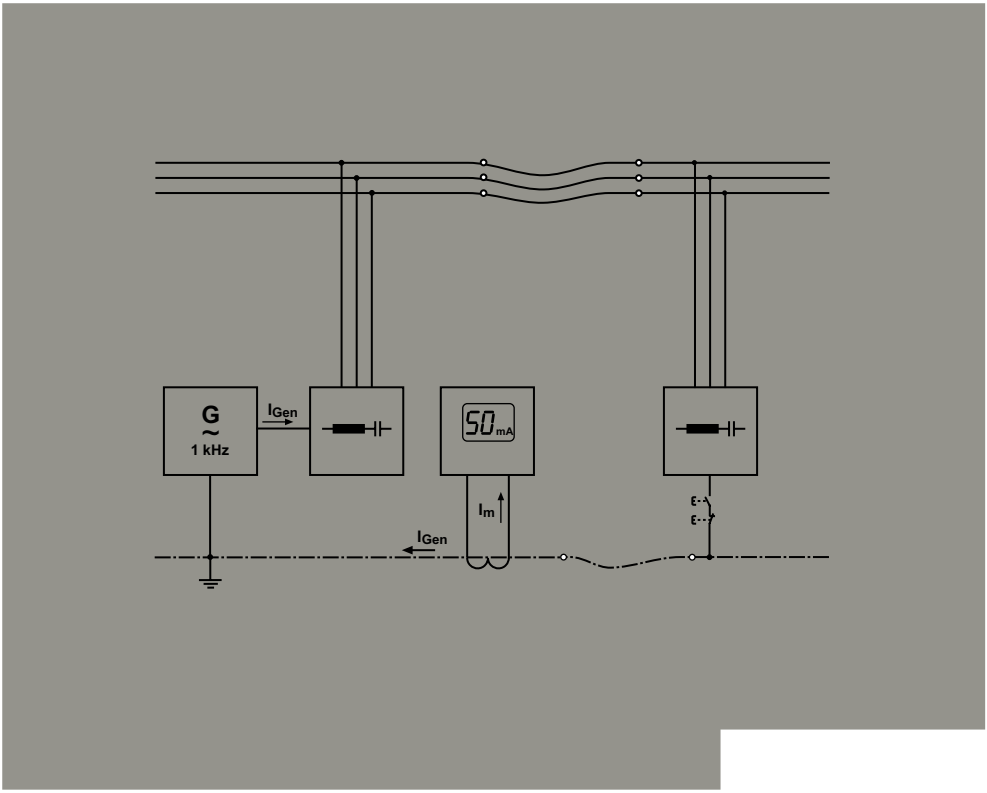
MF loop monitor

System for monitoring the trailing cable protective earth conductor by a measurement frequency loop.
Suitable for mobile electrical equipment
in non-gassy underground and opencast mines



Service and support for Bender products

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* Landline German Telekom: Mon-Fri from 9.00 a.m. to 6 p.m.: 6.3 cents/30 sec.; remaining time: 6.3 cents/min.
Mobile phone: higher, depending on mobile phone tariff

Repair service
Repair, calibration and replacement service
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Table of Contents

1 General instructions

1.1 How to use this manual

This manual is intended for qualified personnel working in electrical engineering and elec tronics! Part of the device documentation, in addition to this manual, is the enclosed "Safety instructions for Bender products".

Read the manual before installing, connecting and commissioning the device.
Always keep the manual within easy reach for future reference.

1.2 Indication of important instructions and information

DANGER! Indicates a high risk of danger that will result in death or serious injury if not avoided.

WARNING! Indicates a medium risk of danger that can lead to death or serious injury, if not avoided.

CAUTION! Indicates a low-level risk that can result in minor or moderate injury or damage to property if not avoided.

Information can help to optimise the use of the product.

1.2.1 Signs and symbols

	Disposal		Temperature range		Protect from dust
	Protect from wetness		Recycling	RoHS	RoHS guidelines

1.3 Training courses and seminars

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

1.4 Delivery conditions

The conditions of sale and delivery set out by Bender apply. These can be obtained from Bender in printed or electronic format.

1.5 Inspection, transport and storage

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

1.6 Warranty and liability

Warranty and liability claims for personal injury and property damage are excluded in the case of:

- Improper use of the appliance.
- Improper installation, commissioning, operation and maintenance of the appliance.
- Failure to observe the instructions in the manual regarding transportation, commissioning, operation and maintenance of the appliance.
- Unauthorized structural modifications to the appliance.
- Failure to observe the technical data.
- Improperly carried out repairs
- Use of accessories and spare parts not recommended by Bender
- Disasters caused by foreign bodies and force majeure.
- Assembly and installation with non-recommended device combinations.

This manual and the enclosed safety instructions must be observed by all persons working with the appliance. In addition, the rules and regulations for accident prevention applicable to the place of use must be observed.

1.7 Disposal of Bender devices

Abide by the national regulations and laws governing the disposal of this device.

For more information on the disposal of Bender devices, refer to:

www.bender.de -> Service & support

1.8 Safety

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. In Europe, the European standard EN 50110 applies.

DANGER! Risk of electrocution due to electric shock!
Touching live parts of the system carries the risk of:

- A fatal electric shock
- Damage to the electrical installation
- Destruction of the device

Before installing and connecting the device, make sure that the installation has been de-energised. The rules for working on electrical systems must be observed.

2 MF loop for monitoring the PE conductor

2.1 Intended use

- The MF loop monitor is used to monitor mobile electrical equipment and the associated supply cables in non-gassy mines underground and in opencast mines. The loop monitor is suitable for IT systems running on 3-phase AC 0…1000 V and 50…60 Hz. The protective earth conductor is monitored.
- The IT systems must not contain operating equipment which generates interference frequencies in the 1 kHz range, e.g. frequency converters.
- The cable capacitance C_e of the cable being monitored must not be greater than 0.6 µF per phase.
- The MF loop monitor is not intended to and must not replace any safety measures!

2.2 Function

2.2.1 Principle

In order to monitor the trailing cable PE conductor, a 1 kHz current is fed into the conductor loop consisting of the PE conductor and the virtual PW (pilot wire) conductor. PW is the parallel circuit consisting of L1, L2 and L3 relating to the generator current I_{Gen}. Details are shown on the principle circuit diagram on page 9. Changes in the loop current caused by interruptions or increased resistance per unit length are recorded by means of a measuring current transformer and the frequency selective SRCM420 residual current monitor. As soon as the current drops below the response value, an alarm is output and the contactor (BS) shuts down.

2.2.2 Components of the MF loop monitor

Signal generator AF460-2

The equipment has two equivalent signal outputs to supply two MF loops. The generator supplies a sinwave output current I_{Gen} of 80 mA maximum at a frequency of 1kHz at both outputs. I_{Gen} is fed into the loops PE, L1, L2 and L3. The coupling device AG410 is connected upstream to supply the current to the outer conductor.

Coupling device AG410

Two coupling devices connect the virtual conductor PW, consisting of L1, L2 and L3, to the rest of the measurement frequency loop. They connect the current circuit of the generator to 3 current circuits of the IT system.

Operator unit BG12-N-1

The contactor (BS) is switched on or off indirectly by means of the operator unit in the loader. The generator current circuit (MF loop) is connected ohmically by pressing the ON button and I_{Gen} increases to approx. 50…60 mA. This current causes the contactor (BS) to switch on via SRCM420. The OFF button must be pressed to switch off the contactor (BS). The generator current circuit is interrupted and the current drops to 28 mA, for example. The size of the current is determined by the local system leakage capacitance C_e. SRCM420 registers this “undercurrent” and switches off the contactor (BS).

Frequency selective current monitor SRCM420

The device monitors the generator current circuit for undercurrent. The measuring current transformer W20 or W35 supplies the required measuring current I_m for SRCM420. Its input filter, which is set to 1 kHz, registers the transformer signal with a signal-to-noise ratio of approx. 40 dB in relation to the fundamental component of 50 Hz. When the value drops below the preselected response value, the device outputs an alarm. This causes the alarm LEDs AL1 and AL2 to light up and the changeover contacts K1 and K2 switch over. When K2 switches over, the contactor (BS) switches off.

2.2.3 Switching off the loop monitor or loader

Pressing the OFF button of the BG12-N-1 interrupts the MF conductor loop. This lowers the generator current I_{Gen} to below the response value I_2. The SRCM420 detects the undercurrent and outputs the associated alarm. In other words, the LEDs AL1 and AL2 light up and the alarm relays K1 and K2 switch over. Among the changeover contacts, which operate in N/C MF loop for monitoring the PE conductor operation, the contacts 11-12 and 21-22 are connected. When K2 switches over, this causes the contactor (BS) to shut down.

2.2.4 Switching on the loop monitor or loader

Pressing the ON button of the BG12-N-1 closes the MF conductor loop. This increases the generator current I_{Gen} to 50…60 mA. The SRCM420 detects a current outside the alarm range and terminates the alarm output. In other words, the LEDs AL1 and AL2 go out and the alarm relays K1 and K2 switch over. Among the changeover contacts which operate in N/C operation, the contacts 11-14 and 21-24 are now closed. When K2 switches over, this causes the contactor (BS) to switch on.

2.2.5 Loop monitor detects longitudinal discontinuity

If a longitudinal discontinuity occurs inside the MF loop and drops the generator current below the response value I_2, the SRCM420 outputs an alarm. This shuts down the contactor (BS).

2.2.6 Meaning of the displayed current values

Generator current I_{Gen} when the operator unit is switched on

Standard: 50…60 mA
When the operator unit BG12-N-1 is switched on, the size of the generator current I_{Gen} is determined by the system leakage capacitance C_e and the ohmic resistance of the entire MF loop. The resulting impedance Z determines the size of the generator current I_{Gen}. This current must be measured after installing the MF loop monitor and is used as a reference value for assessing the system.

Generator current I_{Gen} when the operator unit is switched off

Standard: 10…30 mA
When the operator unit BG12-N-1 is switched off, the size of the generator current I_{Gen} is mainly determined by the system leakage capacitances C_e. This current must be measured after installing the MF loop monitor and is used as a reference value for assessing the system.

Generator current I_{Gen} in the event of a longitudinal discontinuity

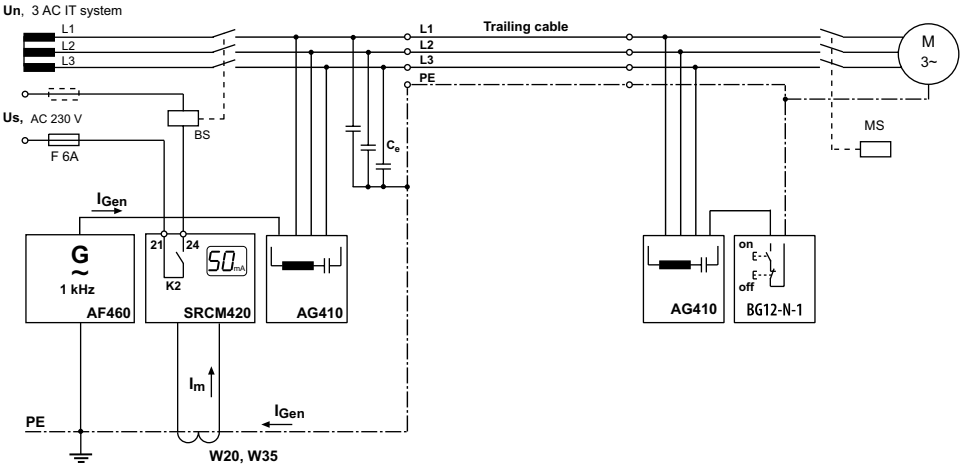
If the generator current drops below the response value I_2, SRCM420 outputs an alarm and shuts down the contactor (BS).

Generator current when the operator unit is switched off and when there are possible transverse discontinuities

Parasitic parallel resistances in the loop, e.g. L1 to PE can cause the contactor (BS) to switch on due to the increase in generator current. These resistances must therefore be monitored constantly by an insulation monitoring device.

The following principle circuit diagram gives an overview of how the MF loop monitor operates.

MF loop for monitoring the PE conductor, principle circuit diagram



3 Installation and connection

3.1 Required components

- Signal generator AF460-2
- 2 Coupling devices AG410
- Frequency-selective current monitor SRCM420-D-2
- Measuring current transformer Type W20 or W35
- Operator unit BG12-N-1
- Operating manual for the MF loop monitor

3.2 Installation

The components of the MF loop monitor are installed dispersed. Dimensional drawings of the enclosure can be found on page 16 onwards.

3.2.1 Installing a stationary switch cabinet

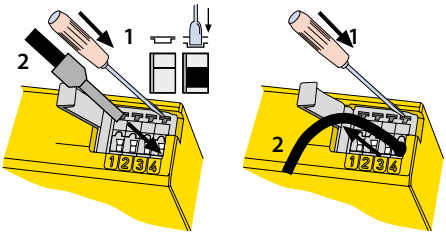
1. AF460-2 and SRCM420 must be snapped into position on DIN rails inside the switch cabinet.
2. The measuring current transformer must be installed near the earthing point of the PE conductor. It can be installed using 4 x M5 screws or mounted on a DIN rail. A snap-on mounting (order number B98080501) will be needed for the latter.
3. The base plate for the AG410 must be fastened with 4 x M5 or 4 x M6 screws. See dimensional drawing on page 17.

3.2.2 Installing on the loader

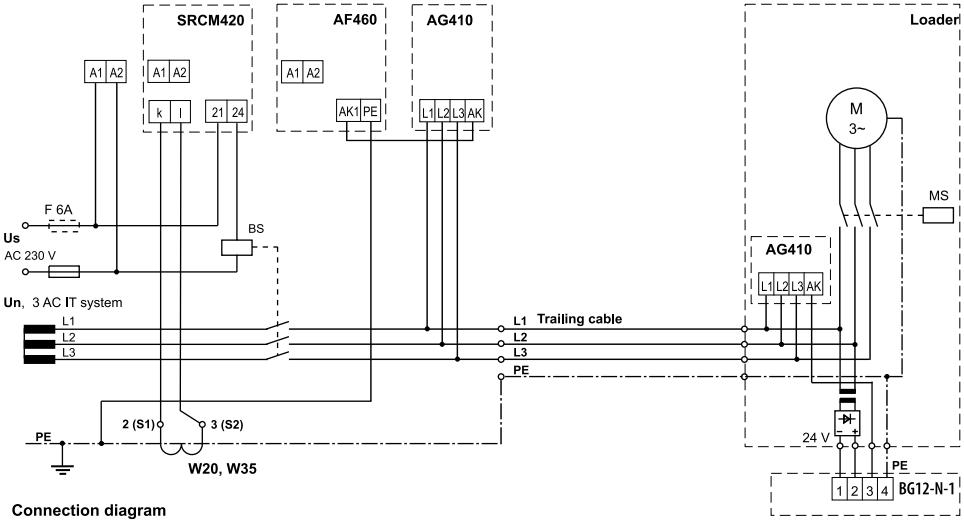
1. Another AG410 must be installed on the loader. Fasten the unit with 4 x M5 or 4 x M6 screws.
2. Mounting dimensions: *BG12-N-1*: 39 mm/219 mm; *BG12*: 38 mm/178 mm

3.3 Connection

The figure below shows the sealing cover open and the connection of the measuring current transformer cables.



The MF loop monitor is run on 3-phase AC IT systems with a maximum nominal voltage U_n of 1000 V. Connect the components according to the connection diagram.



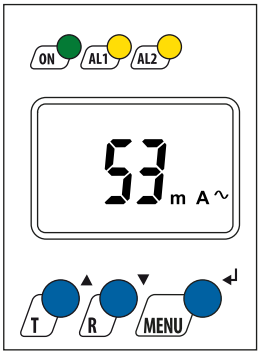
Connection diagram

4 Operating the MF loop monitor

4.1 Display and controls

SRCM420

The frequency-selective current monitor SRCM420 acts as the primary display. Its display signals the status of the main conductor (L1, L2 and L3) / protective earth conductor (PE) of the loop. The SRCM420 continuously displays the generator current I_{Gen} fed in for monitoring. The size of the current in Standard mode is approx. 50…60 mA.

Device front	Element	Function
	ON	constantly lit up: Power On LED; flashing: system fault or fault on the monitor connection
	AL1, AL2	LED Alarm 1 lit up (yellow): value dropped below response value 1 (I_1) LED Alarm 2 lit up (yellow): value dropped below response value (I_2)
	53 mA	53 mA generator current I_{Gen}
	T, ▲	Test button (> 1.5 s): starts a self test; Up button (< 1.5 s): displays the response values
	R, ▼	Reset button: no function Down button (< 1.5 s): displays the response values
	MENU, ↵	MENU key: for menu functions, see page 19 Enter key: for menu functions, see page 19

A complete description of the SRCM420 can be found on page 19 onwards.

AF460-2

The ON LED of the measuring current generator is used as the operating indicator.

BG12-N-1

ON and OFF button of the operator unit for switching the contactor (BS) on and off.

4.2 Commissioning

When the contactor (BS) is switched off, the displayed generator current I_{Gen} is within the range 10…30 mA due to the system leakage capacitances of the permanent wiring and the trailing cable.

Once the system has been switched on by pressing the ON button on the operator unit, the MF loop monitor is activated and the generator current I_{Gen} increases to 50…60 mA. This standard value represents the normal state.

5 Technical data

5.1 Tabulated data

5.1.1 System-specific data

Network configuration ..... IT system
Nominal system voltage ..... 3 phase AC 0…1000 V, 50/60 Hz
Max. system leakage capacitance C_e ..... 0.6 µF per phase

5.1.2 Operator unit BG12-N-1

Supply voltage U_s ..... depending on the device: DC 24 V / AC 230 V
Power consumption ..... ≤ 5 VA
Fuse ..... T 800 mA
Operating temperature ..... −10 °C…+55 °C
Operating mode ..... continuous duty
Position of normal use ..... any
Weight ..... ≤ 800 g

5.1.3 Coupling device AG410

Nominal voltage U_n ..... AC 0…1000 V
Frequency of nominal voltage f_n ..... 50/60 Hz
Weight ..... ≤ 1.6 kg

5.1.4 Signal generator AF460-2

The data labelled with an * are absolute values.

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

Rated voltage ..... 250 V
Rated impulse voltage/degree of pollution ..... 4 kV/III
Protective separation (reinforced insulation) between: ..... (A1, A2) - (AK1, AK2, PE)

Outputs

Number of outputs 2
Measuring voltage U_{Gen} ..... 5 V
Measuring frequency f_{Gen} ..... 1 kHz
Measuring current I_m max. (at $Z = 0\ \Omega$) ..... ≤ 80 mA

Environment/EMC

EMC ..... EN 61326
Operating temperature ..... −25 °C…+55 °C

Classification of climatic conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3) 3K22
Transport (IEC 60721-3-2) 2K11
Long-term storage (IEC 60721-3-1) 1K22

Classification of mechanical conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3) 3M11
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M12

Connection

Connection type ..... screw terminals
Rigid/flexible/conductor sizes ..... 0.2…4 / 0.2…2.5 mm² / AWG 24…12

Multi-conductor connection (2 conductors with the same cross section)
Rigid/flexible ..... 0.2…1.5 / 0.2…1.5 mm²
Stripped length ..... 8…9 mm
Tightening torque ..... 0.5…0.6 Nm

Other

Operating mode ..... continuous duty
Position of normal use ..... any
Degree of protection, built-in components (DIN EN 60529) IP30
Degree of protection, terminals (DIN EN 60529) IP20
Enclosure material ..... polycarbonate
Flammability class ..... UL 94 V-0
Snap-on mounting on a DIN rail ..... IEC 60715
Screw fixing ..... 2 × M4 with mounting clip
Weight ..... ≤ 270 g

5.1.5 Frequency selective current monitor SRCM420

( )* = Factory setting

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

Rated voltage ..... 250 V
Rated impulse voltage/degree of pollution ..... 4 kV/III
Protective separation (reinforced insulation) between ..... (A1, A2) - (k/l, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage tests in compliance with IEC 61010-1 ..... 2.21 kV

Supply voltage

SRCM420-D-2:
Supply voltage U_s ..... AC/DC 70…300 V
Frequency range U_s ..... 42…460 Hz
Power consumption ..... ≤ 3 VA

Measuring circuit

Measuring current transformer external type W20, W35
Load ..... 68 Ω
Rated voltage (measuring current transformer) ..... 800 V
Rated frequency ..... 1 kHz
Measuring range ..... 2…250 mA
Relative uncertainty ..... 0…−20 %
Display accuracy ..... ± 15 %

Response values

Design response current I_1 (pre-warning, AL1) ..... 30 mA…100 mA (36 mA)*
Design response current I_2 (pre-warning, AL2) ..... 30 mA…100 mA (35 mA)*
Hysteresis ..... 10…30 % (15 %)*

Time behaviour

Start-up delay t ..... 1…10 s (1 s)*
Response delay t_{on2} (Alarm) ..... 0.1…1 s (0.2 s)*
Response delay t_{on1} (pre-warning) ..... 0.1…1 s (0.2 s)*
Delay on release t_{off} ..... 1…10 s (1 s)*
Operating time t_{ae} ..... ≤ 100 ms
Response time t_{an} ..... $t_{an} = t_{ae} + t_{on1/2}$

Cable lengths for measuring current transformers

Single wire ≥ 0.75 mm² ..... 0…1 m
Single wire, twisted ≥ 0.75 mm² ..... 0…10 m
Shielded cable ≥ 0.5 mm² ..... 0…40 m

Recommended conductor

shielded, shield one-end at terminal l of SRCM420 and not earthed ..... J-Y(ST)Y min. 2 x 0.8
Connection ..... screw terminals

Displays, memory

Display range measuring value ..... 2…250 mA
Operating uncertainty ..... 0…−30 % / ± 2 digit
Password ..... off / 0…999 (off)*

Inputs/outputs

Cable length for external TEST/RESET button ..... 0…10 m

Switching elements

Switching elements ..... 2 x 1 changeover contact, 11-12-14, 21,22, 24
Operating principle ..... N/C operation
Electrical endurance/number of cycles 10,000

Contact data acc. to IEC 60947-5-1

Utilisation category ..... AC-13 / AC-14 / DC-12 / DC-12 / DC-12
Rated operational voltage ..... 230 V / 230 V / 24 V / 110 V / 220 V
Rated operational current ..... 5 A / 3 A / 1 A / 0.2 A / 0.2 A
Minimum contact rating ..... 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC ..... IEC 62020: 2003-11
Operating temperature ..... −25 °C…+55 °C

Classification of climatic conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3) 3K22
Transport (IEC 60721-3-2) 2K11
Long-term storage (IEC 60721-3-1) 1K22

Classification of mechanical conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3) 3M11
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M12

Connection

Connection type ..... Screw terminals
Rigid/flexible/conductor sizes ..... 0.2…4 / 0.2…2.5 mm² / AWG 24…12

Multi-conductor connection (2 conductors with the same cross section)
Rigid/flexible ..... 0.2…1.5 / 0.2…1.5 mm²
Stripping length ..... 8…9 mm
Tightening torque ..... 0.5…0.6 Nm

Other

Operating mode ..... continuous operation
Position of normal use ..... any
Degree of protection, built-in components (DIN EN 60529) IP30
Degree of protection, terminals (DIN EN 60529) IP20
Enclosure material ..... polycarbonate
Flammability class UL94V-0
DIN rail mounting acc. to ..... IEC 60715
Screw fixing ..... 2 × M4 with mounting clip
Weight ..... ≤ 160 g

5.2 Dimension diagrams

5.2.1 AF460-2 and SRCM420

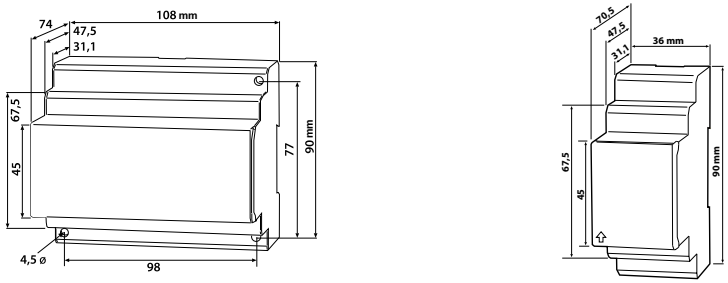


Abb. 5–1 Enclosure dimensions X460 and X420 (Dim. in mm, decimal separator = ,)

5.2.2 Operator unit BG12-N-1

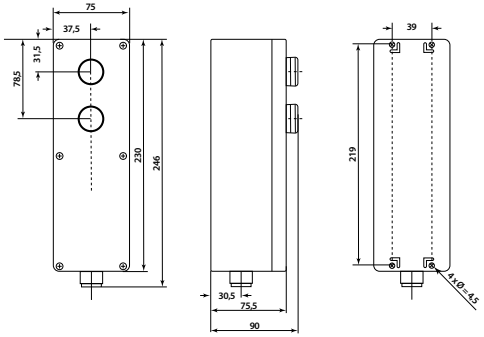


Abb. 5–2 Views: front, side, bottom (Dim. in mm, decimal separator = ,)

5.2.3 Coupling device AG410

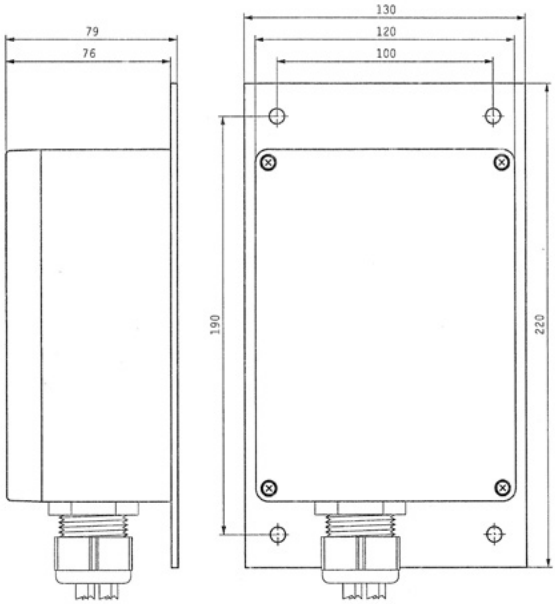
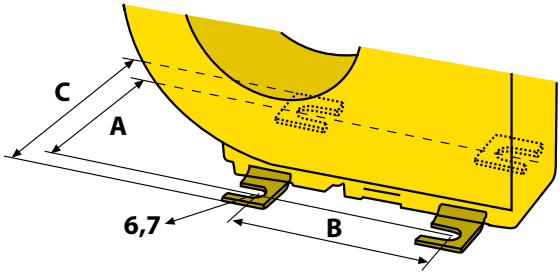


Abb. 5–3 Views: side, front (Dim. in mm)

5.2.4 Measuring current transformer W20, W35



Transformer type	A (mm)	B (mm)	C (mm)
W20 (mounting with 2 angles diagonal)	47	21.4	63
W35 (mounting with 2 angles diagonal)	47	49.8	63

5.3 Ordering details

Device	Supply voltage U_s*	System voltage U_n	Response value I	Meas. Freq.	I_{out}	Art.-No.
AF460-2	DC, AC 42…460 Hz 70…276 V	-	-	1 kHz	2x ≤ 80 mA/5 V	B97022021
AG410	-	3AC 50/60 Hz 0…1000 V	-	-	-	B97022022
BG12-N-1-24	DC 19.2…26.4 V	-	-	-	-	B97022027
BG12-N-1-230	AC 184…264.5 V	-	-	-	-	B97022028
SRCM420-D-2	DC, AC 42…460 Hz 70…300 V	-	30…100 mA	1 kHz	-	B97022020
*Absolute values of the voltage rang						

External measuring current transformer

Type	Inner diameter (mm)	Art.-No.
W20	20	B98080003
W35	35	B98080010
Snap-on mounting for top-hat rail: W20, W35	-	B98080501

Accessories for SRCM420

Mounting clip for housing XM420 (1 pc per device) B98060008

6 Appendix

6.1 Frequency selective current monitor SRCM420

6.1.1 Description of function

Once the supply voltage U_s has been applied, the start-up delay t starts. During this time, if the values drop below the response values, this has no influence on the switch state of the alarm relays. The contactor (BS) is therefore not activated during the start-up delay. The current is measured via an external measuring current transformer. The latest measuring value is shown on the LC display. If the measuring value drops below one or both response values, the set response delays $t_{on1/2}$ start.
Once $t_{on1/2}$ has elapsed, the selected alarm relay trips and the alarm LEDs light up. If the release value is exceeded before t_{on} elapses, no alarm is output: the LEDs AL1 and AL2 do not light up and the alarm relay does not trip. The set release time t_{off} starts if the measuring value exceeds the release value (response value plus hysteresis) again after the alarm relay trips. Once t_{off} has elapsed, the alarm relay switches back to its initial position. The device function can be tested using the test button T. The device is parameterised via the LC display and the control buttons on the front and can be protected by a password.

Connection monitoring

The connections to the measuring current transformer are constantly monitored. If there is an error, the alarm relays K1/K2 trip without delay and the LEDs AL1/AL2/ON flash (Error Code E01). Once the error has been eliminated, the alarm relays automatically return to their original position.

Quick interrogation of the undercurrent response values

If the display is in standard mode, the latest response values I_1 and I_2 can be interrogated by pressing the Up or Down button (< 1.5 s). It is not necessary to switch over to menu mode.
The Enter button must be pressed to leave the quick interrogation.

Automatic self test

Once the system being monitored has been switched on, the device carries out a self test every 24 hours thereafter. During the self test, the internal functional errors are determined and shown on the display as error codes. The alarm relays are not tested during this time.

Manual self test

Pressing the Test button for > 1.5 s causes the device to carry out a self test where the internal functional errors are determined and shown on the display as error codes. The alarm relays are not tested during this time.
While the Test button T is pressed, all the display elements for this device appear on the display. The test takes place afterwards.

Functional error

If there is an internal functional error, all 3 LEDs flash. The display shows an error code (E01…E32). E.g. E01 means: connection monitoring faulty

Delays *t*, t_{on} and t_{off}

The times *t*, t_{on} and t_{off} described in the following delay the output of alarms via the LEDs and relays.

Start-up delay *t*

Once the supply voltage U_s has been switched on, the contactor (BS) cannot be switched on during the pre-selected delay (1…10 s).

Response delay $t_{on1/2}$

When a response value has been exceeded, the current monitor requires the response time t_{an} to elapse before the alarm is output.
A set response delay t_{on} (0,1…1 s) is added to the intrinsic response delay of the device t_{ae} and delays the output of the signal (total delay $t_{an} = t_{ae} + t_{on}$).
If the error no longer exists during the response delay, the alarm signal drops out.

Delay on release t_{off}

After the alarm has dropped out, the alarm LEDs go out and the alarm relays switch back to their initial state. The delay on release (1…10 s) serves to maintain the alarm state signal for the set duration.

Password protection (on, OFF)

If the password protection has been activated (on), the settings can be carried out after entering the correct password (0…999).

Factory settings FAC

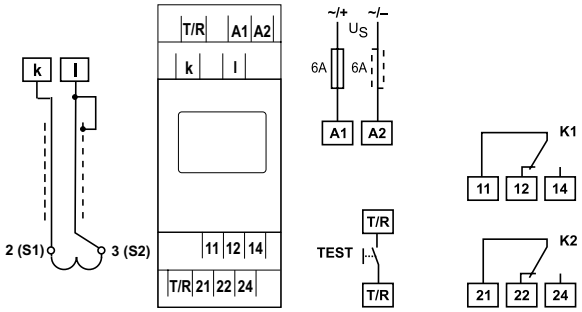
After activating the factory settings, all changed settings are reset to the delivery state.

External test button T/R

Test = press the external button > 1.5 s

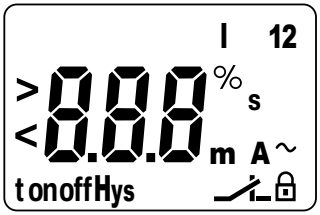
6.1.2 Wiring diagram

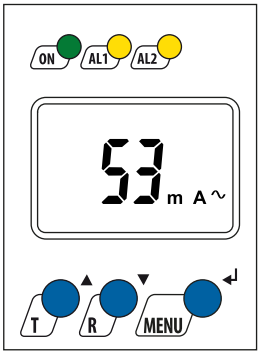
The front plate cover must be opened up on the underside marked with an arrow.



Terminal	Connection
A1, A2	Connection to the voltage supply
k, l	Connection for measuring current transformer
T/R	Connection for external test button
11, 12, 14	Alarm relay K1
21, 22, 24	Alarm relay K2

6.1.3 Display and controls

Display elements	Element	Function
	I1 mA	Response value I_1 in mA (Alarm 1, pre-warning)
	I2 mA	Response value I_2 in mA (Alarm 2, main alarm)
	Hys %	Response value hysteresis in %
	ton1 ton2 t toff	Response delay t_{on1} (K1) Response delay t_{on2} (K2) Start-up delay t Delay on release t_{off} for K1, K2
		Operating mode for relays K1 and K2
		Password protection active

Device front	Element	Function
	ON	Constantly lit up: Power On; Flashing: system error or fault in the connection monitor
	AL1 AL2	LED Alarm 1 lit up (yellow): value dropped below response value 1 (I_1) LED Alarm 2 lit up (yellow): value dropped below response value 2 (I_2)
	53 mA	53 mA generator current I_{Gen} in the measurement loop
	T ▲	Test button (> 1.5 s): Display of the useable display elements, self test starts Up button (< 1.5 s): menu options/values
	R ▼	Reset button: no function Down button (< 1.5 s): menu options/values
	MENU ↵	MENU button (> 1.5 s): menu mode starts Enter button (< 1.5 s): menu option, sub-menu option, confirm value Enter button (> 1.5 s): back to next highest menu level.

i *When the display is in Standard mode, the Up and Down buttons can be used to interrogate the latest response values I_1 und I_2 .*

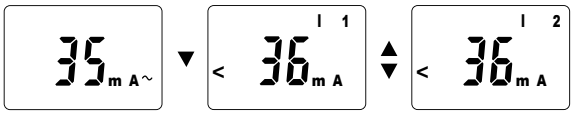
6.1.4 Menu structure

All the parameters which can be changed are found in the "Menu option" and „Adjustable parameter" column. A display-like diagram is used in the "Menu option" column.

Menu	Menu option	Activation	Adjustable parameter
AL (Response values)	I2	-	I_2 (Alarm 2)
	I1	-	I_1 (Alarm 1)
	Hys	-	Hysteresis I_2/I_1
t (Time controller)	t on 1	-	Response delay K1
	t on 2	-	Response delay K2
	t	-	Start-up delay
	t off	-	Delay on release K1/K2
SEt (Device controller)	🔒	OFF	Parameter setting via password
	FAC	-	Reset to factory settings
	SYS	-	Function blocked
InF	-	-	Interrogate hardware/software version

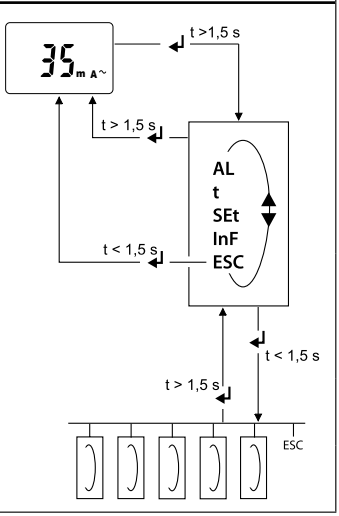
6.1.5 Display in Standard mode

In Standard mode, the latest response values can be interrogated using the Up or Down button.



6.1.6 Display in Menu mode

Setting parameters: overview

Menu option	Adjustable parameter	Menu structure
AL	Interrogate and adjust response values: Current I_2 (AL2) Current I_1 (AL1) Hysteresis of the response values: Hys	
t	Adjust delays: Response delay t_{on1}/t_{on2} Start-up delay t Delay on release t_{off}	
SEt	Switch password protection on or off, Change password; Restore factory settings; Service menu SyS blocked	
InF	Interrogate hardware and software version	
ESC	Move to next highest menu level (Back)	

Adjusting the parameters

Changing the alarm response value I_2 is described as an example. Proceed as follows:

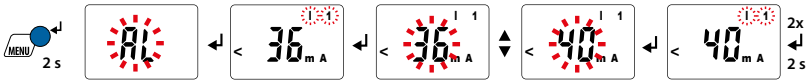
1. Press the MENU/Enter button for longer than 1.5 s. The abbreviation AL flashes on the display.
2. Confirm with Enter. The parameter I1 flashes.
3. Press the Down button in order to choose the parameter I2. The parameter I2 flashes. Confirm with Enter.
4. Adjust the desired response value in mA using the Up or Down button. Confirm with Enter. I2 flashes.
5. You can leave the menu by:
   - pressing the Enter button longer than 1.5 s to move one menu level up in each case or
   - selecting the menu option ESC and confirming with Enter to go one menu level up in each case.

i *The area of the display which can be adjusted flashes in each case. This is shown by an oval mark on the diagrams below. A parameter which can be changed is shown on the menu diagrams horizontally in each case. Start Menu mode by pressing the MENU button for > 1.5 s.*

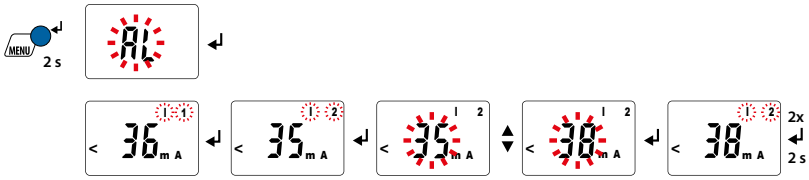
Adjusting response values for undercurrent (I_{Gen}):

- Undercurrent I_2 (I_2 in mA, Alarm 2)
- Undercurrent I_1 (I_1 in mA, Alarm 1)
- Hysteresis (Hys) of the response values I_1 and I_2

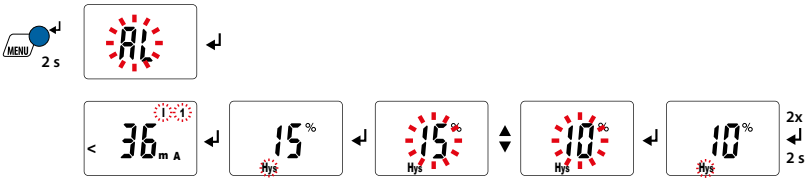
To increase response value I_1



To increase response value I_2

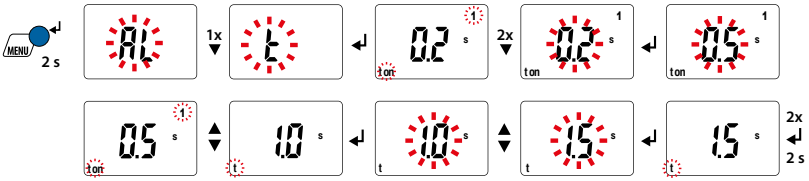


To reduce hysteresis response value



Adjusting delays

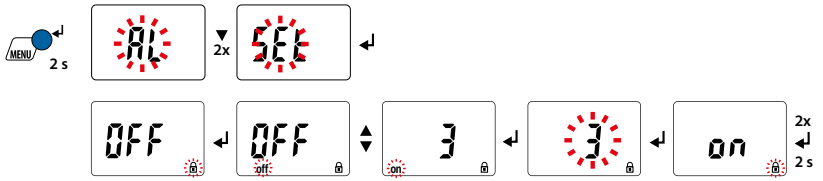
This is how you can specify a response delay t_{on1} (0.1…1 s) for K1, t_{on2} (0.1…1 s) for K2 and a start-up delay t (1…10 s) when starting the device, and a general delay on release t_{off} (1…10 s) for K1 and K2. The control steps for adjusting the response delay t_{on1} and the start-up delay t are shown as an example.



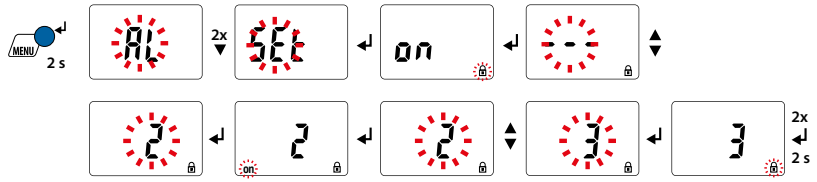
Factory settings and password protection

This menu can by used to switch on the password protection, change the password or switch off the password protection. You can also reset the device to the factory settings.

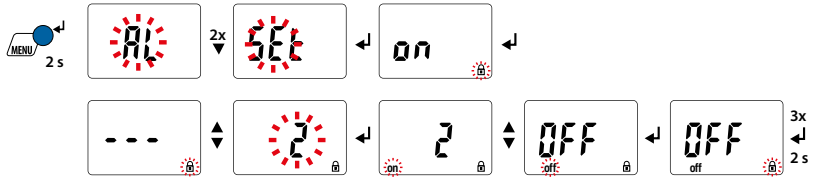
a) To activate password protection



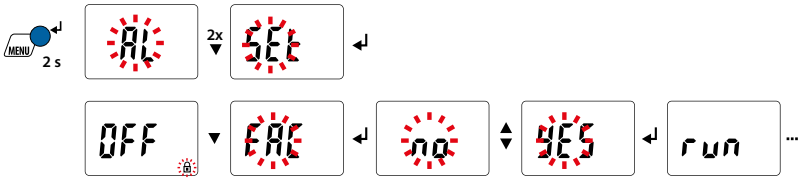
b) To change the password



c) To deactivate password protection

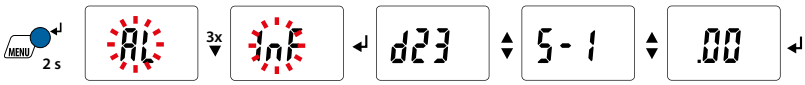


To restore factory settings



Interrogating the device information

This is how you interrogate the hardware (d...) and software (1.xx) versions. Once this function has started, the data are displayed on the screen as a continuous ribbon. Once the routine has been executed, you can select the individual data segments with the Up/Down buttons.



6.1.7 Factory setting

Response value I_2:	35 mA
Response value I_1:	36 mA
Hysteresis:	15 %
Mode of operation K1:	N/C operation (n.c.),
Mode of operation K2:	N/C operation (n.c.)
Response delay K1:	$t_{on1} = 0.2$ s
Response delay K2:	$t_{on2} = 0.2$ s
Start-up delay:	$t = 1.0$ s
Delay on release K1/K2:	$t_{off} = 1.0$ s
Password:	0, Off

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