



Reactive Power Regulator

Serie PFR6 – PFR12

Operation Manual Instruction

1. Introduction

Series reactive power and compensating controller is suitable for self-adjusting capacitor compensating devices in low voltage distribution system (hereinafter referred to as controller) and make power factor reach the presetting state by user to increase the utilization efficiency of power transformer, reduce line loss and improve voltage quality, thereby to increase the economic and social benefits.

2. Function characteristics

- a. To calculate the input-cut capacitance by reactive power, with high precision compensation.
- b. Power factor has high precision measurement, with wide displaying range.
- c. Initial phase preset (homonymy terminal of software adjustment or current polarity).
- d. With friendly human-machine interface, easy to operate.
- e. All kinds of control parameters can be adjusted in whole digit. It is visual and easy to use.
- f. With two working modes: auto run and manual run.
- g. With protection function of over voltage and under voltage.
- h. With power down protection function, so data will not lose.
- i. With low current signal input impedance $\leq 0,01$ ohm

3. Service conditions

- a. Altitude does not exceed 2500 m
- b. Ambient environment: -25°C up to 50°C
- c. Relative humidity: $<50\%$ at 40°C and $<90\%$ at 20°C .
- d. There is no corrosive gas, conductive dust, combustive explosive medium around.
- e. No severe vibration in installation place.

4. Technical data

Rated working voltage (CA):	380V or 220V
Rated working current (CA):	0-5A
Output contact capacity (CA):	220V – 7A
Displaying power factor:	Lag 0,001 – Forward 0,001
Measured reactive power:	0-99999 kVAr
Under voltage protection value:	320V
Control mode:	Automatic selecting the best / loop switch
Sensibility:	60mA
Protection class:	IP40 (outer enclosure)

5. Debugging

Warning: During the process of adjustment, user should abide by the following adjustment steps. The one with * is the controller working under reactive power control mode.

- Assemble the compensating device according to the demand of connection diagram, and then make a detailed examination so as to remove the mistake that may cause serious potential safety hazard.
- Switching in compensation device, the controller enters into automatic state.
- * Input the transformation ratio of at site signal current transformer, for the details see "Parameter Preset".
- * Input the capacity of capacitor of each branch circuit, for the details see "Parameter Preset".
- Operate "ENU" key to make indicator light f manual run shines. As one measure for debugging compensating device, manual run can be used for checking its connection correct or not. Operate "NCREASING" key, one capacitor group input, and operate "DECREASING" key, one capacitor group cut.

- **Note:** The output terminal, the capacitor value of which is zero can't perform input and cut action. The above operation can be without current signal.
- In order to make the controller automatically input and cut capacitor group, beside user should put menu under menu of "Power factor" or "Reactive power", the current signal should lag voltage signal, and the system voltage higher than over voltage protective value and is not lower than under voltage protective value.



6. Key function

Name	Mark	Contents
Menu key		Main menu and submenu for option. Note: Press menu key for 3 sec to enter into parameter preset menu.
Increase key		Preset parameter to increase the data, input capacitor group when the manual run.
Decrease key		Preset parameter to decrease the data, cut capacitor group when for manual run. Under menu "Power factor" display primary current A. Under menu "Reactive power" display voltage signal V.



Reactive Power Regulator Front PFR-12

7. Parameter preset

Selection of being preset parameter	Parameter code	Code meanings	Parameter range	Parameter adjustment
Press "MENU" key for 3 sec to make indicator lights on		Target power factor		Press  key to increase parameter. Press  key to decrease parameter.
Repress "MENU" key		Input time	1-250 s	
Repress "MENU" key		Cut time	1-250 s	
Repress "MENU" key		Over voltage preset	400-480V(Sample 380V) 230-265V(Sample 220V)	
Repress "MENU" key		Signal initial phase	0° or 180° (Note 1)	
Repress "MENU" key		CT transformation ratio preset	30-5000 (Note 2)	
Repress "MENU" key		Capacity of the first loop capacitor	0-100 kVAr (Note 3)	
Repress "MENU" key		Capacity of the second loop capacitor	0-100 kVAr (Note 3)	

Repress "MENU" key		Signal initial phase	0-100 kVAr (Note 3)	
Repress "MENU" key	Store the preset parameter to enter into auto run state			

Note 1: When the voltage signal and current signal input to the controller are on homonymy end state, user should adjust the parameter to "0". When they are on non-homonymy end state, user should adjust the parameter to "180". If the user can't judge whether they are on homonymy end state, cut off all load, then input one group or several groups capacitors, now the power factor that controller displayed is negative and very low. If the power factor is not negative, it can be judged that the voltage signal and current signal are non-homonymy end state. If the initial phase is "80", user should adjust I to "0" and while it is "0", user should adjust it to "180". User should confirm this parameter correct or not after one controller is finished installation, or will cause the abnormal operation for controller.

Note 2: CT transformation ratio preset value is the numerator value of signal current transformer ratio. Eg.: User's signal current transformer ratio is 500/5A, then the CT ratio preset value is 500, other than 100.

Note 3: The output loop capacitance should be preset to "0" if without connected with capacitor. The output loop controller will not output control signal if the preset capacitance of capacitor is "0".

8. Input-cut principle

- 1) When the capacitor bank can't input automatically, user should consider the following condition is tenable or not. It should be noted that the following conditions are necessary, must fulfil.
 - a. Power factor value of system is lower than target power factor value.
 - b. Over voltage indicator light doesn't light.
 - c. We indicate active power of present electric network by P and reactive power by Q, target power factor by $\cos \varphi$. Formula 1 must be tenable.

$$(\text{Capacity of single capacitor} \times 0.65) < Q - P \times \sqrt{\frac{1}{\cos^2 \varphi} - 1}$$

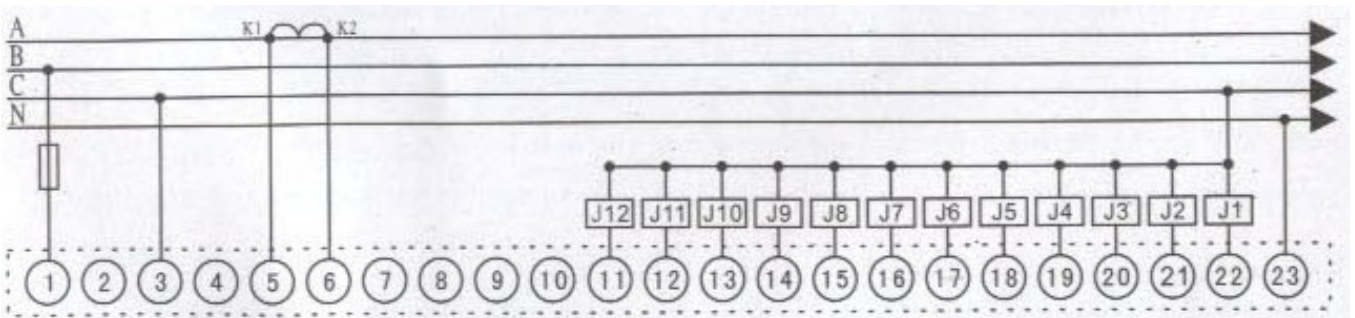
- 2) When the power factor of electric network is higher than target power factor, and the capacitor bank can't cut automatically, user should consider the following condition is tenable or not. We use P to indicate the active power of electric network, Q to indicate reactive power of present electric network and $\cos \varphi$ to indicate target power factor1. Formula 2 must be tenable.

$$(\text{Capacity of single capacitor} \times 0.65) < Q - P \times \sqrt{\frac{1}{\cos^2 \varphi} - 1} - Q$$

9. Display instruction

- Over voltage state if the present menu indicator light flashes frequently, which means the controller works under voltage removal state, the display value is system voltage value.
- Cos β value Displaying 0,985 means present power factor is lagging 0,985.
Displaying -0,985 means present power factor is leading 0,985.
- Under current state Displaying C0 means under current, signal current is less than 60 mA.

10. Connection method



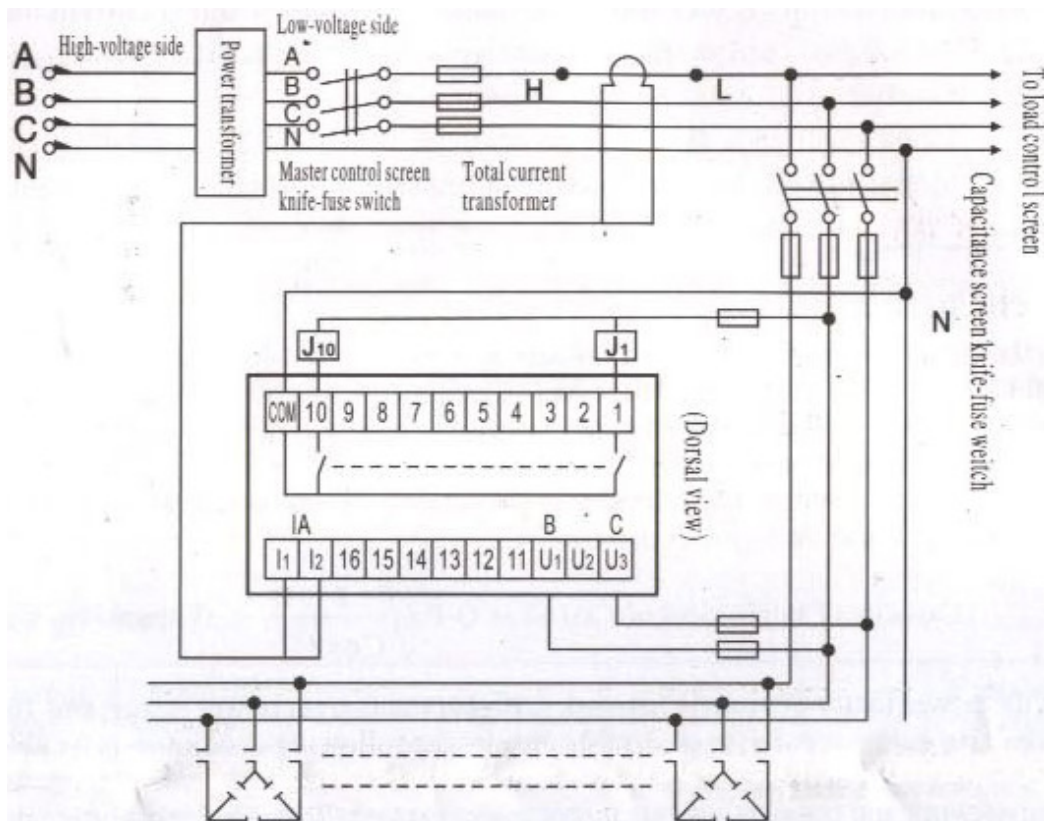
Perforate dimension: 144 x 144 (mm)

1-3 voltage signal input terminal

5-6 in current signal input terminal

23 common terminal of control output terminal

- 1) Controller voltage U1 and U2 connect with B phase and C phase. (See diagram 1 and diagram 2).
- 2) Sampling current terminal I1 and I2 are getting from A phase current transformer sublevel of the total load (major cabinet), never get from the capacitance screen.
- 3) COM is the common source of inner relay of output terminal 1-10 groups of the controller, AC contactor coil voltage 220V.



Connection diagram of PFR-6 and PFR-12 type (Diagram 1)

11. Fault and remove

During using and installing the controller, for some easy neglected connection mistakes will result in compensating device abnormally operating. The regular fault phenomenon and its removal methods are shown as follows.

- a. Control head panel input and indicator lights, but AC contactor can't close. This phenomenon caused by the inside coils of AC contactor that have not obtained power supply or have not enough power. User should check whether the type of AC contactors is the same as the drawing, fuse is perfect, power supply common terminal of AC contactor and output common terminal of controller are connected on the same wiring and the connection is open circuit or not.
- b. With the changing abnormality and not changing of input power of capacitor, the former caused by the incorrect sampling of voltage or current signal. User should pay more attention to check signal sampling. The latter caused by the incorrect position of user's signal mutual indicator inserted. The current mutual inductor should be inserted in the output position where shows total load current change (e.g. total cabinet bus line).
- c. The gauge outfit of controller always displays C0, this phenomenon caused by the big or small signal current or not current of controller input. User should calculate whether the transformation ratio of current mutual inductor is rational or not, current signal loops has open circuit or connected with other instruments in series and parallel or not.
- d. One group or two groups capacitors never input (input indicating lamp can't light). This phenomenon only will take place when in the handwork operating mode, but the common reason is that the user did not preset capacity of capacitor or preset too big data when mends parameters. In this case, as long as preset capacity of capacitors once again.
- e. The reactive power value of controller has a wide gas with onsite value. This phenomenon caused generally because of the incorrect transformation ratio of current mutual inductor preset. User should check whether the transformation ratio of the signal current mutual inductor is in correspondence with preset value or not.
- f. The power factor value of controller has a wide gas with onsite value. There are two possibilities for this phenomenon: one is the incorrect sampling of voltage or current signals; another is current signal exceeds 5,5A (transformation ratio of current mutual inductor selection is unreasonable).
- g. The displayed power factor total value of controller is negative under the condition that without one group capacitor bank input. User only need to exchange the position of current signal wire and connect or readjust the value of initial phase, if it is "0", adjust it to "180" and if it is "180", adjust it to 0".
- h. If there are some difficult problems and user does not solve by himself, please contact with the Technical Service of AENER ENERGIA.