



# LINETRAXX® RCM410R-1/-2

Single-channel AC and pulsed DC sensitive residual current monitor for AC systems



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# 1 General instructions

## 1.1 How to use this manual



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 "Safety instructions for Bender products".



Read the manual before mounting, connecting and commissioning the device. Always 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.



Information can help to optimise the use of the product.

### 1.2.1 Signs and symbols



Disposal



Recycling



Temperature range



Protect from moisture



Protect from dust



RoHS directives

## 1.3 Training courses and seminars

[www.bender.de](http://www.bender.de) > [Know-how-> Seminars.](#)

## 1.4 Delivery conditions

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

The following applies to software products:



["Software clause in respect of the licensing of standard software as part of deliveries, modifications and changes to general delivery conditions for products and services in the electrical industry."](#)

## 1.5 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. The following must be observed when storing the devices:



## 1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded in 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.
- Use of accessories and spare parts not recommended by Bender.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not 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.

## 1.7 Disposal of Bender devices

Abide by the national regulations and laws governing the disposal of this device.



For more information on the disposal of Bender devices, refer to

[www.bender.de](http://www.bender.de) -> [Service & support](#).

## 1.8 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 electrocution due to electric shock!** Touching live parts of the system carries the risk of:

- A fatal electric shock
- Damage to the electrical installation
- Destruction of the device

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

## 1.9 Intended use

The RCM410R devices in conjunction with the specified measuring current transformers (CT) are intended for AC and pulsed DC sensitive residual current measurement according to IEC 62020.

The area of application is the monitoring of residual currents  $I_{\Delta}$  for preventive maintenance in TN, TT and IT systems with  $I_{\Delta} \leq 50$  A rms, whereby  $I_{\Delta}$  is intended to be measured within the range  $f=42\dots70$  Hz.

The devices are intended for operation in control cabinets or similarly protected environments. For intended operation, observe the specifications in the manual.

Any other use than that described in this manual is regarded as improper.

## 2 Function

### 2.1 Device features

- AC and pulsed DC sensitive residual current monitor type A according to IEC 62020
- r.m.s. value measurement
- Residual operating current: 10 mA...30 A (42...70 Hz)
- Prewarning: 50...100 % of the residual operating current
- Supply voltage DC 24 V (RCM410R-1) or AC/DC 100...240 V (RCM410R-2)
- LED strip measured value display
- Adjustable response delay
- Alarm relay (designed as changeover contact)
- N/C or N/O operation and fault memory behaviour selectable
- RS-485 with Modbus RTU
- Continuous CT connection monitoring

### 2.2 Functional description

Once the supply voltage  $U_s$  is applied, the start-up delay  $t$  starts. During this period, exceeding the residual operating current has no influence on the switching state of the alarm relay. The residual current measurement is carried out via an external measuring current transformer. If the measured value exceeds the value of the prewarning and/or the residual operating current, the set response delay  $t_{on}$  starts.

After  $t_{on}$  has elapsed, the alarm relay switches and the corresponding alarm LED lights up. If the value falls below the release value before  $t_{on}$  has elapsed, no alarm is signalled: The LEDs AL1, AL2 do not light and the alarm relay does not switch. The set release time  $t_{off}$  starts if the measured value falls below the release value again after the alarm relay has switched. Once  $t_{off}$  has elapsed, the alarm relay switches back to its initial position. When the fault memory is enabled, the alarm relay remains switched until the T/R button is pressed  $> 1$  s and  $< 3$  s.

The T/R button can also be used to test the device, to enable and disable the NFC function (for service purposes only) and to set the Modbus device address.

#### 2.2.1 Connection monitoring

The connections to the measuring current transformer are continuously monitored. In the event of a fault, the alarm relay switches and the status LED flashes yellow. After the fault has been eliminated, the alarm relay automatically switches back to its initial position and the status LED lights up green. When the fault memory is enabled, the alarm relay only switches back to its initial position when the T/R button is pressed  $> 1$  s and  $< 3$  s. During this period, the status LED flashes yellow.

## 2.2.2 Manual self test

By pressing the T/R button  $> 3$  s and  $< 6$  s, the device simulates a residual current with the value  $1.5 \times I_{\Delta n}$ . All LEDs light up and the relay switches. When the fault memory is enabled, the alarm LEDs and the relay remain active until the fault memory is cleared by means of the T/R button.

## 2.2.3 Malfunction

If an internal malfunction occurs, the status LED lights up RED. The error code can be queried via the device interfaces.

## 2.2.4 Alarm assignments to the alarm relay

The messages "Device error", "Residual operating current  $I_{\Delta n}$ ", "Prewarning", "CT connection fault" and/or "Test" can be assigned to the alarm relay via the device interface.

## 2.2.5 Delay times $t_{br}$ , $t$ , $t_{on}$ , and $t_{off}$

The times  $t_{br}$ ,  $t$ ,  $t_{on}$  and  $t_{off}$  described below delay the output of alarms via LEDs, relay and Modbus RTU.

### 2.2.5.1 Recovery time $t_b$

The recovery time is the time the device needs to be ready for measurement after connecting the supply voltage  $U_s$ .

### 2.2.5.2 Start-up delay $t$

After connecting the supply voltage  $U_s$ , the measuring function is delayed by the set time  $t$  (0...999 s) plus the recovery time  $t_b$ .

### 2.2.5.3 Response delay $t_{on}$

If a residual operating current is exceeded, the residual current monitor requires the response time  $t_{an}$  to output the alarm. A set response delay  $t_{on}$  (0...10 s) 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.

### 2.2.5.4 Delay on release $t_{off}$

If the alarm no longer exists and the fault memory is disabled, the alarm LEDs go out and the alarm relays switch back to their initial position. By means of the delay on release (0...999 s), the alarm state is maintained for the selected period.

## 2.2.6 Factory settings FAC

There are two types of reset:

### 2.2.6.1 Factory settings without interface

After restoring the factory settings, all previously changed settings are reset to the state upon delivery. The settings for the Modbus interface are not reset.

### 2.2.6.2 Factory settings with interface

After restoring the factory settings, all previously changed settings including the settings for the Modbus interface and the device address are reset to the state upon delivery.

## 2.2.7 Combined function button (T/R button)

**Reset** = pressing the T/R button  $> 1\text{ s} < 3\text{ s}$

**Test** = pressing the T/R button  $> 3\text{ s} < 6\text{ s}$

**NFC** = pressing the T/R button  $> 6\text{ s} < 10\text{ s}$

**Addr.** = pressing the T/R button  $> 10\text{ s} < 15\text{ s}$

## 2.2.8 Fault memory

The fault memory can be enabled or disabled. Stored alarms are reset by pressing the T/R button  $> 1\text{ s}$  and  $< 3\text{ s}$  when the fault memory is enabled. The fault memory is factory-set to enabled.

### 3 Mounting and connection

**i** Only qualified personnel are permitted to carry out the work necessary to install, commission and run a device or system.



**Risk of electrocution due to electric shock!** Touching live parts of the system carries the risk of:

- A fatal electric shock
- Damage to the electrical installation
- Destruction of the device

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

#### 3.1 Mounting

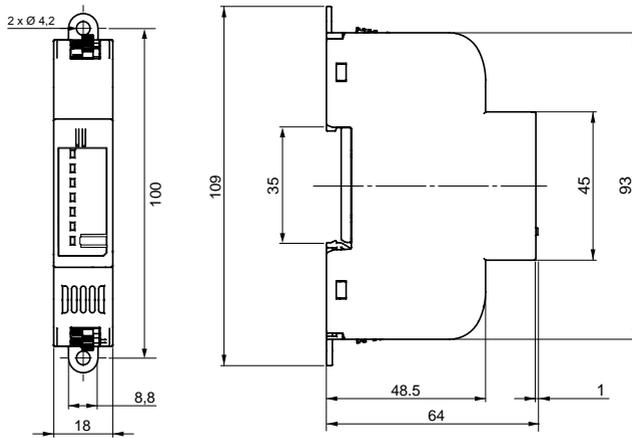
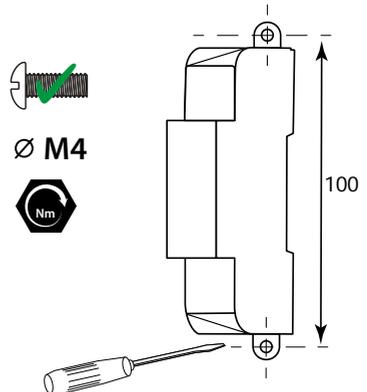
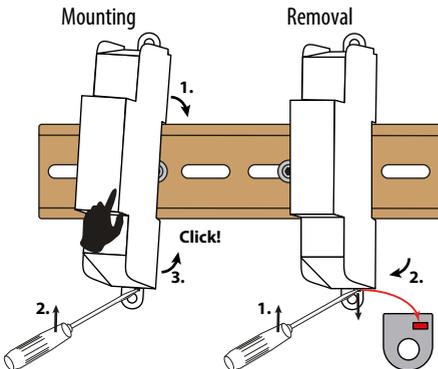


Abb. 3-1 Dimensions in mm

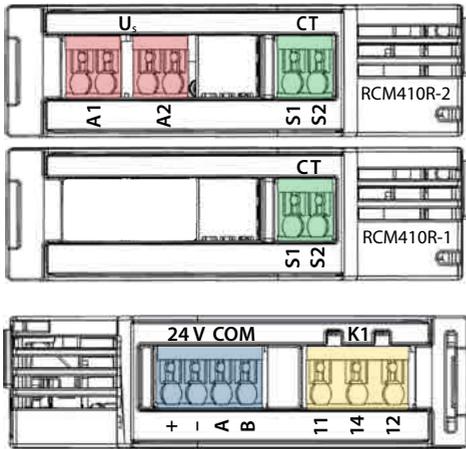
##### DIN rail mounting

##### Screw mounting



## 3.2 Connection RCM410R-1/-2

### 3.2.1 Connections



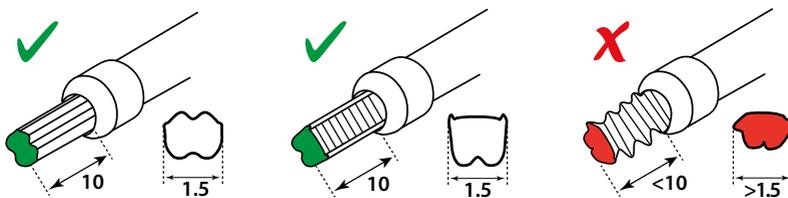
Terminal	Connection
A1, A2	Supply voltage $U_s$
S1, S2	Measuring current transformer
11, 14, 12	Alarm relay K1
+	+24 V
-	Ground
A	RS-485 A
B	RS-485 B

Abb. 3-2 Connections RCM410R-1 and RCM410R-2

The cables are connected to the device via push-in terminals. The maximum permissible conductor cross section is  $1.5 \text{ mm}^2$ .

**!** CAUTION! Short circuit. When finely stranded cables are inserted directly into the push-in terminals, spliced wires can cause a short circuit. Use ferrules.

The terminals only allow the use of ferrules from  $0.25 \text{ mm}^2$  to  $1.5 \text{ mm}^2$ . The maximum cross section of  $1.5 \text{ mm}^2$  should under no circumstances be exceeded!



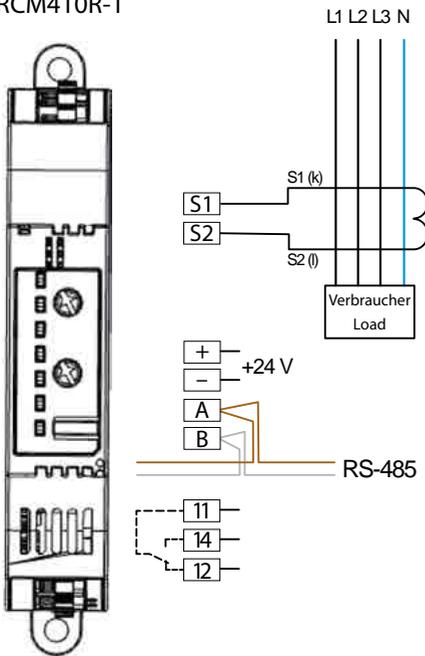
Use crimping pliers which

1. do not exceed the permitted crimp width of the ferrule and
2. do not leave strong crimp impressions on the ferrule.

**i** For a cross section of  $1 \text{ mm}^2$  or more, use suitable crimping pliers similar to the models "CRIMPFOX 6", "Weidmüller PZ6" or "Weidmüller PZ6/5".

### 3.2.2 Wiring diagrams

RCM410R-1



RCM410R-2

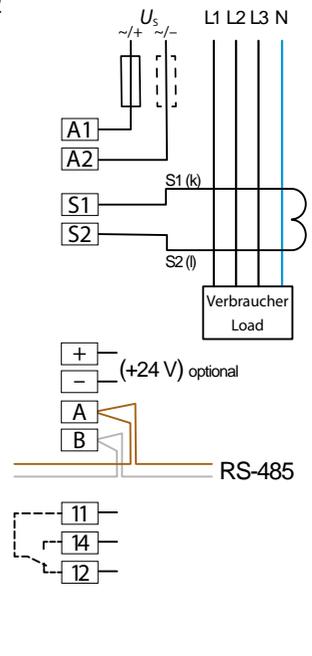
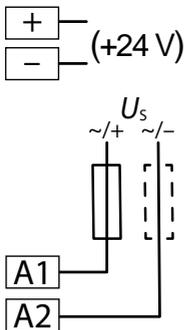


Abb. 3-3 Wiring diagrams RCM410R-1 and RCM410R-2

#### 3.2.2.1 Supply voltage $U_s$

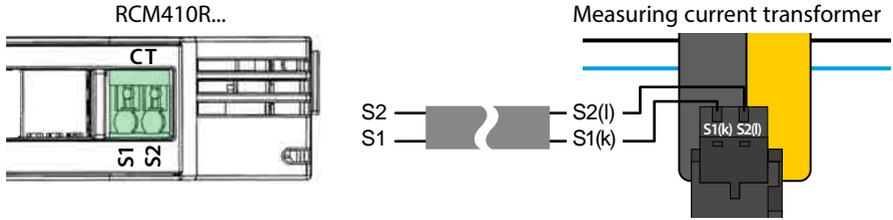


Both device variants can be operated with a voltage of DC +24 V. The connection is made at the bottom side of the device.

The RCM410R-2 can be alternatively operated via terminals A1 and A2 with a voltage of AC/DC 100...240 V. In this case, the device must be provided with a back-up fuse. The connection is made at the top side of the device.

If the device is supplied by an unearthed system, two back-up fuses are required.

### 3.2.2.2 Measuring current transformer connection



- i** Ensure that the measuring current transformers are connected correctly. Terminal "S1" must be connected to terminal "S1" (k) of the measuring current transformer. Terminal S2 must be connected to terminal "S2" (l) of the measuring current transformer.
- i** For further information on the connection of measuring current transformers, refer to the corresponding manuals of the measuring current transformers. The installation instructions specified there must be observed.

#### Suitable measuring current transformers

Series CTAC	Series W	Series WF	Series WR	Series WS
CTAC20(/01)	W20	WF170-1/-2	WR70x175S	WS20x30
CTAC35(/01)	W35	WF250-1/-2	WR115x305S	WS50x80
CTAC60(/01)	W60	WF500-1/-2	WR150x350S	WS80x120
CTAC120(/01)	W120	WF800-1/-2	WR200x500S	WS20x30-8000
CTAC210(/01)	W210	WF1200-1/-2	WR70x175SP	WS50x80-8000
	W20-8000		WR115x305SP	
	W35-8000		WR150x350SP	
	W60-8000		WR200x500SP	

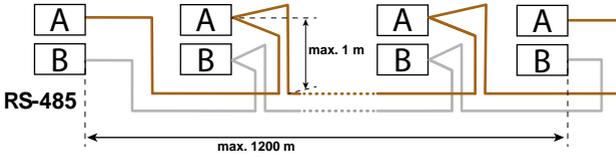
- i** Attention! The use of WF series measuring current transformers is only possible with disabled CT connection monitoring at RCM410R-x. CT connection monitoring is disabled via Modbus using register 32111. After disabling, a CT connection error is only signaled by the LED on the RCC420 of the WF measuring current transformer.

### 3.2.2.3 RS-485 interface

#### Specification

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

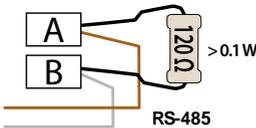
A twisted-pair, shielded cable must be used as bus cable. For example, cable type J-Y(St)Y n x 2 x 0.8 mm<sup>2</sup> is suitable. The shield must be connected to PE at one end.



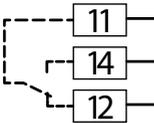
**i** If there are more than 16 bus devices, the interface must be designed to be shockproof, because the maximum permissible total leakage current of 0.5 mA is exceeded.

**Termination**

The bus cable must be terminated at both ends with resistors (120 Ω, < 0.1 W). The terminating resistors are connected in parallel to the terminals A and B.



**3.2.2.4 Relay**



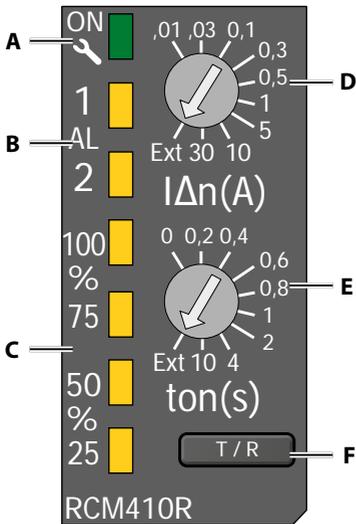
**i** *Caution! High contact currents damage the hard gold plating of the relay contacts. Damaged contacts prevent the relay from switching correctly at low contact currents.*

The terminals 11,14,12 are relay outputs of the measuring sensor. The following settings can be made via the interface:

Function	State	Description
Test	on   off	This parameter determines whether the relay is actuated during a test
Operating mode	N/O principle   N/C principle	This parameter determines the operating mode of the relay. N/O principle = coil is energised during alarm state N/C principle = coil is energised during normal operation
Main alarm	on   off	The relay switches if the residual operating current has been exceeded
Prewarning	on   off	The relay switches if the prewarning threshold has been exceeded
Device error	on   off	The relay switches if a device error exists
CT connection fault	on   off	The relay switches if a measuring current transformer connection fault exists

## 4 Operation and settings on the device

### 4.1 Control panel RCM410R



Control panel RCM410R-1/-2

Control panel	
A	STATUS LED ON – operating modes
B	ALARM LEDs – AL1 / AL2
C	VALUE DISPLAY LEDs – 25, 50, 75, 100 %
D	POTENTIOMETER 1 – Residual operating current $I_{dn}$
E	POTENTIOMETER 2 – Response delay $t_{on}$
F	T/R BUTTON – Test/Reset

#### 4.1.1 STATUS LED

Multicoloured display of various operating modes.



LED	Operating mode
<b>GREEN</b>	START PHASE Device booting after start NORMAL OPERATION Device in fault-free state
<b>YELLOW flashing</b>	CT FAULT CT connection fault
<b>RED</b>	DEVICE ERROR Restart or replacement of the device required.
<b>BLUE flashing</b>	NFC ACTIVE (for service purposes only)

### 4.1.2 ALARM LEDs

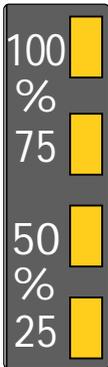
Display of prewarning AL1 and main alarm AL2.



LED	Operating state
AL1	PREWARNING Lights permanently when the prewarning threshold (% value of $I_{\Delta n}$ ) has been exceeded.
AL2	MAIN ALARM Lights permanently when the residual operating current threshold $I_{\Delta n}$ has been exceeded.

### 4.1.3 VALUE DISPLAY LEDs

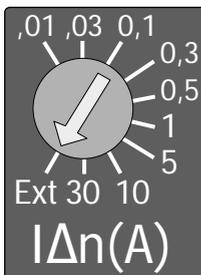
Percentage measured value display (incl. relative uncertainty) in relation to the residual operating current  $I_{\Delta n}$



LED	Operating state
25	Lights permanently when the present measured value is above 25 % of $I_{\Delta n}$ .
50	Lights permanently when the present measured value is above 50 % of $I_{\Delta n}$ .
75	Lights permanently when the present measured value is above 75 % of $I_{\Delta n}$ .
100	Lights permanently when the present measured value is above 100 % of $I_{\Delta n}$ .

### 4.1.4 Potentiometer residual operating current $I_{\Delta n}$

Setting of the residual operating current  $I_{\Delta n}$ .



In switch position "Ext", the values can be changed via the Modbus RTU interface.

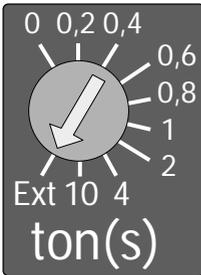
If a fixed value is set at the potentiometer, this value is always valid. In this case, no other residual operating current can be set via Modbus RTU.

If  $I_{\Delta n}$  is exceeded, the main alarm AL2 is triggered.

The prewarning is a percentage value of  $I_{\Delta n}$ . The value can only be set via the Modbus RTU interface.

### 4.1.5 Potentiometer response delay $t_{on}$

Setting of the delay time  $t_{on}$ .



The residual operating current and the pre-warning must be exceeded at least for the set response delay  $t_{on}$  to trigger the respective alarm. The amount by which the response value is exceeded is not relevant.

The parameter can only be changed via the interface in switch position "Ext".

The set response delay  $t_{on}$  is added to the operating time  $t_{ae}$ .

### 4.1.6 T/R BUTTON

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



Mode	Period	Status LED
Reset	1 s to 3 s	flashes yellow
Test	3 s to 6 s	flashes red
NFC	6 s to 10 s	flashes blue
Addr.	10 s to 15 s	flashes green

#### Overview



**i** The NFC mode is available to the Bender service only.

#### 4.1.6.1 "Reset" function

The "Reset" function resets stored alarm states.

#### 4.1.6.2 "Test" function

The "Test" function simulates a residual current of  $1.5 \times I_{An}$  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 relays switches if the alarm assignment "Test" has been activated.
- The test status can be read out via the interface:
  - 0 = no test
  - 1 = internal test
  - 2 = external test (interface)
- $t_{on}$  and  $t_{off}$  are set to 0 s for the duration of the test

**4.1.6.3 "NFC" function**

The "NFC" function can be enabled or disabled. This function is for service purposes only. The NFC function is enabled by pressing the T/R button for a period of 6 s to 10 s. The status LED indicates when the NFC function is enabled. The LED lights green with blue flashes. The enabled NFC function can be disabled by pressing the T/R button again for a period of 6 s to 10 s. Otherwise, it is automatically disabled after 5 min.

**4.1.6.4 "Addr." function**

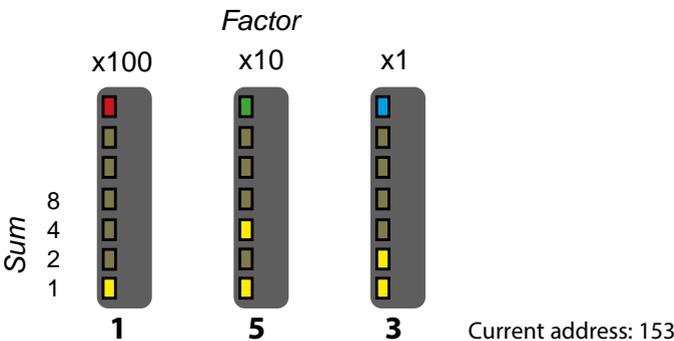
The "Addr." function puts the device into the address setting mode for the RS-485 interface. The LED measured value display and the status LED indicate the devices address.

How to enter an address:

1. Press T/R button until the status LED flashes green.
  - After releasing the T/R button, 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 releasing the T/R button, 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 releasing the T/R button, 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 releasing the T/R button, the status LED lights GREEN.

The address values are displayed via BCD code.

Addresses can only be entered within the valid address range. The valid address range is protected on the software side by an input mask.



## 5 Modbus settings

### 5.1 Overview

Description of the Modbus registers for RCM41x devices. The following Modbus function codes are supported:

- Holding register for reading out values

Status LED

(Read Holding Register; function code 0x03)

- Register for device programming  
(Write Multiple Registers; function code 0x10)

For a complete Modbus protocol specification, visit <http://www.modbus.org>.

#### 5.1.1 Read and write accesses

RO	READ ONLY (read access only)
RW	READ/WRITE (read and write access)
WO	WRITE ONLY (write access only)

#### 5.1.2 Data types

Float	IEEE754 32-bit (single precision floating point number)
Int16	Signed 16-bit integer
Int32	Signed 32-bit integer
UInt16	Unsigned 16-bit integer
UInt32	Unsigned 32-bit integer
String UTF8	ASCII character string

#### 5.1.3 Register areas

Range	Start address	End address
Info	0	999
Measured values	1000	1999
Alarm status	2000	2999
Range	3000	3999
Test status	4000	4999

Range	Start address	End address
CT status	5000	5999
Modbus RTU parameters	32000	32099
Parameters	32100	32199
Device error codes	58000	58999
Control commands	60000	60099

## 5.2 Register table

Address (dec)	Register name	Data type	Bytes	Mode	Value/Unit/Comment	Factory setting
<b>Device information (0-3999)</b>						
0	Device name	String UTF8	32	RO	e.g.: RCM410R-1 RCM410R-2	N/A
16	Article number	String UTF8	32	RO	e.g.: B74602000 (RCM410R-1) B74603000 (RCM410R-2)	N/A
32	Serial number	String UTF8	32	RO	10 digits e.g.: 2002123456	N/A
48	Manufacturer	String UTF8	96	RO	Bender GmbH & Co. KG	N/A
100	Application D number	UInt16	2	RO	642 = D642	N/A
101	Application version number	UInt16	2	RO	xxx = Vx.xx	N/A
102	Application build number	UInt16	2	RO		N/A
103	Boot loader D number	UInt16	2	RO	641 = D641	N/A
104	Bootloader version number	UInt16	2	RO	xxx = Vx.xx	N/A
105	Boot loader build number	UInt16	2	RO		N/A
106	Device status	UInt32	4	RO	Bit 0 (LSB): NFC - 0 = disabled, 1 = enabled Bit 1: Potentiometer $I_{dn} - 0!$ = ext, 1 = ext Bit 2: Potentiometer $ton - 0!$ = ext, 1 = ext Bit 3-31: 0 (reserved)	N/A
<b>Measured values (1000...1999)</b>						
1000	Residual current measured value	Float	4	RO	0...50 [A]	N/A
<b>Alarm status (2000...2999)</b>						
2000	Alarm status	UInt16	2	RO	0 = no alarm 1 = prewarning 2 = main alarm	N/A
<b>Range (3000...3999)</b>						
3000	Measuring range status	UInt16	2	RO	0: " " → within measuring range 1: "<" → below measuring range (not used) 2: ">" → measuring range exceeded	N/A
<b>Test status (4000...4999)</b>						
4000	Test status	UInt16	2	RO	0 = no active test 1 = test active via T/R button, 2 = test active via interface	N/A
<b>CT status (5000...5999)</b>						
5000	CT status	UInt16	2	RO	0 = OK 1 = short circuit 2 = interruption	N/A

Address (dec)	Register name	Data type	Bytes	Mode	Value/Unit/Comment	Factory setting
<b>Modbus RTU parameters (32000...32099)</b>						
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
<b>Parameters (32100...32199)</b>						
32100	Alarm assignment test	Uint16	2	RW	1 = enabled 2 = disabled	1
32101	Operating mode	Uint16	2	RW	1 = N/O principle 2 = N/C principle	2
32102	Alarm assignment prewarning	Uint16	2	RW	1 = enabled 2 = disabled	2
32103	Alarm assignment main alarm	Uint16	2	RW	1 = enabled 2 = disabled	1
32104	Alarm assignment CT connection fault	Uint16	2	RW	1 = enabled 2 = disabled	1
32105	Alarm assignment device error	Uint16	2	RW	1 = enabled 2 = disabled	1
32106	Fault memory	Uint16	2	RW	1 = enabled 2 = disabled	1
32107	Residual operating current	Uint32	4	RW	10...30000 [mA], step size 1 mA	10 mA
32109	Prewarning threshold	Uint16	2	RW	50...100 [%], step size 1 %	50%
32110	Hysteresis	Uint16	2	RW	10...25 [%], step size 1 %	15%
32111	CT connection monitoring	Uint16	2	RW	1 = enabled 2 = disabled	1
32112	Response delay	Uint32	4	RW	0...10000 [ms], step size 1 ms	0
32114	Delay on release	Uint32	4	RW	0...999000 [ms], step size 1 ms	0
32116	Start-up delay	Uint32	4	RW	0...999000 [ms], step size 1 ms	0

Address (dec)	Register name	Data type	Bytes	Mode	Value/Unit/Comment	Factory setting
<b>Device error codes (58000...58999)</b>						
58000	Number of device errors	Uint16	2	RO	Number of active device errors	N/A
58001	Internal device error	Uint16	2	RO	0 = no device error > 0 = internal device error	N/A
58002		Uint16	2	RO		N/A
58003		Uint16	2	RO		N/A
58004		Uint16	2	RO		N/A
58005		Uint16	2	RO		N/A
58006		Uint16	2	RO		N/A
58007		Uint16	2	RO		N/A
<b>Control commands (60000)</b>						
60000	Function selection	Uint16	2	WO	Function selection register to control the function of the following registers. Only specified values are permitted. 1 = Set Modbus address 2 = Find device 4 = Reset to factory settings / Reset parameters 6 = Test 7 = Reset	N/A
<b>Function 1: Set Modbus address</b>						
60000	Function selection	Uint16	2	WO	1 → Selection of "Set Modbus address" function	N/A
60001	Serial number	Uint32	4	WO	Serial number of the device to which the new Modbus address is assigned. The new Modbus address is only assigned to the device with the corresponding serial number.	N/A
60003	Modbus address	Uint16	2	WO	0...247 → New Modbus address	N/A
<b>Function 2: Find device</b>						
60000	Function selection	Uint16	2	WO	2 → Selection of the "Find device" function	N/A
60001	Pattern value part 1	Uint16	2	WO	61918 → Safety pattern must be written for the function to be executed	N/A
60002	Pattern value part 2	Uint16	2	WO	0 → Safety pattern must be written for the function to be executed	N/A
60003	Period	Uint16	2	WO	0...300 → Period in seconds during which the device lights up. If the device receives the value 0, the function is stopped.	N/A

Address (dec)	Register name	Data type	Bytes	Mode	Value/Unit/Comment	Factory setting
<b>Function 4: Reset to factory settings/Reset parameters</b>						
60000	Function selection	Uint16	2	WO	4 → Selection of "Reset to factory settings/Reset parameters" function	N/A
60001	Pattern value part 1	Uint16	2	WO	62663 → Safety pattern must be written for the function to be executed	N/A
60002	Pattern value part 2	Uint16	2	WO	1304 → Safety pattern must be written for the function to be executed	N/A
60003	Type of reset	Uint16	2	WO	1 → Reset to factory settings excluding interface parameters 2 → Reset to factory settings including interface parameters	N/A
<b>Function 6: Test</b>						
60000	Function selection	Uint16	2	WO	6 → Selection of the "Test" function	N/A
60001	Pattern value part 1	Uint16	2	WO	32343 --> Safety pattern must be written for the function to be executed	N/A
60002	Pattern value part 2	Uint16	2	WO	0 → Safety pattern must be written for the function to be executed	N/A
60003	Type of test	Uint16	2	WO	3 → Start RCM test	N/A
<b>Function 7: Reset</b>						
60000	Function selection	Uint16	2	WO	7 → Selection of "Reset" function	N/A
60001	Pattern value part 1	Uint16	2	WO	13623 → Safety pattern must be written for the function to be executed	N/A
60002	Pattern value part 2	Uint16	2	WO	0 → Safety pattern must be written for the function to be executed	N/A
60003	Type of reset	Uint16	2	WO	1 → Reset of the alarm message when fault memory is enabled	N/A

## 6 Error – Cause – Error correction

Error pattern	Cause	Correction	Source
<b>RS-485</b>			
Unstable system	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 configuration or defective component. Only one or more than two devices are 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 mixed up.	Establish correct bus wiring.	
<b>Alarm relays</b>			
Relays do not energise	No alarm message due to defective component or defective controlling devices. No alarm source has been assigned.	Check relay for proper function, replace device if necessary.  Assign alarm sources.	
Relays do not de-energise	No alarm reset due to sticking or defective relay. Switching current > 5 A.	Replace device, if necessary. Observe technical data of the switching output.	
	No switching of the relay due to excessive preloads on contacts.	Observe technical data of the switching output.	
<b>Enclosure</b>			
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.	
<b>Terminals</b>			
Wires detach from the terminal	Due to splicing of wire ends, it is not possible to insert them into the terminal or hold 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.	

## 7 Technical data

\* = factory setting

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

#### RCM410R-1:

Definitions:

Measuring & control circuit (IC1) .....	S1, S2, +, -, A, B
Output circuit (IC2) .....	11, 14, 12
Rated voltage .....	250 V
Overvoltage category .....	III
Operating altitude .....	≤ 2000 m AMSL
Rated impulse voltage:	
IC1/IC2 .....	4 kV
Rated insulation voltage:	
IC1/IC2 .....	250 V
Pollution degree .....	2
Protective separation (reinforced insulation) between:	
IC1/IC2 .....	Overvoltage category III, 300 V
Voltage test (routine test) acc. to IEC 61010-1:	
IC1/IC2 .....	AC 2.2 kV

#### RCM410R-2:

Definitions:

Supply circuit (IC1) .....	A1, A2
Output circuit (IC2) .....	11, 14, 12
Measuring & control circuit (IC3) .....	S1, S2, +, -, A, B
Rated voltage .....	250 V
Overvoltage category .....	III
Operating altitude .....	≤ 2000 m AMSL
Rated impulse voltage:	
IC1/(IC2-3) .....	4 kV
IC2/IC3 .....	4 kV
Rated insulation voltage:	
IC1/(IC2-3) .....	250 V
IC2/IC3 .....	250 V
Pollution degree .....	2
Protective separation (reinforced insulation) between:	
IC1/(IC2-3) .....	Overvoltage category III, 300 V
IC2/IC3 .....	Overvoltage category III, 300 V
Voltage test (routine test) acc. to IEC 61010-1:	
IC1/(IC2-3) .....	AC 2.2 kV
IC2/IC3 .....	AC 2.2 kV

### Supply voltage

#### RCM410R-1:

Supply voltage $U_S$ .....	DC 24 V
Tolerance of $U_S$ .....	-30...+25 %
Power consumption .....	≤ 2 W
Inrush current (< 5 ms) .....	< 10 A

#### RCM410R-2:

Supply voltage $U_S$ .....	AC/DC 100...240 V (47...63 Hz)
Tolerance of $U_S$ .....	±15 %
Power consumption .....	≤ 2 W / ≤ 3.5 VA
Inrush current (< 2 ms) .....	< 1.8 A

### Measuring circuit

External measuring current transformer (type A) .....	CTAC... , W... , WF... <sup>5)</sup> , WR... , WS... series
Measuring current transformer monitoring <sup>1)</sup> .....	on*/off
Load .....	33 Ω
Rated voltage $U_n$ .....	see datasheet measuring current transformer
Operating characteristics .....	type A
Frequency range .....	42...70 Hz
Measuring range (Peak) .....	2 mA...70 A
Measuring range (RMS) .....	2 mA...50 A
Rated residual operating current .....	30 A
Residual operating current $I_{dn}$ (AL2) .....	10 mA...30 A (10 mA)*
Prewarning (AL1) <sup>1)</sup> .....	50...100 % x $I_{dn}$ (50 %)*
Operating uncertainty .....	±10 % (at 0.5...5 x $I_{dn}$ )
Relative uncertainty .....	0...-20 %
Hysteresis <sup>1)</sup> .....	10...25 % (15 %)*

### Time response

Start-up delay $t^{1)}$ .....	0...999 s (0 s)*
Response delay $t_{on}$ .....	0...10 s (0 s)*
Delay on release $t_{off}^{1)}$ .....	0...999 s (0 s)*
Operating time	
$t_{ae}$ at $I_{dn} = 1 \times I_{dn}$ .....	≤ 250 ms
$t_{ae}$ at $I_{dn} = 5 \times I_{dn}$ .....	≤ 100 ms
Recovery time $t_b^{4)}$ .....	≤ 3 s
Response time for measuring current transformer monitoring ≤	10 s

## Displays, memory

Display .....	status LED incl. LED bar graph
Display range measured value .....	0...100 %
Fault memory alarm messages .....	on/off (on)*

## Cable lengths for measuring current transformers

Single wire $\geq 0.75 \text{ mm}^2$ .....	0...1 m
Single wire, twisted $\geq 0.75 \text{ mm}^2$ .....	0...10 m
Shielded cable $\geq 0.75 \text{ mm}^2$ .....	0...40 m

## RS-485 interface

Protocol .....	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).....	$\leq 1200 \text{ m}$
Cable: twisted pair .....	min. J-Y(St)Y 2 x 0.6 mm <sup>2</sup>
Required terminating resistor .....	120 $\Omega$ (0.25 W)
Device address <sup>3)</sup> .....	1...247 (100+SN)*

## Switching elements

Switching elements .....	1 changeover contact
Operating principle .....	N/C or N/O operation (N/C operation)*
Electrical endurance, number of cycles .....	10000

## Connection

Connection type.....	push-in
Connection properties	
rigid .....	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
flexible .....	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
with ferrule .....	0.25...0.75 mm <sup>2</sup>
with ferrule .....	1.0...1.5 mm <sup>2</sup> **

\*\* Use crimping pliers similar to CRIMPFOX 6 / Weidmüller PZ6/ PZ6/5 only.

## Contact data acc. to IEC 60947-5-1:

Utilisation category.....	AC 13	AC 14	DC-12	DC-12	DC-12
Rated operat. voltage .....	230 V	230 V	24 V	110 V	220 V
Rated operat. current.....	5 A	3 A	1 A	0.2 A	0.1 A
Minimum contact rating <sup>2)</sup> .....	1 mA at AC/DC $\geq 10 \text{ V}$				

## Environment/EMC

EMC .....	IEC 62020
-----------	-----------

## Ambient temperatures

Operation .....	-25...+55 °C
Transport .....	-40...+85 °C
Storage .....	-40...+70 °C

## Classification of climatic conditions acc. to IEC 60721 (except condensation and formation of ice)

Stationary use (IEC 60721-3-3).....	3K23
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, internal components (DIN EN 60529) .....	IP30
Degree of protection, terminals (DIN EN 60529) .....	IP20
Enclosure material .....	polycarbonate
DIN rail mounting acc. to .....	IEC 60715
Flammability class .....	UL94 V-0
Documentation number.....	D00403
Weight.....	$\leq 100 \text{ g}$

\* Factory setting

<sup>1)</sup> Can only be configured via RS-485

<sup>2)</sup> Refers to relays that have not been operated with high contact currents

<sup>3)</sup> Factory setting: 100 + last two digits of serial number

<sup>4)</sup> See chapter 2.2.5.1

<sup>5)</sup> See chapter 3.2.2.2

## 7.1 Standards & certifications

Devices of the RCM410R series have been developed according to the following standards:

- IEC 62020

## 7.2 Ordering information

Supply voltage $U_s$		Type	Art. No.
AC/DC	DC		
	24 V	RCM410R-1	B74602000
100...240 V	24 V	RCM410R-2	B74603000

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