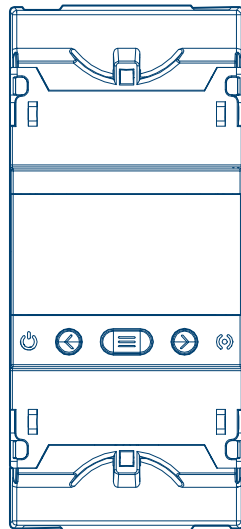


# Protection and monitoring re- lays

## Residual current relays



Residual current relay 0.03–3 A,  
type B, 1-channel

**HR551**

CE UK  
CA

**:hager**

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# 1 Introduction

## 1.1 Document content

This document describes how to assemble and commission **HR55x** residual current relays safely and properly, and how to assemble and use **HR72x** toroidal transformers.

The illustrations and descriptions in this manual are for clarification purposes only and may differ from the actual state of the software due to regular improvements being made.

Date	Document	Version
05/2024	Residual-current-relays_HR55x_manual_EN_2024-05	Version 1

### Residual current relays

HR551	Residual current relay 0.03–3 A, type B, 1-channel
HR554	Residual current relay 0.03–3 A, type B, 4-channel

### Toroidal transformers

HR721	Toroidal transformer ø35
HR722	Toroidal transformer ø55
HR723	Toroidal transformer ø80
HR724	Toroidal transformer ø110

Table 1: Reference list

## 1.2 Target group

This document is intended for installers, system administrators and electrically trained specialists working with a differential current protection and monitoring relay of type B.








The assembly, installation and configuration of electronic devices may only be performed by an electrically trained and certified specialist, in accordance with the relevant installation standards of the country.


The accident prevention regulations valid in the appropriate countries must be complied with.



### 1.3 Symbols used

- Single-step instruction or any sequence.
- ① Multi-step instruction. Sequence must be maintained.

– List

	Installation by an electrical specialist		Accessories		Manufacturer's information in accordance with § 18 Para. 4 of the German Electrical and Electronic Equipment Act
	Usable throughout Europe and Switzerland		Usable in the United Kingdom		

Symbol	Warning word	Consequence on non-observance
	Danger	Leads to serious injuries or death.
	Warning	Can lead to serious injuries or death.
	Caution	Can lead to minor injuries.
	Caution	Can lead to device damage.
	Note	Can lead to physical damage.

Symbol	Description
	Warning against electric shock.
	Warning against damage from mechanical stress

## **2 Safety instructions**

**Electrical devices must only be installed and assembled by a qualified electrician in accordance with the relevant installation standards, guidelines, regulations, directives, safety and accident prevention directives of the country.**

**Failure to comply with these installation instructions may result in damage to the device, fire or other hazards.**

**Before any maintenance, repair or handling work is performed at the device connections, the device must be disconnected from all power sources, including the device's own power supply and the measuring equipment.**

**If an anomaly or a malfunction is identified, the device must not perform any measurements.**

**Contact customer service if you find the device is not functioning correctly.**

**Hager accepts no liability for damage caused by improper handling or by non-observance of warning information and recommendations.**

### 3 Scope of delivery

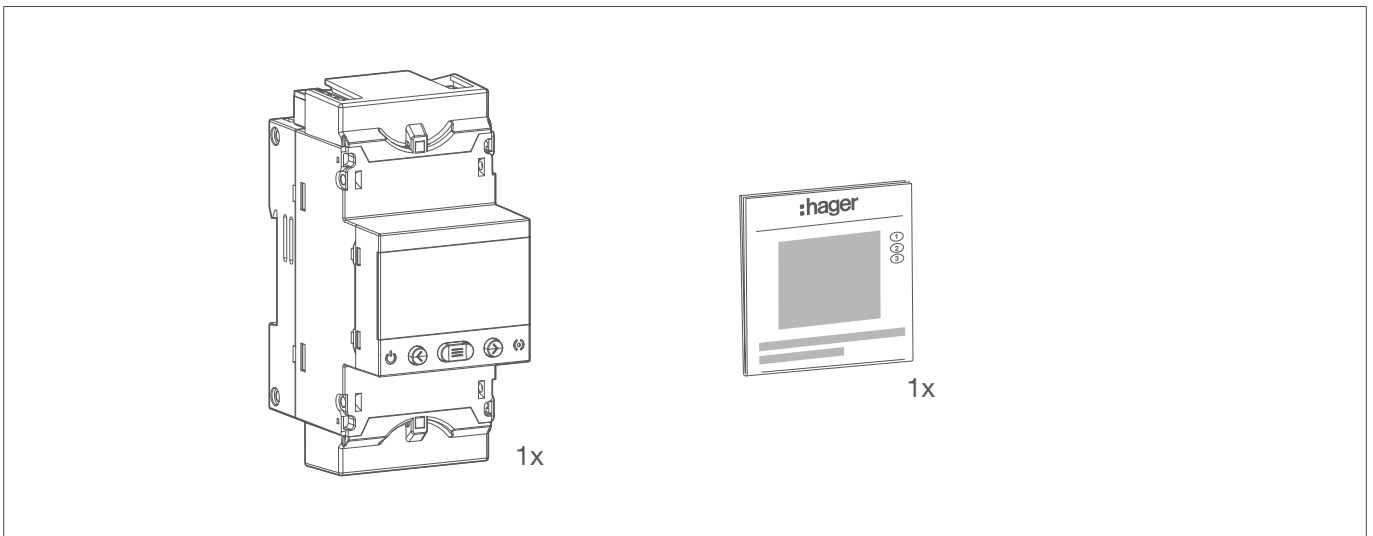


Fig. 1: HR5x scope of delivery

## 4 Design and layout of the device

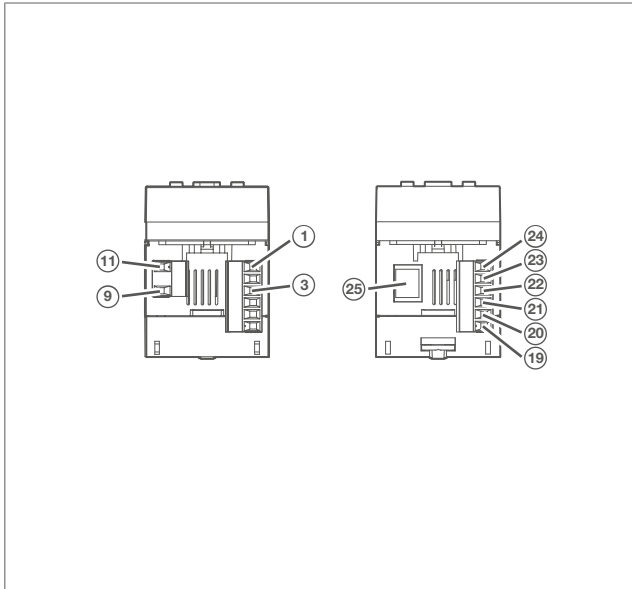


Fig. 2: View of the connecting terminals

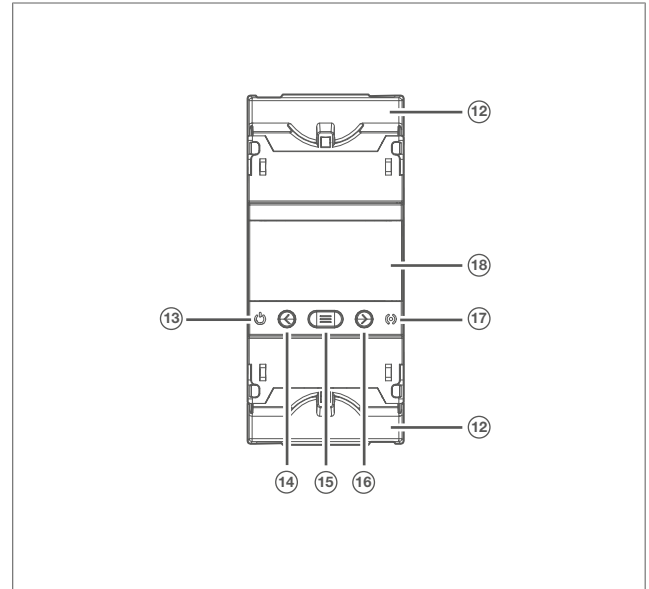


Fig. 3: Front view

- ① R1, trip relay, channel 1 (NO)
- ③ C1, GND channel R1
- ⑨ A1, power supply L
- ⑪ A2, power supply N
- ⑲ Pre-alarm, digital output (NO)
- ⑳ GND pre-alarm, digital output
- ㉑ TRIP, input for external trigger
- ㉒ GND for RS-485 and TRIP input
- ㉓ B-, RS-485 interface
- ㉔ A+, RS-485 interface
- ㉕ RJ45 connector contact for the current transformer connection

- ⑫ Cover for connecting terminals
- ⑬ CPU LED
- ⑭ **T** button
- ⑮ Menu button
- ⑯ **R** button
- ⑰ Alarm LED
- ⑱ LCD screen



## 5 Function

### 5.1 Residual current relays HR551

The device is a differential current protection and monitoring relay of type B, with one channel, configurable leakage pre-warning and an integrated Modbus RS-485 interface, which is compatible with the type B-specific differential current transformers of the HR series.

#### 5.1.1 Correct use

- Residual current monitoring
- Assembly on DIN rail according to IEC 60715:2017
- Connection to external toroidal transformers (HR72x)

#### 5.1.2 Functional description

The device enables continuous monitoring of rated fault currents in earthed power grids. The current induced in the external transformer is detected in the device, measured and the effective value (TRMS) is calculated.

#### 5.1.3 Product characteristics

- Display to show parameters
- Three buttons for scrolling through the various screens and programming the device
- Digital output as pre-alarm function
- Digital input for external tripping
- RS-485 communication

### 5.2 Toroidal transformer HR72x



The HR72x series of devices are electronic differential current protection and monitoring transformers of type B (IEC 60755), which can be used together with HR551 and HR554 differential current protection and monitoring relays. Which device to choose depends on the maximum current of the monitored circuit ( $I_n$ ):

- **HR721** for  $I_n$ : 80 A
- **HR722** for  $I_n$ : 160 A
- **HR723** for  $I_n$ : 250 A
- **HR724** for  $I_n$ : 400 A

#### 5.2.1 Correct use

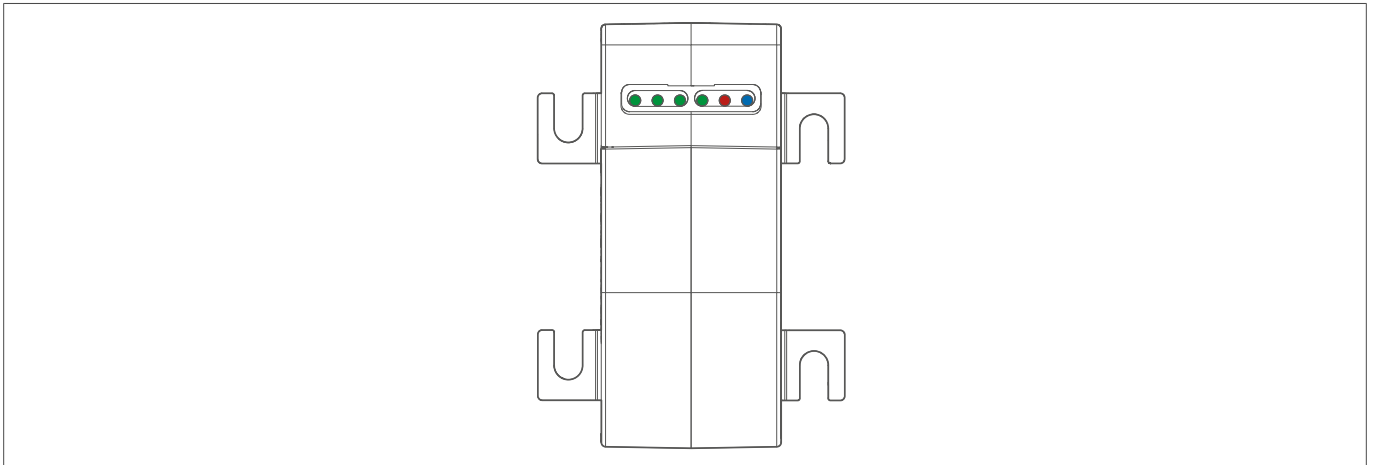
- Assembly on DIN rail according to IEC 60715:2017
- Assembly on mounting plate with clamp
- Connection to residual current relay (HR55x)

#### 5.2.2 Functional description

The toroidal transformer transforms the measured current into a measurable quantity for the differential current relay.

### 5.2.3 Description of LEDs for HR72x

The status LED on the front of the device indicates the current operating status.



	Blue	Indicates that the device is being supplied with power.
	Red	Indicates that a leakage current error has occurred.
	Flashing red	Flashing red: Indicates that a pre-alarm has been triggered.
	Green	Indicates which channel is being used for the toroidal transformer concerned.

Table 2: Description of LEDs

## 6 Information for qualified electricians

### 6.1 Assembly and electrical connection

#### 6.1.1 Assembly of HR72x



**Danger**

Electric shock when live parts are touched!

An electric shock can lead to death!

- Isolate all connection cables before working on the device and cover any live parts in the area!

- 1 Fix the plug-in terminals to the device.

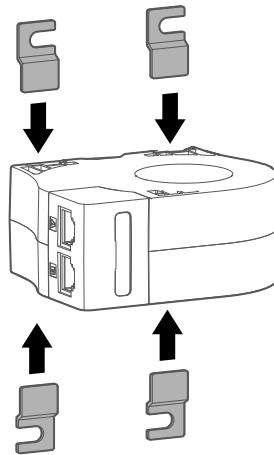


Fig. 4: HR72x – Assembling the plug-in terminals



**Note**

The device can either be assembled on the DIN rail directly or on a mounting plate.

**Assembly option 1: Fixing on the mounting plate**

- Align the device horizontally.
- Fix the device to the mounting plate with screws.

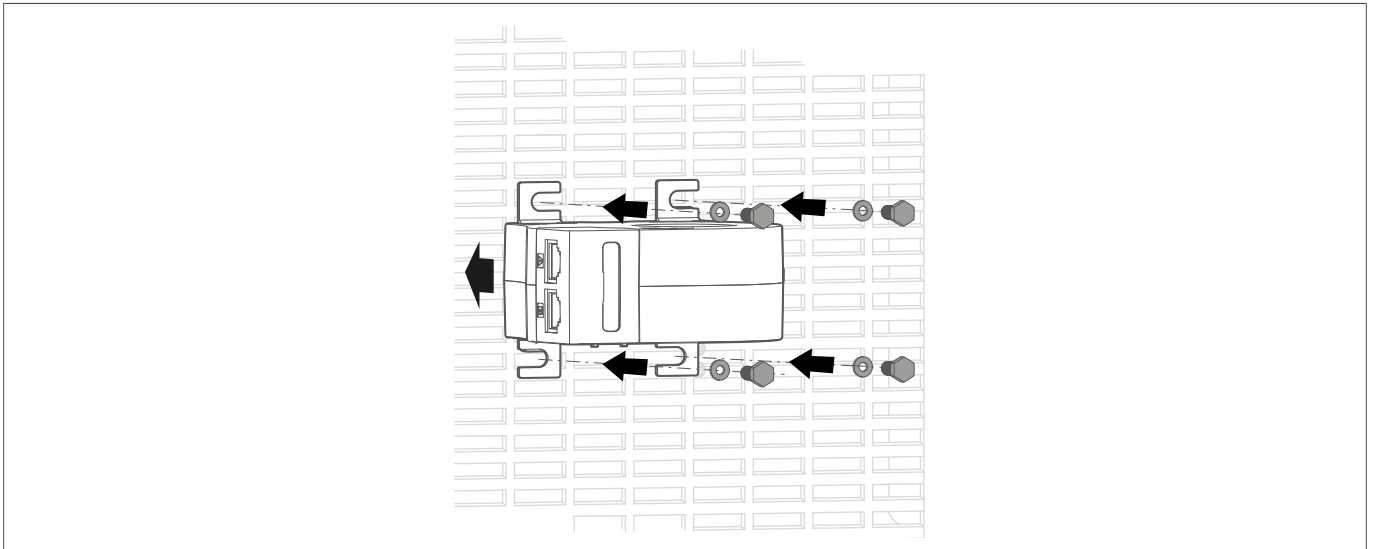


Fig. 5: HR72x – Assembly on the mounting plate

**Assembly option 2: Fixing on the DIN rail**

- Fix the mounting rail onto the DIN rail in the desired assembly direction.
- Attach the device to the fixing clamp.

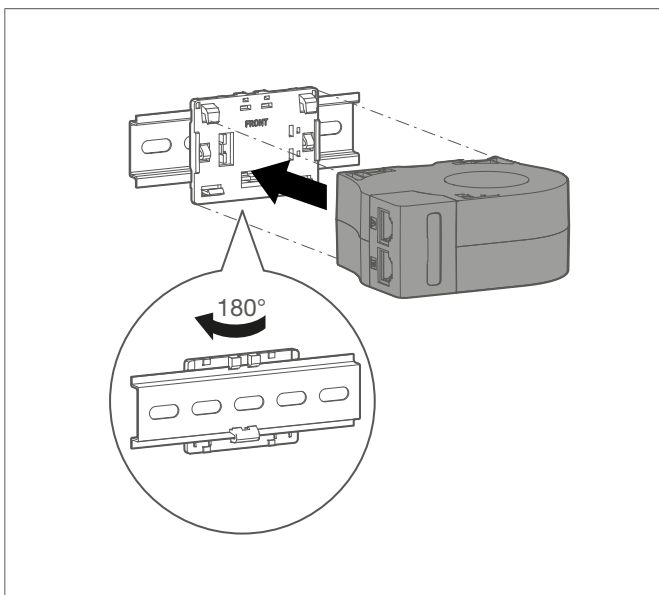


Fig. 6: HR72x – Vertical assembly on the DIN rail

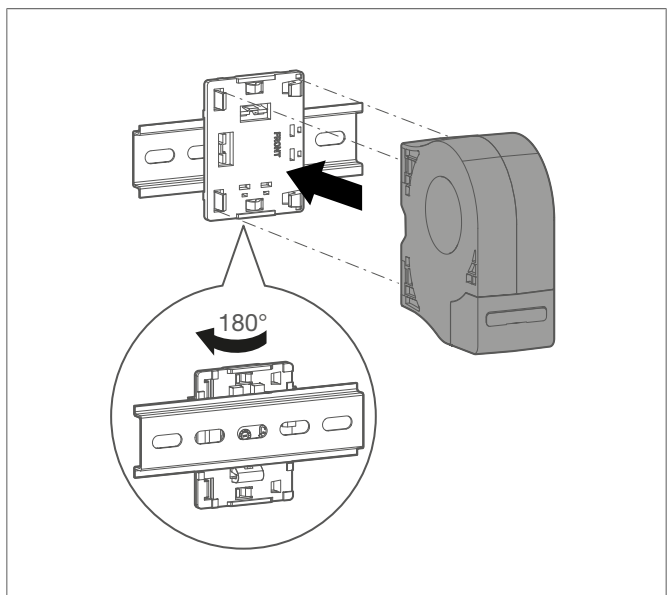


Fig. 7: HR72x – Horizontal assembly on the DIN rail

- 2 Guide the cables through the device.

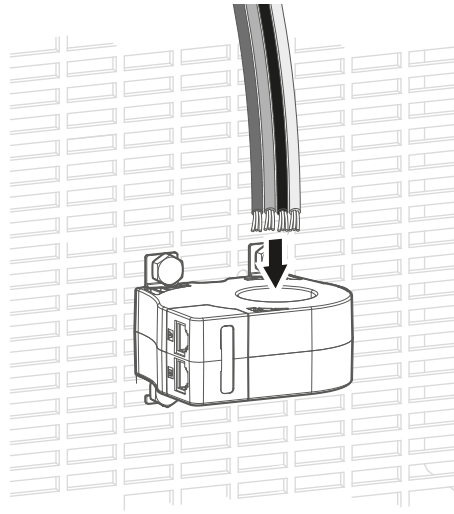


Fig. 8: HR72x – Passing cables through



**Warning**

Risk of destruction!

Passing the cables through incorrectly can damage the device.

Keep the cables in the centre of the toroidal transformer as you guide them through.

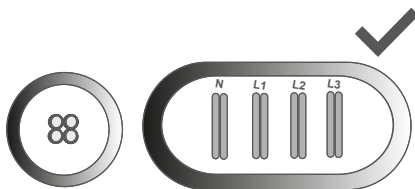


Fig. 9: Correct distribution of cables

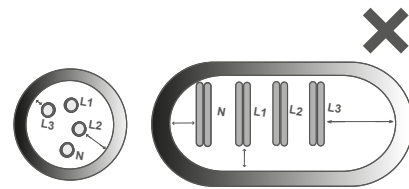


Fig. 10: Incorrect distribution of cables

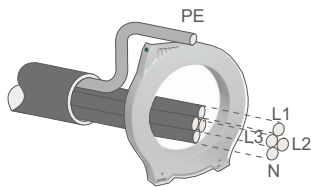


Fig. 11: Cable distribution

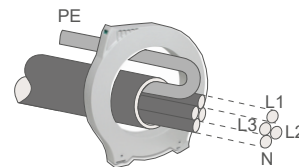


Fig. 12: Cable distribution (cable conduit)



**Note**

The cable length must be greater than the diameter of the toroidal transformer.

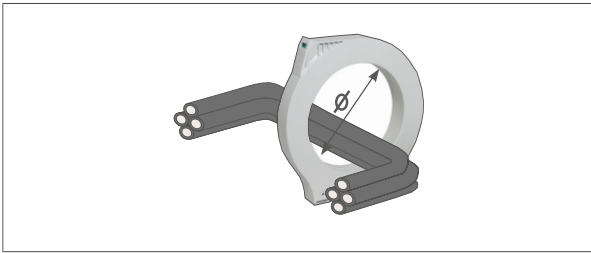


Fig. 13: Avoid cable bends

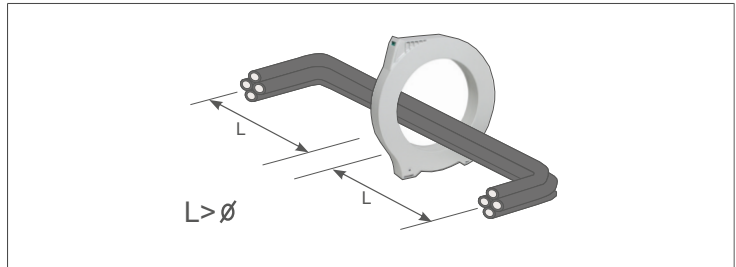


Fig. 14: Avoid cable bends

### 6.1.2 Assembly of HR55x



#### Danger

Electric shock when live parts are touched!  
An electric shock can lead to death!

- Isolate all connection cables before working on the device and cover any live parts in the area!

- 1 Remove the covers of the plug-in connecting terminals.
- 2 Fix the device on the DIN rail.

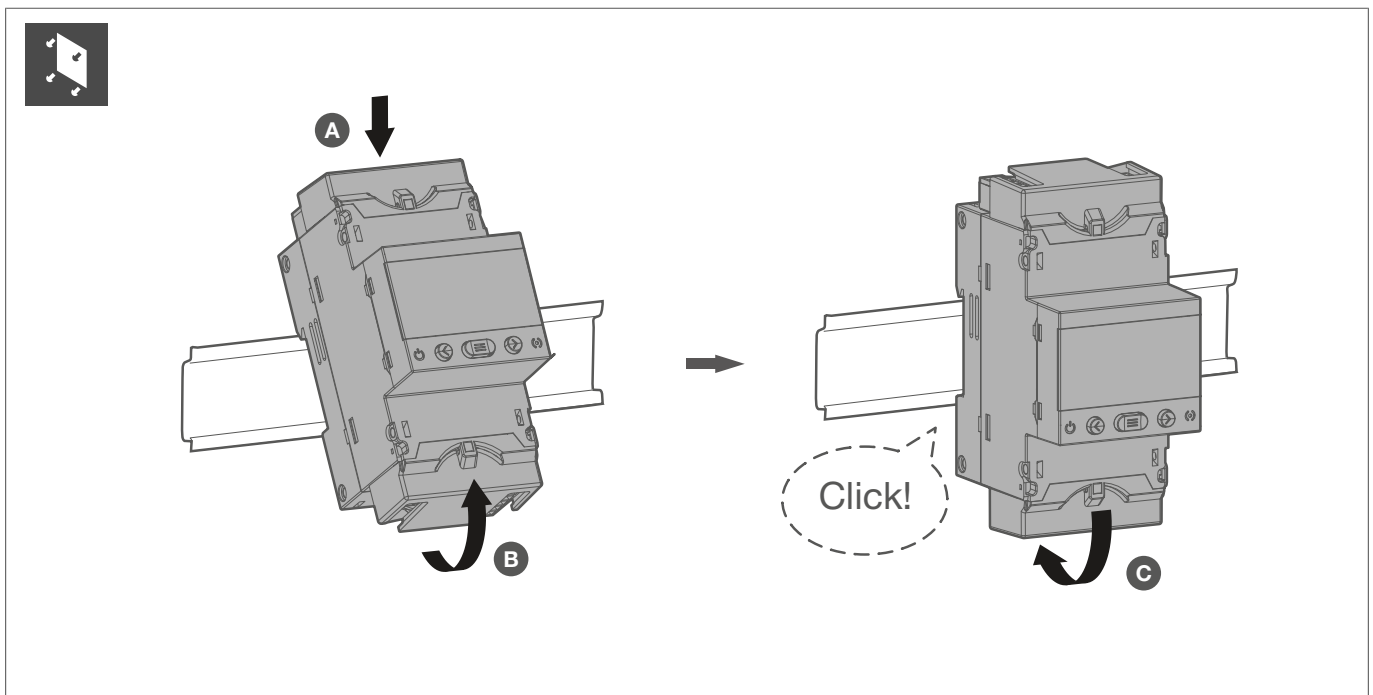


Fig. 15: HR55x – Assembling the device on the DIN rail

- 3 Connect and wire the device.

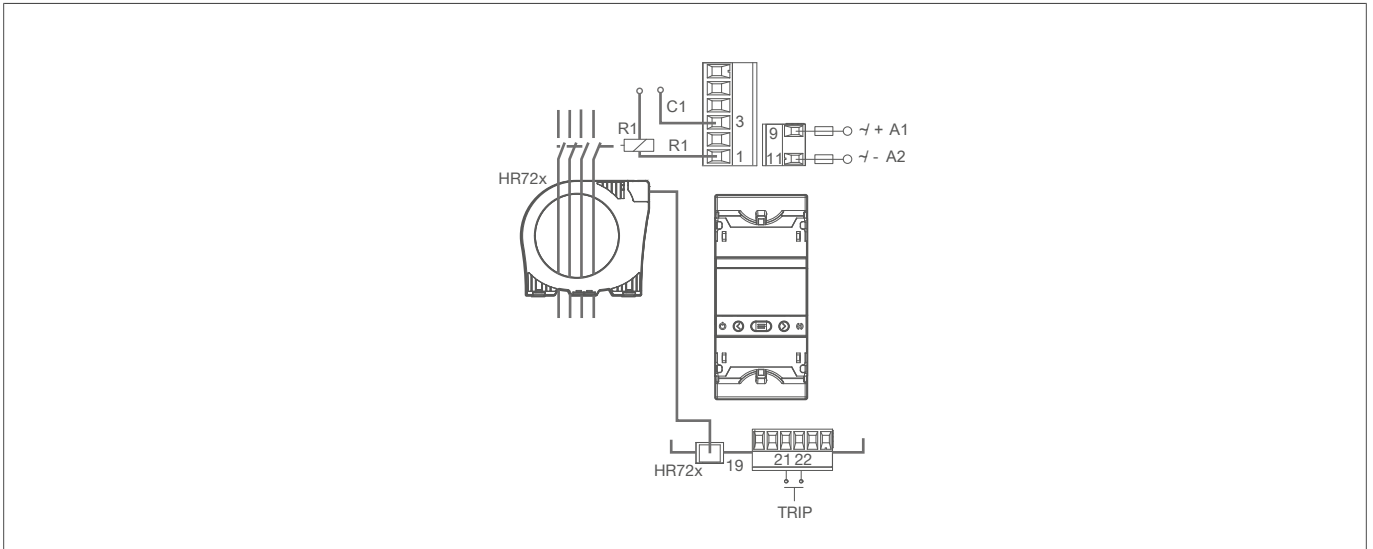


Fig. 16: HR551 – Electrical connection

- 4 Attach the covers of the plug-in connecting terminals.

## 7 Operation

### 7.1 Status LEDs

The device has two LEDs providing information on the status of the device.

LED	Description
CPU LED (13)	White lit constantly: Indicates that the device is switched on
ALARM LED (17)	Flashing red: Indicates that a pre-alarm has been triggered
	Red lit constantly: Indicates that tripping has occurred

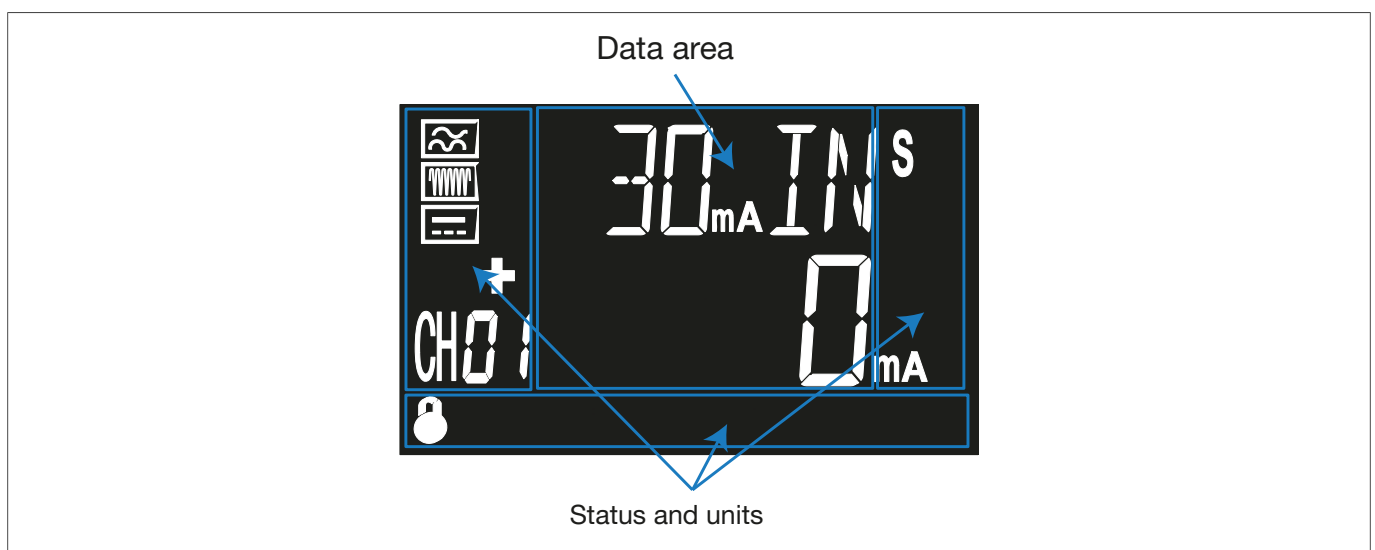
### 7.2 Buttons

The device has three buttons for navigating through the various screens and programming the device.

Buttons	Function	
⏪ <sub>T</sub>	Short: Change the display or setting	Long (> 3 s): Test the relay
⏩ <sub>R</sub>	Short: Change the display or setting	Long (> 3 s): Carry out a reset
☰	Short: Confirm selection	Long (> 3 s): Return to the previous step

### 7.3 Display

The device has an LCD. This LCD is divided into two areas.



**Data area:** Shows all measured values.

**Status and units:** Shows the status, units and device information.











Icon	Description	Icon	Description
	Alternating current		Pre-alarm activated
	Direct current	<b>prog</b>	Programming screen
	High frequency (type F)	<b>trip</b>	The relay has tripped
	The relay is positively polarised	<b>CHO 1</b>	Channel 1
	Internal device error		No time setting configured
	Direct settings are locked To unlock the device, see "Lock menu".		

Table 3: LCD symbols

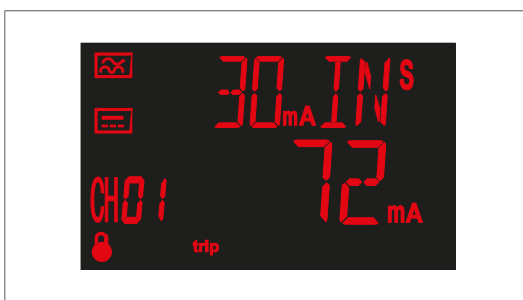
### 7.3.1 LCD screen description



**Blue LCD screen:**  
Settings or set-up menu.



**Yellow LCD screen:**  
Change in the installation.



**Red LCD screen:**  
The relay has tripped due to a rated fault current.  
An individual test has been performed.  
An error has been detected due to a toroidal transformer.

### 7.3.2 Digital output

The device has a digital output (terminal 19 and terminal 20), which is activated when a pre-alarm is triggered.

### 7.3.3 Relay

The relay has output relays (terminal 1 and terminal 3), which trip when a certain channel is affected.

### 7.3.4 Digital input

The device has a digital input (terminal 21 and terminal 22). This is required to perform a trip.

### 7.3.5 Start screen

The start screen appears after the device has been switched on and the initialisation phase has elapsed. The start screen shows the version of the relay.



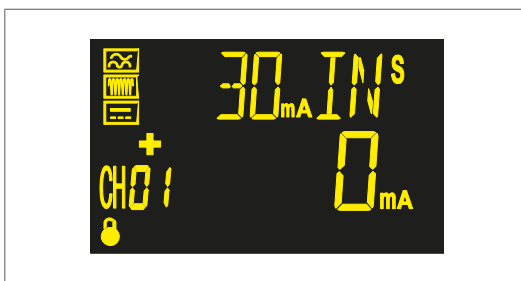
Fig. 17: Start screen



Fig. 18: Start screen – Version information

### 7.3.6 Problems or changes in the installation

If problems arise at the end of a start operation, the following messages may appear on screen:



#### Change in the installation

- Open the set-up menu to save the new installation.



#### The relay cannot find the toroidal transformer

- Open the set-up menu to save the new installation.



#### The relay has detected more toroidal transformers than permitted

- Check the installation.



The relay has detected additional toroidal transformers, which are not registered in the installation

- Open the set-up menu to save the new installation.

### 7.3.7 Channel display screen

The channel display screen shows the discharge current, the trip current values and the recovery current of the channel.

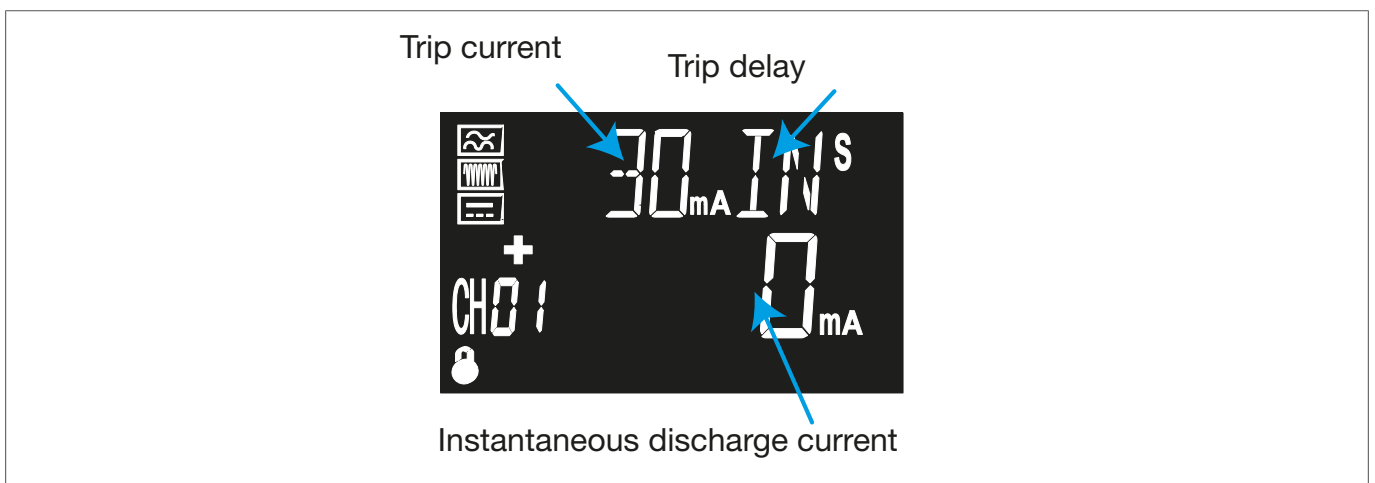
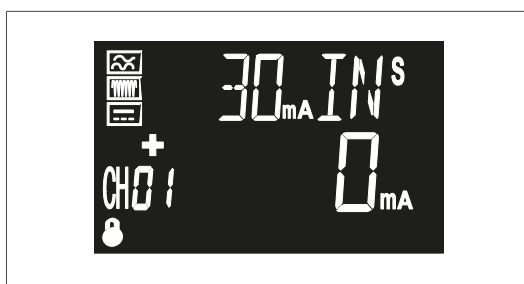


Fig. 19: Channel display screen

The  $\text{>R}$  and  $\text{<T}$  buttons can be used to toggle between the various screens.



Channel 1:

Trip current (mA)

Trip delay

Instantaneous total rated fault current (AC+DC) (mA)

**Note:** If the relay is locked, it is not possible to access the menu, see "Lock menu".



Access to the set-up menu.

**Note:** If another button is not pressed for 60 seconds, the relay jumps back to the display for channel 1.



Access to the lock menu.

**Note:** If another button is not pressed for 60 seconds, the relay jumps back to the display for channel 1.



Access to the event menu.

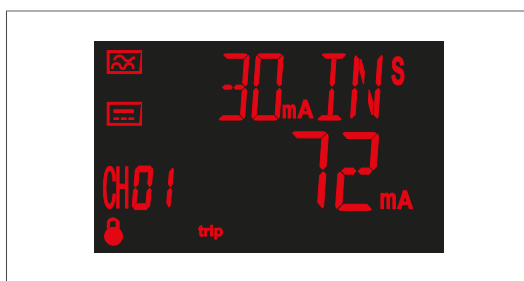
**Note:** If another button is not pressed for 60 seconds, the relay jumps back to the display for channel 1.



Start screen with information on the relay and its version.

### 7.3.8 Screen when the relay trips

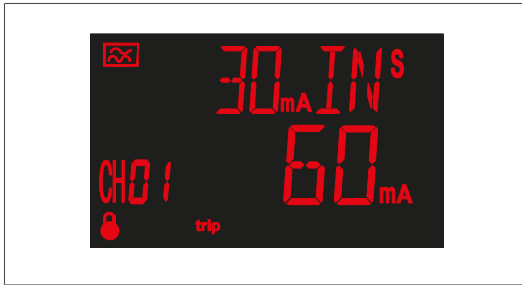
If the relay trips, the red alarm LED lights up. The screen shows precise information on the current value from the last cycle.



Set trip current (mA)

Trip delay

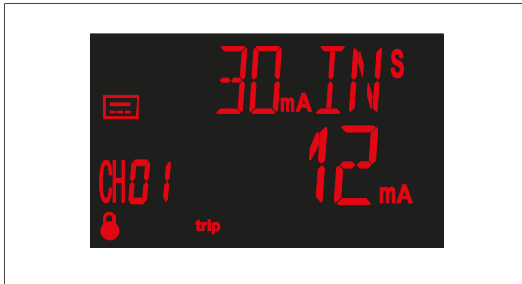
Total rated fault current (AC+DC), which has caused the relay to trip (mA)



Set trip current (mA)

Trip delay

Alternating rated fault current, which has caused the relay to trip (mA)



Set trip current (mA)

Trip delay

Continuous rated fault current, which has caused the relay to trip (mA)

Press the  $\text{>R}$  button for > 3 seconds to return the relay to its initial state.

### 7.3.9 Lock menu

The lock menu must be called up to unlock the screen. You can edit in the lock menu using the  $\text{☰}$  button.



Fig. 20: Lock menu

- Use the  $\text{>R}$  and  $\text{<T}$  buttons to toggle between the options and find the required value.

Possible values	YES: The device lock is activated
	NO: The device lock is deactivated

- Press and hold the  $\text{☰}$  button for > 3 seconds to confirm the entry.






Fig. 21: Device lock activated

### 7.3.10 Event menu

The event menu allows you to view the last 20 events for the device.



Fig. 22: Event menu


- Open the event menu.
- Press the  button.  
The last 20 events open and are shown on screen.  
Press the  and  buttons to toggle between the events.

#### The device can show four different types of event:

- **TRI**, channel relay trip
- **ALA**, active pre-alarm
- **TST**, individual test
- **TRA**, transformer error



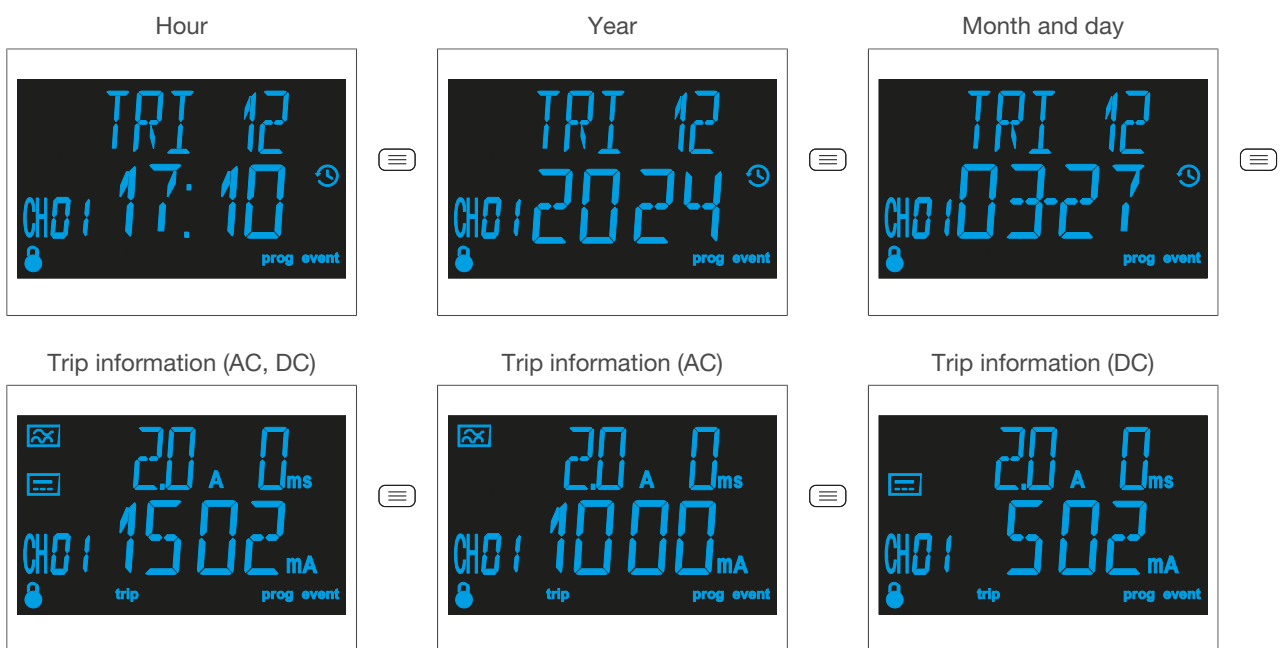
#### Note

To exit the event menu, press the  button for > 3 seconds.

Three different screens are shown to visualise active pre-alarms (ALA), individual tests (TST) and transformer errors (TRA). These differ with respect to their time, year, and month and day data.



The channel relay trip (TRA) is visualised on six screens.





**Note**

The event log can be reset via a setting made in the communication configuration.

### 7.3.11 Individual test

It is possible to perform an individual channel test to check the relay is working correctly.

☑ The channel display screen is shown.

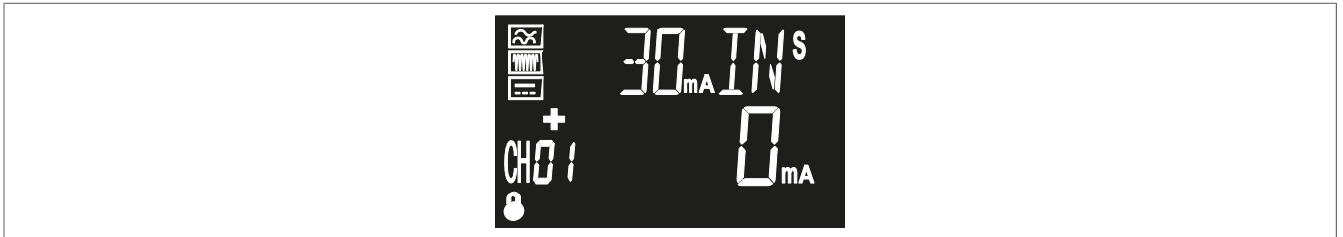


Fig. 23: Channel 1 display screen

- Press the  $\leftarrow$  T button for > 3 seconds.

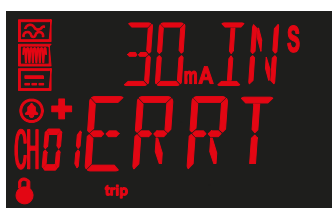
If the relay has tripped correctly, the red screen is shown and the alarm LED lights up red.



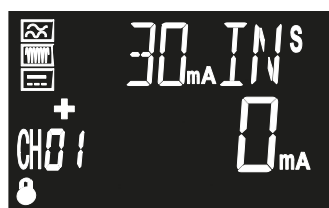
- Press the  $\rightarrow$  R button to show the start screen (channel 1).



If the device has not tripped, an error is displayed for 3 seconds. The screen then switches to the channel display screen.



3 s





### 7.3.12 Setting the trip current and trip delay

#### Direct settings

The trip current, trip delay and trip circuit can be set on the channel display screen.

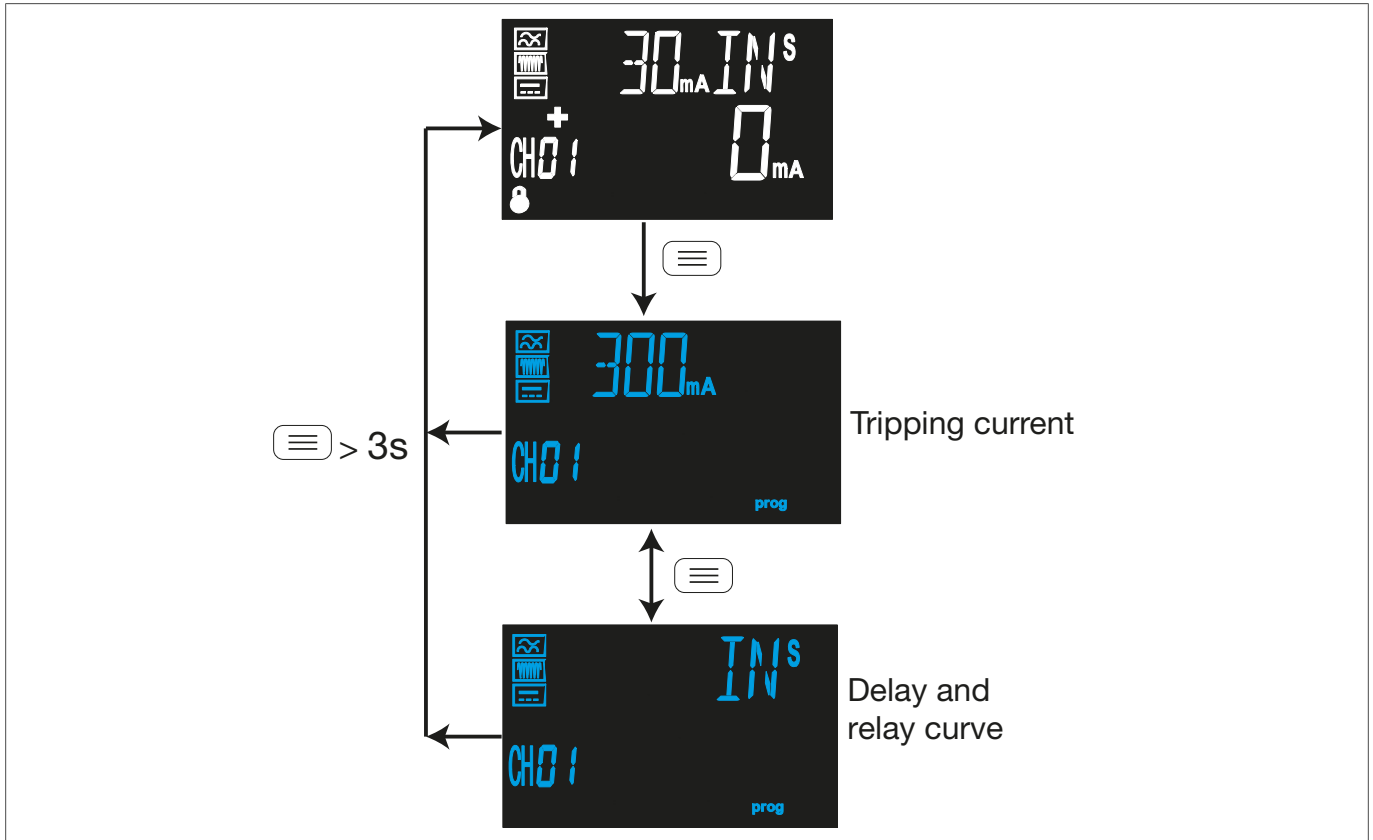


Fig. 24: Overview of direct settings for the trip current, trip delay and trip circuit

#### Setting the trip current

☑ The screen for the trip current "Fig. 25: Screen for the trip current" has been opened



Fig. 25: Screen for the trip current

- Press the **>** R or **<** T button to choose between the different trip currents.
- Press the **☰** button to jump to the next programming point.
- Press the **☰** button for > 3 seconds.

The channel display screen is shown.

	Trip current		
Possible values	30 mA	100 mA	300 mA
	500 mA	1.0 A	3.0 A

Table 4: Setting options for the trip current

### Setting the trip delay

☑ The screen for the trip delay "Fig. 26: Screen for the trip delay" has been opened



Fig. 26: Screen for the trip delay

- Press the **> R** or **< T** button to choose between the different values.
- Press the **☰** button for > 3 seconds to confirm the setting.

The channel display screen is shown.

	Trip delay					
Possible values	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.8 s
	1 s	3 s	5 s	<b>INS</b> , curve INS	<b>[S]</b> , curve SEL	

Table 5: Setting options for the trip delay

## 8 Configuration

### Overview of all configurable parameters

Five main configurations can be set up: **Communication**, **Time setting**, **Pre-alarm**, **Trip relay** and **Installation**. These main configurations can be managed using the symbols shown ("Fig. 27: Set-up menu").

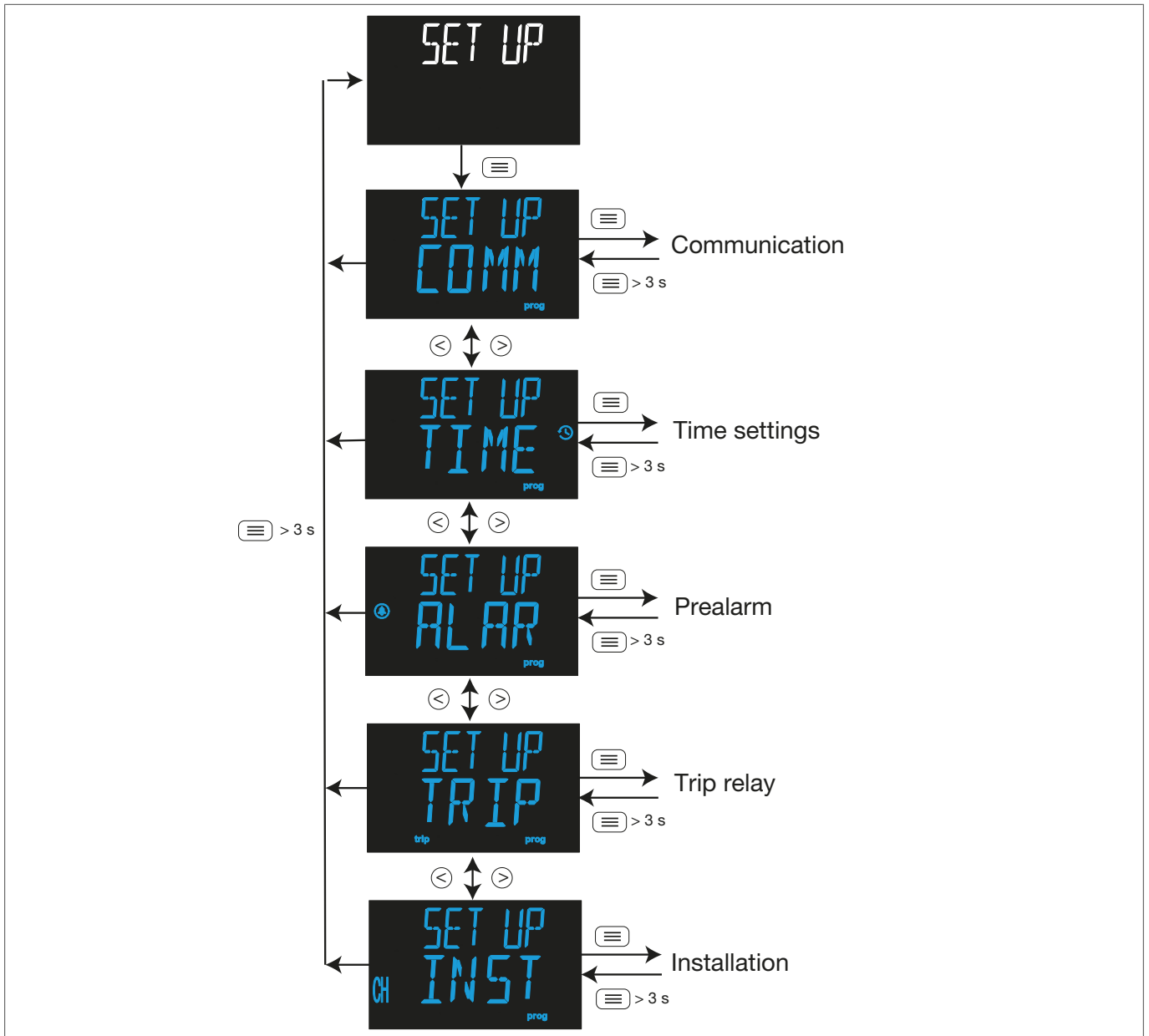


Fig. 27: Set-up menu

## 8.1 Communication

The **Communication** set-up menu is used to edit the settings for RS-485 communication.



Fig. 28: Communication set-up menu

The **Transmission speed**, **Peripheral device no.** and **Parity** parameters can be configured here.

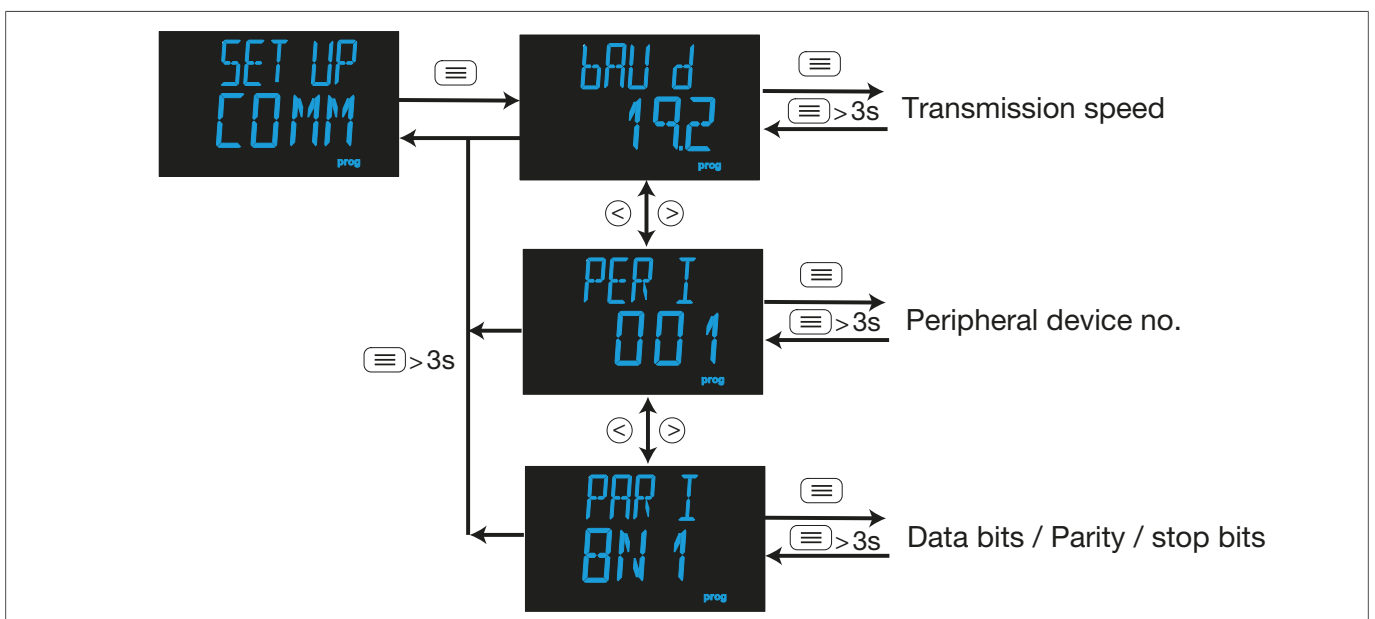


Fig. 29: Communication menu for RS-485 communication

### 8.1.1 Transmission speed

The transmission speed for the RS-485 interface can be set via the baud rate.

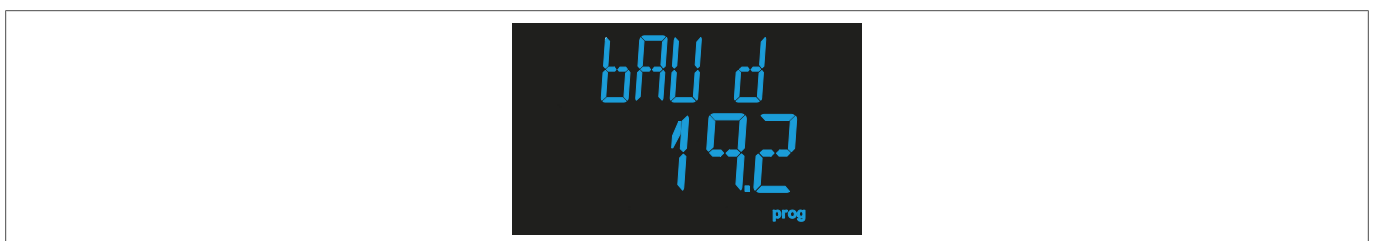



Fig. 30: Baud rate

- Press the  button to edit the baud rate.  
The programming value flashes.

	Transmission speed [baud]		
Possible values	4.8, 4800 bps	38.4, 38400 bps	19.2, 19200 bps
	38.4, 38400 bps	57.6, 57600 bps	115.2, 115200 bps

Table 6: Setting options for the baud rate

- Press the **> R** or **< T** button to choose between the different values.
- Press the **≡** button to jump to the next programming point.
- Press the **≡** button for > 3 seconds to confirm the setting.

The channel display screen is shown.

### 8.1.2 Peripheral no.

The peripheral no. is set in this step.



Fig. 31: Peripheral no.

- Press the **≡** button to edit the peripheral no.  
The programming value flashes.

Peripheral number

Minimum value	1
Maximum value	247

Table 7: Setting options for the peripheral number

- Press the **> R** or **< T** button to choose between the different values.
- Press the **≡** button to jump to the next programming point.
- Press the **≡** button for > 3 seconds to confirm the setting.

The channel display screen is shown.

### 8.1.3 Data bits, stop bits and parity

The data bits, stop bits and parity are set for RS-485 communication in this step.



Fig. 32: Data bits, stop bits and parity

- Press the button to edit the data bits, stop bits and parity. The programming value flashes.

**Data bits, stop bits and parity**

Possible values	8N1, 8 data bits, no parity, 1 stop bit
	8E1, 8 data bits, even parity, 1 stop bit
	8O1, 8 data bits, odd parity, 1 stop bit
	8N2, 8 data bits, no parity, 2 stop bits
	8E2, 8 data bits, even parity, 2 stop bits
	8O2, 8 data bits, odd parity, 2 stop bits

Table 8: Setting options for the data bits, stop bits and parity

- Press the **R** or **T** button to choose between the different values.
- Press the button to jump to the next programming point.
- Press the button for > 3 seconds to confirm the setting. The channel display screen is shown.

## 8.2 Time setting

The **Time setting** set-up menu can be used to edit the time.



Fig. 33: Time setting set-up menu

You can set the year, month, day and hour.

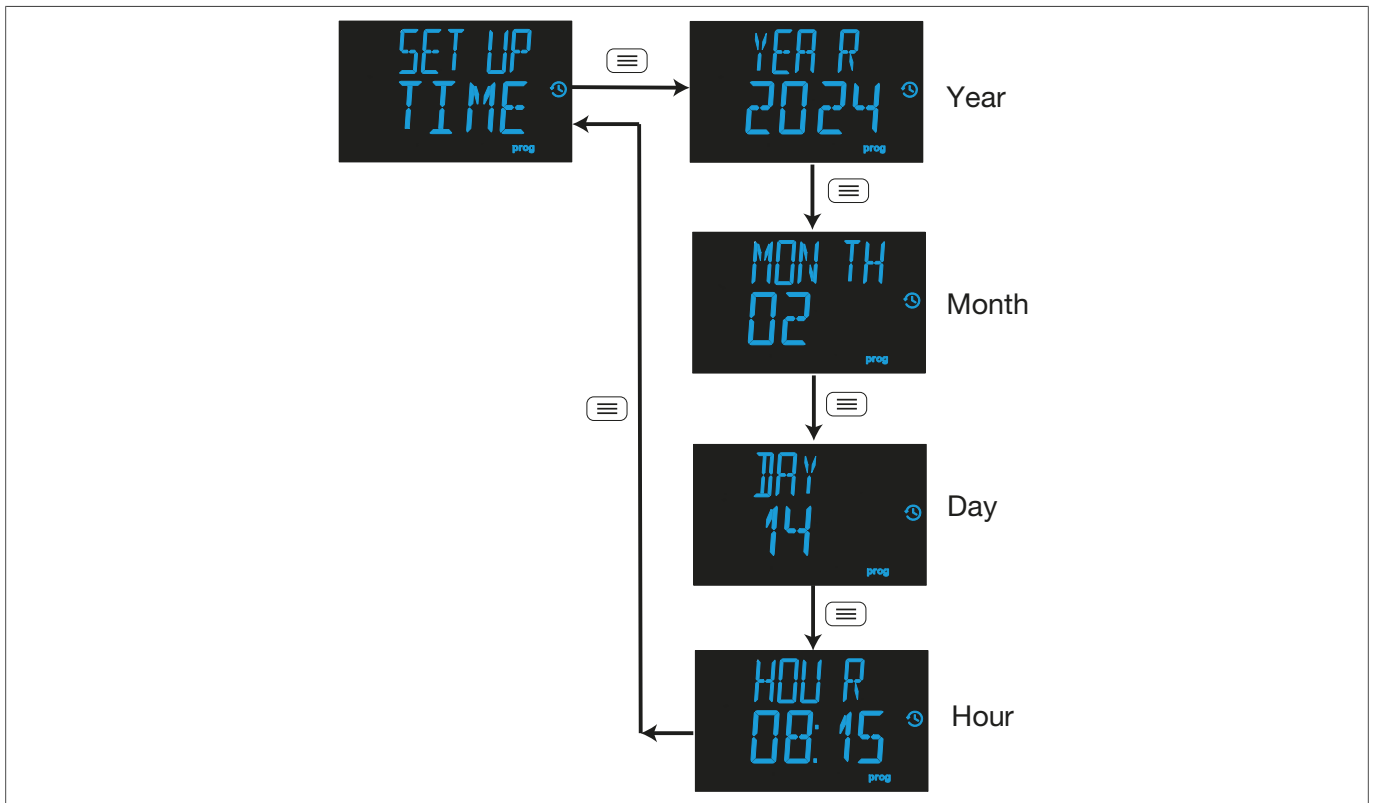


Fig. 34: Time setting menu

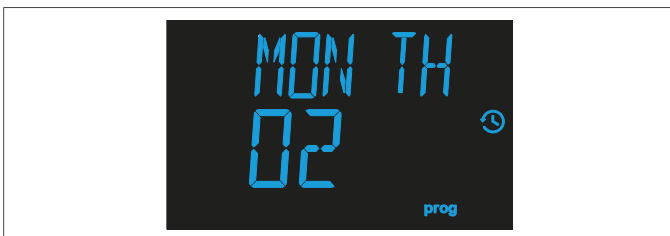
### 8.2.1 Year



Configure the year here.

- Press the  $\text{> R}$  or  $\text{< T}$  button to choose between the different values.
- Press the  $\text{≡}$  button to confirm the setting and jump to the next programming point.

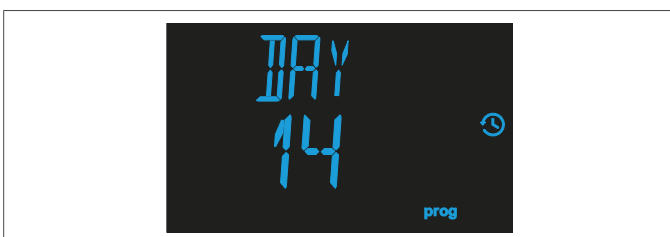
### 8.2.2 Month



Configure the month here.

- Press the  $\text{> R}$  or  $\text{< T}$  button to choose between the different values.
- Press the  $\text{≡}$  button to confirm the setting and jump to the next programming point.

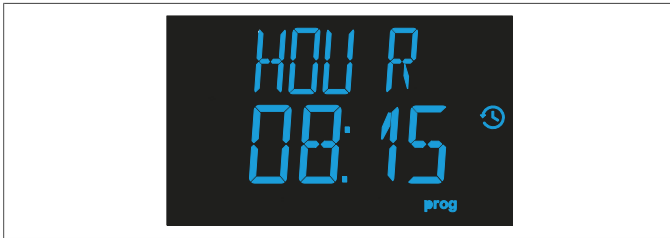
### 8.2.3 Day



Configure the day here.

- Press the  $\text{> R}$  or  $\text{< T}$  button to choose between the different values.
- Press the  $\text{≡}$  button to confirm the setting and jump to the next programming point.

## 8.2.4 Hour



Configure the time here.

- Press the (R) button to increase the time in one-hour increments.
- Press the (T) button to decrease the time in one-hour increments.
- Press the (≡) button to confirm the setting.
- Set the minutes as in steps 1 and 2.
- Press the (≡) button to confirm the setting and go back to the Time setting set-up menu.

## 8.3 Pre-alarm

The **Pre-alarm** set-up menu

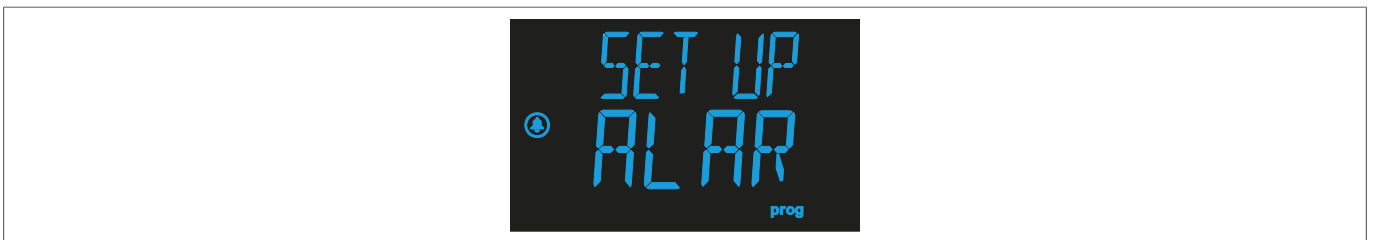


Fig. 35: Pre-alarm set-up menu

The **Current**, **Operation** and **Pre-alarm polarity** parameters can be configured here.

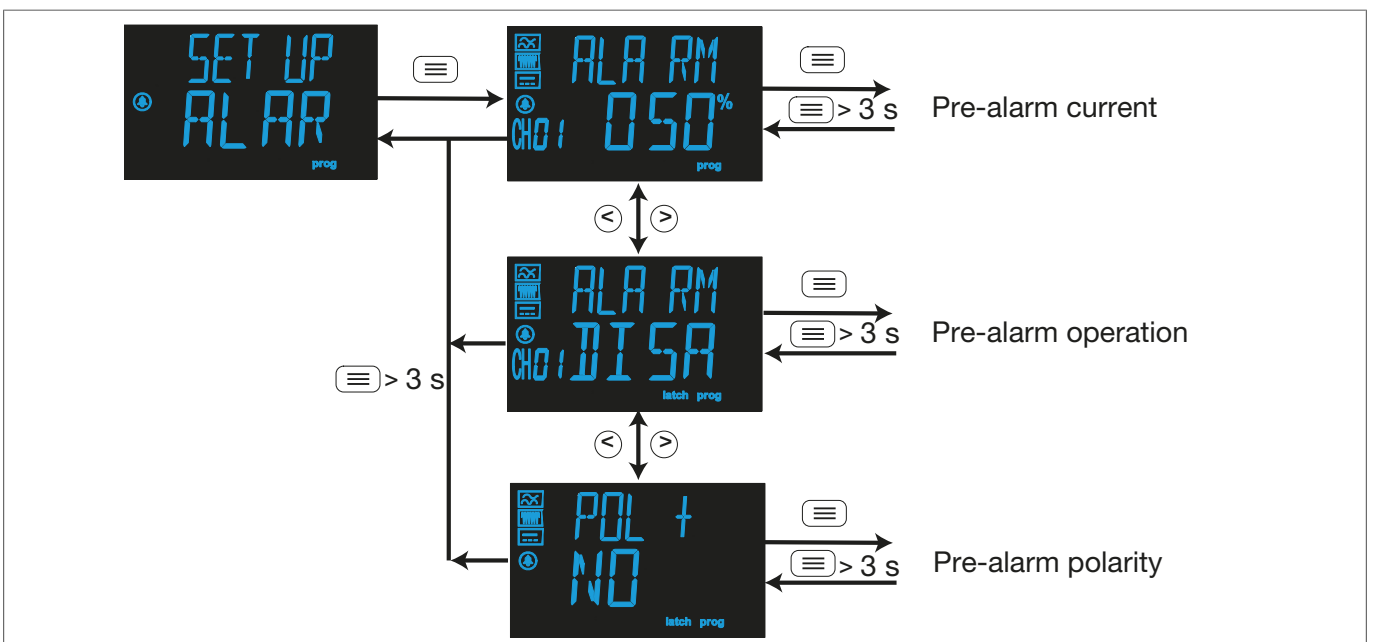


Fig. 36: Pre-alarm menu

### 8.3.1 Pre-alarm trip current

The current at which the pre-alarm is activated according to the percentage of the relay's trip current is set in this step.





Fig. 37: Pre-alarm trip current

- Press the button to set the percentage of the trip current. The programming value flashes.
- Press the R or T button to choose between the different values.

**Pre-alarm trip current**

Minimum value	25%
Maximum value	100%

Table 9: Setting options for the trip current of a pre-alarm

- Press the button for > 3 seconds to confirm the setting.
- Press the R button to go to the next configuration point.

### 8.3.2 Pre-alarm operation

Pre-alarm operation is configured in this step.



Fig. 38: Pre-alarm operation

- Press the button to set the operating mode for the trip current. The programming value flashes.
- Press the R or T button to choose between the different values.

**Pre-alarm operation**

Possible values	DISA: Pre-alarm disabled.
	AUTO: Pre-alarm activated with deactivated interlock; when the pre-alarm condition is no longer met, the pre-alarm is disabled.
	MANU: Pre-alarm activated with activated interlock; pre-alarm disappears on keyboard reset or communication reset.

Table 10: Setting options for the operation of a pre-alarm

- Press the button for > 3 seconds to confirm the setting.
- Press the R button to go to the next configuration point.

### 8.3.3 Pre-alarm polarity

The pre-alarm polarity is configured in this step.



Fig. 39: Pre-alarm operation

- Press the button to set the percentage of the trip current. The programming value flashes.
- Press the R or T button to choose between the different values.

#### Pre-alarm polarity

Possible values	YES: The pre-alarm works with positive polarity (the polarity of the contacts is the reverse of standard polarity).
	NO: The pre-alarm works with standard polarity.

Table 11: Setting options for the polarity of a pre-alarm

- Press the button for > 3 seconds to confirm the setting.
- Press the button again for > 3 seconds to go to the Pre-alarm set-up menu.

## 8.4 Trip relay

The **Trip relay** set-up menu



Fig. 40: Trip relay set-up menu

The Polarity parameter can be configured here.

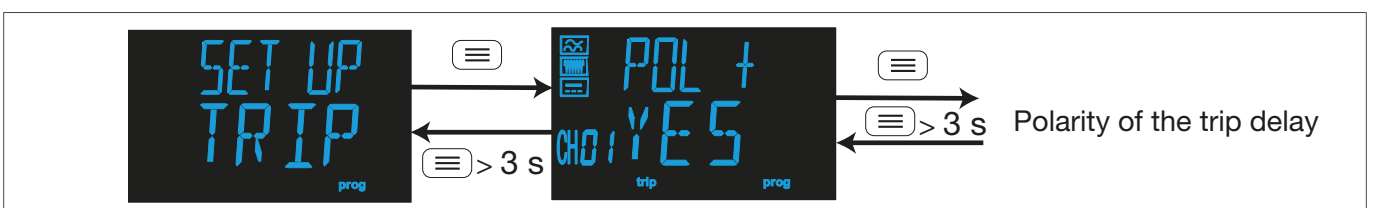


Fig. 41: Polarity menu

### 8.4.1 Polarity

The polarity is configured in this step.

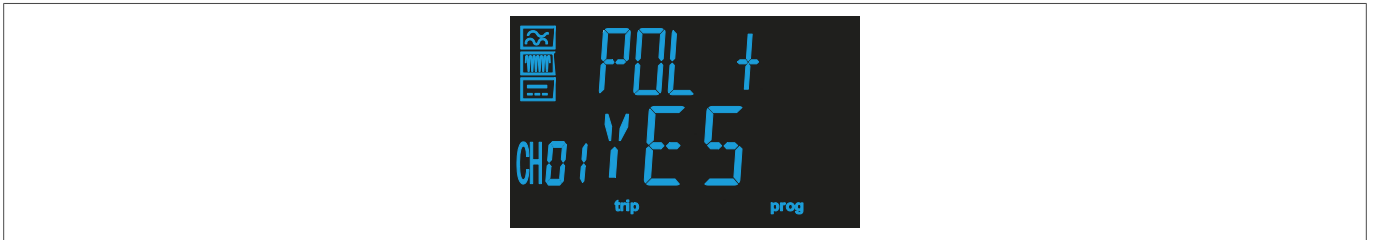


Fig. 42: Polarity

- Press the button to set the polarity. The programming value flashes.
- Press the R or T button to choose between the different values.

#### Polarity

Possible values	YES: The trip relay works with positive polarity. The + symbol appears on the display.
	NO: The trip relay works with standard polarity.

Table 12: Setting options for the polarity

- Press the button for > 3 seconds to confirm the setting and exit programming mode.
- To go to the Trip relay set-up menu, press and hold the button for > 3 seconds.

## 8.5 Installation

The **Installation** set-up menu can be used to save the installation.



Fig. 43: Installation menu



Fig. 44: Installation menu



Fig. 45: Save installation menu

### 8.5.1 Saving the installation



- Press the button to go to programming mode.  
The programming value flashes.
- Press the **R** or **T** button to choose between the different options.

**Saving the installation**

Possible values	YES: The device installation is saved.
	NO: The device installation is not saved.

Table 13: Setting options for saving the installation

- Press the button for > 3 seconds to confirm the setting and exit the mode.

## 9 RS-485 communication

The device has an RS-485 communication connection and features the Modbus® RTU communication protocol.

### 9.1 Connecting devices with RS-485

#### Requirements for the RS-485 cable

- Twisted cable
- With mesh shielding
- Minimum 3 wires



#### Note

The maximum distance between the device and master device is 1200 m.

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Up to 32 devices can be connected.

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An intelligent RS-232-to-RS-485 network protocol converter must be used to communicate with the master device

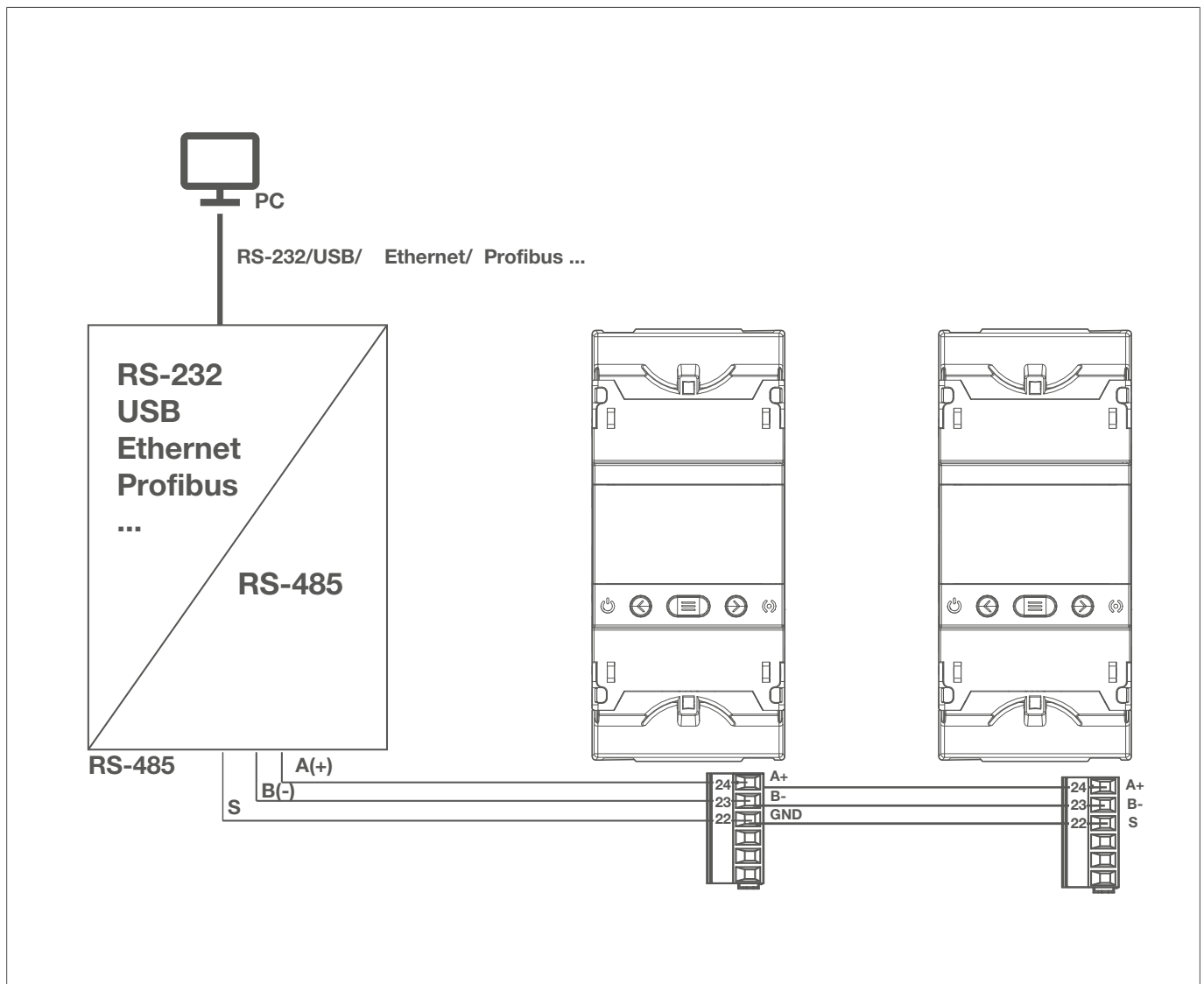


Fig. 46: Connecting Modbus RS-485

## 9.2 Modbus® protocol

The device uses **RTU** mode (Remote Terminal Unit) within the Modbus® protocol.

**The Modbus® functions implemented in the device:**

- **Function 0x01:** Read a relay.
- **Function 0x02:** Read the input status.
- **Functions 0x03 and 0x04:** Read integer registers.
- **Function 0x05:** Write a relay.
- **Function 0x10:** Write several registers.

## 9.3 Modbus® commands



### Note

All Modbus® addresses are in hexadecimal format.

### 9.3.1 Device and installation variables

Functions **0x01** and **0x05** are relevant for saving the new installation variables.

#### Function 0x02

Parameter	Format	Address	Value
The installation was tripped by the <b>TRIP</b> input.	bool	5DC	<b>0:</b> Not tripped - <b>1:</b> Tripped
The installation has changed.	bool	7CE	<b>0:</b> Not changed - <b>1:</b> Changed
Internal error detected in the <b>HR551</b> .	bool	7CF	<b>0:</b> Not detected - <b>1:</b> Detected
Saving the new installation.	bool	F9F	<b>1:</b> Save the installation

Table 14: Modbus memory mapping: HR551

#### Function 0x04

Parameter	Format	Address	Value
Device date and time	Unit [32]	283C - 283D	Device date (epoch format)
Serial no. of the <b>HR72x</b> registered in the system channel	Character string	3458...345E	-
Status of the installation	Unit [16]	3583	<b>0...5</b> (Tab. 16)
Status of the <b>HR551</b>	Unit [16]	3584	<b>0...2</b> ("Fig. X")
ID no. of the <b>HR551</b>	Unit [32]	35E8 - 35E9	-
Serial no. of the <b>HR551</b>	Unit [16]	364C...3652	-

Table 15: Modbus memory mapping: HR551

#### Possible installation statuses

Value	Description
<b>0</b>	Correct installation
<b>1</b>	A new <b>HR72x</b> was detected and added to the system.
<b>2</b>	The <b>HR72x</b> registered in the system is not detected.
<b>3</b>	An <b>HR72x</b> that is not registered in the system was detected.
<b>4</b>	More <b>HR72x</b> than the system can accommodate were detected.
<b>5</b>	No <b>HR72x</b> is registered in the system.

Table 16: Installation statuses

### 9.3.2 Channel variables

#### Function 0x04: Read registers

Configuration variables	Format	Address	Units/Format
Model <b>HR72x</b>	Character string	FA0-FA1	-
Serial no. of the <b>HR72x</b>	Character string	FA2...FA8	-
Firmware version (part 1)	Unit [16]	FA9	-
Firmware version (part 2)	Unit [16]	FAA	-
Revision of the firmware version	Unit [16]	FAB	-
<b>HR72x</b> status	Unit [16]	FAC	<b>0...6</b> (Tab. 18)
<b>HR72x</b> channel	Unit [16]	FAD	<b>1</b> : Channel 1
Programmed tripping curve or delay	Unit [16]	FAE	ms
Programmed trip current	Unit [16]	FAF	mA
Instantaneous total discharge current	Unit [16]	FB0	mA
Instantaneous alternating discharge current	Unit [16]	FB1	mA
Instantaneous direct discharge current	Unit [16]	FB2	mA
Total discharge current, which trips the relay	Unit [16]	FB3	mA
Alternating discharge current, which trips the relay	Unit [16]	FB4	mA
Direct discharge current, which trips the relay	Unit [16]	FB5	mA
Programmed pre-alarm current	Unit [16]	FB6	%
Pre-alarm operation	Unit [16]	FB7	<b>0</b> : Deactivated <b>1</b> : Activated with deactivated interlock <b>2</b> : Activated with activated interlock

Table 17: Modbus memory mapping: Channel variables

#### Possible status of HR72x

Value	Description
<b>0</b>	<b>HR72x</b> in the start phase
<b>1</b>	<b>HR72x</b> in the idle state
<b>2</b>	<b>HR72x</b> was tripped due to a detected discharge current

Table 18: Status of HR72x



**Possible status of HR72x**

Value	Description
3	HR72x tripped by TEST with an error test result
4	HR72x tripped by TEST with a successful test result
5	HR72x was tripped due to communication
6	HR72x tripped by TRIP input

Table 18: Status of HR72x

**Function 0x02**

Parameter	Format	Address	Value
Internal error detected in the HR72x	bool	0000	0: Not detected 1: Detected
Pre-alarm activated	bool	0001	0: Deactivated 1: Activated
Channel tripped	bool	0002	0: Not tripped 1: Tripped
Channel tripped due to discharge current	bool	0003	
Channel was tripped by an error in the HR72x	bool	0004	
Channel is tripped by a test	bool	0005	
Channel tripped due to TRIP input	bool	0006	
Tripped channel due to communication	bool	0007	0: Not detected 1: Detected
HR72x not connected	bool	0008	
Error when writing to the HR72x	bool	0009	
HR72x does not respond to requests	bool	000 A	

Table 19: Modbus memory mapping: Channel status

### 9.3.3 Variables of the trip unit for a test or communication

**Functions 0x01 and 0x05**

Configuration variables	Format	Address	Valid data range	Standard value
Trip due to TEST of the channel	bool	07D0	FF00: Initiate test of the channel 0000: End TEST	0000
Trip due to communication of the channel	bool	07D1	FF00: Channel trip 0000: Channel reset	0000

Table 20: Modbus memory mapping: Configuration of the trip and the pre-alarm

### 9.3.4 Event parameters

- ① Read the **Number of events** in the channel you want to query.
- ② Write the number of the channel you want to query to the Channel selection: 1.
- ③ Write the number of the event you want to query to the **Event selection**.
- ④ Read the eight **Event** registers to query the details of the events.

Parameter	Format	Address	Function	Value
Number of events in the channel	Unit [16]	13BA	0x04	0...100
Channel selection	Unit [16]	36BA	0x03	1
Event selection	Unit [16]	36BB	0x10	1...10
Event	Layout	1388-1389	0x04	Event date (epoch format)
		138A		Type of the event: <b>0:</b> Trip the channel relay <b>1:</b> Pre-alarm activated <b>2:</b> Individual test <b>3:</b> Error in the transformer
		138B		Channel in which the event occurred
		138C		Programmed trip current
		138D <sup>2</sup>		Programmed tripping curve or delay
		138E <sup>2</sup>		Total trip current (alternating + direct current)
		138F <sup>2</sup>		Constant trip current
		1390 <sup>2</sup>		Alternating trip current
Delete events	bool	0F9E	0x01 0x05	<b>1:</b> Deletes saved events

Table 21: Modbus memory mapping: Event

### 9.3.5 Trigger and pre-alarm configuration variables

Function 0x03: Read registers

Function 0x10: Write several registers

#### Configuration of the trip and the pre-alarm

Configuration variables	Format	Address	Valid data range	Standard value
Relay curve or delay <sup>3</sup>	Unit [16]	3714	<b>Tab. 23</b>	0
Trip current <sup>3</sup>	Unit [16]	3715	Tab. 24	30 mA
Pre-alarm current	Unit [16]	3716	1...100%	50%

Table 22: Modbus memory mapping: Configuration of the trip and the pre-alarm

<sup>2</sup> Applicable register if the read event is a relay trip.

<sup>3</sup> To program the relay delay and the trip current, you first need to read off the possible values for every **HR72x**.

**Function 0x03: Read registers**
**Function 0x10: Write several registers**
**Configuration of the trip and the pre-alarm**

Pre-alarm operation	Unit [16]	3717	<b>0:</b> Deactivated <b>1:</b> Activated with deactivated interlock <b>2:</b> Activated with activated interlock	1
Pre-alarm polarity	Unit [16]	36CE	<b>0:</b> Standard polarity <b>1:</b> Positive polarity	0
Polarity of the trip relay	Unit [16]	3718		

Table 22: Modbus memory mapping: Configuration of the trip and the pre-alarm

**Relay curve or delay table**

Parameter	Format	Function	Address	Value
Value 1	Unit [16]	0x04	1004	<b>1:</b> Curve INS – <b>0</b> <sup>4</sup>
Value 2	Unit [16]	0x04	1005	<b>2:</b> Curve SEL – <b>0</b> <sup>4</sup>
Value 3	Unit [16]	0x04	1006	<b>100 ms</b> – <b>0</b> <sup>4</sup>
Value 4	Unit [16]	0x04	1007	<b>200 ms</b> – <b>0</b> <sup>4</sup>
Value 5	Unit [16]	0x04	1008	<b>300 ms</b> – <b>0</b> <sup>4</sup>
Value 6	Unit [16]	0x04	1009	<b>400 ms</b> – <b>0</b> <sup>4</sup>
Value 7	Unit [16]	0x04	100 A	<b>500 ms</b> – <b>0</b> <sup>4</sup>
Value 8	Unit [16]	0x04	100B	<b>800 ms</b> – <b>0</b> <sup>4</sup>
Value 9	Unit [16]	0x04	100C	<b>1000 ms</b> – <b>0</b> <sup>4</sup>
Value 10	Unit [16]	0x04	100D	<b>3000 ms</b> – <b>0</b> <sup>4</sup>
Value 11	Unit [16]	0x04	100E	<b>5000 ms</b> – <b>0</b> <sup>4</sup>
Value 12	Unit [16]	0x04	100F	<b>0</b> <sup>4</sup>
Value 13	Unit [16]	0x04	1010	<b>0</b> <sup>4</sup>
Value 14	Unit [16]	0x04	1011	<b>0</b> <sup>4</sup>
Value 15	Unit [16]	0x04	1012	<b>0</b> <sup>4</sup>
Value 16	Unit [16]	0x04	1013	<b>0</b> <sup>4</sup>

Table 23: Modbus memory mapping: Relay curve or delay table

<sup>4</sup> **0:** Indicates that the value is not available.

**Trip current**

Parameter	Format	Function	Address	Value
Value 1	Unit [16]	0x04	1014	30 mA – 0 <sup>5</sup>
Value 2	Unit [16]	0x04	1015	100 mA – 0 <sup>5</sup>
Value 3	Unit [16]	0x04	1016	300 mA – 0 <sup>5</sup>
Value 4	Unit [16]	0x04	1017	500 mA – 0 <sup>5</sup>
Value 5	Unit [16]	0x04	1018	1000 mA – 0 <sup>5</sup>
Value 6	Unit [16]	0x04	1019	3000 mA – 0 <sup>5</sup>
Value 7	Unit [16]	0x04	101 A	0 <sup>5</sup>
Value 8	Unit [16]	0x04	101B	0 <sup>5</sup>
Value 9	Unit [16]	0x04	101C	0 <sup>5</sup>
Value 10	Unit [16]	0x04	101D	0 <sup>5</sup>
Value 11	Unit [16]	0x04	101E	0 <sup>5</sup>
Value 12	Unit [16]	0x04	101F	0 <sup>5</sup>
Value 13	Unit [16]	0x04	1020	0 <sup>5</sup>
Value 14	Unit [16]	0x04	1021	0 <sup>5</sup>
Value 15	Unit [16]	0x04	1022	0 <sup>5</sup>
Value 16	Unit [16]	0x04	1023	0 <sup>5</sup>

Table 24: Modbus memory mapping: Trip current table

### 9.3.6 RS-485

**RS-485 communication**

Configuration variables	Format	Address	Valid data range	Standard value
Peripheral device number	Unit [16]	36B0	1...247	1
Baud rate	Unit [32]	36B1 - 36B2	4800, 9600, 19200, 38400, 57600, 115200	9600
Data format	Unit [16]	36B3	<b>0:</b> 8N1, <b>1:</b> 8E1, <b>2:</b> 8O1 <b>3:</b> 8N2, <b>4:</b> 8E2, <b>5:</b> 8O2	<b>0</b>

Table 25: Modbus memory mapping: RS-485 communication

<sup>5</sup> **0:** Indicates that the value is not available.

## 10 Appendix

### 10.1 Technical data

Nominal voltage	230 V~, +/- 15%
Frequency	50/60 Hz
Power	7.5 VA
Category of the installation	CAT III 300 V

#### Monitoring functions

Degree of protection	Type B
Sensitivity (I $\Delta$ n)	0.03 – 0.1 – 0.2 – 0.3 – 0.5 – 0.75 – 1 – 1.5 – 2 – 3 A
Settable trigger delay	INS [S] – 0.1 – 0.2 – 0.3 – 0.4 – 0.5 – 0.8 – 1 – 3 – 5 – 10 s
Rated frequency of monitored circuit	50/60 Hz
Rated differential current (non-operating)	0.8 I $\Delta$ n
Rated short-time withstand current (I <sub>cw</sub> )	According to the protection
Conditional short-circuit differential current (I $\Delta$ c)	According to the protection
Uimp of the voltage source	4 kV (CAT III)
Compatible converter	HR721, HR722, HR723, HR724

#### Relay output

Number	1
Max. voltage of open contacts	230 V ~ +/- 15%
Maximum current	6 A
Maximum switching capacity	1500 VA

#### Service life

Electrical (250 V ~ /5 A)	60x10 <sup>3</sup> switching operations
Mechanical	10x10 <sup>6</sup> switching operations

#### TRIP input

Type	Voltage 230 V~
Insulation	5.3 kV
Input resistance	2 k $\Omega$
Operating temperature	-10°C/+50°C
Storage temperature	-20°C/+70°C
Relative humidity	5/95%

#### RS-485 interface

Communication protocol	Modbus® RTU
Baud rate	4.8 - 9.6 - 19.2 - 34.8 - 57.6 - 115.2 kBd
Data bits	8
Stop Bits	1 - 2
Parity	without, even, odd

#### Cable type between the device and HR converter

Connector type	RJ45 Standard according to EIA/TIA-485-A
Cable type	Cat.6 U/UTP - 4 x 2 x AWG24/7
Cable length	Max. 9 m

#### Digital output

Type	Galvanically separated
Voltage	Max. 230 V~
Current	Max 0.1 A

#### Other data

Maximum height	2000 m
Degree of protection	IP30
Conductor cross-section	2.5 mm <sup>2</sup>
Dimensions	52.5 x 118 x 74 mm
Standard	IEC 60947-2-M/IEC 60755

## 10.2 Dimensions

### Dimensions for HR55x

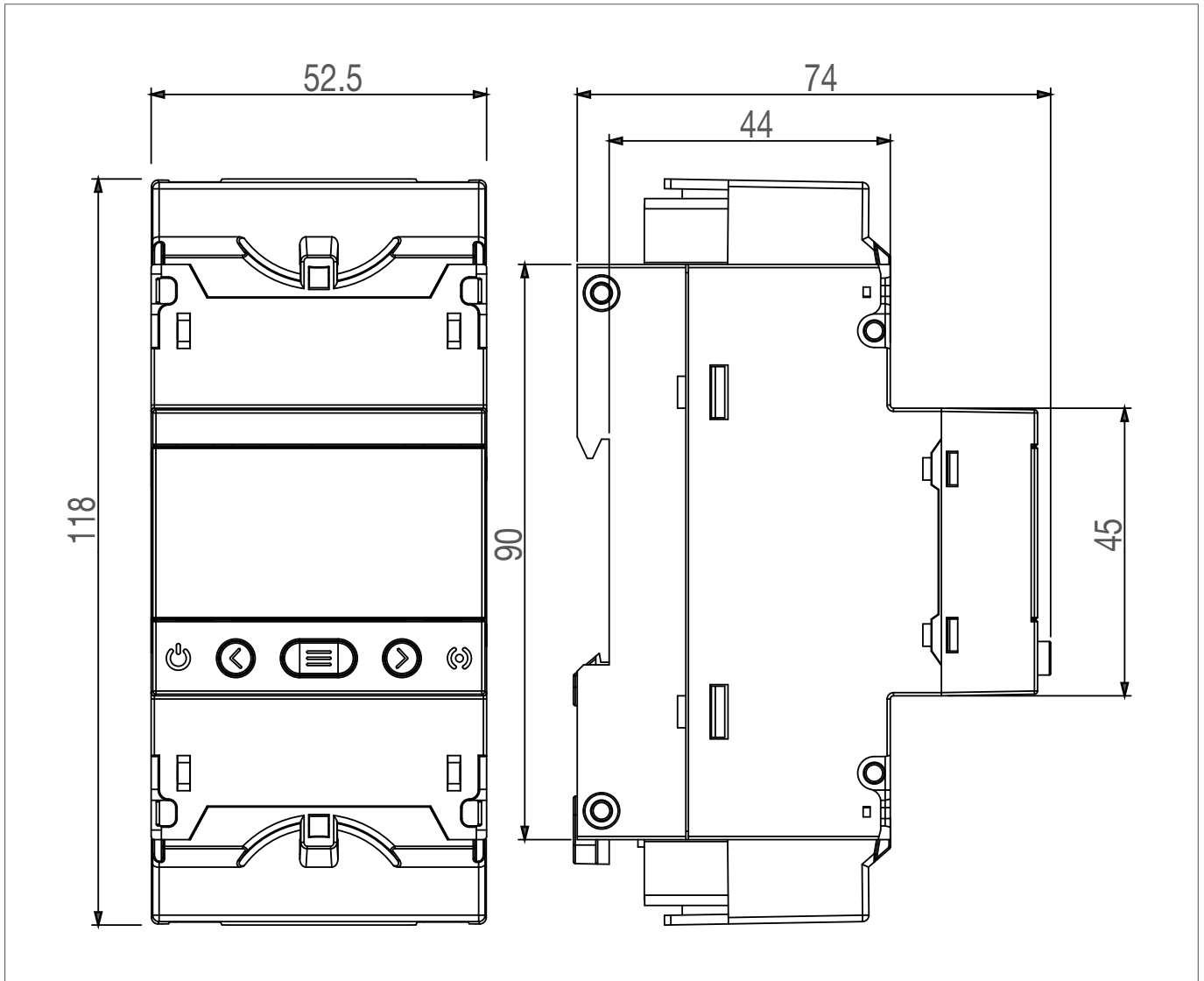


Fig. 47: Dimensions for HR55x

**Dimensions for HR72x**

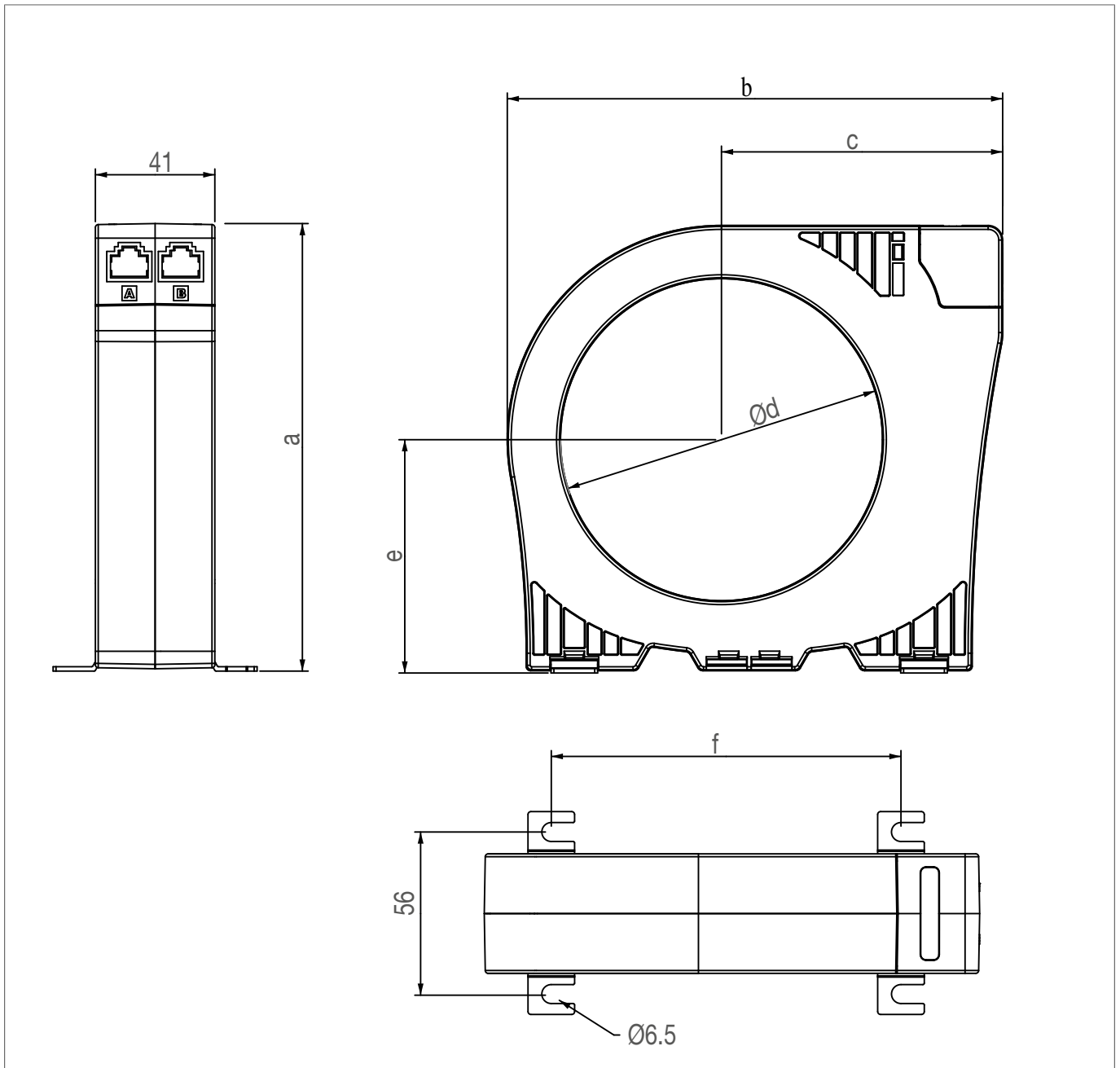


Fig. 48: Dimensions for HR72x

**Device dimensions for HR72x**

	a	b	c	d	e	f	Copper cable (3P+N)
HR721	80	97	61.5	35.5	44.5	54	4x25 mm <sup>2</sup>
HR722	98.5	118	72	55.5	52.5	81.5	4x70 mm <sup>2</sup>
HR723	123.5	140	81.5	80.5	65	101.5	4x120 mm <sup>2</sup>
HR724	153.5	170	96.5	110.5	80	120	4x240 mm <sup>2</sup>

## 10.3 Disposal note



**Correct Disposal of this product (Waste Electrical & Electronic Equipment).**

**(Applicable in the European Union and other European countries with separate collection systems).**

This marking shown on the product or its documentation indicates that it should not be disposed of with other household waste at the end of its working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate this device from other types of waste. Recycle the device responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take this device for environmentally safe disposal.

Business users should contact their supplier and check the terms and conditions of the purchase contract. This product should not be mixed with other commercial waste for disposal.





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