INSTANT SAVING OF ENERGY BILLS AND
ELECTRICAL NETWORKS EFFICIENCY IMPROVEMENT

LV POWER FACTOR CORRECTION SYSTEMS

PRODUCTION OF POWER FACTOR CORRECTION BOARDS AT THE PLANT IN CAVENAGO DI BRIANZA (ITALY)

New systems with vacuum impregnated capacitors

From the ICAR experience in the production of bimetallized paper capacitors and Power Electronic capacitors, we design a new type of capacitor that combines the best features. The new CRM25 capacitors that equip the VP10, VP20 and FV25 families are made of a special polypropylene, characterized by high thickness, and are subjected to a working cycle with autoclave passage that ensures the vacuum seal ensuring a substantial increase in life expectancy, temperature of use (up to 70 ° C) and robustness.

DRY TYPE Capacitors

ICAR Power Factor Correction capacitors in HP10, HP20, HP30, FH20 e FH30 systems are entirely produced with DRY technology, with resin filler. This way, DRY type CRM capacitors and ICAR Automatic Capacitor Banks, will meet the requirements of latest specifications that demand “dry” or “non-oil” capacitors. Resin filler improves the performance of the capacitor in terms of insulation of the active part to ground and heat dissipation generated inside the can while the capacitor is operating.

Detuned Fix Systems

The range of fix power factor correction systems has been extended with the detuned Microfix FH20, FH30 and FV25 families.

Video tutorial youtube

See the tutorials on the youtube channel of ICAR, short videos that guide you step by step in the commissioning and verification of power factor correction systems.
Look at them now, with the QR here on the side

APP for PFCS setup and maintenance

We want to make installer work much easier!
Setup and maintenance operations, often carried out in uncomfortable switch rooms due to bad environment conditions or elevated noise, are now safer and easier for any ICAR Power Factor Correction Systems. They can be indeed connected to POWER STUDIO, the new app available for android tablets and smartphones. It is no longer required to turn on a laptop and to plug cables to carry out monitoring and parameters setting.

EXTEND FOR FREE THE WARRANTY OF YOUR PFC SYSTEM FOR ADDITIONAL 12 MONTHS

Applied to all Automatic Power Factor Correction Systems (MICROmatic, MINImatic, MIDImatic, MULTImatic) of the following ranges:

- FH: Power Factor Correction Systems with high energy density polypropylene capacitors and detuned reactors.
- FD: Power Factor Correction Systems with metallized paper capacitors and detuned reactors.
- TC: Power Factor Correction Systems with metallized paper capacitors.
- VP: Power Factor Correction Systems with high gradient metallized polypropylene capacitors vacuum-impregnated.
- FV: Power Factor Correction Systems with high gradient metallized polypropylene capacitors vacuum-impregnated and detuned reactors.

Fill out the form on the web site www.warranty.icar.com within 60 days from the delivery date to have the right to extension.

Quality

Company Quality

The belief that product quality and Customer satisfaction are the core of a modern organisation, led ORTEA to the implementation of an ISO9001:2015 certified Company Managing System.
The achievement of the ISO14001:2015 and OHSAS18001:2007 accreditation was a natural integration in order to optimise the Company's performance, showing at the same time the commitment towards environmental and safety at work issues.

CERTIFIED
ISO 9001 · ISO 14001
OHSAS 18001

Products Quality

ICAR power factor correction systems are designed according to standards and subjected to tests both in our laboratories and in the most important internationally recognized laboratories, in order to ensure compliance with the main standards:

- CEI EN 60831-1/2 for capacitors
- CEI EN 61439-1/2 e CEI EN 61921 for power factor correction systems

The ICAR test laboratories are able to perform the tests necessary for the production of equipment compliant with standards and / or according to customer specifications. ICAR laboratories are able to perform a wide range of tests performed using advanced test equipment and measurement techniques.

Services

For many companies, the electricity is an important cost element, and a part of the amounts is due to the consumption of reactive energy. All companies that distribute electricity are collecting penalties in the bill of consumption, if the user consumes reactive power over the allowed limits.

So today is particularly convenient to install a power factor correction system effectively, correctly sized, which saves a lot of money: a power factor corrector is often pay for itself within a year.

But we must not forget the power factor correction installed for several years: we must monitor the proper functioning because if you do not keep them in perfect working order, they "lose power", and you are likely to pay penalties. With proper maintenance you can avoid wasting money and unnecessary power dissipation in the electric plant cables and transformers that undergoes premature aging.

It is also important a proper maintenance and use of original spare parts since capacitors, when worn or of poor quality, are likely to burst causing damage to electrical equipment, plant shutdowns due to protection tripping, or even real fire.

Our services:

- Interventions to verify existing power factor correction systems
- Interventions on electrical systems analysis and LV verification to be corrected
- Interventions on the start-up and commissioning of new LV power factor correction banks
- Analysis on the energy quality in LV installations
- Scheduled maintenance on power factor correction systems
- Revamping solutions
- Original spare parts
- Analysis of the Energy Authority Penalties.

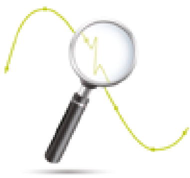
Commissioning

Make your own measurement and let us know

Check-up of existing PFC systems

Local support

Tailor made capacitor banks



Power Quality Assessment

Technical training

Revamping solutions, original spare parts

The 4 reasons to have Power Factor Corrections

Electricity Authorities

The Electricity Authorities, force companies distributing electricity to apply financial penalties to utilities that have a substantial contractual power and low energy cos phi (generally 0,9). The correct power factor of the electric plant allows you to avoid those penalties, which often are not reflected in the bill, and then are paid by the final user without even realizing it.

Economic convenience

Economical benefits due to penalties elimination and current reduction, with consequent optimized dimensioning of the components.
Power Factor Correction is widely convenient, both in the case of central and individual compensation, with Pay-Back less than or equal to 2 years.

Energy efficiency

The power factor correction reduces the"useless" current that affect lines and power components with the following benefits:

- Optimized dimensioning of the components (transformers, switching devices, cables).
- Reduction of voltage drops along the lines.
- Reduction of losses due to joule effect.
- Reduction of aging components.

Power Quality

In many industrial electric plants supplied by MT there is a tension considerably distorted, due often to excessive load of MV/LV transformer. The correct Power Factor Correction with a consequent load reduction by the transformer allow to bring it back to the operating conditions within the linearity limits, substantially reducing the voltage distorsion. Furthermore the proper Power Factor reduces the presence of harmonic currents.

Glossary

Cos phi. Simplifying, in an electrical system is appointed with phi (φ), the phase shift between the voltage and the electric current at the fundamental frequency of the system (50Hz). The cos phi is therefore a dimensionless number between 0 and 1, and varies from moment to moment. Typically, an industrial electrical system has an inductive cos phi, which value depends on the characteristics of the user plant.

Power factor. In an electrical system means, with power factor, the ratio between the active power and the apparent power. Also the power factor is a dimensionless quantity between 0 and 1, which varies from moment to moment. However, the cos phi and the power factor coincide only in systems devoid of sinusoidal harmonic currents. In a system with harmonic, the power factor is always less than the cos phi.

Monthly average power factor.
Electricity bills often show the monthly average power factor, obtained from the ratio between the active power consumed by the user and the apparent power transited the point of delivery. Typically, the average monthly power factor is calculated separately on different time slots.

Isolation level. For a capacitor that complies with IEC 61921, the isolation level is indicative of the voltage pulse that can withstand.

Insulation voltage. For a power factor correction system that complies with the IEC 60439-1/2, the isolation voltage is indicative of the maximum voltage that can withstand the entire system.

Nominal voltage of the capacitor U_N.
It is the rated voltage of the capacitor, at which its output rated power is calculated.

Maximum operating voltage U_{MAX}.
It is the maximum voltage that the capacitor can withstand, for the time indicated by the IEC 60831-1/2. The following relation applies U_{MAX}= 1,1 U_N

Rated operational voltage Ue.
It is the rated voltage of the power factor correction system, which guarantees proper use. A capacitor with a rated voltage can have on board capacitors with voltage U_N > Ue. It may never happen otherwise.

Short-circuit current Icc.
As indicated in the IEC 61439-1 Article 3.8.9.4, is the prospective short-circuit current that the cabinet can endure for a specified time. It's a value stated by the manufacturer of the cabinet on the basis of laboratory tests. The short-circuit current of the cabinet can be increased, in case of need, by installing fuses. In this case the declared data must be accompanied by the words "fuse conditioning short-circuit current".

Steps aboard an automatic power factor corrector. They are the physical units of power factor bank, each controlled by a dedicated switching device (static switch or contactor). A rack may be constituted by a single step (as typically occurs in detuned bank) or more steps. For example, the MULTIrack HP10 from 150kvar/400V consists of 6 steps: 2 from 15kvar and 4 from 30kvar. It 'is easily verified by counting the number of contactors present on the front of the drawer. More step can be merged to achieve larger power steps: in these cases they are controlled by the same controller contact.

Combinations. It is the internal configurations number which proposes a particular automatic power factor corrector, as a function of the steps (number and power) that has on board. For example, a power factor corrector of 280kvar with steps 40-80-160 offers 7 combinations: 40-80-120-160-200-240-280.
The greater the number of possible combinations, the better "accuracy" and the flexibility to use the power factor correction bank.

THD (Total Harmonic Distorsion).
For a periodic non-sinusoidal wave, the THD is the ratio between the rms of all harmonic components value and the rms value of the fundamental at 50Hz.

$THDI_C$. It is the maximum THD that a capacitor can withstand, with regard to the current passing through it. It is 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.

$THDI_R$. It is the maximum THD bearable by the capacitor relatively to the current that circulates in the plant to be corrected. It is an empirical fact, which is based on $THDI_C$ and 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 $THDI_C$ as made by different manufacturers.

THDV. It is the voltage THD bearable by a power factor correction bank with harmonic blocking reactors.

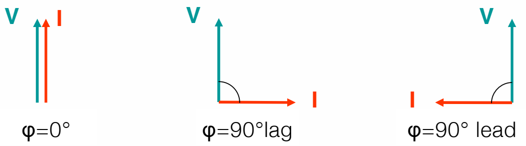
f_N: is the detuning frequency between inductance and capacitance of a detuned capacitor bank, that is a capacitor bank equipped with harmonic blocking reactors. The detuning frequency is the most objective parameter for detuned capacitor bank comparison; the lower the detuning frequency is the sounder the capacitor bank is.
In particular an 180Hz detuned capacitor bank is sounder and more reliable than another with 189Hz detuning frequancy f_N.
As of Ferranti effect, detuned capacitor bank capacitors are exposed to a voltage that is higher than the rated system voltage; for this reason these capacitors are rated for higher voltage according to the p% factor.

Summary

Technical notes

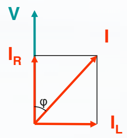
Power factor correction: why?

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



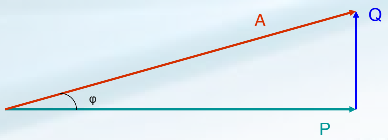
$$\text{Cos}\,\varphi = \frac{I_R}{I}$$

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:



$$FP = \frac{P}{A}$$

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

As far as there are not harmonic currents power factor coincides to cosφ of the angle between current and voltage vectors. Cosφ decreases as the reactive absorbed power increases.

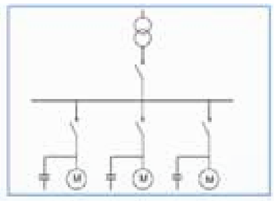
Low cosφ, has the following disadvantages:

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

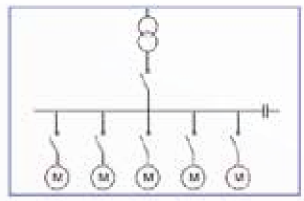
From this we understand the importance to improve (increase) the power factor.
Capacitors need to obtain this result.

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 cosφ a little in excess of 0.9 to avoid paying the penalties provided for by the law.
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 cosφ 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 substatios 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.

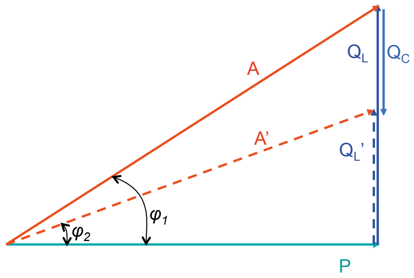
Power factor correction: How many?

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:

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



Can be also written $Q_c = k * P$

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 0,92.
From tha table 1 we find: k = 0,770

and therefore: Q_c = 0,770 * 300 = 231 kvar

where

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)

Starting power factor	Target power factor							
	0,9	0,91	0,92	0,93	0,94	0,95	0,96	0,97
0,60	0,849	**0,878**	0,907	**0,938**	0,970	**1,005**	1,042	**1,083**
0,61	0,815	**0,843**	0,873	**0,904**	0,936	**0,970**	1,007	**1,048**
0,62	0,781	**0,810**	0,839	**0,870**	0,903	**0,937**	0,974	**1,015**
0,63	0,748	**0,777**	0,807	**0,837**	0,870	**0,904**	0,941	**0,982**
0,64	0,716	**0,745**	0,775	**0,805**	0,838	**0,872**	0,909	**0,950**
0,65	0,685	**0,714**	0,743	**0,774**	0,806	**0,840**	0,877	**0,919**
0,66	0,654	**0,683**	0,712	**0,743**	0,775	**0,810**	0,847	**0,888**
0,67	0,624	**0,652**	0,682	**0,713**	0,745	**0,779**	0,816	**0,857**
0,68	0,594	**0,623**	0,652	**0,683**	0,715	**0,750**	0,787	**0,828**
0,69	0,565	**0,593**	0,623	**0,654**	0,686	**0,720**	0,757	**0,798**
0,70	0,536	**0,565**	0,594	**0,625**	0,657	**0,692**	0,729	**0,770**
0,71	0,508	**0,536**	0,566	**0,597**	0,629	**0,663**	0,700	**0,741**
0,72	0,480	**0,508**	0,538	**0,569**	0,601	**0,635**	0,672	**0,713**
0,73	0,452	**0,481**	0,510	**0,541**	0,573	**0,608**	0,645	**0,686**
0,74	0,425	**0,453**	0,483	**0,514**	0,546	**0,580**	0,617	**0,658**
0,75	0,398	**0,426**	0,456	**0,487**	0,519	**0,553**	0,590	**0,631**
0,76	0,371	**0,400**	0,429	**0,460**	0,492	**0,526**	0,563	**0,605**
0,77	0,344	**0,373**	0,403	**0,433**	0,466	**0,500**	0,537	**0,578**
0,78	0,318	**0,347**	0,376	**0,407**	0,439	**0,474**	0,511	**0,552**
0,79	0,292	**0,320**	0,350	**0,381**	0,413	**0,447**	0,484	**0,525**
0,80	0,266	**0,294**	0,324	**0,355**	0,387	**0,421**	0,458	**0,499**
0,81	0,240	**0,268**	0,298	**0,329**	0,361	**0,395**	0,432	**0,473**
0,82	0,214	**0,242**	0,272	**0,303**	0,335	**0,369**	0,406	**0,447**
0,83	0,188	**0,216**	0,246	**0,277**	0,309	**0,343**	0,380	**0,421**
0,84	0,162	**0,190**	0,220	**0,251**	0,283	**0,317**	0,354	**0,395**
0,85	0,135	**0,164**	0,194	**0,225**	0,257	**0,291**	0,328	**0,369**
0,86	0,109	**0,138**	0,167	**0,198**	0,230	**0,265**	0,302	**0,343**
0,87	0,082	**0,111**	0,141	**0,172**	0,204	**0,238**	0,275	**0,316**
0,88	0,055	**0,084**	0,114	**0,145**	0,177	**0,211**	0,248	**0,289**
0,89	0,028	**0,057**	0,086	**0,117**	0,149	**0,184**	0,221	**0,262**
0,90	-	**0,029**	0,058	**0,089**	0,121	**0,156**	0,193	**0,234**

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:

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

where

P= Active power

V= Nominal Voltage

While cosφ 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<<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 cosφ, from a copper cable 3 x 25mm² 100m long carrying 40kW at 400Vac
2. Supplied active power (kW) by a transformer
3. 100kVA, in function of cosφ

cos φ	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.

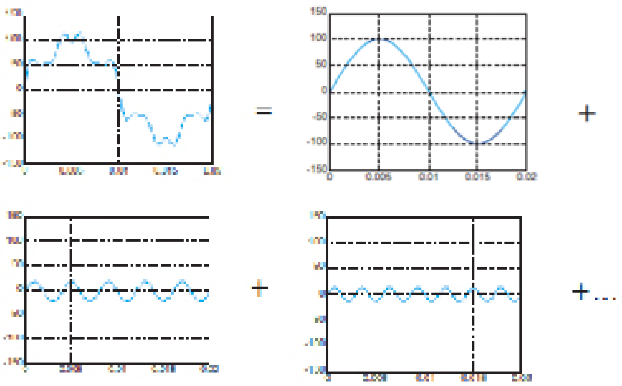
This allows us to optimise on the system sizing.

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 AC 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.

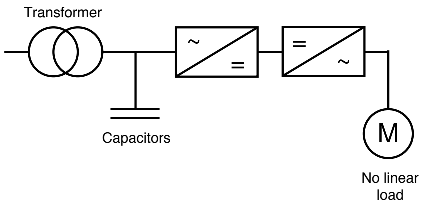
The waveform of the current (or voltage) generated by a nonlinear load (fig. 1), being periodical, could be represented by the sum of many sinusoidal waves (a 50Hz component called fundamental and other components with multiple frequency of the fundamental component so called HARMONICS).

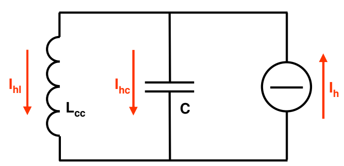


$$I = I_1 + I_2 + I_3 + I_4 + ...I_n$$

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 = 630kVA (rated power transformer)

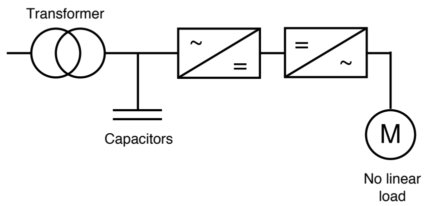
$V_{cc}\%$ = 6 (short-circuit voltage %)

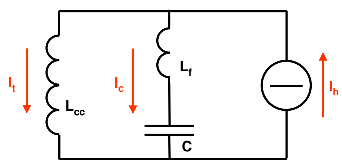
Q = 300kvar (output of power factor correction bank)

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

The result shows that in these conditions the system transformer-capacitor bank has the parallel resonance frequency of 300Hz (6x50Hz).
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

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

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 Ih 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:

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

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

I_3 , I_5… = 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 bimetallized 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.

Power factor correction in presence of distorted voltage

In many industrial electrical systems or in the tertiary sector, the presence of non-linear loads (inverter, welding, filament free lamps, computers, drives, etc..) causes a distortion of the current, which is synthesized by the THDI% numeric parameter: if the current is sinusoidal his THDI% is zero, more the current is deformed so much higher is its THDI%.
In electrical currents with very deformed currents, the power factor correction equipment are carried out in a "filter banks" (or "block" or "blocked" or "detuned" if you prefer), or rather with inductors that prevent harmonic current to reach and damage the capacitor.
Usually the supply voltage remains sinusoidal even if a very deformed current flows in the plant; however, if the MV/ LV transformer impedance is high, the voltage may also be affected by deformation: this impedance, crossed by a distorted current, will create a voltage drop equally distorted, causing on LV users a non-sinusoidal supply voltage (or with a certain THDV%). It is rare that the THDV% reaches 8% (limit of IEC EN 50160), this happens for example when the MV/LV transformer is characterized by a high series impedance and/or is overloaded (saturation).
In a plant with distorted voltage there will be problems of various types, depending on the utilities (breakage or malfunction of electronic parts such as relays, plc, controller, computers; production beyond the acceptable tolerances, etc.). Regarding the power factor correction, a high THDV% creates problems for the blocking reactors used in power factor correction banks. These can saturate and overheat for overload up to be damaged, causing the out of service of the power factor correction bank and/or problems to the capacitors. This will result in an economic loss (payment of penalties for low cos phi) and technical, because the plant will run through by a higher current, resulting in conductors additional overhead (cables, bars) and the transformer. For this problem, ICAR has developed a dedicated solution: the MULTImatic FD25V (for 400V network) and FD70V (for 690V network) power factor correction ranges. They are made with sound heavy dutybimetallized paper capacitors with high performance electronic instrumentation for the electrical parameters control; high linearity reactance allow them to bear up to 8% THDV continuously.

Power factor correction in the presence of a photovoltaic system in spot trading

If on electrical plant of an industrial user is added a photovoltaic system, the active power drawn from the supply is reduced because of the power supplied by the photovoltaic system and consumed by the plant (consumption). Therefore, it changes the relationship between reactive power and active energy drawn from the network and, consequently, the power factor is lower than the same system without photovoltaic. We must therefore pay particular attention to the power factor correction not to have any penalties for low cos phi that could seriously erode the economic benefits of the photovoltaic system.
The power factor correction will be reviewed both for installed capacity, both for construction type. In fact, increasing the power factor corrector power, you will modify the resonance conditions with the MV/ LV transformer which supply the system. When the photovoltaic system has more power than the users one, or if it is possible that power is introduced to the network, the power factor corrector must also be able to run on the four quadrants. The two "standard" quadrants are related to the plant operation as a user that absorbs from the network both active and inductive reactive power, while the two quadrants related on the plant functioning as a generator, it provides the network active power, but it absorbs the inductive reactive power (quadrants of generation.

All ICAR range of cos phi electronic controllers are able to operate in four quadrants, running two different cos phi targets to optimize the system economic performance. To manage the cogeneration quadrants you can alter some parameters settings. It is advisable to enter a value equal to 1, to optimize the yield of the PFC Bank. Refer to the manuals of the controllers for more details. To get the maximum benefit in the time allowed by the PFC Bank, we recommend to use bimetallized paper capacitors, the only ones that guarantee a useful life comparable to the photovoltaic system one.

Power factor correction: quality and safety

Basic requirement

We define safety the absence of dangers for people and things while the good is in use or stored in a warehouse. This means to identify stresses, risks and potential damages and the relevant elimination and to keep them under control so that to reduce the risk to a reasonable level.
Power capacitors and capacitor banks shall not be used:

- For uses other than Power Factor Correction and for AC or DC plants
- As tuned or detuned filters unless specifically approved in written by ICAR.

General requirement

The capacitors are constructed in accordance with IEC - CEI EN methods, parameters and tests. The low voltage capacitors are assembled with the required protection devices and assembled into banks to give a QUALITY product which will operate SAFELY. They are not considered as the indication that the capacitors and the power factor correction equipments are suitable for a use in the same conditions of the tests. The user has to verify that the capacitor and power factor correction equipment are of the correct voltage and frequency suitable for values of the network on which they are installed. The user has to verify that the installation of the capacitors and/or the power factor correction equipment is in accordance with the catalogue and the instructions of use. Capacitors and power factor correction equipment MUST NOT be exposed to damaging action of chemical substance or to attacks of flora and/or fauna. Capacitors and power factor correction equipments must be protected against risks of mechanical damaging to which could be exposed during normal working conditions or during the installation. Capacitors and power factor correction equipments that were mechanically or electrically damaged for any reason during the transport, the storage or the installation must not be used and these that breakdown during use must be immediately removed.

Additional instructions about power factor correction equipments

Definition

Power factor correction equipment means:

- One or more groups of capacitors that can be connected and disconnected on the network automatically or manually using suitable operating devices (contactors, circuit breakers, load-break switch, ...)
- Operating devices
- Control, protection and measure systems
- Connections.

The equipment could be open or closed inside a metal enclosure.

General requirement

Follow ICAR instructions in the documentation attached to equipments considering the safe distance, the connection standard criteria, working standards and the instructions for the controls and the maintenance.

Compatibility

It must be paid attention to the electromagnetic interferences with the near by equipments.

Contactors

It is advisable to adopt capacitor duty contactors (category AC6-b) because they are equipped with pre charge resistors that substantially reduce the inrush currents while capacitors are switched on. The early switching on of these resistors in respect to the closing or the contactor contacts, allows:

- To avoid main contacts melting.
- To avoid capacitor damage.

Recommendations for installation

Fixing and connection

To fix the power factor correction equipments it is advised to use these types of screws:

- Riphaso series with M10 screw
- MICROmatic and MICROfix series wall-mounted with FISHER 8
- MINImatic wall-mounted and floor-mounted with M8 screw
- MULTImatic and MULTImatic HLP floor-mounted with M12 screw.

The installation of the power factor correction equipment is for indoor application; for different use call ICAR technical department.

Protection devices

Operating devices (load-break switch) or operation and protection (circuit-breakers if the cables are longer than 3m) must be dimensioned to withstand capacitive currents (about 1.3 times nominal current), the inrush currents, the number of operations and they must be re-strike free.
The capacitors are made of polypropylene that is a flammable material. Even if a fire doesn't begin from capacitors or inside the panel, they could however spread it creating dangerous gasses. If a danger exists from the presence of an explosive or flammable atmosphere, the IEC standard; "Electric equipment with explosion and fire danger", shall be strictly followed.

Danger for people

When we install power factor correction equipment we must pay attention that the parts which could be exposed to voltage are correctly protected from accidental contacts in accordance with IEC standards. Before the commissioning verify the tightening of the terminal and of all the bolts is correct.

Protections

Fuses

All the capacitors have an overpressure device which when operated, as in the case of breakdown, disconnects the element from use. This device is not a substitution for the fuses or external circuit-breakers that are specified in our power factor correction equipment.

Limit conditions

The influence of each factor below has not to be considered individually, but in combination and with the influence of other factors.

Voltage

Capacitor and capacitor bank nominal voltage is intended as the design and testing voltage.
The safe and proper use of power factor correction capacitors and capacitor banks, implies that the working voltage is not higher than the nominal voltage.
In special conditions, excluding the installation phases, higher over voltage are allowed as per below table (ref. IEC 60831).

Overvoltage factor (x U_N eff)	Max duration	Observation
1	Continuous	Highest average value during any period of capacitor energization. For energization period less than 24h, exceptions apply as indicated below
1,10	8h every 24h	System voltage regulation and fluctuation
1,15	30 min every 24h	System voltage regulation and fluctuation
1,20	5 min	Voltage rise at light load
1,30	1 min	

Note: for voltage without harmonics

The life expectancy of capacitors and power factor correction equipment is greatly reduced when operating in overload conditions. The choice of the nominal voltage is determined by the following considerations:

- On some networks working voltage could be very different from nominal voltage
- Power factor correction equipment in parallel could cause an increase of the voltage at the connection point
- The voltage increases with the presence of harmonics on the network and/or cosφ of in advance
- The voltage at the capacitor terminals increases when capacitors are in series with reactors for harmonic blocking
- If the power factor correction equipment is connected to a motor and not sized correctly, when we disconnect it from the network we may have a phenomena caused by the inertia that makes the motor to work as a self-excited generator consequently increasing of the voltage level at the terminals of the equipment
- The remaining voltage caused by the self-excited after that the equip- ment has been disconnected from the network is dangerous for the generators
- If the power factor correction equipment is connected to a motor with a star-delta starting device we have to pay attention to not cause the overvoltage when this device is working
- All the power factor correction equipments exposed to overvoltage caused by atmospheric lightning must be protected in correct way. If surge arrestors are use they have to be placed as near as possible to the equipment.

If surge arresters are used they should be placed as close as possible to the equipment.

Working temperature

Working temperature of power factor correction equipment is a fundamental parameter for safe operation. As a onsequence it is very important that heat generated is dissipated correctly and that the ventilation is such that the heat losses in the capacitors do not exceed the ambient temperature limits. The highest workings temperature in normal service conditions between two capacitors is measured at a point 2/3 of the capacitors height and at a distance of 0.1m from them. The capacitor temperature must not exceed the temperature limits hereinafter tabled.

	Ambient temperatures (°C)		
		Highest mean over any period of:	
Symbol	Maximum	24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Mechanical Limits

The user has not to expose the equipment to exaggerated mechanical limits of operation. The user has to pay attention to the electrical and geometrical dimensioning of the connections to avoid exceeding the mechanical limits which may be reached by temperature variation.

Other considerations for the working safety

Discharge device

Every capacitor must have a discharge device that can discharge it within 3 minutes. The discharge time is calculated from the starting peak of voltage equal to rad(2)V_N until 75V. Between the capacitor and the discharge system there shall not be a circuit-breaker, fuses or other sectioning devices.

This doesn't relief to short-circuit the capacitor terminals and earth every time it is required to handle the capacitor.

Residual voltage

When the capacitor is placed under tension its residual voltage must not exceed 10% of the rated voltage. This condition is generally satisfied when the power factor correction equipment is calibrated properly, the reactive power controller, reconnection time shall be appropriate to the discharge time.

Case connection

To keep capacitors case at fix voltage and to discharge fault current toward the case itself, they are grounded by connecting to earth the capacitors supporting frame.

Altitude

Power factor correction equipment must not be used above an altitude of 2000m. On the contrary please contact technical assistance of ICAR.

Particular ambient conditions

Power factor correction equipment are not suitable for the applications in places where there are conditions as follows:

- fast generation of mould
- caustic and saline atmosphere
- presence of explosive materials or very flammable
- vibrations.

For environments with these characteristics: high relative humidity, high concentration of dust and atmospheric pollution, please contact technical assistance of ICAR by ORTEA NEXT.

Maintenance

After the disconnection of the bank, prior to accessing the terminals of the capacitors wait 5 minutes and then short-circuit the terminals and earth.

Make these procedures:

Once a month:

- Cleanliness by blast of air of the internal part of the power factor correction equipment and of the air filter anytime there is a cooling system
- Visual control
- Control of the ambient temperature.

Once every 6 months:

- Control of the surfaces condition: painting or other treatments
- Control of the correct tightening of the screw (this operation must be done before the commissioning).

Once a year:

- Checking the contactors status
- Checking the capacitors and chokes (if present) status.

IIf there are concerns about any environmental conditions an appropriate maintenance program must be established (for example in a dusty environment could be necessary to clean using blasts of air more frequently).

Storage and handling

The power factor correction equipment handling must be made carefully avoiding the mechanical stresses and shocks. The equipment in highest cabinet may be hard to handle, because the center of gravity may be very high and decentralized.

Upon receipt of new equipment, make sure that the packaging is not damaged, although mild. Always make sure that the equipment has not been damaged by transportation: take away the packaging and make a visual inspection with open door. If you discover some damage, write it on the delivery note (carrier copy) the reason for refusal or reserve.

The capacitors and power factor correction awaiting installation storage must be done leaving them in their original packaging, in a covered and dry place.

Capacitors used in power factor correction solutions

In our power factor correction systems we only use capacitors made entirely from ICAR: in this way, we can offer to our customers the highest guarantee of the equipment reliability. The capacitors used are divided into three different types, which lead to electrical and thermal performance completely different:

High gradient metallized polypropylene capacitors

They are made by wrapping a metallized polypropylene film with metal layer thickness modulated and filled with resin. The metallization thickness modulation allows to greatly improve the capacitors in terms of:

- increase in power density (kvar/dm³) with a consequent power size reduction of the power factor correction systems
- Robustness improvement against voltage surges, for greater reliability even in systems with the presence of voltage fluctuations due to the network or maneuvers on the system
- improved behavior of the internal short circuit withstand.

According to the characteristics, the metallized polypropylene capacitors are used in HP10, HP20, HP30, FH20 and FH30 families.

High gradient metallized polypropylene capacitors vacuum impregnated

They are made by wrapping a polypropylene film of increased thickness.
The production process of these capacitors involves a passage in the autoclave in order to eliminate humididy and air and hermetically filled with non-toxic insulating oil.
This process, up to now specific of the bimetallized paper capacitors, allows to increase the life expectancy and the robustness.
The vaccum impregnated capacitors are used in VP10, VP20 and FV25 families.

Bimetallized paper capacitors

The bimetallized and impregnated paper capacitors are now the most robust solution for industrial power factor correction.
They are made by wrapping a thin sheet of special paper on the surfaces of which is deposited by evaporation process, a infinitesimal layer of metal alloy with function of electrode; between the sheets of paper is placed a polypropylene film with only the dielectric role between electrode.
The bimetallized paper capacitors robustness is due to the already excellent mechanical paper characteristics, to which are added the impregnation in oil benefits.
This technology, among the most tested for the capacitors production, was also adopted to realize capacitors used in power electronics, since solicited with high frequencies and designed to work with high temperatures.
The ICAR bimetallized paper capacitors are particularly suitable for applications in plants with high harmonic content currents and/or high operating temperatures; they are used for the detuned filters realization for "troubled" installations because, thanks to the steady capacitance throughout the useful life, these capacitors are able to keep in time the tuning of the filter frequency, even in high operating temperatures presence.
In function of the characteristics, the bimetallized paper capacitors are used in TC10,TC20, FD25, FD35 families.

Our paper bimetallized capacitors are, today, the most imitated... but just look at the construction characteristics detail of what is proposed as "3In" or "4In" to realize that they are simple polypropylene capacitors, maybe just a little '"strengthened".
The main different types of capacitors features are shown in the table below.

	High gradient metallized polypropylene capacitors		High gradient metallized polypropylene capacitors vacuum impregnated		Bimetallized paper capacitors	
Temperature category (CEI EN 60831-1)	-25/D		-25/+70 °C		-25/+70 °C	
Max overload	1,3xIn	continuos	1,3xIn	continuos	3xIn	continuos
	2xIn	380s every 60min	2xIn	500s every 60min	4xIn	1600s every 60min
	3xIn	150s every 60min	3xIn	180s every 60min	5xIn	800s every 60min
	4xIn	70s every 60min	4xIn	90s every 60min		
	5xIn	45s every 60min	5xIn	50s every 60min		
Life expectancy at temperature category -25°/D		**100.000h**		**150.000h**		**200.000h**
Life expectancy at climatic category		100.000h		100.000h		130.000h

APFC banks components and solutions

In the majority of industrial plants the power factor correction system is centralized, with high capacity capacitor banks usually equipped with harmonic blocking reactors to protect capacitors from harmonics in the current.

When choosing a capacitor bank, it is necessary to pay attention not only to the quality of the capacitors inside the cabinet, but also to the quality of the other components and to the different solutions adopted by the manufacturer, in order to choose a device which will be efficient, long-lasting and easy to maintain.

Ventilation:
it is preferable to choose capacitor banks with forced ventilation, which reduces the thermal stress on the capacitors. This leads to a longer life of the capacitor bank, therefore to a better economic result.

Regulator:
the intelligent element, which controls the capacitor bank, so it is very important.
It is better to choose regulators with microprocessor, equipped with several measuring and alarm functions: you will appreciate it a lot during the capacitor bank's life.

Internal structure:
it is preferable to choose a capacitor bank with removable racks: it's the best way to reduce time and problems during maintenance.

Contactors:
In order to guarantee excellent long life and reliability, must be of good manafacture. For standard PFC systems, contactors have to be with damping resistors to limit capacitors inrush current (AC6b), for detuned PFC systems are enough standard contactors (the function of the peak smoothing It is performed by the blocking reactance).

Steps:
the criteria of the division of supplied power is fundamental to have a higher precision in compensation. It is always preferable to choose capacitor banks with a high number of steps.

Harmonic blocking reactors:
distorted currents, reactors (if they are of good quality, with a high linearity) protect capacitors from the harmonics in the current.
In detuned capacitor banks, the lower the resonance frequency (a capacitor bank with f_D=180Hz is better than one with f_D=189Hz) the better the blocking capability.
Moreover, because of Ferranti effect, voltage applied on the capacitors grows: therefore, it is better that capacitors have a higher voltage, when technologies are equal (in the case of polypropylene capacitors it is better to choose 550V).

Load break switch:
it is the operation element, the one which has to bear the current of the capacitor bank also in case of overload. According to CEI EN 60831-1 regulation it has to be dimensioned with a nominal current which is at least 1,5 times the nominal current of the capacitor bank.

Filters for the ventilation system:
they protect the capacitor bank from the entrance of dust and foreign bodies, which could worsen its thermal situation.

FIX
POWER FACTOR CORRECTION SYSTEMS

CRTE

CRTE The simplest and most efficient fixed power factor correction is three-phase capacitor. Available from 1kvar to 50kvar at 400V or higher voltages (up to 800V). See dedicated catalog.

SUPERriphaso

Fixed Power factor correction for three-phase systems, modular plastic housing with IP40 protection degree. The modularity of the family SUPERRiphaso allows to obtain the necessary power composing more modules with a simple and quick electrical and mechanical connection. For powers from 5 to 50kvar at 400V. The SUPERriphaso can only be installed in a vertical position, as shown in picture.

MICROfix

Power factor correction for fixed three phase systems, in metal enclosure with IP3X protection degree. MICROfix is equipped with a integrated door lock isolating switch, signal lamps and fuses. For power up to 110kvar at 400V.

MINIfix - MULTIfix

Fixed power factor correction systems for higher powers are made with equipment derived from the MINImatic and MULTImatic series, depending on the power demand. The reactive power on board is still managed in step, is that at the time of insertion or the disconnection, to reduce the stress system.

AUTOMATIC
POWER FACTOR CORRECTION SYSTEMS

MICROmatic

It is the smaller size of automatic power factor correction bank, suitable for small users power factor correction. It is made with modular concept (MICROrack) to simplify the management of spare parts and maintenance. For reactive power up to 64kvar at 400V in very small dimensions. Allows you to have up to 19 steps for optimal power factor correction in the presence of highly variable loads or characterized by long periods of "no load" operation.

MINImatic

For small/medium powers automatic power factor correction, can deliver up to 225kvar 400V, depending on the version. Is made with completely removable rack (MINIRack) to simplify management and maintenance. Very flexible Framework, allows the realization of many variations as shown in the available options table. MINImatic is also available in a version with harmonic blocking reactors and cable entry from bottom.

MIDImatic

Automatic power factor correction medium power, can deliver up to 450kvar at 400V depending on the version.
It is made with easily removable rack, and wiring of the auxiliary plug-in power distribution is with robust copper bars. Choice of cable entry (top/bottom).

MULTImatic

MULTImatic Power factor correction automatic for large users, allows systems of up to several Mvar, with master-slave logic. MULTImatic is made rack (MULTIrack) for easy replacement and maintenance. It is available in SPEED series (for fast loads), detuned or tuned, in the degrees of protection IP 4X standard, IP55, with cable entry from top or bottom. The distribution of power is with robust copper bars. Frameworks of standard equipments made from multiple columns side by side are equipped with a disconnector and a cable entry in each column. Available framework on multiple columns with one single cable entry.

Automatic Capacitor Banks
Standard features

These are the common features to all automatic banks: PFC regulator with temperature control, IP3X** degree of protection, RAL 7035 cabinet paint color, working voltage Ue of 400V*.

	MICROmatic	MINImatic	MIDImatic	MULTImatic
Cable incoming	top/bottom	top	bottom	bottom**
Ventilation	forced	forced	forced	forced
PFC controller	RPC 5LGA	RPC 5LGA	RPC 8LGA	RPC 8BGA

* For Ue working voltage other than 400V please consult us.
** MULTImatic ha grado di protezione standard IP4X. MULTImatic has, in standard, a disconnector and a cable entry for each column. For versions of multiple columns with single cable entry consult us. MULTImatic has standard IP4X protection degree.

Automatic PFC banks option

	MICROmatic	MINImatic	MIDImatic	MULTImatic
Cable incoming top/bottom	yes	yes (4)	yes (4)	yes (4)
IP55 Degree (cable incoming)	no	yes (bottom)	no	yes
Remote communication (1)	yes	yes	yes	yes
Control and protection module MCP5 (2)	no	yes (5)	yes (FH20)	yes (2)
Other paint color (upon request)	yes	yes	yes	yes
Automatic circuit breaker	no	yes (5)	yes	yes

	MICROmatic	MINImatic	MIDImatic	MULTImatic
Fuse melting signaling	no	yes	no	yes
Other Short Circuit fault withstand level	no	yes	yes	yes
Thyristor Switched bank (3)	no	no	no	yes
Controller Remote Software	yes	yes	yes	yes
Modem for Remote Control	no	no	no	yes
Fused main Switch	no	yes	yes	yes

Notes
(1): The regulator can be equipped with additional modules to communicate: RS 485 ModBus or Profinet, Ethernet, modem GSM/GPRS network.
(2): For better protection of power factor correction system against max THD, Max Temp, MULTImatic of FH20, FH30, FD25, FD25V, FD35, FV25 "detuned" families are equipped in standard with integrated MCP5 in the RPC 8BGA controller.
(3): The static switches replace the normal electromechanical contactors and allow the cos φ aadjustment even in the presence of loads with sudden changes in absorption (welding machines, mixers, ovens, etc.)
(4): To be specified in the order.
(5): Contact us.

Thyristor Switched Capacitor Banks (speed)

The MULTImatic ranges can be made with thyristor switches (SPEED version). Compared to traditional power factor correction systems, enables obtaining interesting performances thank to the reaction speed of thyristors, (SCR) that control capacitors banks/steps.

By this solution the following performances are available:

- Switching speed: all the reactive power of the bank can be switched in about 60 ms. This is particularly suitable for plants characterized by fast changing loads (mixers, robots, welders) that could create problems to traditional electromechanic contactors used in standard power factor correction banks.
- Capacitor switching with minimization of the transient current peak. Particularly suitable for plants which power factor correction banks has to perform a great numbers of manoeuvres and in presence of devices sensitive to transient over voltage/currents.
- Silence: with no mechanical components on the move, the real time capacitor banks are really suitable for applications where the installation of the power factor correction switchboard occurs near places which require minimum noises (banks, data elaboration centres, theatres, cinemas, libraries, schools, etc).

- Reduced maintenance: the lack of mechanical parts reduces the stress on the switchboard which therefore needs a little periodical maintenance compare to systems with traditional electromechanical contactors. This characteristic is really useful in rooms with conducting powder that could through the conductors into crises.

Power Factor Correction Tuned Filters

MINImatic and MULTImatic can be used for perform harmonic filtering. They are banks with reactance connected in series to the capacitors. The LC circuit made in this way, has a network resonant frequency that is different from the network frequency (50Hz) and depending on the electric values of the components used (resistance, capacity, inductance) are obtained "detuned" filters or "absorption" filters. These are preferable olutions for those plants characterized by the presence of harmonics due to distorting loads (lighting, power electronics, induction ovens, welders etc), for the reasons described below.

Blocking (detuned) filters
The detuned filters are designed to power factor correction of a system characterized by the presence of harmonics, "protecting" the capacitors that would be damaged. The addition of the filter does not change the system harmonic content: the harmonics will continue to flow without "enter" into power factor corrector. The blocking filters have a tuning frequency lower than that of the harmonic current that circulates in the system with lower order. Typically, the tuning frequency (f_N) is 180-190Hz, and the blocking filter is much more robust the lower the f_N. In systems with particularly high harmonic content, we realize blocking filters tuned to 135-140Hz and therefore particularly sound.

The tuning frequency of a barrier filter can also be expressed with other indicators:
- order of harmonicity N
- barrier factor p (also called "relative impedance" in the CEI EN 61642 art 2.5), which is usually expressed as a percentage

Here are the relationships that link these quantities, indicating with f the network frequency, X_C the capacitive impedance of the capacitors and X_L the inductive impedance:

$$f_D = \frac{X_L}{X_C} \qquad N = \frac{f_D}{f} \qquad f_D = \frac{f}{\sqrt{p}}$$

Due to the Ferranti effect, in the detuned systems the voltage which insists on the capacitors (U_C) is higher than that of the network U according to the following relation

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

For this reason the capacitors in detuned systems have to be selected with a suitably high nominal voltage.

Absorption passive filters
Absorption filters are meant for plant power factor correction capacitors and, at the same time, totally or partially solve the problem of plant harmonics. The filter is tuned near the harmonic frequency to be eliminated, (for example 250Hz to eliminate the 5th harmonic) and, consequently, that current will almost completely flow in the filter, leaving the electric circuit "clean".
Usually the absorption filter is realized after a careful analysis of the circuit and a measurement campaign of the harmonics in order to come up with a solution really "ad hoc".

Power factor correction for high voltages systems (≥ 550V)

The power factor correction systems for applications in nominal voltages of 600/660/690V (eg. voltages used for 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.

Capacitors star connection
A widely used mode embodiment, but risky, provides a capacitors star connection: in this way capacitors are subjected to a voltage equal to the nominal plant divided by $\sqrt{3}$.
- Advantages: you can then use capacitors smaller and cheaper, getting more compact and lightweight frameworks.
- Disadvantages: in case the capacity of the capacitors degradations, a phenomenon that is intended, however, to take place, the voltage across the capacitors of the star will no longer be balanced but will increase on the side with greater capacity degrades up 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.

Using capacitors at full rated voltage, delta-connected
This solution calls for the use of capacitors with a voltage rating at least equal to that of the network.
- Advantages: equipment electrically robust. Even in case of loss of capacity of a capacitor, the other does not suffer any consequences: you reset the malfunctions risks and capacitors damage.
- Disadvantages: cabinet bulkier and heavier, with higher costs.

The ICAR way
ICAR APFC banks for working voltages higher than 550V are made with delta connected capacitors, and so they have a nominal voltage higher than the system network working voltage; this is the most sound and reliable solution. To improve power factor of 690V plants, ICAR uses 900V polypropylene or metallized paper capacitors.

Selection criteria depending on the type of plant

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 (kvar) of the PFC bank and LV/MV transformer apparent power A_T (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 automatic power factor corrector series. The fixed power factor correction must have the same electrical characteristics of the automatic.

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 3 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.

PFC systems selection guidelines

$THDI_R\% > 27$	HP10	VP10	TC10	FH20	FV25	FD25	FH20	FV25	FD25	FH20	FV25	FD25	FH20	FV25	FD25	FH20	FV25	FD25
$20 < THDI_R\% \le 27$	HP10	VP10	TC10	FH20	FV25	FD25	FH20	FV25	FD25	HP20	VP20	TC20	HP30	VP20	TC20	FH20	FV25	FD25
$12 < THDI_R\% \le 20$	HP10	VP10	TC10	FH20	FV25	FD25	FH20	FV25	FD25	HP20	VP20	TC20	HP20	VP20	TC20	FH20	FV25	FD25
$THDI_R\% \le 12$	HP10	VP10	TC10	HP20	VP20	FD25	HP30	VP20	TC20	HP10	VP10	TC10	HP20	VP20	TC20	FH20	FV25	FD25
	$Q_C / A_T \le 0{,}05$			**$0{,}05 < Q_C / A_T \le 0{,}1$**			**$0{,}1 < Q_C / A_T \le 0{,}15$**			**$0{,}15 < Q_C / A_T \le 0{,}2$**			**$0{,}2 < Q_C / A_T \le 0{,}25$**			**$Q_C / A_T > 0{,}25$**		

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 Q_C/A_T is equal to 0.22. The recommended power factor correction is therefore that in the box identified from the abscissa $0.2 < Q_C / A_T \le 0.25$ and the ordinate $20 < THDI_R \% \le 27\%$. You can choose an HP30 family device, or go to the VP20 family or, for even greater reliability of the solution, choose the TC20 family.

Standard power factor correction

The standard power factor correction is used in those plants where there are no current heavily deformed (verify the THD% data of the system current, which must be less than $THDI_R$% of the selected power factor correction family) or resonance problems (see the table selection criteria).

If the harmonics presence in the plant is not negligible, are preferred solutions with reinforced capacitors (i.e. with an higher nominal voltage than that of the network). In case of use in systems with heavy duty cycle, or in the case of installation in cabinets with high temperature, solutions with bimetallized papercapacitors are preferred.

				FIX		AUTOMATIC			
	Capacitor construction tecnology	**Range and nominal values**		**SUPER-riphaso**	**MICROfix**	**MICROmatic**	**MINImatic**	**MIDImatic**	**MULTImatic**
	High gradient Polypropylene	**HP10**	$THDI_R$ = 12% $THDI_C$ = 50% U_N = 415V*		✓	✓	✓	✓	✓
	High gradient Polypropylene	**HP20**	$THDI_R$ = 20% $THDI_C$ = 70% U_N = 460V		✓	✓	✓	✓	✓
	High gradient Polypropylene	**HP30**	$THDI_R$ = 27% THDIC = 85% U_N = 550V	✓	✓	✓	✓		✓
	High gradient Polypropylene vacuum impregnated	**VP10**	$THDI_R$ = 27% $THDI_C$ = 85% U_N = 400V	✓	✓	✓	✓		✓
	High gradient Polypropylene vacuum impregnated	**VP20**	$THDI_R$ = 27% $THDI_C$ = 90% U_N = 460V	✓	✓		✓		✓
	Bimetallized Paper	**TC10**	$THDI_R$ = 27% $THDI_C$ = 85% U_N = 400V				✓		✓
	Bimetallized Paper	**TC20**	$THDI_R$ = 27% $THDI_C$ = 90% U_N = 460V						✓

This table is meant for standard 400V working voltage capacitor bank. For higher voltage plants, please consult us.

Power factor correction with blocking reactors

The power factor correction with blocking reactors (this solution is called in different ways in the technical literature such as "blocking filters", or "detuned filters", or "detuned power factor correctors", etc.) is a solution used when a current flows in the electric system with a high harmonic content (THD) and / or with the resonance risk with the MV/LV transformer. In these cases, the installation of a "normal" power factor corrector, devoid of blocking reactors, can cause the rapid degradation of the capacitors and cause dangerous electrical and mechanical stresses in the components of power plant (cables, busbars, switches, transformers).
Chokes protect the capacitors by harmonics and at the same time exclude the resonances risk; leave without sacrificing the harmonic content of the current system*.

* If you want to reduce the system harmonic content, you must install active or passive filters. Consult us.

This type of power factor correction is therefore to be preferred for systems with important non-linear loads (lighting not luminescent, power electronics, VSD, soft starters, induction furnaces, welding machines...).
ICAR offers two types of solutions with power factor correction with blocking reactors: one with 180Hz blocking frequency (detuned to 3.6 times the line frequency) and another one with 135Hz (2.7). It's correct noting that the lower the tuning frequency is the more robust is the cabinet, because the reactor should have a larger iron core. ICAR power factor correction with blocking reactor, solutions are made with capacitors and inductors produced in the group; also are used only capacitors with rated voltage higher than that of the network, to ensure strength and durability counteracting the Ferranti effect (permanent overvoltage on the capacitor due to the blocking inductance).

FIX AUTOMATIC

Capacitor construction technology	Range and Nominal values		SUPER riphaso	MICRO fix	MICRO matic	MINI matic 10÷80kvar	MIDI matic	MULTI matic da 100kvar
High gradient Polypropylene	**FH20**	$THDI_R$%<60% THDV%<6% U_N=550V f_D=180Hz (n=3,6)		✓		✓		✓
High gradient Polypropylene	**FH30**	$THDI_R$%>60% THDV%<6% U_N=550V f_D=135Hz (n=2,7)		✓		✓		✓
High gradient Polypropylene vacuum impregnated	**FV25**	$THDI_R$%<60% THDV%<6% U_N=460V f_D=180Hz (n=3,6)		✓				✓
Bimetallized Paper	**FD25**	$THDI_R$%<60% THDV%<6% U_N=460V f_D=180Hz (n=3,6)						✓
Bimetallized Paper	**FD35**	$THDI_R$%>60% THDV%<6% U_N=550V f_D=135Hz (n=2,7)						✓

This table is meant for standard 400V working voltage capacitor bank. For higher voltage plants, please consult us. For plant having high voltage distortion (THDV%>6%) it is available the special range FD25V. Please ask our sales department for details.

Selection of the CT, its position and how to connect it to the APFC bank

The electronic regulator installed on the capacitor bank calculates the power factor of the plant that has to be corrected by measuring a phase to phase voltage and the related 90° lagging current. The wiring which is necessary to obtain the signal is realized inside the APFC bank, therefore for a correct operation it is necessary to properly choose, position and wire the CT, which is not included in the capacitor bank.

The CT has to be chosen according to the characteristics of the load that has to be compensated and to the distance between its point of installation and the regulator:

- the primary of the CT has to be chosen according to the current absorbed by the loads that have to be compensated; it does not depend on the power of the APFC bank. The primary has to be approximately the same (or slightly higher) of the maximum current which can be absorbed by the load. However it is better not to choose a CT with an excessive primary: if this happens, when the load will absorb a limited current the CT will supply to the secondary a current which will be too weak to be calculated by the regulator. For example, if the load that has to be compensated has a maximum absorption of 90A, it is advisable to choose a CT with a 100A primary
- the secondary of the CT must be 5A. If you want to use a CT with 1A secondary you will have to parameterize the regulator
- the performance of the CT (apparent power) must be chosen taking into consideration the dissipation of the cable which connects the CT to the APFC bank. The table below shows how many VA are dissipated for each linear meter of a cable with different sections: to correctly calculate the wiring dissipation you need to consider the total route of the cable (way there and way back)

Cable section (mm^2)	VA for each meter of cable at 20°C[1]
2,5[2]	0,41
4	0,254
6	0,169
10	0,0975
16	0,062

1. For each 10°C of temperature variation, the VA absorbed by the cables increase by 4%, the above values are extracted from the typical resistance of flexible A class cables.
2. Minimum section for the connection of cables between current transformer and regulator.

- the precision of the CT is very important to avoid problems of bad functioning of the APFC bank. Choose class 1 CT or, even better, class 0,5.

The wiring has to be carried out with an appropriate section, to not excessively weaken the signal coming from the secondary of the CT: choose a 2,5mm² cable section only if the wiring between the CT and regulator is 1 m max.
Use cable section at least 4mm² for wirings up to 10m, 6mm² up to 20m and 10 mm² for more than 20m wirings.
Connect to earth one of the two clamps of the CT.
It is strongly recommended to use a dedicated CT for the APFC bank, to avoid to put in series more than one device (ammeter, multimeter) on the same CT.

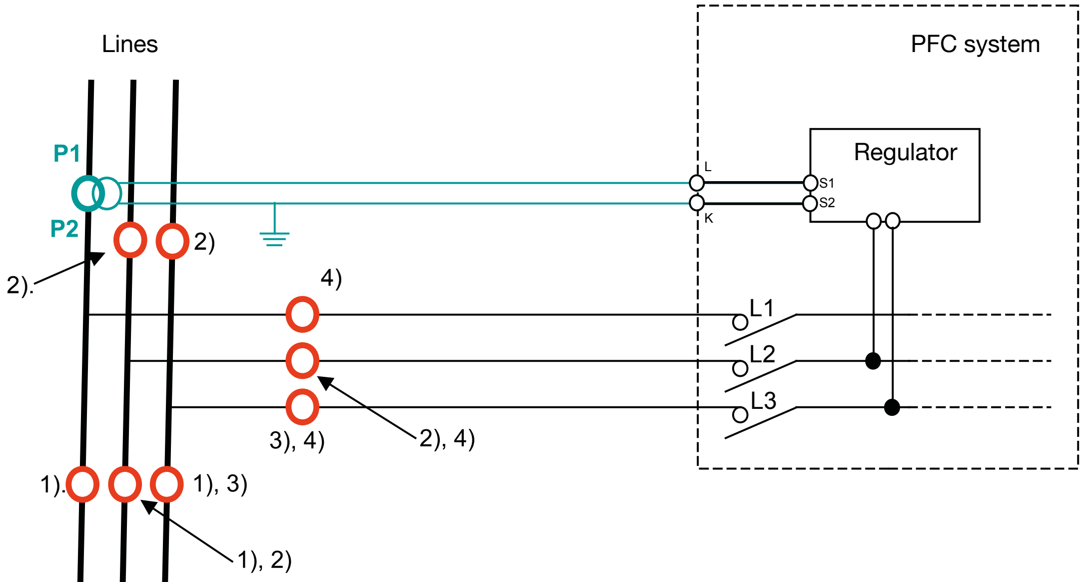
Position of the CT

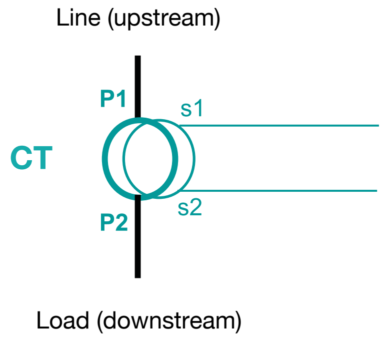
As before mentioned, the electronic regulator installed on the APFC bank accurately calculates the cos phi of the plant if it can measure a phase to phase voltage and the related 90° lagging current. Since the wiring is already internally carried out on the APFC bank on L2 and L3 phases downstream the load break switch (clamps 9 and 10, see the scheme), the CT must be positioned on phase L1 of the power cable upstream the APFC bank (below image, in green). The side of the CT with P1 (or K) mark has to be oriented to the line (upstream). The wiring of the secondary of the CT (clamps S1 and S2) to the APFC bank (clamps L and K) is made by the customer, according to the instructions in the previous points*.

Please note that possible positions here below indicated in red are wrong because:

1. the CT is downstream the APFC bank
2. the CT is on the wrong phase (L2)
3. the CT is on the wrong phase (L3)
4. the CT is installed on the cable that goes to the APFC bank.

For further information read the regulator's manual.





Selection of APFC bank protection device rated current

The low Voltage APFC bank equipped with self-healing capacitors are compliant with IEC EN 60831-1/2 (capacitors) and IEC EN 61439-1/2, IEC EN 61921-1 (complete devices) regulations.
According the above-mentioned regulations, the capacitor bank must be able to work in continuous supporting:
a) An RMS value of 1,3 times the nominal current (this regulation takes into consideration that, when harmonics are present in the system, capacitors are overloaded)
b) A voltage 10% higher than the nominal value of the network, to cope with fluctuations of networks (see regulation IEC EN 50160).
Known this, and considering that APFC banks can have a tolerance on the nominal reactive power up to 5% more than nominal one (while for the single capacitors the tolerance on capacity is up to 10% more than nominal one), it is possible to indicate the calculation necessary for the choice and setup of the protection device to be installed upstream the APFC bank (Circuit Breaker or Fused Load Break Switch).

Calculation of the current

Maximum absorbed current

$$In_{max} = 1{,}3x1{,}1x1{,}05 \frac{Qn}{\sqrt{3 \times Vn}} = 1{,}5In$$

Where In is the nominal current of the device calculated with the data present on the label, that is to say Vn (nominal voltage of the network) and Qn (nominal reactive power of the APFC bank at the nominal voltage of the network).
It is therefore necessary to choose and install a protection device (Circuit Breaker or Fused Load Break Switch) with current ≥ or equal to In_{max}, value according to which it has to be dimensioned the cable (or bars) which supply the APFC bank.

Legend

On board capacitors technology:

- High gradient polypropylene
- High gradient polypropylene vacuum impregnated
- bimetallized paper

Equipment type

Capacitor type

Common technical specifications

Available solutions

Short description

Part numbers and detailed technical features, divided by family device size and cutting in kvar

Other available versions with the same type of capacitor. Refer to the general catalog, or contact your Regional Sales Office

AUTOMATIC POWER FACTOR CORRECTION SYSTEMS

HP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	415V	455V	50 Hz	≤12%	≤50%

MICRO matic · MINI matic · MIDI matic · MULTI matic

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage

All parts inside these products are compliant with Safety Regulations.

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

	Part number	Power (kvar)		Banks U_e=400V	Steps	Discon-nector[5] (A)	Icc[3] (kA)	PFC controller	Weight (kg)	Dimensions (see chapter 7)		
		U_e=415V	U_e=400V							IP3X	IP4X	IP55[4]
MICROmatic	IC0AKF214050652	14	12,6	1.8-3.6-7.2	7	63	50	5LGA	12	49	/	
MICROmatic	IC0AKF220050652	20	18	3.6-7.2-7.2	5	63	50	5LGA	13	49	/	
MICROmatic	IC0AKF222050652	22	19,8	1.8-3.6-2x7.2	11	80	50	5LGA	16	50	/	
MICROmatic	IC0AKF228050652	28	25,2	3.6-7.2-14.4	7	80	50	5LGA	14	49	/	
MICROmatic	IC0AKF230050652	30	27	1.8-3.6-7.2-14.4	15	80	50	5LGA	17	50	/	
MICROmatic	IC0AKF236050652	36	32,4	3.6-2x7.2-14.4	9	100	50	5LGA	18	50	/	
MICROmatic	IC0AKF238050652	38	34,2	1.8-3.6-2x7.2-14.4	19	100	50	5LGA	20	50	/	
MICROmatic	IC0AKF244050652	44	39,6	3.6-7.2-2x14.4	11	125	50	5LGA	22	50	/	
MICROmatic	IC0AKF252050652	52	46,8	3.6-2x7.2-2x14.4	13	125	50	5LGA	24	50	/	
MICROmatic	IC0AKF260050652	60	54	3.6-7.2-3x14.4	15	125	50	5LGA	26	50	/	
MICROmatic	IC0AKF272050652	72	64,8	7.2-2x14,4-28,8	9	160	50	5LGA	28	50	/	
MINImatic	IF0AKF280050652	80	75	7.5-15-22.5-30	10	250	9	5LGA	41	55	/	59
MINImatic	IF0AKF311250652	112	105	7.5-15.22.5-2x30	14	250	9	5LGA	47	56	/	59
MINImatic	IF0AKF313650652	136	125	7.5-15-22.5-30-52.5	17	400	9	5LGA	51	56	/	59
MINImatic	IF0AKF316050652	160	150	15-30-45-60	10	400	9	5LGA	54	56	/	59
MINImatic	IF0AKF319250652	192	180	15-30-60-75	12	400	9	5LGA	60	57	/	60
MINImatic	IF0AKF321650652	216	200	15-30-60-90	13	500	9	5LGA	65	57	/	60
MINImatic	IF0AKF324050652	240	225	15-30-60-120	15	500	9	5LGA	69	57	/	60
MIDI matic	IL0FKF327550884	275	255	15-2x30-3x60	17	630	25	8LGA	150	64	/	/
MIDI matic	IL0FKF332050884	320	300	2x30-4x60	10	800	30	8LGA	170	64	/	/
MIDI matic	IL0FKF340050884	400	375	2x38-4x75	10	800	30	8LGA	210	64	/	/
MIDI matic	IL0FKF348050884	480	450	2x45-4x90	10	1000	30	8LGA	250	64	/	/
MULTImatic	IN0AKF332050700	320	300	2x30-4x60	10	800	50	8BGA	190	/	72	75
MULTImatic	IN0AKF340050700	400	375	2x37.5-4x75	10	1250	50	8BGA	210	/	72	75
MULTImatic	IN0AKF348050700	480	450	2x45-4x90	10	1250	50	8BGA	230	/	72	75
MULTImatic	IN0AKF356050700	560	525	2x52.5-4x105	10	1250	50	8BGA	270	/	74	81
MULTImatic	IN0AKF364050700	640	600	2x60-4x120	10	2x800	50	8BGA	420	/	92	83
MULTImatic	IN0AKF372050700	720	675	2x67.5-4x135	10	2x1250	50	8BGA	500	/	92	83
MULTImatic	IN0AKF380050700	800	750	2x75-4x150	10	2x1250	50	8BGA	520	/	92	83
MULTImatic	IN0AKF388050700	880	825	2x82.5-4x165	10	2x1250	50	8BGA	560	/	92	83
MULTImatic	IN0AKF396050700	960	900	2x90-4x180	10	2x1250	50	8BGA	580	/	92	83
MULTImatic	IN0AKF410450700	1040	975	2x97.5-4x195	10	2x1250	50	8BGA	620	/	94	85
MULTImatic	IN0AKF411250700	1120	1050	2x105-4x210	10	2x1250	50	8BGA	660	/	94	85

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request. For MICROmatic and MIDImatic series short-circuit withstand current conditioned by the upstream protective device
4. For part numbers contact ICAR
5. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

Power factor correction solutions with high gradient metallized polypropylene capacitors

In this chapter you will find the following ranges

	HP10	Automatic Power Factor Correction Systems with high gradient metallized polypropylene film and 400V nominal voltage capacitors
	HP20	Automatic Power Factor Correction Systems with high gradient metallized polypropylene film and 460V nominal voltage capacitors
	FH20	Automatic and fix detuned Power Factor Correction Systems with 180Hz detuned reactors, high gradient metallized polypropylene film and 550V nominal voltage capacitors

Other versions and ranges available

	HP30	Automatic Power Factor Correction Systems with high gradient metallized polypropylene film and 550V nominal voltage capacitors
	FH20/S	Thyristor Switched Automatic detuned Power Factor Correction Systems with 180Hz detuned reactors, high gradient metallized polypropylene film and 550V nominal voltage capacitors
	FH30	Automatic and fix detuned Power Factor Correction Systems with 135Hz detuned reactors, high gradient metallized polypropylene film and 550V nominal voltage capacitors
	FH30/S	Thyristor Switched Automatic detuned Power Factor Correction Systems with 135Hz detuned reactors, high gradient metallized polypropylene film and 550V nominal voltage capacitors
	HP70	660/690V Automatic Power Factor Correction Systems with high gradient metallized polypropylene film and 900V nominal voltage capacitors
	FH70	660/690V Automatic detuned Power Factor Correction Systems with 180Hz detuned reactors, high gradient metallized polypropylene film and 900V nominal voltage capacitors

NB: see page 6 for standard and optional features.

CRM25

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-460-550V
Rated frequency	50Hz
Max current overload In	1,3 In (continuous) 2 In (x380s every 60 minutes) 3 In (x150s every 60 minutes) 4 In (x70s every 60 minutes) 5 In (x45s every 60 minutes)
Max voltage overload Vn	3xUn (x 1 minute)
Insulating voltage	3/15kV - Ue≤660Vac
Temperature class	-25/D
Lifetime temperature class	-25/D: 100.000h
Capacitance tolerance	-5÷+10%
Terminal voltage test	2.15xU_N 2 sec.
Service	continuous
Construction type	high energy metallized polypropylene
Standards	IEC 60831-1/2

GENERALITIES:

- High energy density polypropylene film capacitors
- Metallic case with protection degree IP00
- Internal overpressure protection system
- Resin impregnation

All parts inside these products are compliant with Safety Regulations.

Range	Part number	Model	Rated Voltage U_N (V)	MAX Voltage U_{MAX} (V)	Power (kvar)	Capaci-tance (µF)	DIM (mm)	Weight (kg)	Pcs/Box
HP10	CRMK690063400B0	**CRM-25-11A-0.69-415**	415	**455**	0,69	**12,2**	55x78	**0,25**	36
	CRMK138163400B0	**CRM-25-11A-1.38-415**	415	**455**	1,38	**25,4**	55x78	**0,25**	36
	CRMK275163400A0	**CRM25-11A-2.75-415**	415	**455**	2,75	**50,8**	60x138	**0,5**	36
	CRMK550163400A0	**CRM25-11A-5.50-415**	415	**455**	5,5	**101,7**	60x138	**0,5**	36
HP20	CRMM690063400B0	**CRM-25-11A-0.69-460**	460	**500**	0,69	**10,3**	55x78	**0,25**	36
	CRMM138163400B0	**CRM-25-11A-1.38-460**	460	**500**	1,38	**20,6**	55x78	**0,25**	36
	CRMM275163400A0	**CRM25-11A-2.75-460**	460	**500**	2,75	**41,3**	60x138	**0,5**	36
	CRMM550163400A0	**CRM25-11A-5.50-460**	460	**500**	5,5	**82,7**	60x138	**0,5**	36
HP30 FH20	CRMR138163400B0	**CRM25-11A-1.38-550**	550	**600**	1,38	**14,5**	55x78	**0,25**	36
	CRMR275163400A0	**CRM25-11A-2.75-550**	550	**600**	2,75	**28,9**	60x138	**0,5**	36
	CRMR550163400A0	**CRM25-11A-5.50-550**	550	**600**	5,5	**57,9**	60x138	**0,5**	36

HP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	415V	455V	50 Hz	≤12%	≤50%

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUn
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- IP3X protection degree
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Discharge resistance
- Signal lamp power on.

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=415V	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
MICROfix	IB3DKK155050987	**5,5**	5	40	**8**	44
	IB3DKK211050987	**11**	10	40	**9**	44
	IB3DKK216550987	**16,5**	15	40	**12**	44
	IB3DKK222050987	**22**	20	80	**13**	44
	IB3DKK233050987	**33**	30	80	**15**	44
	IB3DKK243050987	**43**	40	125	**18**	44
	IB3DKK254050987	**54**	50	125	**20**	44
	IB3DKK266050987	**66**	60	160	**22**	44
	IB3DKK287050987	**87**	80	250	**38**	46
	IB3DKK312050987	**120**	110	250	**41**	46

1. IEC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

HP20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	460V	500V	50 Hz	≤20%	≤70%

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUn
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Discharge resistance
- Signal lamp power on.

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar)			LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
		U_e=460V (kvar)	U_e=415V (kvar)	U_e=400V (kvar)			
MICROfix	IB3NLK170050987	7	6	5	40	8	44
	IB3NLK214050987	14	11	10	40	9	44
	IB3NLK219050987	19	16	15	40	12	44
	IB3NLK227050987	27	22	20	80	13	44
	IB3NLK241050987	41	33	30	80	15	44
	IB3NLK254050987	54	44	40	125	18	44
	IB3NLK266050987	66	54	50	125	20	44
	IB3NLK278050987	78	64	60	160	33	46
	IB3NLK310750987	107	87	80	250	38	46
	IB3NLK313250987	132	108	100	250	41	46

1. EC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

HP30

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	THDIc%[2]
400-415V	550V	600V	50 Hz	≤27%	85%

SUPERriphaso

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In	1,3xIn
Max voltage overload Vn	1.1xUe
Insulation level	3/15kV - Ue≤660Vac
Insulating voltage	690Vac
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses (MICROfix)	~ 2W/kvar
Total losses (SUPERriphaso)	~ 0,4W/kvar
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

SUPERriphaso	Part number	Power (kvar) U_N=550V	Power (kvar) U_e=415V	Modules (N°)	Weight (kg)	Dimens. (see chapt. 7)
	IA3DRK182550001	8.25	5	1	1.7	21
	IA3DRK216550001	16.5	10	1	2.1	21

1. EC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

SUPERriphaso: generalities:

- Self-extinguishing plastic enclosure painted with epossidic dust paint, colour RAL7030
- Protection degree IP40
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=550V rated voltage
- Discharge resistance
- SUPERriphaso HP30 modules can be combined, with the mechanical and electrical connection elements supplied, to make monoblocks of up to 5 units (50kvar to 415V). See dimensions 25.

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=550V rated voltage
- Discharge resistance
- Signal lamp power on.

All parts inside these products are compliant with Safety Regulations.

MICROfix	Part number	Power (kvar) U_N=550V	Power (kvar) U_e=415V	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
	IB2DRK210050987	10	5,5	5	40	8	44
	IB2DRK219050987	19	11	10	40	9	44
	IB2DRK227050987	27	15,7	15	40	12	44
	IB2DRK237050987	37	21,1	20	80	13	44
	IB2DRK256050987	56	32,1	30	80	15	44
	IB2DRK278050987	78	45	40	125	28	46
	IB2DRK293050987	93	53	50	125	32	46
	IB2DRK311550987	115	66	60	160	35	46

1. EC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

FH20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400-415V	550V	600V	50 Hz	≤60%	180 Hz	≤6%

100% NON LINEAR LOADS

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In	1,3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7.7%).
- Discharge resistance
- Signal lamp power on.

All parts inside these products are compliant with Safety Regulations.

MICROfix	Part number	Power (kvar) U_e=415V	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
	IB4FFK212550988	13.5	12.5	40	30	45
	IB4FFK225050988	27	25	80	36	45
	IB4FFK250050988	54	50	125	41	45
	IB4FFK275050988	81	75	250	54	45

1. EC /CEI 60831-1 max allowed value

FH30

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400-415V	550V	600V	50 Hz	>60%	135 Hz	≤6%

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In	1,3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses	~ 8W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=550V rated voltage
- Three phase detuning choke with tuning frequency 135Hz (N=2.7 or p=13.7%).
- Discharge resistance
- Signal lamp power on.

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=415V	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
MICROfix	IB7JFK210050989	11	10	40	31	45
	IB7JFK220050989	22	20	80	39	45
	IB7JFK240050989	43	40	125	44	45

1. EC /CEI 60831-1 max allowed value

HP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	415V	455V	50 Hz	≤12%	≤50%

MICRO matic · MINI matic · MIDI matic · MULTI matic

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage

All parts inside these products are compliant with Safety Regulations.

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

	Part number	Power (kvar)		Banks U_e=400V	Steps	Disconnector[5] (A)	Icc[3] (kA)	PFC controller	Weight (kg)	Dimensions (see chapter 7)		
		U_e=415V	U_e=400V							IP3X	IP4X	IP55[4]
MICROmatic	IC0AKF214050652	14	12,6	1.8-3.6-7.2	7	63	50	5LGA	12	49	/	
	IC0AKF220050652	20	18	3.6-7.2-7.2	5	63	50	5LGA	13	49	/	
	IC0AKF222050652	22	19,8	1.8-3.6-2x7.2	11	80	50	5LGA	16	50	/	
	IC0AKF228050652	28	25,2	3.6-7.2-14.4	7	80	50	5LGA	14	49	/	
	IC0AKF230050652	30	27	1.8-3.6-7.2-14.4	15	80	50	5LGA	17	50	/	
	IC0AKF236050652	36	32,4	3.6-2x7.2-14.4	9	100	50	5LGA	18	50	/	
	IC0AKF238050652	38	34,2	1.8-3.6-2x7.2-14.4	19	100	50	5LGA	20	50	/	
	IC0AKF244050652	44	39,6	3.6-7.2-2x14.4	11	125	50	5LGA	22	50	/	
	IC0AKF252050652	52	46,8	3.6-2x7.2-2x14.4	13	125	50	5LGA	24	50	/	
	IC0AKF260050652	60	54	3.6-7.2-3x14.4	15	125	50	5LGA	26	50	/	
	IC0AKF272050652	72	64,8	7.2-2x14,4-28,8	9	160	50	5LGA	28	50	/	
MINImatic	IF0AKF280050652	80	75	7.5-15-22.5-30	10	250	9	5LGA	41	55	/	59
	IF0AKF311250652	112	105	7.5-15.22.5-2x30	14	250	9	5LGA	47	56	/	59
	IF0AKF313650652	136	125	7.5-15-22.5-30-52.5	17	400	9	5LGA	51	56	/	59
	IF0AKF316050652	160	150	15-30-45-60	10	400	9	5LGA	54	56	/	59
	IF0AKF319250652	192	180	15-30-60-75	12	400	9	5LGA	60	57	/	60
	IF0AKF321650652	216	200	15-30-60-90	13	500	9	5LGA	65	57	/	60
	IF0AKF324050652	240	225	15-30-60-120	15	500	9	5LGA	69	57	/	60
MIDI matic	IL0FKF327550884	275	255	15-2x30-3x60	17	630	25	8LGA	150	64	/	/
	IL0FKF332050884	320	300	2x30-4x60	10	800	30	8LGA	170	64	/	/
	IL0FKF340050884	400	375	2x38-4x75	10	800	30	8LGA	210	64	/	/
	IL0FKF348050884	480	450	2x45-4x90	10	1000	30	8LGA	250	64	/	/
MULTImatic	IN0AKF332050700	320	300	2x30-4x60	10	800	50	8BGA	190	/	72	75
	IN0AKF340050700	400	375	2x37.5-4x75	10	1250	50	8BGA	210	/	72	75
	IN0AKF348050700	480	450	2x45-4x90	10	1250	50	8BGA	230	/	72	75
	IN0AKF356050700	560	525	2x52.5-4x105	10	1250	50	8BGA	270	/	74	81
	IN0AKF364050700	640	600	2x60-4x120	10	2x800	50	8BGA	420	/	92	83
	IN0AKF372050700	720	675	2x67.5-4x135	10	2x1250	50	8BGA	500	/	92	83
	IN0AKF380050700	800	750	2x75-4x150	10	2x1250	50	8BGA	520	/	92	83
	IN0AKF388050700	880	825	2x82.5-4x165	10	2x1250	50	8BGA	560	/	92	83
	IN0AKF396050700	960	900	2x90-4x180	10	2x1250	50	8BGA	580	/	92	83
	IN0AKF410450700	1040	975	2x97.5-4x195	10	2x1250	50	8BGA	620	/	94	85
	IN0AKF411250700	1120	1050	2x105-4x210	10	2x1250	50	8BGA	660	/	94	85

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request. For MICROmatic and MIDImatic series short-circuit withstand current conditioned by the upstream protective device
4. For part numbers contact ICAR
5. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

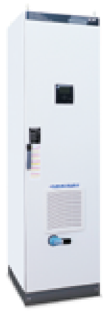
HP20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	460V	500V	50 Hz	≤20%	≤70%

MICRO matic

MINI matic

MIDI matic



MULTI matic

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage

All parts inside these products are compliant with Safety Regulations.

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

	Part number	Power (kvar)			Banks U_e=400V	Steps	Discon-nector[5] (A)	Icc[3] (kA)	PFC controller	Weight (kg)	Dimensions (see chapter 7)		
		U_N=460V	U_e=415V	U_e=400V							IP3X	IP4X	IP55[4]
MICROmatic	IC0JLF214050652	14	11	10,5	1,5-3-6	7	63	50	5LGA	12	49	/	
MICROmatic	IC0JLF220050652	20	16	15	3-2x6	5	63	50	5LGA	13	49	/	
MICROmatic	IC0JLF222050652	22	18	16,5	1.5-3-2x6	11	80	50	5LGA	16	50	/	
MICROmatic	IC0JLF228050652	28	22	21	3-6-12	7	63	50	5LGA	14	49	/	
MICROmatic	IC0JLF230050652	30	24	22,5	1,5-3-6-12	15	80	50	5LGA	17	50	/	
MICROmatic	IC0JLF236050652	36	29	27	3-2x6-12	9	80	50	5LGA	18	50	/	
MICROmatic	IC0JLF238050652	38	31	28,5	1.5-3-2x6-12	19	100	50	5LGA	20	50	/	
MICROmatic	IC0JLF244050652	44	36	33	3-6-2x12	11	100	50	5LGA	22	50	/	
MICROmatic	IC0JLF252050652	52	42	39	3-2x6-2x12	13	100	50	5LGA	24	50	/	
MICROmatic	IC0JLF260050652	60	49	45	3-6-3x12	15	125	50	5LGA	26	50	/	
MICROmatic	IC0JLF272050652	72	58	54	6-4x12	9	250	50	5LGA	29	50	/	
MINImatic	IF0JLF280050652	80	65	60	6-12-18-24	10	250	9	5LGA	41	55	/	59
MINImatic	IF0JLF311250652	112	91	84	6-12-18-2x24	14	250	9	5LGA	47	56	/	59
MINImatic	IF0JLF313650652	136	110	102	6-12-18-24-42	17	250	9	5LGA	51	56	/	59
MINImatic	IF0JLF316050652	160	130	120	12-24-36-48	10	400	9	5LGA	54	56	/	59
MINImatic	IF0JLF319250652	192	155	144	12-24-48-60	12	400	9	5LGA	60	57	/	60
MINImatic	IF0JLF321650652	216	168	156	12-24-48-72	13	400	9	5LGA	65	57	/	60
MINImatic	IF0JLF324050652	240	194	180	12-24-48-96	15	400	9	5LGA	69	57	/	60
MINImatic	IF0JLF327250652	272	220	204	24-2x48-84	8	500	9	5LGA	74	58	/	61
MIDI matic	IL0ULF332050884	320	259	240	2x24-4x48	10	630	25	8LGA	230	64	/	/
MIDI matic	IL0ULF340050884	400	324	300	2x30-4x60	10	800	30	8LGA	255	64	/	/
MIDI matic	IL0ULF348050884	480	389	360	2x36-4x72	10	800	30	8LGA	275	64	/	/
MULTImatic	IN0NLF332050700	320	259	240	2x24-4x48	10	630	25	8BGA	252	/	72	75
MULTImatic	IN0NLF340050700	400	324	300	2x30-4x60	10	800	50	8BGA	274	/	72	75
MULTImatic	IN0NLF348050700	480	389	360	2x36-4x72	10	800	50	8BGA	300	/	72	75
MULTImatic	IN0NLF356050700	560	454	420	2x42-4x84	10	1250	50	8BGA	320	/	74	81
MULTImatic	IN0NLF364050700	640	518	480	2x48-4x96	10	1250	50	8BGA	340	/	74	81
MULTImatic	IN0NLF372050700	720	583	540	2x54-4x108	10	1250	50	8BGA	526	/	70	73
MULTImatic	IN0NLF380050700	800	648	600	2x60-4x120	10	2x800	50	8BGA	552	/	92	83
MULTImatic	IN0NLF388050700	880	713	660	2x66-4x132	10	2x800	50	8BGA	574	/	92	83
MULTImatic	IN0NLF396050700	960	778	720	2x72-4x144	10	2x800	50	8BGA	600	/	92	83
MULTImatic	IN0NLF410450700	1040	842	780	2x78-4x156	10	2x1250	50	8BGA	620	/	94	85
MULTImatic	IN0NLF411250700	1120	907	840	2x84-4x168	10	2x1250	50	8BGA	640	/	94	85
MULTImatic	IN0NLF412050700	1200	972	900	2x90-4x180	10	2x1250	50	8BGA	670	/	94	85
MULTImatic	IN0NLF412850700	1280	1037	960	2x96-4x192	10	2x1250	50	8BGA	690	/	94	85
MULTImatic	IN0NLF413650700	1360	1102	1020	2x102-4x204	10	2x1250	50	8BGA	710	/	90	93
MULTImatic	IN0NLF414450700	1440	1166	1080	2x108-4x216	10	2x1250	50	8BGA	730	/	90	93

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request. For MICROmatic and MIDImatic series short-circuit withstand current conditioned by the upstream protective device
4. For part numbers contact ICAR
5. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

FH20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400-415V	550V	600V	50 Hz	≤60%	180 Hz	≤6%

100% NON LINEAR LOADS

MINI matic | MIDI matic | MULTI matic

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7,7%)
- Control and protection multimeter MCP5, integrated in 8BGA controller (MULTImatic version)

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

All parts inside these products are compliant with Safety Regulations.

	Part Number	Power (kvar)		Steps	Banks Ue=400V kvar	Disconnector[4] (A)	Icc[2] (kA)	PFC Controller	Weight (kg)	Dimensions (see chapt. 7)		
		Ue=415V	Ue=400V							IP3X	IP4X	IP55[3]
MINImatic	IF7AFF210050662	**11**	10	**4**	2x2.5-5	**125**	9	**5LGA**	41	**56**	/	**59**
MINImatic	IF7AFF220050662	**21**	20	**8**	2x2.5-5-10	**125**	9	**5LGA**	47	**56**	/	**59**
MINImatic	IF7AFF230050662	**31**	30	**6**	2x5-2x10	**125**	9	**5LGA**	57	**56**	/	**59**
MINImatic	IF7AFF240050662	**42**	40	**8**	2x5-10-20	**125**	9	**5LGA**	74	**57**	/	**60**
MINImatic	IF7AFF250050662	**52**	50	**10**	2x5-2x10-20	**125**	9	**5LGA**	78	**57**	/	**60**
MINImatic	IF7AFF260050662	**62**	60	**6**	2x10-2x20	**250**	9	**5LGA**	100	**57**	/	**60**
MINImatic	IF7AFF270050662	**73**	70	**7**	10-3x20	**250**	9	**5LGA**	112	**58**	/	**61**
MINImatic	IF7AFF280050662	**83**	80	**8**	2x10-3x20	**250**	9	**5LGA**	126	**58**	/	**61**
MIDI matic	IL4FFF311050892	**116**	110	**11**	10-20-2x40	**250**	15	**8BGA + MCP5**	220	**64**	/	/
MIDI matic	IL4FFF315050892	**158**	150	**15**	10-20-3x40	**400**	20	**8BGA + MCP5**	260	**64**	/	/
MIDI matic	IL4FFF318050892	**194**	180	**9**	20-2x40-80	**400**	20	**8BGA + MCP5**	285	**64**	/	/
MIDI matic	IL4FFF322050892	**235**	220	**11**	20-40-2x80	**630**	20	**8BGA + MCP5**	320	**64**	/	/
MULTImatic	IN7AFF310050701	**107**	100	**5**	20-2x40	**250**	17	**8BGA + MCP5**	220	**/**	72	**75**
MULTImatic	IN7AFF314050701	**150**	140	**7**	20-40-80	**400**	25	**8BGA + MCP5**	260	**/**	72	**75**
MULTImatic	IN7AFF318050701	**194**	180	**9**	20-2x40-80	**400**	25	**8BGA + MCP5**	300	**/**	72	**75**
MULTImatic	IN7AFF322050701	**235**	220	**11**	20-40-2x80	**630**	25	**8BGA + MCP5**	325	**/**	72	**75**
MULTImatic	IN7AFF326050701	**278**	260	**13**	20-2x40-2x80	**630**	25	**8BGA + MCP5**	365	**/**	74	**82**
MULTImatic	IN7AFF330050701	**321**	300	**15**	20-40-3x80	**800**	50	**8BGA + MCP5**	385	**/**	74	**82**
MULTImatic	IN7AFF334050701	**364**	340	**17**	20-2x40-3x80	**800**	50	**8BGA + MCP5**	415	**/**	70	**76**
MULTImatic	IN7AFF338050701	**407**	380	**19**	20-40-4x80	**1250**	50	**8BGA + MCP5**	445	**/**	70	**76**
MULTImatic	IN7AFF342050701	**450**	420	**21**	20-2x40-2x80-160	**1250**	50	**8BGA + MCP5**	475	**/**	71	**77**
MULTImatic	IN7AFF346050701	**492**	460	**23**	20-40-3x80-1x160	**1250**	50	**8BGA + MCP5**	505	**/**	71	**77**
MULTImatic	IN7AFF350050701	**535**	500	**25**	20-2x40-80-2x160	**2x630**	25	**8BGA + MCP5**	775	**/**	94	**86**
MULTImatic	IN7AFF356050701	**600**	560	**7**	80-3x160	**2x800**	50	**8BGA + MCP5**	800	**/**	94	**86**
MULTImatic	IN7AFF364050701	**685**	640	**8**	2x80-3x160	**2x800**	50	**8BGA + MCP5**	860	**/**	94	**86**
MULTImatic	IN7AFF372050701	**770**	720	**9**	80-4x160	**2x1250**	50	**8BGA + MCP5**	920	**/**	90	**96**
MULTImatic	IN7AFF380050701	**856**	800	**10**	2x80-4x160	**2x1250**	50	**8BGA + MCP5**	980	**/**	90	**96**
MULTImatic	IN7AFF388050701	**942**	880	**11**	80-5x160	**2x1250**	50	**8BGA + MCP5**	1040	**/**	91	**95**
MULTImatic	IN7AFF396050701	**1027**	960	**12**	2x80-3x160-1x320	**2x1250**	50	**8BGA + MCP5**	1100	**/**	91	**95**

Other available versions

FH20/S: Thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Other values upon request. For MIDImatic series short-circuit withstand current conditioned by the upstream protective device
3. PFor part numbers contact ICAR
4. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

HP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	415V	455V	50 Hz	≤12%	≤50%

MICRO
rack

MINI
rack

MULTI
rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Aux voltage 110Vca.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Discharge devices

All parts inside these products are compliant with Safety Regulations.
MULTI-rack trays can also be used on MIDImatic systems from the PFCS production date 1st of June, 2016.

	Part number	Power (kvar)		Banks Ue=400V kvar	Weight (kg)	Dim. (see chapt. 7) IP00
		Ue=415V	Ue=400V			
MICRO rack[3]	IC1DKK120050000	**2**	1,8	**1,8**	1,7	**109**
	IC1DKK140050000	**4**	3,6	**3,6**	2	**109**
	IC1DKK180050000	**8**	7,2	**7,2**	2	**109**
	IC1DKK216050000	**16**	14,4	**14,4**	2,3	**109**
MINI rack[3]	IW0AKK216050000	**16**	15	**15**	4	**110**
	IW0AKK232050000	**32**	30	**30**	6	**110**
	IW0AKK256050000	**56**	52,5	**22.5-30**	11	**110**
	IW0AKK280050268	**80**	75	**15-30-30**	13	**110**
	IW0AKK280050000	**80**	75	**7.5-15-22.5-30**	14	**110**
MULTI rack[3]	IX0AKK280050000	**80**	75	**2x7.5-4x15**	19	**120**
	IX0AKK316050000	**160**	150	**2x15-4x30**	27	**120**

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible.
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55 ° C).

HP20

Ue	U_N	U_{MAX} [1]	f	$THDI_R$%	$THDI_C$% [2]
400-415V	460V	500V	50 Hz	≤20%	≤70%

MICRO
rack

MINI
rack

MULTI
rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Aux voltage 110Vca.
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Discharge devices

All parts inside these products are compliant with Safety Regulations.
MULTI-rack trays can also be used on MIDImatic systems from the PFCS production date 1st of June, 2016.

	Part number	Power (kvar)			Banks Ue=400V kvar	Weight (kg)	Dim. (see chapt. 7) IP00
		U_N=460V	U_e=415V	U_e=400V			
MICRO rack [3]	IC1JLK120050000	**2**	1,6	**1,5**	1,5	**1,7**	109
MICRO rack [3]	IC1JLK140050000	**4**	3,2	**3**	3	**2**	109
MICRO rack [3]	IC1JLK180050000	**8**	6,5	**6**	6	**2**	109
MICRO rack [3]	IC1JLK216050000	**16**	13	**12**	12	**2,3**	109
MINI rack [3]	IW0JLK216050000	**16**	13	**12**	16	**4**	110
MINI rack [3]	IW0JLK232050000	**32**	26	**24**	32	**6**	110
MINI rack [3]	IW0JLK256050000	**56**	45	**42**	24-32	**11**	110
MINI rack [3]	IW0JLK280050268	**80**	65	**60**	16-2x32	**13**	110
MINI rack [3]	IW0JLK280050000	**80**	65	**60**	8-16-24-32	**14**	110
MULTI rack [3]	IX0NLK280050000	**80**	65	**60**	2x6-4x12	**19**	120
MULTI rack [3]	IX0NLK316050000	**160**	129	**120**	2x12-4x24	**27**	120

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55 ° C).

FH20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400-415V	550V	600V	50 Hz	≤60%	180 Hz	≤6%

100% NON LINEAR LOADS

MINI
rack

MULTI
rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 380s every 60 minutes) 3xIn (x 150s every 60 minutes) 4xIn (x 70s every 60 minutes) 5xIn (x 45s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In	1.3xIn
Max voltage overload Vn	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+55°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with aux voltage 110Vca
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=415V rated voltage
- Discharge devices
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7,7%)

All parts inside these products are compliant with Safety Regulations.
MULTI-rack trays can also be used on MIDImatic systems from the PFCS production date 1st of June, 2016.

	Part number	Power (kvar)		Banks Ue=400V kvar	Weight (kg)	Dim. (see chapt. 7) IP00
		U_e=415V	U_e=400V			
MINIrack[3]	IW7TFK155050010	5,5	5	2x2.5	14	135
MINIrack[3]	IW7TFK210050274	11	10	2x5	19	135
MINIrack[3]	IW7TFK210050010	11	10	10	15	135
MINIrack[3]	IW7TFK215050010	16	15	5-10	22	135
MINIrack[3]	IW7TFK220050248	21	20	2x10	24	135
MINIrack[3]	IW7TFK220050010	21	20	20	20	135
MULTIrack[3]	IX7TFF220050010	21	20	20	25	130
MULTIrack[3]	IX7TFF240050010	42	40	40	38	130
MULTIrack[3]	IX7TFF260050010	63	60	20-40	63	130
MULTIrack[3]	IX7TFF280050010	84	80	80	54	130

Other available versions
FH20/S: Thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55 ° C).

Power factor correction solutions with high gradient metallized polypropylene capacitors vacuum impregnated

new

In this chapter you will find the following ranges

	VP10	Automatic and Fix Power Factor Correction Systems with high gradient metallized polypropylene film, vacuum impregnated and 400V nominal voltage capacitors
	VP20	Automatic and Fix Power Factor Correction Systems with high gradient metallized polypropylene film, vacuum impregnated and 460V nominal voltage capacitors
	FV25	Automatic and Fix Power Factor Correction Systems with 180Hz detuned reactors, high gradient metallized polypropylene film, vacuum impregnated and 460V nominal voltage capacitors

CRM25

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-460V
Rated frequency	50Hz
Max current overload In	1,3 In (continuous) 2 In (x500s every 60 minutes) 3 In (x180s every 60 minutes) 4 In (x90s every 60 minutes) 5 In (x50s every 60 minutes)
Max voltage overload Vn	3xUn (x 1 minute)
Insulating voltage	3/15kV - Ue≤660Vac
Temperature class	-25/D
Capacitance tolerance	-5÷+10%
Terminal voltage test	2.15xU_N 2 sec.
Service	continuous
Construction type	high energy metallized polypropylene, vacuum impregnated
Life time at temperature class	-25/+55 °C 150.000h
Standards	IEC 60831-1/2

GENERALITIES:

- High gradient metallized polypropylene film capacitors, high thickness
- Metallic case with protection degree IP00
- Internal overpressure protection system
- Oil filler, vacuum process.

All parts inside these products are compliant with Safety Regulations.

Range	Part number	Rated Voltage U_N (v)	Max Voltage U_{MAX} (V)	Power (kvar)	Capacitance (µF)	DIM (mm)	Weight (kg)	Pcs/Box
VP10	CRMT25016320SD0	400	440	2.5	50	60x138	0,5	36
VP20	CRMM25016320SC0	460	500	2.5	37	60x138	0,5	36

Notes:
The indicated overloads apply only to industrial power factor correction applications.Capacitors sold as spare part.

VP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	THDIC%[2]
400V	400V	440V	50 Hz	≤27%	≤85%

SUPERriphaso

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn	1.1xUe
Insulation level (SUPERriphaso)	3/15kV - Ue≤660Vac
Insulating voltage (MICROfix)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses (SUPERriphaso)	~ 0.6W/kvar
Total losses (MICROfix)	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

SUPER riphaso	Part number	Power (kvar) U_e=400V	Modules	Weight (kg)	Dimens. (see chapt. 7)
	IA3VFF175050001	7.5	1	2.1	21

SUPERriphaso: generalities

- Self-extinguishing plastic enclosure painted with epossidic dust paint, colour RAL7030
- Protection degree IP40
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=400V rated voltage
- Discharge resistance
- SUPERriphaso modules can be combined, with the mechanical and electrical connection elements supplied, to make monoblocks of up to 6 units (45kvar to 400V). See dimensions 21.

All parts inside these products are compliant with Safety Regulations.

MICROfix	Part number	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
	IA3VFF175050001	7.5	40	9	44
	IA3VFF215050001	15	40	12	44
	IA3VFF222550001	22.5	80	15	44
	IA3VFF230050001	30	80	18	44
	IA3VFF237550001	37.5	125	27	46
	IA3VFF245050001	45	125	31	46
	IA3VFF245050001	52.5	125	34	46
	IA3VFF245050001	60	160	36	46

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=400V rated voltage
- Discharge resistance
- Signal lams power on

All parts inside these products are compliant with Safety Regulations.

1. EC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

VP20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	THDIC%[2]
400-415V	460V	500V	50 Hz	≤27%	≤90%

SUPERriphaso

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn	1.1xUe
Insulation level (SUPERriphaso)	3/15kV - Ue≤660Vac
Insulating voltage (MICROfix)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses (SUPERriphaso)	~ 0.5W/kvar
Total losses (MICROfix)	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

	Part number	Power (kvar) U_N=460V	Power (kvar) U_e=415V	Power (kvar) U_e=400V	Modules	Weight (kg)	Dim. (see chapt. 7)
SUPER riphaso	IA3ZLF175050001	7.5	6	6	1	2.1	21

SUPERriphaso: generalities

- Self-extinguishing plastic enclosure painted with epossidic dust paint, colour RAL7030
- Protection degree IP40
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=450V rated voltage
- Discharge resistance
- SUPERriphaso modules can be combined, with the mechanical and electrical connection elements supplied, to make monoblocks of up to 6 units (45kvar to 400V). See dimensions 21.

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_N=460V	Power (kvar) U_e=415V	Power (kvar) U_e=400V	Modules	Weight (kg)	Dim. (see chapt. 7)
MICROfix	IB5ZLK175050987	7.5	6	5.5	40	9	44
	IB5ZLK215050987	15	12	11	40	12	44
	IB5ZLK222550987	22.5	18	17	40	15	44
	IB5ZLK230050987	30	24	23	80	18	44
	B5ZLK237550987	37.5	30	28	80	27	46
	IB5ZLK245050987	45	36	34	80	31	46
	IB5ZLK252550987	52.5	43	40	125	34	46
	IB5ZLK260050987	60	45	45	125	36	46

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage
- Discharge resistance
- Signal lams power on

All parts inside these products are compliant with Safety Regulations.

1. EC /CEI 60831-1 max allowed value
2. Attention: in this conditions of load network harmonic amplification phenomena is possible

FV25

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400V	460V	500V	50 Hz	≤60%	180 Hz	≤6%

MICROfix

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn	1.1xUe
Insulation level	3/15kV - Ue≤660Vac
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

MICROfix: generalities

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Short circuit current Icc = 50kA (conditioned by fuses with high breaking power NH00gG)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Protection degree IP3X
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7,7%)
- Discharge resistance

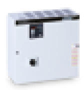
All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=400V	LBS (A)	Weight (kg)	Dimens. (see chapt. 7)
MICROfix	IB5AFF212550988	12.5	40	30	45
	IB5AFF225050988	25	80	36	45
	IB5AFF250050988	50	125	41	45

1. EC /CEI 60831-1 max allowed value

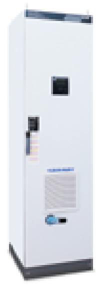
VP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	THDIC%[2]
400V	400V	440V	50 Hz	≤27%	≤85%



MICRO matic

MINI matic



MULTI matic

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

	Codice	Potenza (kvar) U_N=400V	Batterie (kvar) U_e=400V	Combi-nazioni (n°)	Sez. (A)	Icc[3] (kA)	Rego-latore	Peso (Kg)	DIM IP3X (vedi cap 7)	DIM IP4X (vedi cap 7)	DIM IP55[4] (vedi cap 7)
MICRO matic	IC2VFF214050652	14	2-4-8	7	63	50	5LGA	12	49	/	/
	IC2VFF222050652	22	2-4-2x8	11	63	50	5LGA	16	50	/	/
	IC2VFF230050652	30	2-4-8-16	15	80	50	5LGA	17	50	/	/
	IC2VFF236050652	36	4-2x8-16	9	100	50	5LGA	22	50	/	/
MINImatic	IF2VFF237550652	37.5	7.5-2x15	5	125	9	5LGA	81	55	/	59
	IF2VFF252550652	52.5	7.5-15-30	7	125	9	5LGA	84	56	/	59
	IF2VFF275050652	75	7.5-15-22.5-30	10	250	9	5LGA	94	56	/	59
	IF2VFF290050652	90	7.5-15-30-38	12	250	9	5LGA	106	57	/	60
	IF2VFF311250652	112.5	7.5-15-30-60	15	250	9	5LGA	115	57	/	60
	IF2VFF313550652	135	15-2x30-60	9	400	9	5LGA	126	58	/	61
	IF2VFF315050652	150	15-30-45-60	10	400	9	5LGA	132	58	/	61
MULTImatic	IN2VFF316550700	165	15-5x30	11	400	25	8BGA	240	/	72	75
	IN2VFF320650700	206	19-5x38	10	630	25	8BGA	280	/	72	75
	IN2VFF324850700	248	23-5x45	10	630	25	8BGA	300	/	72	75
	IN2VFF328950700	289	26-5x53	11	630	25	8BGA	340	/	74	81
	IN2VFF333050700	330	30-5x60	11	800	50	8BGA	360	/	74	81
	IN2VFF337150700	371	34-5x68	11	800	50	8BGA	400	/	70	73
	IN2VFF341350700	413	38-5x75	10	1250	50	8BGA	420	/	70	73
	IN2VFF345450700	454	41-5x83	11	1250	50	8BGA	490	/	71	78
	IN2VFF349550700	495	45-5x90	11	1250	50	8BGA	505	/	71	78
	IN2VFF353650700	536	49-5x98	11	2x630	25	8BGA	640	/	94	85
	IN2VFF357850700	578	53-5x105	11	2x800	50	8BGA	660	/	94	85
	IN2VFF361950700	619	56-5x113	11	2x800	50	8BGA	700	/	94	85
	IN2VFF366050700	660	60-5x120	11	2x800	50	8BGA	720	/	94	85
	IN2VFF370150700	701	64-5x128	11	2x800	50	8BGA	740	/	90	93
	IN2VFF374350700	743	68-5x135	11	2x1250	50	8BGA	760	/	90	93
	IN2VFF378450700	784	71-5x143	11	2x1250	50	8BGA	820	/	90	93
	IN2VFF382550700	825	75-5x150	11	2x1250	50	8BGA	840	/	90	93
	IN2VFF390850700	908	83-5x165	11	2x1250	50	8BGA	980	/	91	98
	IN2VFF399050700	990	90-5x180	11	2x1250	50	8BGA	1010	/	91	98

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors' inrush current (AC6B)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=400V rated voltage

All parts inside these products are compliant with Safety Regulations.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request. For MICROmatic series short-circuit withstand current conditioned by the upstream protective device
4. For part numbers contact ICAR

VP20

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400-415V	460V	500V	50 Hz	≤27%	≤90%


MINI matic


MULTI matic

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors' inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_N=460V	Power (kvar) U_e=415V	Power (kvar) U_e=400V	Banks U_e=400V (kvar)	Steps	Dis. (A)	Icc[3] (kA)	PFC Controller	Weight (Kg)	Dim. IP3X (see ch. 7)	Dim. IP4X (see ch. 7)	Dim. IP55[4] (see ch. 7)
MINImatic	IF2ZLF237550652	37.5	30	28	5.6-2x11.2	5	125	9	RPC 5LGA	84	56	/	59
	IF2ZLF252550652	52.5	42	39	5.6-11.2-22.4	6	125	9	RPC 5LGA	94	56	/	59
	IF2ZLF275050652	75	60	56	5.6-11.2-16.8-22.4	10	250	9	RPC 5LGA	106	56	/	59
	IF2ZLF290050652	90	73	68	5.6-11.2-22.4-28	12	250	9	RPC 5LGA	115	57	/	59
	IF2ZLF311250652	112.5	90	84	5.6-11.2-22.4-28	15	250	9	RPC 5LGA	126	57	/	60
	IF2ZLF313550652	135	108	101	5.6-11.2-22.4-44.8	9	400	9	RPC 5LGA		58	/	60
	IF2ZLF315050652	150	120	112	11.2-22.4-33.6-44.8	10	400	9	RPC 5LGA	132	58	/	61
MULTImatic	IN2ZLF316550700	165	133	124	11-5x22	11	400	25	RPC 8BGA	240	/	72	61
	IN2ZLF320650700	206	166	155	14-5x28	11	400	25	RPC 8BGA	280	/	72	75
	IN2ZLF324850700	248	199	186	17-5x34	10	630	25	RPC 8BGA	300	/	72	75
	IN2ZLF328950700	289	232	217	20-5x40	10	630	25	RPC 8BGA	340	/	74	81
	IN2ZLF333050700	330	265	248	22.5-5x45	11	630	25	RPC 8BGA	360	/	74	81
	IN2ZLF337150700	371	297	278	25-5x50	11	630	25	RPC 8BGA	400	/	70	73
	IN2ZLF341350700	413	331	309	28-5x56	11	800	50	RPC 8BGA	420	/	70	73
	IN2ZLF345450700	454	364	340	31-5x62	10	800	50	RPC 8BGA	490	/	71	78
	IN2ZLF349550700	495	397	371	33-5x66	11	800	50	RPC 8BGA	505	/	71	78
	IN2ZLF353650700	536	430	402	36-5x72	11	2x630	25	RPC 8BGA	640	/	94	85
	IN2ZLF357850700	578	463	433	39-5x78	11	2x630	25	RPC 8BGA	660	/	94	85
	IN2ZLF361950700	619	496	464	42-5x84	11	2x630	25	RPC 8BGA	700	/	94	85
	IN2ZLF366050700	660	530	495	45-5x90	11	2x630	25	RPC 8BGA	720	/	94	85
	IN2ZLF370150700	701	563	526	48-5x96	10	2x630	25	RPC 8BGA	740	/	90	93
	IN2ZLF374350700	743	596	557	51-5x102	10	2x800	50	RPC 8BGA	760	/	90	93
	IN2ZLF378450700	784	628	587	53-5x106	11	2x800	50	RPC 8BGA	820	/	90	93
	IN2ZLF382550700	825	662	619	56-5x112	11	2x800	50	RPC 8BGA	840	/	90	93
	IN2ZLF390850700	908	730	682	62-5x124	11	2x800	50	RPC 8BGA	980	/	91	98
	IN2ZLF399050700	990	796	744	67-5x134	11	2x800	50	RPC 8BGA	1010	/	91	98

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request
4. For part numbers contact ICAR

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400V	460V	500V	50 Hz	≤60%	180 Hz	≤6%

FV25

MULTI matic

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7,7%)

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=400V	Banks (kvar) U_e=400V	Steps	Discon-nector (A)	Icc[2] (kA)	PFC Controller	Weight (Kg)	Dim. IP4X (see ch. 7)	Dim. IP55[3] (see ch. 7)
MULTImatic	IN5VFF288050701	88	12,5-25-50	7	250	17	RPC 8BGA	250	72	75
	IN5VFF313850701	138	12,5-25-2x50	11	400	25	RPC 8BGA	315	72	75
	IN5VFF317550701	175	25-3x50	7	400	25	RPC 8BGA	380	74	81
	IN5VFF322550701	225	25-4x50	9	630	25	RPC 8BGA	460	70	76
	IN5VFF327550701	275	25-5x50	11	630	25	RPC 8BGA	520	71	77
	IN5VFF335050701	350	2x25-2x50-2x100	14	2x400	25	RPC 8BGA	740	94	85
	IN5VFF340050701	400	2x50-3x100	8	2x630	25	RPC 8BGA	800	94	85
	IN5VFF345050701	450	50-4x100	9	2x630	25	RPC 8BGA	860	90	96
	IN5VFF350050701	500	2x50-4x100	10	2x630	25	RPC 8BGA	920	90	96
	IN5VFF355050701	550	50-5x100	11	2x800	50	RPC 8BGA	980	91	95
	IN5VFF360050701	600	2x50-3x100-200	12	2x800	50	RPC 8BGA	1040	91	95
	IN5VFF365050701	650	50-4x100-200	13	3x630	25	RPC 8BGA	1330	101	103
	IN5VFF370050701	700	2x50-2x100-2x200	14	3x630	25	RPC 8BGA	1355	101	103
	IN5VFF375050701	750	50-3x100-2x200	15	3x800	25	RPC 8BGA	1380	101	103
	IN5VFF380050701	800	2x50-100-3x200	16	3x800	50	RPC 8BGA	1495	102	104
	IN5VFF385050701	850	3x50-3x100-2x200	17	3x800	50	RPC 8BGA	1525	102	104
	N5VFF390050701	900	3x100-3x200	9	3x800	50	RPC 8BGA	1560	102	104

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Other values upon request
3. For part numbers contact ICAR

VP10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400V	400V	440V	50 Hz	≤27%	≤85%

MICRO
rack

MINI
rack

MULTI
rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with damping resistors to limit capacitors' inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=400V rated voltage
- Discharge devices

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=400V	Banks (kvar) U_e=400V	Weight (Kg)	Dim. IP00 (see ch. 7)
MICRO rack[3]	IC2LFF120050000	2	2	2	109
	IC2LFF140050000	4	4	2	109
	IC2LFF180050000	8	8	2	109
MINI rack[3]	IW2VFF175050000	7.5	7.5	10	110
	IW2VFF215050000	15	15	11	110
	IW2VFF222550000	22.5	7.5-15	13	110
	IW2VFF230050000	30	2x15	14	110
	IW2VFF237550000	37.5	7.5-2x15	16	110
MULTI rack[3]	IX2VFF241250000	41.25	3.75-5x7.5	19	120
	IX2VFF282550000	82.5	7.5-5x15	27	120

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55° C).

VP20

Ue	U_N	U_{MAX} [1]	f	$THDI_R$%	$THDI_C$% [2]
400-415V	460V	500V	50 Hz	≤27%	≤90%

MINI rack

MULTI rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-415V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 2W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with damping resistors to limit capacitors' inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=400V rated voltage
- Discharge devices

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_N=460V	Power (kvar) U_e=415V	Power (kvar) U_e=400V	Banks (kvar) U_e=400V	Weight (Kg)	Dim. IP00 (see ch. 7)
MINI rack[3]	IW2ZLF175050000	7.5	6	5.6	5.6	10	110
	IW2ZLF215050000	15	12	11.2	11.2	11	110
	IW2ZLF222550000	22.5	18	16.8	5.6-11.2	13	110
	IW2VFF175050000	30	24	22.4	2x11.2	14	110
	IW2ZLF237550000	37.5	32	30	5.6-2x11.2	16	110
MULTI rack[3]	IX2ZLF241250000	41.25	33	31	2.8-5x5.6	19	120
	IX2ZLF282550000	82.5	70	62	5.6-5x11.2	27	120

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55° C).

FV25

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400V	460V	500V	50 Hz	≤60%	180 Hz	≤6%

MULTI rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	1,3xIn (continuous) 2xIn (x 500s every 60 minutes) 3xIn (x 180s every 60 minutes) 4xIn (x 90s every 60 minutes) 5xIn (x 50s every 60 minutes)
Max voltage overload Vn (capacitors)	3xUn (x 1 minute)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage	690V
Temperature range (bank)	-5/+50°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

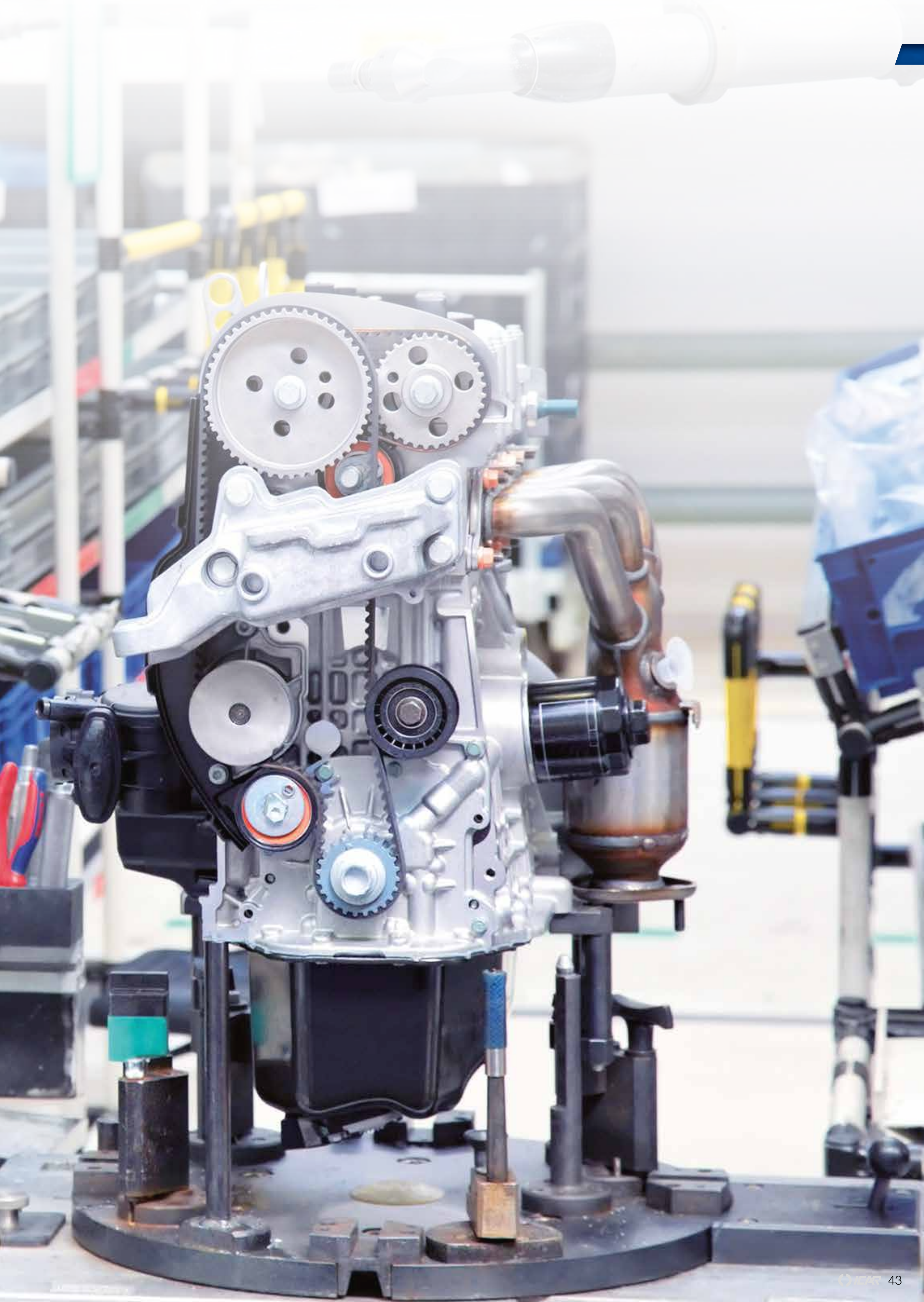
GENERALITIES:

- Contactors
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized polypropylene capacitor with U_N=460V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7,7%)
- Discharge devices

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) U_e=400V	Banks (kvar) U_e=400V	Weight (Kg)	Dim. IP00 (see ch.7)
MULTI rack[2]	IX5VFF225050010	25	25	32	130
	IX5VFF23755001	37.5	12.5-25	35	130
	IX5VFF250050010	50	50	46	130

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55° C).



Power factor correction solutions with metallized paper capacitors

In this chapter you will find the following ranges

TC10	Automatic Power Factor Correction Systems with metallized paper and 400V nominal voltage capacitors
FD25	Automatic Power Factor Correction Systems with 180Hz Detuned reactors, metallized paper and 460V nominal voltage capacitors

Other versions and ranges available

TC20	Automatic Power Factor Correction Systems with metallized paper and 460V nominal voltage capacitors
TC10/S	Thyristor Switched Automatic Power Factor Correction Systems with metallized paper and 400V nominal voltage capacitors
TC20/S	Thyristor Switched Automatic Power Factor Correction Systems with metallized paper and 460V nominal voltage capacitors
FD25/S	Thyristor Switched Automatic detuned Power Factor Correction Systems with 180Hz detuned reactors, metallized paper and 460V nominal voltage capacitors
FD25V	High THDV Automatic detuned Power Factor Correction Systems with 180Hz detuned reactors, metallized paper and 460V nominal voltage capacitors
FD35	Automatic detuned Power Factor Correction Systems with 135Hz detuned reactors, metallized paper and 550V nominal voltage capacitors
FD35/S	Thyristor Switched Automatic detuned Power Factor Correction Systems with 135Hz detuned reactors, metallized paper and 550V nominal voltage capacitors
TC70	660/690V Automatic Power Factor Correction Systems with metallized paper and 900V nominal voltage capacitors
FD70	660/690V Automatic Power Factor Correction Systems with 140Hz detuned reactors, metallized paper and 900V nominal voltage capacitors
FD70V	660/690V high THDV Automatic Power Factor Correction Systems with 180Hz detuned reactors, metallized paper and 900V nominal voltage capacitors

NB: see page 6 for standard and optional features.

CRM25

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400-460-550V
Rated frequency	50Hz
Max current overload In	3xIn (continuous) 4xIn (x1600s every 60 minutes) 5xIn (x800s every 60 minutes)
Max voltage overload Vn	1.1xUn
Insulating voltage	3/15kV - Ue≤660Vac
Temperature class	-25/70°C
Capacitance tolerance	-5÷+10%
Terminal voltage test	2.15xU_N 2 sec.
Service	continuous
Construction type	metallized paper
Life time at temperature class	200.000h a -25/D, 130.000h a -25/70° C
Standards	IEC 60831-1/2

GENERALITIES:

- Metallized paper capacitors
- Metallic case with protection degree IP00
- Internal overpressure protection system
- Oil filler

All parts inside these products are compliant with Safety Regulations.

Range	Part number	Model	Rated Voltage U_N (V)	Max. Voltage U_{MAX} (V)	Power (kvar)	Capacitance (µF)	Dim. (see ch. 7)	Weight (kg)	Pcs/ Box
TC10	CRMT250163400A0	**CRM25-11A-2.50-400**	400	**440**	2,5	**50**	60x138	**0,5**	36
TC20 - FD25	CRMM250163400A0	**CRM25-11A-2.50-460**	460	**500**	2,5	**37**	60x138	**0,5**	36
FD35	CRMR250163400A0	**CRM25-11A-2.50-550**	550	**605**	2,5	**26**	60x138	**0,5**	36

TC10

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	$THDI_C$%[2]
400V	400V	440V	50 Hz	≤27%	≤85%

MINI matic MULTI matic

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	3xIn (continuous) 4xIn (1600s every 60 minutes) 5xIn (800s every 60 minutes)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage (banks)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 3W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized paper capacitor with U_N=400V rated voltage

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) Ue=400V	Banks Ue=400V	Steps	Discon-nector.[5] (A)	Icc[3] (kA)	PFC Controller	Weight (kg)	Dimensions (see chapter 7)		
									IP3X	IP4X	IP55[4]
MINI matic	IF2AFF311250652	112,5	7.5-15-30-60	15	250	9	5LGA	115	57	/	60
MINI matic	IF2AFF313550652	135	15-2x30-60	9	400	9	5LGA	126	58	/	61
MINI matic	IF2AFF315050652	150	15-30-45-60	10	400	9	5LGA	132	58	/	61
MULTImatic	IN2AFF316550700	165	15-5x30	11	400	25	8BGA	240	/	72	75
MULTImatic	IN2AFF320650700	206	18.75-5x37.5	11	630	25	8BGA	280	/	72	75
MULTImatic	IN2AFF324850700	248	22.5-5x45	11	630	25	8BGA	300	/	72	75
MULTImatic	IN2AFF328950700	289	26.25-5x52.5	11	630	25	8BGA	340	/	74	81
MULTImatic	IN2AFF333050700	330	30-5x60	11	800	50	8BGA	360	/	74	81
MULTImatic	IN2AFF337150700	371	33.75-5x67.5	11	800	50	8BGA	400	/	70	73
MULTImatic	IN2AFF341350700	413	37.5-5x75	11	1250	50	8BGA	420	/	70	73
MULTImatic	IN2AFF345450700	454	41.25-5x82.5	11	2x630	25	8BGA	580	/	92	83
MULTImatic	IN2AFF349550700	495	45-5x90	11	2x630	25	8BGA	600	/	92	83
MULTImatic	IN2AFF353650700	536	48.75-5x97.5	11	2x630	25	8BGA	640	/	94	85
MULTImatic	IN2AFF357850700	578	52.5-5x105	11	2x800	50	8BGA	660	/	94	85
MULTImatic	IN2AFF361950700	619	56.25-5x112.5	11	2x800	50	8BGA	700	/	94	85
MULTImatic	IN2AFF366050700	660	60-5x120	11	2x800	50	8BGA	720	/	94	85
MULTImatic	IN2AFF370150700	701	63.75-5x127.5	11	2x800	50	8BGA	740	/	90	93
MULTImatic	IN2AFF374350700	743	67.5-5x135	11	2x1250	50	8BGA	760	/	90	93
MULTImatic	IN2AFF378450700	784	71.25-5x142.5	11	2x1250	50	8BGA	820	/	90	93
MULTImatic	IN2AFF382550700	825	75-5x150	11	2x1250	50	8BGA	840	/	90	93

Other available versions

TC10/S: thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Other values upon request.
4. For part numbers contact ICAR
5. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

FD25

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400V	460V	500V	50 Hz	≤60%	180 Hz	≤6%

100% NON LINEAR LOADS

MULTI
matic

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	3xIn (continuous) 4xIn (1600s every 60 minutes) 5xIn (800s every 60 minutes)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage (banks)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Zink-passivated metallic enclosure painted with epossidic dust paint, colour RAL 7035
- Auxiliary transformer to separate power and auxiliary circuit parts (110V)
- Load-break switch with door interlock designed at 1,495In as per IEC 60831-1 art.34
- Contactors
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Microprocessor Power Factor Correction relay
- CRM25 single phase self-healing metallized paper capacitor with U_N=460V rated voltage
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7.7%)

All parts inside these products are compliant with Safety Regulations.

MULTImatic

Part number	Power (kvar) Ue=400V	Banks Ue=400V kvar	Steps	Discon-nector.[4] (A)	Icc[2] (kA)	PFC Controller	Weight (kg)	Dimensions (see chapter 7)		
								IP3X	IP4X	IP55[3]
IN5AFF288050701	88	12,5-25-50	7	250	17	8BGA + MCP5	250	/	72	75
IN5AFF313850701	138	12,5-25-2x50	11	400	25	8BGA + MCP5	315	/	72	75
IN5AFF317550701	175	25-3x50	7	400	25	8BGA + MCP5	380	/	74	81
IN5AFF322550701	225	25-4x50	9	630	25	8BGA + MCP5	460	/	70	76
IN5AFF327550701	275	25-5x50	11	630	25	8BGA + MCP5	520	/	71	77
IN5AFF335050701	350	2x25-2x50-2x100	14	2x400	25	8BGA + MCP5	740	/	94	85
IN5AFF340050701	400	2x50-3x100	8	2x630	25	8BGA + MCP5	800	/	94	85
IN5AFF345050701	450	50-4x100	9	2x630	25	8BGA + MCP5	860	/	90	96
IN5AFF350050701	500	2x50-4x100	10	2x630	25	8BGA + MCP5	920	/	90	96
IN5AFF355050701	550	50-5x100	11	2x800	50	8BGA + MCP5	980	/	91	95
IN5AFF360050701	600	2x50-3x100-200	12	2x800	50	8BGA + MCP5	1040	/	91	95
IN5AFF365050701	650	50-4x100-200	13	3x630	25	8BGA + MCP5	1330	/	101	103
IN5AFF370050701	700	2x50-2x100-2x200	14	3x630	25	8BGA + MCP5	1355	/	101	103
IN5AFF375050701	750	50-3x100-2x200	15	3x630	25	8BGA + MCP5	1380	/	101	103
IN5AFF380050701	800	2x50-100-3x200	16	3x800	50	8BGA + MCP5	1495	/	102	104
IN5AFF385050701	850	3x50-3x100-2x200	17	3x800	50	8BGA + MCP5	1525	/	102	104
IN5AFF390050701	900	3x100-3x200	9	3x800	50	8BGA + MCP5	1560	/	102	104

Other available versions
FD25/S: thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.
FD25V: version with special reactors, for high armonic voltage distorsion installations (THDV≤8%).
Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Other values upon request.
3. For part numbers contact ICAR
4. MULTImatic of several columns have a disconnector and a cable entry for each column. See page 6.

TC10

Ue	U_N	U_{MAX}[1]	f	$THDI_R\%$	$THDI_C\%$[2]
400V	400V	440V	50 Hz	≤27%	≤85%

MINI rack

MULTI rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	3xIn (continuous) 4xIn (1600s every 60 minutes) 5xIn (800s every 60 minutes)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage (banks)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	capacitors contactors (AC6b)
Total losses	~ 3W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors with damping resistors to limit capacitors inrush current (AC6b)
- Aux voltage 110Vac
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized paper capacitor with U_N=400V rated voltage
- Diacharge devices

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) Ue=400V	Banks Ue=400V	Weight (kg)	Dimensions (see chapter 7) IP00
MINIrack[3]	NRVF17505101100	**7,5**	7,5	**10**	110
	NRVF21505101100	**15**	15	**11**	110
	NRVF22255103200	**22,5**	7.5-15	**13**	110
	NRVF23005102200	**30**	2x15	**14**	110
	NRVF23755105300	**37,5**	7.5-2x15	**16**	110
MULTI rack[3]	MRKT41225318600	**41,25**	3.75-5x7.5	**19**	120
	MRKT82525333600	**82,5**	7.5-5x15	**27**	120

Other available versions

TC10/S: thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Attention: in this conditions of load network harmonic amplification phenomena is possible
3. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55° C.

FD25

Ue	U_N	U_{MAX}[1]	f	$THDI_R$%	f_D	THDV%
400V	460V	500V	50 Hz	≤60%	180 Hz	≤6%

100% NON LINEAR LOADS

MULTI
rack

TECHNICAL CHARACTERISTICS:

Rated operational voltage	Ue=400V
Rated frequency	50Hz
Max current overload In (capacitors)	3xIn (continuous) 4xIn (1600s every 60 minutes) 5xIn (800s every 60 minutes)
Max current overload In (banks)	1.3xIn
Max voltage overload Vn (banks)	1.1xUe
Insulating voltage (banks)	690V
Temperature range (bank)	-5/+40°C
Temperature range (capacitors)	-25/+70°C
Discharge device	mounted on each bank
Installation	indoor
Service	continuous
Internal connection	delta
Operation devices	contactors
Total losses	~ 6W/kvar
Inner surface finish	zinc passivation
Standards (bank)	IEC 61439-1/2, IEC 61921
Standards (capacitors)	IEC 60831-1/2

GENERALITIES:

- Contactors
- FS17 450/750V self-extinguish cable according to IEC 50525 - 50575 - 50575/A1
- Three-phase fuse holder type NH00
- Power fuses NH00-gG
- CRM25 single phase self-healing metallized paper capacitor with U_N=460V rated voltage
- Diacharge devices
- Three phase detuning choke with tuning frequency 180Hz (N=3.6 or p=7.7%)

All parts inside these products are compliant with Safety Regulations.

	Part number	Power (kvar) Ue=400V	Banks Ue=400V	Weight (kg)	Dimensions (see chapter 7) IP00
MULTI rack[2]	MRKT25025112101	**25**	25	**24**	130
	IX5AFF237550010	**37,5**	12,5-25	**35**	130
	MRKT50025924100	**50**	50	**46**	130

Other available versions
FD25/S: thyristor switched and detuned capacitor banks, for fast changing loads. Available in MULTImatic only.
FD25V: version with special reactors, for high armonic voltage distorsion installations (THDV≤8%).
Available in MULTImatic only.

1. Maximum allowed value according to IEC 60831-1 art. 20.1
2. Racks can be used as spare parts in ICAR power factor correction systems properly maintained and in suitably ventilated / conditioned third-party electrical panels (max internal temperature 55° C.

Passive and active harmonic filters

Passive Filters

ICAR proposes FT10 passive filters tuned on the 5th harmonic, made with bimetallized paper capacitors, for a better durability guarantee and long-term absorption precision.
The FT10 passive filters are available in MULTImatic enclosures and standard versions ranging from 60kvar (120A 5th harmonic current consumption) to 180kvar (360A).
Is possible to create custom versions.

MULTI
matic

Active filters

The presence of a strong harmonic content in the current flowing in the electric system can cause significant problems:

- Malfunction of electric devices
- Tripping of protection devices
- Overheating of cables, bars, transformers
- Vibration and breakage due to mechanical stress
- Increase the voltage drops on the lines
- Voltage distortion

The active filter is an electronic device that measures the line current harmonic content, calculates the individual harmonic components in the network and for each inject an equal current (per module and harmonic order) but in phase opposition. In this way it eliminates the present harmonics and leaves unchanged the current at network frequency.

The active filters are preferred when the network harmonic content is on a wide spectrum (for example, the 3rd, the 5th, the 7th, the 11th, the 13th) and/or when there is a resonance risk. The active filters are dimensioned for current, considering the total rms value of the harmonic currents that are to be deleted from the network.

MAIN CHARACTERISTICS:

- Harmonic compensation up to 50th harmonic, individually selectable.
- Modular system extendable (from 60A to 600A) permits low life cycle costs and low losses.
- Easy installation & commissioning, touch screen interface with installation assistant.
- Highest performance: reaction time < 21µs, very fast steady state time < 300 µs.
- Less power dissipation due to 3 level NPC topology: low loss < 15 W att / Amp.
- Flicker compensation.

For further information visit our beb site or contact us.

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.

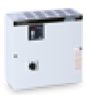
The reactive power regulators RPC used in automatic ICAR power factor correction systems are designed to provide the desired power factor while minimizing the wearing on the banks of capacitors, accurate and reliable in measuring and control functions are simple and intuitive in installation and consultation.
By purchasing a ICAR automatic power factor correction system you receive it ready for commissioning. In fact he controller is already set, you just need to connect it to the line CT and set the value of the primary current.
The controller automatically recognizes the current direction of the CT secondary, to correct any wiring errors.
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.).

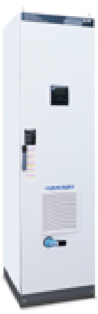
As described below, the ICAR regulators offer important features as for the maintenance and management of the power factor correction bank, aimed at identifying and solving problems, which could lead to its damage with consequent life expectancy reduction.

RPC 5LGA

RPC 8LGA

RPC 8BGA



System Range	PFC Controller
MICROmatic	RPC 5LGA
MINImatic	RPC 5LGA
MINImatic filter	RPC 5LGA
MIDImatic	RPC 8LGA
MIDImatic filter	RPC 8BGA + MCP5 standard
MULTImatic	RPC 8BGA + MCP5 optional
MULTImatic filter	RPC 8BGA + MCP5 standard










Reactive power regulators
RPC 5LGA 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 MIDImatic. 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 harmonic from 2nd to 15th, total harmonic distortion in the current% ($THDI_C$%) 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

- 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)

Safety

The RPC 5LGA and 8LGA controllers have passwords to prevent not authorized access. A backup copy of the factory settings is always available in memory.

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).

Reactive power regulators RPC 5LGA and RPC 8LGA: data sheet

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.

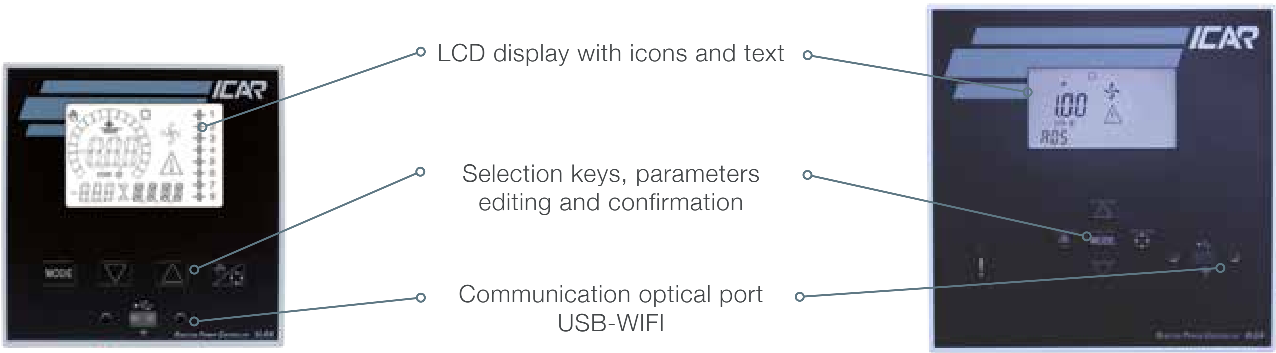
RPC 5LGA

RPC 8LGA

OTHER CHARACTERISTICS	RPC 5LGA	RPC 8LGA
Output relay number	5 (upgradeable up to 7)	8 (upgradeable up to 12)
Dimensions	96x96mm (see drawing 144)	144x144mm (see drawing 147)
Weight	0,35kg	0,65kg
Part number	A25060046411050	A250600006CF025

ADDITIONAL MODULE

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.



RPC 5LGA

RPC 8LGA

Reactive power regulators
RPC 8BGA

The RPC 8BGA reactive power regulator equips MULTImatic automatic power factor correction systems. It is a very innovative controller, with exclusive features:

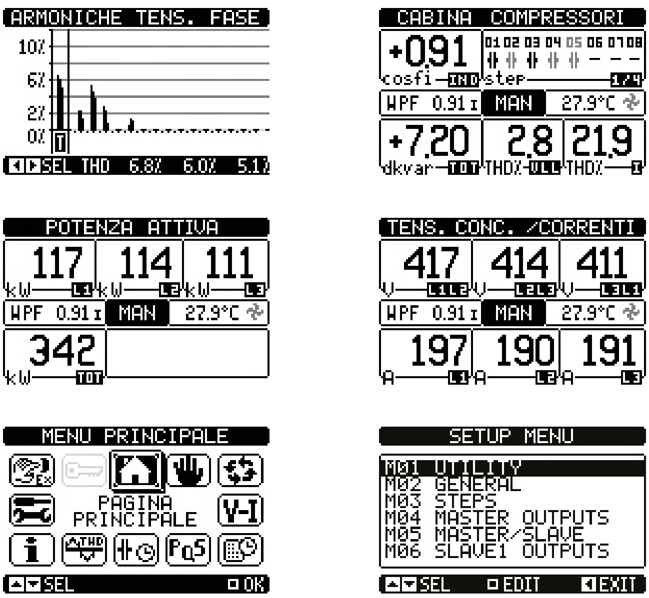
- High electrical performance
- Extended Capabilities
- Graphic display
- Advanced communication
- Upgradability, even after installation
- Powerful supervision software
- Choice language (10 languages available on board)

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 diffi cult to read: 8BGA will amaze you with its display matrix graphic LCD 128x80 pixels. The detail and sharpness allow intuitive navigation between the diff erent 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, USB, WIFI. Now you can see the information of the company cos phi, without having to go in front of the regulator.
Now you can consult it by 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 enhanched with up to four additional modules "plug and play" which greatly expands its performance.
It is 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.

Reactive power regulators RPC 8BGA: data sheet

TECHNICAL CHARACTERISTICS

- Microprocessor control
- 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
- Power consumption: 12 VA (10.5W)
- Output relay current: 5A – 250Vac
- Cos φ range: from 0,5 ind to 0,5 cap (tan φ from -1,732 to +1,732)
- Step switching time: 1s÷1000s (20ms with STR4NO module)
- Alarm relay: yes
- Degree of protection: IP55 on front and IP20 at terminals
- Working temperature range: from -30°C to +70°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: 8 (expandible till 16)
- Dimensions: 144x144mm
- Weight: 0,98Kg
- Part number: A25060046411000

RPC 8BGA

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 retrospectively.

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 and data logging
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 orodatare 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

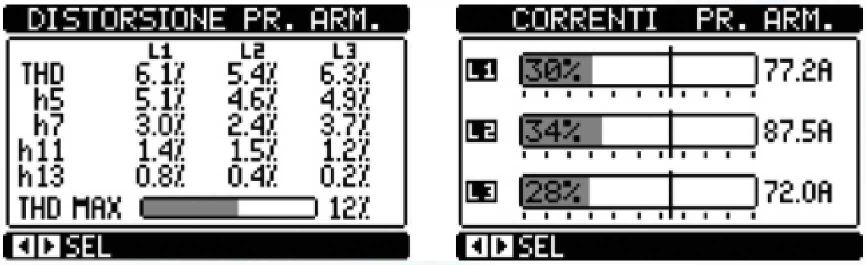
Communication functions
RPC 8BGA regulator is very powerful in terms of communication.
The modules dedicated to these functions allow multiple solutions to remotely control the power factor system and all other variables measured, calculated or obtained from the instrument.

- COM232 isolated RS232 interface
- COM485 RS485 opto-isolated
- WEBETH Ethernet interface with webserver function
- COMPRO isolated Profibus-DP interface
- 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

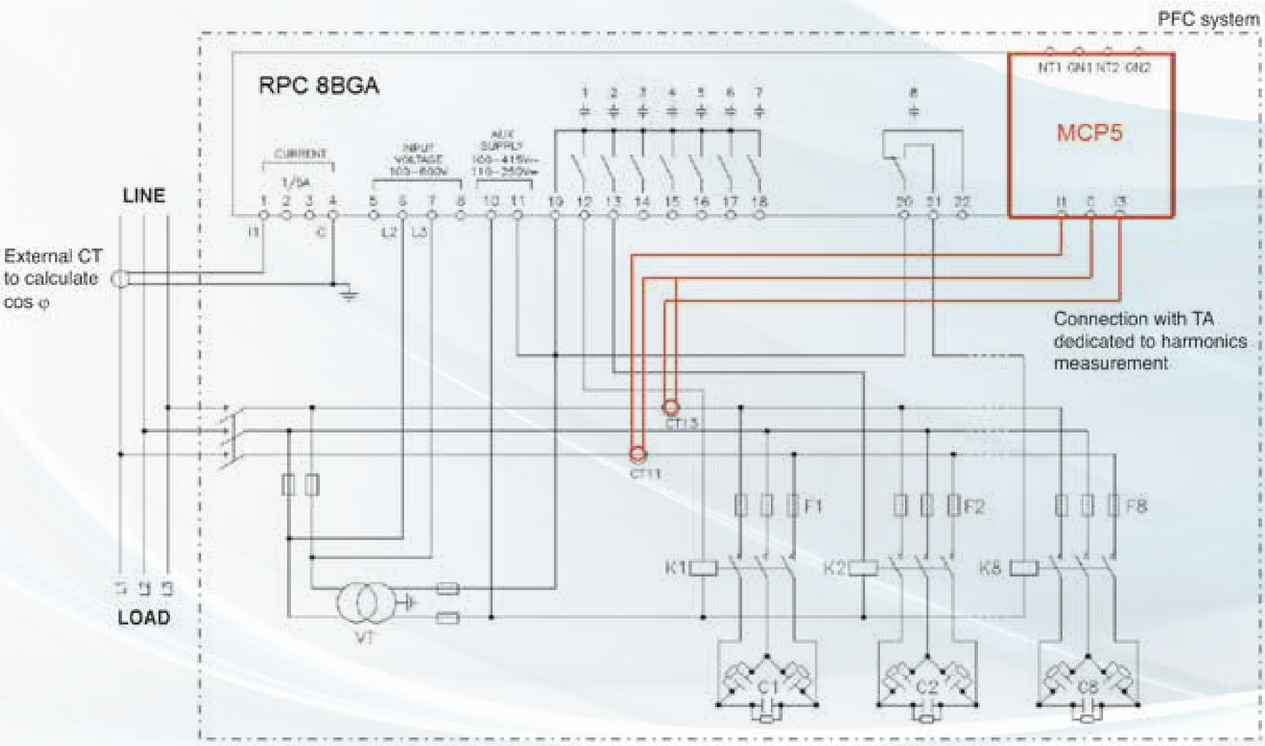
App
New app for PFCS setup and maintenance operations. Setup and maintenance operations, often carried out in uncomfortable switch rooms due to bad environment conditions or elevated noise, are now safer and easier for any ICAR Power Factor Correction Systems. They can be indeed connected to POWER STUDIO, the new app available for android tablets and smartphones. It is no longer required to turn on a laptop and to plug cables to carry out monitoring and parameters setting.
You can get connected with all ICAR PFC controllers (8BGA, 8LGA, or 5LGA) via optical port and WI-FI CX02 dongle.
Through POWER STUDIO you can also upload a previously defined setup file, send commands and download measurements and data from ICAR PFC controllers.

Control and protection module MCP5

MULTImatic detuned systems are equipped with RPC 8BGA controller with MCP5 module.
This module has very important function: it directly monitors, through two CTs installed inside, the current in the capacitors analyzing the harmonic content.
In case of harmonic content increases (for example, due to the aging of the capacitors) exceeding a certain limit value, the PFC system is taken out of service, excluding the risk of bursting or overcharging of the capacitors
The individual harmonics are kept under control, with the possibility of setting an alarm level and an intervention level on each. The MCP5 module also allows to monitor two additional temperatures in order to avoid excessive overheating even inside the panel.



Analysis of the harmonic current absorbed by capacitors, in percentage value.



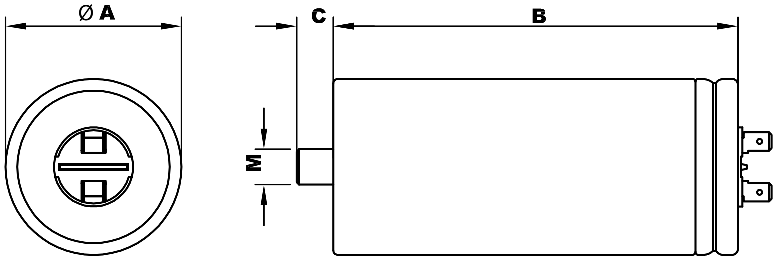
MCP5 module connection scheme

Dimensions

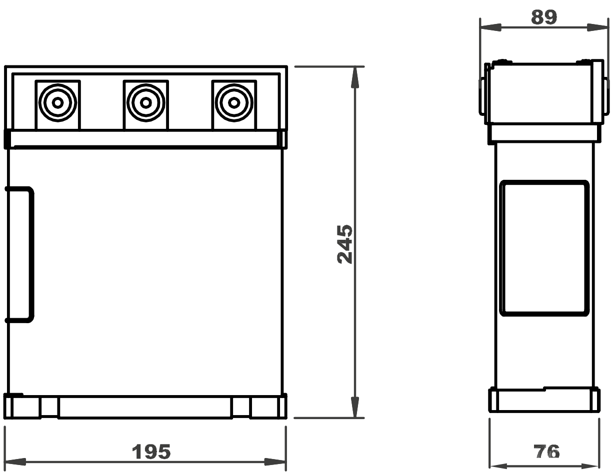
Below the dimensions of the systems in this catalog, identified with the respective code number. For more information see the individual drawings.

	dimensional number	Dimensions			notes
		W (mm)	D (mm)	H (mm)	
SUPERriphaso	21	195	89	245	
MICROfix	44	340	250	600	
	45	550	500	900	
	46	550	500	780	
MICROmatic	49	460	260	480	
	50	610	260	480	
MINImatic	55	420	425	745	
	56	420	425	965	
	57	420	425	1183	
	58	420	425	1403	
	59	600	440	1300	(1)
	60	600	440	1500	(1)
	61	600	440	1700	(1)
MIDImatic	64	600	690	1835	
MULTImatic	70	610	670	2160	
	71	610	670	2360	
	72	610	670	1760	
	73	610	670	2160	
	74	610	670	1960	
	75	610	670	1760	
	76	822	670	2160	(1)
	77	822	670	2360	(1)
	78	610	777	2360	(2)
	80	822	670	1760	
	81	610	777	1960	(2)
	82	822	670	1960	(1)
	83	1220	777	1760	(2)
	84	1432	777	1760	(3)
	85	1220	777	1960	(2)
	86	1432	777	1960	(3)
	90	1220	670	2160	
	91	1220	670	2360	
	92	1220	670	1760	
	93	1220	777	2160	
	94	1220	670	1960	
	95	1432	777	2360	(3)
	96	1432	777	2160	(3)
	98	1202	777	2360	(2)
	101	1830	670	2160	
	102	1830	670	2360	
	103	2042	777	2160	(3)
	104	2042	777	2360	(3)

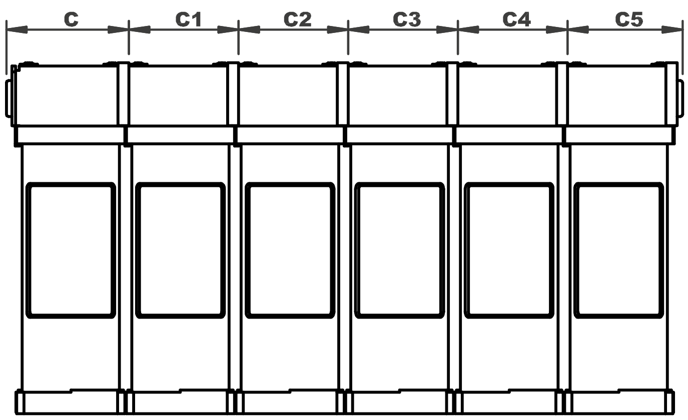
1. Leave 250mm of free space on each side
2. Leave 250mm of free space on the back
3. Leave 250mm of free space both on the back and on each side



Drawing	Ø A	B	C	M
1	40	103	10	8
2	45	128	10	8
3	55	128	12,5	12
4	60	138	12,5	12

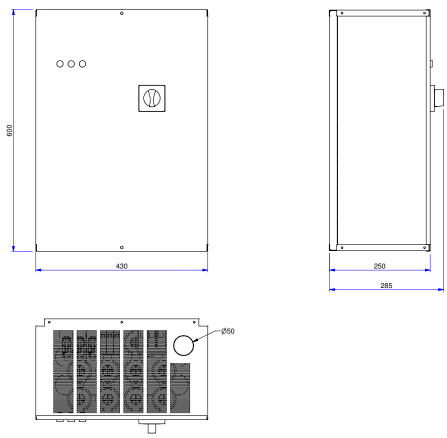


21

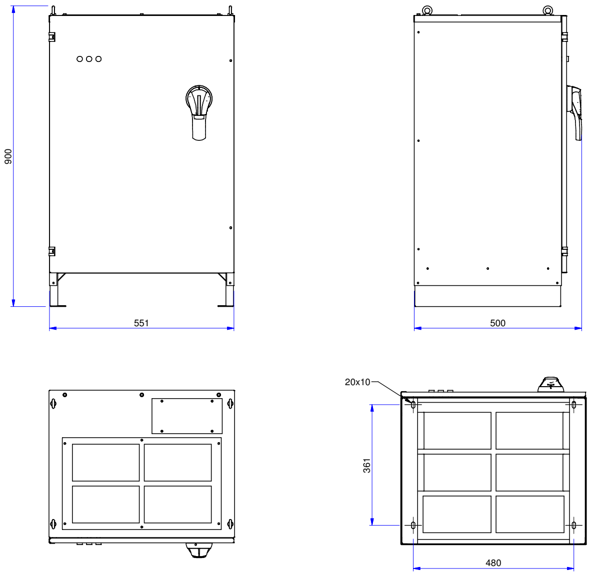


C+C1 = 165
C+C1+C2 = 241
C+C1+C2+C3 = 317
C+C1+C2+C3+C4 = 393
C+C1+C2+C3+C4+C5 = 469

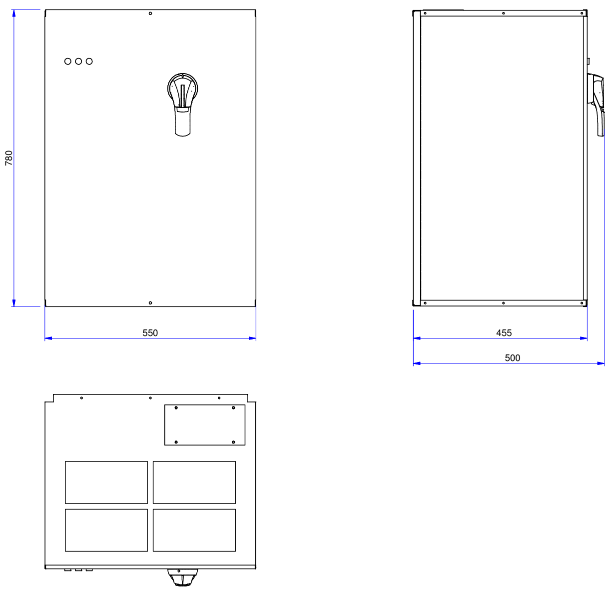
22


600
430
250
285
Ø50

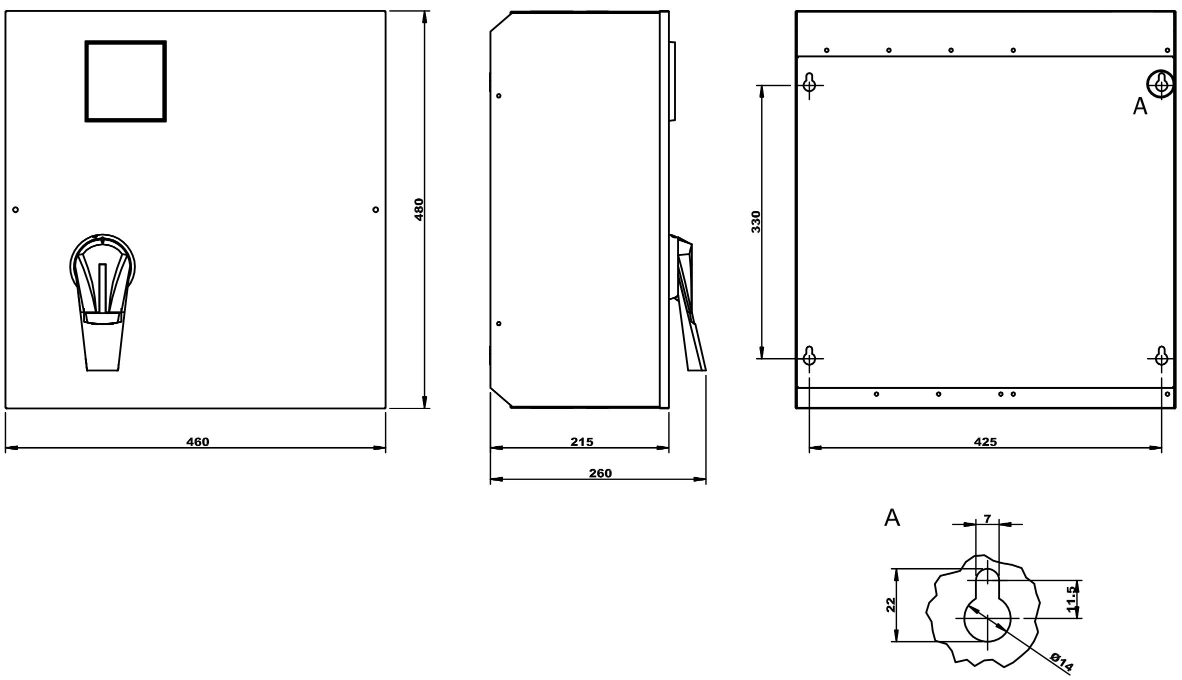
44


900
551
500
20x10
361
480

45

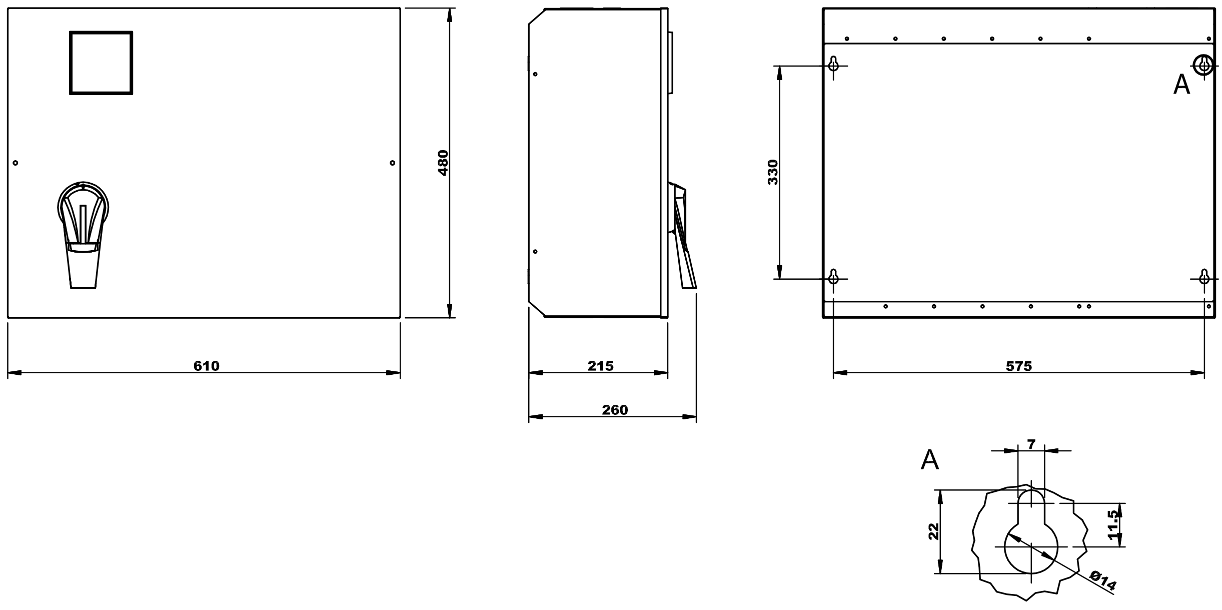

780
550
455
500

46

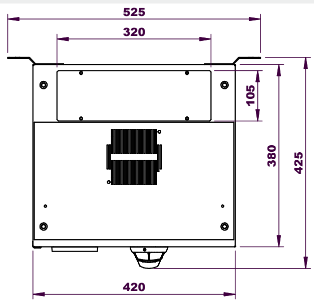

480
460
215
260
330
425
A
A
7
22
11.5
Ø14

49

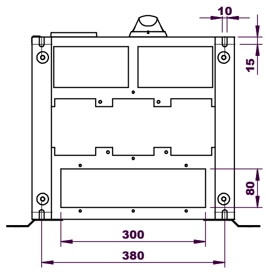
50



Applicable to drawings
55, 56, 57, 58

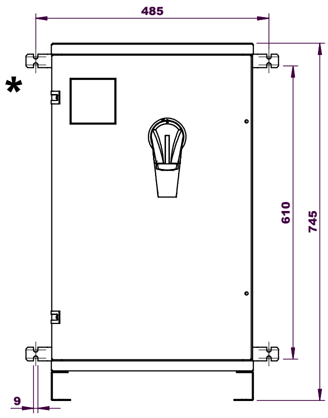


Top view with cable
incoming inlet

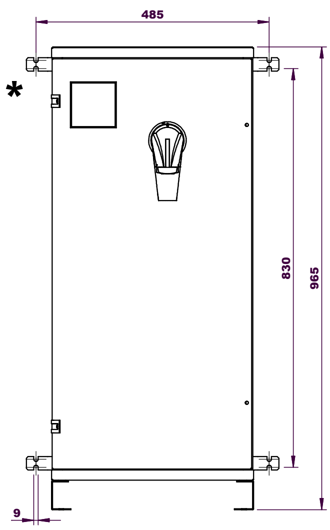


Bottom view with cable
incoming inlet

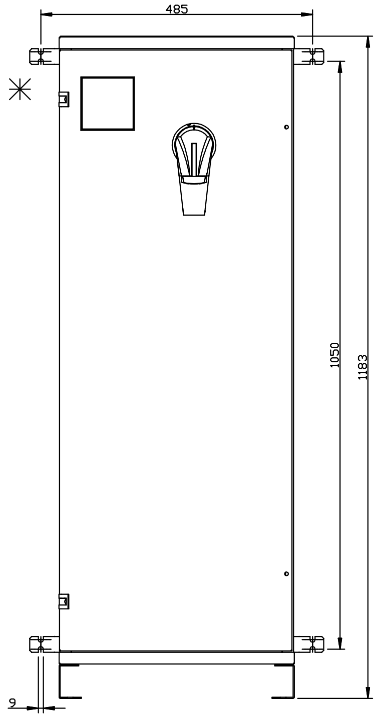
55



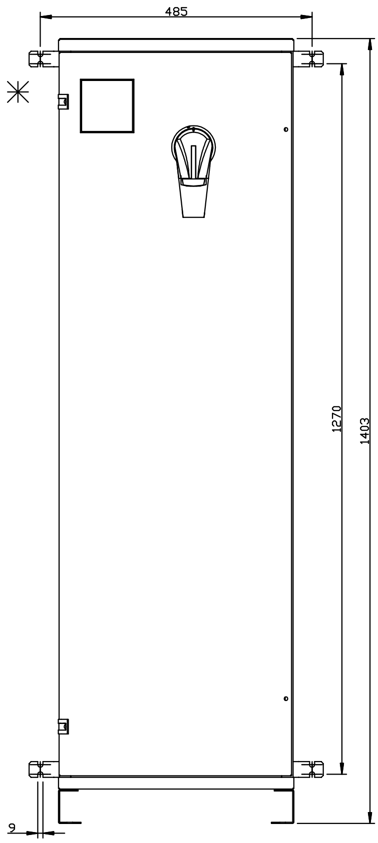
56



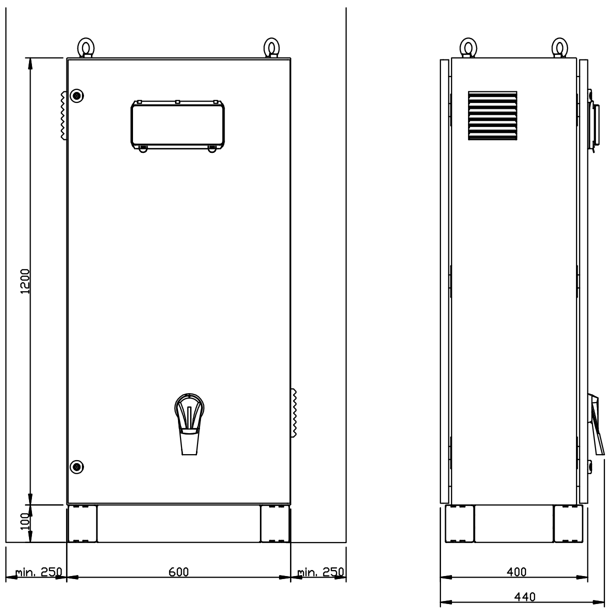
Fixing pads are removable



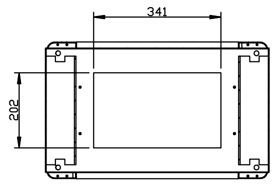
57



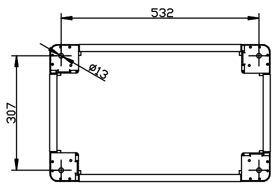
58



Bottom view with cable incoming inlet

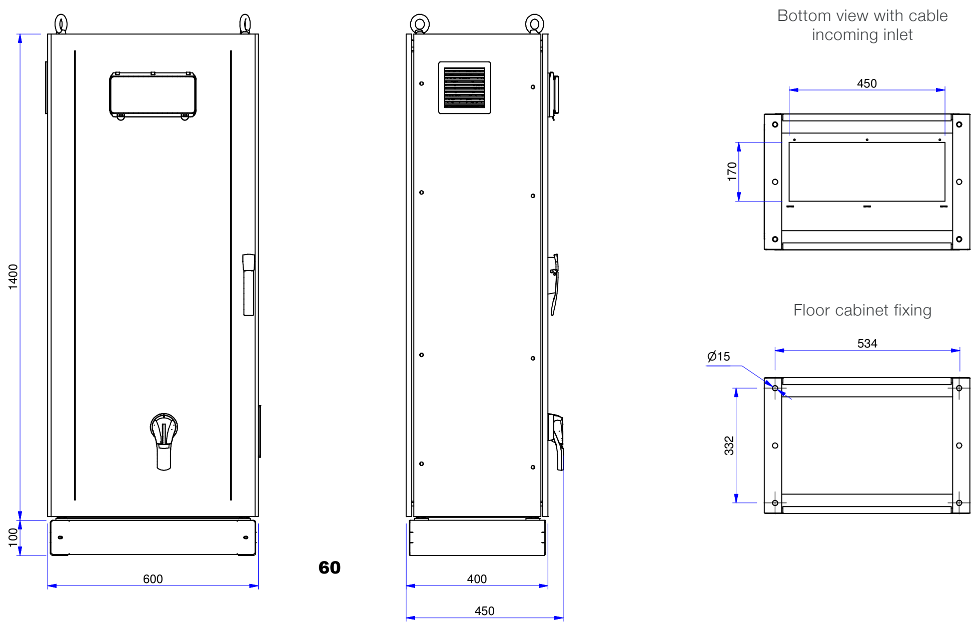


Floor cabinet fixing



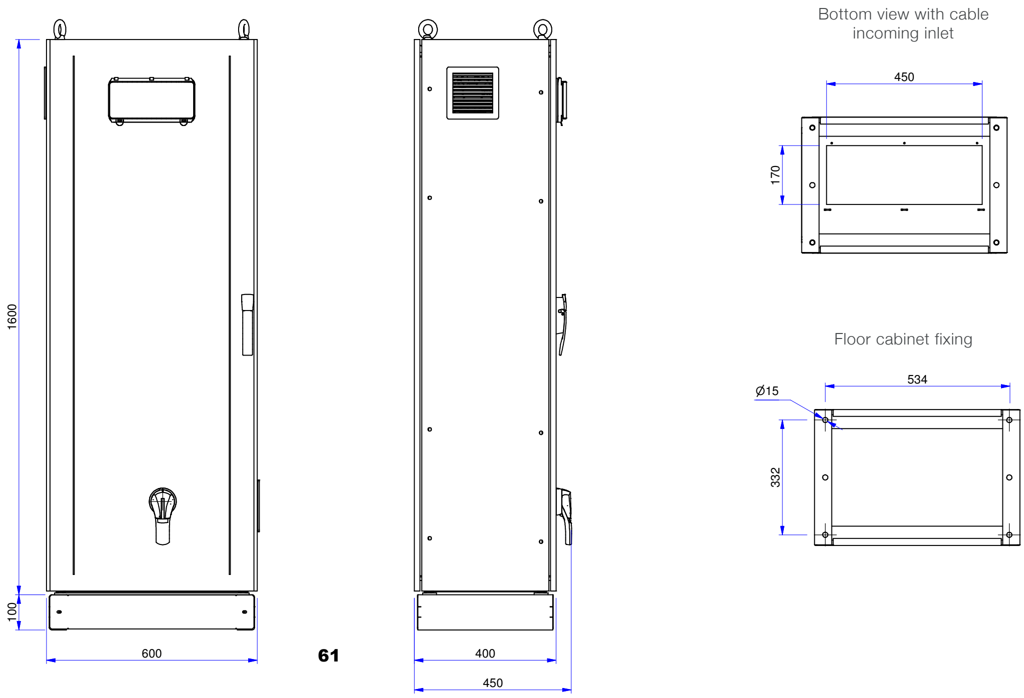
59

60

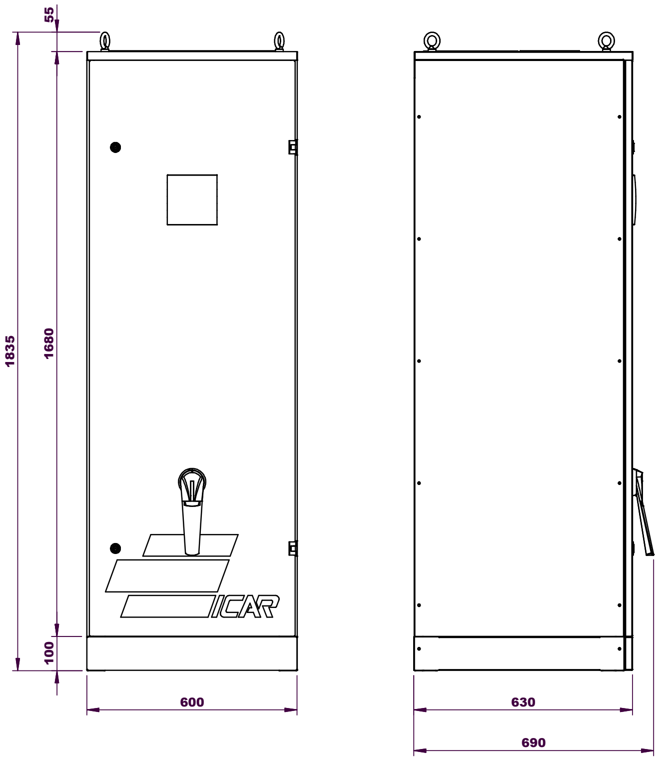

Bottom view with cable incoming inlet
450
170
Floor cabinet fixing
534
Ø15
332
1400
100
600
400
450

60

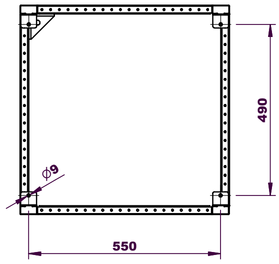
61


Bottom view with cable incoming inlet
450
170
Floor cabinet fixing
534
Ø15
332
1600
100
600
400
450

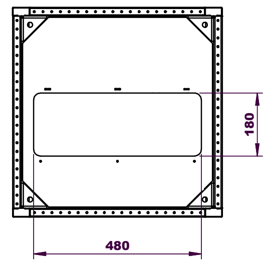
61



Cabinet fixing



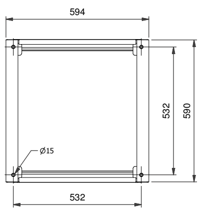
Cables entry from the bottom



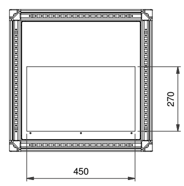
64

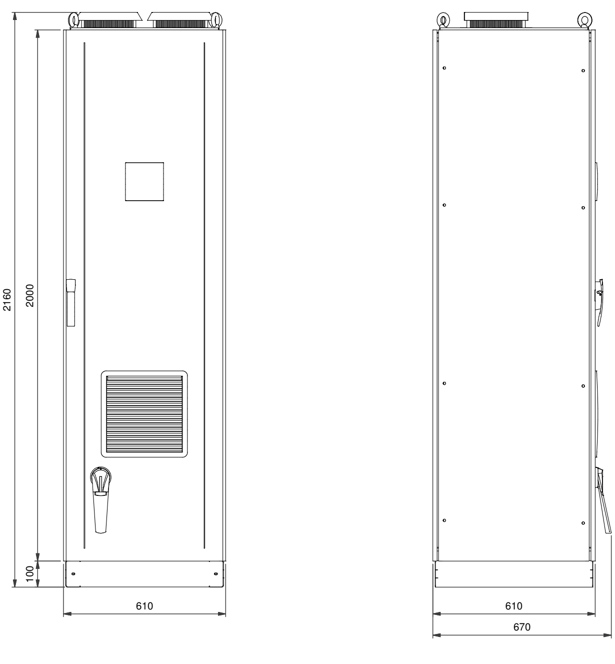
Applicable to drawings 70, 71, 72, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83,84,85,86,90,91,92, 93,94,95,96,98,101, 102,103,104

Floor fixing



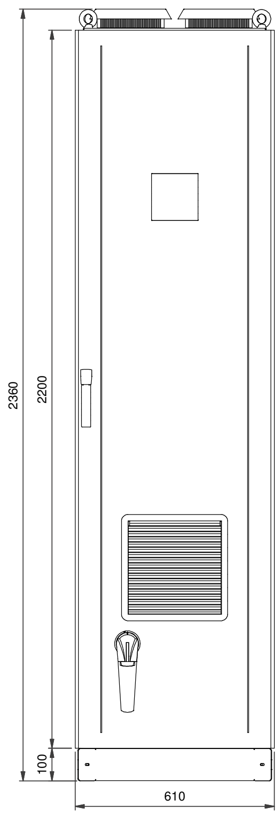
Cables entry from the bottom

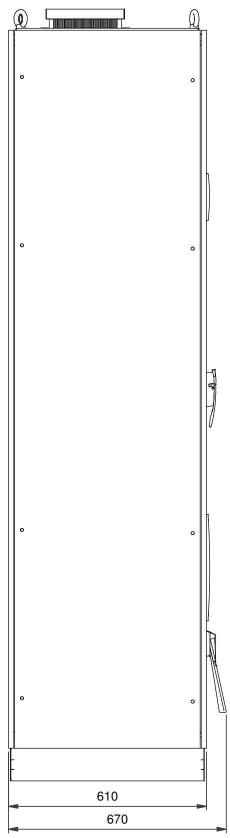




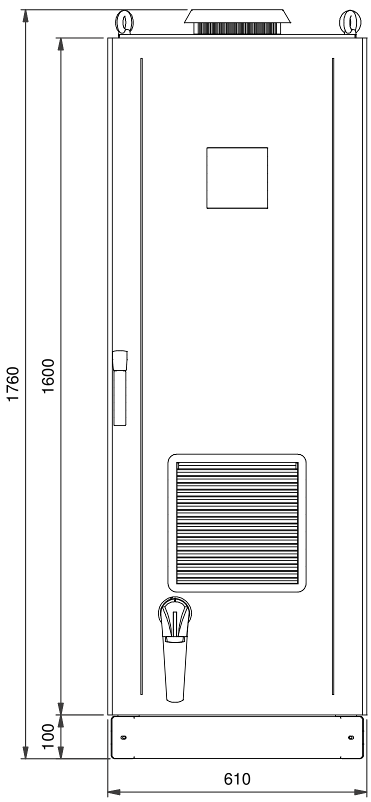
70

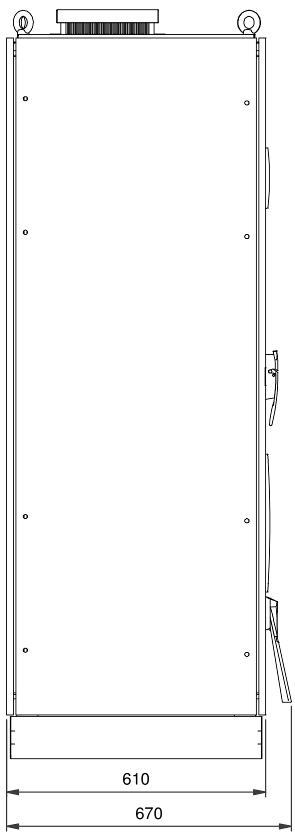
71

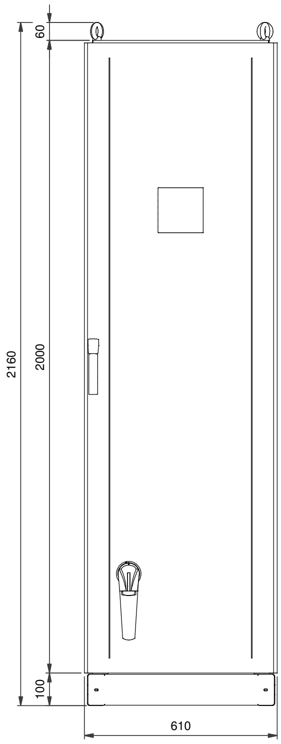


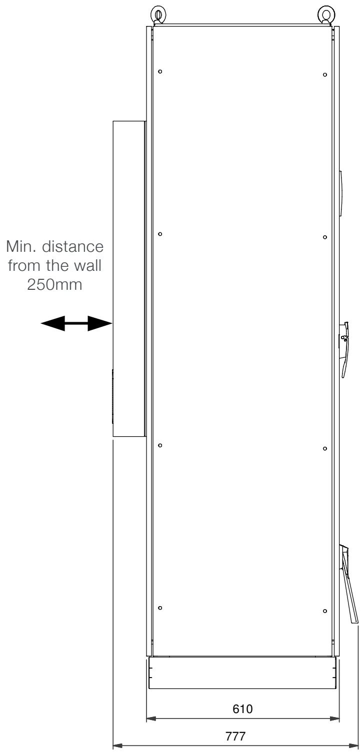


72

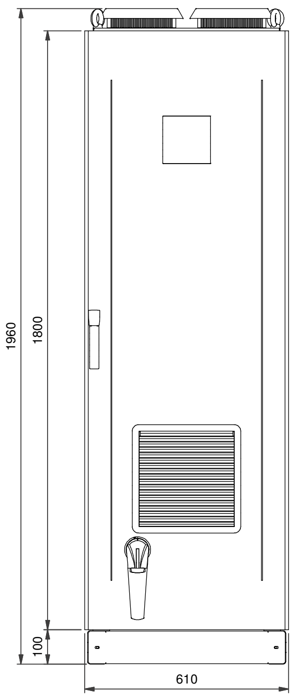


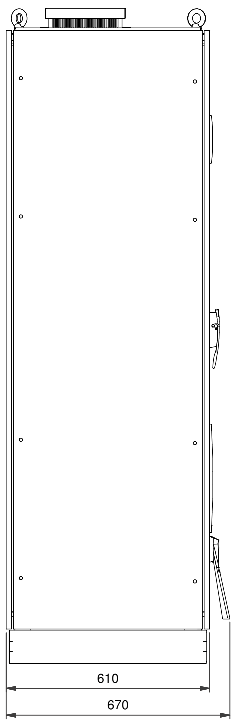



60
2160
2000
100
610


Min. distance
from the wall
250mm
610
777

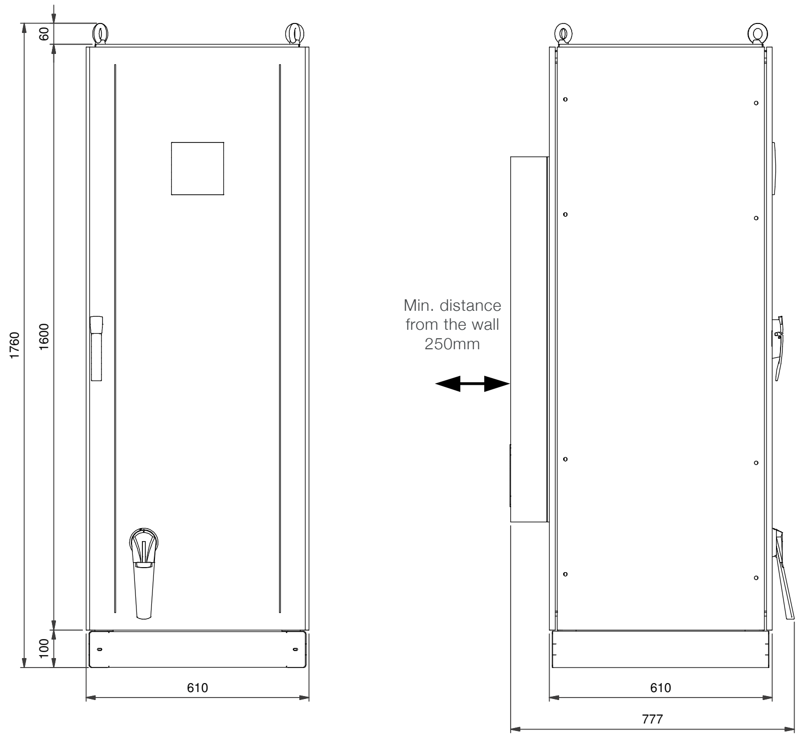
73


1960
1800
100
610

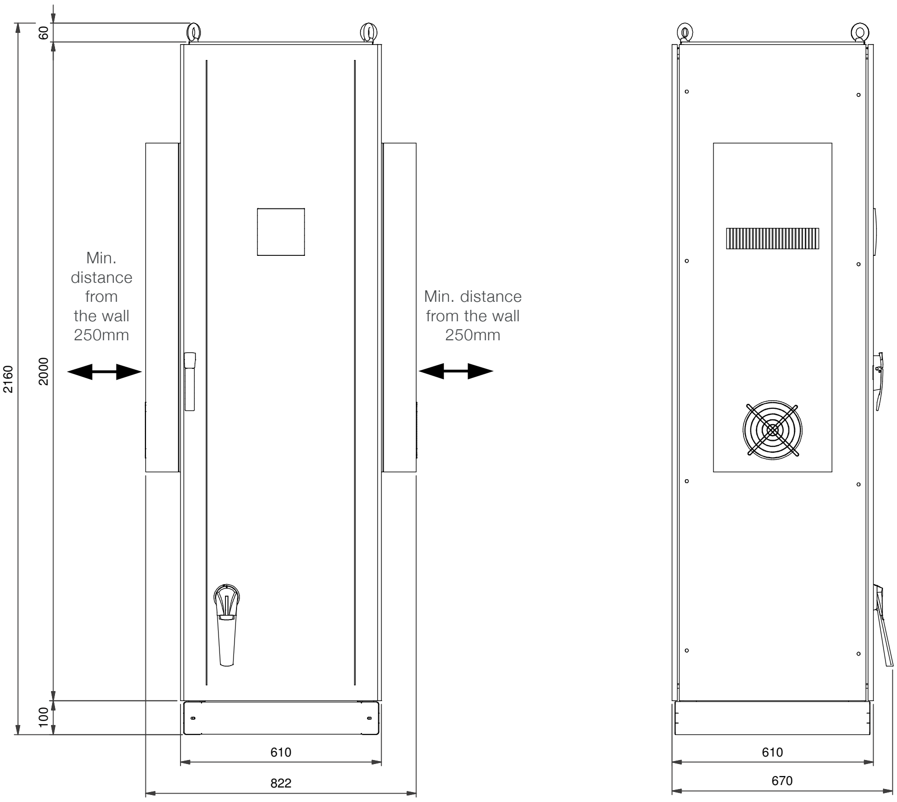

610
670

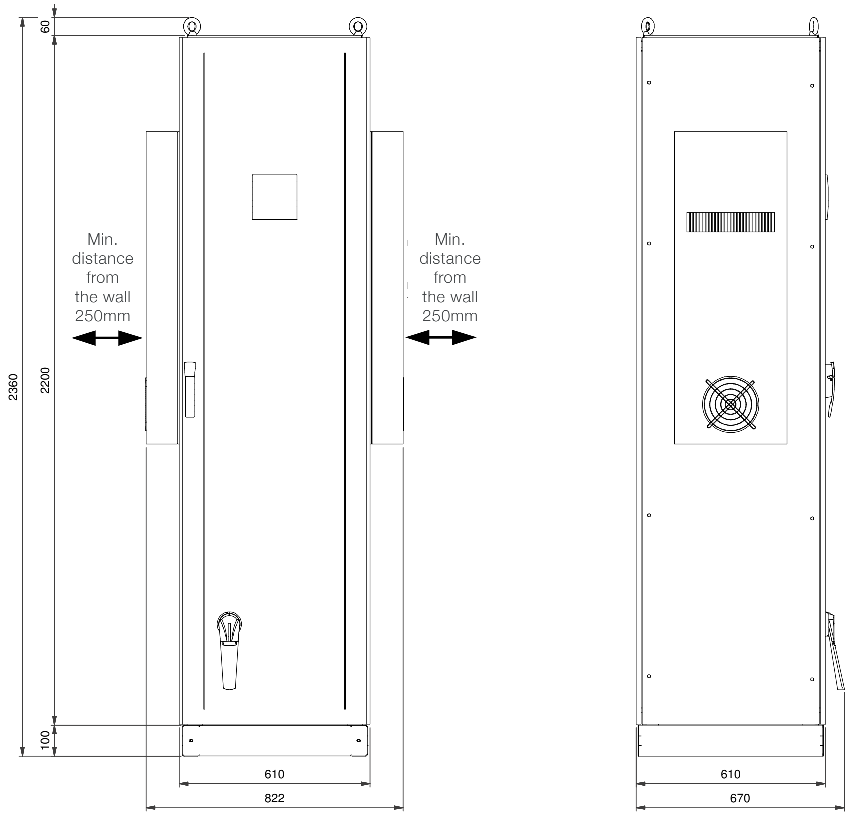
74

75

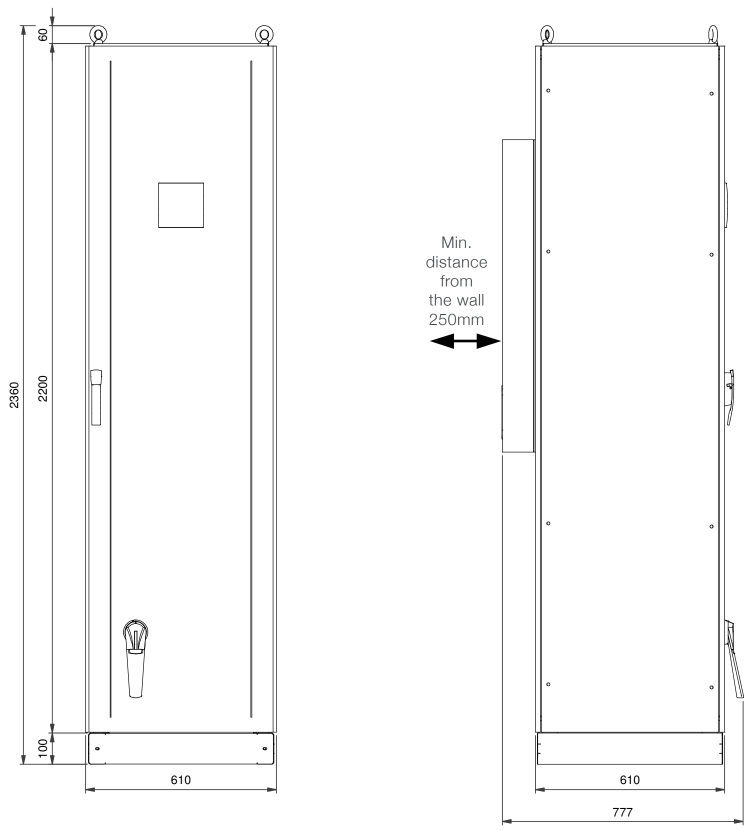

60
1760
1600
100
610
Min. distance
from the wall
250mm
610
777

76


60
2160
2000
100
Min.
distance
from
the wall
250mm
Min. distance
from the wall
250mm
610
822
610
670

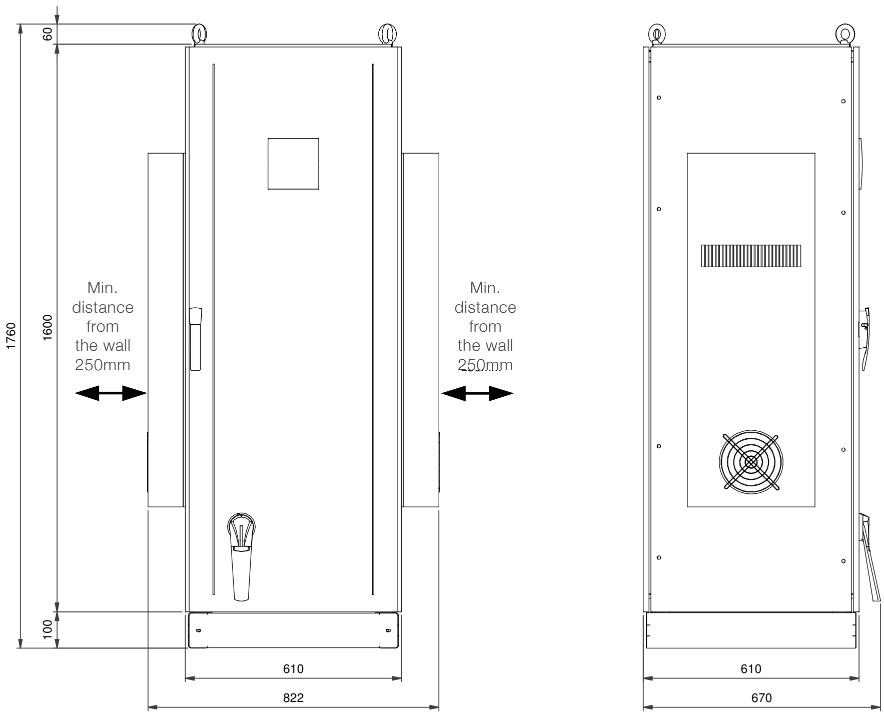

60
2360
2200
100
Min.
distance
from
the wall
250mm
Min.
distance
from
the wall
250mm
610
822
610
670

77

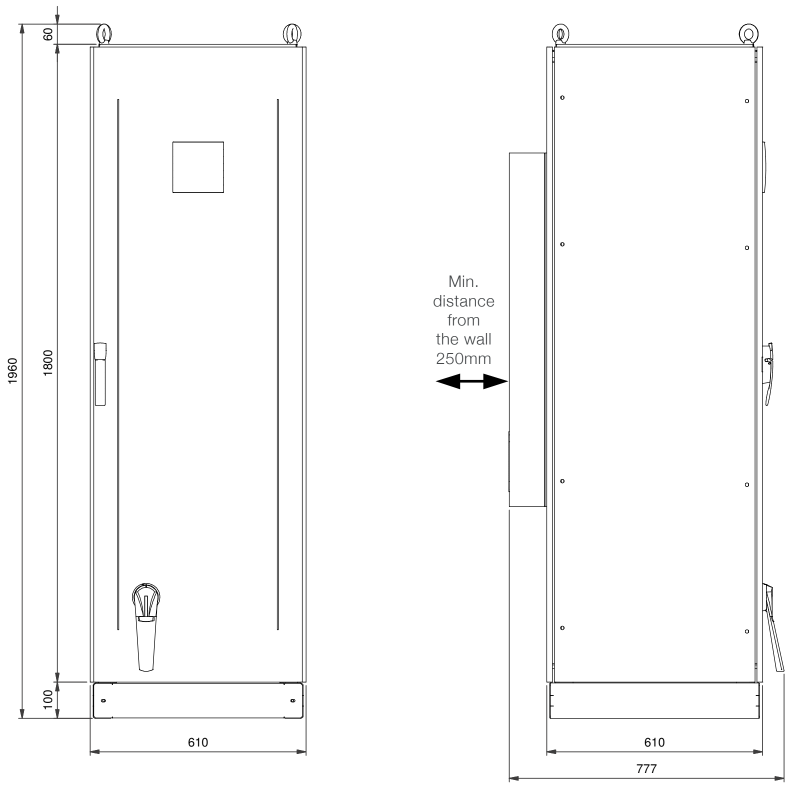

60
2360
2200
100
610
Min.
distance
from
the wall
250mm
610
777

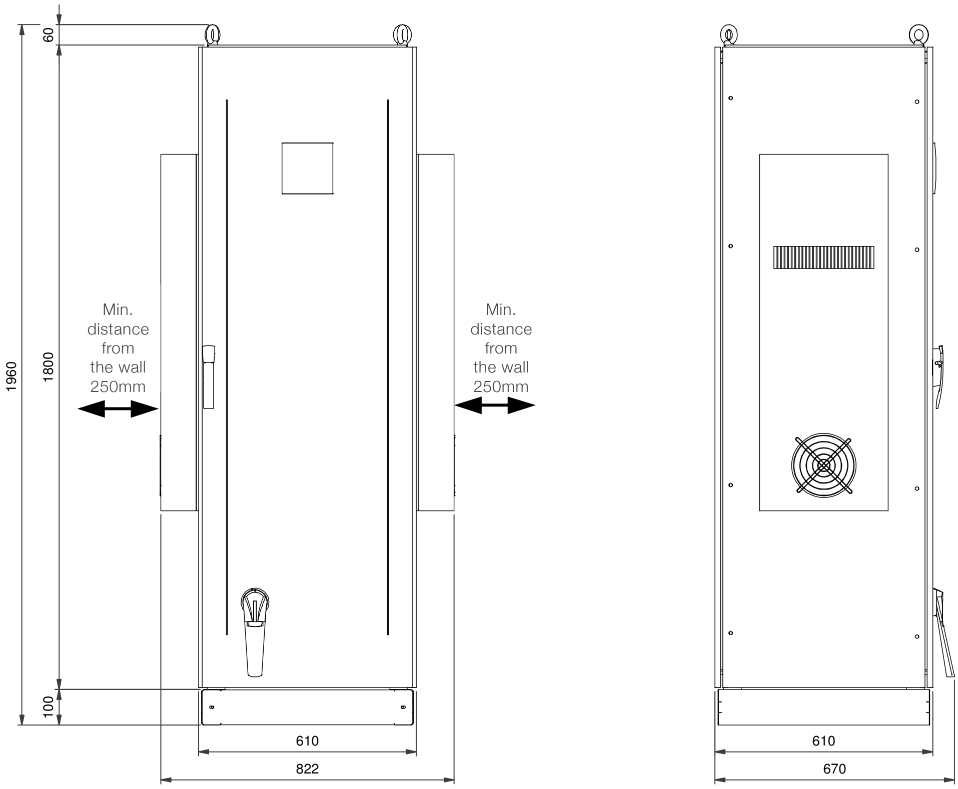
78

80

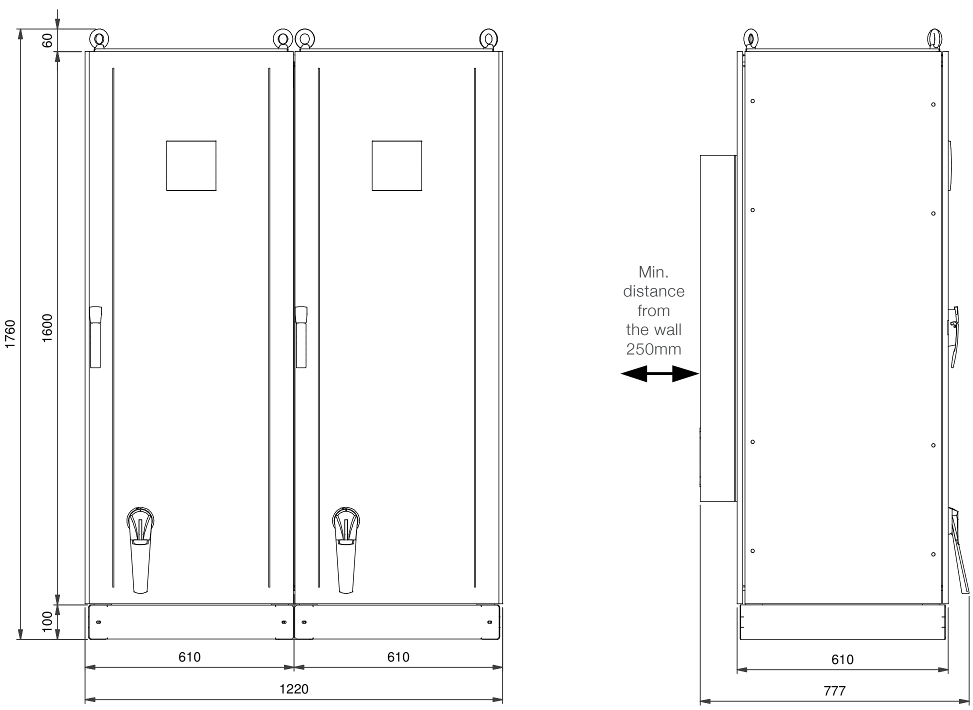

60
1760
1600
100
Min.
distance
from
the wall
250mm
Min.
distance
from
the wall
250mm
610
822
610
670

81


60
1960
1800
100
610
Min.
distance
from
the wall
250mm
610
777



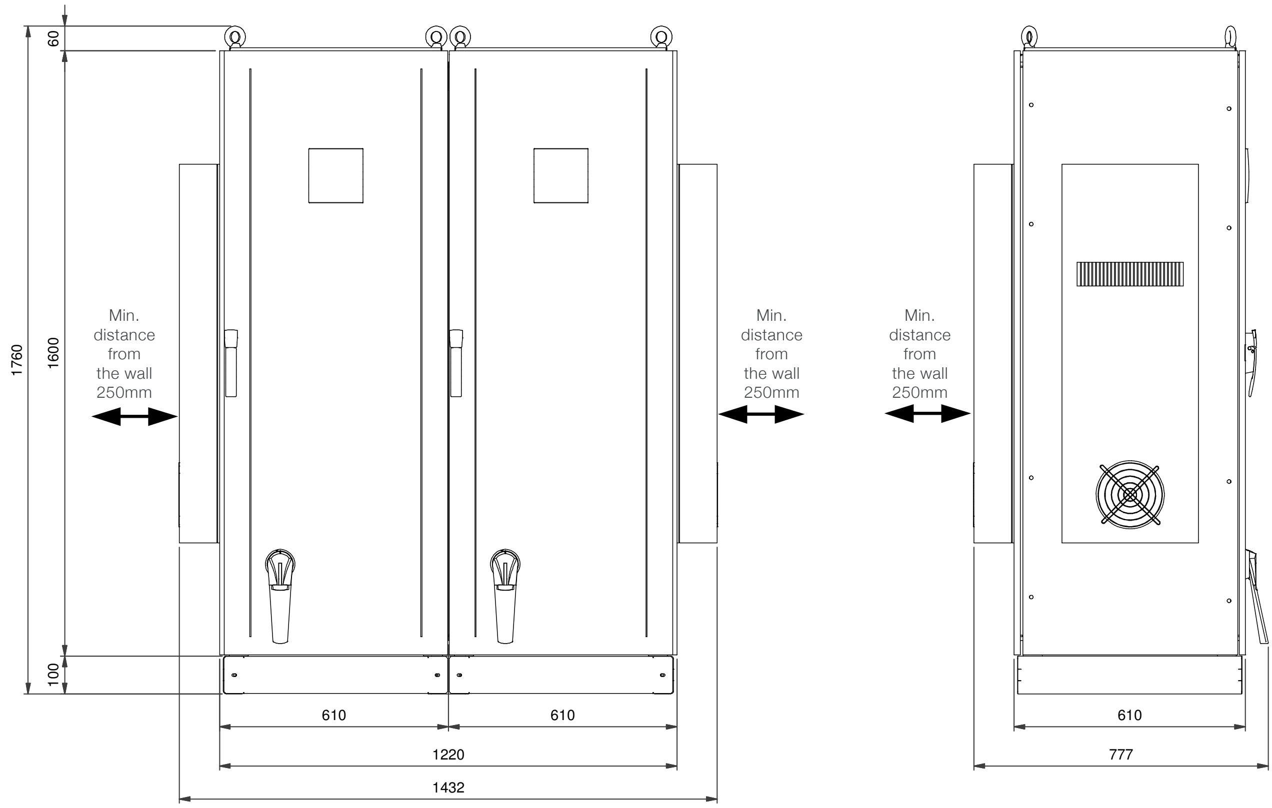
82



83

Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.

84



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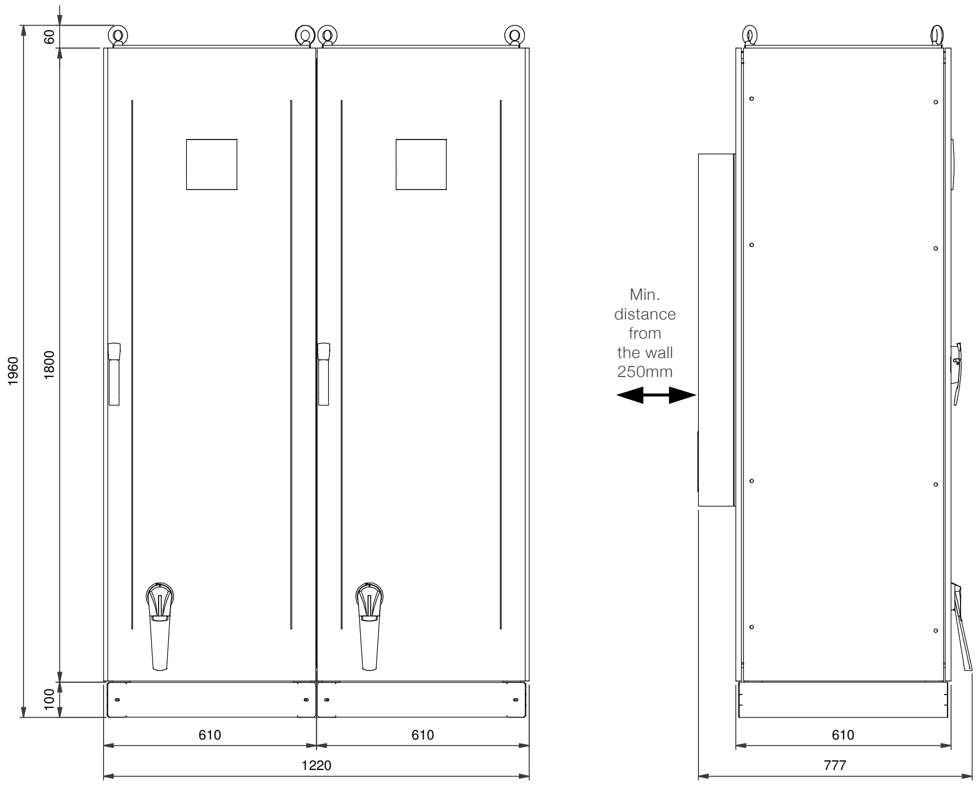
85



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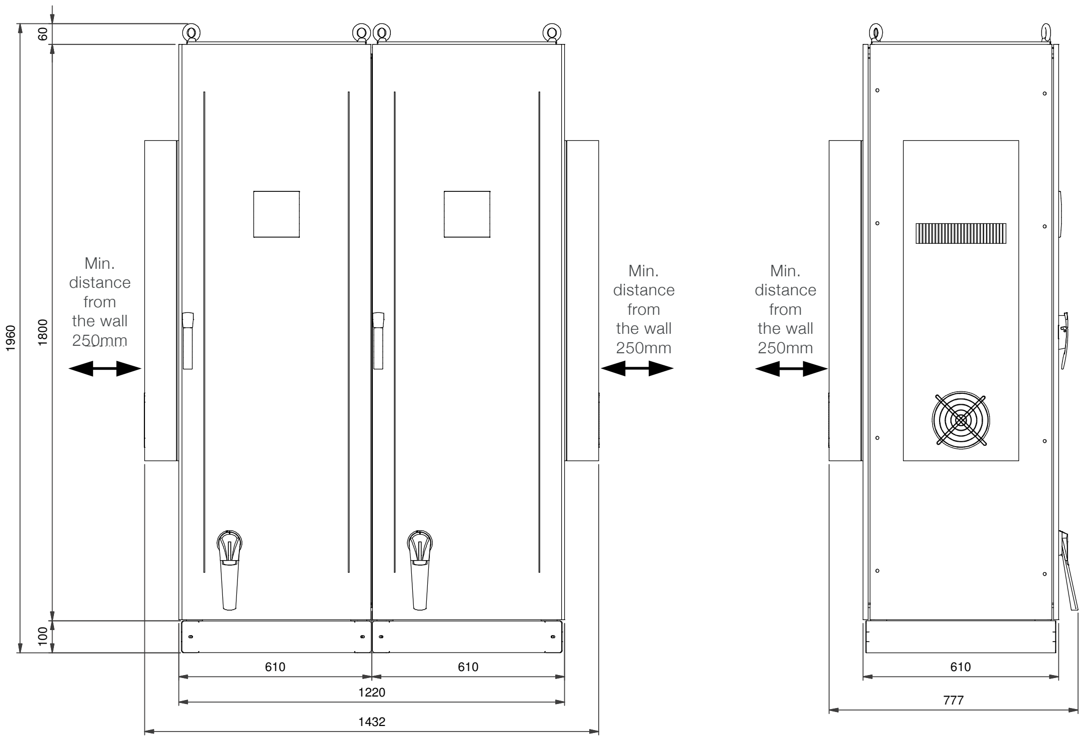
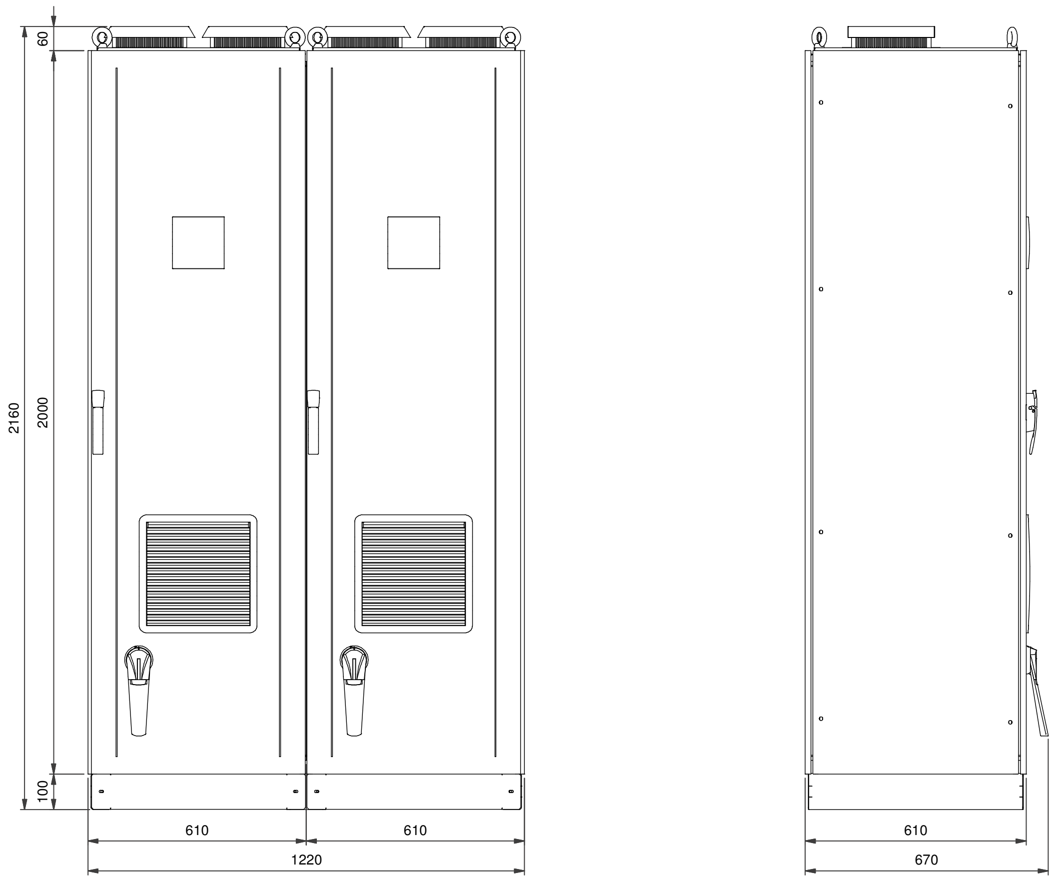


86

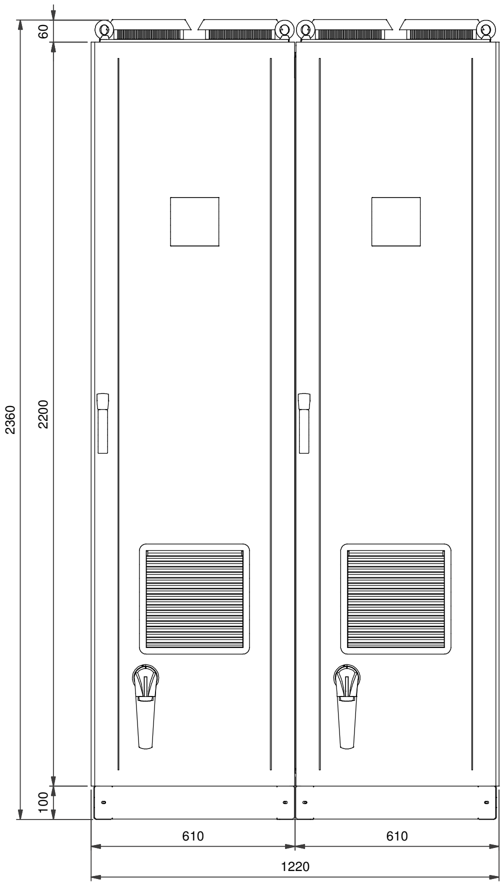
Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.

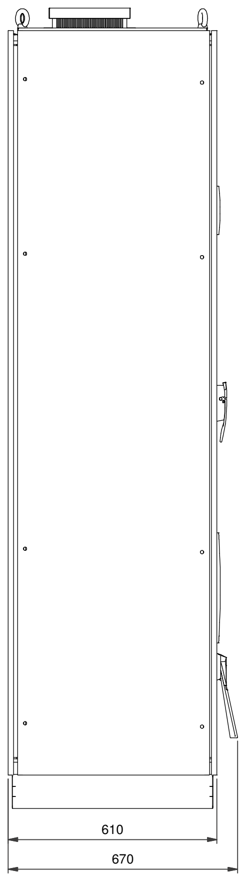


90

Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.

91





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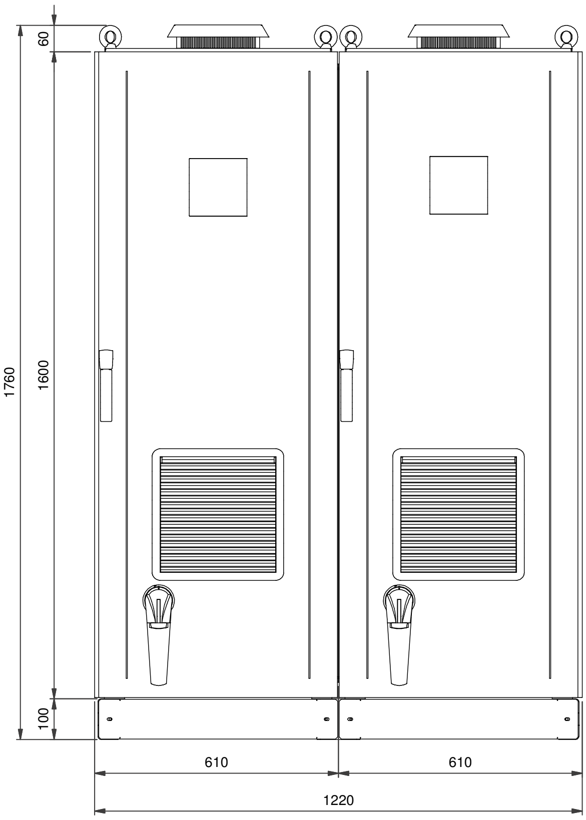
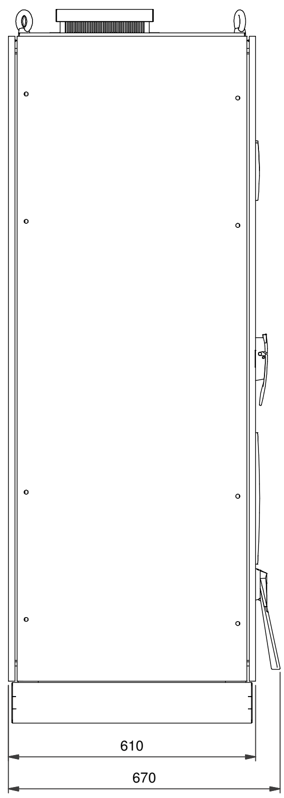
92





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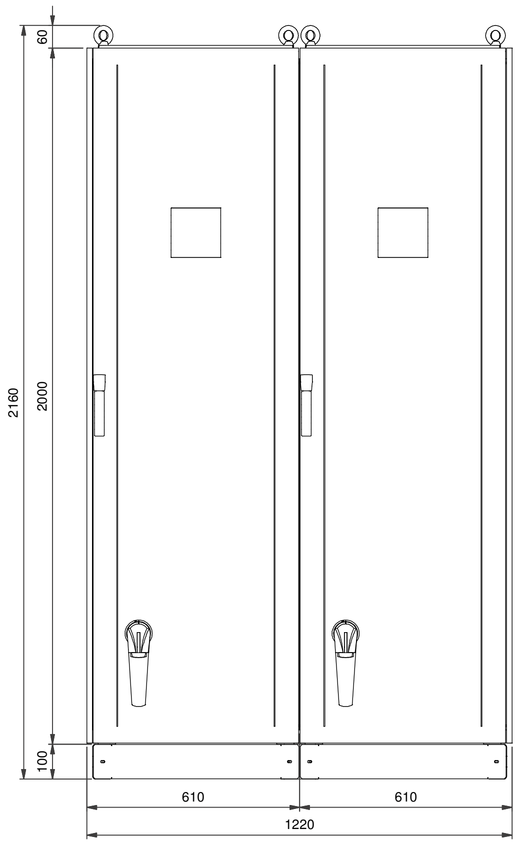
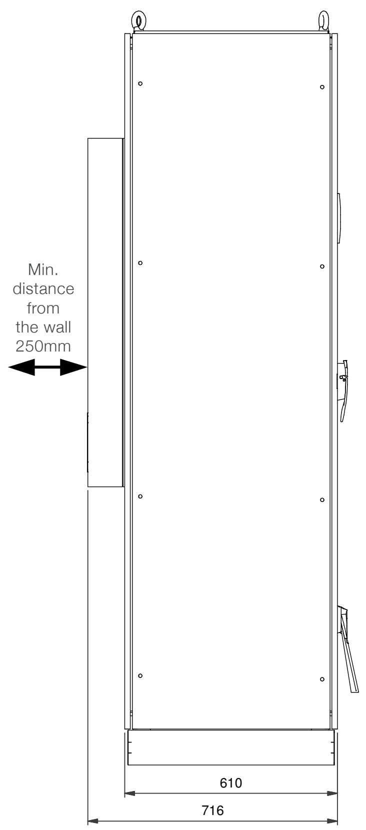
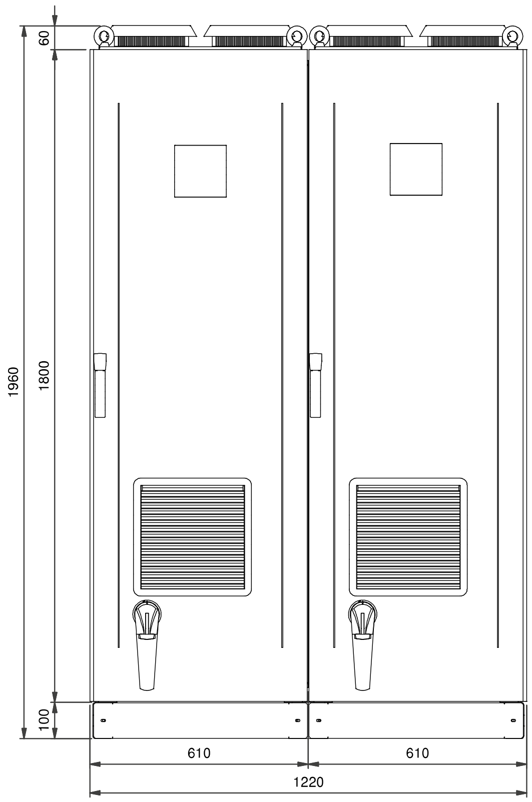
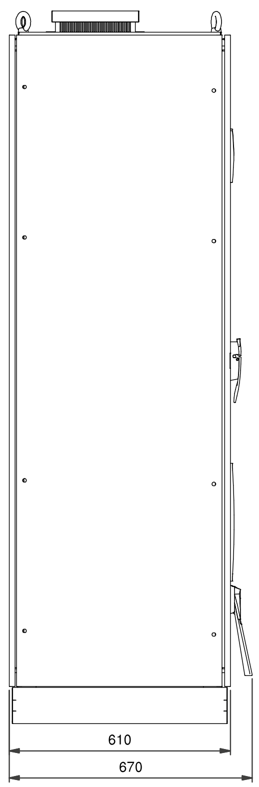




93

Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.

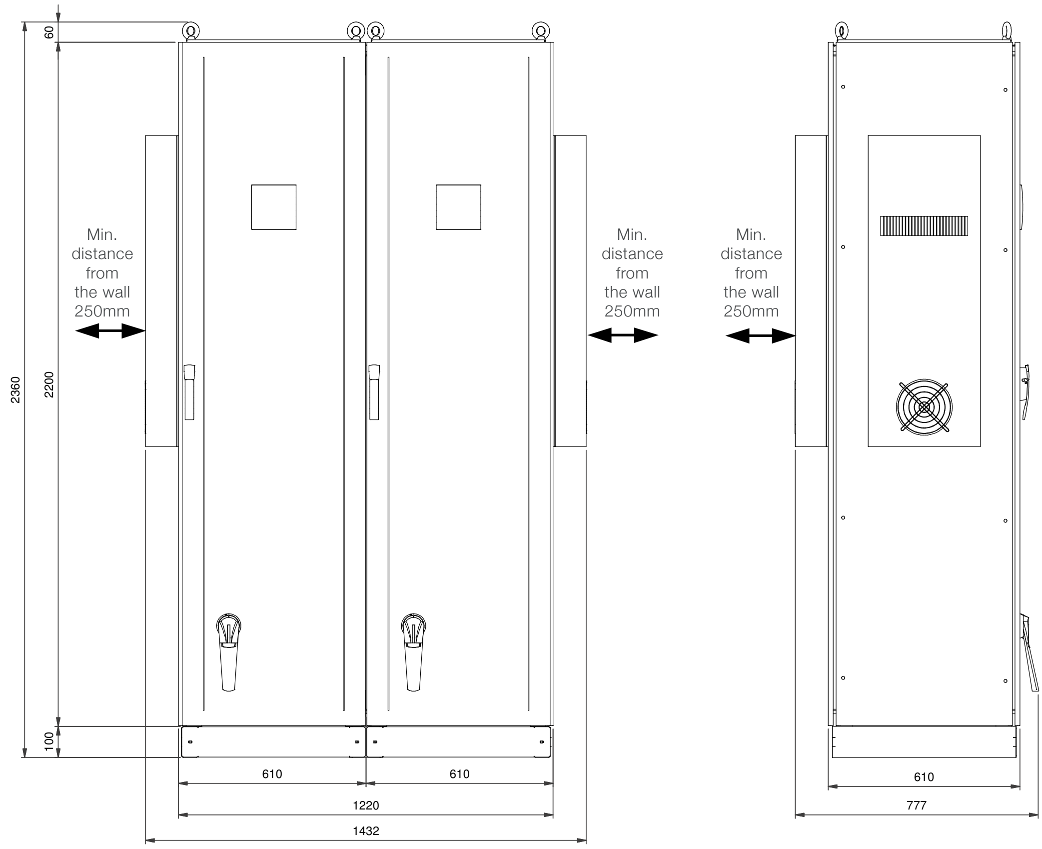




94

Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.

95



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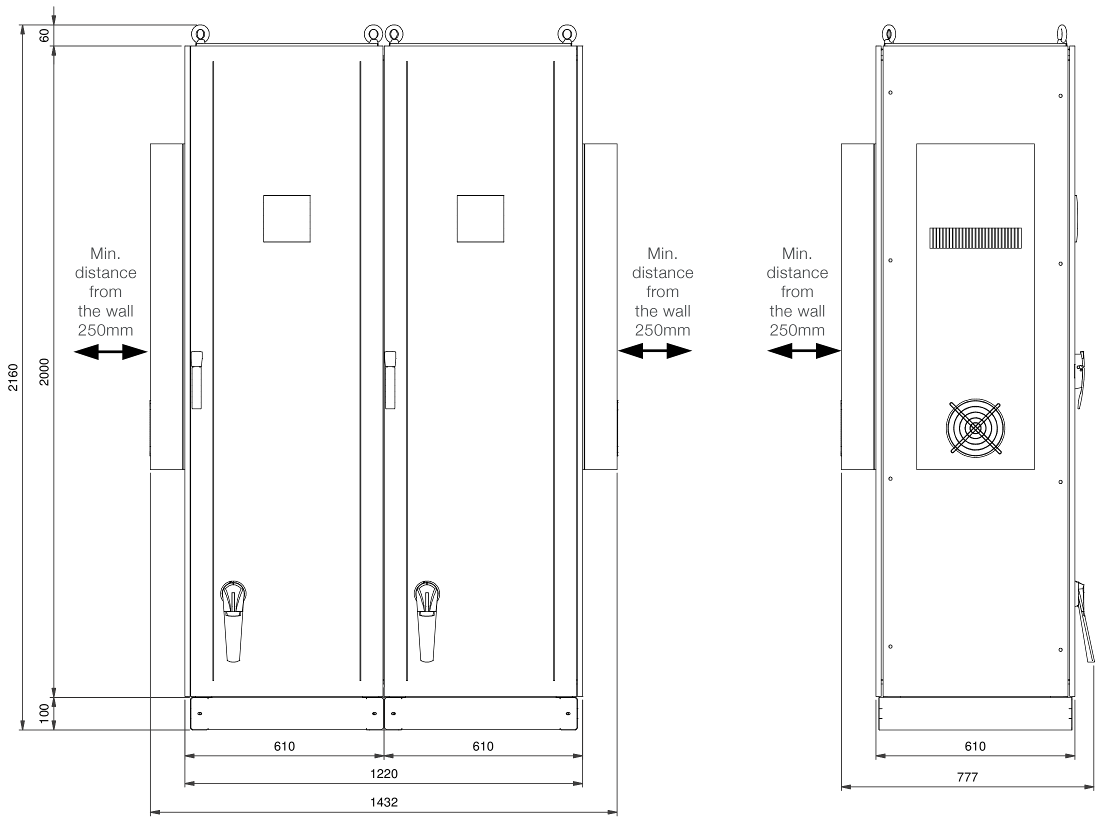
96



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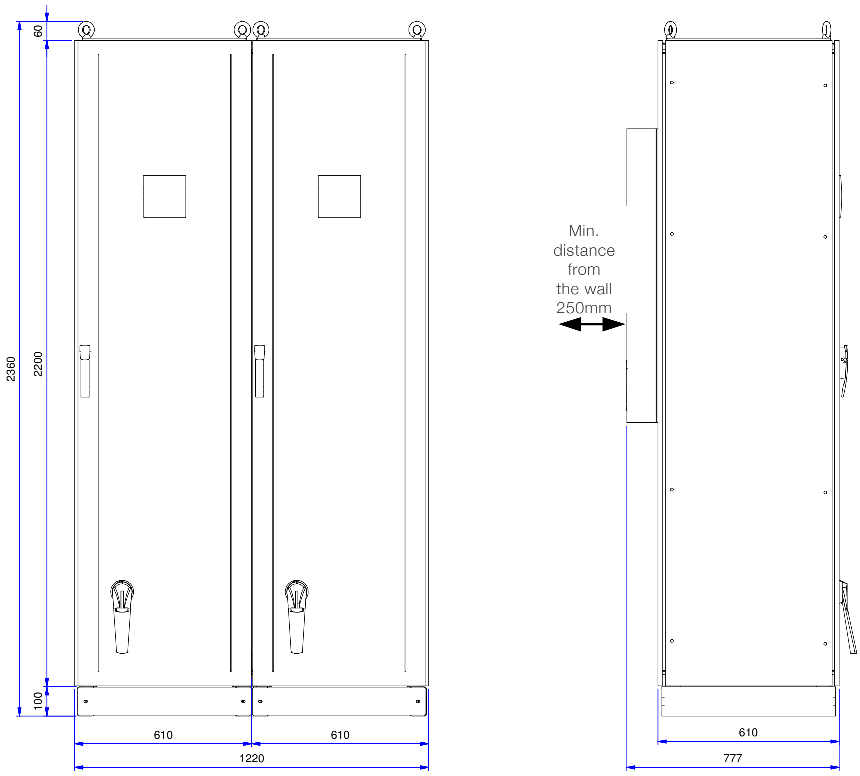
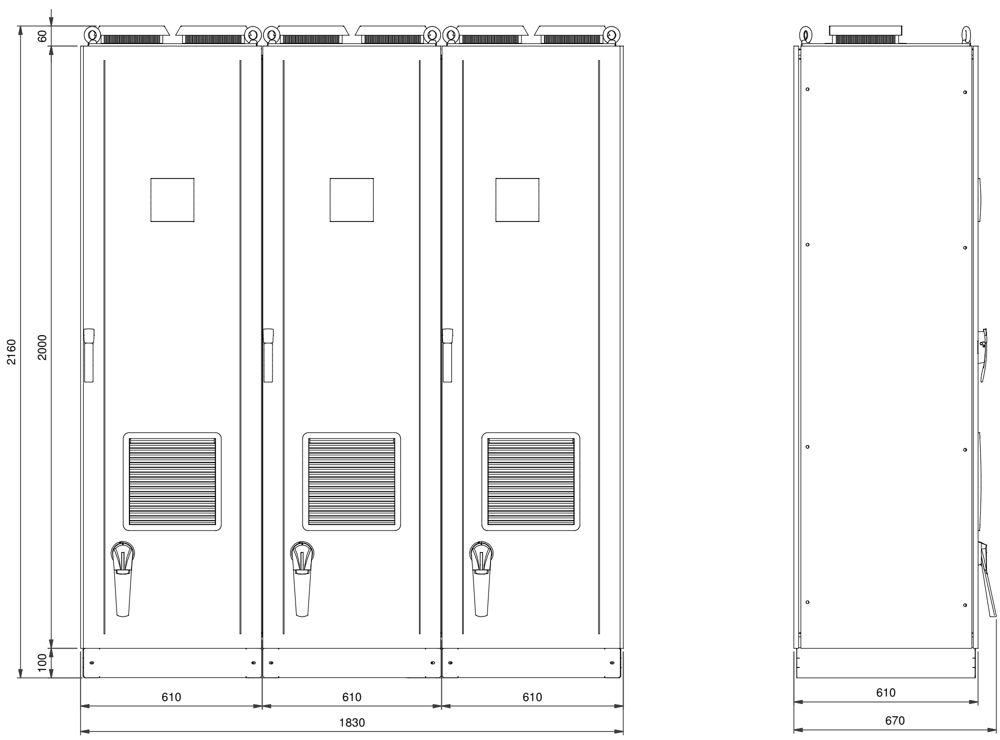


98

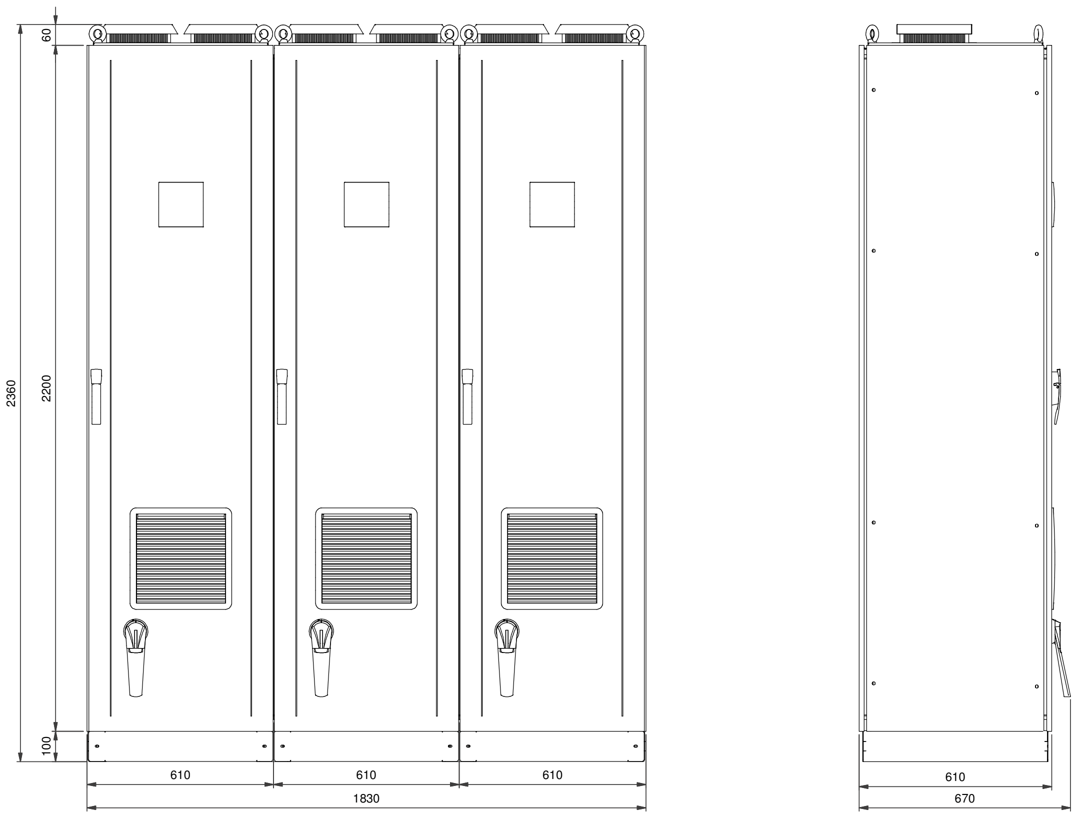
Note: MULTImatic in two columns have two disconnectors and require two cable entries. For versions with single cable entry, contact us.



101

Note: MULTImatic in two columns have three disconnectors and require three cable entries. For versions with single cable entry, contact us.

102



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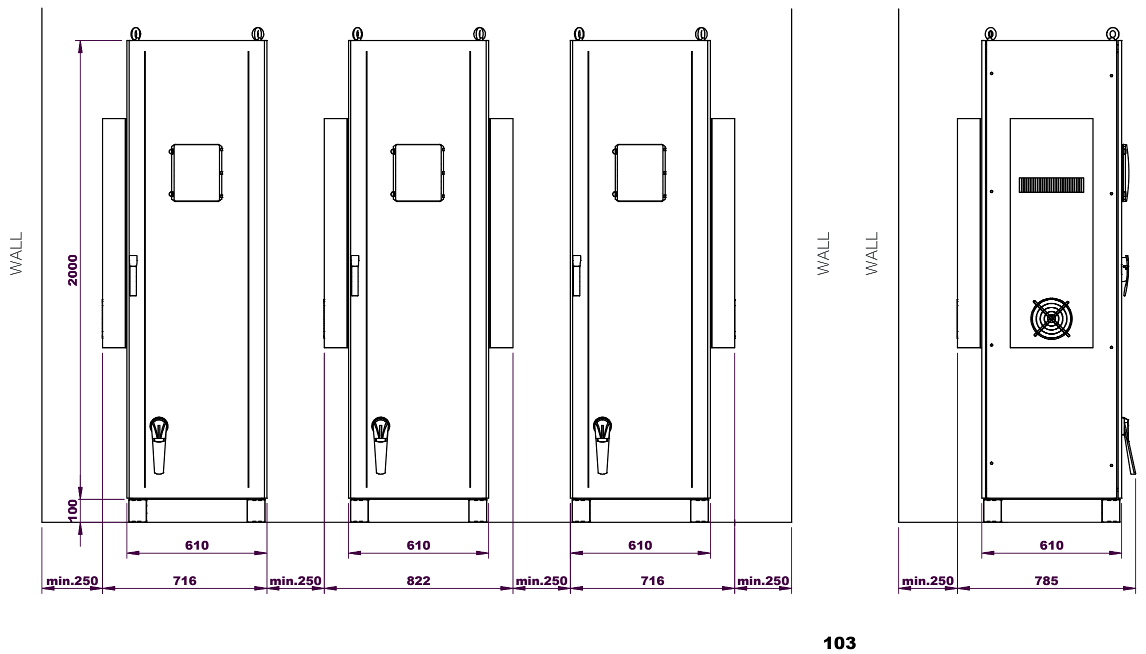
103



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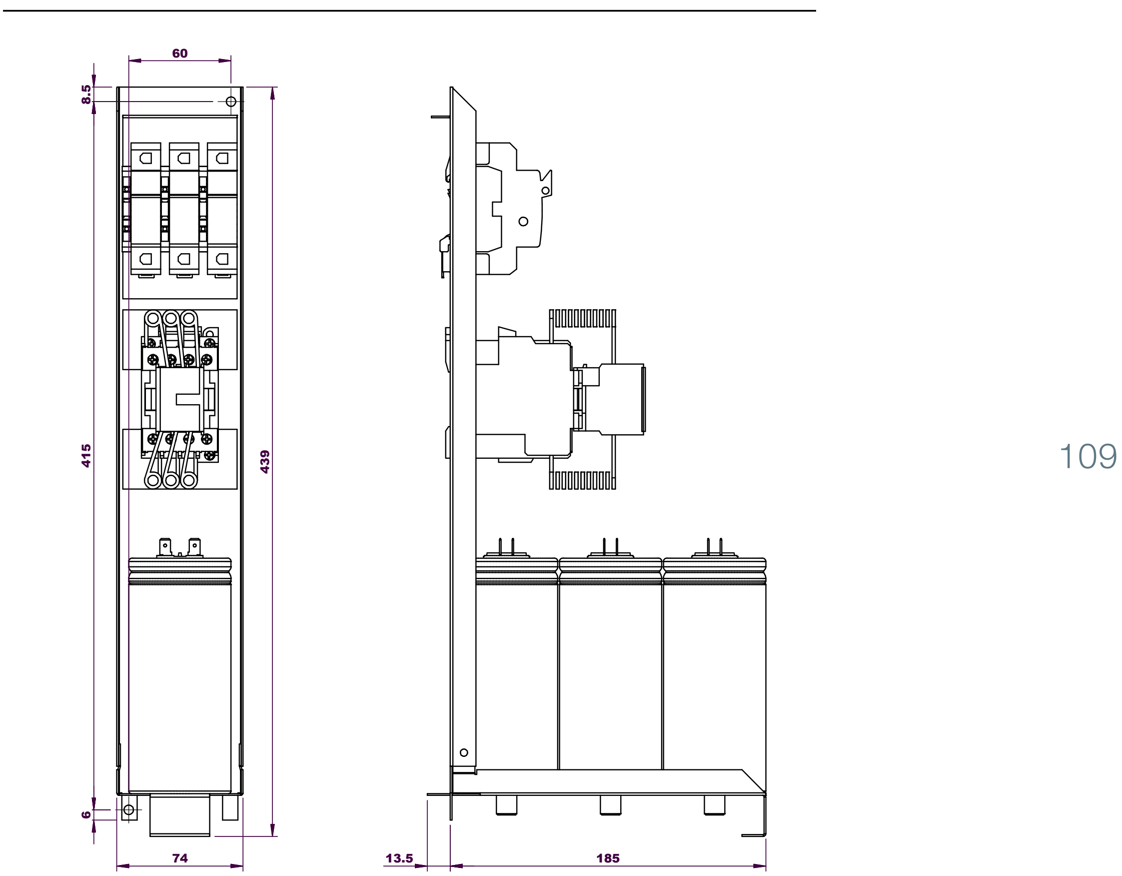

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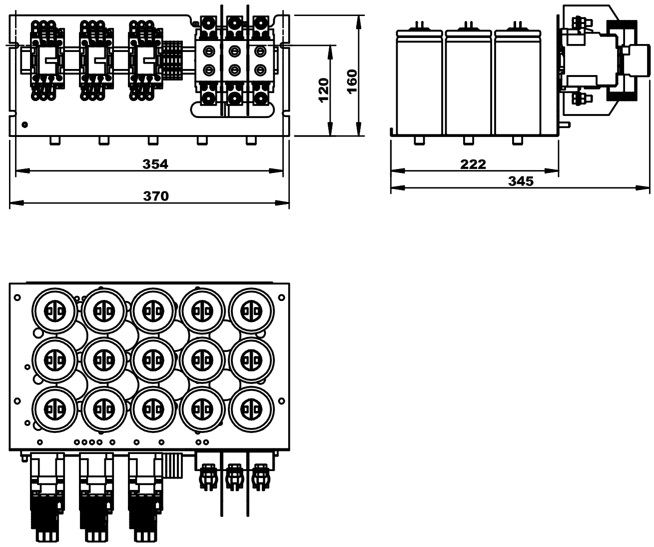

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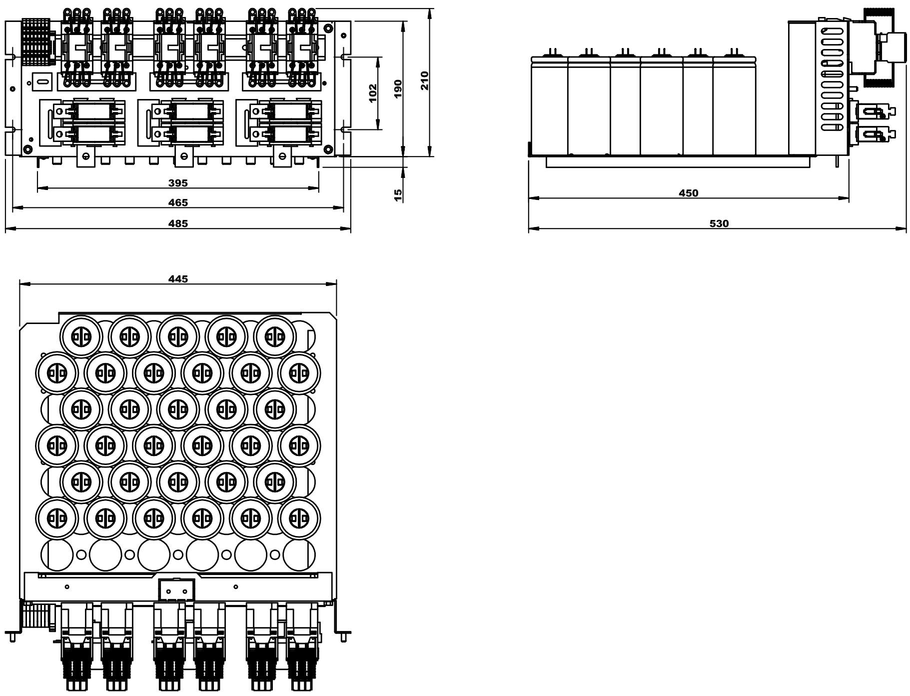
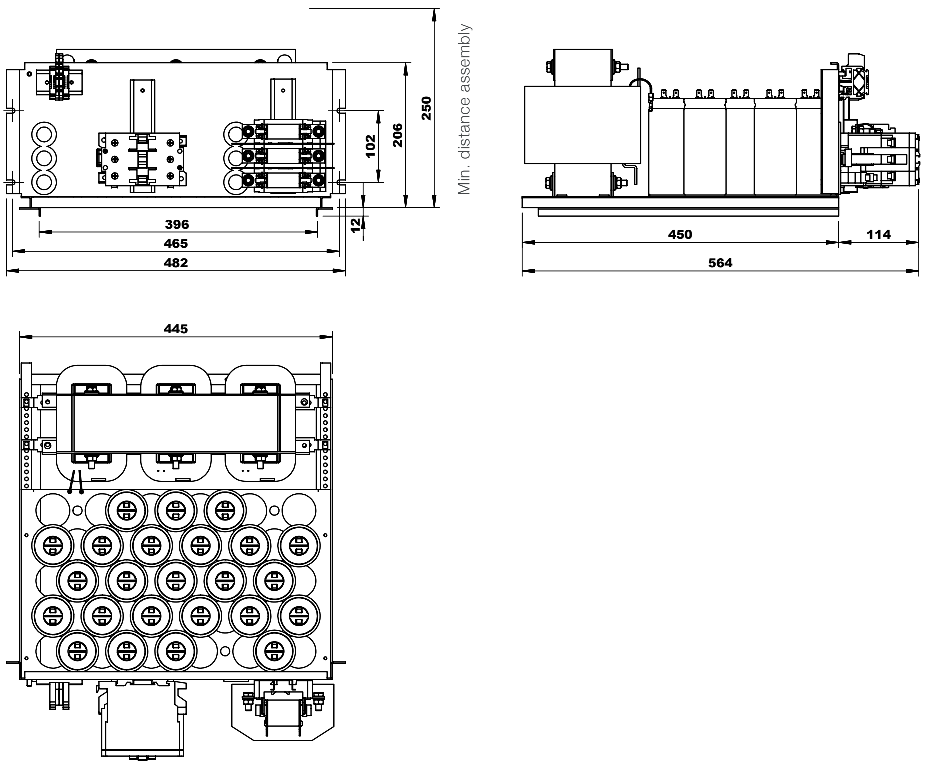
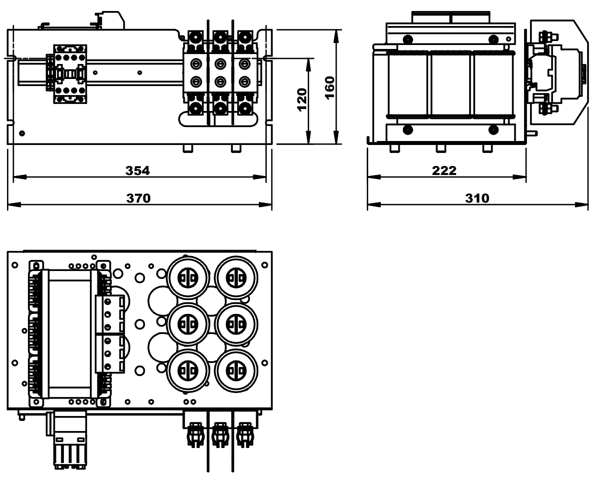
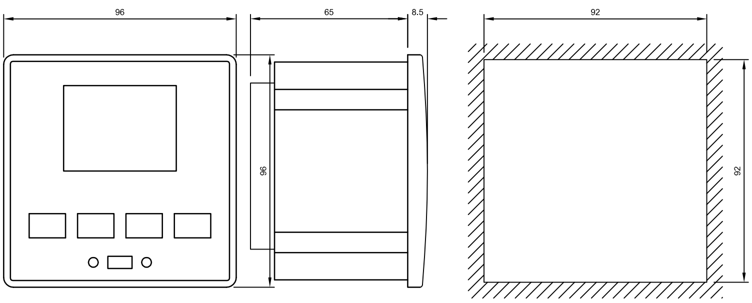




130

135

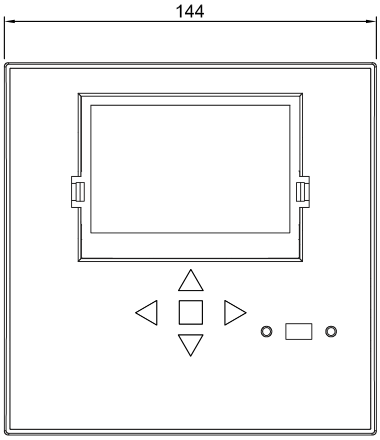




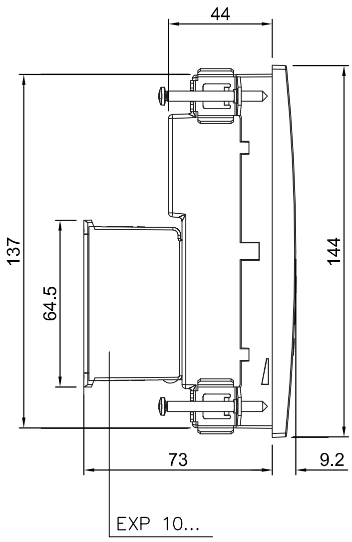
144

Overall dimensions Depth Drilling

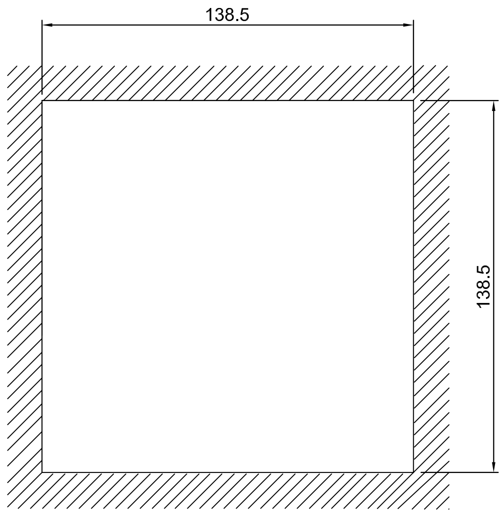
Overall dimensions



Depth



Drilling



* With additional modules the total depth behind the door is 73mm

147

K factor for turning active power into reactive power to achieve target power factor.

Starting power factor	Target power factor									
	0,9	0,91	0,92	0,93	0,94	0,95	0,96	0,97	0,98	0,99
0,30	2,695	2,724	2,754	2,785	2,817	2,851	2,888	2,929	2,977	3,037
0,31	2,583	2,611	2,641	2,672	2,704	2,738	2,775	2,816	2,864	2,924
0,32	2,476	2,505	2,535	2,565	2,598	2,632	2,669	2,710	2,758	2,818
0,33	2,376	2,405	2,435	2,465	2,498	2,532	2,569	2,610	2,657	2,718
0,34	2,282	2,310	2,340	2,371	2,403	2,437	2,474	2,515	2,563	2,623
0,35	2,192	2,221	2,250	2,281	2,313	2,348	2,385	2,426	2,473	2,534
0,36	2,107	2,136	2,166	2,196	2,229	2,263	2,300	2,341	2,388	2,449
0,37	2,027	2,055	2,085	2,116	2,148	2,182	2,219	2,260	2,308	2,368
0,38	1,950	1,979	2,008	2,039	2,071	2,105	2,143	2,184	2,231	2,292
0,39	1,877	1,905	1,935	1,966	1,998	2,032	2,069	2,110	2,158	2,219
0,40	1,807	1,836	1,865	1,896	1,928	1,963	2,000	2,041	2,088	2,149
0,41	1,740	1,769	1,799	1,829	1,862	1,896	1,933	1,974	2,022	2,082
0,42	1,676	1,705	1,735	1,766	1,798	1,832	1,869	1,910	1,958	2,018
0,43	1,615	1,644	1,674	1,704	1,737	1,771	1,808	1,849	1,897	1,957
0,44	1,557	1,585	1,615	1,646	1,678	1,712	1,749	1,790	1,838	1,898
0,45	1,500	1,529	1,559	1,589	1,622	1,656	1,693	1,734	1,781	1,842
0,46	1,446	1,475	1,504	1,535	1,567	1,602	1,639	1,680	1,727	1,788
0,47	1,394	1,422	1,452	1,483	1,515	1,549	1,586	1,627	1,675	1,736
0,48	1,343	1,372	1,402	1,432	1,465	1,499	1,536	1,577	1,625	1,685
0,49	1,295	1,323	1,353	1,384	1,416	1,450	1,487	1,528	1,576	1,637
0,50	1,248	1,276	1,306	1,337	1,369	1,403	1,440	1,481	1,529	1,590
0,51	1,202	1,231	1,261	1,291	1,324	1,358	1,395	1,436	1,484	1,544
0,52	1,158	1,187	1,217	1,247	1,280	1,314	1,351	1,392	1,440	1,500
0,53	1,116	1,144	1,174	1,205	1,237	1,271	1,308	1,349	1,397	1,458
0,54	1,074	1,103	1,133	1,163	1,196	1,230	1,267	1,308	1,356	1,416
0,55	1,034	1,063	1,092	1,123	1,156	1,190	1,227	1,268	1,315	1,376
0,56	0,995	1,024	1,053	1,084	1,116	1,151	1,188	1,229	1,276	1,337
0,57	0,957	0,986	1,015	1,046	1,079	1,113	1,150	1,191	1,238	1,299
0,58	0,920	0,949	0,979	1,009	1,042	1,076	1,113	1,154	1,201	1,262
0,59	0,884	0,913	0,942	0,973	1,006	1,040	1,077	1,118	1,165	1,226
0,60	0,849	0,878	0,907	0,938	0,970	1,005	1,042	1,083	1,130	1,191
0,61	0,815	0,843	0,873	0,904	0,936	0,970	1,007	1,048	1,096	1,157
0,62	0,781	0,810	0,839	0,870	0,903	0,937	0,974	1,015	1,062	1,123
0,63	0,748	0,777	0,807	0,837	0,870	0,904	0,941	0,982	1,030	1,090
0,64	0,716	0,745	0,775	0,805	0,838	0,872	0,909	0,950	0,998	1,058
0,65	0,685	0,714	0,743	0,774	0,806	0,840	0,877	0,919	0,966	1,027
0,66	0,654	0,683	0,712	0,743	0,775	0,810	0,847	0,888	0,935	0,996
0,67	0,624	0,652	0,682	0,713	0,745	0,779	0,816	0,857	0,905	0,966
0,68	0,594	0,623	0,652	0,683	0,715	0,750	0,787	0,828	0,875	0,936
0,69	0,565	0,593	0,623	0,654	0,686	0,720	0,757	0,798	0,846	0,907
0,70	0,536	0,565	0,594	0,625	0,657	0,692	0,729	0,770	0,817	0,878
0,71	0,508	0,536	0,566	0,597	0,629	0,663	0,700	0,741	0,789	0,849
0,72	0,480	0,508	0,538	0,569	0,601	0,635	0,672	0,713	0,761	0,821
0,73	0,452	0,481	0,510	0,541	0,573	0,608	0,645	0,686	0,733	0,794
0,74	0,425	0,453	0,483	0,514	0,546	0,580	0,617	0,658	0,706	0,766
0,75	0,398	0,426	0,456	0,487	0,519	0,553	0,590	0,631	0,679	0,739
0,76	0,371	0,400	0,429	0,460	0,492	0,526	0,563	0,605	0,652	0,713
0,77	0,344	0,373	0,403	0,433	0,466	0,500	0,537	0,578	0,626	0,686
0,78	0,318	0,347	0,376	0,407	0,439	0,474	0,511	0,552	0,599	0,660
0,79	0,292	0,320	0,350	0,381	0,413	0,447	0,484	0,525	0,573	0,634
0,80	0,266	0,294	0,324	0,355	0,387	0,421	0,458	0,499	0,547	0,608
0,81	0,240	0,268	0,298	0,329	0,361	0,395	0,432	0,473	0,521	0,581
0,82	0,214	0,242	0,272	0,303	0,335	0,369	0,406	0,447	0,495	0,556
0,83	0,188	0,216	0,246	0,277	0,309	0,343	0,380	0,421	0,469	0,530
0,84	0,162	0,190	0,220	0,251	0,283	0,317	0,354	0,395	0,443	0,503
0,85	0,135	0,164	0,194	0,225	0,257	0,291	0,328	0,369	0,417	0,477
0,86	0,109	0,138	0,167	0,198	0,230	0,265	0,302	0,343	0,390	0,451
0,87	0,082	0,111	0,141	0,172	0,204	0,238	0,275	0,316	0,364	0,424
0,88	0,055	0,084	0,114	0,145	0,177	0,211	0,248	0,289	0,337	0,397
0,89	0,028	0,057	0,086	0,117	0,149	0,184	0,221	0,262	0,309	0,370
0,90	-	0,029	0,058	0,089	0,121	0,156	0,193	0,234	0,281	0,342
0,91	-	-	0,030	0,060	0,093	0,127	0,164	0,205	0,253	0,313
0,92	-	-	-	0,031	0,063	0,097	0,134	0,175	0,223	0,284
0,93	-	-	-	-	0,032	0,067	0,104	0,145	0,192	0,253
0,94	-	-	-	-	-	0,034	0,071	0,112	0,160	0,220
0,95	-	-	-	-	-	-	0,037	0,078	0,126	0,186

Typical Power Factor of few common loads

		cos phi
Office appliances (computers, printers, etc)		0,7
Fridges		0,8
Commercial mall		0,85
Office block		0,8
Extruders		0,4÷0,7
Resistor furnaces		1
Arc furnaces		0,8
Induction furnaces		0,85
lampade ad incandescenza		1
Incandescent lamps		0,4÷0,6
Discharge lamps		0,5
Fluorescent lamps without integrated PFC		0,9÷0,93
LED lamps without integrated PFC		0,3÷0,6
LED lamps with integrated PFC		0,9÷0,95
Asynchronous motor		
load factor	**0**	0,2
	25%	0,55
	50%	0,72
	75%	0,8
	100%	0,85
Mechanical workshop		0,6÷0,7
Carpentry		0,7÷0,8
Hospital		0,8
Glassworks		0,8
Food appliances with VSD		0,99
Photovoltaic plants with site exchange		0,1÷0,9

CT-ICAR-2019-S10-PFC-2EN

ORTEA NEXT
IMPROVE YOUR POWER QUALITY

Companies are more and more sensitive to Power Quality issues because they can cause troubles and damages to equipments.

Our Power Quality solutions:

VOLTAGE STABILISERS
SAG COMPENSATOR
DRY-TYPE TRANSFORMERS
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