

Power factor controller BLR-CM reference guide



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⚠ IMPORTANT INFORMATION

IF THIS WARNING SYMBOL APPEARS BESIDE A TEXT PASSAGE IN THE MANUAL, THE READER IS STRONGLY ADVISED TO READ THE CORRESPONDING INFORMATION AS IT IS VERY IMPORTANT FOR THE DEVICE USAGE! IT CAN CONTAIN SAFETY ADVICE OR OTHER INFORMATION FOR THE CORRECT HANDLING OF THE DEVICE. IF THE INFORMATION IS DISREGARDED, THE DEVICE MAY BE INOPERABLE OR EVEN DAMAGED!



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Installation and connection

WARNING

ONLY QUALIFIED STAFF IS ALLOWED TO PERFORM THE INSTALLATION. ALSO, ALL VALID RULES FROM THE GOVERNMENT MUST BE KEPT! BEFORE CONNECTING THE DEVICE, CHECK THAT ALL LINES ARE WITHOUT VOLTAGE AND SHORT CURRENT TRANSFORMER SECONDARY CIRCUIT.

1. Compare auxiliary voltage, measurement voltage, control voltage, frequency, and the current path of the device (see type label) with the data of the electricity network.
2. Assemble the relay in the switch panel with the two mounting clips. If the device is not fitting in the cutout, the small plastic bars on the side of the case can be removed with a knife.
3. Connect protective ground to the terminal link of the case.
4. Connect in accordance to the wiring diagram (pages 10–17). Pay special attention to the cross section size of the CT connections. An integrated voltage observation with regard to the auxiliary voltage in BLR-CM guarantees a safety disconnection of the capacitors in case of undervoltage. It must be ensured that auxiliary voltage is taken from the identical phase as control voltage for the contactors. Thus all switching elements are safely switched off in case of undervoltage.
5. The current path of the regulator is designed for current transformers x/5A and also for transformers x/1A. Remove short circuit links of the current transformer before commissioning.

Auxiliary voltage

With the BLR-CM, the measurement voltages and auxiliary voltages are separated. Because of this, it is necessary to connect the auxiliary voltage to separate terminals of the device (clamps La, Lb, and 0). The detailed connection depends on the device type and can be seen on the sticker at the back of the regulator.

Current measurement

For current measurement, transformer types x/1A or x/5A can be used. For connection, the clamps K(S1) and L(S2) have to be used. If desired, an additional ampere meter can be connected in series.

It is also possible to connect a summation current transformer to the BLR-CM. Pay attention that the correct factor is adjusted. This factor for a summation transformer can easily be calculated by adding the single transformer ratios (e.g., $1000A/5A + 1000A/5A + 1000A/5A = 200 + 200 + 200 = \text{factor } 600$).

Note: For three-phase current measurement, please ensure that the current inputs are connected to the correct phases in right hand rotating field.

Voltage measurement

The clamps Um1 and Um2 are for voltage measurement. This input is suitable for voltages between 50 V and 530 V. If the measurement voltage is out of the adjustable tolerance, all active steps are switched off and the regulation stops. In the circuit diagram, the standard connection with L1-N can be seen. There are also other connections possible. In case of using another connection type, the parameters on page 4 (Connection measurement and Phase compensation) have to be adapted. Details of the functions can be found in the referring chapters.

Regulation outputs

The power factor regulator is available with up to 12 outputs. Dependent on the regulator type, the outputs can be relay outputs or transistor outputs. The detailed regulator type can be found on the rear sticker either with the type description or the symbols of the output clamps. **If you have the regulator type with mixed output steps, please pay attention that the clamp A1 is the common root for the relay outputs 1–6 and clamp A2 is the common root for the transistor outputs 7–12.**

Relay outputs

The relay outputs of the power factor controller are designed for the direct connection to contactors. The relay outputs are potential-free with one common root.

Maximum breaking capacity 250 Vac / 5 A, maximum fuse 6 A.

Transistor outputs

The transistor outputs of the power factor controller are designed for the direct connection to thyristor switches. These open-collector outputs have one common root. To trigger a thyristor switch, connect (-) to the root and (+) directly to the thyristor switch.

Maximum breaking capacity 8–48 Vdc / 100 mA.

Alarm relay

For external contact, the regulator is equipped with an alarm relay M (potential-free change-over contact). The breaking capacity is 3 A / 250 Vac. The closing contact is connected to the clamps M and MS, the break contact is connected to the clamps M and MO. This contact is programmed as life-contact. In case of failure of the auxiliary voltage, this contact automatically closes. See circuit diagram on page 17.

Digital input

The power factor regulator has a digital input (clamps DI1 and DI2). This input is detected as active when there is a voltage between 50 and 250 Vac. The function of this input can be programmed in the menu "SETUP / ALARM / INPUT DI". More details for the programming can be found in "ALARM" section. See circuit diagram on page 17.

Digital output

For external contact, the regulator BLR-CM is additionally equipped with a digital output (clamps DO1 and DO2). This output is a potential-free closing contact. The breaking capacity is 5 A / 250 Vac. The function of this output can be programmed in the menu "SETUP / ALARM". More details for the programming can be found in "ALARM" section. See circuit diagram on page 17.

Menu BLR-CM

Meas. values



In this submenu, measurement values of the regulator can be displayed in the bottom display area. The values can be selected with the ▲ / ▼ keys.

The following measurement values can be displayed:

Messung BLR-CM	Messung BLR-CM3phase
ULL (voltage phase–phase)	ULL (voltage phase–phase)
ULN (voltage phase–neutral)	ULN (voltage phase–neutral)
THD of voltage	THD of voltage
I (current)	I1 / I2 / I3 (current)
THD of current	THD 1 / THD 2 / THD 3 of current
P (total active power)	P1 / P1 / P1 (active power for each phase)
Q (total reactive power)	Q1 / Q2 / Q3 (reactive power for each phase)
S (total apparent power)	S1 / S2 / S3 (apparent power for each phase)
F (frequency)	P (total active power)
ΔQ (lacking reactive power for reaching the adjusted target cos w)	Q (total reactive power)
T (temperature at rear side of the device)	S (total apparent power)
WPI / WPE (counter active work import / export)	ΔQ1 (lacking reactive power for reaching target cos w L1)
WQI / WQC (counter reactive work inductive / capacitive)	ΔQ2 (lacking reactive power for reaching target cos w L2)
	ΔQ3 (lacking reactive power for reaching target cos w L3)
	ΔQ (total lacking reactive power)
	CP1 (cos phi L1)
	CP2 (cos phi L2)
	CP3 (cos phi L3)
	Pf 1
	$\frac{P}{S} = \frac{\text{activePower}}{\text{apparentPower}}$
	Pf 2
	Pf 3
	F (frequency)
	T (temperature at rear side of the device)

Note: Counters can be reset by the means of the ► key (separately for active work and reactive work).

Harmonics



The BLR-CM continuously calculates the harmonics of the voltage and current with the Fourier transformation. The rating of the harmonics is done by EN 61000-2-4 up to the 30th harmonic order. The harmonics are displayed in percent and all refer to the TRMS value. After selecting the submenu, these values can be displayed separately for current and voltage (separate for even/odd harmonics) in the main display area. Switching between the different displays can be done by pushing the ◀ ► key. Scrolling in the list is possible by pushing the ▲ / ▼ keys. Every displayed value is related to the fundamental wave.

Stepinfo



This submenu contains information for the single capacitor steps. By means of the + key, the referring step can be selected. Scrolling is possible by pushing the ▼ key to select the following information:

Faulty steps

The detection of faulty steps is only possible when the automatic step-size detection is active (see **page 6**, Step recognition). A step is “defective” when three switching operations are attempted without the desired result.

For the case of a faulty capacitor step, this step will be signed with “F!” in the step symbol. Furthermore, the step type “fault” is shown. Defective steps are blocked for the regulation. A reset of the defective steps is done automatically after 24 hours, after interruption of supply voltage, or by pushing the ► buttons in stepinfo, when the step-type “fault” is shown. Afterward, the step is used again for the regular control.

Step type

For every single step, its function can be defined. You can select between the following functions:

- NORMAL = step is used for normal regulation
- FIX-OFF = step is permanently switched off
- OFF = step is permanently switched off and blended out
- FIX-ON = step is permanently switched on (step is supervised and also switched off in critical situations)
- FAST = step is used for the fast algorithm. All needed steps to reach the target cos phi get switched simultaneously
- FAULT = the step is detected as defective and is blocked

Switch cycles

The BLR-CM counts and shows the switching cycles of each step. This value allows the conclusion about the actual state of the contactors. By pushing the ► key, the counter can be reset.

Stepvalue

The nominal step-value is the capacitor-size based on the value of nominal voltage, which is set at BLR-CM. For the regulation, this value is converted to the actual measured voltage.

When automatic step-size detection is active, this value is updated to a measured estimate of the actual capacitor size. During the first detection, the size of the capacitors is stored in the background as a reference value. The percentage shows the relation between the actual capacitor size and this reference value. When automatic step-size detection is not active, the percentage is not shown. To activate the automatic step-size detection, please see **page 6** (Step recognition).

Setup



In this submenu, basic settings can be made for the BLR-CM. These settings are necessary for correct function and for correct display of the measurement values. This submenu is protected by a Password (factory setting 2402).

The menu is divided into logical groups. The following points explain the associated settings.

Measurement

Settings concerning the measurement can be found in this submenu. These settings are:

CT factor

The CT factor is the ratio of current transformer (e.g., 1000/5 = ratio 200). At BLR-CM3phase, the CT factor is used for all three current channels.

⚠ IMPORTANT

THE DIRECT MEASURING OF CURRENT IS NOT POSSIBLE. FOR CURRENT MEASURING, A CT ALWAYS HAS TO BE USED!

VT factor

VT factor is the ratio of the voltage transformer. If the regulator is connected directly to the measurement voltage without VT, the value 1 has to be used.

Nominal voltage measurement

The correct setting of nominal voltage is necessary because the threshold levels for overvoltage and undervoltage are calculated from this value (see page 5, V-toleranz min and max). The capacitor sizes, which are stored in step database, are also rated to the nominal voltage.

⚠ IMPORTANT

INDEPENDENT OF CONNECTION OF THE VOLTAGE MEASURING CHANNEL, NOMINAL VOLTAGE IS ALWAYS THE PHASE-PHASE VOLTAGE.

Connection measurement

In connection measurement, it has to be determined if the measuring of voltage is done between two phases or between phase and neutral phase. This can be selected by pushing the ◀▶ button. Corresponding to the chosen connection type, "U=L-N" or "U=L-L" can be selected.

Synchronization frequency

For a high precision of the measurement, the sampling rate has to be synchronized to the frequency of the grid. Caused by commutation notches of mains voltage, it is possible that the automatic synchronizing will not work reliably. This creates failures in measurement. To avoid these problems, the following settings can be done:

Automatic synchronizing:

For best measurement results, when mains voltage is without commutation notches.

FIX-50HZ: For a safe operation at 50 Hz grid with bad mains quality.

FIX-60HZ: For a safe operation at 60 Hz grid with bad mains quality.

Phase compensation

The phase compensation enables the user to connect the current and voltage measurement channels in any way. This compensation angle complies with the phase angle between connected ohmic current and voltage. **Table 1** shows the settings for some different connection types. **These settings have to be accurate, otherwise, correct regulation is not possible! If the current transformer is reversed, additionally a phase compensation of 180° has to be respected.**

Table 1. Phase compensation

Description	Connection type								
	L1-N	L2-N	L3-N	L1-N	L2-N	L3-N	L1-N	L2-N	L3-N
Voltage	L1	L2	L3	L2	L3	L1	L3	L1	L2
Current transformer	U=L-N	U=L-N	U=L-N	U=L-N	U=L-N	U=L-N	U=L-N	U=L-N	U=L-N
Phase-Offset	0°	0°	0°	240°	240°	240°	120°	120°	120°
Voltage	L2-L3	L3-L1	L1-L2	L2-L3	L3-L1	L1-L2	L2-L3	L3-L1	L1-L2
Current transformer	L1	L2	L3	L2	L3	L1	L3	L1	L2
Connection	U=L-L	U=L-L	U=L-L	U=L-L	U=L-L	U=L-L	U=L-L	U=L-L	U=L-L
Phase-Offset	0°+90°	0°+90°	0°+90°	240°+90°	240°+90°	240°+90°	120°+90°	120°+90°	120°+90°

Note: At BLR-CM3phase, only the position of the voltage measurement can be compensated, because the regulator calculates the phase angle for the other phase from phase L1.

V-toleranz min

The setting has to be done in percent related to the nominal voltage. If the measurement voltage falls below the adjusted limit, all active steps are switched off and the regulation stops.

V-toleranz max

The setting has to be done in percent related to the nominal voltage. If the measurement voltage exceeds the adjusted limit, all active steps are switched off and the regulation stops.

Test mode

A test mode can be activated here. This mode enables manual control of the capacitor contactors. After testing, this mode has to be deactivated again, because otherwise there is no supervision of the measured values. When restarting the controller after power interruption, the test mode is automatically disabled.

Step

Settings concerning the step database can be found in this submenu. The following settings are possible:

Discharge time

For every single capacitor step, the discharging time can be defined. The discharging time is a blocking time, becoming active after switching off a step. As long as this time is running (display of "!" in the step indication), this step is not available for the regulation. Discharging time should be adapted to the capacitor discharging unit.

For step exits, which are switching thyristor switches, the discharging time can be reduced to zero.

Step type

For every single step, its function can be defined separately. You can select between the following functions:

- NORMAL = step is used for normal regulation algorithm
- OFF = step is permanently switched of an blend out in step indication
- FIX-OFF = step is permanently switched off
- FIX-ON = step is permanently switched on (step is supervised and also switched off in critical situations)

The "Fast" step type is only adjustable for controllers with transistor outputs. Steps that are set "Fast" (only possible for transistor outputs) are not available for the normal regulation algorithm. For each "Fast" step, a nominal value has to be set, because the automatic step size detection is disabled in real time algorithm.

- FAST = step is used for the real time algorithm. All needed steps to reach the target cos phi are switched simultaneously. There is no delay for switching

⚠ IMPORTANT

UNUSED OUTPUT STEPS HAVE TO BE SET TO "FIX-OFF" OR "OFF" TO ENSURE THAT THESE STEPS ARE NO LONGER USED FOR REGULATION. NO NEEDLESS ALARMS ARE CAUSED! FIX STEPS ARE LABELLED BY THE PERMANENT SYMBOL "!" NEXT TO THE STEP NUMBER. STEPS THAT ARE SET "OFF" ARE BLEND OUT.

Step reset

By selecting this point, all step sizes can be reset simultaneously.

Nominal step size

If automatic step size–detection is disabled, it is required to set the nominal step size. For "FAST" steps, it is also required to set the nominal step size. The setting is done in kVAR and is related to nominal voltage, which is set in measuring menu.

The setting is done separately for each exit. The maximum value that can be set is limited to the maximum value that is possible by the ratios for voltage and current transformer.

Control

For a better understanding of this chapter, the following are some general explanations:

Target of compensation: BLR-CM is using two parallel working regulation algorithms.

1. **Normal algorithm** is using "normal" contactor-based steps. The target of compensation of the normal algorithm is to reach the target reactive power, which is calculated by target cos-phi and apparent power. From the reactive power that has to be compensated is built the average in SWITCH INTERVAL (adjustable). In hybrid compensation panels, the installed dynamic steps are considered in calculation of target reactive power, to get an optimum working point for the real time part.
2. **Fast algorithm** is using "fast" transient-free steps. The target of compensation of fast algorithm is the real time target reactive power, which is calculated by apparent power and target cos-phi. For this, there are some more settings possible.

⚠ IMPORTANT

AT BLR-CM3PHASE, THE FAST ALGORITHM IS NOT AVAILABLE. FOR REAL TIME COMPENSATION, THE NORMAL ALGORITHM IS USED WITH SHORT SWITCH INTERVAL AND FIX PROGRAMMED STEP SIZES!

Regulation mode normal algorithm: The controller uses 3 different regulation modes as standard:

1. **Automatic:** The controller is working with the principle of "Best Fit". This means that the controller is comparing the capacitor sizes in the step database with the demand of reactive power. The controller will use the step that gives the best result.
2. **LIFO "Last In, First Out":** The controller starts with step 1 and switches in the next available higher number step, as required. Switching-off is done vice versa.
3. **Combined filter:** Special algorithm for combined filters. The controller is working like in automatic mode with the principle "Best Fit". The difference to automatic mode is, that the controller is connecting always at least the same amount of capacitance on odd numbered steps as even numbered steps.

Regulation mode real time algorithm: In real time algorithm after measuring one mains cycle, the reactive power that has to be compensated is calculated and all necessary steps are switched together in one operation. The time from end of measuring to generate the switching pulse is less 150 µsec. At this time, Eaton thyristor switches need to bring in the capacitors maximum 2/3 of a mains cycle. This time is needed to get the next allowed moment for switching.

In real time algorithm SWITCH INTERVAL, STEP EXCHANGE and SWITCH CYCLES BALANCING are not working. There are some separate settings possible. The real time algorithm is always working in "Best Fit" mode.

Sensitivity (switching threshold): The sensitivity is the switching threshold for switching-on or switching-off the capacitors in percent (%). The range of the sensitivity can be between 55% and 100%. (Factory setting is 60%. Due to this, the following explanations are using 60%.)

Sensitivity is used for checking:

1. The controller is checking with sensitivity, if a switching operation is necessary or if it's possible. The controller is using for this the smallest connected step. If 60% of the power of the smallest step are needed, the pfc-relay is looking in the step database for a suitable step. At switching-off the controller is working vice versa. If at least 60% of the smallest step is overcompensated, the controller is looking for a step, which can be switched-off.
2. To avoid hunting, the controller is only switching steps, which are not overcompensating more than 40% (100%–60%). At switching-off, the regulator is looking for steps, which cause a maximum under compensation of 40% of the step size.

Step exchange: This function is supporting automatic control and combined filter control algorithm to reach optimum results. If the controller detects that target-pf is not reached, it starts searching for a step that gives better results. If step exchange is active, the controller can replace an active step against a step that matches better, to reach the target.

Switch cycles balancing: If this function is active, the controller is using for the next switching operation (from steps with the same or similar size) the step with the minimum number of switching cycles. Switching cycles of the steps are balanced by this. A balanced attrition of contactors and capacitors is assured by this.

Fast regulation: For real time compensation, the controller has a second parallel working algorithm. This algorithm is used for all steps, which are set to step type "FAST" (see **page 5** Step type). The fast algorithm has a reaction time of less 150 μ sec and is switching all necessary steps in one switching operation. In this algorithm, switching time delay, switch cycles balancing and step exchange are not working. The fast algorithm is working in "Best-Fit" principle.

Settings concerning the control functions can be found in this submenu. These settings are possible:

COS PHI 1

This is the setting for target-cos phi 1. It will be valid during normal operation.

COS PHI 2

This is the setting for target-cos phi 2. It will be valid when a switch over is caused by the digital input or another programmable action.

Switch interval

The switch interval is the time delay between switching steps in regulation.

The switch interval has two different functions:

1. Protecting the contactors by reducing the number of switching cycles.
2. Building of the average of the reactive power in the time of the switch interval.

Note: If regulation mode LIFO is selected, the minimum switching interval is 1 sec longer, as the longest discharging time. In HV-version, the minimum switching time delay is 8.7 sec.

Switch interval step exchange

For step exchange, standard switch interval is not used. There is a separate switch interval for step exchange. This is the delay-time between switching-off an active step and switching-in the next step to get a better power factor. Step exchange can be set active in menu on **page 6**.

Step recognition

With the ◀ ▶ key, step recognition can be chosen between "ON" and "OFF".

"Step recognition OFF": Capacitor sizes must be programmed manually:

- A. When there is fast oscillating load in the system, which causes problems of automatic step size detection.
- B. When recognition of defective steps is not wanted.
- C. When capacitor contactors are switching with a delay of more than 200 msec.

"Step recognition ON": Step sizes are detected and corrected automatically during normal operation. "Step recognition ON" is the factory setting, because it allows supervision of the capacitor sizes and gives alarms when there are failures. Step sizes that are programmed manually will be overwritten by step recognition.

Switch cycles balancing

With the ◀ ▶ key, switch cycles balancing can be chosen between "ON" and "OFF". When this function is "ON", the regulator balances the switch cycles of steps with the same or similar size, resulting in an equal attrition of the contactors and capacitors.

Switch cycles balancing %

Difference of similar step sizes in percent for switch cycles balancing.

Step exchange

With the ◀ ▶ key, step exchange can be chosen between "ON" and "OFF". This function changes steps to reach target-pf more exactly.

Control sensitivity

Percentage of the sensitivity of regulation. Factory setting is 60%. This value can be set in a range between 55% and 100%.

Control

Three control modes can be selected:

AUTOMATIC: "Best Fit"

LIFO: "Last in, first out"

Note: For each step, it is checked separately, if switching makes sense. If the steps have different sizes, this can cause inaccuracy. Step recognition is working in this mode as well, when it is active. This can cause that steps are detected as defective and are not used for regulation anymore. These steps are skipped in this mode. If this is not accepted, the step recognition has to be set to "OFF" and the capacitor sizes have to be programmed manually.

Combi - Filter: This setting assures that in combined filters the amount of connected reactive power with lower order harmonic tuning is at least as high as the amount of connected reactive power with higher order harmonic tuning.

Note: The capacitors with higher degree of choking must be connected to the odd exits. The capacitors with smaller degree of choking must be connected to the even exits.

I < limit freeze steps

Yes: If current is detected as zero, the regulator is freezing all the steps until it can measure current again.

No: If current is detected as zero, the regulator is switching-off the capacitors step by step with intervals of 30 sec, to check for a broken cable until it can measure a current again.

The following only affect fast regulation:

Fast control measuring break

Setting of a measuring break after a switching operation. This measuring break avoids errors caused by the reactions of the last switching operation.

This setting must be done carefully to avoid controller overshoot and instability.

Fast control maximum step size

Maximum capacitor power, which is allowed to switch in one switching operation. The controller is switching all necessary steps at the same time. If this is not allowed or if this causes unwanted reactions, then the maximum power that is switched in one cycle can be limited. The setting is done in kVAR.

With setting "0" (factory setting), the limit is not active.

Fast control average Q

Setting of the number of mains cycles, which are used to build the average of reactive power that needs to be compensated. This averaging process starts after the measuring break is finished (see **page 7**).

Fast control sync. Imp.

Yes: The trigger pulse for switching the thyristor-switches is synchronous to the zero-crossing of the mains voltage (rising sinusoid). This can cause a delay of the switching operation, which is less than one mains cycle.

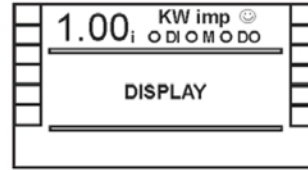
No: The trigger pulse for switching the thyristor-switches is coming directly after finishing the measuring of one period + run time for the algorithm (some μ sec).

Display

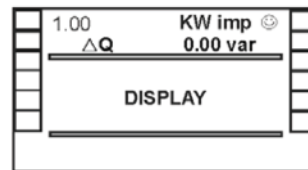
In this submenu, settings can be made according to the display. The following settings are possible:

Display

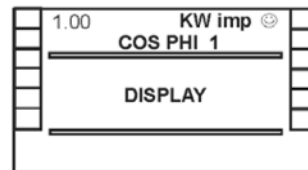
The following masks can be selected for the top display area by pushing the ◀ ▶ key. This masking is permanently displayed. After leaving this submenu, the setting is stored automatically. The following masks are displayable:



Cos φ , DI, M, DO: Display of power factor and status of inputs and outputs (○ =inactive, ● = active).



Cos φ , ΔQ : : Display of power factor and the lacking reactive power.



Cos φ , valid Target cos φ (1 or 2): Showing of power factor and of the chosen target power factor (e.g., tariff switching with digital input).

Contrast

The contrast of the LCD display can be adjusted by pushing the + / - keys. After exiting this submenu, the setting is stored automatically.

Password

By pushing the + / - keys, the password can be changed. Reaching the last digit, the new password is stored by pushing the ◀ key. To remove password protection, set the password to 0000.

Alarm

In the following chapter, all adjustable alarms including trigger are listed.

Alarm	Description
Control alarm	Trigger after 50x switching time not reaching the target cos phi $fQ >$ smallest step (over-/under compensation)
No current	Trigger: $I <$ sensitivity Reaction: switch off steps to reach current flow
Step fault	Trigger: Step size detection not possible Reaction: Alarm after 3 switching trials
Step warning	Trigger: a) Step size falls below an adjustable %value relating to the first acquired step size b) Switch cycles exceeding the adjustable limit for switch cycles
COS PHI	Trigger: The actual COS PHI is outside the adjustable range between 0.80 and 1.00. The delay time can be adjusted from 1s to 36000s.
Harmonics U	Trigger: THD U exceeds the adjusted limit between 1% and 99.9% related to the fundamental wave
Harmonics I	Trigger: THD I exceeds the adjusted limit between 1% and 99.9% related to the fundamental wave
Overload P	Trigger: Amount of P exceeds the adjustable limit between 1 kW and 99.9 MW
Overload Q	Trigger: Amount of Q exceeds the adjustable limit between 1 kVAR and 99.9 MVAR
P-export	Trigger: Alarm will be triggered as soon as P-export is recognized
Temp1 / Temp2	Trigger: Ambient temperature exceeds the adjusted limit
DI Input	Trigger: Apply voltage to the DI input
Overcurrent	Trigger: $I >$ measurement range current channel It is not possible to deactivate this alarm. The controller always generates a signal via the display and the M-relays
Over/undervoltage	Trigger: U beyond the limit. This limit is adjustable under point V-toleranz min and V-toleranz max on page 5 It's not possible to deactivate this alarm. The control stops and the M-relays is activated.

Alarm events

M-Relays: The M-Relay is a volt-free output. It can be used as an NO/NC contact. Maximum fuse 6 A, breaking capacity 250 Vac / 5 A.

Digital Out: The digital output is a volt-free output. It can only be used as an NO contact. Maximum fuse 6 A, breaking capacity 250 Vac / 5 A.

Display: Shows Alarm on Display:

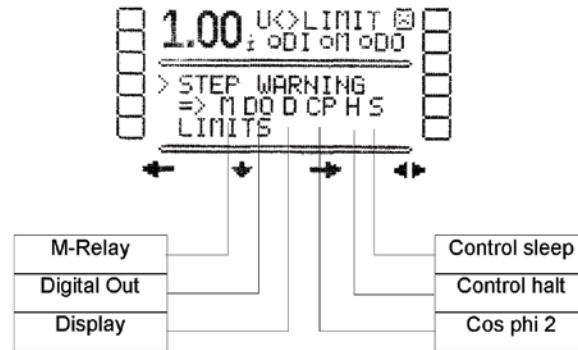


Control sleep: All steps are freezed, control is stopped.

Control halt: All steps are switched off, control is stopped.

Cos phi 2: Switch to a second target cos phi.

The drawing below shows how the enabled alarm is displayed.



Manual

By selecting this submenu, the manual mode for the regulator is active. A valid measurement voltage is required. By pressing the + key, the referring step can be selected. Changing the switching state is possible by pushing the ◀ ▶ key. Manual switching is only possible with a valid measurement voltage. If there is a manual mode necessary without a valid measurement voltage, the test mode on **page 5** has to be activated. After testing, this mode has to be deactivated again.

⚠ IMPORTANT

AFTER SWITCHING OFF AN ACTIVE STEP, THE DISCHARGING TIME IS ACTIVE. ONLY AFTER THIS TIME IS OVER THE STEP CAN BE SWITCHED ON MANUAL AGAIN. DURING THE MANUAL MODE, THE REGULATION FOR THE NOT MANUAL SWITCHED STEPS KEEPS ACTIVE! NEVERTHELESS THE MANUAL MODE SHOULD BE LEFT WHEN IT IS NOT NECESSARY ANY MORE! AFTER LEAVING THE MANUAL MODE, ALL STEPS SHALL BE SWITCHED OFF.

Modbus

This submenu is only enabled if the regulator is equipped with the Modbus interface. The following settings are possible:

- **Baud rate:** The baud rate can be selected by pushing the ◀ ▶ key. The valid range is between 1200 and 38400
- **Parity:** The parity can be selected by pushing the ◀ ▶ key. The following settings are possible: 8E1 (8 data bits/even parity/1 stop bit), 8O1 (8 data bits/odd parity/1 stop bit) and 8N2 (8 data bits/no parity/2 stop bits)
- **Address:** By pushing the ▶ key, it is possible to enter the slave address (slave ID). The valid range is between 1 and 247

The settings for baud rate and parity must be the same for all bus devices. The address must be unique for each device.

Reset

This submenu resets the device to factory settings.

Configuration

In this submenu, the basic configuration can be changed. This should be done only after consultation with Eaton.

Device info



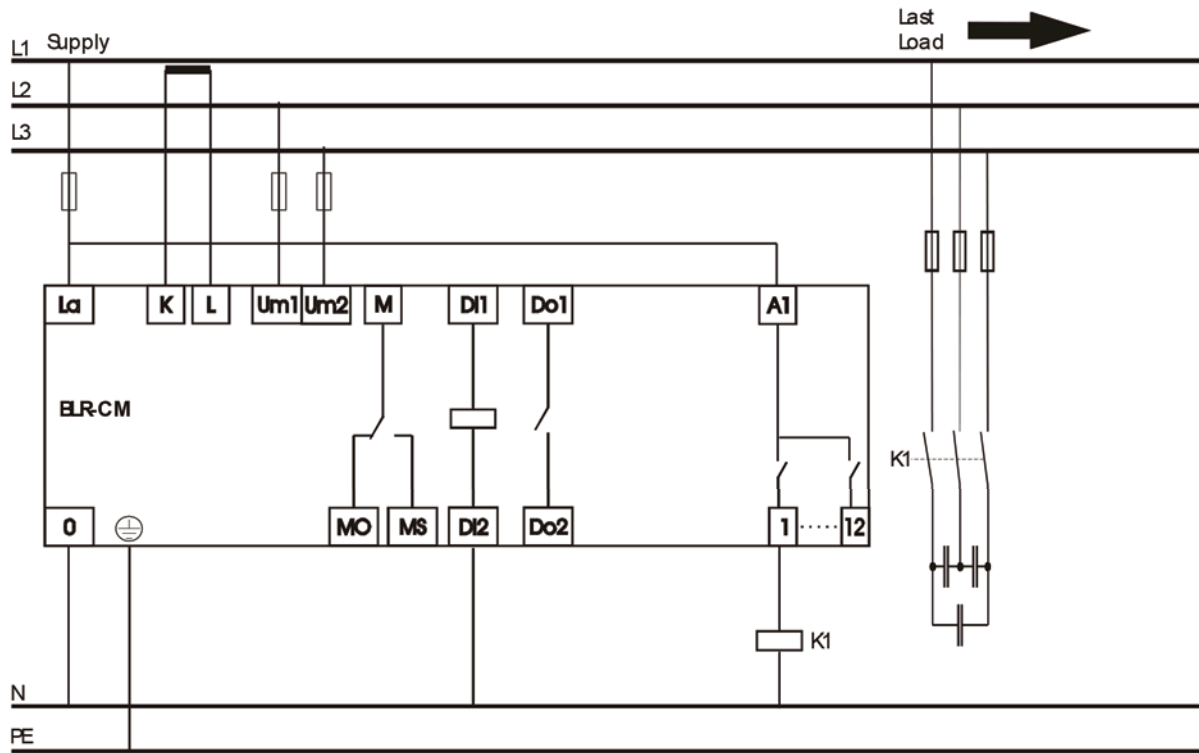
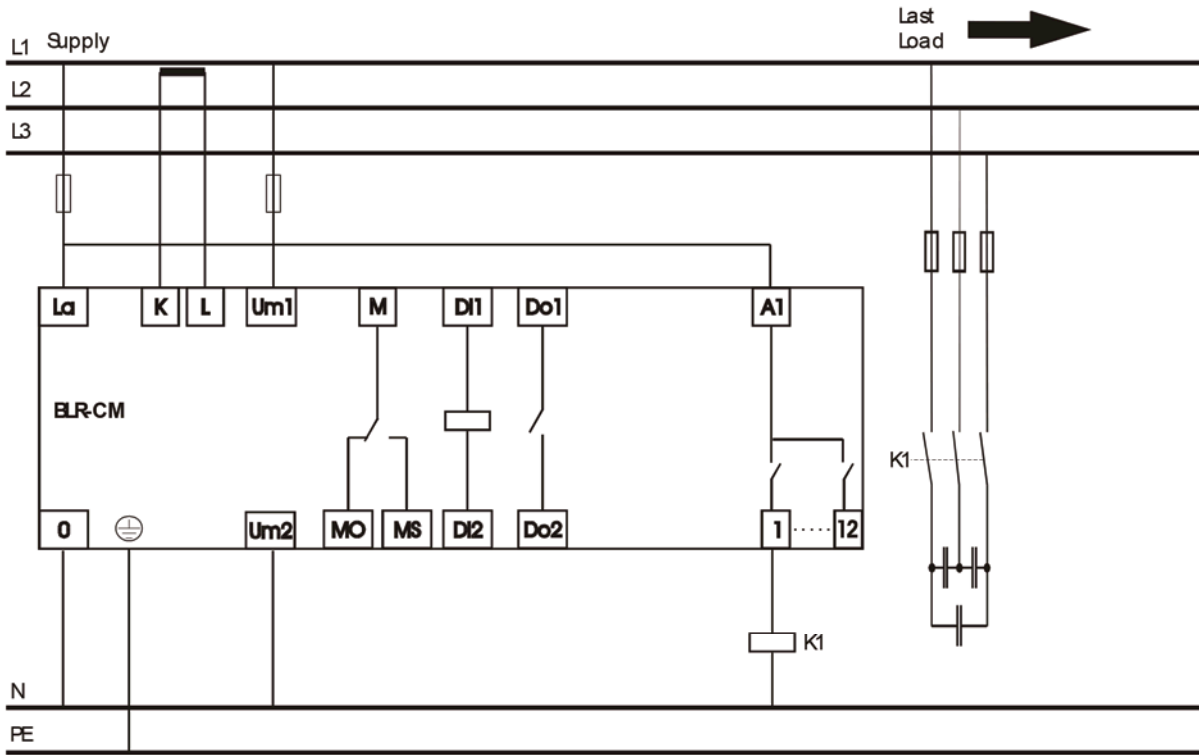
Device type: e.g., BLR-CM

Software version: z. B. VER 02.02.00

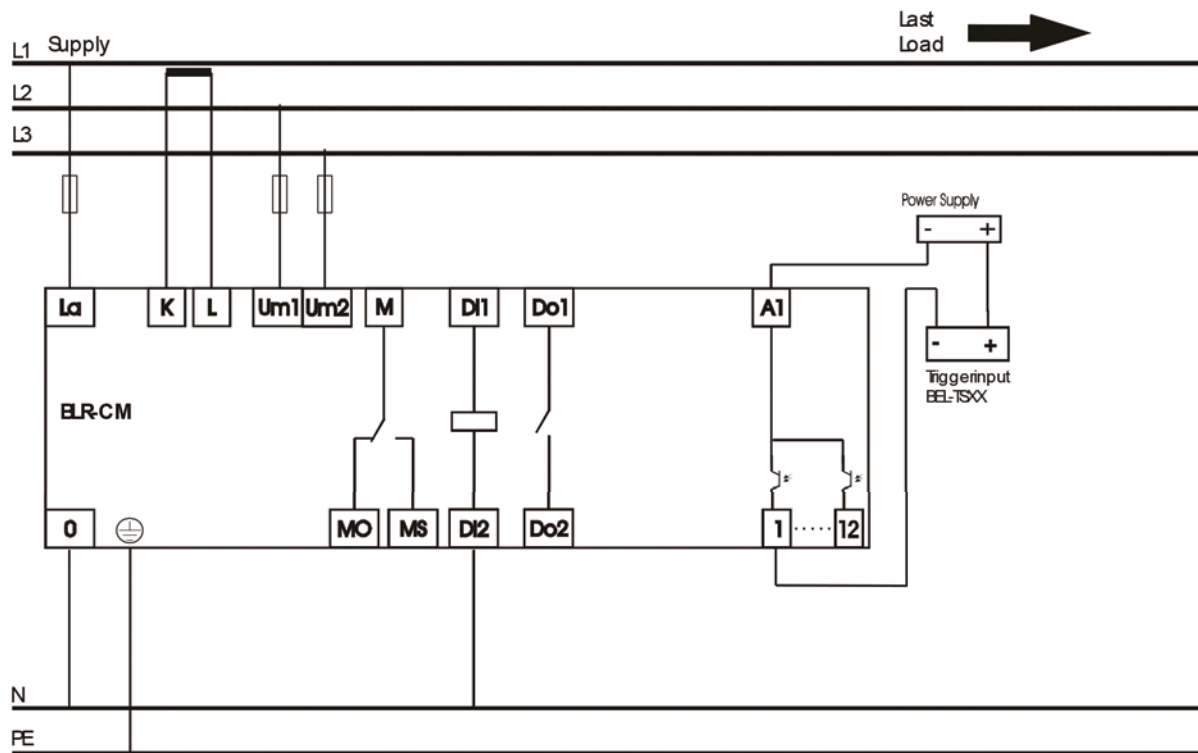
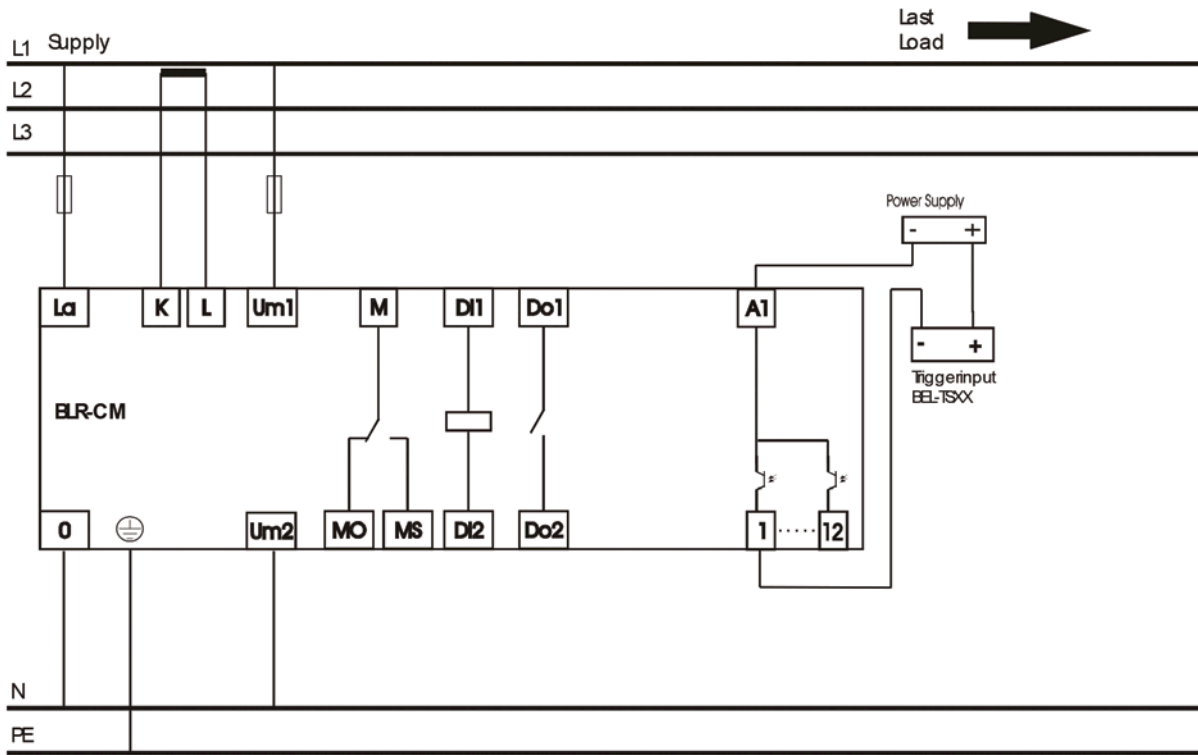
FLG: MB

Wiring diagrams BLR-CM

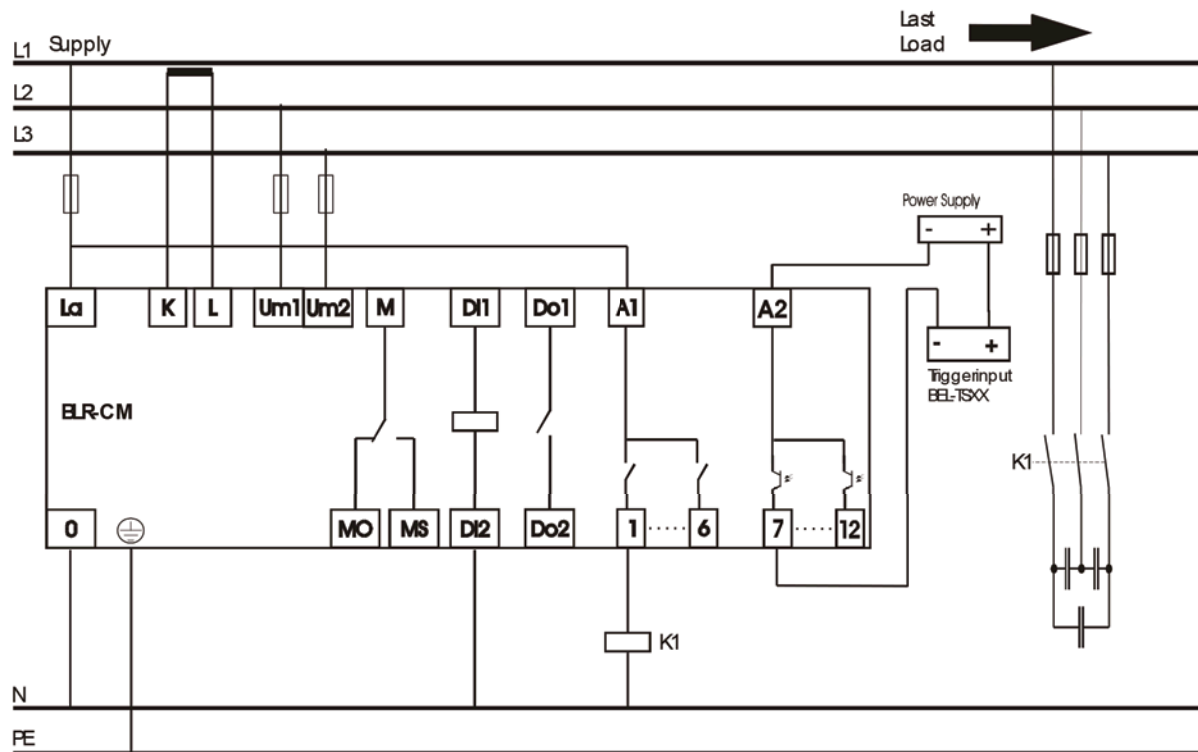
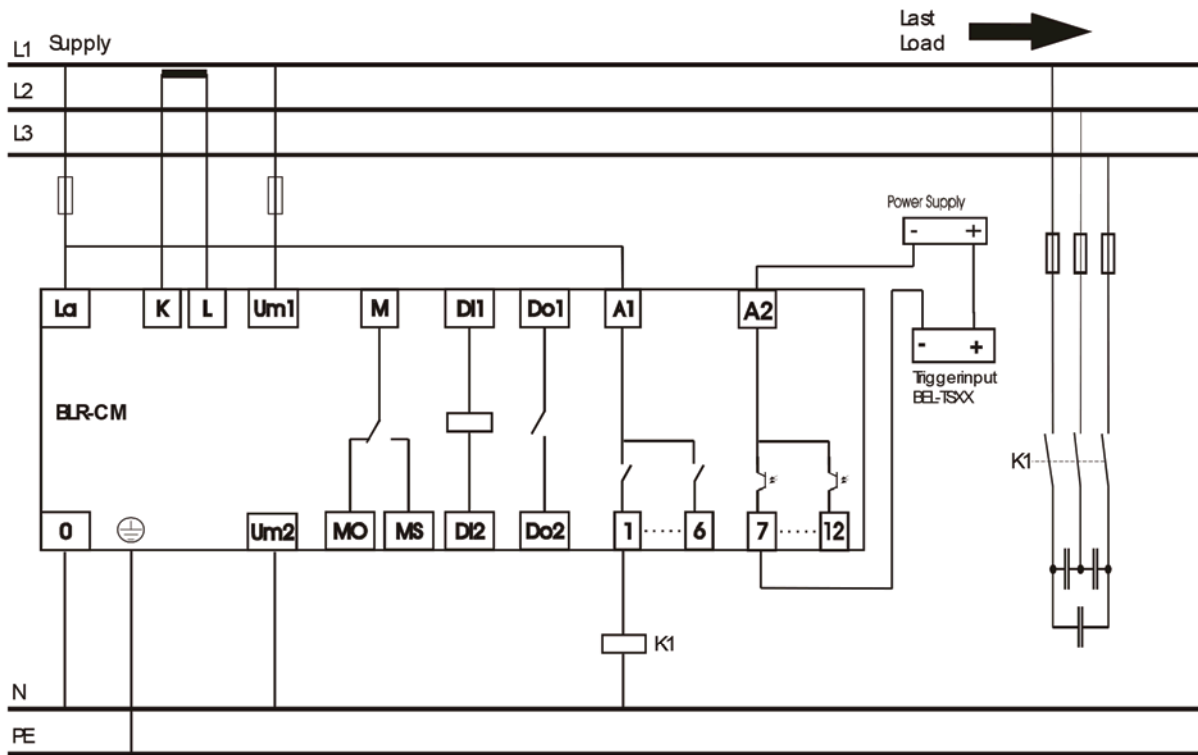
BLR-CM06/12R



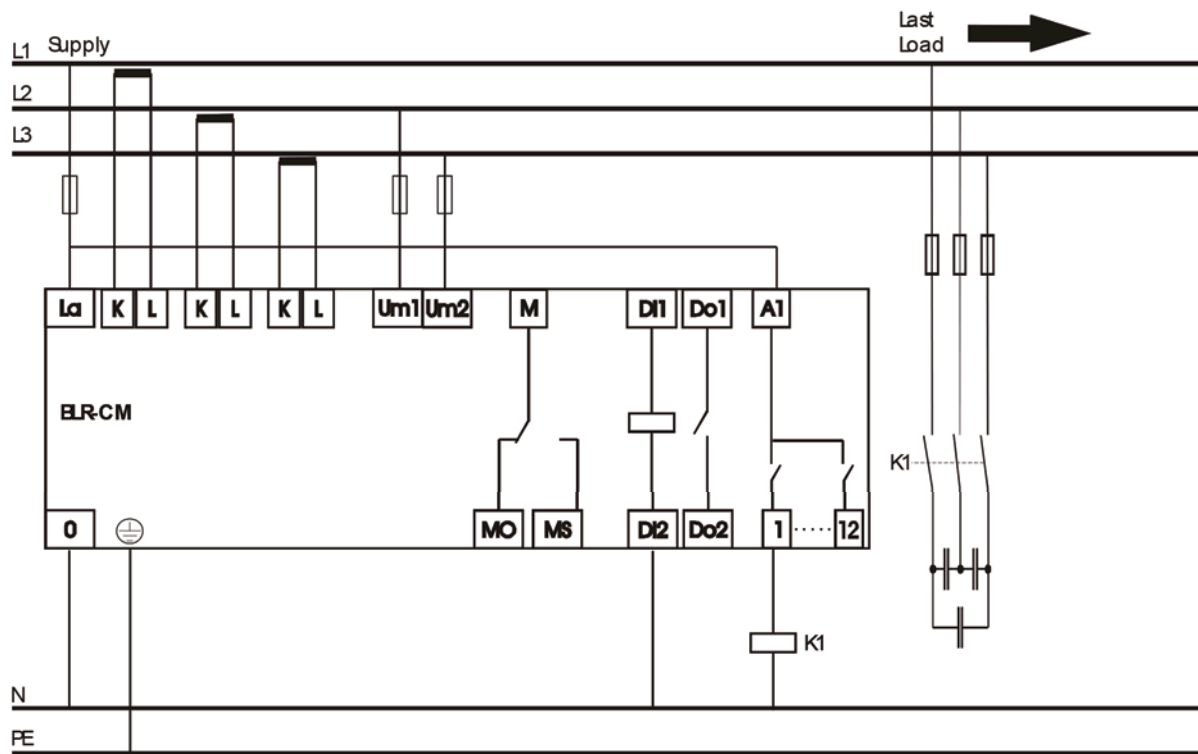
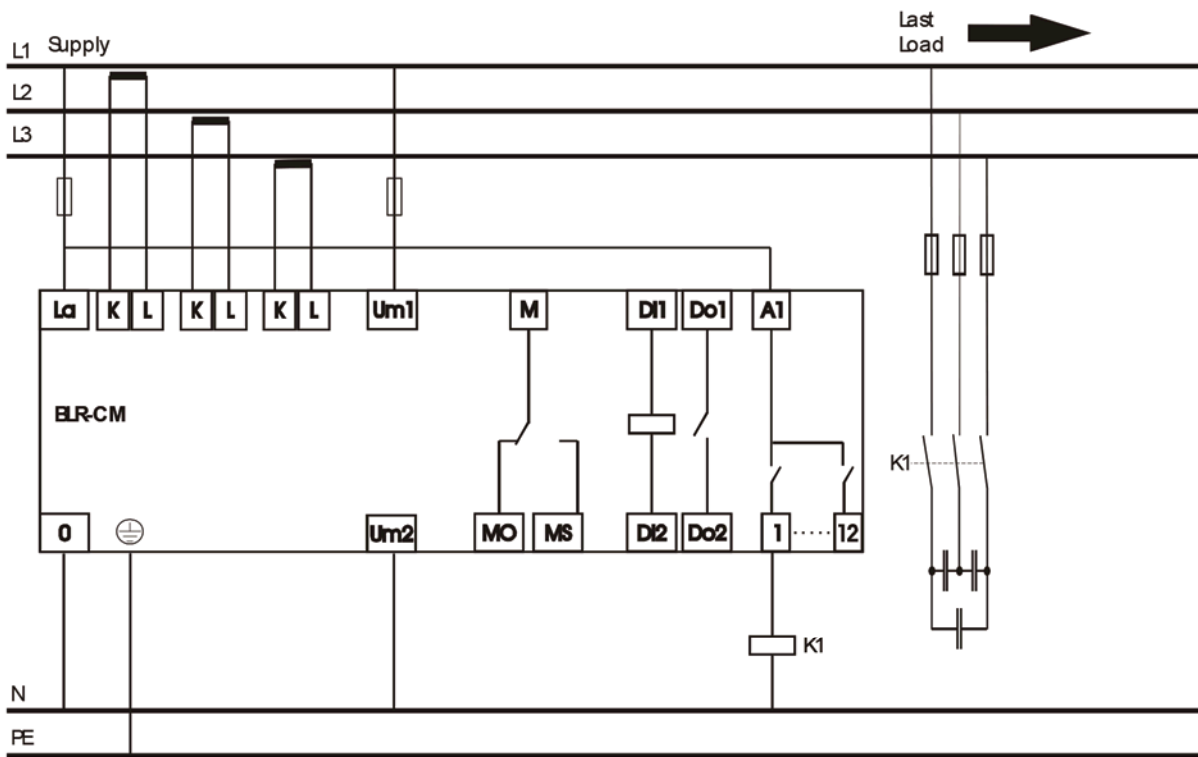
BLR-CM06/12T



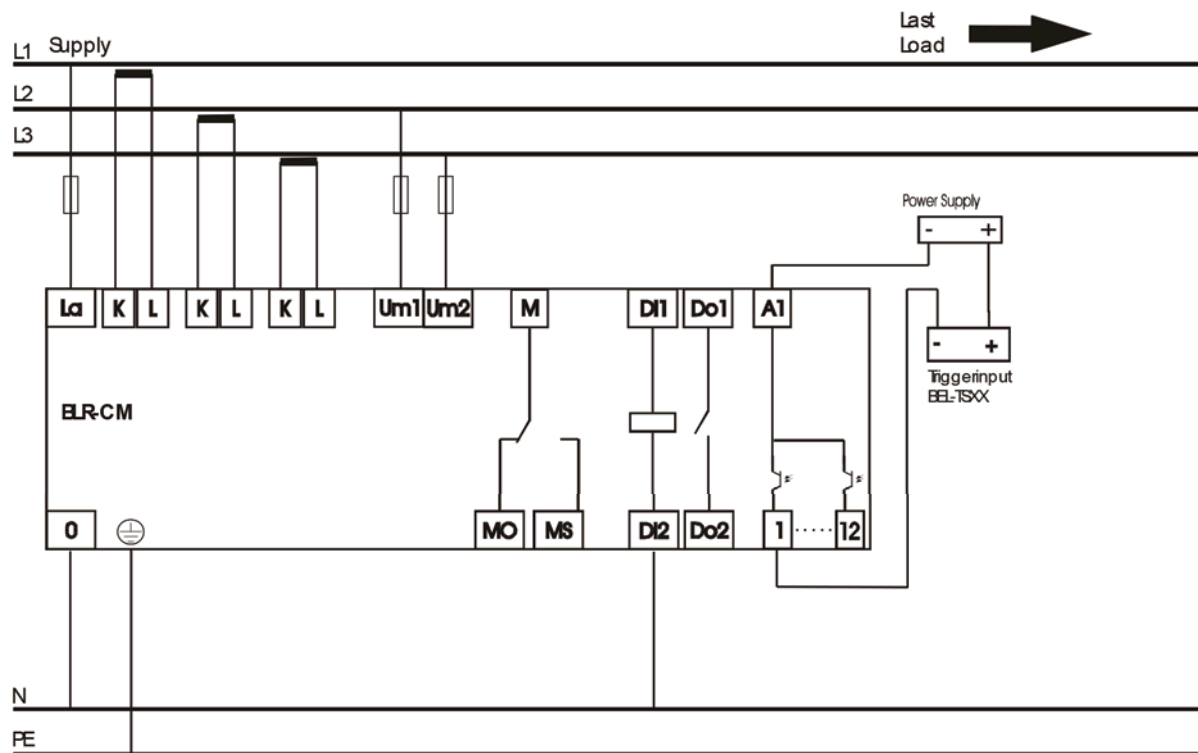
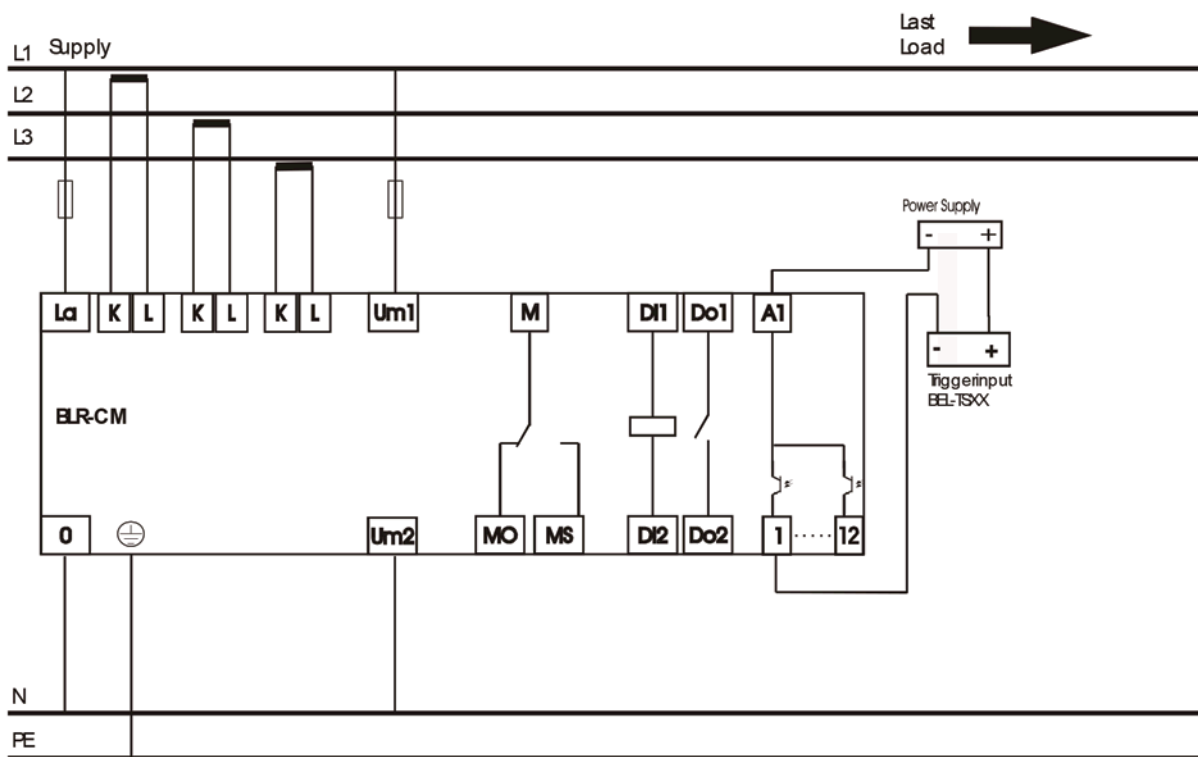
BLR-CM12RT



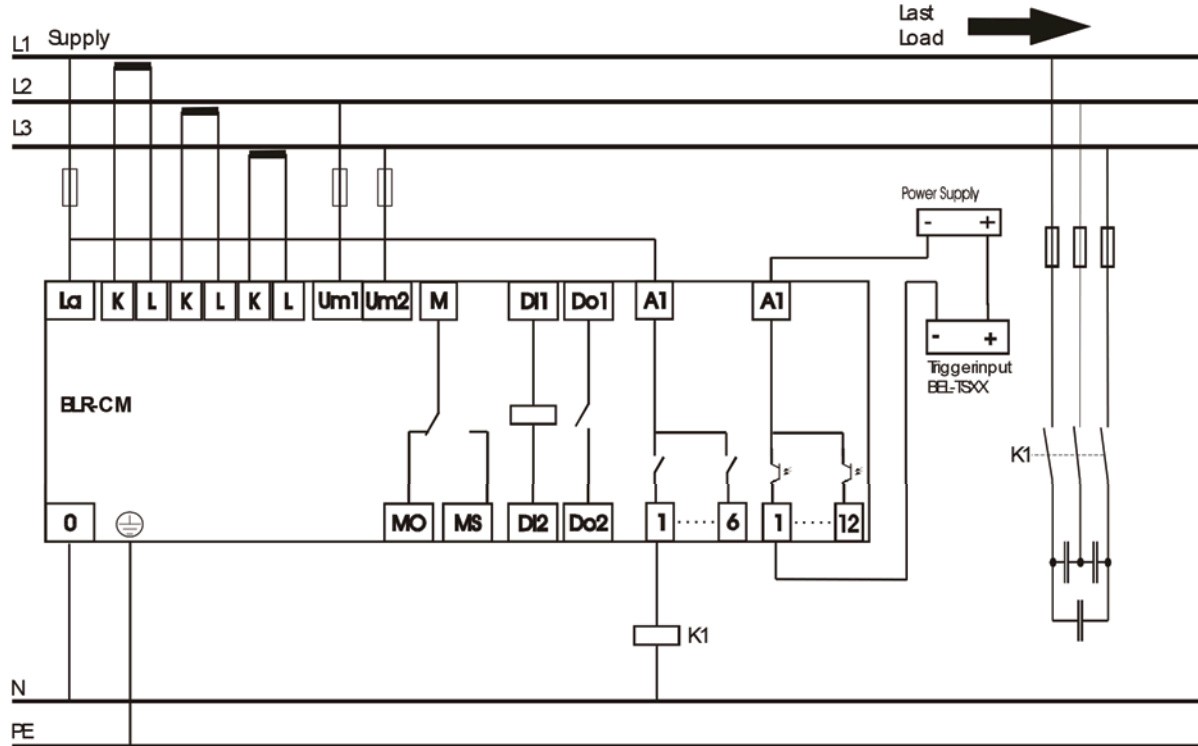
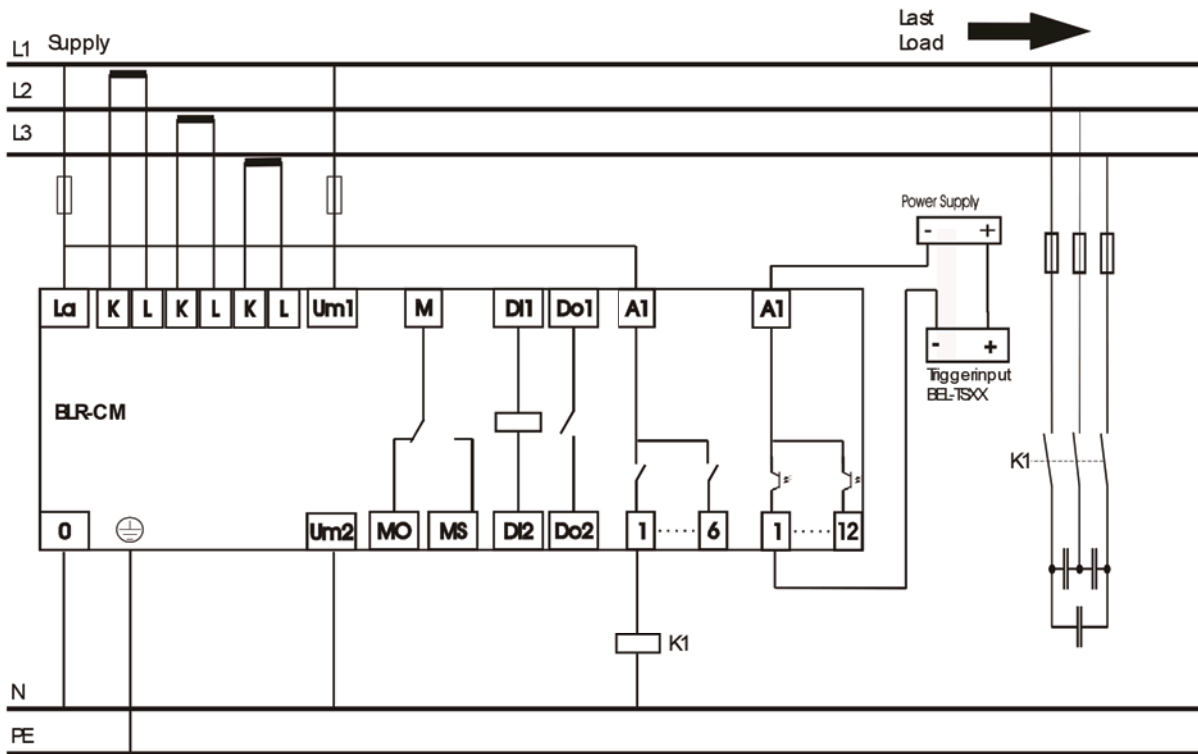
BLR-CM06/12R-3A (BLR-CM3phase)



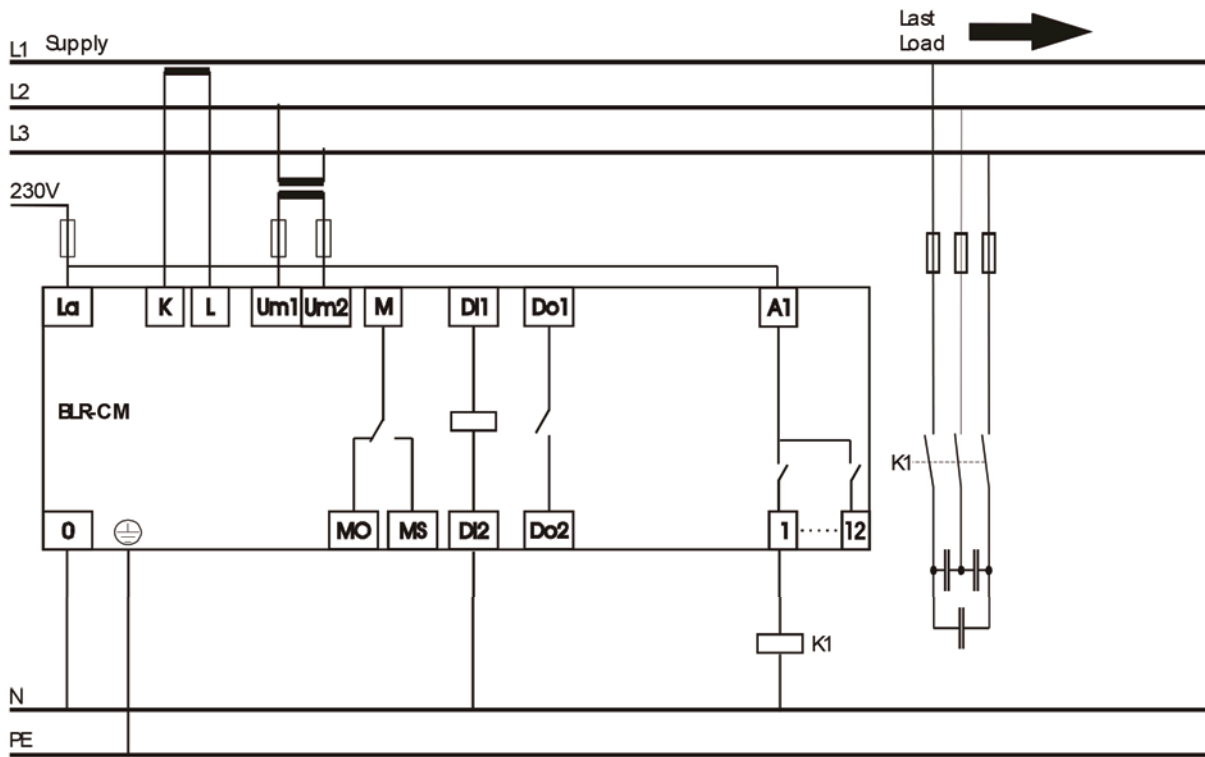
BLR-CM06/12T-3A (BLR-CM3phase)



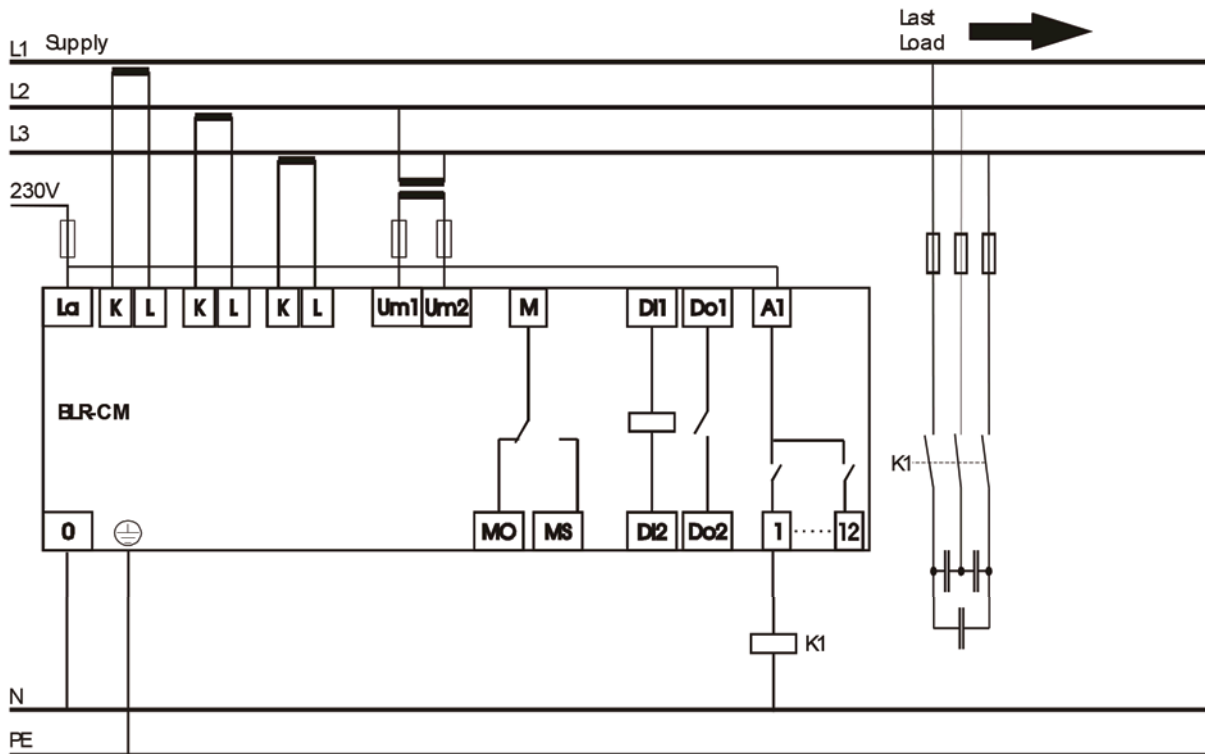
BLR-CM12RT-3A (BLR-CM3phase)



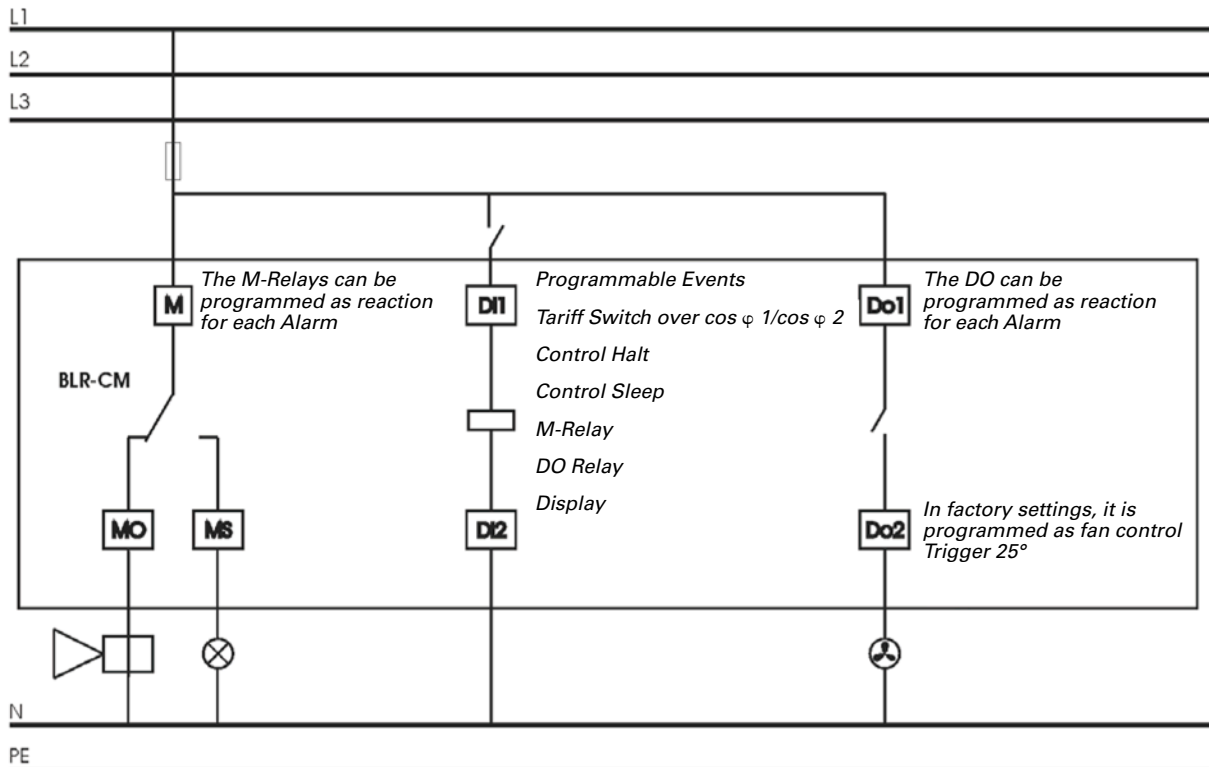
BLR-CM06/12R-HV



BLR-CM06/12R-3AHV (BLR-CM3phase)



BLR-CM I/O



Standard setting

Function	Standard setting	Range of setting
CT ratio	600 (corresponds to 3000:5 CT)	1.0–4000.0
PT ratio	1.7 (240 V units), 3.7 (480 V units), or 4.7 (600 V units), per equipment drawings for MV units	1.0–350.0
Nominal voltage (L-L)	Set per electrical system nominal voltage	100–35000 V
Connection	L-L	L-N, L-L
Discharging time	60 s for units from 208 V to 600 V, 200 s for other units	60 s – 1200.0 s
Step type	normal	normal, fix on, fix off, off, fast
Cos phi 1	i 0.95	0.60 i – 1.00 – 0.70 c
Cos phi 2	i 0.95	0.60 i – 1.00 – 0.70 c
Switch interval	60 s	0.5 s – 1200.0 s
Modbus baud rate	9600	1200–38400
Modbus parity	8E1	8E1, 8O1, 8N2
Modbus address	1	1–247
Synchronization	automatic	auto, 50 Hz, 60 Hz
Phase compensation	90°	0 to 345°, steps 15°
V-tolerance min	10%	2–90%
V-tolerance max	10%	2–30%
Test mode	no	yes / no
Nominal step size	Set to match equipment. Typical sizes for units up to 600 V is 25, 50, or 100 kVAR	1.0 to 99999.9 kVAR
Step recognition	OFF	ON / OFF
Switch cycles balancing	yes	yes / no
Switch cycles balancing limit	10%	1–15%
Step exchange	no	yes / no

Troubleshooting

Problem	Possible cause	Remedy
No display	Auxiliary voltage missing	Check correct connection of auxiliary voltage, if necessary, rectify
Display "U<>LIMIT"	Measurement voltage out of range	Check correct connection of measurement voltage, if necessary, rectify
	Wrong settings for voltage measurement	Check settings in menu "SETUP / MEASUREMENT," if necessary, rectify
Display "I<LIMIT"	Measurement current too small	Check connection of CT, there probably is a break in the line
		CT ratio too high, if necessary replace CT
		Remove short circuit link of the CT
Wrong display of current or voltage	Wrong transformer ratio	Check settings PT- or CT-ratio in menu "SETUP / MEASUREMENT," if necessary rectify
Wrong power factor is displayed	Wrong settings at the regulator	Check settings "NOMINAL VOLTAGE" and "CONNECTION" in menu "SETUP" and setting "PHASE COMPENSATION" in menu "EXTENDED," if necessary rectify
Power factor doesn't change after switching on a step, step is switched off again	CT mounted in wrong position	Check mounting position referring circuit diagram (current of load and capacitors have to be measured!), if necessary rectify
Alarm "overcurrent"	Current higher than allowed	Check CT ratio, replace by a suitable transformer type
Alarm "control"	Permanent overcompensation	Check settings
		Check contactors, probably contact stick together
		Permanent undercompensation
		Check settings
		Check capacitors, possibly fuse defective
		Check dimensioning of the compensation unit
Reversed control mode	Current or voltage clamps interchanged	Correct connection or adapt phase compensation
Single steps are not switched on or off	Wrong settings	Check, if referring steps are defined as fix steps (permanently on or off)
Steps are detected as defective	Step defective	Check capacitor steps, probably fuse, capacitor or contactor is defective
Steps are not switched on	Step size too large	Necessary reactive power smaller than switching threshold of step size of the smallest step
Regulator still doesn't work proper		Contact Eaton

Technical data

Description	Specification
Auxiliary voltage	100–132 V / 207–253 V, 45–65 Hz, max. fuse 6 A
Voltage measuring	50–530 V, 45–65 Hz, PT-ratio 1–350
Current measuring	0–5 A, sensitivity 15 mA, burden 15 mohm Overload 20% continuous, CT-ratio 1–4000
Regulation outputs	6R, 12R, 6T, 12T, 12RT Relays: N/O, one common point, max. fuse 6 A Breaking capacity: 250 Vac / 5 A Static outputs: open-collector, breaking capacity: 8–48 Vdc / 100– mA
Alarm contact	C/O, voltfree, programmable Maximum fuse 6 A, breaking capacity 250 Vac / 5 A
Digital input	50–250 Vac, programmable
Digital output	N/O, voltfree, programmable Maximum fuse 6 A, breaking capacity 250 Vac / 5 A
Interface (optional)	RS-485 Modbus RTU protocol (slave)
Ambient temperature	Operation: 0 °C to +70 °C, storage: –20 °C to +85 °C
Humidity	0%–95%, without moisture condensation
Overvoltage class	II, pollution degree 3 (DIN VDE 0110, Teil 1 / IEC 60664-1)
Standards	DIN VDE 0110 Teil 1 (IEC 60664-1:1992) VDE 0411 Teil 1 (DIN EN 61010-1 / IEC 61010-1:2001) VDE 0843 Teil 20 (DIN EN 61326 / IEC 61326:1997 + A1:1998 + A2:2000)
Conformity and listing	CE, UL, cUL
Terminals	Screw-type, pluggable, max. 2.5 mm ²
Casing	Front: instrument casing plastic (UL94-V0), rear: metal
Protection class	Front: IP 54, rear: IP 20
Weight	Ca. 0.8 kg
Dimensions	144 x 144 x 58 mm (h x w x d), cutout 138 +0.5 x 138+0.5 mm

TYPICAL BLR-CM POWER FACTOR CONTROLLER SETTINGS FOR 480 V AUTOVAR UNITS

+++> SETUP <- PASSWORD 2402 <-				
> MEASUREMENT <-	CT FACTOR	600	**	
	VT FACTOR	3.7		
	NOM. VOLTAGE	480 V		
	CONNECTION	U=L-L		
	EXTENDED			
		SYNCH FREQUENCY.	AUTOMATIC	
		PHASE COMP.	90°	**
		V-TOL (MIN)	-10%	
		V-TOL (MAX)	+10%	
		TEST MODE	NO	
> STEP <-	STEP 01 THRU STEP X	DISCHARGE TIME	60 S	
		STEP TYPE	NORMAL	
		STEP NOM. VALUE Qc	C 50 KVAR**	
	STEP X THRU STEP X	DISCHARGE TIME	60 S	
		STEP TYPE	NORMAL	
		STEP NOM. VALUE Qc	C 50 KVAR**	
> CONTROL <-	COS PHI 1	i 0.95	**	
	COS PHI 2	i 0.95		
	SWITCH INTERVAL	60 SEC		
	STEP EXCHANGE INTERVAL	60 SEC		
	EXTENDED			
		STEP RECOGNITION (ON/OFF)	OFF	
		SWITCH CYCLES BALANCING?	YES	
		SWITCH CYCLES BALANCING LIMIT%	10%	
		STEP EXCHANGE?	NO	
		CONTROL SENSITIVITY %	60%	
		CONTROL TYPE	AUTOMATIC	
		I < LIMIT FREEZE STEPS?	YES	
	> DISPLAY <-	DISPLAY ON SCREEN		
CONTRAST				
	PASSWORD			
> ALARM <-				

! NOTE: TO TOGGLE YES/NO USE PRESS BUTTON LINED-UP WITH !		COS PH 2	CONTROL HALT	CONTROL SLEEP	M RELAY	DO RELAY	DISPLAY
		CP	H	S	M	DO	D
> ALARM <-	CONTROL ALARM	DISABLED	NO	NO	NO	YES	NO
	NO CURRENT	ENABLED	NO	YES	NO	YES	YES
	STEP FAULT	ENABLED	NO	NO	NO	YES	YES
	STEP WARNING	ENABLED	NO	NO	NO	YES	NO
	POWER FACTOR	ENABLED	NO	NO	NO	YES	YES
	HARMONICS U	DISABLED	NO	NO	NO	YES	NO
	HARMONICS I	DISABLED	NO	NO	NO	YES	NO
	OVERLOAD P	DISABLED	YES	NO	NO	YES	NO
	OVERLOAD Q	DISABLED	NO	NO	NO	YES	NO
	P-EXPORT	DISABLED	YES	NO	NO	NO	NO
	TEMP1	DISABLED	NO	NO	NO	NO	YES
	TEMP2	DISABLED	NO	YES	NO	YES	NO
	DI NPUT	DISABLED/ENABLED	NO	YES/NO	NO	NO	YES

** FIELD VERIFY AND ADJUST AS NECESSARY.

For technical support and application engineering assistance, please contact Eaton's TRC at
1-800-809-2772 option 4, option 2
or email pfc@eaton.com