

COMMISSIONING INSTRUCTIONS FOR  
BELUK POWER FACTOR CONTROL RELAY

BLR-Q1

- 1) Connect the Relay in accordance with Figure 1 below:-

WIRING DIAGRAM

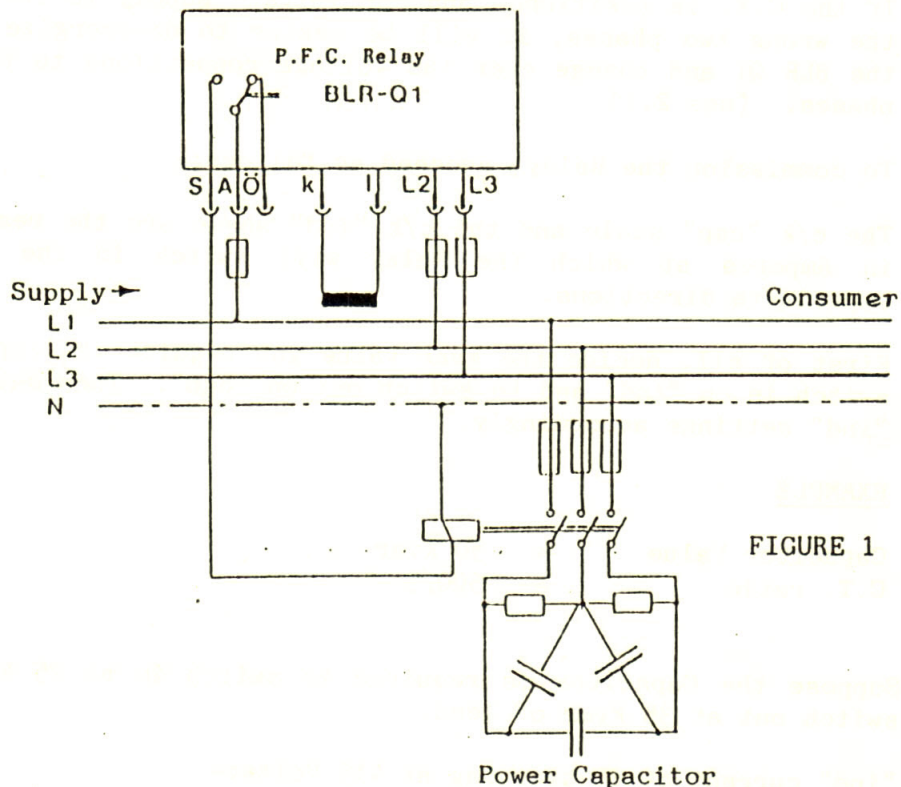


FIGURE 1

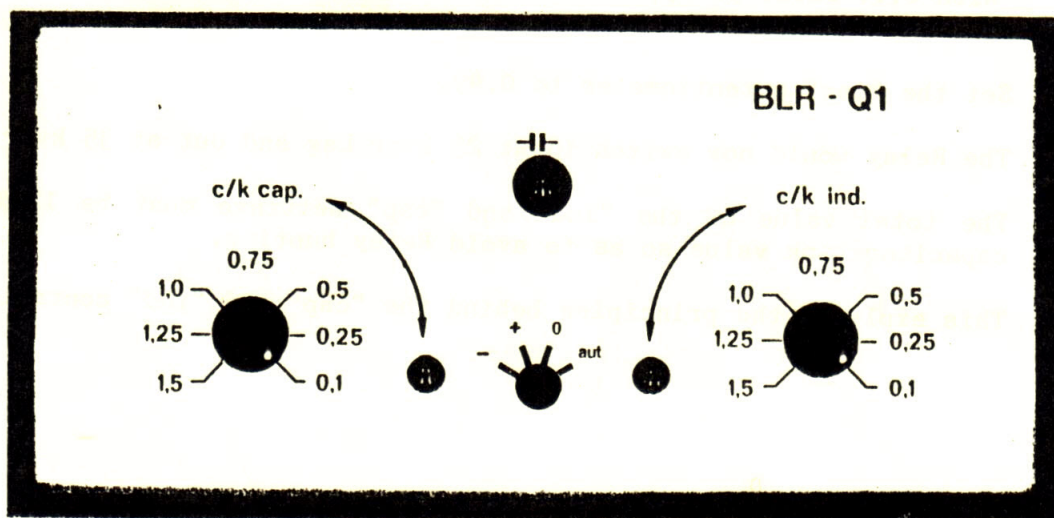
- 2.0) The Current Transformer, connected to terminals k - l must:-

- a.) Measure the total load including the P.F.C. load.
- b.) Be positioned in a different phase to the two phases used for L2 - L3.

N.B. NEVER CONNECT AN OPEN CIRCUIT LOAD CARRYING C.T. TO THE RELAY. THIS CAN GENERATE VOLTAGES WHICH WILL DAMAGE THE ELECTRONIC CIRCUIT. KEEP C.T. SHORT-CIRCUITED WHILST CONNECTING.

- 2.1) Sometimes it is not convenient to place the C.T. in L1 (Red) phase. If so, move the C.T. to another phase.

C.T. on L1 (Red) - Voltage to Relay from L2 (Yellow) - L3 (Blue)  
 C.T. on L2 (Yellow) - Voltage to Relay from L1 (Red) - L3 (Blue)  
 C.T. on L3 (Blue) - Voltage to Relay from L1 (Red) - L2 (Yellow)



2.2) If the C.T. is positioned and the voltage supply to the Relay is from the wrong two phases, it will be easier to de-energize the supply to the BLR Q1 and change over the voltage connections to the correct two phases. (see 2.1)

2.3) To commission the Relay, proceed as follows:-

The c/k "cap" scale and the c/k "ind" scale are the reactive currents in Amperes at which the Relay will switch in the inductive and capacitive directions.

First of all, decide the kvar value you require the capacitor bank to switch in on "ind" and to switch out on "cap". Then set the "cap" and "ind" settings accordingly.

2.4) EXAMPLE

Capacitor Value = 50 kvar  
C.T. ratio = 500/5

Suppose the Capacitor is required to switch in at 25 kvar Lag and to switch out at 35 kvar of lead.

"ind" current at 25 kvar lag at 415 Volts:-

$$\frac{25 \times 1000}{415 \times \sqrt{3}} = 34.78 \text{ Amps}$$

With C.T. ratio 500/5, C.T. output =  $\frac{34.78}{500/5} = 0.3478 \text{ Amps}$

Set the "ind" potentiometer to 0.35.

"cap" current at 35 kvar Lead at 415 volts 3 ph 50 Hz:-

$$\frac{35 \times 1000}{415 \times \sqrt{3}} = 48.68 \text{ Amps}$$

With C.T. ratio 500/5, C.T. output =  $\frac{48.68}{500/5} = 0.4868 \text{ Amps}$

Set the "cap" potentiometer to 0.49.

The Relay would now switch in at 25 kvar Lag and out at 35 kvar lead.

The total value of the "ind" and "cap" settings must be 120% of the capacitor bank value so as to avoid Relay hunting.

This explains the principles behind the "cap" and "ind" controls.

- 2.5) The total values of recommended "ind" and "cap" scale settings are summarised on the attached table, so the settings can be quickly and easily made. The 120% factor is incorporated in this table.

Example: Capacitor Value = 50 kvar  
C.T. ratio = 500/5

Referring to the table, the total value of "ind" and "cap" = 0.86.

We can select any value for "ind" and "cap", so long as they total 0.86.

E.g. for equal settings of "Lag" and "Lead" set both "ind" and "cap" controls to 0.43.

Remember that the "cap" setting must be set to switch out at less than the value of the capacitor. Otherwise, even at no load, there will be insufficient leading kvar to switch the capacitor off when the plant shuts down.

## 2.6) Hand/Auto Control

This front panel switch, rotated by a screwdriver operates as follows:-

+ = Capacitor in manually  
- = Capacitor out manually  
0 = Capacitor stays in its present position.  
aut = Capacitor in and out automatically.

## 3.0) Having set the Relay, switch on the supply.

If there is a lagging load on the system, the "ind" LED should come on.

If the "cap" LED comes on, switch off and swop over L2 - L3. Re-energise. The "ind". LED should now come on.

The Capacitor should switch in after a time delay of approx. 45 - 50 seconds.

- 3.1) N.B. There is a time delay of approx. 45 - 50 seconds on switching in and switching out, after the command has been given, as shown by the "ind" and "cap" LED's. This is to avoid the Relay switching in immediately after a supply failure when an emergency generator could be starting up.

4.0) Fault Finding

4.1) Relay does not function at all:-

Check that the correct voltage is applied to L2 - L3.

4.2) Relay switches in but does not switch out:-

Voltage L2 - L3 is taken from wrong phases.

Check that connections are as 2.1.

C.T. is incorrectly positioned and not measuring the Capacitor bank current.

4.3) Insufficient load on system at time of commissioning:-

Switch capacitor in on the hand "+" control. Change to "auto", Capacitor should switch out.

4.4) Relay does not switch correctly at "ind" and "cap" settings:-

Protection diodes on the C.T. circuit have operated due to over voltage on the C.T. path. Return the Relay for repair.

C/K TABLE FOR BLR-Q1

II	CAPACITOR RATING (kvar)												
	10	12,5	15	20	25	30	40	50	60	75	100	125	150
50/5	1,74	2,20	2,60										
100/5	0,87	1,10	1,30	1,80	2,25								
150/5	0,58	0,73	0,87	1,20	1,50	1,80	2,40						
200/5	0,43	0,54	0,65	0,87	1,10	1,30	1,70	2,20					
250/5	0,35	0,44	0,52	0,70	0,86	1,04	1,38	1,74	2,10				
300/5	0,30	0,36	0,44	0,58	0,74	0,88	1,18	1,46	1,76	2,20			
400/5	0,22	0,27	0,32	0,43	0,54	0,64	0,85	1,06	1,28	1,60	2,10		
500/5		0,22	0,26	0,35	0,44	0,52	0,70	0,86	1,04	1,30	1,74	2,20	
600/5			0,22	0,30	0,36	0,44	0,58	0,74	0,88	1,10	1,45	1,85	2,20
800/5				0,22	0,27	0,33	0,44	0,55	0,65	0,82	1,08	1,35	1,62
1000/5					0,22	0,26	0,35	0,44	0,53	0,66	0,88	1,10	1,32
1500/5							0,23	0,29	0,35	0,44	0,58	0,72	0,88
2000/5								0,22	0,26	0,33	0,44	0,55	0,65
2500/5									0,21	0,26	0,35	0,44	0,52
3000/5										0,22	0,29	0,36	0,44
4000/5											0,22	0,27	0,33