POWER FACTOR CORRECTION UNITS
SERIES VARI, SC & FK

USER'S GUIDE

Vers. 97/01

1.- INTRODUCTION

The **VARI, SC & FK** automatic capacitor banks are provided for the power factor compensation in any installation. The total power needed for the power factor correction is split in several capacitor steps, sized according to a ratio 1:1:1, 1:2:2 or 1:2:4, delivering an accurate regulation according to the load needs.

2.- COMPUTER 6b / 12a: POWER FACTOR REGULATOR.

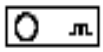
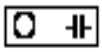
power factor regulators control the connection and disconnection of capacitor steps, depending on the consumed reactive current, in order to keep the power factor within a desired value. These devices have a front display indicating the cos φ measured value.

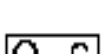
The regulator works according to the FCP control system (Fast Computerized Program), based on microelectronics technology. It uses the microprocessor intelligence to take complex decisions which need a high calculation capacity.

DISPLAY AND LED SIGNS:

Numerical display: During normal operation shows the cos φ. The sign -- indicates that the current measured through the CT is below the sensitivity limit (no capacitors connected in this situation). The sign **01** means that the CT is not properly connected (wrong phase or S1-S2 reversed).

Push button: When pushed, the display shows the number of connected steps

 Lights ON when the measured cos φ is inductive; and  lights ON when the measured cos φ is capacitive.

 : Lights ON when  is pushed and the display shows the number of connected steps

COS φ control: Cos φ setting control from 0.85 Ind. to 0.95 Cap.

C.K. factor setting: See paragraph 3.4.

3.- INSTALLATION AND STARTING THE CAPACITOR BANK THE FIRST TIME

To install and start the first time a capacitor bank, follow the steps below:

3.1.- Initial check (Before the connection of supply)

- Check that the rated voltage for the equipment, shown in the characteristics plate, matches with the phase to phase voltage at the line where the bank has to be installed.
- Check that the rated power shown in the plate of the bank corresponds to the needs.

3.2.- External wiring (Check before the connection of supply)

- All the external cabling has to be connected to the terminals. Wires must have a cross-section suitable for the maximum current demanded by the capacitor bank.

3.3.- Control circuit wiring.

- Only the current transformer needs to be connected to the control system. **The current transformer must be always placed at phase L1, measuring the total current of load + capacitors.** (The figure 1 shows the correct placement of the transformer)
- The PF regulator connections may be seen in the final attached drawing. Notice that the voltage inputs must always be taken from phases L2 and L3, choosing the suitable input of 230 or 400 V, depending on the phase to phase voltage at the line to be compensated.

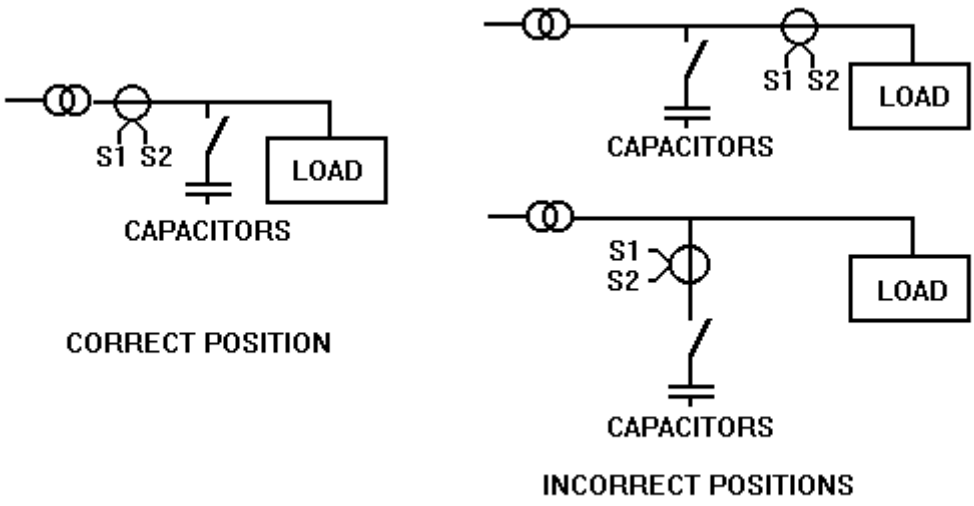


FIGURE 1.- Position of the current transformer

3.4.- Adjustments of the power factor regulator.

- The **COS** φ potentiometer must usually be set to 1.
- The **C/K** factor must be adjusted according to the kvar of the lower step and depending on the primary/secondary ratio of the current transformer. The right value for adjustment is:

$$\mathbf{C/K = \frac{1000 \,.\, Q\ (kvar)}{1{,}73 \,.\, Uc \,.\, Ip/Is}}$$

where Q(kvar) = kvar of the smaller capacitor step, Uc = phase to phase voltage
Ip/Is = current transformer ratio (example: for a 1000/5 CT, Ip/Is = 200)

The C/K value may also be obtained from table 1, which gives this value for different CT ratios and kvar values of the smaller capacitor step.

- Check the rear switch of the power factor regulator and select the program 1:1:1 (all capacitors equal) or 1:2:2 (1st step half the power of the others). Program 1:2:4 is also available with a special regulator identified by a label 1:2:4 beside the switch.

TABLE 1.- C/K values for lines at 400V (phase to phase)

Current	POWER OF THE LOWER CAPACITOR STEP (kvar)						
Trans.	10	20	30	40	50	60	80
150/5	0,48	0,96					
200/5	0,36	0,72					
250/5	0,29	0,58	0,87				
300/5	0,24	0,48	0,72	0,96			
400/5	0,18	0,36	0,58	0,72	0,87		
500/5	0,14	0,29	0,45	0,54	0,72	0,87	
600/5	0,12	0,24	0,36	0,48	0,60	0,72	0,96
800/5	0,09	0,18	0,27	0,36	0,45	0,54	0,72
1000/5	0,07	0,14	0,22	0,29	0,36	0,43	0,57
1500/5	0,05	0,10	0,14	0,19	0,24	0,29	0,38
2000/5		0,07	0,11	0,14	0,18	0,22	0,28
2500/5		0,06	0,09	0,12	0,14	0,17	0,23
3000/5		0,05	0,07	0,10	0,12	0,14	0,19
4000/5			0,05	0,07	0,09	0,11	0,14

C/K values for lines at 230V (phase to phase)

Current Trans.	POWER OF THE LOWER CAPACITOR STEP (kvar)						
	5	10	15	20	30	40	60
150/5	0,42	0,84					
200/5	0,31	0,63	0,94				
250/5	0,25	0,50	0,75	1,00			
300/5	0,21	0,42	0,63	0,84			
400/5	0,16	0,31	0,47	0,63	0,94		
500/5	0,13	0,25	0,38	0,50	0,75	1,00	
600/5	0,10	0,21	0,31	0,42	0,63	0,84	
800/5	0,08	0,16	0,24	0,31	0,47	0,63	0,94
1000/5	0,06	0,13	0,19	0,25	0,38	0,50	0,75
1500/5		0,08	0,13	0,17	0,25	0,33	0,50
2000/5		0,06	0,09	0,13	0,19	0,25	0,38
2500/5		0,05	0,08	0,10	0,15	0,20	0,30
3000/5			0,06	0,08	0,13	0,17	0,26
4000/5				0,06	0,09	0,13	0,20

3.5.- Power wiring.

- If the capacitor bank has to be connected without removing the supply voltage of the full system, the power fuses must be removed first.

- Connect the power cables to terminals **L1, L2 and L3**. The bank does not need a neutral connection. The power cables must be sized according to the power of the capacitor bank.

- Connect the earth cable to the terminal marked for that purpose.

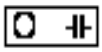
¡ATTENTION! Leave enough free space at the area next to the heat sinks to guarantee the correct cooling. The ambient temperature should no be higher of 40º C. In case of higher temperatures a forced cooling must be provided.

4.- TROUBLE SHOOTING.

The capacitor bank should operate only if there is a minimum load. If the equipment does not work properly check the following points:

4.1.- If the display of the power factor regulator does not light or gives a very slight bright, check the supply voltage and the fuses (power and control fuses)

4.2.- If the display shows the sign --, it means that the power factor regulator sees a current below the minimum threshold. Check the CT connections and the C/K adjustment.

4.3.- If the display shows a numerical value and the LED pointing to  is lighting, means that the power factor regulator sees a capacitive load. If the expected is an inductive load then check the CT connections (Try to reverse the wires connected to terminals S1-S2)

4.4.- During the normal operation, check the number of connected steps by pushing the key **C** in the power factor regulator. Notice that in case of programs 1:2:2 or 1:2:4, the capacitors having a power of 2.P1 or 4.P1 (P1= Power of the 1st step) are counted as 2 or 4 steps.

4.5.- Check that the number of connected steps coincides with the Nr of steps shown by the power factor regulator.

4.6.- If there are some inactive steps and the COMPUTER shows a lack of compensation, check the settings of such COMPUTER.

4.7.- Once the normal operation is achieved, check whehter the current consumption of each step is correct, according to its rated power (Current shown in characteristics label). An excess of consumption may be due to an excess of supply voltage or to the presence of harmonics.

4.8.- In case of a faulty operation which may not be solved with the above indications, contact the CIRCUTOR S.A. technical service.

5.- MAINTENANCE.

5.1.- Yearly inspection:

- Check that all the steps operate when necessary. Otherwise check the fuses.
- Check that the supply voltage is within the limits.
- Check that the current of each step is in accordance with its labelled value. A higher current may be due to the presence of harmonics. A low current may indicate a faulty capacitor.
- Check that there are not loose connections at the terminals.

¡ ATTENTION! For service purposes switch OFF the equipment. After that, a safety time of 3 minutes must elapse before any manipulation inside the equipment to allow the discharge of the capacitors.

6.- TECHNICAL SERVICE AND WARRANTY

All CIRCUTOR's products are covered by a warranty of 1 year in case of any manufacturing default. The warranty does not cover the protection elements like fuses or other neither the elements subject to ageing in normal service.

This warranty will not be applicable in case of wrong manipulation or in case that the rules of installation have not been respected.

CIRCUTOR offers to all its customers the assistance of its TECHNICAL AND ENGINEERING departments.