RCMB132-01

AC/DC sensitive residual current monitoring module for measuring AC and DC currents up to ±100 mA

Intended use

The AC/DC sensitive residual current monitoring module monitors electrically earthed power supplies up to 300 V and connected loads up to nominal currents of 32 A for leakage and fault currents. The module is intended for installation in distribution equipment such as PDUs (Power Distribution Units), outlet boxes or multiple socket-outlets and is supplied with DC 12…24 V.

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

General safety instructions

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

Installation, connection and commissioning are to be carried out by electrically skilled persons only! It is essential to follow the existing safety instructions.

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

This symbol refers to information that is designed to help you make the best use of the product.

Scope of delivery

1 RCMB132-01

2 four-pole plugs (Phoenix Contact, PTSM 0.5/4-P-2.5)

1 cover plug for protecting an open socket

Device features

- AC/DC sensitive leakage and fault current monitoring for preventive maintenance
- High resolution for implementing equipment leakage current monitoring
- Measured value and alarm transmission via Modbus RTU (RS-485)
- Frequency range DC…2 kHz
- Compact design for monitoring nominal loads up to I_n = 32 A
- Low load current sensitivity due to fully shielded measuring current transformer
- Continuous monitoring of the connection to the measuring current transformer
- Integrated test function
- Supply voltage DC 12…24 V

Functional description

The RCMB132-01 is used to measure residual currents and output the values via an interface. The residual current monitoring module measures both AC and DC currents. The rms value is calculated from the DC component included in the residual current and the AC component below 2000 Hz. The RCMB132-01 continuously checks the connection of the internal measuring current transformer.

Via the RS-485 interface:

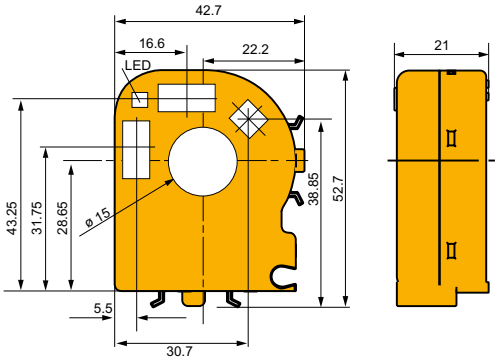
- a signal proportional to the rms value is transmitted (measured value update every 180 ms)
- alarm messages are signalled

- response values are configured
- a functional test can be started

The existing switching outputs S1 and S2 switch to alarm state when the set response value is exceeded or a malfunction occurs.

When S2 (rms) switches, S1 (DC) is also switched simultaneously.

Dimension diagram



All dimensions in mm

Installation and connection

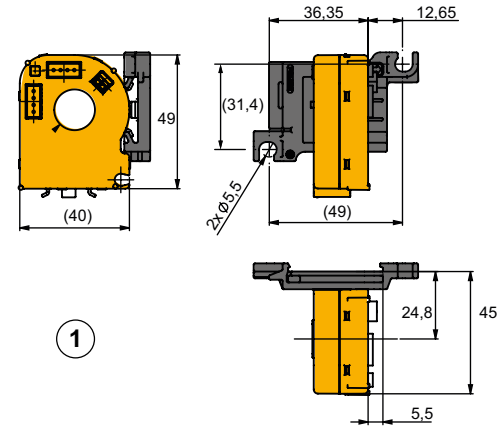
RISK OF AN ELECTRIC SHOCK!
*EXISTING **PROTECTIVE CONDUCTORS** AND LOW-RESISTANCE CONDUCTOR LOOPS **MUST NOT BE ROUTED THROUGH THE MEASURING CURRENT TRANSFORMER!** OTHERWISE, HIGH CURRENTS COULD BE INDUCED INTO THE CONDUCTOR LOOP DUE TO THE AC/DC SENSITIVE MEASURING TECHNOLOGY USED.*

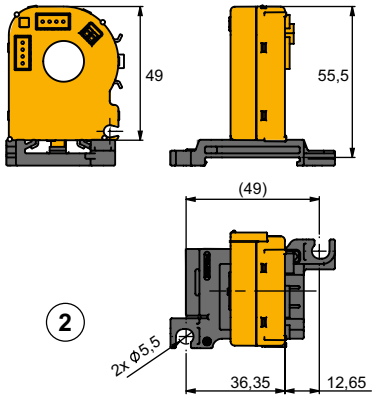
The standard Modbus address of the monitoring module is 100. If several monitoring modules are installed in a system, the Modbus addresses should be set on the bus before common commissioning.

Primary conductors must be insulated in such a way that they fulfil the function of basic insulation for the rated voltage.

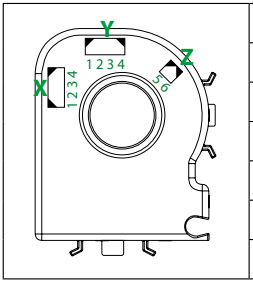
DIN rail mounting

Mounting with mounting foot MCCT20 (accessories, refer to ordering details)





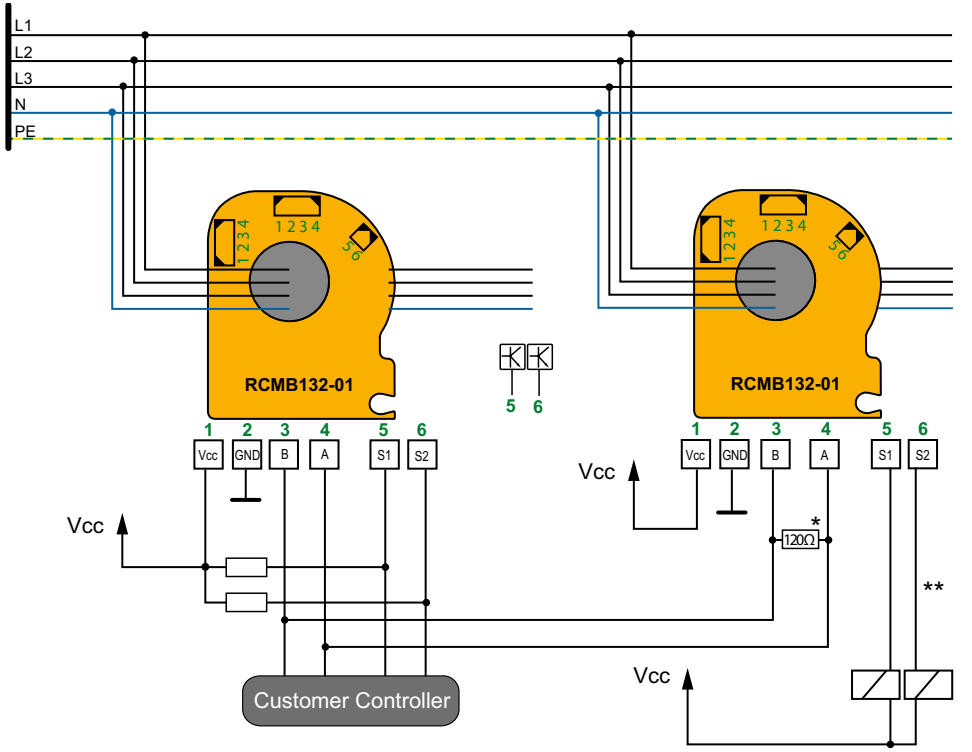
Pin assignment



Pin	Name	Description
X1, Y1	Vcc	Supply voltage (DC 12…24 V)
X2, Y2	GND	Ground
X3, Y3	B	RS-485-B
X4, Y4	A	RS-485-A
Z5	S1	Switching output 1 (DC)
Z6	S2	Switching output 2 (rms)

The two four-pole connectors **X** and **Y** are designed as combinations of socket and plug, the two-pole connector **Z** is designed as push-in terminal.

Wiring diagram (example)



* Terminating resistor 120 Ω must only be set on the last device in the RS-485 bus chain.

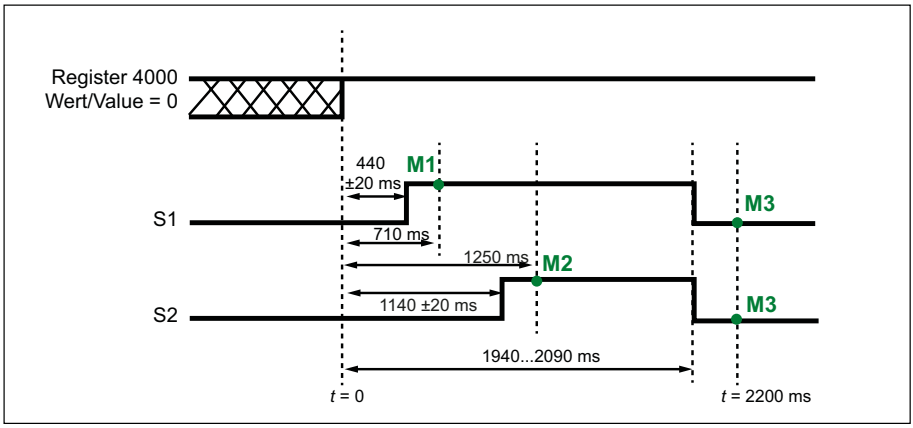
** An external protective circuit is especially required for inductive loads.

Timing diagram "Functional test"

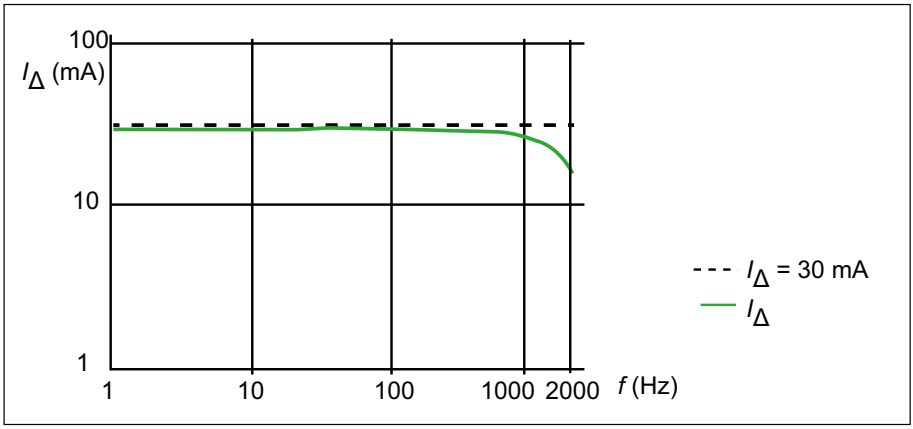
As soon as it is recognised that register 4000 has the value 0, the time measurement starts with *t* = 0.

M1…3 in the timing diagram are the points in time at which a higher-level control can and should check during the functional test that the switching outputs S1…2 actually switch independently of each other. Possible causes for a failed functional test:

- S… is permanently connected to GND
- S… is permanently connected to Vcc
- Short circuit between S1 and S2



Frequency response at response value I_Δ = 30 mA



Dashed line: I_Δ (response value)
Green: I_Δ (measured value)

Modbus register overview

Supported function codes:

0x03	Read Holding Registers
0x04	Read Input Registers
0x06	Write Single Register
0x10	Write Multiple Registers

Properties of the registers:

RO	Read Only
WO	Write Only
RW	Read and Write

"Broadcast" (address "0"): Execute action, do not send a response. Broadcast only functions with write commands.

If there is more than one slave on the bus, a change of the bus address must under no circumstances be triggered via broadcast.

If a new parameter value is stored during a write access, the response of the monitoring module is delayed for a maximum of 55 ms due to the internal storage process. During this time, no Modbus communication is possible. In the event of multiple write accesses (function code 0x10, Write Multiple Registers), the times are added up.

Measured values and statuses

Register	Property	Description	Format	Description/unit	Range
2000	RO	Measured value $I_{\Delta n\,rms}$	UINT16	x 0.1 mA	0…1000
2001	RO	Measured value $I_{\Delta n\,DC}$	UINT16	x 0.1 mA	0…1000
2002	RO	Status word 1 [1]	UINT16	Bit	0…0xFFFF
2003	RO	Status word 2 [2]	UINT16	Bit	0…0xFFFF
2004	RO	Application software version	UINT16	103dez = V1.03	0…0xFFFF
2005	RO	Communication API version	UINT16	256dez = V2.56	0…0xFFFF
2006	RO	Software version	UINT16	604dez = D0604	0…65535
2007	Reserved				
2008	Reserved				
2009	RO	Serial number	UINT32	HiWord	$0…2^{32}$-1
2010				LoWord	
2011	RO	Max. measured value $I_{\Delta n\,rms}$ [3]	UINT16	x 0.1 mA	0…1000
2012	RO	Max. measured value $I_{\Delta n\,DC}$ [3]	UINT16	x 0.1 mA	0…1000
2013…2999	Reserved				

[3] Maximum measured value since last reading of register 2000 or 2001

[1] Status word 1

Status byte	Bit	Meaning	Value
1	Bit 0	Status ERR_OUT	0 = error, deactivated 1 = no error, activated
	Bit 1	Status S1	0 = off, deactivated, triggered 1= on, activated, not triggered
	Bit 2	Status S2	
	Bit 3	Reserved	
	Bit 4	Result last functional test	0 = no error 1 = measured current too low
	Bit 5…6	Reserved	
	Bit 7	Common error	0 = no error 1 = error
2	Bit 8…15	Reserved	

[2] Status word 2

Status byte	Bit	Meaning	Value
3	Bit 0…7	Reserved	
	Bit 8	RMS measurement status	0 = RMS value < response value 1 = RMS value > response value
4	Bit 9	RMS measurement status	0 = DC value < response value 1 = DC value > response value
	Bit 10…15	Reserved	

Parameters

Duration write access: 55 ms.
When writing, the old value is sent first. Only after this does the changeover to the new value take place.

Register	Property	Description	Format	Description/unit	Range
3000	RW	Response value $I_{An\,rms}$	UINT16	x 0.1 mA Example: 300 = 30.0 mA	3.5…100.0 mA
3001	RW	Response value $I_{An\,DC}$	UINT16		
3002	RW	Bus address	UINT16		1…247
3003	RW	Baud rate	UINT16		0* = 19200 bps 1 = 9600 bps
3004	RW	Transmission mode	UINT16		0* = 1-8-E-1 ; 1 = 1-8-O-1 2 = 1-8-N-2; (3 = 1-8-N-1)
3005…3999	Reserved				

** = factory settings*

Control (test, reset, find module)

Register	Property	Description	Format	Comment/Unit	Range
4000	WO	Test & reset	UINT16	Test = approx. 2 s (see timing diagram Abb. 8–1)	0 = start functional test **without** offset measurement 1 = start functional test **with** offset measurement i *Loads must be switched off* 2 = reset measurement 3 = reset µC
4001…4009	Reserved				
4010	WO	Find module [1]	UINT16	Flashing time of the LED in s	1…30
4011…4019	Reserved				
4020	WO	Reset to factory settings (FAC)	UINT16		0 = Reset registers 3000…3001 to FAC 1 = Reset registers 3000…3004 to FAC
4021…4999	Reserved				

1) Prerequisite: Each module has a unique bus address. When writing to register 4010, exactly one slave is addressed via its bus address and starts to flash quickly. Register content 4010 is the flashing period to be used for the search of this module.

Special applications

The following registers can be used for extended identification and addressing of the modules. The three possible functions are explained in the register description.

The value written to register 60000 "Selector" is used to select the action to be executed. It is always written "Selector + serial number + other data" (function code 0x10, Write Multiple Registers). Exception: Reading the serial number in 60001…60002 with function code 0x03 (Read Multiple Registers).

Register	Property	Description	Format	Description/unit	Range
60000	WO	Selector [1]	UINT16		0 = find module 1 = set new bus address
60001…60002	RW [2]	Serial number [3]	UINT32		$0…2^{31}$-1
60003	WO	Data 1	UINT16	Selector in 60000 determines content	Selector = 0: Flashing time LED 1…30 s selector = 1: Bus address 1…247
60004…69999	Reserved				

[1] Register 60000 can only be written together with the correct register content from 60001…60003. The three registers are used as an extension of the Modbus address and only the slave with matching Modbus address and serial number reacts.

*[2] **Write**: address a specific module*

When writing together with register 60000 the factory-set serial number of the module from register 2009 is entered. It is considered an extension of the bus address, so that only the module with exactly this serial number reacts.

***Read**: query serial numbers of existing modules*

When reading registers 60001...60002, each module responds with the specified Modbus address after a random delay time. If several modules have the same Modbus address, different delays avoid simultaneous responses (collisions lead to crc errors). The master must respect a timeout period of 700 ms for reading the serial number so that the last possible response can still be received correctly.

During this time, the master stores all received responses.

*[3] **The serial number cannot be changed**. The write access only refers to the writing in blocks of registers 60000…60003 in order to change a Modbus address or to identify a module.*

1. Trigger signalling if serial number is known ("Find module")

Prerequisite:

The serial numbers of the modules are known.

If the same bus address is assigned to several modules (e.g. because the factory address settings have not been changed yet), the known serial number can be used to control an LED and thereby identify the module.

A broadcast request can also be sent to make a module with a known serial number (but unknown Modbus address) flash.

Master request

Function code	0x10	1 byte	
Start address	60000	2 bytes	
Number of registers	4	2 bytes	
Byte count	8	1 byte	
Selector value	0	2 bytes	Register 60000
Serial number HiWord	Serial high	2 bytes	Register 60001
Serial number LoWord	Serial low	2 bytes	Register 60002
LED flashing time	Flashing time (1…30 s)	1 byte	Register 60003

2. Assign new bus address when the serial number is known

Prerequisite:

The serial numbers of the modules are known.

Each module must have its own Modbus address via which it can be addressed. If the addresses were not assigned during the setup phase and therefore several modules have the same address (factory setting: 100), the known serial number can be used as an extension of the Modbus addressing. Registers 60000…60003 must be written together as a block. This way, only the module with matching bus address and serial number is addressed.

Master request

A broadcast request can also be sent to assign a new Modbus address to a module with a known serial number (but unknown Modbus address).

Function code	0x10	1 byte	
Start address	60000	2 bytes	
Number of registers	4	2 bytes	
Byte count	8	1 byte	
Selector value	1	2 bytes	Register 60000
Serial number HiWord	Serial high	2 bytes	Register 60001
Serial number LoWord	Serial low	2 bytes	Register 60002
New bus address	Bus address (1…247)	1 byte	Register 60003

3. Identify several modules on the bus with the same address

The serial number of the modules are unknown.

If new Modbus addresses are to be assigned to modules, the serial numbers must be known. If the serial numbers are unknown, they must first be read out and assigned to the modules. In order for this to work even if Modbus addresses are assigned multiple times, the response of each module (9 bytes in total) is sent with a random delay. If there are several slaves with the same bus address, there is a certain probability that the responses will not collide and can be read by the master. If the master receives a correct response, it stores the response and waits for further responses until the timeout period (700 ms) has elapsed.

If a new bus address is assigned to a correctly read serial number, this module can be excluded from a repeated request of the serial number by a function in the master.

Master request

Function code	0x03 (or 0x04)	1 byte
Start address	60001	2 bytes
Number of registers	2	2 bytes

Technical data

Insulation coordination according to IEC 60664-1

Primary circuit ..... monitored primary conductors
Secondary circuit ..... Connections Vcc, GND, A, B, S1, S2
All following specifications apply to the insulation between the primary and secondary circuit
- Rated voltage ..... 300 V
- Overvoltage category III
- Rated impulse voltage ..... 4 kV

Operating altitude ..... up to 3000 m AMSL
Rated insulation voltage ..... 320 V
Pollution degree 2
Safe separation (reinforced insulation) ..... between primary and secondary circuit
Voltage test acc. to IEC 61010-1 ..... AC 2.2 kV

Voltage supply

Supply voltage U_s ..... DC 12…24 V
Operating range of the supply voltage ..... ±20 %
Ripple ..... 100 mV
Power consumption ..... < 0.75 W

Measuring circuit

Internal diameter primary conductor opening ..... 15 mm
Measured value evaluation ..... DC, rms
Measuring range ..... AC/DC ±300 mA
Characteristics according to IEC 60755 ..... AC/DC sensitive, type B
$I_{\Delta n1}$
- Response value ..... DC 3.5…100 mA (* 6 mA)
- Response tolerance ..... 0.7…1.0 x $I_{\Delta n1}$

$I_{\Delta n2}$
- Response value ..... rms 3.5…100 mA (* 30 mA)
- Response tolerance
  - DC…1 kHz ..... 0.7…1.0 x $I_{\Delta n2}$
  - 1…2 kHz ..... 1.0…2.0 x $I_{\Delta n2}$

Output range ..... 0…100 mA (rms)
Resolution ..... < 0.2 mA
Frequency range ..... DC…2 kHz
Measuring time ..... 180 ms

Operating uncertainty

DC…500 Hz ..... ±(5 % + 0.5 mA)
501…1000 Hz ..... ±(15 % + 0.5 mA)
1…2 kHz ..... –(50 % ±0.5 mA)

Time response

Response time t_{ae} (relay switching time of 10 ms considered)
- for 1 x $I_{\Delta n}$ ..... ≤ 290 ms
- for 2 x $I_{\Delta n}$ ..... ≤ 140 ms
- for 5 x $I_{\Delta n}$ ..... ≤ 30 ms

Recovery time t_b ..... ≤ 2s

Disturbances

Load current I_n ..... 32 A

Response value assignment

$I_{\Delta n1}$ (DC) S1
$I_{\Delta n2}$ (rms) S2

Outputs

Interface RS-485
Protocol ..... Modbus RTU
Switching outputs ..... Open Collector, not short-circuit-proof
Switching capacity ..... 40 V/50 mA
Output voltage LOW level ..... 0…0.6 V
Output voltage HIGH level ..... 3.1…3.6 V
Hysteresis ..... ≤ 30 %

Environment/EMC

EMC ..... DIN EN 62020:2003 (VDE 0663), where applicable
Ambient temperature (incl. primary conductors routed through module) –25…+70 °C

Classification of climatic conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3) ..... 3K5 (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) 3M4
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M12

Other

Operating mode ..... continuous operation
Mounting ..... any position
Protection class ..... IP 30
Flammability class UL94 V-0
Service life at 40 °C ..... 10 years
Software D0604
Plug (included in scope of delivery) ..... Phoenix Contact, PTSM 0.5/4-P-2.5

** = factory settings*

Ordering details

Type	Measuring range	U_s	Art. No.
RCMB132-01	AC/DC ±100 mA	DC 12…24 V	B94042136
Mounting foot MCCT20			B91080111

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The Power in Electrical Safety©

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