EN Manual

BENDER
The Power in Electrical Safety©

RCMB330

AC/DC sensitive residual current monitoring module
with integrated measuring current transformer

Bender GmbH & Co. KG
PO Box 1161 • 35301 Grünberg • Germany
Londorfer Str. 65 • 35305 Grünberg • Germany
Tel.: +49 6401 807-0 • Fax: +49 6401 807-259
email: info@bender.de • www.bender.de

Photos: Bender Archive

Table of Contents

1. General instructions

1.1 How to use this manual

*This manual is intended for **qualified personnel** working in electrical engineering and electronics!*

Always keep this manual within easy reach for future reference. We have used the following symbols to identify important instructions and information:

*This signal word indicates that there is a **high risk of danger** that will result in **death** or **serious injury** if not avoided.*

*This signal word indicates a **medium risk** of danger that can lead to **death** or **serious injury**, if not avoided.*

*This signal word indicates a **low-level risk** that can result in **minor** or **moderate injury or damage to property** if not avoided.*

*This symbol denotes information intended to assist the user in making **optimum use** of the product.*

1.2 Technical support: service and support

For commissioning and troubleshooting Bender offers:

First level support

Technical support by phone or e-mail for all Bender products

- Questions about specific customer applications
- Commissioning
- Troubleshooting

Telephone: +49 6401 807-760*
Fax: +49 6401 807:-259 Germany: 0700BenderHelp (telephone and fax)
E-mail: support@bender-service.de

Repair service

Repair, calibration, update and replacement service for all Bender products

- Repair, calibration, testing and analysis
- Hardware and software update
- Delivery of replacement devices for faulty or incorrectly delivered devices
- Extended warranty with in-house repair service or replacement device at no extra cost

Telephone: +49 6401 807-780** (technical issues)/
+49 6401 807-784**, -785** (commercial issues)
Fax: +49 6401 807-789
E-mail: repair@bender-service.de

Please send the devices for repair to the following address:
Bender GmbH, Repair-Service, Londorfer Straße 65, 35305 Grünberg

Field service

On-site service for all Bender products

- Commissioning, parameter setting, maintenance, troubleshooting
- Analysis of the electrical installation in the building (power quality test, EMC test, thermography)
- Practical training courses for customers

Telephone: +49 6401 807-752**, -762 ** (technical issues)/
+49 6401 807-753** (commercial issues)
Fax: +49 6401 807-759

E-mail: fieldservice@bender-service.de
Internet: www.bender.de

*Available from 7.00 a.m. to 8.00 p.m. on 365 days of the year (CET/UTC +1)
**Mo-Thu 7.00 a.m. - 4.00 p.m., Fr 7.00 a.m. - 1.00 p.m

1.3 Training courses

Bender is happy to provide training regarding the use of test equipment.

The dates of training courses and workshops can be found on the Internet at www.bender.de -> Know-how -> Seminars.

1.4 Delivery conditions

The conditions of sale and delivery set out by Bender apply.

For software products, the "Softwareklausel zur Überlassung von Standard- Software als Teil von Lieferungen, Ergänzung und Änderung der Allgemeinen Lieferbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (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) set out by the ZVEI (Zentralverband Elektrotechnik- und Elektronikindustrie e.V., (German Electrical and Electronic Manufacturers' Association) also applies.

Conditions of sale and delivery can be obtained from Bender in printed or electronic format.

1.5 Inspection, transport and storage

Inspect the dispatch and equipment packaging for damage, and compare the contents of the package with the delivery documents. In the event of damage in transit, please contact Bender immediately.

The devices must only be stored in areas where it is protected from dust, humidity and spray or dripping water, and in which the specified storage temperatures can be assured.

1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded if they can be attributed to one or more of the following causes:

- 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 and the use of replacement parts or accessories not approved by the manufacturer.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

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

1.7 Disposal

Abide by the national regulations and laws governing the disposal of this device. Ask your supplier if you are not sure how to dispose of the old equipment.

The directive on waste electrical and electronic equipment (WEEE directive) and the directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS directive) apply in the European Community. In Germany, these policies are implemented through the "Electrical and Electronic Equipment Act" (ElektroG). According to this, the following applies:

- Electric and electronic equipment are not to be included in household waste.
- Batteries and accumulators are not to be included in household waste but must be disposed of in accordance with the regulations.
- Old electrical and electronic equipment from users other than private households which was introduced to the market after 13 August 2005 must be taken back by the manufacturer and disposed of properly.

For more information on the disposal of Bender devices, refer to our website at www.bender.de -> Service & support.

2. Safety instructions

2.1 General safety instructions

Part of the device documentation in addition to this manual is the enclosed " Safety instructions for Bender products".

2.2 Working on electrical installations

*Only **qualified personnel working in electrical engineering and electronics** are permitted to carry out the work necessary to install, commission 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:

- An electric shock
- Damage to the electrical installation
- Destruction of the device

***Before installing and connecting the device**, make **sure** that **the installation has been de-energised**. Observe the rules for working on electrical installations.*
***Refer to the rated and supply voltage values** as specified in the technical data!*

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

2.3 Intended use

The RCMB330 residual current monitoring modules are intended for AC/DC sensitive residual current measurement. The area of application is the monitoring of residual currents I_Δ for preventive maintenance in TN, TT and IT system up to 300 V with $I_\Delta \leq 500$ A rms, whereby I_Δ is intended to be measured within the range f= 0…100 kHz.

The devices are intended for operation in control cabinets or similarly protected environments.
Any other use than that described in this manual is regarded as improper.

3. Device description

3.1 Area of application

The RCMB330 residual current monitoring modules are intended for measuring AC and DC fault currents in earthed systems (TN and TT systems). The modules are able to measure residual currents I_{Δ} = 10…500 mA in a frequency range of DC…100 kHz.

Two separately adjustable response values allow a distinction to be made between pre-warning and main alarm.

The modules feature an RS-485 interface with Modbus RTU which can be used to transfer measured values and alarm values. Setting parameters is also possible via this interface.

3.2 Device features

- Continuous residual current monitoring in compliance with DGUV Vorschrift 3 (German Accident Prevention Regulation 3)
- Easy DIN rail or screw mounting
- RS-485 interface with Modbus RTU (reading out measured values/setting parameters)
- Frequency range DC…100 kHz
- Multicolour LED for operation and status messages
- Digitally adjustable filters for AC/DC sensitive measured value acquisition (low-pass filters, type B acc. to IEC 60755, type B+ acc. to VDE 0664-400)
- Separate evaluation of the AC and DC components as well as the RMS value of the residual current possible
- Installation without mechanical separation of the primary conductors
- Extension or modification of functionalities through software updates via Modbus
- Insensitive to load currents due to magnetic screen
- Supply voltage DC 24 V

3.3 Functional description

Residual current $I_{\Delta n}$

The residual current monitoring module measures both AC and DC currents. The message is transmitted via Modbus based on the determined RMS value. If the set residual operating current $I_{\Delta n}$ (main alarm) is exceeded, the LED lights red.

The individual components of the residual current (AC component, DC component) and the RMS value can be evaluated separately with the RCMB module. In addition, it is possible to set the main alarm and prewarning for individual components.

If storing behaviour is enabled (prewarning register 16055, main alarm register 16073), the message must be deleted on the device or via Modbus (register 20001).

Offset calibration

When the device has been **installed,** an offset calibration should first be performed (Refer to "Offset calibration" on page 18.).

Test measuring channels

A test of the measuring channels can be started via Modbus. Simulated measured values/messages are output via Modbus (register 20010).

Test

A device test can be performed on the device or via Modbus (register 20000).

Reset

A reset can be performed on the device or via Modbus to delete the stored messages (register 20001).

RS-485 interface

The RS-485 interface uses the Modbus RTU protocol to

- read out measured values
- set device parameters
- test
- reset
- perform software updates (in preparation)

4. Mounting and connection

*Only **qualified personnel working in electrical engineering and electronics** are permitted to carry out the work necessary to install, commission 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:

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

***Before installing and connecting the device**, make **sure** that **the installation has been de-energised**. Observe the rules for working on electrical installations.*
***Refer to the rated and supply voltage values** as specified in the technical data!*

DANGER

Risk of fatal injury due to electric shock!
If the Modbus RTU system is supplied from several power supply units, impermissibly high touch currents may occur.
*Use **only one power supply unit** in the Modbus RTU system.*

4.1 Dimension diagram

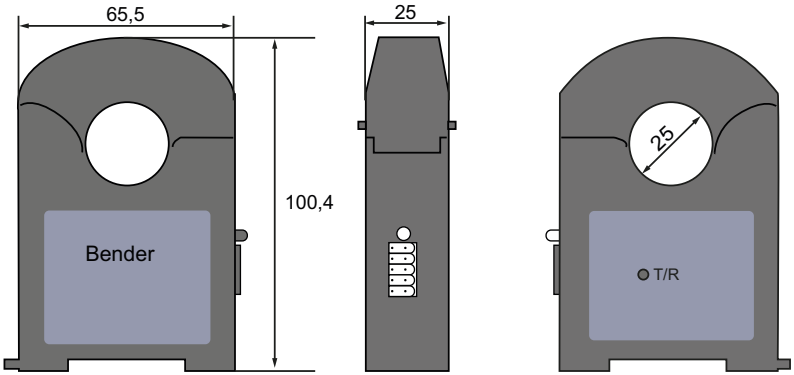
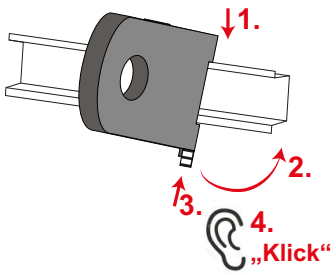


Fig. 4.1: Dimension diagram RCMB330

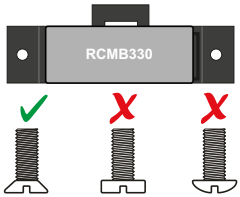
all dimensions in mm, tolerance ±0.5 mm

4.2 Mounting options

4.2.1 DIN rail mounting



4.2.2 Screw mounting



The device can also be screwed on using the supplied adapter. For this purpose, the adapter is inserted into the mounting groove on the bottom of the RCMB330 and fixed with the mounting clip.

4.3 Connecting the device

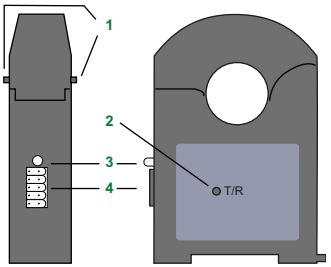
DANGER

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

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

***Before installing and connecting the device**, make **sure** that **the installation has been de-energised**. Observe the rules for working on electrical installations.*
***Refer to the rated and supply voltage values** as specified in the technical data!*

4.3.1 Device view RCMB330



No.	Element	Description
1	Unlock current transformer core	Press both elements together simultaneously and flip the RCMB330 open
2	"T/R" button	For manual test, manual reset, degaussing, offset calibration (use pointed object to press)
3	LED	Combined LED (Refer to "LED" on page 20.)
4	**Terminal block**	

Terminal	Pin no.		Terminal	Description
X1	**5**	**6**	X2	Terminals for jumper to connect the integrated terminating resistor (120 Ω) of the RS-485 interface
B	**4**	**7**	B	RS-485 interface
A	**3**	**8**	A	
GND	**2**	**9**	GND	Supply voltage U_S
+24 V	**1**	**10**	+24 V	

Tab. 4.1: Device view RCMB330

4.3.2 Wiring diagram

*)

The use of a type 2 surge protection device (SPD) is mandatory due to possible impulse voltages and in order to comply with normative requirements. The surge protection device must be connected upstream of the power supply unit on the supply side. Features of the surge protection device:

- Nominal discharge current In (8/20 µs): 20 kA
- Response time: 25 ns
- two-stage: 1 varistor + 1 spark gab

Alternatively, the power supply unit can be connected to a CAT II supply without a surge protection device.

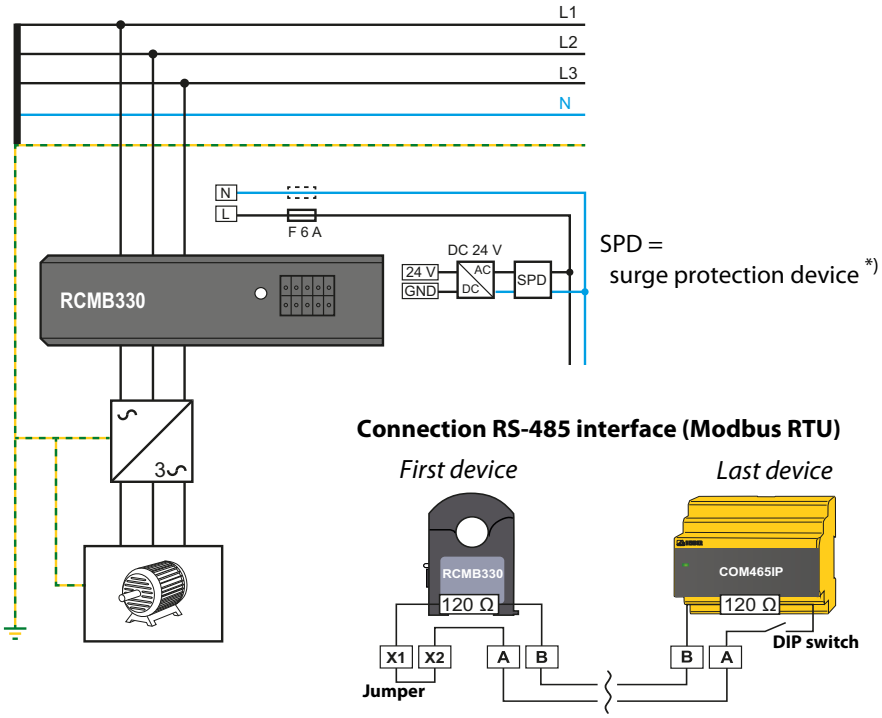


Fig. 4.2: Wiring diagram RCMB330

RCMB330

By using the jumper, the internal 120 Ω terminating resistor can be connected.

COM465IP

By means of the **DIP switch**, the internal 120 Ω terminating resistor can be connected.

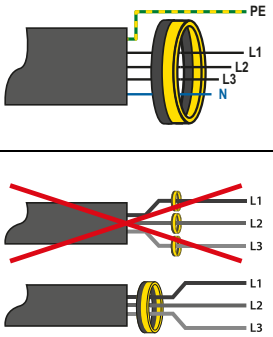
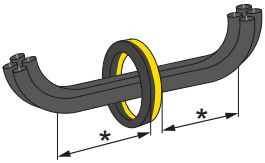
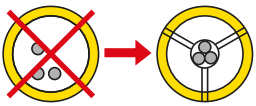
*The **connections** for the power supply (X1, X2) and the RS-485 interface (A, B) are **doubled**, so that the wiring can be carried out directly on the device according to the **daisy-chain** principle required for **Modbus**.*

4.4 Installation instructions for measuring current transformers

Do not route any shielded cables through the measuring current transformer!

CAUTION

Device damage due to interference pulses!
The connecting cable (supply, analogue interface...) must not be routed directly past the current transformer core/primary conductor.

Protective conductors and live conductors Make sure that all current-carrying cables are routed through the measuring current transformer. Never route an existing protective conductor through the measuring current transformer. The cable diameter may not exceed half the current transformer diameter.	
Bending cables The cables may only be bent at a certain distance from the measuring current transformer. * Distance to 90° angle: 2 x external diameter of the current transformer	
Routing cables centrally The cables must be aligned with the centre of the measuring current transformer.	

5. Commissioning

5.1 Address setting

Every RCMB330 has a factory-set Modbus address. The address is 1XX, where XX = the last two digits of the serial number.

Example:
*Serial number = 12345**78*** —> *Modbus address = 178*

If the preset address is to be changed, this can be done

- via a COMTRAXX® gateway,
- via Modbus.

Each address in the bus system may only be assigned once.

5.2 Offset calibration

The RCMB330 should be calibrated after installation in the system to be monitored. The device can be calibrated by pressing the "T/R" button and via the Modbus interface.

Make sure that during the offset calibration the system is switched off and no current flows through the measuring current transformer.

Offset calibration process

Phase	Action	LED flashing pattern	
1	Install the measuring current transformer in the system and close it	**A**	off
2a	Press and hold "T/R" button	**A**	off
2b	Supply the device with supply voltage U_s	**D**	lights red permanently (not ready for operation)
		E	flashes red slowly (ready for calibration)
		F	flashes red quickly (calibration mode)
3	If LED flashes red quickly, start calibration: Release "T/R" button	**F**	flashes red quickly
4	Calibration in progress (approx. 10 s)	**F**	flashes red quickly
5	Calibration finished, normal operating status	**B**	lights green permanently

Fig. 5.1: LED flashing pattern

5.3 Completing and checking installation

The installation should be completed with a functional test.

To test the measuring current transformer, a known current (e.g. from an RCD tester) must flow through the measuring current transformer and be measured.

5.4 Test and reset

5.4.1 Periodic self test

The RCMB330 carries out self-diagnosis of the electronics at regular intervals to ensure that the device functions properly.

5.4.2 Manual test/reset

The integrated "T/R" button allows a function test to be performed locally at any time. It is useful for commissioning, repair measures and periodic inspections by the system operator.

Test Press "T/R" button for 5…10 s

Alternatively, a test can also be performed via the RS-485 interface (register 20000).

Reset Press "T/R" button for 1.5…5 s

Alternatively, a reset can also be performed via the RS-485 interface (register 20001):

5.4.3 Offset calibration

If the compensation range of the measurement technology has been exceeded during operation, an offset calibration must be performed (see Page 18).

5.4.4 Testing measuring channels

Via register 20010, a test alarm can be activated for each measuring channel. The respective detailed measuring channel (4000...7999) switches to alarm state for one minute.

6. LED

The LED indicates the module state by means of colours and lighting/flashing.

LED flashing pattern

No.	Description
A	**Device switched off** Device is de-energised, no monitoring, no monitoring function (LED is off).
B	**Normal operating state** The device is supplied with the specified voltage and ready for operation. It monitors the primary circuit (lights green).
C	**Prewarning** The device is supplied with the specified voltage and monitors the primary circuit. A fault current flows that exceeds the set prewarning limit.
D	**Main alarm** The device is supplied with the specified voltage and monitors the primary circuit (lights red). A fault current flows that exceeds the set main alarm limit.
E	**Degaussing/offset calibration required** Compensation range of the measurement technology has been exceeded (> 100 A) (flashes red slowly). Degaussing/offset calibration must be performed. **Device error** The device is supplied with the specified voltage and monitors the primary circuit. An error is detected by the periodic self tests.
F	**Degaussing/offset calibration mode active** Offset calibration procedure: see Page 18 (flashes red quickly).
G	**Device signalling** Use (Modbus register 20006 = 2) to detect the device in its environment faster. It is automatically deactivated after one minute (flashes quickly red and green in alternation with a pause).

Tab. 6.1: LED indicates system state

7. Modbus registers

This chapter provides a complete description of the Modbus registers for the RCMB330 to allow access to information.

The following Modbus function codes are supported:

- Holding register for reading out values
  (Read Holding Register; function code 0x03)
- Register for device programming
  (Write Multiple Registers; function code 0x10)
- Register for diagnostic functions
  (Diagnostic; function code 0x08)
- Register for event counter
  (Get Com Event Counter; function code 0x0B)
- Register for server ID
  (Report Server ID; function code 0x11)
- Register for device identification
  (Read Device Identification; function code 0x2B)

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

7.1 General overview

7.1.1 Read and write accesses

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

7.1.2 Formats used

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 character string

7.1.3 Overview of the register areas

Area	Start address	End address
Info	0	3999
Detailed measured values	4000	7999
Basic measured values	8000	11999
History	12000	15999
Parameter	16000	19999
Control commands	20000	23999

7.1.4 Representation of values

	Value	Description
Test status	0	No test
	1	Internal test
	2	External test
Alarm status	0	No alarm
	1	Prewarning
	2	Error
	3	Reserved
	4	Main alarm
	5	Reserved
Range	0	=
	1	<
	2	>
	3	Invalid
Unit	0	Invalid
	1	None
	2	Ohm
	3	Ampere
	4	Volt
	5	Percent

	Value	Description
Unit	6	Hertz
	7	Baud
	8	Farad
	9	Henry
	10	Degree Celsius
	11	Degree Fahrenheit
	12	Second
	13	Minute
	14	Hour
	15	Day
	16	Month
	17	Watt
	18	var
	19	VA
	20	Wh
	21	varh
	22	Vah
	23	Degree
	24	Hertz/second

7.1.5 Alarm assignments

Bit number	Description	Bit number	Description
0	Start alarm (prewarning)	16	Start alarm (main alarm)
1	Device error (prewarning)	17	Device error (main alarm)
2	Reserved	18	Reserved
3	AC residual current (prewarning)	19	AC residual current (main alarm)
4	DC residual current (prewarning)	20	DC residual current (main alarm)
5	RMS residual current (prewarning)	21	RMS residual current (main alarm)
6…15	Reserved	22…31	Reserved

7.1.6 Descriptions

Description	Value
Device error	115
DC residual current	155
AC residual current	156
RMS residual current	420
"inactive"	1021
"none"	1022
"invalid"	1023

7.2 Device information

Register	Property	Format	Description	Value/unit/comment	Factory setting
0…999		Reserved			
1000	RO	UINT32	Modbus test register	Is used to configure the interface (endianess, byte order, etc.)	0x12345678
1002	RO	String UTF-8	Device name	Maximum 32 characters (\0 = end character) Character is in the LoByte	Example: RCMB330\0
1034	RO	String-UTF8	Article number		Example: B74043160\0
1066	RO	String-UTF8	Serial number		
1098	RO	String-UTF8	Manufacturer name	Maximum 96 characters (\0 = end character) Character is in the LoByte	Bender GmbH & Co. KG\0
1194	RO	UINT16	Application firmware		609
1195	RO	UINT16	Application version	Version number multiplied by 100. Example: 123 = V1.23	

Register	Property	Format	Description	Value/unit/comment	Factory setting
1196	RO	UINT16	Application Build number		
1197	RO	UINT16	Bootloader firmware		648
1198	RO	UINT16	Boot loader version	Version number multiplied by 100. Example: 123 = V1.23	
1199	RO	UINT16	Boot loader Build number		
1200	RO	UINT32	Counter offset calibration	Counts how often complete, successful offset calibrations were performed.	
1202… 1233	RO	String-UTF8	Internet address manufacturer	Character is in the LoByte in each case. Maximum 32 characters. \0 = NULL character = string end	www.bender.de\0
1234… 1265	RW	String-UTF8	Installation location [1)]		<location>\0
1266	RO	UINT16	Application Modbus module version	Version number x100 Example: 123= V1.23	
1267	RO	UINT16	Overload	1 = Residual current has exceeded the compensation range of the measurement technology. Perform degaussing/offset calibration.	
1268…3999			Reserved		

Tab. 7.1: Modbus register device information

Notes

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 characters 1 to 8, 9 to 16, 17 to 24 and/or 25 to 32 must be written. If the string does not fill a block completely, it must be filled with NULL characters. The installation location is also added to the server ID (function code 17) up to the first NULL character.

7.3 Detailed measured values

The detailed measured values also include status information and units in addition to the pure measured value. This function is essentially required for the Bender COM-TRAXX® system. Detailed measured values can also be interesting for a direct readout of the Modbus registers, since with these registers the measured values and associated status information can be queried at once and directly one after the other.

The 5 registers of each detailed measured value must always be read out as a coherent block including the measuring channel number, as otherwise the data is not up to date due to the software and is therefore inconsistent.

Register	Property	Format	Description		Value/unit
4000	RO	UINT16	AC	Measuring channel number (1)	
4001	RO	Float32		Residual current measured value (AC)	A
4003	RO	UINT16		Test and alarm status [1)]	
4004	RO	UINT16		Range and unit [2)]	
4005	RO	UINT16		Description	
4006…4015		Reserved			
4016	RO	UINT16	DC	Measuring channel number (2)	
4017	RO	Float32		Residual current measured value (DC)	A
4019	RO	UINT16		Test and alarm status [1)]	
4020	RO	UINT16		Range and unit [2)]	
4021	RO	UINT16		Description	
4022…4031		Reserved			
4032	RO	UINT16	RMS	Measuring channel number (3)	
4033	RO	Float32		Residual current measured value (RMS)	A
4035	RO	UINT16		Test and alarm status [1)]	
4036	RO	UINT16		Range and unit [2)]	
4037	RO	UINT16		Description	
4038…4047		Reserved			
4048	RO	UINT16	Device error/ status information	Measuring channel number (4)	
4049	RO	Float32		Device error and status information[3)]	Device/info code
4051	RO	UINT16		Test and alarm status [1)]	
4052	RO	UINT16		Range and unit [2)]	
4053	RO	UINT16		Description	
4054…7999		Reserved			

Tab. 7.2: Detailed measured values

Notes Table 7.2

1) HiByte: Test status; LoByte: Alarm status

2) HiByte: range; LoByte: unit

3) see Table 7.4

7.4 Basic measured values

Register	Property	Format	Description	Unit Value Comment
8000	RO	Float32	Measured value $I_{\Delta n}$ (AC)	A
8002	RO	Float32	Measured value $I_{\Delta n}$ (DC)	A
8004	RO	Float32	Measured value $I_{\Delta n}$ (RMS)	A
8006	RO	Float32	Device error and status information [1]	Device/info code
8008	RO	UINT32	Number of alarms	
8010	RO	Float32	Measured value $I_{\Delta n}$ (AC unfiltered)	A
8012	RO	Float32	Measured value $I_{\Delta n}$ (RMS unfiltered)	A
8014	RO	UINT32	Tripping status (alarm assignment that led to tripping)	Bit, binary coded HiWord: Main alarm LoWord: Prewarning
8016	RO	Float32	Measured value $I_{\Delta n\ max.}$ (AC) [2]	A
8018	RO	Float32	Measured value $I_{\Delta n\ max.}$ (DC)[2]	A
8020	RO	Float32	Measured value $I_{\Delta n\ max.}$ (RMS)[2]	A
8022	RO	Float32	Device error and status information [1][2]	Device/info code
8024	RO	UINT32	Number of alarms [2]	
8026	RO	Float32	Measured value $I_{\Delta n\ max.}$ (AC unfiltered)[2]	A
8028	RO	Float32	Measured value $I_{\Delta n\ max.}$ (RMS unfiltered)[2]	A
8030	RO	UINT32	Tripping status [2]	Bit, binary coded HiWord: Main alarm LoWord: Prewarning
8032… 1200			Reserved	

Tab. 7.3: Basic measured values

Notes Table 7.3

1) see Table 7.4

2) Same data as registers 8000…8014, but the maximum values or cumulative values are output since the last readout.
In the case of the DC measured value, the highest value is stored.

Error codes

Registers 4049, 8022

Error code	Error group	Error	Description	Action
6.00	Calibration error			The error is deleted either by switching the device off/on or by performing a reset. The device restarts completely. If the error persists, return the device or contact Bender service.
6.10		No initial offset calibration	No offset calibration has been performed in the customer installation.	Perform an offset calibration.
6.20		Offset calibration	Measured offset is outside the limits.	Does a (DC) current still flow through the measuring current transformer? Check circuit breaker. The error is deleted either by switching the device off/on or by performing a new offset calibration (if it is successful).
7.10	Internal interface error			If the error occurs frequently, return the device or contact Bender service.
8.00 8.43 8.44 8.46 8.47 8.49 8.60 8.71	Hardware error			If the error occurs frequently, return the device or contact Bender service.
9.03	µC system error			Switch the device off and on again. If the error persists, return the device or contact Bender service.
9.60		Parameter error	Parameter outside permissible limits	Switch the device off and on again. Reset device to factory settings: Modbus register 20007 or 20008. If the error persists, return the device.
9.70				Switch the device off and on again. If the error persists, return the device or contact Bender service.
9.90				

Tab. 7.4: Error codes

7.5 History

A maximum of 50 events can be stored. The events are sorted chronologically in such a way that the most recent event is number 1 and the oldest event is number 50.

The history memory is buffered and is only updated by reading register 12000 so that the sequence does not change during readout (due to a new history event).

The parameter "Overwrite history memory" (register 16089) can be used to set

- whether the history memory fills to a maximum of 50 events and then has to be cleared manually (register 20004)
- whether the oldest event (number 50) is overwritten automatically (factory setting).

Register	Property	Format	Description	Unit Value Comment
12000	RO	UINT16	Event 1 measuring channel number	1)
12001	RO	UINT32	Event 1 start	2)
12003	RO	UINT32	Event 1 end	
12005…12006		Reserved		
12007	RO	Float32	Event 1 min. value	
12009	RO	Float32	Event 1 max. value	
12011	RO	UINT16	Event 1 unit/test status	HiByte: Unit LoByte: Test status
12012	RO	UINT16	Event 1 alarm status min/max	HiByte: Min. value LoByte: Max. value
12013	RO	UINT16	Event 1 range min/max	
12014	RO	UINT16	Event 1 description	
12015…12017		Reserved		
12018…12035	RO		Event 2	
12036…12899	RO		Event 3…50	
12900…15999		Reserved		

1) When register 12000 is read out, the entire history memory is updated.
This way, the data remains consistent.

2) If no time has been set in register 16084:
time in s from the occurrence of the event to the readout of register 12000
(indicates how long before the history memory was read out the event occurred)
If a time is set in register 16084: UNIX time of the event.

7.6 Device parameters and factory settings

t_{on} = response delay t_{off} = delay on release

Register	Property	Format		Description	Value range Unit {Step size}	Factory settings RCMB330
16000	RW	Float32	AC	Limit value main alarm	30…500 mA {1 mA}	30 mA
16002	RW			Limit value prewarning	50 … 100 % {1 %}	60 %
16004	RW			Hysteresis	10 … 25 % {1 %}	15 %
16006	RW			t_{on} main alarm	50 ms…60 min {10 ms}	50 ms
16008	RW			t_{on} prewarning		1 s
16010	RW			t_{off} alarm	0…60 min	1 s
16012	RW		DC	Limit value main alarm	30…500 mA {1 mA}	30 mA
16014	RW			Limit value prewarning	50 … 100 % {1 %}	60 %
16016	RW			Hysteresis	10 … 25 % {1 %}	15 %
16018	RW			t_{on} main alarm	50 ms…60 min {10 ms}	50 ms
16020	RW			t_{on} prewarning		1 s
16022	RW			t_{off} alarm	0…60 min	1 s
16024	RW		RMS	Limit value main alarm	30…500 mA {1 mA}	30 mA
16026	RW			Limit value prewarning	50 … 100 % {1 %}	60 %
16028	RW			Hysteresis	10 … 25 % {1 %}	15 %
16030	RW			t_{on} main alarm	50 ms…60 min {10 ms}	50 ms
16032	RW			t_{on} prewarning		1 s
16034	RW			t_{off} alarm	0…60 min	1 s
16036	RW		Start-up delay		0 … 60 min {10 ms}	0 s

Register	Property	Format	Description		Value range Unit {Step size}	Factory settings RCMB330
16038	RW	UINT16	Prewarning	Reserved		
16039	RW			Alarm assignment start alarm	Alarm assignment 1 = inactive 2 = active	2
16040	RW			Alarm assignment device error		2
16041	RW			Reserved		—
16042	RW			Alarm assignment limit value violation $I_{\Delta n}$ prewarning (AC)		1
16043	RW			Alarm assignment limit value violation $I_{\Delta n}$ prewarning (DC)		1
16044	RW			Alarm assignment limit value violation $I_{\Delta n}$ prewarning (RMS)		2
16045…16054				Reserved		
16055	RW	UINT16		Fault memory mode	1 = off 2 = on	1
16056	RW	UINT16	Main alarm	Reserved		
16057	RW			Alarm assignment start alarm	Alarm assignment 1 = inactive 2 = active	2
16058	RW			Alarm assignment device error		2
16059	RW			Reserved		—
16060	RW			Alarm assignment limit value violation $I_{\Delta n}$ main alarm (AC)		1
16061	RW			Alarm assignment limit value violation $I_{\Delta n}$ main alarm (DC)		1
16062	RW			Alarm assignment limit value violation $I_{\Delta n}$ main alarm (RMS)		2
16063…16072				Reserved		
16073	RW	UINT16		Fault memory mode	1 = off 2 = on	2
16074	RW	UINT16	Filter mode		[1]	4

Register	Property	Format	Description		Value range Unit {Step size}	Factory settings RCMB330
16075	Reserved					
16076						
16077						
16078	RW	UINT16	Wired interface (RS-485)	Modbus address	1…247	Last two digits of the serial number + 100
16079	RW	UINT32		Baud rate	1200 2400 4800 9600 19200 38400 57600	19200
16081	RW	UINT16		Parity/stop bit	1 = 8N2 2 = 8O1 3 = 8E1 4 = 8N1 5 = 8O2 6 = 8E2	3
16082…16083	Reserved					
16084		UINT32	Time[2)]		UNIX time	—
16086		Float 32	Time zone[2)]		-12…+14 {0,25}	
16088		UINT16	Summer time[2)]		0 = off 1 = on 2 = CEST (Automat. switchover: Central Europe) 3 = DST (Automatic switchover: USA, CDN)	
16089			Overwrite history memory		1 = do not overwrite 2 = overwrite automatically	2
16090…19999	Reserved					

Tab. 7.5: Device parameters and factory settings

Notes:

1) Register 16074 "Filter mode"

Register entry	Description
1	Normal (full bandwidth: 100 kHz)
2	Low pass 60 Hz
3	Low pass 500 Hz
4	Low pass 1 kHz
5	Low pass 2 kHz
6	Low pass 5 kHz
7	Low pass 10 kHz
8	Low pass 20 kHz
9	Low pass 50 kHz
10	Type B
11	Reserved
12	Type B+ (up to 100 kHz)
13	Reserved
14	Fire protection (up to 100 kHz)
15…16	Reserved
17	Low pass 180 Hz

2) Is not saved when the device is switched off (value = 0).

7.7 Control commands

Register	Property	Format	Description	Comment Unit Value	Factory settings
20000	RW	UINT16	Device test	Manual device test (behaviour like "T/R" button) **Read** 1 = Test inactive/completed 2 = Test running **Write** 2 = Start test	1
20001	WO	UINT16	Reset	Deleting fault and alarm messages. 1 = perform reset	—
20002	Reserved				
20003					
20004	WO	UINT16	Clear history memory	1 = perform deletion (secured via reg. 20005)	—

Register	Property	Format	Description	Comment Unit Value	Factory settings
20005	RW	UINT16	Allow register write access	Flag to allow changing important registers. Is automatically deactivated after five seconds. 1 = deny; 2 = allow	1
20006	RW	UINT16	Activate device signalling	Makes the LED flash quickly red and green in alternation to detect the device in its environment faster. Is automatically deactivated after one minute. 1 = inactive; 2 = active	1
20007	WO	UINT16	Load factory settings (without interface)	Loads all factory settings except the interface parameters. Secured via register 20005. 1 = restore factory settings	—
20008	WO	UINT16	Load factory settings (all parameters)	Loads all factory settings including the interface parameters. Secured via register 20005. 1 = restore factory settings	—
20009	RW	UINT16	Start offset calibration	**Read** 1 = offset calibration inactive/completed 2 = offset calibration running **Write** 2 = start offset calibration (secured via reg. 20005)	1
20010	RW	UINT16	Test alarm [1)]	0 = no test alarm 1 = test alarm measuring channel 1 2 = test alarm measuring channel 2 3 = test alarm measuring channel 3 4 = test alarm measuring channel 4	0
20011…23999			Reserved		

Tab. 7.6: Control commands

1) Test alarm: Output a test alarm on a measuring channel (measuring channel "Detailed measured values", see Chapter 7.3). The test alarm refers only to bus messages. The test alarm is deactivated after 1 minute (= 0).

7.8 Additional function codes

7.8.1 Diagnostic (function code 0x08)

Sub-function code name	Sub-function code number (decimal)	Error counter	Supported	Notes
Return Query Data	0		X	
Restart Communication	1		X	
Return Diagnostic Register	2		X	1)
Change ASCII Input Delimiter	3			
Force Listen Only Mode	4		X	
Reserved	5…9			
Clear Counters and Diagnostic Register	10		X	
Return Bus Message Count	11		X	2)
Return Bus Communication Error Count	12	X	X	
Return Bus Exception Error Count	13	X	X	
Return Server Message Count	14		X	
Return Server No Response Count	15		X	
Return Server NAK Count	16	X	X	
Return Server Busy Count	17	X	X	
Return Bus Character Overrun Count	18	X	X	
Reserved	19			
Clear Overrun Counter and Flag	20		X	
Reserved	21…65535			

Tab. 7.7: Additional function codes: Diagnostic

1) The diagnostic register is 0 if all error counters are 0. Otherwise it is 1.

2) The 16-bit counters count a maximum of 65535. There is no overflow.

7.8.2 Get Com Event Counter (function code 0x0B)

Response	Notes
Status	If a previously received command is still being processed, then the answer is 0xFFFF. Otherwise it is 0x0000. (Current implementation: always 0x0000).
Event Count	It is a 16-bit counter. This means that a maximum of 65535 is counted. There is no overflow.

Tab. 7.8: Get Com event Counter

7.8.3 Report Server ID (function code 0x11)

Response	Notes	
Byte count	Number of bytes from "Server ID" to "Installation location"	
Server ID	Is always 0x01	
Run Indicator Status	Is always 0xFF	
Manufacturer name	Same information as register 1098	Output as ASCII string.
Device name	Same information as register 1002	
Application D number	Same information as register 1194	
Application version	Same information as register 1195	
Application Build number	Same information as register 1196	
Installation location	Same information as register 1234	

Tab. 7.9: Report Server ID

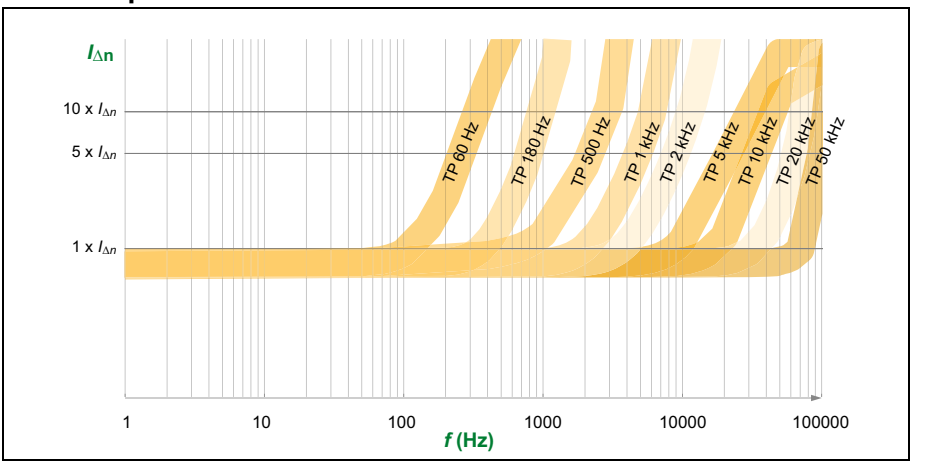
7.8.4 Device Identification (function code 0x2B)

Object ID	Object name / Description	Data type	Category	Supported	Notes
0x00	Manufacturer name	ASCII string	Basic	X	Corresponds to register 1098
0x01	Article number			X	Corresponds to register 1034
0x02	Application software, version and build number			X	Corresponds to registers 1194, 1195 and 1196
0x03	Internet address manufacturer	ASCII string	Regular	X	Corresponds to register 1202
0x04	Device name			X	Corresponds to register 1002
0x05	Model name				
0x06	User application name				
0x07… 0x7F	Reserved				
0x80… 0xFF	Non-public objects		Extended		

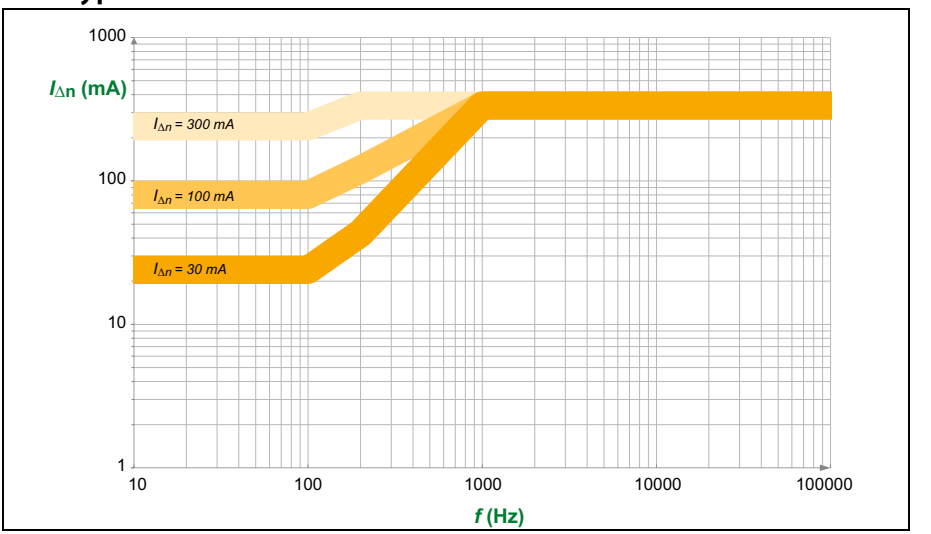
Tab. 7.10: Device Identification

8. Frequency responses

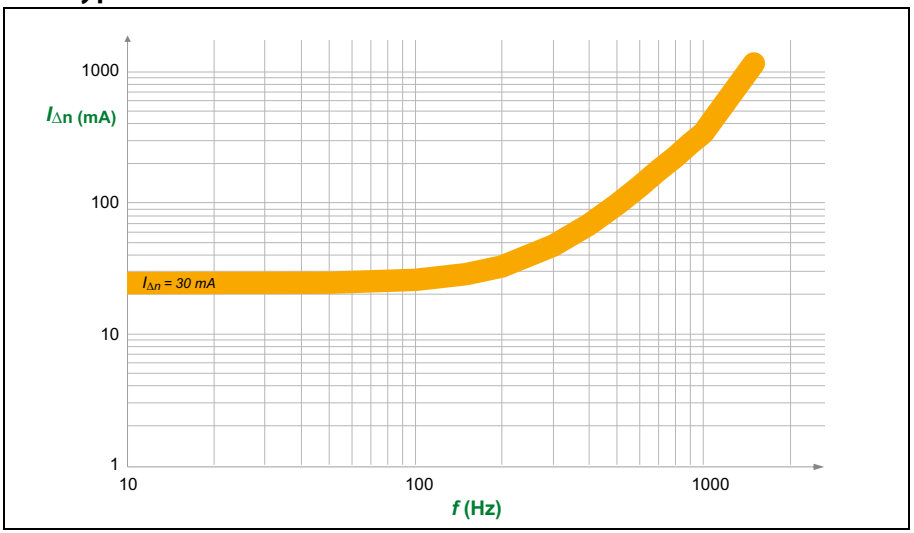
8.1 Low passes LP



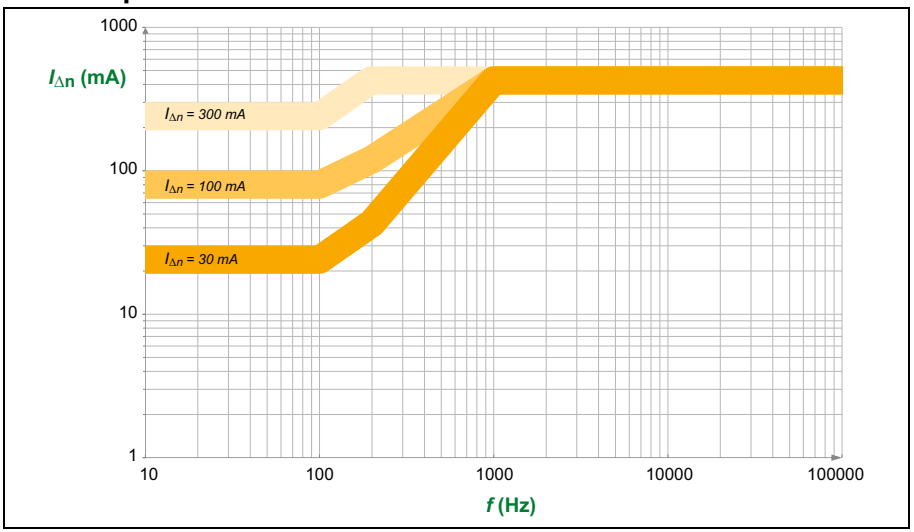
8.2 Type B+



8.3 Type B



8.4 Fire protection 100 kHz



9. Technical data

9.1 Tabular data

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

Definitions

- Measuring circuit (IC1) ..... Primary conductors routed through the current transformer
- Secondary (IC2) ..... terminal block (24 V, GND, A, B, X1, X2)
- Rated voltage ..... 300 V
- Overvoltage category III
- Operating altitude ..... ≤ 2000 m AMSL

Rated impulse voltage

- IC1/IC2 ..... 4 kV

Rated insulation voltage

- IC1/IC2 ..... 300 V

Pollution degree 2

Basic insulation between

- IC1/IC2 ..... 300 V

Supply voltage

Supply voltage U_S ..... DC 24 V
Operating range of U_S ..... ±5 %
Ripple U_S ..... ≤ 2 %
Power consumption ..... ≤ 0.5 W typ. (2.5 W max.)
Inrush current ..... 10 A for 25 µs

Measuring circuit

Measuring current transformer, internal diameter ..... 25 mm
Characteristics according to IEC 62020-1 ..... AC/DC sensitive, type B
Measuring range ..... 10 . . . 500 mA
Residual operating current $I_{\Delta n}$ ..... 30 . . . 500 mA (freely configurable), (30 mA)*
Prewarning ..... 50 . . . 100 % $I_{\Delta n}$ (freely configurable), (60 %)
Rated current I_n ..... 100 A
Operating uncertainty

- DC . . . 50 kHz ..... ±17.5 %
- 50 . . . 100 kHz ..... 0 . . . +55 %

Relative uncertainty

- DC . . . 50 kHz ..... 0 . . . −35 %
- 50 . . . 100 kHz ..... −15 . . . +35 %

Time response

Response delay t_{on} (prewarning) ..... 50 ms . . . 60 min (1 s)*
Response delay t_{on} (main alarm) ..... 50 ms . . . 60 min (50 ms)*
Start-up delay t_{an} ..... 0 s . . . 60 min (freely configurable), (0 s)*
Delay on release t_{off} ..... 0 s . . . 60 min (freely configurable), (1 s)*
Operating time t_{ae}
- at 1 x $I_{\Delta n}$ ..... ≤ 500 ms
- at 2 x $I_{\Delta n}$ ..... ≤ 230 ms
- at 5 x $I_{\Delta n}$ ..... ≤ 100 ms

Response time $t_{an} = t_{ae} + t_{on}$
Recovery time t_b ..... ≤ 1 s

Displays

Multicolour LED ..... Refer to "LED" on page 20.

Interface

Interface/protocol ..... RS-485/Modbus RTU
Baud rate ..... 1.2 . . . 57.6 kbit/s
Cable length ..... 0 . . . 1200 m

Environment/EMC

EMC ..... IEC 62020-1
Operating temperature ..... -25 . . . 70 °C
Classification of climatic conditions acc. to IEC 60721
- Stationary use (IEC 60721-3-3) ..... 3K23 (except condensation and formation of ice)
- Transport (IEC 60721-3-2) ..... 2K11 (except condensation and formation of ice)
- Long-term storage (IEC 60721-3-1) ..... 1K22 (except condensation and formation of ice)

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

Required terminals are included in the scope of delivery

Terminal block

Manufacturer ..... Phoenix Contact
Type ..... PCB plug-in connector - DFMC 0.5/ 8-ST-2.54
The connection conditions of the manufacturer apply.
Connection properties
rigid ..... 0.14 . . . 0.5 mm² (AWG 26 . . . 20)
flexible ..... 0.14 . . . 0.5 mm² (AWG 26 . . . 20)
with ferrules ..... 0.25 . . . 0.34 mm² (AWG 24 . . . 22)

Other

Operating mode ..... continuous operation
Mounting ..... any position
Degree of protection, internal components (DIN EN 60529) IP40
Degree of protection, terminals (DIN EN 60529) IP20
Flammability class UL94 V-0
Software D0609
Weight ..... ≤ 170 g

9.2 Standards and certifications

CE UKCA

9.3 Ordering information

Electronic modules

Supply voltage U_S	Variant	Type	Art. No.
DC 24 V (19.2…28.8 V)	Modbus RTU	RCMB330	B74043160

Accessories

Description	Art. No.
RS-485/USB interface converter	B95012045

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	Max. connected current transformers	Type	Art. No.
Voltage supply	4	STEP-PS/1 AC/24 DC/0.5	B94053110
	14	STEP-PS/1 AC/24 DC/1.75	B94053111
	34	STEP-PS/1 AC/24 DC/4.2	B94053112

9.4 Document revision history

Date	Document version	State/changes
12.2020	00	First edition

INDEX

T

V

W

BENDER
The Power in Electrical Safety©

Bender GmbH & Co. KG
PO Box 1161 • 35301 Grünberg • Germany
Londorfer Str. 65 • 35305 Grünberg • Germany
Tel.: +49 6401 807-0 • Fax: +49 6401 807-259
email: info@bender.de • www.bender.de

BENDER Group

Photos: Bender Archive