

## Product overview

# Residual current monitoring

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

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



# Residual current monitoring with RCM – to achieve improved plant availability and cost reduction

## Up-to-date information – a crucial element of success

Day-to-day international business activities, continuous competitive pressure, the impact of soaring costs and operational availability around the clock – requires maximum possible electrical safety for power supplies in industrial, residential and functional buildings. Continuous monitoring of safety-relevant circuits for fault, residual und operating currents as well as for stray currents. Information about critical operating conditions are obtained at an early state and in this way avoid potential

- hazards to personnel
- damage due to fire and material damage
- electromagnetic interferences

## Your advantages:

- Preventive electrical safety for man and machine
- High availability of the power supply systems
- Reduction in electromagnetic interferences
- Maintenance optimisation with regard to costs and time
- Considerable reduction of operational and investment risks

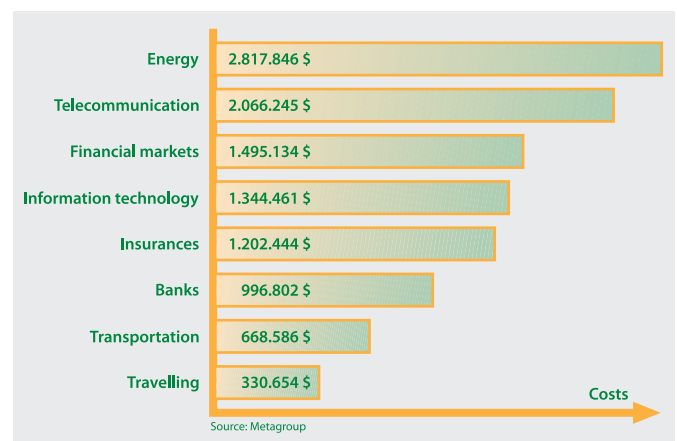
## Innovative measurement technology for all types of fault currents

Modern loads, such as variable-speed drives or switched-mode power supplies generate fault currents which have nothing more in common with the “good old sine wave”. Today, a wide range of harmonics in most versatile wave forms exist in every power supply system. The solution: AC/DC sensitive residual current monitoring (r.m.s value measurement) and the analysis of the harmonics.

## Residual current monitoring for universal use in

- Computing centers, EDP equipment and systems
- Banks, insurances
- Office and administration buildings
- Hospitals, medical practices
- Power generation and distribution
- Power plants
- Radio and television stations
- Communication technology systems
- Traffic engineering (airports, railway, ships, etc.)
- Continuous production processes (even with variable speed drives)

and a lot of other facilities.



Costs per day in case of interruption to operation

### The distinction between RCMs and RCDs

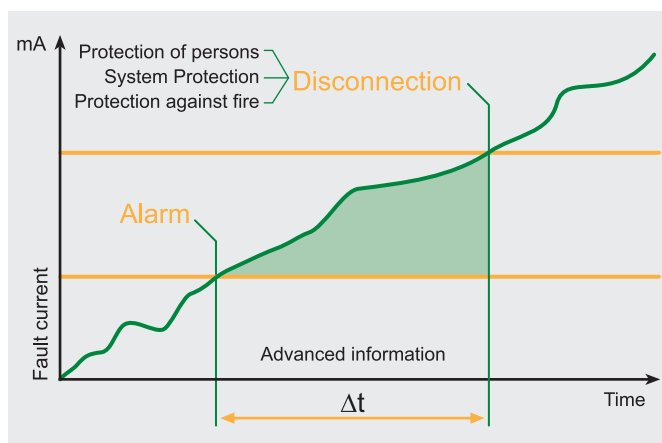
**RCMs** (Residual Current Monitors) monitor residual currents in electrical installations, indicate the currently measured value and signal when the residual current exceeds a preset level. The devices are designed to be used for signalling and/or switching. RCMs comply with the requirements of IEC 62020 (VDE 0663): 2005-11 "Electrical accessories -Residual current monitors for household and similar uses (RCMs)".

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 disconnection.

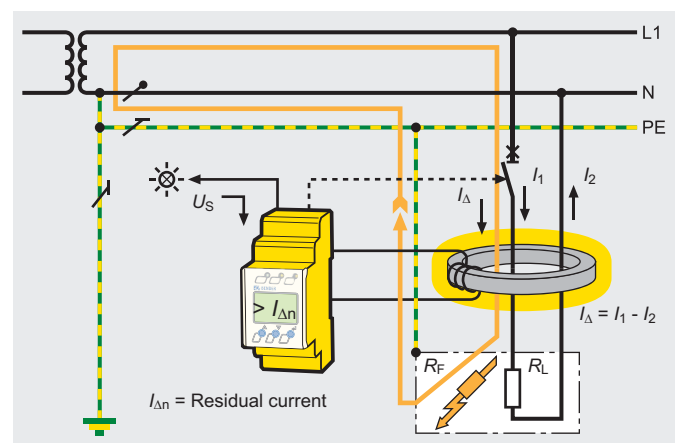
### How does an RCM operate?

All conductors of the load circuit to be monitored (with the exception of the PE conductor) are routed through a measuring current transformer. In a fault-free system, the sum of all currents is zero, so that no voltage is induced in the secondary winding of 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 method of measurement applies to RCMs for pure alternating current and pulsating direct fault currents (Type A as per IEC 60755).

AC/DC sensitive RCM(A) of Type B require special measuring current transformers and a special method of measurement to detect both direct and alternating currents of different frequencies.

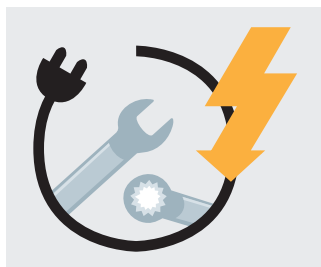


Time gained thanks to advanced information by RCMs



Principle of operation RCM Type A

# The benefits gained from RCM/RCMA/RCMS monitoring



## Optimised maintenance

- Immediate information by centralised or distributed alarm messages
- Optimisation of human and time resources by complete documentation and precise indication of the point of the fault.
- Fast, preventive intervention by remote diagnostics and remote administration via LAN resp. WAN network



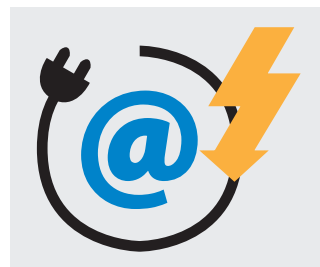
## Increased protection against fire

- Potential fire hazards caused by high fault currents are detected as soon as they occur
- Costs as a consequence of material and ecological damage are avoided
- N conductor overload or interruption are signalled at an early stage
- Material damage due to unintentional displacement of the neutral point caused by N conductor interruption is prevented



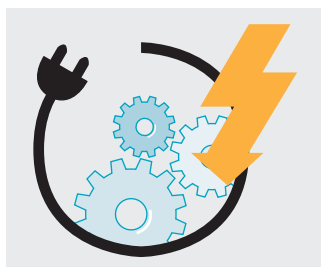
## Improved economic efficiency

- Maintenance and operational costs are considerably reduced
- Expensive and unplanned system downtimes are avoided through up-to-date information
- Higher productivity through increased operational availability
- Cost savings through lower insurance premiums
- Investment management is supported because weak points in the electrical installation are detected



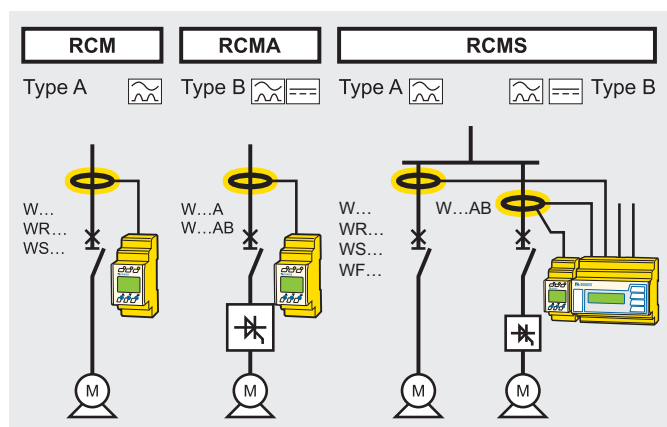
## Thorough information

- Clear and unambiguous on-location information via 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 fieldbus, OPC and Ethernet (TCP/IP)
- Cost reduction through the use of existing communication architecture (Ethernet)



## Higher operational and electrical 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
- Continuous monitoring of systems and devices for insulation deteriorations instead of sampling tests
- Potential faults in newly installed electrical systems or during the commissioning of new devices are detected immediately
- Additional safety through monitoring TN-S systems for unwanted N-PE connections
- Alarm messages can optionally be used for signalling or switching



Application RCM/RCMA/RCMS

## How to distinguish the different versions – RCM, RCMA, RCMS

RCMs differ in the type, frequency, and current wave form which they are capable of detecting:

**RCM series:** Residual current monitors Type A according to IEC 60755 for monitoring alternating currents (42...2000 Hz) and pulsating direct currents.



**RCMA series:** Residual current monitors Type B according to IEC 60755 for monitoring alternating currents, pulsating and smooth direct currents (0...2000 Hz).



**RCMS series:** Multi-channel residual current monitoring system Type A and B according to IEC 60755 for monitoring alternating currents, pulsating and smooth direct currents (0 (42)...2000 Hz).



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

## Causes of fault currents

Poor insulation due to

- Mechanical damage of cables connected to the device
- Too low insulation resistance caused by moisture and dirt
- Damaged cable insulation of devices and lamps through continuous heating

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

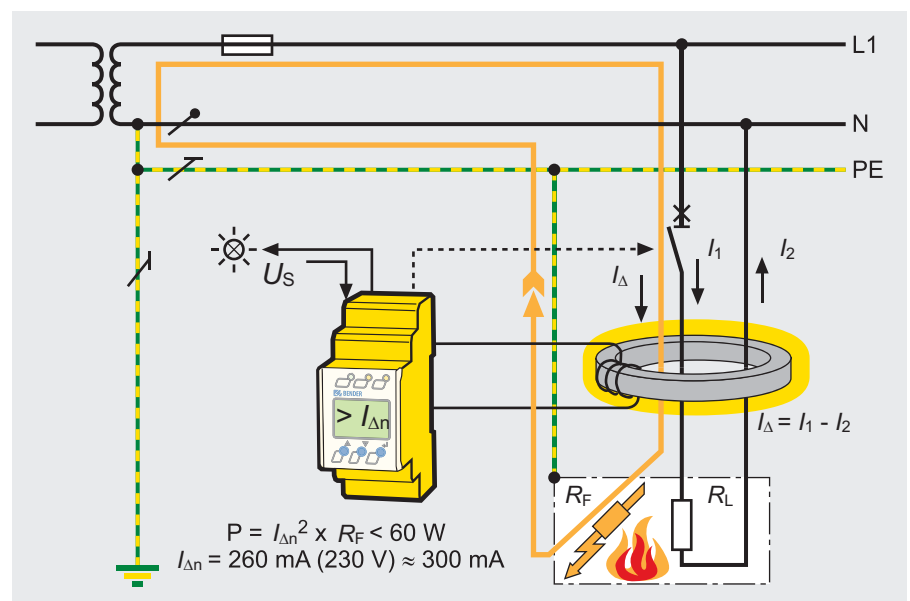
- Electrical current may cause personal injury and machine damage
- Expensive system downtimes
- Increased fire risk
- Data loss and malfunctions in EDP and communication systems
- Expensive and unplanned maintenance work

## 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
- Maintain a high level of operational reliability and availability of the installation by immediate detection and elimination of insulation faults

## Your benefits

- Preventive safety for the protection of man and machine against the hazards of electric current
- Risks of failure through unexpected tripping of protective devices are reduced to a minimum
- Systems and devices are continuously monitored for insulation deteriorations instead of sampling tests
- Maintenance and operational costs are considerably reduced
- The insulation resistance of the electrical installation is kept at a high level.



Fire risk through insulation faults (> 60 W)

# RCMS in practice – for EMC friendly electrical installations with less interferences

## The hazards of uncontrolled currents

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

### Causes:

- Stray currents
- N conductor overload caused by harmonics (e.g. 150 Hz)
- PE and N conductor interruptions

### Effects:

- Unwanted operational interruptions
- 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 electrodes
- High operational and maintenance costs

## RCMS – the extra plus for the highest level of availability of power supplies

Planners of buildings and electrical installations play a major part when electrical safety and the highest level of availability 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

- faulty resp. residual currents,
- operating currents,
- stray currents and
- currents in N and PE connections.

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

# RCMS in practice – monitoring the central earthing point

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?

- Designing the power supply system as a TN-S system (five conductors).
- Connecting 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.

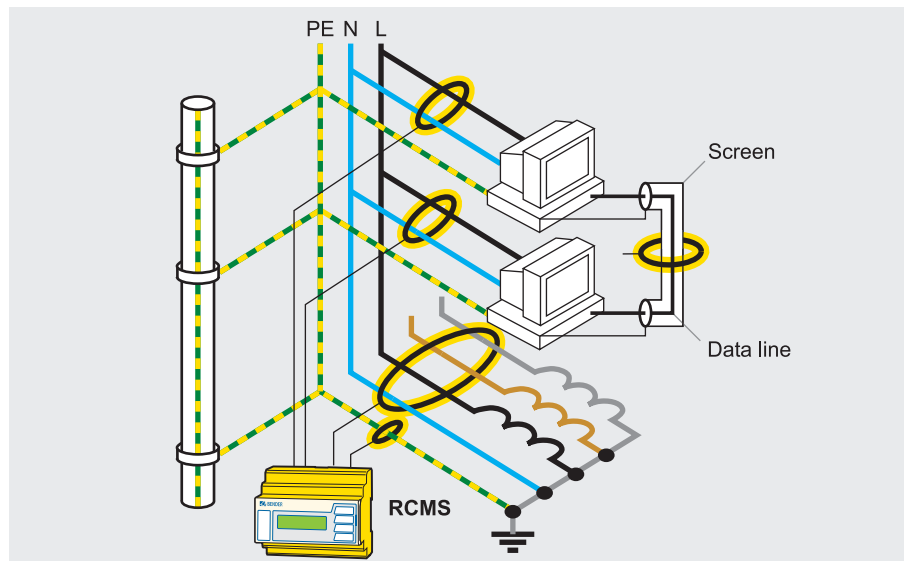
## How to monitor “clean” TN-S systems?

Continuously monitor the currents

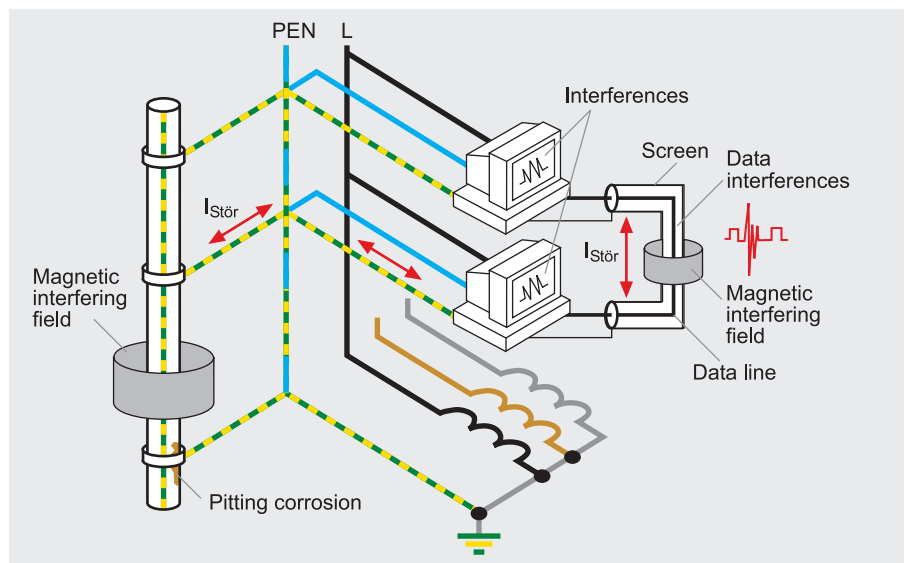
- in the only N-PE connection
- in the central earthing point
- in essential load circuits.

## Your benefits:

- Electromagnetic interferences and interruptions to operation are reduced.
- Stray currents and accidentally installed N/PE-connections 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 communication technology, electrical loads are used (PCs, electronic power supply units, copiers, etc.) which additionally load the N conductor with currents of the third harmonics. 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. When the N conductor is interrupted, uncontrolled shifts of the neutral point and voltage increase may occur, which in the long run may destroy devices and parts of the installation.

## What should you do?

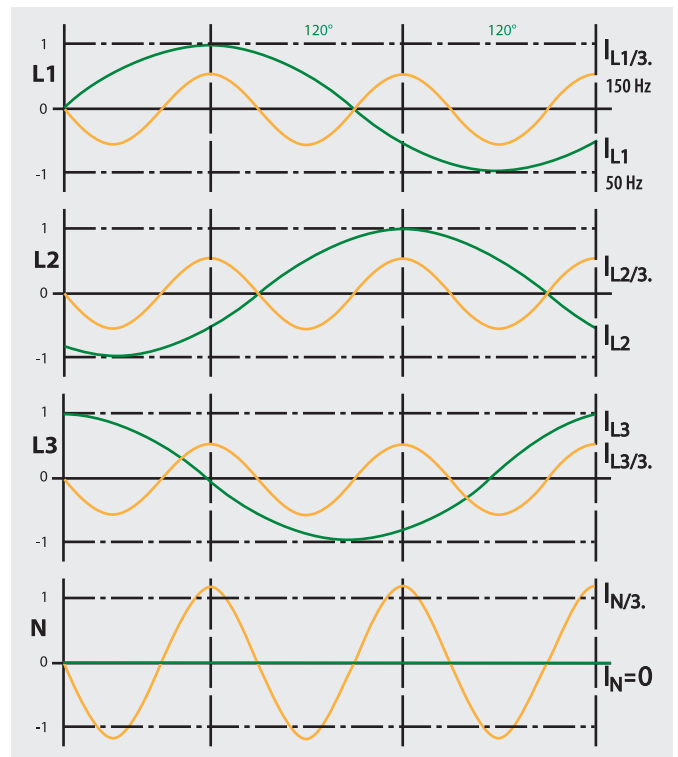
- Avoiding overload of the N conductor or rating the N conductor cross section for harmonic loads.
- Installing a network filter, if required.

## What should you monitor?

- The N conductor should be monitored 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 neutral point is avoided.
- Operational safety and electrical system safety are considerably improved.
- Potential fire hazards are recognised when 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

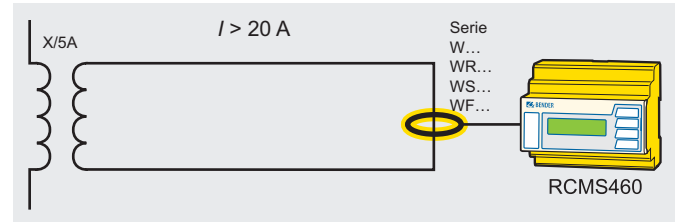


# Application example for an RCMS460/490 system in an office or a PC room

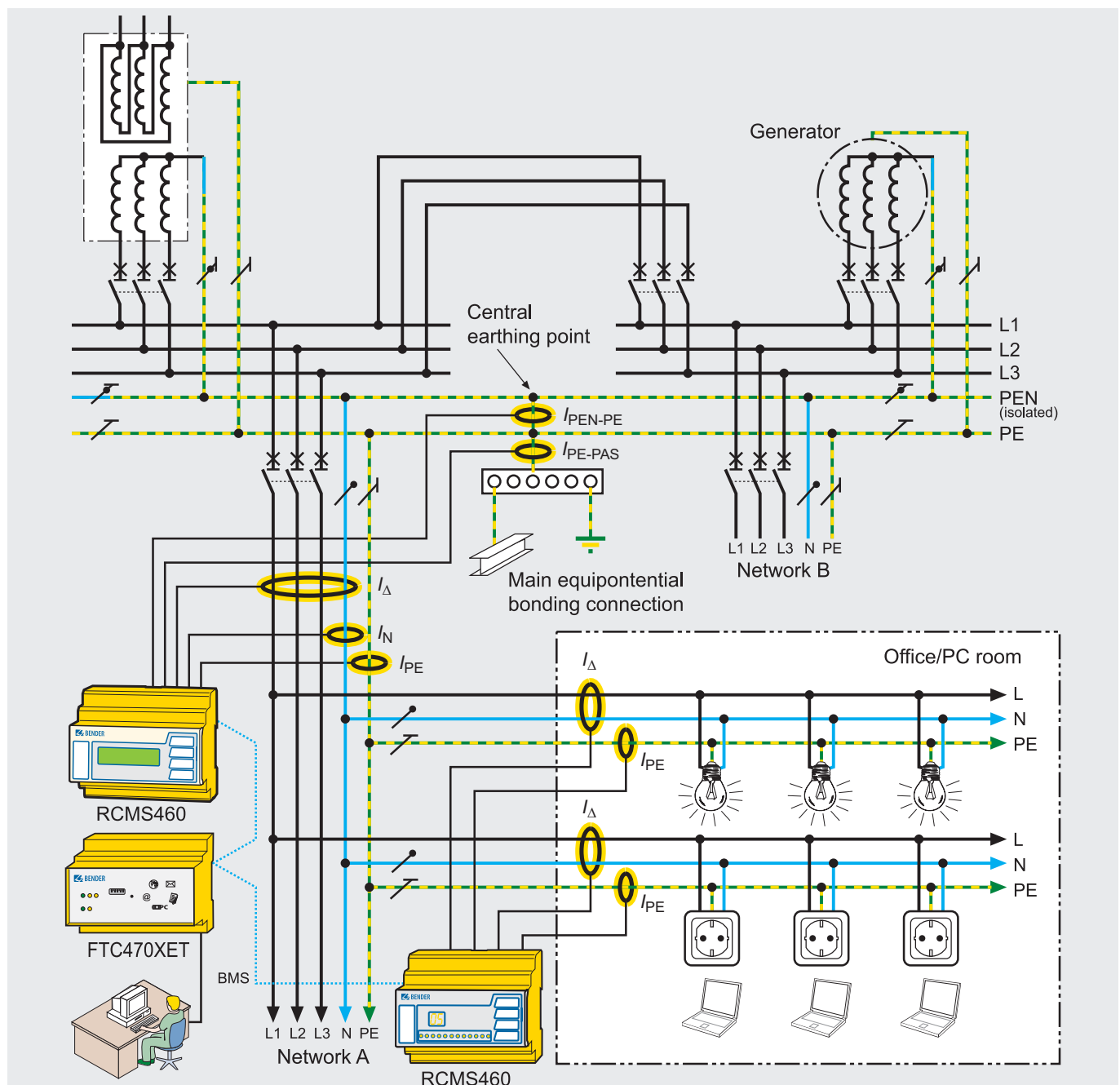
## Legend

- $I_{\Delta}$  = 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 equipotential bonding connection

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

# 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 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.

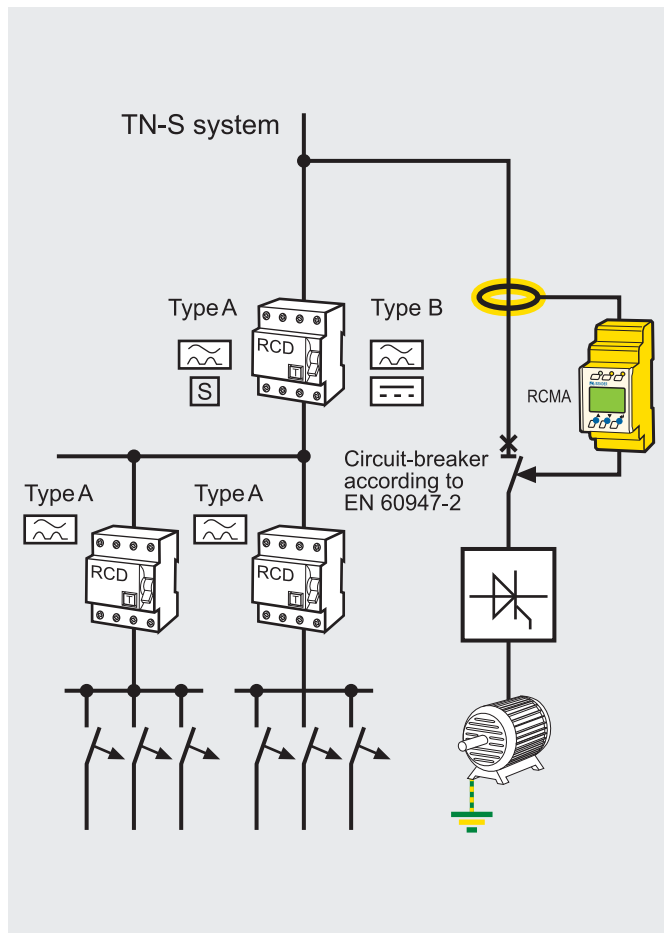
The tripping characteristics of the pulse current sensitive RCDs are negatively influenced by DC currents > 6 mA or even is prevented at all. The use of AC/DC sensitive residual current monitors RCMA allows all common types of fault and residual currents to be detected.

## What should you do?

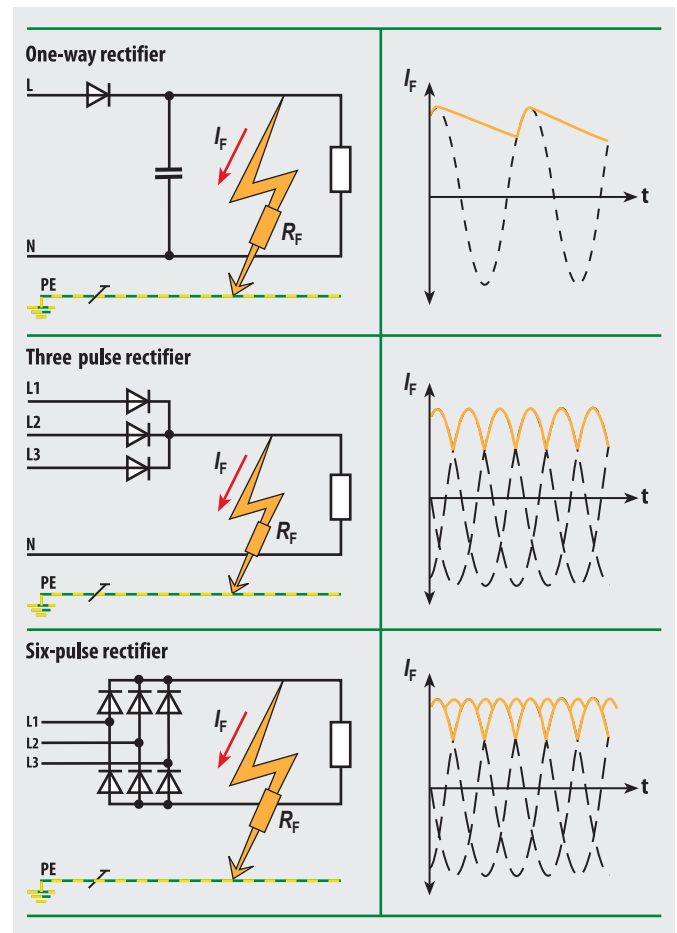
- Testing the systems and devices for the occurrence of smooth DC fault currents.
- Considering DIN EN 50178 (VDE 0160) when variable-speed drives are used.
- Assigning a separate circuit to loads involving smooth DC fault currents.
- Monitoring a circuit or a load with an AC/DC sensitive RCMA.
- Using an RCMA 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 the use of measuring current transformers.



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



Rectifier circuits with DC currents without zero crossing

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



Type		Suitable for				
Type	Art. No.	RCM		RCMA	RCMS	
		RCM420	RCM470DY	RCMA420	RCMA47...	RCMS460/490



Inside diameter (mm)		Design W..., circular type					
ø 20	W20	B 9808 0003	×	×	--	--	×
ø 35	W35	B 9808 0010	×	×	--	--	×
ø 60	W60	B 9808 0018	×	×	--	--	×
ø 120	W120	B 9808 0028	×	×	--	--	×
ø 210	W210	B 9808 0034	×	×	--	--	×



Inside diameter (mm)		Design W...AB, circular type, AC/DC sensitive					
ø 20	W20AB	B 9808 0008	--	--	×	--	×
ø 35	W35AB	B 9808 0016	--	--	×	--	×
ø 60	W60AB	B 9808 0026	--	--	×	--	×
ø 120	W120AB	B 9808 0041	--	--	--	--	×
ø 210	W210AB	B 9808 0040	--	--	--	--	×



Inside diameter (mm)		Design WR..., rectangular type					
70 x 175 (W x H)	WR70x175	B 9808 0609	×	×	--	--	×
115 x 305 (W x H)	WR115x305	B 9808 0610	×	×	--	--	×



Inside diameter (mm)		Design WS..., rectangular type, split-core					
20 x 30 (W x H)	WS20x30	B 9808 0601	×	--	--	--	×
50 x 80 (W x H)	WS50x80	B 9808 0603	×	--	--	--	×
80 x 120 (W x H)	WS80x120	B 9808 0606	×	--	--	--	×



Length A measuring current transformer (mm)		Design WF..., 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	--	--	--	--	×

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

## Other measuring current transformers on request



W...-S... series



W...-A...S series



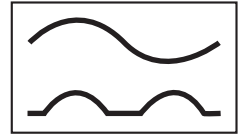
WS...S series



WR...S series

# Device overview

## Residual current monitors RCM



### TN, TT systems



RCMs monitor residual currents respectively fault currents in earthed systems (TN, TT systems) and are predominantly used in electrical installations where an alarm must be provided but disconnection must be prevented in the event of a fault. RCMs are suitable for alternating respectively pulsed 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.

### IT systems



The residual current monitor RCM470DY monitors the residual current in unearthed AC and 3(N)AC systems. The residual current is evaluated directionally, i.e. insulation faults detected on the load side are signalled. That allows selective fault location in extended systems.

### Ordering information

Type	Supply voltage $U_S$	Response value	Art. No.
RCM420-D-1	AC 42...460 Hz 16...72 V, DC 9.6...94 V*	10 mA...10 A	B 9401 4001
RCM420-D-2	AC 42...460 Hz 70...300 V, DC 70...300 V*	10 mA...10 A	B 9401 4002
RCM470DY	AC 50...60 Hz 230 V	10 mA...10 A	B 9402 2025
RCM470DY-72	AC 50...60 Hz 230 V	100 mA...100 A	B 9402 2031
RCM475LY	AC 50...400 Hz 230 V	10 mA...10 A	B 9401 2018
RCM475LY-13	AC 50...400 Hz 90...132 V*	10 mA...10 A	B 9401 2035

\* absolute value

### Type

#### Application range

Type of distribution system
Measuring channels
Residual currents
Rated frequency $f_{\Delta n}$
Classification acc. to IEC 60755

#### Device features – Response values/contacts

Rated residual operating current $I_{\Delta n1}$
Rated residual operating current $I_{\Delta n2}$
Response time
Response delay $t_{on}$
Starting delay $t$
Delay on release $t_{off}$
Alarm relay, alarm
Alarm relay, prewarning
Operating principle, alarm relays

#### Measuring current transformers

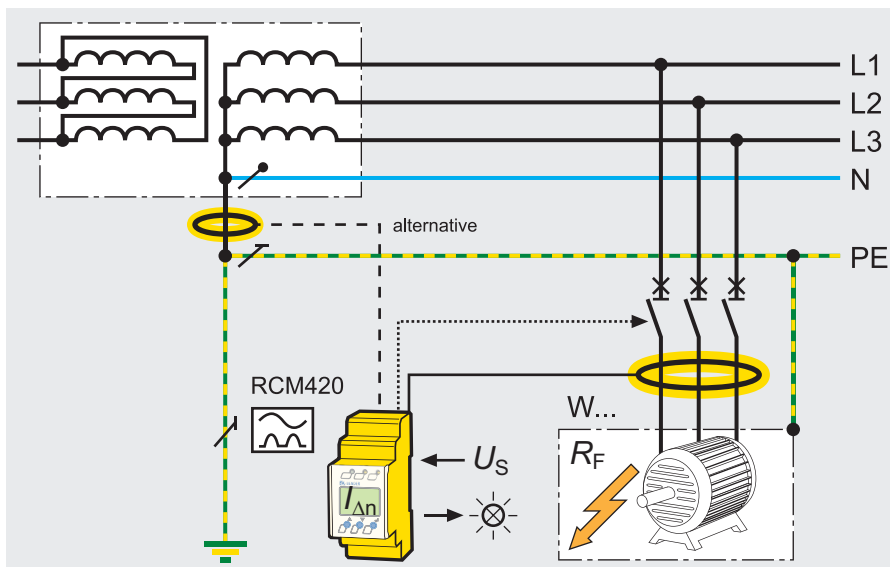
External measuring current transformers
Built-in measuring current transformers (diameter)

#### Displays

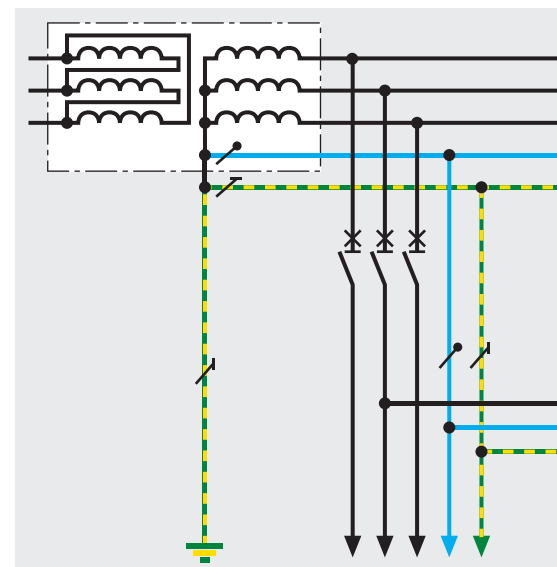
Measured value display
Power On LED
Alarm LED
Connection, external measuring instrument

#### General features

CT connection monitoring
Test/reset button internal/external
Fault memory
Measured value memory
Approvals



Monitoring of an electric load (line or PE)



Monitoring of an electric load



**RCM420**

TN/TT systems
1
AC + pulsed DC
42...2000 Hz
Type A

50...100 % $I_{\Delta n2}$
10 mA...10 A
$\leq 180 \text{ ms } (1 \times I_{\Delta n}); \leq 30 \text{ ms } (5 \times I_{\Delta n})$
0...10 s
0...10 s
0...99 s
1 changeover contact
1 changeover contact
N/O or N/C operation

W..., WR..., WS...
--

LC display
×
Alarm 1, 2
Option

×
×
selectable
×
UL, GL, GOST



**RCM475LY**

TN/TT systems
1
AC + pulsed DC
50...60 Hz
Type A

10 mA...10 A
--
$\leq 250 \text{ ms } (1 \times I_{\Delta n}); \leq 20 \text{ ms } (5 \times I_{\Delta n})$
0...10 s
--
--
2 changeover contacts
--
N/O or N/C operation

--
18 mm

LED bar graph indicator 0...100 %
×
×
×

×
×
selectable
--
UL, GL, GOST



**RCM470DY**

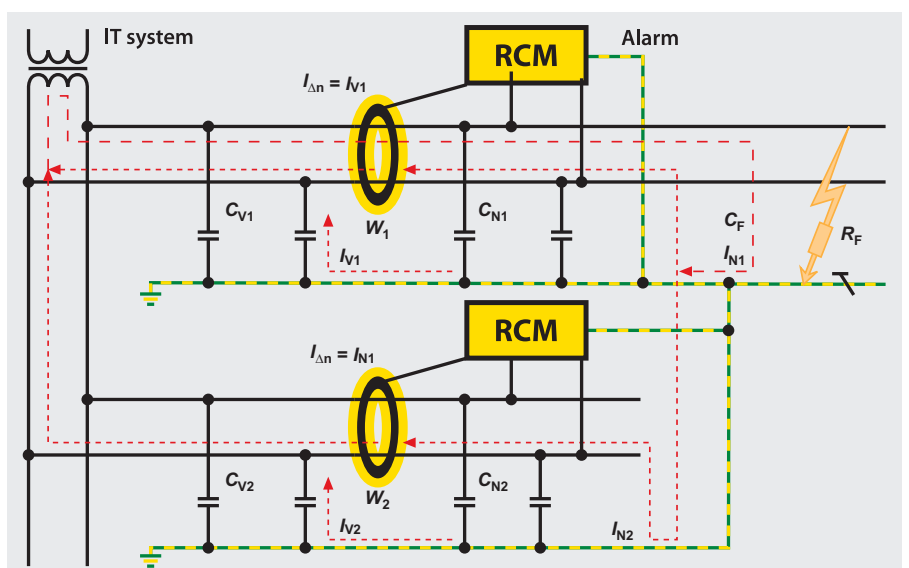
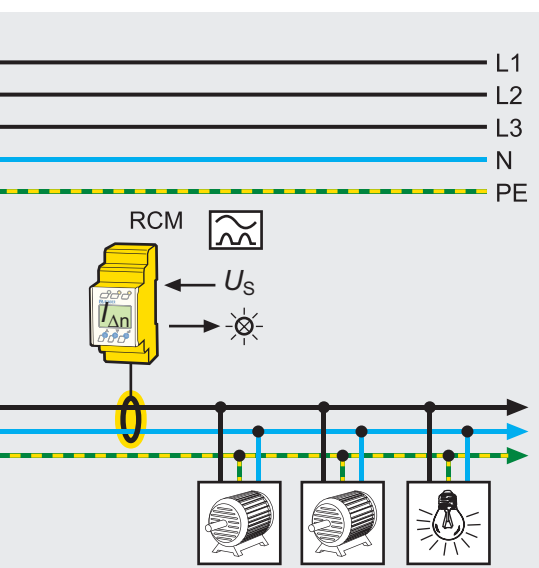
IT systems
1
AC + pulsed DC
50...60 Hz
Type A

10 mA...10 A/100 mA...100 A
--
$\leq 500 \text{ ms}$
0...10 s
--
--
2 changeover contacts
--
N/O or N/C operation

W..., WR...
--

--
×
×
--

×
×
selectable
--
UL, GL, GOST



Monitoring of residual currents in extended IT systems with RCM470DY

# Device overview AC/DC sensitive residual current monitors RCMA



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

## Ordering information

Type	Supply voltage $U_S$	Response value	Art. No.
RCMA420-D-1	DC 9,6...94 V / AC 42...460 Hz 16...72 V	10...500 mA	B 7404 3001
RCMA420-D-2	DC 70...300 V / AC 42...460 Hz / 70...300 V	10...500 mA	B 7404 3002
RCMA423-D-1	DC 9,6...94 V / AC 42...460 Hz 16...72 V	30 mA...3 A	B 7404 3023
RCMA423-D-2	DC 70...300 V / AC 42...460 Hz / 70...300 V	30 mA...3 A	B 7404 3025
RCMA475LY	AC 230 V	30...500 mA	B 9404 2002
RCMA475LY-13	AC 90...132 V	30...500 mA	B 9404 2004
RCMA475LY-21	DC 9,6...84 V	30...500 mA	B 9404 2014
RCMA475LY-23	DC 77...286 V	30...500 mA	B 9404 2015

\* absolute value

## Type

### Application range

Type of distribution system
Measuring channels
Residual currents
Rated frequency
Classification acc. to IEC 60755

### Device features – Response values/contacts

Rated residual operating current $I_{dn1}$
Rated residual operating current $I_{dn2}$
Response time
Response delay alarm $t_{on}$
Response delay prewarning $t_{on}$
Starting delay $t$
Delay on release $t_{off}$
Alarm relay, alarm
Alarm relay, prewarning
Operating principle, alarm relays

### Measuring current transformers

External measuring current transformers

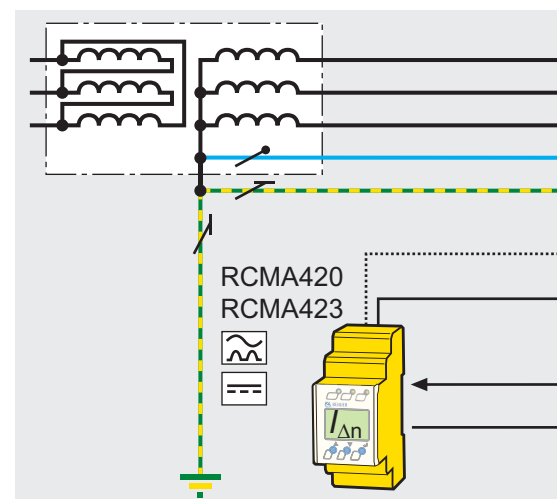
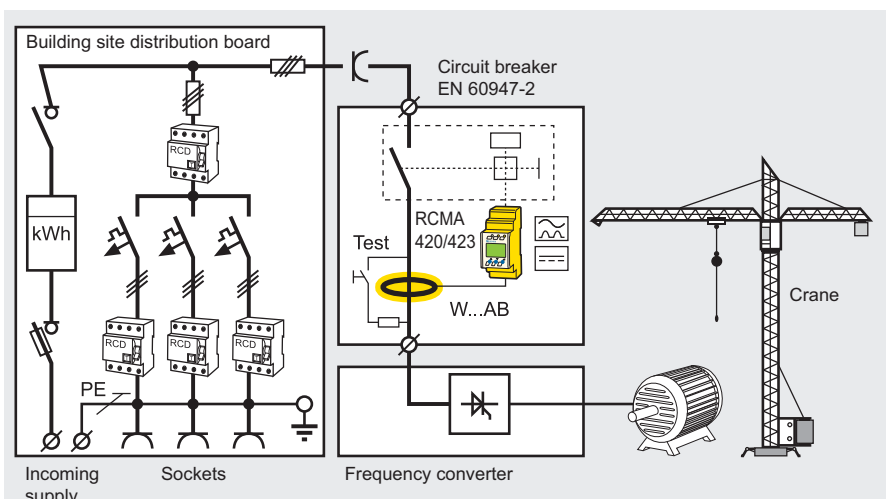
Built-in measuring current transformers (diameter)

### Displays

Measured value display
Power On LED
Alarm LED
Connection, external measuring instrument

### General features

CT connection monitoring
Test/reset button internal/external
Fault memory
Measured value memory
Approvals





RCMA420

TN/TT systems
1
AC + pulsed DC + DC
0...2000 Hz
Type B

50...100% $I_{\Delta n2}$ , min. 5 mA
10...500 mA
$\leq 180$ ms ( $1 \times I_{\Delta n}$ ) $\leq 30$ ms ( $5 \times I_{\Delta n}$ )
0...10 s
0...10 s
0...10 s
0...99 s
1 changeover contact
1 changeover contact
N/O or N/C operation

W20AB
W35AB
W60AB
--

LC display
×
Alarm 1/Alarm 2
Option

×
×
selectable
×
UL, LR, GOST



RCMA423

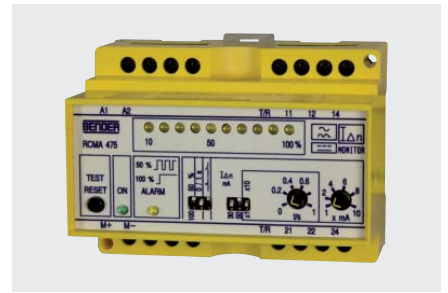
TN/TT systems
1
AC + pulsed DC + DC
0...2000 Hz
Type B

50...100% $I_{\Delta n2}$
30 mA...3 A
$\leq 180$ ms ( $1 \times I_{\Delta n}$ ) $\leq 30$ ms ( $5 \times I_{\Delta n}$ )
0...10 s
0...10 s
0...10 s
0...99 s
1 changeover contact
1 changeover contact
N/O or N/C operation

W20AB
W35AB
W60AB
W120AB
W210AB
--

LC-display
×
Alarm 1 / Alarm 2
Option

×
×
selectable
×
UL, GOST



RCMA475LY

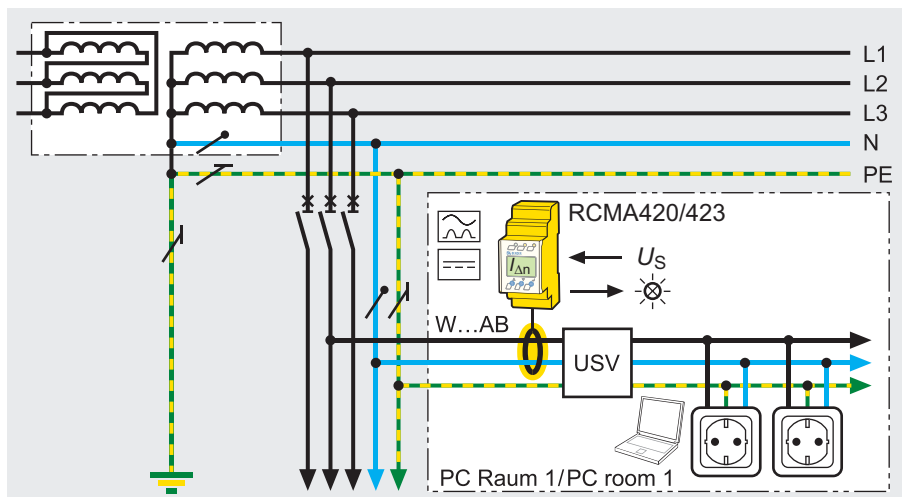
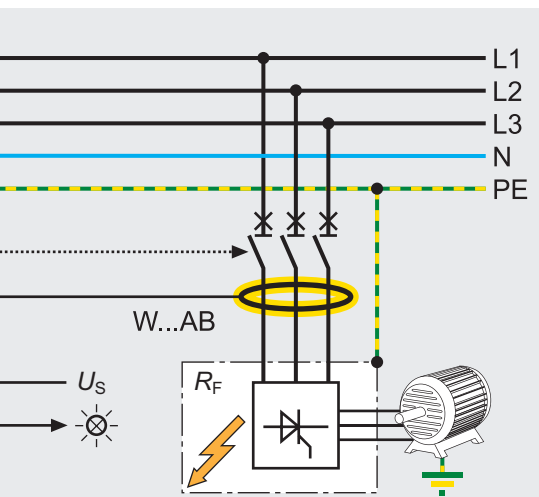
TN/TT systems
1
AC + pulsed DC + DC
0...700 Hz
Type B

30...500 mA
50% of $I_{\Delta n1}/100\%$
$\leq 70$ ms ( $1 \times I_{\Delta n}$ ) $\leq 40$ ms ( $5 \times I_{\Delta n}$ )
0...10 s
0/1 s
--
--
1 changeover contact
1 changeover contact
N/O or N/C operation

--
18 mm

LED bar graph indicator 0...100%
×
Alarm/flashing at 50% $I_{\Delta n1}$
×

×
×
×
--
UL, GOST



Monitoring of computer rooms

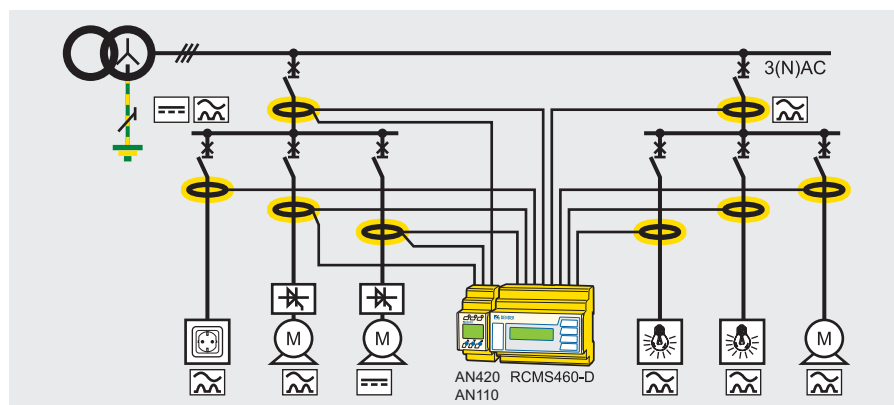
# Device overview residual current monitoring systems RCMS460/490



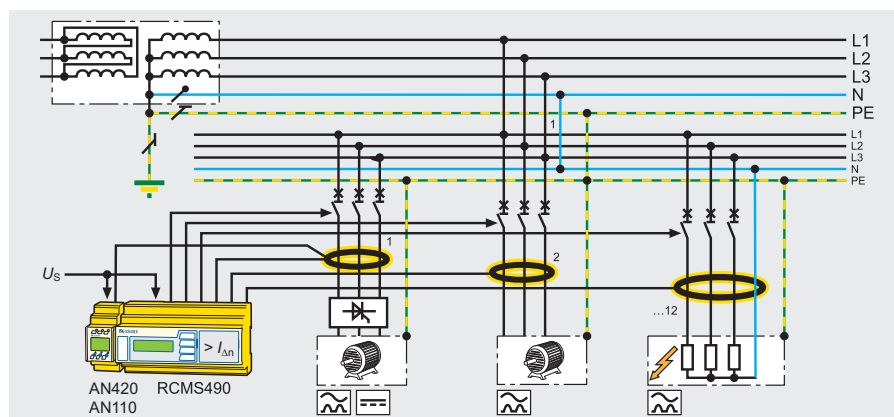
The RCMS system is a multi-channel residual current monitoring system that is designed to monitor up to 12 measuring points or measuring channels per device. In combination with several devices it is capable of monitoring up to 1080 channels. The RCMS is suitable for alternating respectively pulsating and smooth DC residual currents, depending on the selected type of measuring current transformer.

Ordering information					
Type	Description	Supply voltage $U_s^*$		Art. No.	
RCMS460-D-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3001
RCMS460-D-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3002
RCMS460-D4-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3009
RCMS460-D4-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3010
RCMS460-L-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3003
RCMS460-L-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3004
RCMS490-D-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3005
RCMS490-D-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3006
RCMS490-D4-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3011
RCMS490-D4-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3012
RCMS490-L-1	Residual current evaluator	AC 42...460 Hz	16...72 V	DC 16...94 V	B 9405 3007
RCMS490-L-2	Residual current evaluator	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3008
AN420-2	Power supply unit	AC 42...460 Hz	70...276 V	DC 70...276 V	B 9405 3100
WXS-100	Connecting cable length 1 m	--	--	--	B 9808 0506
WXS-250	Connecting cable length 2.5 m	--	--	--	B 9808 0507
WXS-500	Connecting cable length 5 m	--	--	--	B 9808 0508
WXS-1000	Connecting cable length 10 m	--	--	--	B 9808 0509

\* absolute value



RCMS- basic system



RCMS490 system with switching function per measuring channel

## Type

### Application range

Type of distribution system
Classification acc. to IEC 60755
Residual current display range Type A (r.m.s)
Residual current display range Type B (r.m.s)
Rated frequency Type A/Type B

### Device features – Response values/contacts

Number of measuring channels $I_{\Delta}$ or I/O
Rated residual operating current $I_{\Delta n2}$ (alarm), AC/DC sensitive Type B (channel 1...12) pulsed, AC current sensitive Type A (channel 1...12) pulsed, AC current sensitive Type A channel 9...12 (-D4) only
Rated residual operating current $I_{\Delta n1}$ (prewarning)
Operating time for all channels
Operating time for digital inputs I/O
Response delay $t_{on}$ per channel
Starting delay $t$ per device
Delay on release $t_{off}$ per channel
Function selectable per channel
Factor for additional CT
Interface
Common alarm relay for all channels
Alarm relay per channel

### Measuring current transformers

External measuring current transformer Type A
External measuring current transformer Type B

### Displays

Power On LED, alarm LED
Alarm LED per channel
Seven-segment display
LC graphics display (backlit)

### General features

CT connection monitoring
Test/reset button internal/external
History memory 300 data records
Fault memory
Analysis of the harmonics ( $I_h$ , DC, THD)
Data logger (300 data records per channel)
Preset function for $I_{\Delta}$ and I/O
Master / Slave function
Parameter setting function
Internal clock
Password
Address range BMS bus
Display error code
Cut-off frequency adjustable for personnel, plant and fire protection
Language
Approvals





RCMS460-D.../-D4...



RCMS460-L



RCMS490-D.../-D4



RCMS490-L...

TN/TT systems
Type A or B (acc. to CT type)
0...30 A / 0...125 A (-D4)
0...20 A
42...2000 Hz/0...2000 Hz

TN/TT systems
Type A or B (acc. to CT type)
--
--
42...2000 Hz/0...2000 Hz

TN/TT systems
Type A or B (acc. to CT type)
0...30 A
0...20 A
42...2000 Hz/0...2000 Hz

TN/TT systems
Type A or B (acc. to CT type)
--
--
42...2000 Hz/0...2000 Hz

12 (max. 1080 in the system)
10 mA...10 A
6 mA...20 A
100 mA...125 A
10...100 % min. 5 mA
$\leq 180 \text{ ms } (1 \times I_{\Delta n}) \leq 30 \text{ ms } (5 \times I_{\Delta n})$
$\leq 3.5 \text{ s}$
0...999 s
0...99 s
0...999 s
off, <, >, I/O
×
RS-485/BMS protocol
2 x 1 changeover contact
--

12 (max. 1080 in the system)
10 mA...10 A
6 mA...20 A
10...100 % min. 5 mA
$\leq 180 \text{ ms } (1 \times I_{\Delta n}) \leq 30 \text{ ms } (5 \times I_{\Delta n})$
$\leq 3.5 \text{ s}$
0...999 s
0...99 s
0...999 s
off, <, >, I/O
×
RS-485/BMS protocol
2 x 1 changeover contact
--

12 (max. 1080 in the system)
10 mA...10 A
6 mA...20 A
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$\leq 3.5 \text{ s}$
0...999 s
0...99 s
0...999 s
off, <, >, I/O
×
RS-485/BMS protocol
2 x 1 changeover contact
12 x 1 N/O contact

12 (max. 1080 in the system)
10 mA...10 A
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10...100 % min. 5 mA
$\leq 180 \text{ ms } (1 \times I_{\Delta n}) \leq 30 \text{ ms } (5 \times I_{\Delta n})$
$\leq 3.5 \text{ s}$
0...999 s
0...99 s
0...999 s
off, <, >, I/O
×
RS-485/BMS protocol
2 x 1 changeover contact
12 x 1 N/O contact

W..., WR..., WS...
W...AB

W..., WR..., WS...
W...AB

W..., WR..., WS...
W...AB

W..., WR..., WS...
W...AB

Power On, Alarm 1/2
--
--
×

Power On, Alarm 1/2
×
×
--

Power On, Alarm 1/2
--
--
×

Power On, Alarm 1/2
×
×
--

×
×
×
selectable
×
×
×
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×
×
×
1...90
×
×
D, GB, F
UL, GOST, LR

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×
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selectable
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1...90
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UL, GOST, LR

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selectable
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1...90
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D, GB, F
UL, GOST, LR

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1...90
×
×
--
UL, GOST, LR

# Device overview residual current monitoring systems

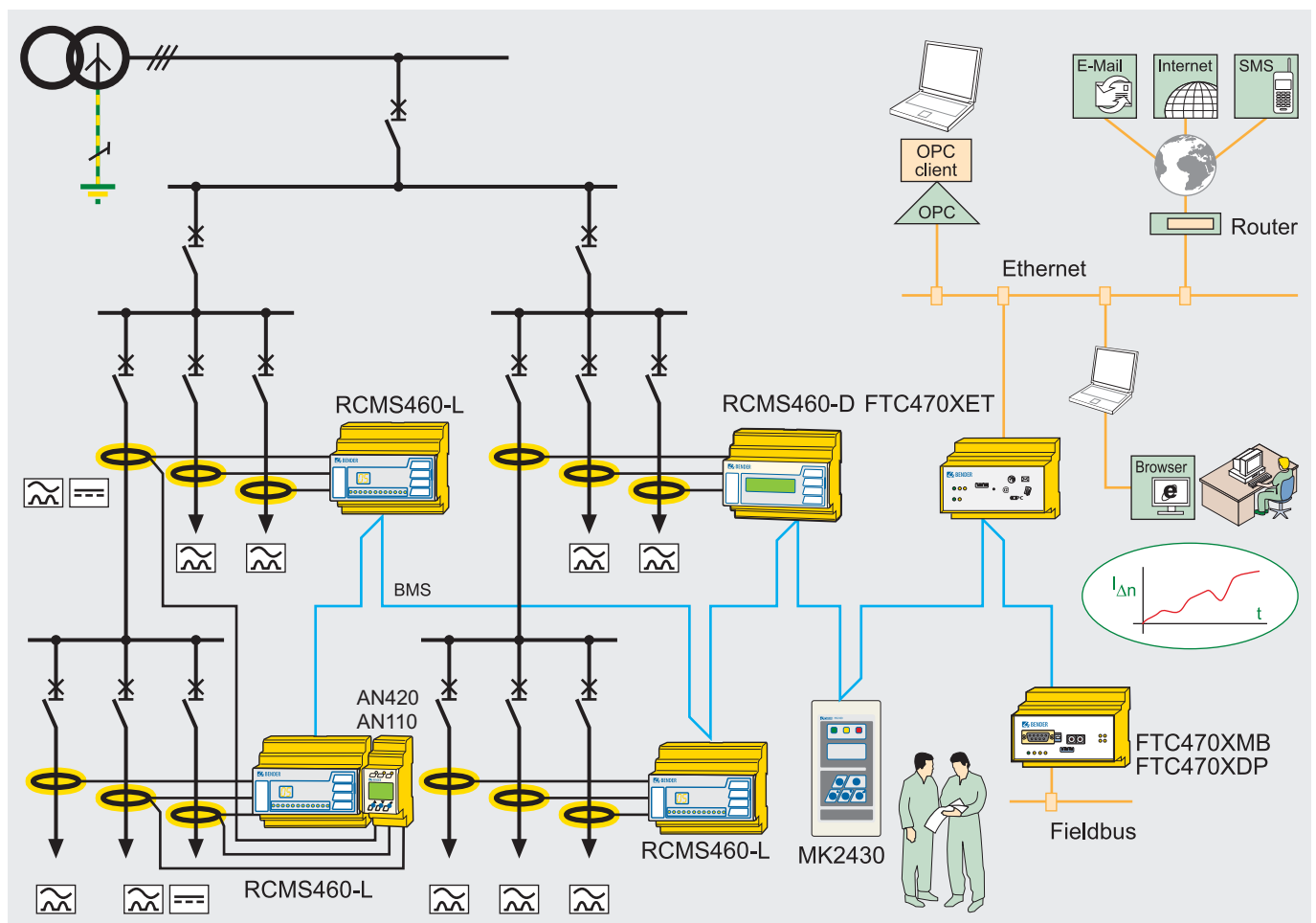
## Application examples

### 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. Hence, operating, warning and fault messages via the web or network, for example, contribute to increasing the transparency of power supply systems, allowing a fast reaction to critical operating states. In addition, important messages can be transferred via short message service or e-mails to mobile phones or laptops of the service personnel. Early information about location and the cause of fault allow time and cost-efficient deployment of service personnel and can avoid equipment failure or the damage of expensive devices.

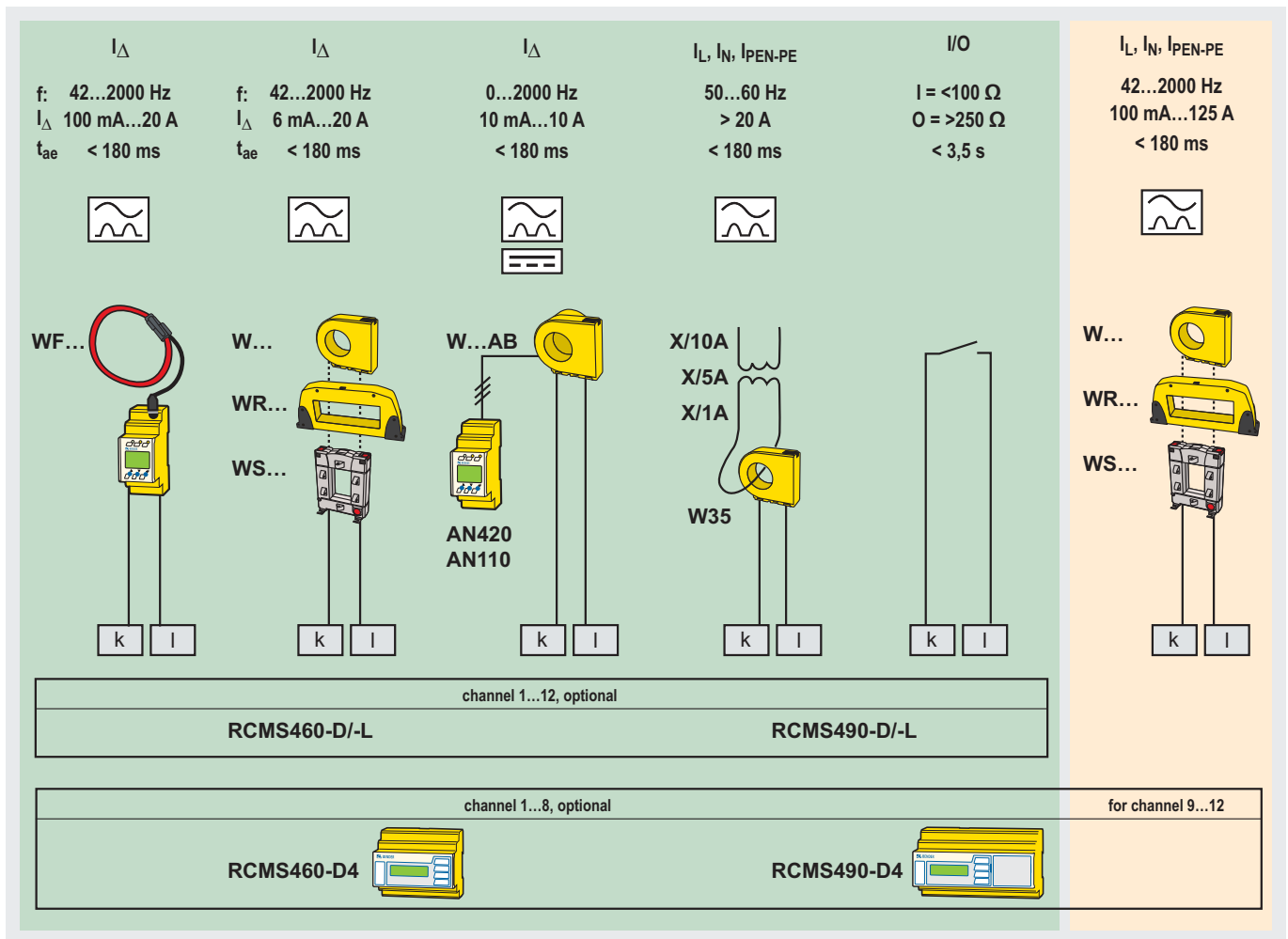
### Electrical Safety Management

Embraced by the term "Electrical Safety management" 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 Building Control and Central Building Process Control Systems provide the maximum possible safety, economic efficiency and transparency. The range of products is completed by comprehensive services beginning with planning and advisory service extending through the whole service life of the products.



RCMS system with central administration via LAN network

# RCMS – flexible in use for all essential current measurements

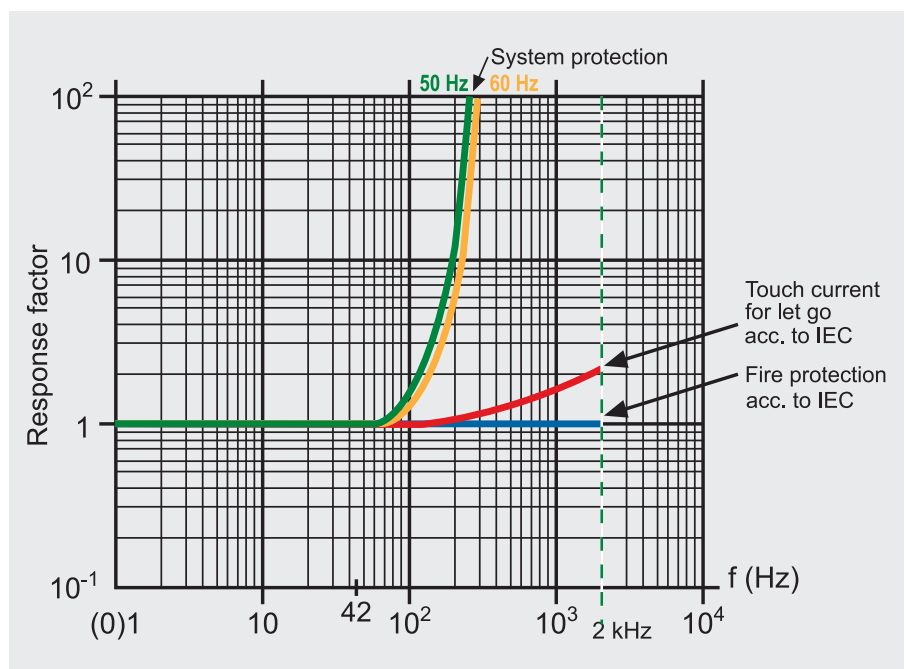


Selection guide for measuring current transformers and measuring ranges

## RCMS – flexible in use for various protective goals

The frequency response characteristics of the RCMS can be set for each channel according to the requirements of each application field, such as for the protection of persons, fire protection, system protection.

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



Frequency response for protective goals

# Electrical safety in systems with high-resistance earthing

In high-resistance earthed systems, the neutral point of one or several transformers or generators is connected to earth directly, via a resistor or a reactance. The impedances are sufficiently low so that transient oscillations are reduced and the conditions with regard to selective earth fault protection can be improved. Essentially, a distinction is drawn between:

- solidly earthed system
- current-limiting, resistance impedance (resistance to earth, reactance)

In systems with current-limiting earthing, the fault current against an exposed conductive part or against earth is low under single fault condition, hence automatic disconnection is not required where exposed conductive parts are earthed individually, in groups or collectively.

In comparison to solidly earthed power supply systems, the resistance earthed neutral point connection provides several advantages regarding the protection of persons and power supply reliability as well as regarding consequential damage in case of phase-to-earth faults. The value of the current at the fault location during the occurrence of an earth fault contributes significantly to the rate of insulation deterioration.

The value of the earth fault current depends on the resistance between neutral point and earth. Typical values of the maximum earth fault current are 5 or 10 A. The resistance (NGR) is calculated according to the Ohm's Law  $NGR = U_o / I_R$  ( $U_o$ : nominal voltage,  $I_R$ : fault current to the neutral point).

The reduction of fault currents imposes exacting requirements on the performance and reliability of the monitoring equipment for selective detection and localization of earth faults, since overcurrent protective devices are not operating in this case.

## Why low-resistance earthing ?

- High availability achieved by reducing the earth fault current to nonhazardous current values
- The fire risk is reduced
- The mechanical damage in case of earth faults is reduced
- Increased protection against electric shock in protective conductors in case of high transient currents
- Transient overvoltages are limited
- Increased protection against material damage and increased plant protection by limiting the fault current
- Fast fault location in case of an earth fault without disconnecting the power supply

## Application

- Mining
- Paper mills
- Chemical industry
- Cement works
- Steel works

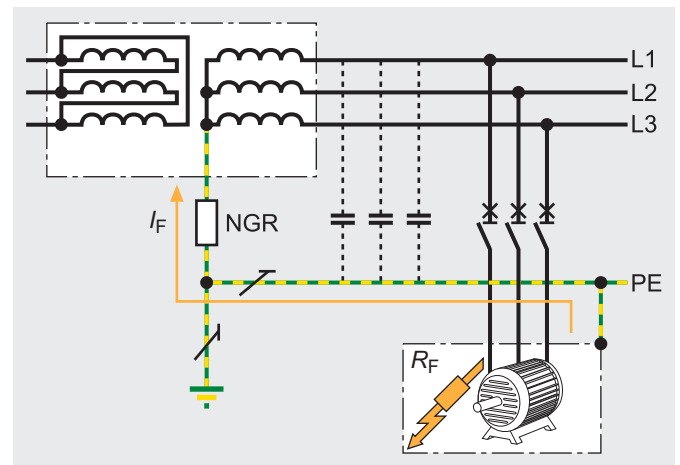


Figure 1: Fault current  $I_F$  in case of a phase-to-earth fault

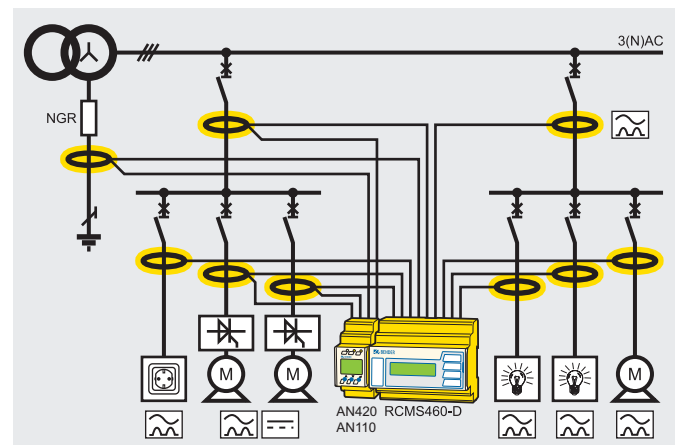


Figure 2 : Selective fault current detection with RCMS

### Functional description – Selective fault location using RCMS

When a phase-to-earth fault occurs in an electrical system with high-resistance earthing, the earth fault current is limited by the resistor (NGR) installed between the neutral point and earth (figure 1).

The earth fault current is limited to nonhazardous current values (5...10 A) which does not lead to operating of an overcurrent protective device. For fast fault location, residual current monitoring devices (RCMS systems) are used, which permanently detect and evaluate the fault current in the neutral point and in the load circuits (figure 2). The twelve-channel residual current evaluators RCMS460/490 can be interconnected and are capable of monitoring 1080 channels. Pulsed DC or AC/DC current sensitive measurements can be performed within 180 ms depending on the type of measuring current transformer.

Information exchange between all RCMS devices takes place via an RS-485 interface (BMS protocol).

### Benefits of application

- Early detection and localization of phase-to-earth faults by installing measuring current transformers in the earthing resistance path and in the load subcircuits.
- Either alarm indication or fast disconnection of the faulty subcircuit
- Selective time delay
- Pulsed DC or AC/DC sensitive fault current measurement depending on the type of measuring current transformer
- Information about the faulty subcircuit at a central location
- History memory, data logger, analysis of the harmonics

### Earth resistance monitoring

In addition to permanent residual current monitoring, the connection between the transformer neutral point and earth at the earthing resistance can be monitored by using an RC48N (figure 3) ground-fault and neutral grounding monitor.

This device combines the following monitoring functions:

- Monitoring of the residual current between the neutral point and earth
- Monitoring of the voltage between the transformer neutral point and earth
- Monitoring of the earth resistance (NGR)

When the limit value is exceeded, the power supply can be disconnected via a circuit breaker. An external RI2000NC remote alarm indicator and an operator panel can be connected to the RC48N.

Ordering information			
Type	Description	Supply voltage $U_s$	Art. No.
RC48N-935	Ground fault neutral grounding monitor	AC/DC 60...264 V	B 9401 3005
CT-M70	Residual current transformer	--	B 911 777

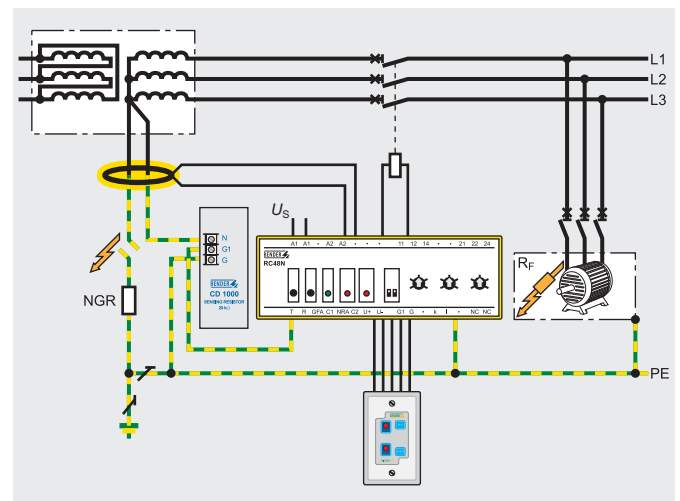
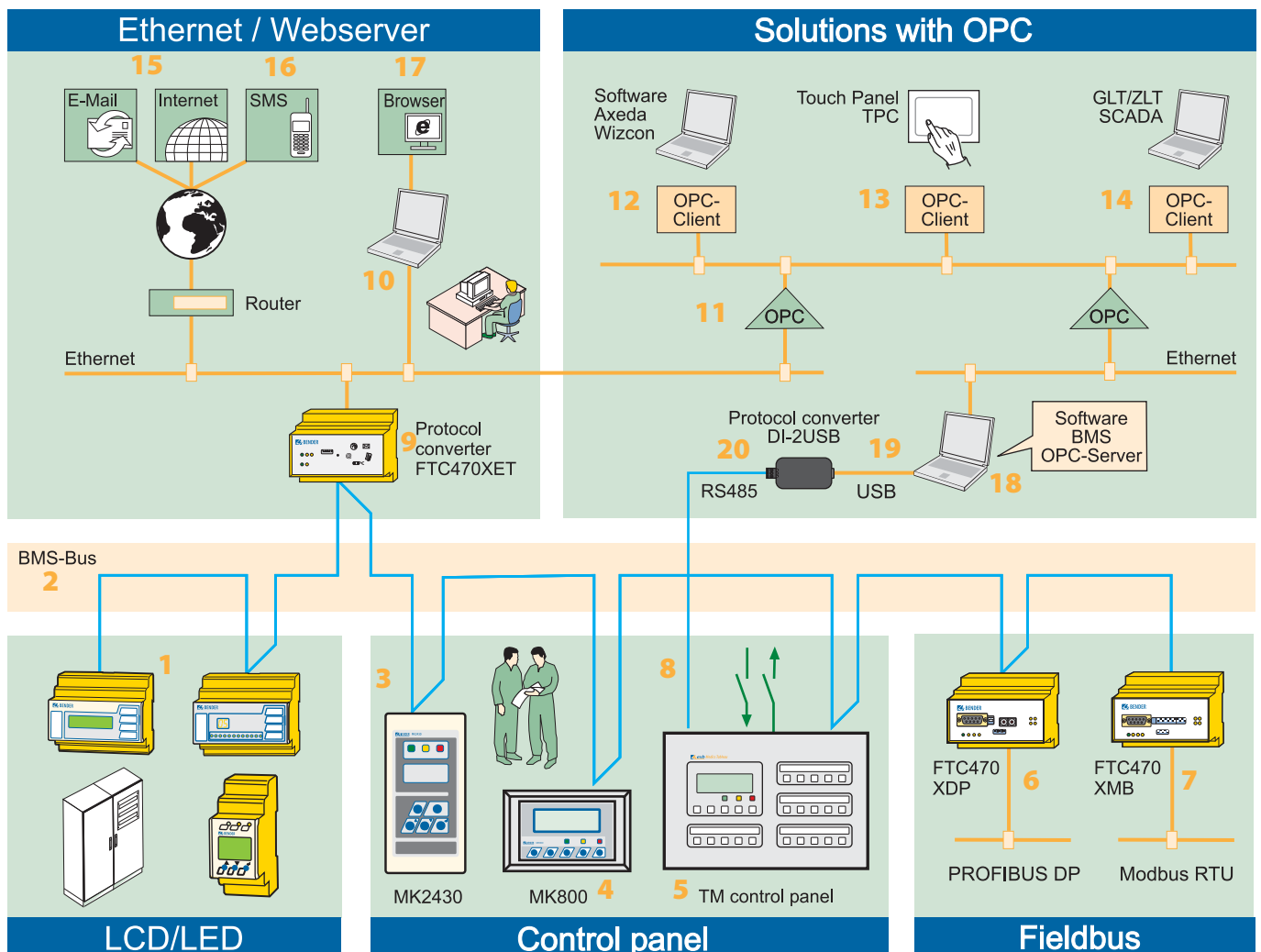


Figure 3: Ground fault and neutral grounding monitor with RC48N

# Bender monitoring systems boundlessly communicative

## Communication possibilities with Bender systems and devices

- 1 - Bender systems or devices with BMS bus, e.g. RCMS, EDS, MEDICS® systems, A-ISOMETER®s IRDH275, 375, 575
- 2 - Bender BMS bus (internal)
- 3 - Alarm indicator and test combination MK2430
- 4 - Alarm indicator and test combination MK800
- 5 - TM alarm indicator and operator panels
- 6 - Protocol converter FTC470XDP Conversion BMS bus/PROFIBUS DP
- 7 - Protocol converter FTC470XMB Conversion BMS bus/Modbus RTU
- 8 - Bender BMS bus (external)
- 9 - Protocol converter FTC470XET Conversion BMS bus/Ethernet (TCP/IP), web server, OPC interface
- 10 - PC with standard browser (Internet Explorer, Firefox, Opera, .etc.)
- 11 - OPC server in FTC470XET
- 12 - OPC client: Axeda Wizcon visualisation software
- 13 - OPC client: Touch Panel TPC for visualisation
- 14 - OPC client: Scada software for visualisation
- 15 - FTC470XET functionality: E-mail notification via Internet
- 16 - FTC470XET functionality: Operation of Bender systems via web browser
- 17 - FTC470XET functionality: Short message service to mobile phones
- 18 - BMS OPC server
- 19 - PC with software BMS OPC server
- 20 - Protocol converter DI-2USB BMS bus (RS-485)/USB



# Accessories for residual current monitors and residual current monitoring systems



Type	FTC470XDP/XMB/XET	9604-4241	DI-1 PSM	DI-2	DI-2USB	RK170
Application	Communication	Measuring instrument	Communication	Communication	Communication	Communication
Function	Protocol converters	% indication	Repeater	Interface converter	Interface converter	Measuring converter
<b>For device family</b>						
RCM	--	×	--	--	--	×
RCMS	×	--	×	with MK and TM panel	with MK and TM panel	--
RCMA	--	×	--	--	--	×
<b>Voltages</b>						
Supply voltage $U_s$	AC 230 V	--	AC/DC 24 V	DC 10...30 V	--	AC 19...264 V, DC 20...297 V
<b>Device features</b>						
Inputs	RS-485 (BMS protocol)	DC 0...400 $\mu$ A	RS-485	RS-485	RS-485	DC 0...400 $\mu$ A
Outputs	--	--	RS-485	RS-232	USB	0(4)...20 mA/ 0...10 V
Electrical isolation	×	--	×	×	×	--
PROFIBUS DP	FTC470XDP	--	--	--	--	--
Modbus RTU	FTC470XMB	--	--	--	--	--
TCP/IP	FTC470XET	--	--	--	--	--
Web server, OPC server	FTC470XET	--	--	--	--	--
E-mail notification	FTC470XET	--	--	--	--	--
Approvals	GL, LR, GOST	--	--	GL, LR	--	--

Ordering information							
Type	Function	Supply voltage $U_s$	Input	Output	Scale	Dimensions	Art. No.
DI-1PSM	Interface converter	AC/DC 24 V	RS-485	RS-485	--	--	B 9501 2044
DI-2	Protocol converters	DC 10...30 V*	RS-485	RS-232	--	--	B 9501 2022
DI-2USB	Protocol converters	--	--	USB	--	--	B 9501 2045
FTC470XDP	Protocol converters	AC 230 V	BMS	PROFIBUS DP	--	--	B 9506 1000
FTC470XMB	Protocol converters	AC 230 V	BMS	Modbus RTU	--	--	B 9506 1002
FTC470XET	Protocol converters	AC 230 V	BMS	TCP/IP	--	--	B 9506 1001
RK170	Measuring converter	AC 19...264 V* DC 20...297 V*	DC 0...400 $\mu$ A	0(4)...20 mA	--	--	B 9504 1500
9604-4241	Measuring instrument	--	DC 0...400 $\mu$ A	--	sector 0...100 %	96 x 96 mm	B 986 807

\* absolute value

# The individual programme that meets your expectations:

## Designed for electrical safety – to meet every requirement – for every application

For more than 60 years Bender innovative measuring and monitoring systems are monitoring power supplies and provide early warning of critical operating conditions in many sectors

- Power supply in industrial, residential and functional buildings
- Machines and systems in production processes
- Power generation and distribution systems
- Information and communication technology systems

### Electrical safety for unearthed power supplies

- Insulation monitoring devices A-ISOMETER®
- Insulation fault location systems EDS
- Earth fault relays

### Electrical safety for earthed power supplies

- Residual current monitors RCM, RCMA
- Residual current monitoring systems RCMS
- For AC, pulsed DC and smooth DC currents (AC / DC sensitive)

### Power supply for medically used rooms

- MEDICS®-Changeover and monitoring modules for medical locations in accordance with DIN VDE 0100-710: 2002-11 and IEC 60364-7-710: 2002-11
- Remote alarm indicator and operator panels
- Complete distribution systems
- IT system transformers

### Measuring and monitoring relays

- For electrical quantities: current, voltage, phase sequence, frequency, etc.
- For special applications such as mining, mobile generators, welding robots, solar photovoltaic systems and many more

### Communication solutions

- Protocol converter for standard bus systems (PROFIBUS, Modbus), Protocol converter for Ethernet (TCP/IP)
- Visualisation of data via Axeda Wizcon and Active X
- Communication via OPC

### Testing systems

- For electrical safety of medical electrical equipment and general electrical equipment
- Function testers for medical electrical equipment
- Equipment management software

### Service

- Function check, EMC check, system quality check
- Electro thermography, commissioning, periodic testing
- Technical approvals of electrical installations by recognised experts, inventory taking / maintenance of installations
- Modernisation, central building control systems/visualisation, on-site training courses
- Fault elimination, insulation fault location



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