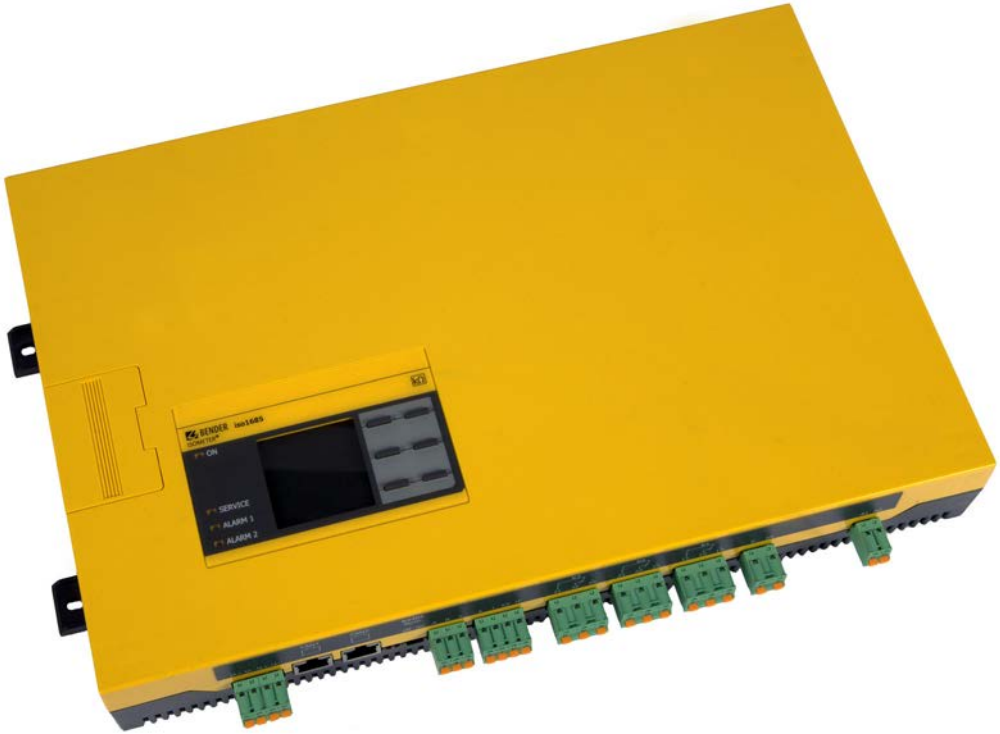
EN Manual

BENDER
The Power in Electrical Safety©

ISOMETER®
isoHR1685DW–925

AC/DC



Insulation monitoring device for isolated mobile elevating working platforms

Software version
isoHR1685DW-925: D0601 V2.2x, D0602 V1.0x

isoHR1685DW-925_D00369_01_M_XXEN/02.2021

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1. Important information

1.1 How to use this manual

*This manual is intended for **qualified personnel** working in electrical engineering and electronics!*

*Read the manual **before** you begin to mount, connect, and commission the unit. Always keep the manual within easy reach for future reference following commissioning.*

To make it easier for you to understand and revisit certain sections in this manual, we have used symbols to identify important instructions and information. The meaning of these symbols is explained below.

DANGER

*This signal word indicates that there is a **high risk of danger** that will result in **electrocution** or **serious injury** if not avoided.*

WARNING

*This signal word indicates a **medium risk of danger** that can lead to **death** or **serious injury** if not avoided.*

CAUTION

*This signal word indicates a **low-level risk** that can result in minor or **moderate injury** or **damage to property** if not avoided.*

*This symbol denotes information intended to assist the user in making **optimum use** of the product.*

1.2 Technical support

1.2.1 End customer support and advice

Technical support by phone or e-mail for all Bender products

- Questions concerning specific customer applications
- Commissioning
- Troubleshooting

Telephone: +49 6401 807-760 (365 Tage von 07:00 - 20:00 Uhr [MEZ/UTC +1])
Fax: +49 6401 807-259
0700BenderHelp (Tel. and Fax in Germany only)
E-mail: support@bender-service.com

1.2.2 Repair

Repair, calibration, update and replacement service for Bender products

- Repairing, calibrating, testing and analysing Bender products
- Hardware and software update for Bender devices
- Delivery of replacement devices
- Extended guarantee, in-house repair service, replacement devices at no extra cost

Telephone: +49 6401 807-780* (technical issues)
+49 6401 807-784*, -785* (sales)
Fax: +49 6401 807-789
E-mail: repair@bender-service.com

Please send the devices for **repair** to the following address:

Bender GmbH, Repair-Service,
Londorfer Straße 65,
35305 Grünberg

1.2.3 Customer service

On-site service for all Bender products

- Commissioning, parameter setting, maintenance, troubleshooting
- Analysis of the electrical installation in the building (power quality test, EMC test, thermography)
- Training courses for customers

Telephone: +49 6401 807-752*, -762* (technical issues)/
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E-mail: fieldservice@bender-service.com
Internet: www.bender.de
* Mo-Thu 07:00 a.m. - 16:00 p.m. , Fr 07:00 a.m. - 13:00 p.m.

1.3 Training courses

Bender is happy to provide training regarding the use of test equipment.
The dates of training courses and workshops can be found on the Internet at

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

1.4 Delivery conditions

Bender sale and delivery conditions apply.

For software products, the "Softwareklausel zur Überlassung von Standard-Software als Teil von Lieferungen, Ergänzung und Änderung der Allgemeinen Lieferbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (software clause in respect of the licensing of standard software as part of deliveries, modifications and changes to general delivery conditions for products and services in the electrical industry) set out by the ZVEI (Zentralverband Elektrotechnik- und Elektronikindustrie e.V.) (German Electrical and Electronic Manufacturers' Association) also applies. Amending the “General Conditions for the supply of Products and Services of the Electrical and Electronics Industry” (GL)*

Sale and delivery conditions can be obtained from Bender in printed or electronic format.

1.5 Storage

The devices must only be stored in areas where they are protected from dust, damp, and spray and dripping water, and in which the specified storage temperatures can be ensured.

1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded if they can be attributed to one or more of the following causes:

- Improper use of the device.
- Incorrect mounting, commissioning, operation and maintenance of the device.
- Failure to observe the instructions in this operating manual regarding transport, commissioning, operation and maintenance of the device.
- Unauthorised changes to the device made by parties other than the manufacturer.
- Non-observance of technical data.
- Repairs carried out incorrectly and the use of replacement parts or accessories not approved by the manufacturer.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

This operating manual, especially the safety instructions, must be observed by all personnel working on the device. Furthermore, the rules and regulations that apply for accident prevention at the place of use must be observed.

1.7 Disposal

Abide by the national regulations and laws governing the disposal of this device. Ask your supplier if you are not sure how to dispose of the old equipment.

The directive on waste electrical and electronic equipment (WEEE directive) and the directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS directive) apply in the European Community. In Germany, these policies are implemented through the "Electrical and Electronic Equipment Act" (ElektroG). According to this, the following applies:

- Electrical and electronic equipment are not part of household waste.
- Batteries and accumulators are not part of household waste and must be disposed of in accordance with the regulations.
- Old electrical and electronic equipment from users other than private households which was introduced to the market after 13 August 2005 must be taken back by the manufacturer and disposed of properly.

For more information on the disposal of Bender devices, refer to our homepage at

www.bender-de.com -> Service & Support.

2. Safety instructions

2.1 General safety instructions

Part of the device documentation in addition to this manual is the enclosed "Safety instructions for Bender products".

2.2 Work activities on electrical installations.

*Only **qualified personnel** are permitted to carry out the work necessary to install, commission and run a device or system.*

DANGER

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

- *An 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**. Observe the rules for working on electrical installations.*

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. The European standard EN 50110 can be used as a guide.

2.3 Device-specific safety information

DANGER

Danger as a result of excessive locating current or excessive locating voltage!
An excessive locating current of the internal locating current injector may damage sensitive loads (e.g. control circuits) or trigger unwanted switching operations. Select a low locating current for these systems. In case of doubt, please contact our service department.

DANGER

Risk of an electric shock!
When opening the device, you may come into contact with live parts. Switch off the mains voltage before opening the device!

WARNING

Make sure that the basic settings meet the requirements of the IT system. Persons without the necessary expertise, in particular children, must not have access to or contact with the ISOMETER®.

CAUTION

Make sure that the operating voltage is correct!
Prior to insulation and voltage tests, the ISOMETER® must be disconnected from the IT system for the duration of the test. In order to check the correct connection of the device, a function test has to be carried out before starting the system.

In case the ISOMETER® issues an alarm message, the insulation fault should be eliminated as quickly as possible.

The alarm message of the ISOMETER® must be audible and/or visible even when the device is installed inside a control cabinet.

When using ISOMETER®s in IT systems, make sure that only one active ISOMETER® is connected in each interconnected system. If IT systems are interconnected via coupling switches, make sure that ISOMETER®s not currently used are disconnected from the IT system and deactivated. IT systems coupled via diodes or capacitances may also influence the insulation monitoring process so that a central control of the different ISOMETER®s is required.

Prevent measurement errors!
When a monitored IT system contains galvanically coupled DC circuits, an insulation fault can only be detected correctly if the rectifier valves (e.g. rectifier diode, thyristors, IGBTs, frequency converters, …) carry a minimum current of > 10 mA.

Safety instructions

Unspecified frequency range
When connecting to an IT system with frequency components below the specified frequency range, the response times and response values may differ from the indicated technical data. However, depending on the application and the selected measurement method, continuous insulation monitoring is also possible in this frequency range.
There is no influence on the insulation monitoring for IT systems with frequency components above the specified frequency range, e.g. within the range of typical switching frequencies of frequency converters (2…20 kHz).

2.4 Address setting and termination

Correct address setting and termination is essential for proper functioning of the isoHR1685D-925 series insulation monitoring device.

CAUTION

Risk of bus errors!
Double assignment of addresses on the respective BMS busses can cause serious malfunctions.

Ensure correct address setting and termination of the device!

2.5 Intended use

*Only **qualified personnel** are permitted to carry out the work necessary to install, commission and run a device or system.*

*Read the operating manual **before** starting to install, connect and commission the device. After successful commissioning, keep the manual within easy reach for future reference.*

The device is used for monitoring the insulation resistance in large power supply systems designed as IT systems. The specific measurement method (AMP^{+}) monitors the insulation resistance also in installations where extremely high system leakage capacitances to earth exist due to interference suppression methods. The adjustment even to high system leakage capacitances occurs automatically.

The device generates locating current pulses required for insulation fault location. That allows the localisation of the insulation fault using permanently installed or mobile insulation fault locators.

Intended use also implies:

- The observation of all information in the operating manual
- Compliance with test intervals

In order to meet the requirements of applicable standards, customised parameter settings must be made on the equipment in order to adapt it to local equipment and operating conditions. Please heed the limits of the area of application indicated in the technical specifications.

Any other use than that described in this manual is regarded as improper.

3.1 Features

ISOMETER® for insulated elevating work platforms

- Continuous monitoring of the insulation levels of elevating work platforms even during operation
- Data storage to prove the insulation condition. For the burden of proof in case of an electrical accident
- Graphical representation of the insulation resistance over time (isoGraph)
- RS-485 interface with Modbus RTU for transfer of data, alarms, acknowledgement via existing communication to work platform
- History memory with real-time clock (buffer for three days) for storing 1023 alarm messages with date and time
- Freely programmable digital inputs
- Automatic device self test with automatic alarm message in the event of a fault
- Connection monitoring
- Separately adjustable response values Ran1 (Alarm 1) and Ran2 (Alarm 2) for pre-warning and alarm
- High-resolution graphic LC display for excellent readability and recording of the device status
- Measurement of high-resistance insulation faults 100 kΩ…100 MΩ
- Automatic adjustment to high system leakage capacitances, for measuring ranges see 11. Chapter "Technical data" on page 33

3.2 Product description

The ISOMETER® isoHR1685DW-925 is used for insulation monitoring of elevating work platforms/overhead catenary vehicles. Working on live overhead lines in public transport with up to 1500 V is a particularly dangerous task. To protect the workers, overhead catenary vehicles are equipped with two insulation levels. Pollution, ageing or damage to the insulation levels make the electricity perceptible to people and can lead to electrical accidents.

The isoHR1685DW-925 makes a valuable contribution to increasing safety when working on live parts.

The device is installed in the vehicle, continuously monitors the insulation level and informs the workers immediately if the insulation level falls below certain threshold values while driving to the work position, before and during work. Bot insulation levels can be monitored.

3.3 Functional description

Insulation monitoring is carried out using an active measuring pulse which is superimposed onto the lifting arm of the elevating work platform and the vehicle chassis via the integrated coupling. If the insulation resistance between the lifting arm and the vehicle chassis falls below the set prewarning response value Ran1, the "ALARM 1" LED lights up and the relay K1 (11/12/14) switches. If the insulation resistance falls below the alarm response value Ran2, the alarm relay K2 (21/22/24) switches and the "ALARM 2" LED lights up.

3.3.1 Insulation monitoring

For insulation monitoring, a pulsating AC measuring voltage is superimposed onto the elevating work platform. The measuring pulse consists of positive and negative rectangular pulses of the same amplitude. The period duration depends on the system leakage capacitances in each case and the insulation resistances of the monitored elevating work platform.

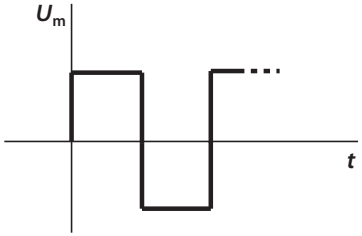


Fig. 3.1: Pulse sequence of the measuring voltage for insulation fault monitoring

An insulation fault between the elevating work platform and earth closes the measuring circuit. If the insulation resistance between the elevating work platform and earth falls below the set response values R_{an1} and R_{an2} (response value R_{an1} can be set equal to or higher than R_{an2}), the associated alarm relays K1 (11, 12, 14) or K2 (21, 22, 24) switch. Detected insulation faults are signalled to other bus devices via the BMS bus. In addition, the alarm LEDs Alarm 1 or Alarm 2 light up.

3.3.2 Assignment of the alarm relays K1, K2, K3

K1 switches when the value falls below the alarm response value R_{an1} (insulation resistance).

K2 switches when the value falls below the alarm response value R_{an2} (insulation resistance).

K3 switches in the event of a device error or a connection fault.

3.3.3 Deactivating the device

If the device is deactivated, it does not measure the insulation resistance, the message Device inactive appears on the display. The IT system is NOT being monitored!

Activation or deactivation is done via

- a digital input
- the menu item Alarm settings
- the BMS bus and Modbus RTU

The standby mode of the ISOMETER®, for example, enables application in coupled systems, since in interconnected systems only one insulation monitoring device may be connected.

3.3.4 Measured value transmission

All recorded measured values, operating messages and alarms are made available via the BMS bus or Modbus RTU.

3.4 History memory

All warnings, alarms and device errors are stored in the internal history memory with date and time stamp. The time the event started, the time of acknowledgement and the end of the event are recorded. The history memory can be called up and reset via the device menu (see "History" on page 26).

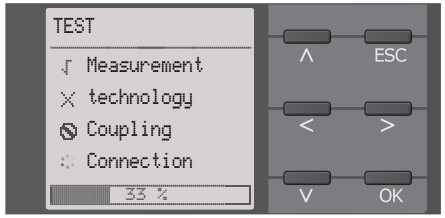
3.5 Self test

3.5.1 Self test after connection to the supply voltage

Once connected to the supply voltage, all internal measurement functions, the components of the process control such as data and parameter memory as well as the connections to the system or lifting arm and to earth are checked. The self test is completed after approx. 60 s. Afterwards, the normal measurement mode begins.

If a device error or a connection fault is detected, the corresponding alarm will be indicated in the display as well as via the alarm relay K3 (31-32-34). This relay operates continuously in N/C operation, i.e. a device error is signalled even in case of a complete device failure.

During this self test, when the device is being started, the alarm relays are not switched.



	Test successful
	Test not successful
	Test not available (e.g. incorrect device settings).
	Test is being carried out.

3.5.2 Automatic self test

All supply voltages are continuously monitored. The following tests are continuously carried out in the background:

- Connection E-KE
- Temperature monitoring of the coupling

A self test is automatically run at 24-hour intervals.

During the automatic self test, the alarm relays K1 (11-12-14) and K2 (21-22-24) are **not** switched. K3 **will not** be switched either.

3.5.3 Manual self test

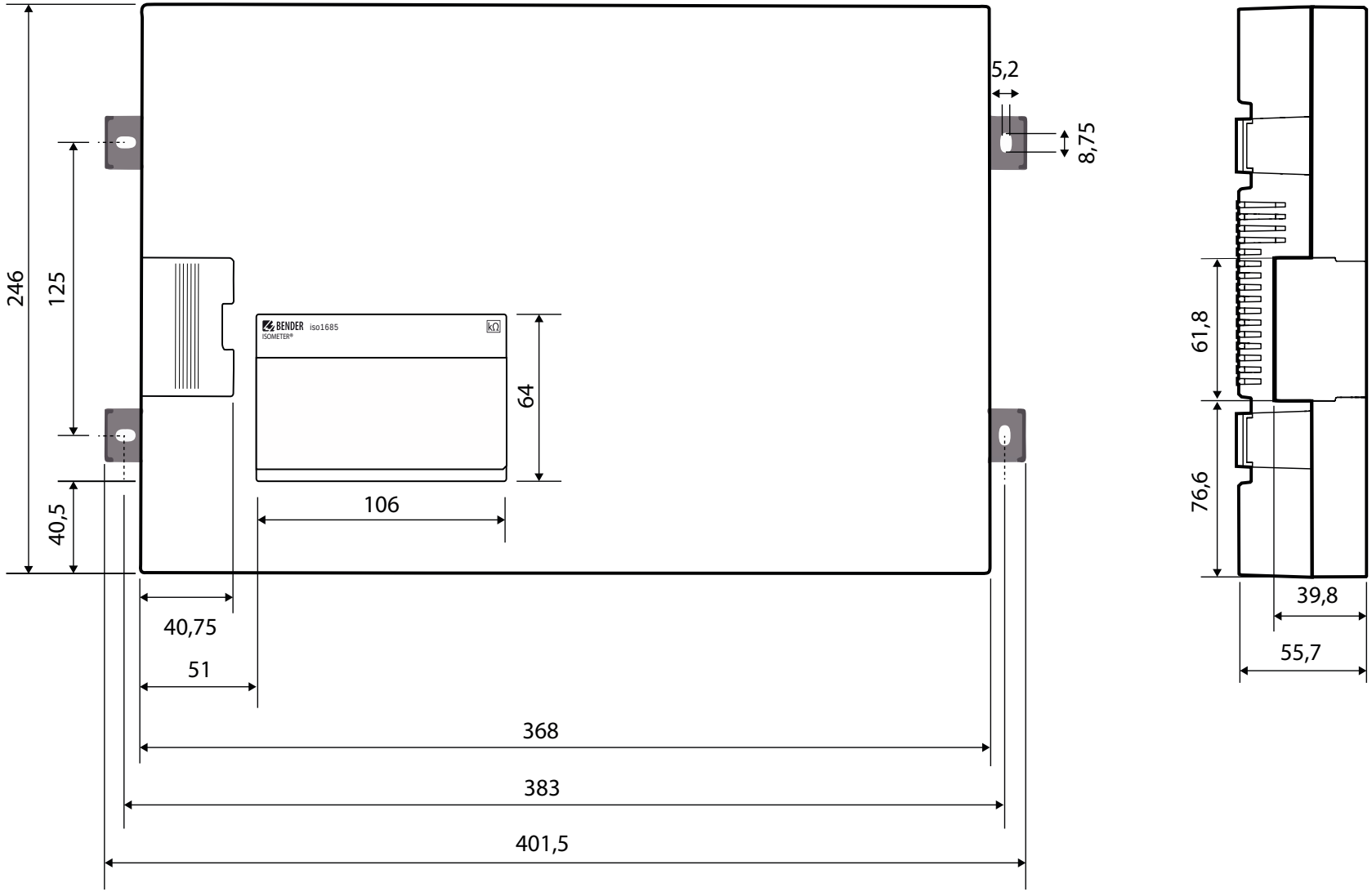
The self test is started via the test button of the ISOMETER®.

The following tests are only carried out in the manual self test mode:

- Internal Flash
- CPU register
- Watchdogs
- Oscillator
- Restart of the device including re-initialisation and recalibration
- Connection monitoring PE

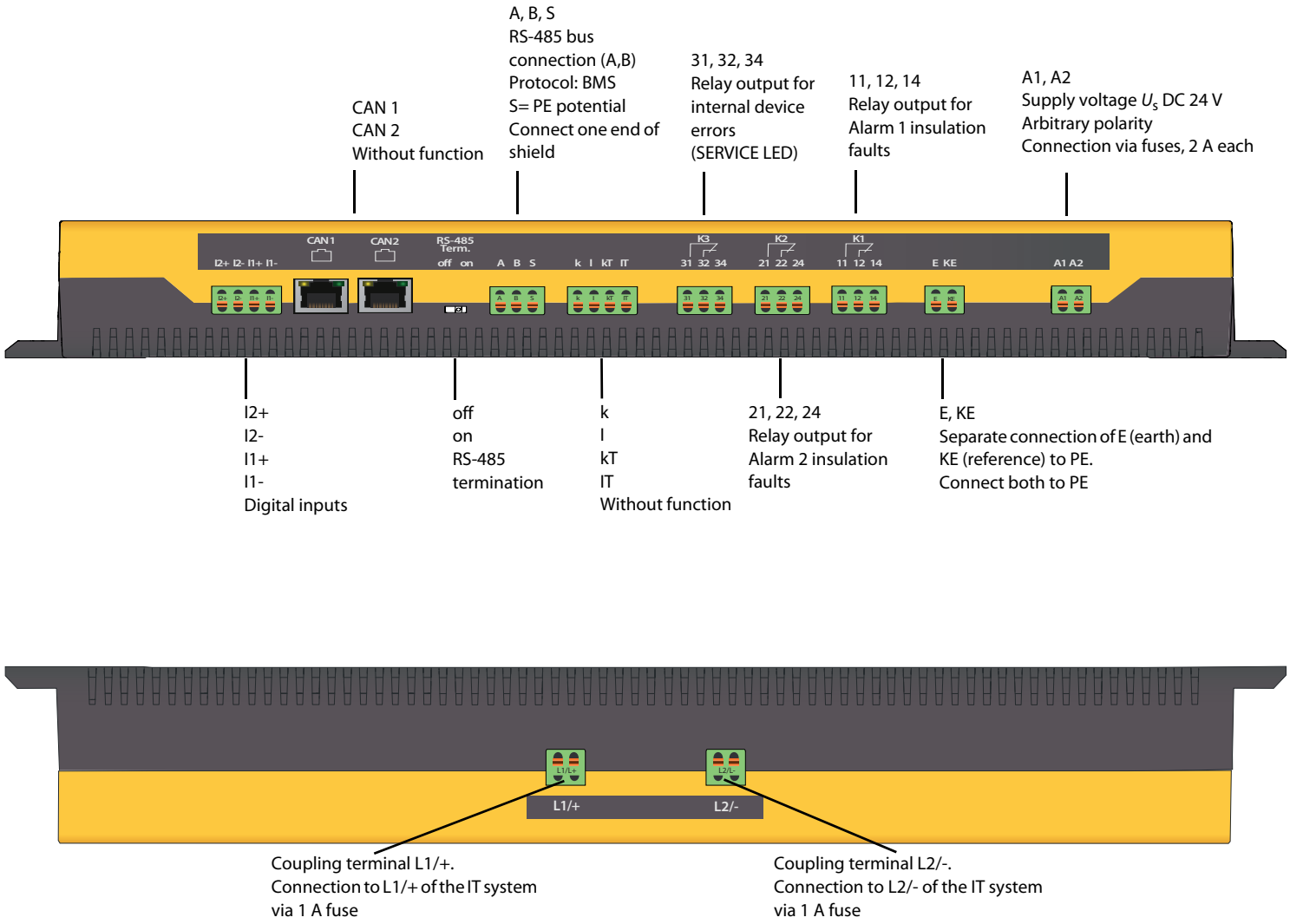
During the manual self test, all alarm relays are switched.

4.1 Dimensions



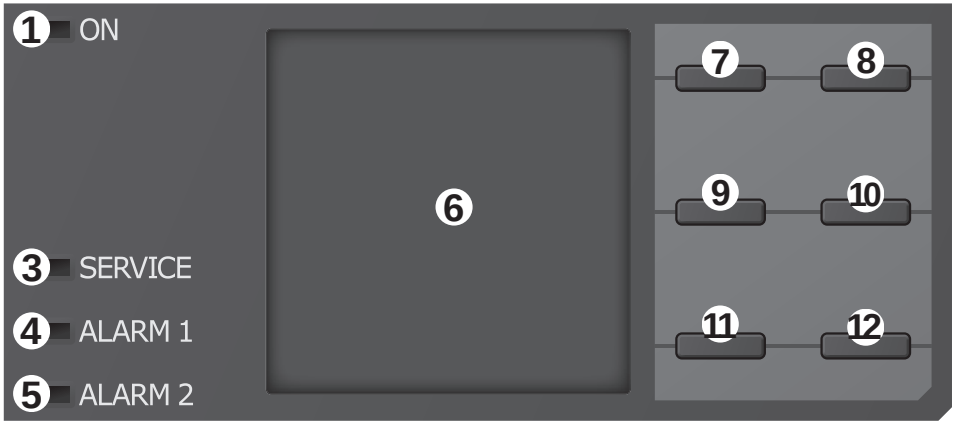
All dimensions in mm

4.2 Connections



Device overview

4.3 Display elements and device buttons



4.3.1 Display elements

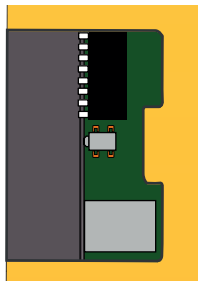
1	ON	The "ON" LED lights when the device is turned on.
3	SERVICE	The "SERVICE" LED lights when there is either a device fault or a connection fault, or when the device is in maintenance mode.
4	ALARM 1	The "ALARM 1" LED lights when the insulation resistance of the IT system falls below the set response value R_{an1}.
5	ALARM 2	The "ALARM 2" LED lights when the insulation resistance of the IT system falls below the set response value R_{an2}.
6	Display	The device display shows information regarding the device and the measurements. Other information is available in chapter „Display“.

4.3.2 device buttons

You can adjust the device settings in the respective menu using the menu buttons. Depending on the menu entry, one of the options displayed below is assigned to the buttons.

7		
	∧	Navigates up in a list or increases a value.
8	MENU	Opens the device menu.
	ESC	Cancels the current process or navigates one step back in the device menu.
9	RESET	Resets alarms.
	<	Navigates backwards (e.g. to the previous setting step) or selects a parameter.
10	TEST	Starts the device self test.
	>	Navigates forwards (e.g. to the next setting step) or selects a parameter.
11	DATA	Indicates data and values.
	∨	Navigates down in a list or reduces a value.
12	INFO	Shows information.
	OK	Confirms an action or a selection.

4.3.3 Operating elements in the service lid



Operating elements	Function
DIP switch (SS8103)	Without function
Button (ST6101)	Alarm reset
Memory card (SD card)	Without function

Device overview

4.4 Operating and navigating

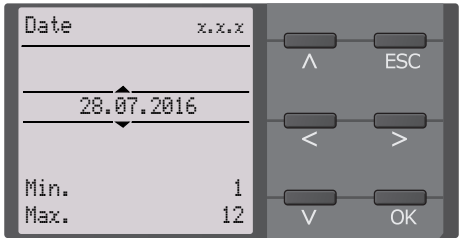
Navigate through the device menu using the device buttons. The functions of the device buttons are described in the chapter "Display elements and device buttons" on page 13.

Navigation in lists

To make a selection in a list, navigate using the V and Λ buttons to the desired menu item. Then click "OK".

Navigation with arrows

Increase or decrease a value using the V and Λ buttons. Move to the left or the right to set different values using the < and > buttons. The value positioned between the ▲▼ symbols is the value that is set.



5. Installation and connection

5.1 Installation

Install the device using four M5 screws, refer also to the dimension diagram where the drilling holes are illustrated (see "Dimensions" on page 11). Install the device so that the display can be read during operation and the system coupling is (L1/+, L2/–) positioned at the top.

CAUTION

Heat on the enclosure surface!
The surface temperature of 60 °C can be exceeded under certain operating conditions.
Keep the cooling slots uncovered by keeping a distance of at least 15 cm above and at least 10 cm below the device to adjacent objects in order to ensure constant air circulation.

5.2 Connection

5.2.1 Connection conditions

*Only **qualified personnel** are permitted to carry out the work necessary to install, commission and run a device or system.*

DANGER

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

- *An 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**. Observe the rules for working on electrical installations.*

WARNING

Risk of injury from sharp-edged terminals!
Risk of lacerations. Handle enclosure and terminals with care.

CAUTION

Risk of property damage due to unprofessional installation!
If more than one insulation monitoring device is connected to a conductively connected system, the system can be damaged. If several devices are connected, the device does not function and does not signal insulation faults. In every conductively connected system only one insulation monitoring device may be connected.

CAUTION

*This signal word indicates a **low-level risk** that can result in minor or **moderate injury** or **damage to property** if not avoided.*

Ensure disconnection from the IT system!
When insulation or voltage tests are to be carried out, the device must be isolated from the system for the test period. Otherwise the device may be damaged.

Check proper connection!
Prior to commissioning of the installation, check that the device is properly connected and functioning. Perform a functional test using an earth fault via a suitable resistance.

Pluggable push-wire terminals
All terminals are pluggable push-wire terminals. Solid connecting wires can be directly plugged in. For connection of flexible cables, the push-wire terminals must be pushed open by pressing the corresponding orange interlocking mechanism with a flat-head screwdriver.

Installation and connection

5.2.2 Step-by-step connection of the ISOMETER®

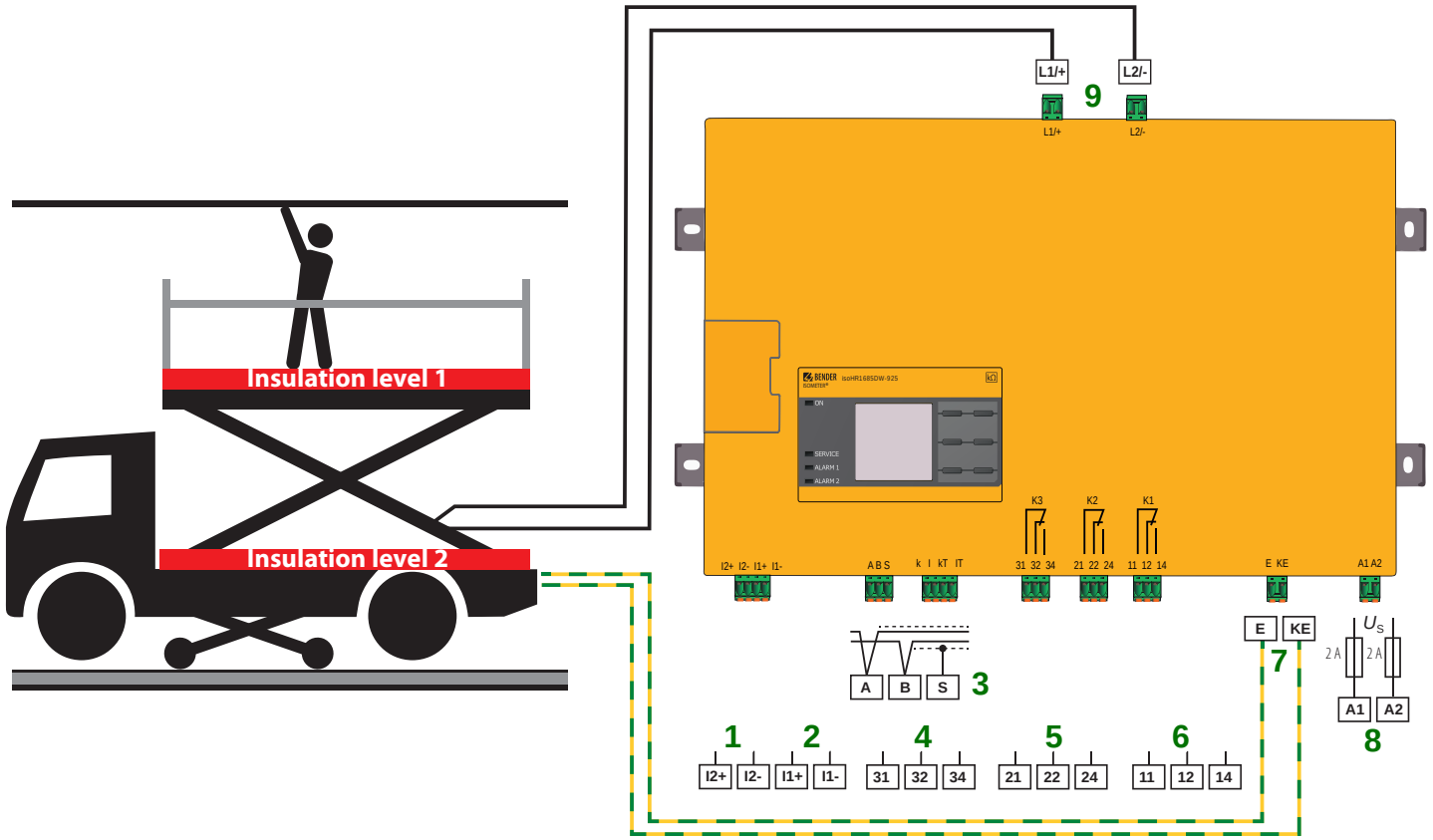
Connect the device according to the wiring diagram.
Proceed as follows:

1. Connect terminal E and KE to earth (PE)
2. Connect terminal A and B to the BMS bus/Modbus
3. Connect terminal S to the bus conductor shield
   (only at one end of the conductor)
4. Connect terminal L1/+ to L1 of the elevating work platform to be monitored
5. Connect terminal L2/- to L2 of the elevating work platform to be monitored

The coupling terminals L1/+ and L2/- are locked. To unplug the terminals, the orange sliders must be slid towards the front (towards the device) to unlock the terminal. Now the terminal can be unplugged.

6. Connect terminal A1/A2 to the supply voltage U_S
7. Connect alarm outputs 11/12/14, 21/22/24 and 31/32/34.

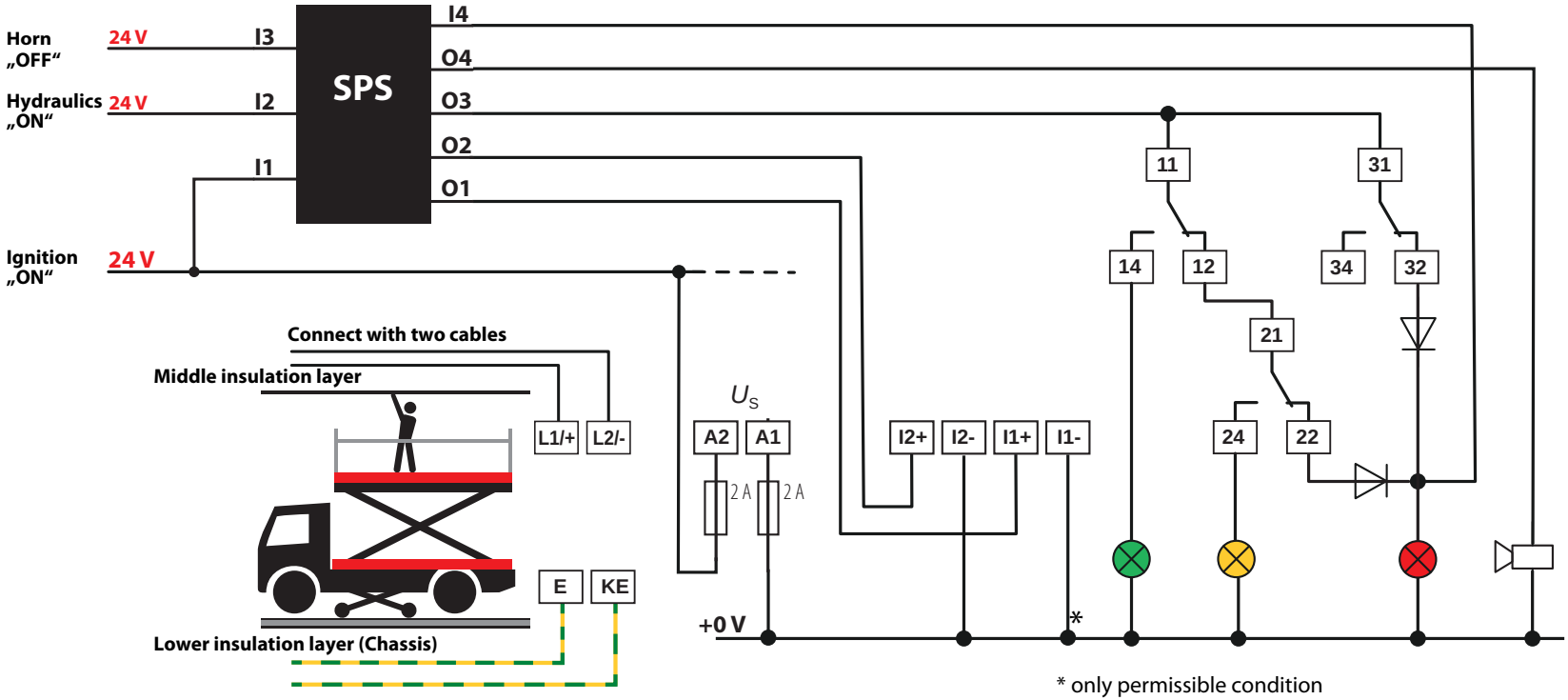
5.3 Connection to an elevating work platform



1	**I2+, I2–**	Initial measurement, digital input
2	**I1+, I1–**	Test, digital input
3	**A, B, S**	Connection to RS-485 bus with BMS bus, Modbus RTU, S = shield (connect one end to PE), can be terminated with S700
4	**31, 32, 34**	Alarm relay K3 for internal device errors
5	**21, 22, 24**	Alarm relay K2 for internal device errors
6	**11, 12, 14**	Alarm relay K1 for internal device errors
7	**E, KE**	Separate connections of E and KE to PE or vehicle chassis
8	**A1, A2**	Connection to U_S = DC 24 V via fuses, 2 A each
9	**L1/+, L2/–**	Connection of the two coupling terminals L1/+ and L2/- to the lifting arm of the work platform

Installation and connection

5.4 Connection to a PLC control system (Example)



* only permissible condition for the start of work

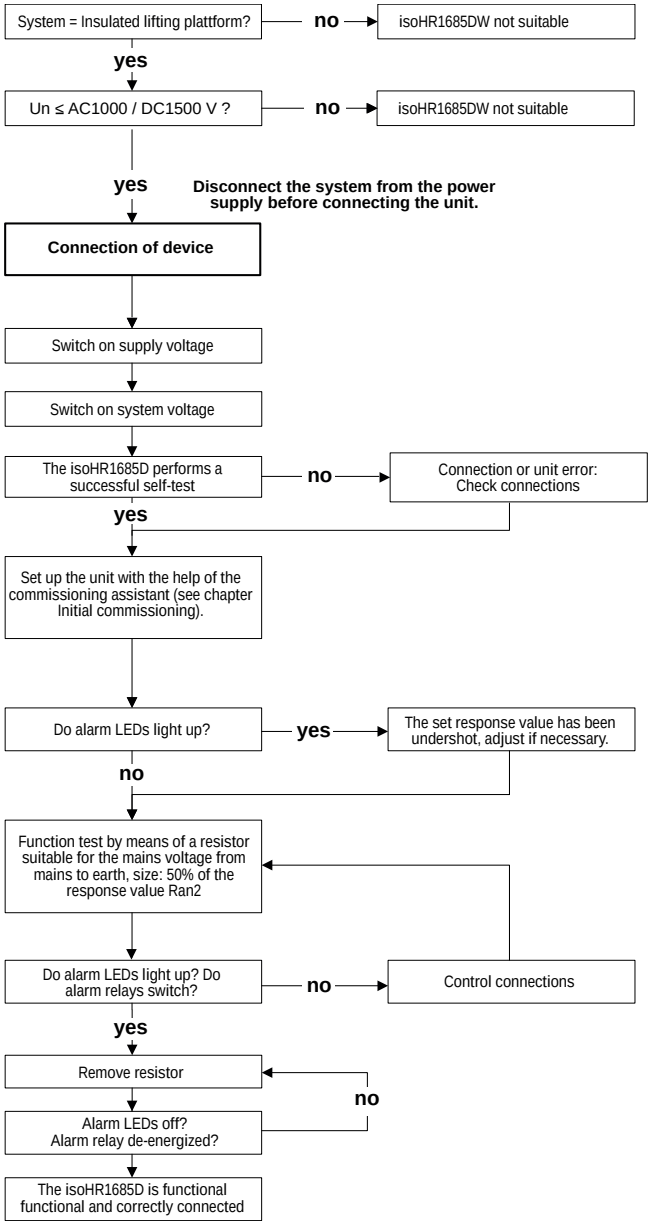
Output Q1
Q1 is enabled with a time delay after the platform is switched on (time delay = 3 s) and emits a pulse of 1 s. (Initial measurement)

Output Q2
Q2 is enabled with a time delay when the I1 control is started (time delay = 80s).
The output is disabled again as soon as the platform is switched on again.
(Isometer runs self-test, initial measurement and is then DISABLED).

Output Q3
Q3 is enabled with a time delay after the platform (hydraulics) I2 is switched on.
(time delay = 100 s) (Q3 = supply for the signal lamp)

Output Q4
The output is enabled when a signal is present at the "I4 Horn Bender Active" input.
This acoustic warning can be switched off and also switched on again via the "Horn Bender Off" button. When restarting the vehicle, the switch-off is always disabled!
(Q4 alarm horn Bender)

6.1 Commissioning flow chart insulation fault monitoring



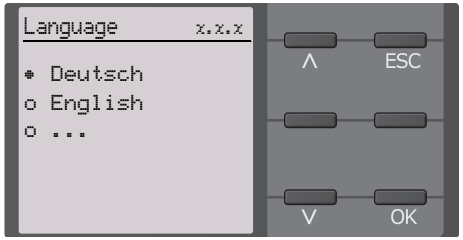
6.2 Initial commissioning

Follow the instructions of the commissioning wizard on the display.

Use the device buttons to navigate. For a description of the device buttons, refer to "Display elements and device buttons" on page 13.

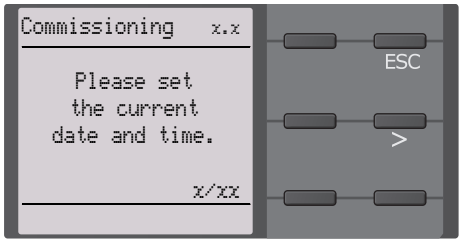
6.2.1 Setting language

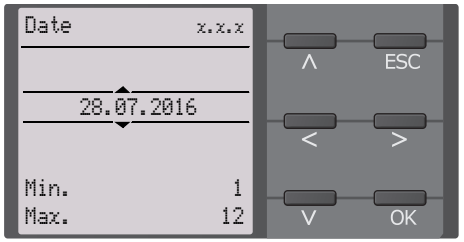
The language selected here will be used in the menu and for device messages.



6.2.2 Setting date and time

Alarm messages in the history memory and the insulation resistance value over time can only be assigned correctly to the isoGraph when date and time are set correctly.

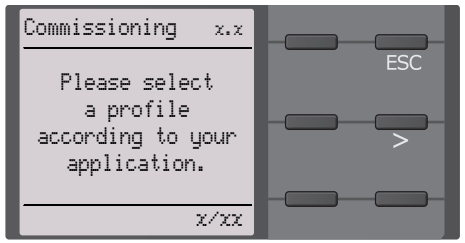


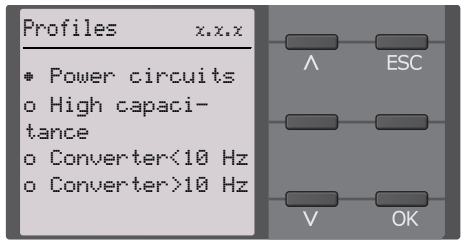


6.2.3 Setting profile

In order to optimally adapt the insulation monitoring device to the system to be monitored, select a profile here that suits your system. For an overview of the profiles, refer to "Device profiles" on page 33.

The Power circuits profile is suitable for most of the IT systems.

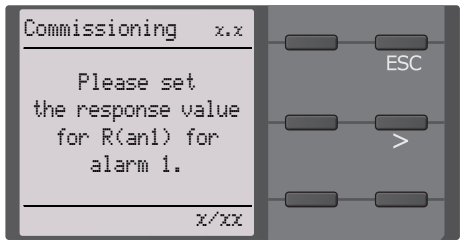


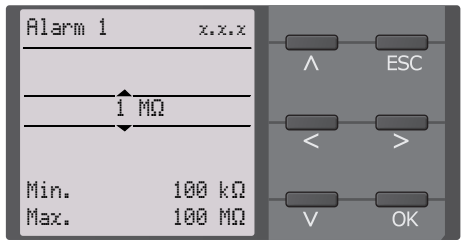


The response value range changes depending on the selected profile. See "Response values for insulation monitoring" on page 35.

6.2.4 Setting response value R_{an1} for alarm 1

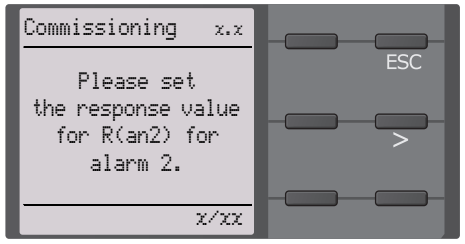
Set the prewarning response value here.

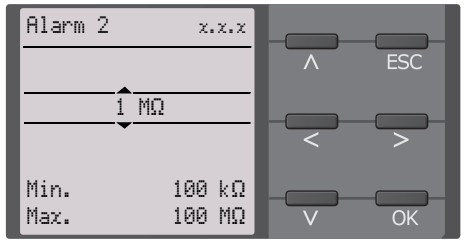




6.2.5 Setting response value R_{an2} for alarm 2

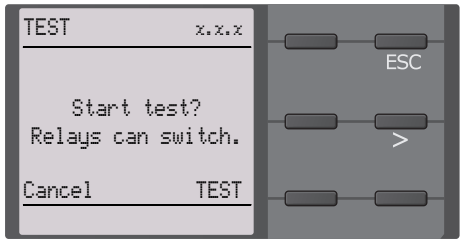
Set the response value for the main alarm here.
A value of 50 Ω/V is recommended for the main alarm.





6.2.6 TEST

Start the device test.
During the test, all relays switch and the ALARM 1 and ALARM 2 LEDs light up briefly.



6.3 Recommissioning

If the device has already been put into operation before, the self test will be started shortly after the supply voltage has been connected. You can restart the commissioning wizard using the following menu path:

Menu/Device settings/Commissioning

This menu can be used to modify previously made settings.

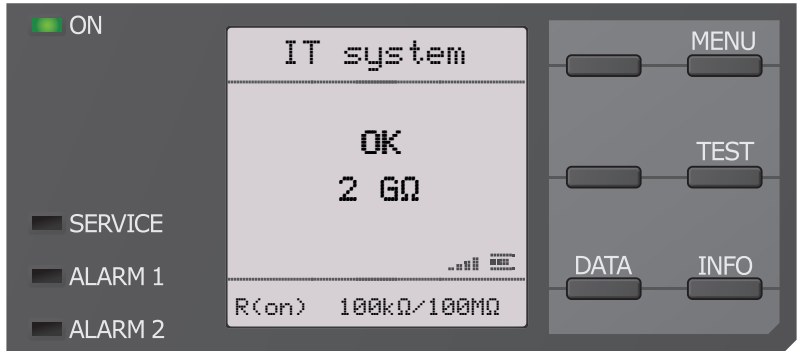
Observe device status!
Once initial commissioning has been completed and the initial measurement taken, the device changes from the alarm state to normal state by adhering to the set response values.

7.1 Standard display

During normal operation, the ISOMETER® displays the message OK and below, the currently measured insulation resistance.

	The signal quality of the measurement suits the selected profile. The better the signal quality, the faster and more exact the device can measure.
	The signal quality of the measurement does not suit the selected profile. Select a different measurement method.
	Update period between the measuring pulses

In the bottom line of the display, the set limit values for R(an) are indicated. In the example below, R_{an1}=4 MΩ and R_{an2}=1 MΩ.



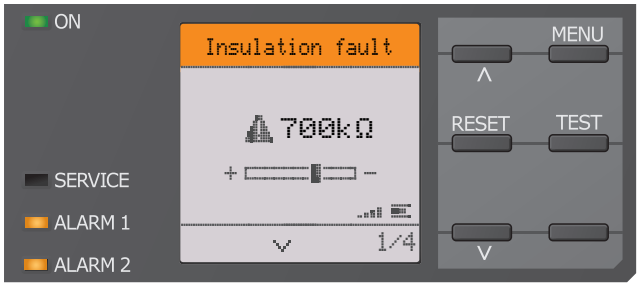
7.2 Fault display (active)

An active fault is displayed by ⚠.
The upper part of the display turns orange and displays the fault message. Depending on the type of fault, the LEDs "ALARM 1", "ALARM 2" or "SERVICE" are activated.

In the following example, a resistance has been detected. Since the values R_{an1}=4 MΩ and R_{an2}=1 MΩ are both below the set response value, „ALARM 1“ and „ALARM 2“ have been triggered.

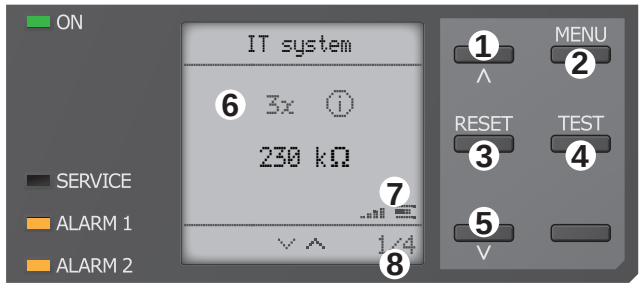
If several fault messages have appeared, you can navigate through the faults using the V and Λ buttons.

If the value falls below R_{an1} in a DC system or a DC offset is detected in an AC system, additional detailed information regarding the DC offset will be displayed.



7.3 Fault display (inactive)

An inactive fault is indicated by ⓘ. If several faults have occurred, the number of faults will also be indicated. The message shown on the display below means that there has been a fault in the past but the device is no longer in fault condition.

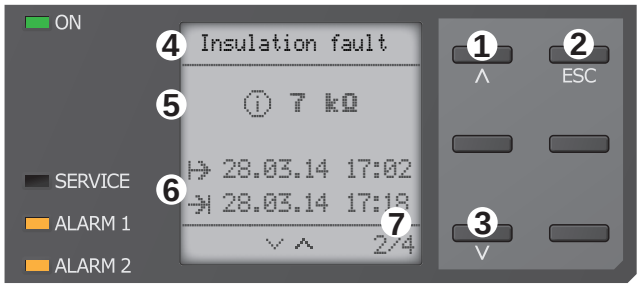


Keypad
1 Next fault message
2 MENU selection
3 Acknowledge fault
4 Perform test measurement
5 Previous fault message

Display
6 Number of faults that have occurred
7 Signal quality & measuring pulses
8 Number of the selected fault/ Fault message count

Display

If several fault messages have appeared, you can navigate through the faults using the V and Λ buttons. In addition to the type of fault and the associated alarm value, you can see when the fault has occurred and for how long it has been active.



Keypad
1 Next fault message
2 Exit view
3 Previous fault message
Display
4 Fault description
5 Alarm value
6 Fault appeared/
Fault disappeared
7 Number of the selected fault/
Fault message count

7.4 Acknowledging a fault message

In order to acknowledge the fault message and return to the ISOMETER®'s standard display, all faults must be acknowledged by means of the "RESET" button.

This means that fault messages can only be reset when the cause of the fault has been eliminated.

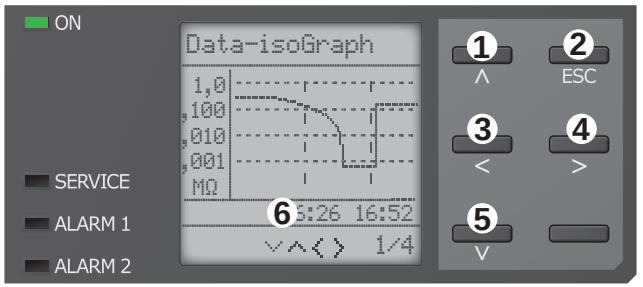
Press the "RESET" button, then > and "OK" to clear the fault memory. The ISOMETER® returns to the standard display.

Keypad
1 Press „RESET"-button
2 Select RESET by pressing >
3 Press the "OK" button to
confirm the deletion
Display
4 Functions

7.5 Data-isoGraph

The isoGraph represents the chronological sequence of the insulation resistance over time. This graphical representation can be displayed over the following time periods: hour, day, week, month and year.

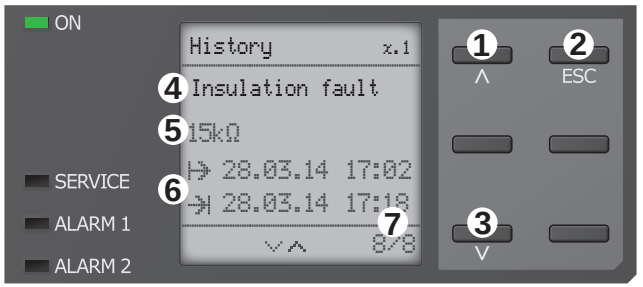
The measured values for individual representations are stored in a separate memory. Up to 100 measured values are available to represent each graph. and the resolution of each graph is determined by these values.



Keypad
1 Change measured value
(jump forward one value)
2 Exit view
3 Change scaling (zoom in)
4 Change scaling (zoom out)
5 Change measured value
(jump back one value)
Display
6 Present time scaling

7.6 History memory

Up to 1023 alarm messages and device errors are stored in the history memory with date and time stamp. If the history memory is deleted, the minimum insulation resistance R_{min} will also be reset in the Data-isoGraph at ***Menu -> Data Measured values -> Reset Data-isoGraph***.



Keypad
1 Next message
2 Exit view
3 Previous message
Display
4 Fault description
5 Alarm value
6 Fault appeared/
Fault disappeared
7 Number of the selected fault/
Fault message count

8.1 Device menu structure

- 1. Alarm settings
  - 1. Insulation alarm
    - 1. Alarm 1
    - 2. Alarm 2
    - 3. Memory
  - 2. Profile
  - 3. Device
  - 4. Coupling monitor
  - 5. Inputs
    - 1. Digital 1
      - 1. Mode
      - 2. t(on)
      - 3. t(off)
      - 4. Function
    - 2. Digital 2
      - 1. Mode
      - 2. t(on)
      - 3. t(off)
      - 4. Function
  - 6. Outputs
    - 1. Relay 1
      - 1. TEST
      - 2. Relay mode
    - 2. Relay 2
      - 1. TEST
      - 2. Relay mode
    - 3. Buzzer
      - 1. TEST
      - 2. Function 1
      - 3. Function 2
      - 4. Function 3
- 2. Data meas. Values
- 3. Control
  - 1. TEST
  - 2. RESET
  - 3. EDS
- 4. History
  - 1. History
  - 2. Delete
- 5. Device settings
  - 1. Language
  - 2. Clock
    - 1. Time
    - 2. Format
    - 3. Summer time
    - 4. Date
    - 5. Format
  - 3. Interface
    - 1. Mode:
    - 2. BMS
      - 1. Address
    - 3. Modbus/RTU
      - 1. Address
      - 2. Baudrate
      - 3. Parity
      - 4. Stoppbits
  - 4. Display
    - 1. Brightness
  - 5. Password
    - 1. Password
    - 2. Status
  - 6. Commissioning
  - 7. Factory setting
  - 8. Service
- 6. Info

Settings

8.2 Settings in the device menu

8.2 (1.) Alarm settings

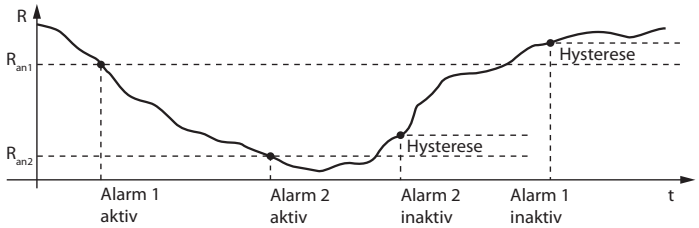
The limit values for the insulation resistances of alarm 1 and alarm 2 can be specified in the alarm settings menu and the profile of the ISOMETER® can be adjusted. If you have activated the password query in the device menu (refer to "Password" on page 28), you must enter the device password in order to change the settings.

You can adjust the following functions:

8.2 (1.1) Insulation alarm

In the Insulation alarm menu, the ISOMETER® limit values for alarm 1 and alarm 2 can be set. Activation or deactivation of the two alarm levels R_{an1} (alarm 1) and R_{an2} (alarm 2) are illustrated in the following graphic:

An alarm will become inactive as soon as the hysteresis of the set operating value is exceeded.



8.2 (1.1.1) Alarm 1

An insulation resistance of 100 kΩ…100 MΩ can be set for alarm 1.

Condition: alarm 1 ≥ alarm 2.

8.2 (1.1.2) Alarm 2

An insulation resistance of 100 kΩ…100 MΩ can be set for alarm 2.

8.2 (1.1.3) Fault memory

Automatic reset of inactive faults at the outputs
(relays 11-12-13, 21-22-24):

*on	If a fault becomes inactive, the programmed outputs remain in fault condition until they are reset manually.
*off	If a fault becomes inactive, the programmed outputs automatically change their state.

8.2 (1.2) Profile

Adapt the area of application of the ISOMETER® to your system profile. For a description of the profiles, refer to "Device profiles" on page 33.
The following can be selected:

*Power circuits	Suitable for most IT systems.
*High capacitance	Suitable for systems with high leakage capacitances. Limit of the measuring range: 200 kΩ
*Converter < 10 Hz	Suitable for systems with extremely low frequency control in the range 1…460 Hz.

8.2 (1.3) Device

Set the ISOMETER® insulation resistance measurement function to active or inactive:

*Active	The device is active.
*Inactive	The device does NOT measure the insulation resistance. The IT system is NOT being monitored! The message Device inactive appears on the display. The ALARM 1 and ALARM 2 LEDs light up.

8.2 (1.4) Start alarm

*Start alarm ON	Device start with alarm message and a measured value of 0 kΩ
*Start alarm OFF	Device start without alarm message and a measured value of ∞ kOhm

Settings

8.2 (1.5) Inputs

The ISOMETER® provides 2 digital inputs (I1, I2) that are freely configurable.

8.2 (1.5.1) Digital 1

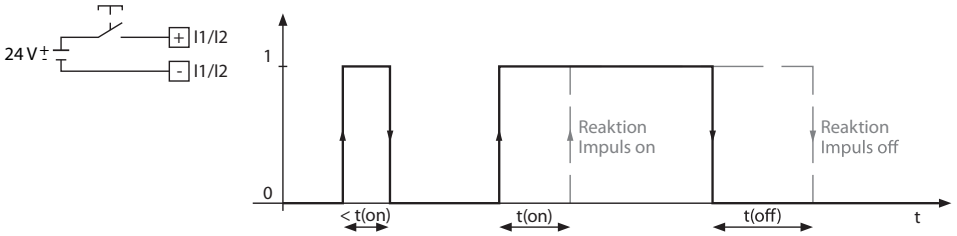
The following parameters can be set for the digital input:

8.2 (1.5.1.1) Mode

The operating mode for the digital input can be set to the following values:

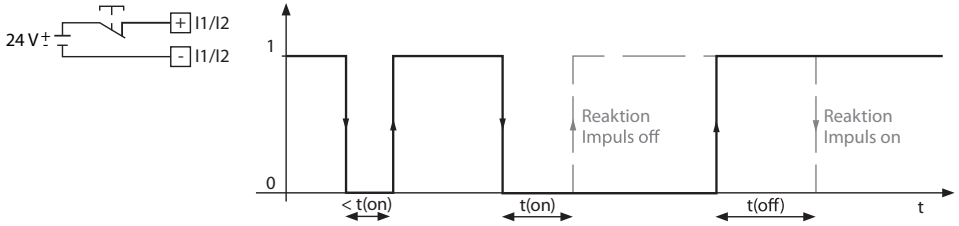
Active high

An event is carried out on the rising edge of the digital input (low to high).
Response time t(on)/t(off) after a switch-on signal.



Active low

An event is carried out on the falling edge of the digital input (high to low).
Response time t(on)/t(off) after a switch-off signal.



8.2 (1.5.1.2) t(on)

The response time t(on) after a switch-on signal can be set between 100 milliseconds and 5 minutes.

8.2 (1.5.1.3) t(off)

The response time t(off) after a switch-off signal can be set between 100 milliseconds and 5 minutes.

8.2 (1.5.1.4) Function

The parameters for the function of the digital inputs of the ISOMETER® can be set differently:

*off	Digital input without function
*TEST	Device self test
*RESET	Reset of fault and alarm messages
*Start initial measurement	Starting a new measurement. All recorded measurements are discarded

8.2 (1.5.2) Digital 2

See "8.2 (1.5.1) Digital 1".

8.2 (1.6) Outputs

The ISOMETER® provides a total of 3 alarm relays.
The following parameters can be set for relay 1 and relay 2:

8.2 (1.6.1) Relay 1

The following parameters can be set for the relay:

8.2 (1.6.1.1) TEST

The functional test of the relay can be activated or deactivated. This only applies to the manual test and not to the cyclic device self test:

*on	The manual test checks the switching function of the relay
*off	The manual test does not check the switching function of the relay

8.2 (1.6.1.2) Relay mode

The relay mode can be adapted to the application:

*N/C	Normally closed - N/C operation contacts 11-12-14/21-22-24 (The alarm relay is energised during normal operation).
*N/O	Normally open - N/O operation contacts 11-12-14/21-22-24 (The alarm relay is de-energised during normal operation).

8.2 (1.6.2) Relay 2

See "8.2 (1.6.1) Relay 1".

8.2 (1.6.3) Relay 3:

Relay 3 does not appear in the device menu. The operating mode is set to N/C operation and the parameters cannot be adjusted.

8.2 (1.6.4) Buzzer

The following parameters can be set for the buzzer:

8.2 (1.6.4.1) TEST

The functional test of the buzzer can be activated or deactivated. This only applies to the manual test and not to the cyclic device self test:

*on	The manual test activates the buzzer sound.
*off	The manual test does not activate the buzzer sound.

8.2 (1.6.4.2) Function 1

The following parameters can be set:

*off	The function is not used.
*Ins. alarm 1	The status of the output changes when the value falls below the set response value R_{an1}.
*Ins. alarm 2	The status of the output changes when the value falls below the set response value R_{an2}.
*Connection fault	The status of the output changes when one of the following connection faults occurs: • No low-resistance connection between the line conductors. • No low-resistance connection between the terminals E and KE to earth (PE).
*Device error	The status of the output changes in the event of an internal device error.
*Common alarm	The status of the output changes on the occurrence of any alarm and fault messages (Ins. alarm 1 & 2, DC-/DC+ alarm, symmetrical alarm, connection and device errors).
*Device inactive	The status of the output changes when the device has been deactivated via a digital input or the control menu.

8.2 (1.6.4.3) Functions 2 and 3

See “8.2 (1.6.4.2) Function 1”.

8.2 (2.) Data measured values

The ISOMETER® stores certain measured values for a specific period of time. You can view these data at `Settings -> Data -> Meas. values`. Navigate through the different views using the Λ and V buttons:

*Data - isoGraph	Displays the insulation resistance over the chronological sequence of the operating time.
*Data - Insulation	Displays the current insulation resistance and the system leakage capacitance.
*Data - Voltage	Displays the system voltages and the partial voltages to earth
*Data - Temperature	Coupling to system

8.2 (3.) Control

In the Control menu, you can run a manual test and reset the alarm messages:

*TEST	Manual device test
*RESET	Reset of fault and alarm messages

8.2 (4.) History

In the history menu, the faults detected by the ISOMETER® are displayed.

For a detailed description, refer to "History memory" on page 22.

*History	Overview of faults that have occurred
*Delete	Reset of the history memory

8.2 (5.) Device settings

The device settings menu allows configuring the basic settings for the ISOMETER®:

8.2 (5.1) Language

Choose the language to be displayed by the ISOMETER®. For example, you can set the languages:

```
*Deutsch
*English
*...
```

8.2 (5.2) Clock

In the clock menu, you can set the display format of date and time for the ISOMETER®:

8.2 (5.2.1) Time

Based on the selected time format you can set the current time to display 24-hour or 12-hour notation (am/pm).

8.2 (5.2.2) Format (time)

Selecting the appropriate time format to be displayed:

*12 h	12-hour notation am/pm
*24 h	24-hour notation

8.2 (5.2.3) Summer time

Summer time can be considered in the following settings:

*off	No automatic change between summer time and standard time.
*DST	Daylight Saving Time Automatic change between summer time and standard time according to North American regulation. Start: Second Sunday in March from 02:00 a.m. to 03:00 a.m. End: First Sunday in November from 03:00 a.m. to 02:00 a.m.
*CEST	Central European Summer Time Automatic change between summer time and standard time according to Central European regulation. Start: Last Sunday in March from 02:00 a.m. CET to 03:00 a.m. CEST. End: Last Sunday in October from 03:00 a.m. CEST to 02:00 a.m. CET.

8.2 (5.2.4) Date

Based on the selected date format, the current date can be set.

8.2 (5.2.5) Format (date)

Select the date format to be displayed:

*dd.mm.yy	day, month, year
*mm-dd-yy	month, day, year

8.2 (5.3) Interface

Set the parameters for connection of other devices to the ISOMETER® in the interface menu.

*Mode
*BMS
*Modbus RTU

8.2 (5.3.1) Mode

Set the parameters for communication with other devices via the BMS bus or Modbus RTU

*BMS
*Modbus RTU

8.2 (5.3.2) BMS

8.2 (5.3.2.1) BMS address

Address setting of the BMS bus from 1 to 90.

8.2 (5.3.3) Modbus RTU

8.2 (5.3.3.1) Modbus RTU address

Address setting in the address range 1 to 247

8.2 (5.3.3.2) Baud rate

*9.6 kB
*19.2 kB
*37.4 kB
*57.6 kB
*115 kB

8.2 (5.3.3.3) Parity

*even
*uneven
*none

8.2 (5.3.3.4) Stop bits

*1
*2
*auto

Settings

8.2 (5.4) Display

Adjust the display brightness for the ISOMETER® in the display menu.

8.2 (5.4.1) Brightness

Adjust the display brightness between 0 % and 100 % in steps of 10.

If no button is pressed on the display for 15 minutes, the brightness of the display decreases. When a button is pressed, the selected brightness is restored.

8.2 (5.5) Password

Use the password function to protect the device parameters against unauthorised adjustment. The default password is 0000.

8.2 (5.5.1) Password

Enter an individual four-digit password.

8.2 (5.5.2) Status

Decide whether the password query should be used:

*on	Password query active
*off	Password query inactive

8.2 (5.6) Commissioning

In the commissioning menu, you can open the ISOMETER®'s commissioning wizard again.

8.2 (5.7) Factory settings

8.2 (5.8) Service

The service menu can only be accessed by Bender service staff.

8.2 (6.) Info

The ISOMETER®'s current settings can be viewed in the Info menu. Navigate through the different views using the Λ and V buttons:

*Info – Device	Device name, serial number, article number
*Info – Software	Software version measurement technology, software version HMI
*Info – Measurement technology	Set profile
*Info – Clock	Time, date, summer time
*Info – BMS	Address of the RS-485 interface

9. Device communication

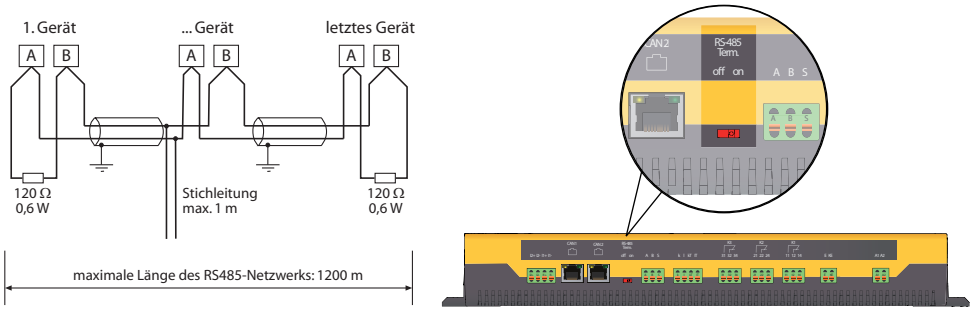
Over the RS-485 interface of the device, data can be transferred either via the BMS protocol or the Modbus RTU protocol. The desired protocol and the protocol parameters are set in the "Interface" menu 8.2 (6.3).

9.1 RS-485 interface with BMS protocol

The RS-485 interface, galvanically isolated from the device electronics, serves as a physical transmission medium for the BMS protocol. When an ISOMETER® or other bus-capable devices are interconnected via the BMS bus in a network, the BMS bus must be terminated at both ends with a 120 Ω resistor. For this purpose, the device is equipped with the terminating switch RS-485 Term. (ON/OFF).

An RS-485 network that is not terminated is likely to become unstable and may result in malfunctions. Only the first and last device in one line may be terminated. Hence, stub feeders in the network must not be terminated. The length of the stub feeders is restricted to 1 m.

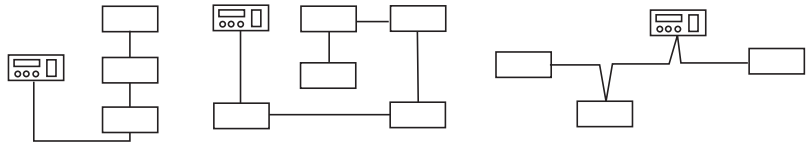
9.1.1 Topology RS-485 network



The optimum topology for an RS-485 network is a daisy-chain connection. In this connection, device 1 is connected to device 2, device 2 to device 3, device 3 to device n etc. The RS-485 network represents a continuous path without branches.

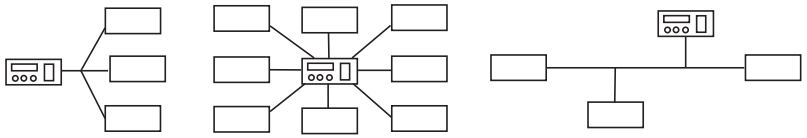
Correct arrangement

Three examples for correct arrangement:



Wrong arrangement

Three examples for wrong arrangement:

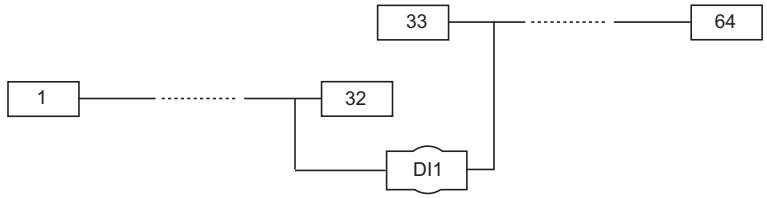


Wiring

The following type of wiring is recommended for the RS-485 network:

Shielded cable, core diameter 0.8 mm (e.g. J-Y(St)Y 2x0.8), shield connected to earth (PE) on one end. Connection to the terminals A and B.

The max number of bus nodes is restricted to 32 devices. If more devices are to be connected, Bender recommends the use of a DI1 repeater.



9.1.2 BMS protocol

This protocol is an essential part of the Bender measuring device interface (BMS bus protocol). Data transmission generally makes use of ASCII characters.

Interface data are:

- Baud rate: 9600 baud
- Transmission: 1 start bit, 7 data bits, 1 parity bit, 1 stop bit (1, 7, E, 1)
- Parity: even
- Checksum: Sum of all transmitted bytes = 0 (without CR and LF)

The BMS bus protocol works according to the Master-Slave principle. Only one master may exist in each network. All bus devices are identified by a unique BMS address. The master cyclically scans all other slaves on the bus, listens to their signals and then carries out the corresponding commands.

A device receives the MASTER function by assigning **bus address 1** to it.

9.1.3 BMS master

A master can query all measured values, alarm and operating messages from a slave. If bus address 1 is assigned to a device, this device automatically represents the master, i.e. all addresses between 1 and 150 are cyclically scanned via the BMS bus for alarm and operating messages. If the master recognises incorrect answers from a slave, the fault message "Fault RS-485" will be issued via the BMS bus.

Fault causes may be:

- Addresses are assigned twice
- A second master exists on the BMS bus
- Interference signals occur on the bus lines
- A defective device is connected to the bus
- Terminating resistors are not activated or connected

9.1.4 Commissioning of an RS-485 network with BMS protocol

- Interconnect terminals A and B of all bus devices in one line
- Switch the terminating resistors on at the start and the end of the RS-485 network. If a device at the end of the bus is not terminated, connect a 120 Ω resistor to terminals A and B
- Switch the supply voltage on.
- Assign the master function and address 1 to a bus-capable device.
- Assign addresses (2...90) to all other bus devices in consecutive order

9.1.5 Setting the BMS address

The ISOMETER® cannot switch on a potential termination at the BMS bus. Even though this is not expected to cause communication problems, the ISOMETER® should be operated as BMS slave if possible (BMS address > 1). If no other device with master capabilities is available on the bus, the ISOMETER® can be set to master (BMS address 1).

Before the ISOMETER® takes over the backup master function after being switched on, it waits to see if another master connects itself to the system. Waiting period: BMS address minus 1 = waiting period in minutes. Example: The isoxx1685... has BMS address 3. It waits 3 minus 1 minutes (= 2 minutes) for a master to connect.

Set the BMS address ((1)2…90) in the device menu via the path:

Device settings > Interface > BMS > BMS address.

9.1.6 Alarm and operating messages via the BMS bus

Messages are transmitted to a maximum of 12 BMS channels. All alarm and operating messages that may occur are described below.

9.1.6.1 Alarm messages

Alarm	Channel	Meaning
Alarm 1 (insulation fault)	1	Insulation resistance "Prewarning" (Value < response value 1, $R_F < R_{an1}$)
Alarm 2 (insulation fault)	2	Insulation resistance "Alarm" (Value < response value 2, $R_F < R_{an2}$)
Connection system	4	Connection fault system
Connection PE	5	Connection fault earth
Device error	7	Internal device error
Overtemperature coupling	10	Overtemperature coupling terminal L1/+
Overtemperature coupling	11	Overtemperature coupling terminal L2/–

9.1.6.2 Operating messages

Alarm	Channel	Meaning
Insulation resistance	1	Current insulation resistance R_F (when $R_F > (R_{an1}$ + hysteresis))
Insulation resistance	2	Current insulation resistance R_F (when $R_F > (R_{an2}$ + hysteresis))
Leakage capacitance	4	Leakage capacitance C_e in nF, µF
Mains voltage	5	Current system voltage U_N
Partial voltage U+/PE	6	Current partial voltage terminal L1/+ to earth
Partial voltage U-/PE	7	Current partial voltage terminal L2/– to earth
Temperature coupling	10	Current temperature of the coupling L1/+
Temperature coupling	11	Current temperature of the coupling L2/–

9.1.6.3 Resetting error messages

Recorded errors are presented as alarm messages on the BMS bus.

The fault messages are reset via the device menu. If the error continues to exist, the message will be generated again. The error can also be reset by means of the acknowledgement command via the BMS bus.

9.1.6.4 Error codes

The following list shows all relevant error codes issued via BMS bus.

BMS Error code	Component	Error	Action
0.30	Connection	Connection earth (E/KE)	Check connection
0.40	Connection	Connection system (L1/+, L2/–)	Check connection
4.05	Parameter	Incorrect measurement method selected	Change measurement method
7.63	System	Timeout system management	Restart the device
8.11	Hardware	Self test insulation measurement	Contact service
8.12	Hardware	Hardware measuring voltage source	Replace device
8.42	Hardware	Supply voltage ADC	Replace device
8.43	Hardware	Supply voltage +12 V	Replace device
8.44	Hardware	Supply voltage –12 V	Replace device
8.45	Hardware	Supply voltage +5 V	Replace device
8.46	Hardware	Supply voltage +3.3 V	Replace device
9.61	Parameter	Insulation measurement	Load factory settings and parameterise again
9.64	Parameter	Voltage measurement	Contact service
9.70	System	General software error	Restart the device
9.71	System	Control flow	Restart the device
9.72	System	Programme sequence insulation measurement	Restart the device
9.74	System	Programme sequence voltage measurement	Restart the device
9.75	System	Programme sequence temperature measurement	Restart the device
9.76	System	Programme sequence history memory	Restart the device
9.77	System	Programme sequence console	Restart the device
9.78	System	Programme sequence self test	Restart the device
9.80	System	Stack error	Restart the device
9.81	System	Internal programme sequence	Restart the device
9.82	System	Internal programme sequence	Restart the device

Device communication

9.2 RS-485 interface with Modbus RTU protocol

Modbus is an internationally widely used protocol for data transfer between devices.

All measured values, messages and parameters are stored in virtual register addresses. Data can be read out with a read command on a register address. With a write command, data can be written into a register address.

The register addresses of the individual measured values and parameters can be found in the "isoxx1685Dx_D00272_00_A_XXDE" manual with the title "ISOMETER® isoxx1685Dx device family - Modbus settings" at http://www.bender.de/manuals.

Alarm message	Description	Measures	Reference	LED indicators
Alarm 1 (insulation fault)	The insulation resistance is lower than the response value R_{an1}	• Determine cause of the insulation fault and eliminate it.		ALARM 1 lights up
ALARM 2 (insulation fault)	The insulation resistance is lower than the response value R_{an2}	• Determine cause of the insulation fault and eliminate it.		ALARM 2 lights up
Check L1-L2 for correct connection	Connection fault system	• Check the wiring of terminals L1/+, and L2/- to the IT system • Press the test button • Check mains voltage • Check the fuses	See chapter "Connection" from page 15.	ALARM 1 + ALARM 2 flash in common mode
Check E-KE connections for interruptions	Connection fault. E/KE not connected to PE	• Check wiring of terminals E and KE to earth (PE) • Press the test button	See chapter "Connection" from page 15.	ALARM 1 + ALARM 2 flash in common mode
Device error x.xx	Internal device error	• Press TEST button • Switch the supply voltage on and off • Contact Bender Service		SERVICE lights up
Overtemperature coupling	Overtemperature coupling terminal L1/+ or L2/ –	• Check mains voltage level and eliminate any existing insulation faults. After cooling down, the device switches on again automatically at a temperature of 80 °C. This device behaviour is normal if a high mains voltage and low insulation fault resistance have been selected.		SERVICE lights up
Check time and date!	Time and date have not been set yet	• Set local date and time (in case of voltage failure buffer for three days)	See chapter "Clock" from page 27.	

11.1 Device profiles

	Power frequency	System leakage capacitance	Measuring voltage	Response value range	Description
Power circuits	DC, 15…460 Hz	0…0.5 µF	±50 V	100 kΩ…100 MΩ	Main circuits without dynamic frequency changes. The universal profile is suitable for all systems primarily with constant mains frequencies and extraneous DC voltages. When using converters and dynamic frequency control, select Converter > 10 Hz or Converter < 10 Hz.
High capacitance	DC, 15…460 Hz	0…1 µF	±50 V	100 kΩ…100 MΩ	For systems with high leakage capacitances, e.g. ship applications, the impact of leakage capacitances on the measuring result can be significantly reduced by selecting this profile.
Converter < 10 Hz	DC, 0.1…460 Hz	0…0.5 µF	±50 V	100 kΩ…100 MΩ	For systems involving extremely low-frequency control in the range of up to 0.1...460 Hz and very slow and continuously changing extraneous DC voltages due to dynamic load conditions in an IT system, continuous insulation monitoring can be optimised using this profile.
Converter > 10 Hz	DC, 10…460 Hz	0…0.5 µF	±50 V	100 kΩ…100 MΩ	This profile is used for systems with dynamic frequency control by converters in the range 10 to 460 Hz in order to optimise the measurement with respect to the measuring time and quality.

11.2 Factory settings

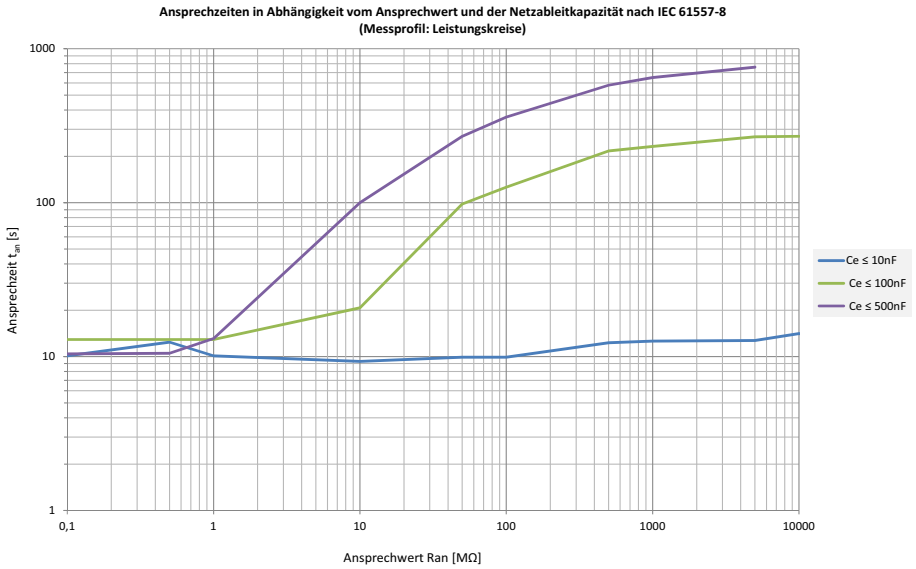
Parameter	Value
Response values/alarms	
Measurement method	Power circuits
Response value R_{an1} (ALARM 1)	4 MΩ
Response value R_{an2} (ALARM 2)	1 MΩ
Fault memory	off
Switching elements	
Relay 1 (11, 12, 14)	Operating mode: N/C operation Function: Insulation measurement
Relay 2 (21, 22, 24)	Operating mode: N/C operation Function: Insulation measurement
Relay 3 (31, 32, 34)	Operating mode: N/C operation Function: Insulation measurement
BMS	
BMS address	2
BMS termination	ON

Parameter	Value
Digital inputs	
Digital input 1	Operating mode: high-active Function: TEST
Digital input 2	Operating mode: high-active Function: "Initial measurement"
Other	
Permissible system leakage capacitance	depending on the set measurement method (refer to "11. Technical data")
Buzzer	off
Menu language	German
Password query	off
Password	0000

Technical data

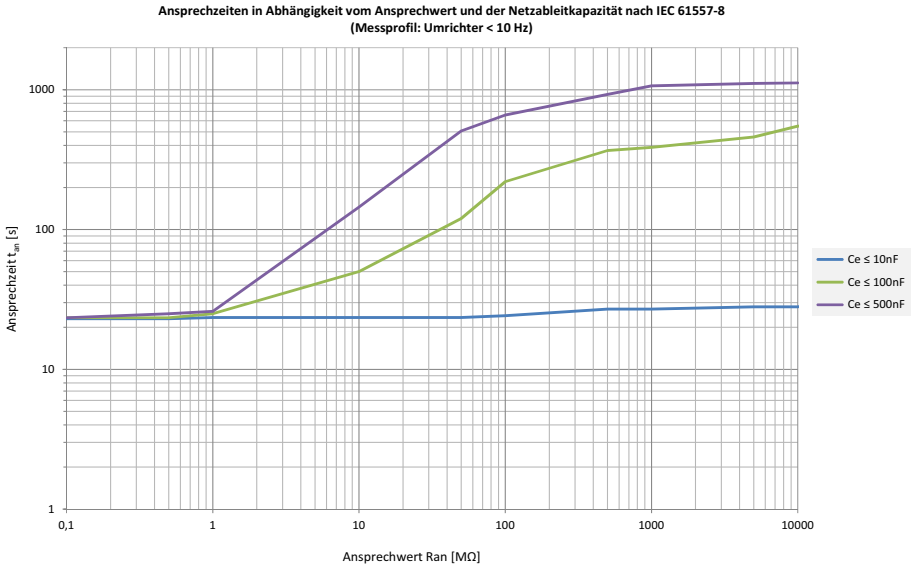
11.3 Diagrams

11.3.1 Response time power circuits profile

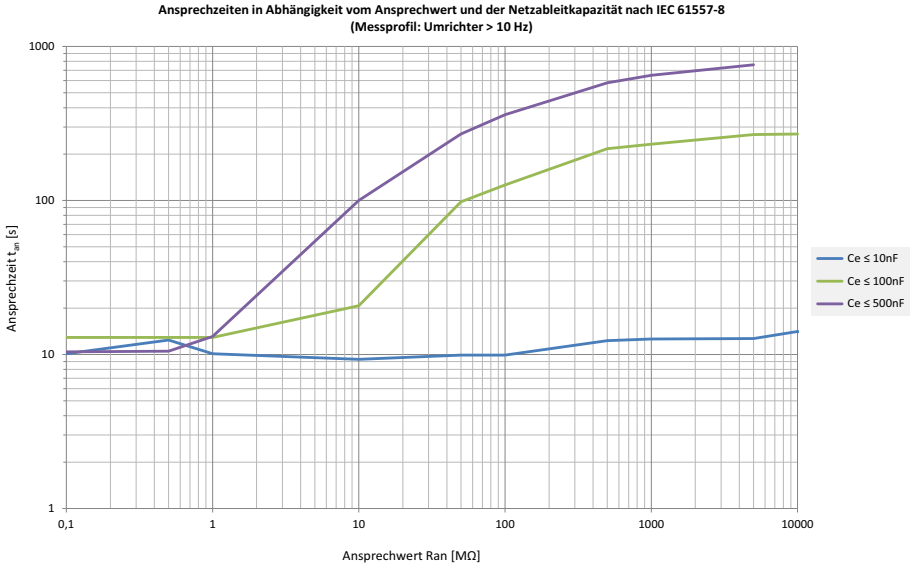


11.3.2 Response time high capacitance profile

11.3.3 Response time converter < 10 Hz profile



11.3.4 Response time converter > 10 Hz profile



Technical data

11.4 Tabular data ( )* = Factory setting

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

Definitions:

- Measuring circuit (IC1) ... (L1/+, L2/-), (E, KE)
- Supply circuit (IC2) ... A1, A2
- Output circuit 1 (IC3) ... 11, 12, 14
- Output circuit 2 (IC4) ... 21, 22, 24
- Output circuit 3 (IC4) ... 31, 32, 34

Control circuit (IC6) ... (A, B), (I1+, I1-, I2+, I2-)
Rated voltage ... 1500 V
Overvoltage category ... III
Rated impulse voltage:

- IC1 / (IC2-5) ... 10 kV
- IC2 / (IC3-5) ... 4 kV
- IC2 / IC1+IC6 ... 800 V
- IC3 / (IC4-6) ... 4 kV
- IC4 / (IC5-6) ... 4 kV
- IC5 / IC6 ... 4 kV

Rated insulation voltage:

- IC1 / (IC2-6) ... 1500 V
- IC2 / (IC3-5) ... 250 V
- IC2 / IC6 ... 50 V
- IC3 / (IC4-6) ... 250 V
- IC4 / (IC5-6) ... 250 V
- IC5 / IC6 ... 250 V

Pollution degree ... 3
Safe isolation (reinforced insulation) between:

- IC1 / (IC2-5) ... Overvoltage category III, 1500 V
- IC2 / (IC3-5) ... Overvoltage category III, 300 V
- IC2 / IC6 ... Overvoltage category III, 50 V
- IC3 / (IC4-6) ... Overvoltage category III, 300 V
- IC4 / (IC5-6) ... Overvoltage category III, 300 V
- IC5 / IC6 ... Overvoltage category III, 300 V

Voltage test (routine test) acc. to IEC 61010-1:

- IC2 / (IC3-5) ... AC 2.2 kV
- IC2 / IC6 ... DC ±0.50 kV
- IC3 / (IC4-6) ... AC 2.2 kV
- IC4 / (IC5-6) ... AC 2.2 kV
- IC5 / IC6 ... AC 2.2 kV

Voltage ranges

Nominal system voltage range U_n ... AC 0 . . . 1000 V
... DC 0 . . . 1500 V
Tolerance of U_n ... AC +10 % / DC +5%
Frequency range of U_n ... DC 0.1 . . . 460 Hz
Supply voltage U_s (see also device nameplate) ... DC 18...30 V
Frequency range of U_s ... DC
Power consumption ... ≤ 9 W

Measuring circuit for insulation monitoring

Measuring voltage U_m (peak value) ... ±50 V
Measuring current I_m (at $R_F = 0\ \Omega$) ... ≤ 1 µA
Internal resistance DC R_i ... ≥ 50 MΩ
Impedance Z_i at 50 Hz ... ≥ 50 MΩ
Permissible extraneous DC voltage U_{fg} ... ≤ DC 1600 V
Permissible system leakage capacitance C_e isoHR1685DW-925 ... profile-dependent, 0 . . . 1 µF

Response values for insulation monitoring

Response value R_{an1} (Alarm 1) and R_{an2} (Alarm 2) ... 100 kΩ . . . 100 MΩ
Condition response value ... $R_{an1} \geq R_{an2}$
Upper limit of the measuring range for setting for measurement method "High capacity" $C_{emax} = 1$ µF ... 24 MΩ
Relative uncertainty (according to IEC 61557-8) ... ±15 %
(100 kΩ . . . 10 MΩ) ... ±200 kΩ ±15 %
Hysteresis ... 25 %

Time response

Response time t_{an} at $R_F = 0.5 \times R_{an}$ (R_{an}= 10 kΩ) and C_e= 1 µF acc. to IEC 61557-8 ... profile-dependent, typ. 10 s

Display

Graphic display 127 x 127 pixel, 40 x 40 mm
Display range measured value ... 100 kΩ . . . 20 GΩ

LEDs

ON (operation LED) ... green
PGH ON ... yellow
SERVICE ... yellow
ALARM 1 ... yellow
ALARM 2 ... yellow

Digital inputs

Operating mode, adjustable ... active high, active low
Functions ... off, test, reset, deactivate device, insulation fault location
High level ... 10 . . . 30 V
Low level ... 0 . . . 0.5 V

Serial interface

Interface/protocol ..... RS-485/BMS/Modbus RTU
Connection ..... terminals A/B
Cable length ..... ≤ 1200 m
Shielded cable (shield to functional earth on one end) ..... 2-core, ≥ 0.6 mm², e.g. J-Y(St)Y 2x0.6
Shield ..... terminal S
Terminating resistor, can be connected (Term. RS-485) ..... 120 Ω (0.5 W)
Device address, BMS bus ..... (1) 2 . . . 90 (2)*
Baud rate BMS bus ..... 9.6 kB
Device address, Modbus RTU ..... 1 - 247
Baud rate Modbus RTU ..... 9.6 / 19.2 / 38.4 / 57.6 / 115 kB
Parity ..... even/uneven
Stop bits ..... 1 / 2 / auto

Connection (except system coupling)

Connection type ..... pluggable push-wire terminals
Connection, rigid/flexible ..... 0.2 . . . 2.5 mm²/0.2 . . . 2.5 mm²
Connection, flexible with ferrule, without/with plastic sleeve ..... 0.25...2.5 mm²
Conductor sizes (AWG) ..... 24 . . . 12

Connection of the system coupling

Connection type ..... pluggable push-wire terminals
Connection, rigid/flexible ..... 0.2 . . . 10 mm²/0.2 . . . 6 mm²
Connection, flexible with ferrule, without/with plastic sleeve ..... 0.25...6 mm²/0.25...4 mm²
Conductor sizes (AWG) ..... 24 . . . 8
Stripping length ..... 15 mm
Opening force ..... 90 . . . 120 N

Switching elements

Switching elements ..... 3 changeover contacts: K1 (insulation fault Alarm 1), K2 (insulation fault Alarm 2), K3 (device error)
Operating mode K1, K2 ..... N/C operation or N/O operation (N/C operation)*
Operating principle K3 ..... N/C operation, cannot be changed
Electrical endurance under rated operating conditions, number of cycles 100,000
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 .... 0.1 A
Rated insulation voltage ..... 250 V
Minimum contact rating ..... 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC ..... IEC 61326-2-4

Technical data

Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3K23(except condensation and formation of ice)
Transport (IEC 60721-3-2) 2K11
Long-time storage (IEC 60721-3-1) 1K22
Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) 3M12
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M12
Deviation from the classification of climatic conditions:
Ambient temperature during operation ..... -40 . . . +70 °C
Ambient temperature transport ..... -40 . . . +80 °C
Ambient temperature long-term storage ..... -25 . . . +80 °C
Area of application ..... ≤ 3000 m AMSL

Other

Operating mode ..... continuous operation
Position of normal use ..... vertical, system coupling on top
Tightening torque of the screws (4x M5) for enclosure mounting ..... 1.0 . . . 1.5 Nm
Degree of protection, internal components IP30
Degree of protection, terminals IP30
Enclosure material ..... polycarbonate
Flammability class V-0
Weight ..... ≤ 1600 g

11.4.1 Standards and certifications

The device isoHR1685D-925 was designed according to the following standards:

- DIN EN 61557-8 (VDE 0413-8)
- IEC 61557-8
- IEC 61326-2-4
- DIN EN 60664-1 (VDE 0110-1)

11.4.2 Ordering details

Type	Response value range	Nominal voltage	Supply voltage *	Art. No.
isoHR1685DW-925	100 kΩ…100 MΩ	AC 0…1000 V DC 0…1500 V	DC 18…30 V	B91065806W

The data marked with an * are absolute values.

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