

## RCMS460 and RCMS490 Series

Digital Multi-Channel Ground Fault Monitor / Ground Fault Relay  
Grounded and High-Resistance Grounded AC/DC Systems



## RCMS460 / RCMS490 Series

### Multi-Channel Ground Fault Monitors for Grounded AC, DC, and AC/DC Systems



RCMS460-D / -L and RCMS490-D / -L

#### Device features

- Selectably monitor either pure AC, pure DC, or AC/DC mix on each separate channel
- True RMS value measurement
- 12 separate monitoring channels, each with its own settings adjustment
- AC ground fault detection up to 2000 Hz
- Fast parallel scanning for all channels
- Response ranges  
10 mA...10 A (DC or AC/DC mix)  
6 mA...20 A (AC only systems)
- Latching or non-latching operation
- Three separately adjustable time delays
- Adjustable frequency behavior for protection of persons, fire protection and plant protection
- History memory with date and time stamp for 300 data records
- Data logger for 300 data records / channel
- Analysis of harmonics, DC, THD
- Two Voltage-free SPDT contacts for entire device
- RCMS490: Additionally one voltage-free SPST contact for each channel
- Selectable between normally energized and normally de energized operation
- TEST / RESET button, internal / external
- -D version: Digital backlit LCD display
- Data exchange via BMS bus
- Password protection
- Continuous CT connection monitoring
- Conforms to RoHS

#### Approvals



#### Description

The RCMS460 and RCMS490 monitor for ground faults in multiple grounded and high-resistance grounded AC, DC, and AC/DC systems. The RCMS460 and RCMS490 are specifically designed to provide advanced warning of developing ground faults without the problems associated with high sensitivity nuisance tripping.

Each RCMS device can monitor up to 12 circuits. Each channel can be separately adjusted to whether it is monitoring pure AC, pure DC, or mixed AC/DC. Setpoints are also separately adjustable on each channel. AC systems up to 2000 Hz can be monitored. Values are read as true RMS values.

The RCMS460 has 2 common SPDT contacts for the device. The RCMS490 has 2 common SPDT contacts, as well as separate SPST contacts for each channel. The common SPDT contacts may be set for normally energized or de-energized operation, as well as latching or non-latching operation.

The -D series features a high quality, backlit LCD display. Detailed analyses are available for each separate channel, as well as for any harmonics that may be on the system. A full-featured onboard menu combines ease of use with flexibility of settings.

In addition, the RCMS series can be used for over- and undercurrent protection on single conductors. An option to use an x/5 ratio current transformer (programmable into the device) allows for a wide range of load currents to be monitored.

#### Applications

- Ground fault detection on multiple systems with single- or three-phase AC (up to 2000 Hz), pure DC, or mixed of AC and DC power
- Generators
- Motors and motor control centers
- Industrial controls
- Heat tracing systems
- Over- and undercurrent protection on single conductors

#### Function

Measurements of the system's ground fault current are taken via external current transformers. On the -D version, each channel's current value is displayed in graphical form.

If the measured value exceeds the response value for one or more channels, the common main alarm SPDT contact will switch over, and an alarm message for that channel will display on the LCD screen. The common alarm LED will also illuminate. On the RCMS490, the channel's corresponding SPST contact will also switch over. If the channel is set to non-latching mode and the ground fault clears, the alarms will then clear. If the channel is set to latching mode, the alarms will not clear until the device is reset manually or the supply voltage is lost.

The device features three separately adjustable time delays: Startup delay (while RCMS is starting), response delay (after alarm is found), and delay on release (after alarm clears). The TEST function allows for an internal operation testing of the device. The device's easy to use onboard menu manages all settings via the detailed LCD display. An optional password protection setting protects unauthorized users from changing settings.

One current transformer is required for each channel. All legs / phases are placed through the current transformer. Depending on the type of circuit being monitored, one of the following CTs is required (CTs are interchangeable for each separate channel):

#### AC-only systems:

- W series (circular type)
- WR series (rectangular type)
- WS series (split-core type)

#### DC or mixed AC/DC systems:

- WAB series
- In addition, for each set of 6 WAB transformers, one AN420 is required.

### History memory in RCMS460-D, RCMS490-D

The -D version features a history memory storing up to 300 data records per channel (date, time, channel, event code, measured value) in nonvolatile memory. Data can be accessed either on board the device or through one of BENDER's protocol converters.

### Analysis of harmonics

The analysis of the harmonics of the measured currents can be selected via a menu item in the -D versions. The DC component, the THD factor and the current value of the harmonics (1...40 at 50 / 60 Hz, 1...5 at 400 Hz) are displayed numerically and graphically.

### Model variations

#### RCMS460-D

The RCMS460-D utilizes a digital, backlit LCD display with a full-featured menu for settings for each separate channel. Graphs of each separate channel as well as the harmonics can be displayed. In addition, one RCMS460 can apply settings across multiple interconnected RCMS devices. A common DPDT contact is available on the device.

#### RCMS460-L

The RCMS460-L utilizes a two-digit 7 segment display where the address of this device is displayed within the BMS bus. The alarm LEDs indicate the measuring where the response value has been exceeded. This unit requires at least one -D be on the system.

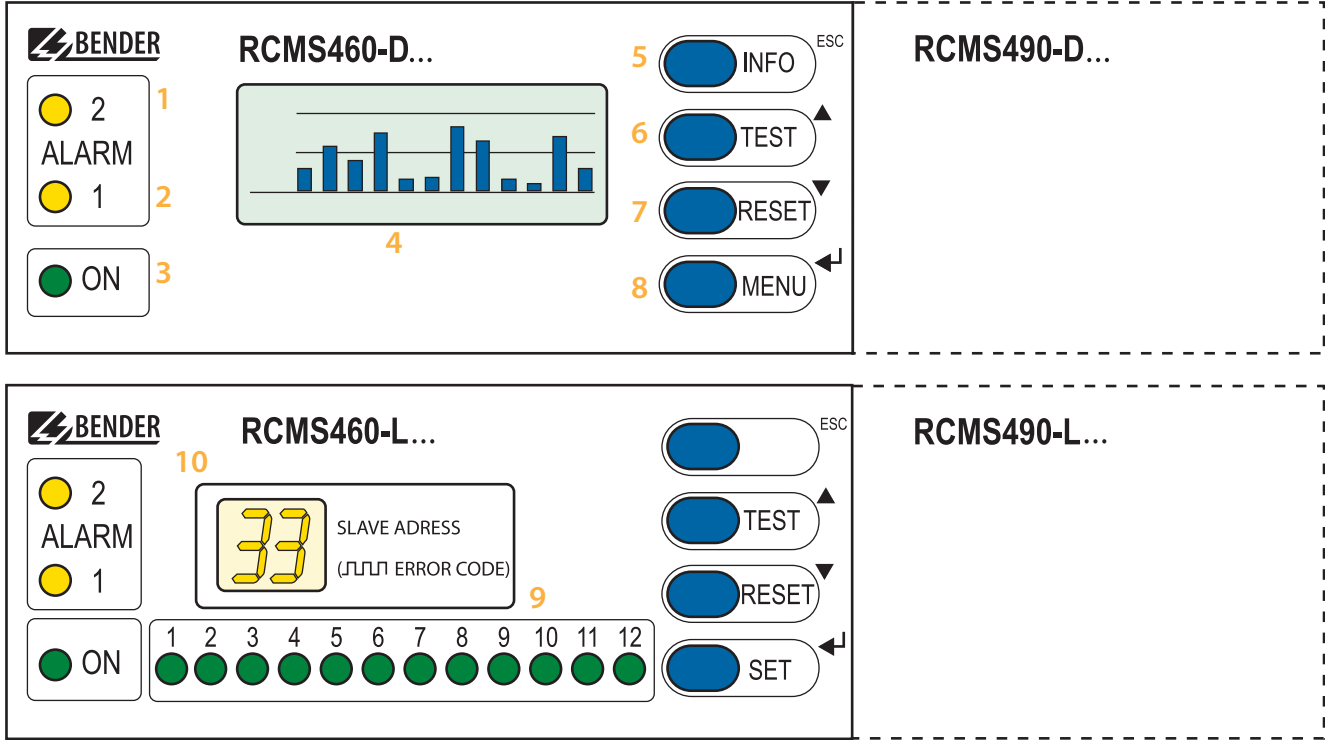
#### RCMS490-D / RCMS490-L

The RCMS490-D and -L versions correspond with the RCMS460 units above. In addition, one SPST contact is available for each channel.

Overview of device types				
Distinctive device features	RCMS460-D	RCMS460-L	RCMS490-D	RCMS490-L
Ground fault setpoint ranges DC and mixed AC/DC, AB type current transformers (type B) AC-only system, standard current transformers (type A)	10 mA...10 A 6 mA...20 A	10 mA...10 A 6 mA...20 A	10 mA...10 A 6 mA...20 A	10 mA...10 A 6 mA...20 A
Allows for digital inputs	×	×	×	×
Backlit, digital LCD display	×	--	×	--
7-segment display and LED line	--	×	--	×
Parameter setting onboard device	×	--	×	--
Password protection	×	--	×	--
Display error code	×	×	×	×
Address range	1...90	1...90	1...90	1...90
Master / slave operating principle	×	×	×	×
Internal clock	×	--	×	--
Common alarm relay(s) for all channels	2 SPDT contacts	2 SPDT contacts	2 SPDT contacts	2 SPDT contacts
Alarm relay per channel	--	--	12 SPST contacts	12 SPST contacts
Analysis of harmonics $I_{\Delta n}$ , DC, THD	×	--*	×	--*
History memory 300 data records (overall)	×	--	×	--
Data logger for 300 data records (per channel)	×	--	×	--
PRESET function	×	--*	×	--*
Number of measuring channels	12	12	12	12
Enclosure type	XM460	XM460	XM490	XM490

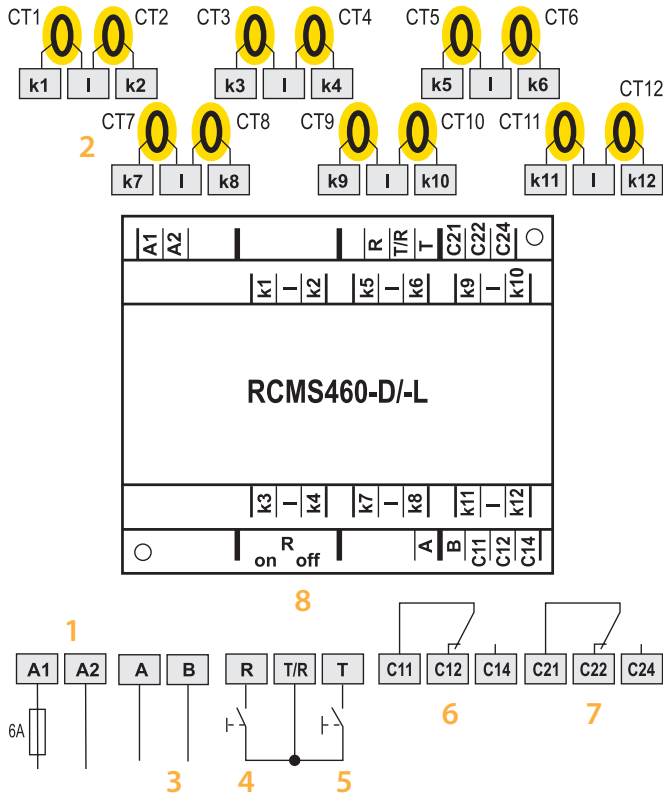
\* only in combination with RCMS4...-D

**Operating and display elements: RCMS460-D / -L and RCMS490-D / -L**



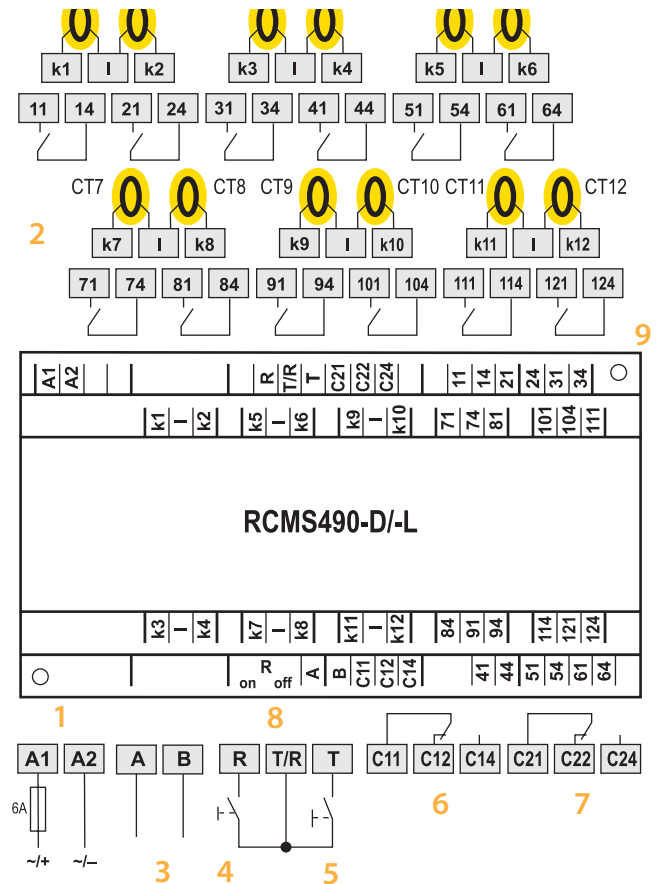
- 1 - LED "ALARM 2": Illuminates when the measured value "Alarm" of any channel has been exceeded.
- 2 - LED "ALARM 1": Illuminates when the measured value "Prewarning" of any channel has been exceeded.
- 3 - LED "ON": Illuminates when power is received to the unit.
- 4 - Backlit LCD display
- 5 - INFO key: Displays pertinent system information (does not apply to RCMS4...-L)  
ESC key: Exits the menu without changing parameters
- 6 - TEST button: Activates self-test  
Arrow up key: Scrolls up inside device's menu
- 7 - RESET button: Resets device  
Down key: Scrolls down inside device's menu
- 8 - MENU key: Toggles between the standard display, the device's internal menu, and alarm display. (does not apply to RCMS4...-L)  
SET key: Sets addresses of -L devices on the system  
Enter key: Confirm change inside device's menu
- 9 - Alarm LEDs "1...12": Illuminate when the corresponding channel has a ground fault. Flashes when the corresponding channel has a current transformer connection error. (-L only)
- 10 - Seven-segment display for device address and error codes (-L only)

**Wiring diagram: RCMS460-D / -L**



- 1 - External supply voltage used to power device  
6 A fuse recommended for internal short circuit protection
- 2 - Connections for current transformers CT1...CT12. Either Type A or Type B measuring current transformers can be selected for each measuring channel. Six W...AB series measuring current transformers require one AN420-2 power supply unit.
- 3 - RS-485 interface (using the BMS bus protocol)
- 4 - External reset button (normally de-energized contact)

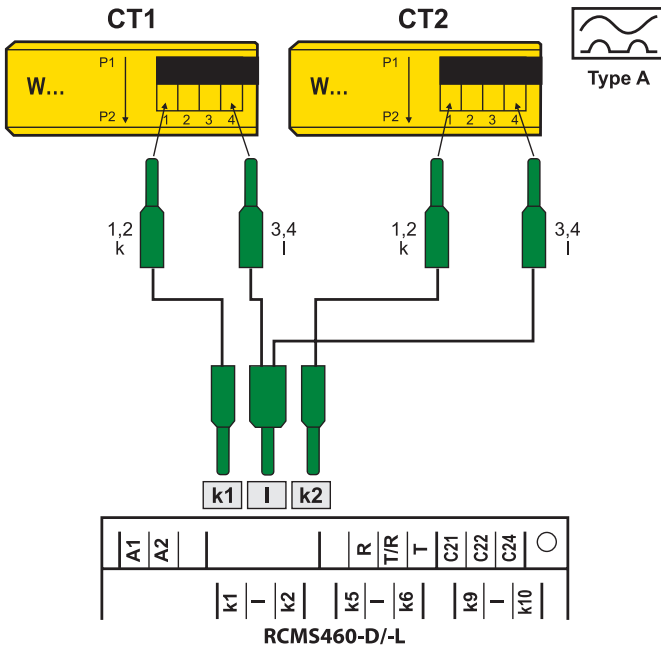
**Wiring diagram: RCMS490-D / -L**



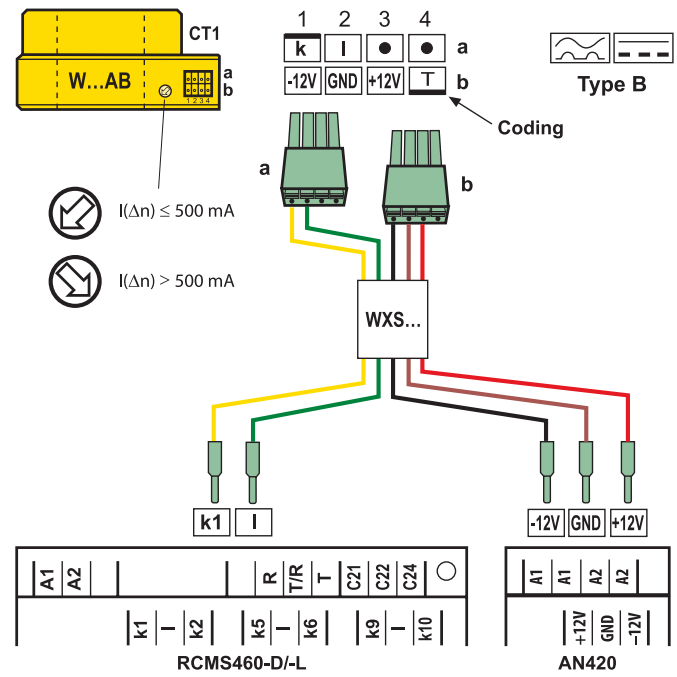
- 5 - External test button (normally de-energized contact); the external T / R cannot be connected in parallel to other devices.
- 6 - Alarm relay K1: ALARM 1, common alarm for prewarning or alarm device error
- 7 - Alarm relay K2: ALARM 2, common alarm for prewarning or alarm device error
- 8 - R<sub>on / off</sub>: Activate or deactivate the BMS bus terminating resistor (120 Ω)
- 9 - SPST contacts (normally de-energized operation, 490 only)

**Wiring, current transformers: W, WR, WS series (AC-only systems, type A)**

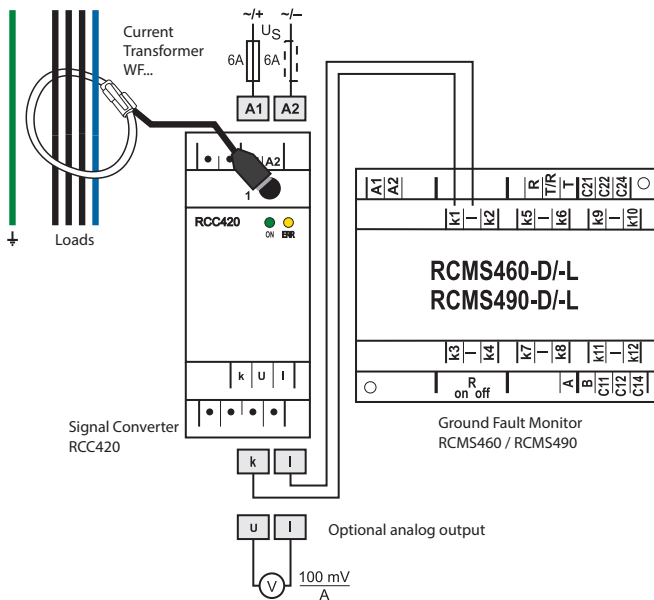
Example: W series



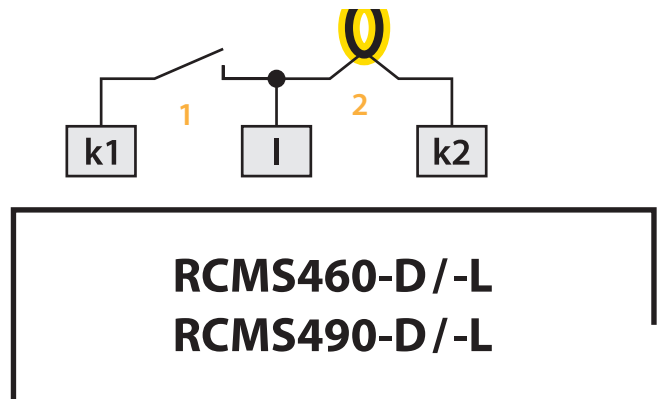
**Wiring diagram, current transformers: WAB series (DC and AC/DC mix, type B)**



**Wiring, current transformers: WF series**



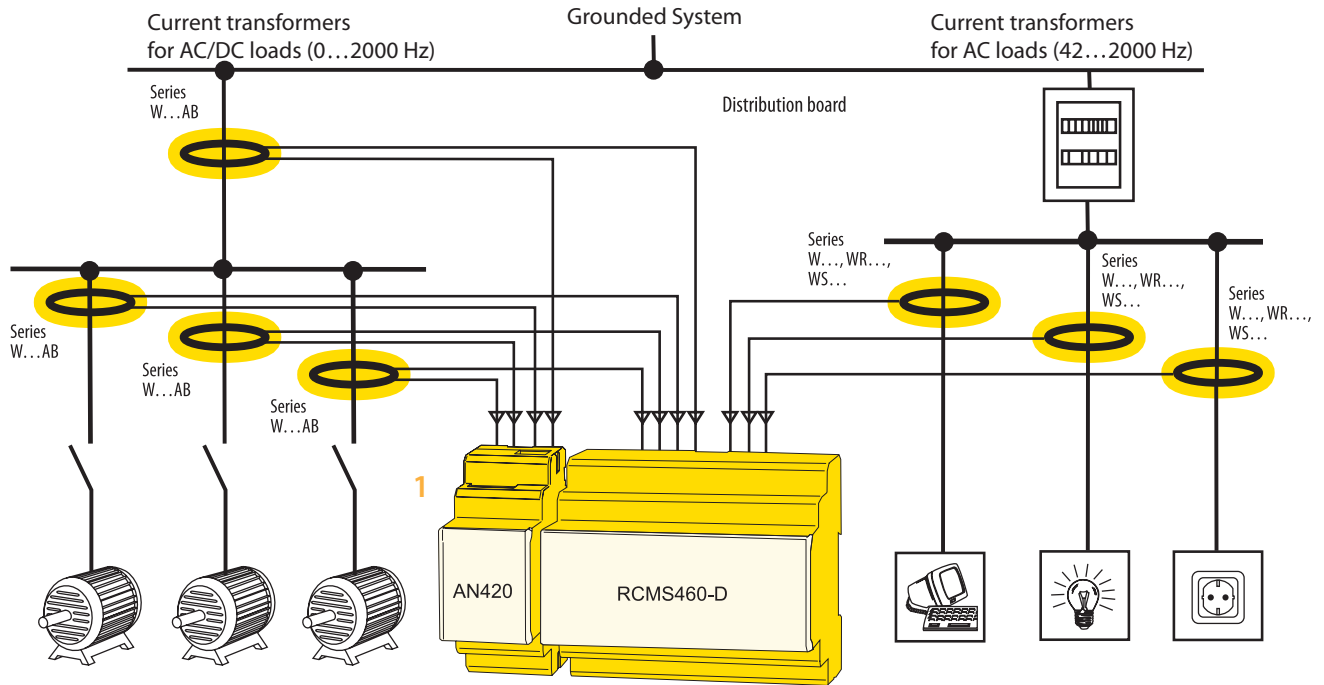
**Wiring: digital inputs**



**RCMS460-D / -L**  
**RCMS490-D / -L**

- 1- Voltage-free contact  
 $0 \triangleq > 250 \Omega$   
 $I \triangleq < 100 \Omega$
- 2- Current transformer input for next channel

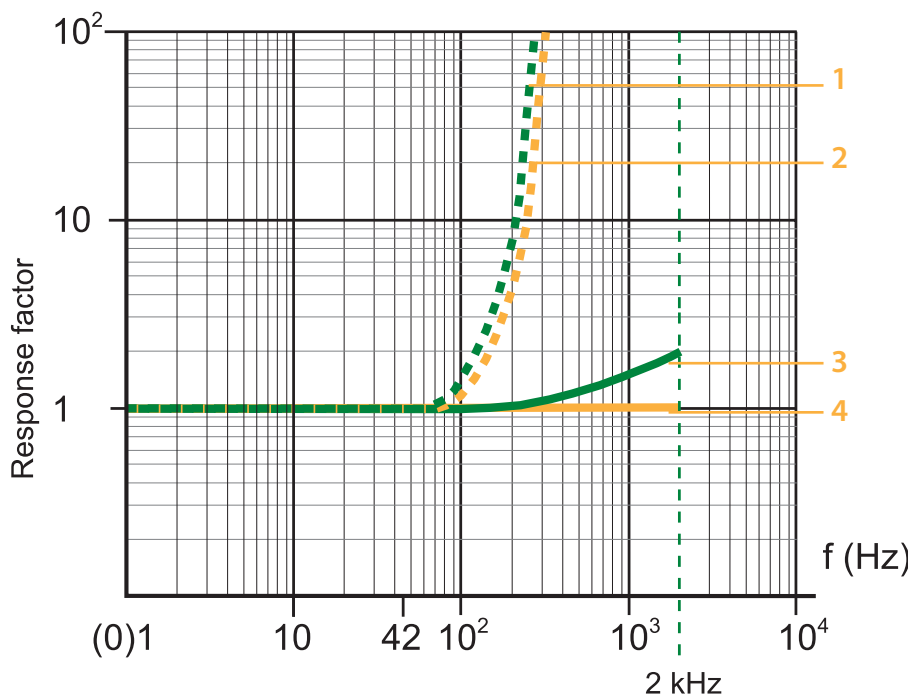
**Example system: RCMS460-D monitoring 7 channels of differing types**



**Frequency settings**

The frequency response of the equipment can be set to a linear frequency response (up to the maximum frequency of 2000 Hz) if used for fire protection or to a frequency response in accordance with IEC 60990 for personnel protection. For plant protection, the ground fault current is measured up to the rated system frequency. The figure below shows the corresponding frequency response.

**Frequency curves and filter settings**



Response factor =  $I_{\Delta} / I_{\Delta n}$

( $I_{\Delta}$ ) Ground fault current:  
Measured value at which the RCMS responds.

( $I_{\Delta n}$ ) Rated ground fault current:  
Set response value

- 1 - Menu selection "50 Hz"  
- Plant protection: Only evaluates the fundamental component of the ground fault current.
- 2 - Menu selection "60 Hz"  
- Plant protection: Only evaluates the fundamental component of the ground fault current.
- 3 - Menu selection "IEC"  
- Touch current for let-go (protection of persons) in accordance with IEC 60990
- 4 - Menu selection "None"  
- Fire protection: Response factor remains the same over the entire frequency range.



## Technical data

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

Rated insulation voltage	250 V
Rated impulse voltage / pollution degree	4 kV / III
Protective separation (reinforced insulation) between (A1, A2) – (k1 / I...k12 / R / RT / T, AB) – (11, 12, 14) – (21, 22, 24)	
Voltage test according to IEC 61010-1	2.21 kV

### Supply voltage

Supply voltage $U_S$	see ordering information
Frequency range $U_S$	see ordering information
Power consumption	$\leq 5$ VA (RCMS460) / $\leq 8$ VA (RCMS490)

### Measuring circuit

External current transformer	W..., WR..., WS... series (Type A) W...AB series (Type B)
CT monitoring	on / off (on)*
Load	68 $\Omega$
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristic acc. to IEC 60755	Type A and Type B depending on the CT type (Type A)*
Rated frequency	0...2000 Hz (Type B) / 42...2000 Hz (Type A)
Cut-off frequency	none, IEC, 50 Hz, 60 Hz (none)*
Measuring range	0...30 A (CT Type A) – 0...20 A (CT Type B) crest factor up to 10 A = 4, up to 20 A = 2
Rated residual operating current $I_{\Delta n2}$ (Alarm)	10 mA...10 A (Type B) 6 mA...20 A (Type A) (100 mA overcurrent)*
Rated residual operating current $I_{\Delta n1}$ (prewarning)	10...100 % $\times I_{\Delta n2}$ min 5 mA (50 %)*
Digital input	$1 \triangleq < 100 \Omega - 0 \triangleq \geq 250 \Omega$
Preset for alarm	Offset: 0...20 A (30 mA)* and $I_{\Delta}$ x factor 1...99 (3)*
Preset for digital input	0 / 1 (I)*
Relative percentage error	0...-20 %
Hysteresis	2...40 % (20 %)*
Factor for additional CT	1...10; x 1...250 (x 1)*
Number of measuring channels (per device / system)	12 / 1080

### Specified time

Starting delay $t$ (startup) per device	0...99 s (0 ms)*
Response delay $t_{on}$ per channel	0...999 s (200 ms)*
Release delay $t_{off}$ per channel	0...999 s (200 ms)*
Operating time $t_{ae}$ at $I_{\Delta n} = 1 \times I_{\Delta n1} / 2$	$\leq 180$ ms
Operating time $t_{ae}$ at $I_{\Delta n} = 5 \times I_{\Delta n1} / 2$	$\leq 30$ ms
Response time $t_{an}$ ( $I_{\Delta n}$ )	$t_{an} = t_{ae} + t_{on} / 2$
Operating time I / 0 inputs	$< 3,5$ s
Scanning time for all channels ( $I_{\Delta n}$ )	$\leq 180$ ms
Recovery time $t_b$	500...600 ms

### Displays, memory

Display range measured value	0...30 A (CT Type A) – 0...20 A (CT Type B)
Display accuracy	$\pm 10$ %
LEDs	ON / ALARM (RCMS4...-D) ON / ALARM / channel 1...12 (RCMS4...-L)
LC display	backlit graphical display (RCMS4...-D)
7-segment display	2 x 7.62 mm (RCMS4...-L)
History memory	300 data records (RCMS4...-D)
Data logger	300 data records per channel (RCMS4...-D)
Password	off / 0...999 (off)*
Language	D, GB, F (GB)*
Fault memory alarm relay	on / off (off)*

### Inputs / outputs

TEST / RESET button	internal / external
Cable length for external TEST / RESET button	0...32 ft (0...10 m)

### Interface

Interface / protocol	RS-485 / BMS
Baud rate	9600 baud
Cable length	0...1200 m
Recommended cable (shielded, shield on one side connected to ground)	J-Y(ST)Y min. 2 x 0.8
Terminating resistor	120 $\Omega$ (0.25 W) can be connected via DIP switch
Device address, BMS bus (RCMS...-D / -L)	1...90 (2)*

### Cable lengths for measuring current transformers W..., WR..., WS...

Single wire $\geq$ AWG 18 (0.75 mm <sup>2</sup> )	0...32 ft (0...10 m)
Single wire, twisted $\geq$ AWG 18 (0.75 mm <sup>2</sup> )	0...32 ft (0...10 m)
Shielded cable $\geq$ AWG 20 (0.5 mm <sup>2</sup> )	0...130 ft (0...40 m)
Recommended cable (shielded, shield on one side to terminal I, not connected to ground)	J-Y(ST)Y min. 2 x 0.8

### Cable lengths for measuring current transformers W...AB

Single wire $\geq$ AWG 18 (0.75 mm <sup>2</sup> )	0...32 ft (0...10 m)
Connection	plug-in connector, recommended WXS...

### Switching elements

Number of changeover contacts	2 SPDT contacts (RCMS460) 2 SPDT contacts, 12 SPST contacts (RCMS490)
Operating principle	normally energized or de-energized
Electrical service life under rated operating conditions	10.000 switching operations
Contact data acc. to IEC 60947-5-1	
Utilization category	AC-13 AC-14 DC-12 DC-12 DC-12
Rated operational voltage	230 V 230 V 24 V 110 V 220 V
Rated operational current	5 A 3 A 1 A 0.2 A 0.1 A
Minimum contact load	1 mA at AC / DC $\geq 10$ V

### Environment / EMC

EMC	IEC 62020: 2003-11
Operating temperature	-13 °F...+131 °F (-25 °C...+55 °C)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (except condensation and formation of ice)
Long-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

### Connection

Connection	screw terminals
rigid / flexible	AWG 24...12 / 24...14
Multi-conductor connection (two conductors of the same cross section)	
rigid / flexible	AWG 24...12 / 24...12
Stripping length	8...9 mm
Tightening torque	0.5...0.6 Nm

### Other

Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (IEC 60529)	IP30, NEMA 1
Degree of protection, terminals (IEC 60529)	IP20, NEMA 1
Enclosure material	polycarbonate
Flammability class	UL94V-0
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Standards	IEC 60200
Technical manual	TGH 1393
Weight	$\leq 0.8$ lb (RCMS460) $\leq 1.2$ lb (RCMS490)

( \*) \* Factory setting



Ordering information				
Type	Supply voltage U <sub>S</sub> *			Art. No.
RCMS460-D-1	DC 16...94 V	AC 42...460 Hz	16...72 V	B 9405 3001
RCMS460-D-2	DC 70...276 V	AC 42...460 Hz	70...276 V	B 9405 3002
RCMS460-L-1	DC 16...94 V	AC 42...460 Hz	16...72 V	B 9405 3003
RCMS460-L-2	DC 70...276 V	AC 42...460 Hz	70...276 V	B 9405 3004
RCMS490-D-1	DC 16...94 V	AC 42...460 Hz	16...72 V	B 9405 3005
RCMS490-D-2	DC 70...276 V	AC 42...460 Hz	70...276 V	B 9405 3006
RCMS490-L-1	DC 16...94 V	AC 42...460 Hz	16...72 V	B 9405 3007
RCMS490-L-2	DC 70...276 V	AC 42...460 Hz	70...276 V	B 9405 3008

Type	Supply voltage U <sub>S</sub> *	Art. No.
AN420-2 (power supply unit for six W...AB)	DC 70...276 V / AC 42...460 Hz 70...276 V	B 9405 3100

**Connector cable for RCMS, "AB" type current transformers, and AN420 power supply**

Type	Length in ft (m)	Ordering No.
WXS-100	3' (1)	B 5111 00028
WXS-250	8' (2.5)	B 5111 00029
WXS-500	16' (5)	B 5111 00030
WXS-1000	32' (10)	B 5111 00027
WXS-1500	50' (15)	B 5111 00035

**Current transformers, DC and AC/DC mix (Type B)**

Type	Inside diameter in inches (mm)	Ordering No.
W20AB	ø 0.75" (20)	B 9808 0008
W35AB	ø 1.35" (35)	B 9808 0016
W60AB	ø 2.25" (60)	B 9808 0026
W120AB	ø 4.7" (120)	B 9808 0041
W210AB	ø 8.25" (210)	B 9808 0040

**Current transformers, AC-only system (Type A)**

Type	Inside diameter in inches (mm)	Ordering No.
W20	ø 0.75" (20)	B 9808 0003
W35	ø 1.35" (35)	B 9808 0010
W60	ø 2.25" (60)	B 9808 0018
W120	ø 4.7" (120)	B 9808 0028
W210	ø 8.25" (210)	B 9808 0034
WR70x175	2.75" x 6.9" (70 x 175)	B 9808 0609
WR115x305	4.5" x 12" (115 x 305)	B 9808 0610
WS20x30 (split-core)	0.75" x 1.35" (20 x 30)	B 9808 0601
WS50x80 (split-core)	2" x 3.1" (50 x 80)	B 9808 0603
WS80x120 (split-core)	3.1" x 4.7" (80 x 120)	B 9808 0606

Other current transformer types on request.

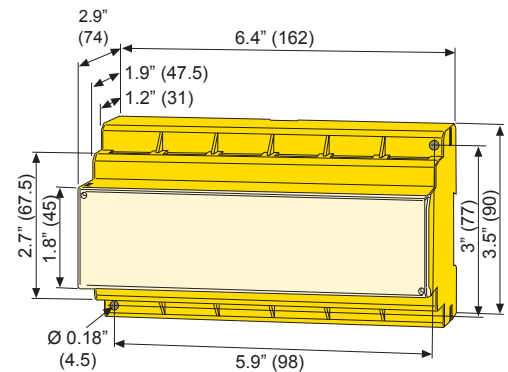
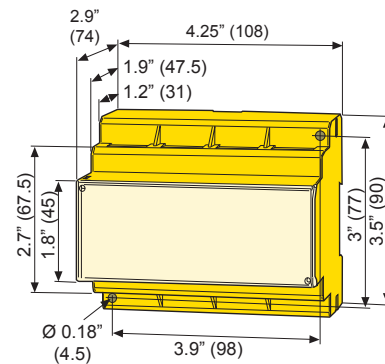
**Accessories**

Type	Art. No.
Mounting clip for enclosure XM420 (1 piece per device)	B 9806 0008
Snap-on mounting for W20... / W35...	B 9808 0501
Snap-on mounting for W60...	B 9808 0502

For further information about measuring current transformers, please refer to the respective data sheets.

**Dimensions: RCMS**

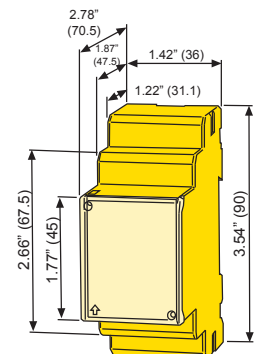
Dimensions in inches (mm)



**Dimensions: AN420**

Dimensions in inches (mm)

Open the front plate cover in direction of arrow.





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