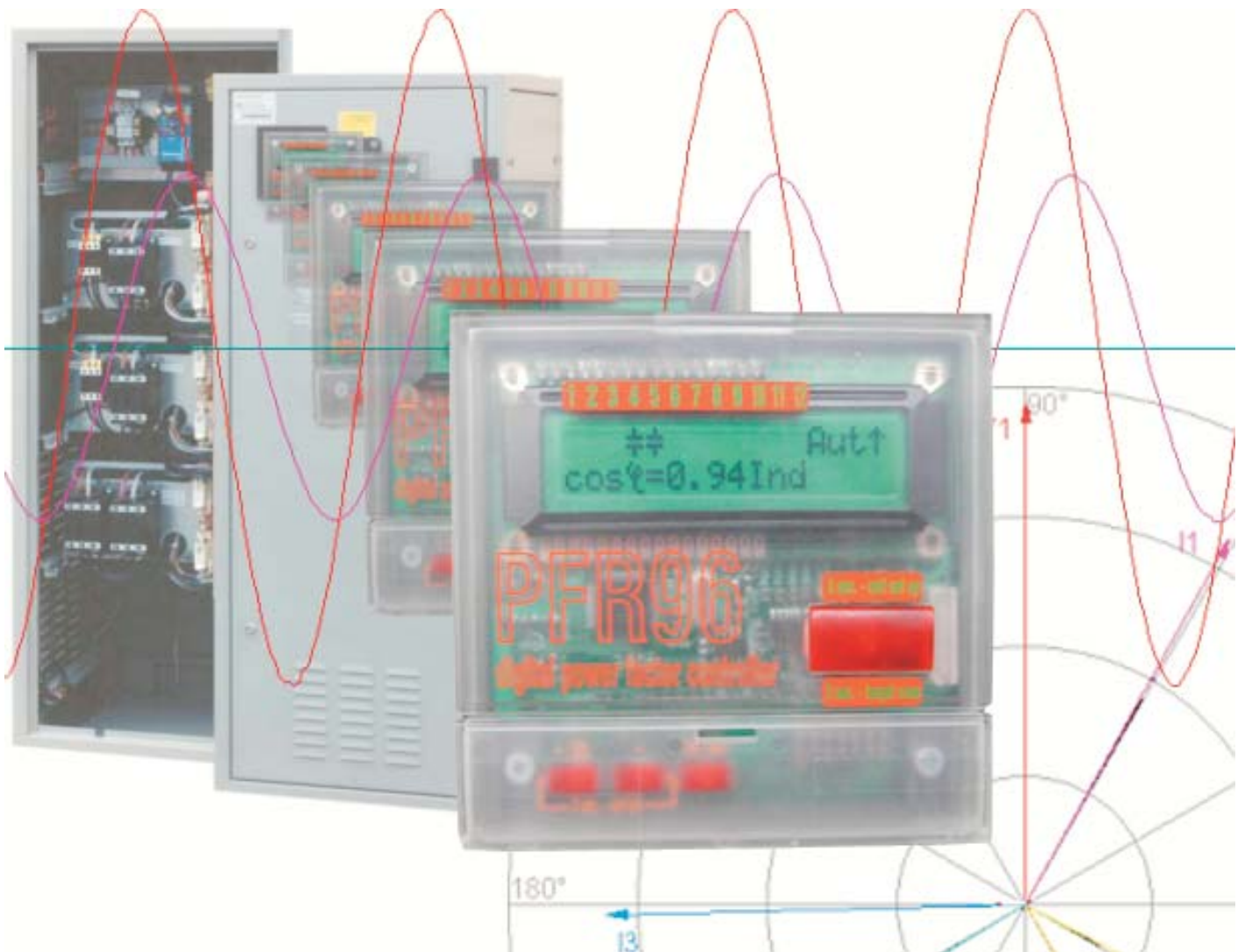


PFR96

THE NEW ELCONTROL DIGITAL POWER FACTOR REGULATORS



PFR96 DIGITAL POWER FACTOR REGULATORS

PFR96 Digital Power Factor Regulators:

Build on the steps of the world's milestones of the automatic power factor regulators, the PFRMD and the PFR, from the company that designed and launched its first regulator, the APR1, in 1959, this new regulator contains the most advanced regulation techniques fitted within just 96x96mm.

PFR96 has been designed with the aim of providing a very easy-to-use approach simultaneously with the most flexible and professional utilisation.

Thanks to the smart setup, it is possible to run immediately the regulator adjusting only the minimum quantity of settings: PFR96 automatically determines the most appropriate working strategy, thus ensuring a trouble-free operation cycle. If required, an advanced setup area can be accessed, achieving the full control of several sophisticated settings and advanced functions, useful to optimise the operating algorithms, to adapt the regulator to different power factor correction systems such as fixed steps, static relays etc, to add alarms and measures on the display.

PFR96 and PFR96Plus:

The PFR96 series includes a base version and the Plus versions. PFR96Plus is characterized by the unique capacitor-current input, providing direct measurement and control of the actual current drawn by the capacitor banks, an integrated RS485 serial-port, as well as the availability of models with up to 12 steps and static relays.

THE WORLD'S MOST COMPACT REGULATOR:

The PFR96Plus is the only regulator providing up to 12 steps and Modbus communication in just 96x96mm.



POWERFUL & EASY-TO-USE:

PFR96 is extremely user-friendly and does not require complicated setup-operations.

The Basic Setup menu requires only a minimum set of parameters, such as the CT ratio, while all other parameters will be determined by the PFR96 ensuring a trouble-free regulating action even for non skilled users.

The Advanced Setup, while still retaining a very user-friendly approach, enables the user to gain access to a series of powerful functions, as described in the following.

MULTILINGUE DISPLAY:



English, Italian, German, Spanish, French plus a 6th, customisable language upon request. The language support adds an additional feeling of comfort for the operator avoiding dangerous misinterpretations of the data and of the setup steps.

BACKLIT DOT-MATRIX DISPLAY:

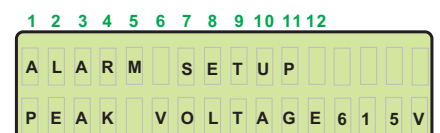
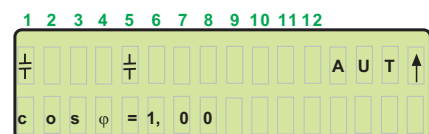
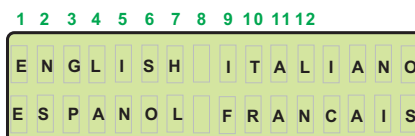
Backlit Dot-Matrix LCD display provides clear and detailed indications for the operator, thus contributing to the PFR96's ease of use. The backlight is automatically turned off after 3 minutes without pressing any key. This allows to reduce the internal consumption and thus the burden on the PFR96 power supply to a minimum, guaranteeing a long and reliable operation of the hardware. The display has been developed in order to be completely readable even without backlight.

FLEXIBLE & EASY TO INSTALL:



Ready to commission the system? Screwdrivers and wrenches can be finally left in your car and get home the same day! PFR96 setup relieves most of the pain due to wrong connections of the installer.

Leave him connecting the CT anywhere and anyhow. Neither the phase nor the direction of the CT will influence the PFR96. Not only the CT and PT ratios, but also the phase and the direction of the CT can be set up. Every step, except the first one, can be configured to be controlled by the regulator –automatically or manually- or to be used as fixed step (permanently ON or OFF, not used by the regulation algorithm anymore). Configuration parameters and life counters are all saved in Eeprom memory. In case of power supply interruptions, at the next power-on the PFR96 will safely restart from the last operational settings avoiding to use unpredictable settings or default points. The PFR96 is capable of 4-quadrant operation, ensuring a reliable regulation for any direction of the power-flow (correction of loads or generators).



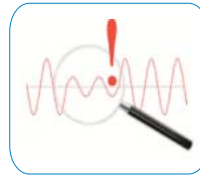
ALARMS:

1 or 2 output-relays (respectively for the 6- and the 12-step versions) can be set by the user to become Alarm-Relays, instead than contactor-control relays.



The Alarms can be linked to the following list of measures: Vrms, THDI, THDI_{cap} of capacitor-current, Vpeak, THDV, Temperature, low PF, with settable thresholds.

INSTANTANEOUS NO-VOLT RELEASE FEATURE:



The voltage RMS value is refreshed every half cycle (at 50 or 60 Hz). In case of a voltage dip lower than 50% of the nominal voltage, the regulator immediately disconnects all the contactors avoiding dangerous bounces of the contacts that can blow the capacitors.

Capacitor banks are called progressively back as soon as the nominal voltage is restored.

ONE-BUTTON CONTROL:

Basic Function:

All basic functions, including the set-up of the target $\cos\phi$, as well as all measurements are accessible via the single PAG button clearly visible on the front Panel.



Advanced Function:

Buttons related to the PFR96's advanced functions are "hidden" beneath the panel's cover, while the Setup Menu is divided into several levels.

ADVANCED REGULATION ALGORITHMS:

PFR96 can be set to use an advanced, optimised regulation logic, allowing to achieve the best correcting action with the minimum number of operations.



At the same time, PFR96 will also equalize the usage of each step: a special operational logic counts the time each capacitor bank has been on- / off-duty and rotates the active banks, thus making sure that all banks are evenly used and achieve their maximum life-time.

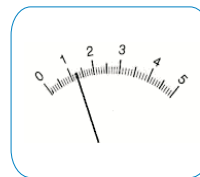
MAINTENANCE WARNING:



PFR96 keeps track of the time each bank has been energised, as well as the number of switching operations performed by each contactor.

Whenever these parameters near the recommended maintenance level of the related components, PFR96 signals it to the operator, suggesting preventive-maintenance instead than risking an untimely breakdown.

DISPLAYED MEASURES:



PFR96 measures and displays several electrical parameters:

- Voltage (Vrms)
- Current (Irms)
- Active Power (P)
- Reactive Power (Q)
- Power Factor ($\cos\phi$)
- Voltage THD(%)
- Current THD(%)
- Operational Counters (*working hours and n° of operations, for each capacitor bank*)
- Internal temperature of the cabinet (°C).

As a unique characteristic, PFR96Plus is equipped with an auxiliary CT input for measuring the actual capacitor current & power and the THD of the capacitor current, which provides a close control of overload risks. All measurements are TrueRMS, thus greatly increasing the reliability and accuracy of the regulating action, even in presence of distorted waveforms.

RELIABLE POWER FACTOR CORRECTION REGULATION:

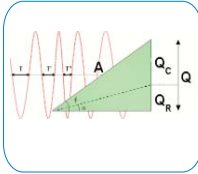
Unlike other regulators, PFR96 does not simply assume a constant 50/60Hz mains frequency.

The mains frequency is NEVER perfectly constant. It will vary constantly. Even if the variation itself is small and negligible

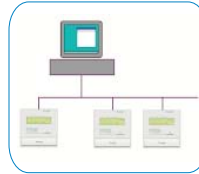
for most purposes, it will introduce important errors in the measurements taken by digital instruments.

Without reliable measurements, there is no possibility of a reliable regulating action.

PFR96 applies the most advanced time-variable sampling techniques, adapting constantly –cycle by cycle- to the true frequency of the mains voltage and thus ensuring that the reference signals are measured accurately and reliably. Moreover, the advanced calculation algorithms adopted by the PFR96 provide the true DPF (Displacement Power Factor), which is the Power Factor of the fundamental waveforms, not influenced by harmonic distortion. PFR96 thus guarantees that the regulating action remains accurate and reliable even when voltages and/or currents are heavily distorted by harmonics.



FLEXIBLE MODBUS RS485:



The PFR96Plus is equipped with an RS485 port supporting Modbus RTU for remote communication and control. Even if this feature may not be necessary at a first moment, it must be considered a valuable possibility in a growingly networked industrial environment.

The flexibility of Modbus registers allows both the compatibility with standard Elcontrol energy management software packages, as well as the development of specific software for PFC management. The wide diffusion of Modbus RTU guarantees the compatibility with all major SCADA environments.

PLUG IN TERMINAL WITH SECURITY LOCKING SCREWS:

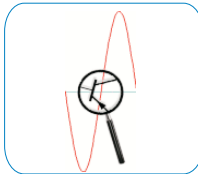


Plug-in connectors allow an easy installation.

Locking screws ensure safe and permanent connection avoiding very dangerous undesired open circuit for current transformers, bouncing for contactors and loss of RS485 communication.

STATIC RELAY OUTPUTS:

PFR96Plus is available as a STATIC RELAY version, equipped with electronic relays instead of electromechanical type. Static Relays allow switching the contactors' control-coil on or off in correspondence to the zero-crossings of the excitation voltage or current respectively.



This ensures that the contactors' operation is smooth (without voltage/current spikes in the excitation coil) and hence that contactors reach their maximum lifetime. Moreover, the regulator's static relays have a virtually infinite lifetime, thus guaranteeing a very long operational lifetime for the regulator itself.

It is the required solution for higher-security plants -such as hospitals- or non-industrial environments, where no electrician is available for immediate maintenance, such as office buildings, banks, entertainment sites, supermarkets, etc.

FASHION INDUSTRIAL DESIGN:

The front side is made with transparent blow moulded plastic elements. The PCB with its components are slightly visible through the coloured plastic front cover. The final look of the device is very attractive. Colours can be eventually customised.

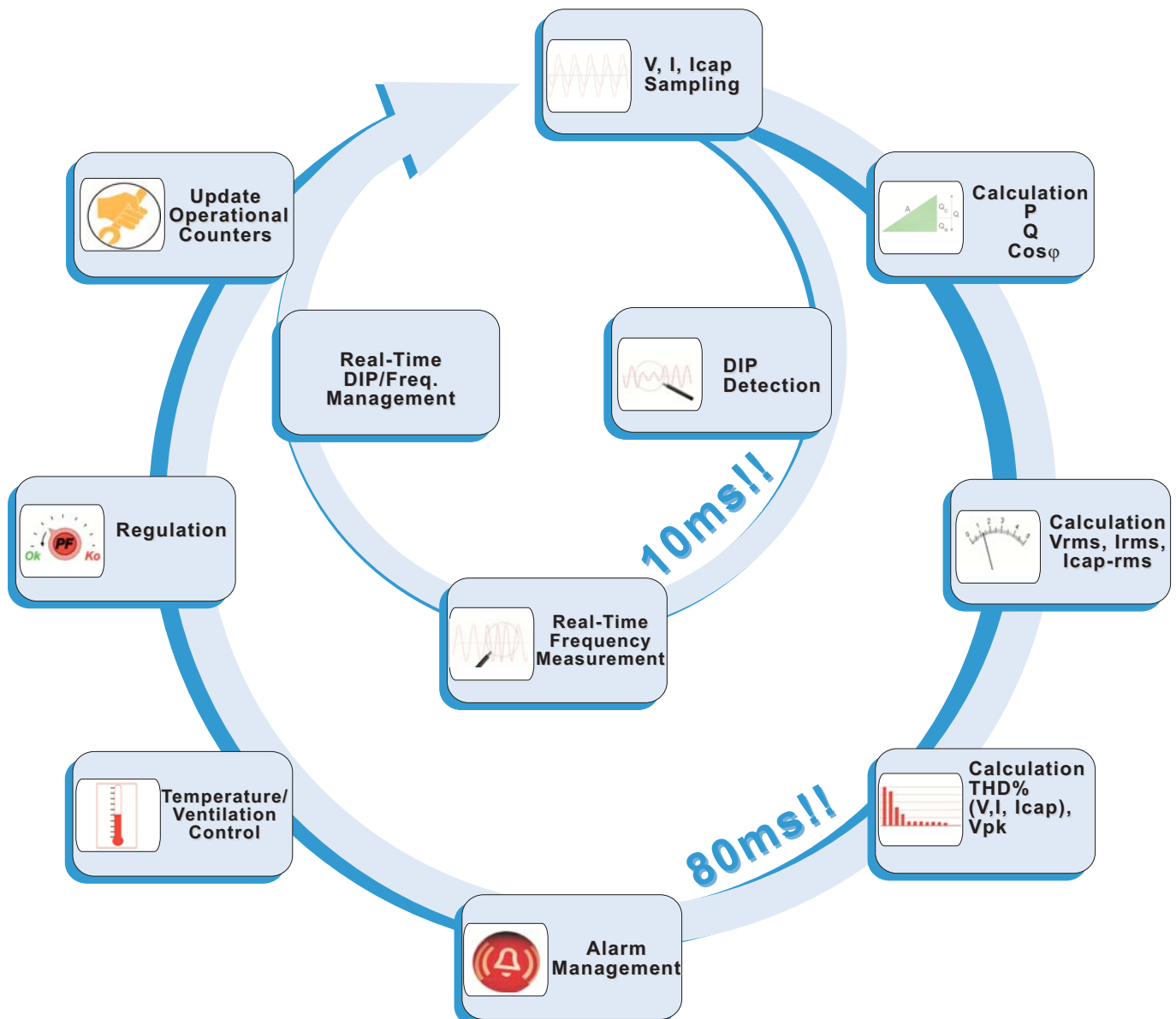
CYCLIC FUNCTION MANAGEMENT:

Thanks to the use of the most advanced technology, PFR96 guarantees outstanding functions and reliable operation in any condition. All functions of the PFR96 follow a cyclic operational logic as described in the diagram below:

A dedicated, high-speed logic samples and monitors the voltage signal with a half-cycle refresh rate (10ms at 50Hz, 8.33ms at 60Hz).

This special function determines the true period of the sampled signals, ensuring a truly reliable conversion of the digital samples into RMS values. Moreover, it enables the PFR96 to detect dangerous voltage dips (reduction of the RMS value of each half-cycle to below 50% of the nominal value) and immediately disconnect active steps in order to avoid contactor bouncing and uncontrolled re-energising of partially loaded capacitors.

The main functional cycle controls the PFR96 main functions: measurements calculation, alarm/ventilation-management, regulating action and operational counters management. All steps of this cycle are performed/updated within just 80ms.



MAIN TECHNICAL DATA:

Power Supply:

- Mains: model 215V/250V
model 380V/440V
50/60Hz
(from Voltage measurement Input)
- Consumption: 10VA max

Measurement Inputs:

- Voltage Input: 440Vac cat.III
- Current Input: 0.1-5A via Current Transformer, overload max. 6A
- Capacitor Current Input: 0.1-5A via Current Transformer, overload max. 6A
- Settable CT-Ratio range: 5/5 – 5000/5
- Current Input Burden: max 0,5VA

Relay Outputs:

PFR96/PFR96Plus-6R:

- 5 Relays with common terminal (capacitor bank control)
- 1 Relay with independent contact (configurable for capacitor bank control –6th step- or for alarm/fan-control)

PFR96Plus-12R:

- 10 Relays with common terminal (capacitor bank control)
- 2 Relays with independent contact (configurable for capacitor bank control –6th / 12th step- or for alarms/fan-control)
- Relay rating: 5A at 250Vac – 2A at 400V

Power Factor Regulation:

- Target-PF range: 0.7 Inductive – 0.7 Capacitive

Communication (PFR96Plus only):

- Serial Port: RS485
- Protocol: MODBUS RTU

Dimensions & Operating conditions:

- Dimensions: 96x96x115.4mm
- Cut-out template: 91x91mm
- Weight: 800g
- Connections: Screw-on connectors 2.5mm²
- Protection level: front IP40, instrument IP20
- Operating Temp. range: -10°C - +50°C
- Storage Temp. range: -25°C - +70°C
- Rel. Humidity range: 20% - 80%
- Condensation: not allowed

Reference Standards:

- EMC: EN61326
- Safety: EN61010-1
- Conformity: CEE 89/336 - CEE 72/23 - CEE 93/68

MODELS:

215 ÷ 250V Power Supply:

- PFR96-6R.230 6 relays
- PFR96Plus-6R.230 6 relays, RS485, Capacitor load analysis
- PFR96Plus-12R.230 12 relays, RS485, Capacitor load analysis
- PFR96Plus-6RS.230 6 static relays (zero-crossing), RS485, Capacitor load analysis
- PFR96Plus-12RS.230 12 static relays (zero-crossing), RS485, Capacitor load analysis

380 ÷ 440V Power Supply:

- PFR96-6R.400 6 relays
- PFR96Plus-6R.400 6 relays, RS485, Capacitor load analysis
- PFR96Plus-12R.400 12 relays, RS485, Capacitor load analysis
- PFR96Plus-6RS.400 6 static relays (zero-cross), RS485, Capacitor load analysis
- PFR96Plus-12RS.400 12 static relays (zero-cross), RS485, Capacitor load analysis

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