

Manual



RCMA421H-DCB WN-35BS

Residual current monitor
for monitoring AC, DC and pulsed DC currents
in earthed and resistance earthed systems
Software version D290 V1.0x



Bender GmbH & Co. KG

P.O. Box 1161 • 35301 Gruenberg • Germany

Londorfer Str. 65 • 35305 Gruenberg • Germany

Tel.: +49 6401 807-0

Fax: +49 6401 807-259

E-Mail: info@bender.de

Web: <http://www.bender.de>

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1. Making effective use of this document

1.1 How to use this manual

This manual has been designed for electrically skilled persons working in electrical engineering and electronics.

To make it easier for you to understand and revisit certain sections of text and instructions in the manual, we have used symbols to identify important instructions and information. Examples of how such symbols are used appear below:



The warning symbol indicates a potential dangerous situation that may result in bodily injury and/or damage to property.

Observe the associated safety instructions.



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

1.2 Intended use

The AC/DC sensitive residual current monitor RCMA421H-DCB with its measuring current transformer WN-35BS is used to monitor earthed and resistive earthed systems (TN and TT systems) in which DC and AC fault currents may occur. These systems involve loads with six-pulse bridge rectifiers or half-wave rectifiers with smoothing, e.g. converters and chargers.

In the event of a rated residual operating current $I_{\Delta n}$ of 6 mA, the device will switch an alarm relay and the associated contactor in accordance with the operating time specified in UL943.

2. Safety instructions

2.1 General safety instructions

In addition to these operating instructions, the “Important safety instruction for Bender products”, which are also included in the scope of supply, are an integral part of the device documentation.

2.2 Working on electrical installations

- Only skilled persons are permitted to carry out the work necessary to install, commission and run a device or system.
- Compliance with applicable regulations governing work on electrical installations, and with the regulations derived from and associated with them, is mandatory. EN 50110 is of particular importance in this regard.



Failure to carry out work on electrical installations properly and correctly can put life and limb at risk!

- If the device is being used in a location outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. European standard EN 50110 can be used as a guide.

2.3 Device-specific safety instructions



According to UL943 every residual current monitor and the associated measuring current transformer is to be tested in pairs. The relevant serial number for the transformer is imprinted on the enclosure of the RCMA421H. The residual current monitor and the measuring current transformer assigned to it may only be used or interchanged in pairs.

3. Function

3.1 Device features

- AC/DC sensitive residual current monitor with external 35 mm measuring current transformer
- Can be used in conjunction with a UL508-listed contactor
- Rated residual operating current $I_{\Delta n} = 6 \text{ mA}$ to UL943
- Operating time to UL943
- rms value measurement, frequency range 0...150 Hz
- Measured value display via multi-functional LCD
- Alarm signalling via LEDs (TPD, ERR) and K2 changeover contact
- Password protection to prevent unauthorised changes being made to device settings
- Permanent fault memory
- N/C operation of alarm relay
- Device test when the power supply voltage is connected
- Automatic self test every 24 hours
- CT-connection monitoring
- RS-485 interface can be terminated with switch
- Internal test circuit to UL943 without additional external components
- Internal test and reset button
- N-PE conductor monitoring on the load side

3.2 Description of function

The RCMA421H-DCB runs a device test when the power supply voltage is connected. During the start-up phase, the TRP LED lights up and the alarm relay switches to the alarm setting. Once the device test has been completed successfully, the ERR alarm LED will stop flashing, the TPD LED will go out and the alarm relay will return to the normal setting.

The device will check the circuit for the presence of residual currents even during the self-test.

An external measuring current transformer (e.g. WN-35BS) is used for residual current measurement. The actual measured value is indicated on the LCD.

This means that changes (e.g. as occur when outgoing feeders switch in) can easily be detected. If the rated residual operating current of 6 mA is exceeded, the alarm relay K2 will change to the alarm state and the TRP alarm LED will light up.

Once the alarm relay has switched, the residual current must fall to less than the rated residual operating current. If it does not, error code E.04 will appear on the display and the ERR alarm LED will flash. This means that the connected contactor has not shut down the faulty circuit.

If the residual current falls below the release value, the error will continue to be signalled due to the permanently activated fault memory. The alarm relay K2 will not switch back to the initial state and the TRP alarm LED will not go out until the Reset button R is pressed or the power supply voltage U_s is interrupted.

Parameters are assigned to the device via the LCD and the control keys on the front panel; this function can be password-protected.

A reset is also possible via the RS-485 interface by activating the RESET command, for example, via an externally connected MK2430 alarm indicator and test combination.

3.2.1 Transformer monitoring

The connections to the measuring current transformer are checked periodically every 10 s for short and open circuits. In the event of an error, the alarm relay K2 will switch, the red TPD alarm LED will light up and the green ERR

alarm LED will flash (error codes E.01 or E.03). Once the error has been eliminated, the alarm LEDs and the alarm relay will remain in the alarm state. Pressing the Reset button R or sending a RESET command via the RS-485 interface will switch K2 back to its initial state and the alarm LEDs will go out.

3.2.2 Quick query of the rated residual operating current

When the display is in standard mode, the rated residual operating current $I_{\Delta n} = 6 \text{ mA}$ can be queried by pressing the Up or Down button (< 1.5 s). Switching to menu mode is not necessary. Quick query mode can be exited by pressing Enter (< 1.5 s).

3.2.3 Self-test, automatic

The device runs a self-test every 24 hours. Any internal malfunctions detected are shown on the display as error codes. The automatic self-test is carried out without internal fault current. The alarm relay is not switched during the 24-hour test.

3.2.4 Self-test, manual

The device runs a self-test when the test button is pressed (> 1.5 s). Any internal malfunctions detected are shown on the display as error codes.

Whilst the test button T is pressed, all display elements available for this device are shown. When the button is released, the tES test symbol appears and the manual self-test commences.

During the manual self-test, an internal test current of approx. 7 mA is evaluated. Consequently, the TPD alarm LED lights up and the alarm relay switches. Once the alarm relay has switched, the residual current must fall to less than the rated residual operating current. If it does not, error code E.04 will appear on the display to indicate that the connected contactor has not shut down the load circuit.

If the self test has not been successfully, the alarm LED TPD will light, the alarm LED ERR will flash, the alarm relay will switch to the alarm state and an error code will be displayed.

3.2.5 Malfunction

In the event of an internal malfunction, the alarm LED TPD will light and the alarm LED ERR will flash. An error code will appear on the display until the fault is removed. Information about error codes appears on page 30.

3.2.6 Password protection (on, OFF)

If password protection has been activated (on), settings can only be made subject to the correct password being entered (0...999).

3.2.7 Factory setting FAC

Activating the factory setting will reset all modified settings, with the exception of the device address, to the default upon delivery.

3.2.8 Erasable history memory HiS

The first alarm value to occur is written to this memory. The memory can be erased via the HiS menu.

3.2.9 RS-485 interface

This interface provides the device with a means of communicating with an alarm indicator and test combination (e.g. MK2430). The ability to output up-to-date measured values and alarms is just one of the features supported. Test and reset commands can be sent to the RCMA421H-DCB from the MK2430.

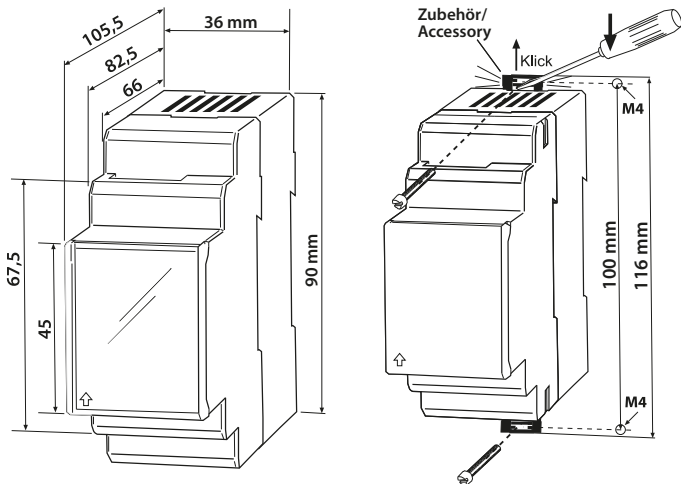
4. Installation and connection



Make sure that the installation area has been de-energised and ensure compliance with the regulations for working on electrical installations.

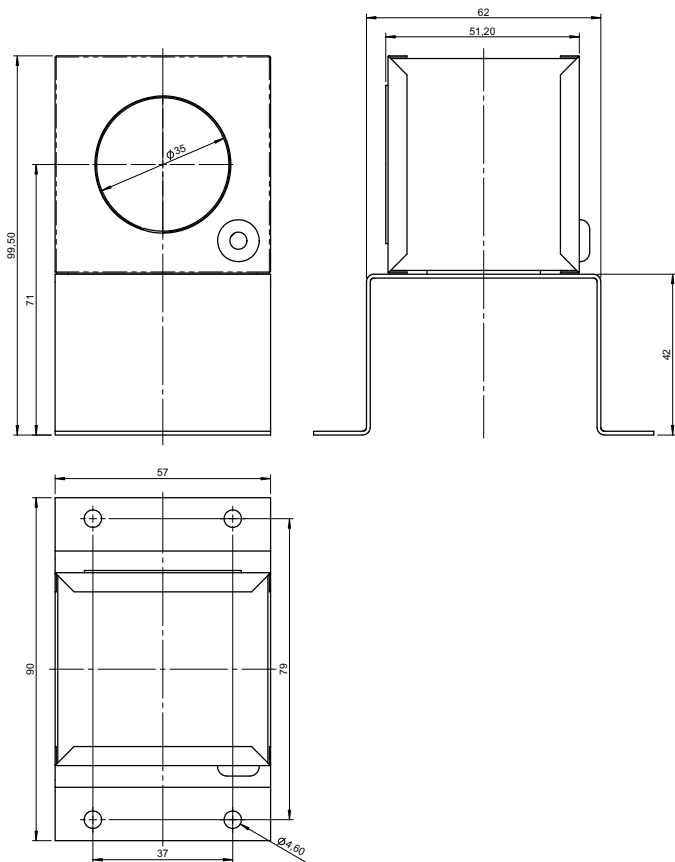
4.1 Dimension diagrams

RCMA421H dimension diagram and drawing for screw fixing



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

Dimension diagram for measuring current transformer WN-35BS



Dimensions in mm

1. Mounting on a DIN rail:

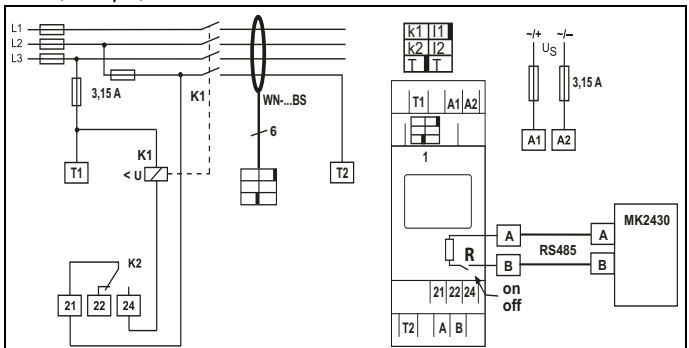
Snap the mounting clip at the rear of the device onto the DIN rail so that it sits securely.

Screw fixing:

Using a tool, position the rear mounting clips (a second mounting clip is required, see the ordering information) so that it protrudes over the enclosure. Fix the device in place with two M4 screws.

2. Wiring

The device must be wired as illustrated in the connection diagram (example).



Terminal	Connections
A1, A2	Connection to the power supply voltage U_s
1	Bush for measuring current transformer's connecting cable
T1, T2	Test connections for internal monitoring circuit
A, B	RS-485 interface, can be terminated with switch R
21, 22, 24	Alarm relay K2: Connection to contactor or load switch
WN...BS	Measuring current transformer
K1	Recommended contactors are listed in the table on page 32

Conductor colours for measuring current transformer

Colour	Pin assignment	Colour	Pin assignment
Brown	k1	Black	I1
Orange	k2	Red	I2
Pink	T	Violet	T

4.2 Factory setting



<i>Rated residual operating current, fixed value:</i>	6 mA
<i>Hysteresis, fixed value:</i>	15%
<i>Bus address:</i>	2
<i>Bus terminating resistor R:</i>	Off
<i>Fault memory M:</i>	Permanently activated
<i>Mode of operation K2:</i>	Permanent
	N/C operation (n.c.)
<i>Password:</i>	0, deactivated (off)

4.3 Commissioning

Checks must be carried out prior to commissioning to ensure that the residual current monitor, the external measuring current transformer and the associated contactors and peripherals have been connected correctly.



Incorrect connections can lead to personal injury and damage to equipment or property!

5. Operation and configuration

5.1 Getting to know the user interface

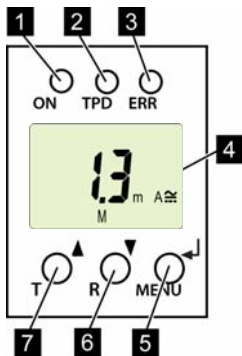


Fig. 5.1: User interface

- 1 Green Power ON LED:**
Lights up when the power supply voltage is connected and the device is running.
- 2 Red TPD alarm LED:**
Lights up when the rated residual operating current $I_{\Delta n}$ is exceeded.
- 3 Yellow ERR alarm LED:**
Flashes in the event of system errors. An error code will appear on the display (e.g. E.03).
- 4 DISPLAY:**
Displays operating information.
- 5 ENTER (< 1.5 s)/MENU (> 1.5 s) button:**
Press this button to apply entries and changes and call up the menu.
- 6 DOWN (< 1.5 s)/RESET (> 1.5 s) button:**
Press this button to reduce input values and navigate through the menu, as well as to perform a reset.
- 7 UP (< 1.5 s)/TEST (> 1.5 s) button:**
Press this button to increase input values and navigate through the menu, as well as to run a manual self-test.

5.2 Understanding information on the standard display

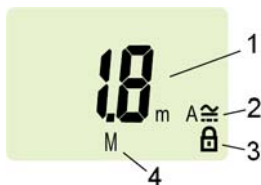


Fig. 5.1: Standard display

- 1 Measured value display in mA:
- 2 Current type display AC/DC
- 3 Password protection activated
- 4 Fault memory activated

The actual measured residual current is displayed by default.

Press the Up or Down button to display the factory-set rated residual operating current $I_{\Delta n}$. Pressing the Enter button restores the measured value.






In standard operation, the display can be toggled to the fixed rated residual operating current $I_{\Delta n}$ of 6 mA using the Up/Down button.

5.3 Getting to know buttons and button functions

The table below lists the functions of the buttons when navigating through the display, navigating through the menu and when making settings. From

Chapter 5.7 Making settings in the menu onwards, just the relevant button symbol is used to indicate that buttons have been pressed.

Button	Button symbol	Function
Up/ Test	 T	<ul style="list-style-type: none"> • Call up next display • Go to next menu/sub-menu/category item • Activate parameter • Change (increase) parameter value • Press and hold down button for more than 1.5 seconds: run manual self-test.
Down/ Reset	 R	<ul style="list-style-type: none"> • Call up next display • Go to next menu/sub-menu • Deactivate parameter • Change (reduce) parameter value • Press and hold down button for more than 1.5 seconds: erase fault memory.
ENTER/ Menu	 MENU	<ul style="list-style-type: none"> • Call up menu/sub-menu • Apply modified parameter value • Press and hold down button for more than 1.5 seconds: call up menu/exit menu/go to next highest sub-menu

5.4 Starting a manual self-test

You can start a self-test manually. During the test, any internal malfunctions detected are shown on the display as error codes. The alarm relay will be switched.

To start a self-test manually:

- Press and hold down the test button T (UP) for more than 1.5 seconds.



The text "tES" appears on the display along with all available display elements.

5.5 Erasing the fault memory

The device has an erasable fault memory.

To erase the fault memory:

- Press and hold down the reset button R (DOWN) for more than 1.5 seconds.

5.6 Calling up and exiting the menu

To call up the menu:

- Press and hold down the MENU (ENTER) button for more than 1.5 seconds.

To exit the menu again:

- Press and hold down the MENU (ENTER) button again for more than 1.5 seconds.







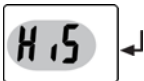


The areas of the display which can be configured flash. This is indicated by an oval marker in the illustrations below. Press and hold down the MENU button > 1.5 s to enter menu mode.

5.7 Making settings in the menu

5.7.1 Selecting menus

Press and hold down the MENU button for more than 1.5 s to call up the menu. Menus are available for a variety of settings. In turn, each menu has a number of sub-menus. The UP/DOWN buttons can be used to navigate between menus. Press and hold down the ENTER button for less than 1.5 s to call up a menu. Press and hold down the ENTER button for more than 1.5 seconds to go to the next highest menu.

Menu/Button to call	Description/Configurable parameters
	Query software version
	1. Press the UP/DOWN buttons to go to the menu.
	Set bus address
	2. Press the UP/DOWN buttons to go to the menu.
	Assign device control parameters <ul style="list-style-type: none"> • Activate or deactivate password protection, change password • Restore factory setting • Service menu SyS (locked)
	3. Press the UP/DOWN buttons to go to the menu.
	Query saved alarm value, erase history memory

Menu/Button to call	Description/Configurable parameters
---------------------	-------------------------------------



4. Press the UP/DOWN buttons to go to the menu.



Go to next highest menu level (Back).

5.7.2 Querying the software version with the InF menu

1. Select the InF menu.
2. Confirm with Enter.

The software version (e.g. d290-1.00) is displayed as running text. Once all information is showing on the display, you can use the UP/DOWN buttons to select individual items.

5.7.3 Setting the bus address

1. Select the Adr menu.
2. Make changes to parameters as illustrated.
3. To go back to the menu level, press and hold down the ENTER button for more than 1.5 seconds once you have modified the parameter(s)..

Menu	Select sub-menu	Change parameter value display	Change/apply param.
------	-----------------	--------------------------------	---------------------

Set bus address

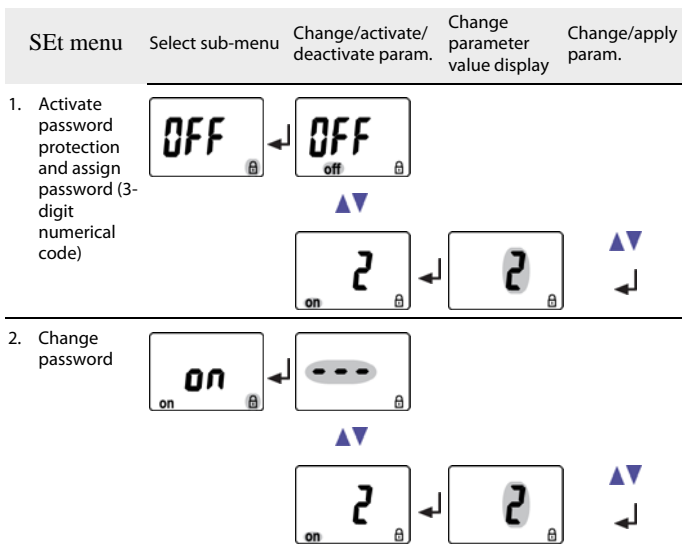


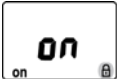
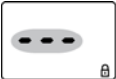














5.7.4 Making settings in the SEt menu




This menu can be used to activate password protection, to modify the password or to deactivate password protection. It is also where the device can be reset to the factory settings.

1. Select the SEt menu.
2. Make changes to parameters as illustrated.

To go back to the menu level, press and hold down the ENTER button for more than 1.5 seconds once you have modified the parameter(s).






SEt menu	Select sub-menu	Change/activate/ deactivate param.	Change parameter value display	Change/apply param.
3. Deactivate password protection				
				
				
				
4. Switch sub-menu				
5. Restore factory setting				<p>"run" appears on the display and the device is reset to the factory settings automatically.</p>
				
6. Switch sub-menu				

SEt menu	Select sub-menu	Change/activate/ deactivate param.	Change parameter value display	Change/apply param.
7. System menu (is locked)				
8. Switch sub- menu				
9. Go back to SEt menu				

5.7.5 Querying and erasing the fault memory in the HIS menu

1. Select the HIS menu.
2. Select the saved error and erase if applicable.
3. To go back to the menu level, press and hold down the ENTER button for more than 1.5 seconds.

HIS menu	Error display/Sub-menu
1. Error: Rated residual operating current exceeded	
2. Switch error display	
3. Error code E.03 See page 30	

HIS menu

Error display/Sub-menu

4. Switch error display



5. Erase fault memory



6. Switch error display



7. Go back to HIS menu



6. Technical data

6.1 Data RCMA421H-DCB-2 in table form

(*) = factory setting

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

Rated voltage	250 V
Overvoltage category/ pollution degree	III/3
Rated impulse voltage	2,5 kV
Protective separation (reinforced insulation) between	(A1, A2) - (k/l, A/B) - (21, 22, 24)
Voltage tests to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage range U_s	AC/DC 100... 250 V
Operating range U_s	AC/DC 70... 300 V
Frequency range U_s	42... 460 Hz
Power consumption	≤ 6.5 VA

Measuring circuit

External measuring current transformer	WN-35BS
Rated voltage (measuring current transformer)	2.5 kV
Rated frequency	0... 150 Hz
AC/DC measuring range	0... 40 mA
Relative uncertainty 0... 20 Hz	-33 %... +100%
Relative uncertainty 20... 90 Hz	0... -33%
Relative uncertainty 90... 150 Hz	± 17.5%

Operating value

Rated residual operating current $I_{\Delta n}$	6 mA
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Time behaviour

Start-up delay t	Operating time $t_{ae} + 3,2$ s
Operating time t_{ae} to UL943	see diagram on page 33

Displays, memories

Display range AC/DC measured value	0 ... 40 mA
Resolution	0.1 mA
Error of indication 0 ... 20 Hz	-33 % ... +100 % / ± 2 digits
Error of indication 20 ... 90 Hz	0 ... 20% / ± 2 digits
Error of indication 90 ... 150 Hz	± 17.5% / ± 2 digits
Error of indication at $I_{\Delta} < 2 \text{ mA}$	± 7 digits
Measured value memory for alarm value (HiS)	Measured values data set
Password	off/0 ... 0.999/0 (off)*

Cable length, WN-35BS measuring current transformer

Cable length	0.5 m
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Interface

Interface/protocol	RS-485/proprietary
Baud rate	9.6 kbps
Cable length	0 ... 1200 m
Recommended cable (shielded, shield connected to PE at one end)	At least J-Y(St)Y 2 x 0.6
Terminating resistor, can be switched	120 Ω, 0.25 W (off)*
Bus address	2 ... 90 (2)*

Switching elements

Number of switching elements	1 changeover contact
Operating principle	N/C operation n.c.
Electrical service life under rated operating conditions	10,000 switching cycles
Contact data to IEC 60947-5-1	
Utilisation category	AC-13 AC-14 DC-12 DC-12 DC-12
Rated operating voltage	230 V 230V 24V 110V 220 V
Rated operating voltage UL	200 V 200V 24V 110V 200 V
Rated operating current	5 A 3A 1A 0.2A 0.1 A
Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	UL943
Operating temperature	-35°C ... +66°C
Climatic class according to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)

Transport (IEC 60721-3-2)	2K3 (except condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-term storage (IEC 60721-3-1)	1M3

Connection

For UL application	use 60/70 °C copper conductors only
Connection type	screw terminals
Rigid/flexible/conductor sizes	0.2 . . 4/0.2 . . 2.5 mm ² /AWG 24 . . 12
Multi-conductor connection (2 conductors with the same cross section)	
rigid/flexible	0.2..0.15/0.2..0.10.5 mm ²
Stripped length	8 . . 9 mm
Tightening torque	0.5 . . 0.6 Nm
Connection type	push-wire terminals
Connection properties:	
Rigid	0.2 . . 2.5 mm ² (AWG 24 . . 14)
Flexible without ferrules	0.2 . . 2.5 mm ² (AWG 24 . . 14)
Flexible with ferrules	0.2 . . 1.5 mm ² (AWG 24 . . 16)
Stripped length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

Operating mode	Continuous duty
Position of normal use	Display-oriented
Degree of protection, built-in components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	Polycarbonate
Flammability class	UL94V-0
Snap-on mounting on a DIN rail	IEC 60715
Screw fixing.....	2 x M4 with mounting clip
Software version	D290V1.0
Weight RCMA421H	≤ 150 g
Weight WN-35BS	≤ 355 g

()* = factory setting

6.2 Error codes

If, contrary to expectations, a device error should occur, error codes will appear on the display. Some of these are described below:

Error code	Meaning
E.01	Connection error: no transformer Action: Check transformer connection for short circuit or open circuit, from T to T and from k2 to I2.
E.02	Connection error: connection system (after finishing manual self-test) Action: Check transformer connection for short circuit or open circuit Check correct connection, from T1 to T2 .




E.03	Connection error: short circuit transformer Action: Check transformer connection for short circuit or open circuit, from k1 to l1..
E.04	Error K1/Q1 (following powering up the device) Action: Check contactor: e.g. contacts sticking, release coil faulty
E...	Error codes > 04 Action: Perform a reset. Restore the device to the factory setting. Should the error persist, contact Bender Service.

After removing the CT mains connector, the error code E.03 / E.04 alternately appears on the display.

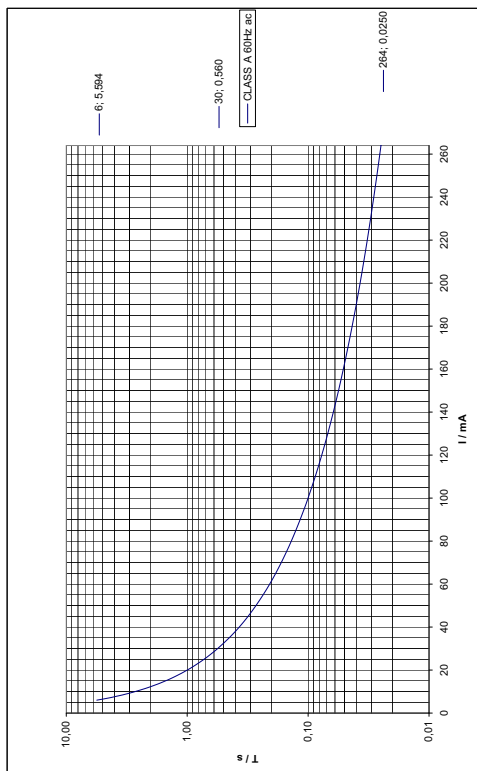
The error code will be erased automatically once the error has been eliminated.

6.3 Recommended contactors

The ABB types listed below have undergone performance testing.

Contactor type	Main contact	Auxiliary contact	
			
A16-30-10-84	3	1	
A26-30-10-84	3	1	
A40-30-10-84	3	1	
A75-30-00-84	3		
A110-30-00-84	3		
A145-30-00-84	3		
A16-30-10-34	3	1	
A26-30-10-34	3	1	
A40-30-10-34	3	1	
A75-30-00-34	3		
A110-30-00-34	3		
A145-30-00-34	3		
A16-40-00-84	4		
A26-40-00-84	4		
A45-40-00-84	4		
A75-40-00-84	4		
EK150* -40-22	4	2	2
A16-40-00-34	4		
A26-40-00-34	4		
A45-40-00-34	4		
A75-40-00-34	4		
EK150** -40-22	4	2	2

6.4 Response times of the RCMA421H system plus contactor in accordance with UL943



6.5 Ordering information

	RCMA421H-DCB-2
Rated residual operating current $I_{\Delta n}$	6 mA
Rated frequency	0...150 Hz
Supply voltage U_s^*	AC/DC 70...300 V AC 42...460 Hz
Art. No.: with screw terminals with push-wire terminals	B 9404 3018 B 7404 3018
*absolute values of the voltage range	

External measuring current transformer

Type	Internal diameter (mm)	Art. No.
WN-35BS	35	B 9808 0044

RCMA421H-DCB accessories

Mounting clip for screw fixing (1 per device) B 9806 0008

External alarm indicator and test combination

Type	Art. No.
MK2430A-12: $U_s = AC 18...28 V / DC = 18...30 V$	B 9510 0006

6.6 Standards, approvals and certifications



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Bender GmbH & Co. KG

P.O. Box 1161 • 35301 Gruenberg • Germany

Londorfer Str. 65 • 35305 Gruenberg • Germany

Tel.: +49 6401 807-0

Fax: +49 6401 807-259

E-Mail: info@bender.de

Web: <http://www.bender.de>

BENDER Group
