LINETRAXX® SmartDetect LCM410

Four-channel load current monitor sensitive to alternating and pulsed currents



LCM410_D00546_00_M_XXEN/06.2026

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1 General information

1.1 How to use the manual



ADVICE
This manual is intended for qualified personnel working in electrical engineering and electronics! Part of the device documentation in addition to this manual is the enclosed supplement "Safety instructions for Bender products".



ADVICE
Read the operating manual before mounting, connecting and commissioning the device. Keep the manual within easy reach for future reference.

1.2 Indication of important instructions and information



DANGER
Indicates a high risk of danger that will result in death or serious injury if not avoided.



WARNING
Indicates a medium risk of danger that can lead to death or serious injury if not avoided.



CAUTION
Indicates a low-level risk that can result in minor or moderate injury or damage to property if not avoided.



ADVICE
Indicates important facts that do not result in immediate injuries. They can lead to malfunctions if the device is handled incorrectly.



Information can help to optimise the use of the product.

1.3 Service and Support

Information and contact details about customer service, repair service or field service for Bender devices are available on the following website: https://www.bender.de/en/service-support.

1.4 Training courses and seminars

Regular face-to-face or online seminars for customers and other interested parties:

https://www.bender.de/en/know-how/seminars

1.5 Delivery conditions

The conditions of sale and delivery set out by Bender GmbH & Co. KG apply. These can be obtained in printed or electronic format.

1.6 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. In the event of complaints, the company must be notified immediately. Please use the contact form at the following address: https://www.bender.de/en/service-support/take-back-of-old-devices/.

When storing the devices, observe the information under Environment / EMC in the technical data.

1.7 Warranty and liability

Warranty and liability claims for personal injury and property damage are excluded in the case of:

- improper use of the device
- incorrect mounting, commissioning, operation and maintenance of the device
- Failure to observe the instructions in this operating manual regarding transport, commissioning, operation and maintenance of the device
- unauthorised changes to the device made by parties other than the manufacturer
- non-observance of technical data
- Repairs carried out incorrectly
- the use of accessories or spare parts that are not provided, approved or recommended by the manufacturer
- Catastrophes caused by external influences and force majeure
- Mounting and installation with device combinations not approved or recommended by the manufacturer

This operating manual and the enclosed safety instructions must be observed by all persons working with the device. Furthermore, the rules and regulations that apply for accident prevention at the place of use must be observed.

1.8 Disposal of Bender devices



Electrical and electronic equipment must not be disposed of with unsorted household waste but must be collected separately from household waste.
The symbol of a crossed-out wheelie bin indicates the requirement for separate collection.

Before returning a used device, used batteries and accumulators that are not enclosed within the device, as well as lamps that can be removed without damage, must be separated from the device and disposed of separately.

Please observe the applicable national regulations regarding the disposal of waste electrical and electronic equipment.

Waste electrical and electronic equipment may contain personal data. The end user is responsible for deleting this data prior to disposal.

Bender GmbH & Co. KG is registered in the Waste Electrical and Electronic Equipment Register (EAR) under WEEE number DE 43 124 402. To fulfill its legal take-back and disposal obligations, Bender has established appropriate return and disposal options. Information on available collection points and the process for returning waste electrical and electronic equipment can be found at: https://www.bender.de/en/service-support/take-back-of-old-devices/

1.9 Safety

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. In Europe, the European standard EN 50110 applies.

DANGER

Risk of fatal injury due to electric shock!

Touching live parts of the system carries the risk of:

- *Electrocution due to electric shock*
- *Damage to the electrical installation*
- *Destruction of the device*

Before installing the device and before working on its connections, make sure that the installation is de-energised.

Observe the rules for working on electrical systems.

1.10 Cybersecurity

- Information on Bender's CRA conformity: https://www.bender.de/en/cert
- To report cybersecurity vulnerabilities, contact: psirt@bender.de

CRA safety aspects during use

RS-485 interface	Communication via the RS-485 interface is not encrypted. • Protect the bus as much as possible from unauthorised access (e.g., through physical shielding or access control). • Please note the instructions for activating write protection in the Commissioning chapter.
NFC interface	With physical access to the device, parameters can be read and written using the Bender Connect app. A glass pane does not provide protection against unauthorised access. • Prevent physical access, for example by means of access control.
System access	COMTRAXX® devices, SCADA systems, and comparable systems may only be accessible to authorised persons.

2 Function

2.1 Intended Use

The device combination, consisting of LCM410 and the designated measuring current transformers, is intended for AC and pulse current-sensitive load current measurement in TN, TT and IT networks. An LCM410 alarms if the adjustable response values are exceeded.

The requirements of the system and operating conditions on site and the application must be taken into account by selection of a suitable device combination and individual parameter setting. Next, the notes, instructions and specifications in this manual must be observed and implemented.

The devices are intended for operation in switch cabinets or in similarly protected environments.

Usage for any other purpose or beyond is considered improper use.

2.2 Device features

Special features

- 4 measuring channels for AC or pulse current sensitive measurement
- Adjustable frequency behaviour
- Space-saving thanks to small size and compact design(1 DU)
- Simple configuration with Bender Connect app via NFC interface

Load current measurement

- Load current monitoring device
- 4 measuring channels for load current measurement
- AC and pulse current sensitive measurement per channel
- Type A characteristic (Type F is compatible)
- RMS value measurement AC (RMS)
- Frequency range: 42 Hz…20 kHz

Response value monitoring

- Main alarm with adjustable response load current I_{Ln}
- Prewarnings: 10...100 % of the response load current I_{Ln}
- Evaluation of AC (RMS)
- Response load current 6 mA...50 A
- Adjustable frequency behaviour
- Choice of overcurrent (default) or undercurrent function per channel
- Adjustable time delays
- Selectable fault memory behaviour
- Preset function
- Reload function
- Start with alarm and start-up delay configurable
- Continuously measuring current transformer connection monitoring

Display and operation

- Configuration with Bender Connect app via NFC interface
- LED bar graph with
  - Device status LED
  - Alarm LEDs for prewarnings and main alarm per channel
- Integrated combined Test/Reset button, connection for external push-buttons
- Sealable transparent cover (optional)

Interfaces

- Digital input (I)
- Digital input/output (Q)
- Multifunctional digital/analogue output (M+)
- RS-485 (Bender Smart Connect | Modbus RTU)
- NFC interface for parameter setting of the device in energised and de-energised state with the Bender Connect app

2.3 Functional description

2.3.1 Configure device start behaviour

Start-up delay

The device is ready for measurement and operation as soon as the poweron U_S has been created and the recovery time t_b has elapsed. During start-up, the device does not report prewarnings or main alarms.

With the adjustable start-up delay time *t*, the start-up can be further delayed in addition to the recovery time.

2.3.2 Connection monitoring

The connections to the measuring current transformers are monitored continuously.

In the event of an error, a message is output via the interfaces and the status LED and the channel LED of the faulty connection flashes yellow.

Once the error(s) has been rectified, the device automatically returns to the initial position and the status LED lights up green.

If the memory is enabled, the alarm messages are only deleted after a reset. The corresponding LEDs flash yellow for this time.

2.3.3 Self-test, manual

By pushing the T/R button (3…6 s), the device simulates an alarm state. All LEDs light up and the outputs switch. The alarm messages are output via the corresponding interfaces. If the fault memory is enabled, the Alarm LEDs and the outputs remain active until the fault memory is deleted with a Reset.

The manual self-test must be carried out periodically (at least every 6 months) by the user.

2.3.4 Malfunction

In the event of an internal malfunction, the status LED changes colour from green to red or yellow. The error code can be queried via the device interfaces.

2.3.5 Delay times t_b, t, t_{on} and t_{off}

The times t_b, t, t_{on} and t_{off} described below delay the output of alarms via LEDs, digital outputs and BSC | Modbus RTU.

Recovery time t_b
The recovery time is the time the device needs to be ready for measurement after the supply voltage U_S has been connected.

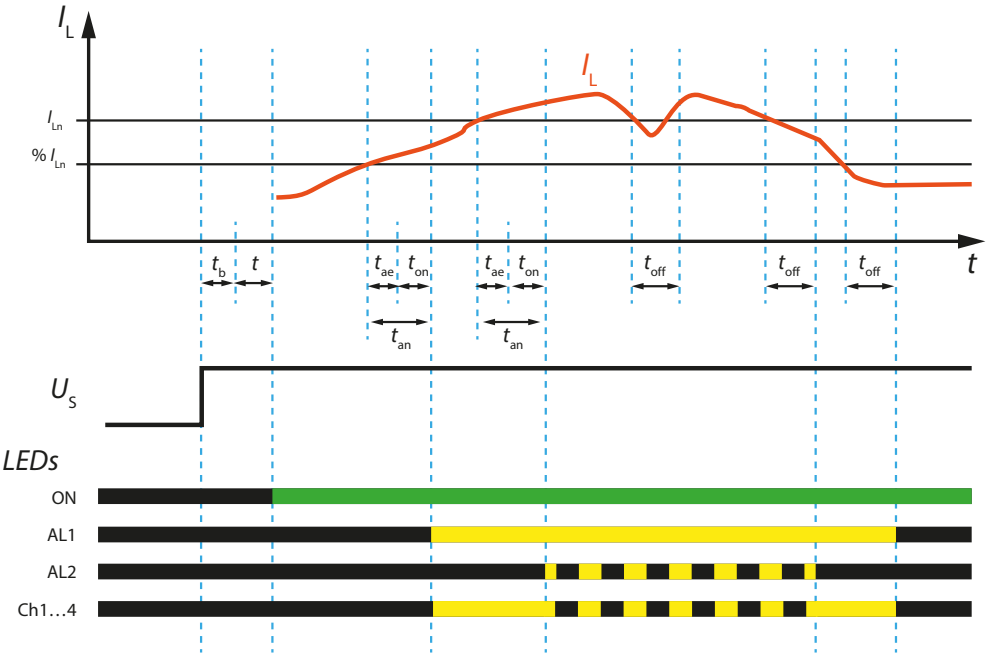
Start-up delay t
After the supply voltage U_S has been connected, the measuring function is delayed by the set time t plus the recovery time t_b.

Operating time t_{ae}
The operating time is device-specific. It cannot be changed.

Response delay t_{on}
If values exceed or fall below the defined load current limits, the load current monitor needs the response time t_{an} to output the alarm. A set response delay t_{on} is added to the device-specific operating time t_{ae} and delays signalling:
Response time $t_{an} = t_{ae} + t_{on}$
If the fault does not persist during the response delay, the alarm is not signalled.

Delay on release t_{off}
If the alarm no longer exists and the storing of a fault in the memory has been disabled, the alarm LEDs go out and the device switches back to the initial status. By means of the delay on release, the alarm state is maintained for the selected period.

Delay times at a glance



2.3.6 Alarm assignments

Messages can be assigned to the outputs via the device interface for

- Test
- Device error
- Prewarning
- Main alarm load current I_L
- Connection fault load current transformer
- Overload measuring channels

can be assigned. Details can be found in the descriptions of the outputs and in the Modbus register overview.

Further Information

“Modbus register overview”, page 34

“Interfaces”, page 22

2.3.7 Response value monitoring

The response value monitoring triggers a prewarning or a main alarm as soon as the measured value violates the response values for prewarning or main alarm. It can be configured individually for each channel. A violation of a response value depends on the set monitoring function (see below) and occurs as soon as a measured value violates a response value for at least the response time t_{an}. The response time t_{an} results from the device related operating time t_{ae} and the adjustable response delay t_{on} ($t_{an} = t_{ae} + t_{on}$).

The start-up delay time t_{on} is reset before it has elapsed as soon as the measured value no longer violates the response value.

An alarm (prewarning or main alarm) is automatically reset as soon as a measured value no longer violates the response value plus a hysteresis for the duration of the delay on release t_{off}. An enabled fault memory function prevents this automatic reset. The delay on release t_{off} is reset before it expires as soon as the Measured value violates the Response value again.

The delay on release t_{off} can be extended to 2 s if the automatic measuring range switchover is enabled.

Monitoring function

Overcurrent and undercurrent modes are available as monitoring functions.

- The **overcurrent** mode checks whether the Measured values exceeds a Response value.
- The **undercurrent** mode checks whether the Measured values falls below a Response value.

Undercurrent mode
Configure the response value of the prewarnings to be higher than the response value for the main alarm(≥ 110 %).

Response values

The response value for the main alarm is set as an absolute value, the response value for the prewarnings is set as a percentages in relation to the response value for the main alarm.

Measured value/CT type	Type A
RMS	Yes
AC	No
DC	No

Alarm signalling

The signalling of an alarm (prewarnings, main alarm) is carried out

- via the alarm LED(s)
- via alarm assignments using an output (Q, M+)
- via Modbus register for alarm and measured values (registers 999…1044)

Settings

Parameters	Adjustable per channel	Modbus register
Main alarm response values	Yes	32600…32622
Prewarning response values	Yes	32624…32635
(Monitoring) Function	Yes	32700…32702
Hysteresis	Yes	32703…32707
Response delay t_{on}	Yes	32902…32908
Delay on release t_{off}	Yes	32910…32916
Type of measuring current transformer	Yes	33100…33103

2.3.8 Automatic measuring range switching

The LCM410 device measures at least 5 times the set response load current (5 x I_{Ln}).

However, once (5 x I_{Ln}) is reached, no measured value is displayed; instead, only the fact that this limit has been exceeded is reported. If the measuring range switch is enabled, larger measured values can also be output as values.

Measured value	Automatic measuring range switching	
	Disabled	Enabled
≤ (5 x I_{Ln})	Measured value output	Measured value output
> (5 x I_{Ln})	Output ">"	Measured value output

*Automatic measuring range switching is only available in combination with Measuring current transformers of the **Type A** measuring current transformers and the **overcurrent function**, see chapter "Response value monitoring".*

The delay on release t_{off} can be extended to 2 s if automatic measuring range switching is enabled.

Parameters	Adjustable per Channel	Modbus register	Value
Automatic measuring range switchover	Yes	32715…32718	Enabled | disabled

2.3.9 Factory settings

There are two ways to carry out a reset:

Factory settings without interface
After restoring the factory settings, all previously changed settings are reset to the state upon delivery. The settings for the RS-485 interface are not reset.

Factory settings with interface
After restoring the factory settings, all previously changed settings including the settings for the RS-485 interface and the device address are reset to the state upon delivery.

These settings are configured in Modbus registers 60000…60003, function 4.

Reset to factory settings via

- **BSC | Modbus RTU**: 2
- **Gateway** (COMTRAXX®):

  System overview > System > Gateway > BSC and Modbus devices > LCM410 > Menu > System > Factory settings

2.3.10 Combined Functions button (T/R button)

Reset = Pressing the T/R button for 1…3 s

Test = Pressing the T/R button 3…6 s

NFC = Pressing the T/R button 6…10 s

Addr. = Pressing the T/R button 10…15 s

Protect = Pressing the T/R button 20…25 s

2.3.11 Fault memory

The storing of a fault in the memory can be enabled or disabled. When the fault memory is enabled, stored alarms can be reset by performing a reset. The storing of a fault in the memory is factory-set to disabled.

2.3.12 Channel function

Settings for the channel functions are configured in Modbus registers 32700…32703.

Measuring current transformer connection

Overcurrent and undercurrent function can be selected for each channel
(register content 32700…32703: 1, 2 or 3)

- **Overcurrent function**
  Prewarning when measured value > prewarning response value %I_{Ln} or
  main alarm when measured value > main alarm response load current I_{Ln}
- **Undercurrent function**
  Prewarning when measured value < prewarning response value %I_{Ln}or
  main alarm when measured value < main alarm response value I_{Ln}

  *Note that with the **undercurrent function**, it must be ensured that the response value of the prewarning is higher than the response load current I_{Ln}. The procedure is explained in the Modbus register table.*

  The settings for the response values are configured in Modbus registers 32600…32635.

Disabling unused channels

When a measuring channel is not connected, it must be disabled (register content 32700…32703: 6).

2.3.13 PRESET function

The adjustable PRESET function can be used to preset the response values on all channels.

For this, the currently measured value is taken into account for every channel. The response value is calculated by multiplying the currently measured value with a preset factor and then adding a preset offset value.

$I_{Ln} = I_L$ x PRESET factor + PRESET offset

The settings for the PRESET factor and PRESET offset are configured in Modbus registers 32713 and 32714.

The PRESET function allows you to configure values up to the maximum response value I_{Ln} (see Technical Data).

2.3.14 Reload function (Automatic fault memory activation)

The reload function can be set separately for each output.

When faults occur only for a limited time but repeatedly in the monitored system while the storing of faults in the memory is disabled, the alarm outputs would switch over to the fault status simultaneously. The reload function permits limiting the number of these switch-overs. As soon as the specified number is reached, the alarm message at the respective output remains active, and switch-overs are suspended until a reset is performed (= fault memory). When an adjustable time period has passed between two alarms, the counter is reset, while the alarm message does not remain active.

The settings for this are configured in the Modbus registers
32418 and 32419 (Input/output Q)
32520 and 32521 (Output M+).

2.3.15 Software update

Download the software and save it to your computer or mobile phone. Allow the update option for the LCM410 and install the software.

After a software update, the device must first be reset to its factory settings. After that, all parameters can be adjusted again.

Download software

https://www.bender.de/service-support/downloadbereich/

Allow software update via

- **BSC | Modbus RTU**: Register 32006

- **Bender Connect App**:
Menu > Settings > Interface > Update > Allow update = On
Menu > Settings > Interface > BSC | Modbus RTU > Write access = Allow

- **Gateway** (COMTRAXX):

Tools > Device management > BSC and Modbus devices > Manage devices > [Update]

Reset to factory settings

See chapter “Factory settings”, page 14

3 Dimensions, mounting and connection

Only skilled persons are permitted to carry out the work necessary to install, put into service and run a device or system.

DANGER

Risk of fatal injury due to electric shock!

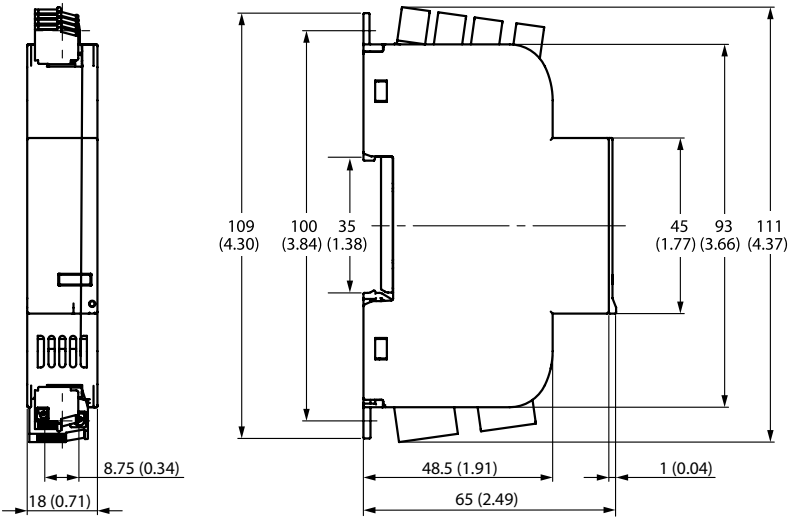
Touching live parts of the system carries the risk of:

- *Risk of electrocution due to electric shock*
- *Damage to the electrical installation*
- *Destruction of the device*

Before installing the device and before working on its connections, make sure that the installation has been de-energised. The rules for working on electrical systems must be observed.

3.1 Dimension diagrams

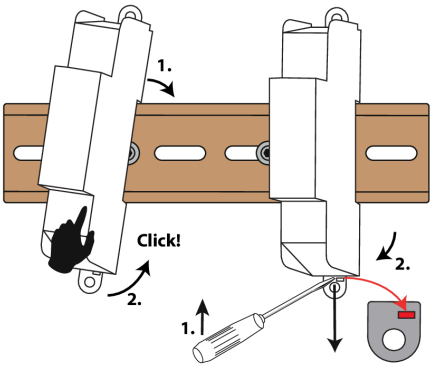
Dimensions in mm (Inch)



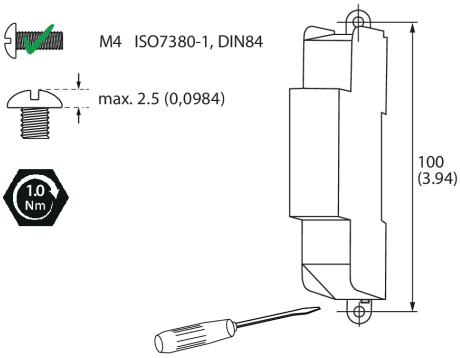
3.2 Mounting and removal

DIN rail mounting

Mounting Removal



Screw mounting

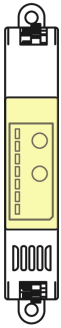


Dimensions in mm (inch)

3.3 Sealable transparent cover

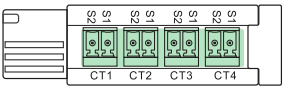
The transparent cover, available as an accessory, prevents settings on the device from being changed. Hook the two hooks on the cover around the top of the enclosure and press the bottom edge around the bottom of the enclosure.

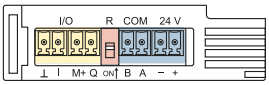
Position of the transparent cover (yellow)



3.4 Connection

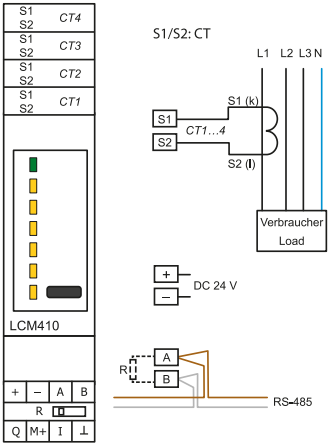
3.4.1 Connections overview

Top	Terminal	Description
	S1, S2 (CT1)	Measuring-current transformer CT1
	S1, S2 (CT2)	Measuring-current transformer CT2
	S1, S2 (CT3)	Measuring-current transformer CT3
	S1, S2 (CT4)	Measuring-current transformer CT4

Bottom	Terminal	Description
	+, -	Supply voltage DC
	A, B	RS-485 interface
	ON (R)	Termination of RS-485 interface
	Q	Digital input/output
	M+	Multifunctional output
	I	Digital input
	⊥	GND

The cables are connected to the device via plug-in terminals. The maximum permissible conductor cross section is 1.5 mm².

3.4.2 Wiring diagram



Legend for wiring diagram

S1/S2: CT	Measuring-current-transformer connection
+, -	Supply voltage connection
A, B	RS-485; for details see “RS-485 interface”, page 29

ADVICE

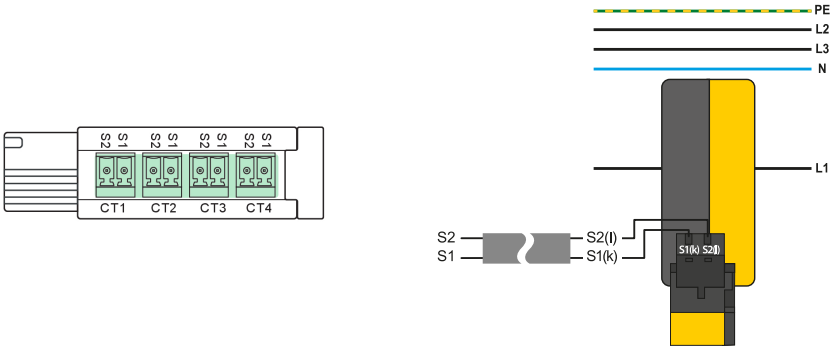
Ensure that only the phase to be monitored passes through the load current transformer at all times in order to accurately measure the actual load current. Running more conductors through the transformer at the same time will distort the measurement result.

Ensure that the 24-V-DC supply is connected correctly. Otherwise the LCM410 can be destroyed!

***For UL applications:** Use 60/75 °C copper conductors only!*

Cable lengths to the measuring current transformer: See technical data.

3.4.3 Wiring of measuring current transformer type A/type F



Measuring current transformers "Type A/Type F"

Ensure that the measuring current transformers are wired correctly. The wiring of S1 is to be connected to the "S1" (k) connection of the measuring current transformer. S2 must be connected to the "S2" (l) connection of the measuring current transformer.

ADVICE
Ensure that only the phase to be monitored passes through the load current transformer at all times in order to accurately measure the actual load current. Running more conductors through the transformer at the same time will distort the measurement result.

For more information on the wiring of measuring current transformers, please refer to the relevant manuals for the measuring current transformers. The installation instructions provided there must be observed.

***For UL applications**:*
The measuring current transformers must be connected to the monitoring device before operation.

3.4.4 Suitable measuring current transformers

Type A/Type F	Type A			
Series CTAC	**Series CTAS**	**Series Wx**	**Series WR**	**Series WS**
CTAC20 CTAC35 CTAC60 CTAC120 CTAC210	CTAS50 CTAS80 CTAS120	W0-S20 W1-S35 W2-S70 W3-S105 W4-S140 W5-S210	WR70x175S WR115x305S WR150x350S WR200x500S WR70x175SP WR115x305SP WR150x350SP WR200x500SP	WS20x30 WS50x80 WS50x80S WS80x120 WS80x80S WS80x120S WS80x160S

4 Interfaces

4.1 NFC (Near Field Communication)

The NFC interface can be used to transmit a previously configured device parameter setting directly to the device.

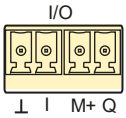
This function is available only via the Bender Connect App, which is available for iOS and Android.

In the Bender Connect App, the device must first be registered. The device-specific setting options are then displayed and can be configured. During data transmission, feedback is provided indicating whether the parameter configuration was successful.

Parameter settings can be transmitted to the device via the Bender Connect App by holding the smartphone close to the device:

- When the device is **unpowered**, parameter settings can be transmitted and are automatically activated once the device is connected to the power supply.
- When the device is **powered**, parameter configuration requires that the NFC interface is activated on the device beforehand.

4.2 Digital inputs and outputs (overview)



Element	Explanation
Q	**Digital input/output** • Input: Execute test or reset • Output: Common alarm according to alarm assignment
M+	**Multi-functional output** • Digital output: Common alarm according to alarm assignment • Analogue voltage or current output: For the direct connection of analogue instruments that analyse and display measured values.
I	**Digital input** Execute test and/or reset, configurable with low-active and high-active.
⊥	**GND** connection of the inputs/outputs

When commissioning the system, an output signal should be verified by an alternative method (e.g. the [BSC | Modbus RTU] interface or the behaviour of another output). In general, redundant monitoring (e.g. using the interface or another output) is recommended when using the analogue/digital outputs.

4.3 Digital input and output Q

Settings in registers 32400…32420

Q is a configurable digital input and output relative to GND.

When it is used as an **input**, a test or reset can be triggered (register 32401).

When it is used as an **output**, the following alarms can be assigned via the alarm assignments (registers 32402…32420):

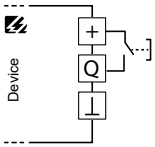
Prewarning (AL1) AC/DC/RMS CH1…4	The output becomes active if AL1 of the selected measuring channel is present.
Main alarm (AL2) AC/DC/RMS CH1…4	The output becomes active if AL2 of the selected measuring channel is present.
CT-connection fault CH1…4	The output becomes active if a CT-connection fault (short circuit or interruption) of the selected measuring channel is present.
Overloading of the measuring channels	The output becomes active if the measuring function no longer works properly since the load current is too high.
Device error	The output becomes active when a device error is present.
Test	The output becomes active in the course of a manual self test in accordance with the test process.

The reload settings (number of repeated connection attempts) are configured in registers 32418 and 32419.

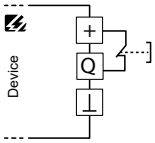
4.3.1 Input

The following settings can be assigned to input Q:

High-active: Event is carried out, when the digital input undergoes a signal change from low to high.



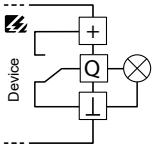
Low-active: Event is carried out, when the digital input undergoes a signal change from high to low.

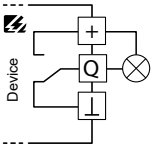


4.3.2 Output

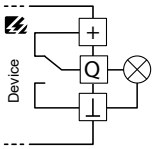
The output Q can be operated in the modes Active, Passive or Permanent. The following settings can be assigned:

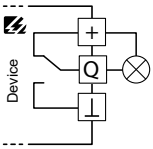
High-active: In the active mode +24 V are internally applied to output Q.



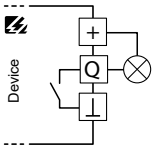


Low-active: In the active mode the GND potential is applied to output Q.

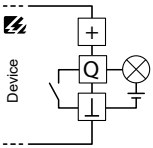




In the **passive mode** an external voltage can be connected (see Technical data). The output switches the applied potential to GND.

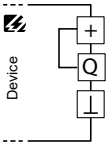


internally

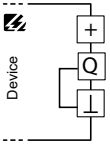


externally

Permanently high: The output is permanently set to +24 V.



Permanently low: The output is permanently switched to GND. In this manner e. g. an additional reference for the digital input can be created.



4.4 Output M+

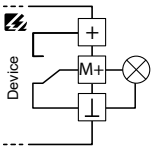
M+ is a multifunctional digital/analogue output with reference to GND.

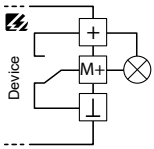
4.4.1 Digital mode

Settings in registers 32500…32501

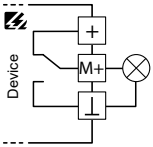
In digital mode, M+ can be operated in Active, Passive or Permanent mode. The following settings can be assigned:

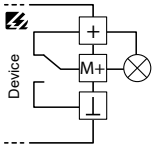
M+ = Active
High-active: In the active mode +24 V are applied to output M+ internally.



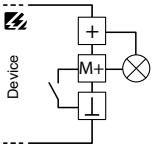


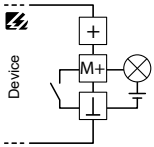
Low-active: In the active mode the GND potential is applied to output M+.





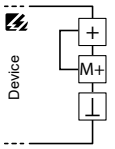
M+ = Passive
In the passive mode an external voltage can be connected (see Technical data). The output switches the applied potential to GND.





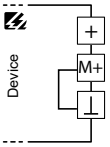
M+ = Permanently high

The output is permanently set to +24 V.



M+ = Permanently low

The output is permanently switched to GND. In this manner e. g. an additional reference for the digital input can be created.



Alarm assignments permit assigning the following alarms to the output M+ in digital mode (registers 32504… 32519):

Prewarning (AL1) AC/RMS CH1…4	The output becomes active if AL1 of the selected measuring channel is present.
Main alarm (AL2) AC/RMS CH1…4	The output becomes active if AL2 of the selected measuring channel is present.
CT-connection fault CH1…4	The output becomes active if a CT-connection fault (short circuit or interruption) of the selected measuring channel is present.
Overloading of the measuring channels	The output becomes active if the measuring function no longer works properly since the load current is too high.
Device error	The output becomes active when a device error is present.
Test	The output becomes active in the course of a manual self test in accordance with the test process.

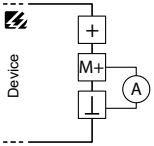
The reload settings (number of repeated connection attempts) are configured in registers 32520 and 32521.

4.4.2 Analogue mode

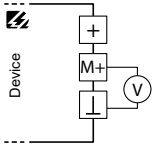
Settings in registers 32500…32503

The RMS value of a channel (CH1…4) is allocated to M+ as analogue output. Here a DC voltage or DC current signal that is proportional to the measured value is present at the output. The maximum scale value can be configured. The following settings can be assigned:

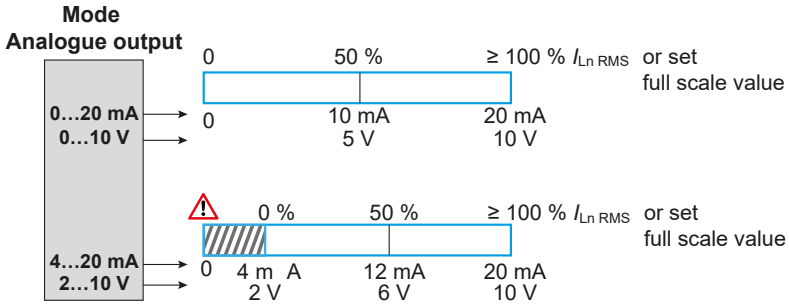
Current output: 0-20/4-20 mA



Voltage output: 0-10/2-10 V



The maximum scale value corresponds to $I_{Ln\ RMS}$ or it can be set at will up to 5 x I_{Ln}, max. 65 A. The overview shows how the measured values I_L (A) of the output signals (in A or V) are shown as proportional values.



Explanation to ⚠ in the diagram:
In the 4…20 mA or 2…10 V mode an output value of 0 mA or 0 V is a sign of a wiring fault of the analogue interface.

4.5 Digital input I

Settings in registers 32300…32301

The digital input "I" can read the status of a potential-free contact.

The digital input "I" can trigger either a test, a reset or the combined function T/R (register 32301). As with the test and reset function of the T/R-button, the combined function T/R is located at the front.

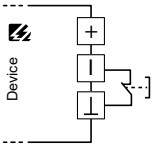
Example (high-active mode)

Closing the contact and opening it within 1…3 s.	Activates the reset function.
Closing the contact and opening it within 3…6 s.	Activates the test function.
Closing the contact and not opening it again (faulty contact).	No function change. A faulty switch can be detected immediately!

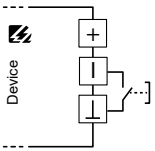
The NFC, address setting, and protect functions are not activated via this input.

The following settings can be assigned to input I:

High-active: Event is carried out, when the digital input undergoes a signal change from low to high.



Low-active: Event is carried out, when the digital input undergoes a signal change from high to low.



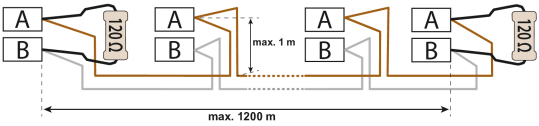
The response delay and the delay on release of the digital input are set to 100 ms each.

4.6 RS-485 interface

Spezification

The device has an RS-485 interface with (BSC | Modbus RTU) protocol. In a system setup it is therefore compatible with other Modbus RTU-capable device series from Bender. Up to 247 Modbus-RTU devices can be used on the bus.

The RS-485 specification restricts the cable length to 1200 m and requires a daisy chain connection.



As bus cable a twisted-pair, shielded cable, shield on one side to PE, must be used. CAT6/CAT7 or J-Y(St)Y min. 2 x 0.8 are suitable.

If there are several devices with their own power supply units on the bus, protection against direct contact shall be ensured, as the maximum permissible total leakage current of 0.5 mA can be exceeded.

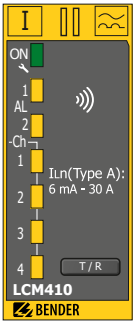
Termination

The bus line must be terminated at both ends with resistors (120 Ω, > 0.25 W).

A terminating resistor is installed in the device and can be enabled or disabled with the DIP switch at the underside of the housing.

5 Operation and settings on the device

5.1 Control panel



Control panel	Meaning
ON/	STATUS LED Operating mode
AL1	ALARM LED Prewarning
AL2	ALARM LED Main alarm
Ch 1…4	CHANNEL DISPLAY LEDs of measuring current transformers 1…4
T/R	Test/reset button

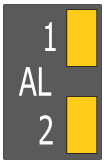
5.2 STATUS LED

Multicoloured display of various operating modes.

LED	Operating mode
Green	START PHASE Device booting after start NORMAL OPERATION Device in fault-free state
Yellow, flashing	CT FAULT Connection fault measuring current transformer The LED flashes synchronously with the LED of the respective faulty measuring current transformer.
Yellow	DEVICE ERROR Troubleshooting required
Red	DEVICE ERROR Device replacement may be required
Blue, flashing (frequency approx. 2 s)	NFC active
Violet, flashing	PROTECT active

5.3 ALARM LED

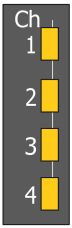
Display of prewarning AL1 and main alarm AL2



LED	Betriebszustand
AL1	PRE-WARNING Lights up continuously when the prewarning threshold has been exceeded on a channel.
AL2	MAIN ALARM Flashes when the load-operating-current threshold I_{Ln} has been exceeded on a channel.

5.4 CHANNEL-INDICATION LEDs

Channel display in relation to the response load current I_{Ln}



LED Ch	Operating mode
1	Measuring channel LED: • Lights up continuously when the prewarning threshold has been exceeded. • Flashes synchronously with the AL2 LED when the response load current I_{Ln} threshold has been exceeded. • Flashes synchronously with the STATUS LED when there is a measuring current transformer connection fault on the corresponding channel.
2	
3	
4	

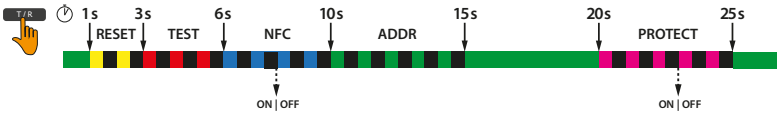
5.5 T/R BUTTON

The T/R button activates different operating modes depending on how long it is pressed.



Mode	Operating time	STATUS LED
RESET	1…3 s	Flashes yellow
TEST	3…6 s	Flashes red
NFC	6…10 s	Flashes blue
ADDR	10…15 s	Flashes green
PROTECT	20…25 s	Flashes violet

Overview



"RESET" function

The "RESET" function on the button resets stored alarm states.

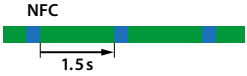
"TEST" function

The "TEST" function simulates a load current of 1.5 x I_{Ln} for a period of 5 seconds. During this period, the device has the following states:

- Display of the alarm value via the LEDs and the interface
- The test status can be read out via the interface:
  - 0 = No test
  - 1 = Internal test
  - 2 = External test (interface)
- For the duration of the test t_{on} and t_{off} are set to 0 s.

"NFC" function

The "NFC" function changes the current activation status of the NFC interface, when the T/R button is pressed and held for a period of 6…10 s. The NFC interface disables automatically within 5 minutes, in case it has not been disabled manually before.



Status indication of normal operation with the NFC interface activated

"ADDR" function

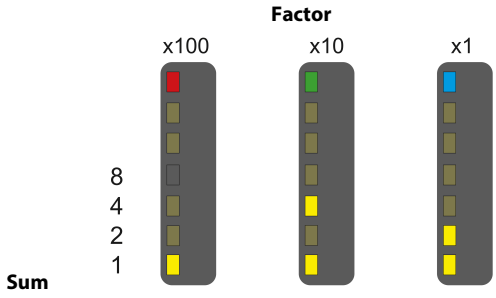
The "ADDR" function switches the device to address setting mode for the RS-485 address. The channel indication LEDs and the status LED indicate the device's address.

How to enter an address:

1. Press and hold the T/R button until status LED flashes green (10…15 s).
   – After the T/R button is released, the status LED lights red.
2. Set HUNDREDS digit. Press T/R button briefly until the desired value appears. Press and hold T/R button once (> 2 s) to confirm.
   – After the T/R button is released, the status LED lights green.
3. Set TENS digit. Press T/R button briefly until the desired value appears. Press and hold T/R button once (> 2 s) to confirm.
   – After the T/R button is released, the status LED lights blue.
4. Set UNITS digit. Press T/R button briefly until the desired value appears. Press and hold T/R button once (> 2 s) to confirm.
5. To exit the address setting mode, press and hold T/R button once (2 s).
   – After the T/R button is released, the status LED lights green.

The address values are displayed via BCD code.

Addresses can only be entered within the valid address range. When there is no input for a period of 5 minutes, the device automatically exits the address setting mode. The device then uses the currently set Modbus address.



Current address: 153

"PROTECT" function

The "PROTECT" function on the T/R button locks or enables write access to the Modbus registers of the individual parameters. Modbus register 32007 "Write access" can only lock write access but cannot enable it.

- When the T/R button is activated for at least 20 seconds, the status LED changes from continuously green to flashing violet and remains like this for the next 5 seconds when the button continues to be pressed.
- When the T/R button is released while the status LED is flashing violet, the activation state of the Modbus register " Write access" switches from the current selection of the two possible states to the other state, i. e. from "enabled" to "locked" or vice versa.

6 BSC | Modbus RTU protocoll

Bender Smart Connect (BSC)

BSC bus: RS-485 interface with BSC protocol

The BSC protocol is an exclusive bus protocol for communication between Bender devices.

It offers functions such as

- Observer mode
- Acknowledge via interface
- Backup master functionality
- Forced alerting
- Auto detection
- Address collision resolution
- Identify device
- Start test

The BSC bus comprises Master, Observer and Slave roles. Further details can be found in the documentation for the device acting as the Master (e.g. CP305, D00425).

LCM410 is always a slave and cannot apply for the role of master or observer.

BSC and Modbus RTU can be used in parallel on the same bus. The BSC master can prompt Modbus RTU devices.

Overview

The following Modbus function codes are supported:

- Holding registers for reading out values (Read Holding Register; function code 0x03)
- Registers for device programming (Write Multiple Registers; function code 0x10)

For a complete Modbus protocol specification, please visit https://www.modbus.org.

Read and write permissions

RO	Read Only (read access only)
RW	Read/Write (read and write access)
WO	Write Only (write access only)

Data types

Float	IEEE754 32-Bit (single precision floating point number)	4 bytes
INT16	Signed 16-Bit Integer	2 bytes
INT32	Signed 32-Bit Integer	4 bytes
UINT8	Unsigned 8-Bit Integer	1 byte (shown as 2 bytes)
UINT16	Unsigned 16-Bit Integer	2 bytes
UINT32	Unsigned 32-Bit Integer	4 Bytes
String UTF8	ASCII character string	

Register ranges

Range	Start address	End address
Info	0	998
Alarm and measuring values	999	1999
Monitoring functions	2000	2999
Status informationen	3000	3999
RS-485 interface parameters	32000	32099
Input "I"	32300	32399
Input/output "Q"	32400	32499
Output "M+"	32500	32599
Response values	32600	32699
Function/response behaviour	32700	32799
Alarm behaviour	32800	32899
Time response	32900	32999
Monitoring functions	33000	33010
Measuring-current transformer	33100	33110
Device error codes	5800	58999
Control commands	59000	59010
Function-control commands	60000	60003

6.1 Device-information registers

Device information (registers 0…998)

Register	Description	Format	Bytes	Prop-erty	Value/Unit/Comment
0	Device name	String UTF8	32	RO	e. g.: LCM410-24
16	Article number	String UTF8	32	RO	e.g.: B74604040
32	Serial number	String UTF8	32	RO	10 digits, e.g.: 2002123456
48	Manufacturer	String UTF8	32	RO	Bender GmbH & Co. KG
64	Application D number	UINT16	2	RO	631 = D631
65	Application version number	UINT16	2	RO	xxx = Vx.xx
66	Application build number	UINT16	2	RO	Build#
67	Boot loader D number	UINT16	2	RO	632 = D632
68	Bootloader version number	UINT16	2	RO	xxx = Vx.xx
69	Boot loader build number	UINT16	2	RO	Build#
70	Device status	UINT16	2	RO	Bit 0 (LSB): NFC with 0 = disabled, 1 = enabled Bit 1…15: 0 (reserved)
71	Device characteristics	UINT16	2	RO	Bit 0 (LSB): Alarm-indicator relays CH1 and CH2 available Bit 1: Harmonic analysis available Bit 2: 0 (reserved) Bit 3: External transformer ("Type A" only) can be used Bit 4: History memory can be used Bit 5…15: 0 (reserved) with 0 = no, 1 = yes
72	IsDevicePowered	UINT16	2	RO	Register to determine whether the device is switched on with 0 = no, 1 = yes
73	Device version	String UTF8	32	RO	

6.2 Alarm/measuring value registers

Measuring values (registers 999…1999)

Register	Description		Format	Bytes	Property	Values / Unit / Comment
999	Number of active messages		UINT16	2	RO	0…n = Number of active messages (device error, alarms, connection faults, …) n is the number of messages that could also be attributed to an output (e. g. relay)
1000	Load current measured value, max.	AC CH1	UINT8	8	RO	**Measured-value block** In each case the max. measured value incl. corresponding alarm and measuring-range states since the last Modbus query is output. Size of the measured-value block: 4 x UINT8 = 8 bytes Content of the measured-value block • Addr. Offset 0 (e.g. 1000): Measured value, part 1 • Addr. Offset 1 (e.g. 1001): Measured value, part 2 • Addr. Offset 2 (e.g. 1002): Alarm status 0: No alarm | 1: Prewarning | 2: Main alarm • Addr. Offset 3 (e.g. 1003): Measuring range 0: „=“ | 1: „<“ | 2: „>“
1004		AC CH2	UINT8	8	RO	
1008		AC CH3	UINT8	8	RO	
1012		AC CH4	UINT8	8	RO	
1016… 1031		Reserved				
1032		RMS CH1	UINT8	8	RO	
1036		RMS CH2	UINT8	8	RO	
1040		RMS CH3	UINT8	8	RO	
1044		RMS CH4	UINT8	8	RO	
1048	Current value of the load current	AC CH1	Float	4	RO	Currently measured value
1050		AC CH2	Float	4	RO	
1052		AC CH3	Float	4	RO	
1054		AC CH4	Float	4	RO	
1056… 1063		Reserved				
1064		RMS CH1	Float	4	RO	
1066		RMS CH2	Float	4	RO	
1068		RMS CH3	Float	4	RO	
1070		RMS CH4	Float	4	RO	
1072	Load current measured value, min.	AC CH1	Float	4	RO	Smallest measured value since the last Modbus query
1074		AC CH2	Float	4	RO	
1076		AC CH3	Float	4	RO	
1078		AC CH4	Float	4	RO	
1080… 1087		Reserved				
1088		RMS CH1	Float	4	RO	
1090		RMS CH2	Float	4	RO	
1092		RMS CH3	Float	4	RO	
1094		RMS CH4	Float	4	RO	

Register	Description		Format	Bytes	Property	Values / Unit / Comment
1096	Load current average	AC CH1	Float	4	RO	Arithmetic mean of the measured value since the last Modbus query
1098		AC CH2	Float	4	RO	
1100		AC CH3	Float	4	RO	
1102		AC CH4	Float	4	RO	
1104… 1111		Reserved				
1112		RMS CH1	Float	4	RO	
1114		RMS CH2	Float	4	RO	
1116		RMS CH3	Float	4	RO	
1118		RMS CH4	Float	4	RO	
1120	Load current measured value, max. [1]	AC CH1	Float	8	RO	Reset register 1000
1122		AC CH2	Float	8	RO	Reset register 1004
1124		AC CH3	Float	8	RO	Reset register 1008
1126		AC CH4	Float	8	RO	Reset register 1012
1128… 1035		Reserved				
1136		RMS CH1	Float	8	RO	Reset register 1032
1138		RMS CH2	Float	8	RO	Reset register 1036
1140		RMS CH3	Float	8	RO	Reset register 1040
1142		RMS CH4	Float	8	RO	Reset register 1044
1144	Current value of the unfiltered load current	RMS CH1	Float	4	RO	Unfiltered real-time RMS measured value
1146		RMS CH2	Float	4	RO	
1148		RMS CH3	Float	4	RO	
1150		RMS CH4	Float	4	RO	

[1] Largest measured value since the last Modbus query, display of the maximum values from the measured-value blocks (offset 0 and 1) of registers 1000…1044 as a **floating point number**.
When queried, simultaneously resets the measured-value block in the specified register.

6.3 Monitoring functions registers

Status monitoring functions (registers 2000…2050)

Register	Description	Format	Bytes	Property	Values / Unit / Comment
2000	CT status CT1	UINT16	2	RO	0 = OK 1 = Short circuit 2 = Interruption
2001	CT status CT2	UINT16	2	RO	
2002	CT status CT3	UINT16	2	RO	
2003	CT status CT4	UINT16	2	RO	
2014	Status Reload memory Input/ output "Q"	UINT16	2	RO	0 = Reload memory inactive 1 = Reload memory active
2015	Status Reload memory Output "M+"	UINT16	2	RO	

6.4 Status information registers

Status information (registers 3000…3999)

Register	Description	Format	Bytes	Property	Values / Unit / Comment
3000	Test status	UINT16	2	RO	0 = No active test 1 = Test active via T/R button 2 = Test active via interface
3001	Status of input "I"	UINT16	2	RO	0 = Input is not operated 1 = Input is operated
3002	Status of input/output "Q"	UINT16	2	RO	0 = Input is not operated 1 = Input is operated 2 = Input /output "Q" is configured as output
3003… 3004	Reserved				
3005	Status of output "Q"	UINT16	2	RO	Current status of the output: 0 = Output inactive (no event of alarm assignments occurred) 1 = Output active (at least one event of alarm assignments occurred)
3006	Status of output "M+"	UINT16	2	RO	
3007… 3008	Reserved				
3009	Active status of input/output "Q"	UINT16	2	RO	The last active status (1) of the output is retained until the next Modbus query.
3010	Active status of output "M+"	UINT16	2	RO	
3011… 3012	Reserved				
3013	Inactive status of input/output "Q"	UINT16	2	RO	The last inactive status (0) of the output is retained until the next Modbus query.
3014	Inactive status of output "M+"	UINT16	2	RO	
3050	Alarm status of the device, binary coded (registers 3070…3071)	UINT16	2	RO	0 = No alarm | 1 = Alarm Bit 0 = Register 3070 Bit 1 = Register 3071 Bit 2…15 = Reserved

Register	Description		Format	Bytes	Property	Values / Unit / Comment
3051	Measuring channel CH1 binary coded (registers 3086…3101)		UINT16	2	RO	0 = No alarm | 1 = Alarm Bit 0 = Prewarning AC Bit 1 = Main alarm AC Bit 2 = Reserved Bit 3 = Reserved Bit 4 = Prewarning RMS Bit 5 = Main alarm RMS Bit 6 = Measuring current transformer connection fault Bit 7 = Measuring channel overload Bit 8…15 = Reserved
3052	CH2 binary coded (registers 3102…3117)		UINT16	2	RO	
3053	CH3 binary coded (registers 3118…3133)		UINT16	2	RO	
3054	CH4 binary coded (registers 3134…3149)		UINT16	2	RO	
3070	Alarm status test		UINT16	2	RO	For the device: 0 = No alarm | 1 = Alarm
3071	Alarm status device error		UINT16	2	RO	
3086	Alarm status CH1	Prewarning AC	UINT16	2	RO	For channel 1: 0 = No alarm | 1 = Alarm
3087		Main alarm AC	UINT16	2	RO	
3088		Reserved				
3089		Reserved				
3090		Prewarning RMS	UINT16	2	RO	
3091		Main alarm RMS	UINT16	2	RO	
3092		Measuring current transformer connection fault	UINT16	2	RO	
3093		Measuring channel overload	UINT16	2	RO	
3102	Alarm status CH2	Prewarning AC	UINT16	2	RO	For channel 2: 0 = No alarm | 1 = Alarm
3103		Main alarm AC	UINT16	2	RO	
3104		Reserved				
3105		Reserved				
3106		Prewarning RMS	UINT16	2	RO	
3107		Main alarm RMS	UINT16	2	RO	
3108		Measuring current transformer connection fault	UINT16	2	RO	
3109		Measuring channel overload	UINT16	2	RO	

Register	Description		Format	Bytes	Property	Values / Unit / Comment
3118	Alarm status CH3	Prewarning AC	UINT16	2	RO	For channel 3: 0 = No alarm | 1 = Alarm
3119		Main alarm AC	UINT16	2	RO	
3120		Reserved				
3121		Reserved				
3122		Prewarning RMS	UINT16	2	RO	
3123		Main alarm RMS	UINT16	2	RO	
3124		Measuring current transformer connection fault	UINT16	2	RO	
3125		Measuring channel overload	UINT16	2	RO	
3134	Alarm status CH4	Prewarning AC	UINT16	2	RO	For channel 4: 0 = No alarm | 1 = Alarm
3135		Main alarm AC	UINT16	2	RO	
3136		Reserved				
3137		Reserved				
3138		Prewarning RMS	UINT16	2	RO	
3139		Main alarm RMS	UINT16	2	RO	
3140		Measuring current transformer connection fault	UINT16	2	RO	
3141		Measuring channel overload	UINT16	2	RO	

6.5 RS-485-parameter registers

RS-485 interface parameters (registers 32000...32010)

Register	Description	Format	Bytes	Prop-erty	Value / Unit / Comment	Factory setting
32000	Device address	UINT16	2	RW	1…247	Last 2 digits of the serial number + 100
32001	Baud rate	UINT32	4	RW	9600, 19200, 38400, 57600, 115200	19200
32003	Parity	UINT16	2	RW	1 = Even 2 = Odd 3 = None	1
32004	Stop bits	UINT16	2	RW	1 = 1 2 = 2 3 = Automatic	3
32005	Reserved					
32006	Allow update	UINT16	2	RW	0 = Do not allow SW-update via RS-485 interface 1 = Allow SW-update via RS-485 interface	0
32007	Write access	UINT16	2	RW	1: Enable write access (parameters can be changed) 2: Write access disabled (parameters can only be read) *Attention: Unlocking can only be done directly on the device!*	1

6.6 Registers of digital input "I"

Parameters of input "I" (32300)

Register	Description	Format	Bytes	Prop-erty	Values / Unit / Comment	Factory setting
32300	Mode	UINT16	2	RW	1 = High-active 2 = Low-active	2
32301	Function	UINT16	2	RW	1 = None 2 = Reset 3 = Test 4 = T/R (test/reset combined)	3

6.7 Registers of input/output "Q"

Parameters of input/ output "Q" (32400)

Register	Description	Format	Bytes	Property	Value / Unit / Comment	Factory setting
32400	Mode	UINT16	2	RW	1 = Output: Passive 2 = Output: High-active 3 = Output: Low-active 4 = Output: Permanently high 5 = Output: Permanently low 6 = Input: High-active 7 = Input: Low-active	3
32401	Function	UINT16	2	RW	0 = None Available with modes 6…7: 1 = Reset 2 = Test Available with modes 1…3: 3 = Prewarning 4 = Main alarm	4
32402	Test	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32403	Device-error alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32404	AC CT1 alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	0
32405	AC CT2 alarm assignment	UINT16	2	RW		0
32406	AC CT3 alarm assignment	UINT16	2	RW		0
32407	AC CT4 alarm assignment	UINT16	2	RW		0
32408 … 32411	Reserved					
32412	RMS CT1 alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32413	RMS CT2 alarm assignment	UINT16	2	RW		1
32414	RMS CT3 alarm assignment	UINT16	2	RW		1
32415	RMS CT4 alarm assignment	UINT16	2	RW		1
32416	Connection-fault alarm assignment CT1…4	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32417	Measuring-channels-overloading alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32418	Reload cycles	UINT16	2	RW	0…10 = Number of switching cycles until the output status is frozen	0
32419	Reload time	UINT16	2	RW	2…60 [s] = Time until reload counter will be reset	6

6.8 Registers of output "M+"

Parameters of output "M+" (registers 32500…32530)

Registers 32505…32530: Alarm assignments of output M+

Register	Description	Format	Bytes	Property	Values / Unit / Comment	Factory setting
32500	Mode	UINT16	2	RW	1 = Output: passive 2 = Output: high-active 3 = Output: low-active 4 = Output: permanently high 5 = Output: permanently low 6 = Output: 0…20 mA 7 = Output: 4…20 mA 8 = Output: 0…10 V 9 = Output: 2…10 V	3
32501	Function	UINT16	2	RW	0 = None Operative with mode 1…3: 1 = Prewarning 2 = Main alarm Operative with mode 6…9: 3 = Channel 1 (RMS) 4 = Channel 2 (RMS) 5 = Channel 3 (RMS) 6 = Channel 4 (RMS)	2
32502	Linearity	UINT16	2	RW	Operative with function 3…6: 1= Linear with respect to maximum scale value (see register 32503) 2= Linear with respect to 100 % of $I_{Ln\ RMS}$	2
32503	Scaling	UINT16	2	RW	Operative only with linearity 1: 6…65000 [mA], increment 1 mA, maximum scale value *Note: This value can be set to max. 5 x $I_{Ln\ RMS}$!*	0
32504	Test	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32505	Device-error alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32506	AC CT1 alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	0
32507	AC CT2 alarm assignment	UINT16	2	RW		0
32508	AC CT3 alarm assignment	UINT16	2	RW		0
32509	AC CT4 alarm assignment	UINT16	2	RW		0
32510… 32513	Reserved					

Register	Description	Format	Bytes	Property	Values / Unit / Comment	Factory setting
32514	RMS CT1 alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32515	RMS CT2 alarm assignment	UINT16	2	RW		1
32516	RMS CT3 alarm assignment	UINT16	2	RW		1
32517	RMS CT4 alarm assignment	UINT16	2	RW		1
32518	Alarm assignment, CT-connection fault	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32519	Measuring-channels-overloading alarm assignment	UINT16	2	RW	0 = Disabled 1 = Enabled	1
32520	Reload cycles	UINT16	2	RW	0…10 = Number of switching cycles until the output status is frozen	0
32521	Reload time	UINT16	2	RW	2…60 [s] = Time until reload counter will be reset	6

6.9 Registers of response-value parameters

Response-value parameters (registers 32600…32635)

Register	Description	Format	Bytes	Property	Values / Unit / Comment	Factory setting
32616	I_{Ln} RMS CT1	Float	4	RW	0.006…30 [A]; increment 0.001;	0.03
32618	I_{Ln} RMS CT2	Float	4	RW		0.03
32620	I_{Ln} RMS CT3	Float	4	RW		0.03
32622	I_{Ln} RMS CT4	Float	4	RW		0.03
32624	Prewarning AC CT1	UINT16	2	RW	With **overcurrent** mode: 10…100 [%]; increment 1 With **undercurrent** mode: 10…100 [%]; increment 1 (prewarning = register value + 100 = 110…200 [%])	70
32625	Prewarning AC CT2	UINT16	2	RW		70
32626	Prewarning AC CT3	UINT16	2	RW		70
32627	Prewarning AC CT4	UINT16	2	RW		70
32628… 32631	Reserved					-
32632	Prewarning RMS CT1	UINT16	2	RW		70
32633	Prewarning RMS CT2	UINT16	2	RW		70
32634	Prewarning RMS CT3	UINT16	2	RW		70
32635	Prewarning RMS CT4	UINT16	2	RW		70

6.10 Function and operating-characteristics registers

Function and response behaviour parameters (32700…32720)

Register	Description	Format	Bytes	Prop-erty	Value / Unit / Comment		Factory setting
32700	CT1 function	UINT16	2	RW	1 = Overcurrent 2 = Undercurrent 4 = Digital input: High-active 5 = Digital input: Low-active 6 = None		1
32701	CT2 function	UINT16	2	RW			
32702	CT3 function	UINT16	2	RW			
32703	CT4 function	UINT16	2	RW			
32704	CT1 hysteresis	UINT16	2	RW	2…40 [%], increment 1 %		15
32705	CT2 hysteresis	UINT16	2	RW			
32706	CT3 hysteresis	UINT16	2	RW			
32707	CT4 hysteresis	UINT16	2	RW			
32708	CT1 filter setting	UINT16	2	RW	1 = 20 kHz 2 = Type A 3 = Type F 6 = 50 Hz 7 = 60 Hz 8 = 150 Hz	9 = 180 Hz 10 = 500 Hz 11 = 1000 Hz 12 = 2000 Hz 13 = 5000 Hz 14 = 10000 Hz	1
32709	CT2 filter setting	UINT16	2	RW			
32710	CT3 filter setting	UINT16	2	RW			
32711	CT4 filter setting	UINT16	2	RW			
32712	Fundamental-harmonic frequency	UINT16	2	RW	50…1000 Hz; increment 1 Hz		50
32713	PRESET factor	UINT16	2	RW	1…99; increment 1		3
32714	PRESET offset	UINT16	2	RW	0…30000; increment 1 [mA]		30
32715	Automatic measuring range switching of CT1	UINT16	2	RW	0 = Disabled 1 = Enabled		0
32716	Automatic measuring range switching of CT2	UINT16	2	RW			
32717	Automatic measuring range switching of CT3	UINT16	2	RW			
32718	Automatic measuring range switching of CT4	UINT16	2	RW			

6.11 Alarm-behaviour registers

Alarm behaviour parameters (32800…32810)

Register	Description	Format	Bytes	Prop-erty	Values / Unit / Comment	Factory setting
32800	CH1 fault memory	UINT16	2	RW	0 = Disabled 1 = Enabled	0
32801	CH2 fault memory	UINT16	2	RW		0
32802	CH3 fault memory	UINT16	2	RW		0
32803	CH4 fault memory	UINT16	2	RW		0

Register	Description	Format	Bytes	Property	Values / Unit / Comment	Factory setting
32804	CH1 start with alarm	UINT16	2	RW	0 = Disabled 1 = Enabled	0
32805	CH3 start with alarm	UINT16	2	RW		0
32806	CH3 start with alarm	UINT16	2	RW		0
32807	CH4 start with alarm	UINT16	2	RW		0

6.12 Time-behaviour registers

Time behaviour parameters (32900…32920)

Register	Description	Format	Bytes	Property	Value / Unit / Comment	Factory setting
32900	Start-up delay *t*	Float	4	RW	0…900 [s], increment 1 ms	0
32902	Response delay t_{on} CH1	Float	4	RW	0…10 [s], increment 1 ms	0
32904	Response delay t_{on} CH2	Float	4	RW		0
32906	Response delay t_{on} CH3	Float	4	RW		0
32908	Response delay t_{on} CH4	Float	4	RW		0
32910	Delay on release t_{off} CH1	Float	4	RW	0…900 [s], increment 1 ms	1
32912	Delay on release t_{off} CH2	Float	4	RW		1
32914	Delay on release t_{off} CH3	Float	4	RW		1
32916	Delay on release t_{off} CH4	Float	4	RW		1

6.13 Monitoring-functions registers

Parameters CT-connection monitoring (33000)

Register	Description	Format	Bytes	Property	Value / Unit / Comment	Factory setting
33000	CT-connection monitoring, CT1	UINT16	2	RO	0 = Disabled 1 = Enabled	1
33001	CT-connection monitoring, CT2	UINT16	2	RO		1
33002	CT-connection monitoring, CT3	UINT16	2	RO		1
33003	CT-connection monitoring, CT4	UINT16	2	RO		1

6.14 Measuring-current-transformer registers

CT parameters (33100)

Register	Description	Format	Bytes	Prop-erty	Values / Unit / Comment	Factory setting
33100	Type of measuring-current transformer, CT1	UINT16	2	RW	1 = "Type A"	1
33101	Type of measuring-current transformer, CT2	UINT16	2	RW		
33102	Type of measuring-current transformer, CT3	UINT16	2	RW		
33103	Type of measuring-current transformer, CT4	UINT16	2	RW		

6.15 Device-error-code registers

Device error codes (registers 58000…58199)

Register content 0 = No error

Undocumented registers 58000...58199 are reserved.

Register	Description	Format	Bytes	Prop-erty	Value / Unit / Comment	Reversible	Device faulty
58000	Number of device errors	UINT16	2	RO	Number of active device errors	X	
58001	0.10	UINT16	2	RO	10 = CT-connection fault, CT1	X	
58002	0.11	UINT16	2	RO	11 = CT-connection fault, CT2	X	
58003	0.12	UINT16	2	RO	12 = CT-connection fault, CT3	X	
58004	0.13	UINT16	2	RO	13 = CT-connection fault, CT4	X	
58005	0.57	UINT16	2	RO	57 = Connection fault at input/output "Q"	X	
58006	0.58	UINT16	2	RO	58 = Connection fault at output "M+"	X	
58007	3.21	UINT16	2	RO	321 = Internal error		X
58008	3.25	UINT16	2	RO	325 = Internal error		X
58009	4.70	UINT16	2	RO	470 = Thermal overload at measuring inputs	X	
58010	4.71	UINT16	2	RO	471 = CT1 overload	X	
58011	4.72	UINT16	2	RO	472 = CT2 overload	X	
58012	4.73	UINT16	2	RO	473 = CT3 overload	X	
58013	4.74	UINT16	2	RO	474 = CT4 overload	X	
58014	4.75	UINT16	2	RO	475 = Invalid setting of CT1: AC and RMS response values are too far apart	X	
58015	4.76	UINT16	2	RO	476 = Invalid setting of CT2: AC and RMS response values are too far apart	X	
58016	4.77	UINT16	2	RO	477 = Invalid setting of CT3: AC and RMS response values are too far apart	X	
58017	4.78	UINT16	2	RO	478 = Invalid setting of CT4: ACand RMS response values are too far apart	X	
58022	4.83	UINT16	2	RO	483 = Invalid setting of CT1: AC response value < 10 mA	X	
58023	4.84	UINT16	2	RO	484 = Invalid setting of CT2: AC response value < 10 mA	X	
58024	4.85	UINT16	2	RO	485 = Invalid setting of CT3: AC response value < 10 mA	X	
58025	4.86	UINT16	2	RO	486 =invalid setting of CT4: AC response value < 10 mA	X	
58026	6.00	UINT16	2	RO	600 = Internal error		X

Register	Description	Format	Bytes	Property	Value / Unit / Comment	Reversible	Device faulty
58027	6.10	UINT16	2	RO	610 = Internal error		X
58028	6.31	UINT16	2	RO	631 = Internal error		X
58029	6.51	UINT16	2	RO	651 = Internal error		X
58030	7.61	UINT16	2	RO	761 = Internal error		X
58031	7.62	UINT16	2	RO	762 = Internal error		X
58032	7.63	UINT16	2	RO	763 = Internal error		X
58033	8.20	UINT16	2	RO	820 = Internal error		X
58034	8.24	UINT16	2	RO	824 = T/R button defective	X	
58035	8.43	UINT16	2	RO	843 = Internal error		X
58036	8.44	UINT16	2	RO	844 = Internal error		X
58037	8.45	UINT16	2	RO	845 = Internal error		X
58038	8.46	UINT16	2	RO	846 = Internal error		X
58039	8.49	UINT16	2	RO	849 = Internal error		X
58040	6.20	UINT16	2	RO	620 = Measured offset is outside the limits	X	
58041	7.64	UINT16	2	RO	764 = Internal error		X
58042	6.95	UINT16	2	RO	695 = Internal error		X
58043	3.30	UINT16	2	RO	330 = The manual self-test was not completed without errors	X	
58044	0.56	UINT16	2	RO	56 = Shutdown check: Although the system is switched off, a (load) current is still flowing	X	
58045… 58099	Reserved						
58100	3.21	UINT16	2	RO	321 = Internal error		X
58101	3.22	UINT16	2	RO	322 = Internal error		X
58102	3.23	UINT16	2	RO	323 = Internal error		X
58103	3.24	UINT16	2	RO	324 = Internal error		X
58104	3.26	UINT16	2	RO	326 = Internal error		X
58105	3.27	UINT16	2	RO	327 = Internal error		X
58106	6.30	UINT16	2	RO	630 = Internal error		X
58107	7.64	UINT16	2	RO	764 = Internal error		X

6.16 Control-commands registers

Control commands (59000)

Register	Description	Format	Bytes	Property	Values / Unit / Comment	Factory setting
59000	NFC	UINT16	2	RW	0 = Disabled 1 = Enabled (automatic disabling after 5 min)	0
59003	Start PRESET function	UINT16	2	WO	1 = Start PRESET	-

6.17 Function-control-commands registers

Register 60000 (function-selection register) defines which function is enabled.
Only specified values are permitted.
0 = Identify device via serial number
1 = Set Modbus address
2 = Identify device
4 = Reset to factory settings with/without interface parameters
6 = Start test
7 = Reset

ADVICE
The registers 60000…60003 must always be written as a block!

Function-control commands (60000)

Register	Description	Format	Bytes	Property	Value/Unit/Comment
Function 0: Identify device via serial number					
60000	Function selection	UINT16	2	WO	0 = Selection of the function "Identify device via serial number"
60001	Serial number	UINT32	4	WO	Serial number of the device to be searched
60003	Period	UINT16	2	WO	0…300 [s] = Time until the corresponding device lights up; 0 = End search function
Function 1: Set Modbus address					
60000	Function selection	UINT16	2	WO	1 = Selection of the function "Set Modbus address"
60001	Serial number	UINT32	4	WO	Serial number of the device to be given a new Modbus address. Only the device with the corresponding serial number will accpet the new Modbus address.
60003	Modbus address	UINT16	2	WO	0…247 = New Modbus address
Function 2: Identify device					
60000	Function selection	UINT16	2	WO	2 = Selection of the "Identify device" function
60001	Pattern value part 1	UINT16	2	WO	61918 Security pattern must be written for the function to be executed.
60002	Pattern value part 2	UINT16	2	WO	0 Security pattern must be written for the function to be executed.
60003	Period	UINT16	2	WO	0…300 [s] = Time until the device lights up. When the device receives the value "0", the function is stopped.

Register	Description	Format	Bytes	Prop-erty	Value/Unit/Comment
Function 4: Reset to factory settings with/without interface parameters					
60000	Function selection	UINT16	2	WO	4 = Selection of the function "Reset to factory settings with/ without interface parameters"
60001	Pattern value part 1	UINT16	2	WO	64199 Security pattern must be written for the function to be executed.
60002	Pattern value part 2	UINT16	2	WO	1304 Security pattern must be written for the function to be executed.
60003	Reset type	UINT16	2	WO	1 = Reset all parameters to the factory settings 2 = Reset to factory settings without interface parameters
Function 6: Start test					
60000	Function selection	UINT16	2	WO	6 = Selection of the function "Start test"
60001	Pattern value part 1	UINT16	2	WO	32343 Security pattern must be written for the function to be executed.
60002	Pattern value part 2	UINT16	2	WO	0 Security pattern must be written for the function to be executed.
60003	Type of test	UINT16	2	WO	3 = Start LCM test
Function 7: Reset					
60000	Function selection	UINT16	2	WO	7 = Selection of "Reset" function
60001	Pattern value part 1	UINT16	2	WO	13623 Security pattern must be written for the function to be executed.
60002	Pattern value part 2	UINT16	2	WO	0 Security pattern must be written for the function to be executed.
60003	Reset type	UINT16	2	WO	1 = Reset of the alarm message when fault memory is enabled

7 Error – Cause – Troubleshooting

Error pattern	Cause	Correction
Device		
No device start	Terminal blocks incorrectly plugged in	Plug in terminal blocks correctly.
	Supply voltage incorrectly connected	Establish correct wiring.
RS-485		
Instable communication	Missing termination due to incorrect commissioning or defective component. No device is terminated.	Configure the terminating resistor, determine the terminating resistor value and replace it if necessary.
	Faulty termination due to incorrect commissioning or defective component. Either only one or more than two devices have been terminated.	Configure the terminating resistor, check quality of the bus signal.
No communication	Incorrect configuration: Different baud rates between bus devices.	Calibrate baud rates between all bus devices.
	Incorrect connection: Terminals A and B are interchanged.	Establish correct bus wiring.
Inputs and outputs		
No level change	Incorrect configuration: Output configured as input	Check configuration.
	Incorrect connection: External connections	Check configuration.
Enclosure		
Broken screw-mounting brackets	Device becomes detached due to broken mounting brackets.	Preventive measure: Use correct screw type and observe max. tightening torque. If the screw-mounting brackets are defective: mount on DIN rail or replace device.
Non-compliance with the insulation guideline	Insufficient insulation due to insufficient distance between mounting screws and connecting wires.	Use screws with plastic cover or mount on DIN rail.
Terminals		
Wires detach from the terminal	Due to splicing of wire ends, it is not possible to insert them into the terminal or fix them firmly in the terminal.	Use ferrules for mounting and connection to flexible cables.
Wires cannot be removed from terminal	Ferrules with strong crimp impressions get stuck in the terminal.	Use correct crimping pliers for mounting and connection with flexible cables.

Meaning of device error codes

The device error codes can be found in the register 58000…58199.

This list is not complete. If you cannot correct the error, please contact Bender Service.

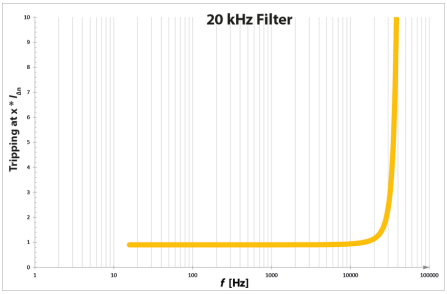
Error code	Meaning	Possible cause	Solution	Reversible	Device broken
0.10 0.11 0.12 0.13	Measuring CT connection fault 0.10 = CT1 0.11 = CT2 0.12 = CT3 0.13 = CT4	Plugs reversed	Inspect plugs/lines and connect them correctly.	X	
		Measuring current transformer defective	Replace measuring current transformer		X
		Electronics for current transformer monitoring defective	Replace LCM410		X
0.56	Shutdown control	Although the system is switched off, a (load) current is still flowing.	Inspect the system and provide a solution for any errors	X	
0.57	Connection fault for input/output "Q"	False connection configuration: Q is configured as a digital input, but - there is a fixed connection to high or low (short circuit) - there is a fixed voltage at Q (short circuit)	Coordinate connection and configuration	X	
		Electronics of the input/output defective	Replace LCM410		X
0.58	Connection fault on "M+" output	False connection configuration: - Load resistance too low - External voltage at the output	Correct connection	X	
		Output electronics defective	Replace LCM410		X
4.70	Thermal overload measurement inputs	Permanently excessive input power when using a type A measuring current transformer	Use measuring current transformers with a greater ratio or connect two measuring current transformers in series	X	
		Analogue measurement technology input circuit defective (e.g. PGA in incorrect measuring range)	Replace LCM410		X
4.71 4.72 4.73 4.74	CT overload (clipping) 471 = CT1 472 = CT2 473 = CT3 474 = CT4	Short-term outliers outside the dynamic range of the measurement technology can result in the RMS value being measured slightly too low. This can lead to errors in the frequency analysis.	Actual current waveforms are more extreme than the Norm requires. If possible and permitted, increase the response value I_{Ln}	X	
6.20	Measured offset is outside the limits	During calibration, a DC current flows through the measuring current transformer.	Inspect with a current clamp and ensure that no current is flowing	X	

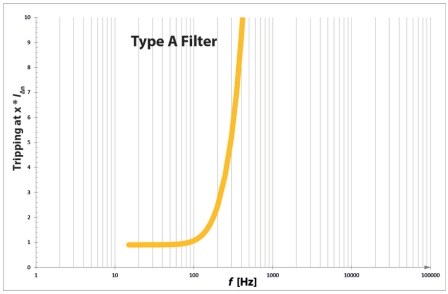
8 Technical data

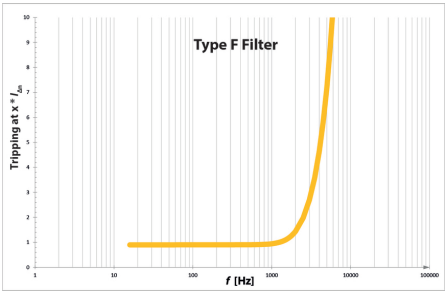
8.1 Frequency responses of the filters

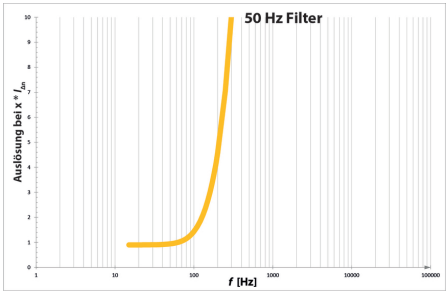
The curves represent the area in which the device triggers a main alarm.

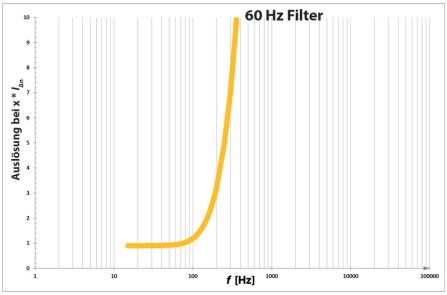
The frequency range below 42 Hz is not defined.

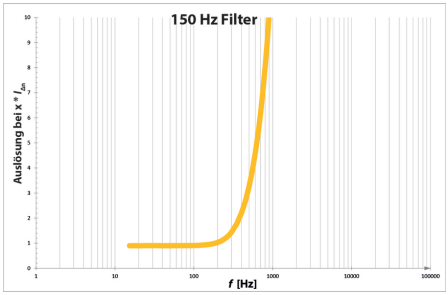


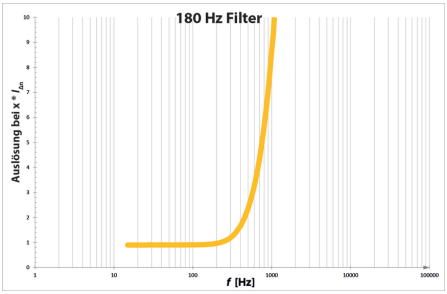


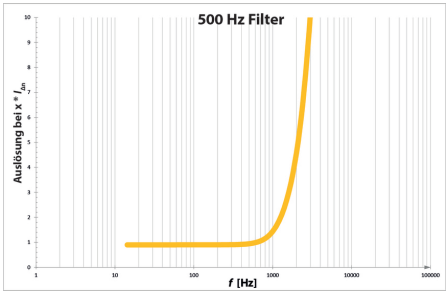


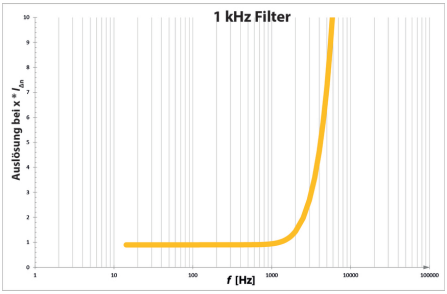


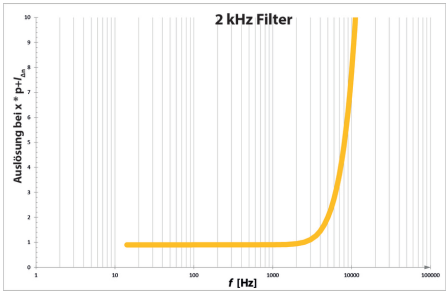


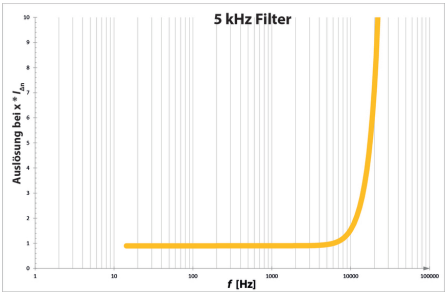


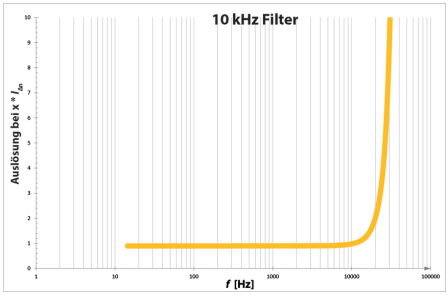

180 Hz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]


500 Hz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]


1 kHz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]


2 kHz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]


5 kHz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]


10 kHz Filter
Auslösung bei x * $I_{\Delta n}$
f [Hz]

8.2 Tabular data

()* = Factory setting

Supply voltage (+, -)

Connection	+, –
Supply voltage U_s	DC 24 V
Protection class of power supply unit	2 or 3
Permissible tolerance	–30…+25 %
Permissible ripple	5 %
Power consumption	≤ 2 W
Inrush current (< 5 ms)	< 10 A

Measuring circuit

Burden (internal)	33 Ω
Frequency range (for details see chapter "Frequency responses of the filters", page 55)	42 Hz…20 kHz
Measuring range (peak)	3 mA…100 A
Measuring range rms	2 mA…70 A
Operating load current	50 A
Response value main alarm I_{Ln}	6 mA…50 A (16 A)*
Prewarning	10…100 % x I_{Ln} (70 %)*
Operating uncertainty	±10 % (at 0.5…5 x I_{Ln})
Relative response uncertainty	6 mA…50 A: -20…0 %
Hysteresis	10…25 % (15 %)*
Fault-memory alarm messages	On/off (on)*
Permissible continuous load current	
single-channel use	85 A
dual-channel use	60 A
use of three channels	49 A
use of four channels	42 A

Measuring-current transformers

Connection	CT1…4 (S1, S2)
Measuring-current transformer series	
Type A	CTAC, CTAS, W, WR, WS
Type F	CTAC

CT connection monitoring	Yes
Rated voltage U_n	See manual of the measuring current transformer
Connecting wires	See manual of the measuring current transformer
Cable length	
CT Type A (single wire ≥ 0.75 mm²)	≤ 10 m
CT Type A (shielded cabel ≥ 0.75 mm²)	≤ 40 m
For UL applications	60/75 °C copper conductors

Time response

Start-up delay t	0…900 s (0 s)*
Response delay t_{on}	0…10 s (0 s)*
Delay on release t_{off}	0…900 s (1 s)*
Operating time t_{ae}	
with 1 x I_{Ln}	≤ 260 ms
with 5 x I_{Ln}	40…120 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on}$
Recovery time t_b	≤ 500 ms
Response time for CT connection monitoring	≤ 10 s

Operation

Display	Status LED, alarm LEDs, channel LEDs
Button T/R	Reset / test / NFC / address setting / protect
Terminating resistor DIP switches	On/off (off)*

RS-485 interface

Connection	A, B
Protocol	BSC | Modbus RTU
Baud rate	Max. 115.2 kbits/s (19.2 kbits/s)*
Parity	Even, no, odd (even)*
Stop bits	1/2/auto (auto)*
Cable length (at 9.6 kbits/s)	≤ 1200 m
Recommended lines, shield on one side connected to PE	
CAT6/CAT7	Min. AWG23
min. J-Y(St)Y 2 x 0.6 mm²	Twisted pair
Device address	1…247 (100 + last two digits of serial number)*

NFC interface

Frequency	13.56 MHz
Transmitting power (modulating; in 0 m distance, e.g.) [1]	0 W

1 • Electromagnetic interference may cause NFC failure.
• The device does not transmit any radio waves when used as intended.

Input I

Connection	I, ⊥
Max. cable length (recommended)	10 m
External connections	Potential-free contact

Input/output Q

Connection	Q, ⊥
Max. cable length (recommended)	10 m
Max. load	20 mA
Low voltage level (output)	0…2 V
High voltage level (output)	10 V…U_S
External voltage (passive mode)	DC 0…(U_S - 1 V)

Output M+

Connection	M+, ⊥
Max. cable length (recommended)	10 m
Max. load	20 mA
Burden	
Current output	≤ 600 Ω
Voltage output	≥ 20 kΩ
Tolerance with respect to final current/voltage value	±20 %
External voltage (passive mode)	DC 0…U_S

Connections

Terminals	Plug-in screw-type terminals
Terminal series	Phoenix Contact MC 1,5/ -ST-3,5 BK
Connection properties	
Rigid	0.14…1.5 mm²
Flexible, without plastic sleeve	0.25…1.5 mm²
Flexible, with plastic sleeve	0.25…0.5 mm²

Stripping length	7 mm
Tightening torque	0.22…0.25 Nm
Conductor cross section AWG	28…16

EMC/Environment

EMC	IEC 61326-1
Operating temperature	
Transport	-40…+85 °C
Long-time storage	-40…+70 °C

Classification of climatic conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3)	3K22
Transport (IEC 60721-3-2)	2K11
Long-term storage (IEC 60721-3-1)	1K22

Classification of mechanical conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3)	3M11
Transport (IEC 60721-3-2)	2M4
Long-term storage (IEC 60721-3-1)	1M12

Other

Operating mode	Continuous operation
Mounting	Vertical
Degree of protection (DIN EN 60529)	
terminals	IP20
internal components	IP30
Enclosure material	Polycarbonate
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Weight	≤ 55 g

8.3 Approvals

Standards & certifications

The LCM410 device has been developed in accordance with the following standards:

- DIN EN IEC 61010-1
- UL508

Licences

For a list of the open-source software used see our Homepage.

Declaration regarding the radio system

EU declaration of conformity

Bender GmbH & Co. KG hereby declares that the device covered by the Radio Equipment Directive complies with Directive 2014/53/EU. The full text of the EU Declaration of Conformity is available at the following internet address:

EU declaration of conformity LCM410

Hereby, Bender GmbH & Co. KG declares that this radio equipment complies with Radio Equipment Regulations 2017 (S.I. 2017/1206). The full text of the UK declaration of conformity is available at the following internet address:

UKCA-Declaration of Conformity LCM410

8.4 Ordering information

Type	Supply voltage U_S	Measuring current transformers that can be used		Art. No.
		Type A	Type F	
LCM410-24	DC 24 V	X	X	B85604049

Accessories	Art. No.
Sealable transparent cover	B80609199

8.5 Document revision history

Date	Document version	Status/changes
06.2026	00	Initial edition



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