EN Manual

EDS440…/441…

Insulating fault locator to locate insulation faults in ungrounded DC, AC and three-phase power supplies (IT systems)

EDS44…_D00201_02_M_XXEN/04.2017

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

Bender GmbH & Co. KG
Postfach 1161 • 35301 Gruenberg • Germany
Londorfer Straße 65 • 35305 Gruenberg • Germany

Tel.: +49 6401 807-0
Fax: +49 6401 807-259

E-Mail: info@bender.de
Web: www.bender.de

Customer service
Service-Hotline: 0700-BenderHelp (Telephone and Fax)
Carl-Benz-Straße 8 • 35305 Grünberg • Germany

Tel.:+49 6401 807-760
Fax:+49 6401 807-629

E-Mail:info@bender-service.com

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1. Important information

1.1 How to use this manual

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

Always keep this manual within easy reach for future reference.
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.

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

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

*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.*

This manual has been compiled with great care. It might nevertheless contain errors and mistakes. Bender cannot accept any liability for injury to persons or damage to property resulting from errors or mistakes in this manual.

1.2 Technical support: service and support

For commissioning and troubleshooting Bender offers you:

1.2.1 First level support

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
In Germany only: 0700BenderHelp (Tel. and Fax)
E-mail: support@bender-service.de

1.2.2 Repair service

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 Str. 65,
35305 Grünberg

1.2.3 Field service

On-site service for all Bender products

- Commissioning, configuring, maintenance, troubleshooting of 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 Manufacturer's Association) also applies.
Sale and delivery conditions can be obtained from Bender in printed or electronic format.

1.5 Inspection, transport and storage

Inspect the dispatch and equipment packaging for damage, and compare the contents of the package with the delivery documents. In the event of damage in transit, please contact Bender immediately. 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.

Important information

1.6 Warranty and liability

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

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

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

1.7 Disposal

Abide by the national regulations and laws governing the disposal of this device. Ask your supplier if you are not sure how to dispose of the old equipment.
The directive on waste electrical and electronic equipment (WEEE directive) and the directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS directive) apply in the European Community. In Germany, these policies are implemented through the "Electrical and Electronic Equipment Act" (ElektroG). According to this, the following applies:

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

For more information on the disposal of Bender devices, refer to our homepage at www.bender-de.com -> Service & support.

2.1 General safety instructions

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

2.2 Work activities on electrical installations

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

DANGER

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

- An electric shock
- Damage to the electrical installation
- Destruction of the device

***Before installing and connecting the device, make sure** that the **installation** has been **de-energised**. Observe the rules for working on electrical installations.*

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

2.3 Device-specific safety instructions

WARNING

Make sure that the basic settings meet the requirements of the IT system. Children and unauthorised persons must not have access to or contact with the ISOMETER®.

CAUTION

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

The EDS440 and EDS441 are built in accordance with state-of-the-art technology and the recognised safety regulations. However, the use of such devices may introduce risks to the life and limb of the user or third parties and/or result in damage to the EDS… or other property. Use the EDS… only:

- As intended
- In perfect working order

Immediately rectify any faults that may endanger safety. Do not make any unauthorised changes and only purchase spare parts and optional accessories recommended by the manufacturer of the devices. Failure to observe this requirement can result in fire, electric shock and injury.
Unauthorised persons must not have access to or contact with the EDS….
Reference signs must always be clearly legible. Replace damaged or illegible signs immediately.

2.4 Intended use

CAUTION

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

The insulation fault locator (IFL) EDS44… is used to locate insulation faults in unearthed DC, AC and three-phase power supply systems (IT systems). Depending on the locating current injector, AC and three-phase systems can be monitored within the range AC 24 to 1000 V; DC systems, within the range DC 24 to 1000 V. An AC residual current can be indicated within the range 42 Hz … 1 kHz, 100 mA…20 A (EDS440) or 100 mA…2 A (EDS441).
The EDS44… complies with the product standard IEC 61557-9.

An EDS system (insulation fault location system) consists of an insulation fault locator EDS440 or EDS441 and a locating current injector. Insulation fault locators EDS440 or EDS441 detect locating current signals generated by the locating current injector via measuring current transformers and evaluate them correspondingly.
Twelve (12) measuring current transformers can be connected for each EDS…. Up to 21 EDS… can be linked via the BS bus (Bender Sensor bus, RS-485 interface with BS protocol) and thereby, up to 252 measuring current transformers can be read. The scanning time for all measuring channels is at least 6 seconds, depending on the profile.

Intended use implies:

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

As a basic principle, our "General Conditions of Sale and Delivery" shall apply. At the latest, these shall be available to the operator when the contract is concluded.

2.5 Requirements for safe insulation fault location

The EDS… has the task of locating the insulation fault downstream of the measuring current transformer R_{Fd}. Therefore, it must reliably detect the locating current caused by the insulation fault. This is only possible under the following conditions:

- The locating current I_L is higher than 2 mA and lower than 50 mA for the EDS440.
- The locating current I_L is higher than 0.2 mA and lower than 5 mA for the EDS441.
- The upstream capacitances C_{Lu} must be at least as high as the downstream capacitances C_{Ld}.
- The system leakage capacitance must not be too high (refer to "Characteristic curves for response sensitivity" on page 39)
- The residual current can be within the following range: 100 mA…10 A (EDS440) or 100 mA…1 A (EDS441).
- Along with the amplitude, the frequency of the residual current influences the reliable detection of the locating current. With regard to this, observe the "Fault curve EDS440…" on page 48 and the "Fault curve EDS441…" on page 49.

Safety instructions

2.6 Periodic verification

The EDS system monitors itself during operation.

We recommend activating the test function on each connected EDS… regularly. There are different possibilities of starting a test:

- Select standard display and then press the "TEST" button on the EDS… for at least one second
- Press an external TEST button connected to the EDS…
- Send a TEST command via the BS bus

Observe the applicable national and international standards, which require regular testing of electrical equipment.

3.1 Features

3.1.1 Areas of application

- Insulation fault location in AC, 3AC and DC IT systems
- Main circuits and control circuits in industrial plants and ships
- Diode-decoupled DC IT systems in power plants
- Systems for medical locations

3.1.2 Standards

The standard for unearthed power supplies (IT systems) DIN VDE 0100-410 (VDE 0100-410):2007-06 (IEC 60364-4-41:2005, modified) requires that the first insulation fault is to be eliminated with the shortest practicable delay. EDS systems enable fast localisation of this insulation fault.

3.1.3 System variants

The insulation fault locators EDS440… and EDS441… differ depending on their response sensitivity. The EDS440… is suitable for main circuits. The EDS441… can be used in control circuits and in circuits in medical locations.

	-L	-S	-LAB-4
EDS440	• LED • BS bus • $I_{\Delta L}$ = 2…10 mA • Main circuits • Digital inputs and outputs	• No LED • BB bus • $I_{\Delta L}$ = 2…10 mA • Main circuits • No internal voltage supply	
EDS441	• LED • BS bus • $I_{\Delta L}$ = 0.2…1 mA • Control circuits • Digital inputs and outputs	• No LED • BB bus • $I_{\Delta L}$ = 0.2…1 mA • Control circuits • No internal voltage supply	• LED • BS bus • $I_{\Delta L}$ = 0.2…1 mA* • Control circuits • W…AB measuring current transformer • Digital inputs and outputs

* High response sensitivity with large system leakage capacitances.

3.1.4 System properties

- Universal system concept
- Modular design, therefore easily adjustable to the given circumstances
- Measuring current transformers available in various sizes and versions
- CT connection monitoring
- 12 measuring channels for measuring current transformer series W…, WR…, WS…
- Fault memory behaviour selectable
- Up to 21 EDS insulation fault locators in the system, 252 measuring channels
- Response sensitivity: EDS440 2…10 mA, EDS441 0.2…1 mA
- AC residual current measurement with configurable response value
- Two alarm relays with one N/O contact each
- N/O or N/C operation selectable
- External test/reset button
- Central indication of faulty outgoing circuits
- Serial interface RS-485, BS bus address range 2…90
- Connection to higher-level control and visualisation systems possible.

Function

3.1.5 Compatibility

Legend:
BS-Bus: Full compatibility, communication via BS bus
BB-Bus: Full compatibility, communication via BB bus
◊= Full compatibility, no communication
= Limited compatibility, communication via BS bus
Limited display of messages of the EDS44… on the device.
Limited parameterisation of the EDS44… via the device possible.
! = Limited compatibility, communication via BS bus
Display of all messages of the EDS44… on the device.
No parameterisation of the EDS44… via the device possible.

3.1.5.1 Insulation fault locators

Device	EDS440-L	EDS440-S	EDS441-L	EDS441-S	EDS441-LAB
EDS440-L	**BS-Bus**	◊			
EDS440-S	◊	**BB-Bus**			
EDS441-L			**BS-Bus**	◊	
EDS441-S			◊	**BB-Bus**	
EDS441-LAB					**BS-Bus**
EDS460/490L	**BS-Bus**	◊			
EDS460/490D	**BS-Bus**	◊			
EDS461/491L			**BS-Bus**	◊	
EDS461/491D			**BS-Bus**	◊	
EDS150	**BS-Bus**	◊			
EDS151			**BS-Bus**	◊	
EDS195P	◊	◊	◊	◊	

3.1.5.2 Measuring current transformers and measuring clamps

Device	Type	EDS440-L	EDS440-S	EDS441-L	EDS441-S	EDS441-LAB
W…/WR…/ WS…	Typ A	◊	◊			
W/WS.8000	Typ A			◊	◊	◊
W…AB	Typ AB					◊

3.1.5.3 Other Bender devices

Device	EDS440-L	EDS440-S	EDS441-L	EDS441-S	EDS441-LAB
COM460	!		!		!
CP700	!		!		!
MK2430	#		#		
IRDH575	#		#		
iso685-D-P/iso685-S-P	**BS-Bus**	**BB-Bus**	**BS-Bus**	**BB-Bus**	**BS-Bus**
isoMED427			◊		
PGH183			◊	◊	
PGH185	◊	◊			
PGH186	◊	◊			

Function

3.2 Operating principle of the EDS system

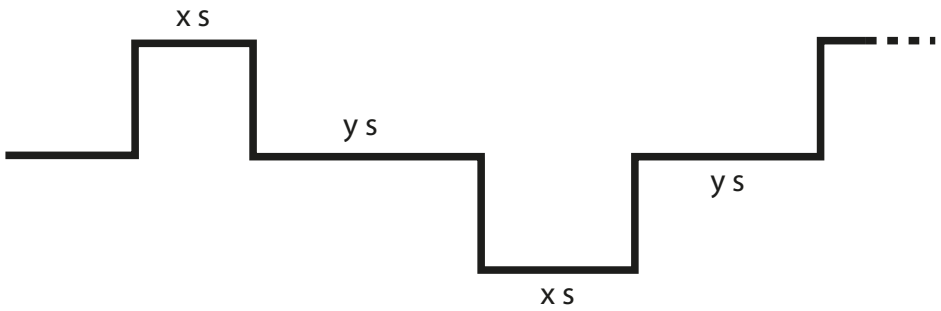
When an insulation fault locator detects an insulation fault, it starts the insulation fault location.

In the event of a first insulation fault, an undefined residual current flows in IT systems, which is primarily defined by the system leakage capacitances and the value of the insulation fault. The basic idea of insulation fault location is the generation of a defined locating current I_L that flows through the insulation fault. The locating current is driven by the system voltage and can be located in the faulty line using the measuring current transformer.

The locating current is generated by the locating current injector. It is limited in amplitude and time. The amplitude depends on the size of the existing insulation fault and the system voltage. It is limited depending on the settings.

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 PE line back to the locating current injector. This locating current pulse is detected by the measuring current transformer on the insulation fault path and signalled by the connected insulation fault locator.

Locating pulse pattern:



The length of the pulse and pause intervals depends on the system conditions (R_F, C_e).

For further information, refer to the data sheet "Technical aspects main catalogue part 1" in the chapter "Technical aspects when using insulation fault location systems".

Due to the influence of system leakage capacitances, the indicated locating current may be false.
The locating current of the locating current injector is limited. Due to this limitation, the resistance of the insulation fault may be lower than the value signalled by the indicated locating current.

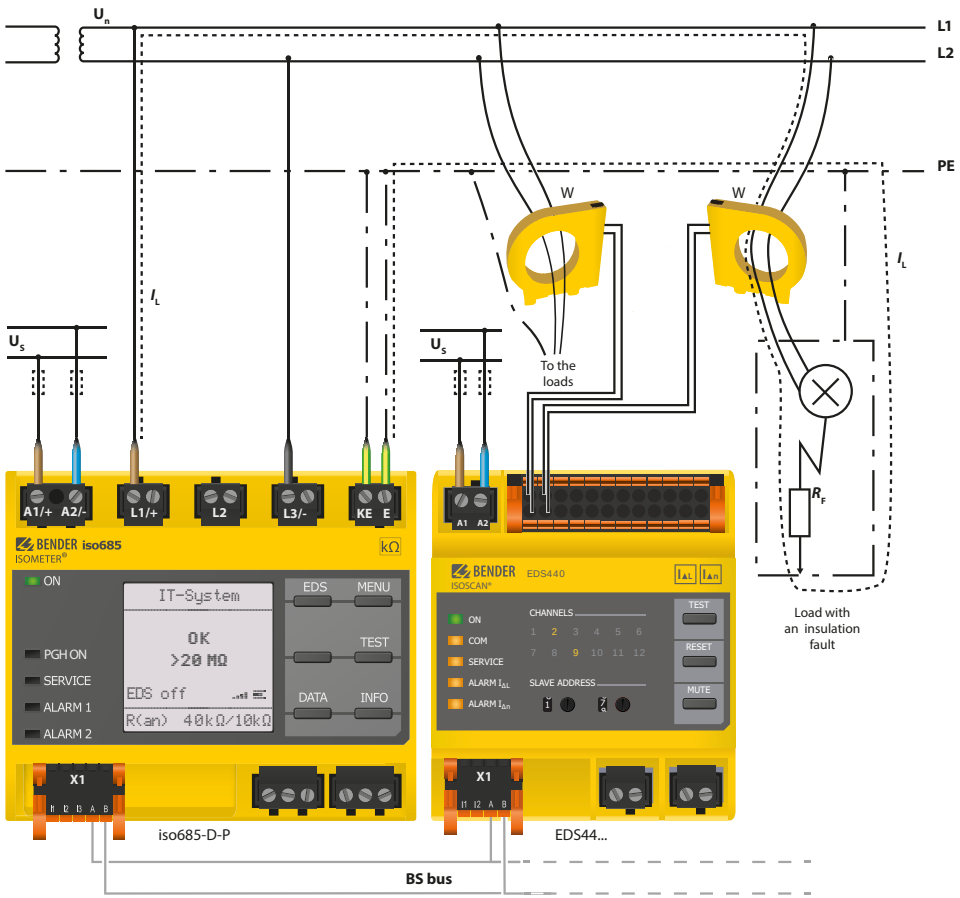
During project planning it is important to observe that even in unfavourable cases, there is no system part in which locating currents may cause harmful reactions.

Under certain conditions, symmetrical insulation faults located downstream of the measuring current transformer are not detected. Low frequency residual currents (e.g. caused by converters) may prevent insulation faults from being detected if their frequency is identical or almost identical to the test pulse frequency of the locating current injector.

Insulation fault location can be affected by components, loads or EMC interference within an IT system. Therefore, reliable fault location may not be possible under all circumstances or an incorrect response may occur.

Function

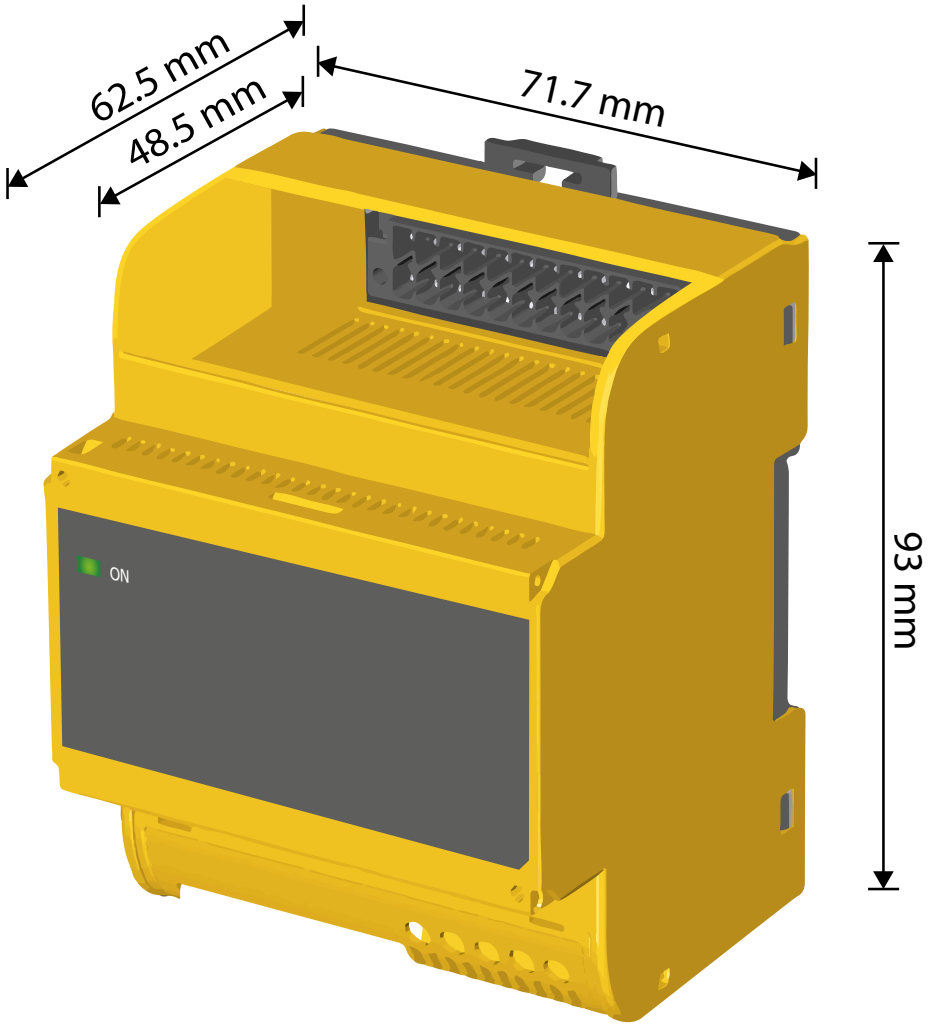
3.3 Schematic diagram EDS system



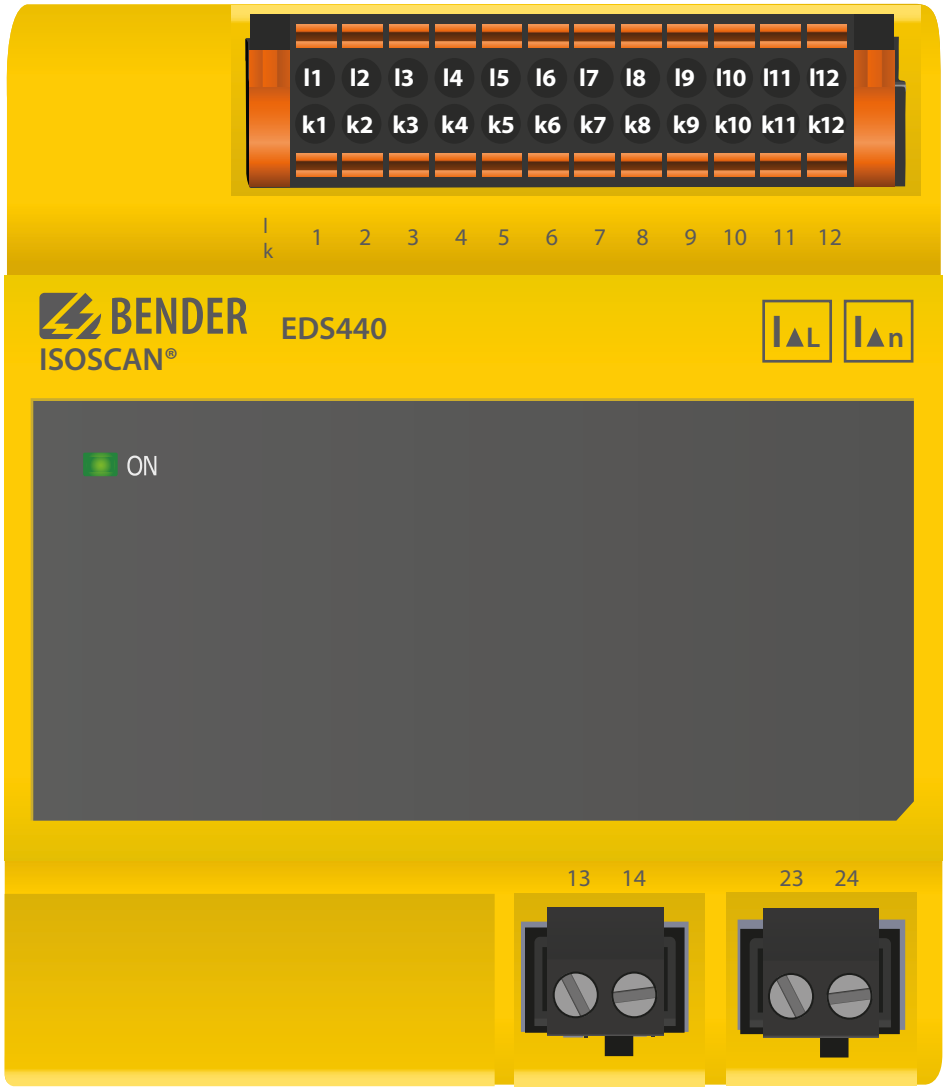
Legend

EDS44…	Insulation fault locator
iso685-D-P	Insulation monitoring device with integrated locating current injector
U_n	Voltage source IT system
U_s	Supply voltage
W	Measuring current transformer
I_L	Test current
R_F	Insulation fault downstream of the measuring current transformer
PE	Protective earth conductor or equipotential bonding conductor
BS bus	BS bus for device communication

4.1 Dimensions



4.2 View EDS440-S

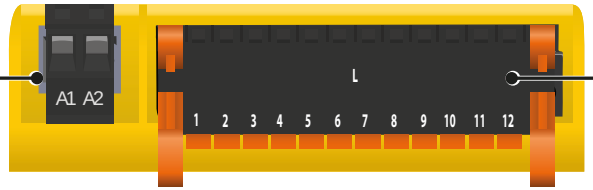


Device overview

4.3 View EDS440-L

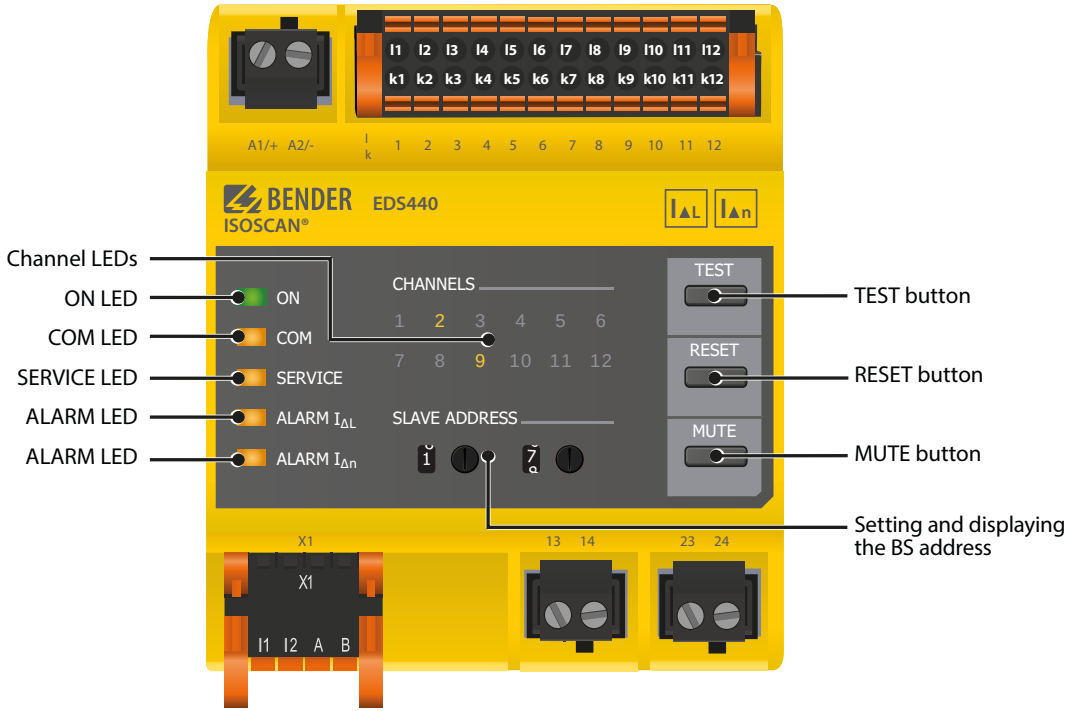
4.4 Connections and control panel EDS44…-L

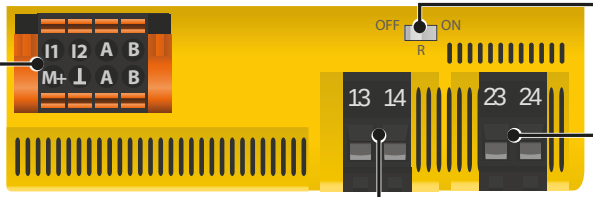
Top view



For a description of the k1-12/l1-12 plug, refer to "Connection to the k1-12/l1-12 interface" on

Side view



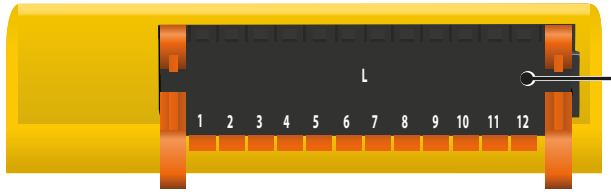


Bottom view

For a description of the X1 plug, refer to "Connection to the X1 interface" on page 20.

4.5 Connections and control panel EDS44…-S

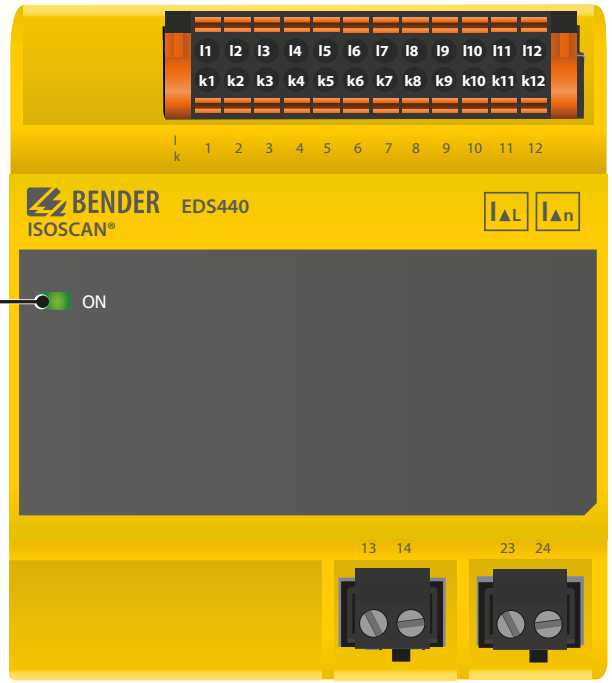
Top view



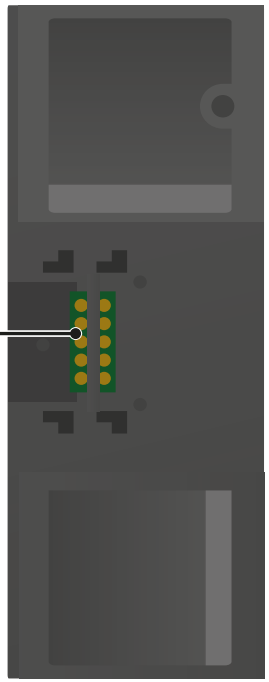
k1-12/l1-12
Connection to current transformer

For a description of the k1-12/l1-12 plug, refer to "Connection to the k1-12/l1-12 interface" on page 20.

Side view

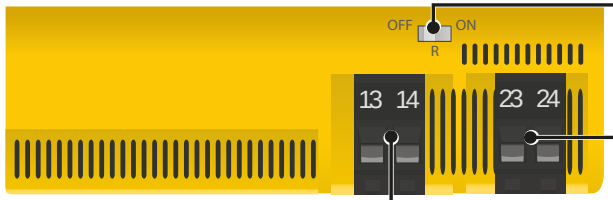


ON LED



X3
BB bus-
interface
to ISOMETER®
iso685-D-P
or iso685-S-P

Bottom view



R Adjustable termination resistor
for the RS-485 interface

23 24
Alarm relay 2 connection

13 14
Alarm relay 1 connection

5.1 General instructions

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

DANGER

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

- An electric shock
- Damage to the electrical installation
- Destruction of the device

***Before installing and connecting the device, make sure** that the **installation** has been **de-energised**. Observe the rules for working on electrical installations.*

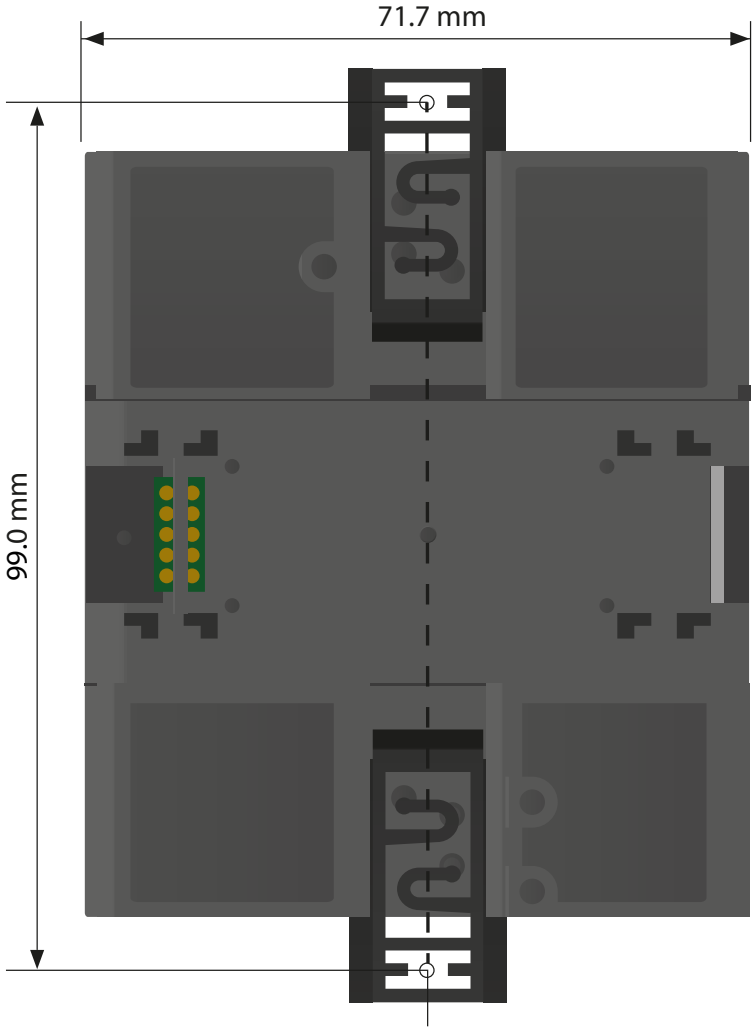
Install the measuring current transformers according to the instructions in the respective data sheet of the measuring current transformer. When connecting the measuring current transformers, it is essential that you observe the maximum cable lengths

The devices are suitable for the following installation methods:

- Distribution panels according to DIN 43871 or
- Quick DIN rail mounting according to IEC 60715
- Screw mounting using M4 screws

5.2 Screw mounting

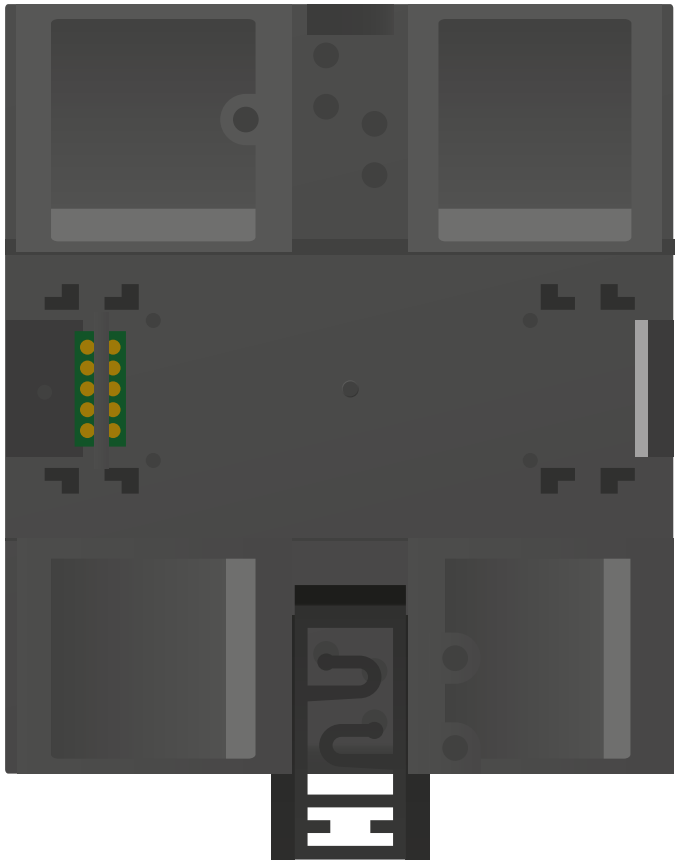
1. Fix the two mounting clips provided with the device manually or using a tool, as illustrated below.
2. Drill the mounting holes for the M4 thread according to the dimensioned drilling template.
3. Then fix the EDS… using two M4 screws.



Mounting

5.3 DIN rail mounting

1. Fix one of the provided mounting clips manually or using a tool, as illustrated below.
2. Snap the EDS… securely on the DIN rail.



6.1 Connection requirements

Consider the minimum distance to adjacent devices:

- lateral 0 mm, top 20 mm, bottom 20 mm.

DANGER

Risk of electric shock!
Before fitting the device and prior to working on the device connections, make sure that the power supply has been disconnected. Failure to comply with this requirement will expose personnel to the risk of an electric shock. Furthermore, the electrical installation may be damaged and the device may be destroyed beyond repair.

CAUTION

Risk of malfunctions due to excessive locating current on sensitive system parts!
An excessive locating current flowing between the IT system and earth may cause controller faults in sensitive system parts, such as 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.

CAUTION

Provide line protection!
According to DIN VDE 0100-430, a line protection shall be provided for the supply voltage.

Consider that: The maximum voltage of the monitored system may not exceed the nominal insulation voltage of all components in use. Select the cables and cable lengths according to the technical data from page 50. If you use cables that are longer than those specified here, Bender cannot guarantee that the equipment will function safely.

For UL applications:
Use 60/75 °C copper wires only! For UL and CSA applications, the supply voltage must be protected via 5 A fuses.

6.2 Connection of the BB bus

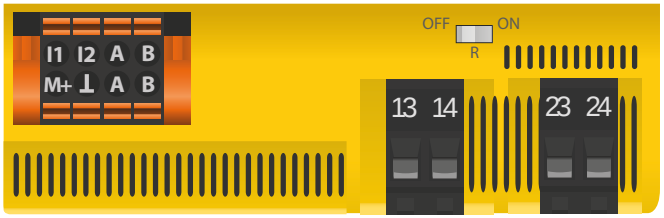
The BB bus is an interface that enables Bender devices to communicate with each other. The BB bus can be used with an ISOMETER® and one or more EDS44…-S. For this purpose, the BB bus is installed at the rear side of both devices and afterwards, both devices are mounted next to each other on the DIN rail. For further information, refer to the quick-start guide enclosed to the BB bus PCBs.

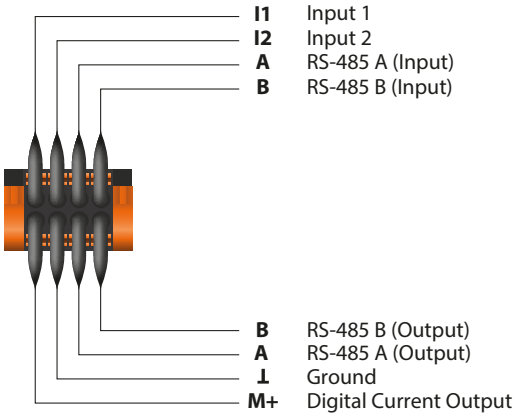
Sensor variant devices that are additionally connected to the ISOMETER® do not require additional supply voltage when the devices are connected to the BB bus via X3.

A maximum of two EDS44…-S can be connected to an ISOMETER®.

When the BB bus is installed, the EDS44… must always be mounted on the right side of the ISOMETER®.

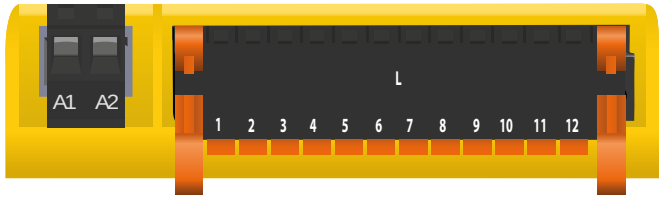
6.3 Connection to the X1 interface

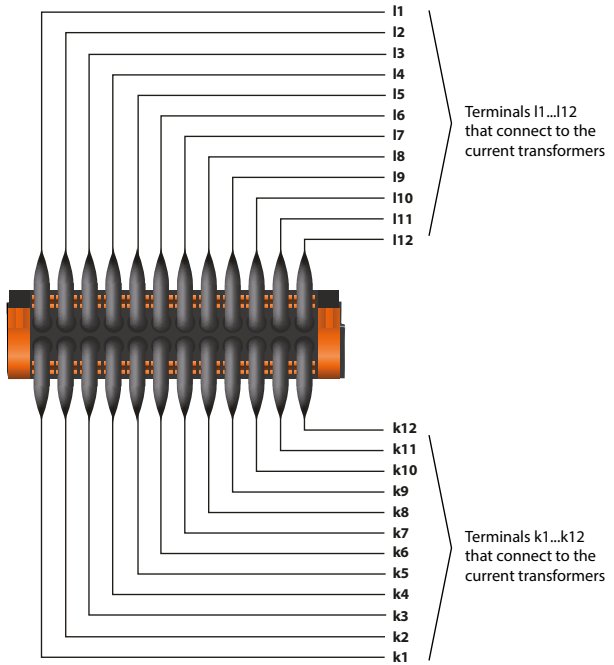




The EDS440/441-L is connected via the X1 plug.
The EDS440/441-S does not feature an X1 interface and can only be connected via the BB bus.

6.4 Connection to the k1-12/l1-12 interface

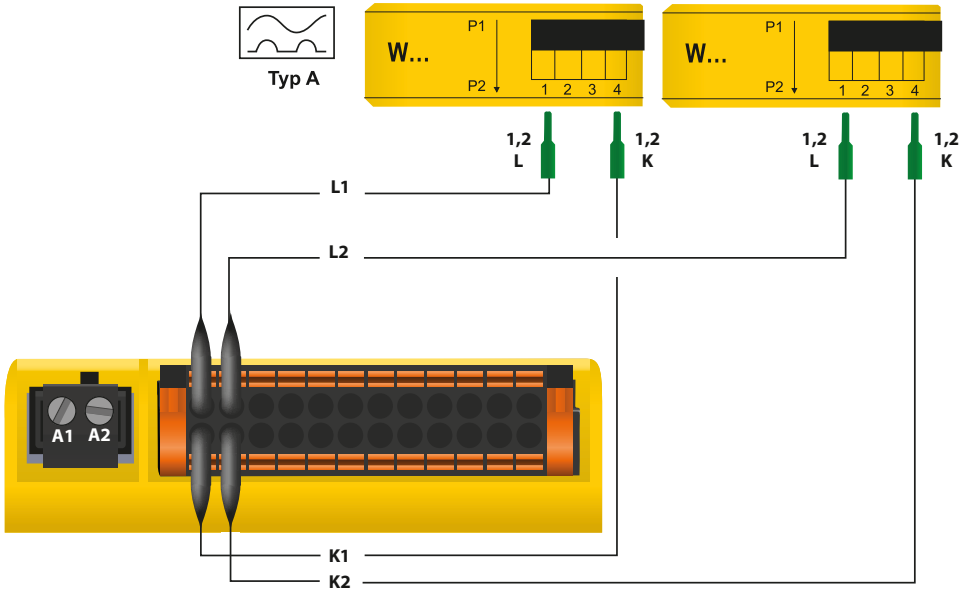




Connection

6.4.1 Connection measuring current transformer W…, WR…, WS… series

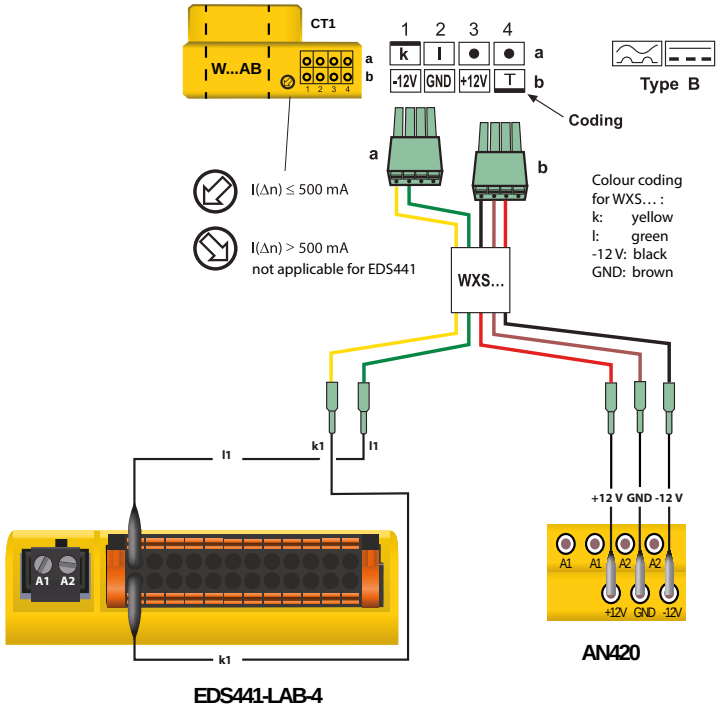
For insulation fault location, the measuring current transformers of the W… (closed), WR… (rectangular) and WS… (split-core) series are used.



Terminals 1 and 2 as well as terminals 3 and 4 of the measuring current transformer are bridged internally. The connections k and l may not be interchanged on the EDS…

You must ensure that all live conductors are routed through the measuring current transformer. Do not route any existing PE conductors or shields of shielded cables through the measuring current transformer! Standard measuring current transformers are not suitable for the EDS44… system and may not be used. An accurate measurement result can only be obtained if these notes are observed.
For further information regarding measuring current transformers, refer to the respective data sheets.

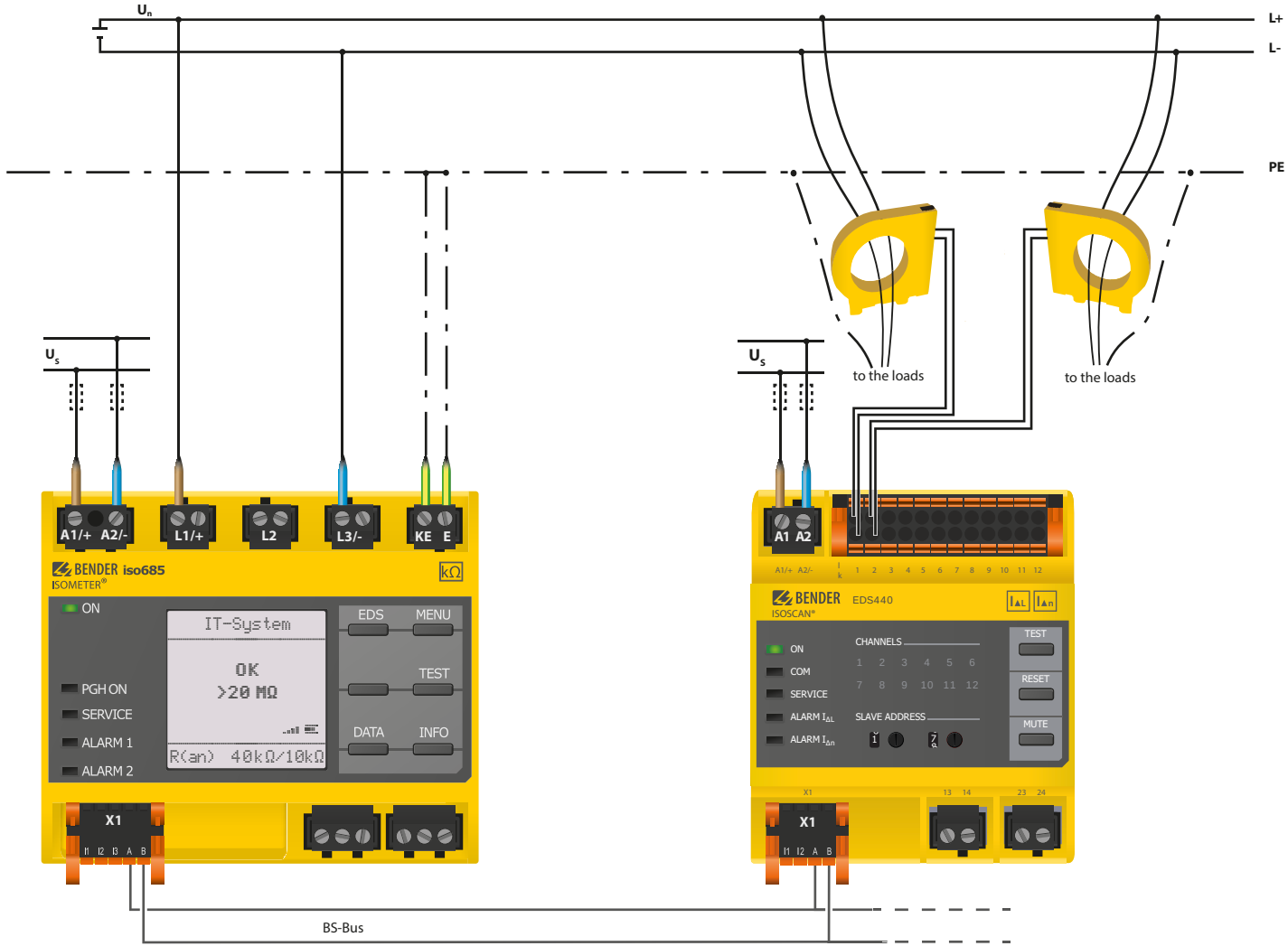
6.4.2 Connecting W…AB series measuring current transformers to the EDS441-LAB-4



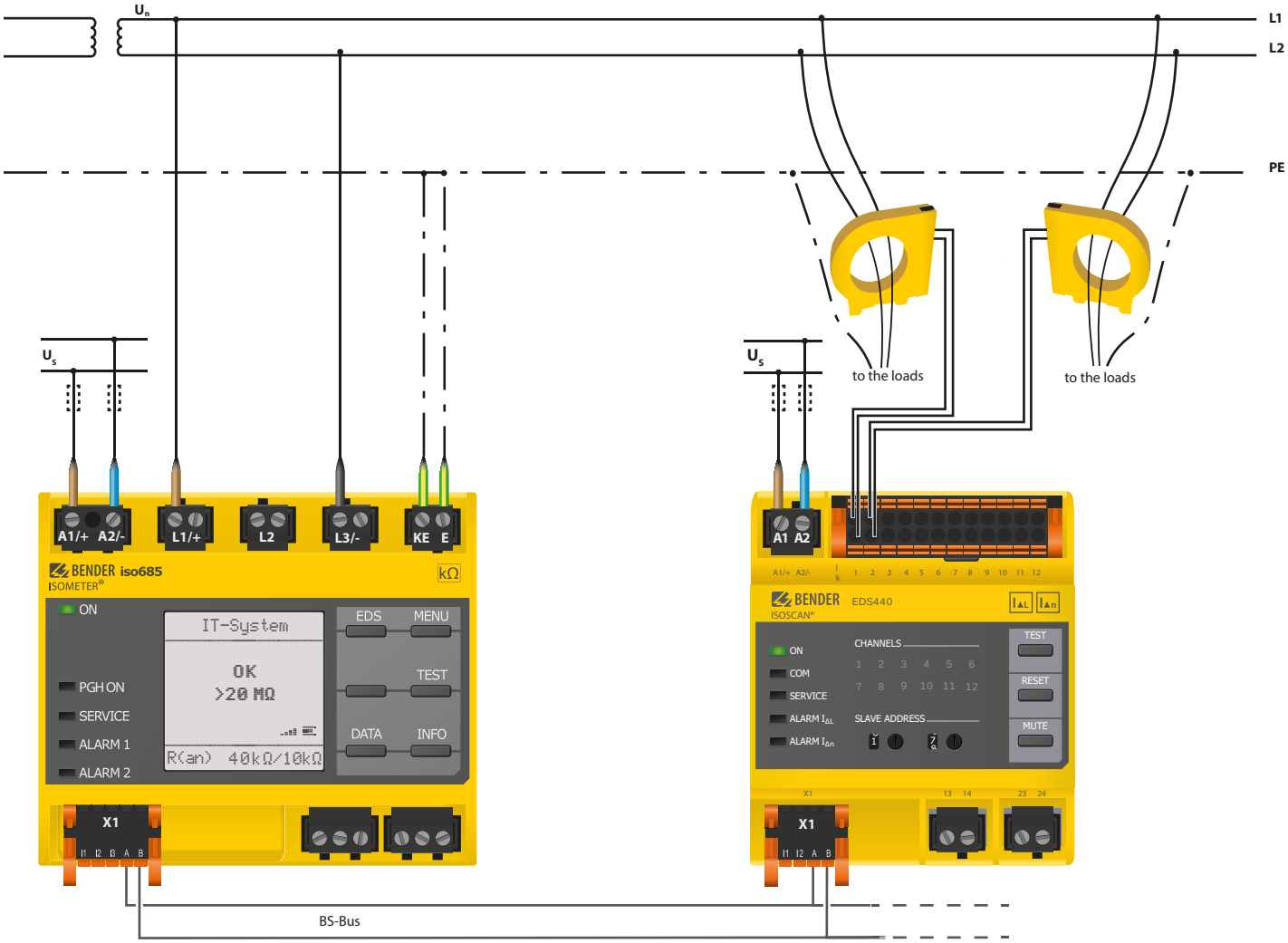
A maximum of 6 measuring current transformers can be connected to a power supply unit AN420 or AN110.

You must ensure that all live conductors are routed through the measuring current transformer. Do not route any existing PE conductors or shields of shielded cables through the measuring current transformer! Standard measuring current transformers are not suitable for the EDS44… system and may not be used. An accurate measurement result can only be obtained if these notes are observed.
For further information regarding measuring current transformers, refer to the respective data sheets.

6.5 Wiring diagram to DC system with ISOMETER® iso685-D-P

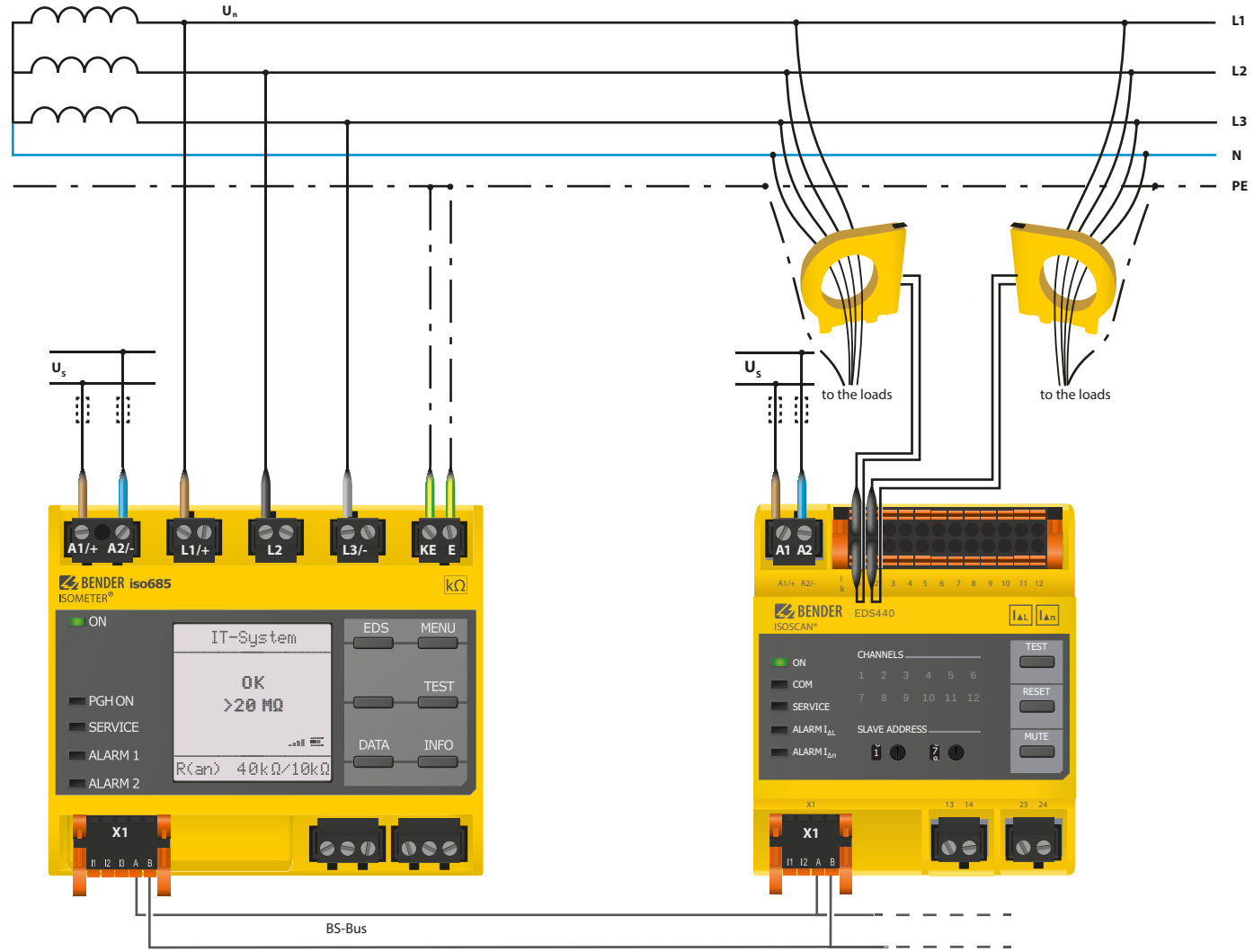


6.6 Wiring diagram to AC system with ISOMETER® iso685-D-P

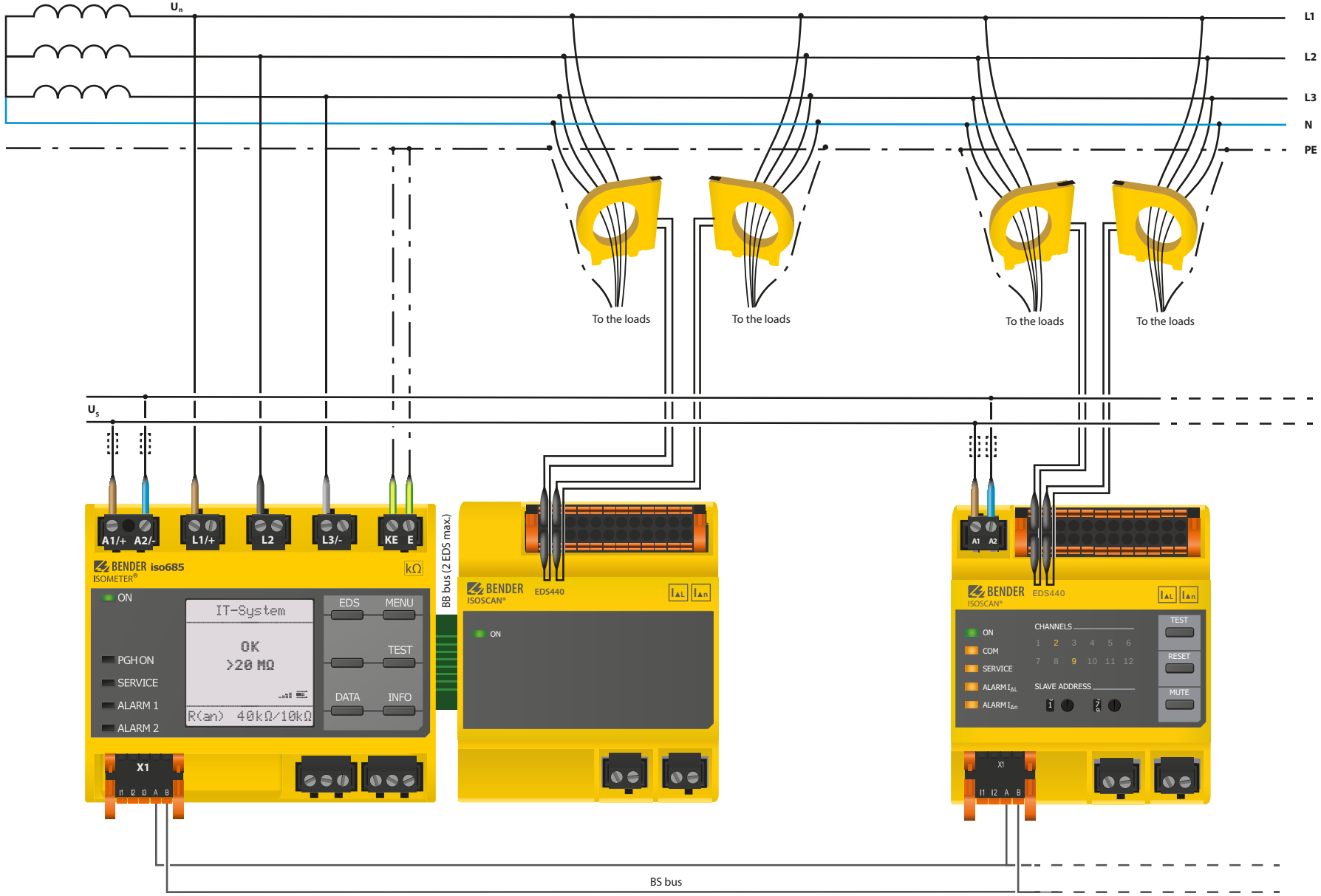


For systems > 690 V and with overvoltage category III a fuse for the connection to the system to be monitored must be provided.
Recommendation: 2 A screw fuses.

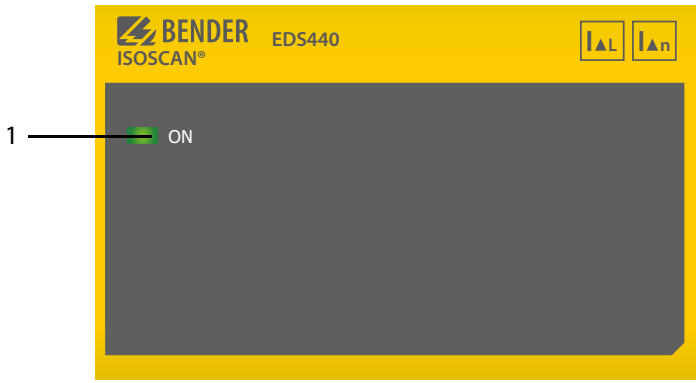
6.7 Wiring diagram to 3(N)AC system with ISOMETER® iso685-D-P



6.8 Connection example: iso685-D-P, EDS440-S and EDS440-L

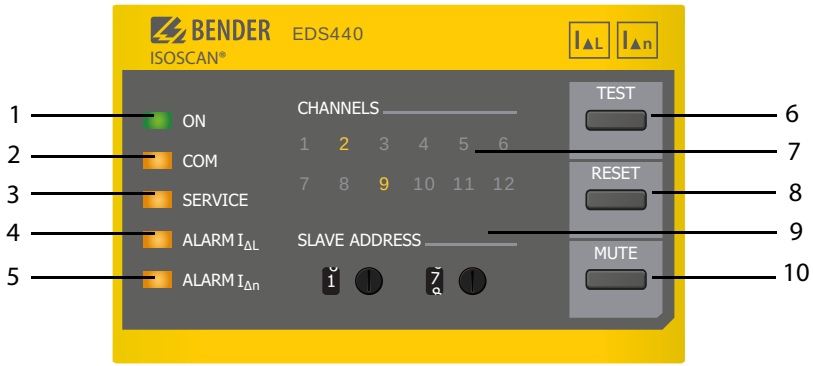


7.1 Operating and display elements EDS…-S



1	The LED "ON" flashes until the device is ready for operation during power up. The LED "ON" is lit when the device is turned on. A measuring current transformer connection test is carried out every 10 minutes. During the test, the LED "ON" flashes.

7.2 Operating and display elements EDS…-L



1	The LED "ON" flashes until the device is ready for operation during power up. The LED "ON" is lit when the device is turned on. A measuring current transformer connection test is carried out every 10 minutes. During the test, the LED "ON" flashes.
2	The LED "COM" flashes quickly while the device communicates via the RS-485 interface. During insulation fault location, the LED flashes to indicate that the locating current injector is sending out a pulse: During the pulse phase the LED lights, during the pause the LED does not light.
3	The LED "SERVICE" lights either when there is a device fault, a connection fault of the measuring current transformers or an error message e.g. due to low-frequency residual currents, external magnetic fields, etc.
4	The LED "ALARM $I_{\Delta L}$" signals the main alarm. The LED lights when an insulation fault is detected (EDS function) on one of the measuring channels.
5	The LED "ALARM $I_{\Delta n}$" lights if the set response value for residual currents is exceeded. The factory setting for the response value is 10 A for the EDS440 and 1 A for the EDS441.
6	A device self test is triggered by pressing the TEST button.
7	The channel LEDs "1"…"12" are lit: A channel LED lights if an insulation fault is detected on the respective measuring channel or if there is a residual current alarm. The channel LEDs "1"…"12" flash: If there is a connection fault of the measuring current transformer, the channel LED flashes slowly (1 Hz). If there is an interference during insulation fault location, the channel LED flashes quickly (2 Hz).
8	You can reset the fault memory using the RESET button. The fault memory can only be reset if the fault memory is activated and the fault has disappeared.
9	SLAVE ADDRESS: Here you can set the device address.
10	You can deactivate the buzzer using the MUTE button. The buzzer is only deactivated for the present alarm message.

7.3 Standard display in the operating mode

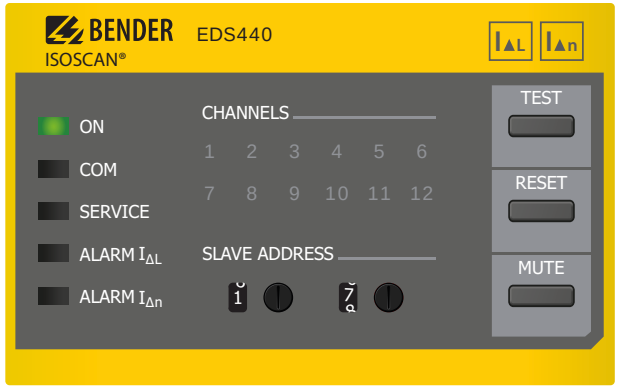
The values of the EDS…-L are basically displayed via the connected ISOMETER® (some values can be displayed on the EDS…-L front panel), while the values of the EDS…-S are only displayed via the connected ISOMETER®.

7.3.1 Standard display EDS…-S

In the operating mode, the EDS… waits for the insulation fault location to start. The green operation LED "ON" is lit. All messages are indicated via the connected ISOMETER®.

7.3.2 Standard display EDS…-L

In the operating mode, the EDS… waits for the insulation fault location to start. There is no alarm on any of the 12 channels. The EDS…-L displays its slave address. Only the green operation LED "ON" is lit. While the device communicates or the insulation fault location is in progress, the LED "COM" flashes additionally.



7.4 Alarm messages

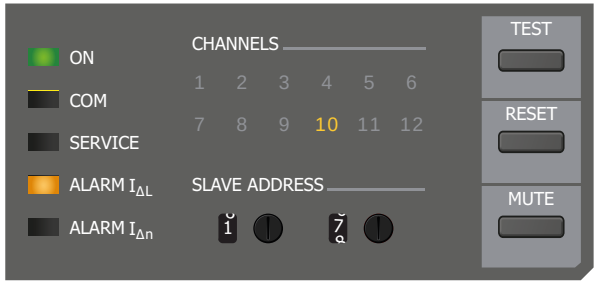
Alarm messages of the EDS44…-L are directly indicated on the device display, while the alarm messages of the EDS44…-S are displayed on the respective ISOMETER®.

Possible causes of an alarm message are:

- Insulation faults, residual current has been exceeded, device faults, measuring current transformer faults or measuring current transformer connection faults and disturbances.

7.4.1 Insulation fault (LED ALARM $I_{\Delta L}$)

If an insulation fault is detected on a measuring channel, (EDS function), the LED "ALARM $I_{\Delta L}$" (main alarm) and the LED of the channel on which the fault was detected, lights up.



In addition, the fault is indicated on the display of the ISOMETER®.

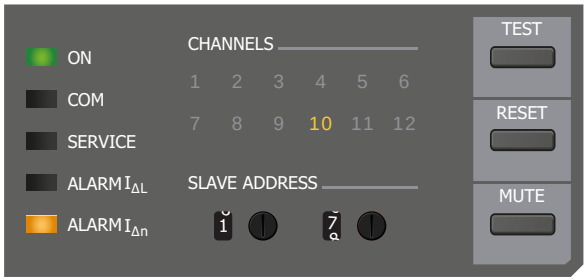
Indication and alarm messages

7.4.2 Residual current exceeded (LED ALARM $I_{\Delta n}$)

This feature of the EDS441… is only suitable for frequencies in the range of 50/60 Hz.

The residual current flowing through the measuring current transformer is continuously measured and displayed. If the residual current is too high, a successful insulation fault location is not possible.

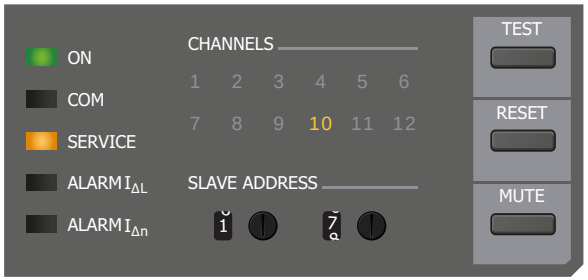
If the residual current (RCM function) is exceeded, the LED "ALARM $I_{\Delta n}$" lights. In addition, the LED of the channel on which the fault was detected lights.



Furthermore, the fault is indicated on the display of the ISOMETER®.

7.4.3 Device fault, connection fault of the measuring current transformers

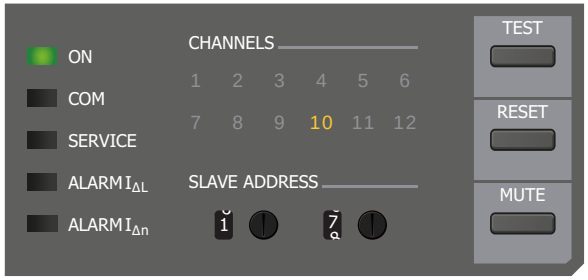
The LED "SERVICE" lights either when there is a device fault or a connection fault of the measuring current transformers. In addition, the corresponding channel LED flashes.



In the event of a device fault, an error code is additionally displayed on the corresponding ISOMETER®. Please have it to hand for Bender service.

7.4.4 Error message

In the event of an error message, the LED of the respective channel flashes.
An error can for example be caused by low-frequency residual currents, external magnetic fields, etc.



7.4.5 Acoustic alarm message

The acoustic alarm (buzzer) can be manually assigned to the following visual alarm messages:

- Alarm $I_{\Delta L}$
- Alarm $I_{\Delta n}$
- Device fault
- Connection fault
- Common alarm
- Insulation fault location in progress

The acoustic alarm can be deactivated by pressing the MUTE button.

For an overview of all alarm messages and recommended measures, refer to "Alarm messages" on page 38.

8. Functional description of the BS bus

The BS bus is used to extend Bender measuring devices (e.g. ISOMETER®) with Bender sensor devices (e.g. EDS). 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 connecting more than ten EDS44…-L to the BS bus, the wiring must be protected against contact.

CAUTION

When using interface converters, a galvanic separation is required.

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

An ISOMETER® can administer a maximum of 252 EDS channels. Therefore, if an EDS has 12 channels, a maximum of 21 EDS devices can be connected via BS bus and BB bus (max. 2 EDS via BB bus).

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 that is necessary for the measuring function. The master also provides the required bus bias voltage for the operation of the BS bus. The measuring device on the BS bus is the master and has address 1. All sensor devices connected to the BS bus require unique addresses.

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.

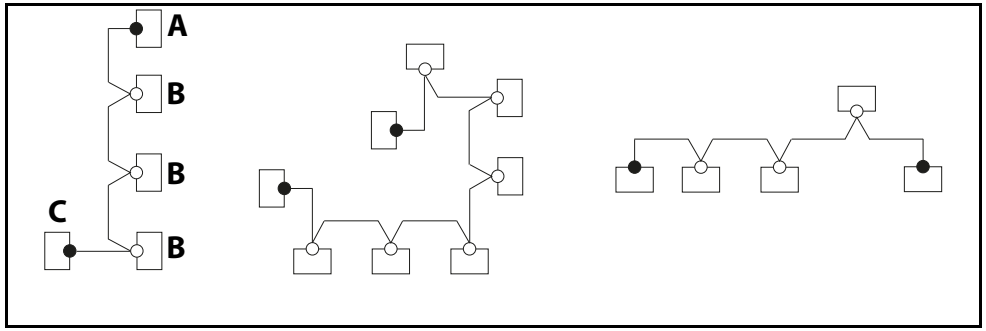
RS-485 specifications/cables

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.

Cable routing

The optimum cable routing 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

A	Master	Terminating resistor activated via switch on device (ON) or external terminating resistor between terminals A and B
B	Slave	Terminating resistor deactivated via switch on device (OFF)
C	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 in one line may be terminated. Therefore, check all devices.

CAUTION

Risk of overcurrent!
Devices connected to the analogue output must have a suitable protective circuit against overcurrent to protect the device in the event of a defective analogue output.

Start the cyclic test of the EDS44… manually at regular intervals (e.g. once a year) to ensure that the relays work and switch correctly.

9.1 Before switching on

Before switching on the EDS44… make sure that the following aspects have been considered:

- The connected supply voltage U_S matches the information on the nameplates of the devices.
- The maximum permissible nominal insulation voltage of the used measuring current transformers and the ISOMETER® with integrated locating current injector is not exceeded.
- The PE conductor is not routed through the measuring current transformer.
- Any magnetic fields that are nearby and could cause interference when mounting the measuring current transformers have been taken into account.
- Regarding the BS bus node address settings, no address has been assigned twice. The ISOMETER® with integrated locating current injector (e.g. ISOMETER® iso685-D-P) has been set as master

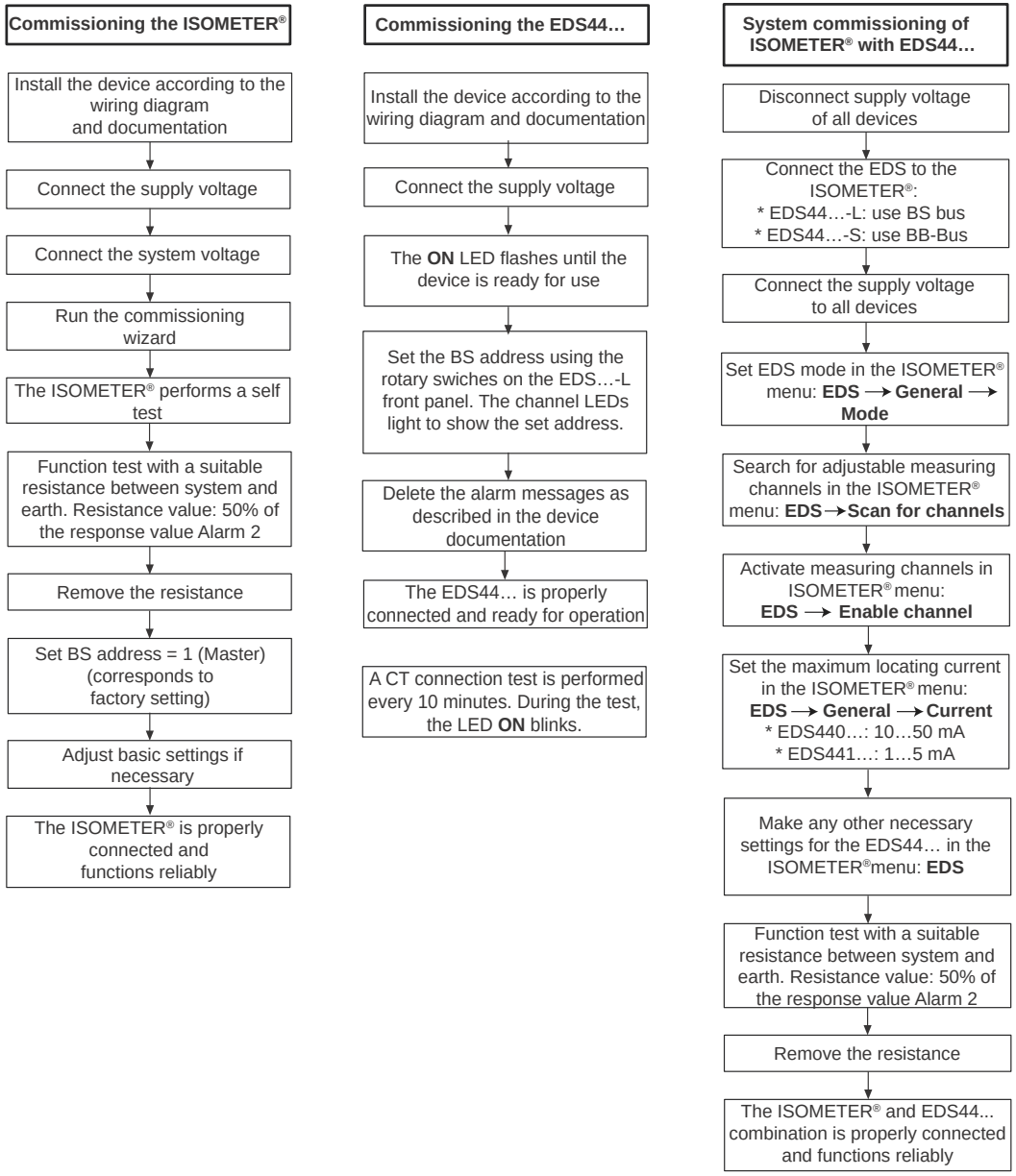
For further information, see "Connection of the BB bus" on page 19 and “Functional description of the BS bus” on page 29.

9.2 Switching on

1. Switch on the supply voltage of all devices connected to the BS bus or the BB bus. First, the LED "ON" flashes on the EDS…. Subsequently, the LED "ON" lights permanently.
2. Eliminate all displayed insulation and device faults via the ISOMETER®. If the response value is exceeded, the respective device fault message is indicated on the EDS…-L by the alarm LED "ALARM $I_{\Delta L}$" or "ALARM $I_{\Delta n}$", which lights up (see "Alarm messages" on page 38).
   - Further information regarding fault messages on the EDS… can be displayed via the ISOMETER® .
   - Device faults may be caused by measuring current transformers not being connected. Check the measuring current transformer connections. Disconnect the channels that are not required in the menu of the ISOMETER®.

Pending alarm messages may temporarily not be available due to synchronisation processes on the BS bus. However, if the cause of the alarm persists, the alarm messages reappear after a few seconds.

9.3 Commissioning flow chart



10.1 Setting the BS address

If the BS address is set to 00, the device goes into the trigger mode "auto". "Trigger function" auf Seite 33.

The BS bus address can be configured directly on the EDS…-L using the rotary switches. The address of positions 1 and 10 is indicated during configuration via illuminated channel LEDs. No indication on the channel LEDs corresponds to position "0".

The BB bus address of the EDS…-S is assigned automatically.

For further information regarding the BS bus, refer to "Functional description of the BS bus" on page 29.

10.2 Resetting saved alarm messages (RESET button)

If the fault memory is enabled, the alarm status will remain, even after the cause of the fault has been eliminated, until a "RESET" is carried out.
Press the "ESC" button on the ISOMETER® to exit the display of the current alarm message.

A RESET is carried out in the following way:

- Press "RESET" button on the front panel of the EDS… for at least one second,
- press an external RESET button connected to the EDS…,
- send a RESET command via the BS bus

Saved alarm messages that are no longer pending are deleted, the alarm relay drops out, the alarm LEDs go out and no alarm messages remain on the BS bus.

10.3 Deactivating buzzer (MUTE button)

Press the MUTE button on the EDS…-L to deactivate the buzzer for the current alarm message.
The buzzer functions can be assigned in the device menu of the ISOMETER®. For further information, refer to "Digital outputs of the EDS44…-L" on page 35 or to the manual of the ISOMETER®.

10.4 Carrying out a test (TEST button)

A test can be carried out to check the device function (hardware components).
There are different ways to start a test:
EDS44…-L:

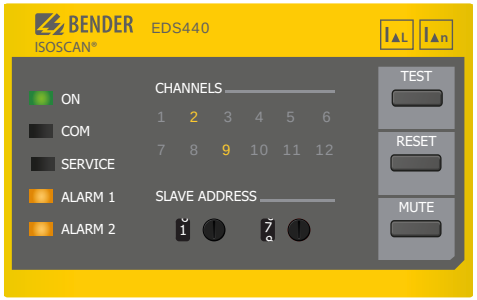
- Select standard display on the ISOMETER® and then press the "TEST" button on the front plate of the EDS…-L for at least one second
- Send a test command via the BS bus

EDS44…-L and -S:

- Press an external test button connected to the EDS…

The EDS… responds as follows:

- LED "ALARM $I_{\Delta L}$" and LED "ALARM $I_{\Delta n}$" light up.
- All alarm relays switch (function can be deactivated).
- An alarm message is sent on the BS bus.
- An entry with the suffix "TEST" is stored in the history memory of the ISOMETER®.
- All active channel LEDs light up.



After finishing the test, all LEDs, with the exception of the "ON" LED, must no longer light.

11.1 Settings on the ISOMETER® concerning the EDS

The settings of the EDS44… are done via the device menu of the ISOMETER®. For a detailed menu description, refer to the manual of the ISOMETER®.

11.1.1 Locating current injector settings

11.1.1.1 Mode

Three different start and stop conditions for insulation fault location can be set on the ISOMETER® :

- Manually: The EDS system can be started manually using a shortcut button or via the menu. Afterwards, the EDS system is permanently active, regardless of the insulation value and the alarm message of the ISOMETER®. The EDS system can be stopped manually at any time using the shortcut button or via the menu.
- auto: The EDS system is activated automatically as soon as the response values of alarm 1 and alarm 2 of the ISOMETER® fall below the limit. It remains active until no more insulation faults are detected. For new measurement of the insulation fault values by the ISOMETER®, the EDS insulation fault location is cyclically interrupted for approx. 5 minutes. The EDS system can be stopped manually at any time using the shortcut button or via the menu.
- 1 Cycle: The EDS system is automatically activated for 5 minutes as soon as the response values of alarm 1 and alarm 2 of the ISOMETER® fall below the limit. After this cycle, the insulation fault location is completed. The EDS system can be stopped manually at any time using the shortcut button or via the menu.

During the insulation fault location process, insulation monitoring is temporarily inactive.

During the insulation fault location process, connection and short-circuit monitoring is temporarily inactive.

11.1.1.2 Test current

You can set the maximum locating current of the locating current injector in the ISOMETER®.

- For the EDS441…, a locating current of 1 mA…5 mA is suitable.
- For the EDS440…, a locating current of 10 mA…50 mA is suitable.

- 1 mA for EDS441…
- 1.8 mA for EDS441…
- 2.5 mA for EDS441…
- 5 mA for EDS441… / EDS440…
- 10 mA for EDS440…
- 25 mA for EDS440…
- 50 mA for EDS440…

11.1.2 Trigger function

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.

The locating current pulse of the ISOMETER® is synchronised with the measurement technology in the EDS…. The EDS… is informed when to expect a locating current pulse . 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. The EDS… only searches for insulation faults if the insulation fault location has been started. It knows the time of the locating current pulse. 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).
The EDS… continuously searches for insulation faults.
If the BS address is set to 00, the device goes into the trigger mode "auto".

11.1.3 Fault memory

Faults that only occur temporarily can be saved in the ISOMETER®.

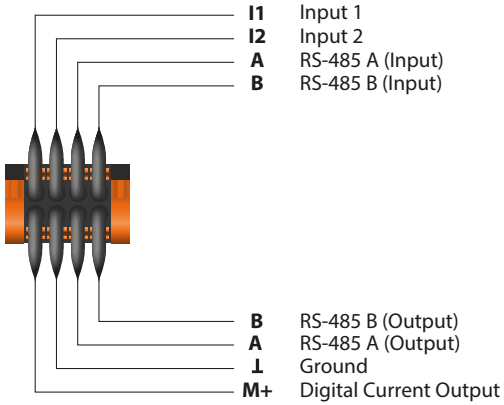
- on — After eliminating the cause of fault, alarm messages remain stored until a RESET is carried out. This function affects alarm messages. Device fault messages cannot be deleted.
- off — EDS… exits the alarm mode as soon as the cause of fault is eliminated.

11.2 Settings of inputs and outputs of the EDS44…-L

The settings of the EDS44… are done via the device menu of the ISOMETER®. For a detailed menu description, refer to the manual of the ISOMETER®.

11.2.1 Digital inputs of the EDS44…-L (I1, I2)

The EDS44…-L has two digital inputs (I1 and I2 at the X1 interface), which you can configure individually.



11.2.1.1 Functions

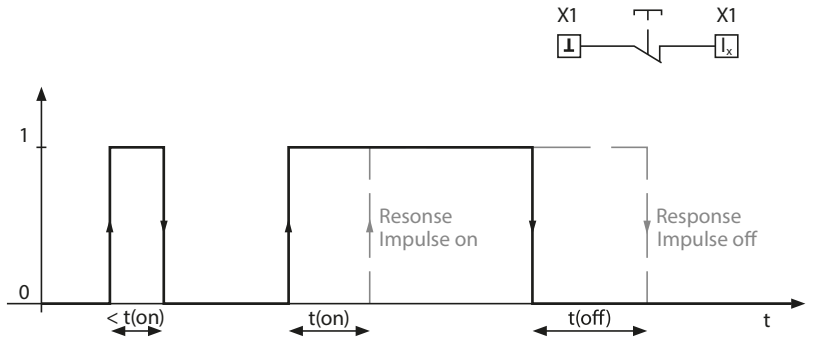
You can assign the following functions for the digital inputs:

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

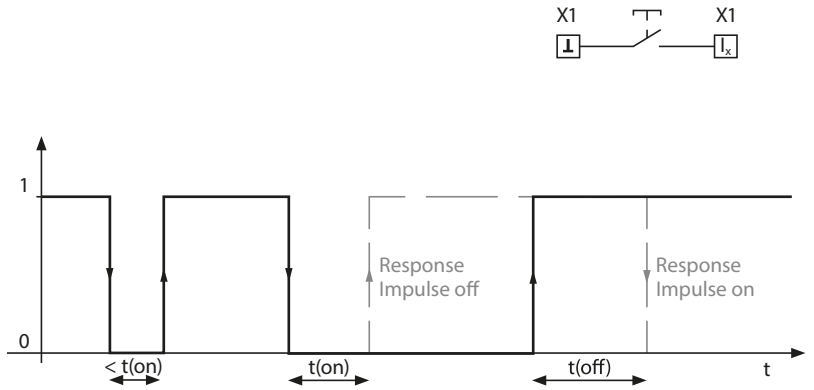
11.2.1.2 Digital input mode

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

- High-active — An event is carried on the rising edge of the digital input (low to high).



- Low-active — An event is carried out on the falling edge of the digital input (high to low).



Settings

11.2.1.3 Response times t(on)/t(off)

t(on)
The response time t(on) after a switch-on signal can be set between 100 milliseconds and 300 seconds.

t(off)
The response time t(off) after a switch-off signal can be set between 100 milliseconds and 300 seconds.

11.2.2 Digital outputs of the EDS44…-L

The EDS44…-L has a digital current output (0 or 20 mA), a buzzer and relays, which can be configured individually.

11.2.2.1 TEST function

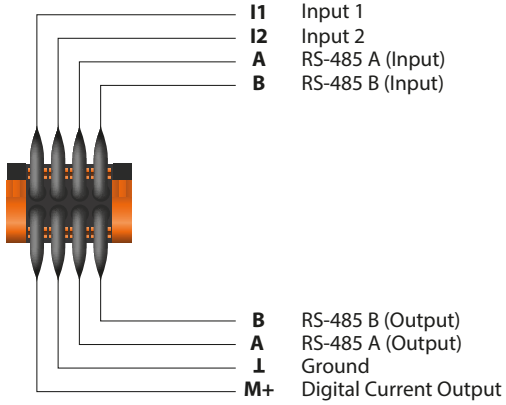
The function test checks the switching functions of the digital outputs. This only applies to the manual test and not to the cyclic device self test.

11.2.2.2 Operating mode of the relays

The relay mode can be adapted to the application:

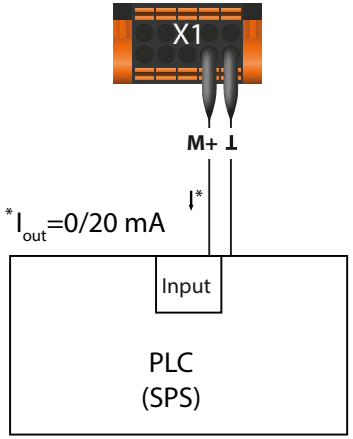
- N/C — Normally closed - N/C operation contacts 13-14 / 23-24 (The alarm relay is energised in normal operation).
- N/O — Normally opened - N/O operation contacts 13-14 / 23-24 (The alarm relay is de-energised in normal operation).

11.2.2.3 Digital current output (M+)



The digital current output is located at M1 of the X1 interface. Is one of the functions that are described under “Function description” on page 36 assigned and active, the digital current output drives 20 mA. Otherwise no current (0 mA) is driven.

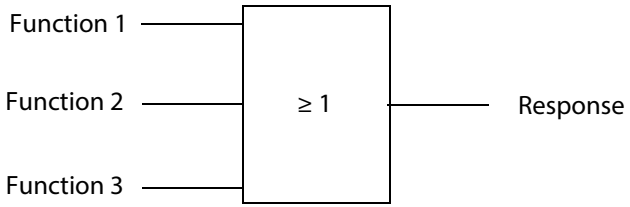
Exemplary connection of the digital current output



Settings

11.2.2.4 Function description

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



The following output functions are possible:

- 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
- Common alarm — The status of the output changes on the ocurrence of any alarm and fault messages ($I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, connection and device fault).
- Insulation fault location active (for buzzer only) — The buzzer signals active insulation fault location.

Settings

11.3 Factory settings

Parameter	Value
General information	
Response value insulation fault location ($I_{\Delta L}$)	5 mA (EDS440…) 0.5 mA (EDS441…, EDS441-LAB)
Response value residual current measurement ($I_{\Delta n}$)	10 A (EDS440…) 1 A (EDS441…, EDS441-LAB)
Measuring current transformer type	Type A: EDS440…, EDS441… Type AB: EDS441-LAB)
Connection monitoring	on (inactive at W…AB!)
Fault memory	off
Trigger mode	com
Relay	
Relay K1 test	on
Relay K1 operating mode	N/O
Relay K1 function 1	$I_{\Delta L}$ alarm
Relay K1 function 2	off
Relay K1 function 3	off
Relay K2 test	on
Relay K2 operating mode	N/O
Relay K2 function 1	$I_{\Delta n}$ alarm
Relay K2 function 2	off
Relay K2 function 3	off

Parameter	Value
Digital current output (M+)	
Dig. Out Test	off
Dig. Out Function 1	off
Dig. Out Function 2	off
Dig. Out Function 3	off
Digital inputs	
Dig. In 1 T(on)	100 ms
Dig. In 1 T(off)	100 ms
Dig. In 1 action	Test
Dig. In 1 mode	active low
Dig. In 2 T(on)	100 ms
Dig. In 2 T(off)	100 ms
Dig. In 2 action	Reset
Dig. In 2 mode	active low
Buzzer	
Buzzer test	on
Buzzer function 1	off
Buzzer function 1	off
Buzzer function 1	off

Alarm message	Description	Actions	Reference
• LED "ALARM $I_{\Delta L}$" lights up • Channel LED lights up	The set response value of the insulation level has been exceeded on one channel.	• Determine the cause of the insulation fault and eliminate it.	see "Insulation fault (LED ALARM IΔL)" on page 27
• LED "ALARM $I_{\Delta n}$" lights up • Channel LED lights up	The set response value of the residual current has been exceeded on one channel.	• Determine cause of the exceeded residual current and eliminate fault.	see "Residual current exceeded (LED ALARM IΔn)" on page 28
• "SERVICE" LED lights up	Internal device fault	• Press the TEST button • Switch the supply voltage off and on • Read out error code on the corresponding ISOMETER® • Contact Bender service	see "Device fault, connection fault of the measuring current transformers" on page 28
• "SERVICE" LED lights up • Channel LED flashes	Connection fault of the measuring current transformers Possible causes: • Measuring current transformer defective • Power supply cable interrupted • Power supply cable short-circuited	• Replace defective measuring current transformer • Check cables	see "Device fault, connection fault of the measuring current transformers" on page 28
• Channel LED flashes	Interferences during measurement Possible causes: • low-frequency residual currents • external magnetic fields	• Identify interference sources and eliminate them	see "Error message" on page 28

If several alarm messages appear at a time, the indication changes correspondingly. In this case, the Alarm LED and the channel LED of the faulty channel light up together for approx. two seconds.

13.1 Characteristic curves for response sensitivity

System type, system voltage, system frequency, leakage capacitance and locating current influence the response sensitivity of the EDS system.

The locating current level can bet set on the ISOMETER®. In AC systems, a reduced locating current occurs, conditioned by the system type. In contrast to DC systems, the factor in AC systems is 0.5 and in 3AC systems, 0.67.

Therefore, for use in AC and 3AC systems, set the response value on the EDS… as follows:

Locating current	*EDS*	*response value*
10 mA	*EDS440*	*< 5 mA*
1 mA	*EDS441*	*< 0.5 mA*

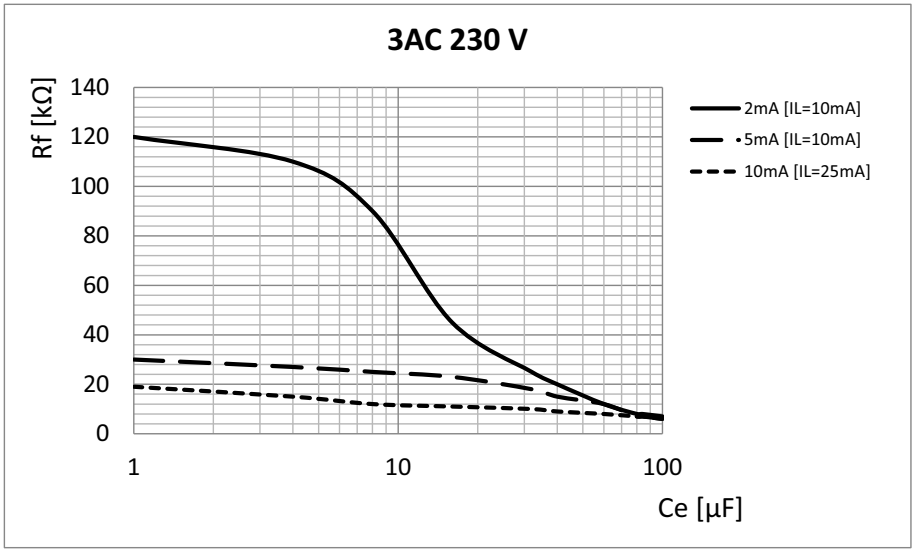
The response values are displayed as a characteristic curve, the maximum error can be ±50 %. The tolerances of the measuring current transformer are included. The characteristic curves apply to the respectively indicated nominal voltage. In the event of nominal voltage deviation, you should calculate with a proportional modification of the response values. System voltages that change during operation or superimposed AC currents that differ from the system frequency (e.g. via frequency inverters) or from DC currents may result in response values beyond the indicated ranges.

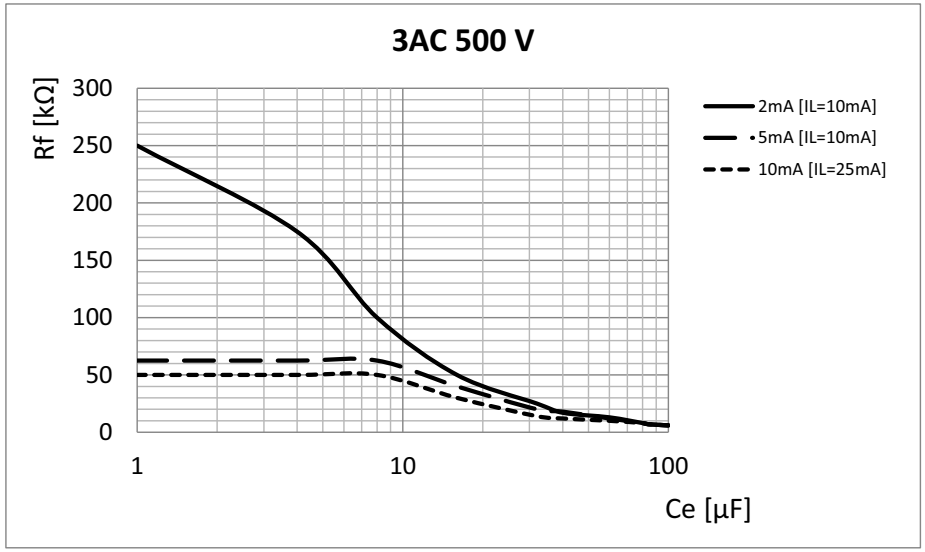
The following characteristics are an easy way of determining a suitable response value for the insulation monitoring device and the EDS…. Proceed as follows:

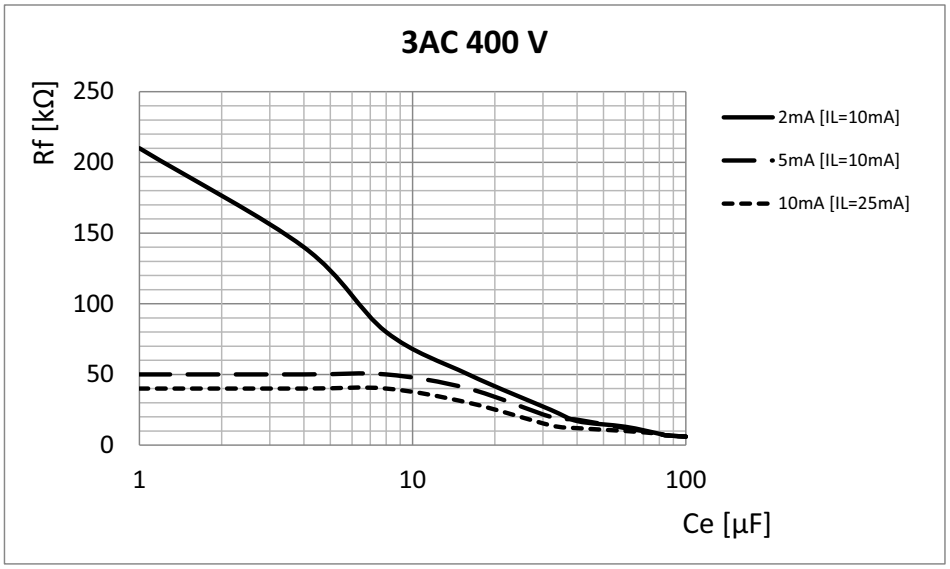
1. Select the characteristics (3 AC, AC, DC) that are appropriate for your type of distribution system.
2. From these, select the diagram that best matches the desired system voltage.
3. Calculate the anticipated leakage capacitance of the system being monitored. The ISOMETER® displays the system leakage capacitance (press the INFO button). Apply this value to the diagram in the form of a vertical line.
4. The characteristics provided indicate the EDS system's response sensitivity when the EDS response value is set to 2 mA, 5 mA and 10 mA. Values above the relevant curve cannot be detected.
5. Select the middle characteristic for an EDS… response value of 5 mA (factory setting). Mark the system leakage capacitance C_e on the characteristic. Read off the relevant resistance R_e from the characteristic. The resistance R_e thus calculated indicates the maximum response value that can be set on the insulation monitoring device (e.g. ISOMETER® iso685-D-P). If higher response values than this are set, insulation fault detection becomes unreliable. A reliable response on the part of the insulation monitoring device must be ensured before the EDS system can be started.
6. If you wish to set a higher or lower response value for the insulation monitoring device, you will need to calculate the resistance (R_e) for the top and bottom characteristics as described under point 5. Values and characteristics that fall between the top and bottom characteristics can be roughly determined on the basis of those actually provided.
7. Set the calculated response values on the insulation monitoring device and the EDS….

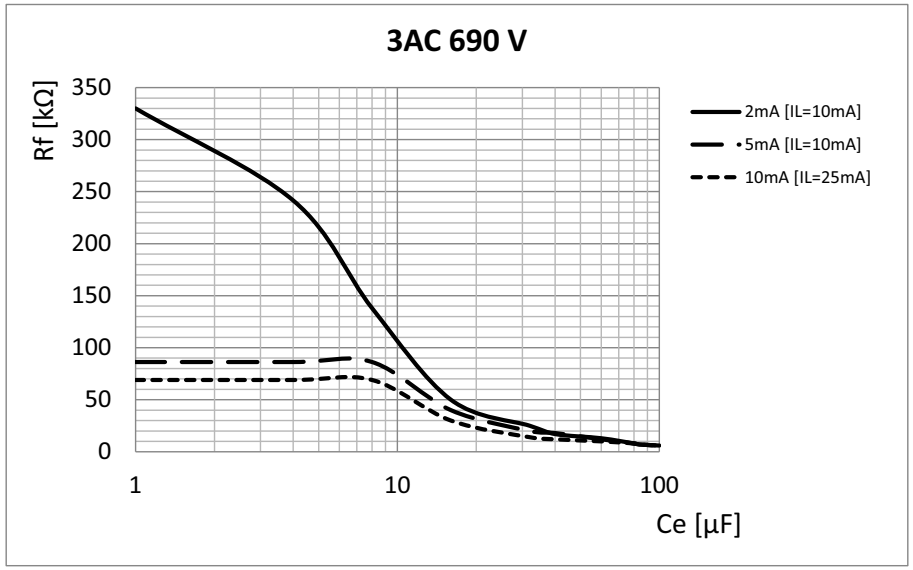
Diagrams

13.1.1 EDS440 characteristics for 3AC systems



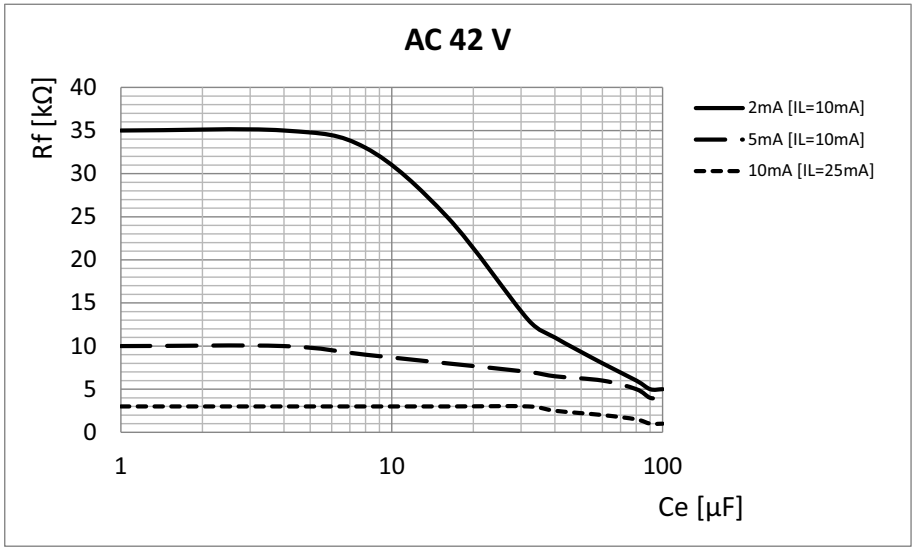


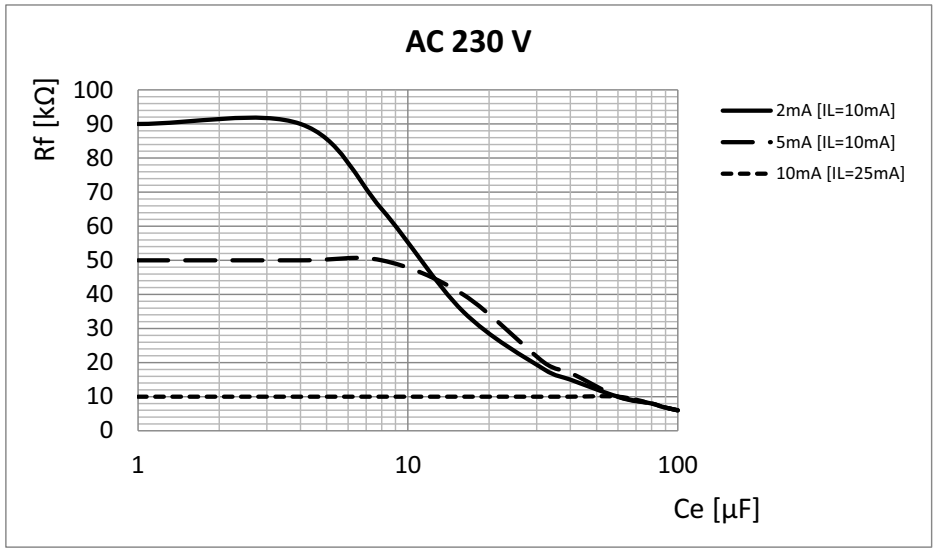


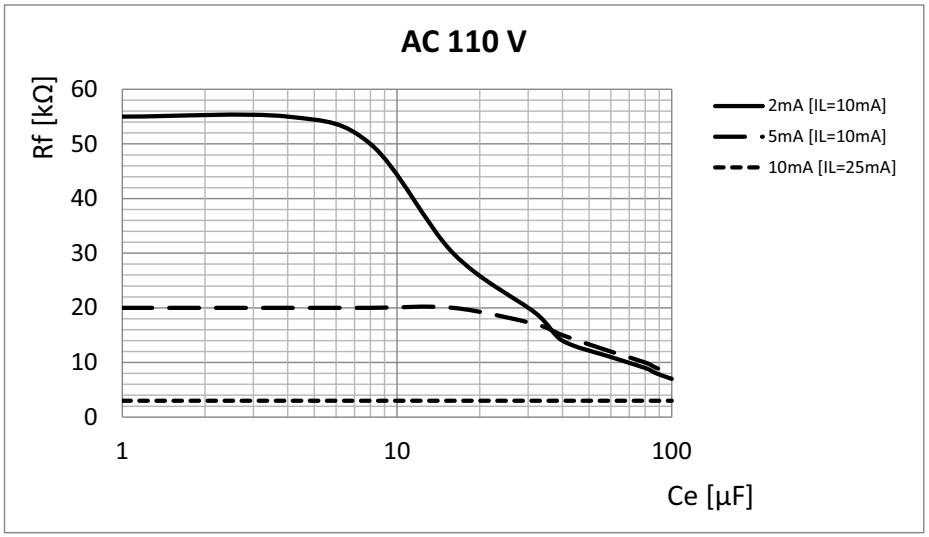


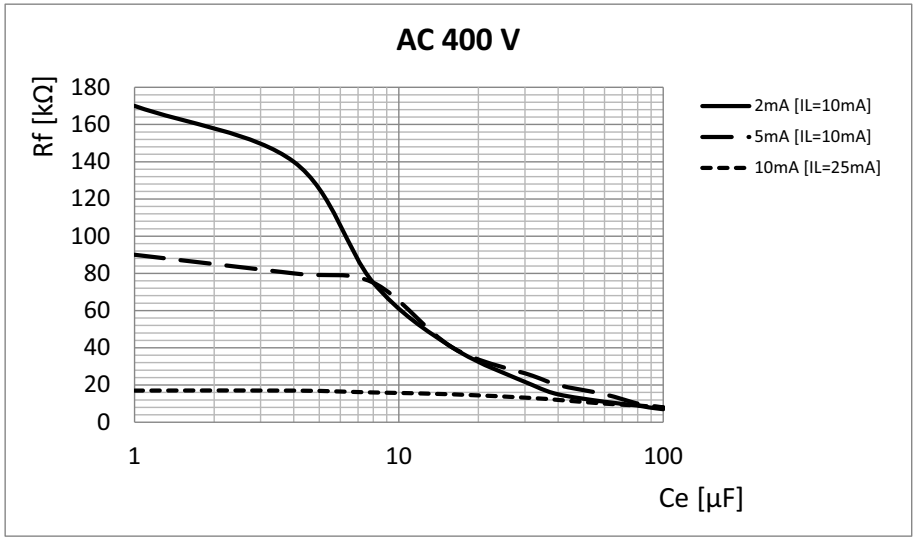
Diagrams

13.1.2 EDS440 characteristics for AC systems



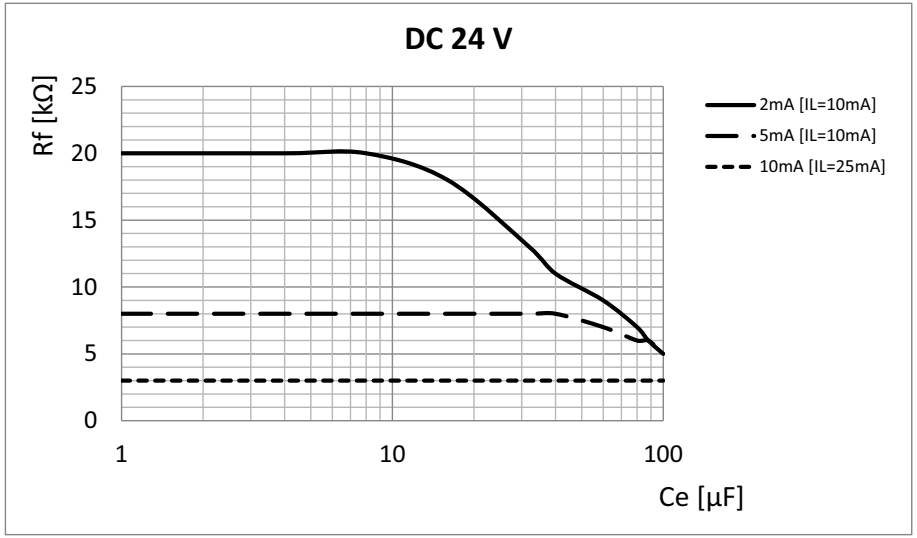


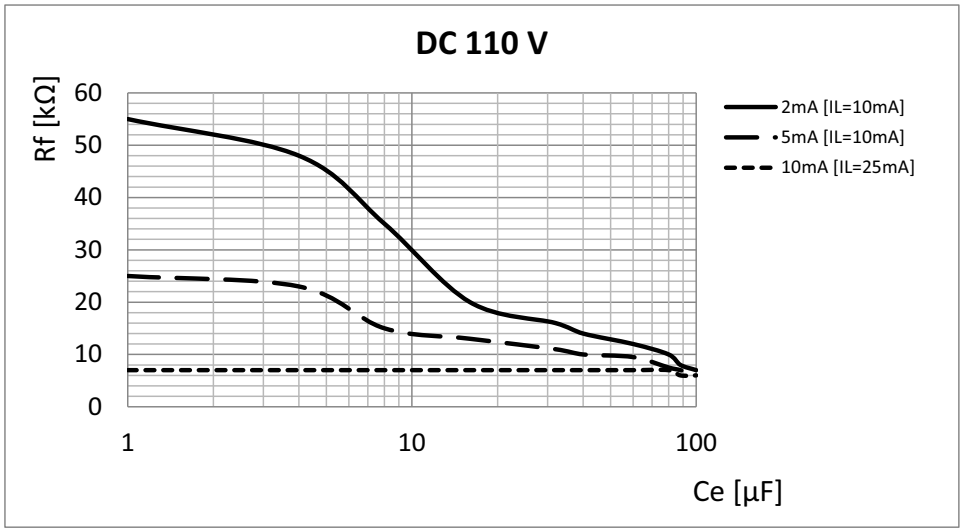


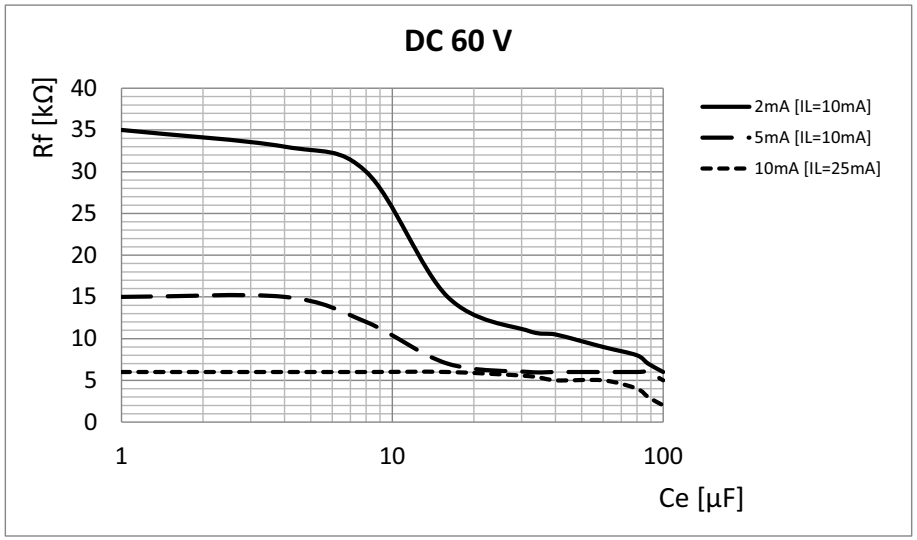


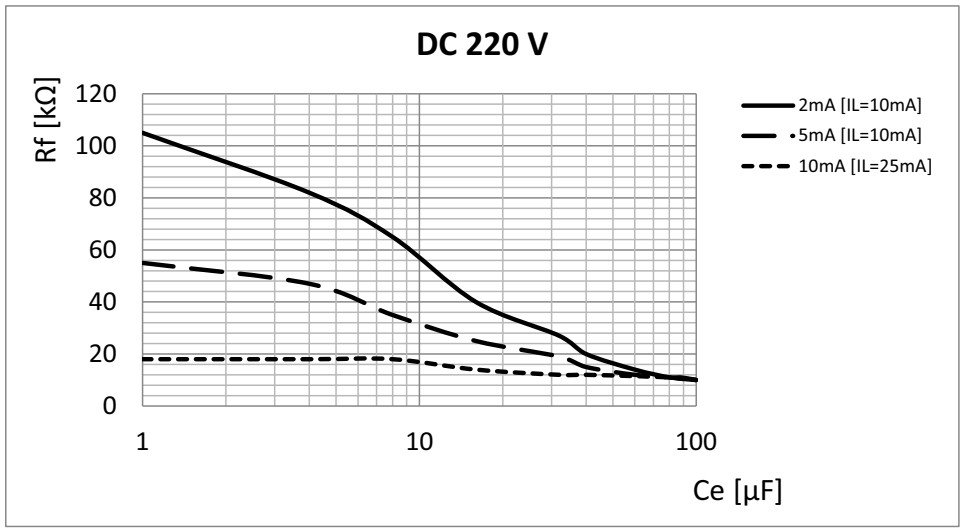
Diagrams

13.1.3 EDS440 characteristics for DC systems

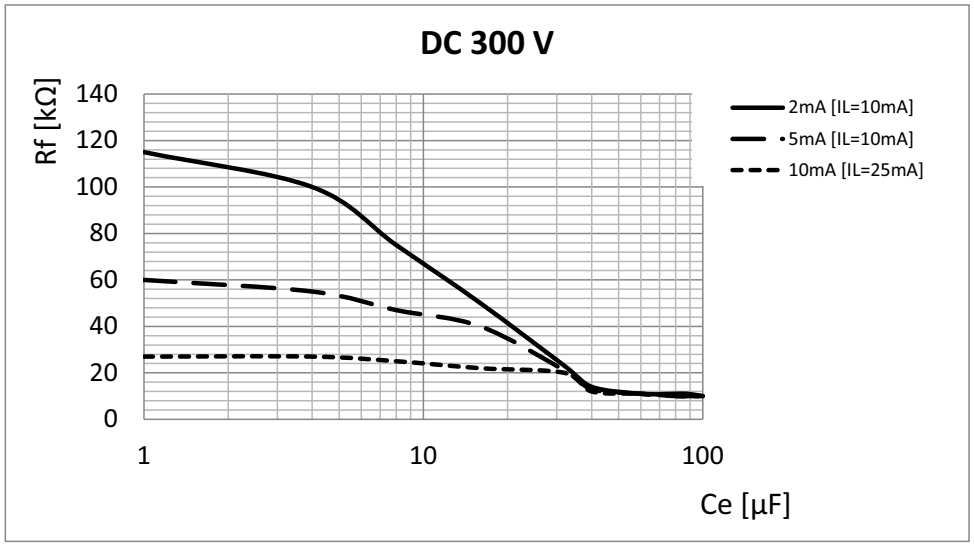


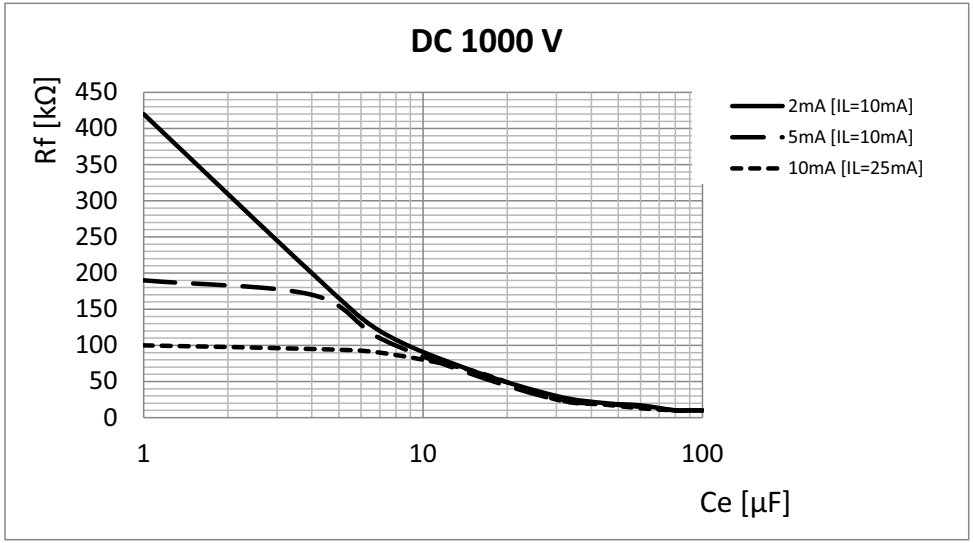


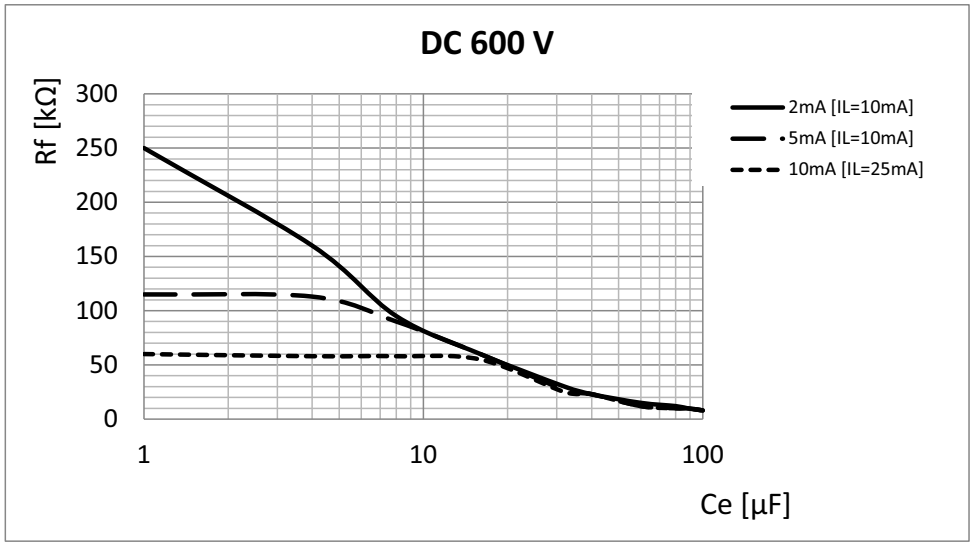




Diagrams

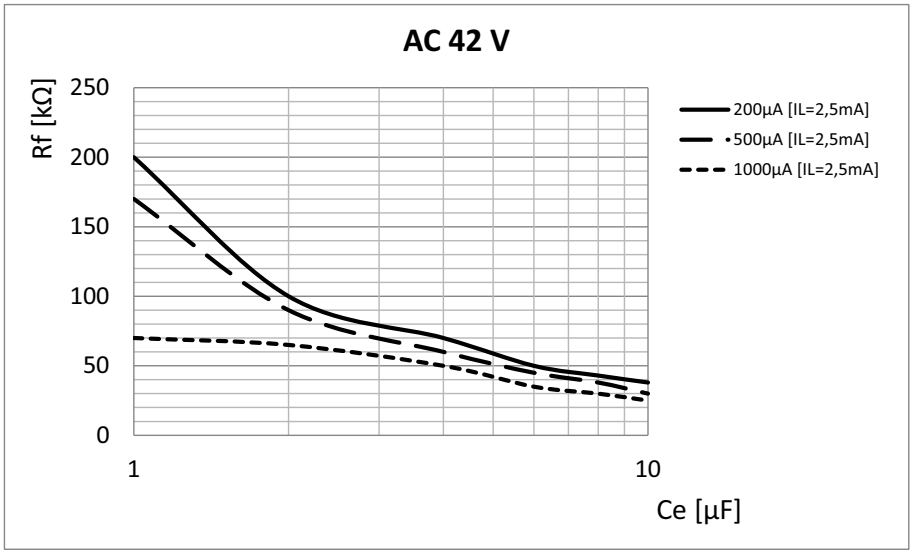

DC 300 V
Rf [kΩ]
140
120
100
80
60
40
20
0
1
10
100
Ce [µF]
2mA [IL=10mA]
5mA [IL=10mA]
10mA [IL=25mA]

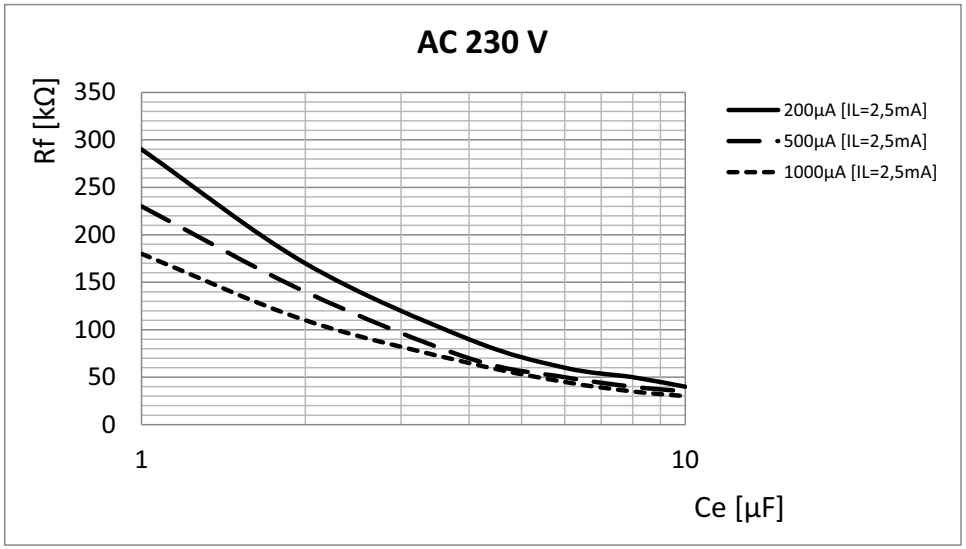

DC 1000 V
Rf [kΩ]
450
400
350
300
250
200
150
100
50
0
1
10
100
Ce [µF]
2mA [IL=10mA]
5mA [IL=10mA]
10mA [IL=25mA]

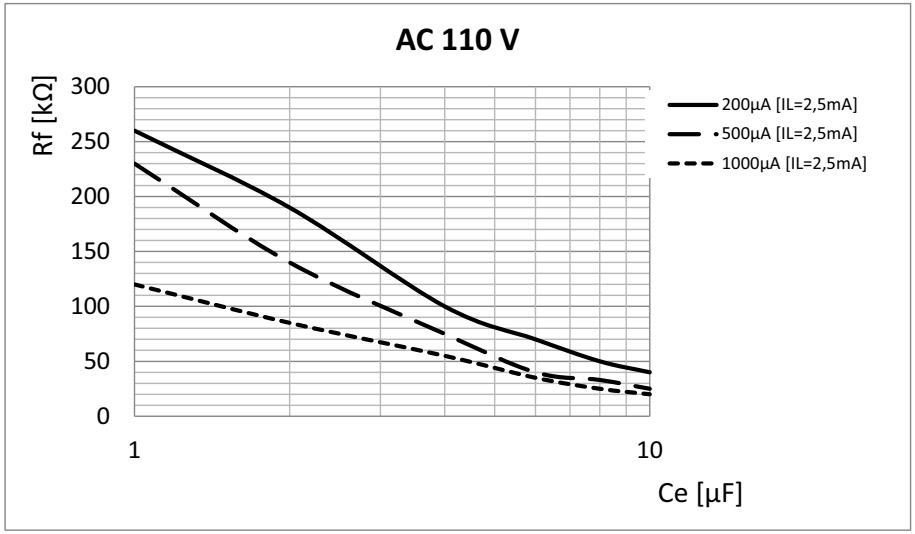

DC 600 V
Rf [kΩ]
300
250
200
150
100
50
0
1
10
100
Ce [µF]
2mA [IL=10mA]
5mA [IL=10mA]
10mA [IL=25mA]

Diagrams

13.1.4 EDS441 characteristics for AC systems

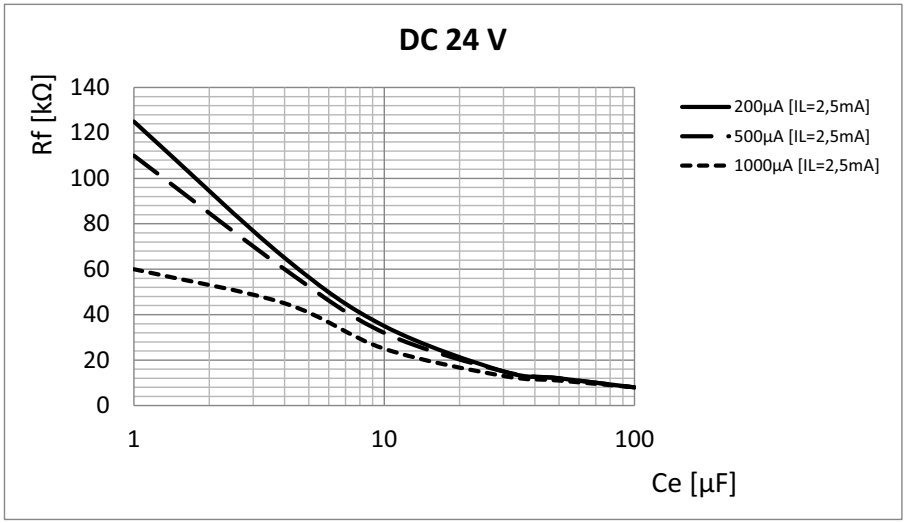


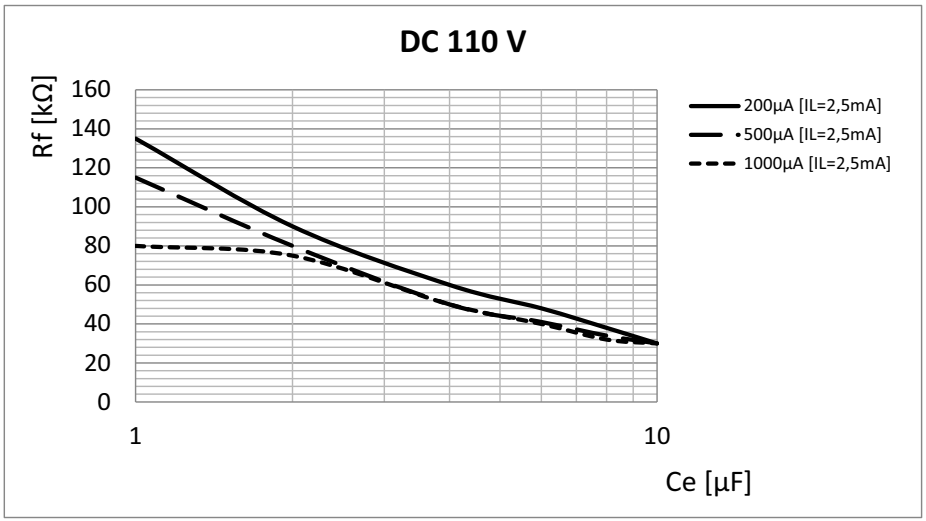


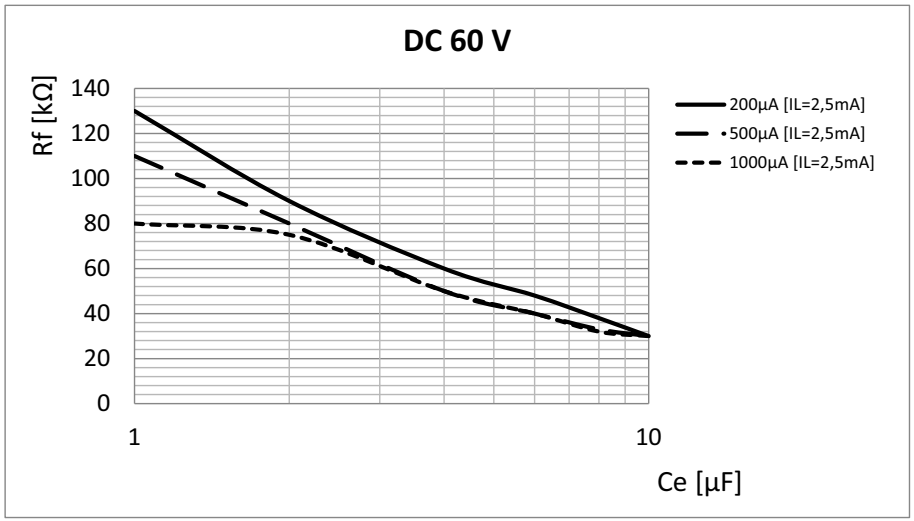


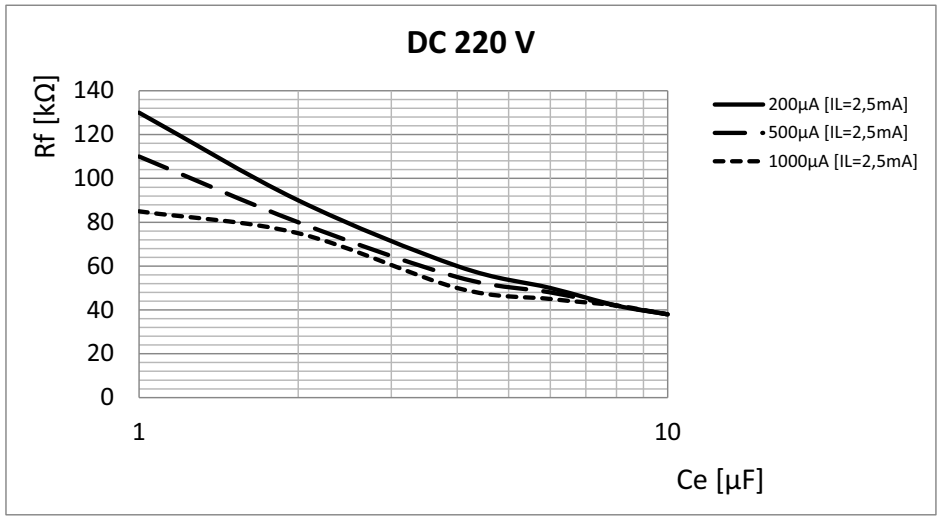
Diagrams

13.1.5 EDS441 characteristics for DC systems



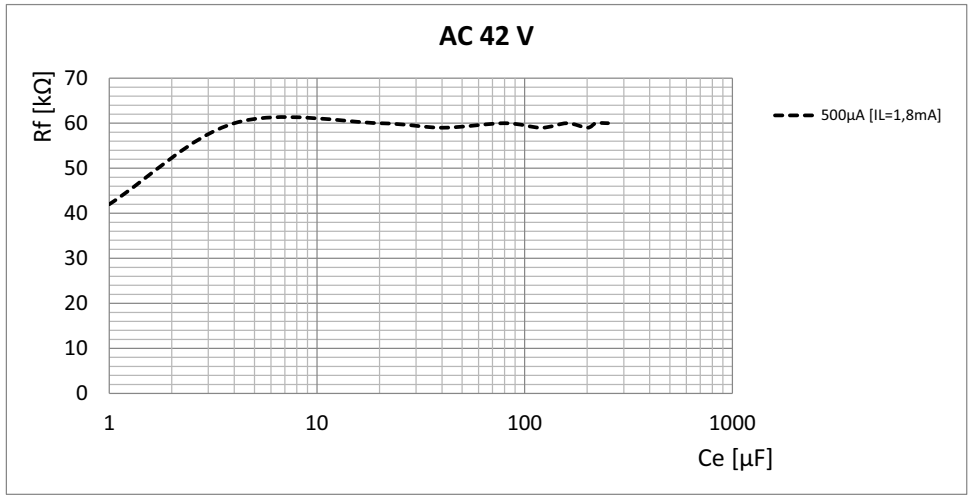


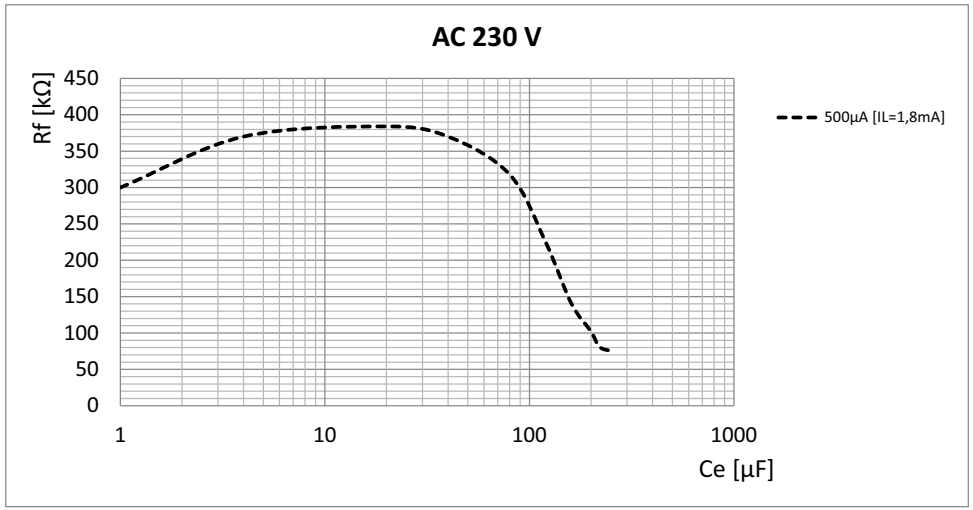




Diagrams

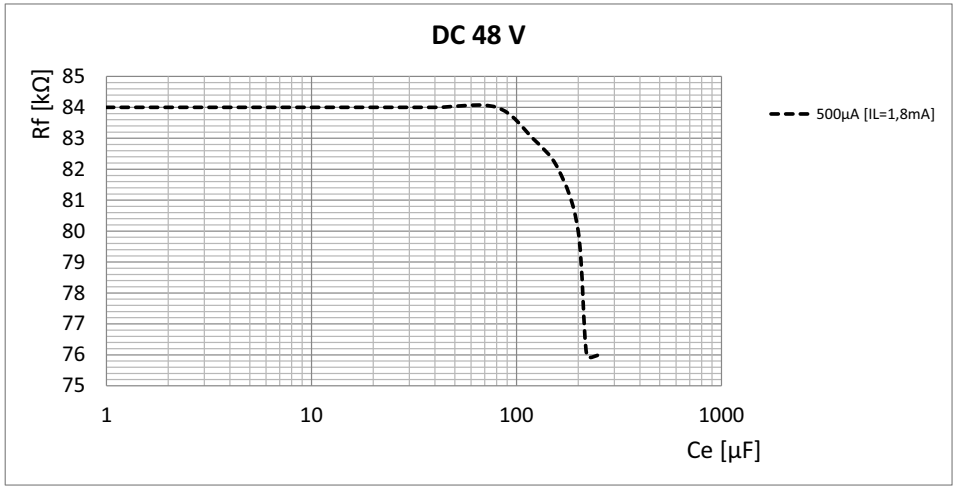
13.1.6 EDS441-LAB characteristics for AC systems

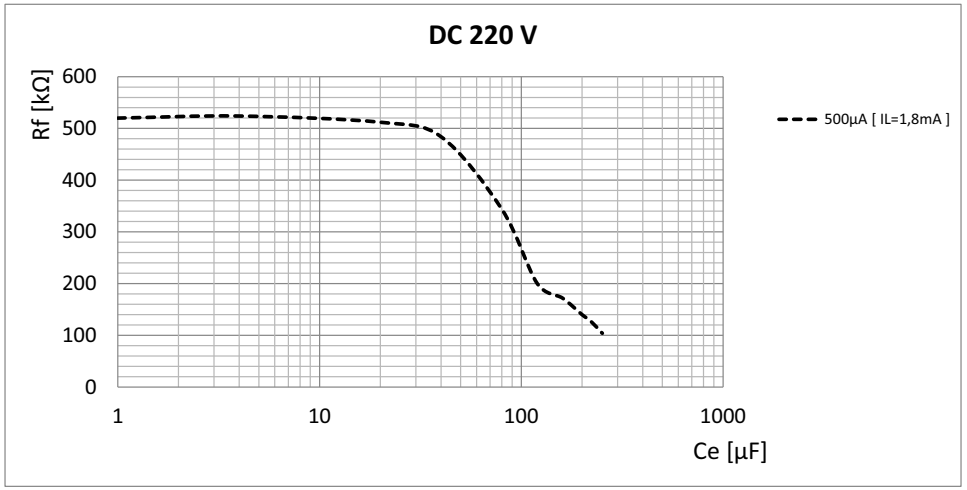


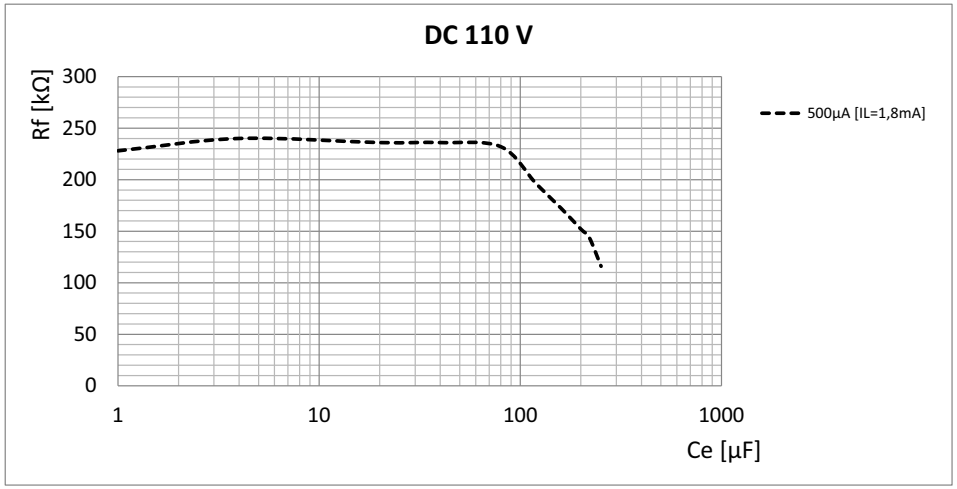


Diagrams

13.1.7 EDS441-LAB characteristics for DC systems

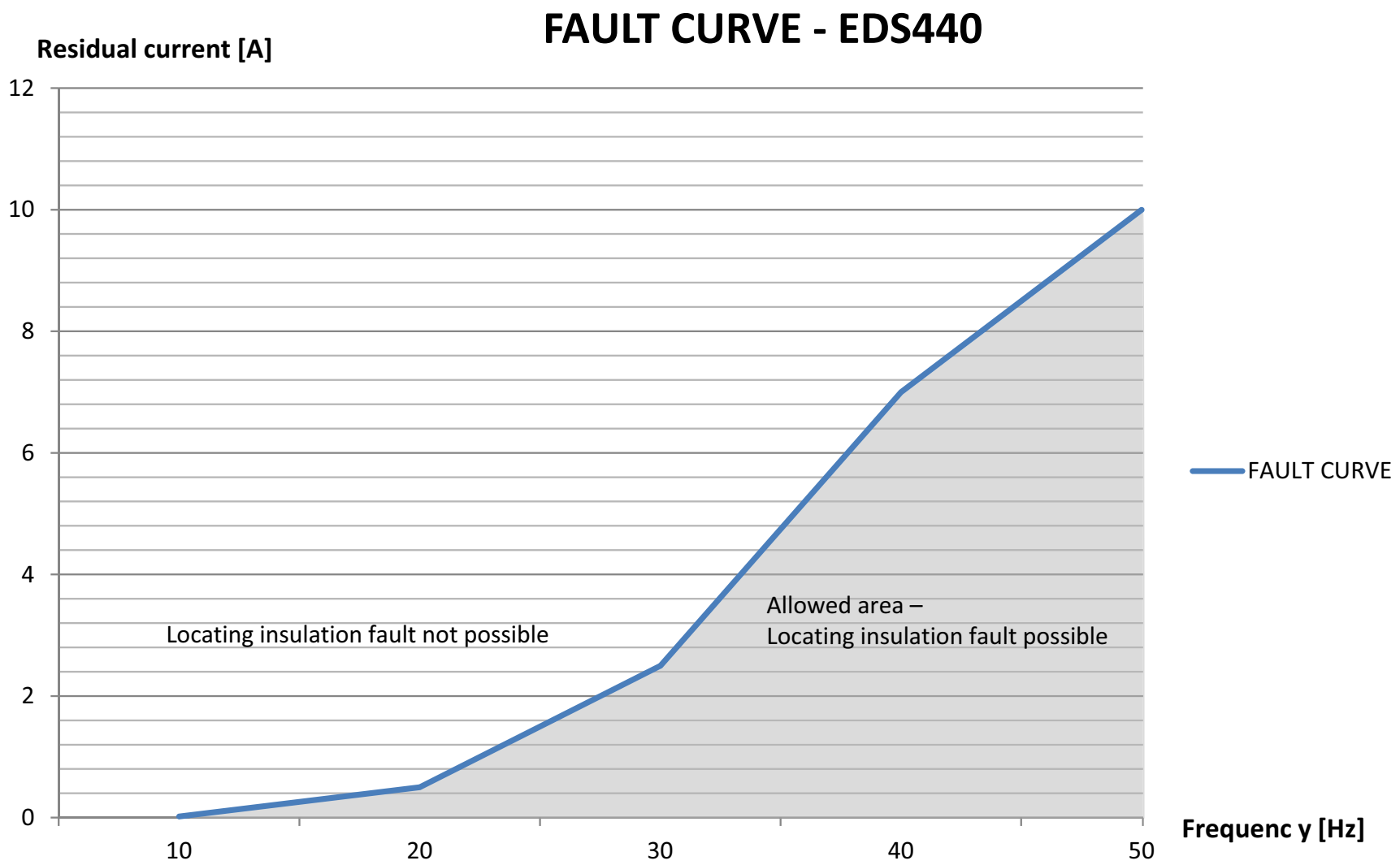






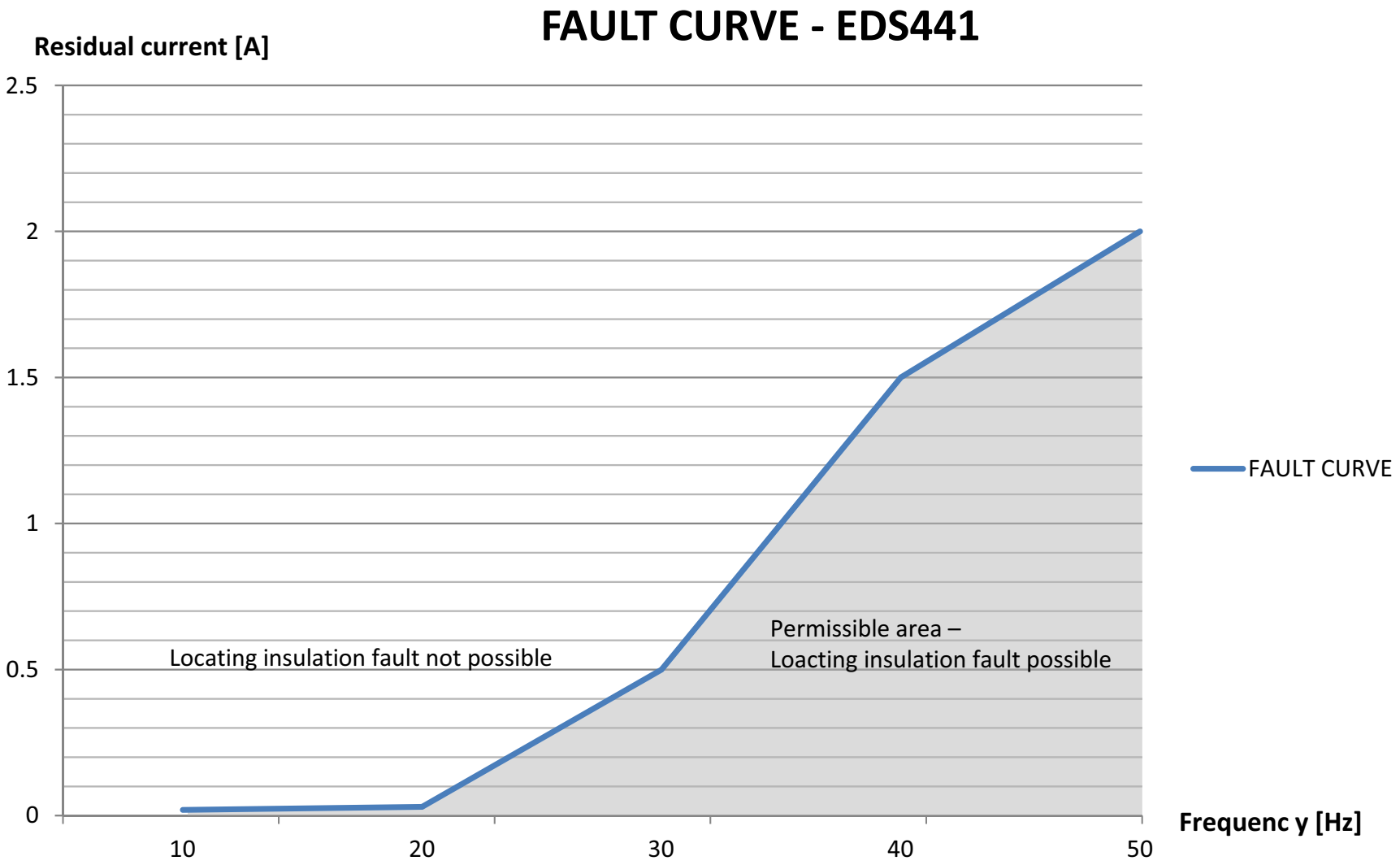
13.2 Fault curve EDS440…

An insulation fault location beyond the grey area causes an error message. The EDS44…-L indicates error messages via flashing LEDs (refer to "Error message" on page 28).
If an EDS44…-S is used, then the error messages are indicated via the ISOMETER®.



13.3 Fault curve EDS441…

An insulation fault location beyond the grey area causes an error message. The EDS44…-L indicates error messages via flashing LEDs (refer to "Error message" on page 28).
If an EDS44…-S is used, then the fault messages are indicated via the ISOMETER®.



14.1 Data in tabular form

Insulation coordination

Rated insulation voltage (IEC 60664-1) ..... AC 250 V
Rated impulse voltage (IEC 60664-1) ..... 4 kV
Overvoltage category III
Pollution degree 2
Protective separation (reinforced insulation) between ..... (A1,A2)-(13,14)-(23,24)-(X1,X2,X3)
Voltage test acc. to IEC 61010-1 ..... 2.2kV

Supply voltage

Supply voltage range Us ..... AC / DC 24...240 V
Tolerance of U_s ..... -20...+15 %
Frequency range of U_s ..... DC, 50...400Hz(1 (2
Tolerance of the frequency range of U_s ..... -5...+15 %
Power consumption, typically 50Hz (400Hz) EDS44...-L ..... ≤4 W / 7 VA (≤4 W, 28 VA)
Power consumption, typically (DC via BB-Bus) EDS44...-S ..... ≤1 W

Response values

Response value insulation fault location ($I_{\Delta L}$) EDS440 ..... 2...10 mA
Response value insulation fault location ($I_{\Delta L}$) EDS441 ..... 0.2...1 mA
Relative uncertainty ($I_{\Delta L}$) EDS440 ..... ±30 %, min. ±2 mA(3
Relative uncertainty ($I_{\Delta L}$) EDS441 ..... ±30 %, min. ±0.2 mA(3
Response value residual current measurement ($I_{\Delta n}$) EDS440 ..... 100 mA...10 A
Response value residual current measurement ($I_{\Delta n}$) EDS441 ..... 100 mA...1 A
Relative uncertainty ($I_{\Delta n}$) EDS44... (42...60 Hz) ..... ±5 %
Relative uncertainty ($I_{\Delta n}$) EDS44... (61...1000 Hz) ..... -20...0 %
Hysteresis ..... 20 %

Time response

Scanning time for all channels insulation fault location ($I_{\Delta L}$) ..... profile-dependent, min. 6 s
Response time residual current measurement ($I_{\Delta n}$) ..... ≤ 400 ms
Response time for measuring current transformer monitoring ..... max.18 min

Measuring circuit

Nominal system voltage U_n EDS440 ..... refer to locating current injector (e.g. ISOMETER® iso685-D-P)
Nominal system voltage U_n EDS441 ..... AC 20...276 V, DC 20...308 V
Measuring current transformer external for EDS440 type ..... W..., WR..., WS...
Measuring current transformer external for EDS441 type ..... W.../8000, WS.../8000
Measuring current transformer external for EDS44x-LAB type ..... W...AB
Load EDS440 ..... 47 Ω
Load EDS441 ..... 1.5 Ω
Rated insulation voltage (measuring current transformer) ..... 800 V

Connection EDS measuring current transformer

Single wire ≥ 0.75 mm² ..... 0...1 m
Single wire, twisted ≥ 0.75 mm² ..... 1...10 m
Shielded cable ≥ 0.5 mm² ..... 10...40 m
Recommended cable (shielded, shield connected to PE on one side) ..... J-Y (St) Y min. 2 x 0.8

Measuring ranges

Rated frequency range ..... DC, 42...1000 Hz(4
Measuring range insulation fault location ($I_{\Delta L}$) EDS440 ..... 1.5...25 mA (50 mA in DC systems only)
Measuring range insulation fault location ($I_{\Delta L}$) EDS441 ..... 0.15...5 mA
Measuring range residual current measurement ($I_{\Delta n}$) EDS440 ..... 100 mA...20 A
Measuring range residual current measurement ($I_{\Delta n}$) EDS441 ..... 100 mA...2 A

LEDs

ON (operation LED) ..... green
COM ..... yellow
SERVICE ..... yellow
$I_{\Delta L}$ ALARM ..... yellow
$I_{\Delta n}$ ALARM ..... yellow
1...12 channel indication ..... yellow

Digital inputs

Number 2
Operating mode, adjustable ..... active high, active low
Function ..... none, test, reset
Voltage level ..... Low DC- 5...5 V, High DC 11...32 V

Digital current output

Number 1
Function ..... none, $I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, device fault, transformer connection fault, common alarm
Current ..... 0 mA DC inactive, 20 mA DC active
Tolerance ..... ±10 %
Burden resistance ..... R ≤ 500 Ω / PR ≥ 0,25 W

Buzzer

Number 1
Function ..... none, $I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, device fault, transformer connection fault, insulation fault location active, common alarm

Technical data

Interfaces

Interface/protocol RS-485/BS
Data rate ..... 9600 baud/s
Cable length ..... ≤ 1200 m
Cable: twisted pair, one end of shield connected to PE ..... recommended: J-Y (St) Y min. 2 x 0.8
Connection X1.A, X1.B
Terminating resistor ..... 120 Ω, can be connected internally
Device address, BS bus ..... 2 . . . 90

Switching elements

Number ..... 2 N/O contacts
Operating mode ..... N/C operation/N/O operation
Function contact 13,14 ..... none, $I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, device fault, transformer connection fault, common alarm
Function contact 23,24 ..... none, $I_{\Delta L}$ alarm, $I_{\Delta n}$ alarm, device fault, transformer connection fault, common alarm
Electrical endurance under rated operating conditions 30000
Rated operational voltage ..... 250 VAC
Rated operational current ..... 7 A
Rated insulation voltage ..... 4 kV
Max. switching capacity ..... 300 W / 2770 VA
Max. switching capacity ..... 30 VDC / 277 VAC

Environment/EMC

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

Ambient temperatures

Operating temperature ..... -25 °C . . . +55 °C
Transport ..... -40 °C . . . +85 °C
Storage ..... -25 °C . . . +70 °C
Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3K5 (no condensation, no formation of ice)
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
Range of use ..... ≤ 2000 m above sea level

Connection

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

Screw-type terminal:

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 sleeve ..... 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:

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

Push-wire terminals X1, X2:

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 TWIN ferrule with plastic sleeve ..... 0.25 . . . 0.75 mm^2

Other

Operating mode ..... continuous operation
Mounting ..... at an ambient temperature >55 °C vertical mounting required
..... at an ambient temperature <55 °C mounting optional
Degree of protection internal components IP40
Degree of protection terminals IP20
DIN rail mounting acc. to ..... IEC 60715
Screw fixing ..... 2 x M4 with mounting clip
Enclosure material ..... polycarbonate
Flammability class ..... UL 94V-0
Dimensions (W x H x D) ..... 72 x 93 x 63
Weight ..... approx. 122 g (EDS44x-S)
..... approx. 242 g (EDS44x-L)

Option "W" data different from the standard version

Ambient temperatures:
Operating temperature ..... -40 . . . +70 °C
Transport ..... -40 . . . +85 °C
Long-term storage ..... -40 . . . +70 °C
Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3K5 (condensation and formation of ice possible)
Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) 3M7

[1] = at a frequency >200 Hz, connection of X1 and k1-12/l1-12 must be insulated.
Only permanently installed devices which at least have overvoltage category CAT2 (300V) may be connected.
2) = only 50/60 Hz are permitted for UL applications.
[3] = effect of a residual current >100 mA results in a greater relative uncertainty.
[4] = the $I_{\Delta n}$ function of the EDS441 . . . is only suitable for 50/60 Hz.

Technical data

14.2 Standards

Observe the applicable national and international standards. The EDS… series meets the device standards:

- DIN VDE 0100-410 (VDE 0100-410):2007-06
- DIN EN 61557-9 (VDE 0413-9):2015-10
- IEC 61557-9:2014-12
- DIN EN 50155 (VDE 0115-200):2010-11

The operating manuals for the individual system components provide you with information about the standards that apply to that particular device.

Technical data

14.3 Ordering information

14.3.1 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

14.3.2 Accessories

Description	Art. no.
EDS440/441 mechanical accessories comprising: terminal cover and 2 mounting clips*	B 9108 0903
EDS440/441 plug kit, screw terminals*	B 9108 0901
EDS440 441 plug kit, push-wire terminals	B 9108 0902
BB bus 4TE connector**	B 9811 0002

* included in the scope of delivery
** included in the scope of delivery of the EDS44x(W)-S-1

Type	Supply voltage U_S	Art. no.
DI-1PSM (RS-485 repeater)	AC/DC 24 V ± 20 %	B 9501 2044
DI-2USB (interface converter RS-485/USB) with USB cable	Supplied by USB interface	B 9501 2045
AN471 (power supply unit for DI-1 or DI-2)	AC 230 V 50/60 Hz AC, DC 20 V	B 924 189
Snap-on mounting W20…/35…		B 9808 0501
Snap-on mounting W60…		B 9808 0502

Technical data

14.3.3 Measuring current transformer for EDS440

Bender measuring current transformers

Type	**Internal diameter/ mm**	**Design type**	**Art. no.**
W20	20	circular	B 9808 0003
W35	35	circular	B 9808 0010
W60	60	circular	B 9808 0018
W120	120	circular	B 9808 0028
W210	210	circular	B 9808 0034
WS20x30	20 x 30	split-core	B 9808 0601
WS50x80	50 x 80	split-core	B 9808 0603
WS80x120	80 x 120	split-core	B 9808 0606

Alternative measuring current transformer from the Bender program

Type	**Internal diameter/ mm**	**Design type**	**Art. no.**
W10/600	10	circular	B 911 761
W0-S20	20	circular	B 911 787
W1-S35	35	circular	B 911 731
W2-S70	70	circular	B 911 732
W3-S105	105	circular	B 911 733
W4-S140	140	circular	B 911 734
W5-S210	210	circular	B 911 735
WR 70x175S	70x175	rectangular	B 911 738
WR 115x305S	115x305	rectangular	B 911 739
WR 150x350S	150x350	rectangular	B 911 740
WR 200x500S	200x500	rectangular	B 911 763
WS 50x80S	50x80	split-core	B 911 741
WS 80x80S	80x80	split-core	B 911 742
WS 80x120S	80x120	split-core	B 911 743
WS 80x160S	80x160	split-core	B 911 755

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

Technical data

Measuring current transformer for EDS441

Bender measuring current transformers

Type	**Internal diameter/ mm**	**Design type**	**Art. no.**
W20-8000	20	circular	B 9808 0009
W35-8000	35	circular	B 9808 0017
W60-8000	60	circular	B 9808 0027
WS20x30-8000	20 x 30	split-core	B 9808 0602
WS50x80-8000	50 x 80	split-core	B 9808 0604

Alternative measuring current transformer from the Bender program

Type	**Internal diameter/ mm**	**Design type**	**Art. no.**
W10/8000	10	circular	B 911 759
W1-35/8000	35	circular	B 911 756
WS20x30/8000	20 x 30	split-core	B 911 764
WS50x80/8000	50 x 80	split-core	B 911 757
W10/8000-6	10	circular, 6-fold	B 911 900

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

Measuring current transformer for EDS441-LAB

Bender measuring current transformers

Type	**Internal diameter/ mm**	**Design type**	**Art. no.**
W20AB	20	circular	B 9808 0008
W35AB	35	circular	B 9808 0016
W60AB	60	circular	B 9808 0026
W120AB	120	circular	B 9808 0041
W210AB	210	circular	B 9808 0040

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

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BENDER
The Power in Electrical Safety©

Bender GmbH & Co. KG
Postbox 1161 • 35301 Gruenberg • Germany
Londorfer Straße 65 • 35305 Gruenberg • Germany

Tel.: +49 6401 807-0
Fax: +49 6401 807-259

E-Mail: info@bender.de
Web: www.bender.de

Customer service
Service hotline: 0700-BenderHelp (Telephone und Fax)
Carl-Benz-Straße 8 • 35305 Gruenberg • Germany

Tel.: +49 6401 807-760
Fax: +49 6401 807-629

E-Mail: info@bender-service.com
Web: http://www.bender.de

BENDER Group

Photos: Bender archive.