EN Manual

BENDER
The Power in Electrical Safety©

ISOMETER®
iso685–D–P
iso685W–D–P
iso685–S–P
iso685W–S–P

AC/DC

**Insulation Monitoring Device
with integrated locating current injector
for IT AC systems with galvanically connected
rectifiers and inverters and for IT DC systems**

iso685-x-P_D00170_05_M_XXEN/05.2018

PLEASE READ THIS MANUAL AND ANY ACCOMPANYING DOCUMENTS CAREFULLY
AND KEEP THEM IN A SECURE PLACE FOR FUTURE REFERENCE.

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Table of contents

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

For commissioning and troubleshooting Bender offers you:

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*

Fax: +49 6401 807-259

0700BenderHelp (Tel. and Fax in Germany only)

E-mail: support@bender-service.de

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 in the event of faulty or incorrectly delivered Bender devices
- Extended guarantee for Bender devices, which includes an in-house repair service or 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.de

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 for Bender products
- 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)
+49 6401 807-753** (sales)

Fax: +49 6401 807-759

E-mail: fieldservice@bender-service.de

Internet: www.bender-de.com

*Available from 7.00 a.m. to 8.00 p.m. 365 days a year (CET/UTC+1)

**Mo-Thu 7.00 a.m. - 8.00 p.m., Fr 7.00 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.

Important information

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 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

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

- *A life threatening 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 instructions

WARNING

Make sure that the basic settings meet the requirements of the IT system. Persons without the required 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 that the device has been correctly connected, a functional test must be carried out before starting the system.

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

If the ISOMETER® is installed inside a control cabinet, the insulation fault message must be audible and/or visible to attract attention.

When using ISOMETER®s in IT systems, make sure that only ONE active ISOMETER® is connected in each galvanically 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 inverters, …) carry a minimum current of > 10 mA.

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 profile, 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 inverters (2…20 kHz).

Safety instructions

2.4 Intended use

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

*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.*

The ISOMETER® iso685–x–P monitors the insulation resistance of unearthed AC/DC main circuits (IT systems) with mains voltages of AC 0…690 V or DC 0…1000 V. The operating range of the nominal voltage U_n can be extended via coupling devices.

DC components existing in AC/DC systems do not influence the operating characteristics. Due to the separate supply voltage, de-energised systems can also be monitored. The maximum permissible system leakage capacitance is 0…1000 µF, depending on the profile.

Intended use also implies:

- 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 range of application indicated in the technical data.

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

3.1 Features

- ISOMETER® for IT AC systems with galvanically connected rectifiers or inverters and for IT DC systems (IT = unearthed systems)
- Automatic adaptation to the existing system leakage capacitance
- Combination of AMP^Plus and other profile-specific measurement methods
- Two separately adjustable response value ranges of 1 kΩ…10 MΩ for Alarm 1 and Alarm 2
- Hgh-resolution graphical LC display
- Connection monitoring (monitoring of the measuring lines)
- Automatic device self test
- Graphical representation of the insulation resistance over time (isoGraph)
- History memory with real-time clock (buffer for three days) for storing 1023 alarm messages with date and time
- Current or voltage output 0(4)…20 mA, 0…400 µA, 0…10 V, 2…10 V (galvanically separated), which is analogous to the measured insulation value of the system
- Freely programmable digital inputs and outputs
- Remote setting via the Internet or Intranet (Webserver/Option: COMTRAXX® gateway)
- Worldwide remote diagnosis via the Internet (made available by Bender Service only)
- RS-485/BS (Bender sensor bus) for data exchange with other Bender devices
- ISOnet: Internal separation of the ISOMETER® from the IT system to be monitored (e.g. if several IT systems are interconnected)
- BCOM, Modbus TCP and web server
- Locating current injection for selective insulation fault location
- Indication of the insulation faults selectively located by the EDS system
- Parameter setting of EDS systems
- Customer-specific texts for each measuring channel

3.1.1 Features EDS44x

- Insulation fault location in AC, 3AC and DC IT systems
- Up to 12 measuring current transformers of the W…, WR…, WS… measuring current transformer series can be connected
- Response sensitivity insulation fault location:
  EDS440 2…10 mA
  EDS441 0.2…1 mA
- Response sensitivity residual current measurement:
  EDS440 100 mA…10 A
  EDS441 100 mA…1 A

Communication of the components via BS bus (RS-485) or BB bus

3.2 Product description

3.2.1 General product description

The ISOMETER® is an insulation monitoring device for IT systems in accordance with IEC 61557-8.

It is universally applicable in AC, 3(N)AC, AC/DC and DC systems. AC systems may include extensive DC-supplied loads (such as rectifiers, inverters, variable-speed drives).

3.2.2 Special ISOMETER® characteristics

The ISOMETER® iso685–D–P belongs to the iso685 device family and features an integrated display. This manual applies in full to this ISOMETER®.

The ISOMETER® iso685–S–P is the sensor variant from the iso685 device family. The only difference between this variant and the ISOMETER® isoHR685-D-B is that it does not have a display. The ISOMETER® iso685–S–P must be used in combination with a front panel through which it is operated. The operation of the front panel is equal to the operation of the ISOMETER® with an integrated display, which is described in this manual.

Only the sensor variant (i.e. ISOMETER® iso685–S–P) can be connected to the front panel. Connection to the display variant (i.e ISOMETER® iso685–D–P) is not possible.

Hereafter, the ISOMETER®s with integrated display are described. This description is similar to the combination of ISOMETER® sensor variants and the front panel FP200. The devices to which this manual applies will be referred to as ISOMETER®s hereafter.

Function

3.3 Function description

The insulation monitoring device continuously monitors the entire insulation resistance of an IT system during operation and triggers an alarm when the value falls below a preset response value. To obtain a measurement the device has to be connected between the IT system (unearthed system) and the protective earth conductor (PE). A measuring current in the µA range is superimposed onto the system which is recorded and evaluated by a microprocessor-controlled measuring circuit. The measuring time is dependent on the selected measurement profiles, the system leakage capacitance, the insulation resistance and possible system-related disturbances.
The response values and other parameters are set using a commissioning wizard as well as via different setup menus using the device buttons and a high-resolution graphical LC display. The selected settings are stored in a permanent fail-safe memory. Different languages can be selected for the setup menus as well as the messages indicated on the display. The device utilises a clock for storing fault messages and events in a history memory with time and date stamp. The settings can be password protected to prevent unauthorised changes.

To ensure proper functioning of connection monitoring, the device requires the setting of the system type 3AC, AC or DC and the required use of the appropriate terminals L1/+, L2, L3/-.

The insulation monitoring device iso685–x–P is able to measure the insulation resistance reliably and precisely in all common IT systems (unearthed systems). Due to various applications, system types, operating conditions, application of variable-speed drives, high system leakage capacitances etc., the measurement technique must be able to meet varying requirements in order to ensure an optimised response time and relative uncertainty. Therefore different measuring profiles can be selected with which the device can optimally adjusted.

If the preset response value falls below the value of Alarm 1 and/or Alarm 2, the associated alarm relays switch, the LEDs ALARM 1 or ALARM 2 light and the measured value is shown on the LC display (in case of insulation faults in DC systems, a trend graph for the faulty conductor L+/L- is displayed). If the fault memory is activated, the fault message will be stored. Pressing the RESET button resets the insulation fault message, provided that the current insulation resistance displayed at the time of resetting is at least 25 % above the actual response value. As additional Information, the quality of the measuring signal and the time required to update the measured value are shown on the display. A poor signal quality (1-2 bars) may be an indication that the wrong measurement profile has been selected.

The ISOMETER® has an internal system isolating switch, which makes it possible to operate several ISOMETER®s in coupled IT systems. For this purpose, the ISOMETER®s are connected via an Ethernet bus. The integrated ISOnet function ensures that only one ISOMETER® is actively measuring at a time, while the other devices are completely isolated from the system and waiting in standby mode for measuring permission.

3.4 Insulation fault location

An additional function of the ISOMETER® in combination with the EDS is the selective insulation fault location. Therefore, the ISOMETER® generates a periodic locating current after the values has fallen below the set response value R_{an2} (LED ALARM 2). Thereby, the system conductors are alternately connected to earth via a defined resistance. The resulting locating current depends on the size of the existing insulation fault and the system voltage. It is limited by the ISOMETER® depending on the settings. The insulation fault is selectively located by means of the EDS and the measuring current transformer connected to it. The locating current flows from the locating current injector via the live lines to the insulation fault position taking the shortest way. From there, it flows through the insulation fault and the conductor PE back to the ISOMETER®. This locating current pulse is detected by the measuring current transformer on the insulation fault path and signalled by the connected EDS.

For the duration of the insulation fault location, the function of the insulation monitoring device is deactivated. If during the insulation fault location the locating current falls below the value measurable by the EDS, the insulation fault location is ended by the ISOMETER®.

CAUTION

Risk of malfunctions due to excessive locating current on sensitive system parts!
The locating current flowing between the IT system and earth can cause controller faults in sensitive parts of the system, such as the PLC or relay. Ensure that the level of the locating current is compatible with the system to be monitored.

3.5 Interfaces

- Communication protocol Modbus TCP
- BCOM for Bender device communication via Ethernet
- BS bus for communication of Bender devices (RS-485)
- BB bus for communication of Bender devices (Bender-internal device bus)
- Integrated web server for reading out measured values and for parameter setting

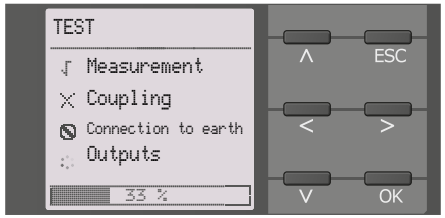
3.6 Self test

After switching on the supply voltage, the ISOMETER, by means of the self-test functions, automatically and continuously checks all internal measuring functions, the components of the process control, such as the data and parameter memory, as well as the connections to the IT system and earth.

The self test can also be activated manually by means of the test button to check the functions of the relays (depending on the configuration) or it can be selected via the "Control" menu (refer to "Control" on page 55).

The progress of the manual self test is shown on the LC display by a bar graph. Depending on the conditions in the IT system being monitored, the self test is completed after 15...20 seconds. The device then returns to the standard mode (i.e. measurement mode) and the actual measured value will be displayed after the measuring time has expired. The display shows the message `Initial measurement` until the first valid value is measured (refer to "Initial measurement" on page 39).

If a fault is detected during the self test, the respective LEDs of the device light (refer to "Alarm messages" on page 69). In addition, the respective message will be indicated on the display and a previously programmed output will provide the respective signal.



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

Function

3.7 Compatibility with EDS devices

Full compatibility, communication with ISOMETER® via BS bus

Device	Notes	
EDS440-L	EDS440-L EDS440W-L	B91080202 B91080202W
EDS441-L	EDS441-L EDS441W-L	B91080205 B91080205W
EDS441-LAB	EDS441-LAB EDS441W-LAB	B91080207 B91080207W
EDS460/490L	Not recommended for new systems	
EDS460/490D	Not recommended for new systems	
EDS461/491L	Not recommended for new systems	
EDS461/491D	Not recommended for new systems	

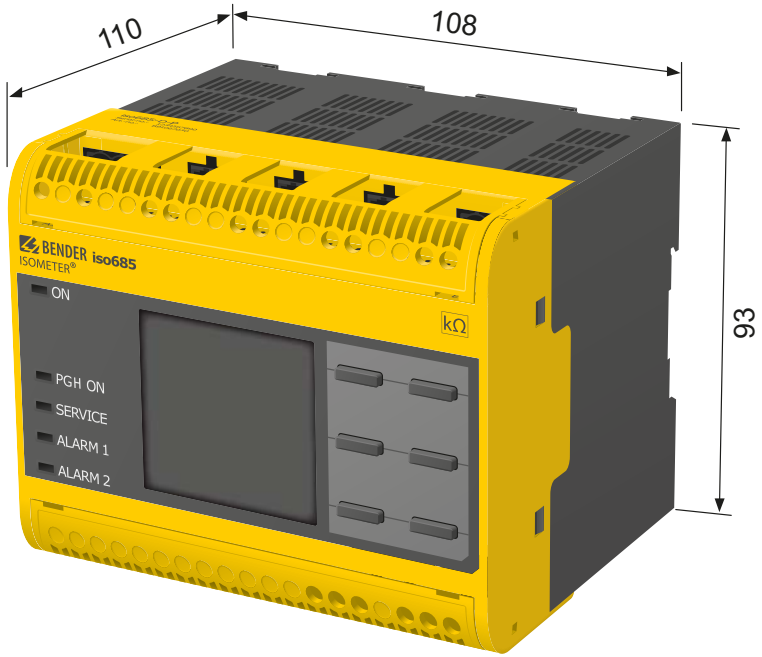
Full compatibility, communication with ISOMETER® via BB bus

Device	Notes	
EDS440-S	EDS440-S EDS440W-S	B91080201 B91080201W
EDS441-S	EDS441-S EDS441W-S	B91080204 B91080204W

Full compatibility, no communication with ISOMETER®

Device	Notes	
EDS195P	EDS195P	B91082040

4.1 Dimensions

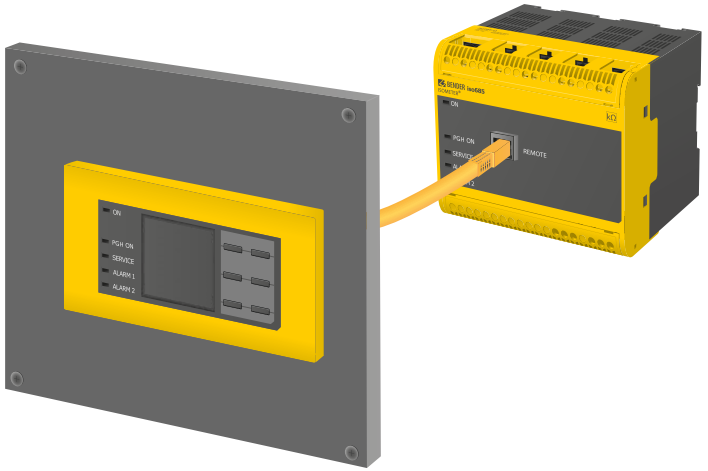


Dimensions in mm.

4.2 Device variants

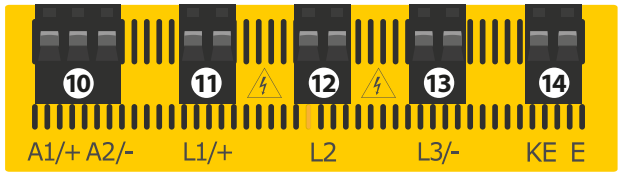
iso685–D–P	The device version iso685–D–P features a high-resolution graphical LC display and control elements for direct operation of the device functions. It **cannot** be combined with an FP200.

iso685–S–P	The device variant ISOMETER® iso685–S–P features **neither a display nor operating controls.** It can only be used in combination with the FP200 and it is operated via this front panel.



4.3 Connections and panel

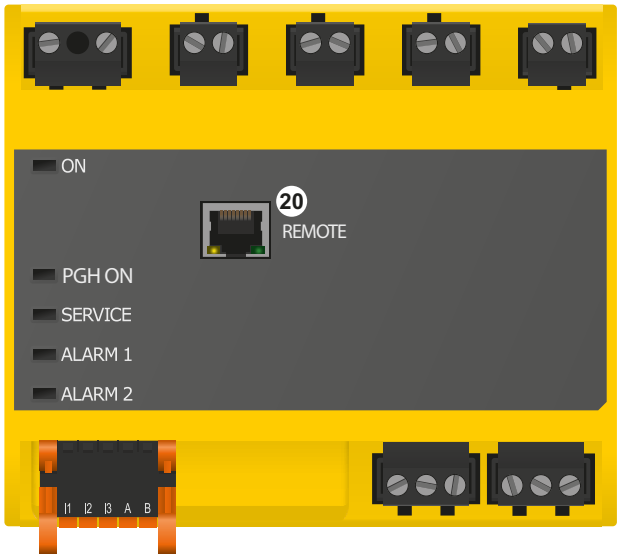
Top



10	A1/+, A2/-	Connection to the power supply U_s
11	L1/+	Connection to the IT system to be monitored
12	L2	Connection to the IT system to be monitored
13	L3/-	Connection to the IT system to be monitored
14	KE, E	Connection to PE

iso685–S–P

Front

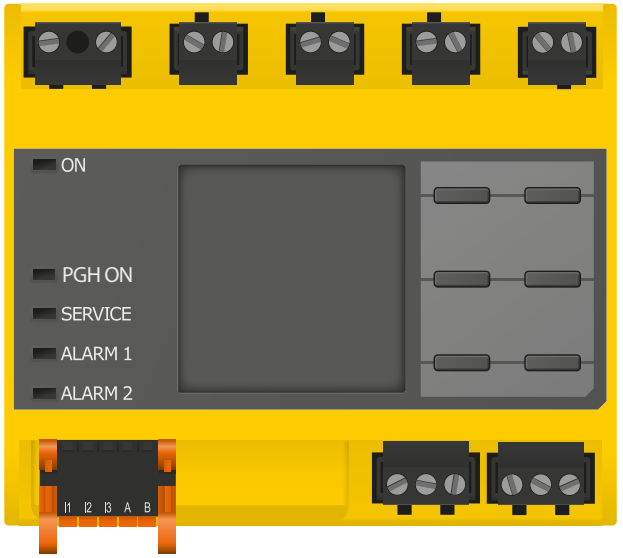


Connection Top

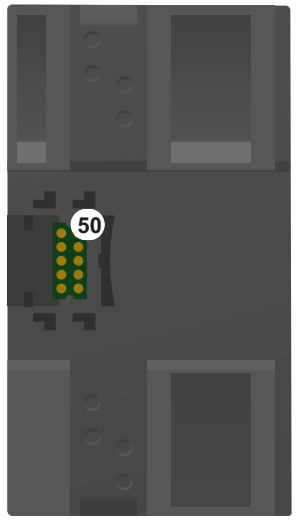
Panel

Connection bottom

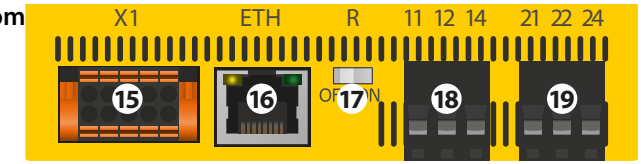
iso685–D–P



Rear



Bottom

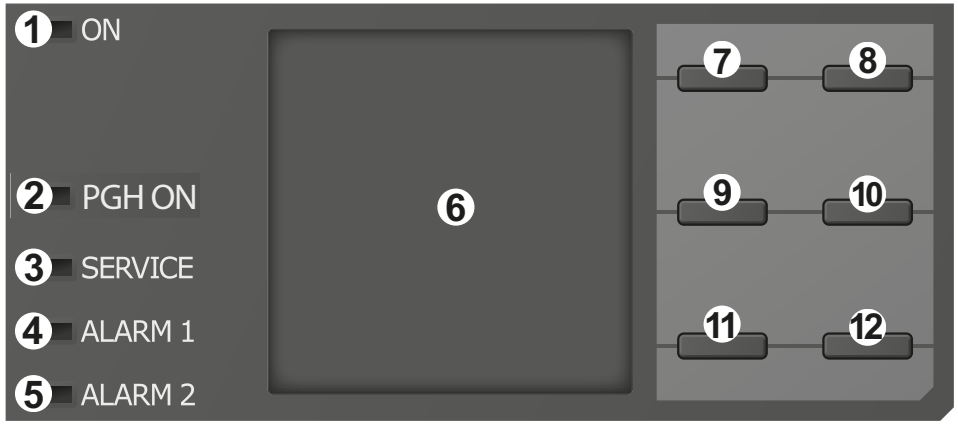


20	X4	REMOTE interface to connect to the FP200(W) *
50	X3	Optional expansion module (BB-Bus) for Bender devices (e.g. BB Bus)
15	X1	Multifunctional I/O interface (refer to Page 24)
16	ETH (X2)	Ethernet interface
17	R	Switchable terminating resistor for termination of the RS-485 interface
18	11 12 14	Connector for alarm relay 1
19	21 22 24	Connector for alarm relay 2

** The connection between the iso685 device and an FP200 (W) may only be established when the device is switched off and de-energized.*

Device overview

4.4 Display elements and device buttons



4.4.1 Display elements

1	ON	The LED "ON" lights when the device is turned on.
2	PGH ON	The LED "PGH ON" flashes during insulation fault location. It indicates that the locating current for the insulation fault location is generated.
3	SERVICE	The LED "SERVICE" lights when there is either a device fault or a connection fault, or when the device is in maintenance mode.
4	ALARM 1	The LED "ALARM 1" lights when the insulation resistance of the IT system falls below the set response value R_{an1}.
5	ALARM 2	The LED "ALARM 2" 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. Further information is available in the chapter"Display" from page 36.

4.4.2 Device buttons

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

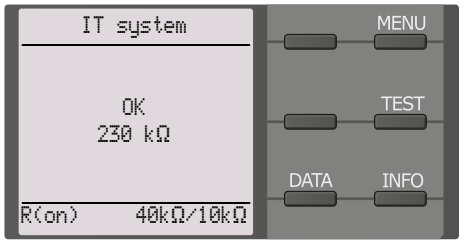
7	EDS	Manually starts the insulation fault location, which runs continuously. Stops the insulation fault location immediately when it is pressed again
	∧	Navigates up in a list or increases a value.
8	MENU	Opens the device menu.
	ESC	Cancels the current process or navigates one step back in the device 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.

Device overview

4.5 Operation and Navigation

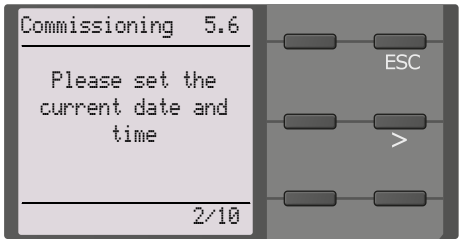
4.5.1 Menu selection

The menu is activated with the "Menu" button



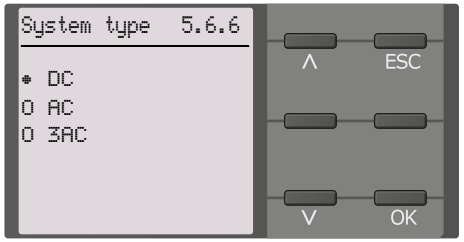
To select a value in a given list (Menu), navigate with the > button. Press "ESC" to exit to the respective menu level.

Information about the device menu can be found in the chapter entitled "" on page 42.



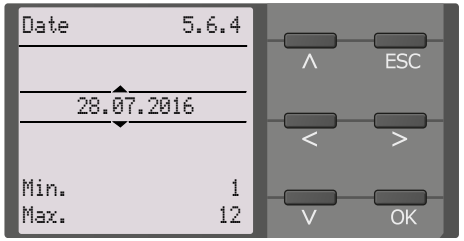
4.5.2 Selecting from a list

To select a value in a given list (Menu), navigate with the V and Λ buttons. The current value is indicated by a black menu point.Confirm the selection with the "OK" button. To exit the list, press the "ESC" button.



4.5.3 Parameter selection and value setting

The parameters are selected using the < and > buttons.The current parameter is indicated by the ▲▼ symbols. Values can be changed with the V and Λ buttons. Confirm the text input with the "OK" button. To exit text input, press "ESC".

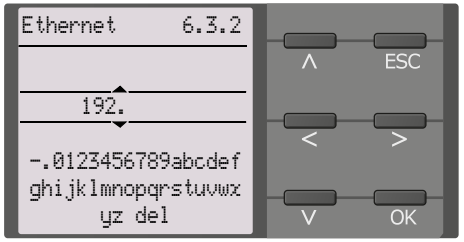


4.5.4 Character input

Select the required character with the V button (forwards) and the Λ button (backwards). To enter the next character, use the > button to select the next position.

To delete a character that has been entered, use the< and > buttons to navigate to the character to be deleted and then select "del" using the V and Λ buttons.

Confirm the entered text with "OK". Press "ESC" to exit character input.

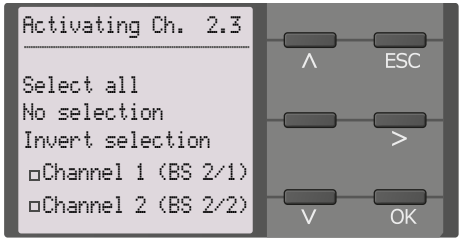


4.5.5 Multiple selection in the device menu

Select 1..n selection points using the V and Λ buttons. Each selection in the List must be confirmed with „OK“.

If you have made your selection, there are two options depending on the menu-item:

- Navigating to the settings for the selection usingr >.
- Initiating the respective action (e.g. activate selected channels) using >.



5.1 General instructions

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

*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.*

DANGER

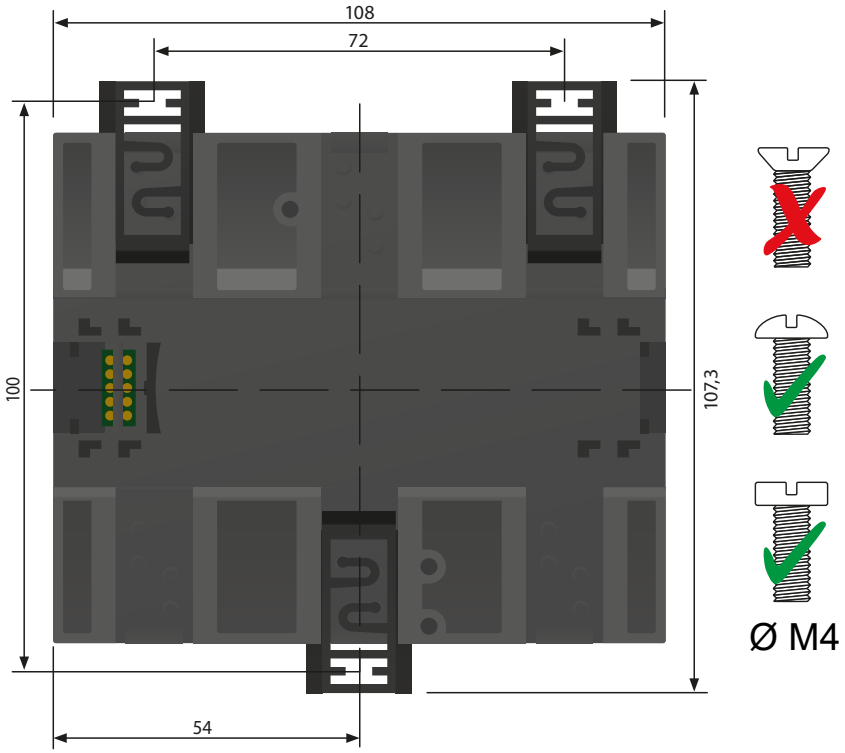
Danger of electrocution due to electric shock!
Touching live parts of the system carries the risk of:

- *A life threatening 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.*

5.2 Screw mounting

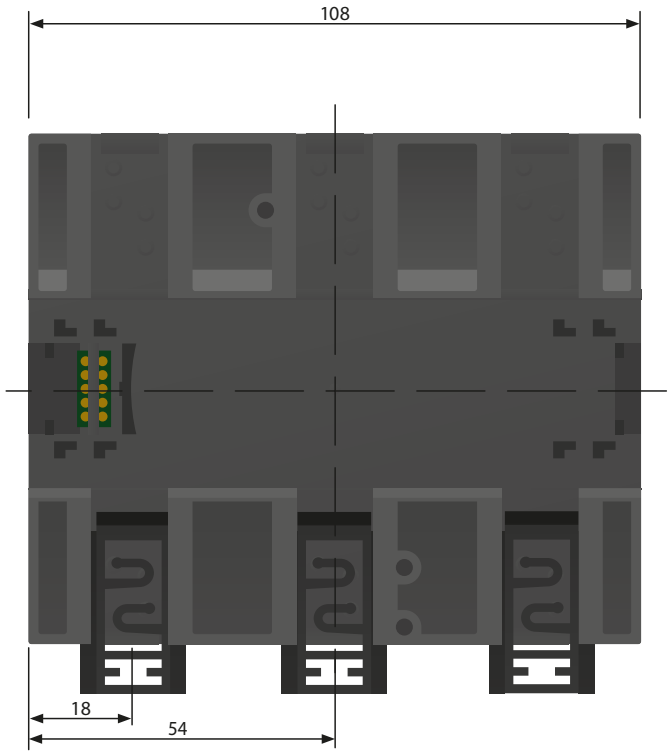
1. Fix the three mounting clips delivered with the device (two of them packed separately) manually or using a tool, as illustrated below.
2. Drill the mounting holes for the M4 thread according to the drilling template.
3. Fix the ISOMETER® using three M4 screws.



Dimensions in mm.

5.3 DIN rail mounting

1. Fix the three mounting clips delivered with the device (two of them packed separately) manually or using a tool, as illustrated below.
2. Mount the ISOMETER® onto the DIN rail.
3. Fix the ISOMETER® onto the DIN rail by pressing the mounting clips until they snap into place



Dimensions in mm.

Mounting clips:
The installation of a third mounting clip is only required for "W variants".

6. Connection

6.1 Connection requirements

Consider the minimum distance to adjacent devices: lateral 0 mm, top 20 mm, bottom 20 mm.

*According to IEC 60364 (VDE 0100), only **qualified personnel** are permitted to carry out the work necessary to install, commission and run a device or system.*

DANGER

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

- *A life threatening 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.*

DANGER

Danger of electric shock!
High voltage can be applied to the terminals L1/+ to L3/- which can be lethal if directly contacted.

- *Make sure that the terminal covers are properly mounted and clicked in before you use the device.*
- *If the device is connected via terminals L1/+, L2, L3/- to an IT system that is live for operational reasons, terminals KE and E must not be disconnected from the protective earth conductor (PE).*
- *Connect the terminals KE and E individually to the protective earth conductor PE.*

CAUTION

Provide line protection!
According to IEC 60364-4-43, a line protection shall be provided for the supply voltage.

CAUTION

Risk of injury from sharp-edged terminals!
Risk of lacerations. Touch the enclosure and the terminals with due care.

CAUTION

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.

CAUTION

Risk of property damage due to unprofessional installation!
*Make sure that only **one** insulation monitoring device is connected in each conductively connected system. If several devices are connected, the device does not function and does not signal insulation faults. As a result, the system can be damaged.*

CAUTION

Risk of property damage due to unprofessional installation!
Load currents can result in damage to property and personal injury. For this reason, do not run any load current through the terminals. The connecting lines L1/+, L2, L3/- to the system to be monitored must be carried out as spur lines.

CAUTION

Malfunction due to incorrect connection
If the device is not connected as is described in the manual, deviations in the technical data and functin restrictions may result.

Connection

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

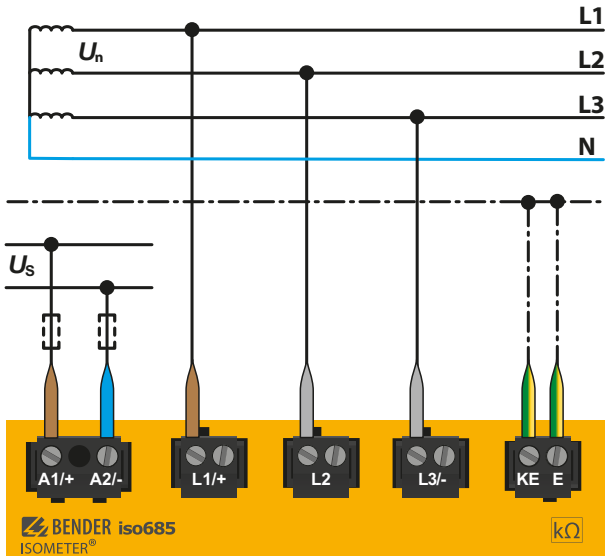
Prevent measurement errors!
When an AC system being monitored contains galvanically coupled DC circuits, take into consideration that: An insulation fault can only be detected correctly when the rectifier valves carry a minimum current of > 10 mA.

For UL applications:
Only use 60/75°C copper lines!
UL and CSA applications require the supply voltage to be protected via 5 A fuses.

6.2 Connection to a 3(N)AC system

WARNING

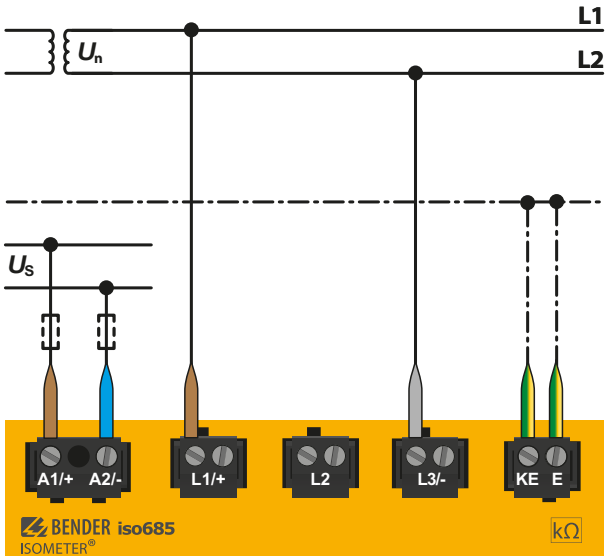
Risk of injury, fire and damage to property due to a short circuit!
According to DIN VDE 0100-430, devices used to protect against a short circuit when terminals L1/+, L2 und L3/- are coupled to the IT system to be monitored can be omitted if the wiring is carried out in such a manner as to reduce the risk of a short circuit to a minimum. Ensure short-circuit proof and earth-fault proof wiring.



6.3 Connection to an AC system

WARNING

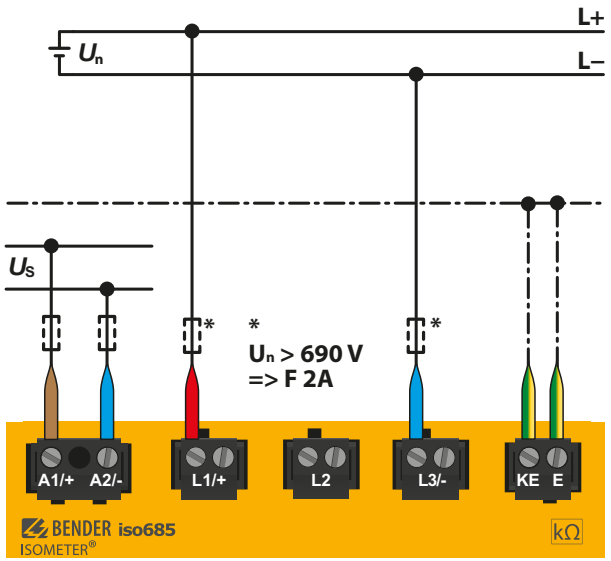
Risk of injury, fire and damage to property due to a short circuit!
According to DIN VDE 0100-430, devices used to protect against a short circuit when terminals L1/+, L2 und L3/- are coupled to the IT system to be monitored can be omitted if the wiring is carried out in such a manner as to reduce the risk of a short circuit to a minimum. Ensure short-circuit proof and earth-fault proof wiring.



6.4 Connection to a DC system

WARNING

Risk of injury, fire and damage to property due to a short circuit!
According to DIN VDE 0100-430, devices used to protect against a short circuit when terminals L1/+, L2 und L3/- are coupled to the IT system to be monitored can be omitted if the wiring is carried out in such a manner as to reduce the risk of a short circuit to a minimum. Ensure short-circuit proof and earth-fault proof wiring.



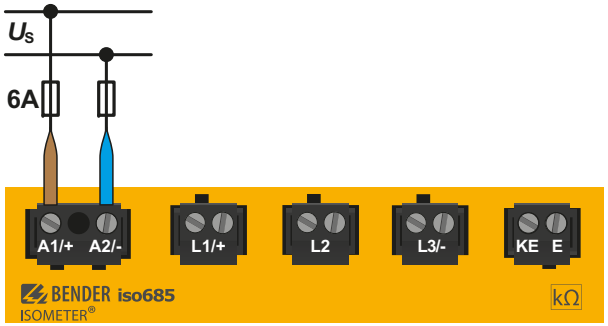
*For systems with a nominal voltage > 690 V and with overvoltage category III, a fuse for the connection to the system to be monitored must be provided. * 2A fuses are recommended.*

6.5 Connection to the supply voltage

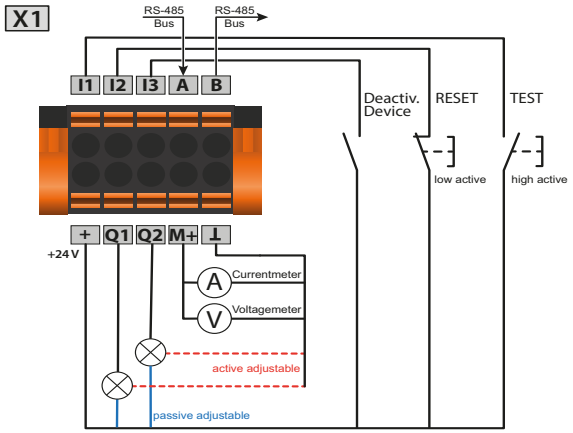
CAUTION

Danger of damage to property due to faulty connections!
The device can be damaged if the unit is simultaneously connected to the supply voltage via the X1 interface and A1/+, A2/- terminals.
Do not connect the device simultaneously via X1, and A1/+, A2/- to different supply voltages.

External power supply used to power the ISOMETER® via terminal X1 must fulfil the noise emission and immunity standards of the required application. For wiring longer than 1 m, shielded cables must be used.

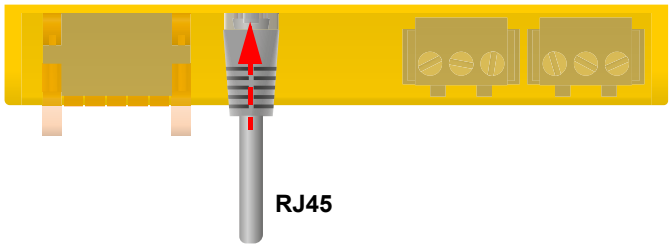


6.6 Connection to the X1 inteface



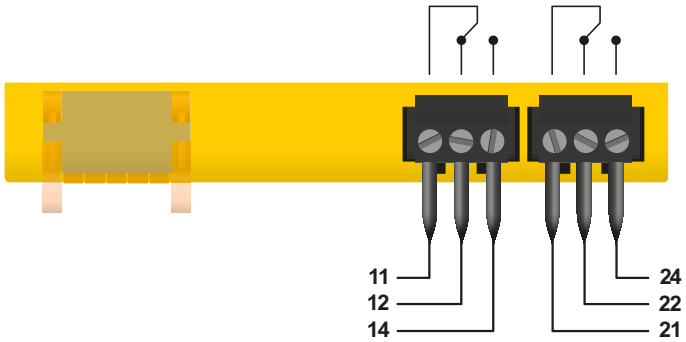
I1…I3 (X1)	Configurable digital inputs (e.g. Test, Reset, …)
A, B (X1)	Serial interface RS-485, termination by means of a DIP switch **R**
+ (X1)	Supply voltage of the inputs and outputs I, Q and M. Electrical overload protection. Automatic shutdown in the event of a short circuit and transient (resettable). If the supply is via an external 24 V source, then A1/+, A2/- must not be connected.
Q1, Q2 (X1)	Configurable digital output
M+ (X1)	Configurable analogue output (e.g. measuring instrument)
⊥ (X1)	Reference potential ground

6.7 Connection to the Ethernet interface ETH



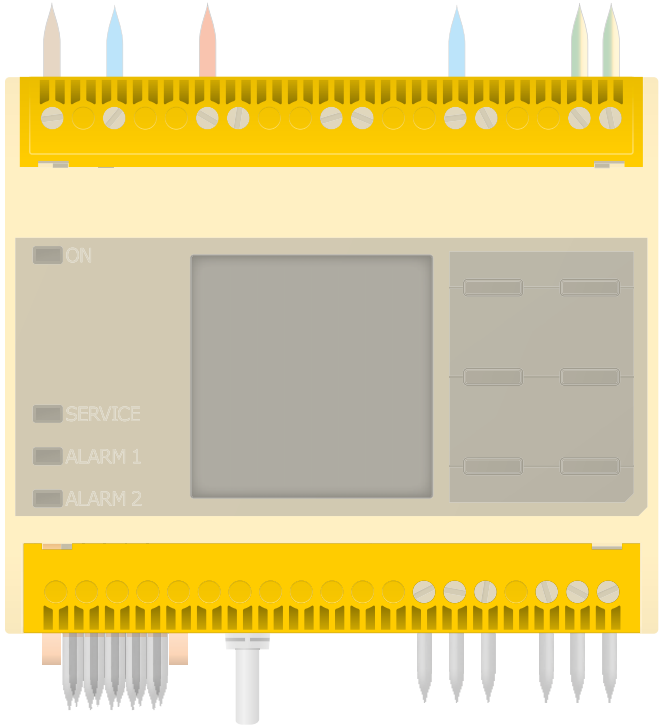
Connect to other ISOMETER®s with a RJ45 plug or network several ISOMETER® in a STAR topology by means of a switch. (refer to 12. “Special functions for coupled IT systems” from page 63)

6.8 Connection to relay interfaces 1 and 2



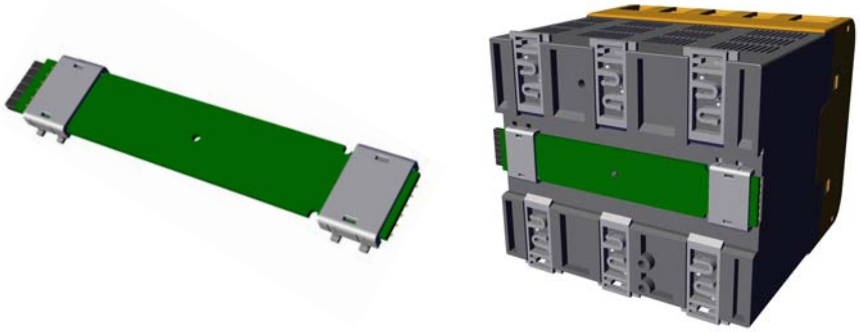
Relay **1**	**1**1 Common contact	**1**2 Normally open (N/O)	**1**4 Normally closed (N/C)
Relay **2**	**2**1 Common contact	**2**2 Normally open (N/O)	**2**4 Normally closed (N/C)

6.9 Position the terminal covers and click it into place



6.10 Connection to the BB bus

The BB bus is an interface that enables Bender devices to communicate with each other. It can be used with an ISOMETER® and one or more EDS44x–S. For this purpose, the BB bus is installed at the rear side of both devices and afterwards, both devices are mounted next to each other on the DIN rail. For further information, refer to the quickstart guide enclosed to the BB bus PCBs.



If the ISOMETER® is combined with an EDS44x–S the BB bus 6TE connector listed in "Accessories" on page 75" must be ordered additionally. It is required to connect the ISOMETER® with the EDS44x–S.

Sensor variant devices that are additionally connected to the ISOMETER® do not require additional supply voltage when the devices are connected to the BB bus via X3.

A maximum of two EDS44x–S can be connected to an ISOMETER®.

When the BB bus is installed, the EDS44x must always be mounted on the right side of the ISOMETER®. In addition, for protection against short circuits, a BB bus end bracket must be mounted to each first and last device on the DIN rail featuring a BB bus.

Connection

Observe the maximum output current!
For devices connected to the BB-Bus: The maximum output current is reduced according to the formula for the calculation of I_{LmaxX1}. Refer to the formula in the Technical Data under "Digital outputs (Q1, Q2)" on page 73.

6.11 Connecting the EDS to the ISOMETER®

CAUTION

Risk of malfunctions due to excessive locating current on sensitive system parts!
The locating current flowing between the IT system and earth can cause controller faults in sensitive parts of the system, such as the PLC or relay. Ensure that the level of the locating current is compatible with the system to be monitored.

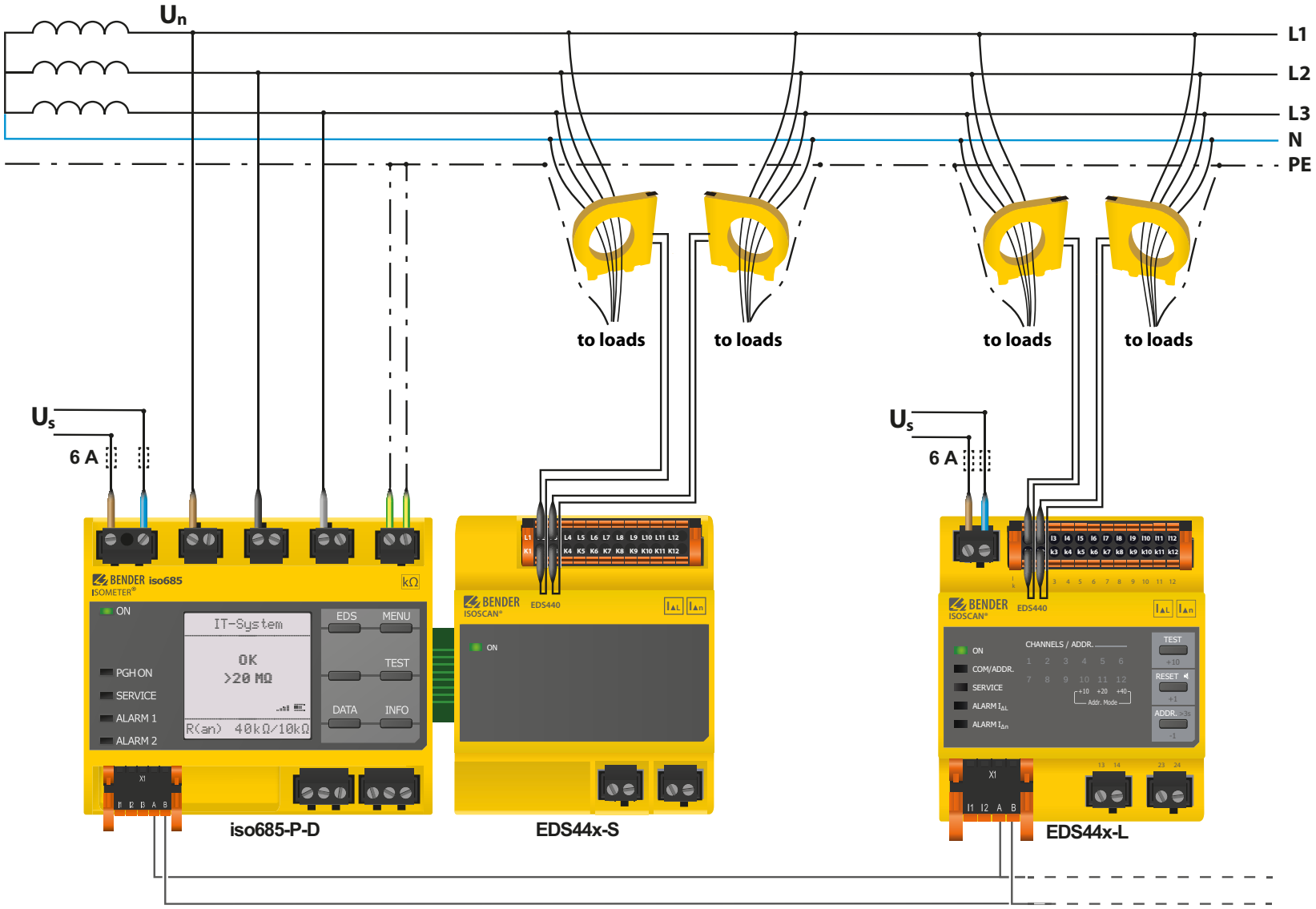
CAUTION

Risk of incorrect measurement
The supplied locating current may influence other connected insulation fault location systems. If they measure the injected locating current, the measurement might be incorrect.

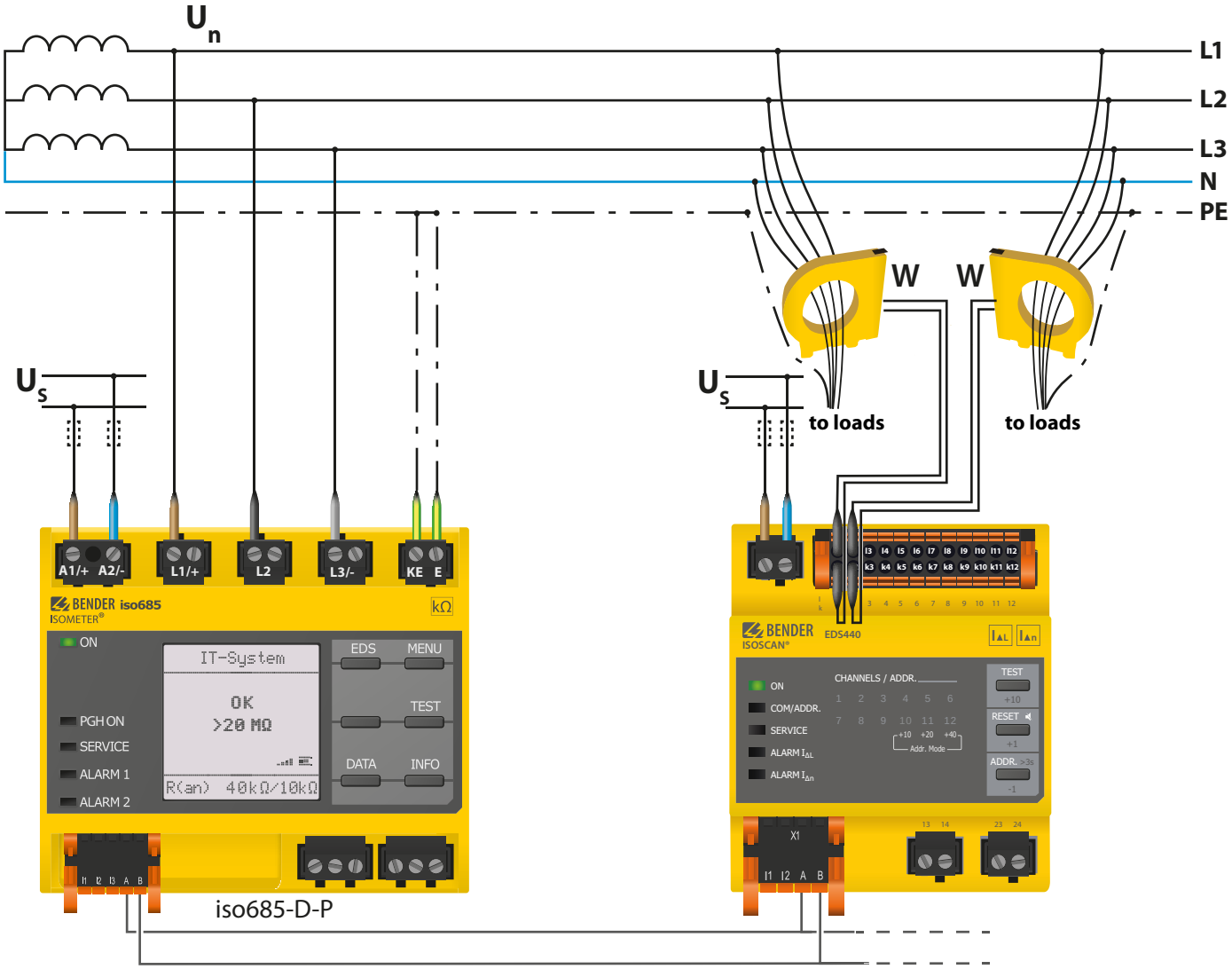
Insulation monitoring is deactivated while the insulation fault location is active.

The EDS44x–S must be connected to the ISOMETER® via the BB bus.
The EDS44x–L must be connected to the ISOMETER® via the BS bus.

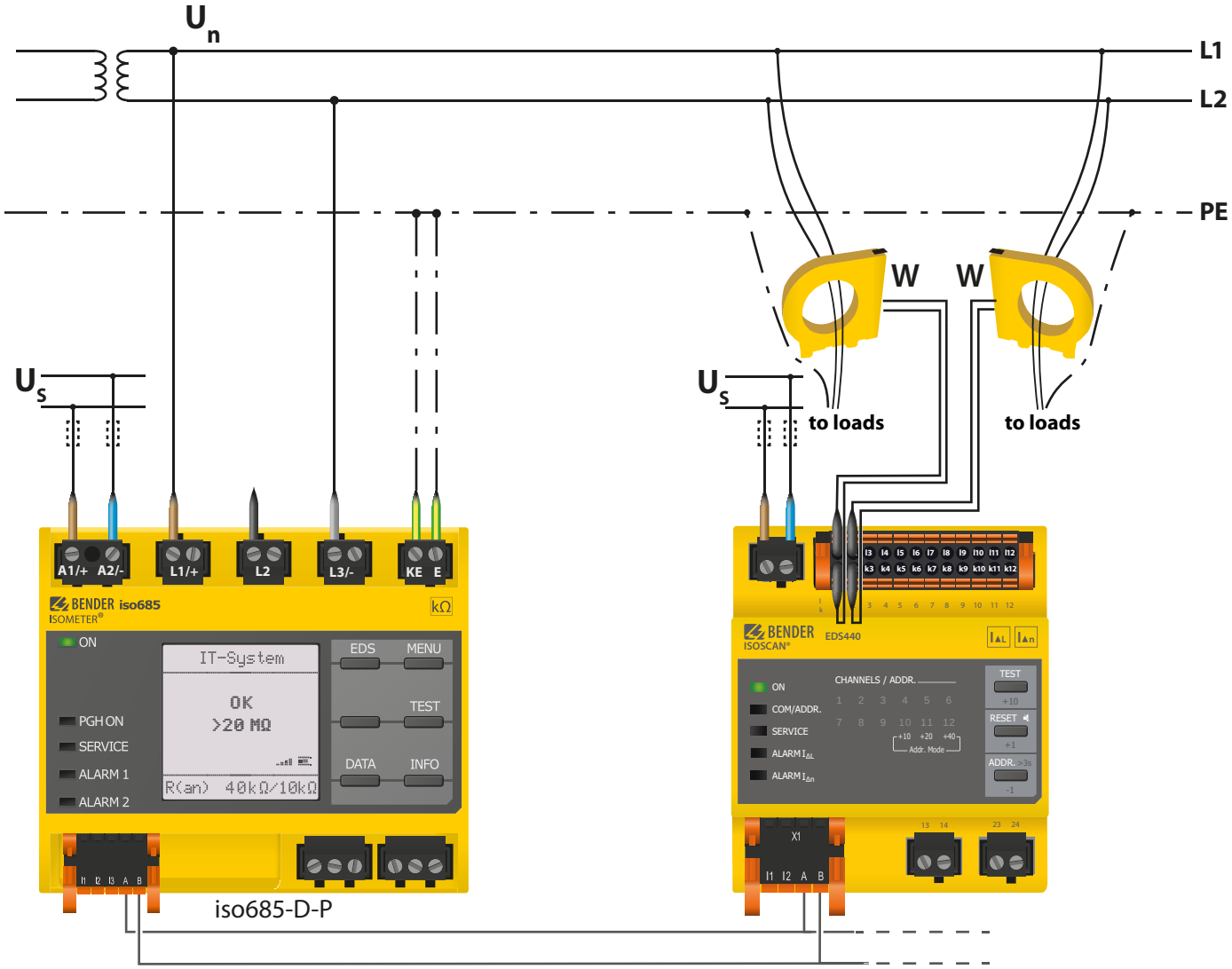
6.11.1 Connection example ISOMETER® to EDS



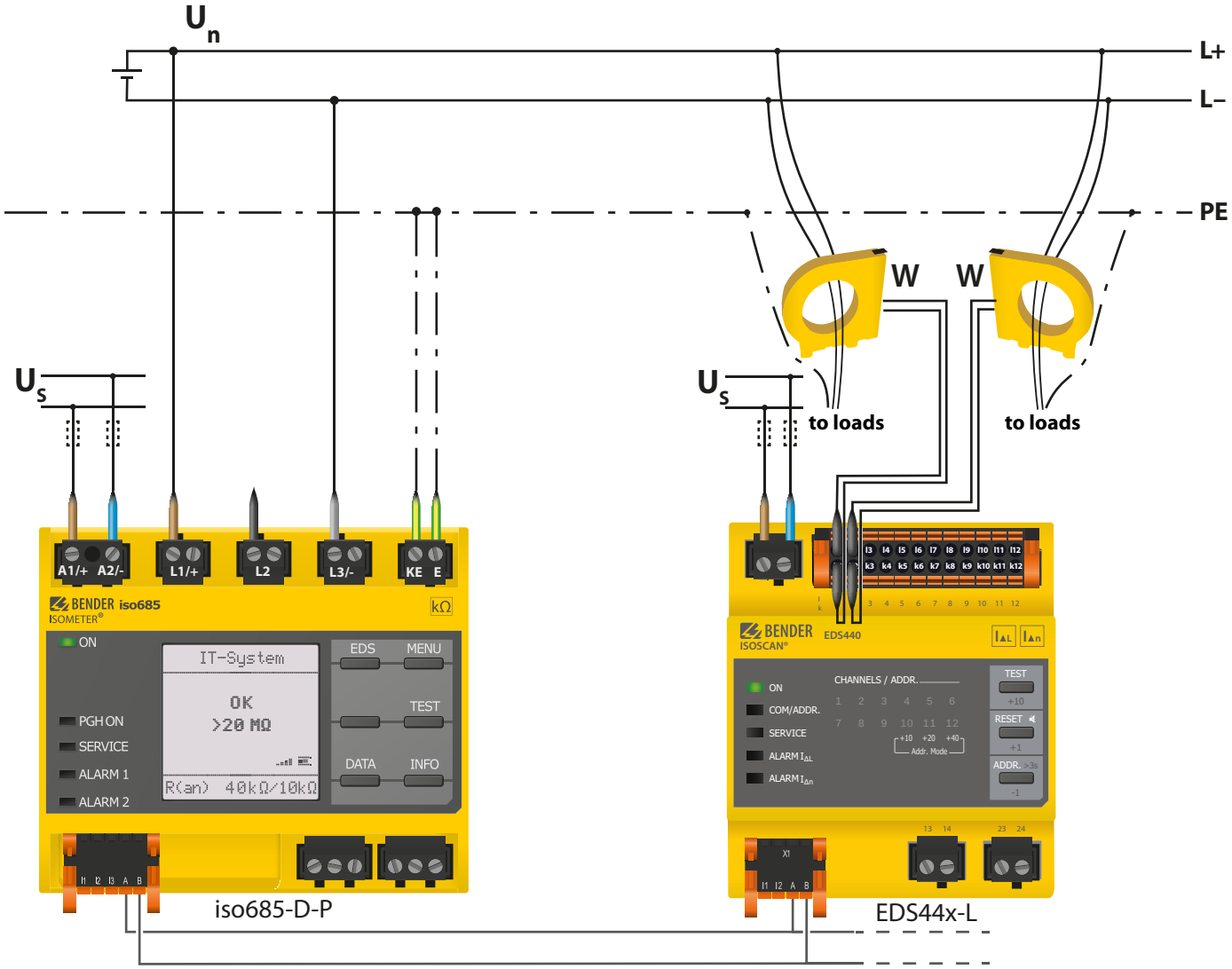
6.11.2 Connection to a 3(N)AC system



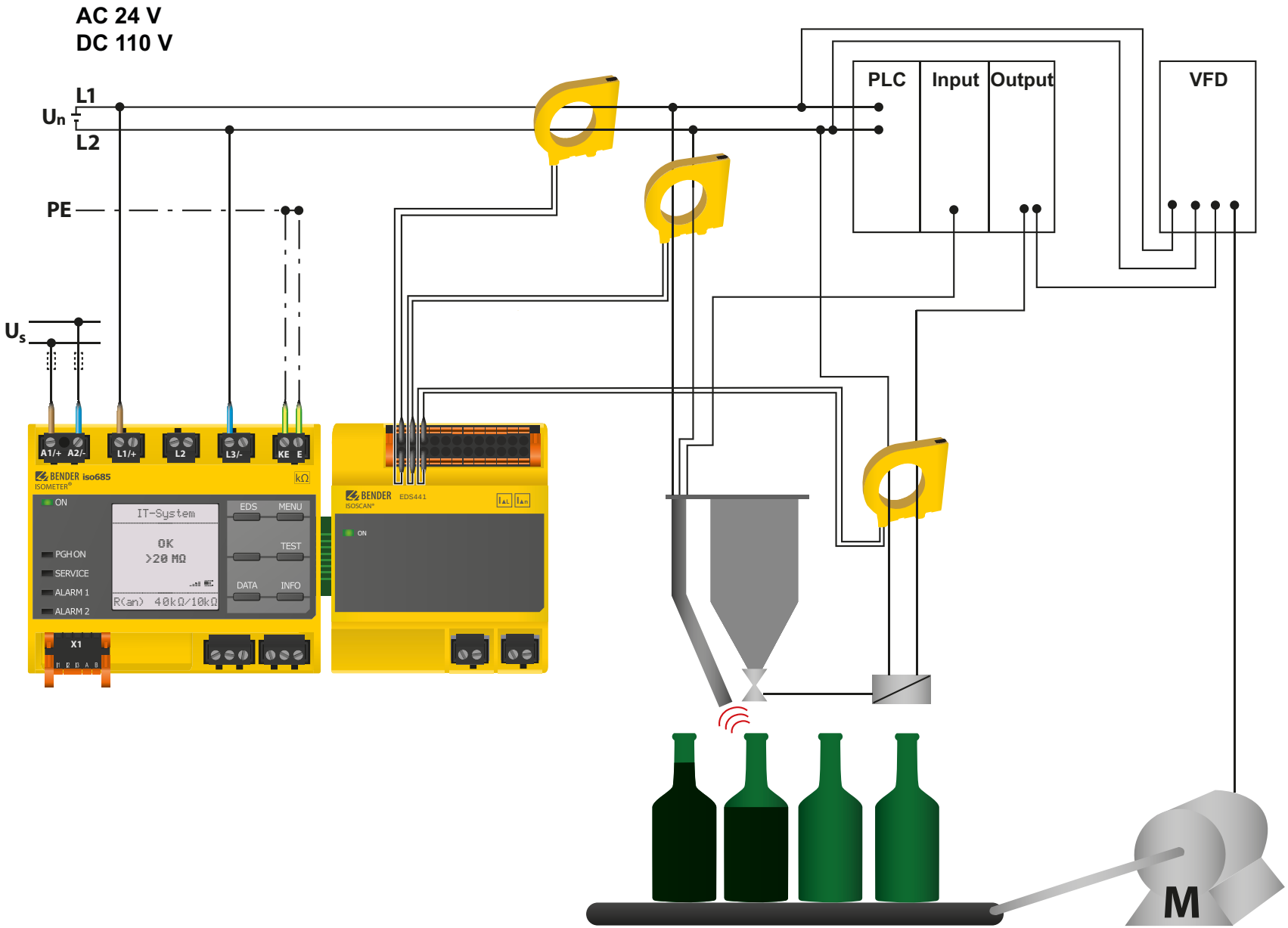
6.11.3 Connection to an AC system



6.11.4 Connection to a DC system



6.11.5 System structure



7.1 General initial commissioning process

1. Check that the ISOMETER® is properly connected to the system to be monitored.
2. Connect the supply voltage to the ISOMETER®. Adjust the device using the commissioning wizard. Afterwards, the ISOMETER® performs a self test in four steps. The alarm relays are not checked during this test. After completion of the test, the measured insulation resistance is shown on the display. If the value exceeds the response values indicated in the lowest line of the display, the message "OK" will additionally be displayed.

For customer-specific configured devices, the commissioning wizard might be deactivated and cannot be run. In this case, the device is preset. However, the commissioning wizard can be started as described at "Commissioning EDS" on page 34.

3. Check the ISOMETER® in the system being monitored, e.g. using a suitable resistance to earth.

Observe the device status!
The device is in the alarm state until initial commissioning has been complete.

After setting the response value R_{an2} for Alarm 2, the device starts a self-test, makes the first measurement and outputs the measured insulation resistance values of the IT system being monitored, then commissioning is completed.

7.2 Commissioning procedure - steps for commissioning

	Commissioning the ISOMETER®	Commissioning the EDS44x	System commissioning ISOMETER® with EDS44x
1	Install the device according to the wiring diagram and documentation	Install the device according to the wiring diagram and documentation	Disconnect supply voltage of all devices
2	Connect the supply voltage	Connect the supply voltage	Connect the EDS to the ISOMETER® * EDS44x–L: use BS bus * EDS44x–S: use BB-Bus
3	Connect the system voltage	The **ON** LED flashes until the device is ready for use	Connect the supply voltage to all devices
4	Run the commissioning wizard	Set the BS address using the rotary swiches on the EDS44x–L front panel. The channel LEDs lights to show the set address.	Set EDS Mode in the ISOMETER® menu **EDS -> General -> Mode**
5	The ISOMETER® performs a self test	Delete the alarm messages as described in the device documentation	Search for adjustable measuring channels in the ISOMETER® menu im ISOMETER® -Menu
6	Function test with a suitable resistance between system and earth. Resistance value: 50% of the response value Alarm 2	The EDS44x is properly connected and ready for operation	Activate measuring channels in ISOMETER® menu **EDS -> Enable channel**
7	Remove the resistance	A CT connection test is performed every 10 minutes. During the test the LED **ON** blinks	Set the max. locating current ISOMETER® menu **EDS -> General -> Current** * EDS440-x: 10…50 mA * EDS441-x: 1…5 mA
8	Set BS address = 1 Master (corresponds to factory setting)		Make any other necessary settings for the EDS44x in the ISOMETER® menu **EDS**
9	Adjust basic settings if necessary		Function test with a suitable resistance between system and earth. Resistance value: 50% of the response value Alarm 2
10	The ISOMETER® is properly connected and functions reliably		Remove the resistance
11			ISOMETER® and EDS44x combination is properly connected and functions reliably

Commissioning

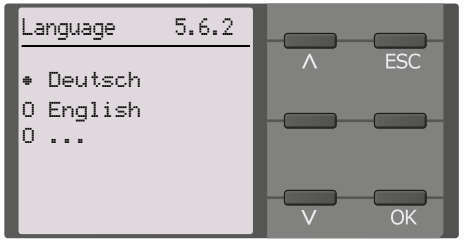
7.3 Initial commissioning

Check network function!
When the device has been integrated into a network, the impact on the network has to be checked with the device switched on and off.

Follow the instructions of the commissioning wizard on the display.

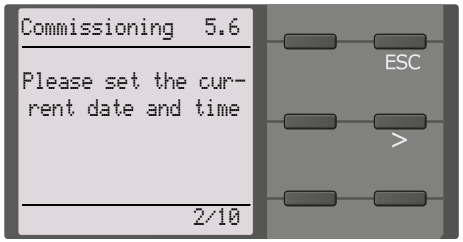
7.3.1 Set language

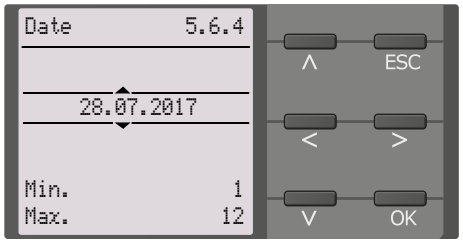
The language selected here will be used in the menu and for device messages.



7.3.2 Set time and date

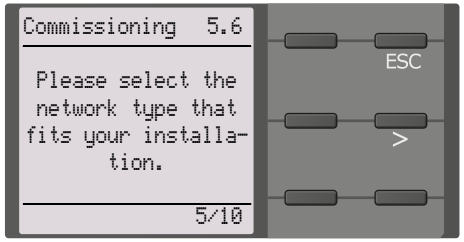
Alarm messages in the history memory and the insulation resistance value over time can only be assigned correctly to the isoGraph when the date and time are set correctly.

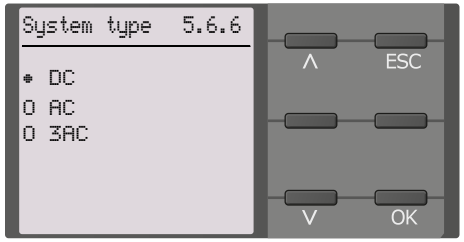




7.3.3 Set system type

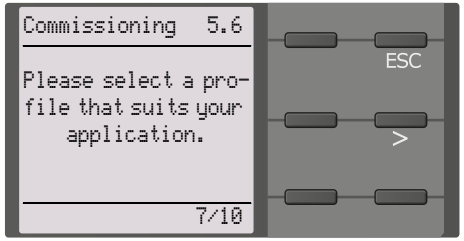
By setting the system type the insulation monitoring device can be optimally adapted to the system to be monitored. The system type is essential information for the insulation monitoring device in order to determine the insulation resistance correctly.

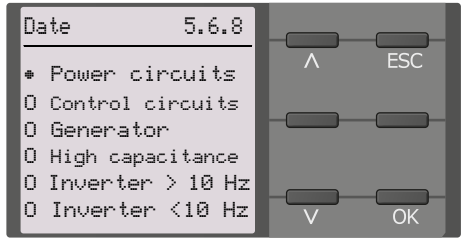




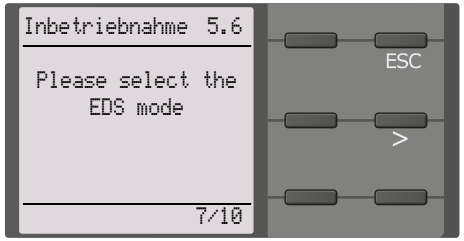
7.3.4 Set profile

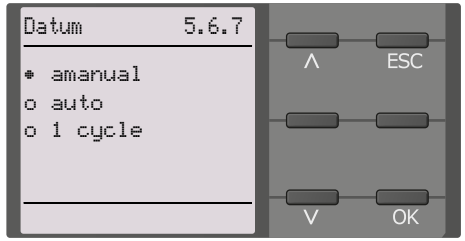
In order to optimally adapt the insulation monitoring device to the system to be monitored, select a profile here that suits your system. For an overview of the profiles, refer to Page 67. The profile "power circuits" is suitable for most IT systems.





7.3.5 Setting EDS mode





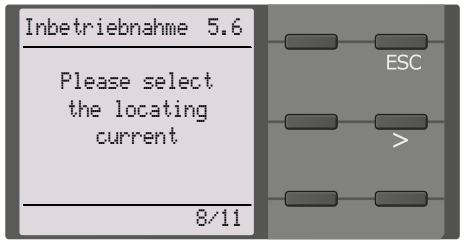
7.3.6 Setting EDS current

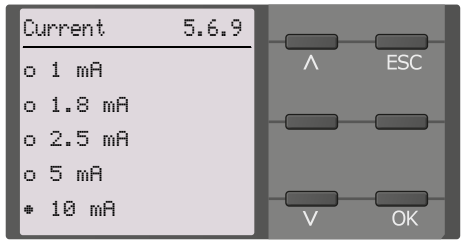
Set the maximum locating current.

EDS441: 1-5 mA

EDS440: 10-50 mA

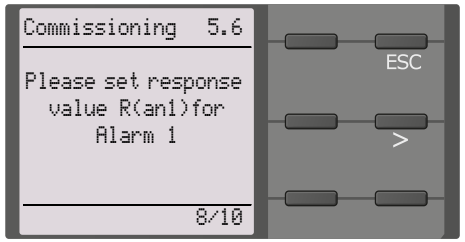
For further information, refer to “Current” on page 49.

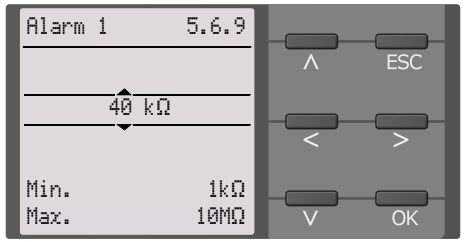




7.3.7 Set response value R_{an1} for Alarm 1

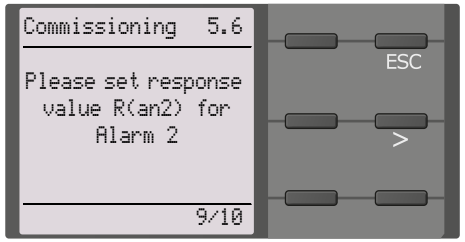
You can set the prewarning response value here. A value of 100 Ω/V is recommended for the prewarning.

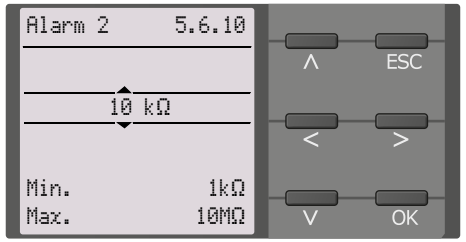




7.3.8 Set response value R_{an2} for Alarm 2

The response value for the main alarm can be set here.A value of 50 Ω/V is recommended for the main alarm.

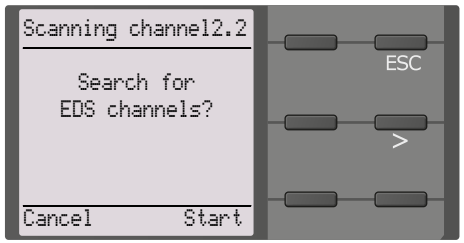


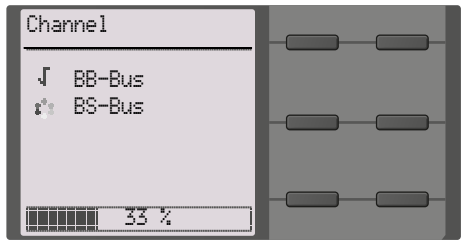


7.4 Commissioning EDS

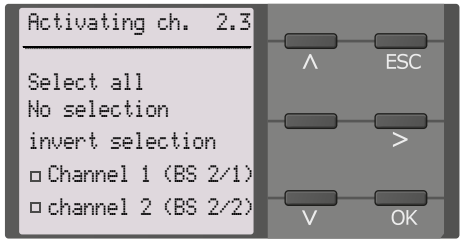
Proceed as follows to put into operation an EDS after commissioning the ISOMETER®:

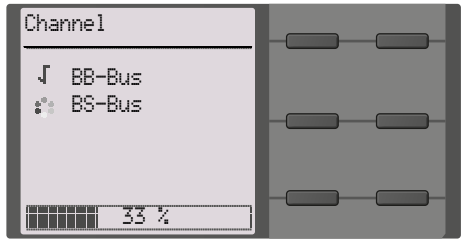
1. First, search for all available measuring channels.
   Menu path: **Menu/EDS/Scan channels.**





2. Activate all or only selected measuring channels. Additionally, select the required menu item, confirm your selection with "OK" and start activation with >
   Menu path: **Menu/EDS/Activate channel.**





3. Test if the maximum locating current to the EDS is correct and adjust if necessary (refer to 7.3.6 "Setting EDS current" on page 34).
   Menu path: **Menu/EDS/General/Current**

In addition to this chapter, commissioning of the ISOMETER® in combination with an EDS is described in the “Commissioning procedure - steps for commissioning” on page 32.

Commissioning

7.5 Recommissioning

If the device has already been put into operation once, the self test will be carried out shortly after connecting the supply voltage. The commissioning wizard will not restart. The commissioning-assistent wizard can be manually started using the menu path:

Menu/Device settings/Commissioning

This menu can be used to modify settings made previously.

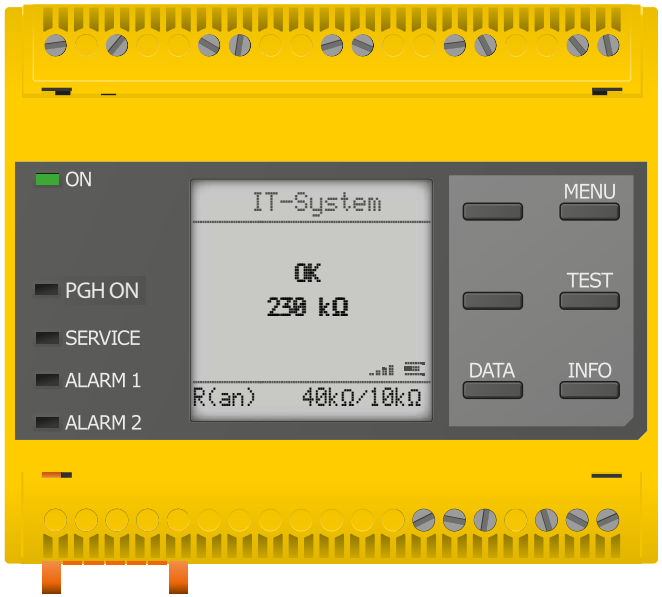
Observe the device status!
Once initial commissioning has been completed and the initial measurement has been taken, the device changes from the alarm state to normal state by adhering to the set response values.

8.1 Standarddisplay

In normal operation, the ISOMETER® displays the message OK and below the latest 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 threshold values for R(an) are shown. In the example below, R_{an1}=40 kΩ und R_{an2}=10 kΩ.



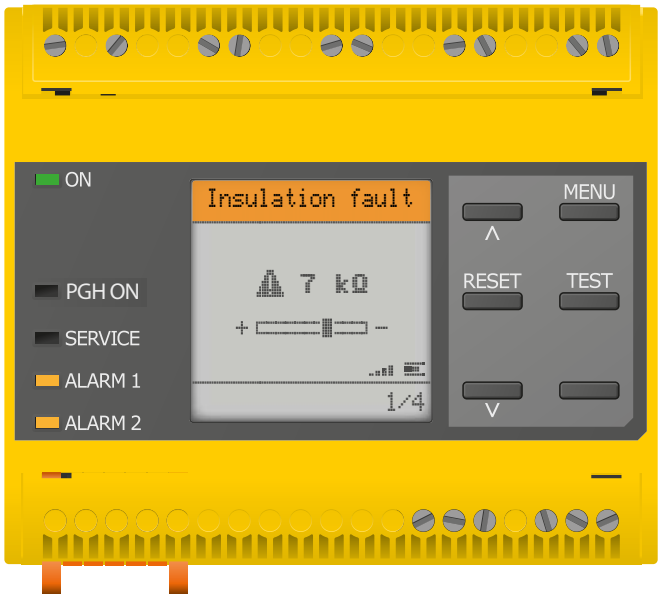
8.2 Fault display (active)

An active fault is displayed by ⚠ .
The upper part of the display becomes 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, the resistance is detected. Since the values R_{an1}=100 kΩ and R_{an2}=20 kΩ are both below the set response value, ALARM 1 and ALARM 2 are triggered.

If several fault messages occur, 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 shift is recognised in an AC system, then the additional information regarding the DC shift will be displayed, as illustrated above.

Display

8.3 Fault display (inactive)

An inactive fault is displayed by ⓘ. If several faults have occurred, the number of faults will also be indicated.

This message means that there has been a fault in the past but the device is no longer in the fault condition.

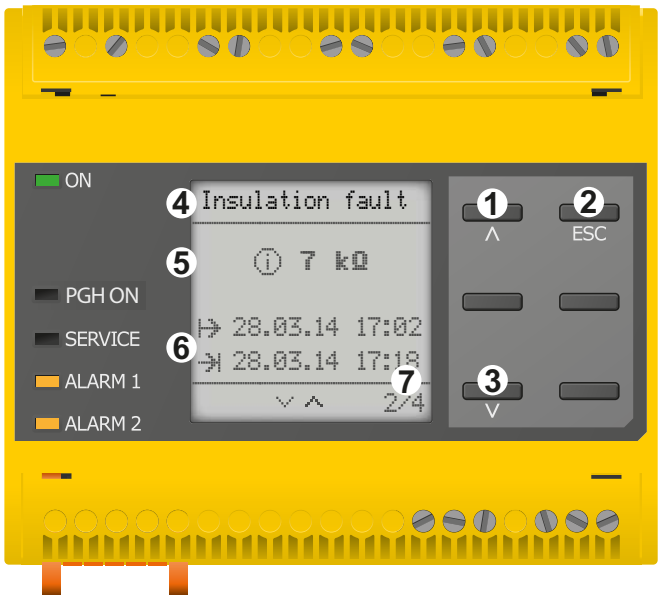
Device keypad

1 View next fault message
2 MENU - Selection
3 Acknowledge fault
4 Carry out test measurement
5 Previous fault message

Display

6 Number of faults occured and faults
7 Signal quality and measuring pulse
8 Number of the selected fault/Number of fault messages

If several fault messages occur, 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 how long it has been active.



Device keypad

1 View next fault message
2 Exit view
3 View previous fault message

Display

4 Fault description
5 Alarm vaue
6 Fault occurance/Fault resolution
7 Number of the selected fault/Number of fault messages

8.4 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® then returns to the standard display.

Device keypad

1 Press RESET button

2 Select RESET with >

3 Confirm to clear the fault memory with the OK button

Display

4 Function - Display

8.5 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.

Device keypad

1 Change measured value (next value)

2 Exit view

3 Change scale (Zoom in)

4 Change scale (Zoom out)

5 Change measured value (previous value)

Display

6 Current timescale

8.6 History memory

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

Device keypad

1 View next message
2 Exit view
3 View previous message

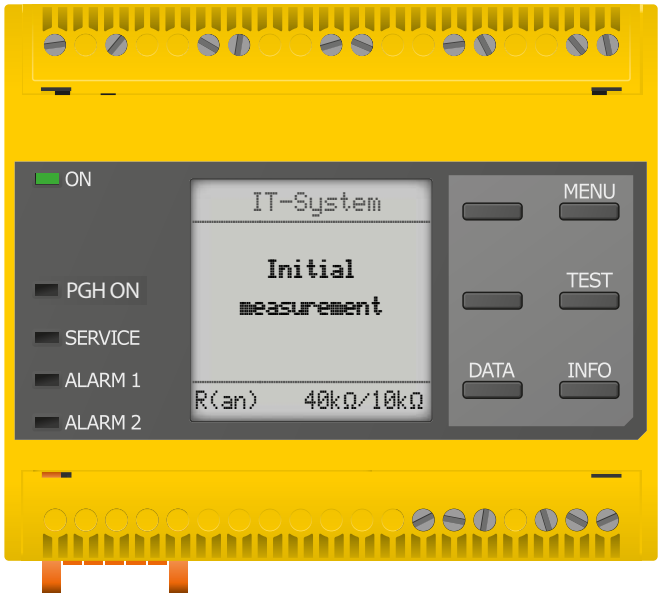
Display

4 Fault description
5 Alarm vaue
6 Fault occurance/Fault resolution
7 Number of the selected fault/Number of fault messages

8.7 Initial measurement

During the initial measurement, the device records all measured values.

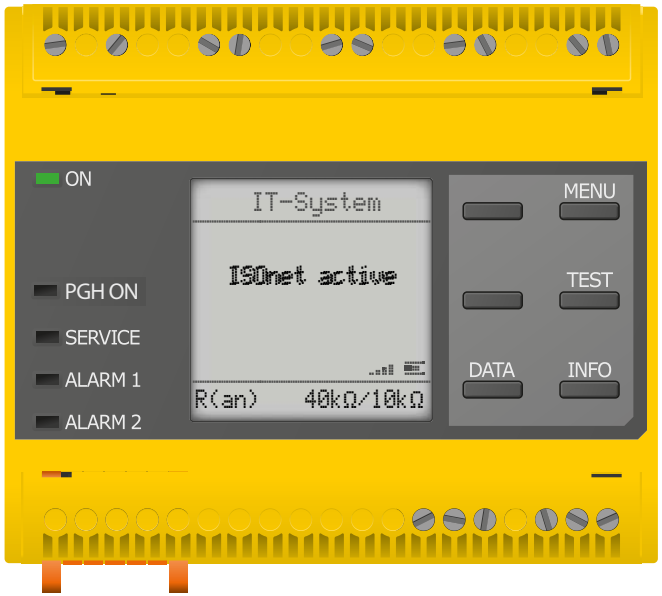
All measured values that may have been recorded before will be discarded if a new initial measurement is started.



8.8 ISOnet mode

The ISOMETER® displays the message "ISOnet active" when the ISOMETER® is in ISOnet mode, but it does not make any measurements.

In this state, The "ON" LED lights continuously and the bar indicating the measurement progress is not pulsing.

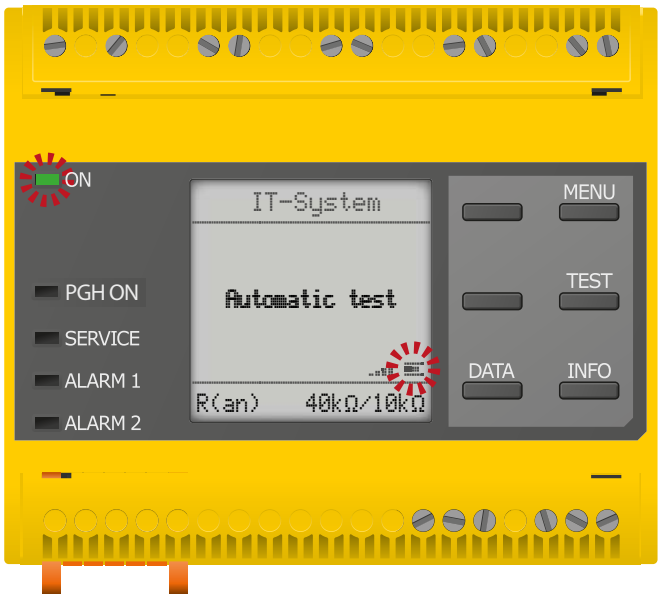


8.9 Automatic test

A blinking "ON" LED and the bar indicating the measurement progress is pulsing (see bottom right of the display) indicates that the ISOMETER® is actively measuring in ISOnet mode.

The ISOMETER® first performs a self test. During this test, the connection to the IT system and to earth are checked. Following this, the ISOMETER® takes an initial measurement and records all measured values (see Page 39).

Hereafter, the ISOMETER® measures for one measuring cycle and then the authorisation for insulation measurement is forwarded to the ISOMETER® with the next higher address.



8.10 Insulation fault location

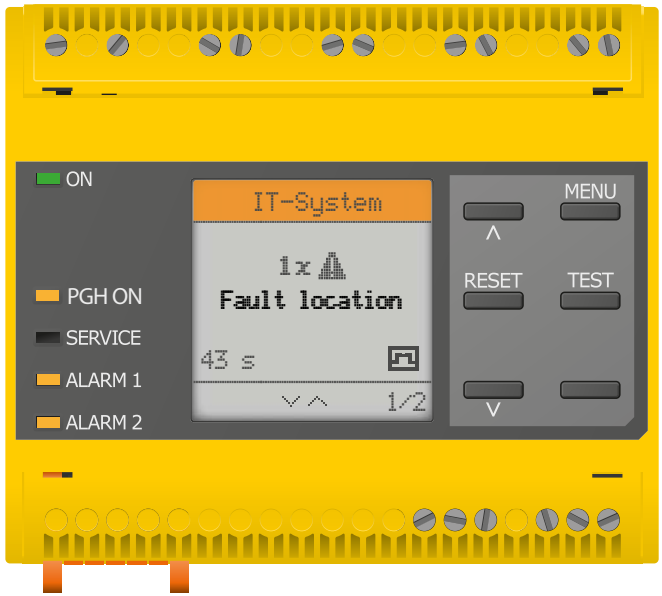
When EDS mode is activated, the ISOMETER® indicates the message "Ins. fault locat.". Below, on the left side it indicates which EDS mode is activated. On the right side it indicates the polarity change of the measuring pulses including the pause in between. During the different pulse phases the following symbols are shown.*

	positive measuring pulse *
	Pause *
	negative measuring pulse *
	The insulation fault location has been started manually and runs continuously. No insulation measurement takes place.
43 s	Insulation fault location in auto mode and 1 cycle. Time countdown of a measurement cycle.
– – –	Time can not be shown

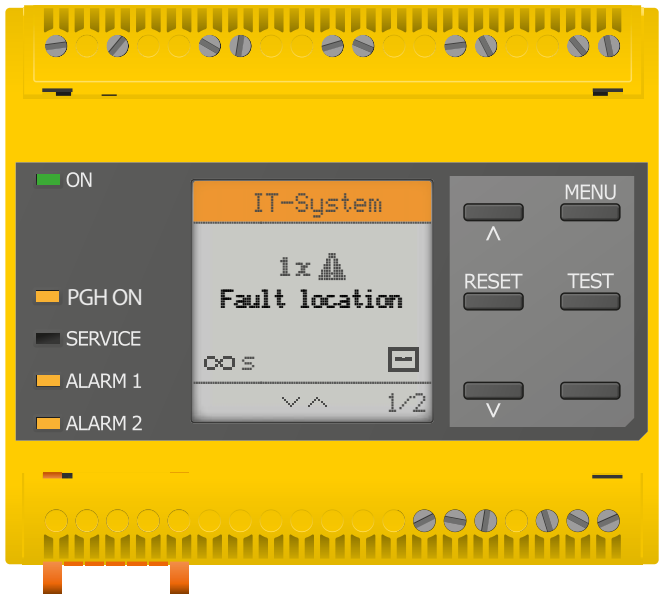
An active fault is displayed by  . The upper part of the display will become orange and displays the fault message. The alarm LEDs are lit. If several fault messages have appeared, you can navigate through the faults using the Λand V buttons.

Visualisation of low frequency measuring processes
When using the LAB method, the pulse can last up to one minute. Therefore, the symbol does not constantly "flash" but is continuously shown for up to one minute during the pulse period.

Insulation fault location in auto mode and 1 cycle.



Insulation fault location has been started manually.



Settings

9. Settings

9.1 Menu structure

- 1. Alarm settings
  - 1. Insulation alarm
    - 1. Alarm 1
    - 2. Alarm 2
    - 3. Memory
  - 2. DC Alarm
    - 1. Alarm
    - 2. U(DC-E)
  - 3. Profile
  - 4. System type
  - 5. ISOnet
    - 1. ISOnet
    - 2. Number of devices
  - 6. Device
  - 7. t(start)
  - 8. Coupling monitoring
  - 9. 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
    - 3. Digital 3
      - 1. Mode
      - 2. t(on)
      - 3. t(off)
      - 4. Function
  - 10 Outputs
    - 1. Relay 1
      - 1. Test
      - 2. Relay mode
      - 3. Function 1
      - 4. Function 2
      - 5. Function 3
    - 2. Relay 2
      - 1. Test
      - 2. Relay mode
      - 3. Function 1
      - 4. Function 2
      - 5. Function 3
    - 3. Digital 1
      - 1. Test
      - 2. Relay mode
      - 3. Function 1
      - 4. Function 2
      - 5. Function 3
    - 4. Digital 2
      - 1. Test
      - 2. Relay mode
      - 3. Function 1
      - 4. Function 2
      - 5. Function 3
    - 5. Buzzer
      - 1. Test
      - 2. Function 1
      - 3. Function 2
      - 4. Function 3
    - 6. Analogue
      - 1. Mode
      - 2. Midscale
      - 3. TEST
      - 4. Function
- 2. EDS
  - 1. General
    - 1. Current
    - 2. Mode
    - 3. Use portable EDS
  - 2. Scan for Channels
  - 3. Enable Channel
  - 4. Group settings
    - 1. Channel
      - 1. CT
      - 2. CT Monitor
      - 3. IΔL Response value
      - 4. IΔL Response value
    - 2. Outputs
      - 1. Relay
        - 1. TEST
        - 2. Relay mode
        - 3. Function 1
        - 4. Function 2
        - 5. Function 3
      - 2. Buzzer
        - 1. TEST
        - 2. Function 1
        - 3. Function 2
        - 4. Function 3
      - 3. Digital Output
        - 1. TEST
        - 2. Function 1
        - 3. Function 2
        - 4. Function 3
    - 3. Digital Input
      - 1. Mode
      - 2. t(on)
      - 3. t(off)
      - 4. Function
    - 4. Device settings
      - 1. System type
      - 2. Frequency
      - 3. Trigger
      - 4. Fault memory
  - 5. Channel
    - 1. Name
    - 2. CT monitor
    - 3. IΔL Response value
    - 4. IΔn Response value
  - 6. Outputs
    - 1. Relay
      - 1. TEST
      - 2. Relay mode
      - 3. Function 1
      - 4. Function 2
      - 5. Function 3
    - 2. Buzzer
      - 1. TEST
      - 2. Function 1
      - 3. Function 2
      - 4. Function 3
    - 3. Digital Output
      - 1. TEST
      - 2. Function 1
      - 3. Function 2
      - 4. Function 3
  - 7. Inputs
    - 1. Mode
    - 2. t(on)
    - 3. t(off)
    - 4. Function
  - 8. Device
    - 1. Name
    - 2. Trigger
    - 3. Fehlerspeicher
  - 9. Service

Settings

- 3. Data meas. values
- 4. Control
- 5. History
- 6. Device settings
  - 1. Language
  - 2. Clock
    - 1. Time
    - 2. Format
    - 3. Summer time
    - 4. Date
    - 5. Format
    - 6. NTP
    - 7. NTP Server
    - 8. UTC
  - 3. Interface
    - 1. Write access
    - 2. Ethernet
      - 1. DHCP
      - 2. IP
      - 3. SN
      - 4. Std. GW
      - 5. DNS Server
      - 6. Domäne
    - 3. BCOM
      - 1. System name
      - 2. Subsystem
      - 3. Device address
      - 4. Timeout
      - 5. TTL for subscription
    - 4. Modbus TCP
      - 1. Port 502
    - 5. BS-Bus
      - 1. Address
  - 4. Display
    - 1. Brightness
  - 5. Password
    - 1. Password
    - 2. Status
  - 6. Commissioning
  - 7. Backup
  - 8. Service
- 7. Info

Menu items coloured RED

After activating password protection, access to the menu items coloured RED is only possible after entering a password.

9.2 Settings in the device menu

Representation of the menu items in the chapter headings

The ISOMETER® settings will be explained in the order corresponding to the device menu. In the following headings in this chapter, the information contained in brackets corresponds to the menu structure shown on the previous page.

9.2 (1.0) Alarm settings

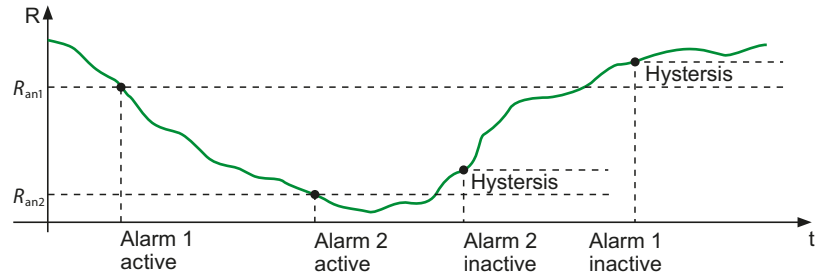
The threshold values for the insulation resistances of Alarm 1 and Alarm 2 can be specified in the alarm settings menu and can be adapted to the ISOMETER® user profile. A device password is required for entering the settings. You can adjust the following functions:

9.2 (1.1) Insulation alarm

In the "Insulation alarm" menu, you can set the thresholds for the ISOMETER® Alarm 1 and Alarm 2.

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.



9.2 (1.1.1) Alarm 1

For Alarm 1, an insulation resistance of 1 kΩ…20 MΩ can be set irrespective of Alarm 2.

9.2 (1.1.2) Alarm 2

For Alarm 2, an insulation resistance of 1 kΩ…20 MΩ can be set irrespective of Alarm 1.

9.2 (1.1.3) Fault memory

Automatic reset of inactive faults at the outputs of relay 1, relay 2, digital output 1, digital output 2:

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

9.2 (1.2) DC alarm

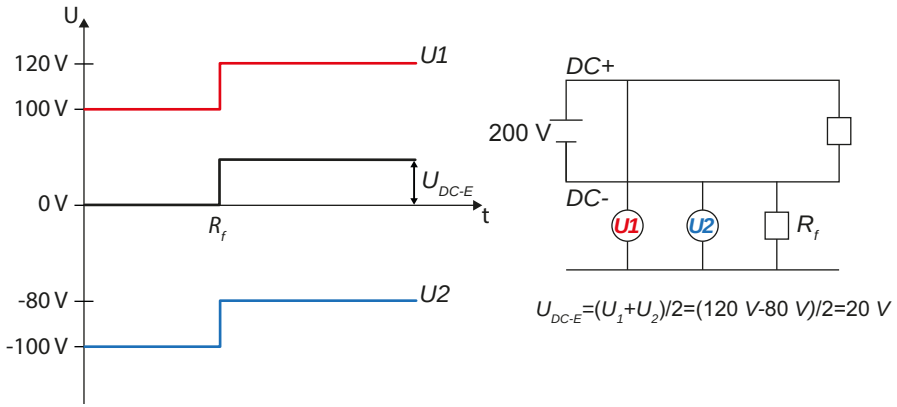
The DC alarm is triggered in the event of a DC offset voltage (U_{DC-E}) in the system.

9.2 (1.2.1) Alarm

•on	The DC alarm is triggered in the event of a DC offset voltage.
•off	The DC alarm is NOT triggered in the event of a DC offset voltage.

9.2 (1.2.2) U(DC-E)

Set the DC alarm to a value between 20 V and 1 kV.



9.2 (1.3) Profile

Adapt the applicabilty of the ISOMETER® to your system profile. For a description of the profiles refer to "Diagrams" on page 67.
The following may be selected:

•Power circuits	Suitable for most IT systems.
•Control circuits	Not recommended for voltages >230 V.
•Generator	Fast measuring times, fast fault location possible.
•High capacitance	Suitable for systems with a high leakage capacitance.
•Inverter > 10 Hz	Suitable for systems with a dynamic frequency control by means of an inverter in the range 10…460 Hz.
•Inverter <10 Hz	Suitable for systems with very low frequency control in the range 0.1…460 Hz.
•Customer specific	Allows Bender service to make customer-specific settings

9.2 (1.4) System type

Adapt the ISOMETER® to the IT system to be monitored. The following may be selected:

•DC	DC system (refer to "Connection to a DC system" on page 23
•AC	Single-phase AC system (refer to "Connection to an AC system" on page 23)
•3AC	3AC system (refer to "Connection to a 3(N)AC system" on page 22)

9.2 (1.5) ISOnet

Make the settings to use the ISONet function.

The ISOnet function ensures via the Ethernet connection that **only one** ISOMETER® of the interconnection is active when several ISOMETER®s are connected to an IT system.

For further information regarding the ISOnet function, refer to "System separation via ISOnet" from page 64.

9.2 (1.5.1) ISOnet

Activate or deactivate the ISONet function

•off	The ISOnet is deactivated
•BCOM	The ISOnet function is activated via BCOM

9.2 (1.5.2) Number of devices

Configure the number of devices (2…20) in a subsystem.

9.2 (1.6) 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 message Device inactive appears on the display. The IT system is NOT being monitored!

9.2 (1.7) t(Start)

The ISOMETER® can be operated with a startup delay of 0…120 seconds. The startup is delayed until the first measurement takes place.

9.2 (1.8) Coupling monitoring

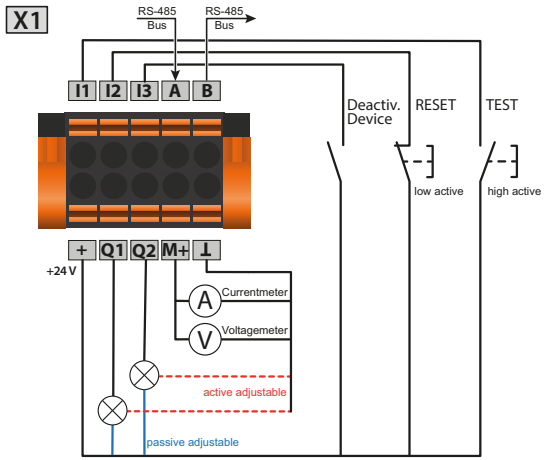
The ISOMETER® continuously monitors the coupling of energised systems. The coupling of deenergised systems is monitored at 8 hour intervals. This monitoring function can be activated or deactivated.

•on	Coupling monitoring is activated.
•off	Coupling monitoring is deactivated.

9.2 (1.9) Inputs

The ISOMETER® provides a total of three digital inputs.

The exemplary wiring diagram shows how the digital inputs can be wired:



9.2 (1.9.1) Digital 1

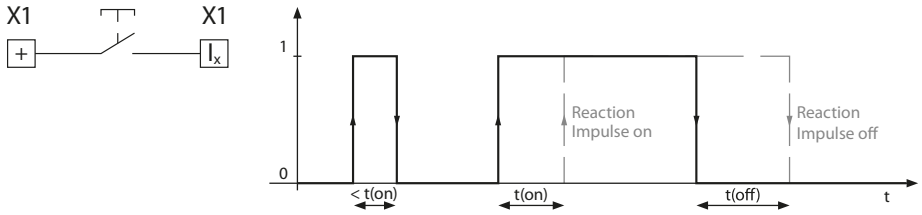
The following parameters can be set for the digital input:

9.2 (1.9.1.1) Mode

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

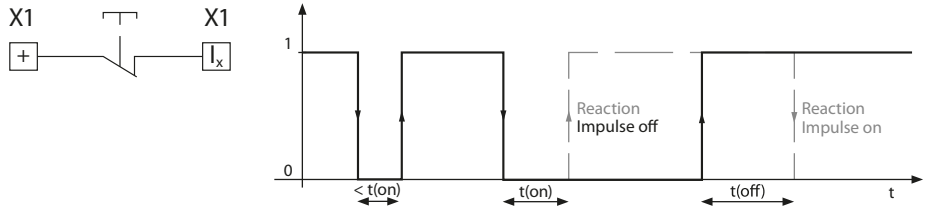
•Active high

An event is executed 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.



9.2 (1.9.1.2) t(on)

The response time t(on) after a switch-on signal can be set between 100 milliseconds and 300 seconds (refer to “9.2 (1.9.1.1) Mode”).

9.2 (1.9.1.3) t(off)

The response time t(off) after a switch-off signal can be set between 100 milliseconds and 300 seconds (refer to “9.2 (1.9.1.1) Mode”).

9.2 (1.9.1.4) Function

The ISOMETER® digital input functions can be configured differently:

*off	Digital input without function
*TEST	Device self test
*RESET	Reset of fault and alarm messages
*Deactivate device	The device DOES NOT measure the insulation resistance, the message Device inactive appears on the display. The IT system is NOT being monitored!
*Start initial measurement	All recorded measurements are discarded and a new measurement will be started

9.2 (1.9.2) Digital 2

Refer to "9.2 (1.9.1) Digital 1".

9.2 (1.9.3) Digital 3

Refer to "9.2 (1.9.1) Digital 1".

Deactivating the ISOMETER® via the digital inputs

The digital inputs are not coupled to each other. To avoid accidental and unintended deactivation of the ISOMETER®, care must be taken during configuration to ensure that the inputs are assigned different functions.

9.2 (1.10) Outputs

The ISOMETER® provides a total of six outputs:
The following parameters can be set for the outputs:

9.2 (1.10.1) Relay 1

The following parameters can be set for each relay:

9.2 (1.10.1.1) TEST

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

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

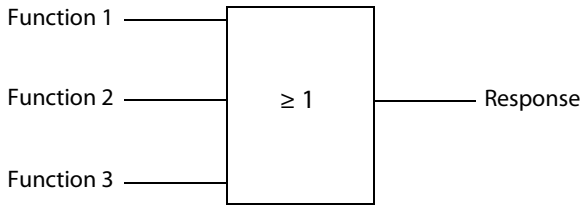
9.2 (1.10.1.2) Relay mode

The relay mode can be adapted to the application:

*N/C	Normally closed- N/C operation contacts11-12-14 / 21-22-24 (in fault-free condition, the alarm relay is energised).
*N/O	Normally opened - N/O operation contacts 11-12-14 / 21-22-24 (in fault-free condition, the alarm relay is de-energised).

9.2 (1.10.1.3) Function 1

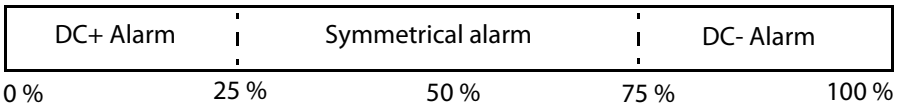
Three functions can be assigned to one output. The functions are linked to an OR operator:



Settings

Select the appropriate setting for 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 fault occurs: • No low-resistance connection between the line conductors. • No low-resistance connection between the terminals E and KE to earth (PE). • The load connected to the current output is too low. • The load connected to the current output is too high. • Load on X1 too high.
*DC- alarm	The status of the output changes in the event of an earth fault in the direction of DC when 75% of the value is exceeded. This does not concern symmetrical faults. This function will only be carried out when the value falls below the response value R_{an1} and when the nominal system voltage is U_n ≥50 V.
*DC+ alarm	The status of the output changes in case of an earth fault in the direction of DC+ when 25% of the value are exceeded. This does not concern symmetrical faults. This function will only be carried out when the value falls below the response value R_{an1} and when the nominal system voltage is U_n ≥50 V.
*Symmetrical alarm	The status of the output changes in the event of a resistance ratio between DC+ and DC- of 25 % to 75 %.



*Device fault	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).
*Measurement ended	The status of the output changes at the end of the initial measurement.
*Device inactive	The status of the output changes when the device has been deactivated via a digital input or the control menu.
*DC offset alarm	The status of the output changes on the occurrence of a DC offset voltage in the system.

9.2 (1.10.1.4) Function 2

Refer to "9.2 (1.10.1.3) Function 1".

9.2 (1.10.1.5) Function 3

Refer to "9.2 (1.10.1.3) Function 1".

9.2 (1.10.2) Relay 2

Refer to "9.2 (1.10.1) Relay 1".

9.2 (1.10.3) Digital 1

The following parameters can be set for each of the digital outputs:

9.2 (1.10.3.1) TEST

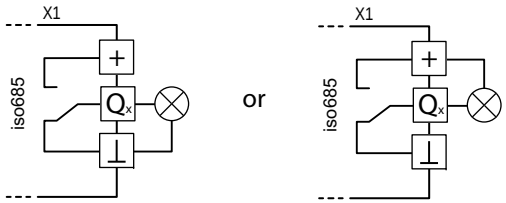
The functional test of the digital output can be activated or deactivated. This only applies to the manual test and not to the cyclic device self test:

*on	The manual test changes the status of the digital output.
*off	The manual test does not change the status of the digital output.

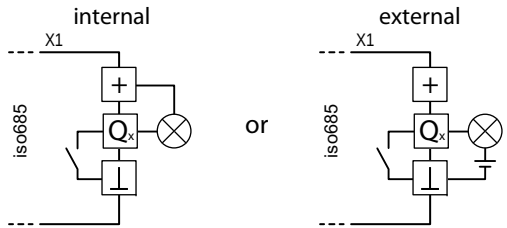
9.2 (1.10.3.2) Mode

The following settings can be used to set the operating mode for the digital output:

*Active — In the active mode +24 V will be internally applied across the Qx output.



*Passive — In passive mode ≤ 32 V are externally connected (refer to the technical data). The output switches the applied potential to ground.



Observe the maximum output current!
Maximum output current in case of internal voltage supply via A1/+ and A2/-: 200 mA in total to X1.
Also refer to the formula, given in the technical data, for calculating I_{LmaxX1}. See "Digital outputs (Q1, Q2)" on page 73.

9.2 (1.10.3.3) Function 1

Refer to "9.2 (1.10.1.3) Function 1".

9.2 (1.10.3.4) Function 2

See "9.2 (1.10.1.3) Function 1"

9.2 (1.10.3.5) Function 3

See "9.2 (1.10.1.3) Function 1"

9.2 (1.10.4) Digital 2

Refer to "9.2 (1.10.3) Digital 1".

9.2 (1.10.5) Buzzer

The following parameters can be set for the buzzer.

9.2 (1.10.5.1) 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.

9.2 (1.10.5.2) Function 1

Refer to "9.2 (1.10.1.3) Function 1".

9.2 (1.10.5.3) Function 2

Refer to "9.2 (1.10.1.3) Function 1".

9.2 (1.10.5.4) Function 3

Refer to "9.2 (1.10.1.3) Function 1".

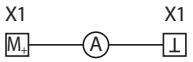
9.2 (1.10.6) Analogue

The following parameters can be set for the analogue output.

9.2 (1.10.6.1) Mode

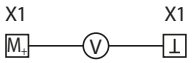
The operating mode of the analogue output can be set to the following values:

Current output



*0-20 mA — Permissible load ≤ 600 Ω
*4-20 mA — Permissible load ≤ 600 Ω
*0-400 µA — Permissible load ≤ 4 kΩ

Voltage output



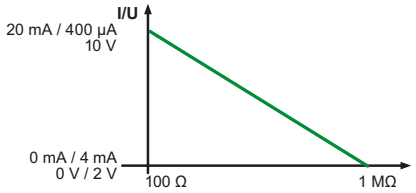
*0-10 V — Permissible load ≥ 1 kΩ
*2-10 V — Permissible load ≥ 1 kΩ

Settings

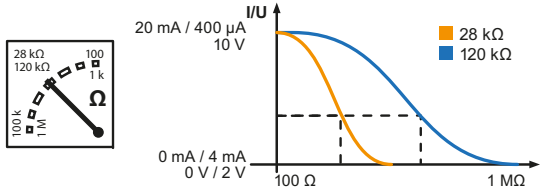
9.2 (1.10.6.2) Midscale

Select the appropriate midscale. The following parameters can be set:

*Linear — The switching signal is linear to the insulation resistance in the indicated measuring range.



*28 kΩ
*120 kΩ — The switching signal is analogue to the midscale of 28 kΩ or 120 kΩ on a measuring instrument.



Calculation of the insulation resistance using the analogue output:

$$R_F = \frac{(A_2 - A_1) * R_{SKM}}{A_3 - A_1} - R_{SKM}$$

A_3= Measured value analogue output

R_{SKM}= 28 kΩ or 120 kΩ/midscale

R_F= Insulation fault in kΩ

Lower value Analogue output A_1	Upper value Analogue output A_2
0 mA	20 mA
4 mA	20 mA
0 µA	400 µA
0 V	10 V
2 V	10 V

9.2 (1.10.6.3) TEST

The functional test of the analogue output can be activated or deactivated. In this way, the analogue output is adjusted once for the entire range. This only applies to the manual test and not to the cyclic device self test:

*on — The manual test checks the analogue output function.
*off — The manual test does not check the analogue output function.

9.2 (1.10.6.4) Function

Select the appropriate setting for the analogue output. The following parameters can be set.

*Insulation value — Depending on the measured insulation value, an analogue current or voltage signal is provided at the output.
*DC shift — Depending on the measured DC shift, an analogue current or voltage signal is provided at the output. This setting can only be used when Linear is selected in the menu "Midscale".

DC+ Alarm		Symmetrical alarm		DC- Alarm
0 %	25 %	50 %	75 %	100 %
0 V/2 V				10 V
0 mA/4 mA				20 mA
0 µA				400 µA

9.1 (2.0) EDS (insulation fault location)

9.2 (2.1) General

9.2 (2.1.1) Current

CAUTION

Risk of malfunctions due to excessive locating current on sensitive system parts!
The locating current flowing between the IT system and earth can cause controller faults in sensitive parts of the system, such as the PLC or relay. Ensure that the level of the locating current is compatible with the system to be monitored.

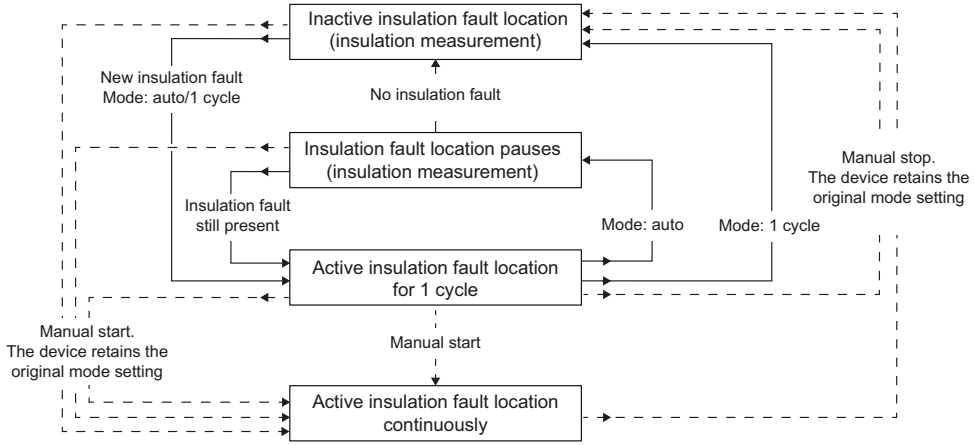
Set the maximum locating current in the ISOMETER®. You can find the device-specific maximum locating currents in the table below.

*1 mA — for EDS441-x
*1.8 mA — for EDS441-x
*2.5 mA — for EDS441-x
*5 mA — for EDS441-x, EDS440-x
*10 mA — for EDS440-x
*25 mA — for EDS440-x
*50 mA — for EDS440-x

9.2 (2.1.2) Mode

To locate insulation faults, select one of the three available modes for insulation fault location.

•Manual	In manual mode, the insulation fault location does not start automatically. If you start the insulation fault location, it remains active without considering the insulation resistance and the alarm message of the ISOMETER®.
•auto	In auto mode, the insulation fault location starts automatically as soon as the response value of alarm 2 of the ISOMETER® has fallen below the preset value. The insulation fault location is cyclically interrupted for an insulation measurement. If the insulation fault still exists after the interruption, the insulation fault location starts again. The insulation fault location only stops if alarm 2 is inactive. If a new insulation fault appears, the insulation fault location restarts automatically.
•1 cycle	In 1-cycle mode, the insulation fault location starts automatically as soon as the response value of alarm 2 of the ISOMETER® has fallen below the preset value. The insulation fault location is stopped after one cycle. If the insulation fault still exists after the interruption, the insulation fault location does NOT start again. If a new insulation fault appears, the insulation fault location restarts automatically for one cycle.



Do not carry out a manual test during a manually started insulation fault location, since the insulation fault location would be aborted by that.

9.2 (2.1.3) Using a portable EDS

If you would like to use a portable EDS, activate this function here. After that, the insulation fault location process will be automatically adjusted.

•on	Insulation faults can be located with a portable EDS.
•off	Insulation faults cannot be located with a portable EDS

If the trigger mode is set to "auto", the use of a portable EDS must be activated in the menu as the measurement method is correspondingly adjusted at this menu point (also refer to "9.2 (2.4.4.3) Trigger").

9.2 (2.2) Scanning channels

For a successful insulation fault location, all active measuring channels must be determined. Indicate if you would like to start the search for EDS measuring channels.

•Cancel	Aborts the scan process.
•Start	Starts the scan process (search) for EDS channels.

Also refer to "Commissioning procedure - steps for commissioning" on page 32.

If one bus device fails, the ISOMETER® asks whether it should search for measuring channels and then automatically determines all channels again. Also refer to "" from page 70.

9.2 (2.3) Activating channels

During initial commissioning all channels are inactive. Before configuring the channels they must be activated in this menu.

Select which measuring channels you would like to activate. Multiple selection is possible here.

•Select all	All measuring channels are selected.
•No selection	No channel is selected.
•Invert selection	The current selection is inverted.
•Channel 1(BS 2/1)	A single channel is selected.

…

•Channel 12 (BS 2/12)

Navigate to the required selection point using the Λ and V buttons. Confirm your selection by pressing "OK". The selected channels are activated with the > button.

Settings

9.2 (2.4) Group settings

Use group settings to adjust the settings for several EDS or EDS channels simultaneously or to read out settings.

If you would like to make settings for each EDS or each EDS channel individually, then please refer to the menus from "9.2 (2.5) Channel" to "9.2 (2.8) Device".

The values indicated in the group settings are not the values of the individual EDS but the factory settings or the last adjusted values in the ISOMETER®. To see the values of the individual EDS, please navigate to the menu points "9.2 (2.5) Channel" to "9.2 (2.8) Device".

9.2 (2.4.1) Channel

Before configuring a measuring channel, you must activate it.

Select which measuring channel you would like to activate and configure.

•Select all	All measuring channels are selected.
•No selection	No channel is selected.
•Invert selection	The current selection is inverted.
•Channel 1 (BS 2/1)	A single channel is selected.
•Channel 2 (BS 2/2)	
•Channel 3 (BS 2/3)	

Navigate to the required selection point using the ∧ and ∨ buttons. Confirm your selection by pressing "OK". Activate the selected measuring channel using the > button and navigate to its setting options.

9.2 (2.4.1.1) Current transformer (CT)

Set the used current transformer.

•Type A	W…/WR…/WS…/ W/WS8000
•Type AB	W…AB

9.2 (2.4.1.2) CT monitoring

Activate or deactivate the CT monitoring.

If CT monitoring is active, an alarm is signalled as soon as a fault occurs on a current transformer of an activated channel (short circuit or interruption).

•on	CT monitoring is activated (the current transformers are monitored).
•off	CT monitoring is deactivated (the current transformers are not monitored).

9.2 (2.4.1.3) $I_{\Delta L}$ Response value

Set the response value for $I_{\Delta L}$ (main alarm for insulation fault location) between 200 µA and 10 mA. The response value must be below the set locating current (refer to 7.3.6 "Setting EDS current" on page 34).

CAUTION

The permissible response value and the response sensitivity depend on the connected EDS (EDS440x or EDS441x).

9.2 (2.4.1.4) $I_{\Delta n}$ Response value

Set the response value for $I_{\Delta n}$ (alarm for residual current measurement) between 100 mA and 10 A.

CAUTION

The permissible response value and the response sensitivity depend on the connected EDS (EDS440x or EDS441x).

9.2 (2.4.2) Outputs

In this menu, the settings for the outputs of the EDS can be made.

•Relays
•Buzzer
•Dig. output

Settings

9.2 (2.4.2.1) Relays

Select the relays that you would like to configure.

•Select all	All relays are selected.
•No selection	No relay is selected.
•Invert selection	The current selection is inverted.
•Relay 1 (BS 2/1)	A single relay is selected.
•Relay 2 (BS 2/2)	

9.2 2.4.2.1.1 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.

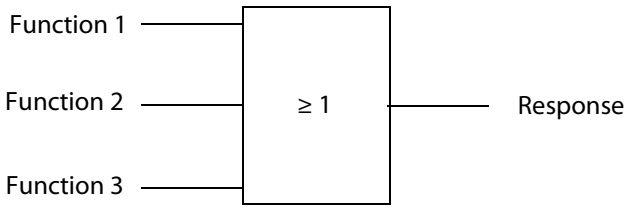
9.2 2.4.2.1.2 Operating mode

The relay operating mode can be adapted to the application.

•N/C	Normally closed- N/C operation contacts11-12-14 / 21-22-24 (in fault-free condition, the alarm relay is energised).
•N/O	Normally opened - N/O operation contacts 11-12-14 / 21-22-24 (in fault-free condition, the alarm relay is de-energised).

9.2 2.4.2.1.3 Function 1

Up to three functions can be assigned to one output. The functions are linked to an OR operator:



Set the function for the outputs:

•off	The function is not used.
•$I_{\Delta L}$	The status of the output changes if an insulation fault is detected (EDS function) on one of the measuring channels.
•$I_{\Delta N}$	The status of the output changes if the residual current (RCM function) is exceeded.
•Device fault	The status of the output changes in the event of an internal device fault.
•Connection fault	The status of the output changes when one of the following measuring current transformer connection faults occurs: • Measuring current transformer defective • Power supply cable interrupted • Power supply cable short-circuited
•Insulation fault location active	The buzzer signals active insulation fault location can only be set for buzzer).
•Common alarm	The status of the output changes on the occurrence of any alarms and fault messages ($I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, connection and device fault).

9.2 2.4.2.1.4 Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 2.4.2.1.5 Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.4.2.2) Buzzer

Select the buzzers that you would like to configure.

•Select all	All buzzers are selected.
•No selection	No buzzer is selected.
•Invert selection	The current selection is inverted.
•Buzzer 1(BS 2/1)	A single buzzer is selected.

Now assign the events on which the buzzers should be triggered.

9.2 2.4.2.2.1 TEST

Refer to "9.2 2.4.2.1.1 TEST".

9.2 2.4.2.2.2 Function 1

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 2.4.2.2.3 Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 2.4.2.2.4 Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.4.2.3) Digital output

Select the digital outputs of the EDS that you would like to configure.

•Select all	All digital outputs are selected.
•No selection	No digital output is selected.
•Invert selection	The current selection is inverted.
•Dig. output 1 (BS 2/1)	A single digital output is selected.

Now make the settings for the digital outputs of the EDS selected before.

9.2 2.4.2.3.1 TEST

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

•on	The manual test changes the status of the digital output.
•off	The manual test does not change the status of the digital output.

9.2 (2.4.2.4) Function 1

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.4.2.5) Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.4.2.6) Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.4.3) Dig. input

Select the digital inputs of the EDS that you would like to configure:

•Select all	All digital inputs are selected.
•No selection	No digital input is selected.
•Invert selection	The current selection is inverted.
•Dig. input 1 (BS 2/1)	A single digital input is selected.
•Dig. input 2 (BS 2/2)	

Now make the settings for the digital inputs of the EDS selected before.

9.2 (2.4.3.1) Mode

The operating mode for the digital input can be set to the following values. For a description of the operating modes, refer to "Mode" on page 45. The following can be selected:

•Active high	An event is carried out on the rising edge of the digital input (low to high).
•Active low	An event is carried out on the falling edge of the digital input (high to low).

9.2 (2.4.3.2) t(on)

The response time t(on) after a switch-on signal can be set between 100 milliseconds and 300 seconds. For a description of the operating modes, refer to "Mode" on page 45.

9.2 (2.4.3.3) t(off)

The response time t(off) after a switch-off signal can be set between 100 milliseconds and 300 seconds. For a description of the operating modes, refer to "Mode" on page 45.

9.2 (2.4.3.4) Function

•off	Digital input without function.
•TEST	Device self test.
•RESET	Reset of fault and alarm messages.

9.2 (2.4.4) Device settings

•Select all	All devices are selected.
•No selection	No device is selected.
•Invert selection	The current selection is inverted.
•BS bus 2 (1-12)	

9.2 (2.4.4.1) System type

Settings made to this menu point will only have an effect on connected EDS460 and NOT on EDS44x devices.

Adjust the EDS to the IT system to be monitored.

•DC	DC system
•AC	Single-phase AC system
•3AC	3AC system

9.2 (2.4.4.2) Frequency

Settings made to this menu point will only have an effect on connected EDS460 and NOT on EDS44x devices.

Configure the mains frequency of the IT system to be monitored.

- 50 Hz
- 60 Hz
- 400 Hz
- DC

9.2 (2.4.4.3) Trigger

The locating current pulse of the ISOMETER® is synchronised with the measurement technology in the EDS via the BB bus or the BS bus. This allows a more reliable detection of the locating current pulse in the event of disturbances.

Disturbances can be caused e.g. by variable-speed drives, rectifiers, actuators, noise filters, PLCs, or control electronics.

• Com	Synchronisation via BS bus or BB bus. The EDS only searches for insulation faults if the insulation fault location has been started. Less time is needed for the insulation fault location as with the setting "auto".
• auto	No synchronisation (e.g. if there is no BS bus or BB bus). The EDS continuously searches for insulation faults.

If the trigger mode is set to "auto", the use of a portable EDS must be activated in the menu (= "ON"), since the measurement method is correspondingly adjusted at this menu point.

9.2 (2.4.4.4) Fault memory

Faults that only occur temporarily can be saved.

• on	After eliminating the cause of fault, alarm messages remain stored until a RESET is carried out. This function applies to alarm and device fault messages.
• off	The EDS exits the alarm mode as soon as the cause of fault is eliminated.

9.2 (2.5) Channel

In this menu, each channel can be configured. Also refer to "9.2 (2.4.1) Channel".

9.2 (2.5.1) Name

Enter a name for the selected channel. This name will also be displayed on the gateways and in the web server and can be edited via these as well.

9.2 (2.5.2) Current transformer monitoring

Refer to "9.2 (2.4.1.2) CT monitoring".

9.2 (2.5.3) Response value $I_{\Delta L}$

Refer to "9.2 (2.4.1.3) IΔL Response value".

9.2 (2.5.4) Response value $I_{\Delta n}$

Refer to "9.2 (2.4.1.4) IΔn Response value".

9.2 (2.6) Outputs

In this menu, each output can be configured. Also refer to "9.2 (2.4.2) Outputs".

9.2 (2.6.1) Relays

Select the relay that you would like to configure.

- Relay 1 (BS 2/1)
- ...

9.2 (2.6.1.1) TEST

Refer to "9.2 2.4.2.1.1 TEST".

9.2 (2.6.1.2) Operating mode

Refer to "9.2 2.4.2.1.2 Operating mode".

9.2 (2.6.1.3) Function 1

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.1.4) Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.1.5) Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.2) Buzzer

In this menu, each buzzer can be configured. Also refer to "9.2 (2.4.2.2) Buzzer".

9.2 (2.6.2.1) TEST

Refer to "9.2 2.4.2.1.1 TEST".

9.2 (2.6.2.2) Function 1

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.2.3) Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.2.4) Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.3) Digital output

In this menu, each digital output can be configured.

Also refer to "9.2 (2.4.2.3) Digital output".

9.2 (2.6.3.1) TEST

Refer to "9.2 2.4.2.3.1 TEST".

9.2 (2.6.3.2) Function 1

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.3.3) Function 2

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.6.3.4) Function 3

Refer to "9.2 2.4.2.1.3 Function 1".

9.2 (2.7) Inputs

In this menu, each digital input can be configured. Therefore, select a digital input.

```
•Dig. input 1 (BS 2/1)
•Dig. input 2 (BS 2/2)
```

9.2 (2.7.1) Mode

Refer to "9.2 (2.4.3.1) Mode".

9.2 (2.7.2) t(on)

Refer to"9.2 (2.4.3.2) t(on)".

9.2 (2.7.3) t(off)

Refer to "9.2 (2.4.3.3) t(off)".

9.2 (2.7.4) Function

Refer to "9.2 (2.4.3.4) Function".

9.2 (2.8) Device

9.2 (2.8.1) Trigger

Refer to "9.2 (2.4.4.3) Trigger".

9.2 (2.8.2) Fault memory

Refer to "9.2 (2.4.4.4) Fault memory".

9.2 (2.9) Service

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

9.1 (3.0) Data measured values

The ISOMETER® stores certain measured values for a specific period of time. You can view these data in the "Data meas. value" menu. Navigate through the different views using the Λ and V buttons:

•isoGraph data	Displays the insulation resistance and chronological sequence. Refer to "Data-isoGraph" on page 38.
•Insulation data	Displays the current insulation resistance, the minimum measured insulation resistance and the leakage capacitance.
•IT system data	Displays the system phase-to-phase voltages and the mains frequency (r.m.s. values)
•IT system data	Displays the system phase-to-earth voltages

9.1 (4.0) Control

In the control menu you can start a manual test, reset alarm messages and start an initial measurement:

•TEST	Perform a manual test of the device
•DEVICE	Set the insulation resistance measurement function of the ISOMETER® to active or inactive:
•RESET	Reset of fault and alarm messages
•Start initial measurement	All recorded measurements are discarded and a new measurement will be started

9.1 (5.0) History

In the history menu, the faults detected by the ISOMETER® are displayed. For a detailed function description refer to "History memory" on page 39:

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

9.1 (6.0) Device settings

The device settings menu allows you to configure the basic settings for the ISOMETER®.

9.2 (6.1) Language

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

*Deutsch
*English
*...

9.2 (6.2) Clock

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

9.2 (6.2.1) Time

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

9.2 (6.2.2) Format (time)

Select the appropriate time format to be displayed:

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

9.2 (6.2.3) Summertime

Summer time can be considered in the following settings:

*off	No automatic change between summer time and standard time.
*DST	Daylight Saving Time (DST) Automatic change between summer and standard time according to North American regulation. Begin: Second Sunday in March from 02:00 local time to 03:00 local time End: On the first Sunday in November from 03:00 local time to 02:00 local time
*CEST	Central European Summer Time (CEST) Automatic change between summertime and standard time according to Central European regulation. Begin: Last Sunday in March from 02:00 Uhr CET to 03:00 CEST End: Last Sunday in October from 03:00 Uhr CEST to 02:00 CET

When set to DST or CEST, changing between summer time and normal time is only done on the date of the official time change.

9.2 (6.2.4) Date

Based on the selected date format you can set the current date.

9.2 (6.2.5) Format (date)

Select the appropriate date format you want to be displayed:

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

9.2 (6.2.6) NTP

Select whether you would like to synchronise the current time via NTP. To use this function, configure the NTP server (refer to "NTP server" on page 56).

*on	Synchronisation via NTP server is activated.
*off	Synchronisation via NTP server is deactivated.

9.2 (6.2.7) NTP server

Set the IP address of the NTP server.

Settings

9.2 (6.2.8) UTC

Configure the time according to UTC (Coordinated Universal Time) For Germany, set +1 for wintertime (CET) and +2 for summer time (CEST).

9.2 (6.3) Interface

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

9.2 (6.3.1) Write access

Decide if the device parameters should be set externally via Modbus or a web server.Displaying and reading data via Modbus and a web server always works, regardless of this setting.

*Allow	Allow external parameter setting.
*Deny	Refuse external parameter setting.

9.2 (6.3.2) Ethernet

Set the parameters for communication with other devices via the Ethernet interface. The Ethernet interface can be used for communication with Modbus, web server and BCOM.

9.2 (6.3.2.1) DHCP

Select whether you want to use automatic address assignment via your DHCP server. If the automatic IP address assignment is enabled, the IP address, the subnet mask and the standard gateway will be automatically assigned. If the automatic IP address assignment is disabled, these settings must be made manually in the menu.

You can view the IP address in the Info menu. (refer to "Info" on page 58).

*on	Activate automatic IP address assignment.
*off	Deactivate automatic IP address assignment.

9.2 (6.3.2.2) IP (manual configuration)

Set the appropriate IP address for the ISOMETER®. Make sure that the address of the device is within the address range of your network. Contact your network administrator to obtain information on the address range of your network..

9.2 (6.3.2.3) SN (manual configuration)

Set the appropriate subnet mask. (Standard subnet mask: 255.255.255.0) Contact your network administrator to obtain more information.

9.2 (6.3.2.4) Std. GW (manual configuration)

If a standard gateway is used in your network, enter its IP address here. If there is no gateway in the network, enter an address as gateway address that is not yet in use in the address range. **Without setting a standard gateway address, the device cannot be accessed.** Contact your network administrator to obtain information on the configuration of your local network.

9.2 (6.3.2.5) DNS server

If you use a DNS server, enter the server's IP address.

For questions regarding the configuration of a DNS server, please contact your network administrator.

9.2 (6.3.2.6) Domain

Enter the domain name.

For questions regarding the configuration of the domain, please contact your network administrator.

9.2 (6.3.3) BCOM

Set the parameters for communication with other devices via BCOM.

For further information, refer to "BCOM" on page 59.

9.2 (6.3.3.1) System name

Set the system name of the network in which the devices are located. In order to guarantee that all devices are able to communicate via BCOM, all devices must have the same system name.

9.2 (6.3.3.2) Subsystem

Configure the subsystem address of the network in which the devices are located. The devices can communicate with subsystems with the same or different address.

9.2 (6.3.3.3) Device address

Assign a device address. Each device must have a different address to distinguish one device from another in the system and ensure correct communication.

9.2 (6.3.3.4) Timeout

Set a timeout time for messages between 100 ms…10 s.

This time specification defines the maximum permissible time for a device to respond.

Settings

9.2 (6.3.3.5) TTL for subscription

Set a time from 1 s…1092 min.

The time indicates in which intervals the ISOMETER® sends messages to a gateway, for example. Essential messages (e.g. insulation alarm or substantial value changes) are always sent immediately.

9.2 (6.3.4) Modbus/TCP

Settings for communication with other devices via Modbus TCP.

For further information, refer to "Modbus/TCP" on page 59.

9.2 (6.3.4.1) Port 502

Choose whether Modbus TCP should be used:

•on	Modbus TCP can be used for communication with other devices.
•off	Modbus TCP cannot be used for communication with other devices.

9.2 (6.3.5) BS-Bus / RS-485

Set the parameters for communication with other devices via the Bender sensor bus.

For further information, refer to "BS bus" on page 61.

9.2 (6.3.5.1) Address

Set the address of the Bender Sensor bus from 1 to 90.

9.2 (6.4) Display

The brightness of the ISOMETER® display can be adjusted in the "Display" menu:

9.2 (6.4.1) Brightness

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

If no key is pressed on the keyboard within a period of 15 minutes, the display brightness is reduced.The original brightness is restored when a key is pressed.

9.2 (6.5) Password

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

9.2 (6.5.1) Password

Enter an individual four-digit password.

9.2 (6.5.2) Status

Decide if you want to use the password query:

•on	Password query active
•off	Password query inactive

9.2 (6.6) Commissioning

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

9.2 (6.7) Data backup

In the data backup menu device settings can be saved or device settings already saved can be restored.

•Save	The ISOMETER® saves your device settings.
•Restore	The ISOMETER® restores your initial device settings.

9.2 (6.8) Service

•Password	The Service menu can only be accessed by Bender Service staff.

9.1 (7.0) Info

You can view the current ISOMETER® settings in the Info menu. Navigate through the different views using the Λ and V buttons:

•Device	Device name, serial number, article number
•Software	Software version measurement technique, software version HMI
•Measurement technique	Selected profile, selected system type
•Clock	Time, date, summer time
•Ethernet	IP address, DHCP status, MAC address
•BS bus	BS address of the device

10.1 Ethernet interface

The Ethernet interface can be used for communication with Modbus, web server and BCOM.

10.2 BCOM

BCOM is intended for communication between Bender devices via Ethernet.

In order to guarantee that all devices are able to communicate via BCOM, all devices must have the same system name. Devices can be organised in subsystems. Each device requires an individual device address.

For more information regarding BCOM, refer to the BCOM manual (D00256) at http://www.bender.de/manuals.

When address 0 has been set for the communication via BCOM the device can be accessed via the network (e. g. for parameter setting, etc.) but it cannot communicate with other devices.

10.3 Modbus/TCP

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

All measured values, messages and parameters are stored in virtual register addresses. Data can be read at a specific register address with a read command. With a write command, data can be written to a register address. The register addresses of the individual measured values und parameters can be found in the manual "iso685-D Annex A" with the title "ISOMETER® iso685 device family - Modbus settings" at http://www.bender.de/manuals.

A maximum of 5 TCP/IP connections can be used simultaneously.

In order to be able to parameterise the device externally via Modbus, the menu item "Allow" must have been set in the "Write access" menu (see "Write access" on page 57).

10.4 Web server

The ISOMETER® has an integrated web server, which conveniently displays ISOMETER® data on every PC via a web browser. The web server can be used to read measured values and parameterise the ISOMETER® .

To access the web server, enter the IP address of the ISOMETER® into the web browser. For example:http://192.168.0.5). The ISOMETER® IP address can be found in the "Info" menu (refer to 9.1 (7.0) "Info" on page 58).

The following web browsers should be used:

The web server offers the following functions:

- Visualisation
  - Indication of device information (e.g. device type, software version, etc.)
  - Indication of current device settings.
  - Indication of alarm messages.
  - Indication of the Modbus information of the individual parameters.
  - Indication of the interfaces in use.
  - Overview of the current measured values.
  - Detailed graphic representation of the insulation resistance (isoGraph).
  - Fast and simple visualisation without any programming.
- Parameter setting
  - Easy and fast parameter setting of the device
  - Easy assignment and editing options for devices
- Maintenance
  - Data storage of specific events for fast support by Bender Service.

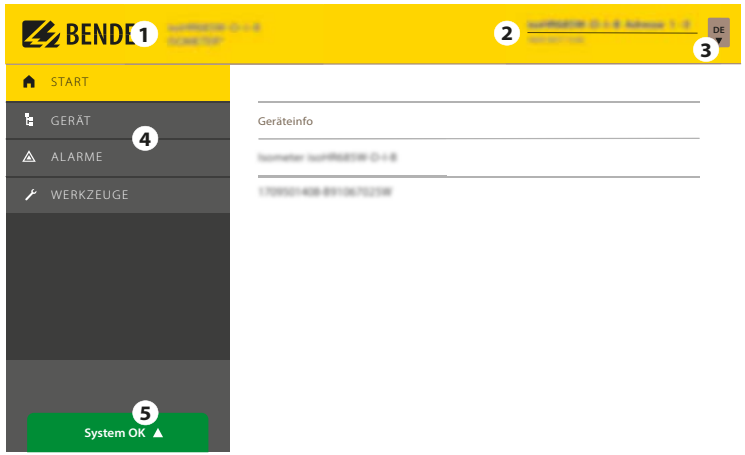
A maximum of 5 TCP/IP connections can be used simultaneously.

Only one device may access the web server at the same time. If several devices try to access the web server it may result in timeouts.

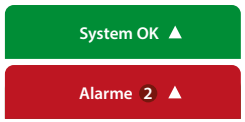
Device communication

Write access is deactivated by default in the device menu (= Deny). To set parameters via the web server, write access must first be activated in the device menu (= Allow) (see "Write access" on page 57).

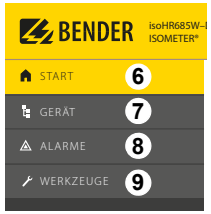
10.4.1 Web server user interface



Legend for user interface

1	LOGO	Logo and device identification
2	System information	Device address Date and time when browser system was accessed. The web interface does not show the current time on the ISOMERTER®. Instead, the actual ISOMETER® time can be determined in the Menu **DEVICE -> Settings -> clock**.
3	Language	Changing the language settings
4	Main menu	Main menu of the web server (first level) • START (1) • DEVICE (2) • ALARMS (3) • TOOLS (4)
5	System message:	 If there are pending alarms, click on the red button or go to menu point "ALARMS" (3) to obtain further information.

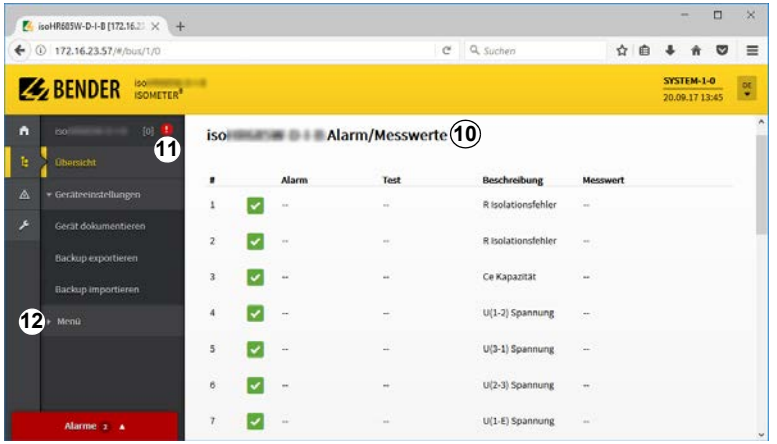
10.4.2 Web server device menu (first level)



Legend for web server device menu (first level)

6	START	Indication of general device information.
7	DEVICE	Indication of an overview of alarm values and measured values. Display and changing the settings.
8	ALARMS	Indication of alarm messages.
9	TOOLS	

10.4.3 Webserver submenu tool



10	Menu path	Displays the current menu path
11		Measurement OK Measurement error
12	Submenu	Submenu closed Submenu open

Device communication

10.5 BS bus

The BS bus is used to extend Bender measuring devices (e.g. ISOMETER®) It is an RS-485 interface with a specially developed protocol for Bender devices. On the BS bus, the transmission of alarm messages takes priority over the transmission of all other messages. For further information, refer to the BS bus manual (document number: D00278) at www.bender.de/manuals.

CAUTION

When using interface converters, a galvanic separation is required.

The compatibility of the BS bus and the BMS bus is restricted!

10.5.1 Master-slave principle

The BS bus works according to the master-slave principle. This means that the measuring device operates as the MASTER, while all sensor devices operate as SLAVES. The master is responsible for the communication necessary for the measuring function. It also provides the required bus bias voltage for the operation of the BS bus.

10.5.2 Addresses and address ranges on the BS bus

Address 1 is assigned to the master. All sensor devices receive unique addresses starting with address 2, assigned in consecutive order without gaps. In the event of a device failure, a maximum gap of 5 addresses is permissible.

10.5.3 RS-485 specifications/cables

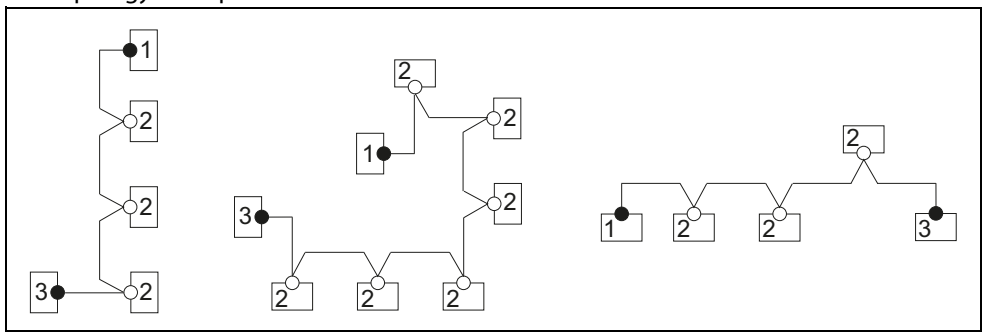
The RS-485 specification restricts the cable length to 1200 m and requires a daisy chain connection. The number of devices on the BS bus is only limited by the BS bus master.

Use twisted pair, shielded cables for bus cabling. For example, cable type J-Y(St)Y n x 2 x 0.8 is suitable. The shield must have a single-ended connection to earth. The BS bus must be terminated at both ends with terminating resistors (120 Ω, 0.25 W). The terminating resistors are connected in parallel to the terminals A and B. Some devices feature integrated terminating resistors and can be activated or deactivated via the "R" button.

10.5.4 Cable routing

The optimum cable routing for the BS bus is a double-terminated bus topology. The length of the branch line is limited to 1 m. These branch lines do not have to be terminated.

Bus topology examples:



Termination

1	Master	Terminating resistor activated via switch on device (ON) or external terminating resistor between terminals A and B
2	Slave	Terminating resistor deactivated via switch on device (OFF)
3	Slave	Terminating resistor activated via switch on device (ON) or external terminating resistor between terminals A and B

CAUTION

Only the first and last device may be terminated. Therefore, check all devices.

11. Device profiles

Adjustment to different applications can be carried out very easily by selecting a device profile.

	Nominal system voltage	System frequency	System leakage capacitance	Measuring voltage	Measuring range	Response values	Description
Power circuits	AC 0…690 V/ DC 0…1000 V	15…460 Hz	0…150 µF	± 50 V	0.1 kΩ…20 MΩ	1 kΩ…10 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 inverters and dynamic frequency control, select inverters > 10 Hz or inverters < 10 Hz.
Control circuits	AC 0…230 V/ DC 0…230 V	15…460 Hz	0…150 µF	± 10 V	0.1 kΩ…20 MΩ	1 kΩ…10 MΩ	This profile is used to reduce the measurement voltage to ±10 V in control systems with lower nominal voltages in order to reduce the impact by the ISOMETER® on sensitive switching elements.
Generator	AC 0…690 V	50…60 Hz	0…5 µF	± 50 V	0.1 kΩ…20 MΩ	1 kΩ…10 MΩ	This profile allows the realisation of a very fast measuring time, e.g. as required for generator monitoring. Furthermore, this profile can be used to support fast fault localisation in an IT system. The generator profile is suitable for AC systems containing DC components.
High capacitance	AC 0…690 V/ DC 0…1000 V	15…460 Hz	0…1000 µF	± 50 V	0.1 kΩ…20 MΩ	1 kΩ…10 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.
Inverter > 10 Hz	AC 0…690 V/ DC 0…1000 V	10…460 Hz	0…20 µF	± 50 V	0.1 kΩ…20 MΩ	1 kΩ…10 MΩ	This profile is used for systems with dynamic frequency control by inverters in the range 10 to 460 Hz in order to optimise the measurement with respect to the measuring time and quality.
Inverter <10 Hz	AC 0…690 V/ DC 0…1000 V	0.1…460 Hz	0 …20 µF	± 50 V	0.1 kΩ…20 MΩ	1 kΩ…10 MΩ	For systems involving extremely low frequency control in the range of up to 0.1...460 Hz and very low and continuously changing extraneous DC voltages due to dynamic load conditions in an IT system, continuous insulation monitoring can be optimised using this profile.*
Customer specific	–	–	–	–	–	–	Allows Bender service to make customer-specific settings. If no settings are made by Bender service, then the profile has the same parameters as the "Power circuits" profile.

For response times, see "Diagrams" on page 67.

When another profile is selected, the value of R_{min} is reset.
Switching between profiles can result in longer measuring times.

**** Low frequency mains voltage***
For very low frequency networks, the nominal system voltage is reduced according to the specifications in the chapter "Technical data" on page .72

12. Special functions for coupled IT systems

12.1 Particularities when monitoring coupled IT systems

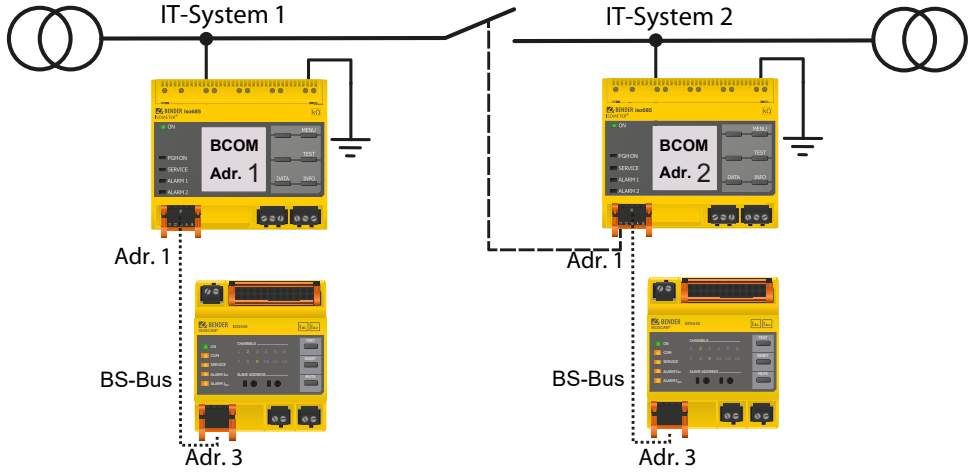
When using ISOMETER®s in IT systems, make sure that only ONE active ISOMETER® is connected in each galvanically interconnected system. If several ISOMETER®s are to be connected to the IT system, ensure that only one ISOMETER® is active in the IT system via system isolation using the digital input or Ethernet (ISOnet function).

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.

12.2 System isolation via digital input with two coupled systems

The coupling switch must have a free contact so that the ISOMETER® iso685–x–P can be deactivated via one of the digital inputs.



Via the X1 connector, the ISOMETER® can be isolated from the IT system and the measuring functions can be deactivated. Therefore, the function of the digital input in use has to be set to "device inactive".

If the digital input used for this function is selected, the connectors L1/+, L2, L3/- are deactivated via internal system isolating switches, the measuring function stops and the following message appears on the display: "Device inactive. Device disconnected".

Stored fault messages are reset when the cause of the fault has been eliminated (Reset function).

If the digital input is no longer selected, first the connection to the IT system is restored and afterwards, an entirely new measuring cycle for the insulation monitoring starts.

This function can be used to disconnect the second ISOMETER® selectively in coupled IT systems via the auxiliary contact of the coupling switch.

Special functions for coupled IT systems

12.3 System separation via ISOnet

The ISOnet function ensures via an Ethernet connection that only one ISOMETER® of the interconnection is active when several ISOMETER®s are connected to an IT system.

CAUTION

For several ISOMETER®s to be able to measure in the same ISOnet interconnection, the settings for the BCOM system name and the BCOM subsystem have to be the same. Only the device address has to be different. If this is not taken into account, the ISOnet function will not work.

If the ISOnet function is deactivated in an ISOMETER® in an ISOnet interconnection, it will measure continuously and will not forward measuring commands to the next device in the interconnection.

In comparison to a solution with coupling switches and function input, the response time will be extended because the measurement in the IT system is not carried out continuously.

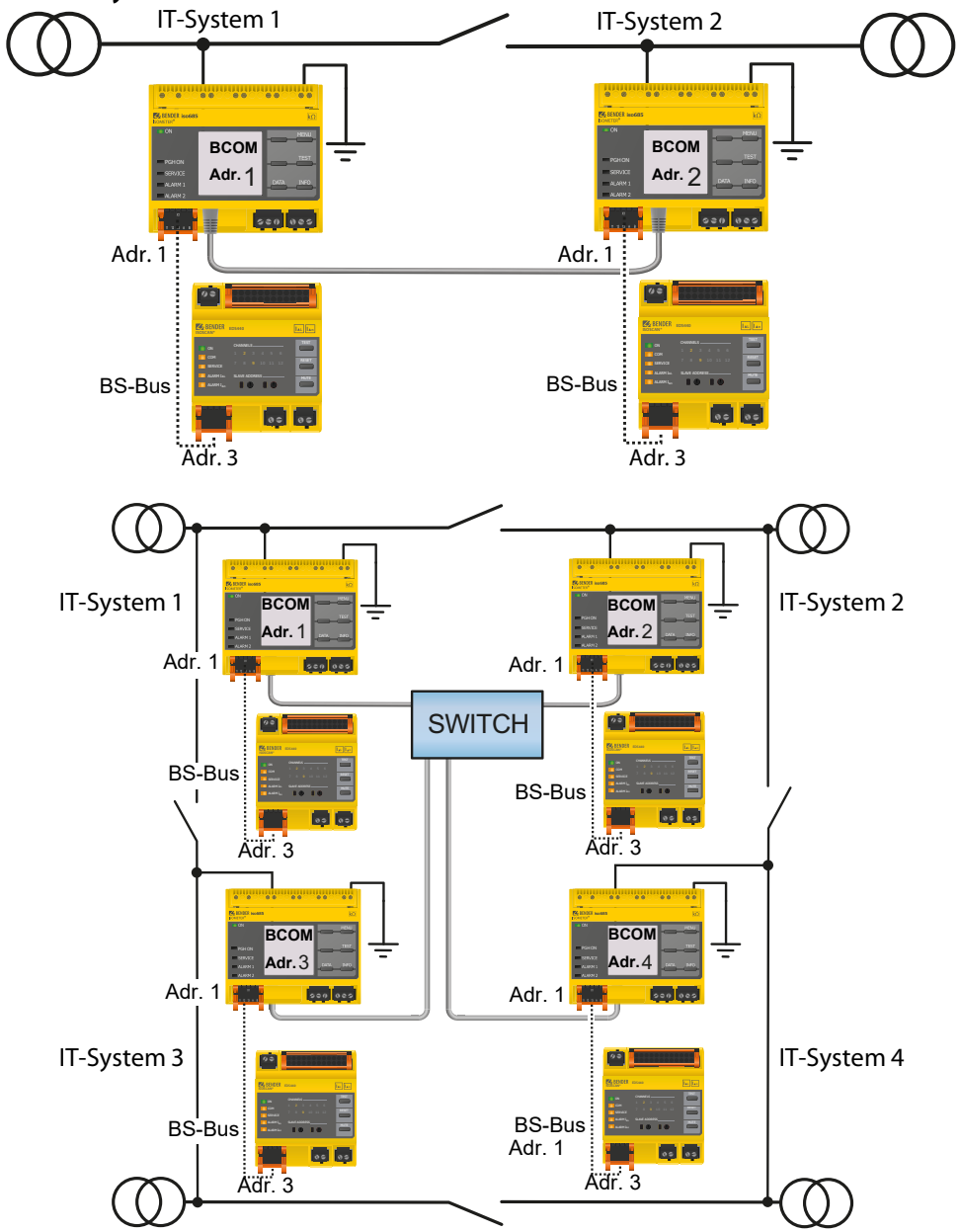
The addresses of the ISOMETER®s in the ISOnet interconnection can be selected at will. The addresses do not have to be subsequent but they have to differ from each other.

If in addition to the ISOnet interconnection the digital inputs are wired and a device is deactivated via a digital input, the device will forward the measuring authorisation until the signal at the digital input disappears. Afterwards, it participates again in the the measuring interconnection.

The IP address of the standard gateway must suit the subnet mask, so that the ISOnet function can operate correctly.

Maximum number of devices in an ISOnet interconnection: 20 devices

12.3.1 System structure



Special functions for coupled IT systems

12.3.2 Configuration and function

For the ISOnet function, the following settings are made in the menu: `Alarm settings -> ISONet -> ISONet = BCOM`. The ISOnet function of all ISOMETER®s existing in the system has to be activated and the number of devices has to be determined - this can be carried out in the menu `Alarm settings ->Number of participants`.

Also the parameters of the Ethernet (DHCP on or IP address, sub net mask and default gateway) and BCOM have to be set so that the devices in the ISOnet interconnection can communicate with each other.

After starting the system, the devices initialise. The initialisation phase ends when the configured number of devices has been reached. Then, the device starts with a measuring cycle with the smallest address. When an ISOMETER® has finished one measuring cycle, the authorisation for insulation measurement is forwarded to the ISOMETER® with the next higher address. While one ISOMETER® is measuring, all other ISOMETER®s are isolated from the system via internal system isolation switches.By limiting to one subsystem it is possible to have several ISOnet interconnections running in one system.

If a single device fails, the remaining ISOMETER®s continue the ISOnet operation. For the failure of one device, two scenarios are possible:

- A device fails during the measuring process.
  After timeout, another device takes over the measuring function.
  In this way, all devices monitor each other.
- The device fails in the inactive mode.
  When forwarding the measuring authorisation, the device is skipped and the next device carries out the measurement.

If a device that has failed before returns, it is taken into the interconnection again and will have its turn during the next run.

13. Insulation fault location

13.1 General description

An additional function of the ISOMETER® in combination with the EDS is the selective insulation fault location. The insulation faults detected in the IT system by the ISOMETER® can be located by means of an EDS and a measuring current transformer.

For further information regarding the function principle of the insulation fault location, refer to 3.4 "Insulation fault location" on page 13.

13.2 Required settings for insulation fault location

Connecting and commissioning the system consisting of ISOMETER® and EDS correctly.

For further information regarding the connection of the EDS, refer to 6.11 “Connecting the EDS to the ISOMETER®” from page 26, at7.2 "Commissioning procedure - steps for commissioning" on page 32 and to the corresponding manual of the EDS.

Setting locating current and EDS mode.

These settings can be made either during initial commissioning (see 7.1 “General initial commissioning process” from page 32) or in the device menu of the ISOMETER® (see 9.1 (2.0) “EDS (insulation fault location)” from page 49).

For further information regarding the locating current for insulation fault location, refer to 9.2 (2.1.1) "Current" on page 49.

For further information regarding EDS modes, refer to 9.2 (2.1.2) "Mode" on page 50.

13.3 Indication on the display

The active insulation fault location is indicated on the display of the ISOMETER®.

For further information, refer to 8.7 “Initial measurement” from page 39.

13.4 Starting and stopping the insulation fault location

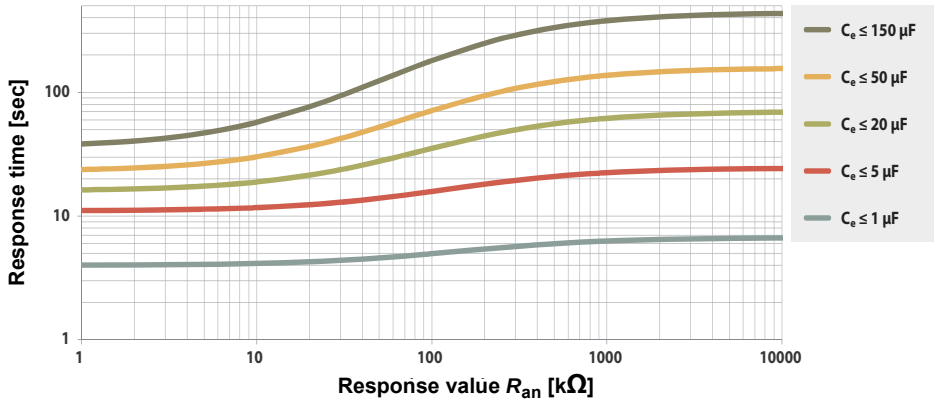
The insulation fault location can be started and stopped via different interfaces:

- Shortcut button "EDS"
  Manually starts/stops the insulation fault location, which runs continuously. If the device is started continuously, it measures until it is manually stopped via the shortcut button (see “Display elements and device buttons” on page 17).
- Device menu
- Modbus
- Web server
- Digital input

For further information regarding start and stop conditions of the insulation fault location, refer to 9.2 (2.1.2) "Mode" on page 50.

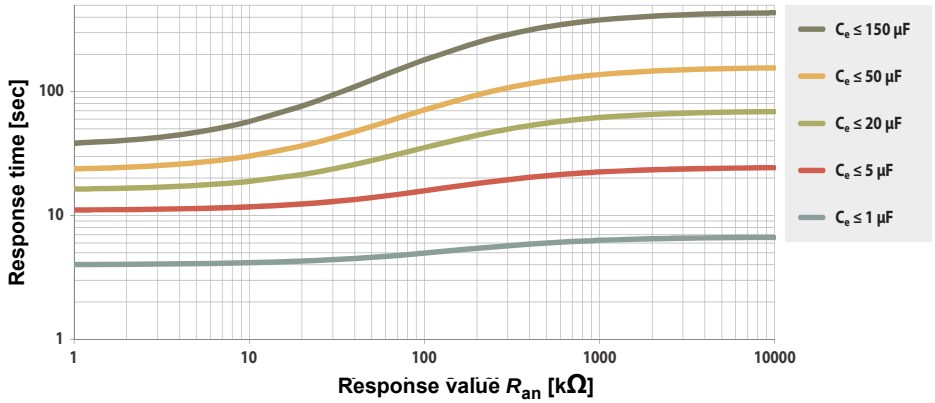
14.1 Response time profile power circuits

Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



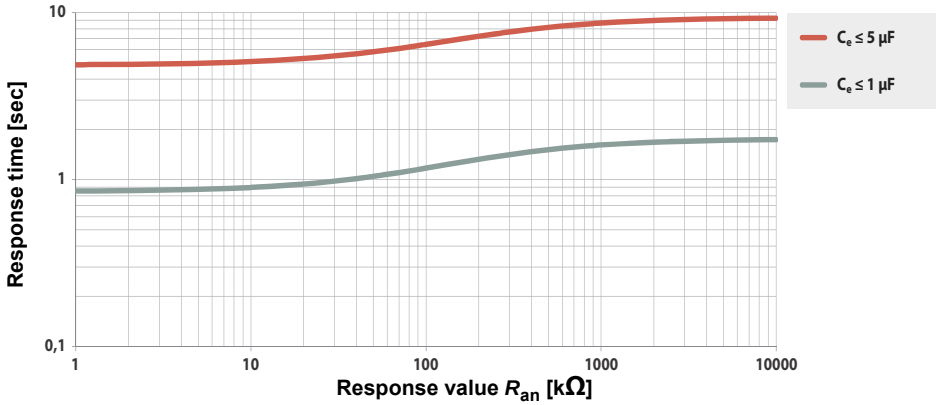
14.2 Response time profile control circuits

Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 230 V, f = 50 Hz) measuring range < 10 MΩ



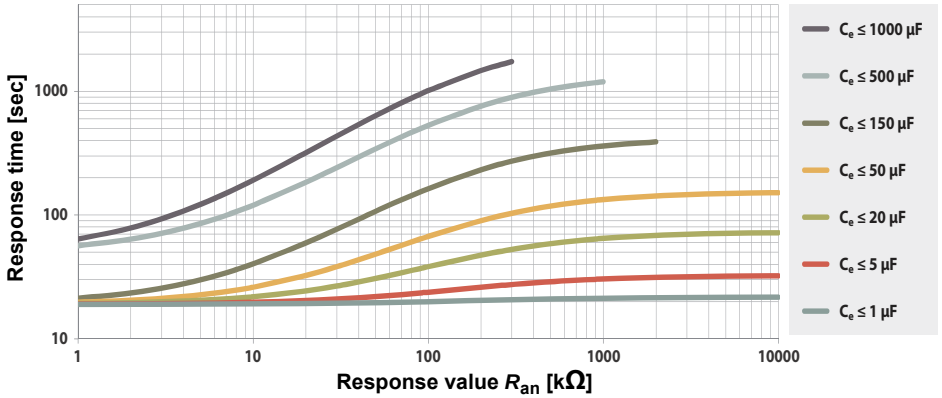
14.3 Response time profile generator

Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



14.4 Response time profile high capacitance

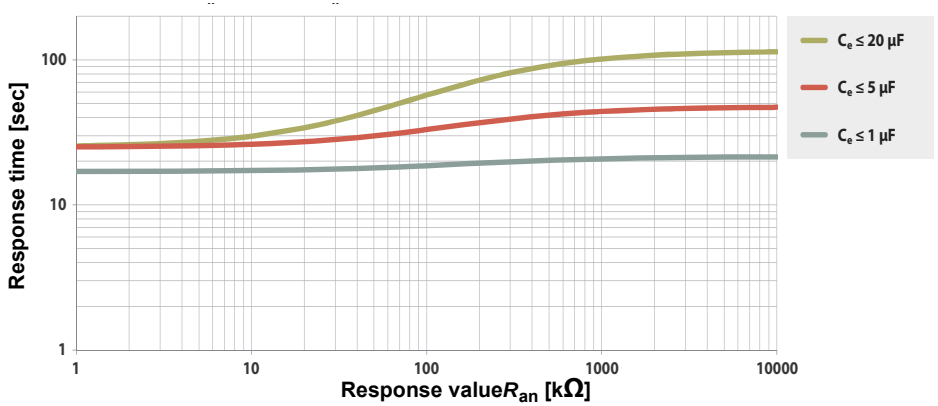
Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



Diagrams

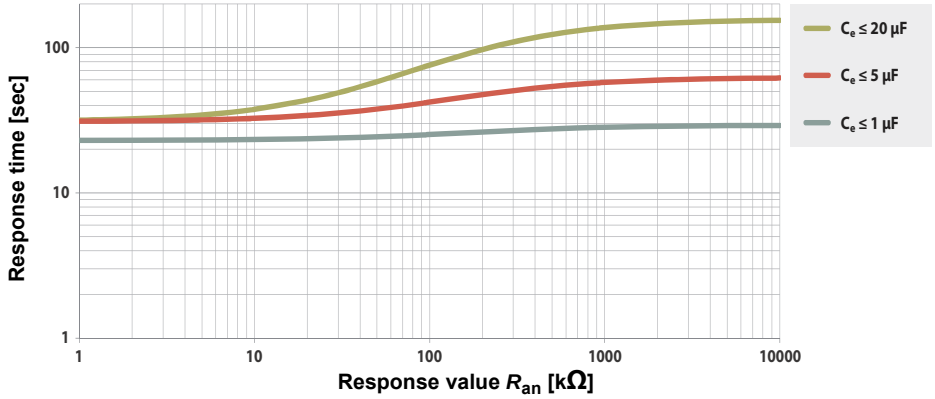
14.5 Response time profile inverter > 10 Hz

Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



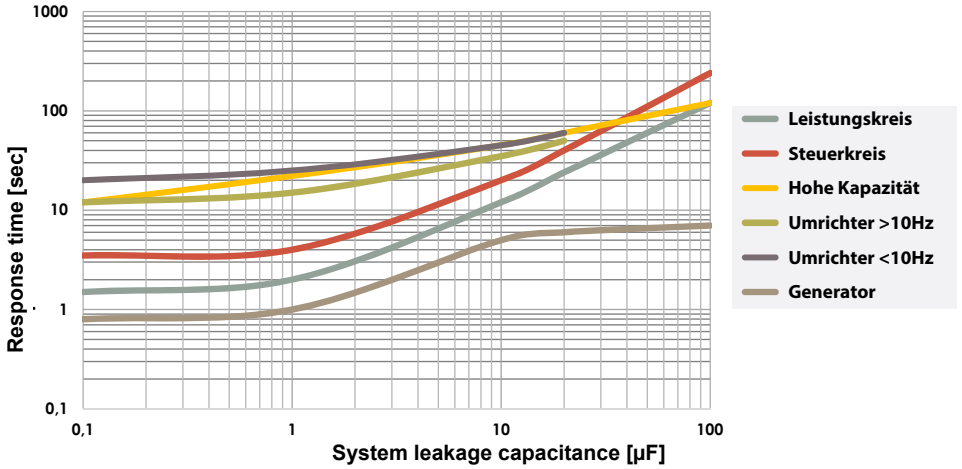
14.6 Response time profile inverter < 10 Hz

Response time as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



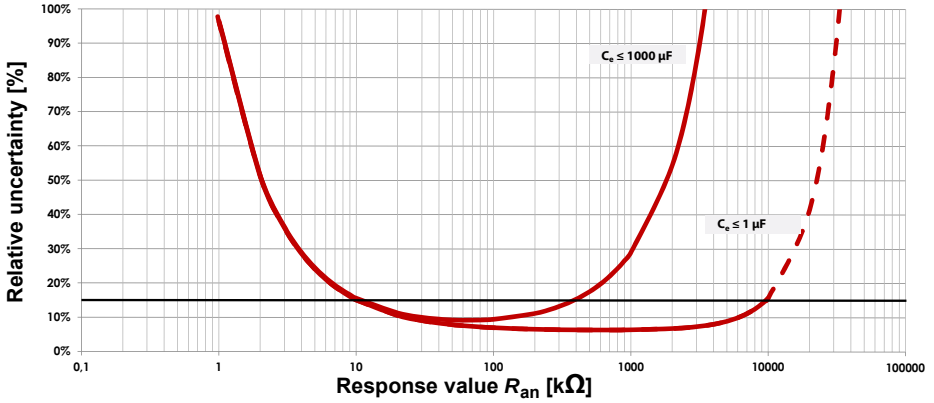
14.7 Response time DC Alarm

Typical response times for DC alarm for RF depending on system profile and system leakage capacitance



14.8 Operating uncertainty

Percentage operating uncertainty as a function of the response value and system leakage capacitance according to IEC 61557-8 (U_n = 690 V, f = 50 Hz) measuring range < 10 MΩ



15.1 Alarm messages of the ISOMETER®

Alarm message	Description	Actions	Reference	LED indicators
Insulation fault	An insulation fault exists. The insulation resistance falls below the response value R_{an1}.	• Observe insulation resistance in the monitored system and, if necessary, eliminate fault. • Reset fault message by pressing the reset button	"Function description" on page 12	ALARM 1 lights
Insulation fault	An insulation fault exists. The insulation resistance falls below the response value R_{an2}.	• Eliminate insulation fault in the system being monitored • Reset fault message by pressing the reset button	"Function description" on page 12	ALARM 2 lights
Check L1-L2-L3 for correct connection!	No low-resistance connection between the line conductors	• Check the wiring of the terminals L1/+, L2 and L3/- to the IT system • Press the test button • Check mains voltage • Check the fuses • Check set system type	"Connection" from page 21 & menu setting "System type" on page 44	ALARM 1 + ALARM 2 flash alternately
Check that E-KE are properly connected.	No low-resistance connection between the terminals E and KE to earth (PE)	• Check the wiring of the terminals E and KE to earth (PE) • Press the test button	"Connection" from page 21	ALARM 1 + ALARM 2 flash in common mode
Service mode active!	The device is in maintenance condition	• Contact Bender Service		SERVICE lights up
Profile does not suit the application!	Wrong profile selected for this application	• Check measured system capacitance or system frequency in the Info menu • Select another profile taking the characteristics into consideration	"Profile" on page 44	
No DHCP server found!	Connection problem at the Ethernet interface	• Check cable connection at the Ethernet interface. • Check the DHCP server's availability. • Check the DHCP's interface configuration in the device	"DHCP" on page 57	
Check time and date!	Time and date have not yet been set.	• Set local date and time (buffer of three days in case of voltage failure)	"Clock" on page 56	
Load on X1 too high!	Sum of the external loads on X1 is too high	• Check load at X1.+, X1.Q1 and X1.Q2 • Check ambient temperature		
Device error x.xx	Internal device error	• Press the test button • Switch the supply voltage on and off • Contact Bender Service		SERVICE lights up
Num. ISOnet devices	The configured number of devices does not match the number of devices that are actually included in the ISOnet interconnection.	• Check settings • Check Ethernet connection	"System separation via ISOnet" on page 64	
Failure Address	One device of the ISOnet interconnection is not accessible.	• Check Ethernet connection • Check device function	"System separation via ISOnet" on page 64	
Disturbance ISOnet	General fault at ISOnet, which is not covered by "Num.ISOnet devices" and "Failure address". For example, sending messages can fail or another device cannot process a message.	• Check Ethernet connection • Check device function • Switch OFF an switch ON th power supply	"System separation via ISOnet" on page 64	

Alarm message	Description	Actions	Reference	LED indicators
DC offset voltage	There is a DC offset voltage in the system.	• Check insulation fault and eliminate fault of DC components.	"DC alarm" on page 44	
Undervoltage	Operating outside the specified supply voltage range	• Check supply voltage		
Overvoltage	Operating outside the specified supply voltage range	• Check supply voltage		
Synchronizing ...	The device synchronises itself over a longer period of time. (longer than 5 minutes)	• Restart the device		

15.2 Alarm messages of the EDS

Alarm message	Description	Measures	Reference	LED indicators
Insulation fault location disturbed!	Interferences during insulation fault location Possible causes: • Low-frequency residual currents • External magnetic fields	• Identify interference sources and eliminate them		
insulation fault x mA	If an insulation fault is located, the message Insulation fault 5 mA appears on the display. The level of the locating current gives information regarding the faulty outgoing circuit. The higher the locating current, the lower the insulation resistance on the detected channel.	• Determine cause of the insulation fault and eliminate it.		
Interference CT connection	A measuring current transformer has not been connected correctly or does not work.	• Check wiring of the measuring current transformers • Check device function • Start new search for EDS channels • Deactivate channel without CT	"Scanning channels" on page 50 & "Activating channels" on page 50	
CT short circuit	Connection fault of CTs Possible causes: • Measuring current transformer defective • Power supply cable short-circuited	• Replace defective measuring current transformer • Check cables		
Residual current	The set response value of the residual current has been exceeded on one channel.	• Determine cause of the exceeded residual current and eliminate fault.		

Additionally, read the operating manual of the EDS.

16. Factory settings

Parameter	Value
Response values/alarms	
Response value R_{an1} (ALARM 1)	40 kΩ
Response value R_{an2} (ALARM 2)	10 kΩ
DC alarm	off
DC-offset voltage for DC alarm	65 V
Fault memory	off
Coupling monitoring	on
System	
System type	3AC
System profile	Power circuits
Time response	
Start-up delay $T_{start-up}$	0 s
Digital inputs	
Digital input 1	
Mode (Operating mode)	Active high
Function	TEST
Digital input 2	
Mode (Operating mode)	active low
Function	RESET
Digital input 3	
Mode (Operating mode)	Active high
Function	Deactivate device
Digital outputs	
Digital output 1	
Function 1	off
Function 2	off
Function 3	off
Digital output 2	
Function 1	off
Function 2	off
Function 3	off

Parameter	Value
Switching elements	
Relay 1	
Test	on
Relay mode	N/C operation
Function 1	Ins. Alarm 1
Function 2	Connection fault
Function 3	off
Relay 2	
Test	on
Relay mode	N/C operation
Function 1	Ins. Alarm 2
Function 2	Device fault
Function 3	Connection fault
Interfaces	
DHCP	off
IP address	192.168.0.5
Net mask	255.255.255.0
BCOM address	system-1-0
Device address BS bus	3
ISOnet	
ISOnet	off
EDS	
Mode	auto
Current	10 mA

17.1 Tabular data

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

Definitions:

- Measuring circuit (IC1) ... L1/+, L2, L3/-
- Supply circuit (IC2) ... A1, A2
- Output circuit 1 (IC3) ... 11, 12, 14
- Output circuit 2 (IC4) ... 21, 22, 24
- Control circuit (IC5) (E, KE), (X1, ETH, X3, X4)

Rated voltage ... 1000 V
Overvoltage category ... III
Rated impulse voltage:

- IC1 / (IC2-5) ... 8 kV
- IC2 / (IC3-5) ... 4 kV
- IC3 / (IC4-5) ... 4 kV
- IC4 / IC5 ... 4 kV

Rated insulation voltage:

- IC1 / (IC2-5) ... 1000 V
- IC2 / (IC3-5) ... 250 V
- IC3 / (IC4-5) ... 250 V
- IC4 / IC5 ... 250 V

Pollution degree (U_n <1000 V) ... 3
Pollution degree for accessible parts on the outside of the device housing (U_n 690 < 1000 V) ... 2
Safe isolation (reinforced insulation) between:

- IC1 / (IC2-5) ... Overvoltage category III,1000 V
- IC2 / (IC3-5) ... Overvoltage category III, 300 V
- IC3 / (IC4-5) ... Overvoltage category III, 300 V
- IC4 / IC5 ... overvoltage category III, 300 V

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

- IC2 / (IC3-5) ... AC 2.2 kV
- IC3 / (IC4-5) ... AC 2.2 kV
- IC4 / IC5 ... AC 2.2 kV

Supply voltage

Supply via A1/+, A2/-:
Supply voltage range U_s ... AC/DC 24 . . . 240 V
Tolerance of U_s ... -30 . . . +15 %
Maximum permissible input current of U_s ... 650 mA
Frequency range of U_s ... DC, 50 . . . 400 Hz[1)]
Tolerance of the frequency range of U_s ... -5 . . . +15 %
Power consumption, typically DC ... ≤ 12 W
Power consumption, typically 50/60 Hz ... ≤ 12 W/21 VA
Power consumption, typically 400 Hz ... ≤ 12 W/45 VA

Supply via X1:
Supply voltage U_s ... DC 24 V
Tolerance of U_s ... DC -20 . . . +25 %

IT system being monitored

Nominal system voltage range U_n ... AC 0 . . . 690 V
... DC 0 . . . 1000 V
... AC/DC 0 . . . 600 V (for UL applications)
Tolerance of U_n ... AC/DC +15 %
Frequency range of U_n ... DC 0.1 . . . 460 Hz
Max. AC voltage $U_{\sim}$ in the frequency range f_n = 0.1 . . . 4 Hz ... $U_{\sim\ max} = 50\ V/Hz^2 * (1 + f_n^2)$

Response values

Response value R_{an1} (Alarm 1) ... 1 kΩ . . . 10 MΩ
Response value R_{an2} (Alarm 2) ... 1 kΩ . . . 10 MΩ
Relative uncertainty (acc. to IEC 61557-8) ... dependent on the profile, ±15 %, at least ±1 kΩ
Hysteresis ... 25 %, at least 1 kΩ

Time response

Response time t_{an} at R_F (= 0,5 x R_{an} (R_{an} = 10 kΩ) and C_e = 1 µF acc. to IEC 61557-8 ...
... profile dependent, typ. 4s (see diagrams)
Response time DC Alarm at C_e = 1 µF acc. to IEC 61557-8 ... profile dependent, typ. 2 s (see diagram)
Start-up delay $T_{start-up}$ ... 0 . . . 120 s

Measuring circuit

Measuring voltage U_m ... profile dependent, ±10 V, ±50 V (see profile overview)
Measuring current I_m ... ≤ 403 µA
Internal resistance R_i ,Z_i ... ≥ 124 kΩ
Internal resistance on decouppled systems (inactive by I/O, inactive by ISOnet or cut-off) ... typ. 50 MΩ
Permissible extraneous DC voltage U_{fg} ... ≤ 1200 V
Permissible system leakage capacitance C_e ... profile dependent, 0 . . . 1000 µF

Measuring ranges

Measuring range f_n ... 0.1 . . . 460 Hz
Tolerance measurement of f_n ... ±1 % ±0.1 Hz
Voltage range measurement of f_n ... AC 25 . . . 690 V
Measuring range U_n (without an external coupling device) ... AC 25 . . . 690 V
... DC 0 . . . 1000 V
Voltage range measurement of U_n ... AC/DC > 10 V
Tolerance measurement of U_n ... ±5 % ±5 V
Measuring range C_e ... 0 . . . 1000 µF
Tolerance measurement of C_e ... ±10 % ±10 µF
Frequency range measurement of C_e ... DC, 30 . . . 460 Hz
Min. insulation resistance measurement of C_e ... depending on the profile and coupling mode, typ. > 10 kΩ

Technical data

Display

Indication ..... graphic display 127 x 127 pixels, 40 x 40 mm [2)]
Display range measured value ..... 0.1 kΩ . . . 20 MΩ
Operating uncertainty (acc. to IEC 61557-8) ..... ±15%, min. 1 kΩ

LEDs

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

Inputs/outputs (X1-Interface)

Cable length X1 (unshielded cable) ..... ≤ 10 m
Recommended cable (shielded, shield connected to PE on one side: J-Y(St)Y min. 2x0.8) ..... ≤ 100 m
Total max. supply output current via X1.+/X1.GND for each output ..... max. 1 A
Total max. supply output current via A1/A2 in total on X1 ..... max. 200 mA
Total max. supply output current via A1/A2 in total on X1 between 16.8 V and 40 V .....
..... $I_{LmaxX1} = 10mA + 7mA/V * U_s$ [3)]
..... (negative values are not allowed for I_{LmaxX1})

Digital inputs (I1, I2, I3)

Number 3
Operating mode, adjustable ..... active high, active low
Functions ..... off, test, reset, deactivate device, start initial measurement
Voltage ..... Low DC -3 . . . 5 V, High DC 11 . . . 32 V
Voltage tolerance ..... ± 10 %

Digital outputs (Q1, Q2)

Number 2
Operating mode, adjustable active, passive
Functions ..... off, Ins. alarm 1, Ins. Alarm 2, connection fault, DC- alarm [4)], DC+ alarm [4)], symmetrical alarm,
..... device fault, common alarm, measurement complete, device inactive, DC offset alarm
Voltage passive ..... DC 0 . . . 32 V, active DC 0/19.2 . . . 32 V

Analogue output (M+)

Number 1
Operating mode ..... linear, midscale point 28 kΩ/120 kΩ
Functions ..... insulation value, DC shift
Current 0...20 mA (< 600 Ω), 4 . . . 20 mA (< 600 Ω), 0 . . . 400 µA (< 4 kΩ)
Voltage 0 . . . 10 V (>1 kΩ), 2 . . . 10 V (>1 kΩ)
Tolerance related to the current/voltage final value ..... ± 20 %

Interfaces

Field bus:

Interface/protocol ..... Web server/Modbus TCP/BCOM
Data rate ..... 10/100 Mbit/s, autodetect
Max. number of Modbus requests ..... <100/s
Cable length ..... ≤ 100 m
Connection RJ45
IP address ..... DHCP/manual* 192.168.0.5*
Network mask 255.255.255.0*
BCOM address system-1-0
Function ..... communication interface

ISOnet

Number ISOnet devices ..... ≤ 20
Max. nominal system voltage range ISOnet ..... AC 690 V
DC 1000 V

Sensor bus:

Interface/Protocol ..... RS-485 / BB-Bus
Data rate mode 1 ..... 9.6 kBaud/s
Leitungslänge (dependant on the Baudrate) ..... ≤1200 m
Cable: twisted pair, one end of shield connected to PE ..... recommended: J-Y(St)Y min. 2x0.8
Connection ..... terminals X1.A, X1.B
Terminating resistor ..... 120 Ω, can be connected internally
Device address ..... 1 . . . 90

Switching elements

Number of switching elements ..... 2 changeover contacts
Operating mode ..... N/C operation/N/O operation
Contact 11-12-14 ..... off, Ins. alarm 1, Ins. Alarm 2, connection fault, DC- alarm [4)], DC+ alarm [4)], symmetrical alarm,
..... device fault, common alarm, measurement complete, device inactive, DC offset alarm
Contact 21-22-24 ..... off, Ins. alarm 1, Ins. Alarm 2, connection fault, DC- alarm [4)], DC+ alarm [4)], symmetrical alarm,
..... device fault, common alarm, measurement complete, device inactive, DC offset alarm
Electrical endurance under rated operating conditions, 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 / 0.1 A
Rated insulation voltage ≤ 2000 m NN ..... 250 V
Rated insulation voltage ≤ 3000 m NN ..... 160 V
Minimum contact rating ..... 1 mA at AC/DC ≥ 10 V

Technical data

Environment/EMC and temperature range

EMC ..... IEC 61326-2-4[5)]
Operating temperature ..... -25 . . . +55 °C
Transport ..... -40 . . . +85 °C
Long-term storage ..... -40 . . . +70 °C

Classification of climatic conditions acc. to IEC 60721:

Staionary use (IEC 60721-3-3) ..... 3K5 (condensation and formation of ice possible)
Transport (IEC 60721-3-2) 2K3
Long-term storage (IEC 60721-3-1) 1K4

Classification of mechanical conditions acc. to IEC 60721:

Stationary use (IEC 60721-3-3) 3M4
Transport (IEC 60721-3-2) 2M2
Long-term storage (IEC 60721-3-1) 1M3
Area of application ..... ≤3000 m NN

Connection

Connection type ..... pluggable screw terminal or push-wire terminal

Screw-type terminals:

Nominal current ..... ≤ 10 A
Tightening torque ..... 0.5 . . . 0.6 Nm (5 . . . 7 lb-in)
Conductor sizes ..... AWG 24-12
Stripping length ..... 7 mm
rigid/flexible ..... 0.2 . . 2.5 mm^2
flexible with ferrules, with/without plastic collar ..... 0.25 . . 2.5 mm^2
Multiple conductor, rigid ..... 0.2 . . . 1 mm^2
Multiple conductor, flexible ..... 0.2 . . 1.5 mm^2
Multiple conductor, flexible with ferrule without plastic sleeve ..... 0.25 . . . 1 mm^2
Multiple conductor, flexible withTWIN ferrule with plastic sleeve ..... 0.5 . . . 1.5 mm^2

Push-wire terminals:

Nominal current ..... ≤ 10 A
Conductor sizes ..... AWG 24-12
Stripping length ..... 10 mm
rigid/flexible ..... 0.2 . . 2.5 mm^2
flexible with ferrules, with/without plastic collar ..... 0.25 . . 2.5 mm^2
Multiple conductor, flexible withTWIN ferrule with plastic sleeve ..... 0.5 . . . 1.5 mm^2

Push-wire terminals X1:

Nominal current ..... ≤8 A
Conductor sizes ..... AWG 24-16
Stripping length ..... 10 mm
rigid/flexible ..... 0.2 . . . 1.5 mm^2
flexible with ferrule without plastic sleeve ..... 0.25 . . . 1.5 mm^2
flexible with ferrule with plastic sleeve ..... 0.25 . . . 0.75 mm^2

Other

Operating mode continuous operation
Mounting (0°) display oriented, cooling slots must be ventilated vertically[6]
Degree of protection internal components IP40
Degree of protection terminals IP20
DIN rail mounting acc. to ..... IEC 60715
Screw fixing ..... 3 x M4 with mounting clip
Enclosure material ..... polycarbonate
Flammability class V-0
ANSI code 64
Dimensions (W x H x D) ..... 108 x 93 x 110 mm
Weight ..... < 390 g

[1)] at a frequency > 200 Hz, the connection of X1 ande Remote must be insulated. Only permanently installed devices which at least have overvoltage category CAT2 (300V) may be connected.
[2)] Indication limited outside the temperature range -25 . . . +55 °C.
[3)] U_s [Volt] = ISOMETER® supply voltage
[4)] For $U_n \geq 50$ V only.
[5)] This is a class A product. This product may cause radio interference in residential areas. In this case, the user may be required to take corrective actions.
[6)] Recommendation: Devices mounted at 0° (display oriented, cooling slots must be ventilated vertically)
For devices mounted at an angle of 45°, the max. working temperature is reduced by 10 °C.
For devices mounted at an angle of 90°, the max. working temperature is reduced by 20 °C.

17.2 Device feature W

Devices with the suffix "W“ feature increased shock and vibration resistance. The electronics is covered with a special varnish to provide increased protection against mechanical stress and moisture.

Combination of ISOMETER® sensor variant with the FP200W:
The requirements of Option "W" will only be fulfilled when the ISOMETER® sensor variant is mounted on DIN rail and connected to the FP200W via the patch cable.
Refer to the quick-start guide FP200 (Document number D00169).

Technical data

17.3 Standards and certifications

The ISOMETER® has been developed in compliance with the following standards:

- DIN EN 61557-8 (VDE 0413-8):2015-12
- IEC 61557-8:2014-12
- IEC 61557-8:2014/COR1:2016
- DIN EN 61557-8 Ber 1 (VDE 0413-8 Ber 1):2016-12

Subject to change! The standards specified take into account the valid edition up to 4/19/18, unless otherwise stated.

17.4 Ordering information

17.4.1 Device

Type	Supply voltage U_S	Art. No.
iso685–D–P	AC 24…240 V; 50…400 Hz; DC 24…240 V	B91067030
iso685W–D–P *	AC 24…240 V; 50…400 Hz; DC 24…240 V	B91067030W
Combination iso685–S–P + FP200	AC 24…240 V; 50…400 Hz; DC 24…240 V	B91067230
Combination iso685W–S–P + FP200W *	AC 24…240 V; 50…400 Hz; DC 24…240 V	B91067230W

* Option „W“: Increased shock and vibration resistance 3K5; 3M7; -40…+70 °C

17.4.2 Accessories

Description	Art. No.
iso685 Mechanical accessories comprising: Terminal cover and 2 mounting clips*	B91067903
iso685 Plug kit, screw terminals*	B91067901
iso685 plug kit, with push-wire terminals	B91067902
Front cover 144x72 transparent (IP65) for FP200 **	B98060005

* included in the scope of delivery

** If the “transparent front cover 144x72 (IP65)” is used, the cutout in the control cabinet must be increased in height from 66 mm to 68 mm (+ 0.7 / -0 mm).

17.4.3 Insulation fault locators

Type	Supply voltage U_S*	Response value	Art. no.
EDS440-S-1	AC/DC 24…240V	2…10mA	B 9108 0201
EDS440W-S-1	AC/DC 24…240V	2…10mA	B 9108 0201W
EDS440-L-4	AC/DC 24…240V	2…10mA	B 9108 0202
EDS440W-L-4	AC/DC 24…240V	2…10mA	B 9108 0202W
EDS441-S-1	AC/DC 24…240V	0,2…1mA	B 9108 0204
EDS441W-S-1	AC/DC 24…240V	0,2…1mA	B 9108 0204W
EDS441-L-4	AC/DC 24…240V	0,2…1mA	B 9108 0205
EDS441W-L-4	AC/DC 24…240V	0,2…1mA	B 9108 0205W
EDS441-LAB-4	AC/DC 24…240V	0,2…1mA	B 9108 0207
EDS441W-LAB-4	AC/DC 24…240V	0,2…1mA	B 9108 0207W

* Absolute values

17.4.4 Suitable system components

Description	Type	Art. No.
Suitable measuring instruments SKMP**: 28 kΩ,120 kΩ	7204-1421	B986763
	9604-1421	B986764
Current values: 0…400 µA, 0…20 mA (Further information can be found under this link)	9620-1421	B986841
Display for front-panel mounting	FP200	B91067904
	FP200W *	B91067904W
ISOMETER® sensor variant AC 24…240 V; 50…400 Hz; DC 24…240 V Only in combination with FP200	iso685–S–P	B91067130
ISOMETER® sensor variant * AC 24…240 V; 50…400 Hz; DC 24…240 V Only in combination with FP200W *	iso685W–S–P *	B91067130W

* Option „W“: Increased shock and vibration resistance 3K5; 3M7; -40…+70 °C

** SKMP = midscale point

BB bus	The BB bus is an interface which enables Bender devices to communicate with each other (Bender-internal device bus). The BB bus can be used with an ISOMETER® and one or more EDS44…-S.
BCOM	Protocol for communication between Bender devices via an IP-based network.
BS bus	The Bender sensor bus is an interface which enables Bender devices to communicate with each other (RS-485 interface).
DHCP	Dynamic Host Configuration Protocol. It is used to assign the network configuration to Clients via a server.
EDS	Insulation fault locator for fault location in an IT system.
EDS button	The shortcut button "EDS" manually starts the insulation fault location, which runs continuously until the button is pressed again, which stops the process immediately. (refer also to "Display elements and device buttons" on page 17).
EDS mode	The insulation fault location can be carried out in three different modes. Depending on the mode, the insulation fault location starts and stops due to different conditions (see also "Mode" on page 50).
ISOnet	Only one ISOMETER® may exist in an isolated system. If several networks monitored by an ISOMETER® are coupled, this function ensures via an Ethernet connection that only one ISOMETER® is actively measuring.
Modbus TCP	Modbus is an international widely spread protocol for data transfer.
PGH	PGH stands for locating current injector. The locating current injector generates a periodic locating current for insulation fault location. This locating current is detected by the measuring current transformers connected to the EDS and evaluated by the EDS.
"PGH ON" LED	The "PGH ON" LED flashes during insulation fault location. It indicates that the locating current for the insulation fault location is generated.
System (BCOM)	The system is the entire installation that is visible for the customer and defined by the customer. The BCOM communication takes place within this system. Naturally, different systems can exist independently in one network.
Subsystem (BCOM)	The subsystem structures parts of the system as units defined by the customer, e.g. all PQ devices. A typical subsystem are also "non BCOM-capable" devices that are hidden behind a proxy.
Web server	A web server presents the device functions graphically. The web server can be used for reading out measured values and for parameter setting.

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optec
energie ist messbar

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