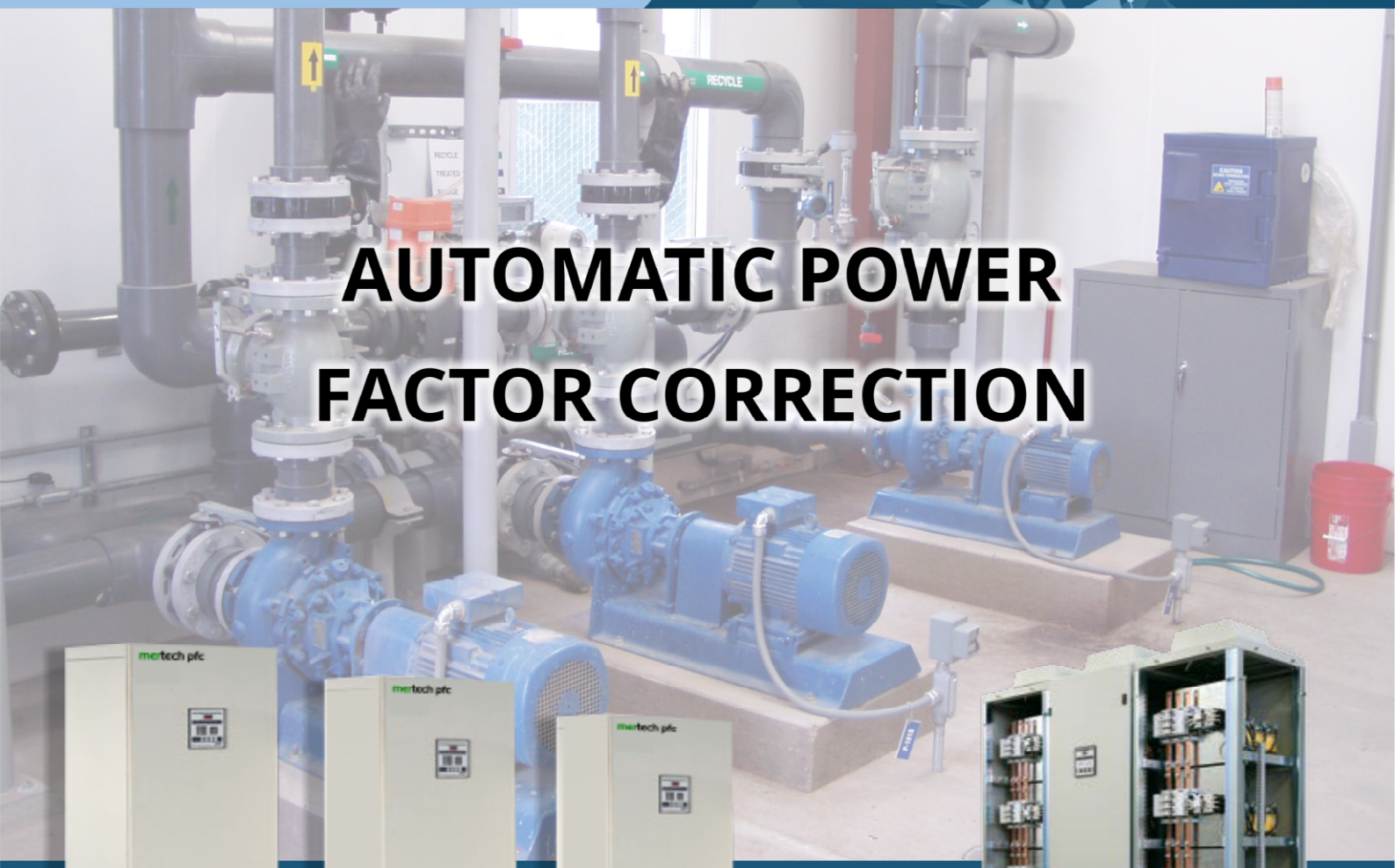
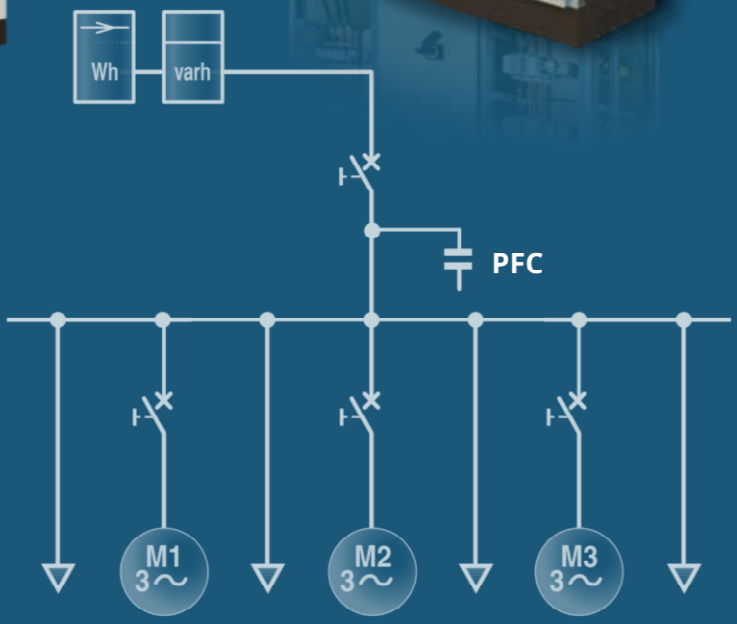
mertech

AUTOMATIC POWER FACTOR CORRECTION

AUTOMATIC POWER FACTOR CORRECTION





mertech pfc

MERTECH SWITCHBOARDS LTD
MERTECH HOUSE
39-49 HASTINGS ST
LUTON, BEDS. LU1 5BE
TEL: +44 01582 422622
mail@mertech.co.uk

AUTOMATIC POWER FACTOR CORRECTION

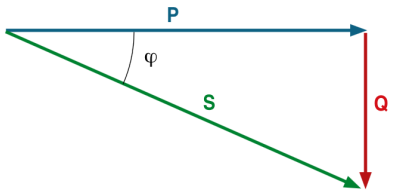
INTRODUCTION

Correct design of electrical installations and service equipments permits reducing waste, but above all a rational use of the electrical energy with ensuing optimisation of the correlated costs.
A fundamental characteristic of minimizing expenses related to the purchase of energy is to reduce losses, starting from generation and on to distribution and use.
Power-factor correction is one of the actions that make it possible to accomplish substantial energy savings as it:
- limits energy losses due to the Joule effect along the cables
- limits drops in voltage along the cables
- reduces plant engineering costs for users, making it possible to utilize conductors with a smaller cross-section
- prevents users from incurring the penalties contained in electrical energy supply contracts.

This brochure sets out to provide an overview of power-factor correction supplied by Mertech, specifying some points of interest; however, it is recommended to contact the Electrical Systems Engineer not only in case of doubt, but also to check the choices made for the various components and their design.

POWER FACTOR

To comprehend the reasons for the usefulness and need for power factor correction, some examples will be illustrated here.
Much electrical equipment (especially in the industrial field, such as for example motors, transformers, reactors or power converters), in addition to power known as "active power" (P) capable of translating into work of a mechanical nature, heat, light, etc., needs power known as "reactive power" (Q) needed to energise magnetic circuits.
In other words, we can affirm that not all the energy is used to do work, but only the portion relating to active power.
Electric installations must however be designed by taking into consideration power known as "apparent power" (S), given by the product of voltage and current. To clarify matters, it is possible to consider the total current to which the apparent power is associated as the vectorial sum of a resistive component IR (component in phase with the voltage due to the resistive portion of the load), to which the active power P is associated, and the inductive current IL (wattless component due to the inductive portion of the load), to which the reactive power Q is associated.
The apparent power S therefore takes account of both the active power P and the reactive power Q. Figure A shows the relationship between active, reactive and apparent power by means of the so-called "power triangle."
The relationship between the active power P and the apparent power S is called the power factor and is usually indicated as "cosφ".



$$S = \sqrt{P^2 + Q^2} \qquad \cos\varphi = \frac{P}{S}$$

$$P = U * I * \cos\varphi = S * \cos\varphi$$

$$Q = U * I * sen\varphi = S * sen\varphi$$

CONSTRUCTION TECHNOLOGY

The automatic power-factor correction equipment, ERA series is composed of:

- *Metal **CABINET** equipped with cooling fins, made of sturdy pressed sheet metal treated with a phosphating process to protect against corrosion and then painted with epoxy powders, colour RAL 7035.*
- *Main three-pole fast-tripping **DISCONNECTING SWITCH** interlocked with the door.*
- *Sets of three **FUSES** type DIII or NH00 curve gG with a high breaking capacity, sized to protect the capacitor banks.*
- *Three-pole **CONTACTORS**, sized for connecting the single batteries. Their peculiarity lies in the fact that the insertion contactors of the limiting resistors close in advance of the main contactors to limit the current peak at the insertion of the residual currents. The coils are 110Vac 50Hz (other voltages on request).*
- *The **CAPACITORS** are the PRT.*
- *Internal connecting **CABLES** are flame-proof type N07VK.*
- *Copper **BARS** size 30x5 mm*
- ***ELECTRONIC REGULATOR** for automatic battery connection and cosφ control.*
- *Forced **VENTILATION SYSTEM** made with special, thermostat-operated fans installed on the top of the cabinet.*

USES

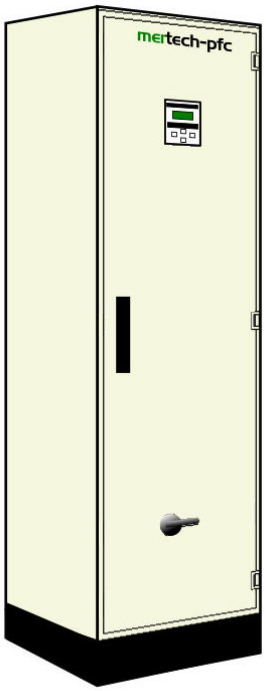
- *The automatic free-standing equipment, ERA series has been specifically designed for industrial power factor correction for medium-large-scale operations.*

INSTALLATION

- *- Check correct terminals, bolts and nuts tightening*
- *- Follow instructions related to installation, connection and periodical maintenance*

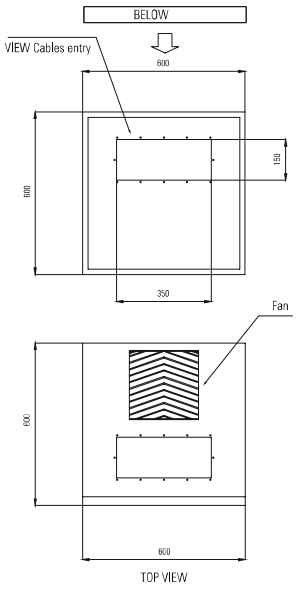
AUTOMATIC POWER FACTOR CORRECTION

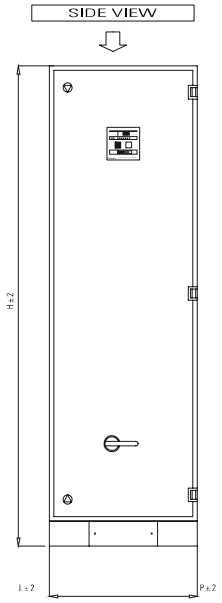
STANDARD AUTOMATIC POWER FACTOR CORRECTION

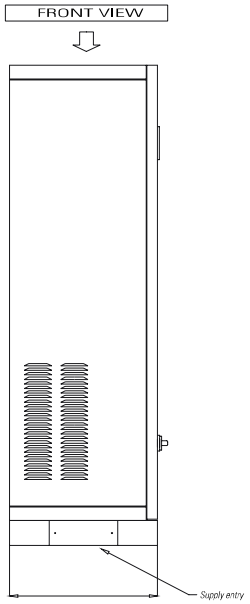


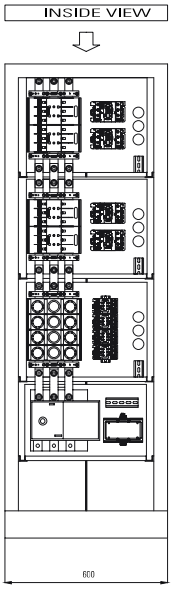
TECHNICAL PARTICULARS	
Rated voltage (Un)	400 - 415 -440 - 480 - 525 V
Rated frequency	50 Hz (60 Hz on request)
Tolerance on capacitance	- 5 % ÷ + 10 %
Temperature class	- 25° C / + 50° C
Installation of the capacitive units	Vertical
Power supply entry	From bottom -
Service	Continuous
Short circuit current	30 kA 1 second
Installation	Indoor, freestanding, in dust-free environments
Ventilation	Natural. Air must be able to circulate freely through the ventilation fins
Degree of protection cabinet closed	IP 30 (IP40/IP55 on request)
Degree of protection cabinet open	IP 00 (IP20 - on request)
Reference standards equipment	CEI EN 60439-1, IEC 439-1, CEI EN 61921, IEC 921 - as far as applicable
Reference standards capacitors	CEI EN 60831-1/2, IEC 831-1/2

Other characteristics can be made on request.





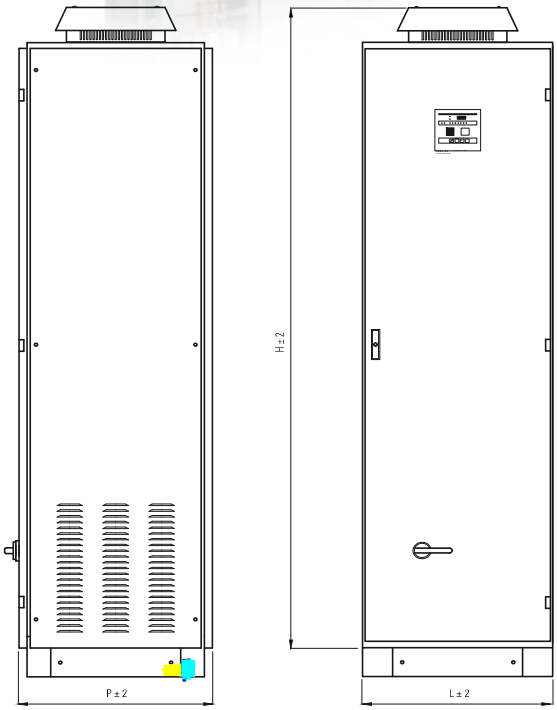




REFERENC with ISOLATOR	E without ISOLATOR	V	Qn kvar	Q 400 V kvar	A	POWER OUTPUT PER TRAY (kvar)										STEPS	ISOLATOR A	CONNECTING CABLE SECT. MM2	DIMENSIONS L (mm)	P (mm)	H (mm)
MERA1.4012	**MERA10.4012**	400	125	125,0	180.2	25	25	25	50							5	630	120	600	600	1700
MERA1.4015	**MERA10.4015**	400	150	150,0	216.5	25	25	25	25	50						6	630	150	600	600	1700
MERA1.4017	**MERA10.4017**	400	175	175,0	252.6	25	25	25	50	50						7	630	185	600	600	1700
MERA1.4020	**MERA10.4020**	400	200	200,0	288.7	25	25	25	25	50	50					8	630	240	600	600	1700
MERA2.4022	**MERA20.4022**	400	225	225,0	324.8	25	25	25	50	50	50					9	630	240	600	600	1900
MERA2.4025	**MERA20.4025**	400	250	250,0	360.8	25	25	25	25	50	50	50				10	630	240	600	600	1900
MERA2.4027	**MERA20.4027**	400	275	275,0	396.9	25	25	25	50	50	50	50				11	630	2x150	600	600	1900
MERA2.4030	**MERA20.4030**	400	300	300,0	433.0	25	25	25	25	50	50	50	50			12	800	2x150	600	600	1900
MERA3.4032	**MERA30.4032**	400	325	325,0	469.1	25	25	25	50	50	50	50	50			13	800	2x150	600	600	2100
MERA3.4035	**MERA30.4035**	400	350	350,0	505.2	25	25	25	25	50	50	50	50	50		14	800	2x185	600	600	2100
MERA3.4037	**MERA30.4037**	400	375	375,0	541.3	25	25	25	50	50	50	50	50	50		15	1000	2x185	600	600	2100
MERA3.4040	**MERA30.4040**	400	400	400,0	577.4	25	25	25	25	50	50	50	50	50	50	16	1000	2x185	600	600	2100

AUTOMATIC POWER FACTOR CORRECTION

AUTOMATIC POWER FACTOR CORRECTION WITH REACTORS



CONSTRUCTION TECHNOLOGY

The automatic power-factor correction equipment, ERAF series is composed of:

- *Metal **CABINET** equipped with cooling fins, made of sturdy pressed sheet metal treated with a phosphating process to protect against corrosion and then painted with epoxy powders, colour RAL 7035.*
- *Main three-pole fast-tripping **DISCONNECTING SWITCH** interlocked with the door.*
- *Sets of three **FUSES** type NH00 curve gG with a high breaking capacity, rated to protect the capacitor banks.*
- *Three-pole **CONTACTORS**, rated for connecting the single batteries. Their peculiarity lies in the fact that the insertion contactors of the limiting resistors close in advance of the main contactors to limit the current peak at the insertion of the residual currents. The coils are 110Vac 50Hz (other voltages on request).*
- *Dielectrically oversized **CAPACITORS** of the "dry" type PRT.*
- *Internal connecting **CABLES** are flame-proof type N07VK.*
- *Copper **BARS** size 30x5 mm*
- ***ELECTRONIC REGULATOR** for automatic battery connection and cosφ control.*
- *Forced **VENTILATION SYSTEM** made with special, thermostat-operated fans installed on the top of the cabinet.*
- *Blocking **REACTORS** made with a core of top-grade magnetic plate with low-loss oriented grain.*

Tuning frequency: 189Hz(p=7%);
on request: 134Hz(p=14%) -210Hz(p=5.67%).

Harmonic distortion in current permitted in continuous operation: 30%In at 250 Hz and 15%

In at 350Hz. Linearity: 2In.

Max harmonic distortion in voltage permitted in network (THD%)=5%.

USES

The automatic free-standing equipment, ERAF series has been specifically designed for industrial power factor correction for medium-large-scale operations in networks with harmonic distortion.

INSTALLATION

- Check correct terminals, bolts and nuts tightening
- Follow instructions related to installation, connection and periodical maintenance

REFERENCE	kvar	V	A	POWER OUTPUT PER TRAY	STEPS	ISOLATOR (A)	DIMENSIONS		
							L (mm)	P (mm)	H (mm)
MERAF.4010.189	100	400	144.3	25 25 50	4	630	600	600	2270
MERAF.4015.189	150	400	216.5	25 25 50 50	6	630	600	600	2270
MERAF.4020.189	200	400	288.7	25 25 50 50 50	8	630	1250	600	2270
MERAF.4025.189	250	400	360.8	50 50 50 50 50	5	630	1250	600	2270
MERAF.4030.189	300	400	433.0	50 50 50 50 50 50	6	800	1250	600	2270
MERAF.4035.189	350	400	505.2	50 50 50 50 50 50 50	7	800	1250	600	2270
MERAF.4040.189	400	400	577.4	50 50 50 50 50 50 50 50	8	1000	1250	600	2270
MERAF.4045.189	450	400	649.6	50 50 50 50 50 50 50 50 50	9	1000	1250	600	2270
MERAF.4050.189	500	400	721.7	50 50 50 50 50 50 50 50 50 50	10	1000	1850	600	2270

AUTOMATIC POWER FACTOR CORRECTION

AUTOMATIC POWER FACTOR CORRECTION RELAY

GENERAL DESCRIPTION

Automatic power factor regulator with microprocessor management for 6 and 8-12 steps activation, with THD I% control regulator, RS232 or RS485 serial connector available on the base of the model.

This device has been designed with a technology to elaborate also very distorted signal able to assure an accurate control of plant electrical values like voltage, current, power factor, internal temperature of the equipment, voltage harmonic distortion. All electrical measurements are made by a complete analysis through FFT (Fast Fourier Transformer) of the wave shape with floating-point.

Using a reliable calculation algorithm, the regulator is able to operate the capacitor steps, switching-in/ switching-off the reactive power needed at the fixed aim, reducing drastically the number of switchings and using, in an homogeneous way, the various steps.

Four keys allows access to parametrisations and to the dedicated measures.

The measures are made in real effective value (True RMS) calculating the power factor directly between voltage and current.

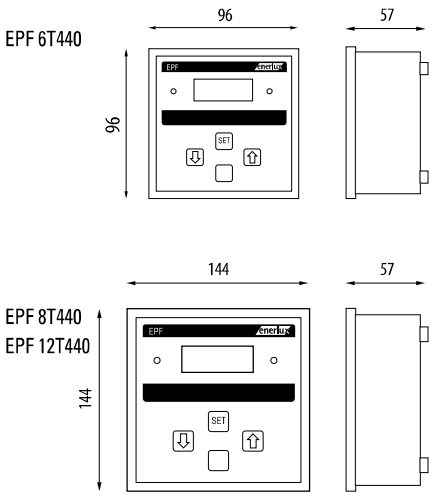
The setting up of each battery is made simply switching-in independently its rated value, for each step that must be set, allowing an easy comprehension and reading of the set parameters.

Further to the normal functions the EPF8T-EPF12T PF regulator shows the network and in case of a signal highly distorted it protects the capacitor batteries disconnecting them from the network; it controls also the internal temperature of the equipment and in case of too elevated internal temperature, it subsequently disconnects the switched-in batteries; it records alarm situations and the number of switchings made by each battery, to be able to verify their wear.

All the batteries can be set in "FIX" mode, that is to say not operated by the device in an automatic mode, but fixed in the line and always protected in case of critical situations.

In the full respect of current standards it also checks eventual micro-interruptions and/or voltage "holes" protecting capacitors, re-energizing them only after discharge transients. All the parametrisations and information, are available on the RS 232 or RS 485 serial connectors.

OVERALL DIMENSION



TECHNICAL PARTICULARS

SUPPLY CIRCUIT	
supply voltage and control	220 - 240 Vac (on request) 415 - 440 Vac
line frequency	(50/60 Hz or automatic)
absorbed power	3,5VA (EPF6T) - 5VA (EPF8T-EPF12T)
AMPEROMETRIC CIRCUIT	
rated current Ie	5 A
operating range	from 6% to 110% of the CT rated one
overcharge peak	20Ie per 10ms - 20Ie -10ms long
MEASUREMENTS AND CONTROL	
Setting of power factor	from 0,85 Ind to 0,95 Cap
voltage measurement range	- 15% + 15% Un (EPF6T) 80 a 525 V (EPF8 e EPF12)
current measurement range	2.5% ÷110% In
tripping sensivity for each step	from 5 to 300s
re-connection time of the same step	from 5s to 240s
temperature measurement range	0°C a 150°C (EPF8T-EPF12T)
current harmonic distortion measurement range on capacitors	0-250% (EPF8T-EPF12T)
OUTPUT RELAYS	
for type at 6 batteries	6
for type at 8 batteries	8
for type at 12 batteries	12
contacts capacitance	8A 250VAC (AC1)
switching voltage	440 VAC
contact internally connected	NO
relay for alarm contact or ventilation	1 x NO/NC (settable)
SERIAL INTERFACE	
serial connector	RS232 o RS485
protocol	MODBUS RTU
CASE	
ABS self-extinguishing embedding	L96xH96xP57mm (EPF6T)
ABS self-extinguishing embedding	L144xH144xP57mm (EPF8T-EPF12T)
degree of protection	IP41(IP54 on request)
backlighted LCD display at high contrast	16 types 2 lines (EPF6T) 16 types 4 lines (EPF8T, EPF12T)
weight	400 gr (EPF6T); 600 gr (EPF8T-EPF12T)
CONDITION	
operation temperature	from -20°C +60°C
stocking temperature	from -30°C +80°C
CONNECTORS	
extractible terminal board	
conductors cross-section	0.2÷2.5mmq
CONFORMITY	
European directives	low voltage CEE 89/336 e 93/68 (EMC)
European standards	EN 50081 ; EN 61000-6-2 ; EN 60240-1

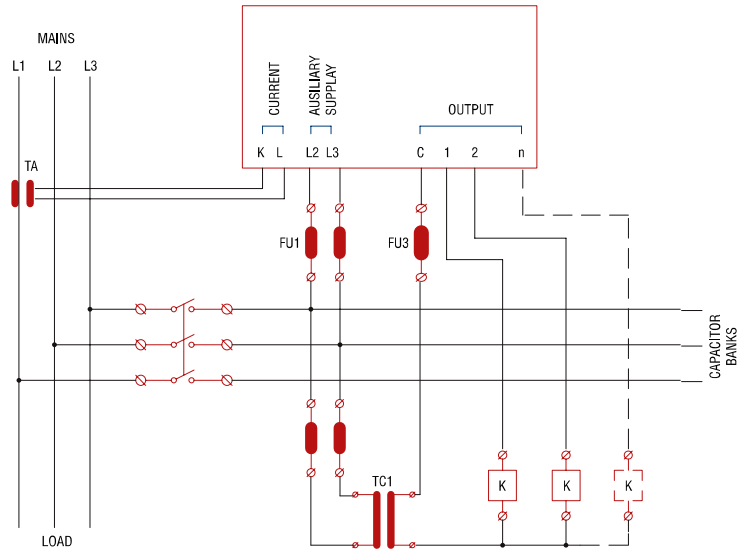
AUTOMATIC POWER FACTOR CORRECTION

AUTOMATIC POWER FACTOR CORRECTION RELAY

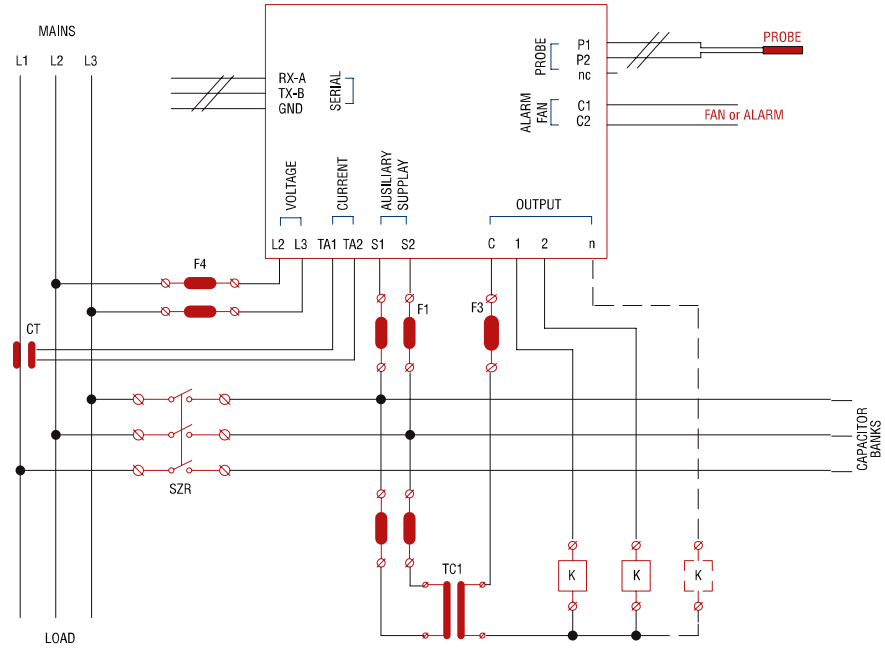
FUNCTIONS

- *Voltage and current measurement at true efficient value (true RMS) and ambient temperature*
- *Setting of insertion mode (2 or 4 quadrants on co-generation)*
- *Exceeding and defecting reactive power measurement.*
- *Setting of the cosφ on the power factor value of the fundamental between current and voltage*
- *Setting of line type (single-phase or three-phase)*
- *Setting of tripping sensitivity for each step.*
- *Measurements of THD I%, RMS Current, Fundamental Current, Harmonic Residual*
- *Setting of THDI% alarm tripping (Threm THD) and resonance frequency (High THD)*
- *Record of the maximum values of: Power, Voltage, Current, THD I% Temperature*
- *Average weekly cosφ*
- *Setting of the external transformer connected in line*

EPF6T



EPF8T - EPF12T



TYPE	CONTACTORS	RATIO BETWEEN BATTERIES						
EPF6T440	6	1 1 1	1 2 2	1 2 4	1 2 4	1 2 4	1 2 4	
EPF8T440	8	1 1 1	1 2 2	1 2 2	1 2 4	1 2 4	1 2 4	1 2 4
EPF12T440	12	*Same method used for previous ones*