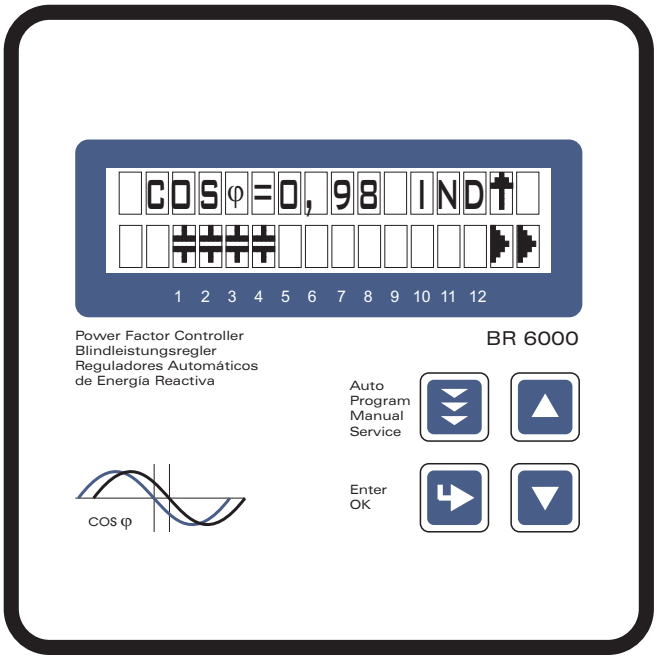
# *Dynamic Power Factor Controller BR 6000T*




Manual

Version 2.0T E

Version 2.0T E, from march 2004

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## Section1 General

The dynamic power factor controller BR6000 T represents the consequent development of the BR6000-series with new innovative ideas and a multitude of functions.
It has been especially designed to control thyristor modules for dynamic switching of power capacitors for power factor correction (for example TSM or similar). By using a very fast type of processor, it has been possible to obtain extreme short switching cycles which allows the usage for dynamic power factor correction.

In addition to a switching time of <40 ms, the intelligent control principle provides an extremely fast tuning of the power factor by simultaneous switching of several steps.
Several parameters that can be edited allow an optimized adjustment to different thyristor modules.

Another novelty is the possibility of a simple coupling of two PFC-controllers with one another (e.g. supports two transformers with coupling switch).

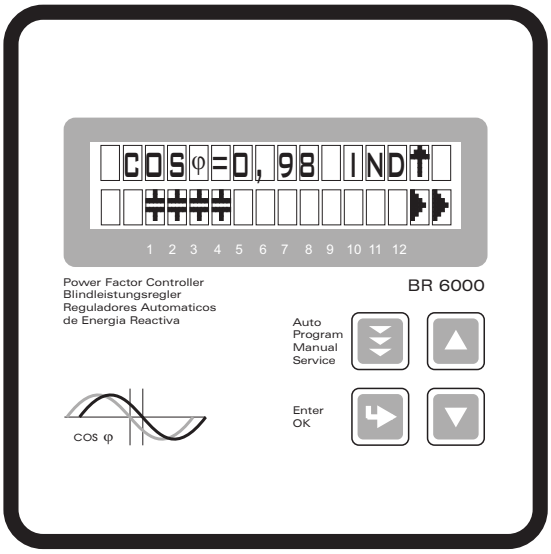
The BR 6000T is distinguished by user-friendly operation based on menu-guided displays in plain text. Its new features permit an intuitive mode of operation. Easy-to-understand symbols and texts in the local language combine simplest operability with self-evident displays.

The basic version contains a number of additional features:

- 12 switching outputs
- Switching outputs with transistor
- Twenty pre-programmed control series with a self-optimized intelligent control response
- **Control-series editor** for user-defined control series
- **Complete menu-guided operation and display**
- **Illuminated graphic display with 2 x 16 characters**
- Four-quadrant operation
- Display of various line parameters (V, I, F, Q, P, S...)
- Storage of maximum line-parameter and switching-operation values as well as of the turn-on times of individual capacitor contactors
- Manual / automatic operation
- Programming of fixed stages and the option of skipping individual outputs
- No-voltage turn-off
- Fault detection for various statuses and interference-message output
- Version in switchboard-integrated housing 144x144x55 mm

The controller is supplied as standard for an operating voltage of 230 VAC (L-N), a measuring voltage of 30...300 VAC (L-N) 50/60 Hz and a measuring current of 5A or 1A (programmable). A measuring-voltage converter is required for different operating voltages.

Fig. 1 BR 6000-T front view



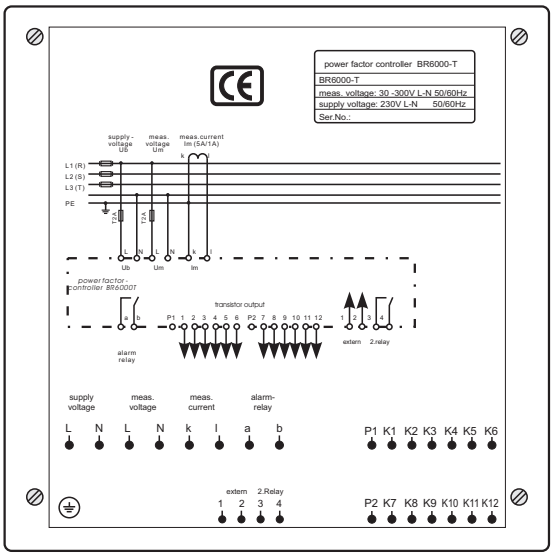

Operating mode
- Automatic
- Programming
- Manual operation
- Service
- Expert mode

Enter / OK
Confirm and
store values

Increase
selected
parameter

Reduce
selected
parameter

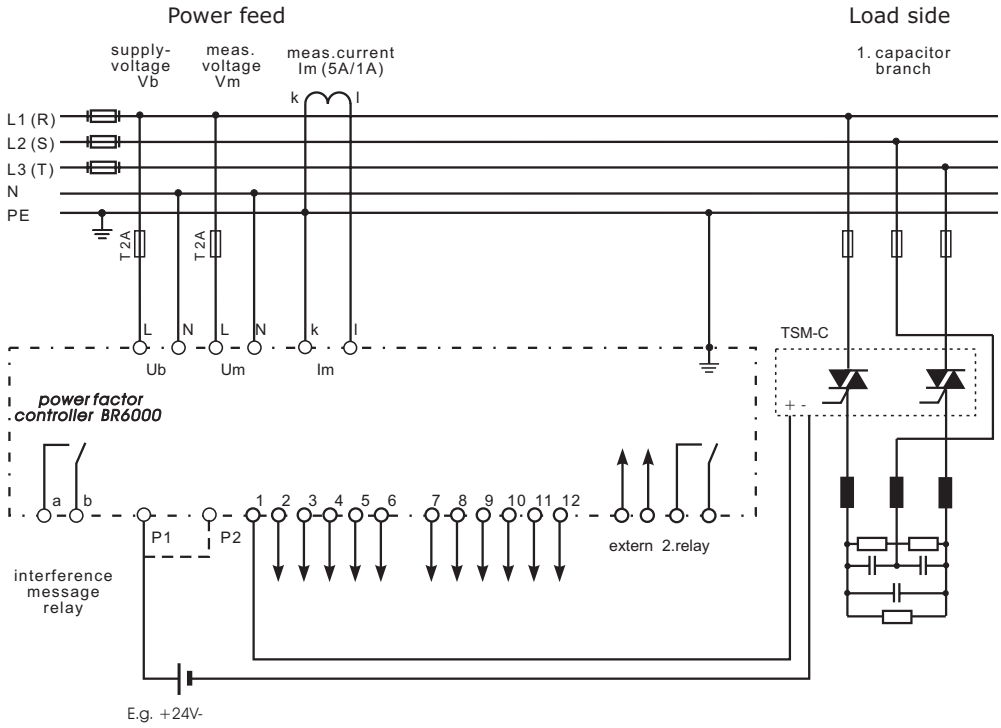
Fig. 2 BR 6000T rear view



## Section 2 Installation and connection of the controller

The BR 6000 is designed to be incorporated into the front panel of a compensation network. It requires a switchboard section of 138 x 138 mm to DIN 43 700. The controller is inserted from the front and is attached by means of the appended clamps. The controller may be inserted only by qualified technicians and must be operated in accordance with the specified safety regulations.
Before the BR 6000 is connected up, all leads and cables must be checked to ensure that no current is flowing through them and the current converter must be short-circuited. Care should be taken to ensure that the measuring voltage and current are in the correct phase position. The measuring-current circuit must be wired with copper leads of 2.5mm$^2$. The connection should be set up as shown in Fig. 3. The specified safety regulations must be observed.
The measuring voltage may lie in the range from 30 - 300 V and is connected between L1-N (corresponds to 50 - 525 V L-L ).
The operating voltage is 230 V +/- 10% and can be connected between L1 - N in a 400-V power line and between L - L in a 110-V power line.

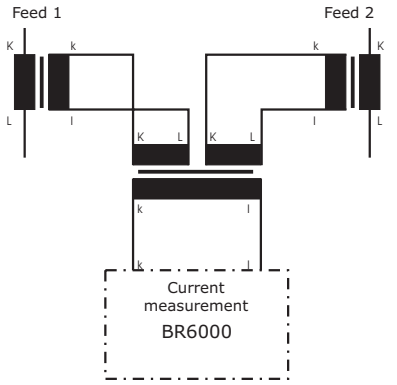
Fig. 3: BR 6000T Connection plan



2.1 Current measurement

When installing the current converter, care should be taken to ensure that the load current flows through it. The outputs of the compensation network must be installed behind the current converter (in the direction of current flow). If the BR 6000T is connected up via sum-current converters, the overall conversion ratio is entered.
Current converter clamps should be grounded on one side!

Measurement via sum current converter

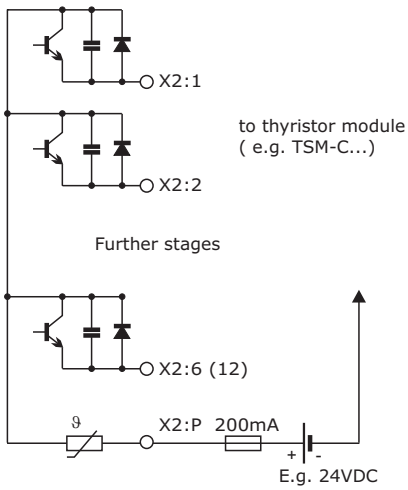



2.2 Switching outputs

The switching outputs of the BR6000T are executed as transistor outputs.

The transistor outputs are used via an additional auxiliary voltage (10 - 24 VDC) for a direct triggering of thyristor switches for the dynamic power factor correction (i.e. TSM). See pict. 3

Block circuit of the transistor output



2.3 Alarm output / fault messages

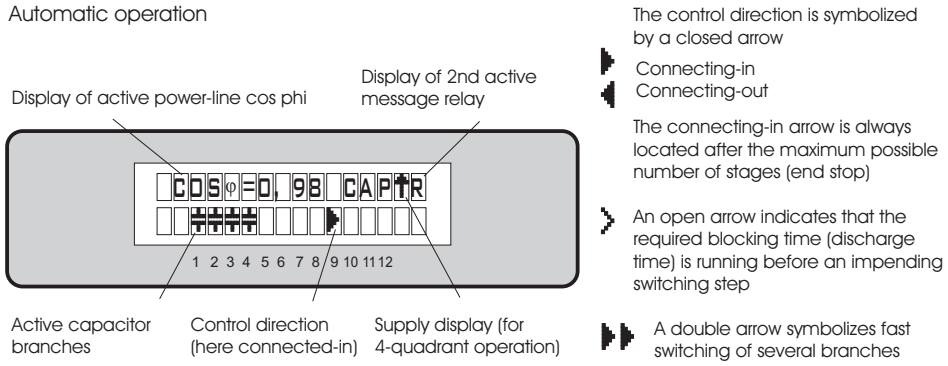
The alarm contact is closed in normal operation and opens in the event of a fault. The relevant fault is simultaneously shown on the display in plain text (alternating with the standard display in automatic operation). The following fault messages are displayed:

| | |
|---|---|
| • UNDER-COMPENSATED | Display and relay output |
| • OVER-COMPENSATED | Display and relay output |
| • OVERCURRENT | Display and relay output |
| • MEASURING VOLTAGE ??? | Display and relay output |
| • OVERTEMPERATURE | Display and relay output |
| • OVERVOLTAGE | Display and relay output |
| • UNDERVOLTAGE | Display and relay output |
| • | |
| • UNDERCURRENT | Only display (warning) |

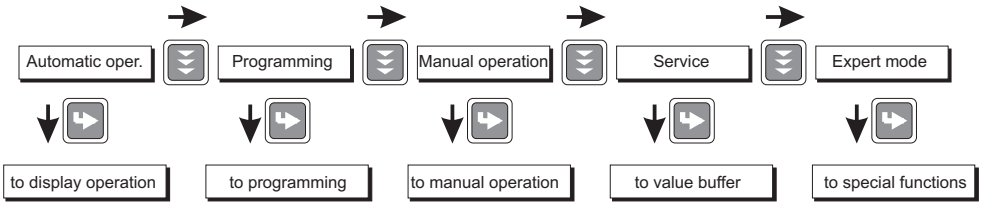
*Checking the alarm output*
The alarm output may be checked by using artificially generated interference in the form of "under-compensation". This is done by interrupting the voltage supply to the power outputs. In automatic operation - with an inductive power line - the controller then connects all capacitor branches in. The display continues to show "Connect-in". A fault message appears after 10 minutes (the display shows "under-compensation / relay is activated").

## Section 3 Operating modes and programming

When the operating voltage is switched on, the BR 6000 briefly displays its designation and software version, then changes to its normal operating status (automatic operation). The active power-line cos-phi value is always displayed in the upper line and the currently connected capacitors are shown as symbols in the lower line (operating display).



Repeated pressing of the "Operating Mode" key takes the user to the various menus in sequence: **Auto**matic operation - **Program**ming - **Manual** (manual operation)- **Service - Expert** mode and back**.**




*3.1 Automatic operation - display functions*

The BR 6000T is set to automatic operation as standard. Capacitor stages are then automatically connected in or out in order to reach the target cosine of the phase angle (cos-phi). This happens when the required reactive power exceeds the value of the smallest capacitor stage.
In automatic operation, various network parameters can be displayed by repeatedly pressing the "ENTER" key:

| Action | Display |
|---|---|
| | |
| ENTER | 1 LINE VOLTAGE in V |
| ENTER | 2 APPARENT CURRENT in A |
| ENTER | 3 REACTIVE POWER in kvar |
| ENTER | 4 ACTIVE POWER in kW |
| ENTER | 5 APPARENT POWER in kVA |
| ENTER | 6 DIFF. kVAR TO TARGET COS |
| ENTER | 7 FREQUENCY in Hz |
| ENTER | 8 TEMPERATURE in °C |
| ENTER | Software version |
| ENTER | Return to: 1 LINE VOLTAGE |

The power value specifies the total power (3-phase) assuming symmetrical load. If no key is pressed for 60 seconds, the display automatically returns to the operating status!

*3.2 Programming:* 

Pressing the "Operating mode" key once takes the user from automatic operation to **Program**ming mode. Parameter 1 ( I-CONVERTER) is reached by pressing "ENTER".
The upper display always shows the parameter and the lower one the set value. The values are changed by pressing the ↑ / ↓ keys. Subsequent pressing of the "ENTER" key stores the value and takes the user to the next parameter.
To quit programming mode in any step, press the "Operating mode" key.

**LANGUAGE SELECTION :** (English, German, Spanish, NL )

**1 I-CONVERTER PRIM**: This selects the primary current of the current converter. Entry is via the ↑ / ↓ keys. (5...7500A) Save and continue with ENTER

**2 I-CONVERTER SEC**: This sets the secondary current of the current converter (5A or 1A possible). Selection via ↑ / ↓. Save and continue with ENTER

**3 END STOPP**: By setting the end stopp, the number of active capacitor branches is matched to the respective compensation network. This is done via the ↑ / ↓ keys. The visible symbols of the capacitors correspond to the connected outputs. The maximum possible number of capacitor branches is pre-set at the works (BR 6000-R12:12 branches). The setting is confirmed and saved with the ENTER key.

**4 CONTROL SERIES**: The ratio of the capacitor branch powers determines the control series, the power of the first capacitor always being assigned the value 1. The control series required for the compensation network is again selected via the ↑/↓ keys. If the required control series should exceptionally not be present (Annex 1), the user may define a special one (control series "E").More on this point in the control-series editor in Annex 1. The selected series is entered with the ENTER key, which also takes the user to the next step.

**5 CONTROL PRINCIPLE**: The control preference may be selected here:

- **Sequential connection**
- **INTELLIGENT loop connection** (default setting)
- **COMBINED CHOKE**

See Section 8 for an explanation of the various control modes.

Selection with ↑ / ↓ keys and confirmation with ENTER leads to the next point:

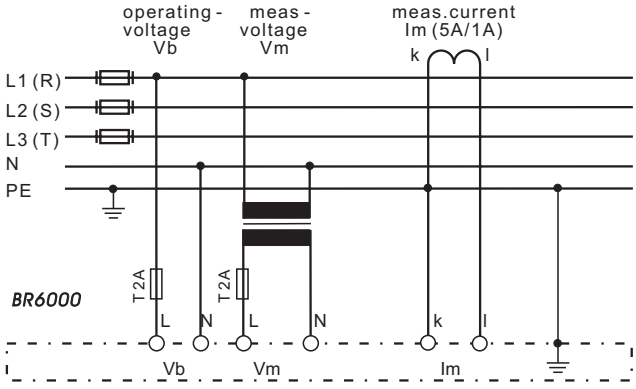
**6 POWER 1. STAGE**: To determine the controller's response sensitivity, the dimensions of the network's smallest capacitor (stage 1) must be known. They are entered in two steps in kvar. The integral kvar values (before the comma) are initially selected via the ↑ / ↓ keys and saved with ENTER. The positions after the comma are then selected, again via the ↑ / ↓ keys. Saving with the ENTER key leads to the next point.

**7 TARGET COS PHI**: By setting the target cos phi, the power factor to be attained via the PF correction is defined. It is also set via the ↑ / ↓ keys. The range may be selected from 0.8 inductive to 0.8 capacitive. Confirming and saving the value with ENTER leads to the next point.

**8 MEASURING VOLTAGE**: Programming the measuring voltage (L-N) of the system (direct measurement) or the L-N voltage on the primary side of a measuring-voltage converter. The values programmed here always refer to the voltage L-N in the system! The voltage is selected via the ↑/↓ keys. Save and continue with ENTER.

**9 V - CONVERTER RATIO**: Standard setting - NO - (direct measurement) When a measuring-voltage converter (e.g. for center-voltage measurement) is used, its conversion ratio should be programmed here. Example: Voltage converter 20000V:100 V => Conversion ratio: 200 Selection via the ↑/↓ keys. Save and continue with ENTER.

Connection of the BR6000 via measuring -voltage converter ( L-N )




**10 CONNECTING TIME**: This refers to the time between connecting the capacitors to increase the momentary network capacitance. It should be noted that in practical operation the real connection time is affected by the discharge time (locking time).

Setting range: 40 ms. ...1 s
Default setting: 1 sec.
Selection is performed via the ↑/↓ keys. Continue with ENTER

**11 DISCONNECTING TIME**: This refers to the time between disconnecting the capacitors to reduce the momentary network capacitance.

Setting range: 40 ms ... 1s
Default setting: 1 sec.
Selection is performed via the ↑/↓ keys. Continue with ENTER

**12 DISCHARGE TIME**: This is the time for which an individual output is blocked between connecting and disconnecting. This blocking time has priority over connecting and disconnecting times. It depends on the capacitor discharge rating and thus is specified by the compensation network.

Setting range: 40 ms ...1s.
Default setting: 80 ms
Selection is performed via the ↑/↓ keys. Continue with ENTER.

**13 ALARM TEMP**:

The temperature inside the BR 6000 is measured and converted to the internal temperature of the switching cabinet. This value can be shown on the display.
The alarm temperature programmed here is the temperature at which the capacitor stages are disconnected in steps. The controller's **alarm relay** responds after ten minutes. At the same time the display shows the cause of the alarm (over-temperature). If the temperature drops again, the required branches are automatically re-connected in steps.

**14 MESSAGE RELAY**:

The message relay can be programmed for <u>one</u> of the following options as required:

"Fan": Relay switches the external cabinet fan.
(Default) The switching threshold can be programmed under 15.
Display: "R"
"Supply": Message when active power is supplied. Display: "R"

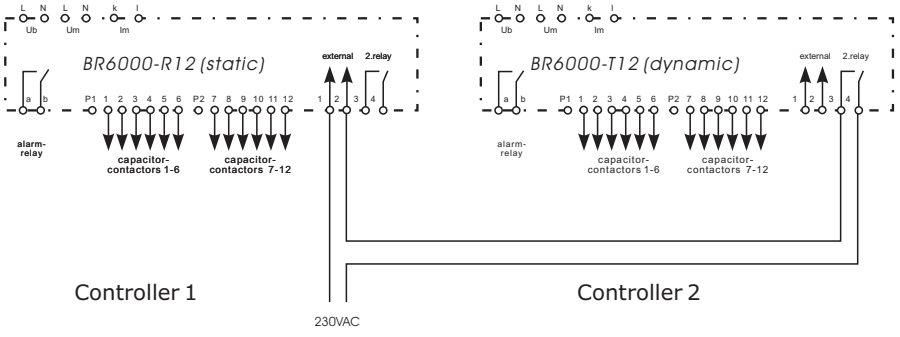
"Undercurrent": This message appears whenever the measuring current is not reached. Display: "R" The signal is generated when the value drops below the response sensitivity of the controller.

"External": The relay switches if an external input signal (230 VAC) is sent to the "cos-phi2 /external" input. This function may be used to directly compensate a larger load, for example - the required 40-second reconnection delay is already integrated.
Display: Capacitor symbol at the top right of the first line.
When this function is selected, the input cannot be used for the signal 'target cos phi2' and the output cannot be used for the fan.

"Remote control R1": Coupling of two controllers via remote control input,
R1= Controller is configured as controller 1 (master)

"Remote control R2": Coupling of two controllers via remote control input,
R2= Controller is configured as controller 2 (slave).

By coupling a BR6000-R with a dynamic controller (BR6000-T) a mixed dynamic system can be designed that implements economically the advantages of a dynamic fast network. When coupling, "Controller1" (as master) and "Controller2" (as slave) has to be programmed in this menu point.For coupling the controllers of both systems have to be connected as follows:



**15 and 16 PARAMETERS for message-relay option:**

Depending on the programming of the message relay, the following parameters may be selected here:

- **Fan option**: Input of the switching threshold for the fan (30-70°C) Only active when option 'Fan' is selected (temperature input as described under point 13)

- **Target cos phi2**: Input of the second target cos phi as described under point 7, e.g. tariff conversion.
  Input signal 230 VAC at input cos phi => target cos phi 2.
  At the active input, the display shows: **2** cos φ ...

**17 DELAY-TIME OF ERROR-MESSAGES**

These Delay time you can change between 0 and 240 seconds.

**CONTRAST**

The display contrast can be changed with this menu point. The contrast depends to a certain degree on the viewpoint of the observer, i.e. on the insertion height of the equipment in the switching cabinet. The ↑ /↓ keys can be used to set an optimal contrast. The contrast changes after a slight delay.

**BASIC SETTING:** Selection YES / NO

When the selection is made with YES and confirmed with ENTER, all parameters are reset to the basic setting made by the **network** manufacturer. (Optimal network values when the controller was supplied with a complete network). If the controller is supplied from the works, this point corresponds to the default setting.
CAUTION: All user settings are lost!

Programming is now completed. The controller has returned to point 1 of the programming menu.

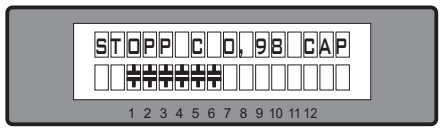
## 3.3 Programming lock

The BR 6000T is equipped with a programming lock to ensure protection from unauthorized or inadvertent changes to the system parameters. The lock can be activated in expert mode. If the lock is active, all parameters can be checked but not changed.

**Section 4** **Manual operation (initial operation, maintenance, service)**
**Programming of fixed stages**

In manual operation, capacitor branches can be connected/disconnected **in the set control series and switching time -** irrespective of prevailing power-line conditions. Connections are made by pressing the ↑ key. Pressing of ↓ leads to the disconnection of stages.
The active operating status and active power factor are always shown on the display (self-explanatory).

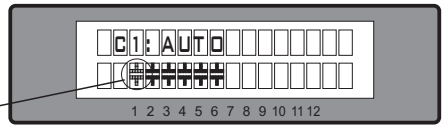
Manual operation




Pressing ENTER takes the user to the menu point "Programming of fixed stages". In the normal case, all stages are programmed for automatic operation (default setting).

Setting of fixed stages

Currently selected stage blinks




In special cases, all controller outputs (C1 - C12) may be permanently defined in succession (continued switching via ENTER) for the following statuses:

- **AUTO**: Automatic (normal) operation
  The relevant output is marked by a capacitor symbol.
- **FIXED**: The output is continuously connected, e.g. for ongoing basic correction. The output is marked by an underlined capacitor symbol.
- **OFF**: The output is continuously disconnected - e.g. for temporarily disconnecting a defective capacitor. The capacitor symbol for this output is faded out. Underlining appears.

The active stage is marked by blinking. The required status is set via ↑ /↓. By pressing ENTER, the user saves this step and moves to the next stage.
The programmed statuses for the outputs also remain visible on the display in automatic operation.
After the required settings have been made, pressing the "Operating Mode" key takes the user to the next menu ("Service") or further to "Automatic Operation".

## Section 5 Service menu

The service menu is reached by the operating-mode key.

| Action | Display |
|---|---|
| | |
| ENTER | 1 max. VOLTAGE in V |
| ENTER | 2 max. REACTIVE POWER in kvar |
| ENTER | 3 max. ACTIVE POWER in kW |
| ENTER | 4 max. APPARENT POWER in kVA |
| ENTER | 5 max. TEMPERATURE in °C |
| ENTER | 6 RESET the maximum values |
| ENTER | FAULT MEMORY E [1] - .... in plaintext |
| ENTER | FAULT MEMORY RESET |
| ENTER | Back to 1 |

## Section 6 Expert mode

Expert mode is used to set values which remain unchanged for normal operation. This level has an access code to protect it from improper operation.

- 1: PASSWORD: 6343

- 2: Basic setting new
  Storage of active programming as a new basic setting (usually performed by the network manufacturer). Caution: The original values are overwritten in the process!

- 3: C/k factor
  The C/k value calculated from the programmed network values can be matched by changing this factor. It should not be changed in the normal case!

- 4: Switching power max ... kvar
  This factor specifies the maximum power which may be switched with a switching step. It can be used to control the intelligent control system which switches several stages as a function of the power-factor requirement.

- 5: Trigger value for switching [50] ( 0....100% )

- 6: Operating lock [NO / YES]

- 7: Phase U/I [ 0 °] ( 0°, 30°, 90°, 120°, 150° ,180°, 240°, 270°)
  Phase correction between voltage and current in the measuring system.
  Normal: 0°, i.e. measuring voltage: L1 - N, current: L1
  Example: 90°; measuring voltage: L2 - L3, current: L1
  As shown in the example, this setting makes it possible to measure also in systems without neutral. However, the measuring voltage is not allowed to exceed 300 V (if necessary, a voltage converter must be used).

  8: Measurement calculating principle [2] ( 1,2,3)

## Section 7 Initial operation

The controller must have been installed before being set up and operated.
All network-specific parameters are fully programmed as described in Section 3.2 (Programming) by being entered in sequence and stored. The controller is then set to automatic operation with the operating mode key. It is now ready for operation.

## Section 8 Control principle

The control response of the BR 6000T can be selected in programming mode. In principle, the controller has 3 different control modes:

**1. Sequential connection**
In sequential connection, the required capacitor stages are successively connected and disconnected in stages (last in - first out). The ranking of each step always corresponds to the power of the smallest stage.
**Advantage**: Exact definition of the next capacitor to be connected in each case

**In order to shorten the settling time, the BR 6000T switches several stages simultaneously for a large power-factor requirement.** The maximum dimensions of the simultaneously switching branches can be changed in expert mode. (Prog. point 7). If the value of the smallest stage is pre-selected, the conventional sequential connection is obtained.

**2. Intelligent loop connection (default setting )**
The intelligent control principle combines the advantages of the network-sparing loop connection (first in - first out) with a much faster settling time, even for large load skips, and reaches this goal with the fewest possible switching operations of the capacitor stages. The optimized time response is achieved by the simultaneous switching of several or larger capacitor groups as a function of the missing power factor in the power line. Both the number of real switching frequencies of the capacitors as well as the turn-on times of the branches are considered.
**Advantage**: Reaches the target cos phi in a fast-optimized settling time with a low switching frequency of the capacitors.

**3. Combined de-tuning (special case for combined de-tuned banks)**
Within a combined de-tuned application, 2 adjoining equal steps are switched with just one joint choke. This pairwise de-tuning requires an appropriate closed control series (i.e. 1:1:1:1..., 1:1:2:2..., 1:1:2:2:4:4... or similar)
The condition for the switching behavior is defined in such a way that the number of activated odd steps is always greater than or equal to the number of activated even steps. The controller complies with the requirements of the control regime while largely conforming to the intelligent switching behavior.

## Section 9 Troubleshooting

| Fault | Check / Solution |
|---|---|
| At target cos phi=1 and inductive load, switch-off or connection in the corrected line Supply / Drawing display switched round | Check terminals of the measuring voltage and current (l and k)!<br>Check phase position |
| Wrong line cos phi is displayed | See above |
| Display:"UNDER CURRENT" | Current in measuring range?<br>Line interruption?<br>Wrong current-converter factor?<br>Current controller short-circuited? |
| Display: "OVERCURRENT"<br>Alarm relay: after 10 min. | Check current-converter ratio<br>Go through measuring current range |
| Display: "UNDERCOMPENSATED"<br>Alarm relay: after 10 min. | Check connection and phase position!<br>All stages connected - target cos phi not reached: compensation network sufficiently dimensioned? |
| Display: "OVERCOMPENSATED"<br>Alarm relay: after 10 min. | Check connection and phase position!<br>Capacitive line, although all stages disconnected |
| Display: "MEASUREMENT VOLTAGE ???"<br>Alarm relay: after 10 min. | No measurement voltage! |
| Display: "OVERTEMPERATURE"<br>Alarm relay: after 10 min. | Network temperature too high: Outputs are switched off in stages irrespective of power-line conditions |
| Stages are disconnected for an inductive line or connected for a capacitive line | If a target cos phi is set which deviates from 1 despite an inductive line load, the display <- (disconnect stages) may light up. The arrows indicate the control direction and not the line conditions. |
| The controller does not connect all stages, or cos phi does not change at the last stages | Check END STOPP! |
| In automatic operation, individual stages are not connected or disconnected: | Check whether individual stages are programmed as fixed stages or OFF in the "Manual operation / Fixed stages" menu! |
| In strongly asymmetrically loaded lines, differences may occur between control response and power-factor measurement, as the power factor is measured in single phase. | Line measurements allow the most favorable phase for measuring the power factor to be determined. The current converter is set accordingly for the measuring current. |
| No operating voltage | Note: No display, alarm relay is closed |

## Section 10 Interface *

The BR 6000 T is equipped without an Interface Rs232 / 485.
An option is another interface for a power-monitoring of the complete PFC-system.

## Section 11 Maintenance and warranty

The BR 6000T should need no maintenance if the operating conditions are observed. However, it is recommended that a functional check of the controller be performed in conjunction with the regular checking of the compensation network. In the event of any interventions in the controller during the warranty period, all warranty claims lapse.

## Section 12 Type series and accessories

| | |
|---|---|
| BR6000-T12 | 12 transistor outputs, 1 interference-message output<br>2nd message relay |
| BR6000-T12/E | 12 transistor outputs, 1 interference-message output<br>2nd message relay, Input power monitoring PFC-system |
| Adapter<br>BR6000-999 | Adapter for Power Factor Controller Br6000<br>(Connection in grids without neutral conductor) |

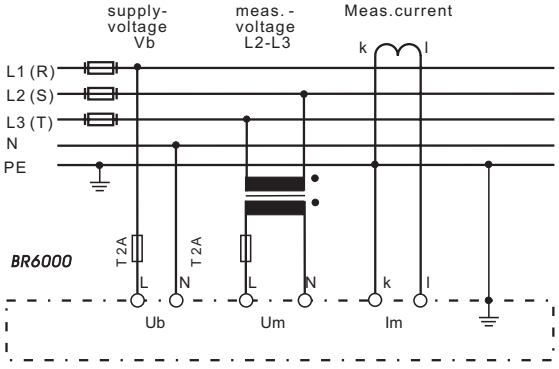
## Annex 1:

Programming of phase-correction between voltage and current in the meas. System

Example 1:

Meas.current: L1
Meas. Voltage L3-L2
( V-converter
must be used)

Phase U/I [ 90°]




| | Meas. Current | meas.voltage | volt.converter | Phase correction |
|---|---|---|---|---|
| Example : | L1 | L1 - L2 | yes | 30° |
| Example : | L1 | L3 - N | no | 120° |
| Example : | L1 | L3 - L1 | yes | 150° |
| Example : | L1 ( k<->l ) | L1 - N | no | 180° |
| Example: | L1 | L2 - N | no | 240° |
| Example: | L1 ( k<->l ) | L2 - L3 | yes | 270° |

**Annex 2: Technical data**

| | |
|---|---|
| Type series | BR 6000..T |
| Outputs | 12 |
| Switching power of transistor output | 24VDC, 20mA |
| Number of active outputs | Programmable |
| Operation and display | Illuminated graphic display 2 x 16 characters with convenient operating level |
| Number of control series | 20 |
| User-defined control series | 1 |
| Control principle | Selectable<br>Sequential connection or<br>self-optimized switching response<br>Four-quadrant operation |
| Operating voltage | 230 VAC, 50 / 60Hz |
| Measuring voltage | 30...300 VAC (L-N), 50 / 60Hz |
| Measuring current | X : 5 / 1A selectable |
| Power drawn | < 5 VA |
| Sensitivity | 40 mA / 10 mA |
| Target cos phi | 0.8 inductive to 0.8 capacitive adjustable |
| Switching time<br>Discharge time | Selectable from 40ms ... 1 sec.<br>Selectable from 40ms ... 1 sec. |
| Fixed stages / skipped stages | Programmable |
| Alarm relay | Standard |
| No-voltage triggering | Standard |
| Display of power-line parameters | Voltage, apparent current, frequency, power factor, active power, apparent power, missing kvar, temperature |
| Storage of maximum values | Voltage, power factor, active power, apparent power, temperature |
| Temperature measurement range | 0 - 100°C |
| Housing | Switchboard-integrated housing |
| | DIN 43 700, 144 x 144 x 53 mm |
| Ground<br>Operating ambient temperature | 1 kg<br>-10 to +60°C |
| Protection type to DIN 40 050 | Front: IP 54, Rear: IP 20 |
| | |
| Coupling 2 controllers<br>(working as master / slave) | possible |
| | |
| | |
| | |
| | |
| | |
| | |

**Annex 3: Table of control series**

| No. | Control series | Loop connection |
|---|---|---|
| 1 | 1:1:1:1:1:1:1:1:1:1:1:1:1:1 | Possible |
| 2 | 1:2:2:2:2:2:2:2:2:2:2:2:2:2 | Possible |
| 3 | 1:2:3:3:3:3:3:3:3:3:3:3:3:3 | Possible |
| 4 | 1:2:3:4:4:4:4:4:4:4:4:4:4:4 | Possible |
| 5 | 1:2:4:4:4:4:4:4:4:4:4:4:4:4 | Possible |
| 6 | 1:2:3:6:6:6:6:6:6:6:6:6:6:6 | Possible |
| 7 | 1:2:4:8:8:8:8:8:8:8:8:8:8:8 | Possible |
| 8 | 1:1:1:1:2:2:2:2:2:2:2:2:2:2 | Possible |
| 9 | 1:1:1:1:1:1:6:6:6:6:6:6:6:6 | Possible |
| 10 | 1:1:2:2:2:2:2:2:2:2:2:2:2:2 | Possible |
| 11 | 1:1:2:2:2:4:4:4:4:4:4:4:4:4 | Possible |
| 12 | 1:1:2:2:4:4:4:4:4:4:4:4:4:4 | Possible |
| 13 | 1:1:1:2:2:2:2:2:2:2:2:2:2:2 | Possible |
| 14 | 1:1:2:3:3:3:3:3:3:3:3:3:3:3 | Possible |
| 15 | 1:1:2:4:4:4:4:4:4:4:4:4:4:4 | Possible |
| 16 | 1:1:2:4:8:8:8:8:8:8:8:8:8:8 | Possible |
| 17 | 1:2:2:3:3:3:3:3:3:3:3:3:3:3 | Possible |
| 18 | 1:2:3:4:4:8:8:8:8:8:8:8:8:8 | Possible |
| 19 | 1:2:2:4:4:4:4:4:4:4:4:4:4:4 | Possible |
| 20 | 1:2:2:2:4:4:4:4:4:4:4:4:4:4 | Possible |
| "E" | Control-series editor | Possible |

**Control-series editor**

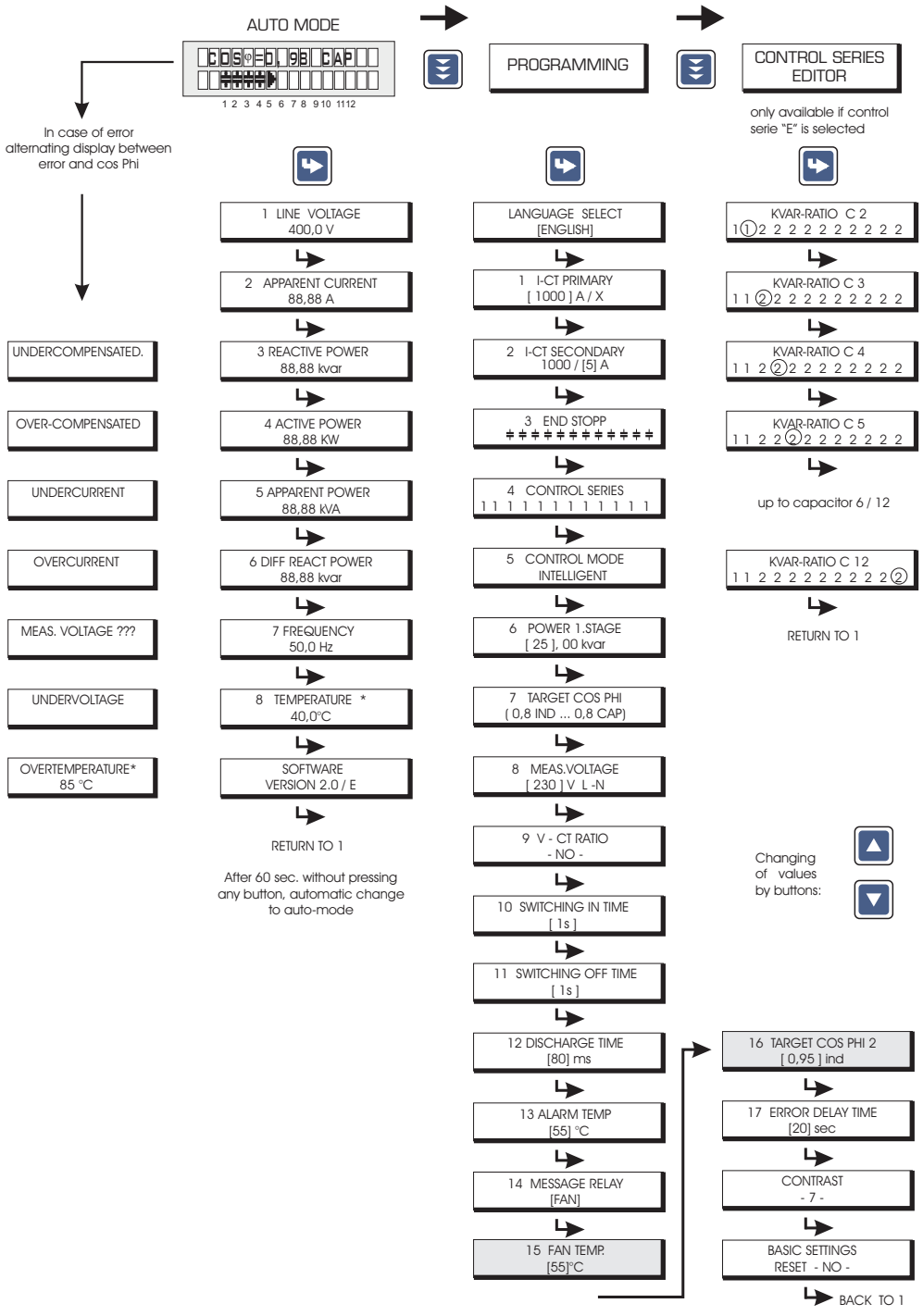
The control-series editor allows the user to simply define his/her own control series if the required control series is not available for any reason.
The last control series - Control Series E - is selected by pressing the "Programming" key (point 4: Control series) and confirmed with ENTER. This leads to the insertion of an additional menu point in the main menu -> the control-series editor. It may be reached via the "Operating Mode" key.

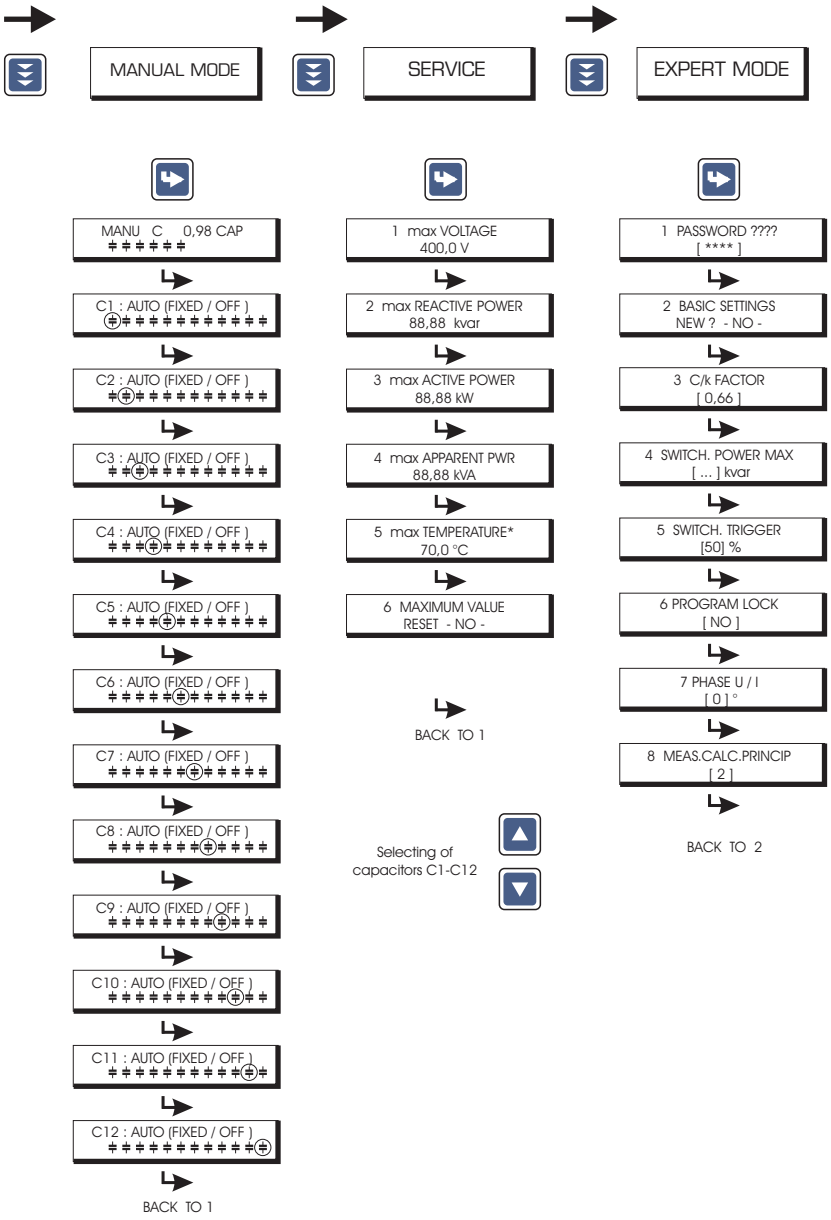

In the control-series editor, all stages can be set in succession to the desired value with the selection keys ↑ / ↓. The next stage in each case is reached by pressing ENTER. An intelligent pre-selection of the stages is integrated, so that only "meaningful" control series can be generated. The maximum number of stages can be limited by a programmed END STOPP < 12.
The user may quit the editor with the "Operating Mode" key.

**Annex 4: Default settings**

Note: The following values for the default settings apply only if the controller is supplied directly from the works. Otherwise, these values are replaced by the basic settings made by the manufacturer of the compensation network (optimal values for the relevant network).

| No. | Parameter | Default setting | Programmed values of this network (to be entered by network manufacturer or operator) |
|---|---|---|---|
| 1 | I CONVERTER prim. | 1000 A | |
| 2 | I CONVERTER sec. | 5 A | |
| 3 | END STOPP | 12 ( 6 ) | |
| 4 | CONTROL SERIES | 1 | |
| 5 | CONTROL PRINCIPLE | INTELLIGENT | |
| 6 | POWER 1. STAGE | 25.00 kvar | |
| 7 | TARGET COS-PHI | 0.98 IND | |
| 8 | MEASURING VOLTAGE | 230 V L-N | |
| 9 | V- CONVERTER RATIO | - NO - | |
| 10 | SWITCH IN TIME | 1 | |
| 11 | SWITH OFF TIME | 1 s | |
| 12 | DISCHARGE TIME | 80 ms | |
| 13 | ALARM TEMP. | 55°C | |
| 14 | MESSAGE RELAY | FAN | |
| 15 | FAN TEMP. | 30°C | |
| 16 | TARGET COS PHI 2 | 0,95 IND | |
| | CONTRAST | 7 | |
| | Capacitor stages | AUTO | |
| | Password | 6343 | Cannot be changed |
| | C/k constant | 0.66 | |
| | Max. simultaneous switching power | 4 x smallest stage power | |
| | Phase U/I | 0° | |
| | Operating lock | NO | |


AUTO MODE
1 2 3 4 5 6 7 8 9 10 11 12
PROGRAMMING
CONTROL SERIES EDITOR
only available if control serie "E" is selected
In case of error alternating display between error and cos Phi
UNDERCOMPENSATED.
OVER-COMPENSATED
UNDERCURRENT
OVERCURRENT
MEAS. VOLTAGE ???
UNDERVOLTAGE
OVERTEMPERATURE* 85 °C
1 LINE VOLTAGE 400,0 V
2 APPARENT CURRENT 88,88 A
3 REACTIVE POWER 88,88 kvar
4 ACTIVE POWER 88,88 KW
5 APPARENT POWER 88,88 kVA
6 DIFF REACT POWER 88,88 kvar
7 FREQUENCY 50,0 Hz
8 TEMPERATURE * 40,0°C
SOFTWARE VERSION 2.0 / E
RETURN TO 1
After 60 sec. without pressing any button, automatic change to auto-mode
LANGUAGE SELECT [ENGLISH]
1 I-CT PRIMARY [ 1000 ] A / X
2 I-CT SECONDARY 1000 / [5] A
3 END STOPP
4 CONTROL SERIES 1 1 1 1 1 1 1 1 1 1 1 1
5 CONTROL MODE INTELLIGENT
6 POWER 1.STAGE [ 25 ], 00 kvar
7 TARGET COS PHI ( 0,8 IND ... 0,8 CAP)
8 MEAS.VOLTAGE [ 230 ] V L -N
9 V - CT RATIO - NO -
10 SWITCHING IN TIME [ 1s ]
11 SWITCHING OFF TIME [ 1s ]
12 DISCHARGE TIME [80] ms
13 ALARM TEMP [55] °C
14 MESSAGE RELAY [FAN]
15 FAN TEMP. [55]°C
KVAR-RATIO C 2
KVAR-RATIO C 3
KVAR-RATIO C 4
KVAR-RATIO C 5
up to capacitor 6 / 12
KVAR-RATIO C 12
RETURN TO 1
Changing of values by buttons:
16 TARGET COS PHI 2 [ 0,95 ] ind
17 ERROR DELAY TIME [20] sec
CONTRAST - 7 -
BASIC SETTINGS RESET - NO -
BACK TO 1




**Annex 5**
Operating diagram (Brief programming)
Power Factor Controller BR6000T