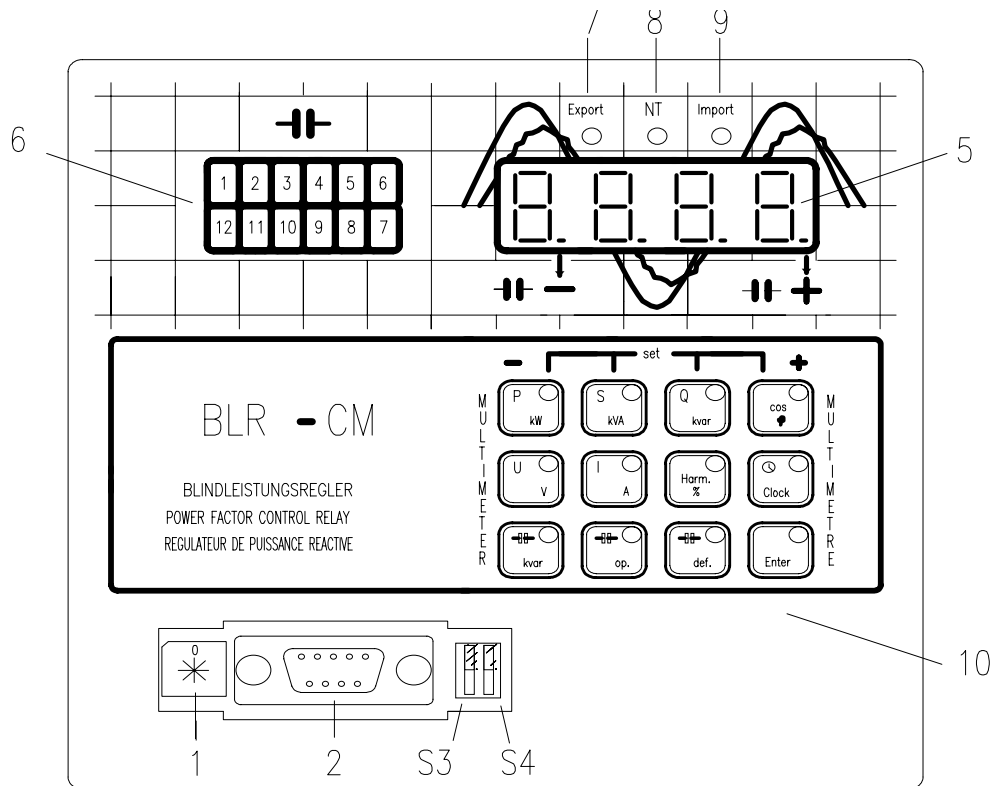


Operating and Commissioning Instructions for BLR-CM

Contents:

- | | |
|---------------------------------|--|
| 1. Installation | 6. Optional parameters |
| 2. Connection diagram | 7. Alarm signals |
| 3. Functioning principle | 8. Indication of measuring values |
| 4. Commissioning | 9. Cancelling of memorized data |
| 5. Standard parameters | 10. Switching programmes |

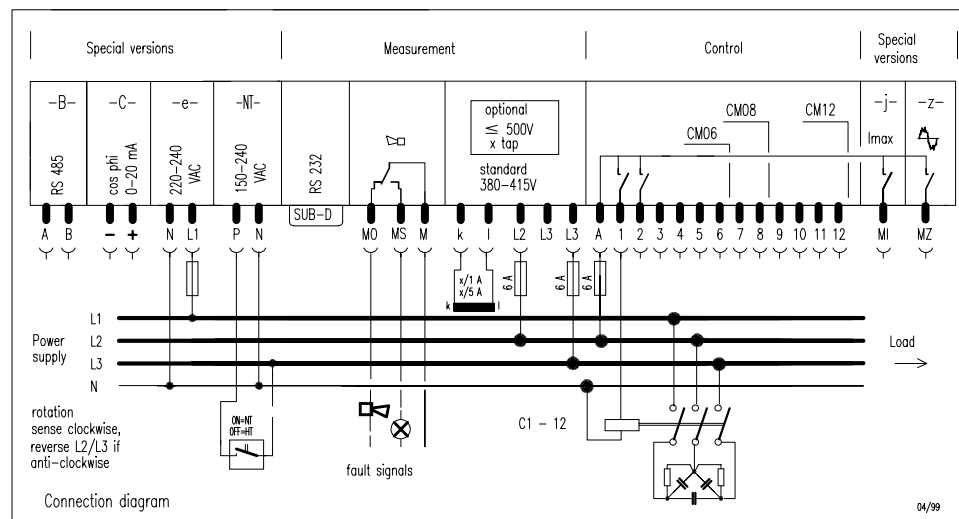


1. Installation

As with all electrical equipment, the appropriate specifications governing electrical installation must be followed when power factor correction equipment is installed. When removing the front nameplate to adjust the function switch and DIP switches, always ensure that your body is not carrying any electrostatic charge. This can be accomplished by simply touching an earthed object, such as the switchboard metal casing to dissipate any electrical charge before removing the cover plate.

- Check that the Measurement and Control Voltage, Supply Frequency and Current Transformer rating comply with the ratings given on the back of the relay.
- Mount the relay in the switch panel:
either by means of two fixing bolts (standard), or:
by means of two side mounting right angled brackets (optional)
- Connect up in accordance with the wiring diagram. **Pay special attention to the cross section size of the C.T. connections. We recommend for runs up to 10 metres 2,5 mm² cross section.** An integrated voltage observation in BLR-C.. guarantees a safety-disconnection of the capacitors in case of excess voltage > 110 % of Un and > 2 sec. (for ex. Un = 400 V disconnection at the value of 440 V and > 2 sec.)

2. Connection-Diagram Operator and Indication Elements



3. Functioning principle

The individual functions of selection switch (1) are listed with character **H..** as sign (for ex.: **H2** = switching time).

The measuring system has been designed with the phase in which the c.t. is integrated is by standard the phase L1. The two other phases L2 and L3 are connected in a clockwise rotation sense to the relay.

The relay has a so-called auto-adapting facility.

In case of BLR-CM a C/k-threshold needs no longer to be entered. The relay measures the connected capacitors all over the daily regulation process according to their compensation impact, memorizes the values, and then compensates deviations from p.f.target with the help of this memory.

By way of entering the c.t. ratio factor (**H6**) it is possible to display the measuring values. All preset parameters and controlled variables remain unaltered even in case of a system failure.

4. Commissioning

The following parameters are already integrated into all new devices:

Standard:

- H1** 1.p.f. target set $\cos \varphi = 1,00$
- H2** switching time delay per step = 40 s
- H5** step limitation acc. to type of relay (6/8/12)
- H6** c.t. factor = 1000
- H7** v.t. factor = 1,00
- H8** Alarm mode = 0
- H9** regulation programme = automatic

Optional

- HA** 2. p. f. target set $\cos \varphi = 1,00$
- HB** asymmetr. switching time factor = 1
- HC** load reversal switching time delay = 30 s
- HD** capacitor max. rating defective = < 50 %
- HE** current max. rating = 0
- HF** Time = CET (central Europ. time)

H3 Automatic function – fully automatic control of compensation plant

H4 Manual operation

This mode is activated by the **ENTER** switch. In the three operating keys LEDs flash. The key symbols "cos φ " (+) enables to connect, and the key "P" (-) to disconnect steps. Decimal dots in the display above the symbols "+" and "-" flash to indicate that the switching time delay has run off.

In order to re-activate automatic compensation the selection button must be put in position H3 again.

All parameters preset on the relay can be adjusted locally when required by means of selecting button. Precondition is that a voltage potential is applied to the relay. Please proceed as follows:

Select appropriate alteration mode by turning the selecting button in requested H-Position. The memorized value is shown on the digital display. Activate the adjusted value by pressing – **Enter** - and use the first (upper) set of keys (2 or 4 respectively; the corresponding LED's flash) to enter the required new value (0-9), directly parallel to the figures on the digital display. To confirm and activate please press the button **Enter** again.

Attention! If adjustments are not confirmed by Enter, the old value remains stored! If the Enter mode is not continued within a period of 3 minutes it is automatically closed.

- (a) Apply the measurement and control voltages. Connect the current transformer, and remove any short circuit link. When commissioning the display is first dark, after 6 s a self test of the optical devices in the display and the keyboard follows which lasts 2 s. The measuring value indicated is the system power factor $\cos \varphi$, other values can be displayed by means of pressing the appropriate button.
Indication "I—0": no current flowing, resp.: < 15 mA of secondary c.t. current.
Any p.f. controlling starts, if reactive vector exceeds > 15 mA of secondary c.t. current at least.
- (b) A pre-adjusted lock-out time prevents any switching operation for a period of 90 s. The elapse of this time is indicated by oscillation of the two decimal dots above the display symbols "+" and "-". After lock-out time, dot in the right-hand display "+" will flash, in the presence of inductive load, if relay is connected correctly.
- (c) Adjust DIP (coding) switch to select alarm function ON (in circuit) or OFF (out of circuit) (if required, adjust memory mode in **H8**) **S3** = power factor alarm, **S4** = harmonic alarm
- (d) Entering the number of connected capacitor steps under **H5** (display shows **CL_3** = Capacitor Limitation – step 3). If the max. number of steps is selected, but capacitors are not connected to all steps, the relay will recognize this, and will make three switchings to verify there is no connection. The disconnected step(s) will then be excluded from the switching sequence. The number of disconnected steps is able to be indicated by pressing the > **def** < button. The disconnected steps will be automatically reactivated and a renewed switching attempt will be made after a period of 7 days or after a system power failure.
- (e) c.t. factor "k" to be adjusted in **H6** (f. ex.: 500 A/5 A = factor 100 or 1000 A/1 A = factor 1000). If a summation transformer is employed the individual transformer values are added to receive the total factor, (f. ex.: 1000 A/5 A + 1000 A/5 A + 1000 A/5 A) x (5 A + 5 A + 5 A/5 A) = (3000 A/15 A) x (15 A/5 A) = (200 x 3) = k = factor 600. Please note here that whenever measuring values are indicated these are always total values of the entire plant.
- (f) If required, adjust voltage factor in **H7** (only when operated in medium voltage systems)

- (g) With the **H8** button it is possible to select two types of low power factor alarm memory: The selecting process it started by <Enter> and can be altered by switching "+" or "-". The display changes accordingly from 0 to 1. To reconfirm, press <Enter> again. (Both functions are described in chapter 7 (a) (d) (f)).
- (h) During commissioning the relay switches – following the selected switching time delay - steps successively until the target power factor $\cos \varphi$ (**H1**) is attained. Each energized step is shown on the LED display (6). As each step switches in, so the digital display of power factor will change. If the installation p. f. deviates from the target $\cos \varphi$, the "+" sign (below target) or the "-" sign (above target) will flash. In the course of a so-called "finding process" every individual capacitor is switched in circuit to judge its size. The finding process is over when the power per capacitor has been evaluated. The values remain memorized even in case of a system power failure. A new finding is actuated exclusively if the capacitor size values are cancelled deliberately (see chapter 9).
- (i) A flashing of the decimal points in the display indicates that the relay has found a suitable unactivated capacitor which will be switched in circuit after elapse of the switching time delay (**H2**). If capacitors of different sizes are operated the appropriate combination of required amounts of power (kvar) can be attained by targeted automatic connection and disconnection of already energized steps.
- (j) When changing over from automatic mode (**H3**) to manual mode (**H4**), steps will be switched in / out by pushing key **cos** (+) / **P** (-) respectively in the rotational switching program - "first in - first out". By changing back in to automatic mode all activated capacitors will be switched off **at once** after preset switching the time delay (**H2**). Afterwards the automatic control will start again.
- (k) The variable load reversal lock-out time (30 s) is activated when the switching direction changes from "up" to "down" or vice versa. This switching time is indicated by the "+" and "-" signs oscillating simultaneously and has been designed to ensure that the capacitors are able to discharge. Optional "s" enables alteration of this parameter locally.
- (l) The two LED's "Import" and "Export" above the display indicate the direction of energy at the measuring point. Export means feedback of active/reactive energy (capacitive) into the local system, and Import consequently means consumption of the same.
- (m) An automatic data log of the measuring values results in a brief blanking of the display (no reset!). **Once the required settings or alterations have been made, set function switch (1) to position H3 "automatic" and replace the front cover plate, so as to inhibit unauthorized interference with relay settings.**

5. Standard parameters

Coding switch (S3)

Relay alarm signals

Switch position **OFF** = alarm signals off – cancel alarm (reset) **ON** = alarm signals on

Coding switch (S4)

Harmonic alarm

Switch position **OFF** = signal off, respectively: cancel alarm (reset) **ON** = alarm signals on

Function switches (1) (Standard version with 10 switch positions)

H0 = Relay not in automatic function. All steps switched off in accordance with the selected step switching time. Digital display will show: **"OFF"**

H1 = Adjustment of pre-set target p. f. within the range 0,70 lag ... 1,0 ... 0,90 lead by means of <Enter; +/-> Target level is shown in the display. **Relay continues to operate automatically.**

- H2** = Adjustment of the step switching time – min. 5 sec. up to 1200 secs.
<Enter; 4 individual buttons> Adjust digitally in strict accordance with value given on the display.
During this setting, relay continues to compensate automatically.
- H3** = Relay in automatic operation, with indication of system p. f. or other measuring values.
If +/- signs are flashing, this indicates that the target p. f. has not been achieved.
A suitable capacitor size will be selected.
- H4** = Manual operation.
<Enter; +/-> adjustable. The display will show alternately: **H** and selected measuring value. Capacitor steps can be switched in rotation after elapse of the selected step switching time using the +/- buttons.
Return to automatic operation by <Enter>.
Automatic regulation has no impact!
- H5** = The number of switching steps can be predetermined, using <Enter; +/->
Digital display will show alternately the number of steps and the predetermined measuring value;
for ex. for 10 steps: "CL10" (CL = Capacitor Limitation).
Do not exceed the existing numbers of control outputs! Automatic regulation is continued.
- H6** = Input of c. t. factor
<Enter; 4 individual keys> Adjust digitally in strict accordance with value given on the above display.
Automatic regulation is continued.
- H7** = Input of voltage transformer factor, if required, standard = 1,00 (= nominal voltage of the relay)
<Enter; +/-> adjustable.
Please refer to digital display.
Automatic regulation is continued.
- H8** = Selects the mode of alarm signal required.
<Enter; +/-> adjustable. Please refer to digital display. If the display shows "A 0", the alarm is stored in the memory and can only be cancelled by briefly actuating DIP switch S3. If the display shows "A 1", the alarm will be cancelled automatically, when the preset target p. f. level has been able to be attained again (load reduction, f. ex.). If requested data are not indicated on the order, the relay will be supplied in "A 1" mode.!
- H9** = Pre-adjustment of switching programme (necessary when relay is operated in filter circuits).
<Enter; +/-> adjustable. Please refer to display.
- 1) "auto" fully automatic switching operation (not applicable for filter circuits)
 - 2) "1:1:1:1" capacitor values 1:1:1:1..... (up / down – no rotational switching)
 - 3) "1:1:2:2" capacitor values 1:1:2:2.....
 - 4) "1:2:2:2" capacitor values 1:2:2:2.....
 - 5) "1:2:3:3" capacitor values 1:2:3:3.....
 - 6) "1:2:4:4" capacitor values 1:2:4:4.....
 - 7) "1:2:4:8" capacitor values 1:2:4:8:8.....
- In all programmes (except for "auto") it must be ensured that all capacitor sizes comply with the mentioned ratios! Automatic detection and indication of capacitor size is limited to the 1st capacitor, assuming all following capacitors will comply with the selected switching programme (3-7)! Detection of failed capacitors is not possible!**

6. Optional Parameters: Use of a function switch (1) with 16 positions

- HA** = Input of second target power factor level for low tariff operation. **Option – NT -**
Setting range 0,70 lag ... 1,0 ... 0,90 lead.
The required target level is adjusted in the display using <Enter; +/->.
Please refer to digital display. In order to activate this feature a supply voltage of 150-240 V AC must be applied across terminals P-N.
(Using a time switch, radio controlled relay etc.) LED (NT) will illuminate if this feature is active.

- HB** = Input of asymmetrical switching time delay. **Option - s -**
 Using <Enter; +/->, adjustable between 0 ... 50.
 Example: if the display shows "Y 10" the factor displayed will multiply the switching time;
 e. g. 10 = 10 x the preset switching time (from "H2") for disconnecting steps.
 (rapid switching on – slow switching off)
- HC** = Rapid contactor switching rate limiter, selectable between 0 and 255 seconds. **Option - s -**
 Using <Enter – 4 individual buttons +/- > adjust to the required value shown on display (for example the display may show "L30"). In the case of reversed switching direction, (connect / disconnect or disconnect / connect respectively) this lockout time is applied by adding to the selected switching time between steps. This helps to prevent the rapid on / off switching of a contactor during times of constantly changing loads and ensures the capacitors are discharged completely.
- HD** = Input of a threshold – loss of capacitor power – defect signal. **Option - s -**
 Using <Enter – 4 individual buttons +/- > adjust to the required value shown on display.
 Digital display shows for example 60. This implies that if the capacitor power (per step) falls below 60 % of the original value the relay triggers an alarm signal (see chapter 7b).
 An external signal is triggered via the standard alarm relay integrated in the controller (contacts **M – MO** close).
- HE** = Input of a thermal current threshold value – reactive current I_{max}. –
 overload alarm contact. **- Option J –**
 <Enter - 4 individual buttons +/-> adjust required value digitally parallel to the display above.
 Adjusting range: 0 – 9999 A
 If preset value is **0** this function is out of service.
 An external fault signal is triggered by a relay integrated in the controller (contacts **A – MI** will close).
- HF** = Date & time adjustment & record **- Option D –**
 This adjusting mode operates on three levels and can be started by
 <Enter; 4 individual buttons +/->
 <Enter; display shows year in 4 digits: f. ex.: 2000
 <Enter; display shows day / month: f. ex.: 26.01.
 <Enter; display shows hour / minute: f. ex.: 15.45
 Leave from this mode by again pressing <Enter>.
 If this option is not integrated display shows: >no_t<

7. Alarm signals

Alarm mode is activated by means of the two coding switches **S3** for power factor alarm and **S4** for harmonic alarm. Alarm signals are triggered whenever a malfunction in the regulation process of the compensation system has been detected, or if permissible threshold values are exceeded. The different alarm signals (2 s) are given alternately with the selected measuring function (5 s) on the digital display.

(a) Power factor alarm (Display shows: **ALLo** / **ALHi**)

This alarm mode supervises under-/overcompensation of the system.

During manual operation this safeguard is by standard not active, because the client can regulate a power value which does not correspond with the actual load situation.

In case of undercompensation the display signals "**ALLo**". If the predetermined power factor is not obtained in case of insufficient capacitance, the alarm signal is triggered after elapse of 75 x the selected step switching time.

In case of overcompensation the signal issued is: "**ALHi**". If the set target p.f. is still surpassed due to overcompensation (welded contacts) after elapse of 75 x the selected step switching time, this alarm will be triggered. External signal is issued by the relay **RA** (contacts **M – MO** close). If manual reset has been predetermined (**H8** set to 0), the alarm signal is recorded until it is cancelled manually: To do this briefly put coding switch **S2** in **OFF** position or press key **cos φ** longer than 10 s. Automatic reset (**H8** set to 1) is triggered in case of reverse of switching direction (**ALLo**: connection ... disconnection, and consequently **ALHi**: disconnection ... connection).

- (b) **Loss in capacitor step (kvar) output alarm** (Display shows: **Alnn**)
 This alarm function observes the loss in compensation power of the individual capacitors when in operation. Calculation basis is the capacitor size recorded during commissioning (original value, can be verified by means of key "kvar" – digital display shows: **F..**). If the actual capacitance falls below 50 % of the original value (verify by means of key "kvar" – digital display shows: **L..**, the loss in capacitance is signalled by "Alnn", **nn** stands for the number of the defective capacitor: **AL12**, f. ex. If more than one step is affected, each of the capacitors is referred to individually by a rolling fault signal). The external signal is triggered by relay **RA** (contacts **M – MO** close).
 The signal is cancelled as soon as the threshold is surpassed again (automatic reset function).
 If coding switch **S2** is set in **OFF** position, signal is no longer visible, however it is active in background.
- (c) **Defective capacitor step alarm** (Display shows: **ALCd**)
 This alarm mode observes any default of capacitor steps.
 To call up the defective steps press key "def". If more than one capacitor fails, each step affected is automatically reported in the alternating indication on the display.
 An external signal is triggered by relay **RA** (contacts **M – MO** close).
 The alarm is cancelled in case of brief interruption of voltage supply, to do this: actuate key "def" longer than 10 s, or automatic cancellation in a 7 day rhythm. By setting coding switch **S3** in **OFF** position it is true that the signal is no longer visible, however it remains active in the background.
- (d) **Harmonic overload alarm** (Display shows: **ALHA**)
 This alarm function observes the harmonic content of the line voltage. External signal is triggered by the relay **RZ** (contacts **A – MZ** close).
 If reset is determined to be done manually (**H8** setting = 0), the alarm signal remains to be recorded until cancellation by briefly setting coding switch **S3** to **OFF** position or by pressing key **Harm.% >10s**.
 If automatic reset has been selected (**H8** setting = 1), the signal is automatically cancelled when in the subsequent time window (in 8 minute intervals) the harmonic load is below the preset value.
- (e) **Overcurrent** (display shows: **AL_I**)
 This function is only actuated if a value > 0 is entered under **HE**.
 Overcurrent is signaled as soon as measured current **I** exceeds preset threshold in **HE**. Signal is cancelled as soon as the current amount no longer exceeds the threshold. (automatic reset, optical function only).
- (f) **Thermal overload** (display shows: **ALdI**)
 This alarm mode is triggered if the thermal current load exceeds the value preset in **HE** (bimetal principle, time window 8 minutes)
 In addition, there is an external signal issued by relay **RI**. (contacts **A – MI** close).
 If reset is determined to be done manually (**H8** setting = 0), the alarm is recorded until it is manually cancelled as follows: Press button "I" longer than 10 s.
 An automatic cancellation of the alarm signal (**H8** setting = 1) follows if in the subsequent time window (8 minute intervals) no renewed alarm has been triggered.

8. Indication of measuring values

Key: A foil keyboard enables to indicate measuring values and/or functions:

P = total active power in kW (basis: symmetrical load)

S = total apparent power in kVA (basis: symmetrical load)

Q = total reactive power in kvar (basis: symmetrical load)

cos φ = The digital display shows the system power factor $\cos \varphi$
 (For example: i 0,87 for inductive or c 0.94 for capacitive load)

U = system three phase voltage in V (delta voltage)

I = apparent current and thermal current load (measuring phase)

Rolling display of thermic current – I_{th} (Bimetal function – time display = 8 min.)

Harm. = Activation of fourier analysis of the system voltage

% Indication of harmonic content of the 3./5./7./9./11./13. Harmonic in % of the basic frequency by one push each on the key. The change in selected harmonic is automatic: f. ex. **5** (Harm.) and **1.2** (%), each remains visible for 3 s.

Clock = Call-up date & time (only with Option – D -)

By one push each on the key, display changes from "yyyy" = year to "dd.mm" = day.month & then to: "hh.mm" = hour.minute etc.If the relay does not include this option, display shows: "no_t".

--||-- = The different capacitors sizes are given in kvar.

kvar By one push each on the key, display changes to the next step. For each step automatically two different values are given alternately, for example:

"2 L" (Last) referring to capacitor 2; display shows alternately the actual capacitor size in kvar.

"2 F" (First) referring to capacitor 2; display shows alternately the capacitor size at the first time of commissioning in kvar.

--||-- = Inquiry of switchings per step.

op. Automatic change of display regarding number of steps and switchings

By pressing the key next step is indicated.

--||-- = Display of defective capacitor steps

def. Several steps are shown in a rolling display.

Enter = Selecting and confirming parameter adjustments and activating of manual operation.

9. Cancelling of memorized data

Following data can be cancelled by means of the appropriate keys:

Thermic display of current I_{th}

Press key **I** >20s

Capacitance per step in kvar

The value **L...kvar** Set selecting switch to **H0** and press **kvar** key longer than 10 s.

The value **F...kvar** Set selecting switch to **H0** and press **kvar** key longer than 20 s.

When cancelling the relay sets all values simultaneously to 0.

Switching cycles per capacitor step

All values of the individual steps are reset simultaneously to 0 by pressing key **op.** longer than 10 s.

Defective steps

Reset of memorized failed capacitors

"Defective steps"

Any memorized "defective" capacitors may be cancelled by means of pushing key **def** >10s.

Searching for defective steps is prompted by net interruption, automatically in a 7-day-rhythm or after a manual reset.

When cancelling all values will be simultaneously set to zero.

10. Data Transmission

The relay contains an interface RS 232 (9-pole SUB-D) behind the removable nameplate for data transmission to a PC or a notebook. By using the BELUK-software "WIN_CM_E" indicating and memorizing of different values and operation cycles is possible, signed with clock and date. Relays including option "D" enable the storaton of data with an internal data logger signed with clock and date. Data stored can be read and analysed by using software "WIN_CM_E" (see special software instructions).

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