ISOMETER® isoMIL685-D-P

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

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ISOMETER® isoMIL685W-D-P

Application

- AC, DC or AC/DC main circuits
- AC/DC main circuits with directly connected DC components, such as rectifiers, converters, variable-speed drives
- UPS systems, battery systems
- Heaters with phase control
- Systems including switch-mode power supplies
- IT systems with high leakage capacitances
- Installations with insulation fault location

Certifications

Device 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 10 kΩ…1 MΩ
- High-resolution graphic LC display for excellent readability and recording of the device status
- 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 of certain parameters via the Internet (Option; COMTRAXX® gateway)
- Worldwide remote diagnosis via the Internet (made available by Bender Service only)
- RS-485/BS (Bender sensor bus) for communication 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

EDS44…

- Insulation fault location in AC, 3AC and DC IT systems (AC 24…690 V, DC 24…500 V)
- 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

Product description

The ISOMETER® is an insulation monitoring device for IT systems in accordance with IEC 61557-8 and IEC 61557-9. 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).

In combination with the insulation fault locators of the EDS44x series or the appropriate measuring current transformers, an insulation fault location system can be set up with the isoMIL685-D-P.

AC/DC

Insulation monitoring function

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 microcontrolled measuring circuit. The measuring time depends 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 or via different setup menus using the device buttons and a high-resolution graphic LC display. The selected settings are stored in a permanent fail-safe memory. Different languages can be selected for the setup menus and 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 protected against unauthorised modifications by a password. To ensure proper functioning of the connection monitoring, the system type 3AC, AC or DC must be set and the appropriate terminals L1/+, L2, L3/- must be connected.

The ISOMETER® 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 an optimised relative uncertainty. Different measurement profiles which can be selected from a setup menu allow optimum adaptation of the measurement technique to the specific application.

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 insulation resistance is at least 25 % above the preset 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.

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®.

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

System setup

In general, an EDS system is constituted by an iso685-…-P as well as one or more EDS44x insulation fault locators with the appropriate measuring current transformers. The information is exchanged between the EDS44x and the iso685-…-P via a backbone bus or a 2-wire sensor bus in order to save time and costs.

The insulation monitoring device iso685-…-P and the insulation fault locators EDS44x constitute a complete IT system monitoring unit. In a system like this, up to 255 channels can be monitored.

The insulation monitoring devices can be connected to various gateways via an Ethernet interface, whereby an almost infinite amount of channels distributed in different IT systems can be monitored.

Measurement method

AMPPlus The iso685-…-P series uses the patented **AMP**Plus measurement method. This measurement method allows concise monitoring of modern power supply systems, also in case of extensive, directly connected DC components and high system leakage capacitances.

Standards

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
- DIN EN 61557-9 (VDE 0413-9):2015-10
- IEC 61557-9:2014-12

Operating elements
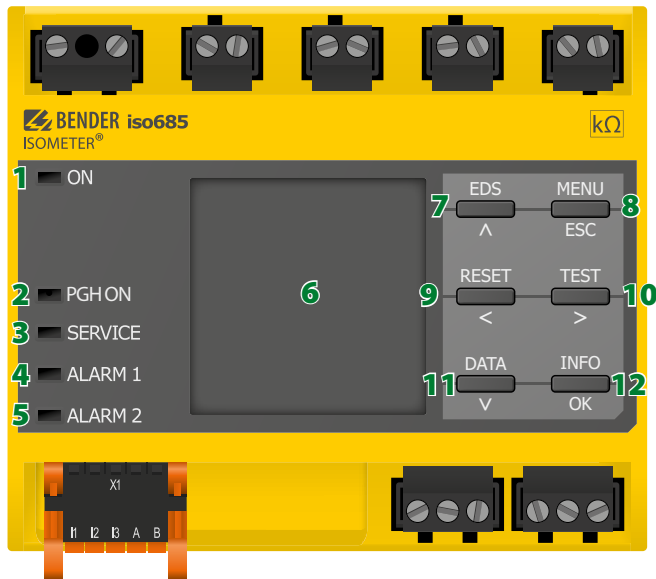
1 -	ON	The LED "ON" lights when the device is turned on.
2 -	PGH ON	The LED „PGH ON" flashes during insulation fault location. It indicates that the locating current for the insulation fault location is generated.
3 -	SERVICE	The LED "SERVICE" lights when there is either a device fault or a connection 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.
7 -	EDS	Manually starts the insulation fault location, which runs continuously. Stops the insulation fault location immediately when it is pressed again.
	$\wedge$	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.
	$\vee$	Navigates down in a list or reduces a value.
12 -	INFO	Shows information.
	OK	Confirms an action or a selection.

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Wiring diagram
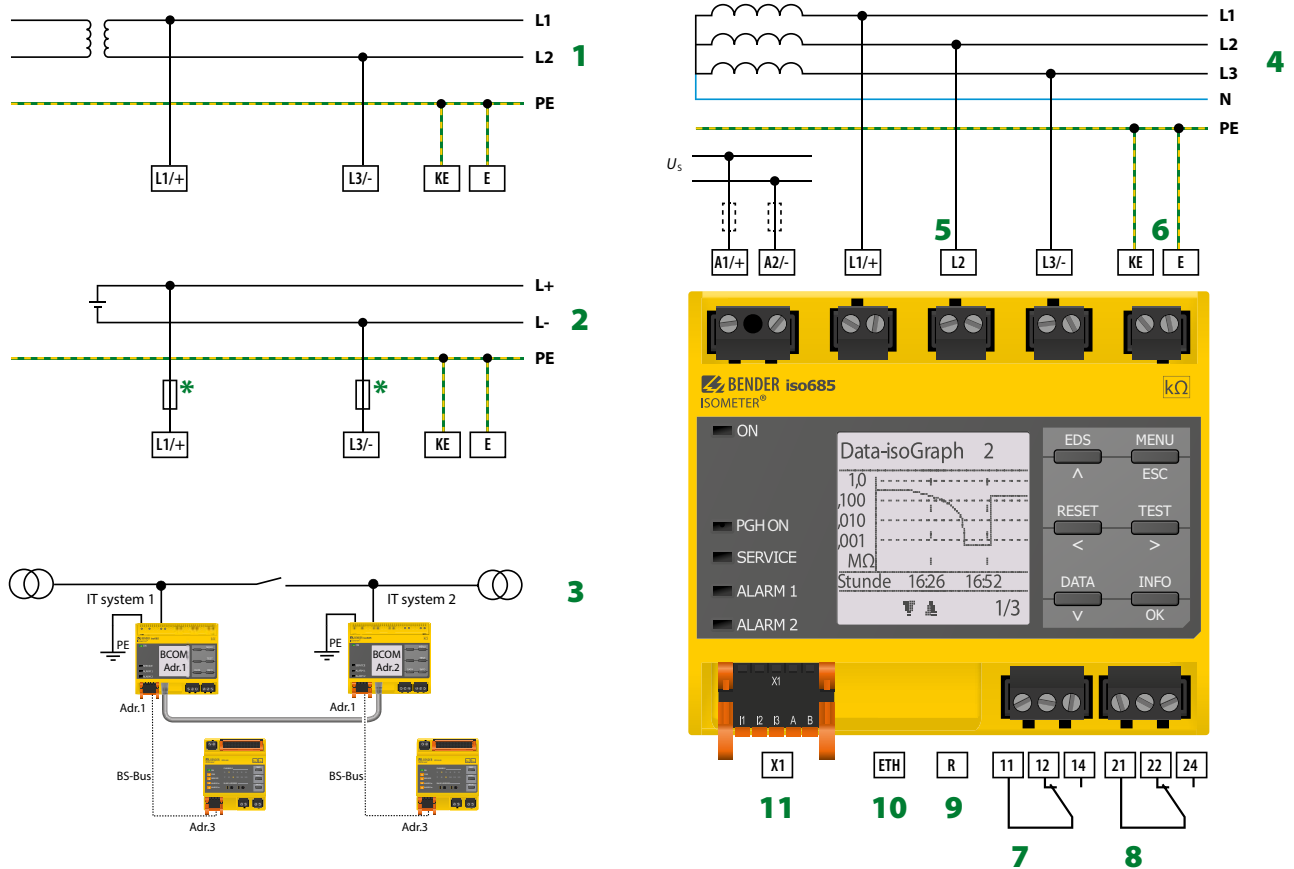
1 - Connection to an AC system U_n
2 - Connection to a DC system U_n
3 - Linked with two IT systems which can be interconnected via a coupling switch. Information regarding the state of the coupling switch is not necessary.
4 - Connection to a 3(N)AC system
5 - Connection to the IT system to be monitored (L1/+, L2, L3/-)
6 - Separate connection of KE, E to PE
7 - (K1) Alarm relay 1, available changeover contacts

8 - (K2) Alarm relay 2, available changeover contacts
9 - Switchable resistor R for RS-485 bus termination
10 - Ethernet interface
11 - Digital interface
* - For systems > 690 V and with overvoltage category III a fuse for the connection to the system to be monitored must be provided.

Recommendation: 2A screw-in fuses.

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

NOTE:
According to DIN VDE 0100-430, devices for protection against a short-circuit can be omitted for the coupling of terminals L1/+, L2, and L3/- to the IT system ≤ 690 V to be monitored if the wiring is carried out in such a manner as to reduce the risk of a short-circuit to a minimum. (Recommendation: Ensure short-circuit-proof and earth-fault-proof wiring).

The connecting lines L1/+, L2, L3/- to the system to be monitored must be carried out as spur lines. No load current may be conducted through the terminals.

For UL applications:
Use 60/70°C copper lines only!
UL and CSA application require the supply voltage to be protected via 5 A fuses.

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Dimension diagram iso685-...-P

Dimensions in mm

110   108   93
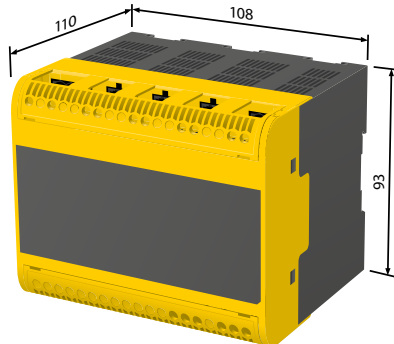
Digital interface X1

Digital interface	Terminal	Colour
	I1	Input 1
	I2	Input 2
	I3	Input 3
	A	RS-485 A
	B	RS-485 B
	+	+24 V
X1	Q1	Output 1
	Q2	Output 2
	M+	Analogue output
	⊥	Ground
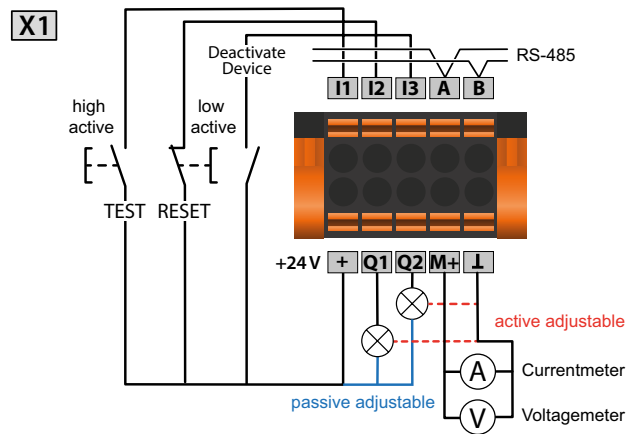
Connection example ISOMETER® with insulation fault locators

iso685-D-P

EDS44…-S

EDS44…-L

BS bus

System setup

ISOMETER®
iso685-D-P

Ethernet

BS

EDS44...-L

EDS44...-L

EDS44...-L

EDS195P

COM465

Router

Browser
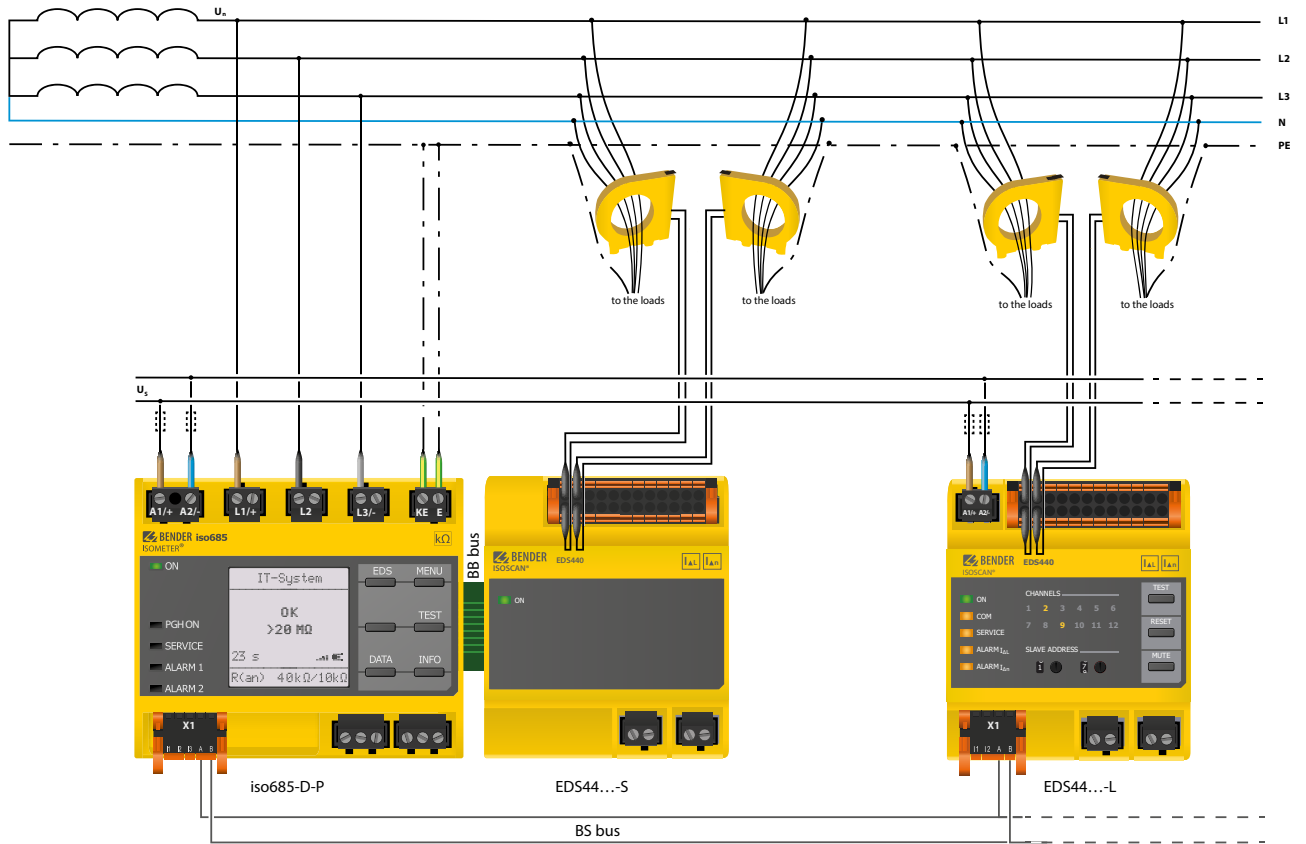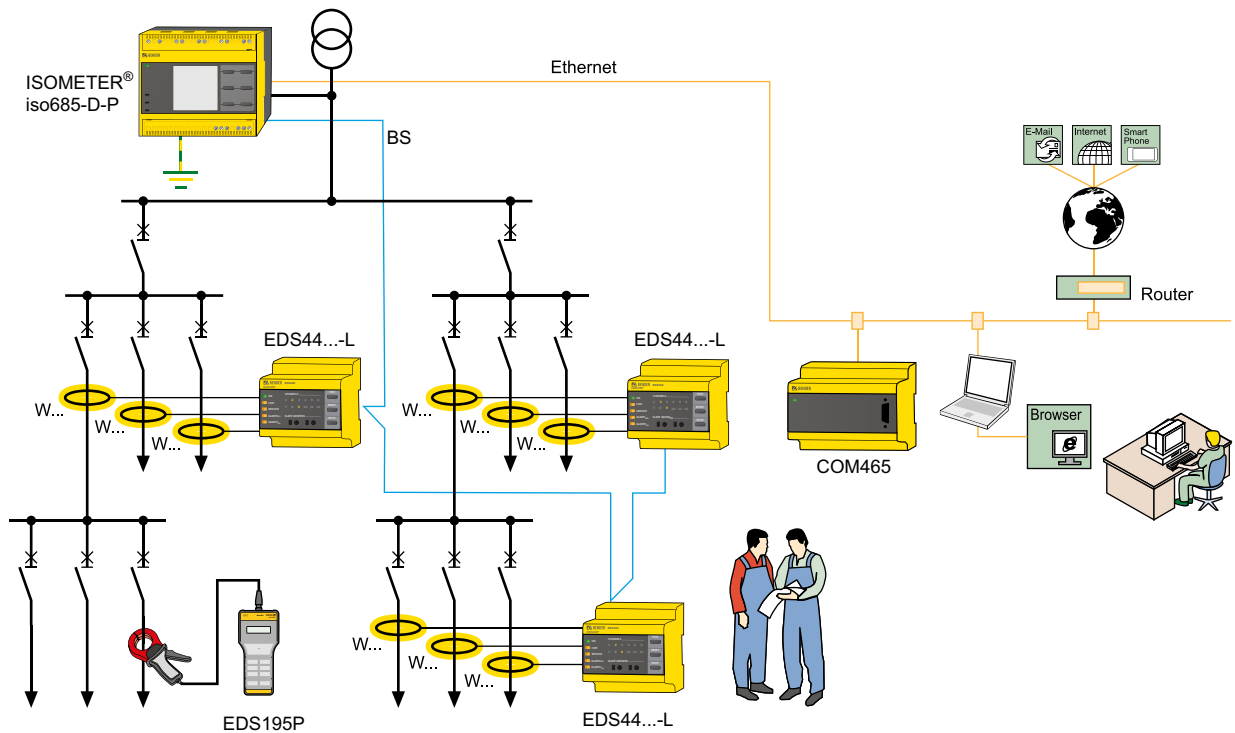
Technical data

Insulation coordination according 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 for accessible parts on the outside of the device housing ($U_n < 690$ V)	3
Pollution degree for accessible parts on the outside of the device housing ($U_n > 690 < 1000$ V)	2
Protective separation (reinforced insulation) between:	
IC1/(IC2-5)	Overvoltage category III, 1000 V
IC2/(IC3-5)	Overvoltage category III, 300 V
IC3/(IC4-5)	Overvoltage categoryIII, 300 V
IC4/IC5	Overvoltage category III, 300 V
Voltage test (routine test) according 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, 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, 1…460 Hz
Max. AC voltage $U_\sim$ in the frequency range $f_n = 0.1…4$ Hz	$U_{\sim\,max} = 50\ \mathrm{V/Hz}^2 *(1+ f_n^2)$

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)	profile dependent, ±15 %, at least ±1 kΩ
	profile control circuit ±15 %, at least ±3 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 according to IEC 61557-8	
	profile dependent, typ. 4 s (see diagrams in manual)
Start-up delay $T_{start-up}$	0…120 s

Measuring circuit

Measuring voltage U_m	profile dependent, ±5 V, ±50 V (see profile overview)
Measuring current lm	≤ 403 µA
Internal resistance R_i, Z_i	≥ 124 kΩ
Permissible extraneous DC voltage U_{fg}	≤ 1200 V
Permissible system leakage capacitance C_e	profile dependent, 0…1000 µF

Measuring circuit for insulation fault location (EDS):

Locating current I_L	1/1.8/2.5/5/10/25/50 mA

Measuring ranges

Measuring range f_n	10…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	AC 25…690 V; DC 25…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

Display

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

LEDs

ON (operation LED)	green
PGH ON	yellow
SERVICE	yellow
ALARM 1	yellow
ALARM 2	yellow
In-/Outputs (X1-Interface)	
Cable length X1 (unshielded cable)	≤ 10 m
Cable length X1 (shielded cable, shield connected to earth (PE) on one end, recommended:	
J-Y(St)Y min. 2x0,8)	≤ 100 m
Total max. supply output current for each output (device supplied by X1.+/X1.GND)	max. 1 A
Total max. supply output current on X1 (device supplied by A1+/A2-)	max. 200 mA
Total max. supply output current on X1 (device supplied by A1+/A2- between 16,8 V and 40 V)	
	$I_{LmaxX1} = 10\ \mathrm{mA} + 7\ \mathrm{mA/V} * U_s$ [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, insulation fault location
Voltage	Low DC -3…5 V, High DC 11…32 V
Tolerance Voltage	± 10 %

Digital Outputs (Q1, Q2)

NNumber	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, common alarm EDS
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 offset
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 %

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Interfaces

Field bus:

Interface/protocol	web server/Modbus TCP/BCOM
Data rate	10/100 Mbit/s, autodetect
Max. amount 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

Sensor bus:

Interface/protocol	RS-485/BS
Data rate	9.6 kBaud/s
Cable length	≤ 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 at the beginning and at the end of the transmission path	120 Ω, can be connected internally
Device address, BS bus	1…90

Switching elements

Number of switching elements	2 changeover contacts
Operating mode	N/C operation/N/O operation
Contact 11-12-14/ 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, common alarm EDS
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	DC-12
Rated operational voltage	230 V	230 V	24 V	48 V	110 V	220 V
Rated operational current	5 A	3 A	1 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	

Environment/EMC

EMC	IEC 61326-2-4 [5]

Ambient temperatures:

Operating temperature	-25…+55 °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)	3K23 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K11
Long-term storage (IEC 60721-3-1)	1K22

Classification of mechanical conditions acc. to IEC 60721:

Stationary use (IEC 60721-3-3)	3M11
Transport (IEC 60721-3-2)	2M4
Long-term storage (IEC 60721-3-1)	1M12
Area of application	≤ 3000 m NN

Connection

Connection type	pluggable screw-type 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 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 with TWIN 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 sleeve	0.25…2.5 mm^2
Multiple conductor, flexible with TWIN 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 TWIN 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	< 510 g

[1] At a frequency > 200 Hz, the connection of X1 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] = supply voltage ISOMETER®
n = Number of BB bus devices
PBB [Watt] = Power of a BB bus device

[4] For U_n ≥ 50 V only.

[5] This is a class A product. In a domestic environment, this product may cause radio interference. 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.

Ordering information

Nominal system voltage range U_n		Supply voltage U_S		Display	Type		Art. No.
AC	DC	AC	DC				
0…690 V; 1…460 Hz	0…1000 V	24…240 V; 50…400 Hz	24…240 V	■	isoMIL685W-D-P		B91067033W

Insulation fault locators

Description	Supply voltage U_S AC/DC	Response value	Type	Art. No.
Insulation fault locators	24…240V	2…10mA	EDS440-S-1	B91080201
			EDS440W-S-1	B91080201W
			EDS440-L-4	B91080202
			EDS440W-L-4	B91080202W
		0.2…1mA	EDS441-S-1	B91080204
			EDS441W-S-1	B91080204W
			EDS441-L-4	B91080205
			EDS441W-L-4	B91080205W
			EDS441-LAB-4	B91080207
			EDS441W-LAB-4	B91080207W

[1] Absolute values

Accessories

Description	Art. No.
A set of screw-type terminals [1]	B91067901
A set of push-wire terminals	B91067902
Enclosure accessories (terminal cover, 2 mounting clips) [1]	B91067903
BB bus 6TE connector [2]	B98110001

[1] included in the scope of delivery

[2] Necessary for the connection of the ISOMETER®s with an EDS44…-S

Suitable measuring instruments on request!

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The Power in Electrical Safety©

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BENDER Group