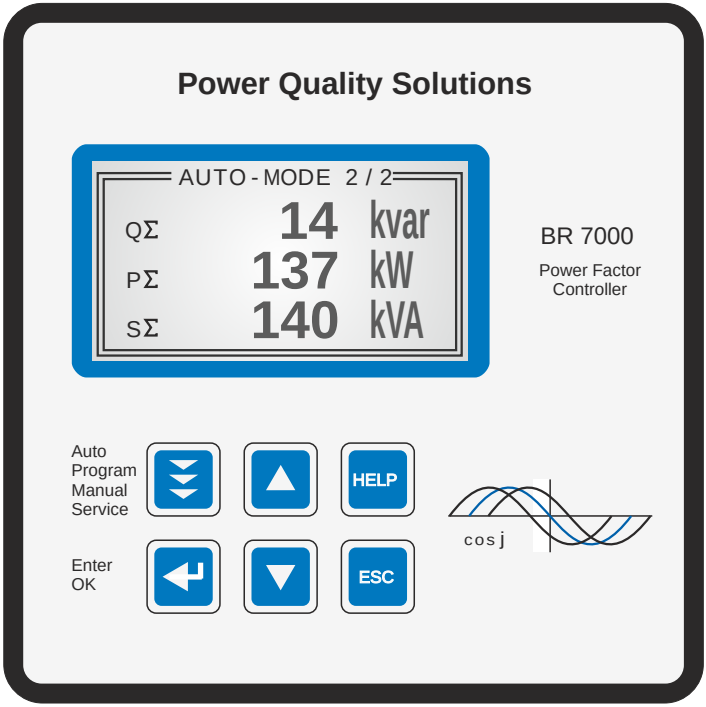
Power Factor Controller
BR 7000



Manual

Version 1.1 E

CAUTIONS:

1. High voltage !

2. BR7000 may only be used indoor !

3. Make sure that the discharge time set in the controller matches the capacitor discharge time !

CONTENTS

Section 1: GENERAL

The power factor controller BR7000 is the consequent follow-up development of the well proven series BR6000.
The main distinctive feature is the new 3-phases measuring system. Due to the 3-phases recording of voltage and current the device allows a convenient usage as grid measuring device and as power factor controller.
All measuring values can be edited and may be displayed in big letters for easier readability.
2 interfaces are standard. By means of the comfortable windows-software that is included in the delivery and by using one interface for a connection to a PC the execution and evaluation of grid measurements is possible. The second interface can be used for customer specific purposes.
Used as PF-controller various control modes are available. They allow not only to control according to the phase with the highest load or the average demand of the phases, but also to realize a real single-phase control (balancing) or a mix of balancing and conventional three-phases-control.
All well proven functions of the BR6000-series are available for the BR7000; for example the control series editor, the automatic initialization etc. For an easy usage the concept of graphic menu navigation has mainly been adapted. New are amongst others an integrated help (HELP-button) and the possibility to jump back in the programming menu by an additional ESCape-button.
The usage of a fully graphic support display allows an additional Oscilloscope-Mode where the phases (half waves) of voltage and current can graphically be displayed.

- ☑ 3 x 5 free programmable switching outputs
- ☑ 1 alarm relay, 1 programmable message relay, 1 relay for the cabinet fan
- ☑ Operating voltage: 110 ... 230VAC (+/-15%)
- ☑ Measuring voltage: 3 x 30 ... 440 VAC (L-N) / 50...760 V (L-L)
- ☑ Measuring current: 3 x 5A / 1A
- ☑ Pre-programmed control series and control series editor
- ☑ Illuminated graphic display 128 x 64 dot, graphical menu navigation
- ☑ 4-quadrant-operation
- ☑ Automatic initialization possible
- ☑ Measuring of capacitor current possible
- ☑ Three-phase display of various grid parameters (U, I, F, Q, P, S Delta Q ...)
- ☑ Switch over to large display possible
- ☑ Display up to 31st harmonic of voltage and current
- ☑ Simultaneous graphical display 1 period of voltage and current in Osci-mode
- ☑ Monitoring of temperature and particular capacitor output
- ☑ Storage of maximum grid parameters and switching operations/switch on times of capacitors with time stamp
- ☑ Manual/automatic operation
- ☑ Programming of fixed steps or mascing of particular outputs possible
- ☑ Control possible as 3-phase, 1-phase or mixed-mode
- ☑ Display of different error messages
- ☑ Error storage
- ☑ Complete 2nd parameter set programmable
- ☑ 2 integrated separate interfaces
- ☑ Integrated clock, several timers possible
- ☑ Integrated help-function/plain text
- ☑ Panel-mounted instrument 144 x 144 x 60 mm

Section 2: INSTALLATION AND INSTRUCTIONS FOR USAGE

The BR7000 is designed as panel mounting instrument in PFC-systems. This requires a cut out of 138 x 138 mm according to DIN 43700 / IEC 61554. The controller has to be inserted from the front and fixed with the clamps (included in delivery). The device may only be installed by qualified personnel and may only be operated according the given safety regulations. In addition the relevant legal and safety instructions have to be obeyed.

The measuring input is designed for 1- and 3-phase grids with or without neutral conductor. The maximum measuring voltage is 440V+ (L-N) / 760V ~ (L-L).
The supply voltage is 110...230 V +/-15%.

Wiring connections must be suitable for the particular voltages. Input leads have to be protected by over-current-protection devices. The supply voltage must be protected by a fuse; it must be possible to switch off the supply voltage by a separator.
The BR7000 must not be operated without protective earth contactor connected!

Before connecting the BR7000, it has to be checked that all connections are at zero potential; current transformers have to be short circuited. Correct phasing of measuring voltage and measuring current have to be checked. The measuring current circuits must be wired with minimum 2.5 mm^2 Cu.

Terminals may only be plugged when de-energized!

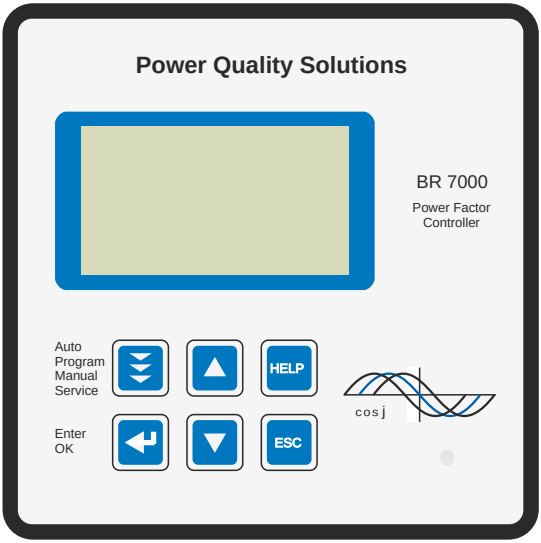
Attention!
During single-phase operation the coil voltage for the capacitor contactors must be drawn from the same phase as the measuring voltage as only the measuring voltage is monitored. (Protection against direct re-switching of contactors during a short-term single-phase voltage drop.)

The controller may only be operated when installed. The complete programming of all application-specific parameters is done according chapter programming. Then the device is set to automatic operation by pushing the operation mode button. The controller is now ready for operation.

Operating the controller without following to these operating instructions may be harmful and dangerous!

The controller is supplied for a standard operating voltage of 110...230VAC (+/-15%), a measuring voltage of 30...440 V~ (L-N) resp. 50...760V~ (L-L), 50/60Hz, and a measuring current of 5A or 1A (programmable). A voltage converter is required for different operating voltages.

Caution!
Voltages which exceed the allowed voltage range can damage the device!

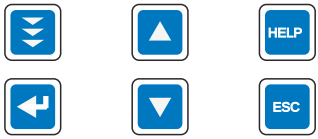


BR 7000 front view

Operating mode:
- Automatic
- Program.
- Manual oper.
- Service
- Expert Mode
- Osci - Mode
- Display Editor

Increase selected parameter

HELP opens Help pages

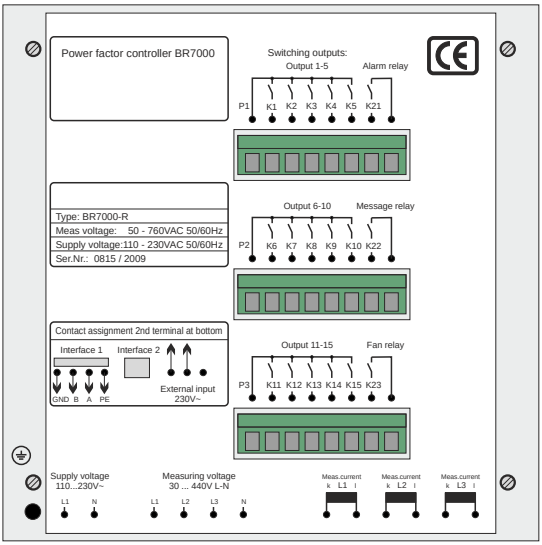


ENTER/ OK Confirmation storage of values

Reduce selected parameter

Escape previous page/value in the display

BR 7000 rear view



The allocation of switching outputs K1...K15 to the capacitors complies to the selected connection variant and the desired CONTROL-MODE (Programming/point 2)

Especially in "Mixed Mode" where some outputs are used for single phase capacitors, others for 3-phase-capacitors the proper connection must be assured!

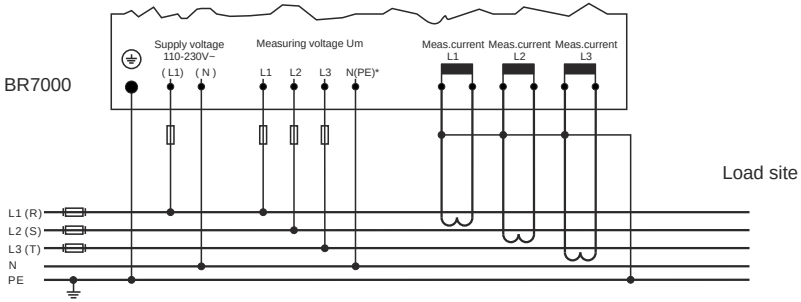
In the "HELP"-menu the BR7000 directly displays the actual correct allocation of outputs (AUTO-MODE: Help-page 7-9).

For examples also see chapter 9.

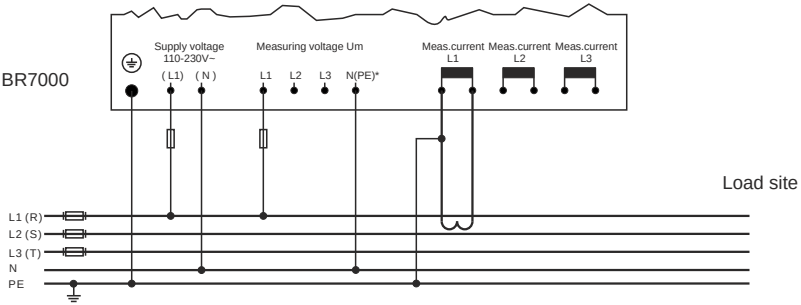
Section 3: CONNECTION ALTERNATIVES MEASURING VOLTAGE AND MEASURING CURRENT

According to the existing grid and the desired operating mode (CONTROL-MODE Programming) the BR7000 has to be connected accord. one of the following alternatives.
In grids without neutral conductor the connector N(PE) from meas.voltage at the controller has to be connect with the PE of the grid !

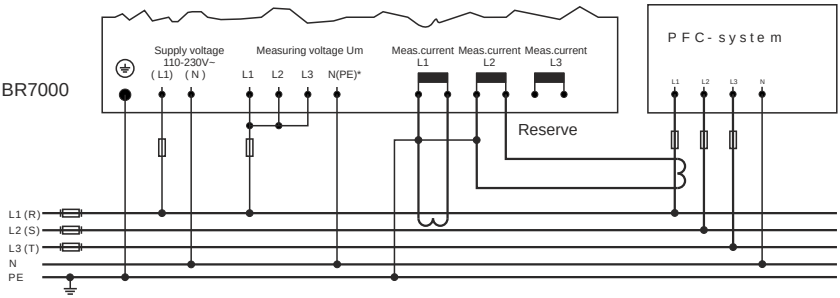
Alternative 1: measuring performed in each phase - 3 current transformers needed
Use: CONTROL-MODE: 1 - 4 (control modes see page 11)



Alternative 2: single-phase measuring via current transformer in L1 Values extrapolated (balance assumed).
Measuring complies with conventional measuring for switching of three-phase capacitors.
Use: CONTROL-MODE 5



Alternative 3: single-phase measuring as alternative 2 , but with capacitor current measuring in the compensation system for collection of real capacitor currents.
Use: CONTROL-MODE 6



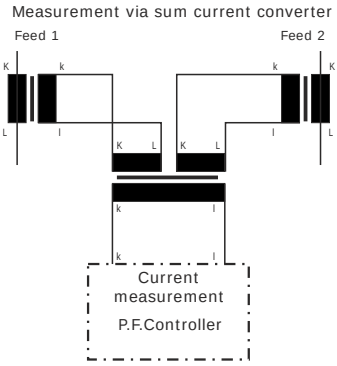
Connection of current transformer / sum current transformer

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 BR7000 is connected up via sum-current converters, the overall conversion ratio is entered.
Current converter clamps should be grounded on one side!

Example:

C.converter 1: 1000/5A
C.converter 2: 1000/5A
Sum-current converter: 5A+5A / 5A

C.converter ratio is: 2000 /5A

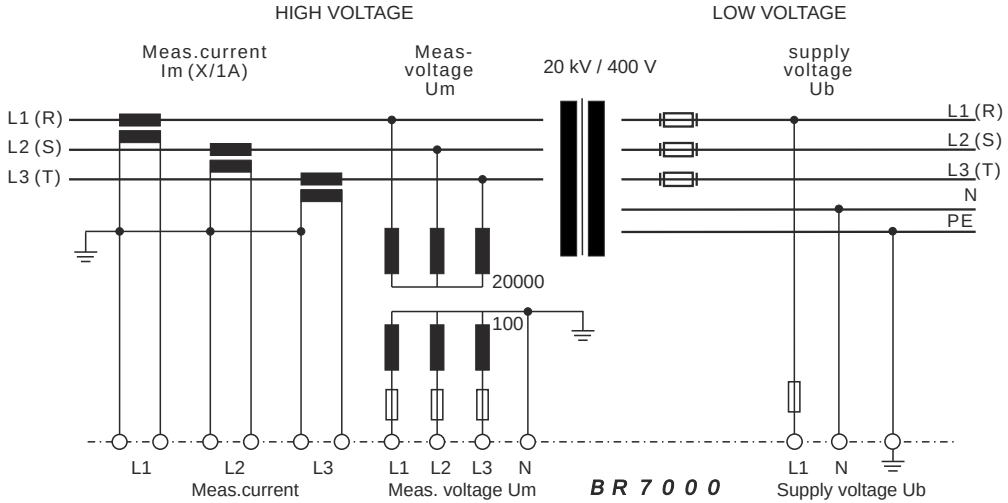


Caution!
Current converter clamps should be grounded on one side !
The secondary clamps of the CT have to be short circuited before current leads are iterrupted !

BR7000 in High Voltage Application

The example shows the connection of BR7000 in HV-application.
The measuring current is taken off primary via X/1A transformer. Measuring voltage produced via transformer 20000/100 V. In this case, the BR7000 has to be programmed as follows:

4 I-CONVERTER sek: X / 1A
14 MEASUR.VOLTAGE: 100 V
15 V-CONVERTER: 20kV / 100 V

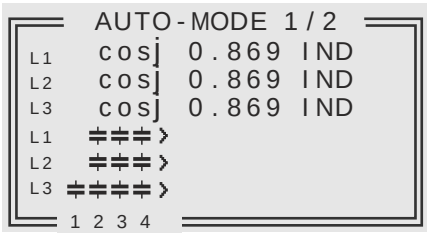


Section 4: DISPLAY - FUNCTIONS

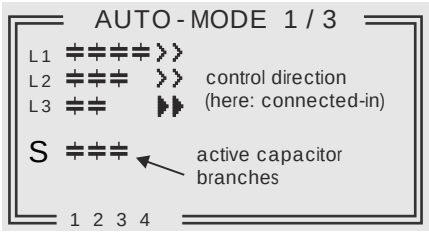
After the operating voltage has been switched on, the BR7000 briefly indicates with description and software-version before changing to automatic operation.

Actual values and symbols of the particular operation state are shown in the display.
In the automatic operation (standard) capacitor steps are automatically switched on or off to reach the pre-set target cos-phi. This happens when the required reactive power is higher than the value of the smallest capacitor step.

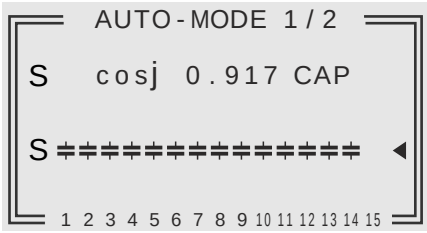
Example 1: Automatic operation
L1...L3: Individual compensation by single-phase capacitors



Example 2: Automatic operation (Mixed Mode)
L1...L3: phase wise compensation by single phase capacitors
S: Three-phase capacitors activated



Example 3: Automatic operation
Measuring in one phase
Controlling of 15 three-phase-capacitors



Number of switching outputs until end stop.
Here: 15 three-phase capacitors, end-stop: 15

Control direction is symbolized by a compact arrow:
Connecting-in
Connecting-out

The connecting-in arrow is always located after the maximum possible number of stages (end stop)

An open arrow indicates that the required blocking time (Discharge time) is running before an impending switching step

A double arrow symbolizes switching of several branches

S The sigma-sign indicates the three-phase-value (mean-value) resp. activated three-phase-capacitors

A Alarm relay activated (declines in case of error)

S Message relay activated: "SUPPLY"

U Message relay activated:"Undercurrent"

H Message relay aktivated: "Harmonics"

F FAN-relay: ON

The particular capacitor outputs are permanently monitored. Inverse display = capacitor out of range

2 Display of 2nd parameter-set

Supply display (i.e.generator operation)

T 2nd Target-cos phi activated by timer

2nd Target-cos phi activated by supply

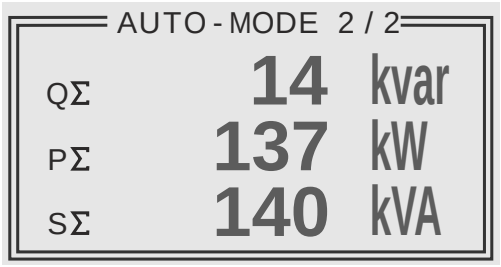
Section 5: DISPLAY OF GRID PARAMETERS

5.1 Display of 3 selected grid parameters

In Auto-Mode, button ↑ leads to display mode 1. Here 3 (free selectable) grid parameters are displayed in large letters. The selection and storage of these values is done in the Display- Editor.

Example: Display mode 1:

Desired values selected in the Display Editor (see section 16)



5.2 Display of particular grid parameters (from AUTO-MODE by pressing ENTER)

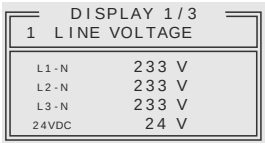
By repeated activation of the "ENTER"-button (in automatic operation) several grid parameters can be displayed (s. table below):

Action	Display	Unit	in%	large display possible	Bargraph possible	3-phase
ENTER	1 LINE VOLTAGE	V		x		x
ENTER	2 APPARENT CURRENT	A	x	x		x
ENTER	3 REACTIVE POWER	kvar	x	x		x
ENTER	4 ACTIVE POWER	kW	x	x		x
ENTER	5 APPARENT POWER	kVA	x	x		x
ENTER	6 DIFF. kvar to target	kvar	x	x		x
ENTER	7 FREQUENCY	Hz		x		x
ENTER	8 TEMPERATURE	°C / °F		x		
ENTER	9 3.-31. HARMONICS	V/ I	x		x	x
ENTER	10 HARMONICS THD-V/I		x		x	x
ENTER	11 Comp.- power	(only at real capacitor current measurement)				
ENTER	12 ENERGY	kvarh / kWh				
ENTER	13 TIME / DATE	↑ / ↓ change the date format				
ENTER	14 Software version					
ENTER	return to: 1					

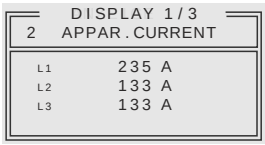
Buttons ↑ / ↓ change the display format:

The values can be displayed in their unit, in % or as large display resp. bar chart.
Examples, see next page.

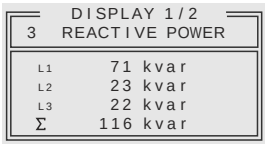
Examples of different displays:



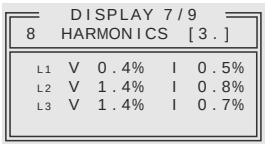
VOLTAGE 3-phas.



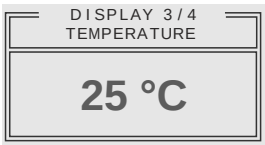
CURRENT: 3-phas.



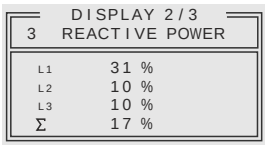
REACTIVE PWR 3-phas.



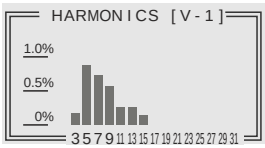
HARMONICS in %



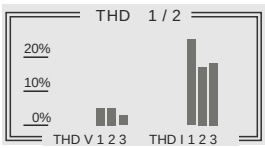
TEMPERATURE °C
LARGE LETTERS



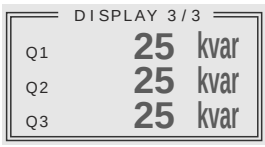
REACTIVE PWR in %



HARMONICS diagram

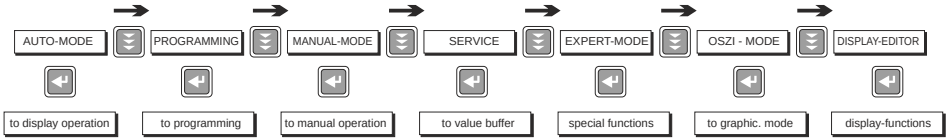


THD V/I as bar diagram



REACTIVE POWER
LARGE LETTERS

Repeated pressing of the "Operating Mode" key activates the various menus in sequence: Automatic operation - Programming - Manual (manual operation)- Service - Expert mode - OsciMode - DisplayEditor and back to Auto.

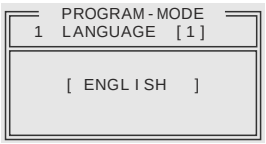


Section 6: PROGRAM-MODE (manual programming)

Pressing the button “Operation Mode“ one time switches from automatic operation to the program mode.
The upper part of the display always shows the parameter, the adjustable values are shown in the lower part. Editable values are generally given in square brackets. Changes of these values can be done by the buttons ↑ / ↓. By pressing the “ENTER-button” the value is stored. Pressing the “ESC”-button allows to go one step back (without storing).

1 LANGUAGE

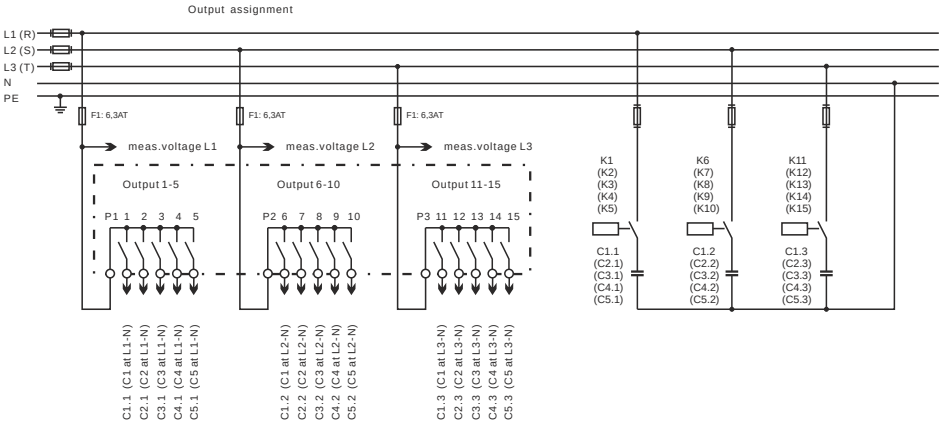
This selects the language of the operating menu
[GERMAN, ENGLISH, SPANISH, RUSSIAN, TURKISH]



2 CONTROL-MODE [1...6]

CONTROL-MODE [1]:
3-phase measuring / max. 3x5 single phase capacitors L-N
(3 current transformers needed), values displayed and calculated per phase. Connection of measuring current and measuring voltage (refer to page 6). Controlling is done with max. 5 outputs per phase in case of switching of single-phase capacitors L-N.

Example :
3x 5 single-phase capacitors (L-N)



Allocation of switching outputs K1...K15 to the capacitors according to the selected connection variant and the desired CONTROL-MODE.

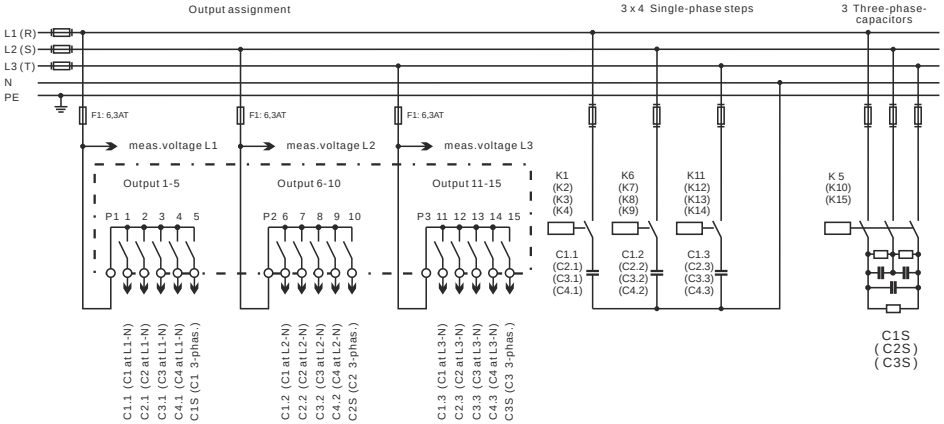
Especially in ”Mixed Mode“ where some outputs are used for single phase capacitors, and others for 3-phase-capacitors the proper connection must be assured!

In the HELP-function the BR7000 directly displays the correct allocation of outputs (AUTO-MODE: Help-page 7-9).

CONTROL-MODE [2]: MIXED-MODE 3-phasige measuring

3 current transformers required. Values displayed and calculated per phase. Connection of measuring current and measuring voltage see page 6.
Controlling done with max. 4 outputs per phase for switching of single phase capacitors L-N.
The rest of the outputs (min. 3, max. 12) are used for switching of three-phase capacitors to control the base load.
Partitioning into single-phase / three-phase capacitors is done at
Programming: 4 ENDSTOP!
The allocation of the switching outputs to the particular capacitors can be retrieved in AUTO-MODE on HELP-pages 7...9.

Example:
3x 4 single-phase-capacitors +
3 standard 3-phase capacitors

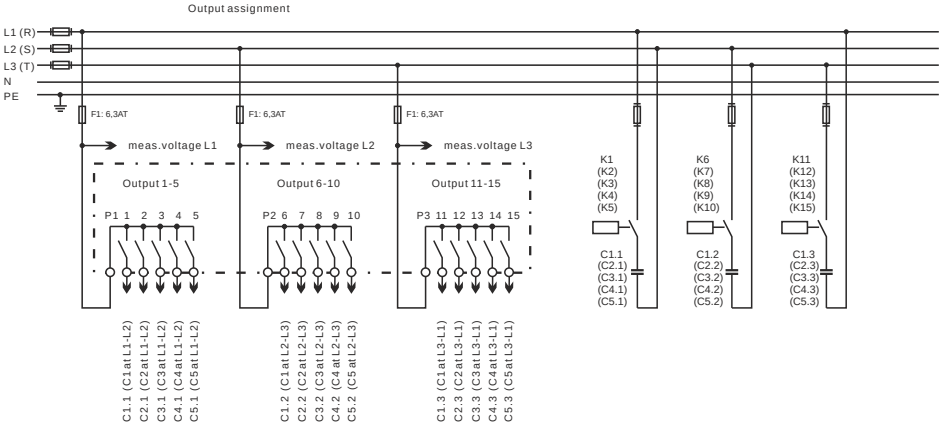


CONTROL-MODE [3]:

3-phase measuring / max. 3x5 single-phase capacitores L-L

3 current transformers required. Values displayed and calculated per phase.
Controlling done with max. 5 outputs per phase, switching of single phase capacitors L-L

Example:
3x 5 single-phase capacitors (L-L)



CONTROL-MODE [4]:

3-phase measuring / max. 15 three-phase capacitors

3 current transformers required. Connection of measuring current and measuring voltage refer to page 6.

Values displayed and calculated per phase.

Controlling done with max. 15 outputs according to maximum or mean-value of the reactive power

CONTROL-MODE [5]:

1-phase measuring / max. 15 three-phase capacitors

Only 2 current transformer in L1 required

Connection of measuring current and measuring voltage see page 6

Values extrapolated to all phases (balance assumed)

Measuring complies with conventional measuring for switching of three-phase capacitors.

CONTROL-MODE [6]:

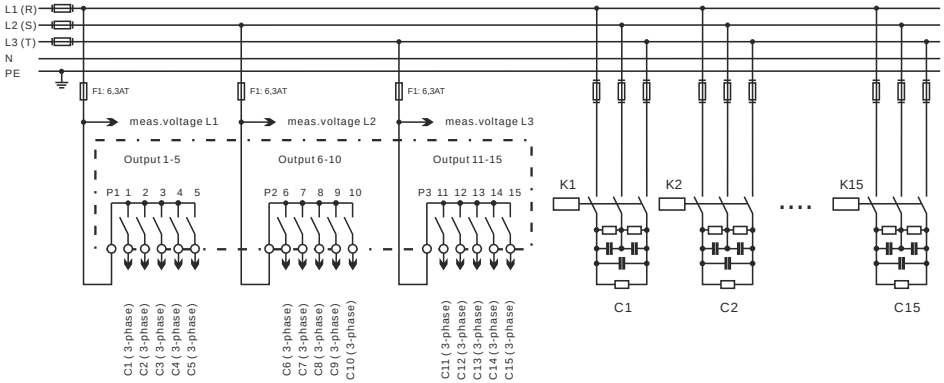
1-phase measuring / max. 15 three-phase capacitors with capacitor current measurement

According variant 5, but the free current inputs (L2 or L3) are used for capacitor current measurement for real monitoring of capacitors.

Connection of measuring current and measuring voltage see page 6!

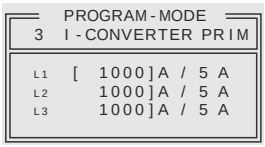
Example:

15 standard 3-phase capacitors



3 I-CONVERTER PRIM [1000] A / X (5 ... 13000) A

Selects the primary current of the current converter.
Sequential adjustment of L1...L3.
via the ↑ / ↓ keys. Save and continue with ENTER

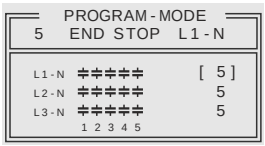


4 I-CONVERTER SEC 1000 A /[5]A (1 / 5 A)

This sets the secondary current of the current converter.
Selection via ↑ / ↓. Save and continue with ENTER

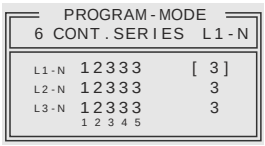
5 END STOPP

Programming of the maximum number of active capacitor branches.
Depending on the selected operation mode the maximum number of connected capacitors at the output groups L1...L3 and (if available) for the output groups S (three-phase capacitors) are set.
The visible symbols of the capacitors correspond to the connected outputs.
Input via ↑ / ↓. Save and continue with ENTER



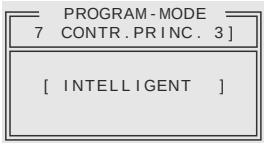
6 CONTROL SERIES [1] (1...20 + ED)

The ratio of the capacitor branch powers determines the control series, the power of the first capacitor always being assigned the value 1.
Selection of desired control series consecutively for L1...L3 and for S (three-phase outputs).
If the required control series should not be present, the user may define a special one in control series “ED” (see Annex 4: Control-series editor)



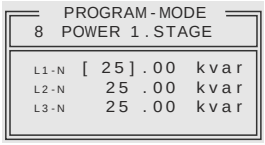
7 CONTROL PRINCIPLE

The control preference may be selected here:
SEQUENTIAL connection
LOOP connection
INTELLIGENT loop connection (default setting)
COMBINED CHOKE
See Section 13 for an explanation of the control modes.
Selection with ↑ / ↓ keys.
Save and continue with ENTER

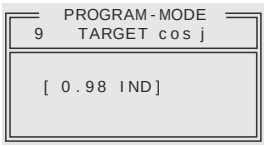


8 POWER 1st STAGE [0.01 ... 255.99] / [10...2550] kvar

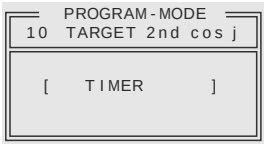
To determine the controller's response sensitivity, the dimensions of the smallest capacitor (stage 1) must be known. They are entered in two steps in kvar. The integral kvar values (before the comma) are initially selected via the ↑ / ↓ keys and saved with ENTER.
The positions after the comma are then selected, again via the ↑ / ↓ keys.
If the capacitor value is below the response sensitivity, a warning will occur (indication of “!” in the display)



9 TARGET COS PHI [0.98 ind] (0.3 ind ... 0.3 cap)
By setting the target cos phi, the power factor to be attained via the PF correction is defined.
Sequential setting of L1 ... L3 via ↑ / ↓,
Save and continue with ENTER.



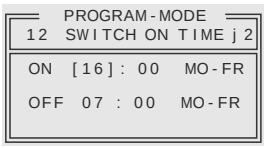
10 TARGET 2nd cosPhi [NO] (1...3)
1: NO (no 2nd target cosPhi, continue with 14)
2: Timer (2nd cos-phi - activated by timer, scheduler with 12,13)
3: Energy supply (2nd target cos-phi - activated by energy-supply)



11 TARGET 2nd cosPhi [0.9 IND] (0.3 ind ... 0.3 cap)
Set point for the 2nd target cosPhi
(only available if selected under 10)

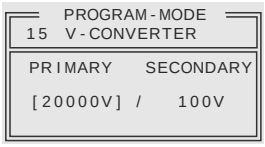
12 SWITCH ON TIME j 2 [HH:MM:SS]
Switch-on time of the timer for the 2nd target-cos phi
(only available if selected under 10)

13 SWITCH OFF TIME j 2 [HH:MM:SS]
Switch-off time of the timer for the 2nd target-cos phi
(only available if selected under 10)

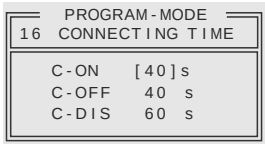


14 MEASURING VOLTAGE L-L [400]V (50...760) V
Programming of measuring voltage.
The values programmed here always refer to the L-L voltage in the system !
Selection via ↑ / ↓. Save / continue with ENTER

15 V-CONVERTER [NO] (300V-77kV / 440V)
When a measuring-voltage converter (e.g. for HV-measurement) is used, its conversion ratio is to be programmed here.
Selection via ↑ / ↓. Save / continue with ENTER

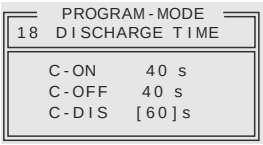


16 CONNECTING TIME: [40] sec. (1 sec. ... 20min.)
The time between connecting the capacitors to increase the momentary network capacitance. It should be noted that in practical operation the real connection time is affected by the discharge time (locking time).
Selection via ↑ / ↓. Save / continue with ENTER



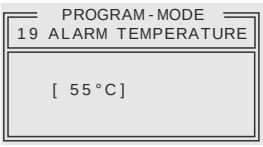
17 DISCONNECT TIME: [40] sec. (1 sec. ... 20min.)
The time between disconnecting the capacitors to reduce the momentary network capacitance.
Selection via ↑ / ↓. Save / continue with ENTER

18 DISCHARGE TIME: [60] sec. (1 sec. ... 20min.)



This is the time for which an individual output is blocked between disconnecting and connecting. It depends on the discharge device of the capacitor. The discharge time of a conventional system without fast discharge resistors or reactors should not be adjusted to less than the data sheet value of the used capacitor.
Selection with buttons ↑ / ↓. Save /Continue with ENTER

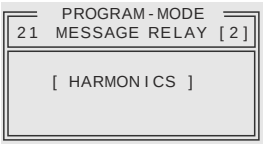
19 ALARM TEMPERATURE [55] °C (20...80)°C



The alarm temperature programmed here is the temperature at which a stepwise disconnection of the capacitors is performed. After 10 min. the standard alarm relay of the controller (K21) will respond. At the same time, the display shows the cause of the alarm (over temperature).
When the temperature drops again, the required branches are automatically re-connected in steps.
Selection with ↑ / ↓. Save / Continue with ENTER

20 FAN TEMPERATURE [30] °C (15...70)°C
Threshold for the fan relay (K23) for control of a cabinet fan.

21 MESSAGE RELAY [Supply] (1...3)



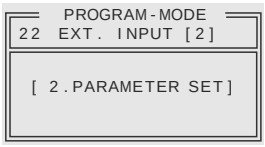
The message relay (K22) can be programmed for one of the following options as required:

1 - OFF
2 - Supply: Message when active power is supplied. Display: **S**
3- Under current:
Message when the measuring current is not met. Signal is generated when the current value drops below the response sensitivity of the controller. Display: **U**
4 - Harmonics:
Message when the limiting value of the total harmonic distortion factor (THD-V) is exceeded. This value can be parameterized under "38 Harmonics" (in %). Display: **H**
5 - ERROR - System current measuring Display: **E**
6 - ERROR - Com1 (interface error)
7 - ERROR - Com2 (interface error) Display: **E**
8 - ERROR - Com1 / 2 (interface error)

22 EXTERNAL INPUT [NO] (1...5)

Setting of the desired action upon applying a control voltage of 110...230V~ at the external input.

1 - NO (no action)
2- 2nd parameter set (switch over to 2nd parameter set). This selection simultaneously activates the following points 23...36 for programming of the values of the 2nd parameter set.
3 - External error (Display of an error message)
4 - Coupling operation parallel (Input for signal of coupling switch)
5 - Coupling operation Master / Slave (Input for signal of coupling switch)
Description of coupling operation s. section 14.2. Coupling operation only possible in CONTROL-MODE 4-6.
6 - Remote - Switch ON
7 - Remote - Switch OFF
8 - Remote - Stopp

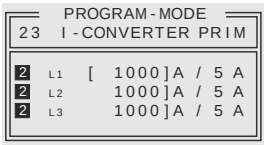


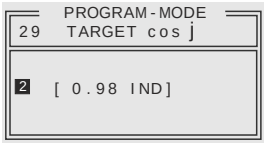
Programming of 2nd parameter set
(only active if 22 EXTERNAL INPUT is set to 2nd parameter set)

2

As a standard, the values of the 2nd parameter set equal the values of the normal parameter set. Menu entries 23...36 permit a systematic change of the 2nd parameter set. Possible applications are for example: changing of target cos-phi, switch-over of current transformer or switch-over the switching times.
By triggering a 110...230V~ signal at the external input, the 2nd parameter set is activated with following values:

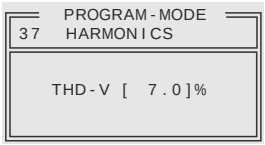
2 23. I-converter prim
2 24. I-converter sec
2 25. End stop
2 26. Control serie
2 27. Control principle
2 28. Power 1st stage
2 29. Target cos-Phi nominal value
2 30. 2nd target cos-Phi NO/supply/Timer
2 31. 2nd target cos-Phi nominal value
2 32. Switch on time target cos-Phi-2
2 33. Switch off time target cos-Phi-2
2 34. Connecting time
2 35. Disconnecting time
2 36. Discharge time



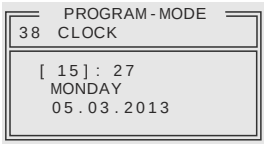


The programming of the 2nd parameter set is performed equivalent to the programming of the 1st set parameters (3-18)

37 HARMONICS [7]% (0,5...25,5)%
Threshold value THD-V (in%). In case this value is exceeded a message will be displayed. THD-V ist the ratio of the geometric sum of unequal harmonics to the 1st harmonic. In any case, a warning will be displayed. Warning via message relay will only be



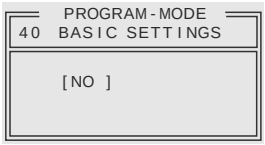
38 CLOCK [HH:MM], DATE [DD.MM.YY]
Set system-time and date
(Due to an internal battery the time will be kept even in case of power loss)
Selection with ↑ / ↓. Save/continue with ENTER



39 CONTRAST [6] (0...10)
Adjustment of display contrast for best readability
Selection with ↑ / ↓. Save/continue with ENTER

40 BASIC SETTINGS [NO] (YES/NO)
When selecting YES and confirmated with ENTER, all parameters are set back to the basic settings of the panel builder (optimum values for the system if the controller has been delivered together with the PFC-system). If the controller has been delivered ex works, this point corresponds to the default settings.

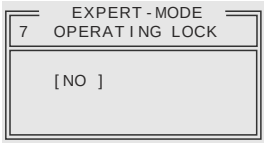
ATTENTION: All user settings get lost!



Section 6.1: PROGRAMMING LOCK

As a protection against unauthorized changes of the system parameters, the BR7000 is equipped with a programming lock. This can be activated in the EXPERT MODE. When the lock is active, all parameters can be checked but not changed.

Alternatives:
Lock active / Not active / Automatic activation after 24 h



Section 6.2: QUICK-PROGRAM

The QUICK-PROGRAMM-MODE can be activated from the menu "PROGRAMMING" by pressing the button "↑" and is used for fast programming of the BR7000.
The list hereafter contains the most important parameters for programming in short form. For most applications the input of these values is already sufficient. Input is done like for normal programming:

1 CONTROL-MODE [1...6]

2 I-CONVERTER PRIM [1000] A / X (5 ... 13000) A
Selection of primary current of the current transformer of the system. Programming is done consecutively for L1...L3.

3 I-CONVERTER SEC 1000 A /[5]A (1 / 5 A)
Secondary current of the CT of the system.

4 END STOP
Programming of the maximum number of active capacitor branches.

5 CONTROL SERIES [1] (1...20 + EDITOR)
The ratio of the capacitor branch power determines the control series, the power of the 1st capacitor always being assigned the value 1.

6 POWER 1st STAGE [0.01 ... 255.99]kvar
To determine the controller's response sensitivity, the dimensions of the smallest capacitor in the system (stage 1) must be known. Input in kvar is done in two steps (before the comma / after the comma).

7 TARGET COS PHI [0.98 ind] (0.3 ind ... 0.3 cap)
Setting the target cos-phi determines the power factor that should be achieved by PFC.

8 CONNECTING TIME: [40] sec. (1 sec. ... 20min.)
This refers to the time between the connections of capacitors to increase the actual system capacitance

9 DISCONNECTING TIME: [40] sec. (1 sec. ... 20min.)
This refers to the time between disconnecting of capacitors to decrease the actual system capacitance.

10 DISCHARGE TIME: [60] sec. (1 sec. ... 20min.)
This is the time for which an individual output is locked between its disconnecting and connecting.

Detailed description can be found in chapter 6 (PROGRAMMING) page 11 ff.

Section 7: AUTOMATIC INITIALIZATION

Automatic initilization is used for the automatic recognition of parameters in the compensation system by the BR7000, for plausibility check and for saving of these parameters. The customer has to make very few adjustments only, if at all.

Activating is done in menu point “PROGRAMMING” by pressing button “↑" twice. [AUTO-INIT] Confirm by ENTER.

[1] CONTROL-MODE
Selection of required control mode according to the wiring of the system, see description page 12 ff.

[2] I-CONVERTER
If the values of the current transformer in the system are known, they should be entered here. [3] I-CT primary / [4] I-CT secondary
If no value is programmed (selection: UNKNOWN), the power of the smallest stage must be entered in the next point. [5]/[6]: Power 1st stage

After entering the above mentioned values, the automatic initialization of the BR7000 will be executed.

[7] START TEST RUN

[8] TEST RUN 1
- 0 Initialization
- 1 Voltagetest
- 2 I-transformer test
- 3 Measuring current test
- 4 Capacitor test C1 - C15

Three test runs are performed, in which all capacitor steps will consecutively be switched on and off. During this process, all required parameters are collected, rated and saved. Under some circumstances another three test runs may be necessary.

After a successful end of AUTO-INIT the BR7000 changes to normal operation. The system values measured are transferred into the particular registers and can be called up any time.

In case of discrepancies (plausibility) or faulty connection the mistake that has been discovered will be displayed after finalization of AUTO-INIT in plain text so that it can be removed. AUTO-INIT can be repeated afterwards.

Section 8: AUTOMATIC TEST RUN

The automatic test run is used for automatic check and comparison of the parameters already programmed in the BR7000 with the measured values of the PFC-system (plausibility). Discrepancies will be displayed in plain text. Activation is done from menu “PROGRAMMING” by pressing button “↑" three times. [TEST-RUN] Confirm with ENTER.
The test run widely complies with the process described in AUTO-INIT, but immediately starting with: [8] TEST RUN 1

The measured values of the system and of the capacitors are compared with the parameters of the BR7000-programming. In case of discrepancies, appropriate error messages are displayed.

NOTE:
The displayed results of AUTO-INIT and TEST RUN are messages that should help the user to search an error. The final evaluation has to be done by the user. There is no guarantee for a 100% fault recognition.

Section 9: HELP-Functions / actual output assignment

The BR7000 features a context related help function.
For each menu item one or more help pages are available which can be accessed directly with the HELP-button. Scrolling is done with "UP/DOWN" buttons, back retrace with ESCape.
In automatic operation (= = =AUTO-MODE= = =) 9 help pages are available. The first pages explain the general meaning of used symbols.

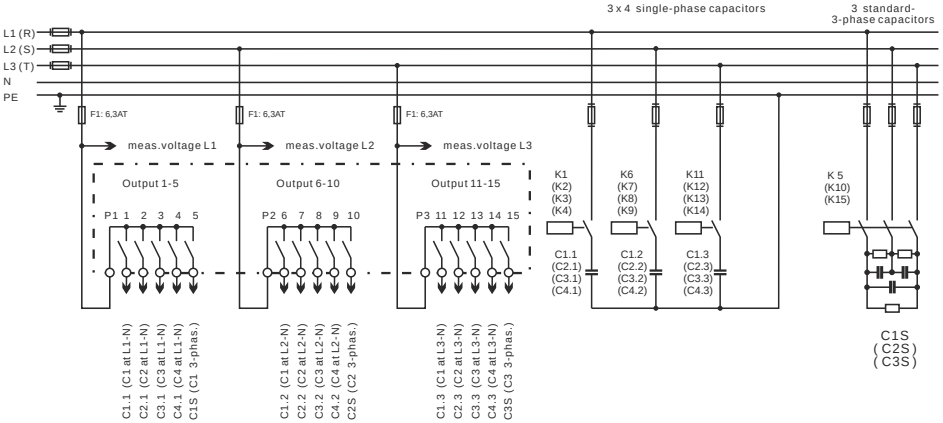
On the help pages 7...9 the actual assignment of the internal relay outputs K01...K15 to the phases and to the capacitors are shown directly.

This table depends on the CONTROL-MODE that is set and will change automatically.

The assignment shown here is not trivial, especially in CONTROL-MODE 2 (MIXED MODE) and must be obeyed without exeption!

s. example page 22

Example: CONTROL-MODE 2 (MIXED-MODE)
set in END STOP to:
4 stages with 3 single- phase capacitors each and
3 stages with 1 three-phase capacitor each



In case of the setting the BR7000 will automatically assign the capacitors according to the wiring diagram.

This output assignment can always be called up in help-mode AUTO-MODE/ HELP/ page 7...9 and is displayed in the example as follows:

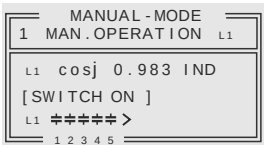
HELP-MODE p. 7/9	HELP-MODE p. 8/9	HELP-MODE p. 9/9
OUTPUT ASSIGNMENT	OUTPUT ASSIGNMENT	OUTPUT ASSIGNMENT
REL K01 -> L1 -> C1.1	REL K06 -> L2 -> C1.2	REL K11 -> L3 -> C1.3
REL K02 -> L1 -> C2.1	REL K07 -> L2 -> C2.2	REL K12 -> L3 -> C2.3
REL K03 -> L1 -> C3.1	REL K08 -> L2 -> C3.2	REL K13 -> L3 -> C3.3
REL K04 -> L1 -> C4.1	REL K09 -> L2 -> C4.2	REL K14 -> L3 -> C4.3
REL K05 -> S -> C1S	REL K10 -> S -> C2S	REL K15 -> S -> C3S

Section 10: MANUAL OPERATION

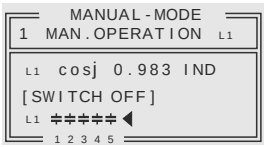
Manual operation is designed for maintenance and service purpose. Menu “MANUAL-MODE” consists of the following sub-windows:

1 MANUAL CONTROL [STOP] L1 (L1...L3)

In manual operation, capacitor steps can be connected /disconnected according to the control series and switching time irrespective of the prevailing power-line-conditions.
Starting position is STOP (no stages connected).



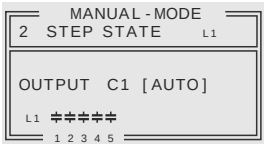
CONNECTION or DISCONNECTION is done by pressing the buttons ↑ resp. ↓
This manual operation is executed consecutevely for particular phases L1-L3 resp. S.
The operation status and the power power factor of the actual phase are permanently shown in the display.



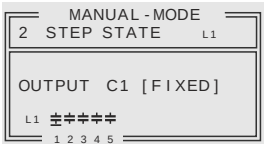
2 STEP STATE C1 - [AUTO] (FIXED/ AUTO/ OFF)

In special cases, all controller outputs (C1- C15) may be permanently defined (continued switching via ENTER) for the following states:

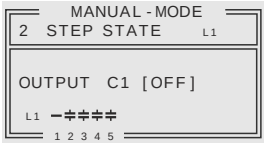
AUTO: Automatic (normal) operation
The relevant output is marked by a capacitor symbol.



FIXED: The output is continuously connected, e.g. for fixed PFC. The output is marked by an underlined capacitor symbol.



OFF: The output is continuously disconnected, e.g. for temporarily disconnecting of a defective capacitor. The capacitor symbol for this output is faded out. “MINUS” sign appears.



The active stage is blinking. The required status is set via ↑ / ↓. By pressing ENTER, the user saves this step and moves to the next stage.
The programmed status for the outputs also remains visible on the display in automatic operation.

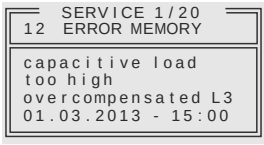
Section 11: SERVICE MENU / Fault memory

This service menu can be reached by the operating-mode key.
The stored maximum values of the grid parameters can be displayed here as well as the number of switching operations of the individual capacitor steps and their operation time.
The desired stage (in square brackets) is selected via the arrow keys.

In addition, a fault memory is available where the last fault events of the system are stored in plain text (e.g. short-term over temperature or over voltage).

Action	Display	Unit	3-phase
ENTER	1 min/max VOLTAGE	in V	L1 ... L3
ENTER	2 max. CURRENT	in A / %	L1 ... L3
ENTER	3 max. REACTIVE POWER	in kvar / %	L1 ... L3
ENTER	4 max. ACTIVE POWER	in kW / %	L1 ... L3
ENTER	5 max. APPARENT POWER	in kVA / %	L1 ... L3
ENTER	6 max. TEMPERATURE	in °C /°F	
ENTER	7 max. THD - V / THD-I	in % / bargraph	L1 ... L3
ENTER	8 MAX. VALUE RESET		
ENTER	9 ENERGY RESET		
ENTER ↑/↓	10 Switch.OPERATIONS C [1] - to C [15]		
ENTER ↑/↓	11 OPERATING TIME C [1]- to C [15]	in h in h	
ENTER	12 ERROR MEMORY	in plaintext with time-stamp	
ENTER	13 ERROR MEMORY RESET		
ENTER	14 C - POWER C[01] - C[15]	in %	
ENTER	15 TEST RUN - Analysis (only at TEST-RUN or AUTO-INIT)		
ENTER	Back to 1		

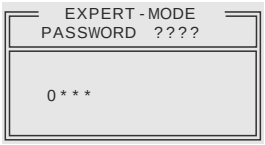
Example ERROR display:
overcompensated in phase L3
with date / time stamp



Section 12: EXPERT-MODE 1 and 2

The expert modes are meant for the adjustment of values which normally should not be changed. As a protection these levels have access codes:

PASSWORD: ExpertMode 1: “6343”
ExpertMode 2: “2244”



12.1 EXPERT-MODE 1 (Code: 6343)

1 BASIC SETTINGS NEW [NO] (NO/YES)
Storage of the present programming as a new basic setting (usually performed by the PFC-system manufacturer).
Caution: All original values will be overwritten!

2 SWITCHING OPERATIONS RESET [NO] (NO/YES)
The stored switching operations of all capacitor stages are reset to zero.
(reset of particular stages in Expert-mode 2)

3 OPERATION TIME RESET [NO] (NO/YES)
The stored operating times of all outputs are set to zero.
(reset of particular stages in Expert-mode 2)

4 INTEGRATION TIME [1] s (1...255 sec.)
The integration time (the time required to calculate the mean values of a measurement) can be changed for special applications.

5 SWITCHING POWER max [100] kvar (multiple of smallest step)
This factor specifies the maximum power which may be switched in one switching step. It can be used to control the intelligent control system, which switches several stages as a function of the power-factor requirement.

6 SWITCHING TRIGGER [66]% IND (30...100%)
[66]% CAP (30...100%)
Threshold for switching on of the next stage.(IND and CAP direction separately)
It should not be changed in the normal case !

7 OPERATING LOCK [NO] (NO / YES / 24H)
24 H means,that the lock will be automatically after 24 hours.

8 SWITCHING OPERATIONS WARNING [50 000] (1000...255000)
After an output has performed this number of switching operations, a warning message is displayed. (Abrasion of capacitor contactors)

9 CONTROL* [MEAN VALUE] (Mean /Maximum value)
*Only at single-phase measuring!
Selection whether the control during single-phase measuring should be done according to the mean or the maximum value of the missing reactive power (of the 3 phases)

10 C-TEST [YES] (YES/NO)
During each switching operation in AUTO-MODE the power of the particular capacitor stage is calculated and compared to the step power of the capacitor stage. An error message will be displayed in case of discrepancies!
(Display as inverse capacitor-symbol)
This test can be suppressed here.

11 C-FAULT(+) [140]% (110...200%)
Here the upwards deviation from the capacitor's nominal value can be determined. In case this value is reached, an error message is displayed (s. point 10)

12 C-FAULT (-) [60]% (10...90 %)
Here the downwards deviation from the capacitor's nominal value can be determined. In case this value is reached, an error message is displayed (s. point 10)

13 TEST ATTEMPTS [6] (2...9)
A C-error message is displayed only after these given numbers of consecutive measurements have indicated an error of the capacitor output.

14 POWER 1st stage [0...255] (0...2550)
Here the range for the input of the 1st stage power can be set to [0...2550]
(for example for HV-measurement)

15 Protocol Com 1 [MODBUS-RTU]

- [None] - Interface switched off
- [MODBUS KTR]
- [MODBUS RTU] - MODBUS-protocol for individual usage
- [ASCII-OUT] - Output of grid values as ASCII data structure ASCII protocol s. section 14.1

Depending on the selection of the protocol, the following configuration menu is offered:

16 BAUDRATE	[9600]	(4800...38400)	transmission rate
17 BUS-ADDRESS	[1]	(1...32)	address
18 ASCII transm. time	[10]s	(5. ..255s)	repetition time ASCII-transmission

Further points:

19 ... 29

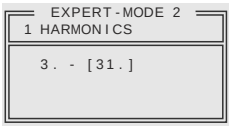
The ASCII-transmission protocol can here be adjusted according to the requirements:

Voltage, current, cos-phi, reactive power, active power, apparent power, outputs, max-/min-values, separator, start signal

12.2 EXPERT-MODE 2 (Code: 2244)

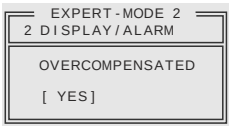
The 2nd expert mode defines all operation-, warning- and fault messages which can be displayed by the BR7000. They can be activated/de-activated separately. When de-activated, the display of the message as well as the possible activation of the alarm-relay or consequent effects on the control behavior are suppressed.
Here also the number of the harmonics to be calculated can be set.

1 HARMONICS 3. - [15.] (possible up to max. 31st)



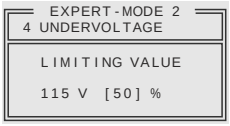
Setting of up to which maximum harmonic the calculation shall be done.
Note: the more harmonics are calculated, the slower the display of the harmonics is updated!

2 NOTIFICATIONS / ALARM [YES] =activ (YES / NO)
Activation/De-activation of the particular operation,- warning- and default messages:
Measuring voltage, over voltage, over-/under compensated, harmonics, over-temperature, over-current, under-voltage, switching operations, measuring current, error COM1, error COM2, Modbus switch off, Modbus-stop, Modbus switch on, system current <, Bus-error external, C-defect, System current >0, overload system, external error, C-defect off, AUTO-INIT-error



3 ALARM RELAY
Delay time [10] min. (1...255 min.)

4 UNDER VOLTAGE [50] % (20...95%)
If the measuring voltage falls below this value, all steps are simultaneously switched off.



5 OVER VOLTAGE [115] % (105...140%)
If the measuring voltage exceeds this value, the stages are switched off step by step. If the measuring voltage is again in the defined range, stepwise re-connection of steps is done.

6 THD-MEAN VALUE
Measuring cycles [3] (1...3)

7 SWITCHING OPERATIONS C1 RESET [NO] (YES/NO)
to
C15 RESET [NO] (YES/NO)
Reset of switching operations of particular capacitor steps,
e.g. after exchange of capacitors or capacitor contactors.

8 OPERATION TIME C1 RESET [NO] (YES/NO)
to
C15 RESET [NO] (YES/NO)
Reset of operation time of particular capacitor steps,
e.g. after exchange of capacitors or capacitor contactors.

Section 13: CONTROL PRINCIPLE

The control behavior can be selected in the programming mode. Generally, the BR7000 offers different possibilities of controlling:

- SEQUENTIAL CONNECTION

  In sequential connection, the required capacitor stages are successively connected or disconnected step by step (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.
  Disadvantage: long reaction time, high switching frequency of small stages, uneven strain on the capacitors.

  In order to shorten the setting times nevertheless, the BR7000 simultaneously switches several steps in case a higher power factor correction is required.
  This applies to all control modes.
  The maximum size of the simultaneously switched branches can be changed in EXPERT-MODE 1. If the value of the smallest stage is pre-selected, the conventional sequential connection is obtained.

- LOOP CONNECTION

  In this variant, the controller operates in loop connection (first in - first out) which minimizes the wear off of the system. E.g. in case of stages of same value always the stage that has been disconnected for the longest time is connected next.
  Advantage: even utilization of stages, increase of life time of system.
  Disadvantage: only effective for control series with groups of same stage power, long reaction times.

- INTELLIGENT (Factory setting)

  The intelligent control principle combines the advantages of the system-saving loop connection (first in first out) with a significantly higher setting time even in case of high load skips, and reaches this target with the fewest possible switching operations of capacitor steps. The optimized time behavior is reached by simultaneous switching of several or larger capacitor groups depending on the missing reactive power in the grid. Additionally, the number of real switchings of the capacitors as well as switch-in times of the branches are considered.
  Advantage: Reaching of target cos-phi in fast, optimized setting times in combination with a low switching frequency of the capacitor.

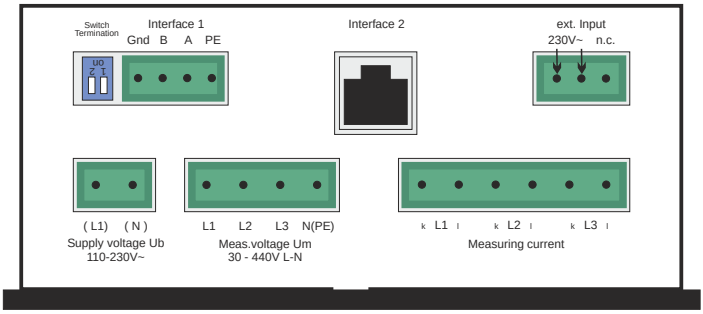
- COMBINED DE-TUNING (Special case for combined de-tuned systems)

  Pair wise de-tuning requires an appropriate control series (e.g. 1:1:1:1..., 1:1:2:2:..., 1:1:2:2:4:4...). The condition for the switching behavior is defined in a way that the number of connected odd steps always is higher or equal to the number of connected even steps. The controller fulfills the requirements in the control regime whilst largely conforming to the switching behavior.

Section 14: INTERFACES

As a standard, the BR7000 is equipped with two isolated RS485 interfaces according to the following assignment:

View from bottom :



.

The following functions can be realized via the interfaces:

- ☑ Parameterization of the controller via PC with enclosed software
- ☑ Remote read out of grid parameters, storage, display, grid analysis with enclosed PC-software BR7000-SOFT during online-operation
- ☑ Usage as system interface for connection of accessories or for coupling of two controllers
- ☑ Usage for customer specific applications (facility master control system, SPC etc.)
- ☑ Optional MODBUS-Protocol (s. Annex 5) or
- ☑ ASCII-Protocol (s.table p. 30)

Interface 1 mainly designed for customer specific applications, whilst
Interface 2 intended for coupling with accessories.

Coupling with a PC for the usage of Windows-Software can be done from both interfaces with accessory “USB-adapter”.

RS485- Bus structure

All devices are connected to one line in parallel. (Example connection of several BR7000 to a PC). This requires a direct connection of the bus lines to the plug connection of the device (no junction box).

Cable

For connection a twisted and shielded cable has to be used. The shielding has to be connected with casing or cabinet parts at both ends.
Max. cable length in the bus is 1,200 m (depending on cable and baud rate).
At the first and at the last device of the bus the cable has to be terminated with resistors. Activation (termination) on the controller side is done with the switch “Termination” next to the clamp “Interface1” (both white switches on “ON”).

14.1 Design of ASCII-transmission protocol

The following data are send one after the other:

DATE	TIME	
U1 = 223 V	U2 = 223 V	U3 = 223 V
I1 = 100 A	I2 = 100 A	I3 = 100 A
PF1 = 1.00	PF2 = 1.00	PF3 = 1.00
Q1 = 100 kvar	Q2 = 100 kvar	Q3 = 100 kvar
P1 = 100 kW	P2 = 100 kW	P3 = 100 kW
S1 = 100 kVA	S2 = 100 kVA	S3 = 100 kVA
OUT1 = -----	OUT2 = -----	OUT3 = -----
U1 max = 228 V	U2 max = 228 V	U3 max = 228 V
U1 min = 220 V	U2 min = 220 V	U3 min = 219 V
I1 max = 110 A	I2 max = 110 A	I3 max = 110 A
I1 min = 100 A	I2 min = 100 A	I3 min = 100 A

The ASCII- transmission protocol can be adjusted to the requirements:
(Expert-Mode 1 / Menu item 20 ff.)

14.2 Controller coupling

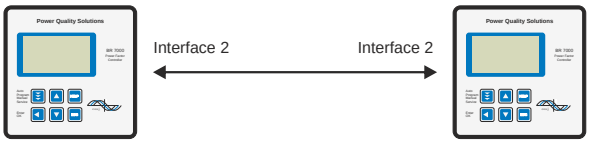
Attention: Controller coupling only possible in CONTROL-MODE 4, 5 and 6 !

Application example:

Two separate systems operate at two transformer feed ins; it exists one coupling with coupling switch between both systems.

a) Coupler opened; both systems operate self-governed;
b) Coupler closed: with the controller coupling both systems are operated symmetrically in *parallel operation* (same number of steps in each system) or both systems are operated in *master/slave mode*. (First all stages of the first system, then all steps of the second system)

Coupling of 2 power factor controllers BR7000 is done via their system interface:



The operation mode coupling operation (parallel operation resp. master-slave-operation) is selected in the program-mode under 22 EXTERNAL INPUT.
The 110...230V~ signal "coupling switch closed" has to be directed to the external input of a controller (master). The programming has to be performed only on this controller. No more settings required !

14.3 Windows-Software for PC (enclosed with delivery)

Windows-Software for programming of the PF-controller BR7000 and for visualization, storage and analysis of grid parameters.

- ☑ Connection to RS485-Bus
- ☑ Administration of several controllers possible
- ☑ Direct connection to USB-port of PC via accessory USB-adapter

It allows a comfortable visualization and analysis of grid parameters during online-operation. At the same time, the storage and graphical analysis of all recorded data incl. the export- and printing function can be performed. The spectrum of harmonics can promptly be displayed as bar chart.

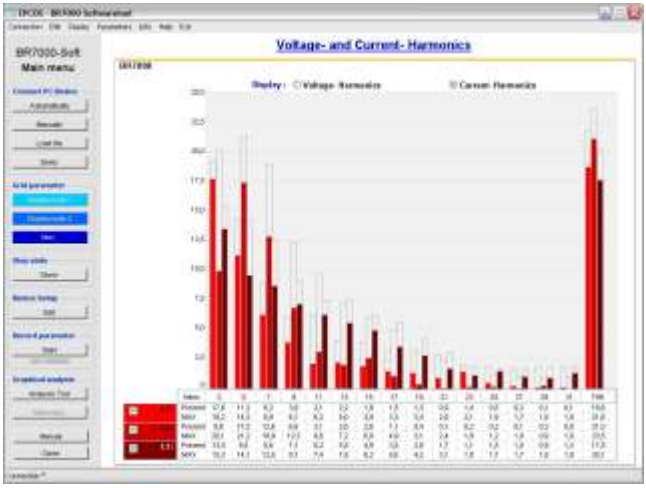
The display and recording mode allows a convenient online-display of different grid parameters. 3 display arrangements with each up to 12 different parameters can be shown simultaneously. All values displayed can be recorded for a later processing.
The step display delivers detailed information about the single switching steps.

With the configuration manager all parameters of the BR7000 can completely be read out, edited and stored and can be delivered back to the device. All values can be recorded in a configuration file.

The graphic mode allows the graphical display of recorded grid parameters for a congruent evaluation. All values can be freely configured. Copy and print function are possible.

A graphic bar diagram in the online-mode allows the display of voltage and current harmonics at one glance.

A detailed description of all software functions can be found in the brochure resp. in the online-help-function of the software.



Section 15: ALARM RELAY / ERROR MESSAGES

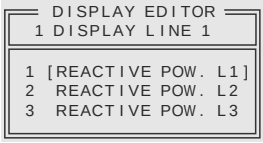
The contact of the alarm relay (K21) is closed during normal operation and opens in case of failure. At the same time, the respective error is indicated in plain text in the display:

UNDER COMPENSATED missing reactive power	- display and relay
OVER COMPENSATED	- display and relay
OVER CURRENT	- display and relay
MEASURING VOLTAGE ???	- display and relay
OVER TEMPERATURE	- display and relay
OVER VOLTAGE	- display and relay
UNDER VOLTAGE	- display and relay
HARMONICS	- display and relay

Additionally, several messages for different operation states are generated. An individual adjustment resp. masking of single messages is possible in EXPERT-MODE 2.
Listing of all messages s. chapter 12.2 item2 (page 27)
During masking, the display of message, the eventual output via alarm relay and possible influcences on the control process are suppressed.

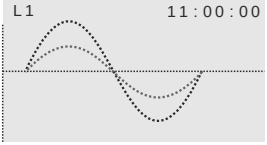
Section 16: DISPLAY-EDITOR

To be reached via button operation mode in the main menu.
In Display editor the values that will be permanently shown in the display mode 1 (s. large letter indication chapter 5) can be selected.
Out of all 50 measuring values that are available for each line (three lines in total) the desired value can be selected.



Section 17: OSCI-MODE

To be reached via button operation menu in the main menu.
In Osci-mode the actual form of a period of voltage and current is graphically displayed. This provides information about phase shift and curve form. Display possible consecutively for L1...L3



Section 18: MAINTENANCE AND WARRANTY

No maintenance of the BR7000 is required when operation conditions are obeyed. Nevertheless a functional check of the controller together with the rotational check of the compensation system is recommended.
The typical life expectancy of the internal Li-battery is min. 8...10 years. It is firmly connected to the circuit board and should only be exchanged by the manufacturer.
In the event of any interventions in the controller during the warranty period, all warranty claims lapse.

Annex 1: Troubleshooting

Fault	Reasons / Solution
For target cos PHI = 1 and inductive load steps are switched out / for the already compensated grid steps are switched in Supply and consumption exchanged.	Check terminals of measuring voltage and measuring current (l and k)! Check phase position! Check phase allocation (voltage/current in same phase)
Wrong cos Phi is displayed	See above
Display “Measuring current < ??” (UNDERCURRENT)	Current in measuring range ? Line interruption ? Wrong current-converter factor ? Current transformer short-circuited ?
Display: "OVERCURRENT” Alarm relay: after 10 min.	Check ratio of current transformer (1/5A) Go through measuring current range
Display: "UNDERCOMPENSATED” Alarm relay: after 10 min.	Check connections and phase position ! All stages connected, target PF not reached: - system sufficient dimensioned ?
Display: "OVERCOMPENSATED" Alarm relay: after 10 min.	Check connections and phase-position ! Capacitive grid although all stages are disconnected
Display: "MEASURING VOLTAGE ??" Alarm relay: after 10 min.	Measuring voltage missing !
Display: ”UNDERVOLTAGE” Alarm relay: after 10 min.	Measuring voltage (in programming) must be in line with real terminal voltage Check programming over-/under voltage range in EXPERT-MODE 2!
Display: "OVER-TEMPERATURE" Alarm relay: after 10 min.	System temperature too high ! Outputs are switched off in stages irrespective of power line conditions.
Display: “HARMONICS” Alarm relay: after 10 min.	Stages switch off consecutively according to the programmed time and control series. Check grid conditions! If permissible: increase threshold TDH-V (7 %)
Display: “WARN. SWITCH.OPERATIONS” Notification for user only! No influence on the control behavior.	Number of switching operations of a capacitor branch has reached the pre-set limiting value of 50,000. Reset possible in EXPERT-MODE.

Fault	Reasons / Solution
In inductive grid stages are switched off resp. in capacitive grid conditions stages are switched on	In case a value other than 1 for target- cos-phi is pre-set, the display “<” may be illuminated despite an inductive grid load. Arrows indicate the control direction, not the grid conditions!
The controller does not connect all stages or cos-phi does not change at the last stages	Check END STOP! Check CONTROL-MODE!
	Check whether in the menu ”Manual operation/fixed steps“ particular steps have been programmed as fixed steps or as OUT
Connected capacitor contactors are not in line with the expected capacitor stages.	Check allocation of outputs to capacitors: In program mode HELP-button call page 7-9 > table of allocations is displayed. Check control-mode and END STOP!
After turn-on, display shows ”SYSTEM TEST“	System test is for checking of the device when starting. If the page appears, at least one test is not OK. The error may be read, but not solved here. Please contact your local service. Depending on the error (e.g. internal battery empty) the device can be used anyhow. Quit screen with “ESC”.
The system permanently switches capacitors on and off although the number of consumers does not change (system oscillating).	Check programming and the capacitance of the smallest stage. Check programming and the values of the current converters. Check programming of the control series and the capacitance of the capacitors.
Operation voltage missing	Note: no display, alarm relay open

Annex 2: Technical Data

Type series	BR 7000....
Operating voltage	110...230 V~, +/-15%, 50 / 60Hz
Measuring voltage (3-phase)	3 · 30...440 V~ (L-N) / 50...760V~ (L-L)
Measuring current (3-phase)	3 · X : 5 / 1A selectable
Power consumption	< 3 VA
Sensitivity	50 mA / 10mA
Switching power	
Relay outputs for capacitor branches	15 relays: freely programmable for switching of single- and three-phase capacitors
Alarm relay	1
Message relay	1, programmable
Relay for panel fan	1
Switching power of relay outputs	250VAC, 1000W
Number of active outputs	programmable
Operation and display	illuminated full graphic display 128x64 dot
Menu Languages	Ger / E / ES / RU / TR
Number of control series	20
User-defined control series	1 via editor
Controlling	true controlling of each phase (L-N) und (L-L)
Modes of operation (1- and 3-phase)	1- phase: up to 3 · 5 single phase capacitors 3- phase: up to 15 three-phase capacitors mixed Mode: for balancing and compensation
Control principle	series switching, circular switching, self-optimized intelligent switching, 4-quadrant operation
Automatic initialization	possible
Meas. of individual capacitor step current	possible
Target- cos j	0.3 ind. ... 0.3 cap adjustable
2nd target cos j (time- or result controlled)	0.3 ind. ... 0.3 cap adjustable
Switch on time	selectable from 1 sec. to 20 min
Switch off time	selectable from 1 sec. to 20 min
Discharge time	selectable from 1 sec. to 20 min
Internal clock / several timers	yes
Manual operation	yes
Fixed steps / skip steps	programmable
Zero voltage release	standard

Display / Display functions	
Display of grid parameters	3-phase
As real value/in %/as bar graph	cos-Phi, voltage, current, frequency, reactive-, active-, apparent power, missing kvar, temperature, THD-U / THD-I
Large display of 3 grid parameters	selection via display-editor
Harmonics	3. - 31. harmonics of U and I display also in % or as bar graph
Osci-mode	graphical display of 1 period U/I in oscilloscope mode
Precision	current / voltage: 1% active, reactive, apparent power: 2%
Integrated auxiliary function	context depending, plain text
Storage function	
Storage of maximum values with time stamp	voltage, current, reactive-, active-, apparent power, temperature, THD-V, THD-I
Storage of switching operations	each output, separately re-settable
Storage of operation time	each capacitor step, separately re-settable
Temperature measuring range	-30 ... 100°C
Temperature monitoring	automatic switching-off of steps
Error storage	error register in plain text with time stamp
Interface	
Software for device settings, visualization, display and recording of grid parameters	2 independent isolated interfaces RS485 (MODBUS RTU, system interface) enclosed in delivery
External Input	110...230V~ isolated
Complete 2nd parameter set	via external input or event driven
Casing	panel-mounted instrument
	DIN 43 700, 144 x 144 x 60 mm
Weight	1 kg
Operating ambient temperature	-20 ... +60°C
Protection class accord. DIN 40 050	front: IP 54, rear: IP 20
Safety standards	IEC 61010-1
Interference resistance	IEC 61000-6-2
EMV-resistance	IEC 61000-4-2: 8kV
	IEC 61000-4-4: 4kV
	EN 61326

Annex 3: Factory settings

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

No.	Parameter	Default setting	Programmed values of this system (to be entered by manufacturer or operator)
1	LANGUAGE	ENGLISH	
2	CONTROL-MODE	[1] 3x5 single-phase capacitors L-N	
3	I CONVERTER PRIM.	1000 A	
4	I CONVERTER SEC.	5 A	
5	END STOP	3 x 5	
6	CONTROL SERIE	1	
7	CONTROL PRINCIPLE	INTELLIGENT	
8	POWER 1st STAGE	25.00 kvar	
9	TARGET COS-PHI	0.98 IND	
10	TARGET 2nd COS-PHI	- NO -	
14	MEASURING VOLTAGE	L-L 400 V (L-N 230V)	
15	V-CONVERTER	- NO -	
16	CONNECTING TIME	40 sec.	
17	DISCONNECT. TIME	40 sec.	
18	DISCHARGE TIME	60 sec.	
19	ALARM TEMPERATURE	55°C	
20	FAN TEMPERATURE	30°C	
21	MESSAGE RELAY	ENERGY SUPPLY	
22	EXT. INPUT	- NO -	
37	HARMONICS THD-V	7 %	
38	CLOCK / DATE		
39	CONTRAST	5	
40	BASIC SETTINGS	- NO -	

No.	Parameter 2nd parameter set / EXPERT-MODE	Default setting	programmed values of this system (to be entered by manufacturer or operator)
23- 36	Values 2nd parameter set Expert-Mode:		Default values are the same as in the 1st parameter set.
	Code Expert-Mode 1	6343	Cannot be changed
	Code Expert-Mode 2	2244	Cannot be changed
1	BASIC SETTINGS	- NO -	
2	SWITCH.OPERATION Reset	- NO -	
3	OPERATING TIME Reset	- NO -	
4	INTEGRATION TIME	1 sec.	
5	SWITCH.POWER	4 x smallest stage	
6	SWITCH.TRIGGER	66 %	
7	OPERATING LOCK	- NO -	
8	SWITCH.OPER.WARNING	50,000	
9	CONTROL*	MEAN VALUE	
10	C- TEST	- YES -	
11	C- FAULT (+) *	140 %	
12	C- FAULT (-) *	60 %	
13	TEST ATTEMPTS *	6	
14	OUTPUT 1st STEP	[0 ...255] kvar	
15	PROTOCOL	MODBUS-RTU	
16	BAUD*	9600	
17	ADRESS *	1	
18	ASCII-REPET.TIME*	10 sec.	
	Selection of parameters content ASCII-protocol	all values “YES” (enabled)	

Annex 4: Table of control series

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

Control series editor: Programming of step values up to 30

The control series editor enables easy creation of own control series in case the required control series is not available.
In "PROGRAM-MODE" the last control series - control series ED - has to be selected and confirmed by ENTER. This adds an additional menu point to the main menu -> control series editor. It can be accessed via button „operation mode“.

In the control series editor all stages can be set consecutively to the desired value with the selection buttons ↑ /↓. Pressing ENTER leads to the next stage.

In the control series editor the particular stages can be programmed up to a value of 30 (!). The values >9 are displayed as follows:
10=A, 11= B, 12=C, 13=D, 14=E, 15=F, 16=G .... 30=U

Attention: All control series can be edited (even downwards). Whether an edited control series “makes sense” is the decision of the customer.

Maximum number of stages can be limited by a programmed ENDSTOP.

By pressing button ”Operation mode“ the editor is left.

Annex 5: MODBUS-Protocol - Part 1: read-only registers (Functioncode 3)

F	Modbus No.	Register / Function	Range	Unit / Digit	Note
3	20	Voltage L1	16 Bit	1 V	
	21	Current L1	16 Bit	1 A	
	22	Frequency L1	16 Bit	1 Hz	
	23	Temperature (cabinet)	16 Bit	1 °C	
	3001	Power multiplier	16 Bit	1, 10, 100, 1000	to multiply with readed power
	3002	Reactive power L1	16 Bit	1 var	to get real values s. No. 3001
	3003	Reactive power L2	16 Bit	1 var	to get real values s. No. 3001
	3004	Reactive power L3	16 Bit	1 var	to get real values s. No. 3001
	3005	Reactive power Sum	16 Bit	1 var	to get real values s. No. 3001
	3006	Active Power L1	16 Bit	1 W	to get real values s. No. 3001
	3007	Active Power L2	16 Bit	1 W	to get real values s. No. 3001
	3008	Active Power L3	16 Bit	1 W	to get real values s. No. 3001
	3009	Active Power Sum	16 Bit	1 W	to get real values s. No. 3001
	3010	Apparent power L1	16 Bit	1 VA	to get real values s. No. 3001
	3011	Apparent power L1	16 Bit	1 VA	to get real values s. No. 3001
	3012	Apparent power L3	16 Bit	1 VA	to get real values s. No. 3001
	3013	Apparent power Sum	16 Bit	1 VA	to get real values s. No. 3001
	3014	Diff. Reactive power L1	16 Bit	1 var	to get real values s. No. 3001
	3015	Diff. Reactive power L2	16 Bit	1 var	to get real values s. No. 3001
	3016	Diff. Reactive power L3	16 Bit	1 var	to get real values s. No. 3001
	3017	Diff. Reactive power Sum	16 Bit	1 var	to get real values s. No. 3001
	3018	Voltage L1	16 Bit	1 V	
	3019	Voltage L2	16 Bit	1 V	
	3020	Voltage L3	16 Bit	1 V	
	3021	Current L1	16 Bit	1 A	
	3022	Current L2	16 Bit	1 A	
	3023	Current L3	16 Bit	1 A	
	3024	cos-Phi L1	16 Bit		800 = 0,800cap
	3025	cos-Phi L2	16 Bit		1000= 1,000
	3026	cos-Phi L3	16 Bit		1200= 0,800ind
	3027	cos-Phi Sum	16 Bit		
	3028	Frequency L1	16 Bit	1 Hz	
	3029	Frequency L2	16 Bit	1 Hz	
	3030	Frequency L3	16 Bit	1 Hz	
	3031	Temperature (cabinet)	16 Bit	1 °C	
	3032	Output (relays) K1 ..16	16 x 1 Bit	0 / 1	
	3033	Output (relays) K17..32	16 x 1 Bit	0 / 1	
	3034	Output (relays) K33..48	16 x 1 Bit	0 / 1	
	3035	Output (relays) K49..64	16 x 1 Bit	0 / 1	
	3036	Control direction L1 / L2 / L3 / Sum	4 x 2 Bit	1= s-off/ 2= stop 3= switch-on	Bit0,1= L1 / Bit2,3= L2 / Bit4,5= L3 / Bit6,7= Sum
	3037	Error register L1 / L2	2 x 8 Bit		High= L1 / Low= L2
	3038	Error register L3 / Sum	2 x 8 Bit		High= L3 / Low= Sum
	3039	Warning register L1 / L2	2 x 8 Bit		High= L1 / Low= L2
	3040	Warning register L3 / Sum	2 x 8 Bit		High= L3 / Low= Sum
	3041	Message register	16 Bit		
	3042	Control status	16 Bit		
	3043	Time	16 Bit		High= Min. / Low= Second
	3044	Date / Time	16 Bit		High= Day / Low= Hour
	3045	Date	16 Bit		High= Month / Low= Year
	3073..3087	3. - 31. Voltage Harmonics L1	16 Bit	0,1 %	
	3088..3102	3. - 31. Voltage Harmonics L2	16 Bit	0,1 %	
	3103..3117	3. - 31. Voltage Harmonics L3	16 Bit	0,1 %	
	3118..3132	3. - 31. Current Harmonics L1	16 Bit	0,1 %	
	3133..3147	3. - 31. Current Harmonics L2	16 Bit	0,1 %	
	3148..3162	3. - 31. Current Harmonics L3	16 Bit	0,1 %	
	3163	Voltage THD L1	16 Bit	0,1 %	
	3164	Voltage THD L2	16 Bit	0,1 %	
	3165	Voltage THD L3	16 Bit	0,1 %	
	3166	Current THD L1	16 Bit	0,1 %	
	3167	Current THD L2	16 Bit	0,1 %	
	3168	Current THD L3	16 Bit	0,1 %	

Annex 5: MODBUS-Protocol - Part 2: read-only registers (Functioncode 3)

F	Modbus No.	Register / Function	Range	Unti / Digit	Note
3	3276	Min. Voltage L1	16 Bit	1 V	
	3277	Min. Voltage L2	16 Bit	1 V	
	3278	Min. Voltage L3	16 Bit	1 V	
	3279	Max. Voltage L1	16 Bit	1 V	
	3280	Max. Voltage L2	16 Bit	1 V	
	3281	Max. Voltage L3	16 Bit	1 V	
	3282	Max. Current L1	16 Bit	1 A	
	3283	Max. Current L2	16 Bit	1 A	
	3284	Max. Current L3	16 Bit	1 A	
	3285	Max. Power multiplier	16 Bit	1, 10, 100, 1000	multiply with read.max. power
	3286	Max. Reactive power L1	16 Bit	1 var	to get real values s. No. 3285
	3287	Max. Reactive power L2	16 Bit	1 var	to get real values s. No. 3285
	3288	Max. Reactive power L3	16 Bit	1 var	to get real values s. No. 3285
	3289	Max. Reactive power Sum	16 Bit	1 var	to get real values s. No. 3285
	3290	Max. Active power L1	16 Bit	1 W	to get real values s. No. 3285
	3291	Max. Active power L2	16 Bit	1 W	to get real values s. No. 3285
	3292	Max. Active power L3	16 Bit	1 W	to get real values s. No. 3285
	3293	Max. Active power Sum	16 Bit	1 W	to get real values s. No. 3285
	3294	Max. Apparent power L1	16 Bit	1 VA	to get real values s. No. 3285
	3295	Max. Apparent power L2	16 Bit	1 VA	to get real values s. No. 3285
	3296	Max. Apparent power L3	16 Bit	1 VA	to get real values s. No. 3285
	3297	Max. Apparent power Sum	16 Bit	1 VA	to get real values s. No. 3285
	3298	Max. Temperature (cabinet)	16 Bit	1 °C	
	3299	Max. Voltage THD L1	16 Bit	0,1%	
	3300	Max. Voltage THD L2	16 Bit	0,1%	
	3301	Max. Voltage THD L3	16 Bit	0,1%	
	3302	Max. Current THD L1	16 Bit	0,1%	
	3303	Max. Current THD L2	16 Bit	0,1%	
	3304	Max. Current THD L3	16 Bit	0,1%	
	3305, 3306	Reactive Energy (inductive)	32 Bit	kvarh	High-, Low- Word
	3307, 3308	Reactive Energy (capacitive)	32 Bit	kvarh	High-, Low- Word
	3309, 3310	Work (+)	32 Bit	kWh	High-, Low- Word
	3311, 3312	Work (-)	32 Bit	KWh	High-, Low- Word
	3329 - 3388	Status of step K1 - K60	2 Bit	1= Off, 2= Auto, 3= Fix, 4=Error	
	3389 - 3448	Valency of step K1 - K60	16 Bit	1	
	3449 - 3508	Switching cycles of step K1 - K60	16 Bit	1	Low- Word } Switching cycles
	3509 - 3568	Switching cycles of step K1 - K60	16 Bit		High-Word } Switching cycles
	3585 - 3644	Operation time of step K1 - K60	16 Bit	1 min	Low- Word } Operation time
	3645 - 3704	Operation time of step K1 - K60	16 Bit		High-Word } Operation time
	3705, 3706	Controller operation time	32 Bit	1 min	High-, Low- Word
	3824, 3825	Output power reference (Master-Sl.)	32 Bit	1 kvar	High-, Low- Word
	3826	Number of outputs (Master-Slave)	16 Bit	1	
	3827, 3828	Diff. Reactive power (Master-Slave)	32 Bit	1 kvar	High-, Low- Word
	3829	Cuppling-switch status (Master-Sl.)	0 / 1	1	

Modbus Function-Code 3 (read-only), E.g.: Read register 3018 (Voltage L1). Result = 233V

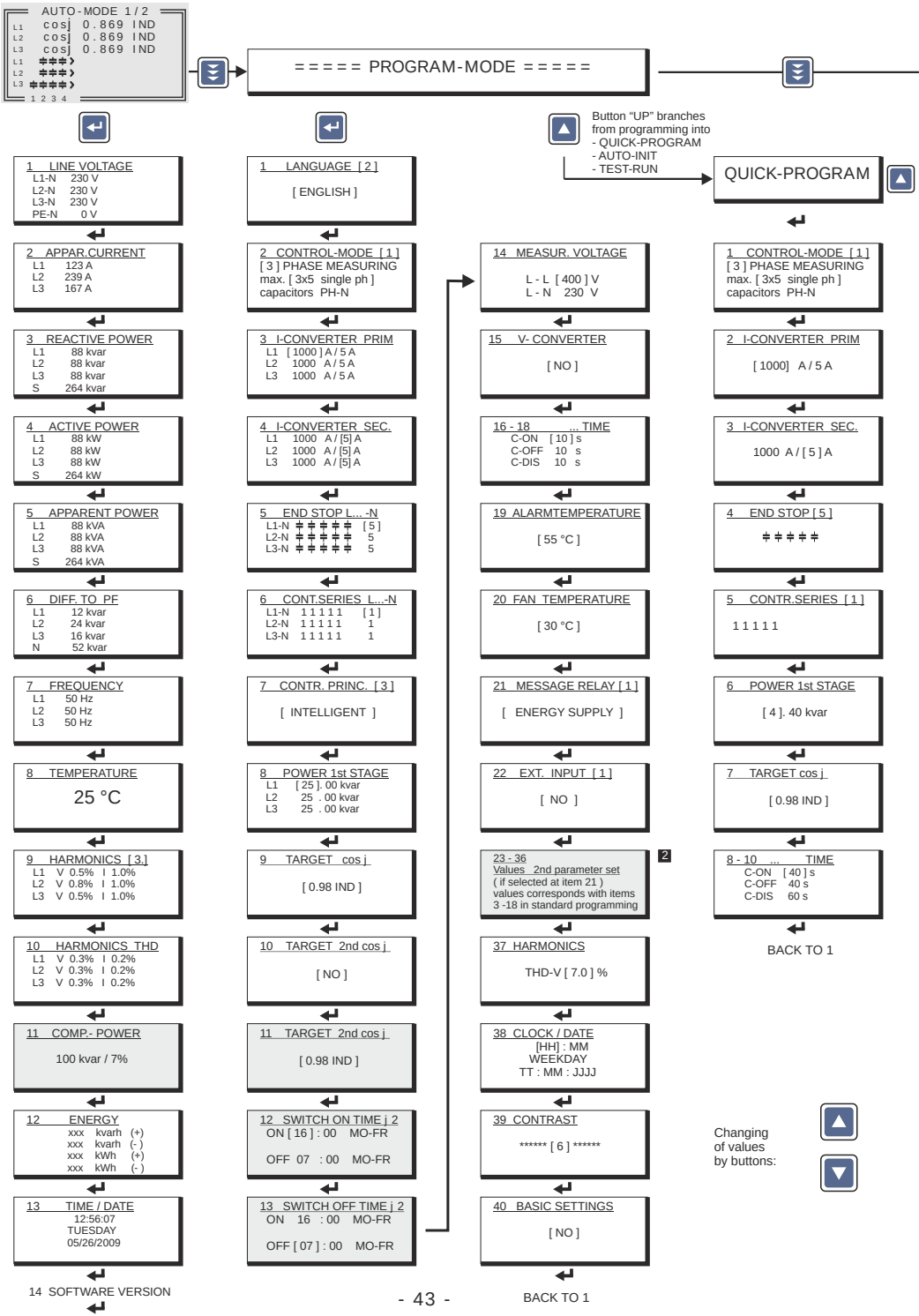
Byte	Master	dec	hex	Response	dec	hex	Resp. Exeption	dec	hex
1	Slave Address	1	0h01	Slave Addr.	1	0h01	Slave Addr.	1	0h01
2	Functioncode	3	0h03	Functionc.	3	0h03	Functionc.	131	0h83
3	Starting register 'H'	11	0h0B	Quantity	2	0h02	Exception code	1	0h01
4	Starting register 'L'	202	0hCA	Data 'H'	0	0h00	CRC 'L'	128	0h80
5	Quantity 'H'	0	0h00	Data 'L'	233	0hE9	CRC 'H'	240	0hF0
6	Quantity 'L'	1	0h01	CRC 'L'	121	0hD4			
7	CRC 'L'	144	0h90	CRC 'H'	202	0hCA			
8	CRC 'H'	122	0h7A						

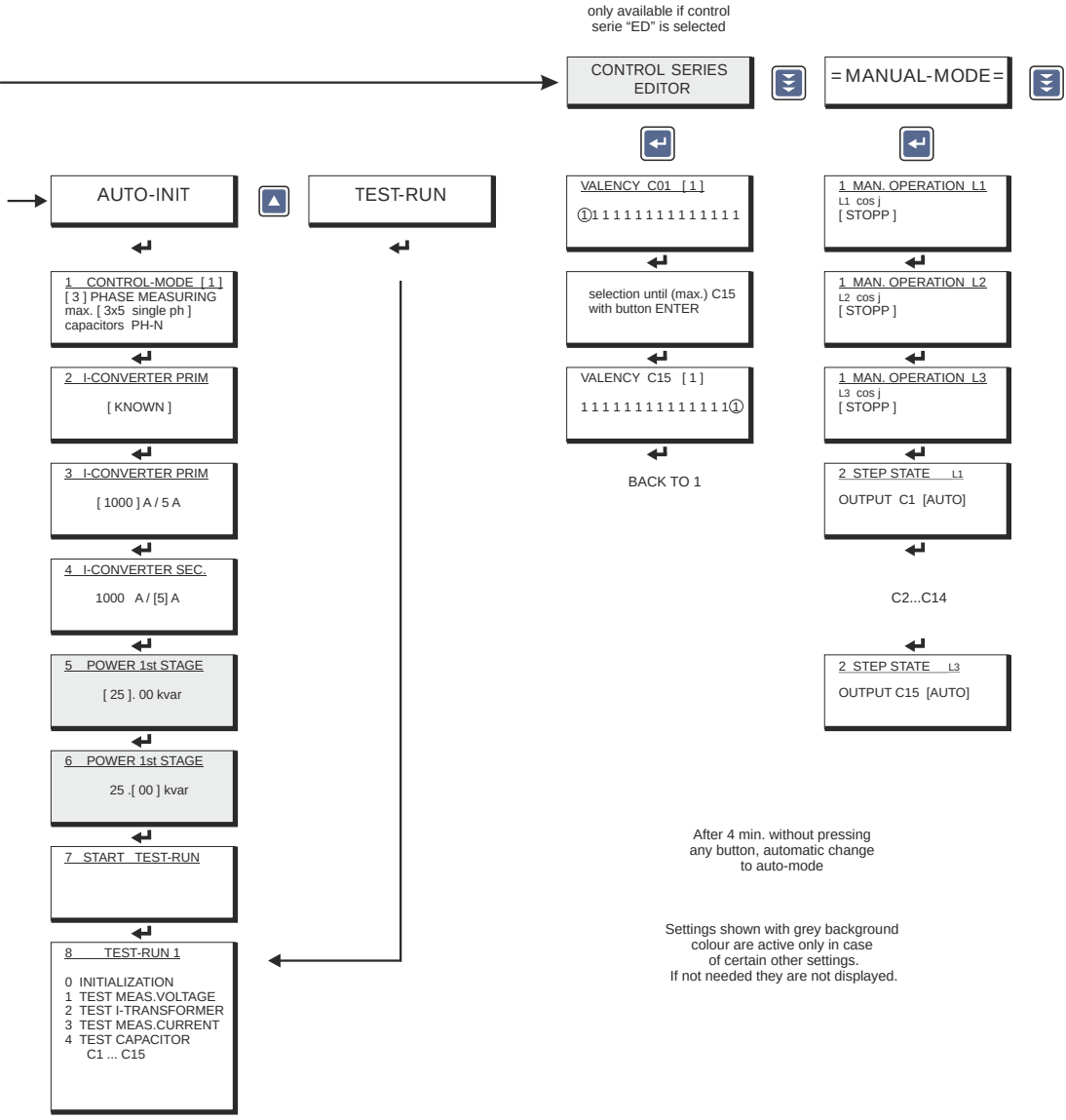
Annex 5: MODBUS-Protocol - Part 3: Read-/ Write-registers (Functioncode 3 / 6)

Modbus No. 3	Modbus No. 6	HIGH-Byte Register / Function	Range	LOW-Byte Register / Function	Range
------	40	Remote: 0= remote off, 1= switching-down, 2= stop, 3= switching-up Bit: 0,1=Sum; 2,3=L1; 4,5=L2; 6,7=L3	8 Bit	Remote-control: max. switching power (multiple of 1st step power)	1 - max 8 Bit
3173	101	Language 0= german, 1= english, ...	0 - 6	Measuring- / Controlling - Mode 0= Mode 1, ...	0 - 5
3174	102	I - converter primary L1 1= 5A, ...	1 - 255	I - converter primary L2 1= 5A, ...	1 - 255
3175	103	I - converter primary L3 1= 5A..	1 - 255	I - converter secondary 0= 1A / 1= 5A	0 / 1
3176	104	Endstop L1	1 - 5	Endstop L2	1 - 5
3177	105	Endstop L3	1 - 5	Endstop Sum	1 - 15
3178	106	Control series L1	1 - 21	Control series L2	1 - 21
3179	107	Control series L3	1 - 21	Control series Sum	1 - 21
3180	108	Control mode 0= Sequent / LiFo, 1= Loop / FiFo, ...	0 - 3	Power of 1st step L1 (integer digits) 0 - 255 kvar / 0 - 2550 kvar	0 - 255
3181	109	Power of 1st step L1 (decimal digits)	0 - 99	Power of 1st step L2 (integer digits)	0 - 255
3182	110	Power of 1st step L2 (decimal digits)	0 - 99	Power of 1st step L3 (integer digits)	0 - 255
3183	111	Power of 1st step L3 (decimal digits)	0 - 99	Power of 1st step Sum (integer d.)	0 - 255
3184	112	Power of 1st step Sum (decimal d.) 0 - 99 / 128= Power 0 - 2550kvar	0 - 99 / 128	Target cos Phi 80= 0,80cap/ 100= 1,00/ 120= 0,80ind	30 - 170
3185	113	Additional option 0= No, 1= Timer , 2= Energy supply	0 - 2	2nd Target cos Phi 80= 0,80cap/ 100= 1,00/ 120= 0,80ind	30 - 170
3186	114	Beginning: Hour	0 - 23	Beginning: Minute	0 - 59
3187	115	Beginning: Weekday 7= Sunday, ..., 14= Mo-Fr, ...	7 - 17	Ending: Hour	0 - 23
3188	116	Ending: Minutes	0 - 59	Ending: Weekday	7 - 17
3189	117	Measuring voltage L-L 50 - 760V with 5V-stepping	10 - 152	Voltage converter (primary) 0= No, 1= 410V, 2= 420V, ...	0 - 255
3190	118	Switch-on delay	0 - 138	Switch-off delay	0 - 138
3191	119	Discharge time	0 - 138	Alarm temperature 20 - 80°C with 1°C stepping	20 - 80
3192	120	Fan start-up temperature 15 - 70°C with 1°C stepping	15 - 70	Message relay 4= Energy Supply, 5= Undercurrent, ..	4 - 6
3193	121	2nd Parameter set	0 / 1	I - converter primary L1	0 - 255
3194	122	I - converter primary L2	0 - 255	I - converter primary L3	0 - 255
3195	123	I - converter secondary	0 - 255	Endstop L1	1 - 5
3196	124	Endstop L2	1 - 5	Endstop L3	1 - 5
3197	125	Endstop Sum	1 - 15	Control series L1	1 - 21
3198	126	Control series L2	1 - 21	Control series L3	1 - 21
3199	127	Control series Sum	1 - 21	Control mode	0 - 3
3200	128	Power of 1st step L1 (integer digits)	0 - 255	Power of 1st step L1 (decimal digits)	0 - 99
3201	129	Power of 1st step L2 (integer digits)	0 - 255	Power of 1st step L2 (decimal digits)	0 - 99
3202	130	Power of 1st step L3 (integer digits)	0 - 255	Power of 1st step L3 (decimal digits)	0 - 99
3203	131	Power of 1st step Sum (integer d.)	0 - 255	Power of 1st step Sum (decimal d.)	0 - 99
3204	132	Target cos Phi	30 - 170	Additional option	0 - 2
3205	133	2nd Target cos Phi	30 - 170	Beginning: Hour	0 - 23
3206	134	Beginning: Minute	0 - 59	Beginning: Weekday	7 - 17
3207	135	Ending: Hour	0 - 23	Ending: Minute	0 - 59
3208	136	Ending: Weekday	7 - 17	Switch-on delay	0 - 138
3209	137	Switch-off delay	0 - 138	Discharge time	0 - 138
3210	138	Voltage-THD threshold 1.0 - 25.5% with 0.1% stepping	10 - 255		0 - 59

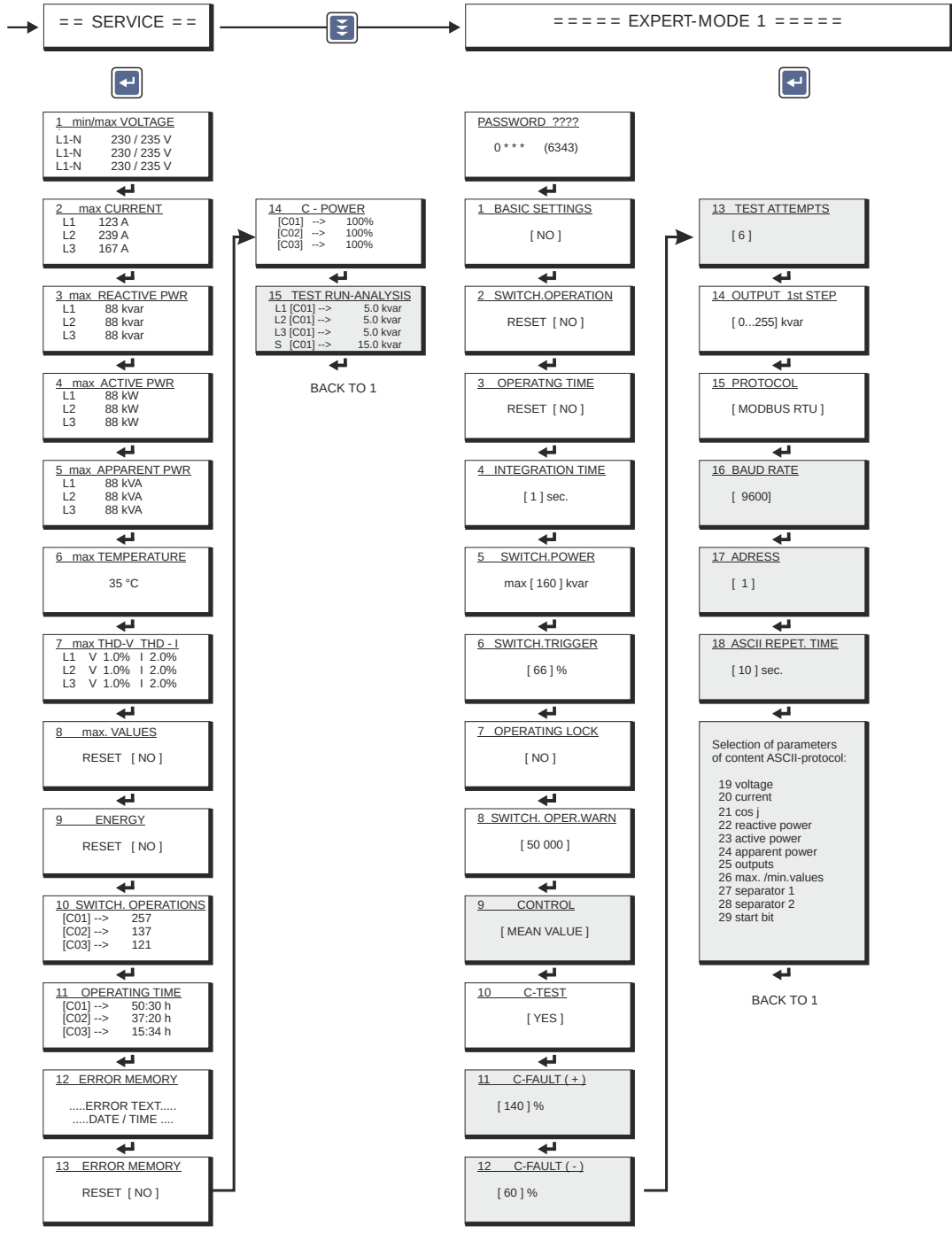
Modbus Function-Code 6 (write), E.g.: Write to Register 101 = 1 (Language = english)

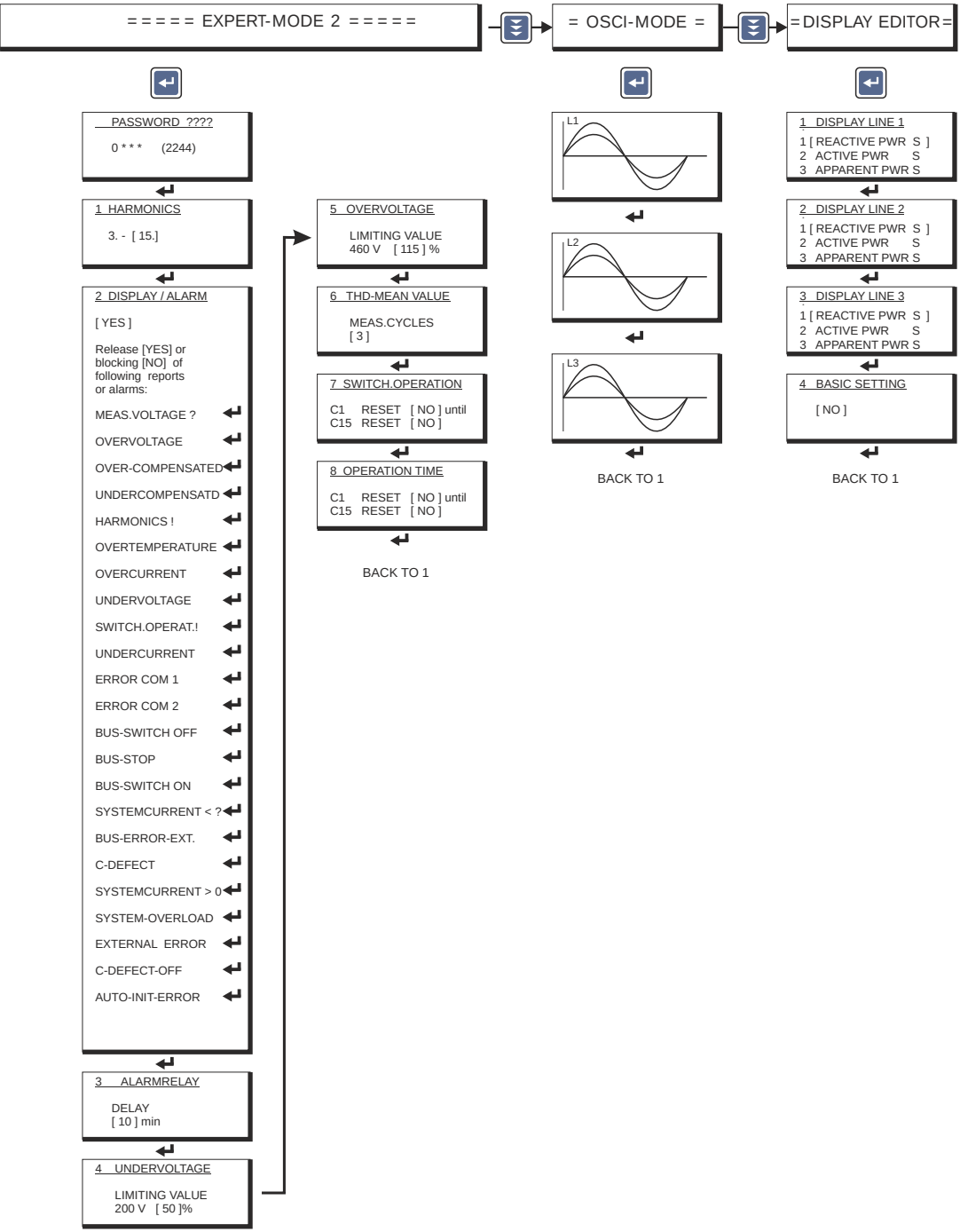
Byte	Master	dec	hex	Responce	dec	hex	Resp.Exeption	dec	hex
1	Slave Address	1	0h01	Slave Addr.	1	0h01	Slave Addr.	1	0h01
2	Functioncode	6	0h06	Functionc.	6	0h06	Functionc.	134	0h86
3	Register Address ‘H’	0	0h00	Reg. Addr. ‘H’	0	0h00	Exception code	1	0h01
4	Register Address ‘L’	101	0h65	Reg. Addr. ‘L’	101	0h65	CRC ‘L’	131	0h83
5	Data ‘H’	0	0h00	Data ‘H’	0	0h00	CRC ‘H’	160	0hA0
6	Data ‘L’	1	0h01	Data ‘L’	1	0h01			
7	CRC ‘L’	88	0h58	CRC ‘L’	88	0h58			
8	CRC ‘H’	21	0h15	CRC ‘H’	21	0h15			


AUTO-MODE 1 / 2
L1 cosj 0.869 IND
L2 cosj 0.869 IND
L3 cosj 0.869 IND
L1
L2
L3
1 2 3 4
===== PROGRAM-MODE =====
Button "UP" branches from programming into
- QUICK-PROGRAM
- AUTO-INIT
- TEST-RUN
1 LINE VOLTAGE
L1-N 230 V
L2-N 230 V
L3-N 230 V
PE-N 0 V
2 APPAR.CURRENT
L1 123 A
L2 239 A
L3 167 A
3 REACTIVE POWER
L1 88 kvar
L2 88 kvar
L3 88 kvar
S 264 kvar
4 ACTIVE POWER
L1 88 kW
L2 88 kW
L3 88 kW
S 264 kW
5 APPARENT POWER
L1 88 kVA
L2 88 kVA
L3 88 kVA
S 264 kVA
6 DIFF. TO PF
L1 12 kvar
L2 24 kvar
L3 16 kvar
N 52 kvar
7 FREQUENCY
L1 50 Hz
L2 50 Hz
L3 50 Hz
8 TEMPERATURE
25 °C
9 HARMONICS [3]
L1 V 0.5% I 1.0%
L2 V 0.8% I 1.0%
L3 V 0.5% I 1.0%
10 HARMONICS THD
L1 V 0.3% I 0.2%
L2 V 0.3% I 0.2%
L3 V 0.3% I 0.2%
11 COMP.- POWER
100 kvar / 7%
12 ENERGY
xxx kvarh (+)
xxx kvarh (-)
xxx kWh (+)
xxx kWh (-)
13 TIME / DATE
12:56:07
TUESDAY
05/26/2009
14 SOFTWARE VERSION
BACK TO 1
1 LANGUAGE [2]
[ENGLISH]
2 CONTROL-MODE [1]
[3] PHASE MEASURING
max. [3x5 single ph]
capacitors PH-N
3 I-CONVERTER PRIM
L1 [1000] A / 5 A
L2 1000 A / 5 A
L3 1000 A / 5 A
4 I-CONVERTER SEC.
L1 1000 A / [5] A
L2 1000 A / [5] A
L3 1000 A / [5] A
5 END STOP L...-N
L1-N [5]
L2-N 5
L3-N 5
6 CONT.SERIES L...-N
L1-N 1 1 1 1 1 [1]
L2-N 1 1 1 1 1 1
L3-N 1 1 1 1 1 1
7 CONTR. PRINC. [3]
[INTELLIGENT]
8 POWER 1st STAGE
L1 [25]. 00 kvar
L2 25 . 00 kvar
L3 25 . 00 kvar
9 TARGET cos j
[0.98 IND]
10 TARGET 2nd cos j
[NO]
11 TARGET 2nd cos j
[0.98 IND]
12 SWITCH ON TIME j 2
ON [16] : 00 MO-FR
OFF 07 : 00 MO-FR
13 SWITCH OFF TIME j 2
ON 16 : 00 MO-FR
OFF [07] : 00 MO-FR
- 43 -
14 MEASUR. VOLTAGE
L - L [400] V
L - N 230 V
15 V- CONVERTER
[NO]
16 - 18 ... TIME
C-ON [10] s
C-OFF 10 s
C-DIS 10 s
19 ALARMTEMPERATURE
[55 °C]
20 FAN TEMPERATURE
[30 °C]
21 MESSAGE RELAY [1]
[ENERGY SUPPLY]
22 EXT. INPUT [1]
[NO]
23 - 36
Values 2nd parameter set
(if selected at item 21)
values corresponds with items
3 -18 in standard programming
2
37 HARMONICS
THD-V [7.0] %
38 CLOCK / DATE
[HH] : MM
WEEKDAY
TT : MM : JJJJ
39 CONTRAST
****** [6] ******
40 BASIC SETTINGS
[NO]
BACK TO 1
QUICK-PROGRAM
1 CONTROL-MODE [1]
[3] PHASE MEASURING
max. [3x5 single ph]
capacitors PH-N
2 I-CONVERTER PRIM
[1000] A / 5 A
3 I-CONVERTER SEC.
1000 A / [5] A
4 END STOP [5]
5 CONTR.SERIES [1]
1 1 1 1 1
6 POWER 1st STAGE
[4]. 40 kvar
7 TARGET cos j
[0.98 IND]
8 - 10 ... TIME
C-ON [40] s
C-OFF 40 s
C-DIS 60 s
BACK TO 1
Changing of values by buttons:



Operating diagram (Brief programming)
Power Factor Controller BR 7000 (V1.1)


== SERVICE ==
===== EXPERT-MODE 1 =====
1 min/max VOLTAGE
L1-N 230 / 235 V
L1-N 230 / 235 V
L1-N 230 / 235 V
2 max CURRENT
L1 123 A
L2 239 A
L3 167 A
3 max REACTIVE PWR
L1 88 kvar
L2 88 kvar
L3 88 kvar
4 max ACTIVE PWR
L1 88 kW
L2 88 kW
L3 88 kW
5 max APPARENT PWR
L1 88 kVA
L2 88 kVA
L3 88 kVA
6 max TEMPERATURE
35 °C
7 max THD-V THD - I
L1 V 1.0% I 2.0%
L2 V 1.0% I 2.0%
L3 V 1.0% I 2.0%
8 max. VALUES
RESET [NO]
9 ENERGY
RESET [NO]
10 SWITCH. OPERATIONS
[C01] --> 257
[C02] --> 137
[C03] --> 121
11 OPERATING TIME
[C01] --> 50:30 h
[C02] --> 37:20 h
[C03] --> 15:34 h
12 ERROR MEMORY
.....ERROR TEXT.....
.....DATE / TIME ....
13 ERROR MEMORY
RESET [NO]
14 C - POWER
[C01] --> 100%
[C02] --> 100%
[C03] --> 100%
15 TEST RUN-ANALYSIS
L1 [C01] --> 5.0 kvar
L2 [C01] --> 5.0 kvar
L3 [C01] --> 5.0 kvar
S [C01] --> 15.0 kvar
BACK TO 1
PASSWORD ????
0 * * * (6343)
1 BASIC SETTINGS
[NO]
2 SWITCH.OPERATION
RESET [NO]
3 OPERATNG TIME
RESET [NO]
4 INTEGRATION TIME
[1] sec.
5 SWITCH.POWER
max [160] kvar
6 SWITCH.TRIGGER
[66] %
7 OPERATING LOCK
[NO]
8 SWITCH. OPER.WARN
[50 000]
9 CONTROL
[MEAN VALUE]
10 C-TEST
[YES]
11 C-FAULT (+)
[140] %
12 C-FAULT (-)
[60] %
13 TEST ATTEMPTS
[6]
14 OUTPUT 1st STEP
[0...255] kvar
15 PROTOCOL
[MODBUS RTU]
16 BAUD RATE
[9600]
17 ADRESS
[1]
18 ASCII REPET. TIME
[10] sec.
Selection of parameters
of content ASCII-protocol:
19 voltage
20 current
21 cos j
22 reactive power
23 active power
24 apparent power
25 outputs
26 max. /min.values
27 separator 1
28 separator 2
29 start bit
BACK TO 1


===== EXPERT-MODE 2 =====
= OSCI-MODE =
=DISPLAY EDITOR=
PASSWORD ????
0 * * * (2244)
1 HARMONICS
3. - [15.]
2 DISPLAY / ALARM
[YES]
Release [YES] or blocking [NO] of following reports or alarms:
MEAS.VOLTAGE ?
OVERVOLTAGE
OVER-COMPENSATED
UNDERCOMPENSATD
HARMONICS !
OVERTEMPERATURE
OVERCURRENT
UNDERVOLTAGE
SWITCH.OPERAT.!
UNDERCURRENT
ERROR COM 1
ERROR COM 2
BUS-SWITCH OFF
BUS-STOP
BUS-SWITCH ON
SYSTEMCURRENT < ?
BUS-ERROR-EXT.
C-DEFECT
SYSTEMCURRENT > 0
SYSTEM-OVERLOAD
EXTERNAL ERROR
C-DEFECT-OFF
AUTO-INIT-ERROR
3 ALARMRELAY
DELAY
[10] min
4 UNDERVOLTAGE
LIMITING VALUE
200 V [50]%
5 OVERVOLTAGE
LIMITING VALUE
460 V [115] %
6 THD-MEAN VALUE
MEAS.CYCLES
[3]
7 SWITCH.OPERATION
C1 RESET [NO] until
C15 RESET [NO]
8 OPERATION TIME
C1 RESET [NO] until
C15 RESET [NO]
BACK TO 1
L1
L2
L3
BACK TO 1
1 DISPLAY LINE 1
1 [REACTIVE PWR S]
2 ACTIVE PWR S
3 APPARENT PWR S
2 DISPLAY LINE 2
1 [REACTIVE PWR S]
2 ACTIVE PWR S
3 APPARENT PWR S
3 DISPLAY LINE 3
1 [REACTIVE PWR S]
2 ACTIVE PWR S
3 APPARENT PWR S
4 BASIC SETTING
[NO]
BACK TO 1

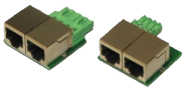
Accessories

Universal-Measuring

Devices

MMI 6000

MMI 7000



RJ45-adaptor
connect several devices
to a RS485-Interface
via LAN-cable

DataLog SD
for recording data
of BR6000 / BR7000

Thyristor-switches
10 ... 200kvar / 400 ... 690V