

ELECTRONIC POWER FACTOR REGULATOR
 type **QR**
INSTRUCTION MANUAL

PAG. 7

• **ENGLISH**

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1. GENERAL

The regulator works according to binary logic sequence; the switching on and off capacitors banks always starts from the first bank. The regulator effects a measurement of reactive power with “square method”, therefore it’s important that the regulator is supplied with two phases and the current signal is brought from the third phase. Simple connection mistake can cause incorrect working.

2. INSTALLATION

MECHANICAL FIXING

The Regulator should be fixed to a board, (drilling template 91x91mm.) by special accessories included. The plastic case is insulating self-extinguishing material.

ELECTRICAL CONNECTIONS

The terminal board with male faston 6,35 x 0,8 mm. is available on the back of the regulators. The wiring diagram is shown in Fig.1 (pag.9). In connecting the voltmetric circuit (V-V), make sure that the voltage of the regulator is the same as the mains voltage.

HOW TO CHOOSE THE CURRENT TRANSFORMER (C.T.)

- Use a Current Transformer (C.T.) with 5A at secondary circuit and primary equal or slightly higher than the maximum current absorbed by the loads. The C.T. must be chosen in such a way to obtain a good current signal in the secondary circuit. Current values between 0.5 and 5Amps are suitable to obtain good working conditions of the regulator.
- The C.T. must be good quality (first class) and with power equal or higher to 5VA. If the C.T. has been mounted far from the equipment, it needs to add to the normal demanded, the power consumed from connection cables (normally 0.2VA per meter of bifilar lines with 2.5mm² c.s.a.) and the power dissipated by others possible devices connected in the circuit.

The equations, used to calculate the real losses, are as below:

$$R=2\rho xL/S \quad (\Omega) \quad \text{Total resistance of amperometric circuit}$$
$$P=(R+0.08) x I^2 \quad (\text{VA}) \quad \text{Losses of amperometric circuit}$$

‘ ρ ’ is the electrical resistivity (0.018 for the copper)

‘ L ’ is the length of amperometric circuit (m) ‘ S ’ is the cross sectional area of cables at the secondary of C.T.

‘ I ’ is max. current at the secondary of C.T. ‘0.08’ are the internal resistance of P.F. regulator

- The cables at the secondary of C.T. have to be of 2,5mm² c.s.a. (cross sectional area)
- The C.T. connection must not be protected with fuses or interrupted by switch.
- The C.T. has to be connected to the line, upstream to the load and the P.F.Equipment: the C.T., can then measure the current demanded by the load, inductive and capacitive. Possible capacitors for fixed P.F.Regulation will be connected downstream to the C.T., as they aren’t used and dimensioned for the compensation of the no load losses of transformer that supplies the load.
- It’s important to check that the phase, where the C.T. is connected, is the same that will be connected to terminals of the main switch, inside the equipment, signed with the letter “R” (L1).
- Before doing any work on the C.T. circuit, be sure that the C.T. is short-circuited, otherwise dangerous voltages can rise, bringing to breakdown the C.T.
- Compensating two or more lines (transformers in parallel), you need to use two or more C.T. (.../5) of which the secondary circuits will supply an add transformer with 5Amps at secondary: connect the current transformers at the same phase.
- Connecting two or more cables (for load and P.F.Regulator) on the same terminal - phase “R”(L1) - from the general main switch, it needs to pass through the hole of the C.T. all the derived cables.

NUMBER OF CAPACITOR BANKS

The banks that can be controlled by the regulator are the following: 3 (series QR3), 4 (series QR4) and 6 (series QR6)

POWER OF CONTROLLED BANKS

For correct operation of the automatic banks, the power ratio per bank should be:

- a. equal to each other (1.1.1.1.1.1)
- b. double of the previous bank (1.2.4.8.16.32)
- c. equal or double of the previous bank (1.1.2.2.4.4)

NUMBER OF STEPS

Is determined by the power combination which has been used on single capacitor bank:

- Examples: 6 banks in the sequence 1.1.1.1.1.1 make 6 steps
 6 banks in the sequence 1.1.2.4.4.4 make 16 steps
 6 banks in the sequence 1.2.4.8.16.32 make 63 steps

Note. Where the step sequence is uneven too high a number of steps will result in a high number of switching operations which will considerably reduce the life of the equipment. With the first step too high hunting may occur which again would produce excessive wear and reduced life of the components.

- Normally 8-16 regulating steps is the best solution to adopt.

3. PRELIMINARY TESTS

They must be carried out in any single case as a function of the C.T. transformer ratio, the power of the first bank and the degree of power factor improvement desired.

Trimmer C/K: the indicative arrow of the trimmer must set, behaving with a screwdriver, in correspondence of the division of the scale relative to the value of the C/ K. The value to be set can be calculated by dividing the power of the first bank expressed in kvar (C) and the C.T. transformer ratio (K).

Example: first bank=12,5kvar and C.T.=600/5=120 C/K=12,5:120=0,10



C/K		1 st bank power expressed in kvar (C)									
T.A.	K	2,5	5	6	10	12,5	20	25	40	50	
30/5	6	0,41	0,83	1,00	-	-	-	-	-	-	
50/5	10	0,25	0,50	0,60	1,00	-	-	-	-	-	
60/5	12	0,21	0,42	0,50	0,83	1,00	-	-	-	-	
80/5	16	0,16	0,31	0,38	0,63	0,78	-	-	-	-	
100/5	20	0,13	0,25	0,30	0,50	0,63	1,00	-	-	-	
150/5	30	0,08	0,17	0,20	0,33	0,42	0,67	0,83	-	-	
200/5	40	0,06	0,13	0,15	0,25	0,31	0,50	0,63	1,00	-	
250/5	50	0,05	0,10	0,12	0,20	0,25	0,40	0,50	0,80	1,00	
300/5	60	-	0,08	0,10	0,17	0,21	0,33	0,42	0,67	0,83	
400/5	80	-	0,06	0,08	0,13	0,16	0,25	0,31	0,50	0,63	
500/5	100	-	0,05	0,06	0,10	0,13	0,20	0,25	0,40	0,50	
600/5	120	-	-	0,05	0,08	0,10	0,17	0,20	0,33	0,42	
800/5	160	-	-	-	0,06	0,08	0,13	0,16	0,25	0,31	
1000/5	200	-	-	-	0,05	0,06	0,10	0,13	0,20	0,25	
1200/5	240	-	-	-	-	0,05	0,08	0,10	0,17	0,21	
1500/5	300	-	-	-	-	-	0,06	0,08	0,13	0,17	
2000/5	400	-	-	-	-	-	0,05	0,06	0,10	0,13	

- If two or more C.T. 's are used with an additional transformer, the value of the primary current is the sum of each C.T. Example: n.3 C.T. 's 500/5 = n.1 C.T. 1500/5.
 - If the regulator is used in 230Vac three-phase supply, the C/K value have to be multiplied by 1,8.

Trimmer %: in normal conditions the trimmer have to be set at 25%, whereas with lower values the medium value of power factor must be increased (the P.F. increases).

The regulator can start working after connection and calibration as explained above.

AUTOMATIC operation

Set the regulator "MAN/AUT" selector on AUT. When inductive loads are connected (motors, transformers, discharges lamps,...) the yellow LED  is lit, and the regulator switches on, with regular steps, the necessary banks. If there is an excess of capacitive load, the yellow LED  is lit, and the excess banks are disconnected. To connect (disconnect) capacitor banks, it will be necessary that the inductive (capacitive) LED remain lit at least for 15-30 secs. When the load is corrected (P.F. medium 0,95) inductive and capacitive LEDs will be off.

MANUAL operation

Set the regulator "MAN/AUT" selector on MAN. Using the switch +C/-C it's possible respectly connect or disconnect the capacitors banks. The switch must be pushed for 15" or 30" (first bank) in order to make it work. When it is released, the existing situation is memorized and stored. When the banks are connected, the relevant LED's are on. If the power supply is interrupted, the regulator disconnects all the capacitor banks. When the power supply is restored, the regulator begins its normal functioning again, it needs however insert the capacitors banks by the switch again.

4. ALARMS (only QR4 and QR6)

An internal troubleshooting system checks the efficiency of the whole regulator. The series QR is also equipped with an internal check system of the maximum temperature through the red led MAX. TEMP. placed on the board. When the led is off, the regulator works properly. If a temperature higher than 50°C is reached inside the regulator, the led is on, and a circuit sets all connected banks to zero. The regulator resets automatically when the overheating stops. Both the intervention for high temperature and a failure in the regulator are signalled by contact of a relay; for the series QR it leads to the terminal ALARM and is NC (normally closed). This contact has a power of 5Amps at 250Vac (resistive load).

5. OPERATION ANOMALIES AND REMEDIES

All devices are thoroughly tested at works. Most malfunctions are caused by incorrect connections. The most common faults are as follow.

TROUBLES	REASONS AND SOLUTIONS
Main led (green) OFF	<ul style="list-style-type: none"> Power supply failure Check if supply voltage is present (fastons V-V). Check if supply voltage is equal to the rated voltage of the regulator (fastons V-V).
Yellow capacitive led (—°—) is ON without capacitors banks working	<ul style="list-style-type: none"> Reverse the connections on the terminal A-A (K-L)
Banks led 's (1-2-3) ON but capacitors banks not working	<ul style="list-style-type: none"> Check if supply voltage is equal to the rated voltage of the regulator (fastons V-V). Check if phase "L1" has been connected on "C" terminal. Check the neutral connection on contactors. Check the three-pole contactor.
All capacitors banks on with a low inductive load on the network	<ul style="list-style-type: none"> Power of P.F. equipment not sufficient Check the capacitors feel and/or increase the power. C.T. is connected upstream to the load but not of capacitors Connect the C.T. as shown in the connection diagram. C.T. installed in the wrong phase: connect to phase L1. Possible capacitive load condition and terminal connection reverse.
Leds _○○○_ and — ³³ — OFF	<ul style="list-style-type: none"> Possible stand-by condition: at least one capacitor bank on, check the P.F. value. Low C.T. signal current: check the C.T. choice and the electrical connection by considering that the minimum current signal must be 500mA. Possible manual working condition: chose the automatic (AUT) operation.
Yellow led capacitive (— ³³ —) always lit also changing the A-A (K-L) cables	<ul style="list-style-type: none"> Zero current signal: check that the C.T. isn't short-circuited. Check the current signal on the secondary circuit of C.T. with tester. C.T. connected on the supply cable of the P.F.C. equipment Connect according to electrical scheme Fig.1. C.T. installed in the wrong phase: connect to phase L1. Trimmer % not well regulated: adjust it next "0".
Continous switching on/off of one bank (hunting phenomena)	<ul style="list-style-type: none"> The C/K value is not correct: check in table "C/K" for the right value. The power of first bank is too high.
Red alarm led is ON	<ul style="list-style-type: none"> Alarm of maximum temperature: you see paragraph 4. ALARMS.

Other operation anomalies: please check again the correctness of the installation operations and check again all points of "operation anomalies and remedies". A simple connection mistake can cause the P.F. Controller to function incorrectly. If the P.F. Controller continues to work incorrectly, contact the Technical Office of the COMAR CONDENSATORI S.p.A, referring to the serial number of the equipment (visible on the plate) and the value of measured current on the secondary circuit of the C.T.

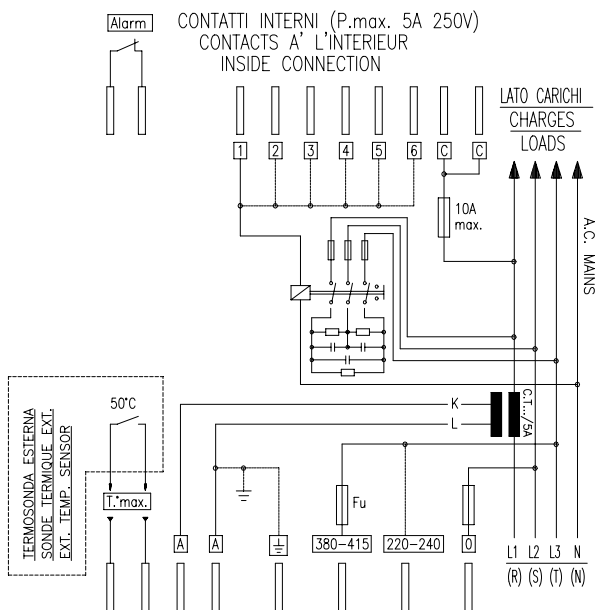


Fig.1 Electrical connection of QR6 regulator

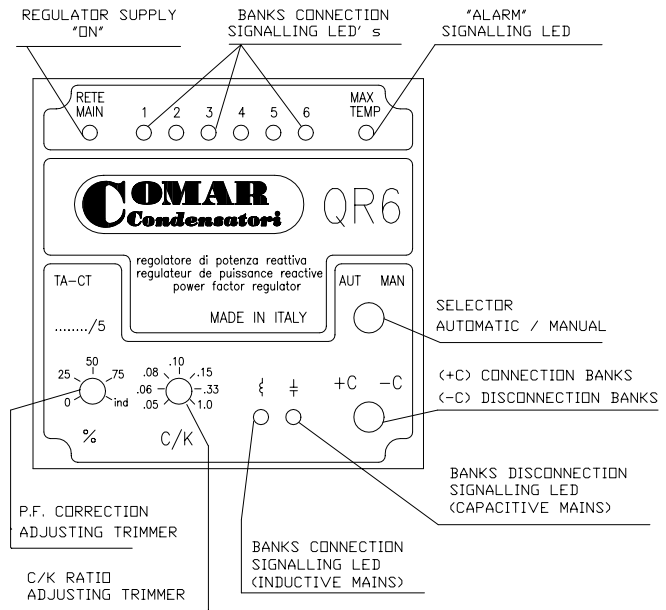


Fig.2 Front of the electronic regulator type QR6

6. TECHNICAL DATA

Operation	AUTOMATIC or MANUAL
Rated supply voltage	Multivoltage 220÷240/ 380÷415 Vac ±10% (254/440Vac on request) 230/ 400Vac -10% / +5% continuous operation
Rated consumption	10 VA
Rated supply current	By C.T. secondary winding 5Amps max., 1 st class - 5VA (I _{min.} = 500mAmps)
Current circuit consumption	2VA
Rated frequency	50Hz and 60Hz
Nr. max. of capacitors banks controlled	3 (series QR3) - 4 (series QR4) - 6 (series QR6)
Output relays	5Amps 250Vac resistive loads
Max current on relays common circuit	5Amps at 40°C resistive load
Switching steps delay	30" first bank - 15" other (7" first bank - 4" other on request)
Alarm delay	1"± 1" (only series QR4 and QR6)
Power Factor setting	0,90 IND ÷ 1,00 IND
Electrical connections	With male faston 6,35x0,8 mm.
Mechanical dimensions	96x96 mm FRONT panel according to DIN43700 - 102 mm. thickness
Cut out dimension	91x91 mm. (tolerance -0mm. / +1mm.)
Plastic case	Insulating self-extinguishing material
Cut out dimension	91x91 mm. (tolerance -0mm. /+ 1mm.)
Weight	0,8 Kg
Mechanical fixing	by special accessoires included
Protection degree (CEI-EN 605.29)	IP 40 front panel - IP00 rear side
Working temperature	-5°C / + 50°C
Storage temperature	-10°C / + 50°C
Relative humidity	max. 90% at 20°C non-condensing
Type service	Indoor service, no dusty condition. Do not place directly under sunlight.

GENERAL INSTRUCTION

- Read the instructions in this handbook because they provide important indications about the safety of installation, use and maintenance of installation. Take carefully this handbook for any information.
- Check the integrity of the equipment after unpacking it. In case of doubt, don't use the P.F. Corrector and ask for skilled staff.
Note: If the equipment has fallen or has been violently or shaken during shipping, it could suffer internal damage which may be dangerous.
- Before connect the equipment, check the data card: this has to be in conformity with the power electric network (the plate is located on the back of the P.F. Regulator).
- This equipment will be assigned only to the use for which it has been specifically made. Each other use has to be considered improper and therefore dangerous.
- In order for the correct functioning of the equipment the limits of voltage, current and temperature, imposed by the CEI and IEC standards, must never be exceeded.
- The equipment has to be protected from atmospheric conditions. No type of tampering is permitted on the electronic circuits of P.F. Regulator.
- Possible interventions will be performed by COMAR staff.

WARRANTY

Comar Condensatori S.p.A. guarantees its own products for twelve months from purchase date. The warranty covers the faults of materials and manufacture and it has to be understand for goods ex-works. Before the equipment works, all instructions, present on this handbook, have to be meticulously followed. Breakdowns caused from improper use and/or not conformity to enclosed instructions and faults caused from tampering by unqualified technicians aren't covered.

The not respect also of a one of the previous points make to decay the right of warranty.

LIABILITY

Comar Condensatori S.p.A. are not liable for direct or indirect damages consequent the missing or the incorrect operation.

In any case and for any reason COMAR Condensatori S.p.A. can not be considered liable for possible direct or indirect damages, consequent the malfunctioning of P.F. Corrector, caused from mistakes of assembly or from inadequate use of the same.

The manufacturer reserves the right to modify data and sizes without previous notice.