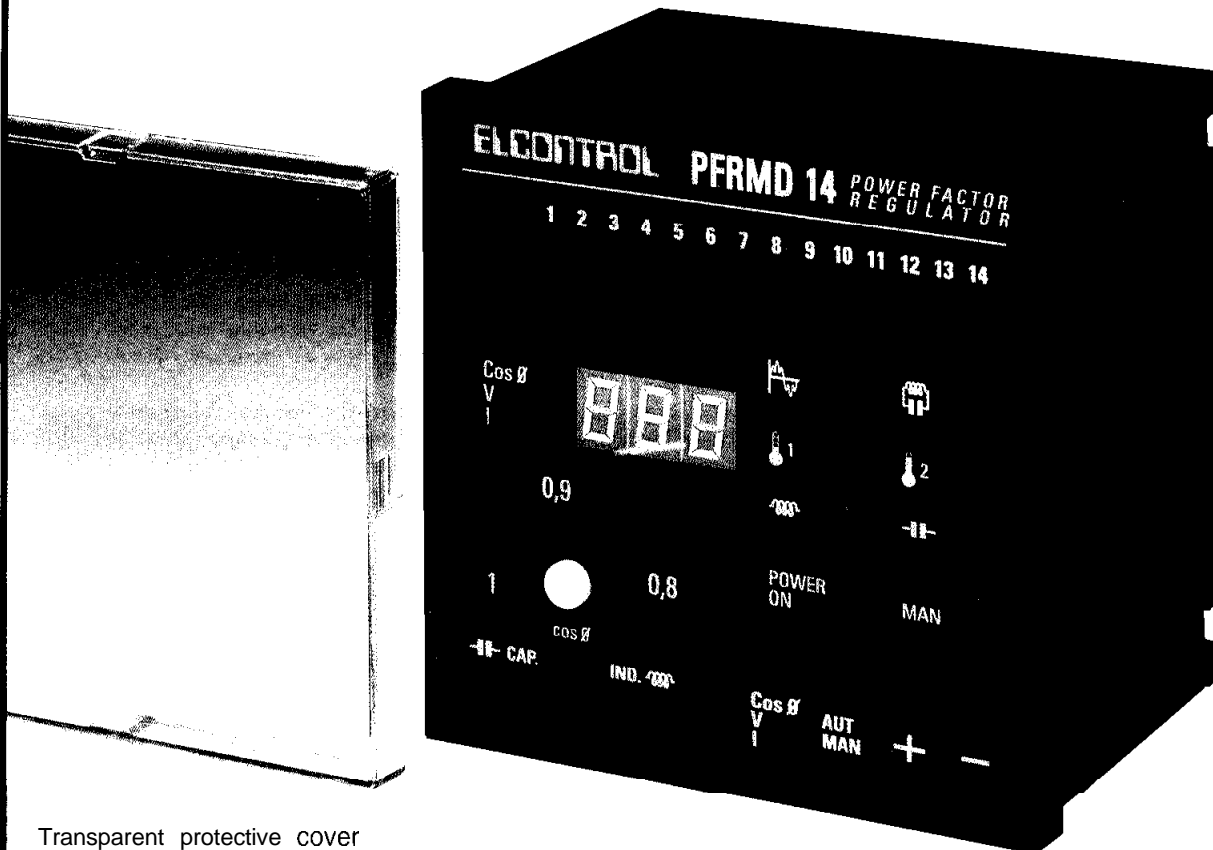


PFRMD Intelligent Microprocessor

The PFRMD is a microprocessor controlled automatic power factor regulator, assembled in a 144x144 mm format container for flush mounting (DIN standard 43700). It can operate on three-phase low voltage systems at 220, 380, 415 VAC and also on high voltage systems by taking the voltage and current measurement signals from transformers (voltage transformer and current transformer). A version configured for performing single-phase measurements is available. The PFRMD measures permanently the reactive power consumption in the load, and according to the control logic, it can connect

or disconnect the required amount of capacitor steps needed to obtain the the preset $\cos\phi$ value by means of a microprocessor-controlled logic. The PFRMD optimizes the use of the capacitor elements in a bank. The steps are rotated in order to obtain in the shortest time, and with the minimum number of operations, any desired combination. The "Top-up" function reduces considerably the number of operations, while the power factor correction is guaranteed. The regulation procedure and alarm management functions are the intelligent type, thanks to the microprocessor and software developed entirely by ELCONTROL.



Transparent protective cover



CESI approved

**Microprocessor-controlled
intelligent logic.**

**Measurements
in True RMS**

**Ideal for power factor correction
in the presence of harmonics**

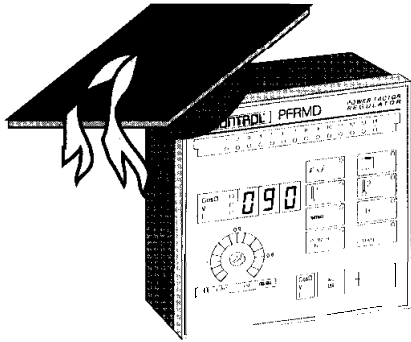
**Lengthen the life of your power
factor correction system**

**Maintains optimum control of P.F.
system even under fault conditions**

The PFRMD optimizes the use of the system's components, obtaining the necessary combinations in the least possible time with fewer movements.

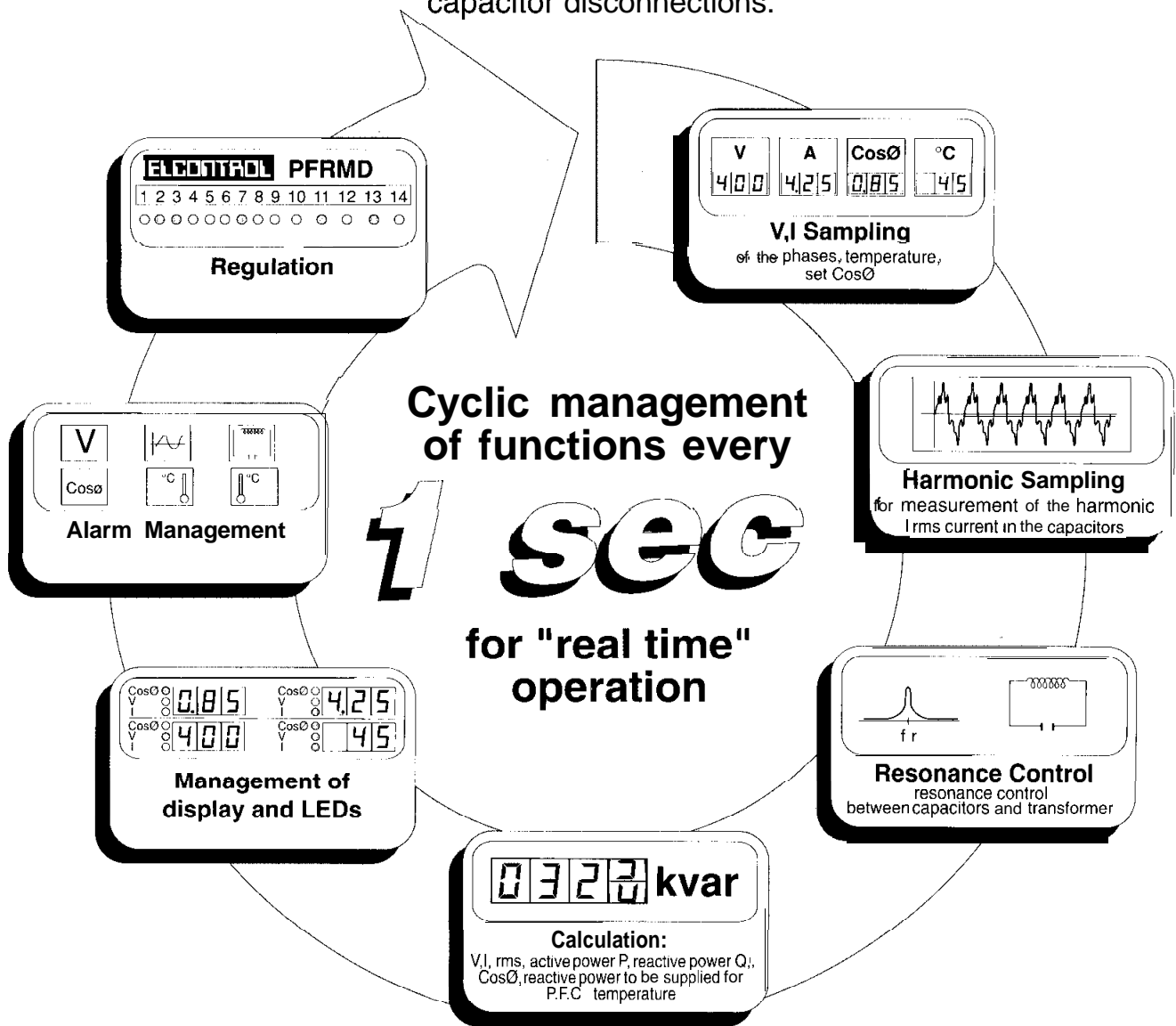
By means of the capacitor bank functions it signals and disconnects the defective steps.

based Power Factor Regulators



An INTELLIGENT P.F. regulator.

- Measurements in True RMS.
- Fully optimised connection / disconnection reduces switching steps to a minimum for maximum service life of the P.F.C. installation.
- The condition of the P.F.C. installation can be constantly monitored, signalling fault conditions in real time.
- Multiple monitoring functions provide alarm signalling on a range of possible malfunctions within the P.F.C. system.
- Potentially dangerous fault conditions trigger automatic capacitor disconnections.



The PFRMD can genuinely be called "Intelligent" because, thanks to the microprocessor, it cyclically performs a check-up of the above function blocks at 1 second measurement intervals, which enable the regulator to perform any operations in real time. In short, this sequence is the central block of the program structure, enabling the management of all of the resource coordination activities and interaction with the user.

Display of data



CosØ

The PFRMD normally displays the system's CosØ measurement.

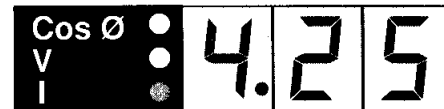


Voltage

press the pushbutton to display the mains voltage

Current

Pressing the pushbutton a second time the secondary current of the CT is displayed



Temperature

pressing the pushbuttons +a simultaneously, the temperature of the P.F.C system is displayed.



Automatic C/K

With this new function the regulator determines, by means of the measurements themselves, the power of each capacitor step and eliminates the need for manual setting of the C.T.ratio. The measurement is performed automatically and stored during the first hours of operation. The regulation logic takes into account the real power of each step and the power necessary to correct the power factor, using only the power steps strictly necessary, closest to the power required.

Lengthens the life of the p.f.c. system

The connect and disconnect logic was studied taking into account three principal objectives which are decisive for the long life of the system:

• Equalization of the number of stsp operations

The PFRMD reaches this objective by counting the number of operations of each step and always connecting those steps that have worked the least. This translates into a considerable reduction in the number of maneuvers with resulting longer service life of the entire system.

• Capacitors "resting"

The PFRMD connects a step only if it has been out of circuit for at least two minutes, in order to reduce the stress on the partially loaded capacitors.

• "Top-up" function

The PFRMD constantly monitors the actual power factor and compares it with the desired pre-set value. Any spare capacity is utilised to maintain the power factor at a level between cosØ 1 and the preset value.

This ensures that reactive energy consumption is kept to a minimum and unnecessary switching operations are completely eliminated.

Continuous check of the condition of the system (option-selectable)

The PFRMD logic carries out a check of the steps at each connection and disconnection, comparing these measurements with those initially stored. The PFRMD is thus able to:

- Indicate defective steps whose power is reduced by 20% or more.
- Single out contactors with poor contact performance.

In both cases the PFRMD automatically eliminates the defective step from the configuration, and does not reconnect it.

Temperature Control



A sensor located inside the equipment constantly monitors the temperature. When it exceeds a threshold of 40°C (programmable), an output relay for ventilation control is automatically activated. Should the temperature exceed 60°C (programmable), it automatically disconnects the capacitor banks within 3 seconds, simultaneously activating an alarm relay. When the temperature reenters normal limits, the equipment automatically begins to operate again. The two LEDs located on the front panel of the PFRMD indicate that the two temperature thresholds have been exceeded. The temperature in centigrade is shown on the display.

Harmonic overload protection

The PFRMD is the first regulator ever to perform measurements in True RMS, that is, to be able to constantly determine the harmonic content of the electrical system. The PFRMD constantly stands guard so that harmonic limits, dangerous to capacitors, are not exceeded.

Should the rms current exceed 120% (programmable) of the fundamental due to harmonics for more than 2 minutes, the regulator automatically and rapidly disconnects all of the capacitor banks and begins to function again normally only when normal conditions return. If the situation is repeated 6 times during a period of 60 minutes, the PFRMD permanently disconnects the capacitors, simultaneously activating the alarm relay. An LED on the front panel signals the alarm state.

Resonance control Resonance risk signalling

Again, thanks to RMS measurements, the PFRMD also makes it possible to avoid either phenomena which are destructive to the PFC system. The PFRMD signals the danger of resonances, specifically, abnormal amplifications of the 5th and 7th harmonic, which, even if they are not necessarily dangerous to the plant, are nonetheless an indication of danger and a warning to the user to carry out a more in-depth study. If either the 5th or 7th harmonic goes beyond 60% of the fundamental, the LED will flash every second to indicate the 5th harmonic and every 1/2 second to indicate the 7th harmonic.

Protection from resonance

When the rms current exceeds 150% (programmable) of the fundamental, the regulator identifies the presence of resonance and after a maximum of 1 second activates the quick disconnection of all of the capacitor banks. The regulator begins to function again normally when it returns within normal conditions. If the situation is repeated 6 times during a period of 60 minutes, the PFRMD permanently disconnects the capacitors and simultaneously activates the alarm relay. The harmonic overload LED signals the alarm.

Additional alarms

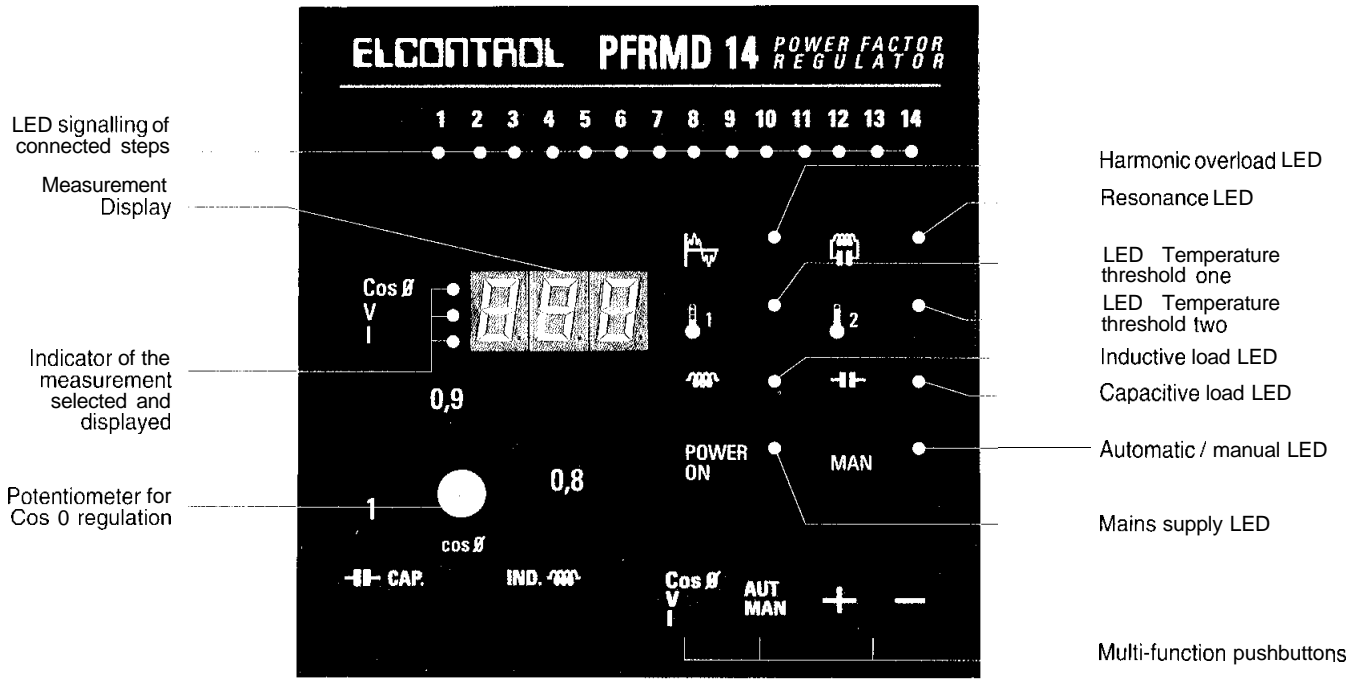
- **Lack of P.F. correction** - Any condition which for more than 30 minutes impedes the power factor compensation of the electrical system to the preset CosØ, the PFRMD activates the alarm relay while the regulation function continues.
- **Mains failure** The PFRMD immediately disconnects the capacitor steps and the alarm relay activates the alarm.
- **"Weighing" not possible** If one or both of the first two steps is not serviceable, the PFRMD is not able to determine the basic capacity, and after repeated attempts it signals the problem.
- **High applied voltage (optional)** - In cases where the voltage exceeds 110% of the rated voltage (programmable), the PFRMD disconnects the steps (in 3 seconds) and the output relay signals the alarm condition.

On request

For special system requirements the PFRMD can be set at the factory with alarm thresholds different from the standard ones, in addition to a maximum voltage alarm.

based Power Factor Regulators

Front panel



Only four pushbuttons for all functions and regulations

Cos φ Measurement display
 This pushbutton enables the display of the three parameters displayed in the following order: Cos 0, V, I

AUT **MAN** **Automatic/Manual**
 Selects the type of function AUTOMATIC (by default when it is turned on) or MANUAL (selected by pushbutton)

+ **Manual connection**
 This pushbutton connects the steps in sequential order starting from step one

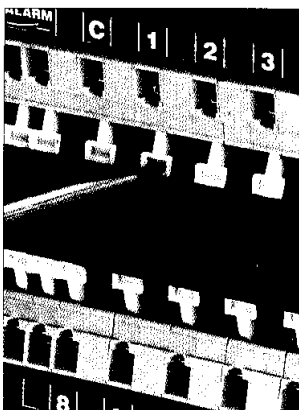
- **Manual disconnection**
 This pushbutton disconnects the steps in sequential order starting from step one.

Cos φ **+** **AUT** **MAN** **Temperature**
 To display the temperature within the P.F.C. panel, press these two pushbuttons simultaneously. (The temperature is in degrees C).

+ **-** **Programmed Cos 0**
 To display the cos 0 set by the potentiometer located on the front panel, press these two pushbuttons simultaneously;

- **+** **AUT** **MAN** **Reset**
 To reset the "weight" of the steps stored, press these two pushbuttons in succession and keep them pressed simultaneously for about ten seconds

Rear panel

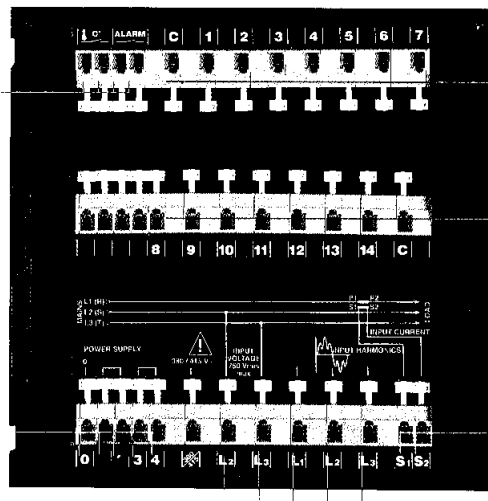


Connection board without screws

Alarm command outputs

Power supply input

Voltage inputs



Contactor command outputs of capacitor banks 1 to 7

Contactor command outputs of capacitor banks 8 to 14

Current inputs

Harmonic measurement inputs

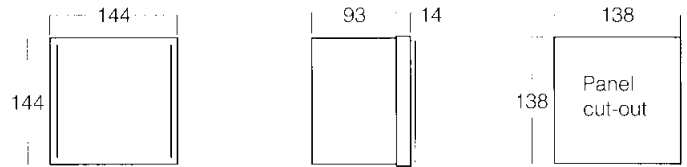
Technical features

General specifications

- Voltage measurement input: max 750 VAC ± 10% (50/60 Hz selectable)
- Current measuring input: max 5 Amp. (50/60 Hz selectable)
- Input impedance: 4 MOhm
- Current consumption: max 0.2 VA
- Supply also possible from HV network VT secondary connects to 100/120 VAC supply input terminals. HV CT secondary must be connected to terminals Si S2 of the PFRMD (VT connected phase-to-phase CT connected to third phase).
- Zeroing device in absence of voltage measuring signal
- A built-in filter provides normal operation of the regulator even in the presence of line disturbance
- Number of output contacts equal to the number of capacitor steps.
- Output contact rating: 5 Amperes-250 VAC; or ZA-440VAC (for higher ratings an auxiliary relay must be used)
- Maximum rating of relay common terminal 10A at 40°C

Mechanical specifications

- Mechanical dimensions of the equipment: front panel 144x144 mm. according to standard DIN43700.
- Insulated self-extinguishing container for flush mounting
- Panel cut-out: 138x138 mm. (tolerance -0mm./ + 1mm.); maximum panel thickness: 12 mm
- Weight: from 1.45 to 1,6 Kg. (according to the version).
- Transparent protective mask for the front panel
- Connection board: screw connections
- Screw brackets for mounting to panel Maximum panel thickness 12 mm.



Power

- Mains:
 - 100 ± 120 VAC ± 10% 50/60 Hz
 - 200 ± 240 VAC ± 10% 50/60 Hz
 - 346 ± 415 VAC ± 10% 50/60 Hz
- Consumption 15 VA max

Measurements of the fundamental quantities

- Measurement technique: Fixed sampling A/D
- Sampling frequency: 2.5 KHz
- Number of samples per phase: 250 (100 msec)
- Repetition rate of measurement 1 sec.

Environmental conditions

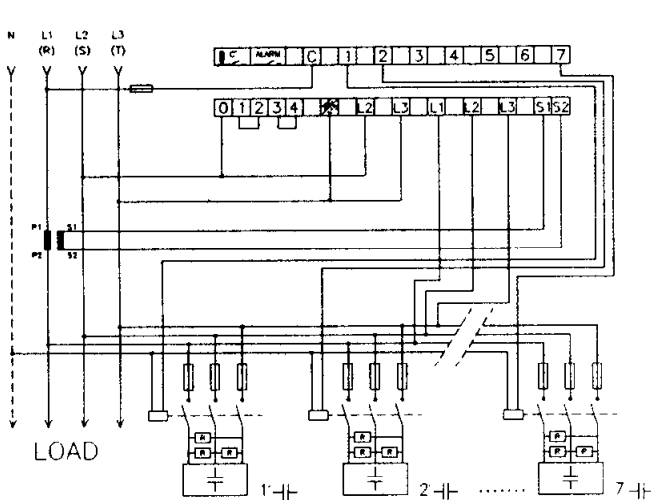
- Protection rating for the front panel with mask: IP 50
- Operating temperature: from -10°C to + 70°C
- Storage temperature: from -25°C to + 70°C
- Relative humidity (maximum): 90 % at 20°C
- Maximum altitude: 2000 meters
- To be installed internally, away from heat sources

Ordering information

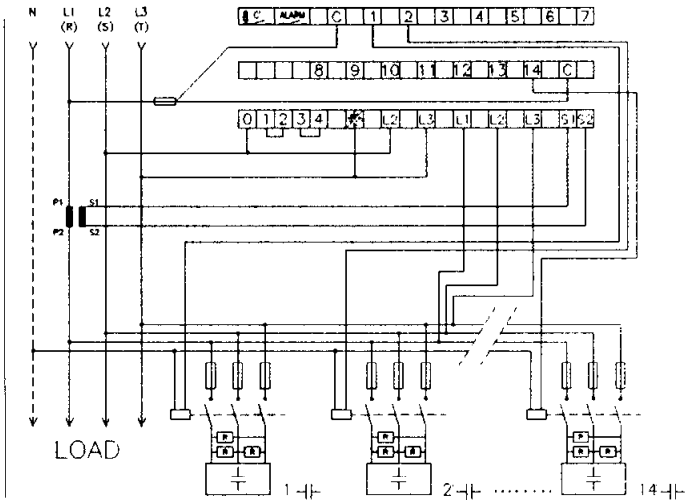
STANDARD TYPES: PFRMD3/4/5/6/7/10/12/14

N.B. For special uses the PFRMD can be supplied with alarm PROGRAMMING different from the standard programming

Connection diagram for PFRMD steps 3-4-5-6-7



Connection diagram for PFRMD steps 10-12-14



Insert the Current Transformer C.T. in series to the line with the greater amount of the inductive load. The CT is always connected upstream of the reactive load and the power factor compensation capacitors. The line chosen for the C.T. becomes Li(R) in the connection diagram

MODELS	PFRMD 3	PFRMD 4	PFRMD 5	PFRMD 6	PFRMD 7	PFRMD 10	PFRMD 12	PFRMD 14
No of Contactor Command Outputs	3	4	5	6	7	10	12	14
Output relay contact rating	5 A 250 VAC - 100 VDC							
Power supply voltage	110 - 220 - 380 VAC ± 10 % - 50/60 Hz							

proyectos s.a.c.l.
 Montevideo 561 3P H - 1019 Bs.As, Argentina
 Tel./Fax (54) 011. 4371 4926 /4372 3795.