

1 SAFETY

This equipment has been constructed and tested to standards and left the factory in perfectly technical safety conditions. To maintain these conditions and to ensure safe operation, the user must follow the information and markings covered in these instructions. Before starting check that the operating voltage and rated voltage coincide and that a suitably sized earth wire is connected (earthing). The short circuit current at the connection point must not exceed the short circuit current of the isolating switch. Otherwise protect the equipment supply line with a suitable circuit breaker or fuses.

• IMPORTANT !



- The symbol on the left means "READ THE INSTRUCTIONS" wherever it appears.
- All interruptions of the protection line inside or outside the equipment may make it dangerous.
- Before carrying out any servicing or repairs or replacing pieces or fuses the equipment must be disconnected from all power sources. (Break the switch or circuit-breaker contact).
- Electrical capacitors may represent a danger or a risk to property and to people. The operator who opens capacitors must therefore adhere strictly to the safety instructions dictated by good operating practice and the information given in this manual.
- The capacitors inside the equipment may remain charged; before opening wait at least 60 seconds then short-circuit them and earth all terminals.
- Ensure that fuses used as replacements are of the type and rated required. Never use repaired protection devices or short-circuit the fuse-holders.
- If it has been seen that safe operation is no longer possible, ensure that the equipment cannot be used intentionally or accidentally.

2 OPERATOR SAFETY •READ THESE PAGES CAREFULLY BEFORE INSTALLING AND STARTING UP THE EQUIPMENT..



- The equipment described in this manual must only be run by skilled staff.
- Servicing or repairs with the equipment open must only be run by skilled staff.
- For correct, safe use of the equipment and for servicing or repairs, the people involved must comply with normal safety procedures.
- If it is suspected that the equipment is no longer safe, for example because of knocks or wear, deactivate it and ensure that it cannot be restarted accidentally. Contact authorised engineers for checks and any repairs.

3 INSTRUCTIONS

- Normal safety procedures must be complied with when changing internal fuses and other equipment components (see sections 1 and 2 above).
- Faultily power factor correction equipment must be repaired quickly; in case of difficulty contact the manufacturer.

4 ENVIRONMENTAL WORKING CONDITIONS

- Protection degree IP30
- Temperature range -5 +40°C
- Maximum relative humidity 90% A 20°C
- Maximum altitude 2000 meters above sea levels
- For installation indoors, protected from accidental knocks, heat sources and sunlight, in dust-free environments, making certain to maintain a distance of at least 15 cm from the walls for ventilation. (Do not block the side air vents).

5 TECHNICAL AND CONSTRUCTION FEATURES

- **METAL STRUCTURE**
 1. Galvanized metal sheet
 2. Air vents on the side and on the doors.
 3. Fixing holes built on the wall fixed on the structure
 4. Cable input with cable membrane.
 5. Front and side panels painted sheet.

• GENERAL PROTECTION



- Triple-pole master circuit-breaker with door interlock, of type for operation with load present and having dual break for each pole
- A set of three fuses of appropriate size provides general protection on the power circuit.

• REGULATION THE DEVICES, COMMAND AND PROTECTION

PFR96 Power Factor Regulator contained in 96x96mm casing, controls the reactive power by commanding the activation/deactivation of capacitor banks. The operation logic is optimised in order to minimise time and number of switching cycles and rotate active bank, thus guaranteeing equal use of the capacitor banks. **Alphanumeric back-lit LCD** display for visualization of measurement values, state of banks and alarm conditions. Available measure are the values of voltage and current, active and reactive power, **THD of voltage and current**, internal temperature, number of operations and hours of operation for each bank.

Automatic Manual operation.

Cumulative no alarm contacts (5A-250V) for: harmonic voltage overload,

harmonic current overload, excessive peak voltage, excessive rms voltage, over temperature, insufficient power factor correction.

Immediate release protection against voltage dips during >10ms and <50%Un.

Delay time between steps programmable from 5 to 300 sec. Specific functions model **PFR96 PLUS: RS485** communication port, additional ct input for measurement of the current drawn capacitor banks. This measurement allows a close control of the reactive power, the current drawn by the capacitor banks and its harmonic distortion; on this parameter it is possible to activate an alarm.

• CAPACITORS

Capacitors elements in self-healing metallized polypropylene film, single phase in metal casing, ecological, with excessive internal pressure device and discharge resistors. They are attached to the support plate by a bar hold, delta and parallel connected in order to obtain three phase power.

• REFERENCE STANDARDS:

- IEC 831-1/2; CEI EN 60831-1; CEI EN 60831 -2.

• ELECTRICAL SPECIFICATIONS:

Rated voltage:	230V – 400V – 440V – 500V
Rated frequency:	50Hz
Max overvoltage:	1.1 Vn (Max duration 8 hrs every 24 hr)
Max overcurrent:	1.3 In
Capacity:	-5 +10%
Temperature category:	-25/C (-25 + +50°C)
Max environmental temperature:	55°C
Max Ave value for 24 hr period:	45°C
Max Ave value in a year:	35°C
Dielectric losses:	-3d 0.5 W/kVAr
Installation:	indoors

6**CHOICE OF CT**

Before installation the equipment study the connection alternatives in **(Tab.1)** to select the appropriate current transformers. The C.T. may be of "**BAR**" or "**WIRE**" type but should be of good quality.

The C.T. must have values:

- At the "**PRIMARY**" winding equal to or a little greater than the max current consumed by the load downstream of the C.T. itself
- At the "**SECONDARY**" winding 5 Amp.
- Using CT 2, the secondary CT should be connected in parallel. It is necessary to respect the cyclical sense of the current and avoid that the sum of the current going out from the TA is over 5Amp.

7**INSTRUCTIONS FOR INSTALLATION AND CONNECTION**

1. Position and fix the mechanically the equipment near the point of connection.
2. Connect the device to the network in accordance with the schedule set out in (Table 2).
3. Mount the current transformer CT. series at the phase of the network, identified as L1 (R) that goes to the left clamp disconnecter of the power supply of the equipment.
The T.A. should be always mounted upstream of the load which must be corrected and of the equipment.

8**COMMISSIONING THE EQUIPMENT**

1. Check that the connections have been made in accordance with the instructions in the above points and especially that the C.T. has been installed upstream of the load and of the equipment on phase L1 (R).
2. Close the equipment circuit-breaker contact (Tab.1d) and adjust the **PFR96** automatic regulator.

8.a) MANUAL OPERATION TEST

1. Check that the power factor regulator **PFR96** is supplied with power.
2. Place the regulator **PFR96** manual operating modality using the **AUT / MAN (Tab.3d)**.
3. Hold the key **+ / SEL (Tab3b)** for the manual insertion of the capacitor steps.
4. At interval of time, $\frac{+}{-}$ symbols of batteries which has been inserted will be appear on the display.
5. Hold the button pressed **- (Tab3c)**.
6. At this point, at intervals of time the symbols of the inserted capacitor banks will disappear from the display $\frac{+}{-}$ indicating the exclusion of the capacitors.

8.b) OPERATING TEST WITH LOAD DISCONNECTED

1. Repeat the operations 1, 2, 3, and 4 described above.
 2. Turn the selector switch **(Tab.3 d)** to automatic "**AUT**".
 3. At this point the regulator will start to disconnect capacitor banks 1, 2 etc. since the banks should be disconnected in absence of inductive load.
- N.B.** If the regulator continues to connect capacitors 3, 4, etc. the current supply is inverted: reverse the position of the two CT wires.

8.c) OPERATING TEST WITH LOAD CONNECTED

1. Check that the power factor regulator **PFR96** is supplied with power.
2. Turn the selector switch **(Tab.3d)** to automatic "**AUT**".
3. On the regulator display will appear an upwards led next the indication "**AUT**" thus, on the display, with regular time intervals will appear the symbols of the connected capacitor banks which will indicate the connection of the capacitor steps until the load compensation is executed.
4. If the Led is directed downwards it is necessary to revert the C.T. wires "**AUT**" Led illuminates instead of the "**IN**" Led reverse the CT wires.
5. As the load is reduced the number of capacitor banks connected will decrease until all are disconnected.

The equipment is now ready for trouble-free operation.

Capacitor banks will be connected or disconnected in sequence as the load varies, with a time delay of approximately 10-30 sec.

N.B. For visual checks of **PFR96** regulator and thus equipment operation, remember the following:

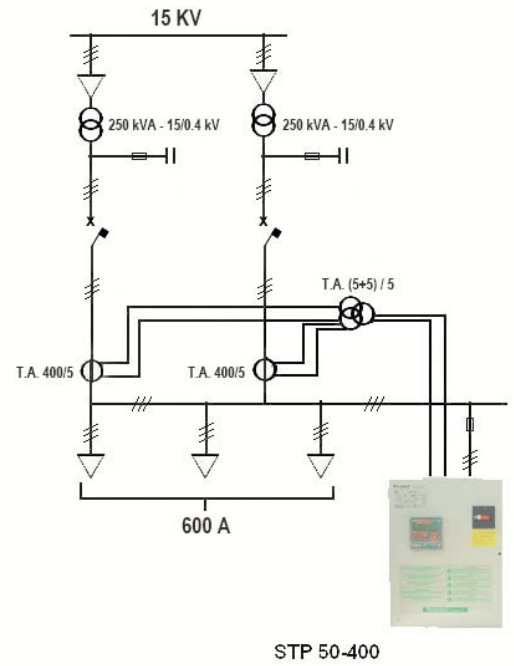
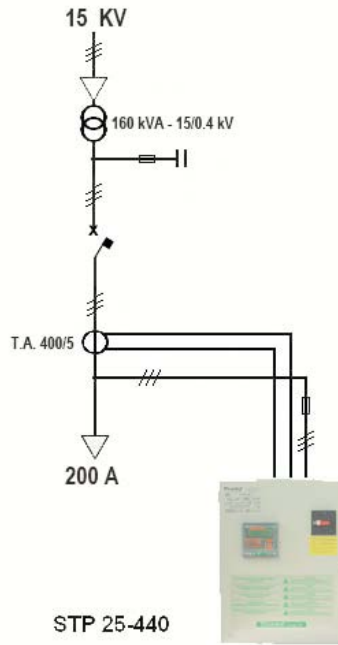
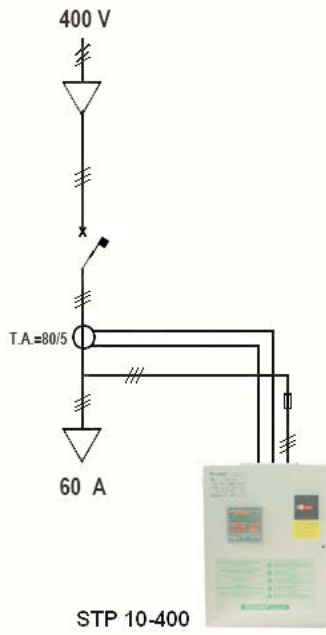
- **Red Led "IN" (inductive load)** shows bank being connected
- **Red Led "OUT" (capacitive load)** shows bank being disconnected
- When neither Led is illuminated the regulator is in equilibrium, meaning that the $\cos\phi$ is near the selected value (0.95).

If the reactive power of the equipment is not sufficient to raise the load's $\cos\phi$ to the preset value, all the banks will be connected and the red led "**IN**" will still be illuminated.

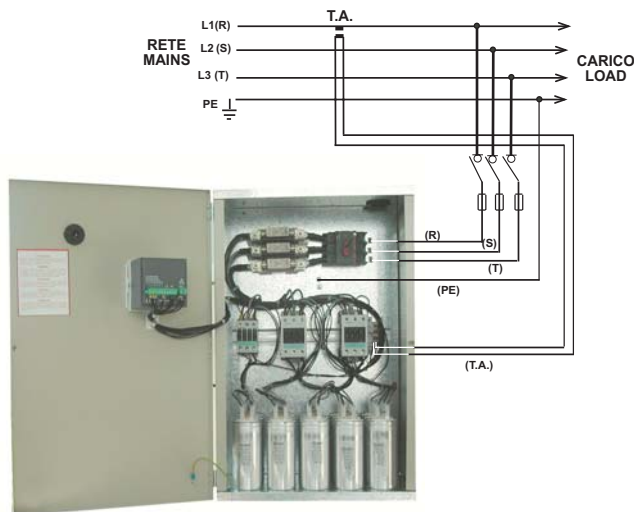
9**CHECKING OPERATION OF THE EQUIPMENT**

- For immediate checking of operating precision remember that:
 1. The equipment should be connected when the load is connected.
 2. The equipment should be disconnected when the load is reduced or disconnected.
 3. When the inductive $\cos\phi$ reaches 1, the current circulating in the circuit upstream of the power factor corrector is reduced, while with capacitive $\cos\phi$ it is increased.
- If the equipment is not functioning correctly check the connections **(see Tab.1)**. Check that the CT is connected to the correct phase by measuring, **(see Tab.4 a)**, the voltage between the cable to which the CT is connected and the left connector of the equipment circuit breaker. This reading should be zero: otherwise connect the CT to the correct phase or modify the equipment supply circuit.
- Then connect an ammeter clamp (range 6 Amp.) to the secondary winding of the CT **(see Tab.4 b)**. If about 1/5 of the inductive load is connected the current will increase by a certain amount even if the unit is not running. If one or two capacitor banks are connected manually the current will decrease. If this is the case the CT is connected correctly.
- Start the equipment operating again.

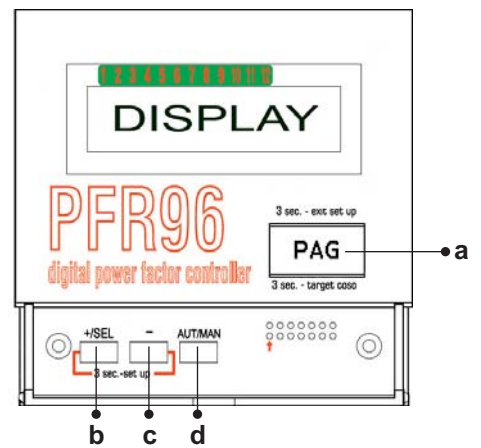
TAB.1 - SELECTED C.T.



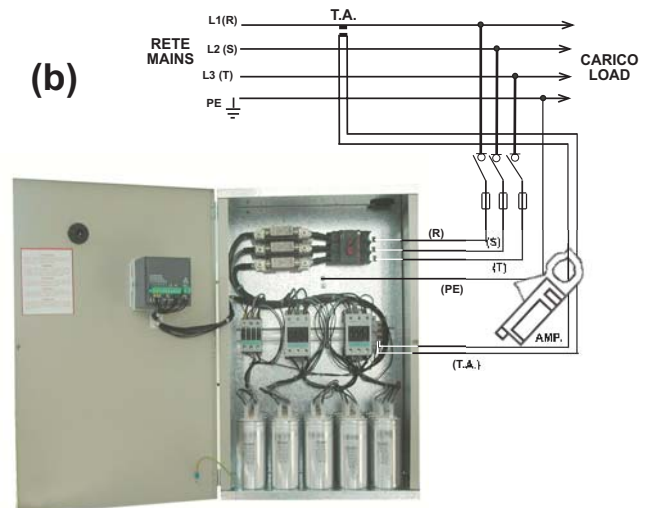
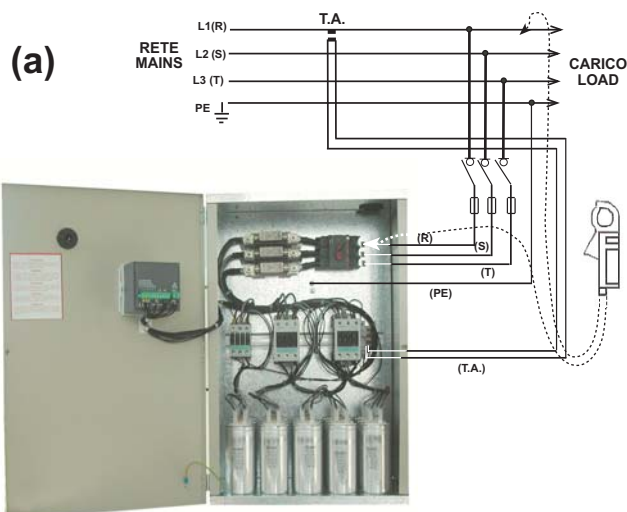
TAB.2 - CONNECTION



TAB.3 - REGULATOR



TAB.4 - TEST a-b

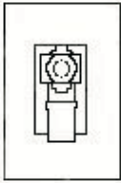


MAINTENANCE

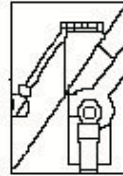
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MAINTENANCE INSTRUCTIONS

- ⚠ Before carry out any maintenance procedures read the "SAFETY", " OPERATOR SAFETY" and "IMPORTANT NOTES" sections of this manual carefully.
- Regular inspection and servicing is essential for power factor correction equipment as stated in international standards.
- To be carried out during installation and afterwards every 3 months. Any problems should be promptly corrected.
- Check all electrical and mechanical connections according to the following procedure.



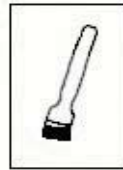
Check that the surfaces around the electric contact surfaces are not blackened.



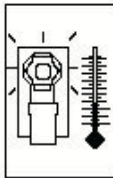
Check that the terminals are tightened securely.



Check overvoltage and overcurrent devices.



Clean the various equipment components regularly.



Check that the equipment does not have hot spots or signs of averheating and that it is suitably ventilated.



Check that the regulator is set for proper operation. carry out automatic and manual operation tests (see paragraphs 8a-b-c).

MAINTENANCE CHART

DATE							OPERATOR STAMP AND SIGNATURE

WARNING: Elcontrol Energy Net declines all liability for any damage to people or property caused by unsuitable or incorrect use of the products. EEN reserves the right to change product specification without prior notice.