4. Protection from high speed switching.
5. Electronic Fast Switch doesn't need any external supply.

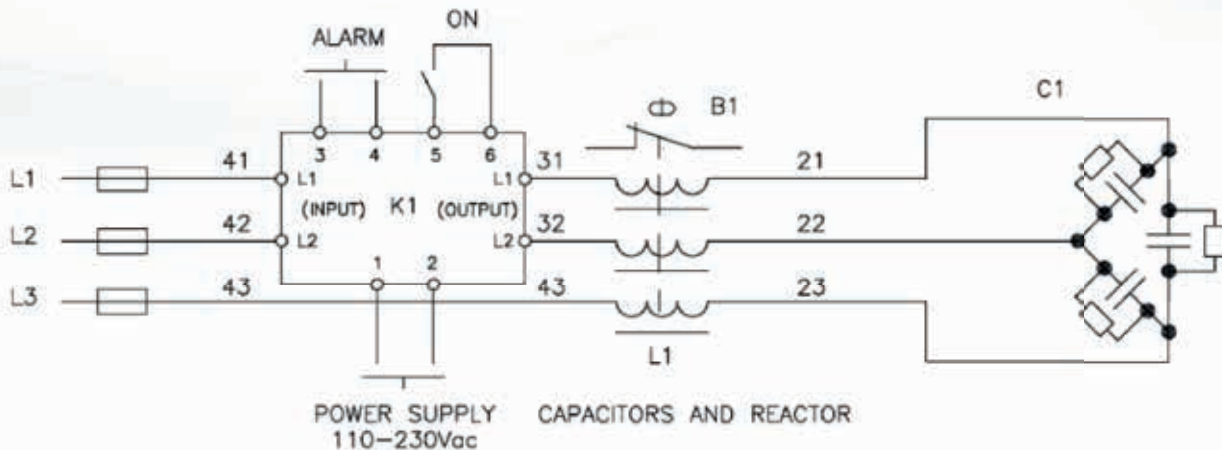
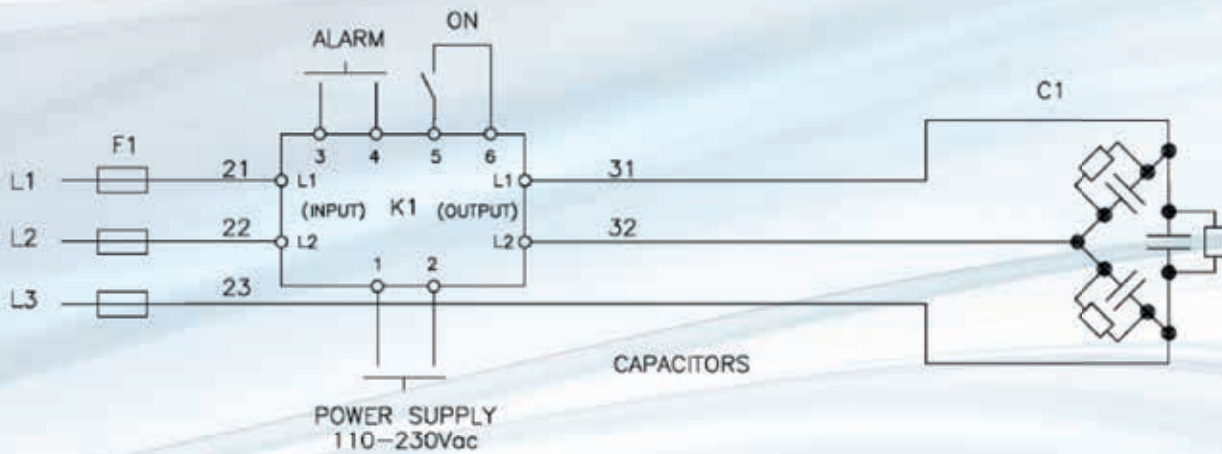
TECHNICAL DATA SHEETS AND TABLES

TECHNICAL CHARACTERISTICS

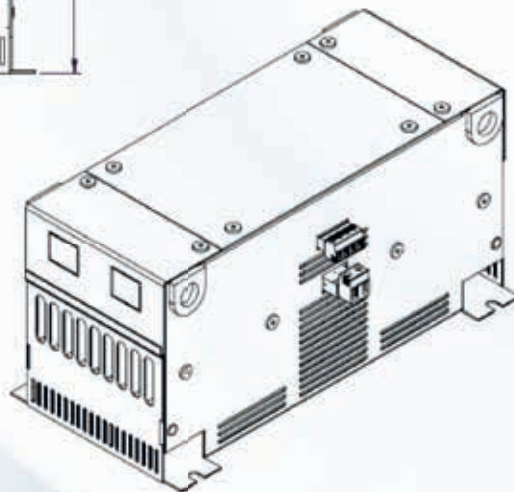
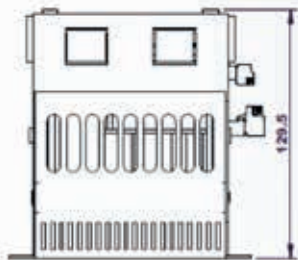
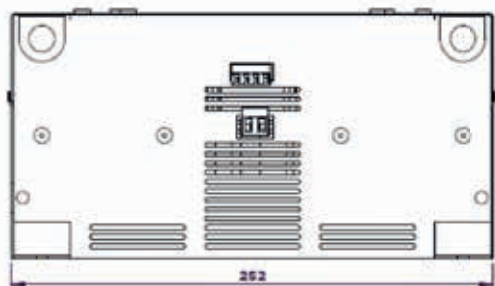
Voltage	400-415V
Frequency	50Hz
Activation	Using external contact voltage free (type SSR Bi-directional opto-mos recommended); no need for 24Vdc
Duty cycle max speed	20ms ON – 20ms OFF
Operating ambient temperature	-5/+45°C

PART NUMBER	Max Power	Dimensions (mm) [WxHxD]	Weight (kg)
IS100K0IE100K	50kvar	252x220x129,5 (81)	3 Kg
IS100K0IE100K	100kvar	242x215x132 (82)	-

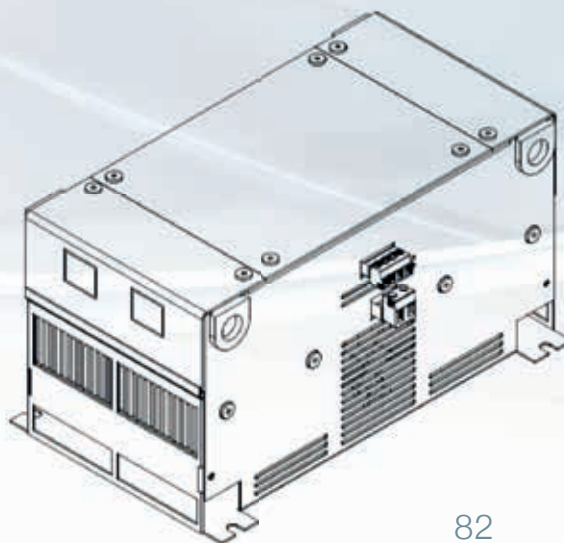
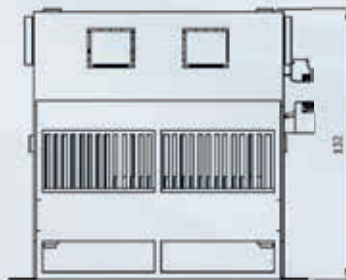
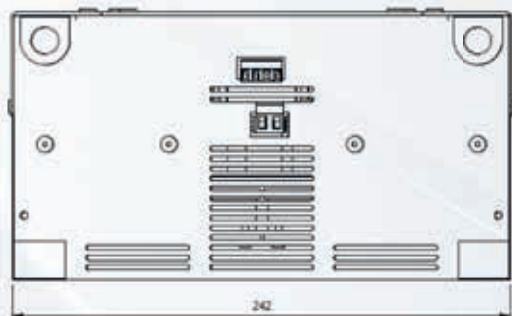
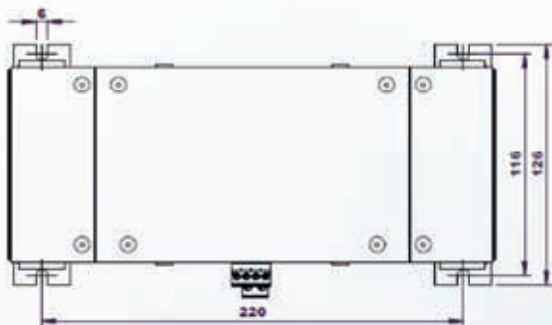
CONNECTING DIAGRAM



THYRISTOR SWITCHES



81



82

Fast Discharge device RPD 3A

GENERAL CHARACTERISTICS

Fast Discharge Resistor RPD 3A is designed to discharge power capacitors within few seconds. It can be used with rated network voltage up to 400V and frequency 50 or 60Hz. The highest capacitor bank power it can deal with is 75 kvar and its discharge time till residual capacitor voltage of 50V is 3 seconds.

Several discharge times till residual capacitor voltage of 50V are shown in table below. They are shown for 230V and 400V capacitor rated voltage and frequency of 50 and 60 Hz.

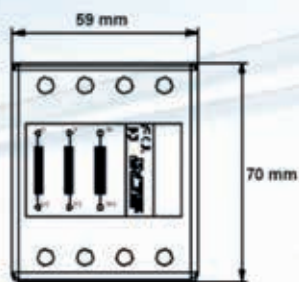


Q (kvar)	230V - 50Hz (seconds)	230V - 60Hz (seconds)	380V - 60Hz (seconds)	400V - 50Hz (seconds)	400V - 60Hz (seconds)
5	0.5	0.4	0.2	0.2	0.2
10	0.9	0.8	0.4	0.4	0.3
12,5	1.1	1.0	0.4	0.5	0.4
20	1.8	1.5	0.7	0.8	0.7
25	2.3	1.9	0.9	1.0	0.8
40	3.7	3.1	1.4	1.6	1.3
50	4.6	3.8	1.8	2.0	1.6
75	6.9	5.7	2.7	3.0	2.5

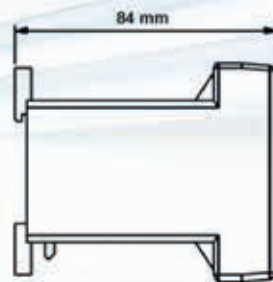
TECHNICAL CHARACTERISTICS

- Working voltage: 200÷400V
- Frequency: 50/60Hz
- Service: continuous
- Phases: 3
- Working temperature: -5/+40°C
- Degree of protection: IP20
- Weight: 0,4Kg

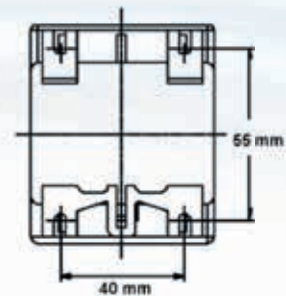
DIMENSIONS



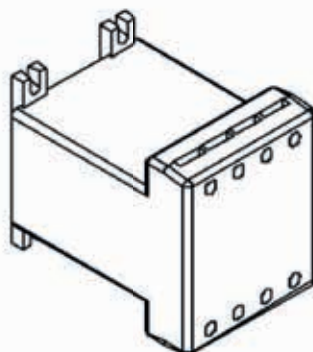
**FRONT
VIEW**



**SIDE
VIEW**

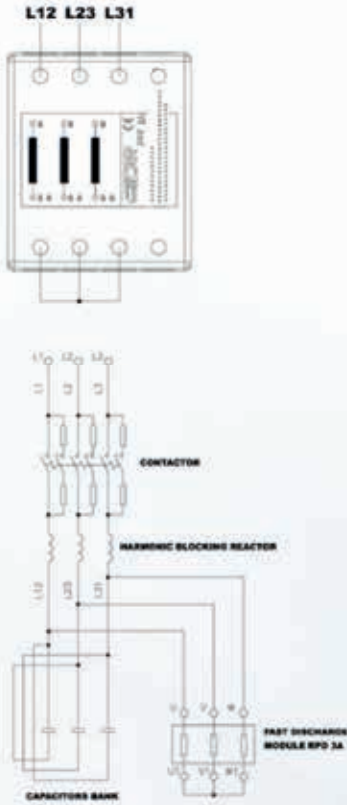


**REAR VIEW
(FIXING
DETAILS)**

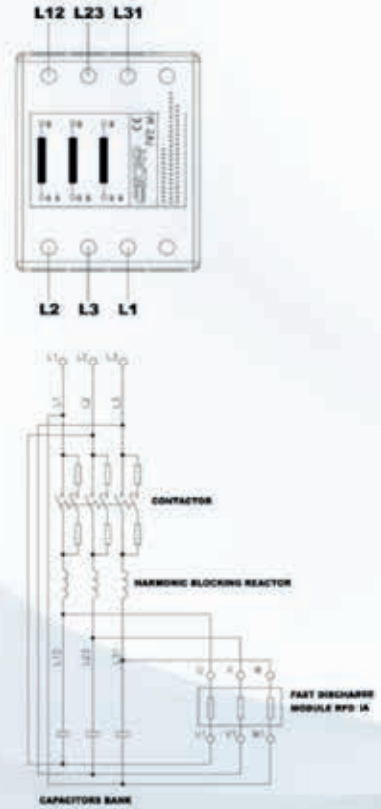


CONNECTING DIAGRAMS

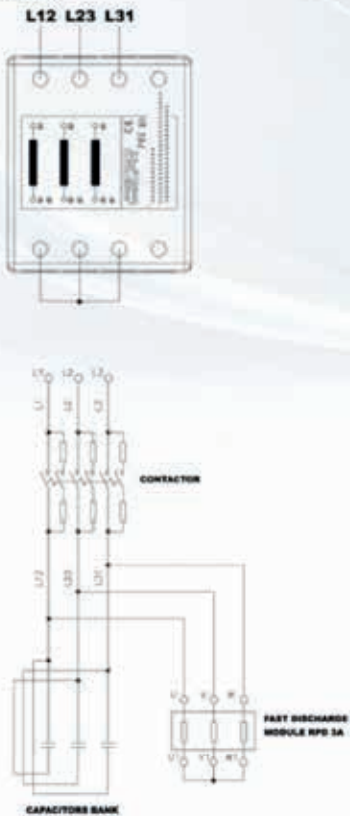
CONTACTOR OUTSIDE TO THE CAPACITORS DELTA CONNECTION (SINGLE PHASE OR THREE PHASE CAPACITORS)



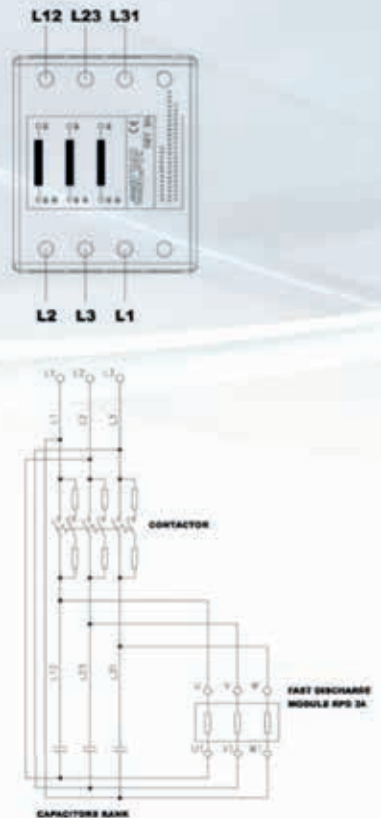
CONTACTOR INSIDE TO THE CAPACITORS DELTA CONNECTION (SINGLE PHASE CAPACITORS ONLY)



CONTACTOR OUTSIDE TO THE CAPACITORS DELTA CONNECTION (SINGLE PHASE OR THREE PHASE CAPACITORS)



CONTACTOR INSIDE TO THE CAPACITORS DELTA CONNECTION (SINGLE PHASE CAPACITORS ONLY)



EUORack TRAYS



GENERAL CHARACTERISTICS

EUORack system is ideal solution for OEM and switchgears manufacturers, they are indeed suitable to the most common switchgears sizes, in addition:

- EUROrack is compact and with high power density,
- EUROrack is available detuned and not detuned,
- Powers from 12,5 kvar to 100kvar in a single tray.
- Bus bars suitable to bear up to 400kvar detuned or not detuned.
- Easy to assembly as power bus bars and NH fuses are incorporated in the tray support.

EUORacks are sound for plants where the current Total Harmonic Distortion is as much as 100% (detuned FH30). EUROracks are equipped with ICAR high energy density metallised polypropylene capacitors which assure elevated performances with low losses and small dimensions.

DESIGN FEATURES

Every tray is complete of:

- Capacitor Duty Contactors (230Vac coil).
- Self-extinguish cable harness according to EN 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Three phase self-healing polypropylene capacitors with 525V rated voltage (FH only).
- Three-phase tinned copper bus bar system
- Discharge resistors.
- Three phase detuning chokes (FH only) with dedicated frequency detuning; each coil winding temperature sensor and NC switch.
- All components inside these products are compliant with EU Safety Regulations

STANDARD ACCESSORIES

(supplied along with each tray)

- Side rack support brackets, suitable for 600-400 mm depth cabinets
- Connecting tinned copper bars and bolts,
- IP20 plexiglass protection.

OPTION

- Adaptation bracket, for fitting of 600 mm width trays in 800 mm width cabinets, and 800 mm width trays in 1000 mm width cabinets.

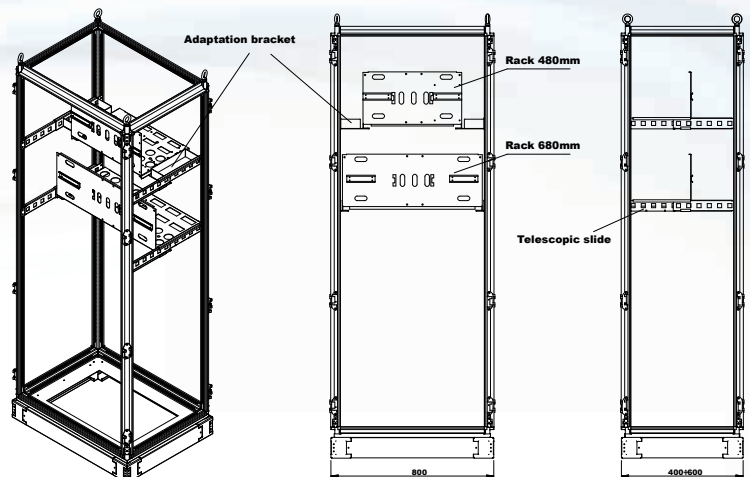
CABINET FITTING

EUORacks FH trays are easy to fit inside any standard cabinet thanks to sliding and adjustable side supports. These brackets enable EUROracks to be used in variable dept cabinet, i.e. 400 mm (HP only) and 600 mm.

Furthermore thanks to extensible brackets, 480 mm width racks could be also fitted in 800 mm width cabinet (see drawing below), allowing a very flexible combination of steps and total reactive power.

The maximum reactive power the bus bar system can bear is 400kvar 415V 50Hz, both detuned and not detuned. Extensions of additional trays is possible at any time.

Every rack auxiliary and control component is supplied already wired to the terminal board, which is available on a DIN rail of any tray support.



HP10

U_e	U_N	U_{MAX}^1	f	THDI _R %
400-415V	415V	455V	50 Hz	≤12%



TECHNICAL CHARACTERISTICS

Rated operational voltage	$U_e= 400-415V$
Rated frequency	50 Hz
Max current overload I_n (tray)	$1.3xI_n$
Max voltage overload V_n (bank)	$1.1xV_n$
Max current overload I_n (capacitors)	$2xI_n$
Max voltage overload V_n (capacitors)	$3xV_n$
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continuous
Capacitors connection	delta
Switching devices	Capacitor duty contactors (AC6b)
Total Tray losses	2 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61921
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 10%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- $3U_i$ three phase self-healing polypropylene capacitors with 415V rated voltage.
- Discharge devices.
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER $U_N=415V$ (kvar)	POWER $U_N=415V$ (kvar)	POWER $U_e=400V$ (kvar)	STEPS $U_e=400V$ (kvar)	DIM IP20 WxHxD (mm)	OVERALL DRAWING
IY0AKK225050359	25	25	25	25	480x275x340	93, 95
IY0AKK250050359	50	50	50	2x25	480x275x340	93, 95
IY0AKK275050359	75	75	75	3x25	480x275x340	93, 95
IY0AKK310050359	100	100	100	4x25	480x275x340	93, 95
IY0AKK312550359	125	125	125	5x25	680x275x336	94, 96
IY0AKK315050359	150	150	150	6x25	680x275x336	94, 96

U_e : power factor correction bank working voltage

U_N : capacitors rated voltage

U_{MAX} : capacitor admissible maximum voltage

THDI_R%: current total harmonic distortion of the plant

U_e	U_N	U_{MAX}^1	f	THDI _R %
400-415V	450V	445V	50 Hz	≤20%



TECHNICAL CHARACTERISTICS

Rated operational voltage	$U_e= 400-415V$
Rated frequency	50Hz
Max current overload I_n (tray)	1.3x I_n
Max voltage overload V_n (bank)	1.1x V_n
Max current overload I_n (capacitors)	2x I_n
Max voltage overload V_n (capacitors)	3x V_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continuous
Capacitors connection	delta
Switching devices	Capacitor duty contactors (AC6b)
Total Tray losses	2 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61921
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 18%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- 3U_t three phase self-healing polypropylene capacitors with 450V rated voltage.
- Discharge devices.
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER $U_N=450V$ (kvar)	POWER $U_e=415V$ (kvar)	POWER $U_e=400V$ (kvar)	STEPS $U_e=400V$ (kvar)	DIM IP20 WxHxD (mm)	OVERALL DRAWING
IY0JHK230050359	30	26	25	25	480x275x340	93, 95
IY0JHK260050359	60	52	50	2x25	480x275x340	93, 95
IY0JHK290050359	90	78	75	3x25	480x275x340	93, 95
IY0JHK312050359	120	104	100	4x25	480x275x340	93, 95
IY0JHK315050359	150	134	125	5x25	680x275x336	94, 96
IY0JHK318050359	180	160	150	6x25	680x275x336	94, 96

U_e : power factor correction bank working voltage

U_N : capacitors rated voltage

U_{MAX} : capacitor admissible maximum voltage

THDI_R%: current total harmonic distortion of the plant

U_e	U_N	U_{MAX}^1	f	THDI _R %
400-415V	525V	580V	50 Hz	≤27%



TECHNICAL CHARACTERISTICS

Rated operational voltage	$U_e = 400-415V$
Rated frequency	50Hz
Max current overload I_n (tray)	$1.3xI_n$
Max voltage overload V_n (bank)	$1.1xV_n$
Max current overload I_n (capacitors)	$2xI_n$
Max voltage overload V_n (capacitors)	$3x V_n$
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continous
Capacitors connection	delta
Switching devices	Capacitor duty contactors (AC6b)
Total Tray losses	2 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61921
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 25%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- $3U_i$ three phase self-healing polypropylene capacitors with 525V rated voltage.
- Discharge devices.
- Degree of protection IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER $U_N = 525V$ (kvar)	POWER $U_e = 415V$ (kvar)	POWER $U_e = 400V$ (kvar)	BANKS $U_e = 415V$ (kvar)	DIM IP20 WxHxD (mm)
IY0SQK240050359	40	25	25	480x275x458	480x275x340
IY0SQK280050359	80	50	2x25	480x275x458	480x275x340
IY0SQK312050805	120	75	3x25	480x275x458	480x275x340
IY0SQK316050359	160	100	4x25	480x275x458	480x275x340
IY0SQK316050803	160	100	2x12,5-25-50	480x275x458	680x275x336
IY0SQK320050359	200	125	5x25	680x275x458	680x275x336
IY0SQK324050359	240	150	6x25	680x275x458	680x275x336
IY0SQK324050804	240	150	2x12,5-25-2x50	680x275x458	680x275x336

U_e : power factor correction bank working voltage

U_N : capacitors rated voltage

U_{MAX}^1 : capacitor admissible maximum voltage

THDI_R %: current total harmonic distortion of the plant

U _e	f	THDI _R %	f _N	p
400-415V	50 Hz	≤20%	215 Hz	5,4%



TECHNICAL CHARACTERISTICS

Rated operational voltage	U _e = 400-415V
Rated frequency	50Hz
Max current overload I _n (tray)	1.3xI _n
Max voltage overload V _n (bank)	1.1xV _n
Max current overload I _n (capacitors)	2xI _n
Max current overload V _n (capacitors)	1,3 V _n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continous
Capacitors connection	delta
Switching devices	Capacitor duty contactors
Total Tray losses	6 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion has values up to 20%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

Generalities:

- Contactors(230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_i three phase self-healing polypropylene capacitors with 525V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 215 Hz.
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER U _e =415V (kvar)	POWER U _e =400V (kvar)	STEPS U _e =400V (kvar)	DIM IP20 WxHxD (mm)	OVERALL DRAWING
IY7HFK212550368	13.5	12.5	12.5	480x275x450	91, 97
IY7HFK218850368	20	18.75	6.25-12.5	480x275x450	91, 97
IY7HFK225050369	27	25	2x12.5	480x275x450	91, 97
IY7HFK225050368	27	25	25	480x275x450	91, 97
IY7HFK250050425	54	50	2x25	480x275x450	91, 97
IY7HFK250050368	54	50	50	480x275x450	91, 97
IY7HFK275050368	80	75	25-50	680x275x450	92, 98
IY7HFK310050368	107	100	50-50	680x275x450	92, 98

U_e: power factor correction bank working voltage
 THDI_R%: current total harmonic distortion of the plant



FH20

U _e	f	THDI _R %	f _N	p
400-415V	50 Hz	≤60%	180 Hz	7,7%



TECHNICAL CHARACTERISTICS

Rated operational voltage	U _e = 400-415V
Rated frequency	50Hz
Max current overload I _n (tray)	1.3xI _n
Max voltage overload V _n (bank)	1.1xV _n
Max current overload I _n (capacitors)	2xI _n
Max current overload V _n (capacitors)	1,3 V _n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continuous
Capacitors connection	delta
Switching devices	Capacitor duty contactors
Total Tray losses	6 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 60%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- 3U_i three phase self-healing polypropylene capacitors with 450V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 180 Hz
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER U _e =415V (kvar)	POWER U _e =400V (kvar)	STEPS U _e =400V (kvar)	DIM IP20 WxHxD (mm)	OVERALL DRAWING
IY7TFK212550360	13.5	12.5	12.5	480x275x450	91, 97
IY7TFK218850360	20	18.75	6.25-12.5	480x275x450	91, 97
IY7TFK225050362	27	25	2x12.5	480x275x450	91, 97
IY7TFK225050360	27	25	25	480x275x450	91, 97
IY7TFK250050422	54	50	2x25	480x275x450	91, 97
IY7TFK250050360	54	50	50	480x275x450	91, 97
IY7TFK275050360	80	75	25-50	680x275x450	92, 98
IY7TFK310050360	107	100	50-50	680x275x450	92, 98

U_e: power factor correction bank working voltage
 THDI_R%: current total harmonic distortion of the plant

U _e	f	THDI _R %	f _N	p
400-415V	50 Hz	100%	135 Hz	13,7%



TECHNICAL CHARACTERISTICS

Rated operational voltage	U _e = 400-415V
Rated frequency	50Hz
Max current overload I _n (tray)	1.3xI _n
Max voltage overload V _n (bank)	1.1xV _n
Max current overload I _n (capacitors)	2xI _n
Max current overload V _n (capacitors)	1,3 V _n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge resistors	on each capacitor
Use	indoor
Service	continuo/continuous
Capacitors connection	delta
Switching devices	Capacitor duty contactors
Total Tray losses	6 W/kvar
Capacitor Dielectric losses	0,2 W/kvar
Inner surface finish	zinc passivation
Tray Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitor Applicable standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 100%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- 3U_i three phase self-healing polypropylene capacitors with 450V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 180 Hz
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	POWER U _e =415V (kvar)	POWER U _e =400V (kvar)	STEPS U _e =400V (kvar)	DIM IP20 WxHxD (mm)	OVERALL DRAWING
IY7NFK212550426	13.5	12.5	12.5	480x275x450	91, 97
IY7NFK218850426	20	18.75	6.25-12.5	480x275x450	91, 97
IY7NFK225050427	27	25	2x12.5	480x275x450	91, 97
IY7NFK225050426	27	25	25	480x275x450	91, 97
IY7NFK250050428	54	50	2x25	480x275x450	91, 97
IY7NFK250050426	54	50	50	480x275x450	91, 97
IY7NFK275050426	80	75	25-50	680x275x450	92, 98

U_e: power factor correction bank working voltage
 THDI_R%: current total harmonic distortion of the plant



HP10

(400V - 60Hz)

U _e	U _N	U _{MAX} ¹	f	THDI _R %
400V	400V	440V	60 Hz	≤12%

**TECHNICAL CHARACTERISTICS**

Rated operational voltage	U_e = 400
Rated frequency	60Hz
Max current overload I _n (bank)	1.3xI_n
Max voltage overload V _n (bank)	1.1xV_n
Max voltage overload V _n (capacitors)	3xV_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continuous
Capacitors connection	delta
Operation devices	capacitor duty contactors (AC6b)
Total Joule losses	~2W/kvar
Surface finish	galvanisation
Banks applicable standards	IEC 61439-1/2 IEC 61921
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 18%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- 3U_i three phase self-healing polypropylene capacitors with 400V rated voltage.
- Discharge devices.

Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

Part Number	Power (Kvar) U _e =400V	Steps (kvar) U _e =400V	DIM IP20 WxHxD (mm)	Overall Drawing
IY0AFF225060359	25	25	480x275x335	93,95
IY0AFF250060359	50	2 x 25	480x275x335	93,95
IY0AFF275060359	75	3 x 25	480x275x335	93,95
IY0AFF310060359	100	4 x 25	480x275x335	93,95

U_e: power factor correction bank working voltage

THDI_R%: current total harmonic distortion of the plant

HP30

(440V - 60Hz)

U_e	U_N	U_{MAX}^1	f	THDI _R %
440V	480V	530V	60 Hz	≤20%



TECHNICAL CHARACTERISTICS

Rated operational voltage	$U_e = 440V$
Rated frequency	60Hz
Max current overload I_n (bank)	1.3x I_n
Max voltage overload V_n (bank)	1.1x V_n
Max voltage overload V_n (capacitors)	3x V_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continuous
Capacitors connection	delta
Operation devices	capacitor duty contactors (AC6b)
Total Joule losses	~2W/kvar
Surface finish	galvanisation
Banks applicable standards	IEC 60439-1/2 IEC 61921-1
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion without existing capacitors has values up to 25%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

Generalities:

- Contactors (230Vac coil).
- N07V-K self-extinguish cable according to IEC 20/22/2 – IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_t three phase self-healing polypropylene capacitors with 480V rated voltage.
- Discharge devices.
- Degree of protection IP20.

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) $U_N=480V$	Power (kvar) $U_e=440V$	Steps (kvar) $U_e=440V$	DIM IP20 WxHxD(mm)	OVERALL DRAWING
Contact us	36	25	25	480x275x340	93,95
Contact us	72	50	2x25	480x275x340	93,95
Contact us	108	75	3x25	480x275x340	93,95
Contact us	144	100	4x25	480x275x340	93,95

U_e : power factor correction bank working voltage
 THDI_R %: current total harmonic distortion of the plant



HP30

(480V - 60Hz)

U_e	U_N	U_{MAX}^1	f	THDI _R %
480V	480V	530V	60 Hz	≤12%

**TECHNICAL CHARACTERISTICS**

Rated operational voltage	$U_e = 480V$
Rated frequency	60Hz
Max current overload I_n (bank)	1.3x I_n
Max voltage overload V_n (bank)	1.1x V_n
Max voltage overload V_n (capacitors)	3x V_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continuous
Capacitors connection	delta
Operation devices	capacitor duty contactors (AC6b)
Total Joule losses	~2W/kvar
Surface finish	galvanisation
Banks applicable standards	IEC 60439-1/2 IEC 61921-1
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion, without capacitors installed, has values lower than 25%. Use of high energy density metallised polypropylene capacitors assures elevated performances, high resistance to strong voltage overload, low losses and small dimensions.

Generalities:

- Contactors with damping resistors to limit capacitors' inrush current (230Vac coil).
- N07V-K self-extinguish cable according to IEC 20/2212 – IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- 3U_t three phase self-healing polypropylene capacitors with 480V rated voltage.
- Discharge devices.
- Degree of protection IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) $U_N=480V$	Power (kvar) $U_e=480V$	Steps (kvar) $U_e=480V$	DIM IP20 WxHxD(mm)	OVERALL DRAWING
Contact us	30	25	25	480x275x340	93,95
Contact us	60	50	2x25	480x275x340	93,95
Contact us	90	75	3x25	480x275x340	93,95
Contact us	120	100	4x25	480x275x340	93,95

U_e : power factor correction bank working voltage

THDI_R%: current total harmonic distortion of the plant

FH20

(230V - 60Hz)

U _e	f	THD _{I_R} %	f _N	P
230V	60 Hz	≤60%	227 Hz	7%



TECHNICAL CHARACTERISTICS

Rated operational voltage	U_e= 230V
Rated frequency	60Hz
Max current overload I _n (bank)	1.3xI_n
Max voltage overload V _n (bank)	1.1xV_n
Max voltage overload V _n (capacitors)	3xV_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range (capacitors)	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continous
Capacitors connection	delta
Operation devices	contactors
Total Joule losses	~6W/kvar
Inner surface finish	zinc passivation
Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion has values up to 60%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

Generalities:

- Contactors(230Vac coil).
- N07V-K self-extinguish cable according to IEC 20/22/2 – IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_t three phase self-healing polypropylene capacitors with 270-380V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 227Hz.
- Degree of protection IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) U _e =480V	Steps (kvar) U _e =480V	DIM IP20 WxHxD(mm)	OVERALL DRAWING
IY7TGG225060360	25	25	480x275x450	92,98
IY7TGG250060360	50	2x25	680x275x450	92,98

U_e: power factor correction bank working voltage

THD_{I_R} %: current total harmonic distortion of the plant



FH20

(400V - 60Hz)

U _e	f	THDI _R %	f _N	P
400V	60 Hz	≤60%	227 Hz	7%

**TECHNICAL CHARACTERISTICS**

Rated operational voltage	U_e = 400V
Rated frequency	60Hz
Max current overload I _n (bank)	1.3xI_n
Max voltage overload V _n (bank)	1.1xV_n
Max voltage overload V _n (capacitors)	3xV_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range (capacitors)	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continous
Capacitors connection	delta
Operation devices	contactors
Total Joule losses	~6W/kvar
Inner surface finish	zinc passivation
Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion has values up to 60%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

Generalities:

- Contactors(230Vac coil).
- N07V-K self-extinguish cable according to IEC 61439-1/2 IEC 61921 IEC 61642 IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_t three phase self-healing polypropylene capacitors with 480V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 227Hz.
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) U _e =400V	Steps (kvar) U _e =400V	DIM IP20 WxHxD(mm)	OVERALL DRAWING
IY7TFF225060360	25	25	480x275x450	92,98
IY7TFF250060360	50	50	680x275x450	92,98

U_e: power factor correction bank working voltage

THDI_R %: current total harmonic distortion of the plant

FH20

(480V - 60Hz)

U _e	f	THD _{I_R} %	f _N	P
480V	60 Hz	≤60%	227 Hz	7%



TECHNICAL CHARACTERISTICS

Rated operational voltage	U_e= 480V
Rated frequency	60Hz
Max current overload I _n (bank)	1.3xI_n
Max voltage overload V _n (bank)	1.1xV_n
Max voltage overload V _n (capacitors)	3xV_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range (capacitors)	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continous
Capacitors connection	delta
Operation devices	contactors
Total Joule losses	~6W/kvar
Inner surface finish	zinc passivation
Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion has values up to 60%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

Generalities:

- Contactors(230Vac coil).
- N07V-K self-extinguish cable according to IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_t three phase self-healing polypropylene capacitors with 575V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 227Hz.
- Degree of protection: IP20

All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) U _e =480V	Steps (kvar) U _e =480V	DIM IP20 WxHxD(mm)	OVERALL DRAWING
IY7TGG225060360	25	25	480x275x335	93,95
IY7TGG250060360	50	50	480x275x335	93,95

U_e: power factor correction bank working voltage

THD_{I_R} %: current total harmonic distortion of the plant



FH30

(380V - 60Hz)

U _e	f	THDI _R %	f _N	P
380V	60 Hz	≤100%	168 Hz	13%

**TECHNICAL CHARACTERISTICS**

Rated operational voltage	U_e= 380V
Rated frequency	60Hz
Max current overload I _n (bank)	1.3xI_n
Max voltage overload V _n (bank)	1.1xV_n
Max voltage overload V _n (capacitors)	3xV_n
Insulating voltage (bank)	690V
Capacitors insulating level	3/15kV
Temperature range (capacitors)	-5/+40 °C
Discharge device	on each capacitor
Use	indoor
Service	continous
Capacitors connection	delta
Operation devices	contactors
Total Joule losses	~8W/kvar
Inner surface finish	zinc passivation
Applicable standards	IEC 61439-1/2 IEC 61921 IEC 61642
Capacitors standards	IEC 60831-1/2

Main characteristics

Power factor correction banks indicated for the plants where the current harmonic distortion has values up to 100%. Use of high energy density metallised polypropylene capacitors assures elevated performances with low losses and small dimensions.

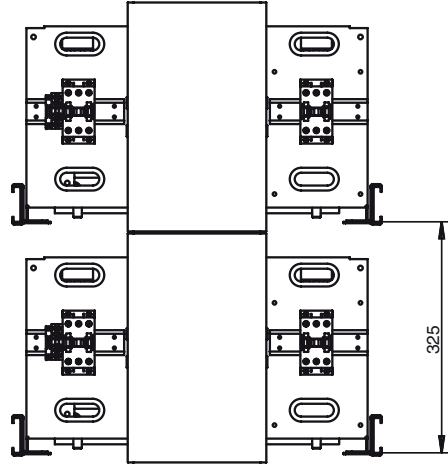
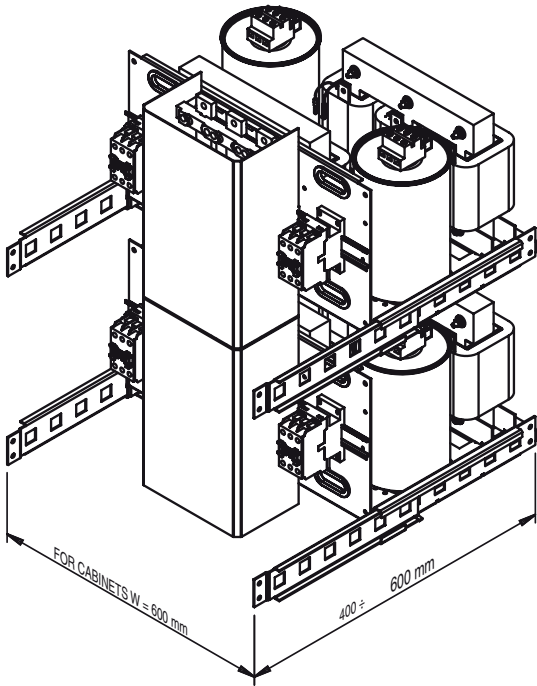
Generalities:

- Contactors(230Vaccoil).
- N07V-K self-extinguish cable according to IEC 20/22/2 – IEC 50267-2-1 standards.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- Series 3U_t three phase self-healing polypropylene capacitors with 480V rated voltage.
- Discharge devices.
- Three phase detuning choke with tuning frequency 168Hz.
- Degree of protection: IP20

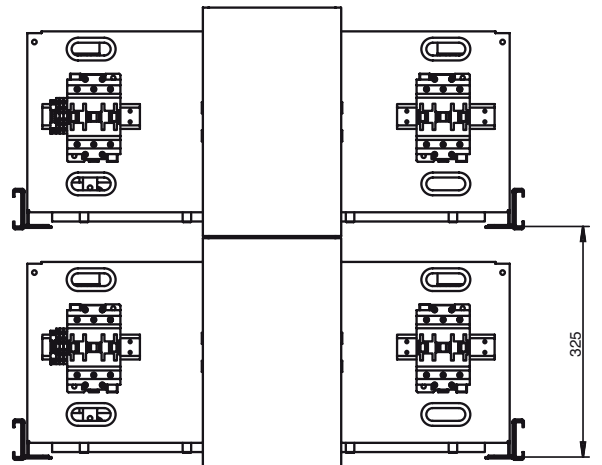
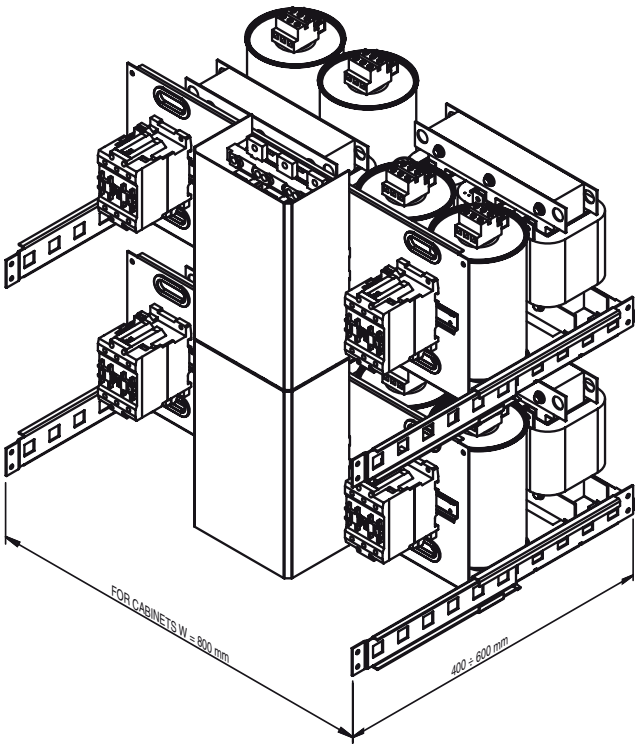
All components inside this products are compliant with EU Safety Regulations.

PART NUMBER	Power (kvar) U _e =380V	Power (kvar) U _e =380V	DIM IP20 WxHxD(mm)	OVERALL DRAWING
Contact us	12,5	12,5	480x275x430	92,98
Contact us	25	2x12,5	480x275x430	92,98
Contact us	25	25	480x275x430	92,98
Contact us	50	50	480x275x430	92,98

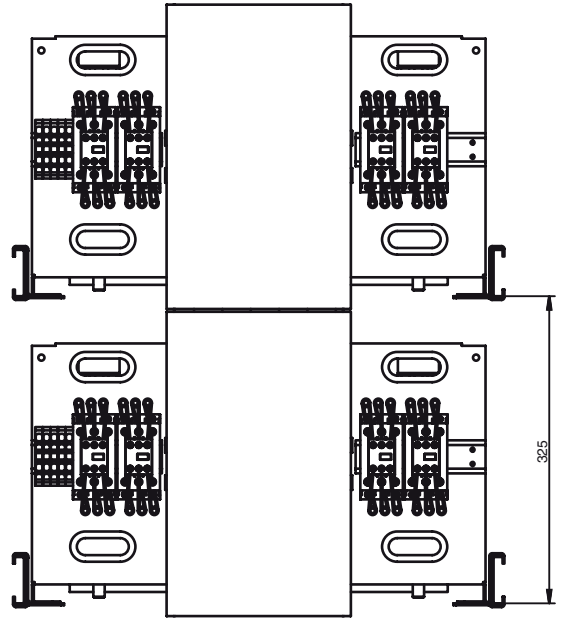
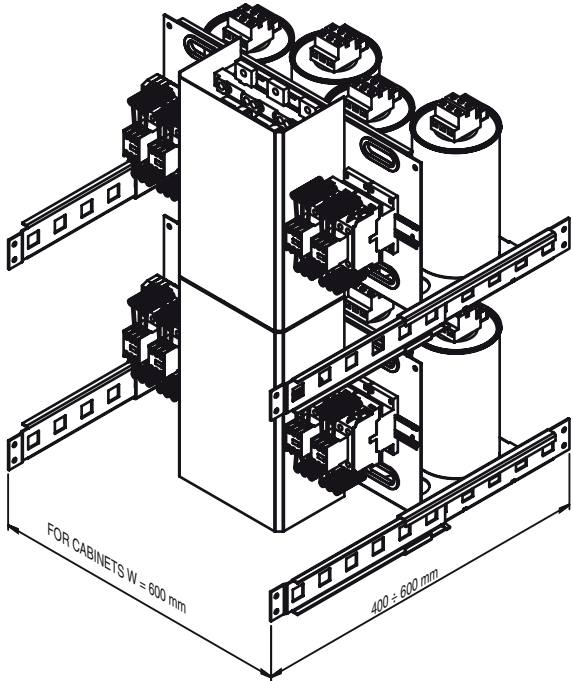
U_e: power factor correction bank working voltage
THDI_R%: current total harmonic distortion of the plant



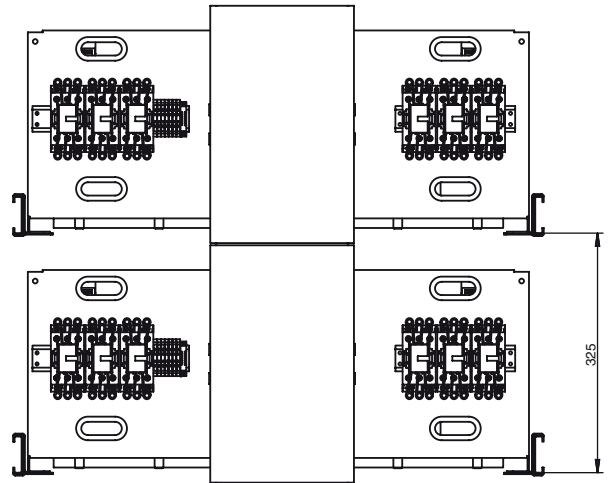
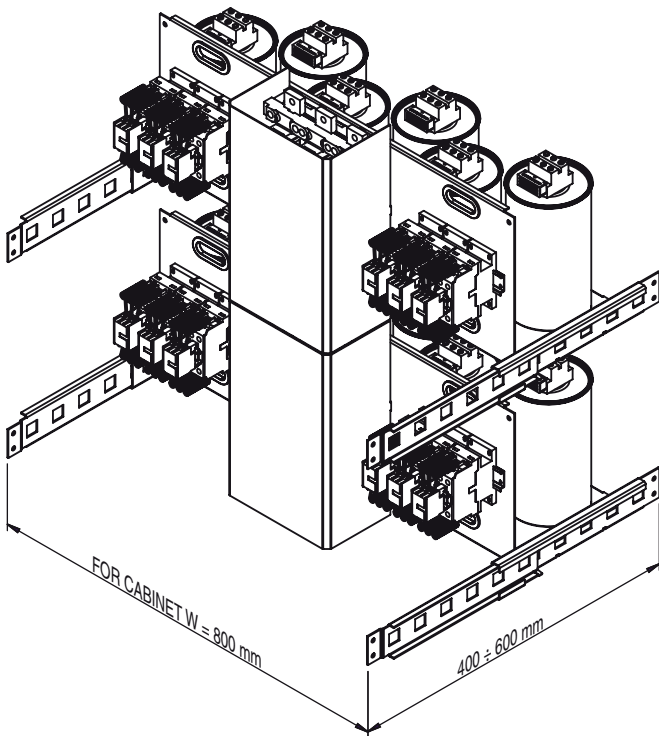
91



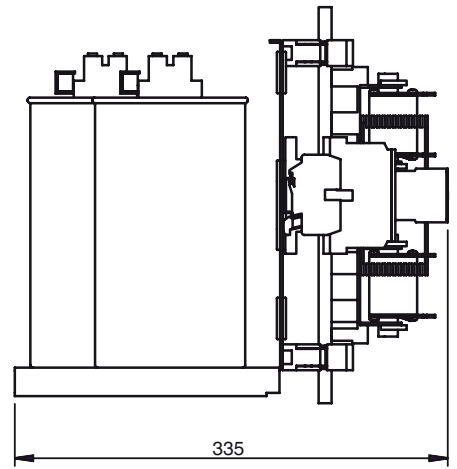
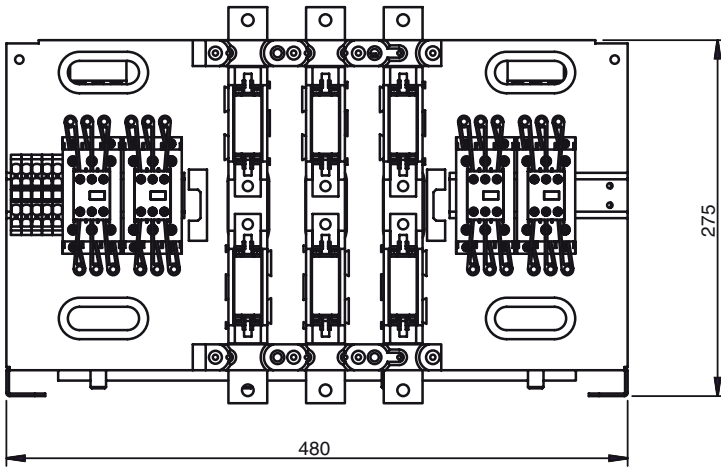
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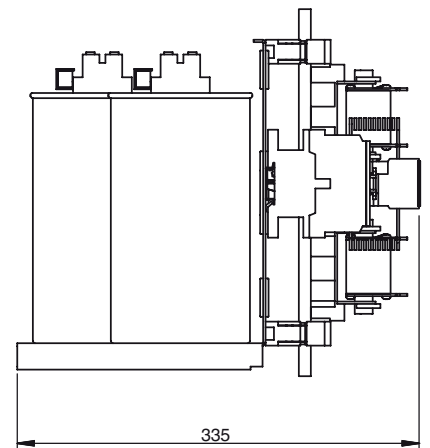
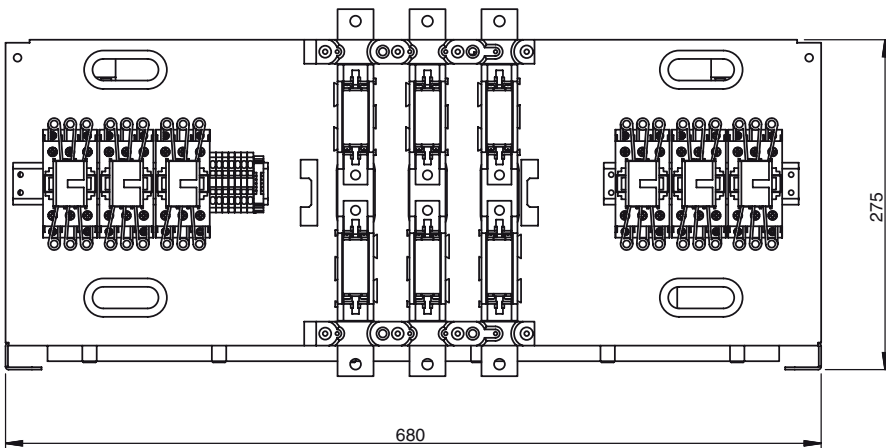
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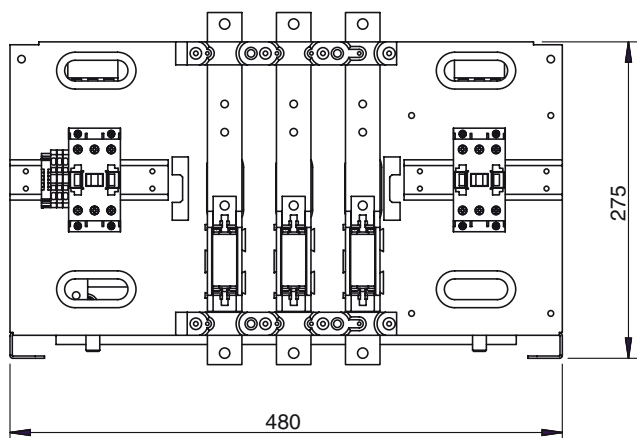
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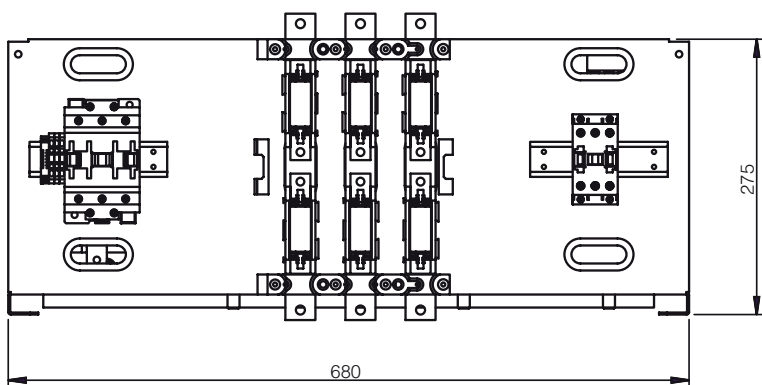
95



96



97



98

NOTE

A series of horizontal dotted lines for writing notes.



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