

R.4

Automatic capacitor banks with static system



Automatic capacitor banks with static system

Introduction	R4-3
R.4 - Automatic capacitor banks with static system	
Selection table	R4-4
ECK / EMK Automatic capacitor banks with static system	R4-5
PLUS E ntelligent automatic capacitor banks with static system	R4-7
EMB / EMF Static switching units (three-phase)	R4-9
CPC3 Zero step control board	R4-11

Automatic capacitor banks with static system

Automatic capacitor banks with static system - E Series

The **E Series** capacitor banks with static system have been designed for Power factor correction purposes in networks with fluctuating loads.

The variations in power are relatively fast (in milliseconds) so that the switching operations are carried out by thyristors, which are connected to a voltage control board, so that the connection and disconnection of the capacitor is carried out with a zero voltage difference.

Transients are prevented between the connection and disconnection of steps, obtaining the immediate response to the load fluctuations.

Functions and advantages of capacitor banks with a static system

The functions or advantages of this compensation system are as follows:

- Immediate response to the compensation request. The response time of the Power factor correction can be of a single network frequency cycle, thus achieving an almost instantaneous compensation.
- Elimination of start-up transients produced by the capacitor's connection. The connection takes place when the voltage network matches that of the capacitor when it is partially or totally loaded, as seen Fig.1.

- The lack of transients in the connection allows us to eliminate gaps, flicker and any other alteration generated by the connection's transient.
- Limited switching operations
- Lower wear of capacitors and switching elements, due to the elimination of transients and the total absence of mobile mechanical parts. This is how we can greatly increase the working life of the unit, as compared to conventional electromechanical contactor units.

Connection of a static capacitor bank

Static capacitor banks are usually connected to the general switchboard or secondary switchboards in the case of large-scale installations.

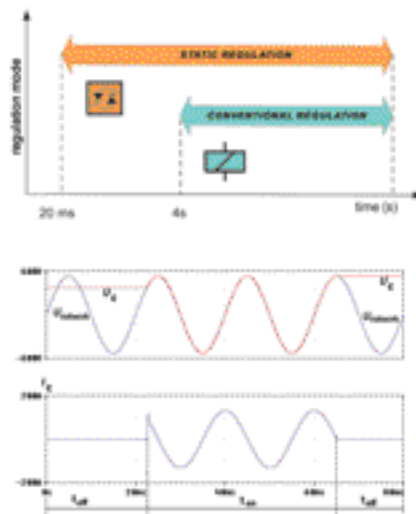


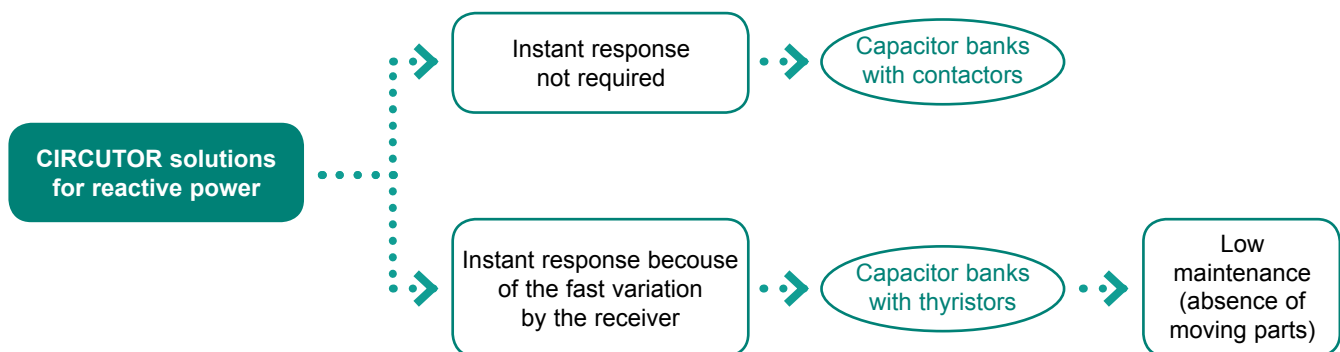
Fig. 1



Classification of the static system, depending on the compensation method

Static compensation systems are as follows, as in the case of capacitor banks:

- Fixed static systems - the most common application is in individual units that require a quick compensation response (for ex., welding equipment). **EMB/ EMF Series**.
- Automatic static system. For the monitoring of variable loads. **ECK / EMK Series**.



Product selection table

	Equipment	Compensation	Level of harmonics in the installation	Scope	Page
EMS / EMK		Automatic	Low THD(I) ≤ 15% THD(U) ≤ 2.5%	Up to 100 kvar: ECK Up to 400 kvar: EMK4 Up to 600 kvar: EMK6 Up to 800 kvar: EMK8 Up to 1200 kvar: EMK12	5
EMF		Individual (Static module with fuse protection)	Low THD(I) ≤ 15% THD(U) ≤ 2.5%	25 to 45 kvar (230 V) 40 to 80 kvar (400 V)	9
EMB		Individual (Static module with terminal connection. No protection)	Low THD(I) ≤ 15% THD(U) ≤ 2.5%	25 to 45 kvar (230 V) 40 to 80 kvar (400 V)	9
PLUS EC/E		Automatic	Low THD(I) ≤ 15% THD(U) ≤ 2.5%	Up to 100 kvar: PLUS EC Up to 400 kvar: PLUS E4 Up to 600 kvar: PLUS E6 Up to 800 kvar: PLUS E8 Up to 1200 kvar: PLUS E12	7
see R6		Automatic	High THD(I) ≥ 15% THD(U) ≥ 2.5%		R6
CPC3					11

ECK / EMK

Automatic capacitor banks with static system



Description

The **E** Series capacitor banks have been designed for Power factor correction purposes in networks with fluctuating loads.

The variations in power are relatively fast (in milliseconds) so that the switching operations are carried out by thyristors, which are connected to a voltage control board, so that the connection and disconnection of the capacitor is carried out with a zero voltage difference.

Transients are prevented between the connection and disconnection of steps, obtaining the immediate response to the load fluctuations.

Application

The most common application is with individual loads or in installations where a quick compensation response is needed (for ex., welding units, motors for lifting units, lifts, etc.)

Features

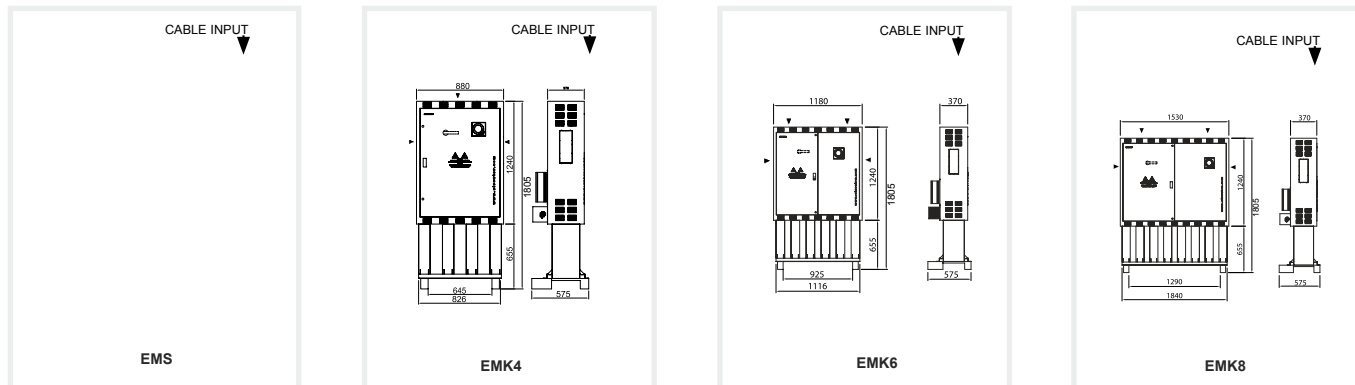
Features		
Operating voltage		230, 400 V (for other voltages, please ask)
Support voltage		440 V (400 V)
Capacity tolerance		± 10%
Unit composed of		<ul style="list-style-type: none"> • CS capacitor. Three-phase measurement • Static switching unit on each step, composed of static contactors (thyristors) • Individual protection of each step with high rupture power (HRP). NH-00 or Neozed series, depending on the type • Two-pole earth leakage protection system for regulator and capacitor bank switching operations • Power factor regulator of the computer df series • Heat removal radiators • Built-in thermostat on the radiator for the disconnection of each step in case of high temperatures (90 °C).
Add-ons		<ul style="list-style-type: none"> • Manual capacitor bank header switch • Automatic capacitor bank header switch • Automatic switch + Earth leakage protection at the capacitor bank's header • Forced ventilation unit + thermostat • Polycarbonate board to protect against direct contacts • Auto-transformer 400/230 V
Insulation level		3 / 15 kV
Discharge resistance		75 V / 3 minutes
Overload		1.3 times the nominal hold current
Overvoltage		<ul style="list-style-type: none"> • 10 % 8 over 24 hours • 15 % up to 15 minutes over 24 hours • 20 % up to 5 minutes over 24 hours • 30 % up to 1 minutes over 24 hours
Switching voltage		400 V
Ambient conditions		
Class D temperature	Daily mean	45 °C
	Annual mean	35 °C
	Maximum	50 °C
	Minimum	-25 °C
Humidity		80% RH
Altitude		2,000 m
Construction features		
Degree of protection		IP 21
Colour		RAL 7035 Grey RAL 3005 Maroon
Assembly conditions		
Type of assembly		Vertical
Ventilation		Natural or forced, depending on the option
Distance between capacitors		Minimum, 2 cm
Standards		
CEI 60831-1, CEI 70/7, UNE 20827, UNE 20010, BS 1650, VDE 560		

ECK / EMK

Automatic capacitor banks with static system



Dimensions



References

kvar	Composition	Switch (A)	Cable section (mm ²)	Weight (kg)	Dimensions (mm) width x height x depth	Type	Code
440 V 400 V							
18,75 15,49	(6,25 + 12,5)	63 A	6	13	400 x 700 x 170	EMS-18,75-440	R49300
31,25 25,82	(6,25 + (2 x 12,5))	63 A	16	16	400 x 700 x 170	EMS-31,25-440	R49304
43,75 36,15	(6,25 + (3 x 12,5))	125 A	25	17	400 x 700 x 170	EMS-43,75-440	R49308
56,25 46,48	(6,25 + (4 x 12,5))	125 A	35	31	400 x 1006 x 170	EMS-56,25-440	R49312
68,75 56,81	(6,25 + (5 x 12,5))	125 A	50	32	400 x 1006 x 170	EMS-68,75-440	R49316
81,25 67,14	(6,25 + (6 x 12,5))	200 A	70	36	400 x 1006 x 170	EMS-81,25-440	R49320
93,75 77,47	(6,25 + (7 x 12,5))	200 A	70	37	400 x 1006 x 170	EMS-93,75-440	R49324
97,25 80,37	(7,5 + (6 x 15))	200 A	70	36	400 x 1006 x 170	EMS-97,25-440	R49328
112,25 92,76	(7,5 + (7 x 15))	250 A	95	37	400 x 1006 x 170	EMS-112,25-440	R49332
100	83 (25 + 25 + 50)	250	70	132	880 x 1895 x 575	EMK4-100-440	R47405
125	103 (25 + 50 + 50)	250	95	137	880 x 1895 x 575	EMK4-125-440	R47410
150	124 (3 x 50)	400	120	142	880 x 1895 x 575	EMK4-150-440	R47415
175	147 (25 + 50 + 100)	400	150	147	880 x 1895 x 575	EMK4-175-440	R47420
200	165 (50 + 50 + 100)	400	185	152	880 x 1895 x 575	EMK4-200-440	R47421
250	207 (50 + (2 x 100))	630	240	157	880 x 1895 x 575	EMK4-250-440	R47422
275	227 (25 + 50 + (2 x 100))	630	240	157	880 x 1895 x 575	EMK4-275-440	R47423
300	248 (50 + 50 + (2 x 100))	630	2 x 120	162	880 x 1895 x 575	EMK4-300-440	R47424
350	289 (50 + (3 x 100))	800	2 x 150	167	880 x 1895 x 575	EMK4-350-440	R47425
400	331 (4 x 100)	800	2 x 185	172	880 x 1895 x 575	EMK4-400-440	R47426
400	331 (50 + 50 + (3 x 100))	800	2 x 185	168	1180 x 1895 x 575	EMK6-400-440	R47431
450	372 (50 + (4 x 100))	1000	2 x 185	174	1180 x 1895 x 575	EMK6-450-440	R47435
500	413 (5 x 100)	1000	2 x 240	178	1180 x 1895 x 575	EMK6-500-440	R47436
550	455 (50 + (5 x 100))	1250	2 x 240	182	1180 x 1895 x 575	EMK6-550-440	R47437
600	496 (6 x 100)	1250	2 x 240	186	1180 x 1895 x 575	EMK6-600-440	R47438
600	496 (50 + 50 + (5 x 100))	1250	2 x 240	168	1530 x 1895 x 575	EMK8-600-440	R47442
650	537 (50 + (6 x 100))	1600	3 x 150	179	1530 x 1895 x 575	EMK8-650-440	R47444
700	579 (7 x 100)	1600	3 x 150	185	1530 x 1895 x 575	EMK8-700-440	R47448
750	620 (50 + (7 x 100))	1600	3 x 185	195	1530 x 1895 x 575	EMK8-750-440	R47450
800	661 (8 x 100)	1600	3 x 185	200	1530 x 1895 x 575	EMK8-800-440	R47455
800	661 (50 + 50 + (7 x 100))	1000 / 630	2 x 240 / 240	335	2360 x 1895 x 575	EMK12-800-440	R47500
850	702 (50 + (8 x 100))	1250 / 630	2 x 240 / 240	341	2360 x 1895 x 575	EMK12-850-440	R47505
900	744 (9 x 100)	1250 / 630	2 x 240 / 240	347	2360 x 1895 x 575	EMK12-900-440	R47603
950	785 (50 + (9 x 100))	1250 / 800	2 x 240 / 185	353	2360 x 1895 x 575	EMK12-950-440	R47604
1000	826 (10 x 100)	1250 / 800	2 x 240 / 185	359	2360 x 1895 x 575	EMK12-1000-440	R47605
1050	868 (50 + (10 x 100))	1250 / 1000	2x240/ 2x240	362	2360 x 1895 x 575	EMK12-1050-440	R47606
1100	909 (11 x 100)	1250 / 1000	2x240/ 2x240	365	2360 x 1895 x 575	EMK12-1100-440	R47607
1150	950 (50 + (11 x 100))	2 x 1250	2x240/ 2x240	368	2360 x 1895 x 575	EMK12-1150-440	R47608
1200	992 (12 x 100)	2 x 1250	2x240/ 2x240	371	2360 x 1895 x 575	EMK12-1200-440	R47609

PLUS E

Automatic capacitor banks with static system



Description

State-of-the-art intelligent capacitor banks that are capable of measuring the three installation phases and compensating the power factor consumption of each phase in real time. In addition, they correct the total zero power factor and balance the active power in each phase.

The **PLUS E** Power factor correction unit has been designed with **CIRCUTOR's** measurement system technology, effectively creating a compensation + measurement unit. As a power quality analyzer, it displays any electrical parameter of the network in real time and records it in its internal memory, with maximum and minimum values, date and hour.

Application

Plus capacitor banks are ideal to compensate modern installations that often have unbalanced loads. Its three-phase measurement system, phase-by-phase compensation and power analyzer functions make it the ideal solution to compensate installations with a variation of quick loads, between 20 ms and 4 s, and/or large unbalances between phases, such as welding units, cranes, lifts and lifting units, smelters, hospitals, automotive industry or any other sector or unit that requires an efficient compensation of the power factor.

Features

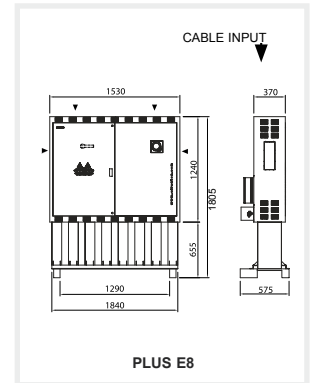
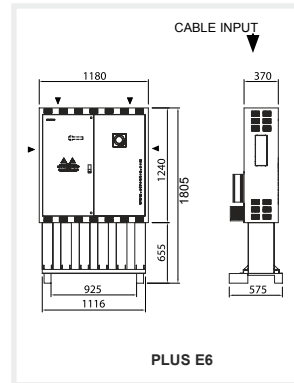
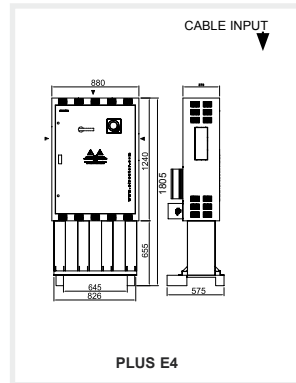
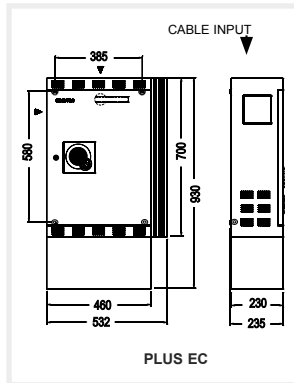
Features		
Operating voltage	230, 400 V (for other voltages, please ask)	
Support voltage	440 V (400 V)	
Capacity tolerance	± 10%	
Unit composed of	<ul style="list-style-type: none"> • CS capacitor. Three-phase measurement • Static switching unit on each step, composed of static contactors (thyristors). Power analyzer function. • Individual protection of each step with high rupture power (HRP). NH-00 or Neozed series, depending on the type • Two-pole earth leakage protection system for regulator and capacitor bank switching operations • Power factor regulator of the computer Plus series, three-phase measurement and power quality analyzer function • Heat removal radiators Built-in thermostat on the radiator for the disconnection of each step in case of high temperatures (90 °C). 	
Add-ons	<ul style="list-style-type: none"> • Manual capacitor bank header switch • Automatic capacitor bank header switch • Automatic switch + Earth leakage protection at the capacitor bank's header • Forced ventilation unit + thermostat • Polycarbonate board to protect against direct contacts • Auto-transformer 400/230 V 	
Insulation level	3 / 15 kV	
Discharge resistance	75 V / 3 minutes	
Overload	1.3 times the nominal hold current	
Overvoltage	<ul style="list-style-type: none"> • 10 % 8 over 24 hours • 15 % up to 15 minutes over 24 hours • 20 % up to 5 minutes over 24 hours • 30 % up to 1 minutes over 24 hours 	
Switching voltage	400 V	
Ambient conditions		
Class D temperature	Daily mean	45 °C
	Annual mean	35 °C
	Maximum	50 °C
	Minimum	-25 °C
Humidity		80% RH
Altitude		2,000 m
Construction features		
Degree of protection		IP 21
Colour		RAL 7035 Grey RAL 3005 Maroon
Assembly conditions		
Type of assembly		Vertical
Ventilation		Natural or forced, depending on the option
Distance between capacitors		Minimum, 2 cm
Standards		
		CEI 60831-1, CEI 70/7, UNE 20827, UNE 20010, BS 1650, VDE 560

PLUS E

Automatic capacitor banks with static system



Dimensions



References

kvar	Composition	Switch (A)	Cable section (mm ²)	Weight (kg)	Dimensions (mm) width x height x depth	Type	Code
440 V 400 V							
7,5	6,2 (2,5 + 5)	63	6	44	532 x 930 x 235	PLUS EC-7.5-440	R48300
12,5	10 (2,5 + 5 + 5)	63	6	50	532 x 930 x 235	PLUS EC-12.5-440	R48302
17,5	14 (2,5 + 5 + 10)	63	16	51	532 x 930 x 235	PLUS EC-17.5-440	R48304
25	21 (5 + (2 x 10))	100	16	52	532 x 930 x 235	PLUS EC-25-440	R48306
35	29 (5 + 10 + 20)	100	25	54	532 x 930 x 235	PLUS EC-35-440	R48308
43,75	36 (6,25 + (3 x 12.5))	160	25	55	532 x 930 x 235	PLUS EC-43.75-440	R48310
50	41 (10 + (2 x 20))	160	35	56	532 x 930 x 235	PLUS EC-50-440	R48312
55	45 (5 + 10 + (2 x 20))	160	35	57	532 x 930 x 235	PLUS EC-55-440	R48314
60	50 (3 x 20)	160	50	59	532 x 930 x 235	PLUS EC-60-440	R48316
70	58 (10 + (3 x 20))	160	70	59	532 x 930 x 235	PLUS EC-70-440	R48318
75	62 (3 x 25)	250	70	60	532 x 930 x 235	PLUS EC-75-440	R48320
80	66 (4 x 20)	250	70	61	532 x 930 x 235	PLUS EC-80-440	R48322
87,5	72 (12.5 + (3 x 25))	250	70	62	532 x 930 x 235	PLUS EC-87.5-440	R48324
100	83 (4 x 25)	250	70	63	532 x 930 x 235	PLUS EC-100-440	R48326
100	83 (25 + 25 + 50)	250	70	132	880 x 1895 x 575	PLUS E4-100-440	R48405
125	103 (25 + 50 + 50)	250	95	137	880 x 1895 x 575	PLUS E4-125-440	R48410
150	124 (3 x 50)	400	120	142	880 x 1895 x 575	PLUS E4-150-440	R48415
175	147 (25 + 50 + 100)	400	150	147	880 x 1895 x 575	PLUS E4-175-440	R48420
200	165 (50 + 50 + 100)	400	185	152	880 x 1895 x 575	PLUS E4-200-440	R48421
250	207 (50 + (2 x 100))	630	240	157	880 x 1895 x 575	PLUS E4-250-440	R48422
275	227 (25 + 50 + (2 x 100))	630	240	157	880 x 1895 x 575	PLUS E4-275-440	R48423
300	248 (50 + 50 + (2 x 100))	630	2 x 120	162	880 x 1895 x 575	PLUS E4-300-440	R48424
350	289 (50 + (3 x 100))	800	2 x 150	167	880 x 1895 x 575	PLUS E4-350-440	R48425
400	331 (4 x 100)	800	2 x 185	172	880 x 1895 x 575	PLUS E4-400-440	R48426
400	331 (50 + 50 + (3 x 100))	800	2 x 185	168	1180 x 1895 x 575	PLUS E6-400-440	R48431
450	372 (50 + (4 x 100))	1000	2 x 185	174	1180 x 1895 x 575	PLUS E6-450-440	R48435
500	413 (5 x 100)	1000	2 x 240	178	1180 x 1895 x 575	PLUS E6-500-440	R48436
550	455 (50 + (5 x 100))	1250	2 x 240	182	1180 x 1895 x 575	PLUS E6-550-440	R48437
600	496 (6 x 100)	1250	2 x 240	186	1180 x 1895 x 575	PLUS E6-600-440	R48438
600	496 (50 + 50 + (5 x 100))	1250	2 x 240	168	1530 x 1895 x 575	PLUS E8-600-440	R48442
650	537 (50 + (6 x 100))	1600	3 x 150	179	1530 x 1895 x 575	PLUS E8-650-440	R48444
700	579 (7 x 100)	1600	3 x 150	185	1530 x 1895 x 575	PLUS E8-700-440	R48448
750	620 (50 + (7 x 100))	1600	3 x 185	195	1530 x 1895 x 575	PLUS E8-750-440	R48450
800	661 (8 x 100)	1600	3 x 185	200	1530 x 1895 x 575	PLUS E8-800-440	R48455
800	661 (50 + 50 + (7 x 100))	1000 / 630	2 x 240 / 240	335	2360 x 1895 x 575	PLUS E12-800-440	R48500
850	702 (50 + (8 x 100))	1250 / 630	2 x 240 / 240	341	2360 x 1895 x 575	PLUS E12-850-440	R48505
900	744 (9 x 100)	1250 / 630	2 x 240 / 240	347	2360 x 1895 x 575	PLUS E12-900-440	R48603
950	785 (50 + (9 x 100))	1250 / 800	2 x 240 / 185	353	2360 x 1895 x 575	PLUS E12-950-440	R48604
1000	826 (10 x 100)	1250 / 800	2 x 240 / 185	359	2360 x 1895 x 575	PLUS E12-1000-440	R48605
1050	868 (50 + (10 x 100))	1250 / 1000	2x240/ 2x240	362	2360 x 1895 x 575	PLUS E12-1050-440	R48606
1100	909 (11 x 100)	1250 / 1000	2x240/ 2x240	365	2360 x 1895 x 575	PLUS E12-1100-440	R48607
1150	950 (50 + (11 x 100))	2 x 1250	2x240/ 2x240	368	2360 x 1895 x 575	PLUS E12-1150-440	R48608
1200	992 (12 x 100)	2 x 1250	2x240/ 2x240	371	2360 x 1895 x 575	PLUS E12-1200-440	R48609

EMB / EMF

Static switching units (three-phase)



Description

The static switching modules of the **EM** Series are the basic building block for the construction of static capacitor banks for Power factor correction purposes.

These capacitor banks use thyristors instead of the classic contactors for the connection of each large group of capacitors and they are ideal in installations where the leakage current suffers quick and large fluctuations (load changes in intervals that can range from split seconds to 8 or 10 seconds).

Application

The static switching units of the **EM** Series have been designed to connect and disconnect capacitors in milliseconds.

They can be used to build capacitors with various steps, or for the individual compensation of a load that must be compensated instantly due to connection / disconnection deficiencies, for example, in welding units, cranes, lifts, etc.

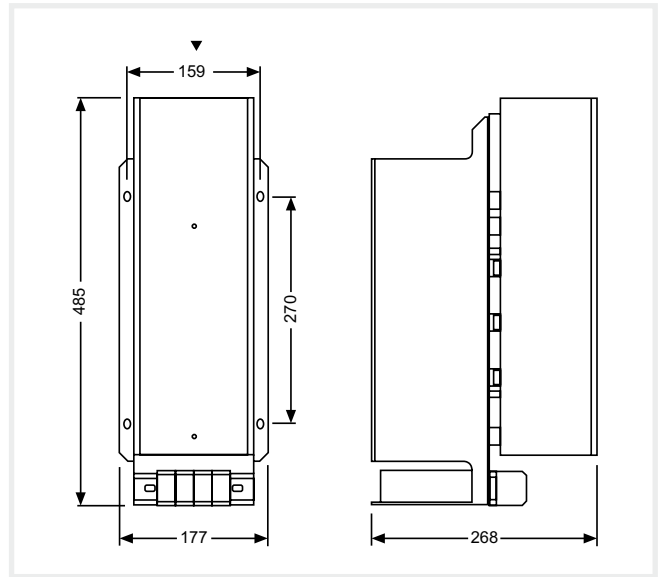
Features

Features	
Standard voltages	230, 400 V a.c. (other voltages up to 660 V a.c., please ask)
Frequency	50 / 60 Hz
Nominal switched power	See table with types
Overload capacity	1.5 I_n during 1 min
Protections	
Fuses	NH adapted to the gauge (type EMF)
du / dt	RC protection at 1000 V/ μ s
Thermostat	90 °C
di / dt	100 A/ μ s ($L=12 \mu$ H, not included, it must be installed in series with the capacitor)
Ambient conditions	
Maximum ambient temperature	40 °C
Maximum temperature of the dissipator	80 °C
Construction features	
Degree of protection	IP 00
Weight	10.5 kg
Standards	
EN 60.439 (IEC 439, UNE EN 60439), IEC 146, CSA 22.2 No. 14	

EMB / EMF

Static switching units (three-phase)

Dimensions



References

With fuses

kvar	Weight (kg)	Dimensions (mm) width x height x depth	Type	Code
25	10,5	177 X 485 X 268	EMF-25/230	R41111
37,5	10,5	177 X 485 X 268	EMF-37.5/230	R41112
45	10,5	177 X 485 X 268	EMF-45/230	R41114
40	10,5	177 X 485 X 268	EMF-40/400	R41133
60	10,5	177 X 485 X 268	EMF-60/400	R41136
80	10,5	177 X 485 X 268	EMF-80/400	R41137

With terminals

kvar	Weight (kg)	Dimensions (mm) width x height x depth	Type	Code
25	10	177 X 485 X 268	EMB-25/230	R41211
37,5	10	177 X 485 X 268	EMB-37.5/230	R41212
45	10	177 X 485 X 268	EMB-45/230	R41214
40	10	177 X 485 X 268	EMB-40/400	R41233
60	10	177 X 485 X 268	EMB-60/400	R41236
80	10	177 X 485 X 268	EMB-80/400	R41237

CPC3

Zero step control board



Description

Controls the connection of thyristors to the zero voltage step, thus avoiding any transient and enabling various switching operations in one second.

Application

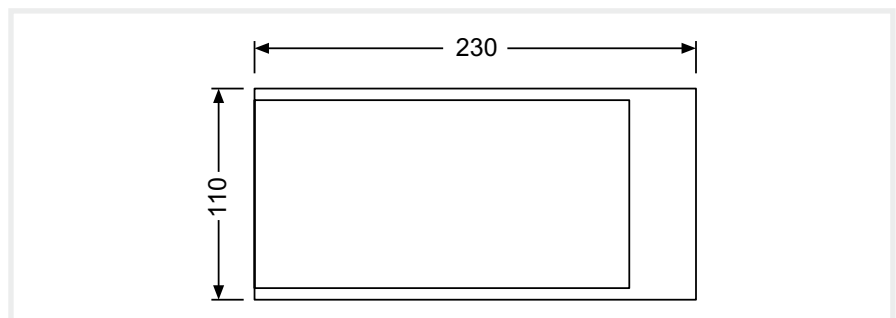
The **CPC3i** control boards used for the quick connection of capacitors can be used for the connection and disconnection of capacitors in a network cycle, as well as the individual compensation of the power factor consumption in each phase.



Features

Features	
Power supply	230 / 400 / 690 V (depending on the type)
Insulation level	3 / 15 kV
Working voltage	230 / 400 / 690 V (depending on the type)
Frequency	50 / 60 Hz
Degree of protection	IP 00
Ambient conditions	
Maximum ambient temperature	40 °C
Assembly conditions	
Static switch control	Voltage-free contact RS-485 Communications (RS Type)

Dimensions



References

V	Control	Type	Code
230 / 400	Three-phase	CPC3b	R4Z111
230 / 400	Three-phase	CPC3i-4T	R4Z661
230 / 400	Phase-Phase, by communications	CPC3i-4RS	R4Z662
230 / 400	Phase-Phase, by static relays	CPC3i-4F	R4Z663
690	Three-phase	CPC3i-6T	R4Z664
690	Phase-Phase, by communications	CPC3i-6RS	R4Z665
690	Phase-Phase, by static relays	CPC3i-6F	R4Z666

R.4

Automatic capacitor banks with static system

+ information: central@circutor.es
www.circutor.com



CIRCUTOR, SA - Vial Sant Jordi, s/n
08232 Viladecavalls (Barcelona) España
Tel. (+34) 93 745 29 00 - Fax: (+34) 93 745 29 14
central@circutor.es

