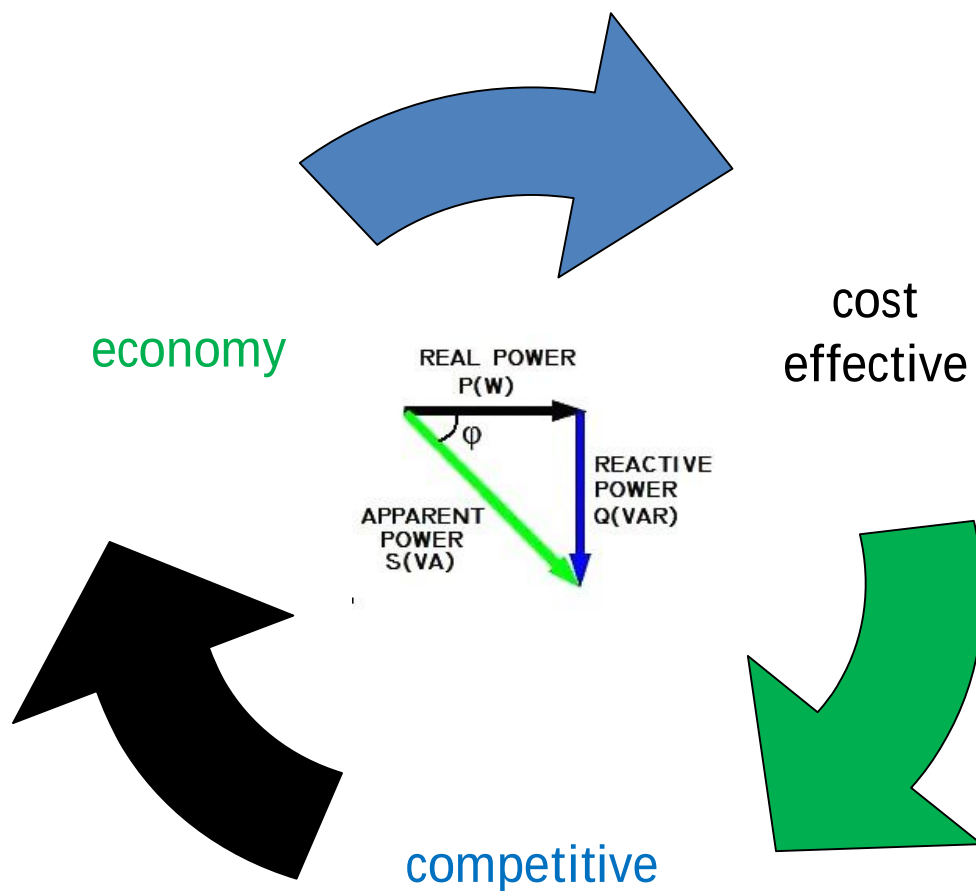




LOW VOLTAGE POWER FACTOR CORRECTION CAPACITOR BANKS

CATALOGUE

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What is reactive energy and why it is necessary to compensate it

Reactive energy is consumed by the receivers, such as transformers, motors, ballasts, fluorescent tubes, etc. and it is charged as well as the active energy by the electric power suppliers.

Reactive energy (E_r) is expressed in kilovar hours (kVARh). It is used in particular to create the magnetic field in the windings of motors, transformers, etc. Without the magnetic field their operation would be impossible. Q is the reactive power (kvar) which corresponds to this energy.

Active energy (E_a) is expressed in kilowatt hours (kWh). It can be used, after processing by the receiver, in the form of work or heat. Active power P [kW] corresponds to this energy.

The apparent power is by definition $S = \sqrt{P^2 + Q^2}$ [kVA]

The tangent $\tan \varphi$ is the ratio $\varphi = E_r / E_a$ and the power factor or $\cos \varphi$ is the ratio $\cos \varphi = P / S$.

The energy metering devices record active and reactive energy consumption'

The electricity suppliers generally show the term $\tan \varphi$ or $\cos \varphi$ on their bill.

Unlike the $\cos \varphi$, it is easy to see that the value of $\tan \varphi$ should be as small as possible in order to have the least reactive energy consumption.

A good power factor is $\cos \varphi$ high (close to 1) or $\tan \varphi$ low (close to 0).

Reactive power compensation gives you the following benefits:

- savings on electrical equipment, a decrease of the power demand
- an increase in available power of the supply transformer
- lower voltage drops and Watt losses in cables
- savings on electricity bills by eliminating reactive energy consumption
- the reduction of subscribed power kVA [if available]

To compensate for reactive power, it is necessary to provide reactive power by installing compensation equipment instead of taking it from the main distribution.

If the value of reactive power to compensate it is small compared to the total apparent power of all the loads ($Q_c / S_t < 15\%$), we can choose fixed type compensation equipment. If this value is higher ($Q_c / S_t > 15\%$) it is advisable to choose an automatic compensation equipment.

Compact, cost effective solution automatic capacitor banks type QA1

Application

Central reactive power compensation in mains without or with little harmonic load $Sh/St < 15\%$
 Sh = total apparent power of harmonics producing loads

Equipment

- Cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas or resin impregnated, long life ($>130.000h$) capacitors;
- Special capacitor contactors with leading inrush current limiting resistances;
- Highly reliable automatic power factor regulator with voltage, current, PF and current THD displays, alarms for overvoltage, over and under compensation;
- Fuse switch disconnectors with NH fuses or MCB (option) for groups of capacitors;
- Forced ventilation for higher compensation power;
- Sturdy wall mounted cabinet;
- Compensation powers up to 200 kvar;

Standards

EN 61921, EN 60439-1, EN 60831-1

Rated voltage

230 – 690V, 50Hz

Installation

Indoor, outdoor on demand, up to 2000m above sea level

Protection

IP21 or IP54 on demand



Basic types

Q[kvar]	Steps	Dimensions HxWxD [mm]	Type
12.5	2.5+2x5	600x400x260	QA1-12.5/3
15	3x5	600x400x260	QA1-15/3
17	1x1.5+1x3.15+2x6.25	600x400x260	QA1-17/4
17.5	1x2.5+3x5	600x400x260	QA1-17.5/4
20	2x5+1x10	600x400x260	QA1-20/3
25	1x5+2x10	600x400x260	QA1-25/3
40	2x5+1x10+1x20	600x400x260	QA1-40/4
50	2x6.25+1x12.5+1x25	600x400x260	QA1-50/4
55	1x5+1x10+2x20	600x400x260	QA1-55/4
75	1x5+1x10+3x20	800x600x260	QA1-75/5
90	1x10+4x20	800x600x260	QA1-90/5
100	2x6.25+1x12.5+3x25	800x800x300	QA1-100/6
125	2x12.5+4x25	800x800x300	QA1-125/6
150	2x12.5+3x25+1x50	800x800x300	QA1-150/6
175	5x25+1x50	1000x800x300	QA1-175/6
200	4x25+2x50	1000x800x300	QA1-200/6



Options

Other power, number of steps: **maximum flexibility, we adapt to your requests!**

Input general switch/ input general breaker



Automatic Bank

Un: 3x400V + N, 50Hz

Qn: 50 kvar (2 x 6.25 + 12.5 + 25 kvar)

Input: 125A/ 10 kA MCB



Automatic bank

Un: 3x400V + N, 50Hz

Qn: 195 kvar (5 + 10 + 9 x 20 kvar)

Input: 60 mm bus bars system
(30x10mm² copper bars)

Protection: 4 x 125A bus-mounting
NH fuse switch disconnectors



Automatic Bank

Un: 3x400V + N, 50Hz

Qn: 25 kvar (5 + 2 x 10 kvar)

Input: 63A panel- mounting
NH fuse switch disconnectors

Fixed type capacitor banks QAF

Application

Local (load) reactive power compensation in mains without or with little harmonic loads.

Equipment

- Cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas or resin impregnated, long life (>130.000h) three phase capacitors;
- Fuse switch disconnectors with NH fuses or MCB (option);
- Green lamp on door for POWER ON signaling
- Sturdy wall mounted cabinet;
- Compensation powers up to 50 kvar

Standards

EN 61921, EN 60439-1, EN 60831-1

Rated voltage

230 – 690V, 50Hz

Installation

Indoor, outdoor on demand
up to 2000m above sea level

Protection

IP21 or IP54 on demand

Basic types

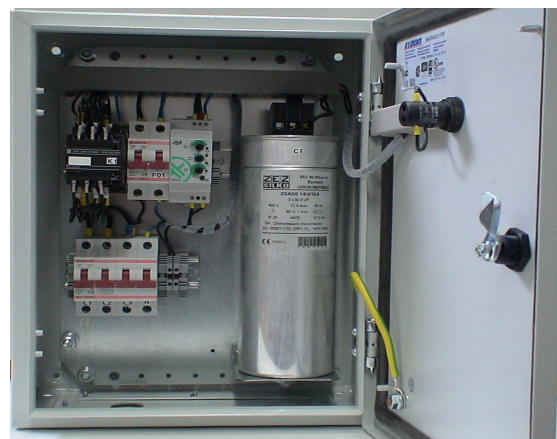
Q[kvar]	Dimensions HxWxD [mm]	Type
5	400x300x260	QF-5
10	400x300x260	QF-10
12.5	400x300x260	QF-12.5
15	400x300x260	QF-15
20	400x300x260	QF-20
25	400x300x260	QF-25
30	400x300x260	QF-30
40	400x300x260	QF-40
50	400x300x260	QF-50

Obs. For other reactive power please ask!



Fixed bank

Un: 3x400V, 50Hz
Qn: 15 kvar
Input: 63A/ 10kA MCB



One step automatic bank

Un: 3x400V, 50Hz
Qn: 1x20 kvar
Protection: 63A/ 10kA MCB

High power automatic capacitor banks type QA2

Application

Central reactive power compensation in mains without or with little harmonic load
 $Sh/St < 15\%$ (Sh = total apparent power of harmonics producing loads)

Equipment

- Cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas or resin impregnated, long life ($>130.000h$) capacitors;
- Special capacitor contactors with leading inrush current limiting resistances;
- Highly reliable automatic power factor regulator with voltage, PF, voltage THD, temperature and reactive power needed displays, alarms for overvoltage, over and under compensation, overtemperature, THD disconnection, etc.;
- Bus mounted fuse switch disconnectors with NH fuses for groups of capacitors;
- Forced ventilation;
- Sturdy floor standing modular cabinet;
- Compensation powers up to 900 kvar;

Standards

EN 61921, EN 60439-1, EN 60831-1

Rated voltage

230 – 690V, 50Hz

Installation

Indoor, outdoor on demand, up to 2000m above sea level

Protection

IP21 or IP54 on demand



Basic types

Q[kvar]	Steps	Dimensions HxWxD [mm]	Type
250	2x25+4x50	1900x800x600	QA2-250/6
275	1x25+5x50	1900x800x600	QA2-275/6
300	2x25+4x50 +1x100	1900x800x600	QA2-300/6
350	2x25 + 6x50	1900x800x600	QA2-350/8
400	2x25 + 7x50	1900x1600x600	QA2-400/9
500	2x25 + 9x50	1900x1600x600	QA2-500/11
600	12x50	1900x1600x600	QA2-600/12
700	10 x 50 + 2x100	1900x1600x600	QA2-700/12
800	8 x 50 + 4x100	1900x2400x600	QA2-800/12
900	6 x 50 + 6x100	1900x2400x600	QA2-900/12



Options

Other power, number of steps: **maximum flexibility, we adapt to your requests!**

Input general switch/ input general breaker

Compensation in the presence of current harmonics

It is well known that some electrical loads (electronic converters such as the inverter, rectifier, variable speed motors, welding machines, arc furnaces, fluorescent tubes) inject harmonic currents in mains that overload the capacitors.

Harmonics can cause destruction of capacitors and generate resonances on the network or cause malfunctions of equipment.

For centralized compensation in power networks with an average degree of harmonic pollution ($15 < Sh/St < 25$), we can use capacitors with superior rated voltage of 440V or 480V. These capacitors endure better the effect of harmonic overload.

But we must verify by careful calculation that the appearance of resonance in the electric network it is not possible! If the resonance is possible or the calculation shows that the harmonic overload or the degree of deformation of network voltage is too high, the solution is to use capacitor banks with anti-resonance protection reactors.

Capacitor banks type QAM with reinforced capacitors

Application

Centralized compensation in mains with an average degree of harmonic pollution $15\% < Sh/St < 25\%$ (Sh = apparent power of the loads generating harmonics)

Equipment

- Three phase cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas or resin impregnated, long life ($>130.000h$), 440 or 480V rated capacitors;
- Special capacitor contactors with leading inrush current limiting resistances;
- Highly reliable automatic power factor regulator with voltage, PF, voltage THD, temperature and reactive power needed displays, alarms for overvoltage, over and under compensation, overtemperature, THD disconnection, etc.;
- Bus or panel mounted fuse switch disconnectors with NH fuses for groups of capacitors;
- Forced ventilation;
- Sturdy floor standing modular cabinet;
- With or without switch disconnector on the cabinet door;
- Autotrafo 400/230V for auxiliary voltage supply;
- Compensation power up to 900 kvar;

Standards

EN 61921, EN 60439-1, EN 60831-1

Rated voltage

230 – 690V, 50Hz

Installation

Indoor, outdoor on demand, up to 2000m above sea level

Protection

IP21 or IP54 on demand

Options

Rated voltages of capacitors 440V or 480V, with or without input switch disconnector



Automatic Bank

Un: 3x400V + N, 50Hz

Qn: 300 kvar (2x25+5x50 kvar)

Group protection with bus-mounted
NH fuse switch disconnecter

Input: switch disconnecter 630A



Automatic Bank

Un: 3x400V + N, 50Hz

Qn: 350 kvar (2x25+6x50 kvar)

Group protection with bus-mounted
NH fuse switch disconnecter

Reactor protected automatic capacitor banks type QAR

Application

Central reactive power compensation in mains with harmonic loads.

25% < Sh/St < 50% (Sh = apparent power of the loads generating harmonics)

Equipment

- Cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas or resin impregnated, long life (>130.000h) capacitors with rated voltages 440, 480 or 525V;
- Special capacitor contactors with leading inrush current limiting resistances;
- 7% or 14% three phase detuning reactors, vacuum impregnated, temperature controlled;
- Highly reliable automatic power factor regulator with display for voltage, PF, voltage THD, temperature and reactive power needed, alarms for overvoltage, over and under compensation, overtemperature, THD disconnection, etc.;
- Fuse switch disconnectors with NH fuses for groups of capacitors;
- Controlled forced ventilation system;
- Sturdy floor standing cabinet;
- Compensation powers up to 900 kvar;

Standards

EN 61921, EN 60439-1, EN 60831-1

Rated voltage

230 – 690V, 50Hz

Installation

Indoor, outdoor on demand, up to 2000m above sea level

Protection

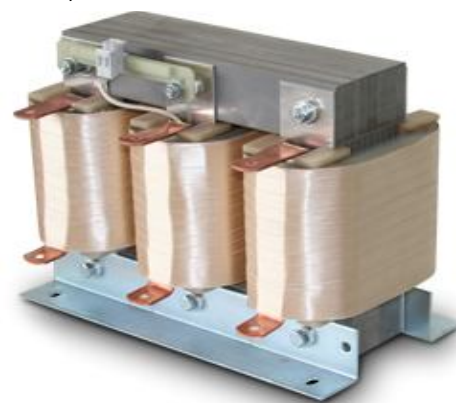
IP21 or IP54 on demand

Basic types

Q[kvar]	Steps	Dimensions HxWxD [mm]	Type
15	3x5	600x400x260	QAR-15/3
25	1x5+2x10	600x400x260	QAR-25/3
50	2x6.25+12.5+25	600x400x260	QAR-50/4
75	5+2x10+3x20	800x600x260	QAR-75/5
100	2x6.25+12.5+3x25	800x800x300	QAR-100/6
125	2x12.5+4x25	800x800x300	QAR-125/6
150	2x12.5+3x25+1x50	800x800x300	QAR-150/6
175	5x25+1x50	1000x800x300	QAR-175/6
200	4x25+2x50	1000x800x300	QAR-200/6
250	2x25+4x50	1900x800x600	QAR-250/6
300	2x25+4x50 +1x100	1900x800x600	QAR-300/6
350	2x25 + 6x50	1900x800x600	QAR-350/8
400	2x25 + 7x50	1900x1600x600	QAR-400/9
500	2x25 + 9x50	1900x1600x600	QAR-500/11
600	12x50	1900x1600x600	QAR-600/12
700	10x50 + 2x100	1900x1600x600	QAR-700/12
800	8x50 + 4x100	1900x2400x600	QAR-800/12
900	6x50 + 6x100	1900x2400x600	QAR-900/12

Options: Other power, number of steps: **maximum flexibility, we adapt to your requests!**

Input general switch/ input general breaker





Reactor protected automatic bank (7%)

Un: 3x600V , 50Hz

Qn: 500 kvar (10 x 50 kvar)

Input: 2x60 mm bus bars system
(2x30x10mm² copper bars)

Protection: 10 x 100A bus-mounting
NH fuse switch disconnectors



Reactor protected automatic bank (7%)

Un: 3x400V , 50Hz

Qn: 100 kvar (2x12.5+25+50 kvar)

Input: 250A/ 35kA MCCB

Harmonic filters

In case of heavily polluted harmonic networks, the user may face a double need:

- Compensating for reactive energy and protecting the capacitors
- Reduce the rate of voltage distortion at acceptable values, compatible with the proper functioning of the most sensitive receptors (PLCs, industrial computers, capacitors ...)

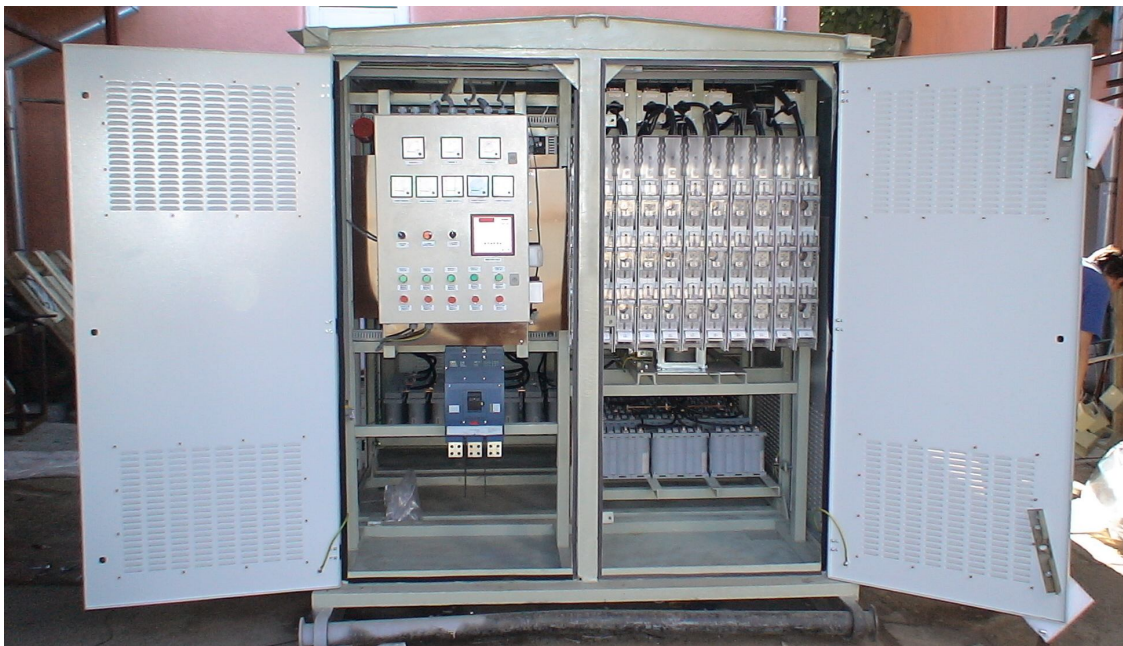
For this application, we use a passive harmonic filter which is a series combination of a capacitor and an inductor. The tuning frequency is the frequency of the harmonic current that we want to eliminate or reduce.

There is no standard solution for passive harmonic filters, each case must be studied in part:

- Analysis of the network on which the equipment must be installed with measurements of current and voltage harmonics
- Software simulation by computer taking into account the harmonic impedances of the network and different filter variants
- The design of each component of the filter according to the previous data
- Measurement of the effectiveness of the system after installation on site

The harmonic filter can be fixed or automatic.

We have extensive experience in the design and supply of passive harmonic filters.

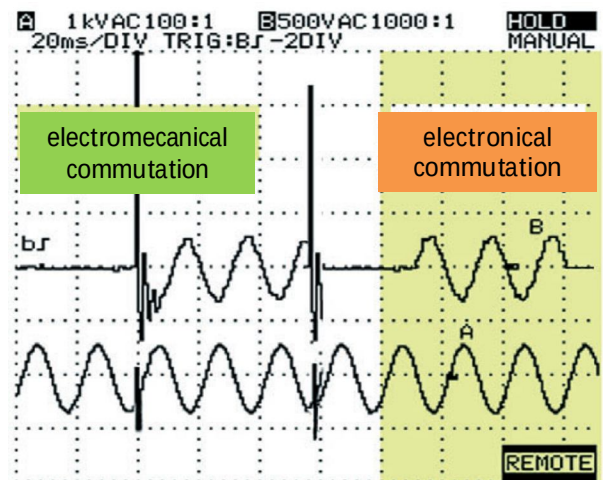
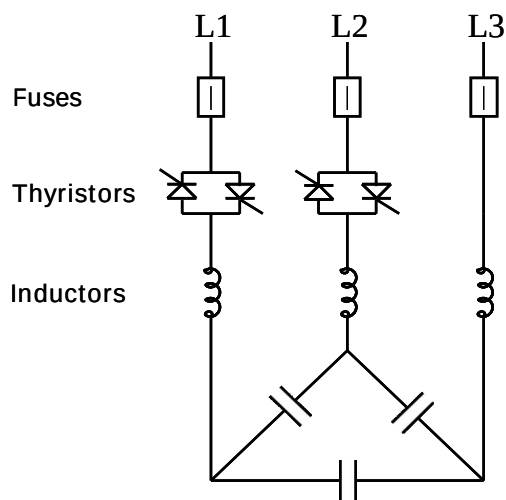


Mobile equipment for automatic reactive compensation and harmonic filtering
for oil rigs

3x660V, 50Hz, 600kvar, filtering for 5-th and 7-th harmonics

Ultra fast compensation

In case of loads with ultra-fast cycles (welding, electric arc furnaces, fast accelerating lifts) the capacitor switching by traditional system (electromechanical contactors) is no longer appropriate. Switching groups of capacitors or capacitor-inductor are made using the electronic switches. The connection / disconnection occurs at the zero crossing of the current. This would result in the elimination of transients associated with electromechanical switching (peak currents and voltages). This eliminates the possibility of damage to sensitive loads working on the same network (computers, electronic devices, etc.) and at the same time significantly increases the life of Capacitors.



Individual reactive compensation for modern transformers with reduced no-load losses

Transformer power [kVA]	6 a 20/0.4 kV capacitor power [kvar]	35/0.4 kV capacitor power [kvar]
100	3	4
160	4	4
250	5	6
400	6	7
630	8	8
1000	10	11
1600	12	13
2500	22	22
4000	27	27
6300	35	35
10000	45	45

Electric motors compensation

The table below gives an indication of the maximum power capacitor that can be connected directly to the terminals of an asynchronous motor. **But in all cases** should be checked if the maximum intensity of the capacitor current [A] does not exceed 90% of the magnetizing current (no load) of the electric motor!

Electric motor power	Speed [rev/min]			
	3000	1500	1000	500
[kW]	[kvar]	[kvar]	[kvar]	[kvar]
1.1	0.5	0.5	0.7	0.8
1.5	0.6	0.8	0.8	0.8
2.2	1	1	1	1
3	1.5	1.6	1.6	1.6
4	1.6	1.8	2	2
5.5	2	2	2.2	3
7.5	3	3	3.5	4.16
11	4.16	4.16	4.16	6.25
15	6.25	6.25	6.25	8.33
18.5	6.25	8.33	8.33	8.33
22	8.33	8.33	8.33	12.5
30	12.5	12.5	16.6	20.8
37	16.6	16.6	20.8	25
45	16.6	20.8	20.8	25
55	20.8	20.8	25	33.3
75	25	25	33.3	41.6
90	33.3	33.3	41.6	50
110	37.5	41.6	50	50
132	41.6	50	50	62.5
160	50	62.5	62.5	75
200	62.5	62.5	75	100
250	75	75	75	100

Protection breakers and connecting cables for capacitor banks

Three phase capacitor bank power (400V) [kvar]	Breaker 3(4) poles rated/thermic [A]	single phase cable section	
		Copper [mm ²]	Aluminum [mm ²]
10	20/20	6	10
20	40/40	10	16
30	63/63	16	25
40	80/80	25	35
50	100/100	35	50
60	125/125	35	50
70	160/140	35	50
80	160/160	50	70
90	200/180	50	70
100	200/200	70	95
125	250/250	70	95
150	400/300	95	120
175	400/350	120	185
200	400/400	150	240
225	630/450	150	240
250	630/500	185	2 x 120
275	630/550	185	2 x 120
300	630/600	2 x 95	2 x 150
325	630/630	2 x 95	2 x 150
350	800/700	2 x 120	2 x 185
375	800/750	2 x 120	2 x 185
400	800/800	2 x 150	2 x 240
450	1000/900	2 x 150	2 x 240
500	1000/1000	2 x 185	4 x 150
550	1250/1100	2 x 185	4 x 150
600	1250/1200	4 x 120	4 x 185
650	1250/1250	4 x 120	4 x 185
700	1600/1400	4 x 150	4 x 240
750	1600/1500	4 x 150	4 x 240
800	1600/1600	4 x 150	4 x 240
850	2000/1700	4 x 150	4 x 240
900	2000/1800	4 x 150	4 x 240
950	2000/1900	4 x 185	4 x 300
1000	2000/2000	4 x 185	4 x 300

Recommended section it is the minimum necessary, for single phase cables, in air, at ambient temperature of 30°C.



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