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## AUTOMATIC REGULATORS INTRODUCTION



**Computer** reactive energy regulators measure  $\cos \varphi$  in the installation, checking the connection and disconnection of the steps or power fractions into which the capacitor bank is divided. By doing this, the target programmed  $\cos \varphi$  is achieved.

The whole range of **computer** regulators is based on the **FCP** system (Fast Computerized Program), which gives the regulator the capacity to accurately inform on the status of the system and to take decisions to obtain the best regulation.

The **FCP** system also allows:

- The minimisation of a number of operations, increasing the life of the parts in the capacitor bank
- The increase of the equipment's response speed improving energy and saving costs

## BASIC CONCEPTS FOR A REACTIVE ENERGY REGULATOR

### Measurement function

Regulators operate by measuring current and voltage in the power system.

Current measurement is carried out single-phase using a current transformer located in a phase at the start of the installation.

Voltage measurement is by direct connection to the other two phases.

It is necessary to respect the sequence order (L1, L2, L3) of the phases depending on the type of regulator for it to operate properly.

### First step current and C/K

In order to operate, the computer regulators need to know the ratio between the current measurement transformer ( $k$ ) and the current in the first step of the bank ( $I_c$ ). This ratio is known as the  $C/K$  parameter.

$$C/K = \frac{I_c}{K}$$

This value may be given in two ways:

- Entering the current of the first step and the current transformer primary.
- Directly calculating the coefficient.

### Connection programs

The capacitor banks are divided into power steps. The connection program defines the existing proportion between the first step in the remaining steps in the bank.

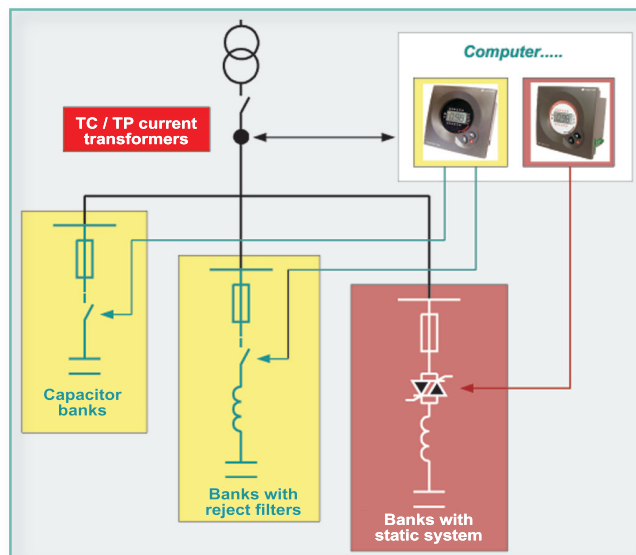
The usual connection programs are:

1:1:1:1	1:2:2:2	1:2:4:4	1:2:4:8	1:1:2:2
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The reason for the different connection programs is to facilitate better setting for reactive power demand in the installation.

### Number of steps or regulator outputs

This is the number of steps or fractions which the regulator may operate.





### Connection and safety time.

The regulator operates with two basic parameters for the capacitors to work properly: connection time and safety time.

- Connection time ( $T_r$ ).

In order to avoid an excessive number of operations, the regulator waits a few seconds before giving the connection command. In this way the **computer** regulator avoids connection at an instant power point.

- Safety or reconnection time ( $T_s$ ).

Once a step has been disconnected, a discharge time is required to prevent the capacitor being quickly reconnected without having had time to discharge. This is the reconnection time.

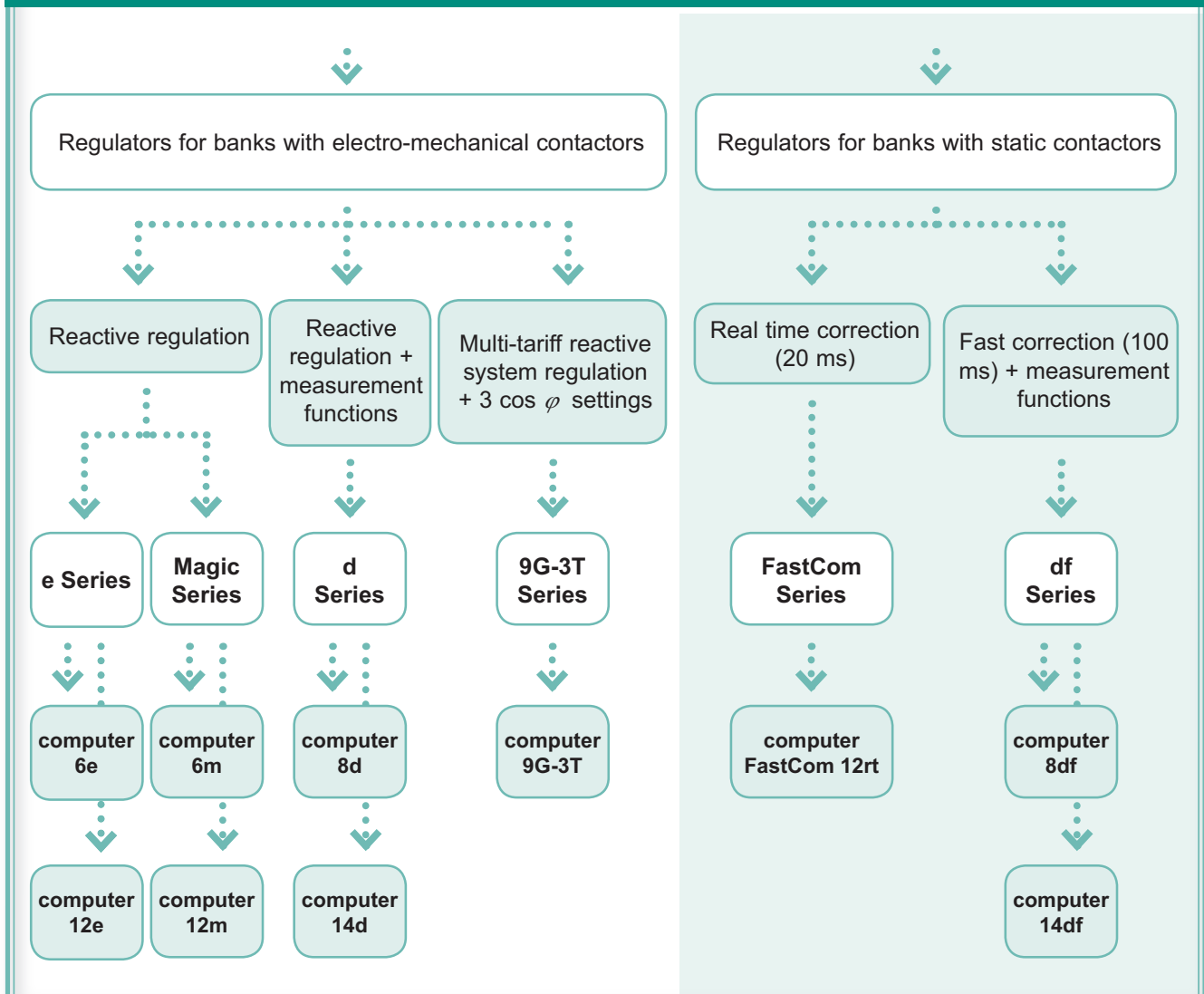
As a general criterion, there is a relationship between connection time ( $T_r$ ) and safety time ( $T_s$ ) of  $T_s = 5 T_r$ .

### Four quadrant regulator.

Capacity for measuring  $\cos \varphi$  and regulating capacitor banks even if active power flows:

- From system to load, i.e. the usual installation.
- From load to system, i.e. energy generating installations

## Computer REACTIVE ENERGY REGULATORS



## REGULATORS FOR CONTACTORS



For power factor correction in variable loads, the **computer** regulators accurately track the existing load curve making  $\cos \varphi$  attain programmed target values.

The **computer** regulators give the operation command to the bank's steps with a minimum connection response time of 4 seconds (programmable).

The bank's reactive power will be disconnected if it is not required.

The **MAGIC** series regulators are a new range of high technology regulators designed for simple and effective regulation. The **MAGIC** series has also been designed for easy and intuitive handling.

### The performance of **MAGIC**:

- High accuracy regulation
- Parameter configuration in RUN-TIME, i.e. without having to disconnect the unit
- Totally digital setting and handling
- 4 Alarm Levels:
  - Low load current or current transformer not connected
  - Wrong phase connection
  - Over correction
  - Lack of correction

### Parameters on display

**MAGIC** includes an LCD display where the following data may be shown:

- $\cos \varphi$  in the installation
- Signalling the connected steps
- Nature of the load, inductive or capacitive
- Programming menu tracking cursor
- Alarm

### Connections

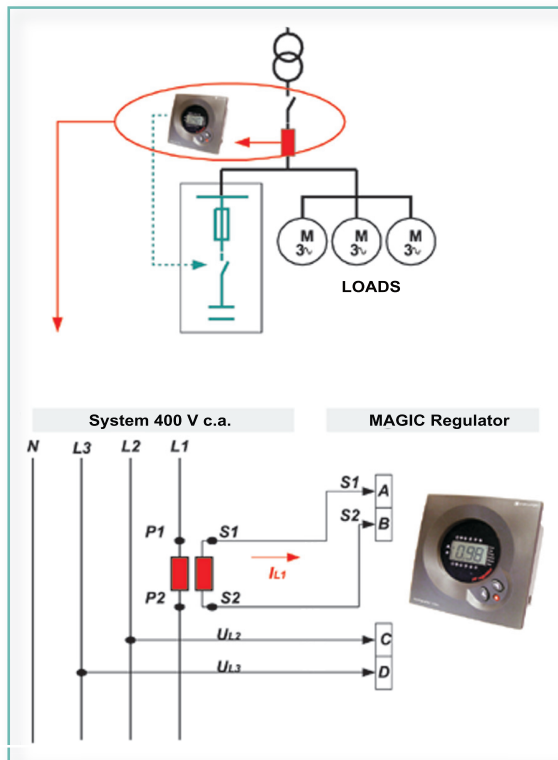
Connecting the **MAGIC** is very easy, as shown in the diagram. **MAGIC** has to be connected at the head of the installation where all loads in installation are measured.

For it to work correctly it is important to maintain the phase sequence in the connection, as shown. If this is not the case, the regulator will set off the relevant alarm.

A current transformer also has to be mounted for the installation's current signal.

This diagram is also valid for other operating voltages.

### COMPUTER MAGIC SERIES



### COMPUTER 8d / 14D SERIES

#### Main features

- Current and THD ( $I$ ) measurement function where the measurement is taken.
- Alarm functions: overcurrent, harmonic distortion, lack of correction, overvoltage and wrong correction.
- Option for remote signalling using alarm relay



## COMPUTER MULTI-TARIFF 9G-3T SERIES

The MULTI-TARIFF regulators are designed to check reactive energy in electrical systems with three target  $\cos \varphi$ . To do this, the regulator independently measures and regulates  $\cos \varphi$  in each hourly slot. This regulator is for energy generating stations. That is to say, for wind power generation stations, solar power stations and hydraulic stations.

### Main features

- 3 target  $\cos \varphi$  settings.

T1	0,95 Inductive	T2	1	T3	0,95 Capacitive
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- Changing the  $\cos \varphi$  setting is done via a pulse from an energy meter. There are three terminals for this. The use of **CIRWATT** energy meters is recommended.
- 4 quadrant regulation
- Connection type selection (situation of the current transformer).
- Measurement of power consumed and generated.
- Display in the event of an alarm.
- 9 available steps.

### Parameters on display

In addition to the functions which the **MAGIC** series includes the multi-tariff regulator also has T1, T2, T3 signalling the period in which it is operating.

## FEATURES

	Computer 8d / 14d		Computer 6m / 12m		Computer 6e / 12e		Computer 9G-3T
	8d	14d	6m	12m	6e	12e	
<b>Voltage circuit</b>							
Power supply voltage	230 / 400 V a.c.		400 V a.c. (*)		230 V a.c./ 400 V a.c.	400 V a.c. (*)	400 V a.c. (*)
Voltage tolerance	±15 %		+15% / -10%		±15 %		±15 %
Consumption with all relays connected	5 V·A	10 V·A	3 V·A	4 V·A	5 V·A	6 V·A	4V·A
Frequency	45...65 Hz						
<b>Current circuit</b>							
Consumption	0,5 V·A		0,5 V·A		0,5 V·A		0,5 V·A
Rated current ( $I_n$ )	5 A		5 A		5 A		5 A
<b>Output relay</b>							
Maximum voltage	400 V a.c.		250 V a.c.		250 V a.c.		250 V a.c.
Rated current	10 A		10 A		10 A		10 A
Electrical life (no. of operations at full load)	100 000		100 000		500 000		100 000
<b>Alarm relay</b>							
Maximum voltage	400 V a.c.		-		-		-
Rated current	10 A		-		-		-
Electrical life (no. of operations at full load)	100 000		-		-		-
<b>Assembly features</b>							
Working temperature	-10 / +50 °C		-10 °C / +50 °C		-10 °C / +50 °C		-10 °C / +50 °C
Mounting	Panel						
Connection	Plug type terminal block			Terminal block			
Protection grade	IP 54 (front) IP 31 (rear)			IP 52 (front) IP 31 (rear)			
<b>Performance</b>							
Built in control system	FCP						
Cos $\varphi$ setting	0,80 L - 0,95 C		0,85 L - 0,95 C		0,85 L - 0,95 C		0,85 L - 0,95 C
Cos $\varphi$ display	Display (3 digits)		Display (3 digits)		Display (2 digits)		Display (3 digits)
Connection programs	1.1.1.1 / 1.2.2.2 / 1.2.4.4 / 1.2.4.8 / 1.1.2.2						
No. of output relays	3 / 6 / 8	10 / 12 / 14	6	12	3 / 6	8 / 10 / 12	9
Connection delay Tr	4 a 999 s		4 a 999 s		4 ; 10 ; 30 ; 60 s		4 a 999 s
Safety delay Ts	5 · Tr						
Standards	EN 61010, IEC 1010-1, EN 50081-2, EN 50082-2						

(\*) Other voltages on request

### D SERIES



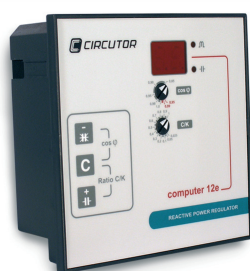
Power supply voltage	No. of steps	Alarm	Dimensions	Type	Code
230 / 400 V a.c.	3	-	96 x 96	computer 8d-3-96	R10111
230 / 400 V a.c.	6	-	96 x 96	computer 8d-6-96	R10112
230 / 400 V a.c.	8	-	96 x 96	computer 8d-8-96	R10113
230 / 400 V a.c.	6	yes	96 x 96	computer 8d-6-96a	R10114
230 / 400 V a.c.	8	yes	96 x 96	computer 8d-8-96a	R10115
230 / 400 V a.c.	3	-	144 x 144	computer 8d-3-144	R10121
230 / 400 V a.c.	6	-	144 x 144	computer 8d-6-144	R10122
230 / 400 V a.c.	8	-	144 x 144	computer 8d-8-144	R10123
230 / 400 V a.c.	6	yes	144 x 144	computer 8d-6-144a	R10124
230 / 400 V a.c.	8	yes	144 x 144	computer 8d-8-144a	R10125
230 / 400 V a.c.	10	yes	144 x 144	computer 14d-10-144a	R10211
230 / 400 V a.c.	12	yes	144 x 144	computer 14d-12-144a	R10212
230 / 400 V a.c.	14	yes	144 x 144	computer 14d-14-144a	R10213

### MAGIC SERIES



110 V a.c.	6	-	144 x 144	computer 6m	R10811001
110 V a.c.	12	-	144 x 144	computer 12m	R10812001
230 V a.c.	6	-	144 x 144	computer 6m	R10811002
230 V a.c.	12	-	144 x 144	computer 12m	R10812002
400 V a.c.	6	-	144 x 144	computer 6m	R10811
400 V a.c.	12	-	144 x 144	computer 12m	R10812
480 V a.c.	6	-	144 x 144	computer 6m	R10811001
480 V a.c.	12	-	144 x 144	computer 12m	R10812004

### E SERIES



230 / 400 V a.c.	3	-	144 x 144	computer 6e-3	R10511
230 / 400 V a.c.	6	-	144 x 144	computer 6e-6	R10512
400 V a.c.	8	-	144 x 144	computer 12e-8	R10711
400 V a.c.	10	-	144 x 144	computer 12e-10	R10712
400 V a.c.	12	-	144 x 144	computer 12e-12	R10713

### 9G-3T SERIES



110 V a.c.	9	-	144 x 144	9G-3T	R11100001
400 V a.c.	9	-	144 x 144	9G-3T	R11100



## STATIC REGULATORS (REAL TIME)



Regulating reactive energy using a static system is ideal for installations which are sensitive to transients or with very fast reactive power fluctuations ( $< 0.2$  s).

In order to do so, instant regulation and/or free of transient connection is required.

There are two types of fast regulators depending on the speed of load fluctuation:

- **Computer 8df/14df** regulators. Response time 0.1 seconds.
- **Computer Fast-comp** regulators, real time regulation from 20 ms.

### COMPUTER FAST-COMP 12RT SERIES

**Fast-comp** series regulators is a new range of rapid regulators with a 20 ms response time especially for real time correction requirements.

#### Main features

- Adjustable response time from 20 ms.
- Regulation in 2 or 4 quadrants in terms of load requirements.
- Option for correcting using a FCP or lineal system.
- Connection selection (current transformer wiring).
- 12 steps available.

#### Parameters on display.

The **Fast-comp** regulator includes **MAGIC** series functions plus type of connection monitoring.

#### Applications

Installations such as, foundries, lifts and lifting equipment, cranes, welding installations, hospitals, etc.

### COMPUTER 8DF / 14DF SERIES

#### Main features

- Current and THD ( $I$ ) measurement function where the measurement is taken.
- Alarm functions: overcurrent, harmonic distortion, lack of correction, overvoltage and wrong correction.
- Option for remote signalling using alarm relay
- Response time 0.1 seconds.

## FEATURES

	computer 8df / 14df		computer Fast-comp 12rt		computer 8df / 14df		computer Fast-comp 12rt
	8df	14df					
<b>Voltage circuit</b>				<b>Outputs</b>			
Power supply voltage	230 / 400 V a.c.		400 V a.c. (*)	N° of outputs	8	14	12
Voltage tolerance	±15 %			Maximum voltage	200 V d.c. / 200 V <sub>PEAHLK</sub> a.c.		
Consumption	5 V·A	10 V·A	3 V·A	Maximum current	100 mA		100mA
Frequency	45...65 Hz			<b>Alarm relay</b>			
<b>Current circuit</b>				Maximum voltage	400 V a.c.		-
Consumption	0,5 V·A		0,5 V·A	Rated current	10 A		-
Rated current ( $I_n$ )	5 A		5 A	Electrical life (No. of operations at full load)	100 000		-

(\*) Other voltages on request

	Computer 8df / 14df	Computer Fast Comp 12rt
<b>Performance</b>		
Built in control system	FCP	FCP and linear
Cos $\varphi$ setting	0,80 L - 0,95 C	0,85 L - 0,95 C
Cos $\varphi$ display	Display (3 digits)	
Connection programs	1.1.1.1 / 1.2.2.2 / 1.2.4.4 / 1.2.4.8 / 1.1.2.2	
No. of output relays	8    14	12
Connection delay Tr	0,1 to 9,99 s	20 ms to 2 s
Safety delay Ts	0,1 to 9,99 s	20 ms to 2 s
Phase selection	yes	

	Computer 8df / 14df	Computer Fast Comp 12rt
<b>Assembly features</b>		
Working temperature	-10 / +50 °C	-10°C / +50°C
Mounting	Panel	
Connection	Plug type terminal block	Terminal block
Protection grade	IP 54 (front) IP 31 (rear)	IP 52 (front) IP 31 (rear)
<b>Standards</b>	<b>EN 61010, IEC 1010-1, EN 50081-2, EN 50082-2</b>	

(\*) Other voltages on request

## DF SERIES



Power supply voltage	No. of steps	Alarm	Dimensions	Type	Code
230 / 400 V a.c.	8	yes	96 x 96	computer 8df-8-96a	R10311
230 / 400 V a.c.	8	yes	144 x 144	computer 8df-8-144a	R10321
230 / 400 V a.c.	14	yes	144 x 144	computer 14df-14-144a	R10411

## FAST SERIES



Power supply voltage	No. of steps	Alarm	Dimensions	Type	Code
400 V a.c.	12	--	144 x 144	Fast-Comp 12 rt-144	R10912

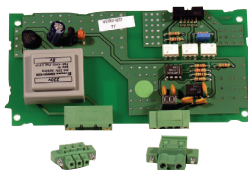
## ACCESSORIES



**Current harmonic relay**

Rated current (I <sub>n</sub> )	Trip time (settable)	Type	Code
10 A	0,5 ... 30 s	WDH / 010-30	P32022
20 A	0,5 ... 30 s	WDH / 020-30	P32023
50 A	0,5 ... 30s	WDH / 050-30	P32024
100 A	0,5 ... 30 s	WDH / 100-30	P32025
... / 5 A*	0,5 ... 30 s	WDH / TS-30	P32020

\*Separate current transformer  
 – Trip setting 5 ... 50% I<sub>n</sub>  
 – Maximum current: 2 In permanent



RS-485 Communications module  
 (Includes *EASYCOMM Software*)  
 (for 14d and 14df computer only)  
**R18011**

**Reactive current and harmonic relays**



Fig. 1



Fig. 2

Dimensions	Type	Code	Figura
6 mód.	Royal A4-P	M20241	fig.1
96 x 48	Royal A4	M20242	fig.2

- Measuring de V, A, Hz, W, V-A, var, cos  $\varphi$  demand, THD in single-phase or three-phase balanced systems





## PRISMATIC CAPACITORS



**CS** prismatic capacitors are dry capacitors covering every power and voltage range at both 50 and 60 Hz.

Their design as well as their manufacturing process and testing give the **CS** prismatic capacitors a high degree of quality and an extremely long life.

The prismatic capacitors are equipped with different basic capacities. These capacities are configured to obtain the required voltage and power.

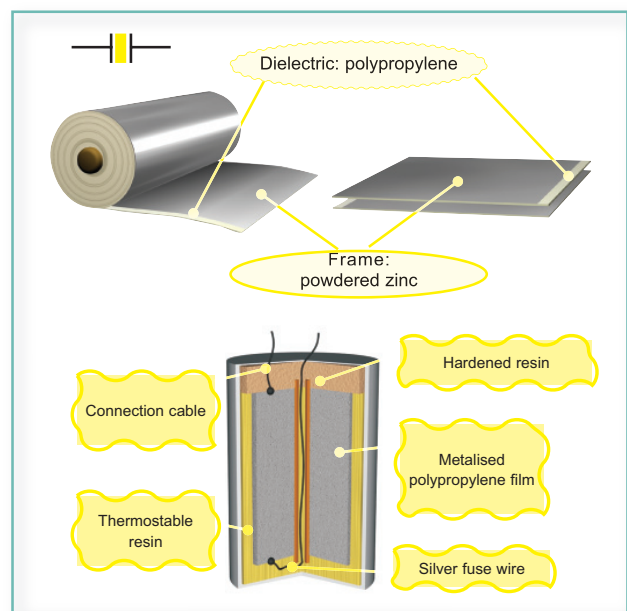
### Basic coils

The basic coils are made with metalised polypropylene and are encapsulated in heat resistant polyethylene resin. The system gives the basic capacity great electrical and mechanical strength.

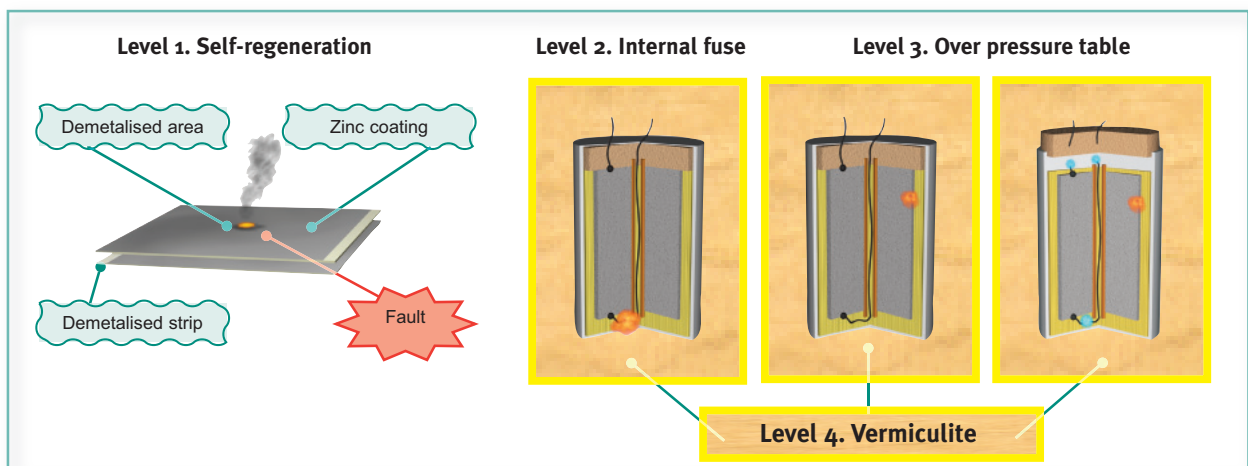
### CS prismatic capacitor

The basic coil set is located in a metal casing filled with vermiculite. This component offers a great degree of safety given its dielectric property as an inert, non flammable material.

### TECHNOLOGY



### PROTECTION LEVELS



In the event of a fault:

- Level 1. The zinc coating evaporates at the point of the "fault" and therefore the arc disappears
- Level 2. If the current is large (high-voltage, harmonics) the internal fuse disconnects the basic capacity
- Level 3. If the fault is not limited by the fuse, gases are generated inside the faulty capacitor and raising the overpressure cover disconnects the basic capacitor.
- Level 4. For better safety, the VERMICULITE (inert and fireproof) prevents any form of fire.

### ADVANTAGES OF CS PRISMATIC CAPACITORS

The technology has the following advantages:

- Continuity of service:  
In the event of a fault with a basic coil, it is disconnected without affecting the remaining coil leaving them to operate normally.
- Improved protection level:  
Each basic coil is equipped with protection with the vermiculite being the overall protection. This system increases the life of the unit.

### RANGE OF CS PRISMATIC CAPACITORS

The range of CS prismatic capacitors is structured in different types depending on the maximum power of the unit. These different models facilitate the assembly of capacitor banks in different cabinet sizes. This decreases the volume of the capacitor banks and therefore their cost.

Range	Type of capacitor	Maximum power	Voltages	Frequency
Low power	Type CV	25 kvar	from 230 to 480 V a.c.	50 / 60 Hz
Medium power	Type CQ	50 kvar	from 230 to 480 V a.c.	50 / 60 Hz
High power: • Electro-mechanical bank. • Static banks	Type CS Type CS-6B	100 kvar	from 230 to 1 000 V a.c.	50 / 60 Hz
Filters: • Electro-mechanical bank. • Static banks	Type CF Type CF-6B	100 kvar	from 230 to 1 000 V a.c.	50 / 60 Hz

See details for each type in the technical features table

### FEATURES

Electrical features		Environmental conditions	
Overcurrent	1.3 times the rated current permanently	Class C temperature: Daily measurement	40°
Overvoltage	10 %, 8 out of 24 hours	Annual average	30°
	15 %, up to 15 minutes out of 24 hours	Maximum	50°
	20 %, up to 5 minutes out of 24 hours	Minimum	-40°
	15 %, up to 1 minute out of 24 hours		
Insulation level	3 / 15 kV	Humidity	80 %
Power tolerance	+15 / -5 %	Altitude	2 000 m
Discharge resistance	75 V / 3 min	<b>Assembly conditions</b>	
Frequency	50 or 60 Hz	Mounting	Vertical
Losses: • Dielectric • Total	< 0,2 W / kvar < 0,5 W / kvar	Ventilation	Natural or forced according to cabinet design
		Distance between capacitors	4 cm minimum
Protection	<ul style="list-style-type: none"> <li>• Dielectric regeneration.</li> <li>• Internal fuse.</li> <li>• Overpressure system.</li> <li>• Vermiculite</li> </ul>	<b>Standards</b>	<b>CEI 60831-1, CEI 70/7, UNE 20827, UNE 20010, BS 1650, VDE 560</b>
		Mechanical features	
Casing	Treated and painted steel RAL 3005		
Terminals: • Power • Earth	. M6 for CV, M10 for CQ, <b>CS, CS-6B, CF, CF-6B</b> . M6		
		Tightening torques	. CV 5 Nm . CQ, CS, CS-6B, CF, CF-6B: 15 Nm
Protection grade	IP42 with terminal cover		



## CS

50 Hz	60 Hz	230 V			
kvar	kg	Dimensions	Type	Code	
10	12,5	6,5	360 x 390 x 120	CS-23/10	R2021C
12,5	15	8	360 x 390 x 120	CS-23/12,5	R2021D
15	17,5	8	360 x 390 x 120	CS-23/15	R2021E
20	25	11,5	360 x 390 x 120	CS-23/20	R2021F
25	30	13	360 x 390 x 120	CS-23/25	R2021G
30	35	14,5	360 x 610 x 120	CS-23/30	R2021H
40	50	15	360 x 610 x 120	CS-23/40	R2021J
50	60	16,5	360 x 760 x 120	CS-23/50	R2021K

50 Hz	60 Hz	400 V			
kvar	kg	Dimensions	Type	Code	
15	17,5	6,5	360 x 390 x 120	CS-40/15	R2023E
20	25	7,5	360 x 390 x 120	CS-40/20	R2023F
25	30	7,5	360 x 390 x 120	CS-40/25	R2023G
30	35	8	360 x 390 x 120	CS-40/30	R2023H
40	50	9,5	360 x 390 x 120	CS-40/40	R2023J
50	60	12	360 x 390 x 120	CS-40/50	R2023K
60	70	13	360 x 610 x 120	CS-40/60	R2023L
80	95	15	360 x 610 x 120	CS-40/80	R2023Q
100	120	18,5	360 x 760 x 117	CS-40/100	R2023R

50 Hz	60 Hz	440 V			
kvar	kg	Dimensions	Type	Code	
15	17,5	4,1	360 x 390 x 120	CS-44/15	R2024E
20	25	4,9	360 x 390 x 120	CS-44/20	R2024F
25	30	4,9	360 x 390 x 120	CS-44/25	R2024G
30	35	4,9	360 x 390 x 120	CS-44/30	R2024H
40	50	6,4	360 x 390 x 120	CS-44/40	R2024J
50	60	9,5	360 x 390 x 120	CS-44/50	R2024K
60	70	9,5	360 x 390 x 120	CS-44/60	R2024L
80	95	12,5	360 x 610 x 120	CS-44/80	R2024Q
100	120	15,6	360 x 610 x 120	CS-44/100	R2024R

50 Hz	60 Hz	460 V			
kvar	kg	Dimensions	Type	Code	
15	17,5	6	360 x 390 x 120	CS-46/15	R2025E
20	25	6,5	360 x 390 x 120	CS-46/20	R2025F
25	30	7	360 x 390 x 120	CS-46/25	R2025G
30	35	8	360 x 390 x 120	CS-46/30	R2025H
40	50	9,5	360 x 390 x 120	CS-46/40	R2025J
50	60	12	360 x 610 x 120	CS-46/50	R2025K
60	70	13	360 x 610 x 120	CS-46/60	R2025L
80	95	15	360 x 760 x 120	CS-46/80	R2025Q
100	120	18,5	360 x 760 x 120	CS-46/100	R2025R

50 Hz	60 Hz	480 V			
kvar	kg	Dimensions	Type	Code	
8	10	4,9	360 x 390 x 120	CS-48/10	R288AC
12,5	15	4,9	360 x 390 x 120	CS-48/15	R288AE
16,7	20	4,9	360 x 390 x 120	CS-48/20	R288AF
20,8	25	6,4	360 x 390 x 120	CS-48/25	R288AG
25	30	7,9	360 x 390 x 120	CS-48/30	R288AH
33,3	40	7,9	360 x 610 X 120	CS-48/40	R288AJ
41,7	50	11	360 x 610 X 120	CS-48/50	R288AK
50	60	14	360 x 610 X 120	CS-48/60	R288AL
66,7	80	17,1	360 x 760 X 120	CS-48/80	R288AQ
83,8	100	17,1	360 x 760 X 120	CS-48/100	R288AR

50 Hz	60 Hz	500 V			
kvar	kg	Dimensions	Type	Code	
10	12,5	7	360 x 390 x 120	CS-50/10	R202CD
15	17,5	8	360 x 390 x 120	CS-50/15	R202CE
20	25	8,5	360 x 390 x 120	CS-50/20	R202CF
25	30	9	360 x 390 x 120	CS-50/25	R202CG
30	35	9	360 x 390 x 120	CS-50/30	R202CH
40	50	14	360 x 390 x 120	CS-50/40	R202CJ
50	60	15	360 x 390 x 120	CS-50/50	R202CK
60	70	17	360 x 390 x 120	CS-50/60	R202CL
80	95	22	360 X 760 X 120	CS-50/80	R202CQ
100	-	24	360 X 760 X 120	CS-50/100	R202CR

50 Hz	60 Hz	690 V			
kvar	kg	Dimensions	Type	Code	
10	12,5	4,9	360 x 390 x 120	CS-69/10	R202BC
15	17,5	4,9	360 x 390 x 120	CS-69/15	R202BE
20	25	4,9	360 x 390 x 120	CS-69/20	R202BF
25	30	6,4	360 x 390 x 120	CS-69/25	R202BG
30	35	7,9	360 x 610 X 120	CS-69/30	R202BH
40	50	7,9	360 x 390 x 120	CS-69/40	R202BJ
50	60	11	360 x 390 x 120	CS-69/50	R202BK
60	70	14	360 x 390 x 120	CS-69/60	R202BL
80	95	17,1	360 x 610 X 120	CS-69/80	R202BQ
100	-	22	360 x 610 X 120	CS-69/100	R202BR

50 Hz	60 Hz	1 100 V			
kvar	kg	Dimensions	Type	Code	
10	17,5	5,5	360 x 390 x 120	CS-110/10	R2027C
20	30	7,5	360 x 390 x 120	CS-110/20	R2027F
30	50	9,5	360 x 610 X 120	CS-110/30	R2027H
40	60	12	360 x 610 X 120	CS-110/40	R2027J
50	70	17	360 x 610 X 120	CS-110/50	R2027K
60	95	17,5	360 x 610 X 120	CS-110/60	R2027L
70	120	18,5	360 x 760 X 120	CS-110/70	R2027M

**CS-6B / DUAL VOLTAGE**
**6 TERMINALS**

kvar		230 / 400 V			
50 Hz	60 Hz	kg	Dimensions	Type	Code
5	6	6,5	360 x 390 x 120	CS-2340/5	R20288
7,5	9	6,5	360 x 390 x 120	CS-2340/7,5	R2028A
10	12,5	8	360 x 390 x 120	CS-2340/10	R2028C
12,5	15	9	360 x 390 x 120	CS-2340/12,5	R2028D
15	17,5	9	360 x 390 x 120	CS-2340/15	R2028E
20	25	12	360 x 390 x 120	CS-2340/20	R2028F
25	30	14,5	360 x 390 x 120	CS-2340/25	R2028G
30	35	15	360 x 610 x 120	CS-2340/30	R2028H
40	50	15,5	360 x 610 x 120	CS-2340/40	R2028J

kvar		400 / 690 V			
50 Hz	60 Hz	kg	Dimensions	Type	Code
5	6	2,5	360 x 610 x 120	CS-4069/5	R20298
7,5	9	3,5	360 x 610 x 120	CS-4069/7,5	R2029A
10	12,5	4,5	360 x 610 x 120	CS-4069/10	R2029C
12,5	15	5	360 x 610 x 120	CS-4069/12,5	R2029D
15	17,5	6	360 x 610 x 120	CS-4069/15	R2029E
20	25	6,5	360 x 610 x 120	CS-4069/20	R2029F
25	30	7	360 x 610 x 120	CS-4069/25	R2029G
30	35	7,5	360 x 610 x 120	CS-4069/30	R2029H
40	50	8,5	360 x 610 x 120	CS-4069/40	R2029J
50	60	10,5	360 x 610 x 120	CS-4069/50	R2029K
60	70	13,5	360 x 610 x 120	CS-4069/60	R2029L
80	95	15	360 x 610 x 120	CS-4069/75	R2029

**CV**

50 Hz		60 Hz		230 V		
kvar	kg	Dimensions	Type	Code		
2,5	3	3	204 x 435 x 75	CV-23/2,5	R20114	
3,75	4,5	3,5	204 x 435 x 75	CV-23/3,75	R20116	
5	6	3,5	204 x 435 x 75	CV-23/5	R20118	
7,5	9	4	204 x 435 x 75	CV-23/7,5	R2011A	
10	12,5	4	204 x 435 x 75	CV-23/10	R2011C	
12,5	15	4,5	204 x 435 x 75	CV-23/12,5	R2011D	
15	17,5	4,5	204 x 435 x 75	CV-23/15	R2011E	

50 Hz		60 Hz		400 V		
kvar	kg	Dimensions	Type	Code		
2,5	3	2,5	204 x 435 x 75	CV-40/2,5	R20134	
5	4,5	2,5	204 x 435 x 75	CV-40/5	R20138	
7,5	9	3	204 x 435 x 75	CV-40/7,5	R2013A	
10	12,5	3	204 x 435 x 75	CV-40/10	R2013C	
12,5	15	3,5	204 x 435 x 75	CV-40/12,5	R2013D	
15	17,5	4,5	204 x 435 x 75	CV-40/15	R2013E	
20	25	4,5	204 x 435 x 75	CV-40/20	R2013F	
25	30	6,5	204 x 435 x 75	CV-40/25	R2013G	

50 Hz		60 Hz		460 V		
kvar	kg	Dimensions	Type	Code		
2,5	3	1	204 x 435 x 75	CV-46/2,5	R20154	
5	6	1	204 x 435 x 75	CV-46/5	R20158	
7,5	9	1,5	204 x 435 x 75	CV-46/7,5	R2015A	
10	12,5	1,5	204 x 435 x 75	CV-46/10	R2015C	
12,5	15	2	204 x 435 x 75	CV-46/12,5	R2015D	
15	17,5	3	204 x 435 x 75	CV-46/15	R2015E	

**CQ**

50 Hz		60 Hz		230 V		
kvar	kg	Dimensions	Type	Code		
10	12,5	4,9	360 x 520 x 75	CQ-23/10	R2031C	
12,5	15	4,9	360 x 520 x 75	CQ-23/12,5	R2031D	
15	17,5	4,9	360 x 520 x 75	CQ-23/15	R2031E	
20	25	6,4	360 x 520 x 75	CQ-23/20	R2031F	
25	30	7,9	360 x 520 x 75	CQ-23/25	R2031G	
30	35	7,9	360 x 520 x 75	CQ-23/30	R2031H	

50 Hz		60 Hz		400 V		
kvar	kg	Dimensions	Type	Code		
10	12,5	4	360 x 520 x 75	CQ-40/10	R2033C	
12,5	15	4,5	360 x 520 x 75	CQ-40/12,5	R2033D	
15	17,5	5	360 x 520 x 75	CQ-40/15	R2033E	
20	25	6	360 x 520 x 75	CQ-40/20	R2033F	
25	30	6	360 x 520 x 75	CQ-40/25	R2033G	
30	35	6	360 x 520 x 75	CQ-40/30	R2033H	
40	50	7	360 x 520 x 75	CQ-40/40	R2033J	
50	60	9	360 x 520 x 75	CQ-40/50	R2033K	

50 Hz		60 Hz		460 V		
kvar	kg	Dimensions	Type	Code		
10	12,5	4,1	360 x 520 x 75	CQ-46/10	R2035C	
12,5	15	4,1	360 x 520 x 75	CQ-46/12,5	R2035D	
15	17,5	4,1	360 x 520 x 75	CQ-46/15	R2035E	
20	25	4,9	360 x 520 x 75	CQ-46/20	R2035F	
25	30	4,9	360 x 520 x 75	CQ-46/25	R2035G	
30	35	4,9	360 x 520 x 75	CQ-46/30	R2035H	
40	50	7,9	360 x 520 x 75	CQ-46/40	R2035J	
50	60	7,9	360 x 520 x 75	CQ-46/50	R2035K	



## CAPACITORS FOR DETUNED FILTERS, CF SERIES



**CF** capacitors are designed to be assembled with **RB** series reactors. This means, reactors for rejection filters at 7% (189 Hz).

**CF** capacitors for rejection filters have been designed to take into account the following:

- System operating voltage.
- Increase in voltage caused by the filter reactance.
- Capacitive power used by the reactor.
- Safety margin for possible overloads by harmonics.

Therefore, the capacitor is sized so that power stated in the data tables is given the system's service voltage.

### SYSTEM VOLTAGE

The **CF** capacitor range is divided into two types in terms of their configuration:

Three terminal **CF** capacitor for electro-mechanical banks

Six terminal **CF -6B** capacitor for static banks

50 Hz System			
System voltage (V)	Serie	Capacitor voltage (V)	Type of operation
400	CF 46	460	Electro-mechanical
400	CF 46-6B	460	Static
690	CF 79	790	Electro-mechanical
60 Hz System			
230	CF 26	260	Electro-mechanical
440	CF 50	500	Electro-mechanical
460	CF 55	525	Electro-mechanical
480	CF 55	550	Electro-mechanical

The following table proposes an explanatory example for the use of a **CF** capacitor with **RB** reactor.

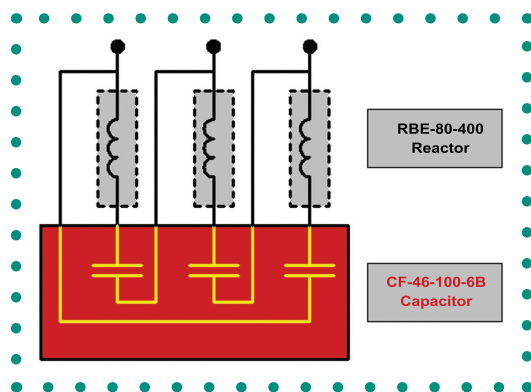
<p>75 kvar at 400 V</p> <p>CF-46/100 Capacitor</p>	<p>80 kvar at 400 V</p> <p>RB-80-400 Reactor</p> <p>CF-46/100 Capacitor</p>
<p>CF-46/100 capacitor:</p> <ul style="list-style-type: none"> <li>. Rated voltage 460 V at 50 Hz</li> <li>. Rated power 100 kvar</li> <li>. Effective power at 400 V, 74 kvar</li> </ul>	<p>RB-70-400 reactor set with CF-46/100 capacitor:</p> <ul style="list-style-type: none"> <li>. Rated voltage CF, 460 V at 50 HZ</li> <li>. Rated power 100 kvar</li> <li>. Effective power at 400 V with 80 kvar reactor in series</li> </ul>
<p>Power delivered by the capacitor + reactor: 80 kvar at 400 V. Power delivered by the capacitor: 75 kvar at 400 V.</p>	

**CF 50 Hz**

CF 460V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF 46/6	R2115A
10	6	360 x 390 x 120	CF 46/12,5	R2115D
12,5	6,5	360 x 390 x 120	CF 46/15	R2115E
15	6,5	360 x 390 x 120	CF 46/19	R2115F
20	7	360 x 390 x 120	CF 46/25	R2115G
25	8	360 x 390 x 120	CF 46/30	R2115H
30	9,5	360 x 390 x 120	CF 46/37	R2115J
40	12	360 x 610 x 120	CF 46/50	R2115K
50	16	360 x 610 x 120	CF 46/62	R2115L
60	18,5	360 x 610 x 120	CF 46/74	R2115P
80	20	360 x 760 x 117	CF 46/100	R2115R

CF 790 V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF 79/6	R211DA
10	6	360 x 390 x 120	CF 79/12,5	R211DD
15	6,5	360 x 390 x 120	CF 79/19	R211DF
20	7,5	360 x 390 x 120	CF 79/25	R211DG
25	8	360 x 390 x 120	CF 79/30	R211DH
30	9,5	360 x 390 x 120	CF 79/37	R211DT
40	12	360 x 390 x 120	CF 79/50	R211DK
50	16	360 x 390 x 120	CF 79/62	R211DL
60	18,5	360 x 610 x 120	CF 79/74	R211DP
80	19	360 x 610 x 120	CF 79/100	R211DR

**CF 6B 50 Hz**



CF 460-6B V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF- 46/6-6B	R2125A
10	6	360 x 390 x 120	CF 46/12,5-6B	R2125D
15	6,5	360 x 390 x 120	CF 46/19-6B	R2125F
20	7	360 x 390 x 120	CF 46/25-6B	R2125G
25	8	360 x 390 x 120	CF 46/30-6B	R2125H
30	9,5	360 x 390 x 120	CF 46/37-6B	R2125J
40	12	360 x 610 x 120	CF 46/50-6B	R2125K
50	16	360 x 610 x 120	CF 46/62-6B	R2125L
60	18,5	360 x 610 x 120	CF 46/74-6B	R2125P
80	18,5	360 x 760 x 120	CF 46/100-6B	R2125R

**CF 60 Hz**

CF 260 V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	7	360 x 390 x 120	CF 26/5	R2112C001
10	8	360 x 390 x 120	CF 26/10	R2112I001
12,5	8,5	360 x 390 x 120	CF 26/15	R2112D001
15	8,5	360 x 390 x 120	CF 26/20	R2112M001
20	9,5	360 x 390 x 120	CF 26/25	R2112P001
25	9,5	360 x 390 x 120	CF 26/30	R2112G001
30	13	360 x 610 x 120	CF 26/40	R2112H001
40	16,5	360 x 610 x 120	CF 26/50	R2112Q001

CF 500 V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF 50/6	R211CA001
10	6	360 x 390 x 120	CF 50/12,5	R211CD001
12,5	6,5	360 x 390 x 120	CF 50/15	R211CE001
15	6,5	360 x 390 x 120	CF 50/19	R211CF001
20	8	360 x 390 x 120	CF 50/25	R211CG001
25	8	360 x 390 x 120	CF 50/30	R211CH001
30	9,5	360 x 390 x 120	CF 50/37	R211CJ001
40	12	360 x 610 x 120	CF 50/50	R211CK001
50	16	360 x 610 x 120	CF 50/62	R211CL001
60	18,5	360 x 610 x 120	CF 50/74	R211CP001
80	21	360 x 760 x 120	CF 50/100	R211CR001

CF 525 V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF 55/7	R2116C001
10	6	360 x 390 x 120	CF 55/15	R2116E001
12,5	6,5	360 x 390 x 120	CF 55/18	R2116F001
15	6,5	360 x 390 x 120	CF 55/22	R2116G001
20	8	360 x 390 x 120	CF 55/29	R2116H001
25	10	360 x 390 x 120	CF 55/37	R2116J001
30	11	360 x 610 x 120	CF 55/44	R2116K001
45	14	360 x 610 x 120	CF 55/59	R2116L001
55	17,1	360 x 610 x 120	CF 55/73	R2116P001
65	20,2	360 x 760 x 120	CF 55/88	R2116S001
90	21,7	360 x 760 x 120	CF 55/117	R2116T001

CF 550 V				
kvar (*)	Weight kg	Dimensions	Type	Code
5	6	360 x 390 x 120	CF 55/7	R2116C001
12,5	6	360 x 390 x 120	CF 55/15	R2116E001
15	6,5	360 x 390 x 120	CF 55/18	R2116F001
17,5	6,5	360 x 390 x 120	CF 55/22	R2116G001
25	8	360 x 390 x 120	CF 55/29	R2116H001
30	10	360 x 390 x 120	CF 55/37	R2116J001
35	11	360 x 610 x 120	CF 55/44	R2116K001
50	14	360 x 610 x 120	CF 55/59	R2116L001
60	17,1	360 x 610 x 120	CF 55/73	R2116P001
70	20,2	360 x 760 x 120	CF 55/88	R2116S001
95	21,7	360 x 760 x 120	CF 55/117	R2116T001

(\*) System voltage, as per previous page table



## CILYNDRICAL CAPACITORS, CLZ SERIES



CLZ cylindrical capacitors are dry capacitors with a tubular casing covering a wide range of powers and voltages both in 50 Hz and 60 Hz.

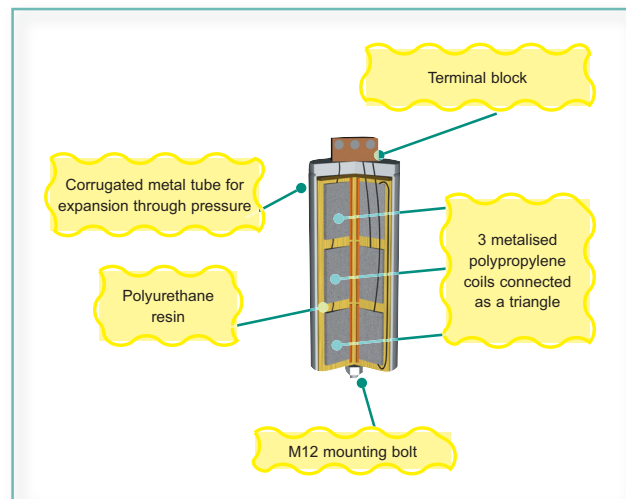
Its design, manufacturing and testing processes mean that CLZ cylindrical capacitors have a high degree of quality and have an extremely long life.

CLZ capacitors comprise three basic capacities in a metal cylindrical casing which is filled with gel for the dielectric and mechanical support functions.

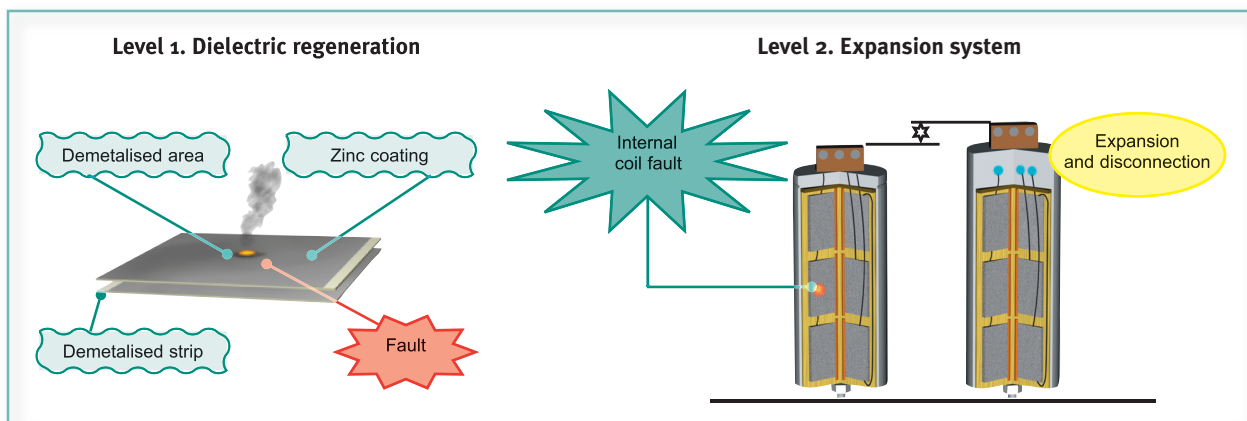
CLZ capacitors have the following components:

- Cable connection terminal according to type.
- Metal tube with an expansion fold
- Mounting bolt
- Option for attaching an additional cover for a higher degree of protection.

### TECHNOLOGY



### PROTECTION LEVELS



In the event of a fault:

- Level 1. The metallic coating evaporates at the point of the "fault" and therefore the arc disappears.
- Level 2. If the dielectric regeneration system is insufficient the pressure created inside forces the capacitor to expand, the power cables are disconnected and the unit does not operate.

### CYLINDRICAL CAPACITOR RANGE

CLZ capacitors are built in two ways:

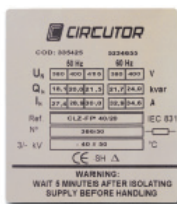
- CLZ-FPT with IP00 protection grade. Electrical connection using FASTON terminals.
- CLZ-FP with IP20 protection grade. Electrical connection using connection terminals.

Higher protection grades using the TLCZ terminal covers

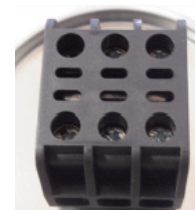
Range	Type of capacitor	Maximum power	Voltages	Frequency
Low power	Type CLZ-FPT	2 kvar	from 230 to 480 V	50 / 60 Hz
High power	Type CLZ-FP	50 kvar	from 230 to 520 V	50 / 60 Hz



• **FASTON TERMINALS**  
For CLZ-FPT capacitors with powers equal to or less than 2 kvar



• **MULTI-MARKED LABELS**  
Use of information plates with power equivalents at 220/230/240V, 380/400/415 V, 440/460 V, 480/520/550 V (50 or 60 Hz)



• **IP20 PROTECTION GRADE**  
Use of terminals with board makes terminal cover unnecessary (CLZ-FP)

### FEATURES

Electrical features	
Overcurrent	1.3 times the rated current permanently
Overvoltage	10 %, 8 out of 24 hours 15 %, up to 15 minutes out of 24 hours 20 %, up to 5 minutes out of 24 hours 15 %, up to 1 minute out of 24 hours
Insulation level	3 / 15 kV
Tolerance	+15 / -5 %
Discharge resistance	75 V / 3 min
Frequency	50 or 60 Hz
Losses: • Dielectric • Total	< 0,2 W / kvar < 0,5 W / kvar
Protection	CLZ system levels: • Dielectric regeneration. • Expansion system
Mechanical features	
Casing	Aluminium
Power terminals	M10
Mounting bolt	M12
Protection grade	IP 00 for <b>CLZ-FPT y CLZ-FP &gt;30 kvar</b> IP 20 for <b>CLZ-FP ≤ 30 kvar</b> IP 54 for <b>CLZ-FP</b> with terminal cover

Environmental conditions	
Class D temperature: Daily measurement	45°
Annual average	35°
Maximum	55°
Minimum	-25°
Humidity	80 % Hr
Altitude	2 000 m
Assembly conditions	
Mounting	Vertical
Ventilation	Natural or forced according to cabinet design
Distance between capacitors	2 cm minimum
Standards	CEI 60831-1, CEI 70/7, UNE 20827, UNE 20010, BS 1650, VDE 560





## CLZ-FPT / CLZ-FP



CLZ-FPT									
Type	50 Hz			60 Hz		Dimensions mm (d x h)	Weight kg	Type	Code
	380 V	400 V	415 V	380 V	400 V				
CLZ-FPT-40/0,5	0,45	0,5	0,54	0,5	0,6	50 x 158	0,4	A	R20430
CLZ-FPT-40/1	0,9	1	1,1	1,1	1,2	50 x 158	0,4	A	R20431
CLZ-FPT-40/1,5	1,4	1,5	1,6	1,6	1,8	50 x 158	0,4	A	R20432
CLZ-FPT-40/2	1,8	2	2,2	2,2	2,4	50 x 158	0,4	A	R20433



CLZ-FP									
Type	50 Hz			60 Hz		Dimensions mm (d x h)	Weight kg	Type	Code
	220 V	230 V	240 V	220 V	230 V				
CLZ-FP-23/2,5	2,3	2,5	2,7	2,7	3	85 x 175	1,2	B	R20514
CLZ-FP-23/4	3,7	4	4,4	4,4	4,8	85 x 245	1,6	C	R20517
CLZ-FP-23/5	4,6	5	5,4	5,5	6	85 x 245	1,6	C	R20518
CLZ-FP-23/7,5	5,7	7,5	8,2	8,2	9	85 x 245	1,6	C	R2051A
CLZ-FP-23/10	9,1	10	10,9	11	12	85 x 245	1,6	C	R2051C
CLZ-FP-23/12,5	11,4	12,5	13,6	-	-	110 x 245	2,6	E	R2051D
CLZ-FP-23/15	13,7	25	-	-	-	110 x 245	2,6	E	R2051E



CLZ-FP									
Type	50 Hz			60 Hz		Dimensions mm (d x h)	Weight	Type	Code
	380 V	400 V	415 V	380 V	400 V				
CLZ-FP-40/2	1,8	2	2,2	2,2	2,4	85 x 175	1,2	B	R20533
CLZ-FP-40/2,5	2,3	2,5	2,7	2,7	3	85 x 175	1,2	B	R20534
CLZ-FP-40/3	2,7	3	3,2	3,2	3,6	85 x 175	1,2	B	R20535
CLZ-FP-40/4	3,6	4	4,3	4,3	4,8	85 x 175	1,2	B	R20537
CLZ-FP-40/5	4,5	5	5,4	5,4	6	85 x 175	1,2	B	R20538
CLZ-FP-40/6,25	5,6	6,25	6,7	6,7	7,5	85 x 175	1,2	B	R20539
CLZ-FP-40//7,5	6,8	7,5	8,1	8,1	9	85 x 245	1,6	C	R2053A
CLZ-FP-40/8	7,2	8	8,6	8,6	9,6	85 x 245	1,6	C	R2053B
CLZ-FP-40/10	9	10	10,8	10,8	12	85 x 245	1,6	C	R2053C
CLZ-FP-40/12,5	11,3	12,5	13,5	13,5	15	85 x 245	1,6	C	R2053D
CLZ-FP-40/15	13,5	15	16,3	16,1	18	110 x 245	2,6	E	R2053E
CLZ-FP-40/20	18,1	20	21,5	21,5	24	110 x 245	2,6	E	R2053F
CLZ-FP-40/25	22,6	25	26,9	-	-	110 x 261	2,6	F	R2053G
CLZ-FP-40/30	27,1	30	32,3	-	-	136 x 220	3,8	G	R2053H
CLZ-FP-40/40	36,1	40	-	-	-	136 x 261	4,4	H	R2053J
CLZ-FP-40/50	45,1	50	-	-	-	136 x 355	6,2	I	R2053K

**CLZ-FP**



CLZ-FP								
Type	50 Hz		60 Hz		Dimensions mm (d x h)	Weight	Type	Code
	400 V	415 V	380 V	400 V				
CLZ-FP-44/2	2	2,2	2,4	2,6	85 x 175	1,2	B	R20543
CLZ-FP-44/2,5	2,5	2,7	3	3,3	85 x 175	1,2	B	R20544
CLZ-FP-43/3	3	3,3	3,6	3,9	85 x 175	1,2	B	R20545
CLZ-FP-44/4	4	4,4	4,8	5,2	85 x 175	1,2	B	R20547
CLZ-FP-44/5	5	5,5	6	6,6	85 x 175	1,2	B	R20548
CLZ-FP-44/6,25	6,25	6,8	7,5	8,2	85 x 175	1,2	B	R20549
CLZ-FP-44/7,5	7,5	8,2	9	9,8	85 x 175	1,2	B	R2054A
CLZ-FP-44/8	8	8,7	9,6	10,5	85 x 245	1,2	C	R2054B
CLZ-FP-44/10	10	10,9	12	13,1	85 x 245	1,6	C	R2054C
CLZ-FP-44/12,5	12,5	13,7	15	16,4	85 x 245	1,6	C	R2054D
CLZ-FP-44/15	15	16,4	18	19,7	110 x 245	2,6	E	R2054E
CLZ-FP-44/20	20	21,9	24	26,2	110 x 245	2,6	E	R2054F
CLZ-FP-44/25	25	27,3	-	-	110 x 245	2,6	E	R2054G
CLZ-FP-44/30	30	-	-	-	136 x 220	3,8	G	R2054H
CLZ-FP-44/40	40	-	-	-	136 x 261	4,4	H	R2054J
CLZ-FP-44/50	50	-	-	-	136 x 355	6,2	I	R2054K



CLZ-FP									
Type	50 Hz			60 Hz		Dimensions mm (d x h)	Weight	Type	Code
	480 V	525 V	550 V	480 V	525 V				
CLZ-FP-52/2	1,7	2	2,2	2	2,4	85 x 175	1,2	B	R20553
CLZ-FP-52/2,5	2,1	2,5	2,7	2,5	3	85 x 175	1,2	B	R20554
CLZ-FP-52/3	2,5	3	3,3	3	3,6	85 x 175	1,2	B	R20555
CLZ-FP-52/4	3,3	4	4,4	4	4,8	85 x 175	1,2	B	R20557
CLZ-FP-52/5	4,2	5	5,5	5	6	85 x 175	1,2	B	R20558
CLZ-FP-52/6,25	5,2	6,25	6,8	6,2	7,5	85 x 175	1,2	B	R20559
CLZ-FP-52/7,5	6,3	7,5	8,2	7,5	9	85 x 245	1,6	C	R2055A
CLZ-FP-52/8	6,7	8	8,7	8	9,6	85 x 245	1,6	C	R2055B
CLZ-FP-52/10	8,4	10	11	10	12	85 x 245	1,6	C	R2055C
CLZ-FP-52/12,5	10,4	12,5	13,7	12,5	15	110 x 220	2,2	D	R2055D
CLZ-FP-52/15	12,5	15	16,5	15	18	110 x 245	2,6	E	R2055E
CLZ-FP-52/20	16,7	20	22	20,1	24	110 x 245	2,6	E	R2055F

IP54 covers for CLZ-FP	
Type	Code
TLCZ-FP85	R29911
TLCZ-FP110	R29912
TLCZ-FP110B (25 kvar)	R29913



## REACTORS FOR FILTERING



Capacitor banks with rejection filters are designed for systems with a significant harmonic content. They avoid possible resonances with the system and capacitor overload.

In order to do this they have a series of reactors and capacitors tuned to a frequency which does not coincide with any harmonic range.

Rejection filters may be defined in different ways:

- By the increase in voltage produce by the reactor on the capacitor (overvoltage factor).

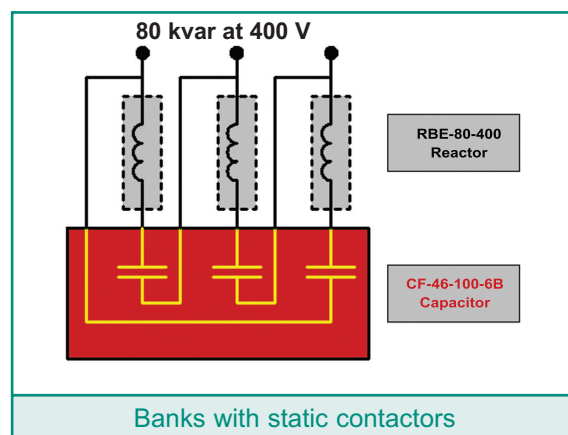
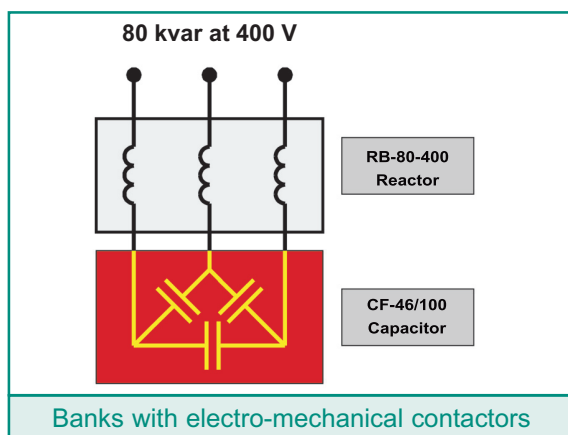
$$p(\%) = 100 \cdot \frac{U_L}{U_C} = 100 \cdot \left( \frac{\omega}{\omega_r} \right)^2$$

- By the tuned filter frequency value in Hz
- By the range or relative frequency to which it has been tuned

The following table shows the relationship between the two ways of selecting the filter in the most common equipment.

p	Order or relative frequency	Frequency for 50 Hz systems	Frequency for 60 Hz systems	Reactor for electro-mechanical contactor	Reactor for static contactor
14 (%)	2,7	134 Hz	162 Hz	RBC	-
7 (%)	3,8	189 Hz	227 Hz	R/RB, RX/RBX	RE/ RBE

The reactor wiring depends on the application



### FEATURES

	R / RX/ RE	RB / RBX /RBE		R / RX/ RE	RB / RBX /RBE
<b>Electrical features</b>			<b>Assembly conditions</b>		
Voltage	400 V a.c.		Mounting	Vertical	
Frequency	50 or 60 Hz		Connections	Using terminals	Using aluminium plate
Power	According to table		Minimum distances between reactors	4 cm	
Overcurrent: Permanent Transient (1 min)	1,17 I <sub>n</sub> 2 I <sub>n</sub>		Termostato de protección	Trip temperature 90 °C	
Tolerance	3 %		<b>Assembly features</b>		
Insulation voltage	4 kV		Core material	Orientated grain coating	Orientated grain coating with multiple scatters
Linearity (5% de L)	1,8 I <sub>n</sub>		Conductor material	Copper wire	Aluminium band
<b>Environmental features</b>			Insulation	Vacuum varnish impregnation	
Maximum ambient temperature	45 °C		Protection grade	IP 00	
Altitude	1 000 m		Dimensions	Ver tablas	
			Temperature category	Class F (155 °C)	
			<b>Standards</b>	<b>IEC 289, IEC 076</b>	

**REACTORS III FOR FR SERIES**  
 400 V a.c. , 50 Hz , p = 7 %


Type	Code	kvar	For capacitor	$I_n$	Losses
R-5-400	P70110	5	CF 46 / 6	7,5 A	25 W
R-10-400	P70115	10	CF 46 / 12,5	15 A	50 W
R-15-400	P70117	15	CF 46 / 19	22 A	57 W
RB-20-400	P70125	20	CF 46 / 25	30 A	76 W
RB-25-400	P70130	25	CF 46 / 30	37 A	90 W
RB-30-400	P70135	30	CF 46 / 37	45 A	120 W
RB-40-400	P70140	40	CF 46 / 50	60 A	145 W
RB-50-400	P70145	50	CF 46 / 62	75 A	185 W
RB-60-400	P70150	60	CF 46 / 74	90 A	205 W
RB-80-400	P70155	80	CF 46 / 100	120 A	235 W
RB-100-400	P70160	100	CF 46 / 62 (x2)	145 A	250 W
RB-120-400	P70165	120	CF 46 / 74 (x2)	175 A	295 W

Type	Code	kvar	For capacitor	$I_n$	Losses
RX-6,25-400	P7101F	6,25	CF 46 / 7,5	9	36 W
RX-12,5-400	P70013	12,5	CF 46 / 15	18	53 W
RX-25-400	P70016	25	CF 46 / 30	37	92 W
RBX-50-400	P70019	50	CF 46 / 63	75	187 W

**REACTORS III FOR FRE SERIES (STATIC BANKS)**  
 400 V a.c. , 50 Hz , p = 7 %


Type	Code	kvar	For capacitors	$I_n$	Losses
RE-5-400	P70210	5	CF 46 / 6-6B	7.5 A	25 W
RE-10-400	P70215	10	CF 46 / 12,5-6B	15 A	50 W
RE-15-400	P70220	15	CF 46 / 19-6B	22 A	57 W
RBE-20-400	P70225	20	CF 46 / 25-6B	30 A	76 W
RBE-25-400	P70230	25	CF 46 / 30-6B	37 A	90 W
RBE-30-400	P70235	30	CF 46 / 37-6B	45 A	120 W
RBE-40-400	P70240	40	CF 46 / 50-6B	60 A	145 W
RBE-50-400	P70245	50	CF 46 / 62-6B	75 A	185 W
RBE-60-400	P70250	60	CF 46 / 74-6B	90 A	205 W
RBE-80-400	P70255	80	CF 46 / 100-6B	120 A	235 W

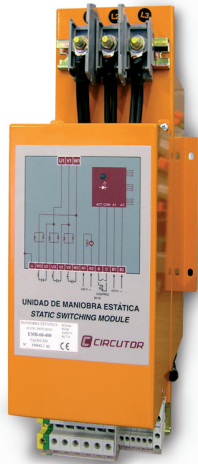
**REACTORS III FOR R / RBC SERIES**  
 400 V a.c. , 50 Hz , p = 14 %


Type	Code	kvar	$I_n$	L (mH)	Losses
R-5-400-14%	P70110 00 003	5	7,5 A	16,31	31 W
R-10-400-14%	P70115 00 003	10	15 A	8,15	61 W
R-12,5-400-14%	P70117 00 003	12,5	18 A	6,52	65 W
R-15-400-14%	P70120 00 003	15	22 A	5,43	71 W
R-20-400-14%	P70125 00 003	20	30 A	4,07	110 W
R-25-400-14%	P70130 00 003	25	37 A	3,26	112 W
RBC-30-400-14%	P70135 00 003	30	45 A	2,71	146 W
RBC-40-400-14%	P70140 00 003	40	60 A	2,03	181 W
RBC-50-400-14%	P70145 00 003	50	75 A	1,63	225 W
RBC-60-400-14%	P70150 00 003	60	90 A	1,35	254 W

R type reactor: Cu wire  
 RBC type reactor: Cu foil



## EM STATIC OPERATION UNITS (REAL TIME)



**EM** static operation units include all the necessary parts in a compact format for operation using thyristors in a static system capacitor bank step.

**EM** modules are divided into two basic blocks:

- Static power block.
- Control block

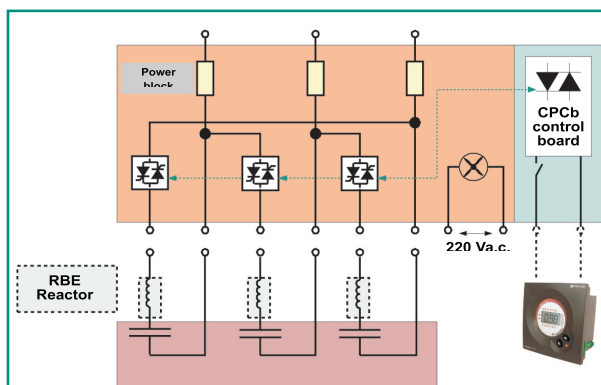
The two blocks are assembled in a small frame to be installed on an electrical switchboard.

The **EM** modules have two options depending on the design of the board:

- **EMF** modules equipped with general protection using fuses
- **EMB** modules without general protection. This has to be taken into account on the board where the module is to be assembled.

### STATIC POWER BLOCK

On the static power block there are the necessary step operation and protection as shown in the following summary table.



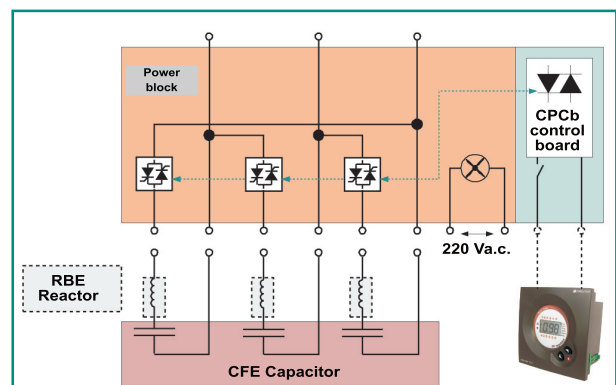
#### EMF

Power block

- 6 thyristors, 2 per phase
- General protection fuses
- Fan and thermostat

Control card

- Controls the connection and disconnection of the thyristors.



#### EMB

Power block

- 6 thyristors, 2 per phase
- Fan and thermostat

Control card

- Controls the connection and disconnection of the thyristors.

### CONTROL BLOCK

The control block is formed by the control board. This board controls the connection of the thyristors with voltage passing through zero avoiding any type of transient event.

The card connection order is sent by the **Computer 8d-f**, **Computer 14d-f** or **Fast-com** reactive regulators.

EMF 230 V				
kvar	Weight kg	Dimensions mm	Type	Code
25	10,5	177x470x285	EMF-25/230	<b>R41111</b>
37,5	10,5	177x470x285	EMF-37,5/230	<b>R41112</b>
45	10,5	177x470x285	EMF-45/230	<b>R41114</b>
EMF 400 V				
40	10,5	177x470x285	EMF-40/400	<b>R41133</b>
60	10,5	177x470x285	EMF-60/400	<b>R41136</b>
80	10,5	177x470x285	EMF-80/400	<b>R41137</b>

EMB 230 V				
kvar	Weight kg	Dimensions mm	Type	Code
25	10	177x470x285	EMB-25/230	<b>R41211</b>
37,5	10	177x470x285	EMB-37,5/230	<b>R41212</b>
45	10	177x470x285	EMB-45/230	<b>R41214</b>
EMB 400 V				
40	10	177x470x285	EMB-40/400	<b>R41233</b>
60	10	177x470x285	EMB-60/400	<b>R41236</b>
80	10	177x470x285	EMB-80/400	<b>R41237</b>

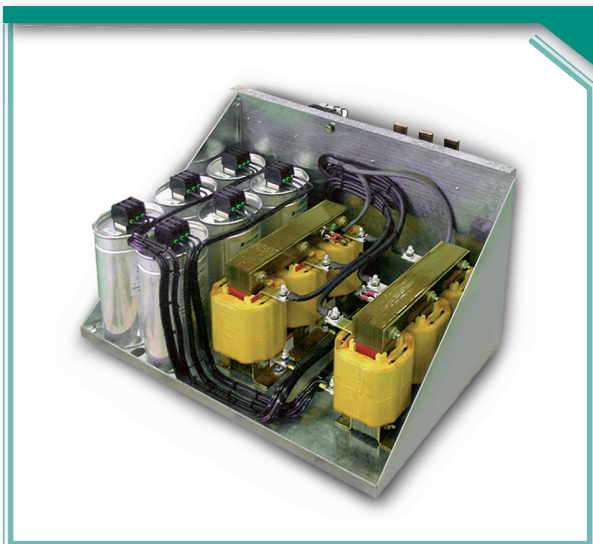
## FEATURES

Electrical features	
Voltage	220-240 V a.c. / 380-400 V a.c.
Frequency	50 or 60 Hz
Operating power	According to table
Overcurrent	1,5 $I_n$ for 1 minute
Auxiliary voltage (V a.c.)	430 / 230 Vac (indicated on the module features plate)
Ventilator voltage	230 V a.c.
Mechanical features	
Casing	Painted steel
Protection grade	IP 00
Dimensions	See table
Weight	See table

Environmental conditions	
Temperature inside the assembly cabinet	Maximum 45 °C
Altitude	Maximum 2 000 m
Assembly conditions	
Mounting	Vertical
Ventilation	Forced. Included in the module
Maximum temperature of the dissipater	80 °C
Minimum distance between modules	5 cm
Minimum distance between modules and other equipment	10 cm
Protection	
dU/dt	<b>RC</b> protection at V/μs
Thermostat	Trip at 90°C. (Prevents enabling, A-C circuit)
di/dt	100 A/μs (requires assembly of L in series of 16 μH)
<b>Standards</b>	<b>EN 60-439, (IEC 439, UNE-20-098), IEC 146</b>



## RACK



The correction system using **RACKS** grouped in modules assembled and cabled with all the necessary parts for capacitor bank step to operate. Therefore, the composition of the bank is by attaching a **RACK** with the appropriate power.

### Composition

The racks comprise:

- Step protection fuses.
- Operation contactor
- **CLZ-FP** capacitors
- Rejection reactors. (For **RACK-F** only)
- Support frame.

### Connections

- Each module has terminals for connecting the regulator operation and for the auxiliary command voltage.
- Connection between racks has to be via a copper plate

### Range

There are two types of **RACK**:

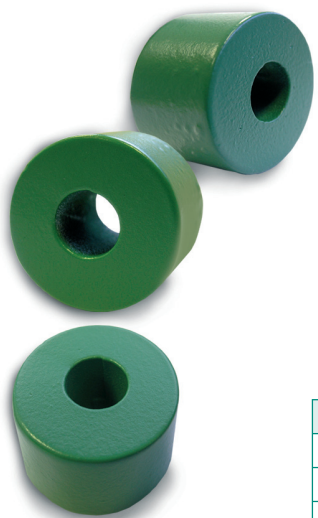
- **RACK** for standard banks without filters. Designed for 600 mm wide cabinets
- **RACK-F** for rejection filter banks tuned to 189 Hz. Designed for 800 mm wide cabinets

RACK 400 / 415 V a 50 HZ						
kvar	Composition (fuse+contactor)	Nº of steps	Weight (kg)	Dimensions (mm)	Type	Code
5	1 + 1	1 x 5	13,2	492 x 330 x 280	RACK-1x5-400	R20918
10	1 + 1	1 x 10	13,5	492 x 330 x 280	RACK-1x10-400	R2091C
12,5	1 + 1	1 x 12,5	13,8	492 x 330 x 280	RACK-1x12,5-400	R2091D
15	1 + 1	1 x 15	14	492 x 330 x 280	RACK-1x15-400	R2091E
20	1 + 1	1 x 20	14,5	492 x 330 x 280	RACK-1x20-400	R2091F
25	1 + 1	1 x 25	14,7	492 x 330 x 280	RACK-1x25-400	R2091G
30	1 + 1	1 x 30	16,1	492 x 330 x 280	RACK-1x30-400	R2091H
40	1 + 1	1 x 40	17,1	492 x 330 x 280	RACK-1x40-400	R2091J
50	1 + 2	2 x 25	20,3	492 x 330 x 280	RACK-2x25-400	R2092G
50	1 + 1	1 x 50	17,4	492 x 330 x 280	RACK-1x50-400	R2091K
60	2 + 2	2 x 30	22,2	492 x 330 x 280	RACK-2x30-400	R2092H
100	2 + 2	2 x 50	24,8	492 x 330 x 280	RACK-2x50-400	R2092K

RACK-FR 400 / 415 V a 50 HZ						
kvar	Composition (fuse+contactor)	Nº of steps	Weight (kg)	Dimensions (mm)	Type	Code
5	1 + 1	1 x 5	30	692 x 275 x 430	RACK-FR-7%-1x5-400	R21018
10	1 + 1	1 x 10	32,5	692 x 275 x 430	RACK-FR-7%-1x10-400	R2101C
12,5	1 + 1	1 x 12,5	34	692 x 275 x 430	RACK-FR-7%-1x12,5-400	R2101D
15	1 + 1	1 x 15	35,2	692 x 275 x 430	RACK-FR-7%-1x15-400	R2101E
20	1 + 1	1 x 20	39,5	692 x 275 x 430	RACK-FR-7%-1x20-400	R2101F
25	1 + 1	1 x 25	42	692 x 275 x 430	RACK-FR-7%-1x25-400	R2101G
30	1 + 1	1 x 30	47,4	692 x 275 x 430	RACK-FR-7%-1x30-400	R2101H
40	1 + 1	1 x 40	48,4	692 x 275 x 430	RACK-FR-7%-1x40-400	R2101J
50	1 + 2	1 x 50	57,4	692 x 275 x 430	RACK-FR-7%-1x50-400	R2101K
50	1 + 1	2 x 25	71,3	692 x 275 x 430	RACK-FR-7%-2x25-400	R2102G
60	2 + 2	2 x 30	74,8	692 x 275 x 430	RACK-FR-7%-2x30-400	R2102H
100	2 + 2	2 x 50	95,8	692 x 275 x 430	RACK-FR-7%-2x50-400	R2102K

ACCESSORIES

Components for power factor correction



**IMPEDANCES LIMITING INRUSH CURRENTS. IR SERIES**

The connection of capacitors has a significant current peak associated with it. These values may be up to 275 times the capacitor nominal current.

There are two possible solutions to limit these transients to tolerable levels for the contactors and capacitors:

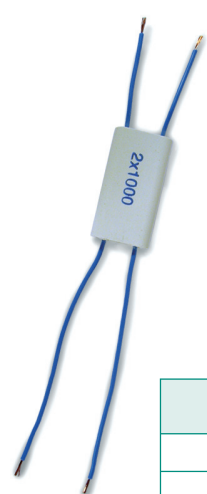
- Use of special contactors for capacitive cut off with limiting resistances
- Use of **IR** series limiting impedances.

**IR** impedances are assembled in each of the three power cables between the contactor and capacitor.

The selection of the **IR** impedances is done in terms of the diameter of the cable used as shown in the following table.

Type	Cable diameter (mm)	Code
IR-6	6	R3Z310
IR-10	10	R3Z320
IR-25	25	R3Z330
IR-35	35	R3Z340
IR-50	50	R3Z350
IR-70	70	R3Z360

**FAST DISCHARGE REACTORS. RD SERIES**



**RD** series fast discharge resistance steps have to be installed for a faster and therefore a more accurate regulation of the bank.

With **RD** resistances, the step discharge time is less than 10 seconds. Therefore regulation can be done in a shorter time than that stated in the IEC60831-1 standard which proposes a residual voltage of 75 V in 3 minutes.

Resistances are connected using an auxiliary contact which is normally closed from the contactor in such a way that when the capacitor is disconnected the **RD** resistance remains connected.

Type	Power (kvar)	Resistance ( $\Omega$ )	Dissipated power (W)	Code
RD-25	1 - 25	2 x 1 500	10	R3Z210
RD-60	25 -60	2 x 1 000	10	R3Z220
RD-100	60/100	2 x 1 000	15	R3Z230





## RECOMMENDATIONS FOR THE ASSEMBLY OF CAPACITOR BANKS

### GENERAL STANDARDS

#### On assembly

The capacitors and reactors must be vertically assembled.  
Capacitor terminals must not be used as a connection bridge for other capacitors.

#### Distances

Maintenance minimum distances between parts is vital for guaranteeing proper working. The following table shows the minimum distances between the parts

	Horizontal distance between parts	Comments
Prismatic capacitors	4 cm	
<b>CLZ</b> capacitors	2 cm between edges	<ul style="list-style-type: none"> <li>• The upper part of the capacitor may expand 2 cm in the event of a fault.</li> <li>• Connection must be made using a flexible cable.</li> </ul>
<b>RB/RBX/RBE</b> filter reactors	4 cm	Assemble capacitors below the filter reactors. This way over heating of the capacitors is prevented and improves the available space in the cabinet.

### ASSEMBLY FEATURES

The operating temperature inside the board between parts must not exceed the values stated in the IEC 60831-1 standard

Ambient temperature, °C according to the IEC 60831-1 standard				
Type of capacitor	Category	Maximum temperature (*)	Highest measurement in 24 hours	Highest measurement in 1 year
<b>CV-CQ-CS-CF</b>	C	50	40	30
<b>CLZ</b>	D	55	45	35

### CONNECTION OF THE STEPS

#### Limiting connection currents

In order to protect the capacitors and operating equipment, the connection current points have to be limited.  
Different solutions are recommended for this:

- Contactors with preload resistance
- **IR** series inductances
- Series reactance using cable connection returns (in terms of the step current).

#### Fast reconnection

In order to increase connection operations the use of **RD** resistance is recommended.

### DESIGN OF COMPONENTS FOR BANK STEPS

- The rated current for the components is defined in accordance with the criteria stated in the IEC 60831 standard. A rated current between 1.4 and 1.5 times the bank's rated current is recommended.
- Fuse calibre is calculated using a sizing of 1.6 times the rated current.
- Capacitor cables must be sized to permanently support 1.43 times its rated current as a minimum.
- Cables have been calculated for an operating temperature of 40 °C. Possible cable groupings have not been taken into account. Therefore in terms of the assembly and the actual operating conditions, the express calculation of the diameters to be used is advised.

DESIGN OF COMPONENTS FOR BANK STEPS WITH REJECT FILTERS

Power kvar (at system voltage)	System 230 V – 60 Hz			System 400 V – 50 Hz			System 460 V – 60 Hz			System 480 V – 60 Hz		
	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse
	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A
7,5	18,8	6	35	10,8	6	20	9,4	6	20	9,0	6	20
10	25,1	10	50	14,5	6	25	12,6	6	25	12,0	6	20
12,5	31,4	10	63	18,1	6	35	15,7	6	25	15,1	6	25
15	37,7	10	63	21,7	6	50	18,8	6	35	18,1	6	35
20	50,3	25	100	28,9	10	50	25,1	10	50	24,1	10	50
25	62,8	25	125	36,1	10	63	31,4	10	50	30,1	10	50
30	75,4	35	125	43,4	16	80	37,7	10	63	36,1	10	63
35	88,0	50	160	50,6	25	100	44,0	16	80	42,1	16	80
37,5	94,2	50	160	54,2	25	100	47,1	16	80	45,2	16	80
40	100,5	50	160	57,8	25	100	50,3	25	100	48,2	25	80
50	125,7	70	200	72,3	35	125	62,8	25	100	60,2	25	100
60	-	-	250	86,7	50	160	75,4	35	125	72,3	35	125
70	-	-	-	101,16	50	160	88,0	50	160	84,3	50	160
80	-	-	-	115,61	70	160	100,5	50	160	96,3	50	160

DESIGN OF COMPONENTS FOR BANK STEPS WITH REJECT FILTERS

Power kvar (at system voltage)	System 230 V – 60 Hz			System 400 V – 50 Hz			System 460 V – 60 Hz			System 480 V – 60 Hz		
	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse	$I_n$	Diameter	Fuse
	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A	A	mm <sup>2</sup>	A
7,5	18,8	10	35	10,8	6	20	9,4	6	20	9,0	6	20
10	25,1	10	50	14,5	6	25	12,6	6	25	12,0	6	20
12,5	31,4	16	63	18,1	10	35	15,7	6	25	15,1	6	25
15	37,7	16	63	21,7	10	50	18,8	10	35	18,1	6	35
20	50,3	25	100	28,9	10	50	25,1	10	50	24,1	10	50
25	62,8	35	125	36,1	16	63	31,4	16	50	30,1	10	50
30	75,4	50	125	43,4	25	80	37,7	16	63	36,1	16	63
35	88,0	70	160	50,6	35	100	44,0	25	80	42,1	25	80
37,5	94,2	70	160	54,2	35	100	47,1	35	80	45,2	25	80
40	100,5	70	160	57,8	35	100	50,3	35	100	48,2	35	80
50	125,7	95	200	72,3	35	125	62,8	35	100	60,2	35	100
60	-	-	-	86,7	50	160	75,4	50	125	72,3	35	125
70	-	-	-	101,16	70	160	88,0	50	160	84,3	50	160
80	-	-	-	115,61	95	160	100,5	70	160	96,3	70	160


**System voltage 230 V at 50 Hz and 7 % reactors**

Capacitor voltage 260 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 26/6,3	R2112A	R-5-230	P70110001
10	CF 26/12,5	R2112D	R-10-230	P70115001
12,5	CF 26/16	R2112F	R-12,5-230	P70117001
15	CF 26/18	R2112E	R-15-230	P70120001
20	CF 26/25	R2112G	RB-20-230	P70125001
25	CF 26/30	R2112H	RB-25-230	P70130001
30	CF 26/37	R2112J	RB-30-230	P70135001
40	CF 26/48	R2112K	RB-40-230	P70140001
50	CF 26/60	R2112L	RB-50-230	P70145001

**System voltage 230 V at 60 Hz and 7 % reactors**

Capacitor voltage 260 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 26/5	R2112C001	R-5-230	P701100011
10	CF 26/10	R2112I001	R-10-230	P701150011
12,5	CF 26/15	R2112D001	R-12,5-230	P701170011
15	CF 26/20	R2112M001	R-15-230	P701200011
20	CF 26/25	R2112P001	RB-20-230	P701250011
25	CF 26/30	R2112G001	RB-25-230	P701300011
30	CF 26/40	R2112H001	RB-30-230	P701350011
40	CF 26/50	R2112Q001	RB-40-230	P701400011

**System voltage 400 V at 50 Hz and 7 % reactors**

Capacitor voltage 460 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 46/6	R2115A	R-5-400	P70110
10	CF 46/12,5	R2115D	R-10-400	P70115
12,5	CF 46/15	R2115E	R-12,5-400	P70117
15	CF 46/19	R2115F	R-15-400	P70120
20	CF 46/25	R2115G	RB-20-400	P70125
25	CF 46/30	R2115H	RB-25-400	P70130
30	CF 46/37	R2115J	RB-30-400	P70135
40	CF 46/50	R2115K	RB-40-400	P70140
50	CF 46/62	R2115L	RB-50-400	P70145
60	CF 46/74	R2115P	RB-60-400	P70150
80	CF 46/100	R2115R	RB-80-400	P70155

**System voltage 440 V at 60 Hz and 7 % reactors**

Capacitor voltage 500 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 50/6	R211CA001	R-5-400	P70110
10	CF 50/12,5	R211CD001	R-10-400	P70115
12,5	CF 50/15	R211CE001	R-12,5-400	P70117
15	CF 50/19	R211CF001	R-15-400	P70120
20	CF 50/25	R211CG001	RB-20-400	P70125
25	CF 50/30	R211CH001	RB-25-400	P70130
30	CF 50/37	R211CJ001	RB-30-400	P70135
40	CF 50/50	R211CK001	RB-40-400	P70140
50	CF 50/62	R211CL001	RB-50-400	P70145
60	CF 50/74	R211CP001	RB-60-400	P70150
80	CF 50/100	R211CR001	RB-80-400	P70155

**System voltage 690 V at 50 Hz and 7 % reactors**

Capacitor voltage 790 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 79/6	R211DA	RE-5-400	P70210
10	CF 79/12,5	R211DD	RE-10-400	P70215
15	CF 79/19	R211DF	RE-15-400	P70220
20	CF 79/25	R211DG	RE-20-400	P70225
25	CF 79/30	R211DH	RE-25-400	P70230
30	CF 79/37	R211DT	RE-30-400	P70235
40	CF 79/50	R211DK	RE-40-400	P70240
50	CF 79/62	R211DL	RBE-50-400	P70245
60	CF 79/74	R211DP	RBE-60-400	P70250
80	CF 79/100	R211DR	RBE-80-400	P70255

**System voltage 480 V at 60 Hz and 7 % reactors**

Capacitor voltage 525 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 55/7	R2116C001	R-5-400	P70110001
10	CF 55/15	R2116E001	R-10-400	P70115001
12,5	CF 55/18	R2116F001	R-12,5-400	P70117001
15	CF 55/22	R2116G001	R-15-400	P70120001
20	CF 55/29	R2116H001	RB-20-400	P70125001
25	CF 55/37	R2116J001	RB-25-400	P70130001
30	CF 55/44	R2116K001	RB-30-400	P70135001
45	CF 55/59	R2116L001	RB-40-400	P70140001
55	CF 55/73	R2116P001	RB-50-400	P70145001
65	CF 55/88	R2116S001	RB-60-400	P70150001
90	CF 55/117	R2116T001	RB-80-400	P70155001

**System voltage 460 V at 60 Hz and 7 % reactors**

Capacitor voltage 550 V				
Power kvar	Capacitor type	Code	Reactor type	Code
5	CF 55/7	R2116C001	R-5-400	P70110001
12,5	CF 55/15	R2116E001	R-10-400	P70115001
15	CF 55/18	R2116F001	R-12,5-400	P70117001
17,5	CF 55/22	R2116G001	R-15-400	P70120001
25	CF 55/29	R2116H001	RB-20-400	P70125001
30	CF 55/37	R2116J001	RB-25-400	P70130001
35	CF 55/44	R2116K001	RB-30-400	P70135001
50	CF 55/59	R2116L001	RB-40-400	P70140001
60	CF 55/73	R2116P001	RB-50-400	P70145001
70	CF 55/88	R2116S001	RB-60-400	P70150001
95	CF 55/117	R2116T001	RB-80-400	P70155001

## CLZ CILYNDRICAL CAPACITORS AND REACTORS FOR MAKING ELECTRO-MECHANICAL REJECTION FILTERS

### Operating voltage 400 V / 50 Hz and 6 % reactors

Power kvar	Power kvar design	Capacitor type	Code	Reactor type	Code
5,5	6,25	CLZ-FP-6,25/44	<b>R20549</b>	RX-6,25-400	<b>P7101F</b>
11	12,5	CLZ-FP-12,5/44	<b>R2054D</b>	RX-12,5-400	<b>P70013</b>
22	25	CLZ-FP-25/44	<b>R2054G</b>	RX-25-400	<b>P70016</b>
44	50	2 x CLZ-FP-25/44	<b>2 x R2054G</b>	RBX-50-400	<b>P70019</b>

### Operating voltage 440 V / 60 Hz and 7 % reactors

Power kvar	Power kvar design	Capacitor type	Code	Reactor type	Code
6,25	5,5	CLZ-FP-52/2,5 + CLZ-FP-52/3	<b>R20555 + R20557</b>	RX-6,25-400	<b>P7101F</b>
12,5	14	CLZ-FP-52/4 + CLZ-FP-52/10	<b>R20557 + R2055C</b>	RX-12,5-400	<b>P70013</b>
25	28	CLZ-FP-52/20 + CLZ-FP-52/8	<b>R2055F + R2055B</b>	RX-25-400	<b>P70016</b>
50	55	2 x CLZ-FP-52/20+ CLZ-FP-52/15	<b>2 X R2055F + R2055E</b>	RBX-50-400	<b>P70019</b>

### Operating voltage 460 V / 60 Hz and 7 % reactors

Power kvar	Power kvar design	Capacitor type	Code	Reactor type	Code
6,25	5,5	CLZ-FP-52/2,5 + CLZ-FP-52/3	<b>R20555 + R20557</b>	RX-6,25-400	<b>P7101F</b>
12,5	14	CLZ-FP-52/4 + CLZ-FP-52/10	<b>R20557 + R2055C</b>	RX-12,5-400	<b>P70013</b>
25	28	CLZ-FP-52/20 + CLZ-FP-52/8	<b>R2055F + R2055B</b>	RX-25-400	<b>P70016</b>
50	55	2 x CLZ-FP-52/20+ CLZ-FP-52/15	<b>2 X R2055F + R2055E</b>	RBX-50-400	<b>P70019</b>

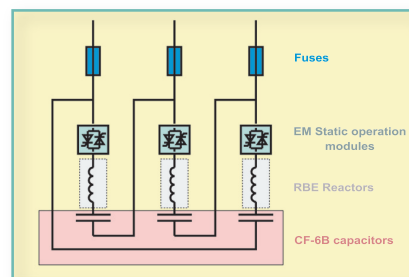
### Operating voltage 480 V / 60 Hz and 7 % reactors

Power kvar	Power kvar design	Capacitor type	Code	Reactor type	Code
7,5	5,5	CLZ-FP-52/2,5 + CLZ-FP-52/3	<b>R20555 + R20557</b>	RX-6,25-400	<b>P7101F</b>
15	14	CLZ-FP-52/4 + CLZ-FP-52/10	<b>R20557 + R2055C</b>	RX-12,5-400	<b>P70013</b>
30	28	CLZ-FP-52/20 + CLZ-FP-52/8	<b>R2055F + R2055B</b>	RX-25-400	<b>P70016</b>
60	55	2 x CLZ-FP-52/20+ CLZ-FP-52/15	<b>2 X R2055F + R2055E</b>	RBX-50-400	<b>P70019</b>

## COMPONENTS FOR MAKING STEPS USING THE STATIC SYSTEM

The following diagram is required for making parts for static rejection filters. As stated, the components to select are:

- Static operation module
- **CF-6B** capacitors
- **RBE** reactors



### Operating voltage 400 V / 50 Hz and 7 % reactors (\*)

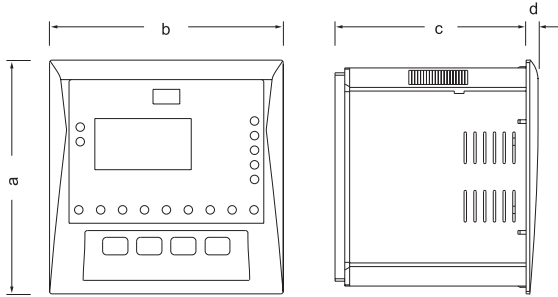
Power kvar	Capacitor		Reactor		EMF module		EMB module	
	Type	Code	Type	Code	Type	Code	Type	Code
5	CF 46/6 – 6B	<b>R2125A</b>	RE-5-400	<b>P70210</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
10	CF 46/12,5-6B	<b>R2125D</b>	RE-10-400	<b>P70215</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
15	CF 46/19-6B	<b>R2125F</b>	RE-15-400	<b>P70220</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
20	CF 46/25-6B	<b>R2125G</b>	RBE-20-400	<b>P70225</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
25	CF 46/30-6B	<b>R2125H</b>	RBE-25-400	<b>P70230</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
30	CF 46/37-6B	<b>R2125J</b>	RBE-30-400	<b>P70235</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
40	CF 46/50-6B	<b>R2125K</b>	RBE-40-400	<b>P70240</b>	EMF-40-400	<b>R41133</b>	EMB-40-400	<b>R41233</b>
50	CF 46/62-6B	<b>R2125L</b>	RBE-50-400	<b>P70245</b>	EMF-60-400	<b>R41136</b>	EMB-60-400	<b>R41236</b>
60	CF 46/74-6B	<b>R2125P</b>	RBE-60-400	<b>P70255</b>	EMF-60-400	<b>R41136</b>	EMB-60-400	<b>R41236</b>
80	CF 46/100-6B	<b>R2125R</b>	RBE-80-400	<b>P70250</b>	EMF-80-400	<b>R41137</b>	EMB-80-400	<b>R41237</b>

(\*) Other upon request

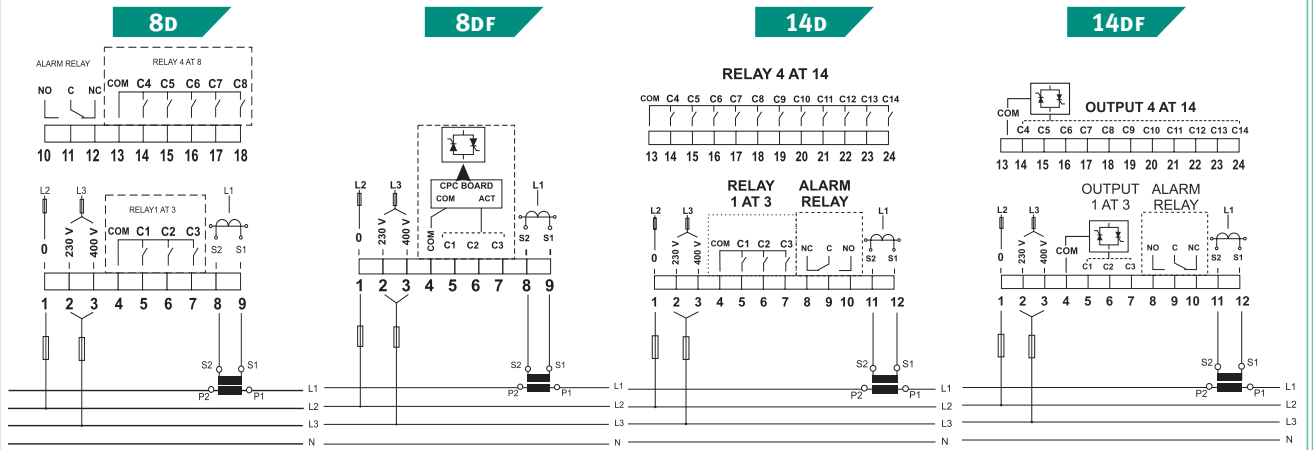


**DIMENSIONS / CONNECTIONS**

**COMPUTER 8-96 / 8DF-96 / COMPUTER 8D-144 / 8DF-144 / COMPUTER 14D / 14DF**

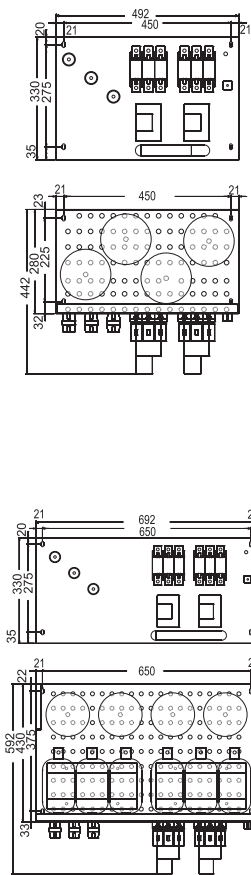


Dimensions in mm	Computer 8d-96 / 8df-96	Computer 8d-144 / 8df-144	Computer 14d / 14df
a	96	144	144
b	96	144	144
c	78,5	76	76
d	5,3	9,4	9,4



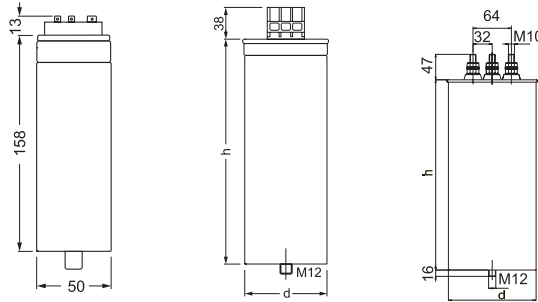
Components for power factor correction

**RACK / RACK-FR**



**CLZ-FPT**

**CLZ-FP**

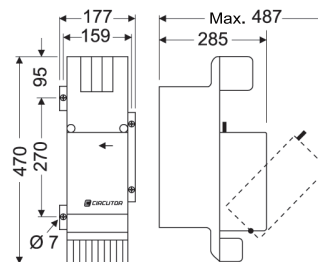


Type A

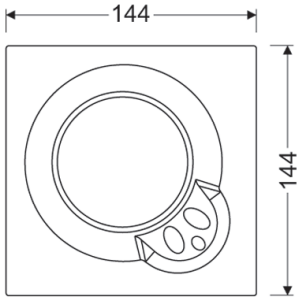
Type	d	h
B	85	175
C	85	245
D	110	220
E	110	245
F	110	261

Type	d	h
G	146	220
H	146	261
I	146	355

**EMB / EMF**



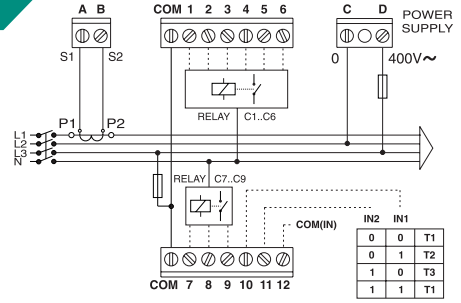
COMPUTER 6M / 12M / FASTCOMP 12RT / 9G-3T



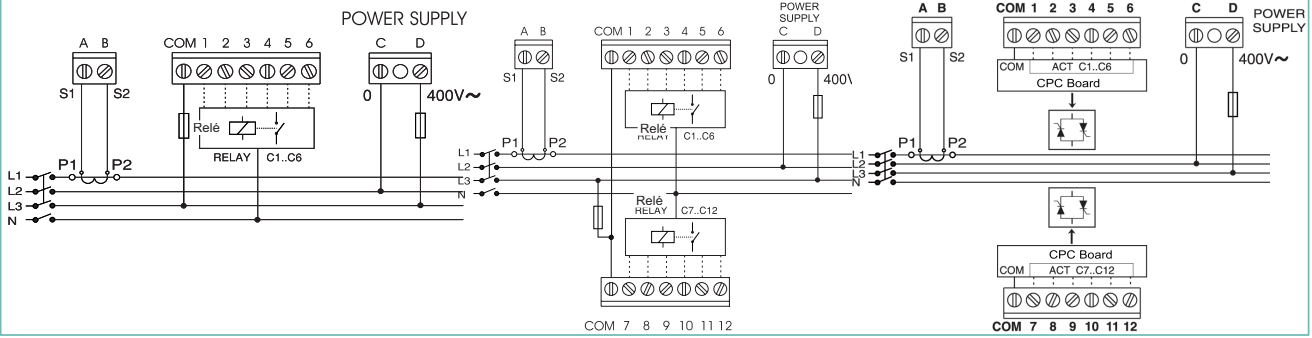
6M

12M

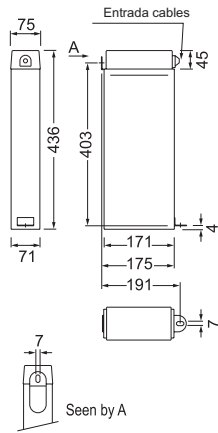
9G-3T



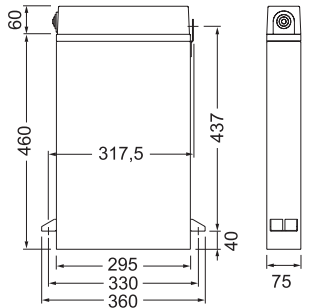
FASTCOMP 12RT



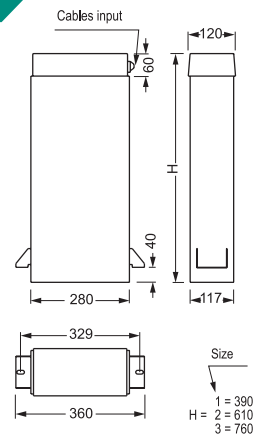
CV



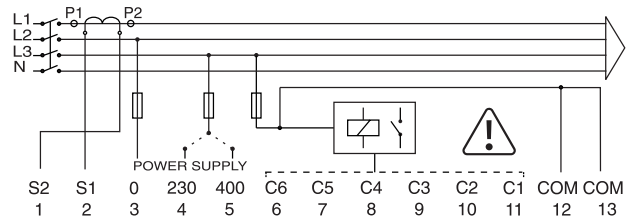
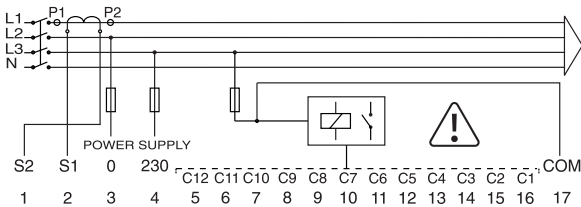
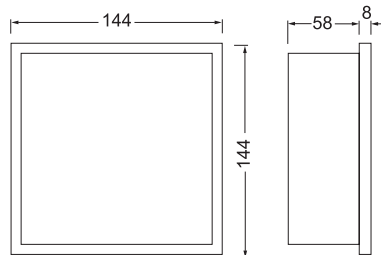
CQ



CS / CF



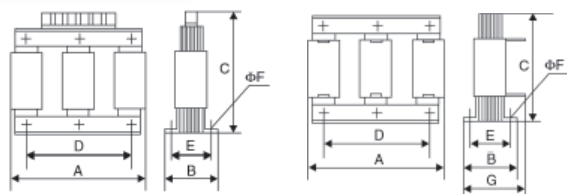
COMPUTER 6E / 12E





## DIMENSIONS

### R / RB / RX / RBX-7%



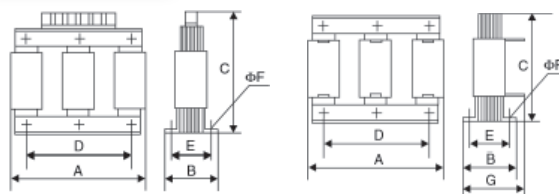
Type R / RX

Type RB / RBX

Type	A mm	B mm	C mm	D* mm	E* mm	F mm	G mm	kg
R-5-400	155	112	165	75	85	7	---	6
R-10-400	180	102	190	90	75	7	---	8
R-12,5-400	180	112	192	90	85	7	--	9,2
R-15-400	180	112	190	90	85	7	---	9,5
RB-20-400	260	124	174	150	90	7	150	14
RB-25-400	260	124	174	150	90	7	150	14
RB-30-400	290	124	231	160	90	9	150	19
RB-40-400	293	124	231	160	90	9	150	20
RB-50-400	310	144	233	160	110	9	175	27
RB-60-400	305	146	260	160	110	11	180	31
RB-80-400	335	155	280	180	120	11	185	38
RB-100-400	338	170	300	180	135	11	215	50
RB-120-400	355	170	350	200	135	13	220	58
RX-6,25-400	180	102	190	90	75	7	--	8
RX-12,5-400	180	112	192	90	85	7	--	9,2
RBX-25-400	180	137	196	90	110	7	--	15
RBX-50-400	292	144	232	160	110	9	175	26

\* Distance between fixing screws

### RE / RBE



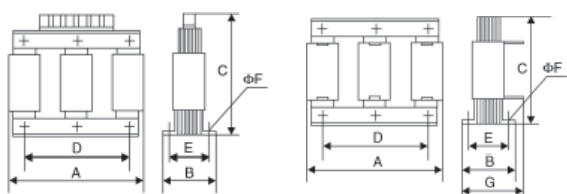
Type RE

Type RBE

Type	A mm	B mm	C mm	D* mm	E* mm	F mm	G mm	kg
RE-5-400	155	92	165	75	75	7	--	6
RE-10-400	180	102	190	90	75	7	--	8
RE-15-400	180	112	190	90	85	7	--	9,5
RE-20-400	180	122	190	90	95	7	--	11,5
RE-25-400	240	122	250	130	90	9	--	17
RE-30-400	240	132	250	130	100	9	--	20,5
RE-40-400	240	147	250	130	115	9	--	25,5
RBE-50-400	310	154	233	160	120	9	185	29
RBE-60-400	310	154	234	160	120	9	185	30
RBE-80-400	338	165	280	180	130	11	195	41

\* Distance between fixing screws

### R-14% / RBC-14%



Type R-14%

Type RB-14%

Type	A mm	B mm	C mm	D* mm	E* mm	F mm	G mm	kg
R-5-400-14%	180	102	197	90	75	7	-	9,5
R-10-400-14%	180	122	197	90	95	7	-	13
R-12,5-400-14%	180	137	197	90	110	7	-	16
R-15-400-14%	250	122	250	130	90	9	-	21,5
R-20-400-14%	250	132	250	130	100	9	-	25
R-25-400-14%	250	147	256	130	115	9	-	30,5
RBC-30-400-14%	285	154	233	160	120	9	181	35
RBC-40-400-14%	290	159	233	160	125	9	184	41
RBC-50-400-14%	307	164	233	160	130	9	194	48
RBC-60-400-14%	335	196	280	280	150	11	197	60

\*Distance between fixing screws



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