

# Product overview

## Residual current monitoring

AC, pulsed DC and AC/DC sensitive residual current monitors RCM, RCMA, RCMB

Multi-channel AC, pulsed DC and AC/DC sensitive residual current monitoring system RCMS







**Differences – RCM, RCMA, RCMB, RCMS**

RCMs differ in terms of type, frequency and waveform of the currents that they are capable of detecting:

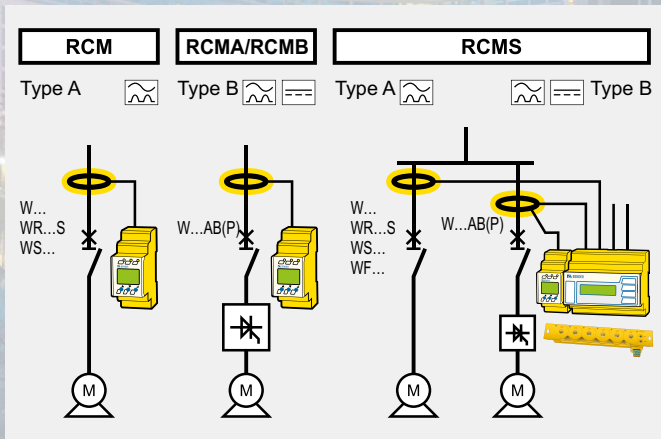
**RCM series:** Residual current monitors type A in accordance with IEC 60755 for monitoring AC currents (42...2000 Hz) and pulsating DC fault currents.



**RCMA, RCMB series:** Residual current monitors type B in accordance with IEC 60755 for monitoring AC currents, pulsating and smooth DC fault currents (0...2000 Hz).



**RCMS series:** Multi-channel residual current monitoring system type A and B in accordance with IEC 60755 for monitoring AC currents, pulsating and smooth DC fault currents (0 (42)...2000 Hz).



RCM/RCMA/RCMB/RCMS application



# Find out today what won't happen tomorrow

## Signalling instead of shutdown

Reporting critical operating states today to avoid unwanted events, such as interruptions to operation, costly damage to property or even physical injuries.

## Highest possible system availability thanks to innovative measurement technology

Periodic testing and monitoring of electrical installations and equipment is expensive in terms of time and money. Besides that, many installations may not be disconnected because they have to be constantly available. Your time and cost-saving alternative are Bender's residual current monitoring systems for earthed power supplies (TN/TT systems).

They monitor electrical installations for residual and/or fault currents, display the current measured value and signal when pre-set response values are exceeded as required by the relevant standards. The continuous residual current monitoring

of electrical installations and equipment assists with preventive maintenance in accordance with the German Social Accident Insurance (DGUV) regulation 3 (formerly BGV A3).

## Safe power supply – in all areas

The range of application of residual current monitoring systems extends from data centres, banks, insurances and office buildings, hospitals, traffic engineering to energy supply and distribution, broadcasting stations, communication technology systems and continuous production processes.

## 5-year guarantee for the latest measurement technology

For decades, Bender residual current monitoring has been a name for the latest "Made in Germany" measurement technology as well as for durability and quality. In the light of the above, Bender offers an exceptionally long warranty period of five years.

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## In practice

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# Residual current monitoring with RCM – to increase system availability and reduce costs

## Information advantage – a key success factor

Daily international business activities, continuous competitive pressure, the impact of soaring costs and operational availability around the clock – this requires the maximum possible level of electrical safety for power supplies in industrial, residential and functional buildings. Continuous monitoring of safety-relevant circuits for fault, residual and operating currents as well as for stray currents. You gain information regarding potential critical operating conditions at an early stage, thus avoiding:

- Danger to persons
- Fire damage and material damage
- EMC interferences

## Your benefits:

- Preventive electrical safety for man and machine
- High availability of power supply systems
- Reducing EMC interferences
- Time and cost-optimised maintenance
- Significant reduction of operating costs and cost risks
- Saving potential thanks to periodic verification according to the German Social Accident Insurance (DGUV) regulation 3

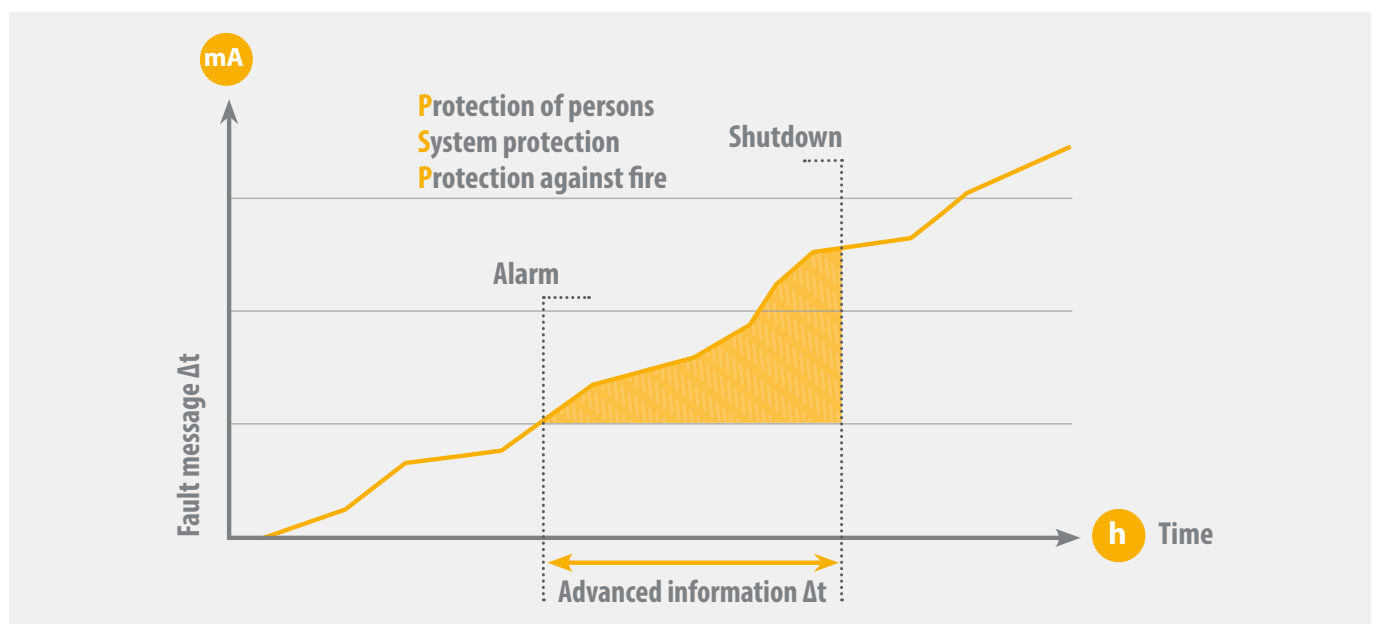
## Innovative measurement technology for all types of fault currents

Modern loads, such as variable-speed drives or switched-mode power supplies generate fault currents that have nothing in common with the good old sine wave. Today, a wide range of harmonics in most versatile waveforms exist in every power supply system.

The solution: AC/DC sensitive residual current monitoring (true r.m.s. value measurement) and analysis of the harmonics.

## Universal residual current monitoring for:

- Data centres, EDP equipment and systems
- Banks, insurance companies
- Office and administration buildings
- Hospitals, medical practices
- Power generation and distribution
- Power stations
- TV and broadcasting stations
- Communication technology systems
- Traffic engineering (airports, railway, ships, etc.)
- Continuous production processes (even with variable-speed drives) and many more facilities.



Information advantage due to RCM

### The difference between RCMs and RCDs

**RCMs** (residual current monitors) monitor residual currents in electrical installations, indicate the current value and signal when the response values are exceeded.

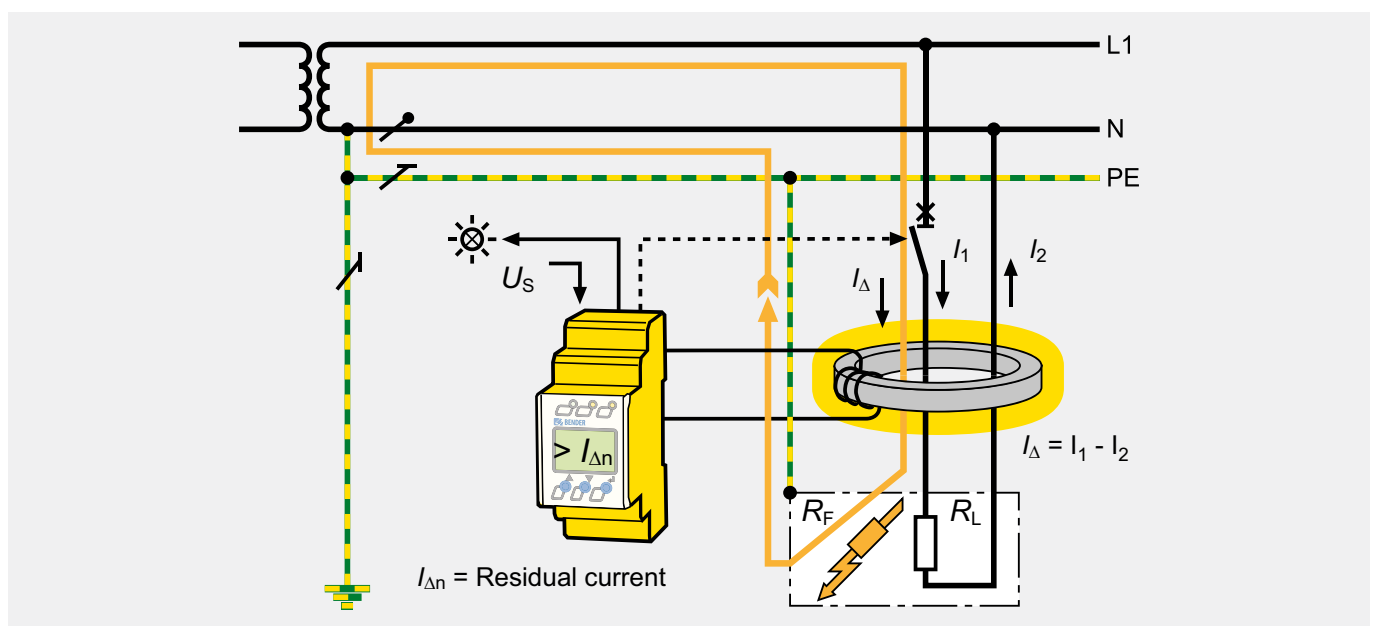
The devices are designed for signalling and/or switching. They comply with DIN EN 62020 (VDE 0663) "Electrical accessories – Residual current monitors for household and similar use (RCMs) (IEC 62020)".

In contrast to RCMs, the intended use of **RCDs** (residual current protective devices) is to provide protection in electrical installations in accordance with the standard IEC 60364, e.g. in bathrooms. RCDs always cause a shutdown.

### How does an RCM operate?

All conductors of the outgoing circuit to be monitored (except the PE conductor) are routed through a measuring current transformer. In a fault-free system, the sum of all currents is equal to zero so that no voltage is induced in the measuring current transformer. If a fault current ( $I_{\Delta}$ ) flows via PE or other paths, the difference in current in the measuring current transformer generates a current flow which is detected by the RCM. This measurement method applies to RCMs for pure AC current and pulsating DC fault currents (type A in accordance with IEC 60755).

AC/DC sensitive RCMA and RCMB of type B require special measuring current transformers and a special measurement method to detect both DC and AC currents of different frequencies.



Principle of operation RCM type A

# Your benefit from RCM/RCMA/RCMS monitoring



## Optimised maintenance

- Immediate information by centralised or distributed alarm messages
- Optimised planning of time and personnel resources through complete documentation and precise indication of the fault location
- Fast, preventive intervention by remote diagnostics and remote administration via LAN or WAN network



## Increased fire protection

- Detecting potential fire hazards caused by high fault currents as soon as they occur
- N conductor overload or interruption are signalled at an early stage
- Preventing material damage due to unintentional displacement of the star point caused by N conductor interruption
- Avoiding consequential costs resulting from material and ecological damage



## Improved economic efficiency

- Maintenance and operating expenses are considerably reduced
- Avoiding expensive and unplanned system downtimes through information at an early stage
- Higher productivity through increased operational reliability
- Saving of costs through lower insurance premiums
- Supporting business decisions on investments by recognising weak points in the electrical installation



## Comprehensive information

- Clear information centrally indicated on an LC display
- Transparency of all safety-related information through data transfer via bus systems and integration into LAN/WAN networks
- Easy integration into facility management systems via field bus, OPC and Ethernet (TCP/IP)
- Cost reduction through the use of existing communication architecture (Ethernet)



## Higher operational and system safety

- Preventive safety for the protection of man and machine against the hazards of electric current
- Risks of failure through unexpected operation of safety devices are kept to a minimum
- Monitoring systems and devices continuously for insulation deteriorations instead of spot checks at long intervals
- Detecting potential faults in newly installed electrical systems or during the commissioning of new devices immediately
- Additional safety by monitoring TN-S systems for unwanted N-PE connections
- Alarm messages either for signalling or switching off

# Periodic Verification – Reliable operation of the electrical installation

For reliable operation of the electrical installation, periodic verification in accordance with IEC 60364-6 is required. The responsible electrically skilled person determines the test intervals during risk assessment. Recommendations can be extracted from the applicable regulations and standards.

For example:

- IEC 60364-6
- EN 50110-1
- DGUV regulation 3 (formerly BGV A3)

## The employer has to ensure that electrical installations and equipment are tested for its proper working condition.

- Prior to commissioning
- At fixed intervals

## The testing principles usually comprise three steps

- Visual inspection
- Testing and measuring of protective measures, insulation resistances, loop resistances
- Functional test

All the tests – with the exception of insulation measurements – can be carried out while the electrical installation is operating. For insulation resistance measurements, electrical installations must be disconnected.

## Problem: In installations where high availability is required, a shutdown is not possible. These include:

- Communication systems
- Data centres
- Banks, insurance companies
- Office buildings
- Industry

In these cases, insulation measurement cannot be carried out.

## What should you do?

The responsible electrically skilled person has to perform a risk assessment according to the German Ordinance on Industrial Safety and Health to determine the type, scope and interval for periodic testing.

Continuous residual current monitoring (RCMS) permits modified test intervals which meet practical requirements. This way, the electrical installation can be disconnected if continued deterioration in the insulation is detected.

Only faulty stationary electrical installations and equipment have to be disconnected, repaired, tested and put in operation after the occurrence of a common alarm message from the RCMS.

Fault-free installations and equipment do not need to be disconnected for insulation tests. Hence, the test interval for an insulation measurement is determined by an RCMS alarm.

## Your benefits

- Test intervals for insulation measurements adapted to a practical application
- Increased personnel, fire and installation protection
- Saving costs through adapted, practical-oriented test intervals
- Continuous monitoring of the insulation level
- The load, which is the main disturber of any electrical system, is additionally monitored by means of RCM technology

RCMS +  
electrically  
skilled person

?

Classical  
insulation  
measurement

### “Can you disconnect your electrical installation for the purpose of insulation measurement?”

Essential parts of the electrical installation that cannot be disconnected should be monitored using a permanently installed residual current monitoring system (RCMS) and the alarm message should be sent to the responsible electrically skilled person.

# RCM/RCMS in practice – Protection against unexpected shutdown and fire hazards

## Causes of fault currents

- Inadequate insulation due to mechanical damage of cables connected to the device
- Too low insulation resistance due to humidity and dirt
- Brittle wire insulation of devices and lamps due to continuous heating

## Insulation faults have serious consequences, e.g.

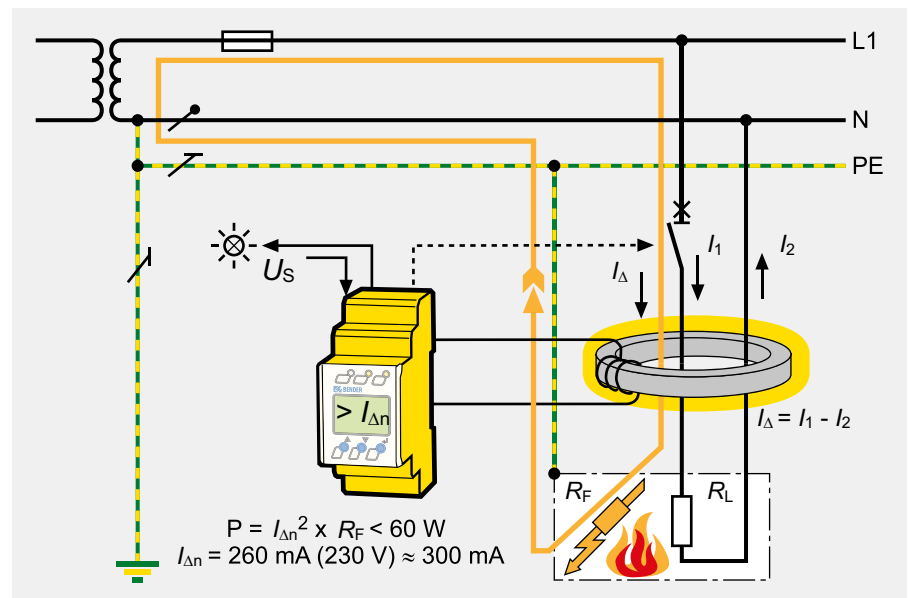
- Hazard to man and machine arising from electric current
- Expensive system downtimes
- Increased fire risk
- Data loss and disturbances in EDP and communication systems
- Unplanned and expensive maintenance work

## What should you do?

- Continuously monitor the residual current of essential installations (or parts of installations), devices, etc.
- Install RCMs in addition to existing protective devices

## Your benefits

- A high level of operational reliability and availability of the installation by immediate detection and elimination of insulation faults
- Preventive safety for the protection of man and machine against the hazards of electric current
- Risks of failure through unexpected operation of safety devices are kept to a minimum
- Monitoring systems and devices continuously for insulation deteriorations instead of spot checks at long intervals
- Maintenance and operational costs are considerably reduced
- The insulation resistance of the electrical installation is kept at a high level in accordance with the requirements of BGV A3 (German Accident Prevention Regulation)



Fire risk due to insulation faults (> 60 W)



# RCMA in practice – Increased safety in case of smooth DC fault currents

Smooth DC fault currents or residual currents without zero crossing in particular occur in loads or electrical installations containing rectifiers. These are, for example, battery chargers, variable-speed drives, building site distribution boards for frequency-controlled devices, batteries, uninterruptible power supply systems, etc.

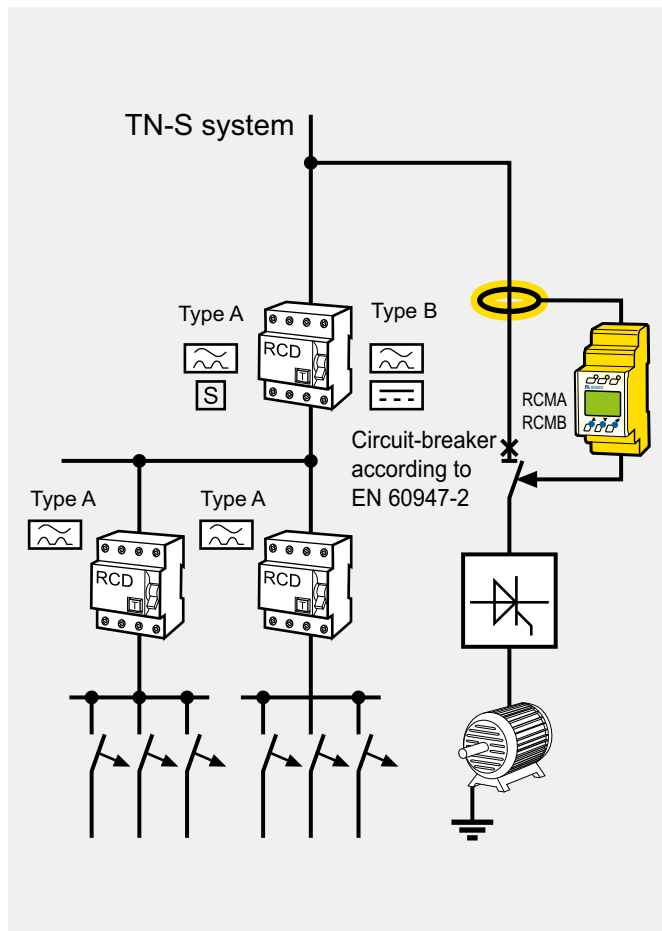
The tripping characteristics of the pulsed DC sensitive RCDs are negatively influenced by DC currents > 6 mA or even prevented. The use of AC/DC sensitive residual current monitors RCMA allows all common types of fault and residual currents to be detected.

## What should you do?

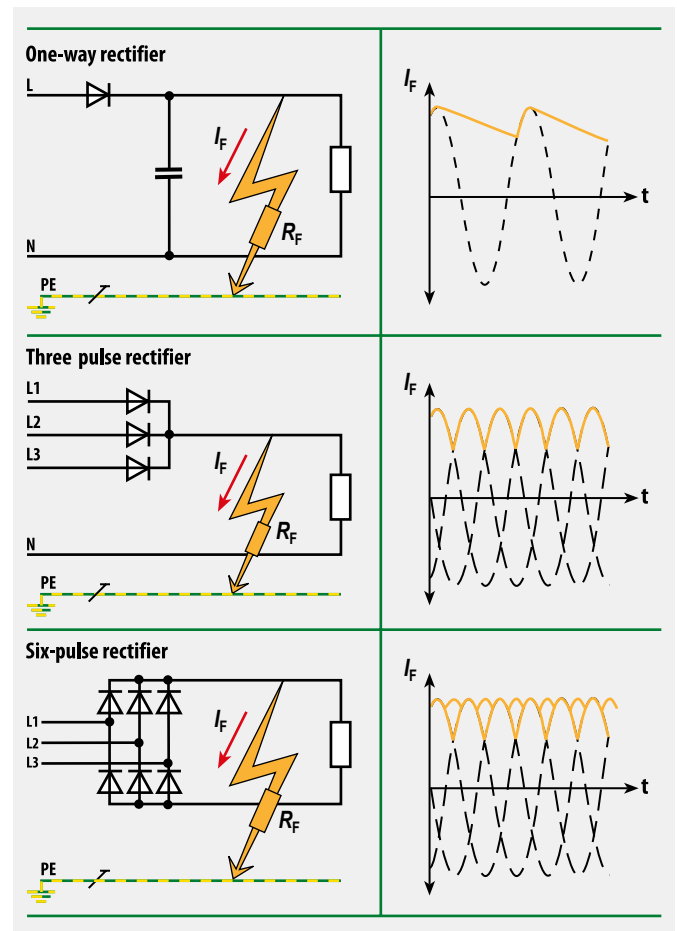
- Check systems and devices for potential smooth DC fault currents
- For variable-speed drives, consider DIN EN 50178 (VDE 0160).
- Assign a separate circuit to loads involving smooth DC fault currents
- Monitor an outgoing circuit or a load by using an AC/DC sensitive RCMA/RCMB
- Use the RCMA/RCMB in combination with a circuit breaker for disconnection according to EN 60947-2

## Your benefits

- Comprehensive protection against all common types of faults and residual currents
- In combination with a circuit breaker according to EN 60947-2 it can also be used for systems with rated currents > 125 A
- Optimum adaptation to the electrical installation thanks to variable response values and response delay
- Nearly independent of nominal voltage and load current of the installation due to measuring current transformers



Example of an installation according to DIN EN 50178 (VDE 0160)



Rectifier circuits with DC currents without zero crossing

# RCMS in practice – for reliable and EMC friendly electrical installations

## The hazards of uncontrolled currents

Residual currents or fault currents caused by insulation faults can affect the system and operational safety. Even when the electrical installations have been designed and erected by planners and builders in conformance with the standards, modern loads, such as PCs, copiers etc. increasingly cause malfunctions.

### Causes:

- Stray currents
- N conductor overload caused by harmonics
- Interruptions of PE and N conductors

### Effects:

- Unwanted interruptions to operation
- Fire damage
- Impact on protective devices
- Inexplicable malfunctions
- Inexplicable damage to fire alarm, telecommunication and EDP systems
- Data loss
- Damage due to corrosion to pipes, lightning protection systems and earth conductors
- High operational costs and maintenance costs

## RCMS – the plus point for high availability of power supplies

Planners of buildings and electrical installations play a major role when electrical safety and high availability of power supplies are concerned. Already during the planning phase, the foundation for further smooth operation can be laid.

With the use of multi-channel RCMS residual current monitoring systems, power supplies can be monitored, AC, pulsed DC and AC/DC sensitive, at critical points for:

- Fault or residual currents
- Operating currents
- Stray currents
- Currents in N and PE conductors
- The RCMS150 is particularly suitable for final circuits with 4x4 mm<sup>2</sup> or 2x6 mm<sup>2</sup>

In this way a substantial contribution is made to obtain a high level of availability of the power supply.

# RCMS in practice – monitoring the central earthing point (CEP)

Power supplies in modern buildings of information technology have to be designed as TN-S systems (N and PE separated) with a central earthing point. This is required by IEC 60364-4-444: 1996, IEC 60364-5-51: 1997, IEC 60364-4-54: 1980, and IEC 60364-7-710: 2002-11, for example.

## What should you do?

- Design the power supply system as a TN-S system (five conductors)
- Connect the N conductor to the PE/equipotential bonding system only at one central point in order to guarantee that currents are returned directly to the power source

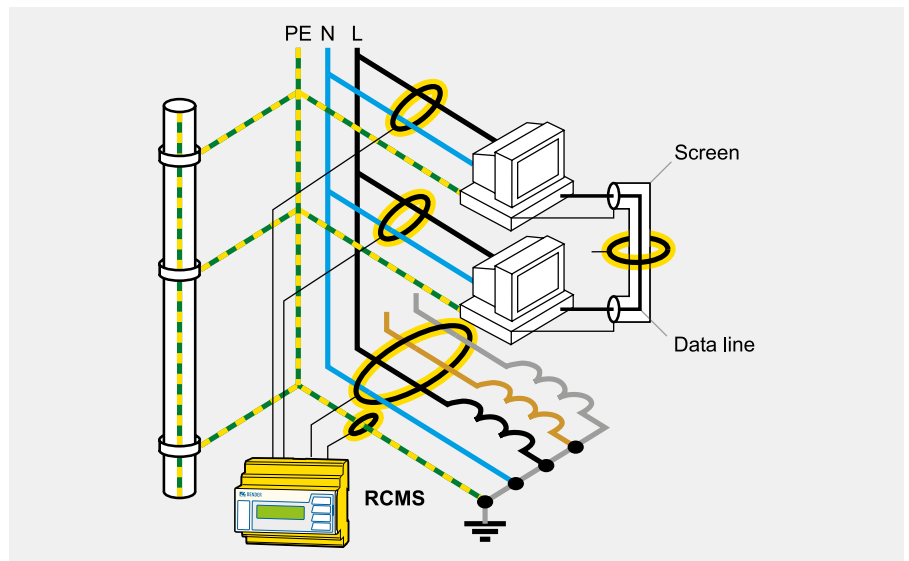
## How to monitor “clean” TN-S systems?

Continuously monitor the currents

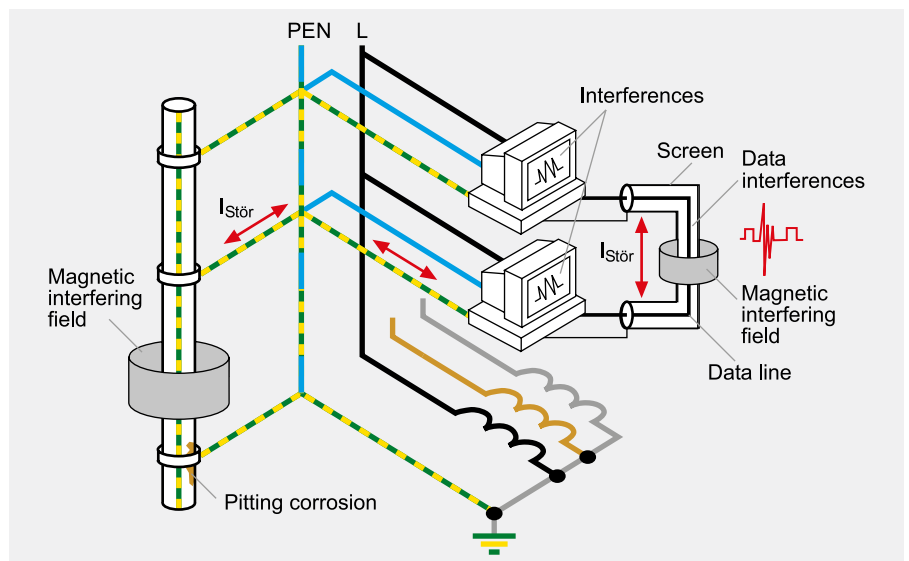
- in the only N-PE connection.
- in the central earthing point (CEP)
- in essential load circuits

## Your benefits:

- EMC interferences and interruptions to operation are reduced
- Stray currents and N/PE connections which have been accidentally installed are recognised
- Potential fire hazards are recognised when they are developing



EMC-friendly TN-S system (five conductors) for communication systems



EMC-unfavourable TN-C system (four conductors)

# RCMS in practice – monitoring currents in N conductors

In modern buildings of information technology, electrical loads are used (PCs, electronic power supply units, copiers, etc.) which additionally load the N conductor with third harmonic currents. This applies even when the devices are largely symmetrically distributed on the phase conductors. Independent of the remaining load distribution, the sum of the 150 Hz current occurring in the phase conductors flows in the N conductor. This may overload the N conductor and result in fire hazard. If the N conductor is interrupted, uncontrolled shifts of the star point and voltage increase may occur, which in the long run may destroy devices and parts of the installation.

## What should you do ?

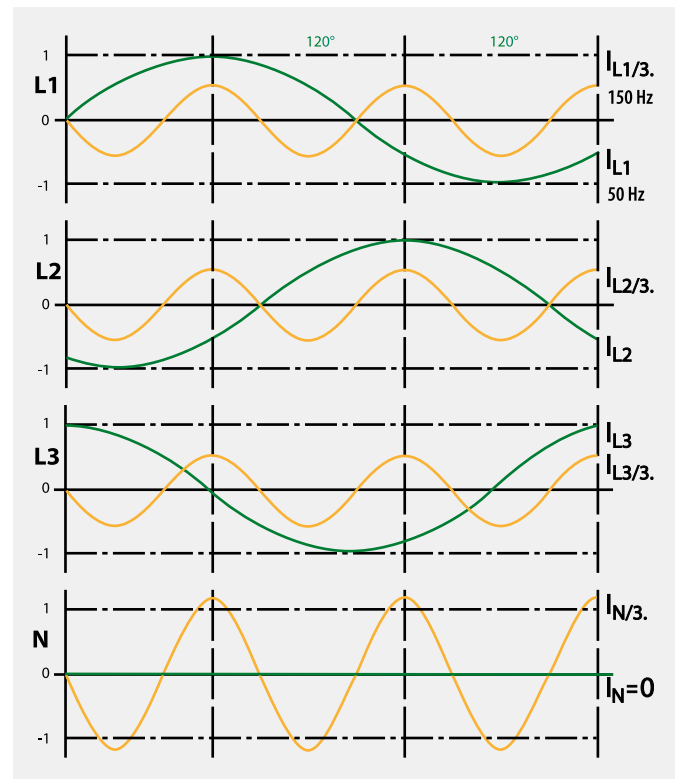
- Avoid overload of the N conductor or rate the N conductor cross section for harmonic loads
- Install a network filter, if required

## What should you monitor ?

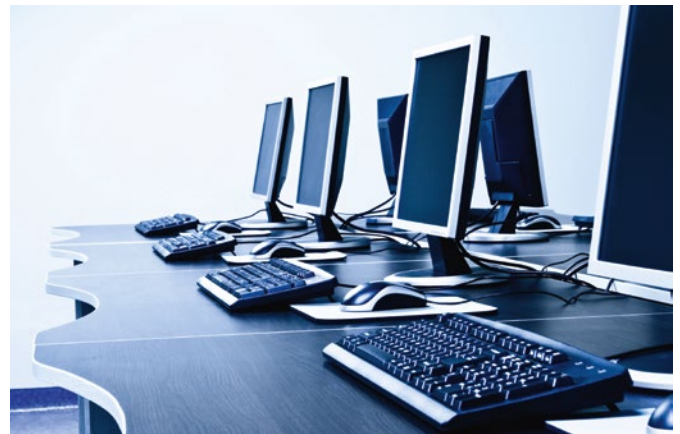
- Monitor the N conductor continuously for overcurrent

## Your benefits

- Overload or possible interruption of the N conductor are signalled at an early stage
- Material damage due to unwanted displacement of the star point is avoided
- Reliability of operation and system safety are considerably improved
- Potential fire hazards are recognised as they are developing
- Maintenance costs are considerably reduced



The 150 Hz currents of the phase conductor summarise in the N conductor



EDP devices can be the cause of harmonics

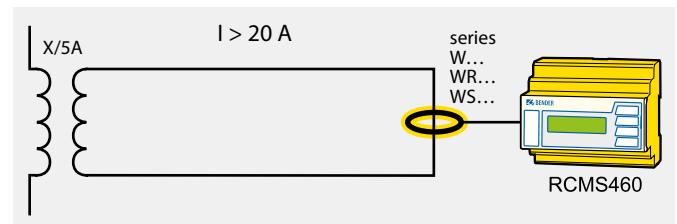


# Application example for an RCMS system in an office or a PC room

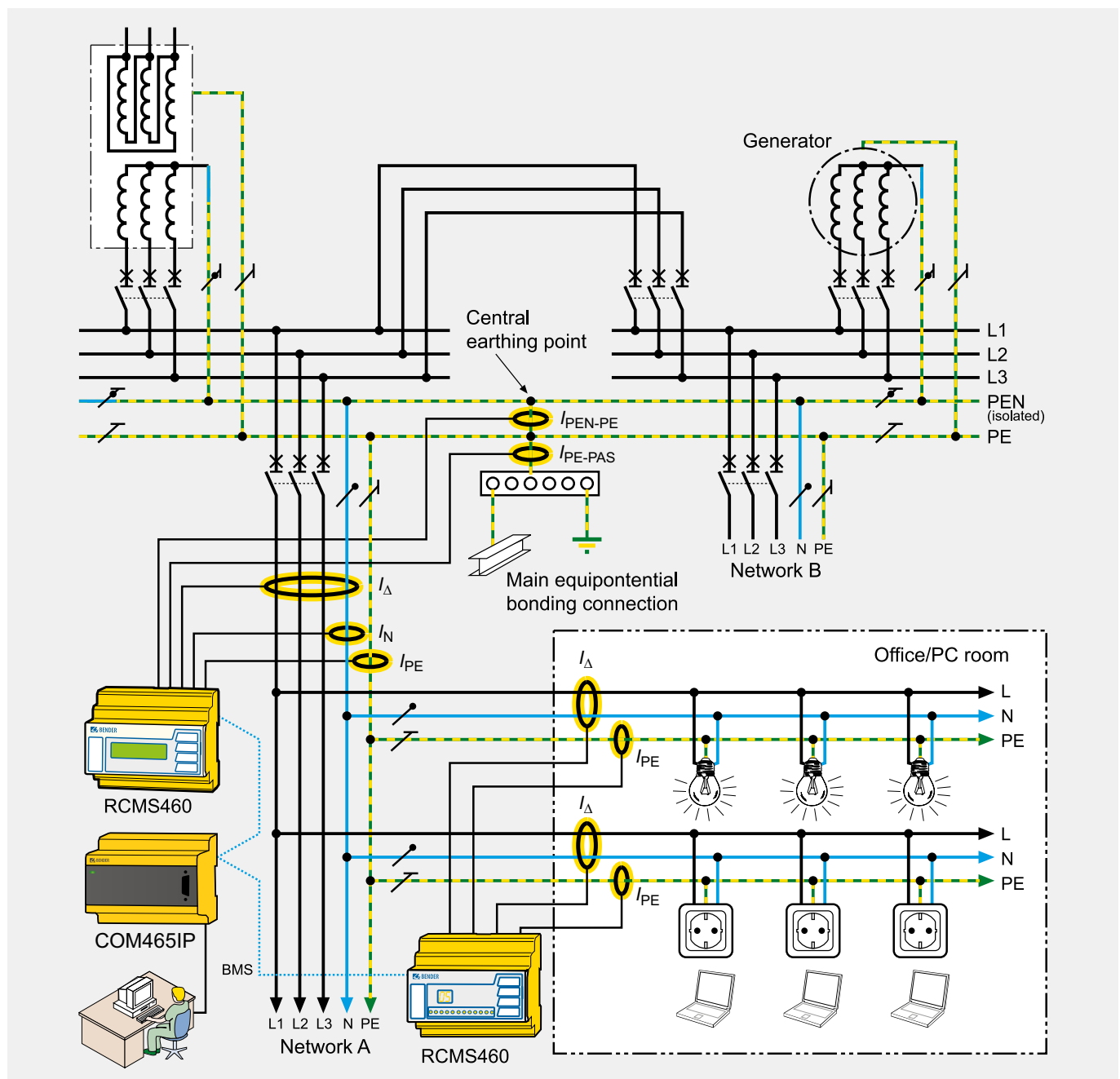
## Legend

- $I_{\Delta}$  = Residual/fault current
- $I_L$  = Current in the phase\*
- $I_N$  = Current in the N conductor\*
- $I_{PE}$  = Current in the PE conductor (PE)\*
- $I_{PEN-PE}$  = Current in the PEN-PE connection\*
- $I_{PE-PAS}$  = Current in the equipotential bonding connection

**Note:** When the TN-S system with multiple feed is operated in normal mode, the PEN conductor is used only as a neutral conductor.



\* Currents in the frequency range of 42...2000 Hz up to 20 A can directly be measured with a measuring current transformer of the W... series. Currents > 20 A can be measured with a current transformer X/5A and an additional current transformer such as W20.



Power supply in an office building

# Residual current monitors RCM



Type of distribution system	TN/TT	■
	IT	–
Residual currents		■
		–
Rated frequency		42...2000 Hz
Number of measuring channels		1
Response value	$I_{\Delta n1}$	50...100 % $\times I_{\Delta n2}$
	$I_{\Delta n2}$	10 mA...10 A
Operating time		$\leq 180 \text{ ms } (1 \times I_{\Delta n}), \leq 30 \text{ ms } (5 \times I_{\Delta n})$
Response delay $t_{\text{on}}$		0...10 s
Start-up delay $t$		0...10 s
Delay on release $t_{\text{off}}$		0...300 s
Alarm relay	Main alarm	1 changeover contact
	Prewarning	1 changeover contact
	Operating principle	N/C operation or N/O operation
Displays	LC display	■
	Power On LED	■
	Alarm LEDs	■
	Connection, external measuring instrument	■ (Option)
Installation	DIN rail	■
	Screw mounting	■

## Ordering information

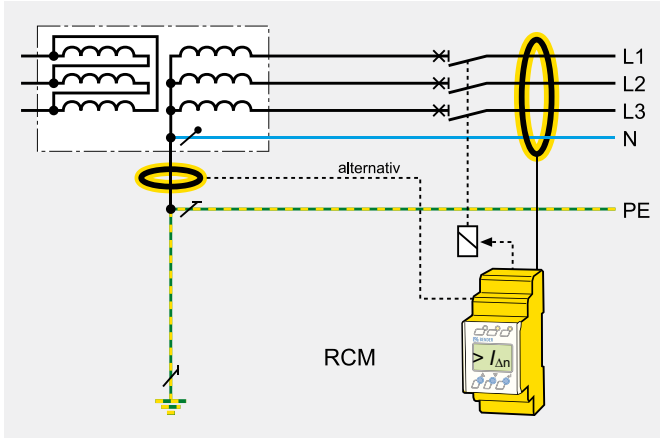
Response range $I_{\Delta n}$	Supply voltage <sup>1)</sup> $U_s$	Type	Art. No.
10 mA...10 A	AC 16...72 V, 40...460 Hz/DC 9.6...94 V	RCM420-D-1	B74014001
	AC 70...300 V, 40...460 Hz/DC 70...300 V	RCM420-D-2	B74014002

Device version with screw-type terminals on request.

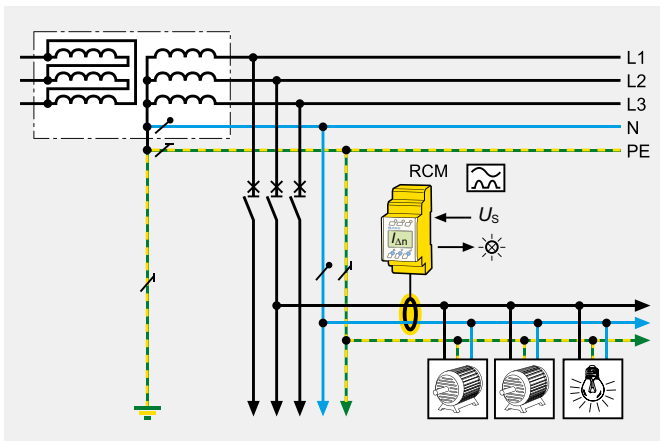
<sup>1)</sup> Absolute values



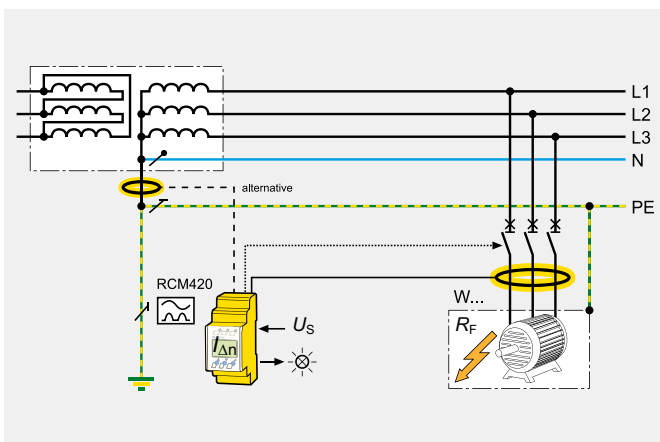
### Application examples



Monitoring of an incoming supply for fault currents (line or PE)



Monitoring of electrical loads

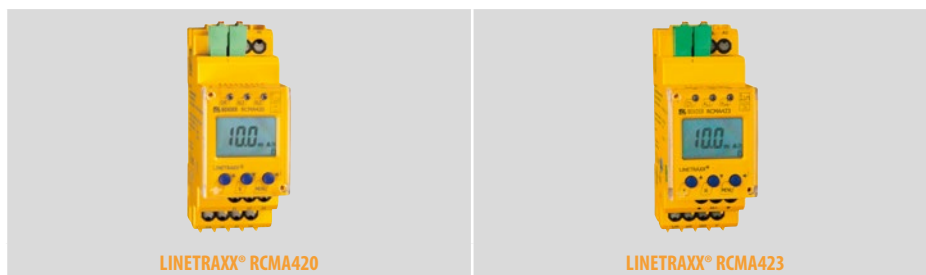


Monitoring of an electric load

RCMs monitor residual currents or fault currents in earthed systems (TN, TT systems) and are mainly used in installations where an alarm should be provided but a shutdown should be prevented in the event of a fault. RCMs are suitable for alternating and pulsating DC currents.

They can also be used in combination with existing protective devices for monitoring and indication of the present fault current. For that purpose, response values and response times are variable.

# AC/DC sensitive residual current monitors RCMA



Type of distribution system	TN/TT	■	■
	IT	–	–
Residual currents		■	■
		■	■
Rated frequency		0...2000 Hz	0...2000 Hz
Number of measuring channels		1	1
Response value	$I_{\Delta n1}$	50...100 % $I_{\Delta n2}$	50...100 % $I_{\Delta n2}$
	$I_{\Delta n2}$	10...500 mA	30 mA...3 A
Operating time		$\leq 180 \text{ ms } (1 \times I_{\Delta n}), \leq 30 \text{ ms } (5 \times I_{\Delta n})$	$\leq 180 \text{ ms } (1 \times I_{\Delta n}), \leq 30 \text{ ms } (5 \times I_{\Delta n})$
Response delay $t_{on}$		0...10 s	0...10 s
Start-up delay $t$		0...10 s	0...10 s
Delay on release $t_{off}$		0...300 s	0...300 s
Alarm relay	Main alarm	1 changeover contact	1 changeover contact
	Prewarning	1 changeover contact	1 changeover contact
	Operating principle	N/C operation or N/O operation	N/C operation or N/O operation
Displays	LC display	■	■
	Power On LED	■	■
	Alarm LEDs	■	■
	Connection, external measuring instrument	■ (Option)	■ (Option)
Installation	DIN rail	■	■
	Screw mounting	■	■

## Ordering information

Response range $I_{\Delta n}$	Supply voltage <sup>1)</sup> $U_s$	Type	Art. No.
10...500 mA	AC 16...72 V, 42...460 Hz/DC 9.6...94 V	RCMA420-D-1	B74043001
	AC 70...300 V, 42...460 Hz/DC 70...300 V	RCMA420-D-2	B74043002
30 mA...3 A	AC 16...72 V, 42...460 Hz/DC 9.6...94 V	RCMA423-D-1	B74043023
	AC 70...300 V, 42...460 Hz/DC 70...300 V	RCMA423-D-2	B74043025

Device version with screw-type terminals on request.

<sup>1)</sup> Absolute values



# AC/DC sensitive residual current monitoring modules RCMB

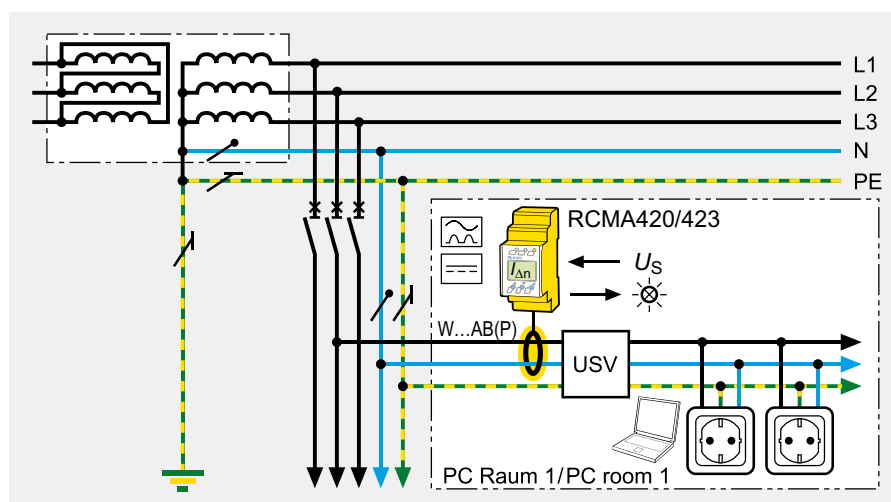


Special applications		Fault current monitoring in installations containing frequency converters	MRCD applications	MRCD applications
Type of distribution system	TN/TT	■	■	■
	IT	■	-	-
Residual currents		■	■	■
		■	■	■
Number of measuring channels		1	1	1
Response value	$I_{\Delta n1}$	-	-	-
	$I_{\Delta n2}$	0...500 mA (DC 0...500 Hz)	30 mA (DC 0...1 kHz)	30 mA (DC 0...10 kHz)
Delay on release $t_{off}$		-	2 s (after reset)	2 s (after reset)
Operating principle, alarm relays		-	N/C operation	N/C operation

## Ordering information

Supply voltage $U_S$	Inside diameter	Type	Art. No.
DC			
20.4...28.8 V	ø 20 mm	RCMB20-500-01	B 9404 2103
	ø 35 mm	RCMB35-500-01	B 9404 2104
20.4...28.8 V	ø 35 mm	RCMB35-30-01	B 9404 2100
	ø 35 mm	RCMB35-30-02	B 9404 2106

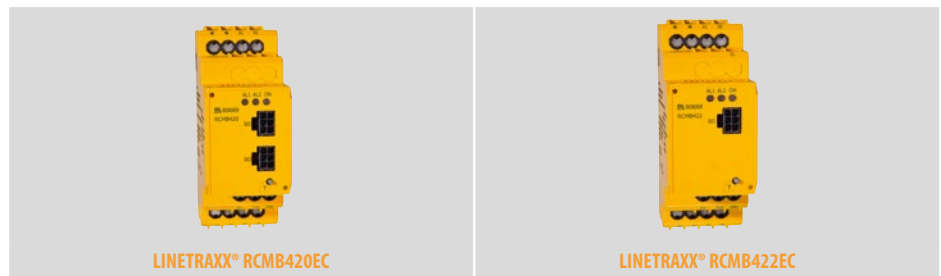
## Application example



AC/DC sensitive RCMs are used in earthed systems (TN, TT systems) where in addition to fault currents and different frequencies, smooth DC fault currents occur. In particular, this is the case for loads including six-pulse rectifiers or one-way rectification with smoothing. Application fields include converters, frequency-controlled devices on construction sites, charging sets, uninterruptible power supply systems, medical facilities, PC switched-mode power supplies and the like.

Monitoring of computer rooms

# AC/DC sensitive residual current monitors RCMB



Special applications		Fault current monitoring of AC charging stations for electric vehicles	Fault current monitoring of AC charging stations for electric vehicles
Type of distribution system	TN/TT	■	■
	IT	–	–
Residual currents		■	■
		■	■
Rated frequency		0...2000 Hz	0...2000 Hz
Number of measuring channels		2	1
Response value	$I_{\Delta n1}$	DC 6 mA	DC 6 mA
	$I_{\Delta n2}$	RMS 30 mA	RMS 30 mA
Operating time $t_{ae1}$		< 600 ms ( $1 \times I_{\Delta n1}$ )	< 600 ms ( $1 \times I_{\Delta n1}$ )
Operating time $t_{ae2}$ at DC or > 15 Hz		< 180 ms ( $1 \times I_{\Delta n2}$ ), < 70 ms ( $2 \times I_{\Delta n2}$ ), < 20 ms ( $5 \times I_{\Delta n2}$ )	< 180 ms ( $1 \times I_{\Delta n2}$ ), < 70 ms ( $2 \times I_{\Delta n2}$ ), < 20 ms ( $5 \times I_{\Delta n2}$ )
Delay on release $t_{off}$		2 s (after reset)	2 s (after reset)
Operating principle alarm relays		N/C operation	N/C operation
Length connecting cable for current transformer		1.5 m	1.5 m
Displays	Power On LED	■	■
	Alarm LEDs	■	■
Installation	DIN rail	■	■
	Screw mounting	■	■

## Ordering information

Measuring range		Frequency range	Channels	Supply voltage $U_s$		Type	Art. No.
DC	AC/DC			AC	DC		
0...6 mA	0...30 mA (r.m.s.)	0...2000 Hz	2 x residual current	110...240 V, 50/60 Hz	150...220 V	RCMB420EC-2	B74042500
				–	18...36 V	RCMB420EC-25	B74042503
			1 x residual current	110...240 V, 50/60 Hz	150...220 V	RCMB422EC-2	B74042502

Delivery incl. measuring current transformers.

Measuring current transformers available with shorter cable on request (minimum order quantity 250 pcs.)

# AC/DC sensitive residual current monitoring system RCMS



Special applications		Monitoring of final circuits, acc. to the German Social Accident Insurance (DGUV) regulation 3
Type of distribution system	TN/TT	■
	IT	–
Residual currents		■
		■
Rated frequency		0...2000 Hz
Number of measuring channels		6/virtually 12
Internal diameter of measuring channels (mm)		10
Response value	$I_{\Delta n1}$	50...100 % x $I_{\Delta n2}$
	$I_{\Delta n2}$	3...300 mA (type B)/3...300 mA (DC)
Response delay $t_{on}$		0...600 s
Start-up delay $t$		0.5...600 s
Delay on release $t_{off}$		0...600 s
Operating principle alarm relays		–
Displays	Power On LED	■
	Alarm LEDs	■
Installation	DIN rail	■
	Screw mounting	■

- High availability thanks to finely structured measurements
- Fast and precise fault location
- The RCMS150 can be used with the RCMS460/490 in a system setup

## Ordering information

Nominal supply voltage $U_s$	Type	Art. No.
DC		
24V	RCMS150	B94053025

# Residual current monitoring system



Type of distribution system	TN/TT	■	■	■	■	
	IT	–	–	–	–	
Residual currents		■	■	■	■	
		■	■	■	■	
Parameter setting function	Parameter setting function	■	–	■	–	
	Master/Slave	■	■	■	■	
	Address range	1...90	1...90	1...90	1...90	
Measuring circuit	Measuring channels per device	12	12	12	12	
	W..., WR..., WS..., W...AB, W...F series measuring current transformers	■	■	■	■	
	CT monitoring	■	■	■	■	
	Rated residual operating current $I_{\Delta n2}$ (alarm)	AC/DC sensitive 0...2000 Hz (type B)	10 mA...10 A	10 mA...10 A	10 mA...10 A	10 mA...10 A
		pulsed DC sensitive 42...2000 Hz (type A)	6 mA...20 A	6 mA...20 A	6 mA...20 A	6 mA...20 A
		pulsed DC sensitive 42...2000 Hz (type A) for channels 9...12 (RCMS4xx-D4/-L4)	100 mA...125 A	100 mA...125 A	100 mA...125 A	100 mA...125 A
	Rated residual operating current $I_{\Delta n1}$ (prewarning)	10...100 %, min. 5 mA	10...100 %, min. 5 mA	10...100 %, min. 5 mA	10...100 %, min. 5 mA	
	Function selectable per channel: off, <, >, I/O	■	■	■	■	
	Cut-off frequency adjustable for personnel, plant and fire protection	■	*	■	*	
	Preset function for $I_{\Delta n2}$ and I/O	■	■	■	■	
Hysteresis	2...40 %	2...40 %	2...40 %	2...40 %		
Factor for additional CT	■	■	■	■		
Switching elements	Common alarm relay for all channels	2 x 1 changeover contacts	2 x 1 changeover contacts	2 x 1 changeover contacts	2 x 1 changeover contacts	
	Alarm relay per channel	–	–	12 x 1 N/O contact	12 x 1 N/O contact	
Time response	Start-up delay 0...99 s	■	■	■	■	
	Response delay, delay on release 0...999 s	■	■	■	■	
	Operating time at	$I_{\Delta n} = 1 \times I_{\Delta n2} \leq 180$ ms	■	■	■	■
$I_{\Delta n} = 5 \times I_{\Delta n2} \leq 30$ ms		■	■	■	■	
Displays, memory	Analysis of the harmonics (IA, DC, THD)	■	*	■	*	
	History memory for 300 data records	■	–	■	–	
	Data logger for 300 data records per channel	■	–	■	–	
	Internal clock	■	–	■	–	
	Password	■	–	■	–	
	Language English, German, French, Swedish	■	–	■	–	
	Backlit graphic LC display	■	–	■	–	
7-segment display and LED line	–	■	–	■		

\* only in conjunction with RCMS4xx-D, MK2430 or COM465IP





The multi-channel RCMS system is designed to monitor up to 12 measuring points or measuring channels per device or up to 1080 channels when several devices are interconnected. The RCMS system is suitable for alternating, pulsating and smooth direct currents, depending on the type of measuring current transformer.

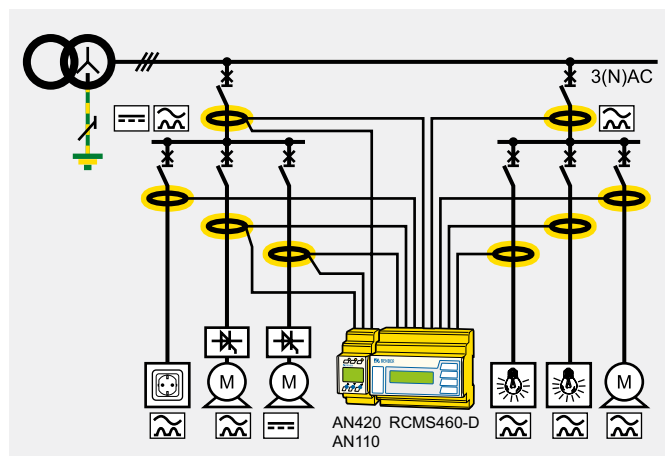
### Ordering information RCMS460/490-D

Residual current measurement		Common alarm relay for all channels	Alarm relay per channel	4 channels for load current measurement	Supply voltage $U_S$	Type	Art. No.		
pulsed DC sensitive	AC/DC sensitive								
6 mA...20 A	10 mA...10 A	2 x 1 changeover contacts	-	100 mA...125 A	AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS460-D-1	B94053001		
					AC 70...276 V, 42...460 Hz/DC 70...276 V	RCMS460-D-2	B94053002		
					AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS460-D4-1	B94053009		
					AC 70...276 V, 42...460 Hz/DC 70...276 V	RCMS460-D4-2	B94053010		
				12 x 1 N/O contact	-	100 mA...125 A	AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS490-D-1	B94053005
							AC 70...276 V, 42...460 Hz/DC 70...276 V	RCMS490-D-2	B94053006
							AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS490-D4-1	B94053011
							AC 70...276 V, 42...460 Hz/DC 70...276 V	RCMS490-D4-2	B94053012

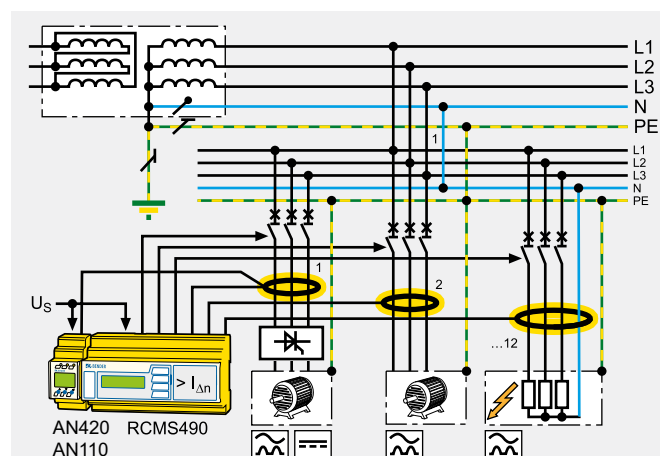
### Ordering information RCMS460/490-L

Current measurement		Common alarm relay for all channels	Alarm relay per channel	Supply voltage $U_S$	Type	Art. No.
pulsed DC sensitive	AC/DC sensitive					
6 mA...20 A	10 mA...10 A	2 x 1 changeover contacts	-	AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS460-L-1	B94053003
				AC 70...276 V, 42...460 Hz/DC 70...276 V	RCMS460-L-2	B94053004
		2 x 1 changeover contacts	12 x 1 N/O contact	AC 16...72 V, 42...460 Hz/DC 16...94 V	RCMS490-L-1	B94053007
				AC 70...276 V, 2...460 Hz/DC 70...276 V	RCMS490-L-2	B94053008

### Application examples (Power supply in an office building, refer to page 11)



RCMS basic system



RCMS490 system with switching function per measuring channel

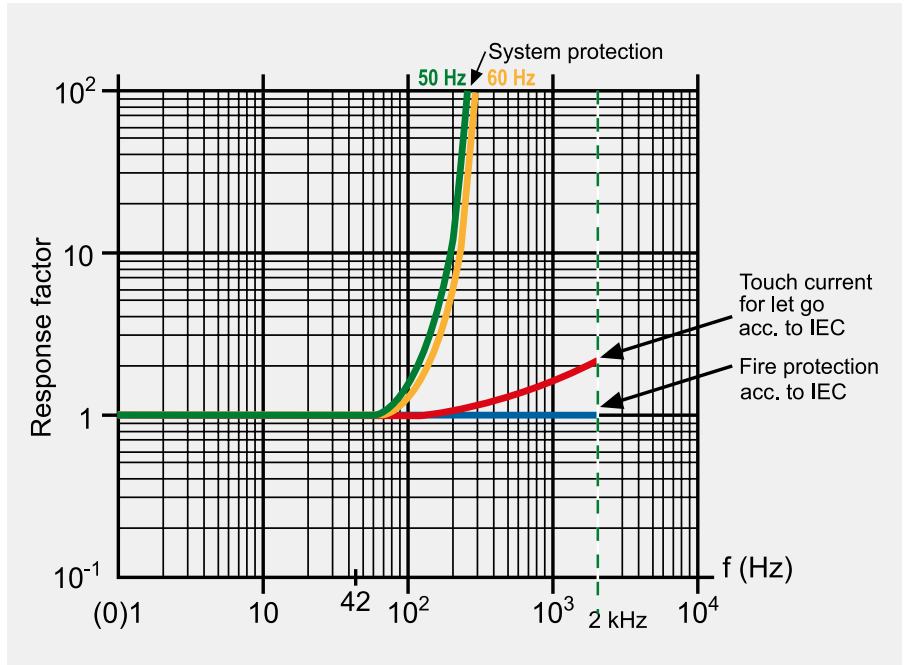
# Protection of persons – fire protection – property protection

## RCMS – flexible in use for all essential current measurements

### RCMS – flexible for various protective goals

The frequency response of the RCMS can be set for each channel according to the selected protective goal, i.e. protection of persons, fire protection and property protection.

$$\text{Response factor} = \frac{\text{Residual operating current } (I_{\Delta})}{\text{Rated residual operating current } (I_{\Delta n})}$$



Frequency response for protective goals

### Selection guide for measuring current transformers and measuring ranges

$I_{\Delta}$	$I_{\Delta}$	$I_{\Delta}$	$I_L, I_N, I_{PEN-PE}$	I/O	$I_L, I_N, I_{PEN-PE}$
f: 42...2000 Hz $I_{\Delta}$ 100 mA...20 A $t_{ae}$ < 180 ms	f: 42...2000 Hz $I_{\Delta}$ 6 mA...20 A $t_{ae}$ < 180 ms	0...2000 Hz 10 mA...10 A < 180 ms	50...60 Hz > 20 A < 180 ms	I = <100 $\Omega$ O = >250 $\Omega$ < 3,5 s	42...2000 Hz 100 mA...125 A < 180 ms
WF... 	W... WR...S(P) WS... 	W...AB(P) AN420 AN110 	X/10A X/5A X/1A W35 		W... WR...S(P) WS... 
k	k	k	k	k	k
I	I	I	I	I	I
channel 1...12, optional					
RCMS460-D/-L		RCMS490-D/-L			
channel 1...8, optional				for channel 9...12	
RCMS460-D4		RCMS490-D4			

# Measuring current transformers for residual current monitors and residual current monitoring systems

Dimensions	Type	Art. No.	Suitable for			
			RCM	RCMA		RCMS
			RCM420	RCMA420	RCMA423	RCMS460 RCMS490



Internal diameter (mm)	W... series, circular type					
ø 20	W20	B98080003	■	–	–	■
ø 35	W35	B98080010	■	–	–	■
ø 60	W60	B98080018	■	–	–	■
ø 120	W120	B98080028	■	–	–	■
ø 210	W210	B98080034	■	–	–	■



Internal diameter (mm)	W...AB series, circular type, AC/DC sensitive					
ø 20	W20AB	B98080008	–	■	■	■
ø 35	W35AB	B98080016	–	■	■	■
	W35ABP	B98080051	–	■	■	■
ø 60	W60AB	B98080026	–	■	■	■
	W60ABP	B98080052	–	■	■	■
ø 120	W120AB	B98080041	–	–	■	■
ø 210	W210AB	B98080040	–	–	■	■



Inside diameter (mm)	WR... series, rectangular type					
70 x 175 (W x H)	WR70x175S	B977738	■	–	–	■
	WR70x175SP	B911790	■	–	–	■
115 x 305 (W x H)	WR115x305S	B911739	■	–	–	■
	WR115x305SP	B911791	■	–	–	■
150 x 350 (W x H)	WR150x350S	B911740	■	–	–	■
	WR150x350SP	B911792	■	–	–	■
200 x 500 (W x H)	WR200x500S	B911763	■	–	–	■
	WR200x500SP	B911793	■	–	–	■



Inside diameter (mm)	WS... series, rectangular type, split-core					
20 x 30 (W x H)	WS20x30	B98080601	■	–	–	■
50 x 80 (W x H)	WS50x80	B98080603	■	–	–	■
80 x 120 (W x H)	WS80x120	B98080606	■	–	–	■



Length A measuring current transformer	WF... series, flexible					
170	WF170	B 7808 0201	■	–	–	■
250	WF250	B 7808 0203	■	–	–	■
500	WF500	B 7808 0205	■	–	–	■
800	WF800	B 7808 0207	■	–	–	■
1200	WF1200	B 7808 0209	■	–	–	■
1800	WF1800	B 7808 0221	■	–	–	■

Approvals: UL approval, with the exception of WS, LR series

## Other measuring current transformers on request



W...S... series



WS...S series

# Accessories for residual current monitors and residual current monitoring systems



Application		BMS Modbus RTU gateway	Condition Monitor gateway	Condition Monitor/ PROFIBUS gateway	Condition Monitor gateway	Interface repeater BMS bus
Device family RCMS		■	■	■	■	■
Functions	Protocol input	BMS	BMS/Modbus RTU/TCP	BMS/Modbus RTU/TCP	BMS/Modbus RTU/TCP	RS-485
	Protocol output	Modbus RTU	Ethernet/Modbus TCP	Ethernet/Modbus TCP, PROFIBUS DP	Ethernet/Modbus TCP	RS-485
	Indication	LCD/LED	LED	LED	7" colour LCD	—
	Alarm messages	■	■ <sup>1,2)</sup>	■ <sup>1,2)</sup>	■ <sup>1,2,3)</sup>	—
	Measured values	■	■ <sup>1,2)</sup>	■ <sup>1,2)</sup>	■ <sup>1,2,3)</sup>	—
	Device parameter setting	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—
	Alarm list	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1,3)</sup>	—
	History memory	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—
	Diagrams	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1,3)</sup>	—
	Visualisation	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—
	E-mail notification	—	■ <sup>1,4)</sup>	■ <sup>1,4)</sup>	■ <sup>1,4)</sup>	—
	Device tests	■	■ <sup>1,2)</sup>	■ <sup>1,2)</sup>	■ <sup>1,2)</sup>	—
	PEM... and energy meter support	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—
	SNMP	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—
Data logger	—	■ <sup>1)</sup>	■ <sup>1)</sup>	■ <sup>1)</sup>	—	
Supply voltage $U_s$		AC/DC 76...276 V	AC/DC 24...240 V, DC 24 V	AC/DC 24...240 V, DC 24 V	DC 24 V	AC 85...260 V, 50...60 Hz

<sup>1)</sup> Available functions on the web server – accessible by means of a PC with a browser, <sup>2)</sup> available via the protocol,

<sup>3)</sup> On the device-internal LC display, <sup>4)</sup> TLS/SSL support







# Bender monitoring systems – seamless communication

## Modern communication

Due to the fact that increasing demands are placed on communication capability, data transparency and flexibility, the use of modern fieldbus and network technologies has become a must in the field of automation of electrical installations.

For example, operating, alarm and fault messages via the Web or the network substantially contribute to increasing the transparency of power supply systems, and also allow a fast reaction to critical operating states. In addition, important messages can be transferred via SMS or e-mail to the mobile phones or laptops of service personnel. Early information about the location and cause of a fault as early allows time and cost-efficient deployment of service personnel and can avoid equipment failure or damage to expensive devices.

## Electrical Safety Management

The term “Electrical Safety Management” means that Bender provides coherent solutions for the electrical safety of power supplies in all areas. Carefully matched products and systems with innovative measuring techniques, communication solutions for the visualisation of data from Bender monitoring systems as well as easy connection to fieldbus systems and to SCADA systems (Supervisory Control and Data Acquisition) provide the maximum possible safety, economic efficiency and transparency. The range of products is completed by comprehensive services, which extend right through the whole service life of the products.



### COM465IP

Condition Monitor with integrated gateway for the connection of Bender devices to Ethernet TCP/IP networks



### COM462RTU

BMS Modbus RTU gateway for the connection of BMS-capable Bender devices with the Modbus RTU



### CP700

Condition Monitor with integrated gateway and touch screen for the connection of Bender devices to Ethernet TCP/IP networks

# Retrofit

## Is your system still state of the art?

Even the most modern electrical systems cannot escape the marks of time. Whether diminishing operational reliability, changed legal stipulations or increasing energy costs: Upgrading to the respective current state of the art is indispensable. Products for monitoring energy quality and fault search are typically retrofitted.

## Risk assessment according to operating safety regulations: Does your presently installed monitoring equipment recognise symmetrical and asymmetrical insulation faults?

Symmetrical and asymmetrical insulation faults present a high risk potential. Bender insulation monitoring devices continuously monitor your systems, insulation faults are captured and reported. Bender insulation monitoring devices comply with IEC 61557-8.

**We will check your electrical installations and provide you with recommendations on how to proceed further.**

## Bender delivers flexible solutions for retrofit projects

Modern monitoring methods can be integrated in older installations as well – also during ongoing operations. Retrofitting is possible via devices such as divisible transformers, whereby the transformers are not even required to be shut down nor must cable installations be disconnected.

**Successor devices from Bender can conveniently replace older installations. Long-term availability is thus guaranteed.**





# POWERSCOUT®

## Find out today what won't happen tomorrow

Moisture, deterioration, dirt, mechanical damage or faults due to the impact of current, voltage and temperature cause malfunctions in every electrical installation. The web-based software solution POWERSCOUT® helps you detect malfunctions at an early stage and eliminate the causes in an economically reasonable way. This guarantees high installation and operational safety and reduces costs.

POWERSCOUT® is your tool: It can be precisely adjusted to your system and your monitoring requirements during setup. Easy, clear and fast. Open the browser, log in, select the required measuring devices and measured quantities, done.



*POWERSCOUT®: The web-based software solution for analysis, predictive maintenance and report.*

### **Analysis – as individual as your system– as simple as possible**

Predictive maintenance prevents downtimes, reduces costs and staff deployment. POWERSCOUT® informs you about the condition of your electrical installation at all times, since the meaningful visualisations with flexible dashboards can be retrieved via any display device: smartphone, laptop, computer. On request, POWERSCOUT® sends you graphically processed reports at specified intervals.

### **Continuous monitoring instead of random tests**

Manual data acquisition is time consuming, error prone and only provides random sampling results. POWERSCOUT® gives you an insight into the entire data of your installation at any time, since all measured values are automatically and continuously saved. Your data is stored reliably and remains available for years.

### **Basis for periodic verification**

The automated POWERSCOUT® report on residual currents forms the basis for measuring without switch-off by means of periodic verification. In order to maintain the correct status for electrical installations and stationary electrical equipment, periodic verification must be carried out.

This can be ensured, for example, by means of continuous monitoring of the installation carried out by qualified personnel. In this case, it would be smart to rely on continuous monitoring with multi-channel residual current monitoring systems (RCMS) and an evaluation (CP700) adapted to the system. The automatic POWERSCOUT® reports based on this monitoring enable the qualified person in charge to adjust the time limits for the insulation test within the context of periodic verification.

#### **Analysis**

- Continuously recording insulation values
- Recognising connections and optimising maintenance
- Cross-system evaluation possibilities
- Access from any place
- Supporting investment decisions

#### **Predictive maintenance**

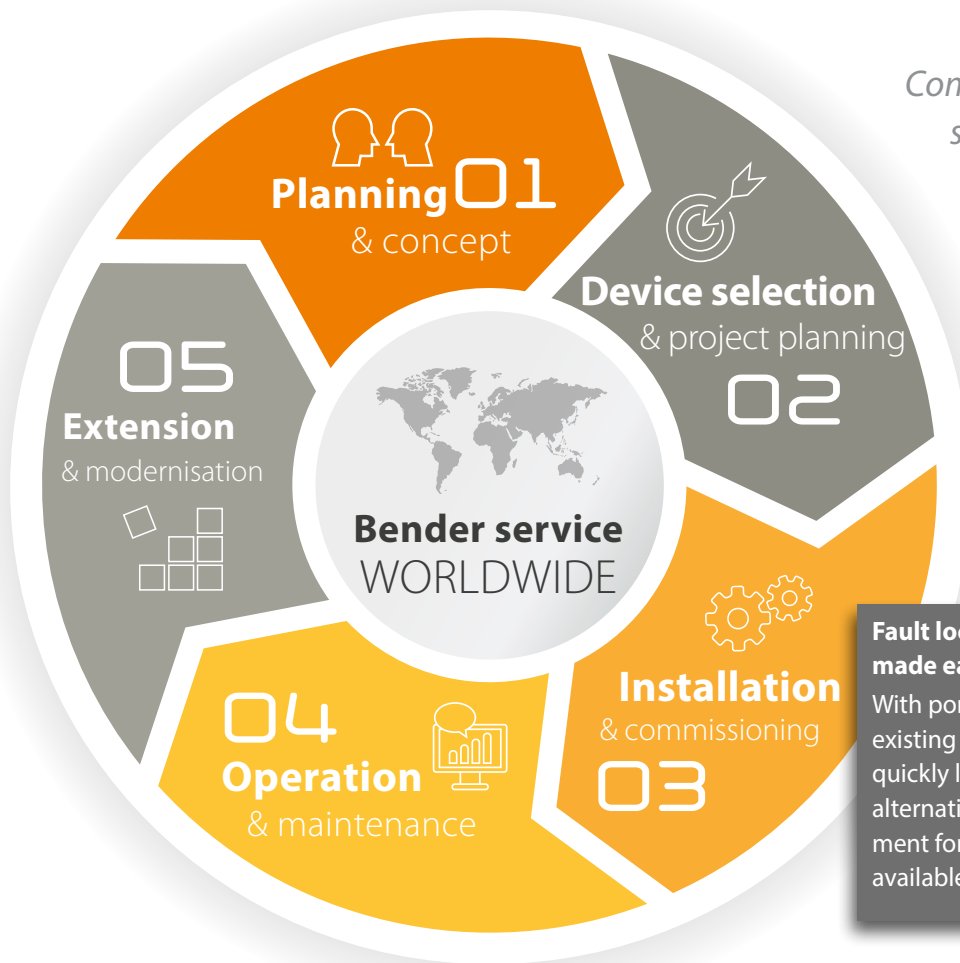
- Higher availability
- Continuous monitoring
- Early detection of gradually developing insulation faults
- Early detection and reporting of short-time insulation degradation
- Less costs incurred due to unexpected malfunctions and shut-downs

#### **Reports**

- Historical comparisons
- Safe storage of measured values
- Event and alarm statistics

# Support during all stages

Comprehensive service for your installation: remote, by phone, on site



*Competent service for maximum safety and high availability of your installation*



### Fault location – made easy

With portable fault location systems, existing insulation faults can be quickly located. They are the best alternative if no stationary equipment for insulation fault location is available.

**From planning to modernisation** – Our extensive know-how is at your disposal during all project phases.

**Furthermore, with our first-class service we guarantee maximum safety for your electrical installations.**

We offer services ranging from support over telephone to repairs and on-site service – with modern measuring devices and competent employees.

### Secure yourself:

- High availability of your installation thanks to fast reaction to fault messages
- Increased profitability of your capital expenditure (CapEx) via optimised maintenance processes
- Targeted operating expenditure (OpEx) due to less downtimes and shorter service visits
- Support for your prospective system monitoring and regular tests of your system/power quality/monitoring devices
- Automatic control, analysis, correction, new settings/updates
- Competent assistance with setting changes and updates

### Bender Remote Assist

Bender Remote Assist offers you support via remote access, high-quality service and advice for your challenging task consisting in ensuring consistent high safety in your systems.

Many service visits, fault clearance but also analyses and controls can be carried out remotely – without the expenses of time and money that an on-site visit of a technician implies.

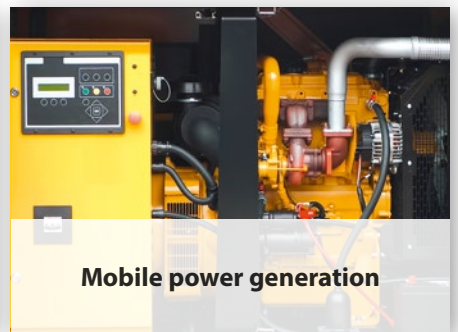
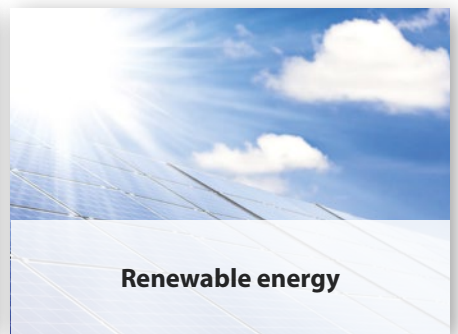
This fast, efficient help and advice by our expert network allows the highest possible availability of your system.



# Bender. So that your world is safer.

Our world is networked on a global scale; it is digital, mobile and highly automated – whether in manufacturing industry, inside or outside buildings, in operating theatres and power stations, in trains, underwater or underground: it never stands still and it is more dependent than ever on a reliable and, above all, safe electrical power supply.

And exactly that is our mission: we make electricity safe. Using our technologies we ensure that electricity is permanently available and guarantee faultless protection against the hazards of electric shock. We protect buildings, plants and machinery and therefore your investments and plans. But what we primarily protect are the lives of the people who are involved with electricity.



[www.bender.de](http://www.bender.de)



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