

Power Factor Controller

„BR 5306 / 5312“

Instruction book

1. GENERAL

The BR 53 is equipped with a single-chip micro-computer. This version, which has been additionally improved by a number of new design solutions, offers many advantages over the former version. Among these are:

- Stepless variation of the C / k value from 0.05 to 1.5
- Stepless variation of the target p.f. from 0.80 inductive to 0.80 capacitive
- 32 regulating series, including user-friendly circular circuits
- Connection of up to 12 capacitor branches
- End-stop setting between 1 and 12 capacitor branches in all regulating series
- 4 different switching times (40s, 20s, 4 s, 40 s/4 s cap)
- Internal and external trouble indication
- Permanent indication of the direction of regulation (" + C"/" - C")
- Indication of readiness for operation ("on")
- Permanent indication of the p.f. of the mains
- Connection to current transformers X/5A and X/1 A
- Integrated Manual / Automatic control
- Corrosion resistant plastic housing with protective insulation
- DIN dimensions, small mounting depth (144 x 144 x 120 mm)

The BR 53 is available in two basic versions:

- BR 5306 for connection of 6 capacitor branches
- BR 5312 for connection of 12 capacitor branches.

2. REACTIVE POWER ACQUISITION

Reactive power is determined by single phase measurement. This requires a current transformer in phase L1 (R) as well as connection of phases L2 (S) and L3 (T). Connection of the phases L2 and L3 also provides for internal current supply to the BR 53.

Display of "on" signals that this voltage is being applied. Special versions for the connection of voltages other than 400 V are available on request. The current transformer may be connected in other phases provided that at $\cos \phi = 1$ the measuring current is angularly phase-shifted by 90 degrees relative to the measuring voltage.

3. SETTING THE C/k VALUE

The C/k value is calculated from the following formula:

$$C/k = (0,6...0,8) \frac{C}{1,73 \times U \times k}$$

C : Output of the 1 st capacitor branch in var

U : Voltage of the mains

k : Transformation ratio of the transformer

This shows that the C/k value depends on the output of the 1 st capacitor branch (stepped wattage) and the transformation ratio of the transformer. Select these values such that a C/k value between 0.05 and 1.5 is obtained. Set the calculated C/k value on the front panel (Fig.1).

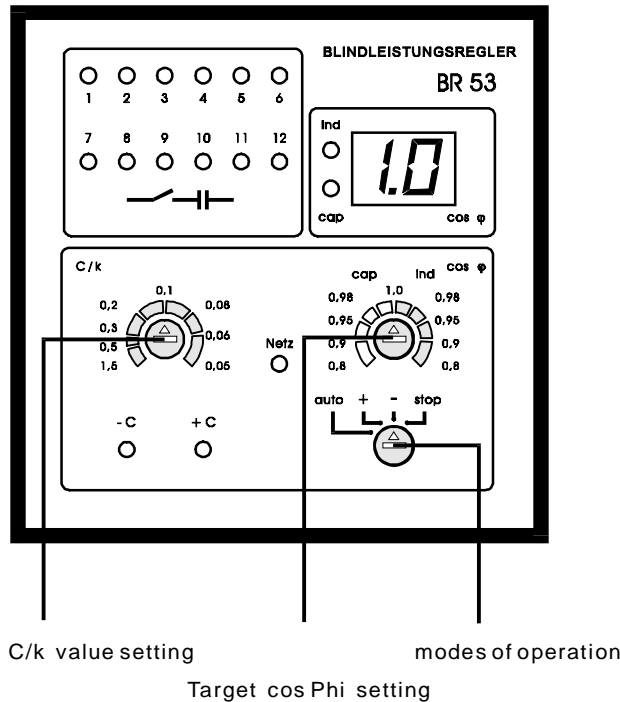


Fig. 1

4. SETTING THE TARGET POWER FACTOR

The target power factor is the power factor to be attained by reactive power compensation. The BR 53 allows setting the target p.f. within the range of 0.80 ind to 0.80 cap on a scale on the front panel. (Fig. 1)

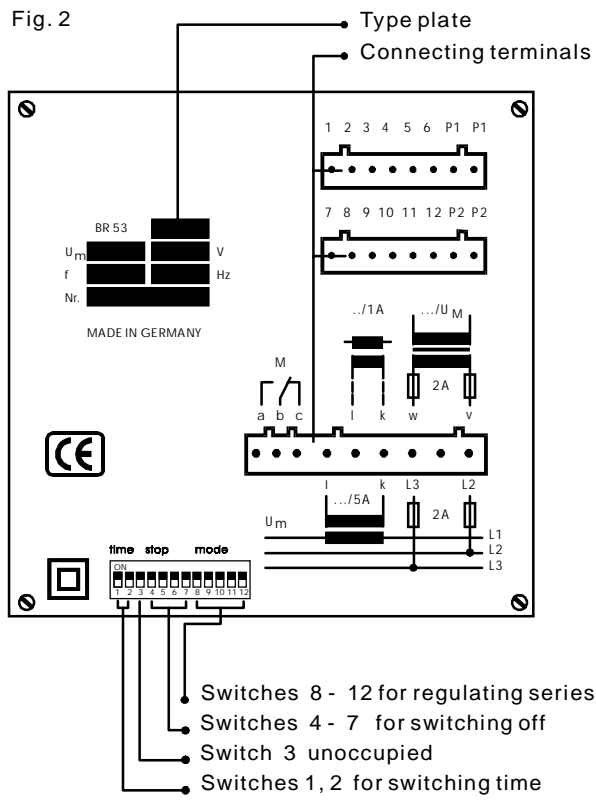
5. SETTING THE REGULATING SERIES (Table 1)

The regulating series is determined by the ratios of the capacitor branch powers, the power of the 1st capacitor branch representing valency 1. The BR 53 allows 32 regulating series to be set. These are available both as conventional sequence circuits (last in - first out) and as circular circuits (first in - first out) (Table 1). The switches "Mode 8, 9, 10, 11 and 12" on the back of the appliance (Fig. 2) are provided for setting the regulating series.

Regulating series 0 to 8 allow connecting and disconnecting in conventional sequence connection all capacitor stages which are in common use.

Regulating series 9 to 17 differ from those mentioned above only in that the most powerful capacitor branches of equal valency are operating in circular circuitry, which decreases the loading of the system.

Fig. 2



- Switches 8 - 12 for regulating series
- Switches 4 - 7 for switching off
- Switch 3 unoccupied
- Switches 1, 2 for switching time

Table 1

List of regulating series












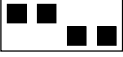
No.	Valency of capacitor branch												circular circuit	max No of stages		" mode" switch			
	1	2	3	4	5	6	7	8	9	10	11	12		BR 5306	BR 5312	8	9	10	11
0	1:1:1:1:1:1:1:	1:1:1:1:1:1:1												6	12				
1	1:2:2:2:2:2:2:	2:2:2:2:2:2:2												11	23				
2	1:2:3:3:3:3:3:	3:3:3:3:3:3:3												15	33				
3	1:2:3:4:4:4:4:	4:4:4:4:4:4:4												18	42				
4	1:2:4:4:4:4:4:	4:4:4:4:4:4:4												19	43				
5	1:2:3:6:6:6:6:	6:6:6:6:6:6:6												24	60				
6	1:2:4:8:8:8:8:	8:8:8:8:8:8:8												31	79				
7	1:2:4:8:16:16:	16:16:16:16:16:16												47	143				
8	1:2:4:8:16:32:	32:32:32:32:32:-												63	223				
9	1:1:1:1:1:1:1:	1:1:1:1:1:1:1	K											6	12				
10	1:2:2:2:2:2:2:	2:2:2:2:2:2:2	K											11	23				
11	1:2:3:3:3:3:3:	3:3:3:3:3:3:3	K											15	33				
12	1:2:3:4:4:4:4:	4:4:4:4:4:4:4	K											18	42				
13	1:2:4:4:4:4:4:	4:4:4:4:4:4:4	K											19	43				
14	1:2:3:6:6:6:6:	6:6:6:6:6:6:6	K											24	60				
15	1:2:4:8:8:8:8:	8:8:8:8:8:8:8	K											31	79				
16	1:2:4:8:16:16:	16:16:16:16:16:16	K											47	143				
17	1:1:1:1:1:2:2:	2:2:2:2:2:2:2	K											8	20				
18	1:1:1:1:1:1:6:	6:6:6:6:6:6:6	K											11	47				
19	1:1:2:2:2:4:4:	4:4:4:4:4:4:4	K											12	36				
20	1:1:2:2:4:4:4:	4:4:4:4:4:4:4	K											14	38				
21	1:1:2:3:3:3:3:	3:3:3:3:3:3:3	K											13	31				
22	1:1:2:4:4:4:4:	4:4:4:4:4:4:4	K											16	40				
23	1:1:2:4:8:8:8:	8:8:8:8:8:8:8	K											24	72				
24	1:2:2:3:3:3:3:	3:3:3:3:3:3:3	K											14	32				
25	1:2:3:4:4:8:8:	8:8:8:8:8:8:8	K											22	70				
26	1:1:2:2:2:2:2:	2:2:2:2:2:2:2	K											10	22				
27	1:1:1:2:2:2:2:	2:2:2:2:2:2:2	K											9	21				
28	1:2:2:4:4:4:4:	4:4:4:4:4:4:4	K											17	41				
29	1:2:2:2:4:4:4:	4:4:4:4:4:4:4	K											15	39				
30	1:1:1:2:2:2:2:	4:4:4:4:4:4:4	K											9	33				
31	1:1:1:2:2:2:2:	4:4:4:8:8:8:8	K											9	45				

6. SETTING OF SWITCHING OFF (Table 2)

Switching off setting allows the number of active capacitor branches to be adapted to the capacitor system used. The BR 53 permits setting between 1 and 12 active capacitor branches.

The BR 53 is delivered with the switching off point set to the maximum possible number of capacitor branches (BR 5306 - 6 branches, BR 5312 - 12 branches) Use the switches "end stop 4, 5, 6 and 7" on the back of the appliance.

When setting the switching off point, avoid selecting a number of capacitor branches larger than that of the branches acutally connected to prevent faulty switching of the BR 53, which might result in insufficient reactive power compensation.

Table2 Activecapacitorbranches	Switch 4 5 6 7
0	
1	
1 - 2	
1 - 3	
1 - 4	
1 - 5	
1 - 6	
1 - 7	
1 - 8	
1 - 9	
1 - 10	
1 - 11	
1 - 12	

7. SETTING THE SWITCHING TIME





The BR 53 allows the following switching times to be set:

- switching time 40 s
- switching time 20 s
- switching time 40 s / 4 s cap
- switching time 4 s

These are independent of the reactive load.

The switching time depends on the discharging devices of the capacitors, so that it is determined by the capacitor system. In most cases, switching times 40 s and 20 s are used. Switching time 40 s / 4 s cap decreases overcompensation in case of capacitive reactive load of the mains by providing for a disconnection time of 4 s with capacitive excitation and "automatic" control, and 40 s with all other modes of operation. This switching time is available for regulating series 1 : 1 : 1 : 1 only.

Switching time 4 s is intended to be used for servicing of the capacitor system. It may, however, also be used in case of extreme compensation problems, provided that the capacitors are equipped with the required discharging devices. Set the switching time by means of switches "time 1 and 2" on the back of the appliance.

Switching time	Switch 1 2
40s	
20s	
4s	
40s/4s cap	

8. INDICATION OF CAPACITOR BRANCHES

LEDs on the BR 53 are signalling permanently which capacitor branches are connected. In the case of regulating series with circular circuits, note that in spite of equal valency it will not be the capacitor branch of the next number that is connected or disconnected, but the branch that has had the longest non-switching period.

9. INDICATION OF THE DIRECTION OF REGULATION

The LEDs "- C" and "+ C" of BR 53 are signalling whether at the current reactive power of the mains capacitor stages must be connected or disconnected or whether the capacitor branches connected are compensating the reactive power of the mains as desired. In the " Automatic " mode of operation, the condition of the capacitor branches will not be changed unless "+ C" or "- C" are " on " throughout the set switching time. Thus, the indication of the direction of regulation depends on

- the setting of the C/k value
- the setting of the target power factor
- the current reactive power of the mains.

It is independent of the selected mode of operation.

10. POWER FACTOR INDICATION

The power factor in the mains to be compensated can be indicated by a display unit irrespective of the C/k value and target power factor settings. This unit may be ordered separately.

11. TROUBLE SIGNALLING

The BR 53 has an internal trouble signalling facility. When "- C" or "+ C" are "on" for 10 min without interruption and no change of the capacitor branches takes place, trouble will be indicated by the "- C" or "+C" LEDs blinking.

The trouble message is cancelled as soon as the exciting "- C" or "+ C" signals goes off or the mode of operation switch is operated.

When an internal trouble message is given or the voltage supply breaks down, the trouble signalling relay will drop and close the contact b, c.

When connecting the external trouble signalling relay, fuse this circuit with a fuse T 4 A. The maximum switching voltage is 250 V a.c.

12. PROTECTION AGAINST VOLTAGE FAILURE

When the measuring voltage breaks down, the BR 53 will disconnect all capacitor branches. They will be connected again according to the selected switching time in the "Automatic" mode, when the voltage comes back. With the "Stop" mode, the desired capacitor branches have to be reclosed through the "+" mode.

13. MODES OF OPERATION

The BR 53 can be operated both manually and automatically. The mode of operation is to be selected by means of the respective switch on the front panel. The direction of regulation and p.f. of the mains are indicated independently of the selected mode of operation, and the regulating series, trouble signalling facility and switching time are also acting independently of the operating mode.

When selecting the switching time 40s / 4s cap, note that the 4s switching time becomes effective only with capacitive direction of regulation in the "Automatic" mode and only in the regulating series 1 : 1 : 1 : 1 : 1...

"AUTOMATIC" mode of operation

Turn the mode switch to "auto". In this mode, the BR 53 operates in dependence on the signals "+ C" and "- C". This means that the mode of operation of the BR 53 is determined by the reactive power conditions of the mains to be compensated.

"MANUAL-STOP" mode

The mode switch is to be set to position "stop". In this mode, the indicated position of the capacitor branches will not be changed, no matter what the reactive power conditions in the mains are like. Mind that a trouble message is given when the inductive or capacitive signal is applied for more than 10 min.

"MANUAL TURN-ON" mode

The mode switch has to be turned to position "+". In this mode, stages are connected irrespective of the mains conditions, until the set switching off point is reached or the mode of operation changed.

Trouble will be signalled, when this mode is kept after the set switching off point has been reached and "+ C" or "- C" has been on longer than 10 min.

„MANUAL TURN-OFF“ mode

The mode switch has to be set to position „-“. In this mode, stages are disconnected, irrespective of the mains conditions, until all capacitor branches are disconnected or the mode of operation is changed.

Again, trouble will be signalled when this mode is kept after disconnection of the last capacitor branch and when „+C“ or „-C“ has been longer than 10 min.

14. MOUNTING THE UNIT

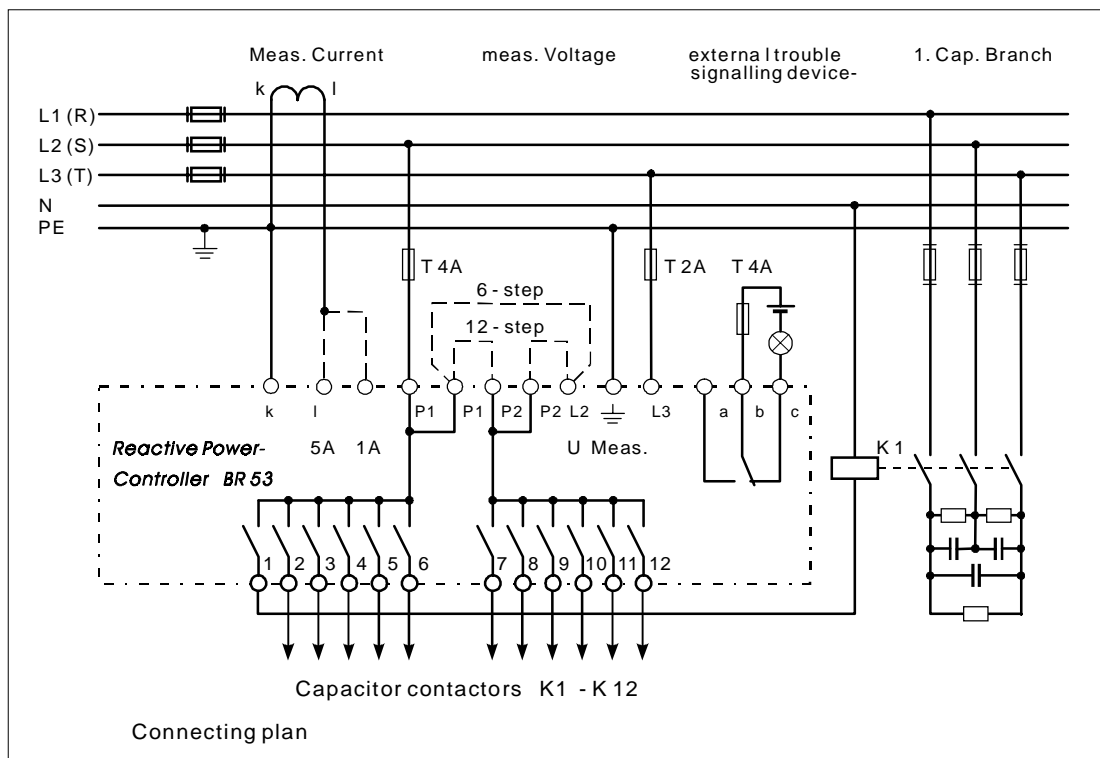
The BR53 is intended for panel mounting. It requires a cut-out of 138x138 mm according to DIN 43700.

15. CONNECTION

Before connecting the BR53, make sure that all lines are dead, and short the current transducer. Connect as shown in Fig.3. A voltage differing from the measuring voltage and not exceeding 220V may be connected to „P1“ and „P2“ for the capacitor contactors. Mind that for the BR53 within the capacitor system fuses have to be connected in series as shown in Fig.3.

Select the lines such that the diameter of the pure wire does not exceed 2.0 mm. When connecting the measuring voltage and the measuring current, take care to ensure correct phase position. For connection of the measuring circuit, use a copper lead of 2.5 sqmm

Fig.3



16 PUTTING INTO OPERATION

Having connected the BR 53 as shown in Fig. 3 , remove the fuses of the capacitors.

Set the "stop" mode, the desired regulating series, the switching off point and the switching time 4 s on the BR 53. As soon as the measuring voltage is connected, "on" lights up on the BR 53. It signals that the measuring voltage is applied. No capacitor branches must be connected. Allow the regulator to remain in this condition for one minute at least.

Turn the mode switch to " + ". Connect the capacitor branches according to the regulating series till the set switching off point is reached. From this moment on, no further switching cycles must take place. Move the mode switch to " - ", and disconnect the capacitor branches according to the regulating series. When all capacitor branches are disconnected, no further switching cycles must take place. Move the mode switch to "stop", set the target p.f. to 1 and the C/k value to 0,05.

When the short in the current transformer circuit has been eliminated and the mains is inductively loaded, the "+ C" LED on the BR 53 goes on.

To check the trouble signalling facility, this signal must be applied uninterruptedly for 10 min. After this period, the "+ C" LED will be blinking to indicate trouble, and the relay for external trouble signalling will drop. Subsequently, the measuring voltage is switched off. Set the desired C/k value, target cos and switching time for automatic operation. Put in the fuses for the power capacitors. Having connected the measuring voltage, set the mode switch to "auto". The BR 53 now operates automatically.

17. INFORMATION REGARDING TROUBLE

If the "- C" LED is alight in spite of an inductive mains load when the BR 53 is put into operation, this points to the fact that the measuring voltage or measuring current terminals may have been mixed up, with target p.f. set to 1, or that the phase position was not considered. This also applies in the event that the "+ C" LED remains "on" although compensation is completed. If target p.f. is set to a value other than 1 , "cap", for instance, may be lighting in spite of inductive mains load, without the BR 53 being defective, as "+ C" and "- C" indicate the regulating direction of the BR 53, but not the mains conditions.

A capacitor branch being alternately connected and disconnected in regular intervals without any changes in the reactive power conditions of the mains calls for an increase in the C/k value until the alternate connecting and disconnecting is stopped.

The BR 53 is designed for reactive power compensation in mains loaded symmetrically. Irregular phase loading, therefore, may cause shifting of the measurement results. Use the phase in which the current measurement is taken as reference value for reactive power determination.

18. MAINTENANCE AND GUARANTEE

The BR 53 is maintenance-free, provided that the operating conditions are observed. It is advisable, however, to test the functions of the regulator when carrying out the regular inspection of the capacitor system.

No guarantee claims will be accepted if repairs are carried out on the regulator within the guarantee period.

19. TECHNICAL DATA:

Type:	BR53
Outputs:	12 (BR5312), 6 (BR5306)
No of regulating series:	32
Max. No. Of stages:	223
Measuring voltage:	400V, option: 100V, 230V, 440V
Measuring current:	5A option: 1A
Frequency:	50Hz option: 60Hz
Switching capacity of outputs:	2000VA, 250Va.c. (p.f.=1)
Switching time:	40s, 20s, 4s, 40s / 4scap
Sensitivity:	C/k-value of 0.05 to 1.5
Target p.f.	0.8 ind. to 0.8 cap
Trouble signalling facility:	10 min responding time
Dimensions:	DIN 43700: 144x144x130mm
Weight:	1.2 kg
Degree of protection:	Front IP40, Back IP00
Transportation and storage temp:	-55 ... +60 °C
External trouble signalling device:	Zero-potential changeover contact 250Va.c., 4A

Other data may be agreed upon with the manufacturer. We reserve the right of modifications.