

# **LINETRAXX® MRCDB300 series**

AC/DC sensitive residual current monitoring modules  
for MRCD applications





MRCDB300 series

### Device features

- Structure of a protective device in accordance with IEC 60947-2 Annex M in combination with a circuit breaker providing isolating properties
- Monitoring of the connected circuit breaker by means of contact feedback
- RS-485 interface with Modbus RTU (reading out measured values/setting parameters)
- Integrated switching outputs with two changeover contacts K1 and K2 (galvanically isolated)
- Fulfils the protection goals protection of persons, fire protection and plant protection (depending on the variant)
- Frequency range DC...100 kHz
- Combined test and reset button
- Multicolour LED indicating operation, exceeded response value, disturbances and status messages
- AC/DC sensitive type B measured value acquisition acc. to IEC 60755
- AC/DC sensitive type B+ measured value acquisition acc. to VDE 0664-400
- Exchangeable electronic enclosure without mechanical separation of the primary conductors
- Extension/retrofitting or modification of functionalities in case of changed monitoring requirements
- Insensitive to load currents due to full magnetic shield (CTBC20P...210P only)
- Connection monitoring of the measuring current transformer with cyclical test current
- Use of all MRCDB300 for all CTBC... measuring current transformer sizes
- Supply voltage DC 24 V

### Certifications



### Product description

The AC/DC sensitive MRCDB300 device series is 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 particularly loads containing six-pulse rectifiers or one-way rectifiers with smoothing, such as converters, battery chargers, construction site equipment with frequency-controlled drives. When the response value  $I_{\Delta n2}$  (alarm) is reached, the output relays K1 and K2 switch.

By using an MRCDB300 module and a switching element with isolating properties, the device combination fulfils the requirements of IEC 60947-2 Annex M for an MRCD protective device.

The application is specifically intended for protection goals such as protection of persons, fire protection and plant protection. The switching element must not exceed a switch-off time of 20 ms.

The residual current monitoring modules each consist of the MRCDB300 evaluation electronics and a CTBC20(P)...210(P) series measuring current transformer core.

To assemble a complete module, both the electronics and a measuring current transformer core are required; if ordered separately, these two components must then be plugged together and calibrated during commissioning.

The CTBC20P...210P series measuring current transformers feature an integrated magnetic shield and are suitable for applications with high load currents or inrush currents.

### Function

#### Residual current $I_{\Delta n}$

The residual current monitoring module measures both AC and DC currents. Tripping takes place based on this determined r.m.s. value. When the response value set for  $I_{\Delta n2}$  (alarm) is exceeded by a residual current, the output relay K2 switches an undervoltage release (recommended) or a shunt release (N/O operation) within the required tripping time and the LED lights up red.

When the fault memory is enabled, pressing and holding the "T" button between 1.5 and 5 s resets the device after the cause of the tripping has been eliminated.

The MRCD module automatically checks the measuring current transformer and the function of the residual current measurement cyclically.

#### Test

Press the "T" button or the external test button for 5...10 s to start the manual self test of the device.

#### Contact feedback

The contact feedback ensures that the trip circuit is in the desired switching state.

#### RS-485 interface

The RS-485 interface enables both reading out the measured values and setting the parameters of the device via Modbus RTU. Furthermore, a test can be triggered via the bus.

**Variants**

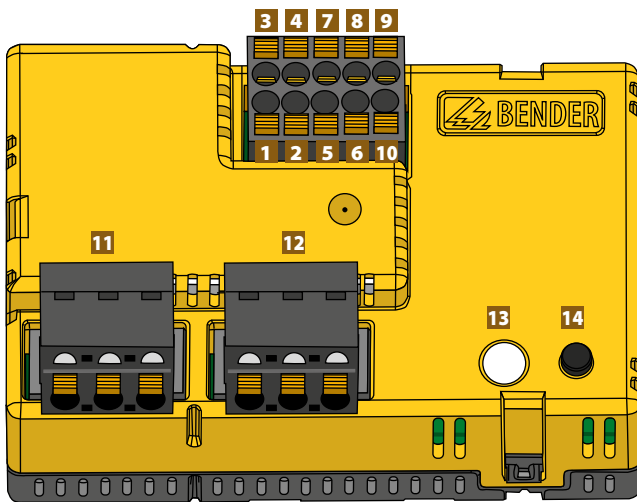
**Electronic modules**

- **MRCD301**  
Type B modular residual current protective device acc. to IEC 60755 for the **protection of persons** in case of indirect contact, response value 30 mA;
- **MRCD302**  
Type B+ modular residual current protective device acc. to VDE 0664-100 for **fire protection**, response value 300 mA; cut-off frequency 20 kHz (cannot be changed)
- **MRCD303**  
Modular residual current protective device for **plant protection** (N/C operation), freely configurable
- **MRCD305**  
Modular residual current protective device type B acc. to IEC 60755 for the **protection of persons** in case of indirect contact; for applications with pulse-shaped, very high peak load currents (> 1 kA for < 1 s), e.g. welding applications, response value 30 mA

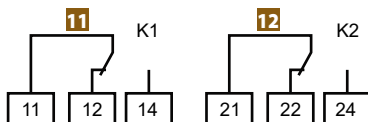
**Measuring current transformers**

- **CTBC20**  
Measuring current transformer, internal diameter 20 mm
- **CTBC20P**  
Measuring current transformer shielded, internal diameter 20 mm
- **CTBC35**  
Measuring current transformer, internal diameter 35 mm
- **CTBC35P**  
Measuring current transformer shielded, internal diameter 35 mm
- **CTBC60**  
Measuring current transformer, internal diameter 60 mm
- **CTBC60P**  
Measuring current transformer shielded, internal diameter 60 mm
- **CTBC120**  
Measuring current transformer, internal diameter 120 mm
- **CTBC120P**  
Measuring current transformer shielded, internal diameter 120 mm
- **CTBC210**  
Measuring current transformer, internal diameter 210 mm
- **CTBC210P**  
Measuring current transformer shielded, internal diameter 210 mm

**Wiring diagram**

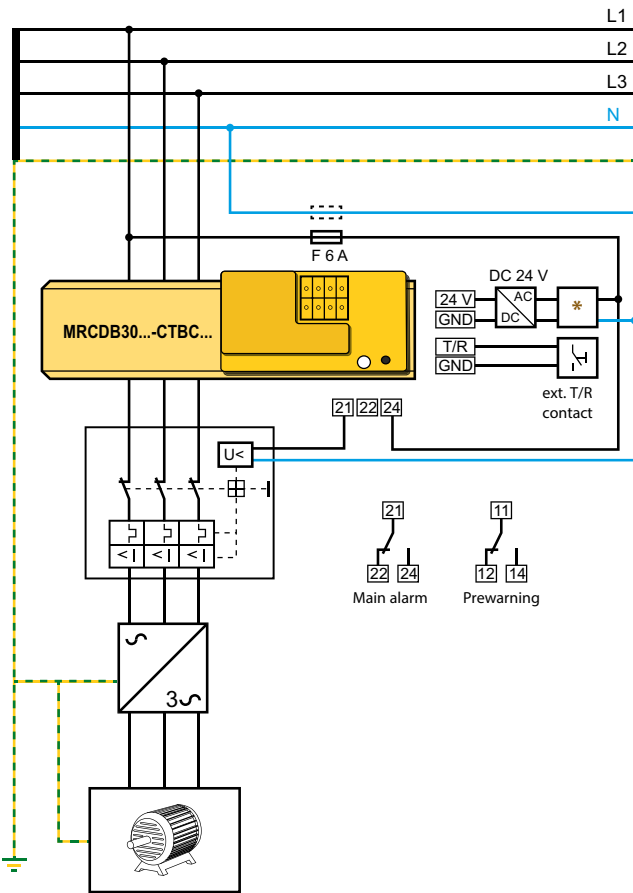


1	24 V	Supply voltage $U_s$
2	GND	
3	D1	Contact feedback
4	DG	
5	T/R	Connection external test/reset
6	GND	
7	A	RS-485 interface
8	B	
9	X1	Terminals for cable bridge for connection of the integrated terminating resistor of the RS-485 interface
10	X2	
11	11, 12, 14	Alarm relay K1
12	21, 22, 24	Alarm relay K2
13	ON/AL	Combined LED: operation "ON" and "Alarm"
14	T	Test and reset button

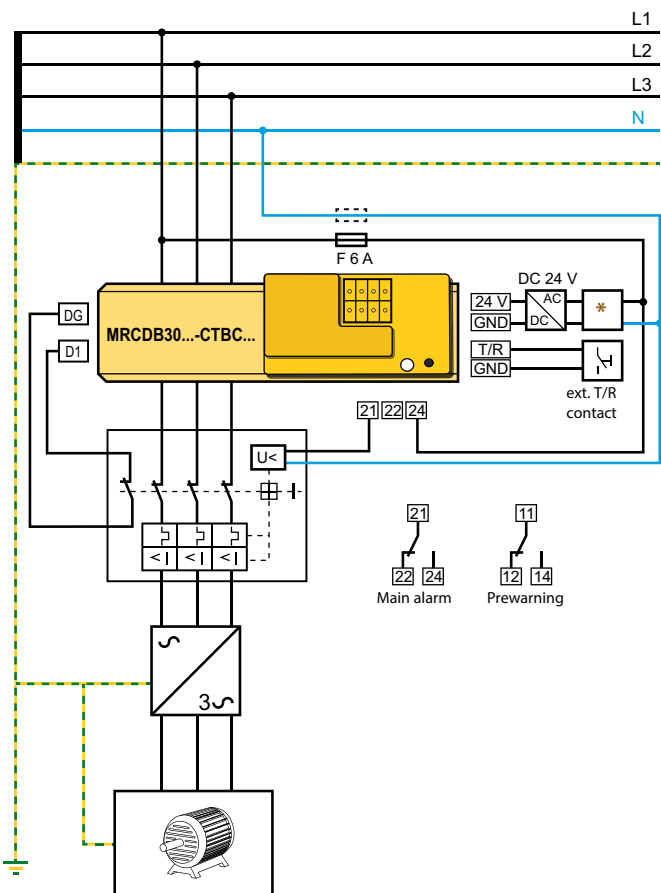


**Wiring diagrams**

N/C principle



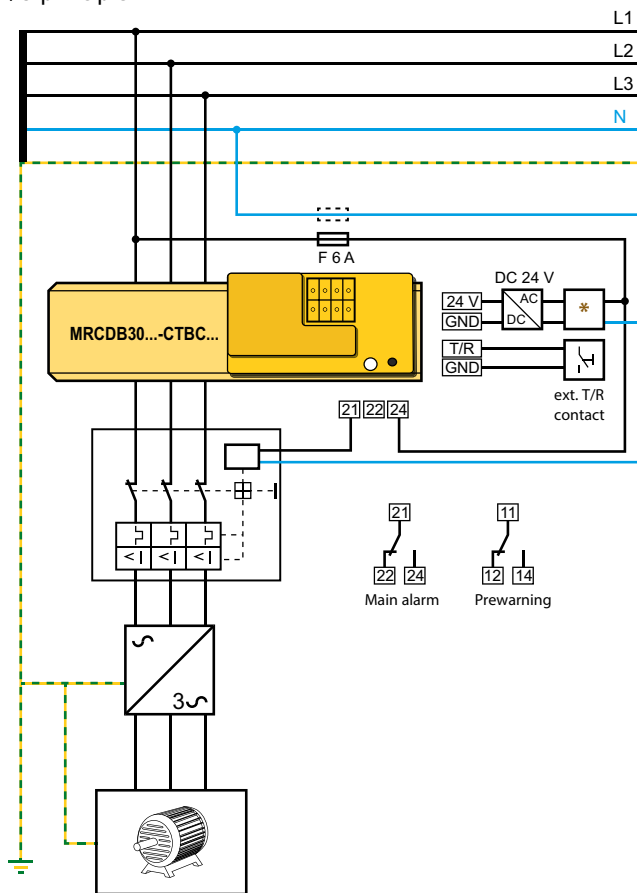
N/C principle, contact feedback



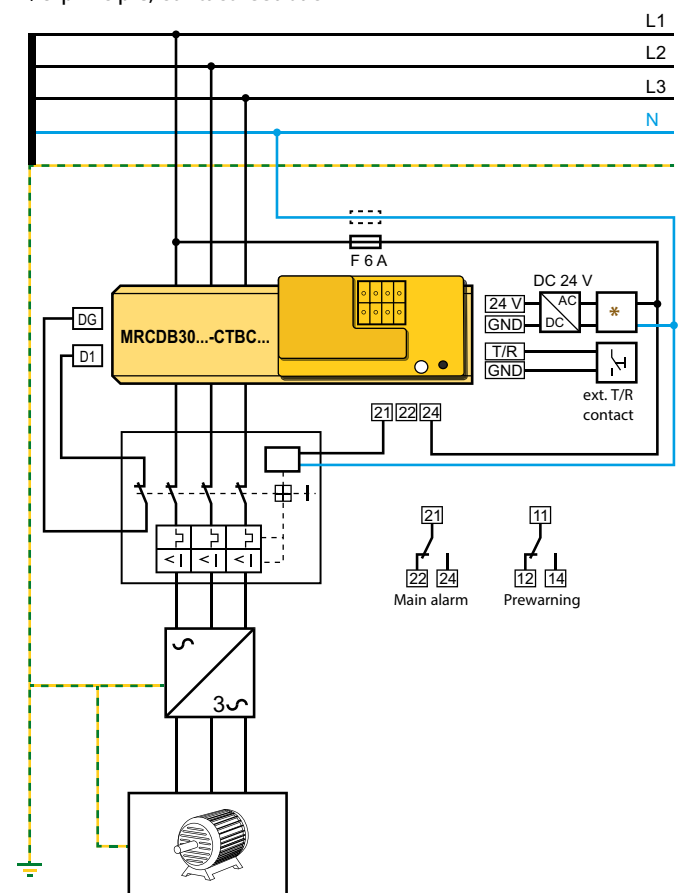
- \* – The use of a type 2 surge protection device (SPD) is mandatory due to possible impulse voltages and in order to comply with normative requirements.
- The surge protection device must be connected upstream of the power supply unit on the supply side.
- Features of the surge protection device:  
 Nominal discharge current  $I_n$  (8/20  $\mu$ s): 20 kA  
 Response time: 25 ns  
 two-stage: 1 varistor + 1 spark gap  
 Alternatively, the power supply unit must be connected to a CAT II supply without a surge protection device.

Wiring diagrams

N/O principle

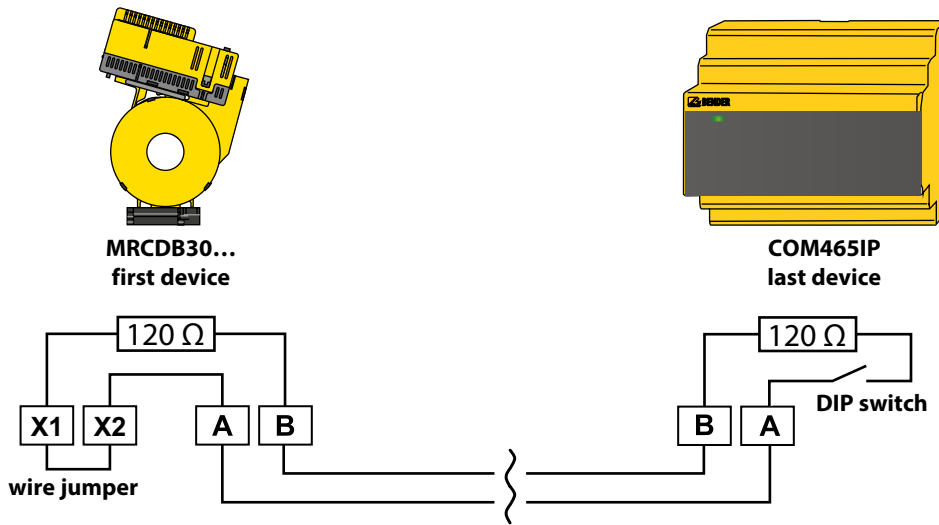


N/O principle, contact feedback



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**Connection RS-485 interface (Modbus RTU)**



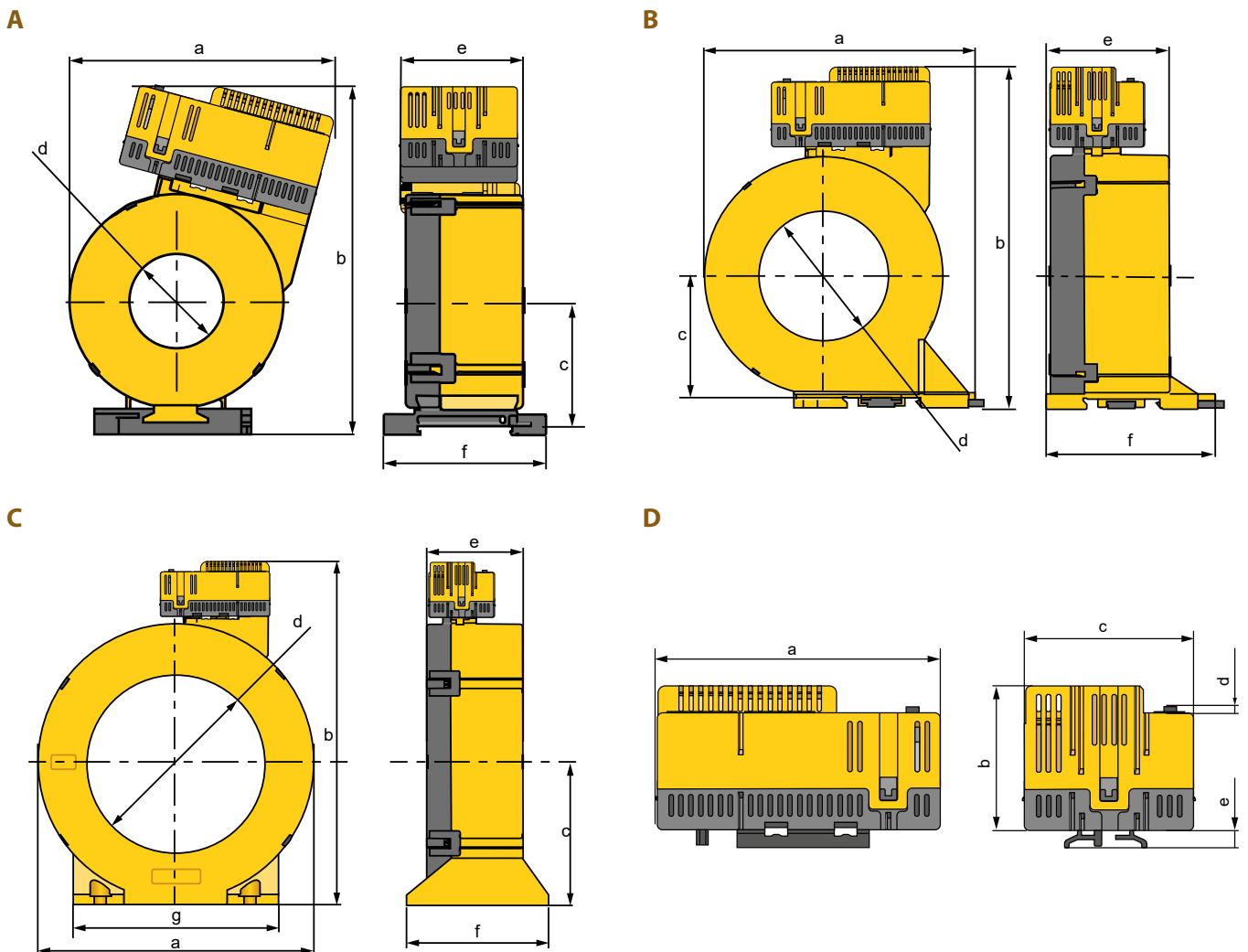
The internal 120 Ω terminating resistor can be connected by using the **wire jumper**.  
 The internal 120 Ω terminating resistor can be connected by means of the **DIP switch**.

**System states: LED and output relays**

The LED indicates the system state by means of colours and lighting/flashing. The N/O contacts of relay outputs K1 and K2 have defined switching positions for each system state.

System state	LED		Notes	Changeover contact	
	green (ON)	red (alarm)		K1	K2
Device switched off	off	off	Device is deenergised, no monitoring, no monitoring function	de-energised	de-energised
Normal operating state	lights	off	The device is supplied with the specified voltage and monitors the primary circuit. No residual current flows which would lead to tripping.	energised	energised
Prewarning	lights	Flashes briefly	The device is supplied with the specified voltage and monitors the primary circuit. A fault current flows which exceeds the set limit of the prewarning.	de-energised	energised
Alarm state	off	lights	The device is supplied with the specified voltage and monitors the primary circuit. A fault current flows which exceeds the set limit of the alarm.	de-energised	de-energised

**Dimension diagrams**

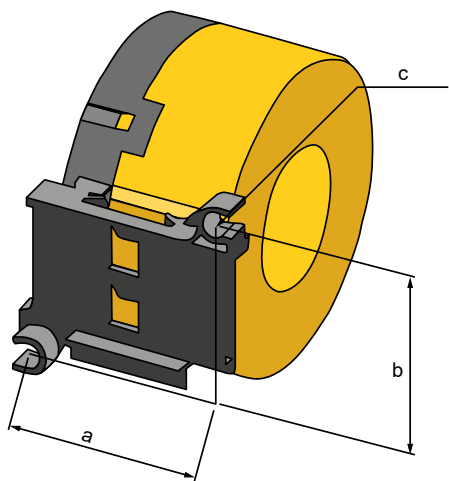


Dimensions (mm)								
	Type	a	b	c	d	e	f	g
<b>A</b>	MRCDB30...-CTBC20(P)	81	112	37	∅ 20	46	60	
	MRCDB30...-CTBC35(P)	97	130	47	∅ 35	46	61	
<b>B</b>	MRCDB30...-CTBC60(P)	126	158	57	∅ 60	56	78	
<b>C</b>	MRCDB30...-CTBC120(P)	188	232	96	∅ 120	65	96	139
	MRCDB30...-CTBC210(P)	302	346	153	∅ 210	67	113	277
<b>D</b>	MRCDB30...	74	37	44	2	4.6		

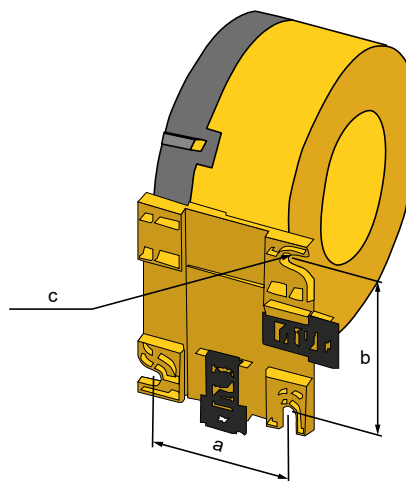
Tolerance: ±0.5 mm

**Mountings**

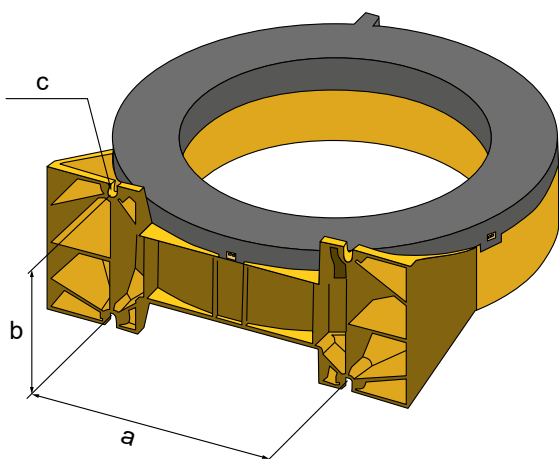
**CTBC20(P)/CTBC35(P)**



**CTBC60(P)**



**CTBC120(P)/CTBC210(P)**



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



**Technical 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 1 (24 V, GND, D1, DG, T/R, GND, A, B, X1, X2)
Control circuit 1 (IC3)	Terminal block 2 (11,12,14)
Control circuit 2 (IC4)	Terminal block 3 (21,22,24)
Rated insulation voltage	800 V
Overtoltage category	III
Area of application	≤ 2000 m AMSL
Rated impulse voltage:	
IC1/(IC2-IC4)	8 kV
IC2/(IC3-IC4)	4 kV
IC3/IC4	4 kV
Rated insulation voltage:	
IC1/(IC2-IC4)	800 V
IC2/(IC3-IC4)	250 V
IC3/IC4	250 V
Pollution degree	2
Safe isolation (reinforced insulation) between:	
IC2/(IC3-IC4)	300 V
Basic insulation between:	
IC1/(IC2-IC4)	800 V
IC3/IC4	300 V
Voltage test (routine test) acc. to IEC 61010-1:	
IC2/(IC3-IC4)	AC 2.2 kV
IC3/IC4	AC 2.2 kV

**Supply voltage**

Supply voltage $U_s$	DC 24 V
Operating range of $U_s$	±20 %
Ripple $U_s$	≤ 1 %
Power consumption	≤ 2.5 W
Inrush current	1.7 A for 1 ms

**Measuring circuit**

Internal diameter measuring current transformer	see dimension diagrams page 7
Characteristics according to IEC 62020 and IEC/TR 60755	AC/DC sensitive, type B
Measuring range	5 mA...20 A
Response value $I_{\Delta n}$	see frequency responses in manual
MRCDB301 (protection of persons)	30 mA
MRCDB302 (fire protection)	300 mA
MRCDB303 (plant protection)	30 mA...3 A (freely configurable), (30 mA)*
MRCDB305 (protection of persons)	30 mA
Prewarning	50 %...100 % $I_{\Delta n}$ (freely configurable), (60 %)*
Rated current $I_n$	
CTBC20 at $I_{\Delta n} = 30$ mA	40 A
CTBC20 at $I_{\Delta n} = 300$ mA	63 A
CTBC20P	80 A
CTBC35 at $I_{\Delta n} = 30$ mA	80 A
CTBC35 at $I_{\Delta n} = 300$ mA	125 A
CTBC35P	160 A
CTBC60 at $I_{\Delta n} = 30$ mA	160 A
CTBC60 at $I_{\Delta n} = 300$ mA	250 A
CTBC60P	320 A
CTBC120 at $I_{\Delta n} = 100$ mA	330 A
CTBC120P at $I_{\Delta n} = 100$ mA	630 A
CTBC210 at $I_{\Delta n} = 300$ mA	630 A
CTBC210P at $I_{\Delta n} = 100$ mA	630 A
CTBC210P at $I_{\Delta n} = 300$ mA	1000 A
Operating uncertainty	±17.5 %
Relative uncertainty	0...-35 %
Test winding	yes

**Possible response values (to be set on the evaluator)**

CTBC20, CTBC20P	10...500 mA
CTBC35, CTBC35P, CTUBC60, CTBC60P	30 mA...10 A
CTBC120P, CTBC210P	100 mA...10 A
CTBC120, CTBC210	300 mA...10 A

**Time response**

Response delay $t_{on}$	
MRCDB301, MRCDB302, MRCDB305	0 s
MRCDB303	0 s...60 min (freely configurable), (0 s)*
Start-up delay $t_{an}$	0 s...60 min (freely configurable), (0 s)*
Delay on release $t_{off}$	2 s after reset
Operating time $t_{ae}$	
at 1 x $I_{\Delta n}$	≤ 180 ms
at 2 x $I_{\Delta n}$	≤ 130 ms
at 5 x $I_{\Delta n}$	≤ 20 ms
Response time	$t_{an} = t_{ae} + t_{on}$
Recovery time $t_b$	≤ 1 s

**Indication**

Multicolour LED red/green, see table "System states: LED and output relays" on page 6

**Inputs**

	T/R, GND, D1, DG
Maximum length connecting cable	10 m

**Outputs**

Number of changeover contacts	2
Operating principle	
MRCDB301, MRCDB302, MRCDB305	N/C principle
MRCDB303	N/C principle or N/O principle, (freely configurable), (N/C principle)*
Switching outputs (K1, K2)	250 V, 5 A
Switching capacity	1500 VA/144 W

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

Rated operational voltage AC	250 V/250 V
Utilisation category	AC-13/AC-14
Rated operational current AC	5 A/3 A
Rated operational current AC (for UL applications)	3 A/3 A
Rated operational voltage DC	220/110/24 V
Utilisation category	DC12
Rated operational current DC	0.1/0.2/1 A
Minimum current	10 mA at DC 5 V
Electrical endurance, number of cycles	10,000

**Environment/EMC**

EMC	IEC 60947-2 Annex M
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 1

Manufacturer	Phoenix Contact
Type	DFMC 1.5/5-ST-3.5 BK

The connection conditions of the manufacturer apply.

#### Connection properties

rigid	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
flexible	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
with ferrule	0.25...0.75 mm <sup>2</sup> (AWG 24...19)

#### Terminal block 2, 3

Manufacturer	Phoenix Contact
Type	FKCVW 2.5/3-ST-5.08

The connection conditions of the manufacturer apply.

#### Connection capacity

rigid	0.2...2.5 mm <sup>2</sup> (AWG 24...13)
flexible	0.2...2.5 mm <sup>2</sup> (AWG 24...13)
with ferrule	0.25...2.5 mm <sup>2</sup> (AWG 24...13)

### Mounting CTBC...

Screw type	
CTBC20...60(P)	DIN EN ISO 7045 - M5
CTCB120...210(P)	DIN EN ISO 7045 - M6
Washer type	
CTBC20...60(P)	DIN EN ISO 7089/7090 - 5
CTCB120...210(P)	DIN EN ISO 7089/7090 - 6
Tightening torque	
CTBC20...35 (P)	0.6 Nm
CTCB60...210(P)	1 Nm

### 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	D0579
Documentation number	D00343
Weight	
MRCDB300	≤ 100 g
CTBC20	≤ 160 g
CTBC20P	≤ 220 g
CTBC35	≤ 240 g
CTBC35P	≤ 320 g
CTBC60	≤ 460 g
CTBC60P	≤ 620 g
CTBC120	≤ 1390 g
CTBC120P	≤ 1750 g
CTBC210	≤ 4220 g
CTBC210P	≤ 4870 g

( ) \* Factory setting

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

## Ordering details

### Electronic modules

Supply voltage U <sub>s</sub>	Variant	Type	Art. No.
DC 24 V (19.2...28.8 V)	Protection of persons	MRCDB301	B74043120
	Fire protection	MRCDB302	B74043121
	Protection of persons, fire protection and plant protection (freely configurable)	MRCDB303	B74043122
	Protection of persons for applications with pulsed, very high peak load currents (> 1 kA for < 1 s), e.g. welding applications	MRCDB305	B74043125

Required terminals are included in the scope of delivery.

### Measuring current transformers

Internal diameter	Type	Art. No.
20 mm	CTBC20	B98120001
	CTBC20P	B98120002
35 mm	CTBC35	B98120003
	CTBC35P	B98120004
60 mm	CTBC60	B98120005
	CTBC60P	B98120006
120 mm	CTBC120	B98120007
	CTBC120P	B98120020
210 mm	CTBC210	B98120008
	CTBC210P	B98120021

P = full magnetic shield

### Accessories

Description	Art. No.
Interface converter USB to RS-485	B95012045
Terminal block for MRCD module <sup>1)</sup>	B74043124
Snap-on mounting for CTBC20 and CTBC20P <sup>1)</sup>	B91080111
Snap-on mounting for CTBC35 and CTBC35P <sup>1)</sup>	B91080112

<sup>1)</sup> Included in scope of delivery

### Suitable system components

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

**Example for the composition of an MRCD module**



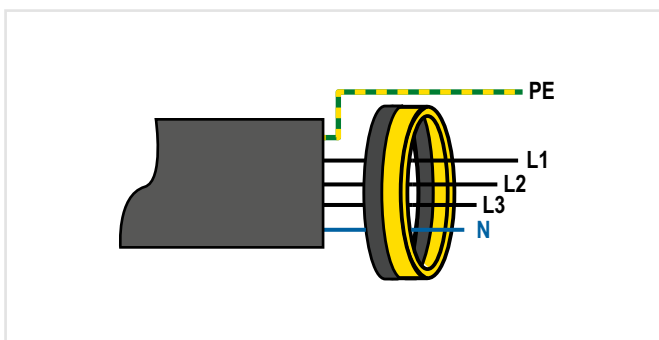
**Evaluation unit: MRCDB301**

**Measuring current transformer: CTBC35**

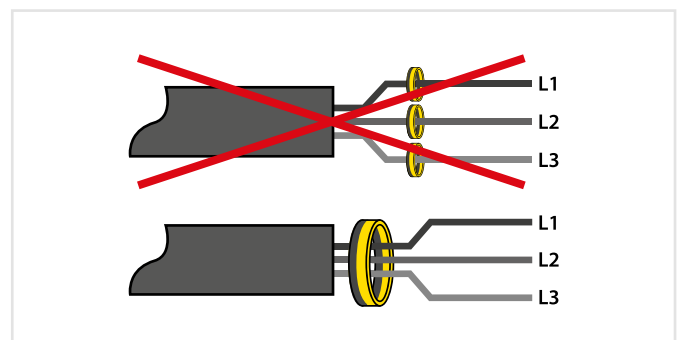
**Final MRCD module**

**Installation instructions**

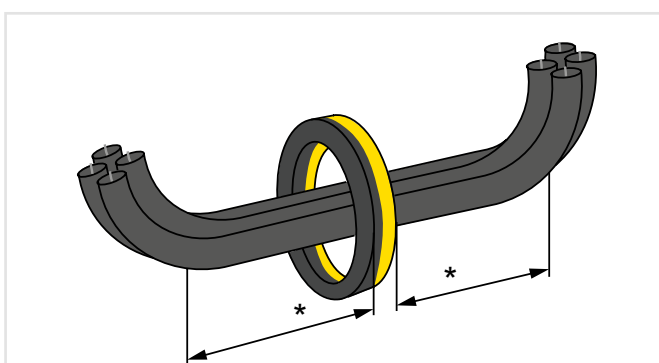
- Do not route any shielded cables through the measuring current transformer.
- Existing protective conductors and low-resistance conductor loops must not be routed through the measuring current transformer! Otherwise, high currents could be induced into the conductor loop due to the AC/DC sensitive measuring technology used.



Never route an existing protective conductor through the measuring current transformer.

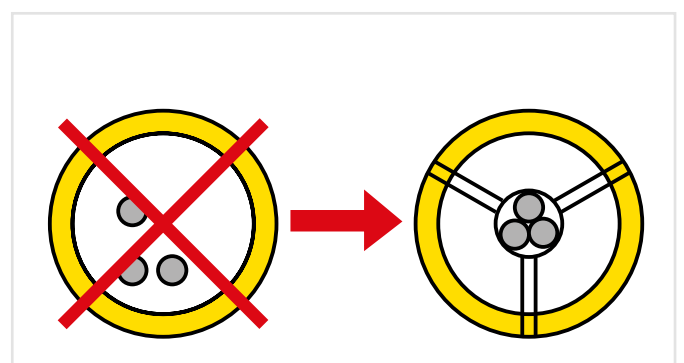


All current-carrying cables must be routed through the measuring current transformer.



\* Distance to 90° angle: 2x external diameter of the current transformer

The primary conductors should only be bent from the specified minimum distance. The minimum bending radius specified by the manufacturers for the conductors used must be observed.



The cables must be aligned with the centre of the measuring current transformer.



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