BENDER

Operating Manual

CME420

Current monitor with
window discriminator function
for direct monitoring of AC currents up to 16 A
and for monitoring with current transformers up to 32 kA

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Table of Contents

1. How to use this documentation effectively

1. 1 How to use this manual

This manual is intended for experts in electrical engineering and electronics!

In order to make it easier for you to find specific text passages or references in this manual and for reasons of comprehensibility, important information is emphasized by symbols. The meaning of these symbols is explained below:

Information calling attention to hazards are marked with this warning symbol.

Information intended to assist the user to make optimum use of the product are marked with the Info symbol.

1. 2 Intended use

The current monitor is designed to monitor the threshold values of AC currents for overcurrent and undercurrent conditions. In case of direct measurement, currents up to 16 A can be continuously monitored. For indirect measurement by means of a current transformer, a transformation ratio factor up to 2000 can be set. The device allows pure overcurrent and pure undercurrent operation, as well as window operation between two adjustable response values. The device is factory set to overcurrent operation.

1.3 Information about factory setting

Seite 32 provides a summary of all factory settings.
If you want to reset the current monitor to factory settings refer to Seite 30.

2. Safety information

2. 1 Safety instructions

In addition to this data sheet, the documentation of the device includes a sheet entitled "Important safety instructions for BENDER products“.

2. 2 Work activities on electrical installations

- All work activities necessary for installation, commissioning or work activities during operation of electrical devices or systems are to be carried out by adequately skilled personnel.
- Observe the relevant regulations applying to work on electrical installations, in particular DIN EN 50110 or its subsequent regulation.

Unprofessional work activities on electrical installations may result in a threat of danger to the life and health of human beings!

- If the equipment is used outside the Federal Republic of Germany, the respective national standards and regulations are to be observed. The European standard EN 50110 is recommended to be used as a directive.

3. Function

3. 1 Device features

- Undercurrent or overcurrent monitoring in AC systems, < I or > I and current monitoring with window discriminator function.
- Direct current monitoring up to AC 16 A
- Indirect current monitoring by means of a current transformer, suitable for standard current transformers x/ 1 A, x/ 5 A, x/ 10 A
- Adjustable switching hysteresis
- r.m.s. value measurement AC
- Starting delay, response delay and delay on release
- Measured value display via multi-functional LC display
- Alarm indication via LEDs (AL1, AL2) and changeover contacts (K1, K2)
- N/C operation or N/O operation selectable
- Password protection against unauthorized parameter changing
- Fault memory behaviour selectable

3. 2 Function

Once the supply voltage is applied, the starting delay "t" is activated. Measured values changing during this time do not influence the switching state of the alarm relays.
The devices provide two separately adjustable measuring channels (overcurrent/undercurrent). When the measured value exceeds (ALARM 1) resp. drops below (ALARM 2) the adjusted threshold value, the time of the response delays "ton 1/2" begins. After the expiry of the response delay, the alarm relays switch and the alarm LEDs light. If the measured value falls below or exceeds the adjusted delay on release (response value plus hysteresis) after the alarm relays have switched, the delay on release starts "t_{off}". After the expiry of "t_{off}", the alarm relays switch back to their initial position. With activated fault memory, the alarm relays do not change their actual state until the reset button R is pressed.

3.2.1 Automatic self test

The device automatically carries out a self test after connecting to the system to be monitored and later every 24 hours. During the self test internal functional faults or connection faults will be determined and will appear in form of an error code on the display. The alarm relays are not checked during this test.

3.2.2 Manual self test

After pressing the internal test button for > 1.5 s, a self test is performed by the device. During this test, internal malfunctions will be determined and appear in form of an error code on the display. The alarm relays are not checked during this test.
While the test button T is pressed and held down, all device-related display elements appear on the display.

3.2.3 Malfunction

In the event of an internal malfunction, all three LEDs flash. An error code appears on the display (E01...E32).
For example, E08 means: Incorrect internal calibration. In such a case please contact the Bender Service.

3.2.4 Specify the number of reload cycles

If faults occur only temporarily, but recurrently, in the system being monitored, with deactivated fault memory M, the alarm relays would switch synchronously to the error status.
RL in the out menu can be used to limit the number of these changeover processes. As soon as the specified number of processes is exceeded, the fault memory will come on and an activated alarm remains stored.

3.2.5 Erasable history memory

The first alarm value that occurs will be entered in this memory. The memory can be cleared via the menu HiS.

3.2.6 Assigning alarms to the alarm relays K/1K2

Different alarm categories can be assigned to the alarm relays K1/K2 via the menu "out".

3.2.7 Time delays t, t_{on} and t_{off}

The times t, t_{on} and t_{off} described below delay the output of alarms via LEDs and relays.

3.2.8 Starting delay t

After connection to the supply voltage U_S, the alarm indication is delayed by the preset time t (0...99 s).

3.2.9 Response delay $t_{on1/2}$

If the current value exceeds or falls below the threshold value, the current monitor does not initiate an alarm before the response time t_{an} has elapsed.
A set response delay $t_{on1/2}$ (0...99 s) adds up to the device-related operating time t_{ae} and delays alarm signalling (total delay time $t_{an} = t_{ae} + t_{on}$). If the fault does not continue to exist before the time of the response delay has elapsed, an alarm will not be indicated.

3.2.10 Release delay t_{off}

When no alarm exists after deactivating the fault memory, the alarm LEDs will go out and the alarm relays switch back to their initial position. After activating the release delay (0...99 s), the alarm state is continuously maintained for the selected period.

3.2.11 Password protection (on, OFF)

With activated password protection (on), settings can only be carried out when the correct password (0...999) has been entered.

3.2.12 Factory setting FAC

After activating the factory setting, all settings previously changed are reset to delivery status.

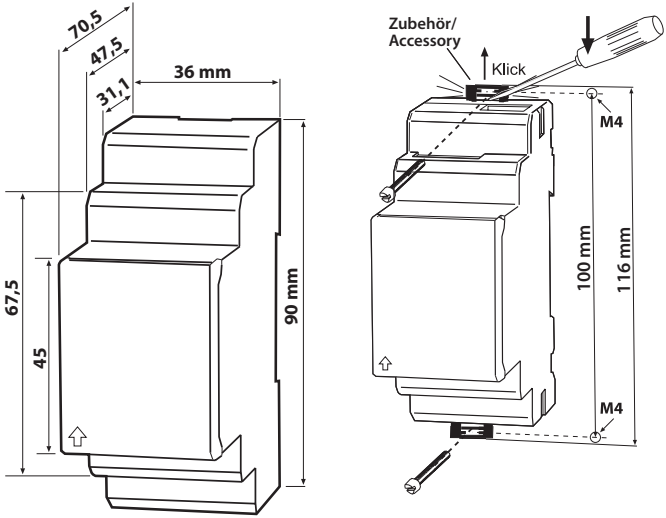
3.2.13 Display accuracy

The display accuracy of the measured current values depends on the set response values. When an alarm response value I2 of 10 A has been selected, currents smaller than 350 mA are displayed as < 0.3 A.

4. Installation and connection

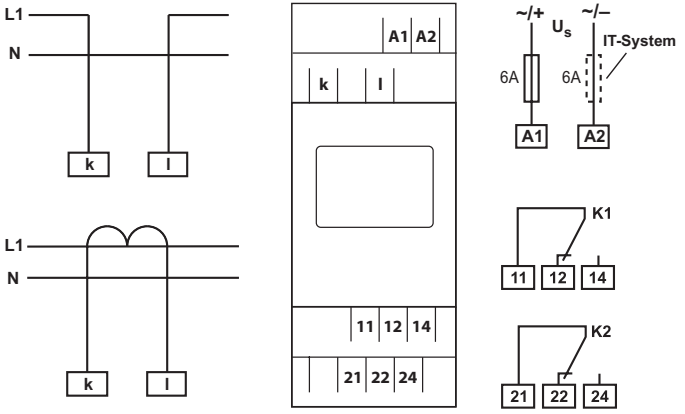
Ensure safe isolation from supply in the installation area. Observe the installation rules for live working.

Dimension diagram and drawing for screw fixing



The front plate cover is easy to open at the lower part identified by an arrow.

1. **DIN rail mounting:**
   Snap the rear mounting clip of the device into place in such a way that a safe and tight fit is ensured.
   Screw fixing:
   Use a tool to move the rear mounting clips (a second mounting clip required, see ordering information) to a position that it projects over the enclosure. Then fix the device using two M4 screws.
2. **Wiring**
   Connect the device according the wiring diagram.



Terminal	Connections
A1, A2	Connection to supply voltage U_S
k, l	Connection to the conductor to be monitored: directly or by means of a current transformer
11, 12, 14	Alarm relay K1
21, 22, 24	Alarm relay K2

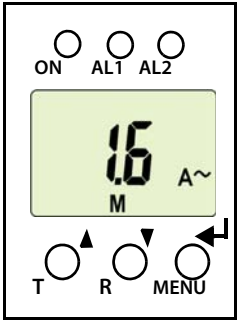
5. Operation and setting

5. 1 Used display elements

A detailed description of the meaning of the display elements is given in the table below.

Used display elements	Element	Function
	**RL**	Reload function with memory = off (L = I.)
	n	Transformation ratio factor for external current transformer
	<I **>I**	Undercurrent Overcurrent
	r1, 1 **r2, 2**	Alarm relay K1, Alarm relay K2
	I Hys, %	Response value hysteresis in %
	ton1, ton2, t, toff	Response delay t_{on1} (K1), Response delay t_{on2} (K2) Starting delay t, Delay on release t_{off} for K1, K2
	M	Fault memory active
		Operating mode of the relays K1, K2
		Password protection active

5. 2 Function of the operating elements

Device front	Element	Function
	**ON**	Power On LED, green
	AL1, **AL2**	LED Alarm 1 lights (yellow): Response value 1 reached LED Alarm 2 lights (yellow): Response value 2 reached
	1,6 A, **M**	I = 1.6 A flow via the terminals k and l, Fault memory active
	T, ▲	Test button (> 1.5 s): Indication of the display elements, starting a self test; Up key (< 1.5 s): Menu items/values
	R, ▼	Reset button (> 1.5 s): Deleting the fault memory; Down key (< 1.5 s): Menu items/values
	MENU, ↵	MENU key (> 1.5 s): Starting the menu mode; Enter key (< 1.5 s): Confirm menu item, submenu item and value. Enter key (> 1.5 s): Back to the next higher menu level.

5. 3 Menu structure

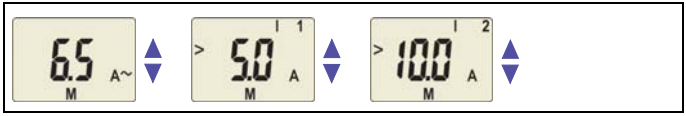
All adjustable parameters are listed in the columns menu item and adjustable parameters. A display-like representation is used to illustrate the parameters in the column menu item. Different alarm categories can be assigned to the alarm relays K1, K2 via the submenus r1, r2. This is done by activation or deactivation of the respective function.

Menu	Sub menu	Menu item	Activation	Adjustable parameter
AL (response - values)	→	> I2	ON (HI)	Overcurrent (alarm)
		> I1	ON (HI)	Overcurrent (prewarning)
		Hys		Hysteresis < I21, > I21
out (output control)	→	M	ON	Fault memory
		1	-	Operat. mode K1 (n.c.)
		2	-	Operat. mode K2 (n.c.)
		RL		Reload function (memory = off)
	r1 (K1: (assignment alarm category)	1 Err	ON	Device error at K1
		r1 I1	ON	Prewarning I1 at K1
		r1 I2	OFF	Alarm I2 at K1
		1 tES	ON	Device test
	r2 (K2: (assignment alarm category)	2 Err	ON	Device error at K2
		r2 I1	OFF	Prewarning I1 at K2
		r2 I2	ON	Alarm I2 at K2
		2 tES	ON	Device test
t (timing check)	→	t on 1	-	Response delay K1
		t on 2	-	Response delay K2
		T	-	Starting delay
		t off	-	Delay on release K1/K2

Menu	Sub menu	Menu item	Activation	Adjustable parameter
Set (device control)	→	I 12	HI	Setting ranges: High, window function, low
		n	1	Transformation ratio factor external current transformer
		🔒	OFF	Parameter setting via password
		FAC	-	Re-establish factory settings
		SYS	-	Function blocked
InF	→		-	Display hard / software version
HiS	→	Clr	-	History memory for the first alarm value, erasable

5. 4 Display in standard mode

By default, the currently measured current is displayed or, if required, the measured overcurrent value. The current response values (prewarning) and I2 (alarm) can be displayed using the Up and Down key. If you want to return to the measured value, press the enter key.



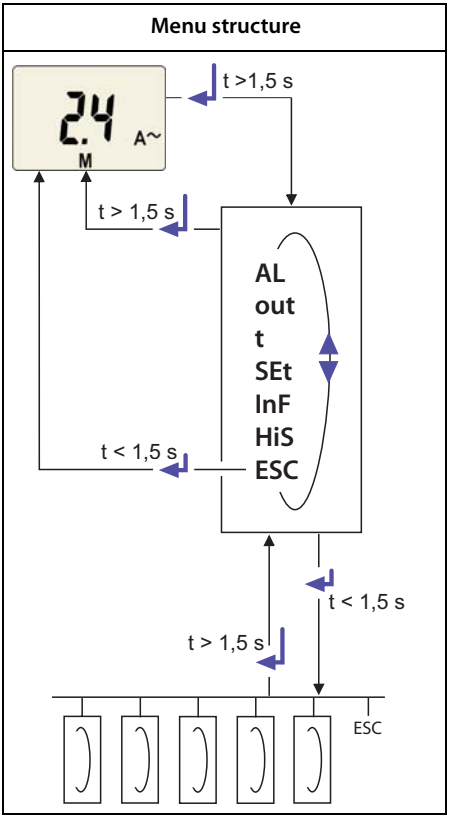
In the standard mode, the currently set response values I1 and I2 can be displayed using the Up and Down keys.

5. 5 Display in menu mode

5.5.1 Parameter query and setting: overview

Menu item	Adjustable parameter
AL	Response values query and setting: – Alarm I2 (AL2), (undercurrent, overcurrent or window function can be set in the SEt/I menu) – Prewarning I1 (AL1), (50 % of I2) – Specify the hysteresis of the response values: Hys I12
out	Configuration of the fault memory and the alarm relays: – Activating/deactivating the fault memory – Select N/O operation (n.o.) or N/C operation (n.c.) individually for each K1/K2 – Specify the number of the reload cycles – Assign the alarm categories undercurrent or overcurrent or device error individually to each K1/K2 (1, r1 / 2, r2).
T	Delay settings: – Response delay t_{on1}/t_{on2} – Starting delay t – Delay on release t_{off} (LED, relay)
SEt	Parameter setting for device control: – Select the appropriate parameter for response values:High (HI), low (Lo) or window function (In). – Set the transformation ratio (n) for the current transformer – Enable or disable password protection, change the password – Re-establish factory settings – Service menu SyS blocked
InF	Query hard and software version
HiS	Query the first stored alarm value
ESC	Move to the next higher menu level (back)

Menu structure



Parameter settings

An example is given below on how to change the alarm response value for overcurrent > I1. It is presumed that the option overcurrent (HI) has been selected in the SEt/I menu (factory setting). Proceed as follows:

1. Press the MENU/Enter key for more than 1.5 seconds. The flashing short symbol AL appears on the display.
2. Confirm with Enter. The parameter response value I2 flashes, in addition the associated overcurrent value > 10.0 A appears.
3. Use the Down key to select the parameter response value I1. The parameter I1 flashes, in addition the associated percentage value for prewarning 50 % of I2 appears.
4. Confirm with Enter. The current value for prewarning appears on the flashing display.
5. Use the Up or Down key to set the appropriate response value. Confirm with Enter. I1 flashes.
6. You can exit the menu by:
   - Pressing the Enter key for more than 1.5 seconds to reach the next higher level or
   - selecting the menu item ESC and confirming with Enter to reach the next higher level.

The currently active segments are flashing! In the figures below, the segments where device settings can be carried out are highlighted by an oval. The menu mode can be reached by pressing the MENU key for more than 1.5 seconds.

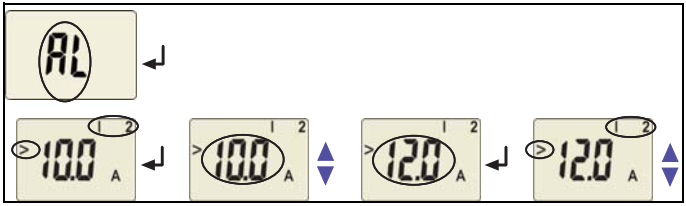
5.5.2 Switching over from overcurrent to undercurrent operation or to window operation

The operating mode can be selected in the SEt/I menu using the parameters HI, Lo and In. By default, overcurrent operation (HI) is set. Refer to page28 for a detailed description on how to switchover to the window mode.

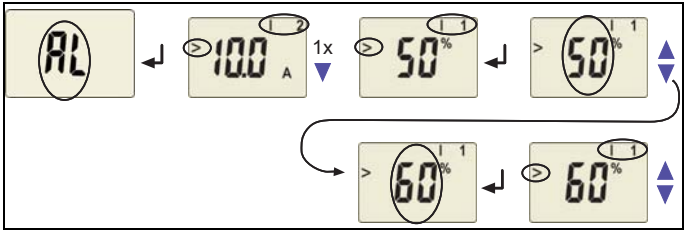
5.5.3 Response value setting for overcurrent:

- Response value I2 (overcurrent)
- Response value I1 (overcurrent)
- Hysteresis (Hys) of the response values I1, I2

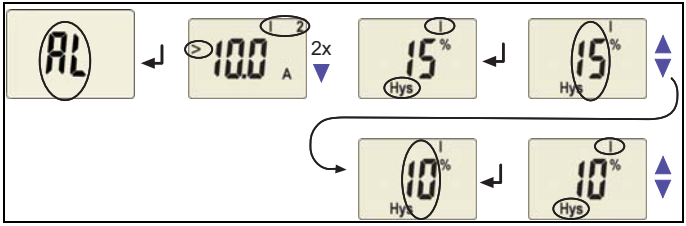
Increasing the response value I2 (Example: overcurrent)



Increasing the response value I1 (prewarning overcurrent

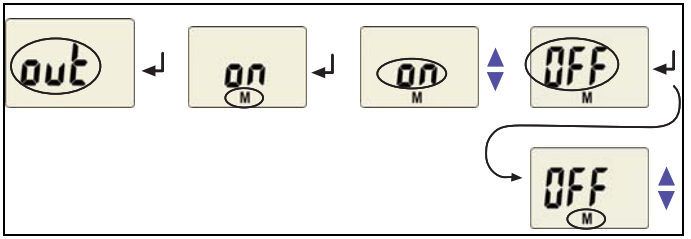


Setting the hysteresis of the response value

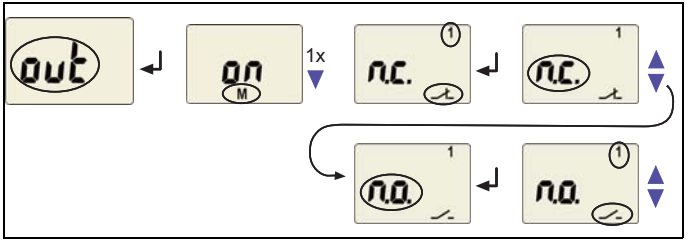


5.5.4 Setting the fault memory and operating principle of the alarm relays

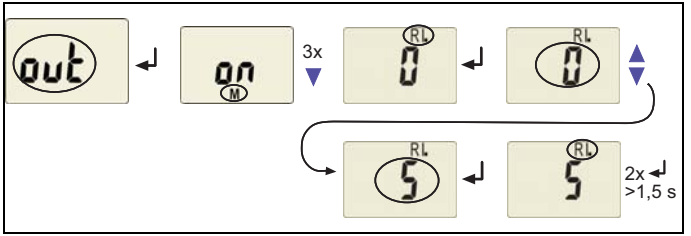
Deactivating the fault memory



Setting the alarm relay K1 to N/O operation (n.o.)



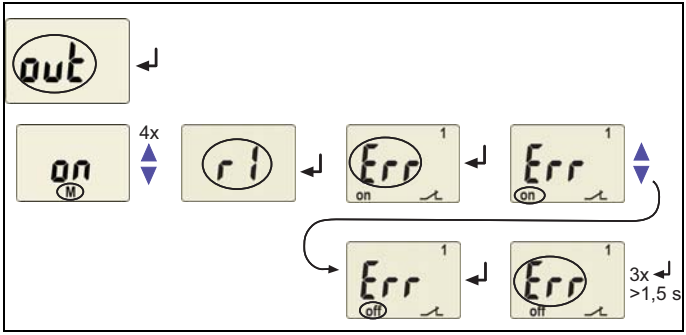
Setting the number of reload cycles



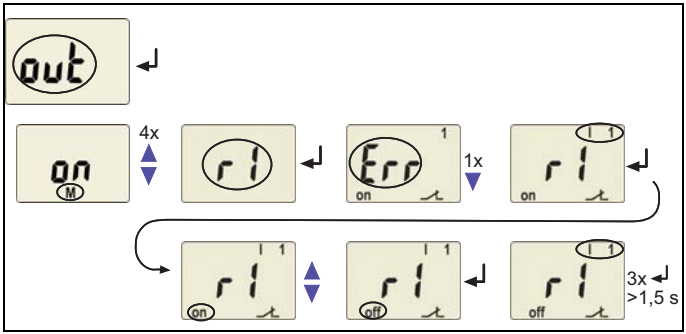
5.5.5 Assigning alarm categories to the alarm relays

Overcurrent, undercurrent and device-related errors of the current monitor can be assigned to the alarm relays K1 (r1, 1) and K2 (r2, 2). By default, the alarm relays K1 and K2 signal prewarning and alarm in case of overcurrent.

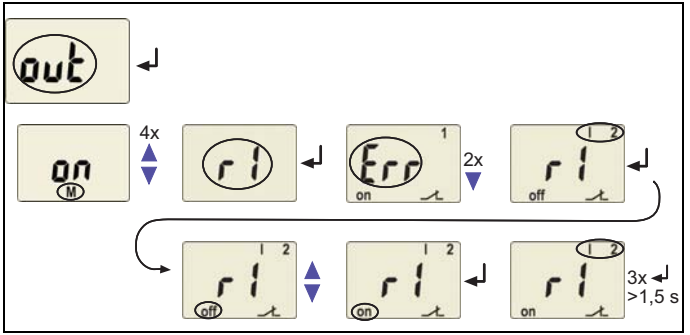
Alarm relay K1: Deactivating the category device error



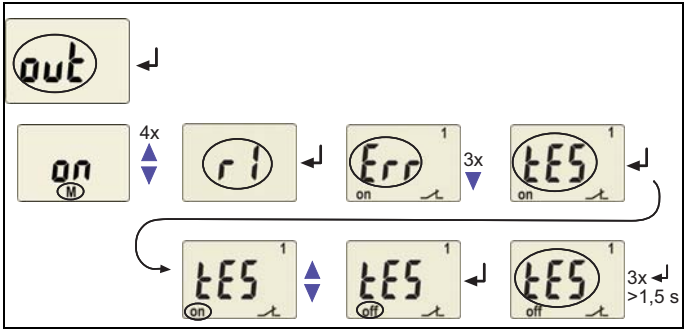
Alarm relay K1: Deactivating the category response value I1



Alarm relay K1: Activating the category response value I2



Alarm relay K1: Deactivating the category device test



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When an alarm relay (K1/K2) has been deactivated in the menu, an alarm will not be signalled by the respective changeover contact! An alarm will only be indicated by the respective alarm LED (AL1/AL2)!

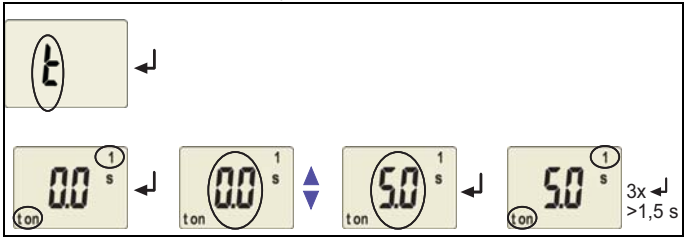
5.5.6 Setting the time delays

The following delays can be specified:

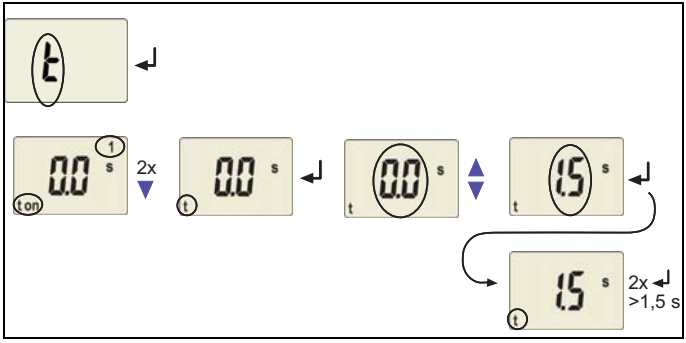
- Response delay t_{on1} (0...99 s) for K1, and t_{on2} (0...99 s) for K2
- Starting delay t (0...10 s) when the device is being started
- Common delay on release t_{off} (0...99 s) for K1, K2. The setting t_{off} is only relevant when the fault memory M is deactivated.

The operating steps for the setting of the response delay t_{on1} and the starting delay t are illustrated by way of example.

Setting the response delay t_{on1}

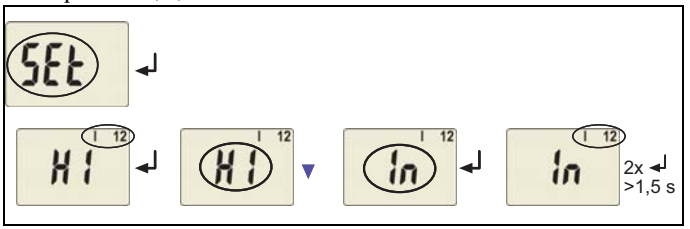


Setting the starting delay t

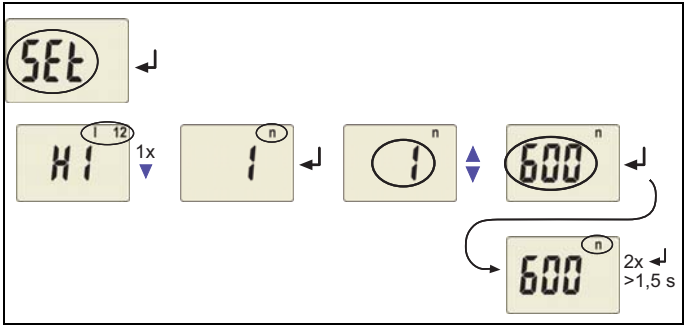


5.5.7 Changing from overcurrent operation to window operation

Use this menu item to set whether the response values of the device apply to overcurrent (HI) or undercurrent operation (Lo). In addition, window operation (In) can be selected. .



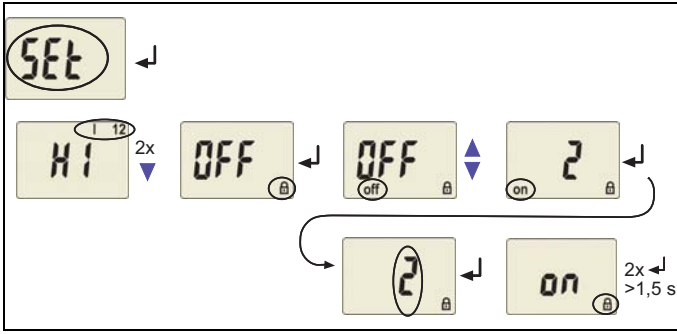
5.5.8 Setting the transformation ratio for external current transformer



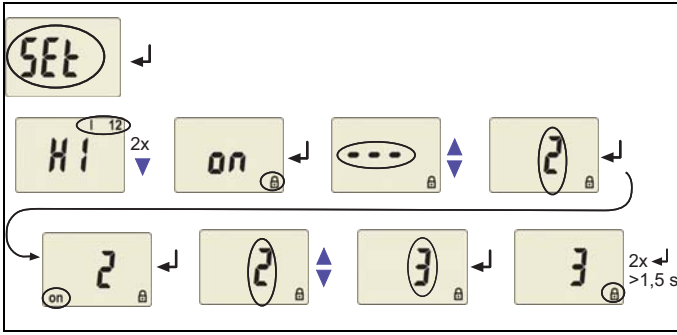
5.5.9 Factory setting and password protection

Use this menu to activate the password protection, to change the password or to deactivate the password protection. In addition, you can reset the device to its factory settings.

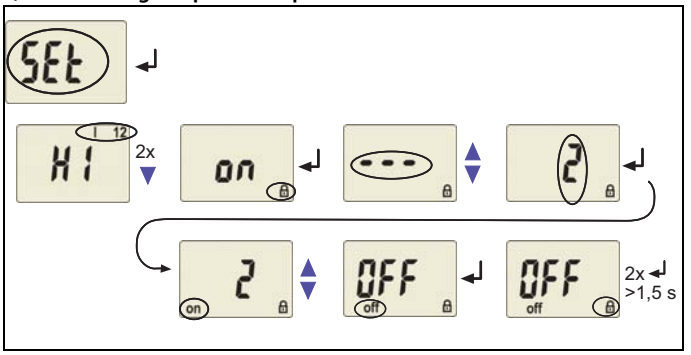
a) Activating the password protection



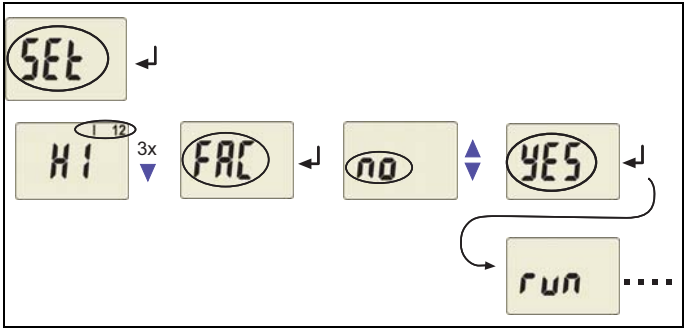
b) Changing the password



c) Deactivating the password protection

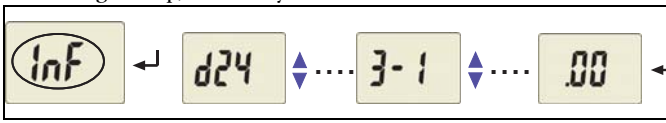


5.5.10 Re-establishing the factory settings



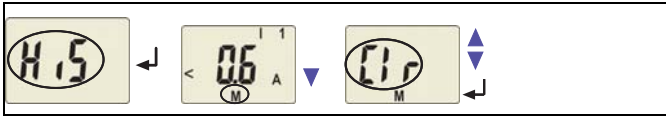
5.5.11 Device information query

This function is used to query the hardware (d...) and software (1.xx) versions. After activating this function, data will be displayed as a scrolling text. Once one pass is completed you can select individual data sections using the Up/Down keys.



5.5.12 History memory query

The history memory can be selected via the menu HiS. Use the Up and Down keys to view the next display. If Clr is flashing, the history memory can be cleared by pressing the Enter key.



5. 6 Commissioning

Prior to commissioning, check proper connection of the current relay.

Please note that the maximum permissible measuring current continuously applied is 16 A in case of direct measurement!

5. 7 Factory setting

Response value overcurrent I1 (prewarning)	*5 A (50 % of I2)*
Response value overcurrent I2 (alarm)	*10 A*
Hysteresis:	*15 %*
Fault memory M:	*activated (on)*
Operating mode K1/K2	*N/C operation (n.c.)*
Starting delay:	*t = 0,5 s*
Response delay:	t_{on1} *= 1 s* t_{on2} *= 0 s*
Release delay:	t_{off} *= 1 s*
Password:	*0, deactivated (Off)*

6. Technical data

6. 1 Data in tabular form

( )* = factory setting

Insulation coordination acc. to IEC 60664-1/IEC 60664-3

Rated insulation voltage ..... 250 V
Rated impulse voltage/pollution degree ..... 2.5 kV / III
Protective separation (reinforced insulation) between ..... (A1, A2) - (k, l) - (11, 12, 14) - (21, 22, 24)
Maximum nominal voltage of the system being monitored
when the conductor being monitored is directly connected:
With protective separation ..... AC 230 V
Without protective separation ..... AC 400 V
Voltage test acc. to IEC 61010-1 ..... 2.21 kV

Supply voltage

CME420-D-1:
Supply voltage U_s ..... AC 16...72 V / DC 9.6...94 V
Frequency range U_s ..... 42...460 Hz
CME420-D-2:
Supply voltage U_s ..... AC/DC 70...300 V
Frequency range U_s ..... 42...460 Hz
Power consumption ..... ≤ 3 VA

Measuring circuit

Measuring range (r.m.s. value) ..... AC 0.05...16 A
Overload capability, continuous ..... 17.6 A
Overload capability <1 s ..... 40 A
Rated frequency f_n ..... 42...460 Hz

Response values

Undercurrent< I (alarm 2) ..... Direct connection: AC 0.1...16 A (1 A)*
..... or external current transformer
Undercurrent < U (alarm 1) ..... 100 %...200 % (150 %)*

Overcurrent > I (alarm 2) ..... Direct connection: AC 0.1...16 A (10 A)*
..... or external current transformer
Overcurrent > U (alarm 1) ..... 10 %...100 % (50 %)*
External current transformer..... x/1 A, x/5 A, x/10 A
Transformation ratio factor n ..... 1...2000 (1)*
Relative percentage error at 50 Hz / 60 Hz ..... ±3 %, ±2 digits
Relative percentage error in the range of 42...2000 Hz..... ±5 %, ±2 digits
Hysteresis ..... 10...40 % (15 %)*

Specified time

Starting delay ..... 0...99 s (0.5 s)*
Response delay t_{on1} ..... 0...99 s (1 s)*
Response delay t_{on2} ..... 0...99 s (0 s)*
Delay on release t_{off}..... 0...99 s (1 s)*
Operating time t_{ae} ..... ≤ 70 ms
Response time t_{an} ..... $t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b ..... ≤ 300 ms

Displays, memory

Display ..... LC display, multi-functional, not illuminated
Measuring range measured value x transformation ratio factor..... AC 0.01...16 A x n
Operating error at 50 Hz / 60 Hz ..... ±3 %, ±2 digits
Operating error in the range of 42...2000 Hz..... ±5 %, ±2 digits
Measured-value memory (HiS) for the first alarm value..... data record measured values
Password ..... Off / 0...999 (OFF)*
Fault memory (M) alarm relay ..... on / off (on)*

Switching elements

Number ..... 2 relays, with one changeover contact each (K1, K2)
Operating principle ..... N/C operation n.c. / N/O operation n.o. (N/C operation n.c.)*
Electrical service life under rated operating conditions ..... 10000 switching operations
Contact data acc. to IEC 60947-5-1:

Utilization category	AC-13	AC-14	DC-12	DC-12	DC-12
Rated operational voltage	230 V	230 V	24 V	110 V	220 V
Rated operational current	5 A	3 A	1 A	0.2 A	0.1 A

Minimum contact load ..... 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC ..... IEC 61326
Operating temperature ..... -25 °C...+55 °C
Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) .....3K5 (except condensation and formation of ice)
Transportation (IEC 60721-3-2) .....2K3 (except condensation and formation of ice)
Storage (IEC 60721-3-1) .....1K4 (except condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) 3M4
Transportation (IEC 60721-3-2) 2M2
Storage (IEC 60721-3-1) 1M3

Connection

Connection ..... screw terminals
Connection properties:
rigid/ flexible ..... 0.2...4 / 0.2...2.5 mm^2 / AWG 24...12
Multi-conductor connection (2 conductors with the same cross section):
rigid/ flexible ..... 0.2...1.5 mm^2 / 0.2...1.5 mm^2
Stripping length ..... 8...9 mm
Tightening torque ..... 0.5...0.6 Nm

Other

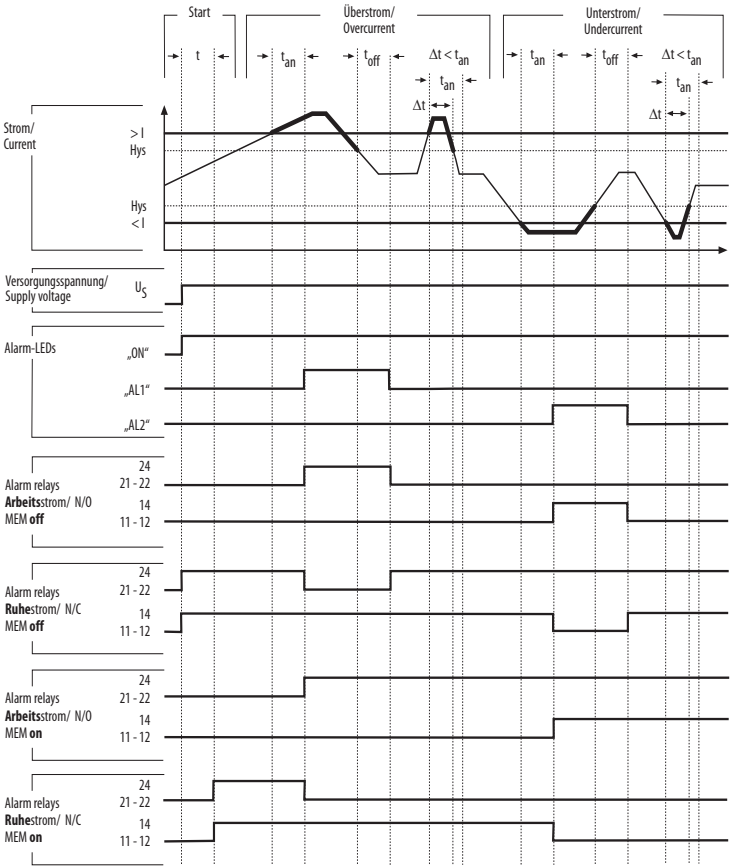
Operating mode ..... continuous operation
Position ..... any position
Degree of protection DIN EN 60529, internal components IP30
Degree of protection DIN EN 60529, terminals IP20
Enclosure material ..... polycarbonate
Flammability class UL94 V-0
DIN rail mounting acc. to ..... IEC 60715
Screw fixing ..... 2 x M4 with mounting clip
Weight ..... ≤ 160 g
( )* = factory setting

6. 2 Ordering information

Device type	Supply voltage U_s*	Response value	Art. No.
CME420-D-1	DC 9.6 V...94 V / AC 42...460 Hz, 16...72 V	0.1...16 A x n	B 9306 0001
CME420-D-2	DC 70...300 V / AC 42...460 Hz, 70...300 V	0.1...16 A x n	B 9306 0002
*Absolute values of the voltage range			
Mounting clip for screw fixing (1 piece per device, accessories)			B 9806 0008

t = Starting delay
t_{an} = Response time
t_{off} = Delay on release

6. 3 Timing diagram: Current monitoring



INDEX

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