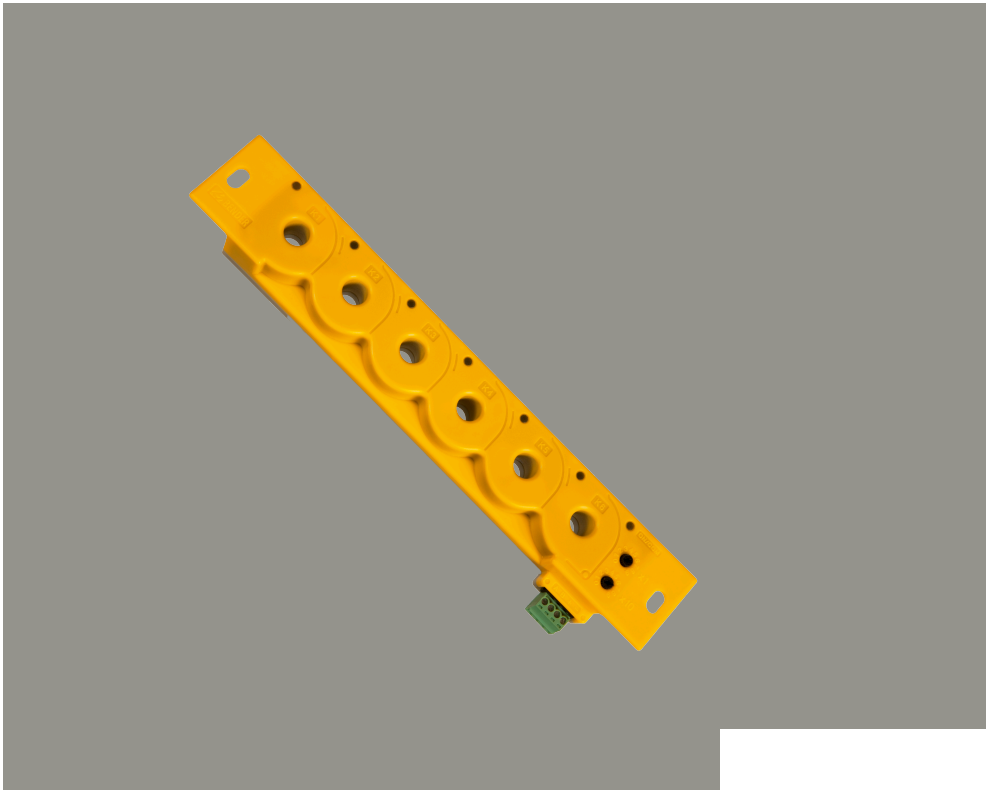
LINETRAXX® RCMS150 series

Residual current monitor type B with integrated measuring current transformers for earthed AC/DC systems (TN and TT systems)



RCMS150_D00259_04_M_XXEN/03.2024

BENDER

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1 General information

1.1 How to use the manual

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

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

1.2 Indication of important instructions and information

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

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

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

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

Information can help to optimise the use of the product.

1.3 Signs and symbols


Disposal


Protect from moisture


Protect from dust


Temperature range


Recycling

RoHS directives

1.4 Service and Support

Information and contact details about customer service, repair service or field service for Bender devices are available on the following website: Fast assistance | Bender GmbH & Co. KG.

1.5 Training courses and seminars

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

www.bender.de > know-how > seminars.

1.6 Delivery conditions

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

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"

1.7 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. In the event of complaints, the company must be notified immediately, see "www.bender.de > service & support.".

The following must be observed when storing the devices:

1.8 Warranty and liability

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

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

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

1.9 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 > service & support.

1.10 Safety

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

DANGER ***Risk of fatal injury due to electric shock!***

Touching live parts of the system carries the risk of:

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

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

2 Product description

2.1 Intended use

The RCMS150 devices are suitable for measuring residual currents up to I_{Δ} = 500 mA in a frequency range of DC…2 kHz. The monitored circuit is rated for a voltage of 300 V and a load current of 32 A. If cables with double or reinforced insulation are routed through the measuring current transformers, higher voltages may occur. The device can be operated at an altitude of up to 2000 m above mean sea level.

In order to meet the requirements of applicable standards, customised parameter settings must be made on the equipment in order to adapt it to local equipment and operating conditions. Please heed the limits of the range of application indicated in the technical data.

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

2.2 Device features

- Continuous residual current monitoring by means of periodic verification
- AC/DC sensitive residual current monitoring system type B with 6 channels K1…6 (each channel features 2 measuring channels: 1 x RMS, 1 x DC)
- Ideal for applications with space limitations
- Easy DIN rail or screw mounting to standard distribution panels
- 2 separately adjustable response values (DC or RMS) per channel
- Continuous self monitoring
- Fully shielded measuring current transformers to avoid external influences due to magnetic fields that may cause disturbances
- Compatible with Bender gateways of type COM465IP or CP9…

RCMS150 (RS-485 interface with BMS protocol)

- Compatible with RCMS460/490 in a system setup
- Address range 2…90, can be adjusted directly on the device
- Up to 89 RCMS150 can be used on the bus

RCMS150-01 (RS-485 interface with Modbus RTU protocol)

- Compatible with other Modbus RTU-capable device series from Bender, such as the RCMB300 series and RCMB13…-01 in a system setup
- Address range 1…99, can be adjusted directly on the device via detent potentiometers
- Address range 1…247, can be adjusted via the bus
- Up to 247 RCMS150-01 can be used on the bus

2.3 Functional description

The residual currents are recorded and evaluated as RMS values in the frequency range DC…2 kHz. The response values can be set via the interface. The user can set four response values per channel K1…6:

$I_{\Delta n1\ RMS}$, $I_{\Delta n2\ RMS}$, $I_{\Delta n1\ DC}$, $I_{\Delta n2\ DC}$

*The response values $I_{\Delta n1...}$ apply to the **prewarnings**, the response valuese $I_{\Delta n2...}$ apply to the **main alarms**.*

If one of the four set response values $I_{\Delta n...}$ is exceeded, the assigned response delay $t_{on...}$ starts. If the response value continues to be exceeded, the corresponding alarm message (prewarning or main alarm) is indicated

on the gateway after the response delay $t_{on...}$ has elapsed. In the event of a main alarm, the alarm LED of the respective channel K1…6 lights up yellow.

A pending alarm message is emitted via the BMS or Modbus interface with address and measuring channel indication and can be evaluated by means of a gateway.

If the recorded residual current falls below the release value (response value minus hysteresis) the delay on release t_{off} begins. If the value remains below the release value after t_{off} has elapsed, the LED of the respective channel goes out. The alarm message is reset on the interface. If the fault memory is enabled (only applicable to RCMS150-01), the alarm message remains on the bus despite the LED going out.

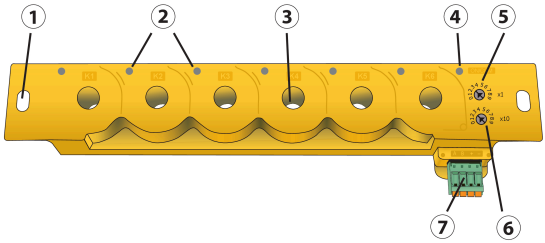
All devices can be accessed via the network from any PC using a standard web browser. Like this, all relevant measurement data of the monitored system are available. All device- related parameters of the RCMS150… can be set via the gateway technology.

To ensure the device function, a continuous automatic self test is run, which monitors the function of all measuring current transformers. In the event of a device error, the alarm LED of the respective channel flashes and an error message is output via the interface.

During the manual self test, a residual current is induced in the respective current transformer at each individual channel K1…6 one after the other via test windings and it is checked whether the corresponding main alarm is triggered. The duration of the test depends on the response delays of the main alarms.

2.4 Device overview, operating and display elements

Device overview



1	Slot for screw mounting
2	Alarm LEDs for channels K1…6 (yellow)
3	Line feed-through of the measuring current transformers for the channels K1…6
4	ON LED: Power on LED (green)
5	Detent potentiometer: Setting the **unit place** of the bus address (BMS bus or Modbus RTU)
6	Detent potentiometer: Setting the **tens place** of the bus address (BMS bus or Modbus RTU)
7	Plug: Connection to the supply voltage Connection RS-485 (BMS bus or Modbus RTU)

Operating elements

RCMS150-01
If both detent potentiometers are set to 0, the device uses the address parameterised via Modbus (1…247).

Display elements (LEDs)

Meaning of the LEDs

LED		Meaning
ON (green)	lights	Normal operation indicator
	flashes quickly	RCMS150: Device error or BMS bus address set incorrectly
	flashes slowly	RCMS150-01: Device error
	flashes very quickly	RCMS150-01: Identify device (via Modbus RTU)
	Flash code	Interface address output
ALARM K1…K6 (yellow)	lights	Main alarm (response value $I_{\Delta n}$ exceeded)
	flashes	Device error channel

3 Mounting

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

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

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

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

If you are familiar with the configuration of computer networks, you can connect the RCMS150… yourself. Otherwise please contact your EDP administrator!

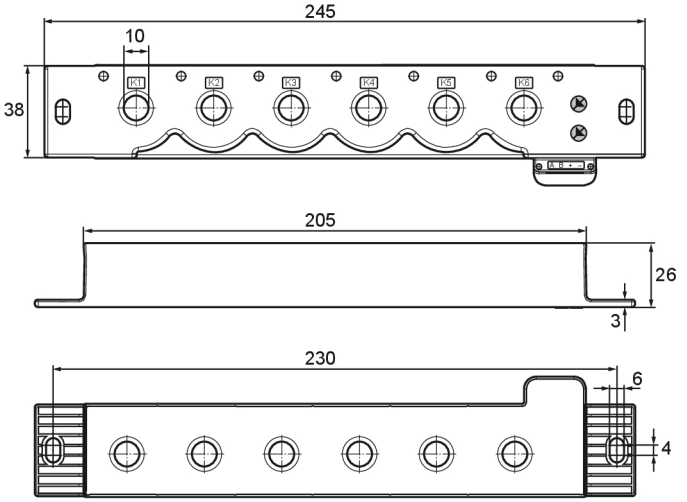
3.1 Important information on mounting

- Mounting is to be carried out with suitable equipment and tools according to the documentation.
- The device must only be installed by appropriately qualified personnel in deenergised state. Disconnect the switchboard cabinet from the power supply and protect the system against accidental switch-on.
- The general safety conditions as well as the prevailing national accident prevention regulations are to be adhered to. Electrical installation is to be carried out according to all applicable local laws (e.g. wire cross section, protection, PE connection).
- The climatic conditions must be complied with. The device is only permitted to be used in closed rooms.

3.2 Type of mounting

The devices of the RCMS150 series are intended for screw mounting. As an alternative, they can also be mounted on a DIN rail using the optionally available fastening set.

3.3 Dimension diagram



Dimensions in mm

4 Connection

DANGER ***Risk of electric shock!***
Follow the basic safety rules when working with electricity. Observe the information on ***rated voltage and supply voltage*** *specified in the technical data!*

Wiring diagram

CAUTION ***Risk of short circuit!***
Only insulated conductors with an insulation that is suitable for at least the monitored voltage may be routed through the measuring current transformer. The rated voltage of the RCMS150… must not be exceeded.

CAUTION ***For UL applications***
The conductors passing through the current transformer (primary conductors) shall be UL R/C isolated cables:
- isolation voltage min. 300 V
- min. 80 °C

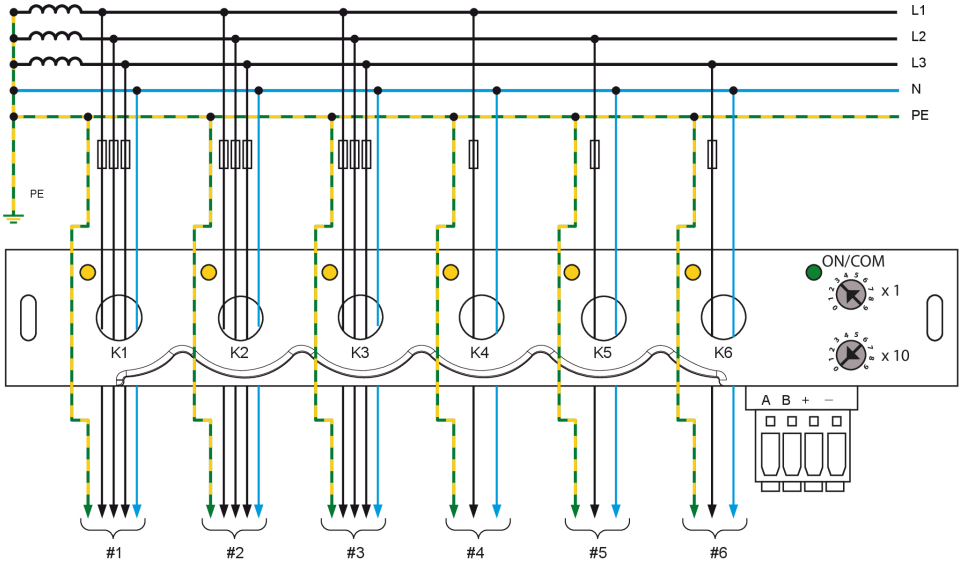
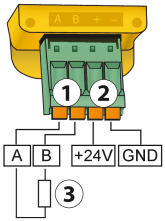


Figure 4-1: Wiring diagram RCMS150

Terminal

Detail: Terminal		
1	RS-485 interface (BMS-Bus or Modbus RTU)	
2	Supply voltage U_S DC 24 V	
3	Terminating resistor 120 Ω (required for both the first and the last bus device)	

5 Commissioning

1. **Mount the RCMS150**
2. **Set the bus address**

When assigning the bus addresses make sure that each address is only assigned once on the bus!

Address setting RCMS150 (BMS bus)	
Factory setting bus address	2
Setting range BMS bus	2…90
Adjustment on the device	Move the detent potentiometers to the corresponding position using a screwdriver.
Address setting RCMS150-01 (Modbus RTU)	
Factory setting bus address (Detent potentiometers to 00)	Last two digits of the serial number + 100
Setting range Modbus RTU	1…247
Addresses 1…99: Adjustment on the device	Move the detent potentiometers to the corresponding position using a screwdriver.
Addresses 1…247: Adjustment via the bus	Set the detent potentiometers to 00 using a screwdriver. Now the internally stored address (factory setting) is active. It can be changed via the interface.

3. **Bus installation**

   Please note that both the beginning and end of the bus require a 120-Ω terminating resistor.

4. **Route outgoing circuits** to be monitored **through the current transformers**

CAUTION ***Risk of short circuit!***
Only insulated conductors with an insulation that is suitable for at least the monitored voltage may be routed through the measuring current transformer. The rated voltage of the RCMS150… must not be exceeded.

Do not route any protective earth conductors through the measuring current transformers (see wiring diagram)!

5. Connect the RCMS150… to the **supply voltage** (DC 24 V).

   RCMS150 (BMS bus)
   The ON LED flashes to indicate the set BMS bus address after the device has been switched on or after the address has been changed: Unit place - Pause - Tens place.
   Example: ***** *** designates the BMS bus address 35.
   After indicating the address, the RCMS150 automatically switches to the standard display state. If the ON LED flashes quickly, the BMS bus address has been set incorrectly.

RCMS150-01 (Modbus RTU)
The set Modbus address is only indicated by the ON LED flashing after an address change via the detent potentiometers on the device: Hundreds place – Pause – Tens place – Pause – Unit place.
Example: * ***** *** designates the Modbus address 153.
After indicating the address, the RCMS150-01 automatically switches to the standard display state.
The ON LED does not indicate address changes via the bus.

6. **Connect RCMS150… to master** (e.g. COM465IP, software version ≥ 2.1, option C or CP9…).

6 Display via web server

The measured values (measuring channels) of the individual measuring current transformers of the RCMS150… can be displayed in the web browser.

6.1 Example of a system design

6.2 Starting the web browser

After commissioning the RCMS150…, start the web browser. Enter the IP address of the gateway (CP9… or COM465IP).

BMS bus	You can find the RCMS150 in the bus overview.
Modbus RTU	You can add the RCMS150-01 to your system in the browser: **Tools > Device management > Modbus devices > Manage devices > Add device > Search and configure devices**

6.3 User interface web browser

Basic operation: see manual of the gateway (CP9… or COM465IP).

6.4 Web application: Menu overviews

Web application: Menu overview RCMS150

Menu overview RCMS150 (BMS-Bus)				Description
Overview				Current measured values and alarm states of the 12 measuring channels (1…6: RMS; 7…12: DC)
Configure e-mail				Generate e-mails to report device failure. Set recipients via the gateway for each channel. Details: refer to gateway manual
Report				Create a report of all active devices
Menu	Settings	Edit texts	Device	Screen and printout: Specify alarm text for device and device failure
			Channel 1 - 12	Screen and printout: Specify alarm text for measuring channel 1…12 for prewarning and main alarm
		Channel	General	Channel K1…6: Hysteresis, t_{off}, $t_{start\text{-}up}$
			RMS	Channel K1…6: $t_{on1/2\ RMS}$, $I_{\Delta n1/2\ RMS}$ (measuring channels 1…6)
			DC	Channel K1…6: $t_{on1/2\ DC}$, $I_{\Delta n1/2\ DC}$ (measuring channels 7…12)
		Factory settings		Reset to factory settings; texts are not affected by this action.
	Control	TEST		Run device test
	Info			Device, software and manufacturer information

When setting the response values $I_{\Delta n2}$, the ratio of $I_{\Delta n2RMS}$ to $I_{\Delta n2DC}$ must only be between 0.2 and 5.

Web application: Menu overview RCMS150-01

Menu overview RCMS150-01 (Modbus RTU)				Description
Overview of the 12 measuring channels				Current measured values/alarm states, software
Alarms/ measured values	Graphical representation K1…6, each $I_{\Delta\,RMS}$ and $I_{\Delta\,DC}$			
Settings	Edit texts	Device		Alarm text device/device failure
		Measuring channel 1…12	Description	Alarm texts of the measuring channels in the event of a prewarning/main alarm
			Main alarm	
			Prewarning	
	Alarm settings	General	Channel K1…6	Hysteresis, t_{off}, $t_{start\text{-}up}$, fault memory
		RMS		$t_{on1/2\,RMS}$, $I_{\Delta n1/2\,RMS}$ (measuring channels 1…6)
		DC		$t_{on1/2\,DC}$, $I_{\Delta n1/2\,DC}$ (measuring channels 7…12)
System	Interface	Device address		The address set here is only used if both detent potentiometers are set to 0.
		Baud rate		
		Parity/Stop bits		
		Identify devices		LED flashes green very quickly
	Clock	Clock		
		UTC offset		
		Summer time		
	Factory settings	Write access		This box must be ticked for security reasons.
		Channel 1…6		Reset to factory settings; texts are not affected by this action.
		Without interface		
		With interface		
Control	Test	Channel 1…6		Run response test. A current is induced in the measuring current transformers via a test winding.
	Reset	Channel 1…6		Clear fault memory
	Communication test	Measuring channel 1…12		A test alarm is set at the selected measuring channel on the interface.
	Offset calibration	Write access		This box must be ticked for security reasons.
		Channel 1…6		Perform offset calibration

Menu overview RCMS150-01 (Modbus RTU)	Description
Info	Device name, article number, serial number, installation location, operating time, manufacturer

When setting the response values $I_{\Delta n2}$, the ratio of $I_{\Delta n2RMS}$ to $I_{\Delta n2DC}$ must only be between 0.2 and 5.

7 Overview Modbus registers (RCMS150-01 only)

This chapter provides a complete description of the Modbus registers to facilitate access to information.

RCMS150-01 supports the following Modbus functions:

1. Register for reading values (Read Holding Register; function code 0x03)
2. Register for writing values (Write Multiple Registers; function code 0x10)

The device exchanges the data in big-endian order. The counting method of the registers is 0-based. To check these properties, the UINT32 register 0 can be read and compared with the target value 0x12345678.

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

7.1 General overview

7.1.1 Read and write permissions

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

7.1.2 Used formats

Float32	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 string - String terminated with null character \0 - 16-bit Word: one character in HiByte, one character in LoByte

7.1.3 Overview of the register ranges

Range	Start address	End address
Info	0	999
Measured values	1000	31999
Interface parameters	32000	32099
Parameters	32100	57999
Control commands	59000	59999

7.2 Device information

Device information (Registers 0…999)

* = Factory setting

Register	Format	Property	Description	Comment/Factory settings ()*
00000	UINT32	RO	Modbus test register	0x12345678* Is used to configure the interface (endianess, byte order, etc.).
00002	String UTF8	RO	Device name	RCMS150-01\0*
00018	String UTF8	RO	Article number	B94053026\0*
00034	String UTF8	RO	Serial number	—
00050	String UTF8	RO	Manufacturer name	Bender\0*
00066	String UTF8	RO	Manufacturer Internet address	www.bender.de\0*
00082	UINT16	RO	Device version	Version number multiplied by 100. Example: 123 = V1.23
00083	UINT16	RO	Device patch version	—
00084	UINT16	RO	IU application D number	657*
00085	UINT16	RO	IU application Version	—
00086	UINT16	RO	IU application Build number	—
00087	UINT16	RO	IU application Modbus module version	—
00088	UINT16	RO	IU Bootloader D number	711*
00089	UINT16	RO	IU Bootloader Version	—
00090	INT16	RO	IU Bootloader Build number	—
00091	UINT16	RO	MU1 Application D number	489*
00092	UINT16	RO	MU1 Application Version	—
00093	INT16	RO	MU1 Application Build number	0
00094	UINT16	RO	MU1 Bootloader D number	0
00095	UINT16	RO	MU1 Bootloader Version	0
00096	INT16	RO	MU1 Bootloader Build number	0
00097…00126		Reserved		
00127	String UTF8	RW	Installation location[1)]	<location>\0*
00143…00999		Reserved		

1) When writing this parameter, it must be ensured that the entire character string is structured in 8-character blocks and that one block must always be written completely with one Modbus command. This means that the characters 1…8, 9…16, 17…24 and/or 25…32 must be written in each case. If the string does not fill a block completely, it must be filled with NULL characters.

7.3 Measured values

Register	Format	Property	Description	Comment/unit
01000	Float32	RO	Residual current measured value (K1 RMS)	Current instantaneous value. For status, refer to table Status K1…6
01002	Float32	RO	Residual current measured value (K1 DC)	
01004	UINT32	RO	Status K1	
01006	Float32	RO	Residual current measured value (K2 RMS)	
01008	Float32	RO	Residual current measured value (K2 DC)	
01010	UINT32	RO	Status K2	
01012	Float32	RO	Residual current measured value (K3 RMS)	
01014	Float32	RO	RO Residual current measured value (K3 DC)	
01016	UINT32	RO	Status K3	
01018	Float32	RO	Residual current measured value (K4 RMS)	
01020	Float32	RO	Residual current measured value (K4 DC)	
01022	UINT32	RO	Status K4	
01024	Float32	RO	Residual current measured value (K5 RMS)	
01026	Float32	RO	Residual current measured value (K5 DC)	
01028	Float32	RO	Status K5	
01030	Float32	RO	Residual current measured value (K6 RMS)	
01032	Float32	RO	Residual current measured value (K6 DC)	
01034	UINT32	RO	Status K6	
01036	Float32	RO	Device error and status information	If device errors are present, the error code is output here with a factor of 100, see “Error codes”, page 27. If there are several errors, the error with the highest error number is output. Example: 800 = 8.00 (hardware error)

Register	Format	Property	Description	Comment/unit
01038	Float32	RO	Residual current measured value min (K1 RMS)	Indicates the smallest value since the last readout. In the case of signed measured values, the lowest value is stored temporarily.
01040	Float32	RO	Residual current measured value min (K1 DC)	
01042	UINT32	RO	Status K1 min	
01044	Float32	RO	Residual current measured value min (K2 RMS)	
01046	Float32	RO	Residual current measured value min (K2 DC)	
01048	UINT32	RO	Status K2 min	
01050	Float32	RO	Residual current measured value min (K3 RMS)	
01052	Float32	RO	Residual current measured value min (K3 DC)	
01054	UINT32	RO	Status K3 min	
01056	Float32	RO	Residual current measured value min (K4 RMS)	
01058	Float32	RO	Residual current measured value min (K4 DC)	
01060	UINT32	RO	RO Status K4 min	
01062	Float32	RO	Residual current measured value min (K5 RMS)	
01064	Float32	RO	Residual current measured value min (K5 DC)	
01066	UINT32	RO	Status K5 min	
01068	Float32	RO	Residual current measured value min (K6 RMS)	
01070	Float32	RO	Residual current measured value min (K6 DC)	
01072	UINT32	RO	Status K6 min	
01074	Float32	RO	Device error and status information min	

Register	Format	Property	Description	Comment/unit
01076	Float32	RO	Residual current measured value average (K1 RMS)	Indicates the arithmetic average value since the last readout.
01078	Float32	RO	Residual current measured value average (K1 DC)	
01080	Reserved			
01082	UINT32	RO	Residual current measured value average (K2 RMS)	
01084	Float32	RO	Residual current measured value average (K2 DC)	
01086	Reserved			
01088	Float32	RO	Residual current measured value average (K3 RMS)	
01090	Float32	RO	Residual current measured value average (K3 DC)	
01092	Reserved			
01094	Float32	RO	Residual current measured value average (K4 RMS)	
01096	Float32	RO	Residual current measured value average (K4 DC)	
01098	Reserved			
01100	Float32	RO	Residual current measured value average (K5 RMS)	
01102	Float32	RO	Residual current measured value average (K5 DC)	
01104		RO	Reserved	
01106	Float32	RO	Residual current measured value average (K6 RMS)	
01108	Float32	RO	Residual current measured value average (K6 DC)	
01110	Reserved			
01112				

Register	Format	Property	Description	Comment/unit
01114	Float32	RO	Residual current measured value max (K1 RMS)	Indicates the highest value since the last readout. In the case of signed measured values, the highest value is stored temporarily.
01116	Float32	RO	Residual current measured value max (K1 DC)	
01118	UINT32	RO	Status K1 max	
01120	Float32	RO	Residual current measured value max (K2 RMS)	
01122	Float32	RO	Residual current measured value max (K2 DC)	
01124	UINT32	RO	Status K2 max	
01126	Float32	RO	Residual current measured value max (K3 RMS)	
01128	Float32	RO	Residual current measured value max (K3 DC)	
01130	UINT32	RO	Status K3 max	
01132	Float32	RO	Residual current measured value max (K4 RMS)	
01134	Float32	RO	Residual current measured value max (K4 DC)	
01136	UINT32	RO	Status K4 max	
01138	Float32	RO	Residual current measured value max (K5 RMS)	
01140	Float32	RO	Residual current measured value max (K5 DC)	
01142	UINT32	RO	Status K5 max	
01144	Float32	RO	Residual current measured value max (K6 RMS)	
01146	Float32	RO	Residual current measured value max (K6 DC)	
01148	UINT32	RO	Status K6 max	
01150	Float32	RO	Device error and status information max	
01152…31999			Reserved	

7.3.1 Status K1…6

Bit number	Description
0	DC prewarning
1	DC main alarm
2	RMS prewarning
3	RMS main alarm
4	Manual self test
5	Device error
6…31	Reserved

7.3.2 Error codes

Error code	Error	Description	Action
3.40	Channel error	Possible error cause: Temperature too high.	Check if ambient temperature is within the permissible range. Check if supply voltage DC 24 V is within the permissible range. Check if the residual current through the channel is too high or if there are high pulses. If the above points do not apply and the error occurs frequently, return the device.
6.00	Calibration error	Calibration data faulty.	Switch the device off and on again. If the error persists, return the device.
6.50	Production data faulty	Values outside the limits or checksum incorrect.	Error is only cleared by switching the device off/ on. If the error persists, return the device.
7.10	Internal communication error	Device-internal communication is disturbed.	Switch the device off and on again. If the error persists, return the device.
7.62			
8.46	Internal supply voltage	Impermissible deviation	If the error occurs frequently, return the device.
9.10	µC parameter error	Parameters outside permissible limits or error while saving. Affected channel: Gateway > Overview measuring channels or Modbus registers 1004…1034 (5 = device error)	Switch the device off and on again. Reset the corresponding channel to factory settings: via the gateway or Modbus registers 59013…59018. If the error persists, return the device.
9.60	µC parameter error	Parameter outside permissible limits	Switch the device off and on again. Reset device to factory settings: Modbus register 59020. If the error persists, return the device.
9.70	µC task/ programme sequence	General software error	Switch the device off and on again. If the error persists, return the device.
9.90	Error µC cycle generation	Unacceptable deviation or failure of the µC cycle source.	

7.4 Interface parameters

Register	Description	Format	Property	Unit	Setting range	Factory setting
32000	Modbus address*	UINT16	RW	—	1…247	The last two digits of the serial number + 100
32001	Modbus baud rate	UINT32	RW	Baud	1200 / 2400 / 4800 / 9600 / 19200 / 38400 / 57600	19200
32003	Modbus parity/ stop bit	UINT16	RW	—	0 = 8N2 1 = 8O1 2 = 8E1 3 = 8N1 4 = 8O2 5 = 8E2	2 (8E1)
32004…32099		Reserved				

* The address is only used if both detent potentiometers are set to 0.

7.5 Parameters

Parameter K1

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32100	Reserved						
32102	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32104	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32106	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s
32108	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32109	Reserved						
32110	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32112	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32114	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %
32116	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32118	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32120	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32122	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32124	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K2

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32126	Reserved						
32128	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32130	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32132	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s
32134	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32135	Reserved						
32136	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32138	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32140	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32142	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32118	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32144	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32146	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32150	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K3

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32152	Reserved						
32154	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32156	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32158	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s
32160	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32161	Reserved						
32162	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32164	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32166	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %
32158	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32170	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32172	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32174	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32176	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K4

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32178	Reserved						
32180	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32182	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32184	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32186	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32187	Reserved						
32188	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32190	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32192	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %
32194	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32196	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32198	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32200	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32202	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K5

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32204	Reserved						
32206	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32208	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32210	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s
32212	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32213	Reserved						
32214	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32216	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32218	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %
32220	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32222	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32224	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32226	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32228	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K6

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32230	Reserved						
32232	Response value Hysteresis	Float32	%	RW	10…25 %	0.1 %	15 %
32234	t_{off}	Float32	s	RW	0 s …10 min	10 ms	1 s
32236	$t_{start\text{-}up}$	Float32	s		0.5 s…10 min	10 ms	0.5 s
32238	Fault memory	UINT16	—	RW	0 = off 1 = on	—	0 (aus)
32239	Reserved						
32240	$I_{\Delta n2}$ RMS	Float32	A	RW	3…300 mA	0.1 mA	30 mA
32242	t_{on} main alarm RMS	Float32	s	RW	0 s…10 min	10 ms	0 s
32244	$I_{\Delta n1}$ RMS	Float32	%	RW	50…100 %	0.1 %	50 %
32246	t_{on} prewarning RMS	Float32	s	RW	0 s…10 min	10 ms	1 s
32248	$I_{\Delta n\,2}$ DC	Float32	A	RW	3…300 mA	0.1 mA	6 mA
32250	t_{on} main alarm DC	Float32	s	RW	0 s…10 min	10 ms	0 s
32252	$I_{\Delta n1}$ DC	Float32	%	RW	50…100 %	0.1 %	50 %
32254	t_{on} prewarning DC	Float32	s	RW	0 s…10 min	10 ms	1 s

Parameter K1…K6

Register	Description	Format	Unit	Prop.	Setting range	Step size	Factory setting
32256	Copy parameters	UINT32	—	RW	[1]		0
32258	Time [2] [3]	UINT32	Unix time	RW	0… 0xFFFFFFFF	1	0
32260	Time zone [2] [4]	Float32	h	RW	-12 ... +14	0.25	0
32262	Summer time [2] [5]	UINT16	—	RW	0 = off 1 = on 2 = CEST 3 = DST	—	0 (off)
32263…57999		Reserved					

1) Used to copy the parameters of one channel to other channels. Source channel and target channels are binary coded. In the low word, the source is indicated and in the high word, the targets are indicated. The source channel may also be set for the target channels (it is automatically omitted during the copying process). Bit 0 is reserved (must not be set), bit 1 corresponds to channel 1, bit 2 corresponds to channel 2, etc. Timeout: Up to 200 ms are required per selected target channel. If all 6 channels are selected as target, the process can take up to one second.
2) Lost when the device is switched off.
3) Unix time: Second count since 01.01.1970, 00:00 h
4) Offset of the time zone

5) CEST = automatic switching: Central Europe
DST = automatic switching: USA, CDN

Wait for at least 10 s before changing the response values. If the measured values do not normalise afterwards, a device restart/reset (or similar) must be carried out.

When setting the response values $I_{\Delta n2}$, the ratio of $I_{\Delta n2}$ RMS to $I_{\Delta n2}$ DC must only be between 0.2 and 5.

7.6 Control commands

Register	Description		Format	Property	Setting range	Factory setting	Comment
59000	Allow register write access		UINT16	RW	0 = Deny 1 = Allow	0	1)
59001	K1	Test	UINT16	RW	**Read** 0 = No test performed yet 1 = Test running 2 = Test successful 3 = Test failed **Write** 1 = start test	0	2)
59002	K2		UINT16	RW			
59003	K3		UINT16	RW			
59004	K4		UINT16	RW			
59005	K5		UINT16	RW			
59006	K6		UINT16	RW			
59007	K1	Fault memory reset	UINT16	WO	1 = Perform reset	—	3)
59008	K2		UINT16	WO		—	
59009	K3		UINT16	WO		—	
59010	K4		UINT16	WO		—	
59011	K5		UINT16	WO		—	
59012	K6		UINT16	WO		—	
59013	K1	Load factory settings	UINT16	WO	1 = Apply factory settings	—	4)
59014	K2		UINT16	WO		—	
59015	K3		UINT16	WO		—	
59016	K4		UINT16	WO		—	
59017	K5		UINT16	WO		—	
59018	K6		UINT16	WO		—	
59019	Load channel-independent factory settings (without interface)		UINT16	WO	1 = Apply factory settings	—	5)
59020	Load channel-independent factory settings (with interface)		UINT16	WO	1 = Apply factory settings	—	6)

Register	Description		Format	Property	Setting range	Factory setting	Comment
59021	Device signalling		UINT16	RW	0 = off 1 = on	0	7)
59022	Test alarm		UINT16	RW	0…12	0	8)
59023	K1	Offset measurement	UINT16	WO	1 = Perform offset measurement	—	9)
59024	K2		UINT16	WO		—	
59025	K3		UINT16	WO		—	
59026	K4		UINT16	WO		—	
59027	K5		UINT16	WO		—	
59028	K6		UINT16	WO		—	
59029…59999	Reserved						

Notes
1) Flag to allow modification of important registers. Is automatically deactivated after five seconds.
2) Manual test on corresponding channel. The duration of the test depends on the set response times.
3) Reset the fault memory on the corresponding channel.
4) Loads all factory settings of the corresponding channel (e.g. parameters of channel 1: registers 32100 to 32124). Secured via register 59000.
5) Loads the following channel-independent factory settings without interface parameters:
   – Register 1269: Installation location
   – Register 16162: Time
   – Register 16164: Time zone
   – Register 16166: Summer time
   – Secured via register 59000.
6) Loads the following channel-independent factory settings with interface parameters (secured via register 59000)
   – Register 1269: Installation location
   – Register 16158: Modbus address
   – Register 16159: Modbus baud rate
   – Register 16161: Modbus parity/stop bit
   – Register 16162: Time
   – Register 16164: Time zone
   – Register 16166: Summer time
7) The Power on LED flashes green quickly to identify the device more quickly in a cluster of devices. Is automatically deactivated after one minute.
8) Output a test alarm on a measuring channel. The test alarm is deactivated after 1 minute (= 0).
   0 = No test alarm/end test alarm
   1…12 = Output test alarm on corresponding channel/active
9) Perform an offset measurement on the corresponding channel. Secured via register 59000.

8 Glossary

Term	Explanation
#	In the overview: measuring channel number 1…12 1…6: RMS of channels K1…6 7…12: DC of channels K1…6
Channel	RCMS150…has 6 measuring current transformers (= channels). 2 measuring channels (RMS and DC) are available for each channel, which makes 12 measuring channels in total: 1…6: residual current AC/DC sensitive (RMS) 7…12: residual current DC
Configure e-mail	Functionality of the gateway: To which user group should a device failure be reported?
Device error (at > Edit texts)	Specification of the text that is displayed in the event of a device **error**
Device failure (at > Edit texts)	Specification of the text that is indicated in the event of a device **failure**
Edit texts	It is essential that each measuring channel is clearly identified in the overview or in the reports. The alarm texts that are indicated in the event of prewarnings/ main alarms can be identical or different for all channels. If no individual text is assigned, the general text will be indicated in the event of an alarm.
Factory settings	All settings are reset.
Hysteresis	The hysteresis prevents constant setting and resetting of the alarm when the measured value varies around the response value. If, for example, a hysteresis of 20 % is set, the alarm state will not be exited until the measured value is 20 % below the response value. Setting range: 10…25 %, resolution of setting 0.1 %
IΔn	Response value residual current $I_{\Delta n1}$ RMS : Response value prewarning RMS $I_{\Delta n2}$ RMS : Response value main alarm RMS $I_{\Delta n1}$ DC : Response value prewarning DC $I_{\Delta n2}$ DC : Response value main alarm DC
Main alarm	In the event of a main alarm, a message is sent via the bus and the respective LED lights up on the RCMS. Is triggered by: • Exceeding the set response value during residual current measurement • Fault of measuring current transformer • Device error
Message	2 message levels are distinguished: prewarning and main alarm.
Overview	The current state and the measured value are indicated for all 12 measuring channels (#).

Term	Explanation
Prewarning	Preliminary stage to main alarm, the less severe response value has been reached (e.g. 50 % of the main alarm response value). If there is a prewarning, a message is sent via the bus. Is triggered by: • Exceeding the set response value during residual current measurement • Fault of measuring current transformer • Device error
Report	The report includes: • The current measured values for each channel • Values of the general settings for hysteresis, t_{off}, $t_{start\text{-}up}$ • Response values and t_{on} for prewarnings and main alarms • Information regarding the RCMS150…
Response value main alarm	Response value of the main alarm ($I_{\Delta n2}$)
Response value prewarning	Indication of the response value alarm (50…100 %) ($I_{\Delta n1}$) as a percentage value
RMS	**R**oot **M**ean **S**quare: The currents are detected and evaluated as RMS values in the frequency range of 0…2000 Hz.
t(off)	Delay on release t_{off} Starts when the condition that triggers the message (for prewarning or main alarm) no longer exists. The RCMS150… only stops signalling if the condition that triggers the message no longer exists after the delay on release has elapsed. Setting range: 0…10 minutes.
t(on)	Response delay t_{on} Starts when a condition that triggers the message (for prewarning and main alarm) exists. Signalling is only done by the RCMS150… if the condition that triggers the message still exists after the response delay has elapsed. Setting range: 0…10 minutes.
t(start-up)	Start-up delay $t_{start\text{-}up}$ Time delay after the RCMS150 has been switched on. No alarm message is generated during this time period. This time delay is required if the RCMS150… and the system to be monitored are switched on simultaneously. Currents caused by switching operations are ignored. Setting range: 500 ms…10 minutes.

9 Technical data

9.1 Factory settings of the Modbus interface

For an overview of the factory-set parameters, see table “Parameters”, page 28.

9.2 Tabular data

( )* = factory settings

Insulation coordination according to IEC 60664-1	
Output circuit	(+, –, A, B)
Primary circuit	Primary conductors routed through the current transformer
Rated insulation voltage	300 V
Overvoltage category	III
Rated impulse withstand voltage monitored circuit/ output circuit	4 kV
Range of use	≤ 2000 m above sea level
Rated insulation voltage	250 V
Pollution degree	3
Insulation	
To achieve double insulation (DI) for overvoltage category III, insulated primary conductors with sufficient rated voltage must be used on the application side.	
BI	Overvoltage category III
DI	Overvoltage category II
Voltage test acc. to IEC 61010-1	AC 2.2 kV

Power supply	
Nominal supply voltage U_S	DC 24 V
Operating range U_S	±20 %
Power consumption	< 4 W

Residual current measuring range	
Frequency range	0…2000 Hz
Measuring range	±500 mA
Resolution measured value	1 % of the set response value

Response values

Residual current $I_{\Delta n2}$ RMS	RMS 3…300 mA (30 mA)*
for LR applications	RMS 10…300 mA (30 mA)*
Residual current $I_{\Delta n2}$ DC	DC 3…300 mA (6 mA)*
for LR applications[1)]	DC 10…300 mA (6 mA)*
Ratio $I_{\Delta n2}$ RMS / $I_{\Delta n2}$ DC	0.2…5
Prewarning $I_{\Delta n1}$ RMS/DC	50…100 % of $I_{\Delta n2}$ (50 %)*
Response tolerance	
DC, 10…500 Hz	-20…0 %
500 Hz…2 kHz	-20…+100
Hysteresis	10…25 % (15 %)*

1) For LR applications, $I_{\Delta n2}$ DC must be changed to a value ≥ 10 mA.

Time response

Start-up delay $t_{Start\text{-}up}$	0.5…600 s (0.5 s)*
Response delay	
t_{on1} RMS/DC	0…600 s (1 s)*
t_{on2} RMS/DC	0…600 s (0 s)*
Delay on release	
t_{off}	0…600 s (1 s)*

Indication (LEDs)

For a description of the LEDs, refer to page 10	
ON	green
ALARM K1…K6	yellow

Interface

Interface	RS-485
Connection	terminals A/B
Cable	shielded, shield on one side to PE
recommended	CAT6/CAT7 min. AWG23

Interface

alternative	J-Y(St)Y min. 2 x 0.8
Bus terminating resistor external	(2 x) 120 Ω (0.25 W)
Protocol	BMS
Cable length	≤ 1200 m
Device address	2…90 (2)*
Protocol	Modbus RTU
Cable length	≤ 1200 m
Device address	1…247 (last 2 digits of the serial number + 100)*

Environment/EMC

EMC	
Immunity	IEC 62020-1
Emission	IEC 62020-1
Operating temperature	-25…+70 °C
for UL applications	-25…+65 °C
Classification of climatic conditions acc. to IEC 60721	
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

Connection

Connection type	dual plug-in push-wire terminal
Connection properties	
rigid/flexible / conductor sizes	0.2…1.5 mm² / AWG 24…16
Multi-conductor connection (2 conductors with the same cross section)	
rigid	0.2…1.5 mm²
flexible	0.2…1.5 mm²

Connection

flexible with ferrule without plastic sleeve	0.25…1.5 mm²
flexible with ferrule with plastic sleeve	0.25…0.75 mm²
Stripping length	10 mm

Other

Operating mode	continuous operation
Position of normal use	any
Enclosure material	polycarbonate
Flammability class	UL94 V-0
Screw mounting to standard distribution panels with 12 TE	2 x M6
DIN rail mounting	mounting clip (accessories)
Tightening torque	1.5 Nm
Weight	170 g

Measuring current transformer

Diameter cable gland	10 mm
Load current	32 A

Bus parameters

Alarm	threshold value exceeded, system fault
Measured value	measured value, DC component, r.m.s. (resolution 0.1 mA)
Times	response delay, delay on release, start-up delay

( )* = Factory settings

9.3 Standards, approvals, certifications

B94053026W only

B94053025 only

9.3.1 Approvals

- UL508
- CSA
- LR (B94053026W only)

9.3.2 Conformity

EU Declaration of Conformity

The EU Declaration of Conformity is available at the following Internet address:

https://www.bender.de/fileadmin/content/Products/CE/CEKO_RCMS150.pdf

UKCA Declaration of Conformity

The UKCA Declaration of Conformity is available at the following Internet address:

https://www.bender.de/fileadmin/content/Products/UKCA/UKCA_RCMS150.pdf

9.4 Ordering information

Type	Supply voltage U_S	Protocol	Art. No.
RCMS150	DC 24 V	BMS	B94053025
RCMS150-01		Modbus RTU	B94053026
RCMS150-W-01			B94053026W
Mounting clip for DIN rail mounting			B91080110

Suitable system components

The use of the listed power supply units is recommended. The use of a surge protection device is mandatory for these power supply units.

Description	Type	Art. No.
Power supply	STEP-PS/1 AC/24 DC/0.5	B94053110
	STEP-PS/1 AC/24 DC/1.75	B94053111
	STEP-PS/1 AC/24 DC/4.2	B94053112

Accessories

Description	RCMS 150	RCMS 150-01	Type	Art. No.
Condition monitor with integrated gateway	X	X	COM465IP	B95061065
	X	X	CP907-I (flush-mounted enclosure)	B95061031
	X	X	CP907-I (control cabinet door mounting)	B95061032
RS-485 repeater	X	X	DI-1DL	B95012047
Residual current monitoring system (In this case, no condition monitor/gateway is necessary)*	X	—	RCMS460-D-1	B94053001
	X	—	RCMS460-D-2	B94053002
	X	—	RCMS490-D-1	B94053005
	X	—	RCMS490-D-2	B94053006

* Suitable for measured value and alarm indication only, not suitable for parameter setting.

9.5 Document revision history

Date	Document version	State/Changes
08/2016	00	First edition
07/2021	01	*Added* Device variant RCMS150-01 with Modbus RTU interface UKCA logo
08/2022	02	*Added* Chapter 8.1: Operating temperature UL Chapter 8.3: UL Logo
02.2024	03	*Added* Device variant RCMS150-W-01 with LR approval
03.2024	04	*Editorial revision* Layout of entire document

Bender GmbH & Co. KG

Londorfer Straße 65
35305 Grünberg
Germany

Tel.: +49 6401 807-0
info@bender.de
www.bender.de