



LINETRAXX® MRCDB423

Modular Residual Current Device type B for additional protection (protection against indirect contact) in earthed systems (TN and TT systems)



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1 General instructions

1.1 How to use this manual



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 "Safety instructions for Bender products".



Read the manual before mounting, connecting and commissioning the device. Always 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.



Information can help to optimise the use of the product.

1.3 Signs and symbols



Disposal



Recycling



Temperature range



Protect from moisture



Protect from dust



RoHS directives



Press button once



Hold button for x seconds



Element flashes

1.4 Training courses and seminars

www.bender.de/en -> Know-how -> Seminars.

1.5 Delivery conditions

The conditions of sale and delivery set out by Bender apply. These can be obtained from Bender 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."

1.6 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. The following must be observed when storing the devices:



1.7 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded in 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.
- Use of accessories and spare parts not recommended by Bender.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not 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.

1.8 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/en -> [Service & support](#).

1.9 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 electrocution due to electric shock! *Touching live parts of the system carries the risk of:*

- A fatal 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. The rules for working on electrical systems must be observed.

1.10 Intended use

The AC/DC sensitive MRCDB423 with the corresponding CTUB101-CTBC... measuring current transformers and a circuit breaker according to IEC 60947-2 are used as additional protection (protection against indirect contact) in earthed systems (TN and TT systems) in which AC or DC fault currents may occur. Part of these systems are in particular loads with six-pulse rectifiers or one-way rectifiers with smoothing, such as converters, battery chargers, construction site equipment with frequency-controlled drives.

Since the values are measured with measuring current transformers, the MRCDB423 is almost independent of the nominal voltage and the operating current of the monitored system.

The response value $I_{\Delta n2}$, the response delay t_{on2} as well as the currently measured residual current I_{Δ} are shown on the standard display.

Connection voltages and technical requirements for operating the device are specified in the technical data. Any other use of the device than that described in this document is regarded as improper.

Information on factory settings

How to reset the MRCDB423 to the factory settings is described in section 5.5 on page 12.

For a list of the factory settings, refer to section „5.6 Setting ranges and factory settings“ on page 12.

2 Function

2.1 Device features

- AC/DC sensitive MRCD type B in accordance with IEC 60947-2 Annex M
- Operating characteristic type B in accordance with IEC 60755
- RMS value measurement of the residual current
- Alarm and prewarning indication via display and LEDs
- Alarm and prewarning output via relays (K1/K2)
- Measuring current transformer connection monitoring
- Fault memory

2.2 Functional description

After connecting the supply voltage U_s , the start-up delay is active. During start-up delay " t ", the device is in alarm state, which means that the output relays K1 and K2 are open and the installation is switched off. During start-up delay, changes on the measured residual currents do not influence the relays K1/K2. The residual current measurement is carried out via an external CTUB101-CTBC20(P)...210(P) measuring current transformer. The currently measured value is indicated on the LC display. This allows changes to be detected, e.g. when outgoing circuits are connected to the system.

If the set value of the prewarning $I_{\Delta n1}$ is exceeded, response delay t_{on1} starts. After t_{on1} has elapsed, the output relay K1 switches and the prewarning LED lights up. The fault remains stored in the device: The output relay K1 remains in alarm state and the prewarning LED lights until the reset button "R" is pressed or the supply voltage is interrupted. The residual current measurement continues to be carried out.

If the set residual operating current $I_{\Delta n2}$ is exceeded, response delay t_{on2} starts. After t_{on2} has elapsed, output relays K1 and K2 switch. Output relay K2 trips the circuit breaker, which disconnects the outgoing circuit to be monitored. The prewarning and main alarm LEDs light up. The fault remains stored in the device: Both output relays remain in alarm state and the LEDs light until the reset button "R" is pressed or the supply voltage is interrupted.

Since the installation has been switched off, residual current measurement is no longer possible. After switching off, an automatic offset measurement is carried out. The described device combination meets the requirements of IEC 60947-2 Annex M for an MRCD protective device.

The device function can be tested using the test button "T". Parameters are assigned to the device via the LCD and the control buttons on the front panel; this function is password-protected.

2.3 Standard display

The standard display shows the following:

- Residual operating current $I_{\Delta n2}$
- Response delays t_{on2}
- Residual current (present measured value)

The displayed values change periodically every 4 s.

2.4 Connection monitoring

The connections to the measuring current transformer are continuously monitored. In case of a transformer connection fault, the output relays K1 and K2 switch, all LEDs flash. In addition, the error code "E.01" appears on the display. Output relay K2 trips the circuit breaker, which disconnects the outgoing circuit to be monitored. When the connection fault has been eliminated and the reset button "R" is pressed, the output relays K1 and K2 switch back to their initial position.

2.5 Manual self test

The device carries out a self test by pressing and holding the test button "T" (> 2 s), during which any internal malfunctions are detected and displayed as an error code.

The output relays K1/K2 are switched so that the circuits breakers disconnects. After switching off, the MRCDB423 carries out an offset calibration.

i *Due to this offset calibration, the self test must not be carried out without a circuit breaker connected, which will shut down the installation. Otherwise, the measurement function may be faulty after the self test has been performed.*

This function prevents long-term drifting.

While pressing and holding the test button "T", all device-relevant display elements are shown.

2.6 Malfunction

In the event of an internal malfunction, all three LEDs flash. The display shows an error code (E.01...E.32). In such cases, please contact the Bender Service.

2.7 Time delays t and t_{on}

The times t and t_{on} described below delay the signalling of prewarning and main alarm via LEDs and the output relays.

2.7.1 Start-up delay t

After the supply voltage U_s has been switched on, the device is in alarm state, which means that the output relays K1 and K2 are open and the installation is switched off. This parameter cannot be adjusted.

2.7.2 Response delay $t_{on1/2}$

When exceeding a response value $I_{\Delta n1/2}$, the MRCDB423 requires the response time t_{an} to output the alarm. A set response delay $t_{on1/2}$ (0...10 s) is added to the device-specific operating time t_{ae} and delays signalling.

(Total delay time $t_{an} = t_{ae} + t_{on}$).

If the fault does not persist during the response delay, the alarm is not signalled.

i *If $I_{\Delta n2}$ is set to 30 mA (personal protection), the response delay t_{on2} of K2 is automatically and invariably set to 0 s.*

2.8 External, combined test or reset button T/R

Reset = pressing the external button briefly (< 1 s)

Test = pressing and holding the external button (> 2 s)

The device function can be tested using the test button "T".

2.9 Device parameter settings

The device parameters are set via the control buttons on the front. The device parameter settings are password-protected.

3 Dimensions and mounting

3.1 Dimensions

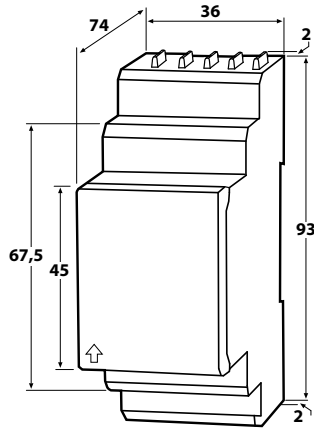
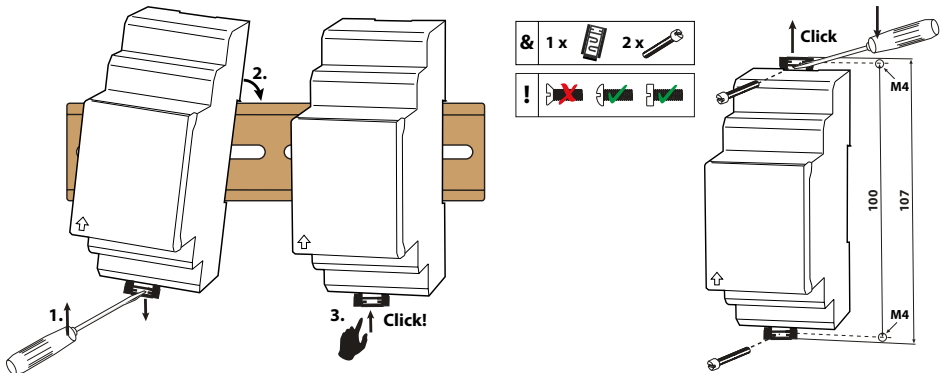


Abb. 3-1 Dimensions in mm

3.2 Mounting



Variant A: DIN rail mounting

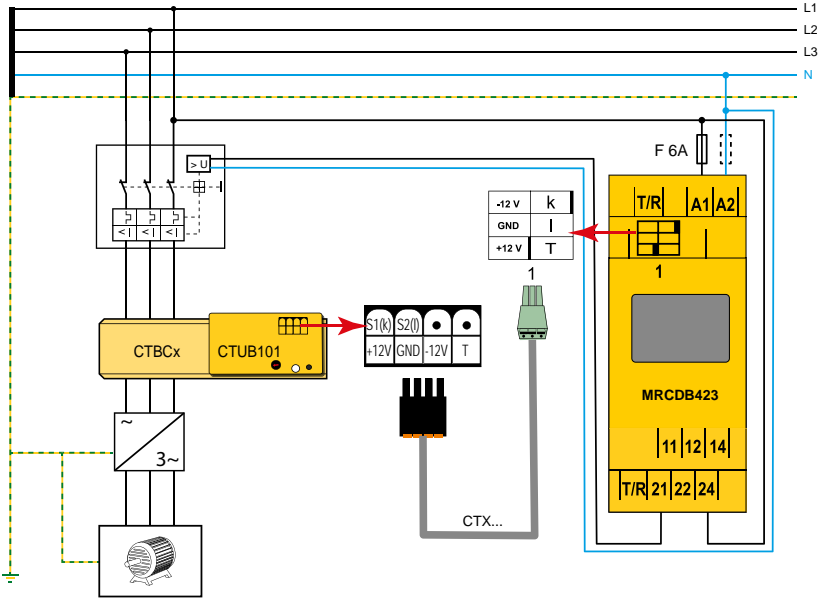
Variant B: screw mounting

The front plate cover can be opened at the lower part marked with an arrow.

4 Connection



DANGER! Risk of fatal injury due to electric shock! Touching live system parts can result in fatal injuries. Ensure that there is no voltage in the installation area and follow the rules for working on electrical equipment.



Terminal	Connections
A1, A2	Connection to supply voltage U_s
1	Socket for connection cable of measuring current transformer
T/R	Connection for a combined external test and reset button
11, 12, 14	Output relay K1 (alarm)
21, 22, 24	Output relay K2

i To comply with IEC 60947-2 Annex M, the MRCDB423 must be operated according to the N/C principle in combination with a circuit breaker with undervoltage release or shunt trip. The circuit breaker must be able to switch off in less than 17 ms and comply with the IEC 60947-2 standard.



WARNING! An electric shock caused by excessively high fault currents can result in serious injuries or death. The MRCDB423 device must not be operated without a circuit breaker and must only be used in switching applications! After the output relay K2 switches off, an automatic offset measurement is carried out, which takes an existing fault current as the basis for the calibration. This may cause the protection to fail because the system does not switch off if the fault current is too high.

5 Operation and settings

5.1 Function of the operating elements

Device front	Element	Function
	ON (green)	lights continuously: Power On LED, flashes: system fault or malfunction of connection monitoring
	AL1	Alarm LED lights (yellow): response value $I_{\Delta n1}$
	AL2	LED TRIP lights (yellow): response value $I_{\Delta n2}$
	13 mA	13 mA flow through the measuring current transformer,
	M	fault memory active
	T	Standard display: (> 2 s): display test, self test
	▲	Menu display: arrow-up button (< 1 s)
	R	Standard display: Reset button; (> 2 s): Clearing the fault memory
	▼	menu display: arrow-down button (< 1 s)
	MENU	Standard display: Menu display: Enter button
	(< 1 s)	<ul style="list-style-type: none"> • Confirm menu item, submenu item and value. • Back to the next higher menu level
	(> 2 s)	

5.2 Display elements

The display elements are shown for one second when a device test is started. The following table lists the elements that are linked to functions.

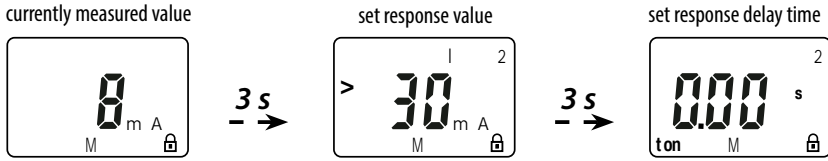
Element	Function
I2	Response value $I_{\Delta n2}$ in mA
I1	Response value $I_{\Delta n1}$ in % of $I_{\Delta n2}$
ton1	Response delay t_{on1} (K1)
ton2	Response delay t_{on2} (K2)
M	Fault memory active
	Password protection enabled

5.3 Meaning of the LEDs

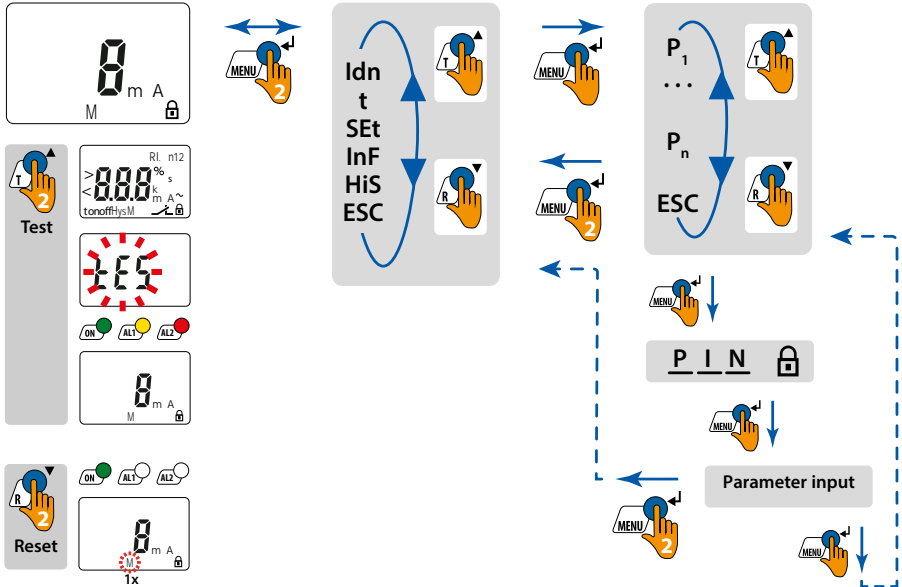
Meaning	ON	AL1	AL2
Error message (system error)			
Prewarning			
Message, Test $I_{\Delta n1}$ or Residual operating current $I_{\Delta n2}$ reached			

5.4 Standard display

On the standard display, the device alternately shows the following information during operation:



5.5 Menu structure



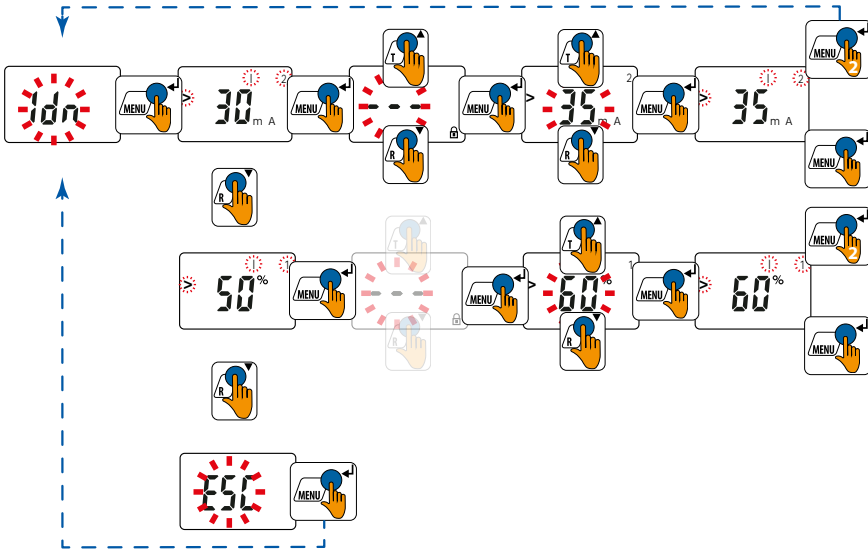
5.6 Setting ranges and factory settings

Menu	Parameter	Description	Range	Factory settings
AL	I2 >	Response value I2; "Greater than" comparison	30 mA...3.0 A	30 mA
	I1 >	Response value I1; "Greater than" comparison	50...100 %	50 %
t	ton1	Response delay output relay 1	0...10 s	1 s
	ton2	Response delay output relay 2	0...10 s	0 s
Set	---	Password for parameter setting	off/000...999	000
	FAC	Reset to factory settings	YES / no	no
	SYS	Service menu (locked)	000...999	-
InF	-	Software version		
HiS	-	Display memory for the first fault		

5.7 Parameter input

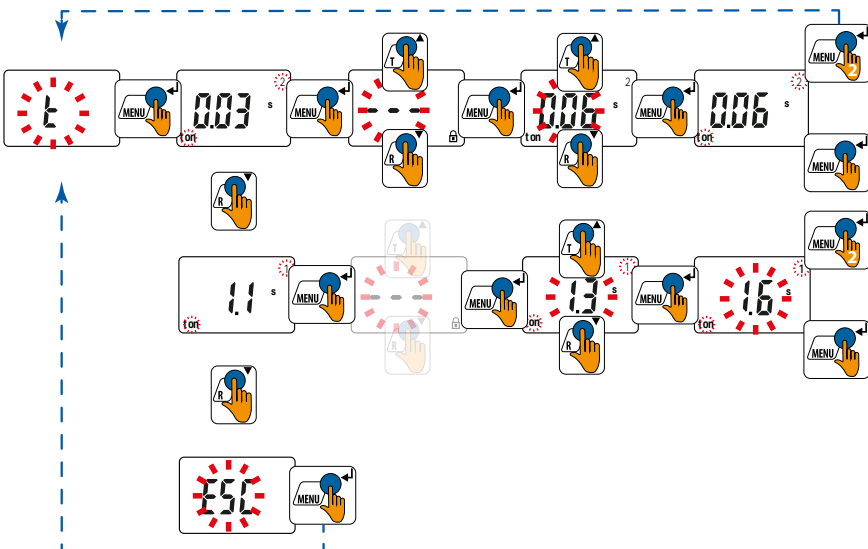
5.7.1 I_{dn} menu

Setting of the response values for the alarm I_{dn} (mA) and the prewarning (%)



5.7.2 t menu

Setting of the response delay times t_{on1} and t_{on2}



5.7.3 SEt menu

Reset to factory settings

System

5.7.4 InF menu

The menu displays the software version of the device. The first pass is automatic; afterwards all characters can be displayed with the T button (back) and the R button (forward).

Press ESC to return to the menu selection.

5.7.5 HiS menu

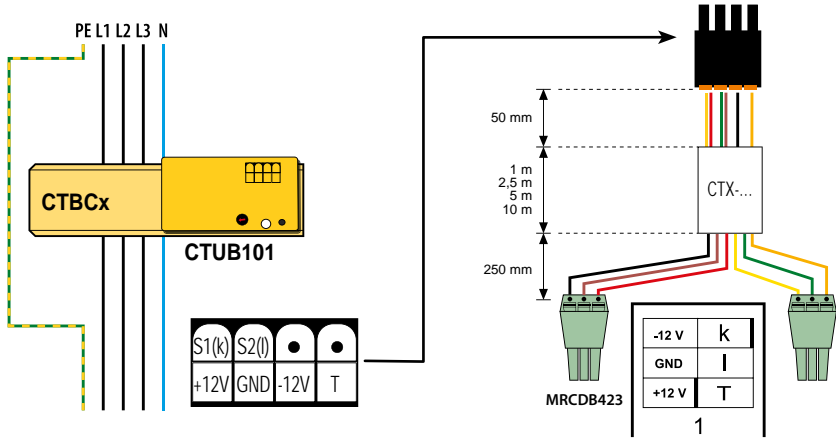
The History menu displays the value in the fault memory and clears it on request (CLr).

Press ESC to return to the menu selection.

6 Measuring current transformers

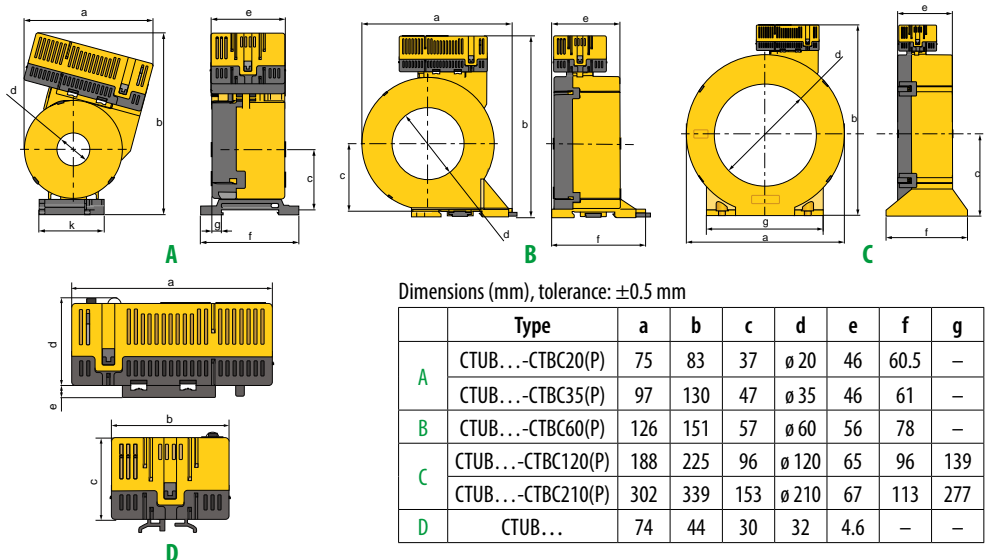
CTUB101-CTBC... series measuring current transformers in combination with MRCDs convert AC and DC currents into an evaluable measuring signal. They can be used in DC, AC, and 3(N)AC systems. The shielded measuring current transformers of the CTUB101-CTBC...P series also feature a full magnetic shield to prevent nuisance tripping due to external influences.

6.1 Wiring diagram

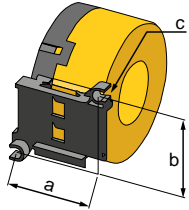


i The measuring range must be set according to the response values in the evaluator. It is imperative to observe the manual of the respective measuring current transformer.

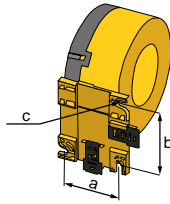
6.2 Dimension diagrams



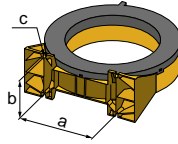
6.3 Fastening



CTBC20(P), CTBC35(P)



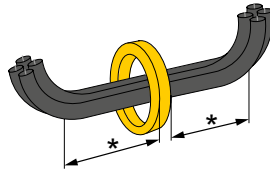
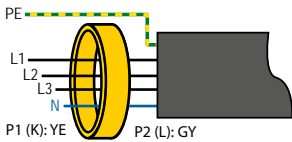
CTBC60(P)



CTBC120(P) ... CTBC210(P)

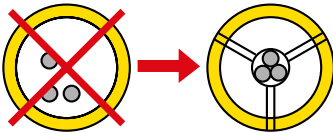
Type	a	b	c
CTBC20(P)	31.4	49	2 x \varnothing 5.5
CTBC35(P)	49.8	49	2 x \varnothing 5.5
CTBC60(P)	56	66	3 x \varnothing 6.5
CTBC120(P)	103	81	4 x \varnothing 6.5
CTBC210(P)	180	98	4 x \varnothing 6.5

6.4 Mounting instructions

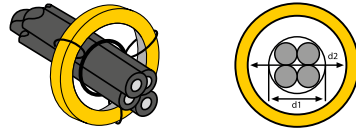


All current-carrying cables must be routed together through the measuring current transformer. Never route an existing protective conductor through the measuring current transformer.

The primary conductors may only be bent from the specified minimum distance. The minimum bending radius specified by the manufacturers must be observed.
* Distance to 90° angle = 2 x external diameter



The cables must be centred in the measuring current transformer.



To prevent nuisance tripping, the measuring current transformers should not be completely filled with cables. The internal diameter of the current transformer should be at least twice the diameter of the conductor bundle to be measured. The following applies: $d2 \geq 2 \times d1$

6.5 Shielded measuring current transformer variants

When used in outgoing circuits with high load or inrush currents, local saturations of the magnetic core material of the measuring current transformers can occur. It is therefore recommended to use the shielded P versions to prevent nuisance tripping.

The values are listed in the technical data and refer to a correctly selected internal diameter of the measuring current transformer: $d2 \geq 2 \times d1$ (cable diameter).

7 Technical data

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

MRCD423-D-1:

Rated voltage	100 V
Overvoltage category/pollution degree.....	III/2
Rated impulse voltage	2.5 kV

MRCD423-D-2:

Rated voltage	250 V
Overvoltage category/pollution degree.....	III/2
Rated impulse voltage	4 kV

Protective separation (reinforced insulation) between.....

..... (A1, A2) - (k, l, T/R) - (11, 12, 14) - (21, 22, 24)

Voltage tests acc. to IEC 61010-1 2.21 kV

Supply voltage

MRCD42-D-1:

Supply voltage range U_s	AC 24...60 V / DC 24...78 V
Operating range supply voltage U_s	AC 16...72 V / DC 9.6...94 V
Frequency range U_s	DC, 42...460 Hz

MRCD423-D-2:

Supply voltage range U_s	AC/DC 100...250 V
Operating range supply voltage U_s	AC/DC 70...300 V
Frequency range U_s	DC, 42...460 Hz

Power consumption..... ≤ 6.5 VA

Measuring circuit

External measuring current transformer type.....

..... CTUB101 - CTBCxx(P); CTUB101 - CTBCxxx(P)

Rated voltage (measuring current transformer) 800 V

Operating characteristic in accordance with IEC 6075 type B

Rated frequency..... 0...2 000 Hz

Operating uncertainty..... 0...35 %

Response values

 Rated residual operating current $I_{\Delta n1}$

 50...100 % of $I_{\Delta n2}$ (50 %)*

 Rated residual operating current $I_{\Delta n2}$

..... 30 mA...3 A (30 mA)*

Time response

 Start-up delay t (1 s)*

 Response delay t_{on1} 0...10 s (1 s)*

 Response delay t_{on2} 0...10 s (0 s)*

 Operating time t_{ae} at $I_{\Delta n} = 1 \times I_{\Delta n1/2}$ ≤ 180 ms

 Operating time t_{ae} at $I_{\Delta n} = 5 \times I_{\Delta n1/2}$ ≤ 23 ms

 Response time t_{an} $t_{an} = t_{ae} + t_{on1/2}$

 Recovery time t_b ≤ 300 ms

Displays, memory

Display range measured value AC/DC 0...6 A

Error of measured value display ±17.5 % / ±2 digit

Measured-value memory for alarm value Data record measured values

Password off / 000...999 (000)*

Fault memory output relay yes

Inputs/outputs

Cable length for external test/reset button 0...3 m

Cable length for measuring current transformer connection.....

0...3 m

Switching elements

Number of switching elements 2 x 1 changeover contact

Operating principle N/C operation

Electrical endurance, number of cycles

..... 10000

Contact data acc. to IEC 60947-5-1:

Utilisation category..... AC-13 AC-14 DC-12 DC-12 DC-12

Rated operational voltage 230 V 230 V 24 V 110 V 220 V

for UL.....200 V 200 V 24 V 110 V 200 V

Rated operational current. 5 A 3 A 1 A 0.2 A 0.1 A

Minimum contact rating 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC IEC 60947-2 Annex M (limit value class A according to CISPR11)

Operating temperature -25...+55 °C

Transport -25...+70 °C

Long-term storage..... -25...+55 °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

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..... screw-type terminals

Connection properties:

 Rigid/flexible 0.2...4/0.2...2.5 mm² (AWG 24...12)

Multi-conductor connection (2 conductors with the same cross section):

 Rigid/flexible 0.2...1.5/0.2...1.5 mm²

Stripping length..... 8...9 mm

Tightening torque..... 0.5...0.6 Nm

Other

Operating mode continuous operation
 Position of normal use display-oriented
 Degree of protection, internal components (IEC 60529) IP30
 Degree of protection, terminals (IEC 60529) IP20
 Enclosure material polycarbonate
 Flammability class UL94V-0
 DIN rail mounting acc. to IEC 60715
 Screw fixing 2 x M4 with mounting clip
 Weight ≤ 150 g

7.1 Ordering information

	MRDCB423-D-1	MRDCB423-D-2
Order number	B94043055	B94043056
Response range	30 mA...3 A	30 mA...3 A
Rated frequency	0...2000 Hz	0...2000 Hz
Supply voltage U_s	DC 9.6...94 V / AC 42...460 Hz, 16...72 V	DC 70...300 V / AC 42...460 Hz, 70...300 V

Measuring current transformer type	∅	Art. No.
CTUB101-CTBC20	20 mm	B78120010
CTUB101-CTBC20P (shielded)		B78120020
CTUB101-CTBC35	35 mm	B78120012
CTUB101-CTBC35P (shielded)		B78120022
CTUB101-CTBC60	60 mm	B78120014
CTUB101-CTBC60P (shielded)		B78120024
CTUB101-CTBC120	120 mm	B78120016
CTUB101-CTBC120P (shielded)		B78120026
CTUB101-CTBC120	210 mm	B78120018
CTUB101-CTBC120P (shielded)		B78120028

7.2 Error codes

Error code	Meaning
E.01	<p>Error measuring current transformer monitoring</p> <p>Actions:</p> <ul style="list-style-type: none"> – Check transformer connection for short circuit or interruption. – Check the measuring range setting on the potentiometer of the measuring current transformer and adjust it to the response value set on the MRCDB423. <p>The error code will be deleted once the error has been eliminated and the reset button has been pressed.</p>
E.02	<p>Error measuring current transformer monitoring during a manual self test</p> <p>Action:</p> <ul style="list-style-type: none"> – Check transformer connection for short circuit or interruption. <p>The error code will be deleted once the error has been eliminated, the manual self test has been run again (test button "T") and the reset button "R" has been pressed.</p>
E. ...	<p>Error codes > 02</p> <p>Action:</p> <ul style="list-style-type: none"> – Perform a reset. Restore the factory settings of the device. <p>The error code will be deleted automatically once the error has been eliminated. Should the error persist, please contact the Bender Service.</p>

7.3 Document revision history

Date	Document version	Software version	Changes
05/2021	01	V 1.03	<ul style="list-style-type: none"> - Set in DIN A5 format - "Intended use" has been changed - Warning text below wiring diagram (p.10), - Several textual amendments



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