

iso685 Series

Digital Ground Fault Monitor / Ground Detector

With Fault Location Options

For Ungrounded (Floating) AC/DC Systems



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Features

- A single solution for monitoring for ground faults in virtually all types of ungrounded systems up to 690 VAC / 1000 VDC (voltage couplers extend this range)
- Detects ground faults by monitoring the system's insulation resistance, with two separately adjustable alarm values (1 kΩ - 10 MΩ)
- Incorporates multiple measurement methods to ensure optimal measurement technique for system type
- Predefined measurement profiles to simplify setup process by system type / application
- Works on AC, DC, and mixed AC/DC systems, as well as systems with variable frequency drives (VFD/ASD)
- Automatic adaption to system leakage capacitance
- Detailed digital display with multilingual display options
- Advanced trending of system isolation via onboard time-based graphing
- History memory storing over 1000 time-stamped alarm records
- A variety of alarm outputs, including dry contacts, analog outputs, and advanced communication options
- Normally energized (failsafe) or de-energized (non-failsafe) operation for alarm contacts
- Automatic self-test and self-monitoring
- Web server interface for viewing device status and changing settings
- Connects to Modbus/TCP networks

Approvals



Description

This device meets or exceeds the requirements of NEC 250.21(B) and CEC 10-106(2) for ground detectors in ungrounded AC systems, as well as the 2014 requirement of NEC 250.167(A) for ungrounded DC systems.

The iso685 is the newest generation of ground fault monitoring for ungrounded AC/DC systems. Encompassing Bender's extensive expertise in ungrounded systems into one device, the iso685 works on virtually all types of systems, with simple installation and preset settings features.

During initial setup, the iso685 features predefined profiles that tailors the device's settings to your application.

Function

When the insulation resistance from system to ground falls below the set response value, the alarm relays switch and the alarm LEDs activate. Two separately adjustable alarm contacts can be set to a prewarning and main warning alarm. The measured value is indicated on the LCD display or an externally connectable measuring instrument. A latching setting ("fault memory") allows the device to reset automatically or require a manual reset. An external and internal test/reset can be activated remotely or on the device. A comprehensive INFO menu displays additional information such as the system's leakage capacitance.

The iso685 continuously monitors the equipment ground connection to ensure proper operation. The device's easy-to-use onboard menu manages all settings via the detailed LCD screen.

The iso685 may alternatively be powered by 24 VDC (not supported by "P" option), connected through the X1 connector on the device. Refer to wiring diagram for more information.

Key device features

- **Wide voltage range** - The iso685 standalone connects to systems up to 690 VAC / 1000 VDC. Voltage couplers now extend the system voltage range up to 12 kV AC / 1760 VDC.
- **Measurement techniques** - A culmination of Bender's expertise rolled into one device, with multiple measurement techniques available to optimize system readings for virtually any application
- **Additional values displayed** - The iso685 will also display system leakage capacitance, phase-to-phase system voltage, and phase-to-ground system voltage.

Advanced display and data trending

- **New display** - Large, detailed display, backlit and easy to read
- **Onboard, visual data trending** - view a graph of the system's isolation to ground onboard the device's display - no external software required
- **Larger history log** - History memory storing over 1000 timestamped alarm records

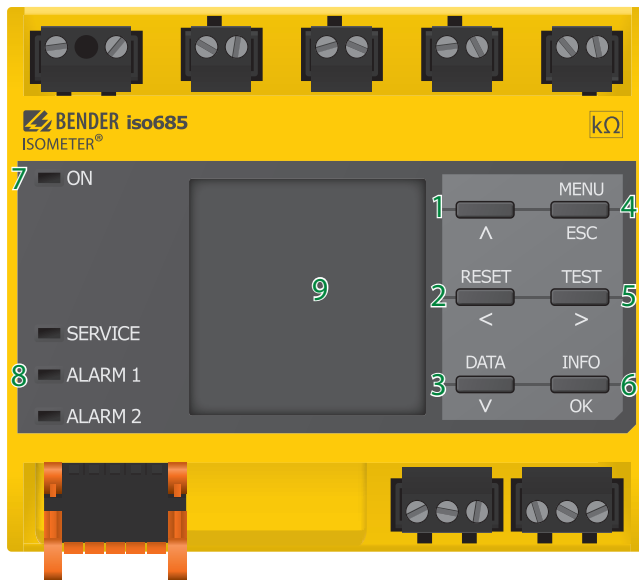
Simplified installation, setup, and use

- **Predefined profiles** - A simple profile selection allows for optimized settings based on system type / application
- **Selectively backlit keypad** - Only the button labels that are available for the current device screen will be backlit, simplifying day-to-day use of the device

Advanced communication capabilities

- **Built-in web server** - Connect the iso685 to an Ethernet network and view device status, change settings, and more
- **Modbus/TCP support** - Integrate the iso685 into modern communication networks

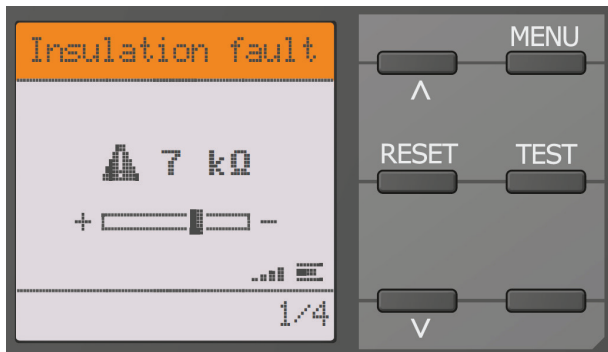
Displays and controls



- 1 - "∧" button: Up button, increase value in menu
- 2 - "RESET" button: Resets device in alarm in latched mode
"<" button: Back button, select parameter
- 3 - "DATA" button: Displays data values
"v" button: Down button, decrease value in menu
- 4 - "MENU" button: Enters main menu
"ESC" button: Return to previous menu level
- 5 - "TEST" button: Activates self-test
">" button: Right / forward button, select parameter
- 6 - "INFO" button: Display system information
"OK" button: Confirm values
- 7 - LED "ON": Power is applied to the device
- 8 - Alarm LED indicators: "SERVICE," "1," "2"
- 9 - Backlit LCD display

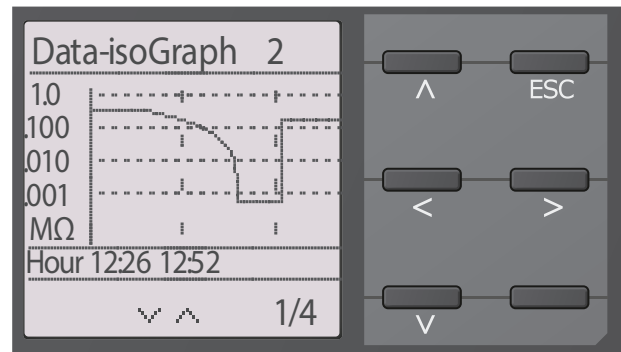
NOTE: For items 1 through 6, only the button labels that are currently available based on the device's location in the menu will be backlit. Not all keypad labels may be visible at once.

Sample screen: Device in alarm



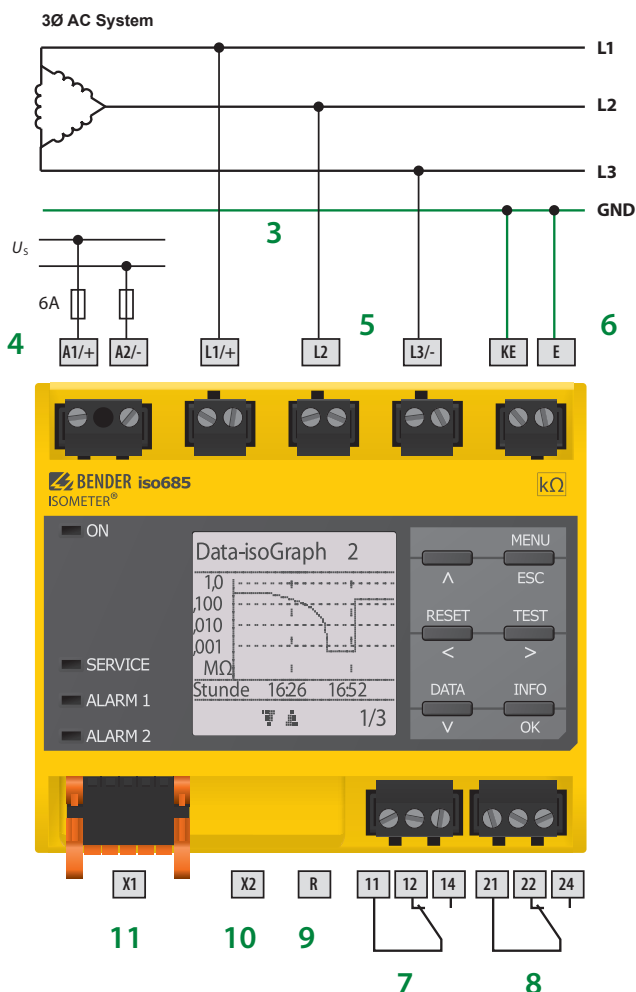
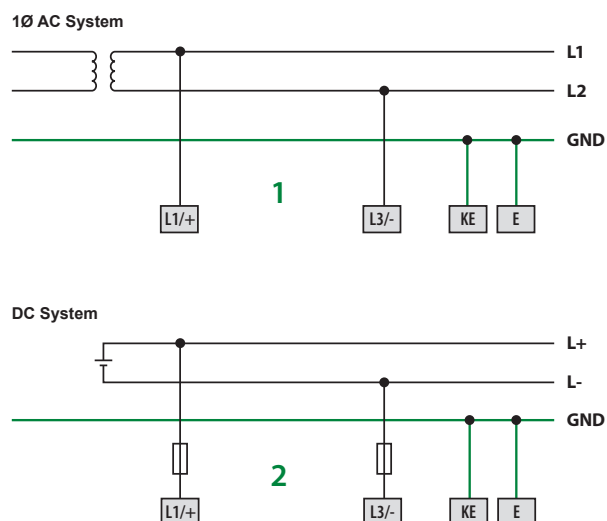
Fault alarms are displayed with the corresponding insulation resistance value. For DC systems or AC systems with large amounts of DC components, if a sufficient shift in DC voltage between positive to ground and negative to ground is detected, the shift will be displayed below the insulation resistance value.

Sample screen: Trending graph



Measured insulation resistance data is trendable over fixed periods of time, allowing for greater assistance in troubleshooting and locating faults. Graphs are accessed onboard the device - no additional software required.

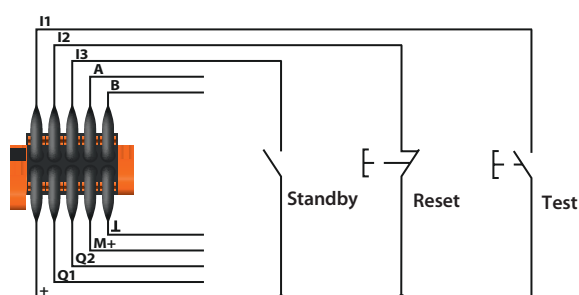
Wiring: Standard models



- 1 - System connections to single-phase AC system
- 2 - System connections to DC system
- 3 - System connections to three-phase AC system
- 4 - Supply voltage connections - 5 A fuse required
- 5 - Line connections to monitored system
- 6 - Connections to equipment / protective ground
- 7 - Alarm relay K1 - SPDT dry contact
- 8 - Alarm relay K2 - SPDT dry contact
- 9 - Switchable termination resistor - used when connecting to Bender RS-485 bus
- 10 - Ethernet port - connects iso685 to Ethernet for accessing the built-in web server or connecting to BCOM or Modbus/TCP networks
- 11 - Connector for digital inputs, RS-485, analog output

Wiring: X1 interface

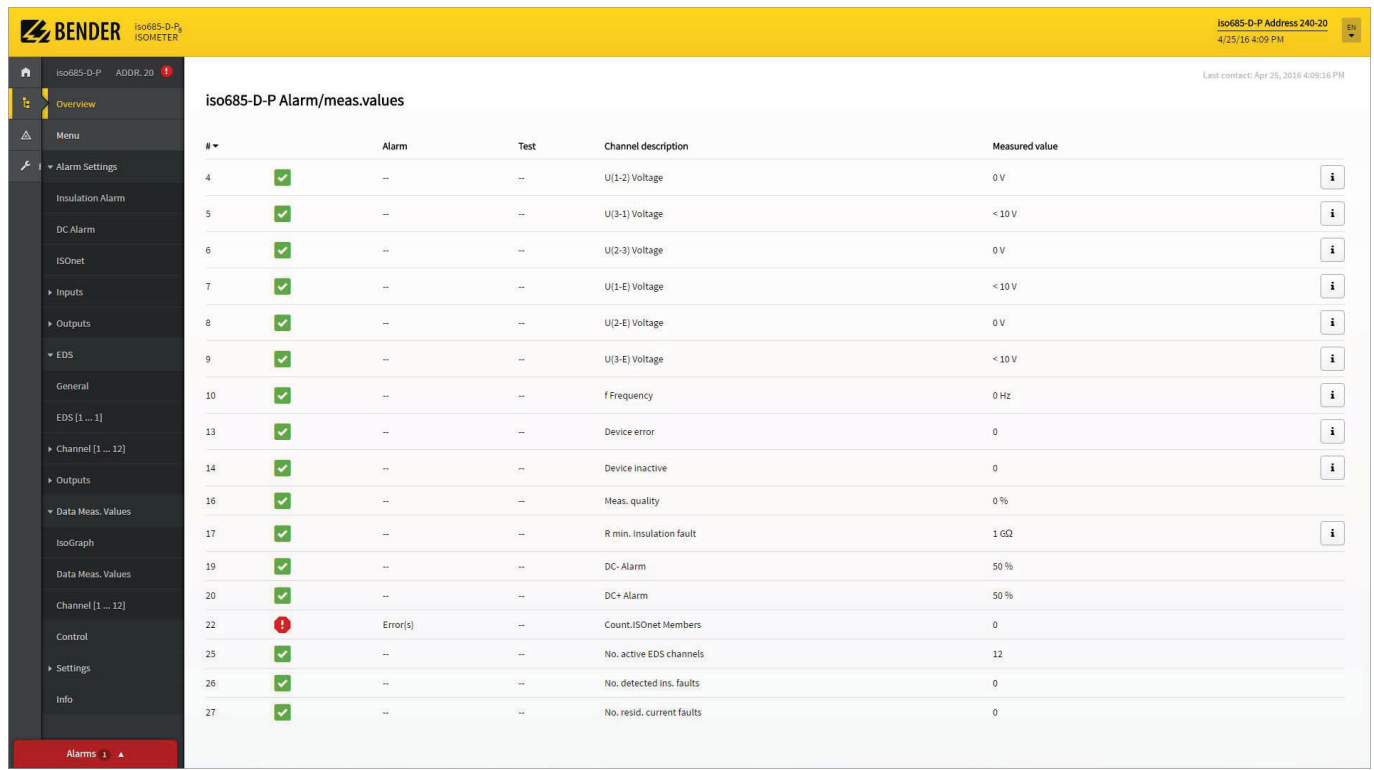
Digital interface	Terminal	Description
	I1	Input 1
	I2	Input 2
	I3	Input 3
	A	RS-485 A
	B	RS-485 B
	+	+24 V
	Q1	Output 1
	Q2	Output 2
	M+	Analog output
	⏏	Ground



The iso685 may also be powered by 24 VDC, connected via the + and GND terminals. To avoid damage to the device, **Do not connect 24 VDC power to the X1 terminals and power to the A1/A2 terminals simultaneously.**

24 VDC power is not supported for "P" models.

Built-in web interface (example shown: iso685-D-P)



The screenshot displays the BENDER iso685-D-P web interface. The top header shows the device name 'iso685-D-P' and address 'ADDR: 20'. The left sidebar contains navigation options: Overview, Menu, Alarm Settings, Insulation Alarm, DC Alarm, ISOnet, Inputs, Outputs, EDS, General, EDS [1...1], Channel [1...12], Data Meas. Values, IsoGraph, Data Meas. Values, Channel [1...12], Control, Settings, and Info. The main content area is titled 'iso685-D-P Alarm/meas.values' and displays a table of alarm and measurement data.

#	Alarm	Test	Channel description	Measured value
4	✓	--	U(1-2) Voltage	0 V
5	✓	--	U(3-1) Voltage	< 10 V
6	✓	--	U(2-3) Voltage	0 V
7	✓	--	U(1-E) Voltage	< 10 V
8	✓	--	U(2-E) Voltage	0 V
9	✓	--	U(3-E) Voltage	< 10 V
10	✓	--	f Frequency	0 Hz
13	✓	--	Device error	0
14	✓	--	Device inactive	0
16	✓	--	Meas. quality	0 %
17	✓	--	R min. insulation fault	1 GΩ
19	✓	--	DC- Alarm	50 %
20	✓	--	DC+ Alarm	50 %
22	!	--	Count.ISOnet Members	0
25	✓	--	No. active EDS channels	12
26	✓	--	No. detected ins. faults	0
27	✓	--	No. resid. current faults	0

The built-in web interface shows the status of the iso685, as well as allowing the configuration of settings remotely. Each iso685's web server can be accessed individually. Additionally, Bender's COM465IP and CP700 communication modules allow for the consolidation of iso685 and other Bender devices into a single interface.

Modbus/TCP support

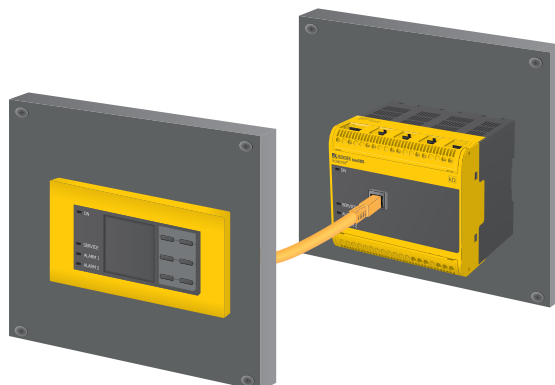
iso685 devices support integration into Modbus/TCP networks, with full read and write control. Refer to iso685 user manual for more information.

"S" option: External, panel-mounted HMI

As an alternative to the standard built-in display and controls, "S" models feature an external, panel-mounted HMI module. The FP200 module connects to the iso685 via a low-voltage RJ-45 cable. The FP200 is easily panel mountable. This option is ideal for applications requiring only low voltage to the front of a panel.

This option is available alongside all other iso685 models*. Refer to ordering information for more details.

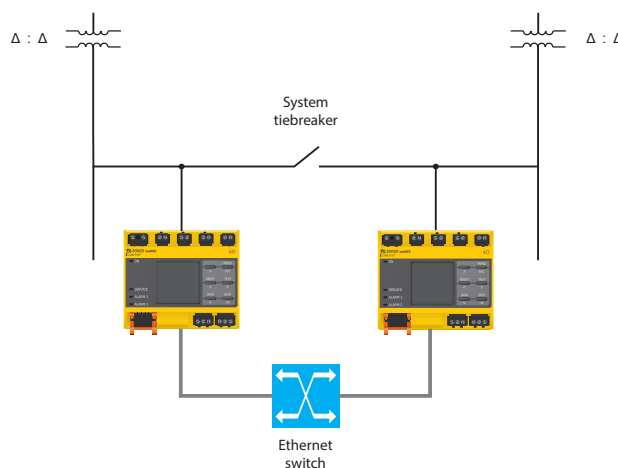
* Refers to models with "S" option. "D" option models with built-in display are not compatible, and cannot be converted to use the FP200.



"B" option: Tiebreaker support

"B" models feature automatic support for multiple devices on systems with tiebreakers. One iso685 is typically required for a complete isolated system. Multiple devices are required when systems may be disconnected via a tiebreaker.

iso685-B devices connect to each other via an Ethernet network / switch and automate the process of ensuring systems are monitored properly regardless of an open or closed tiebreaker. No connection to the tiebreaker is necessary - system state detection is automatic.



"P" option: Ground fault location

Automatic ground fault location

The iso685-D-P combines with one or more EDS440 / EDS441 modules and current transformers to provide a fault location system for ungrounded systems. Installed equipment can locate faults down to the branch / load level automatically after a fault is detected. Each branch utilizes a single current transformer, connected to an EDS module. Each EDS module can monitor up to twelve separate branches.

Function

When the iso685 detects a ground fault on the system, a tracer signal is created, the level of which varies based on the system voltage and magnitude of the ground fault. EDS modules monitor all channels in parallel for this tracer signal. Once the tracer signal is detected by the connected EDS module, an alarm is activated showing which channel has located the fault. Alarms display on the EDS module itself ("L" versions), the connected iso685, and any connected remote communication equipment.

System configuration

In general, a fault location system for a single system requires the following:

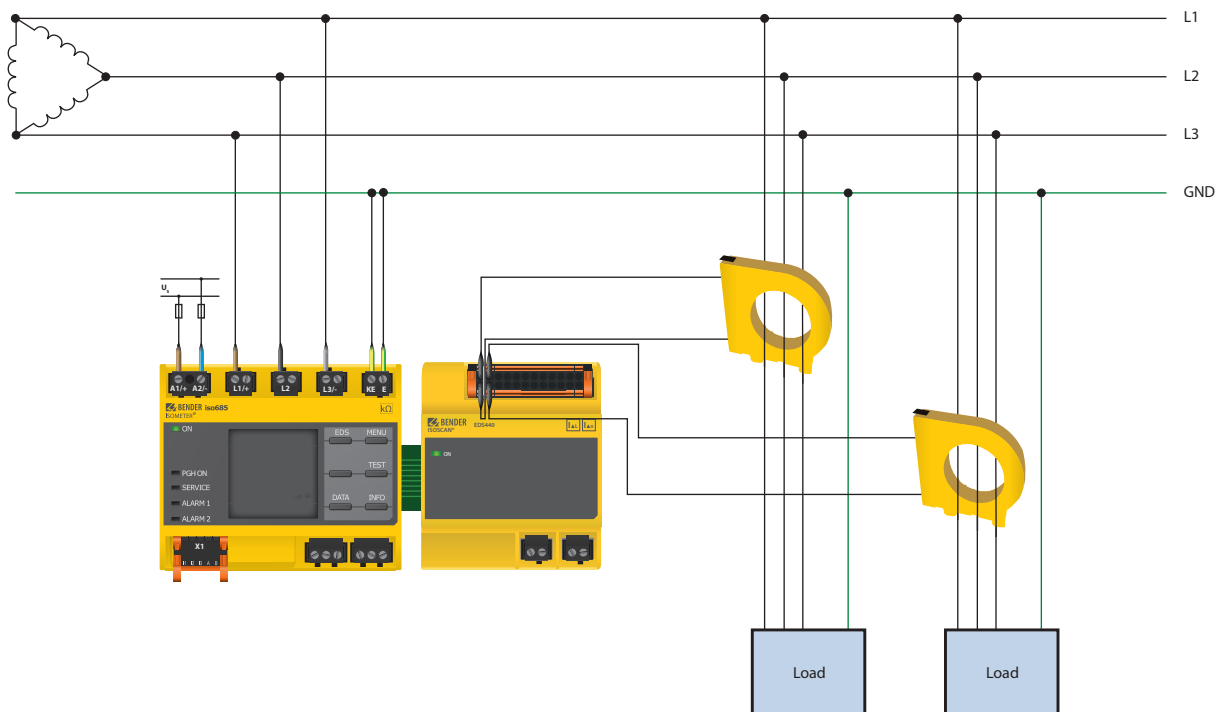
- One iso685-D-P
- One or more EDS440 / EDS441 modules (depending on monitored system) - each module can monitor up to 12 branches
- One compatible current transformer per branch

Refer to EDS440 / EDS441 series datasheet for more information on ground fault location systems.

Portable ground fault location

The tracer signal generated by the iso685-D-P is also compatible with EDS3090 series portable fault location systems.

Example wiring diagram: iso685-D-P and EDS440-S on three-phase AC system



Technical data: iso685 (standard)

Insulation coordination

Rated insulation voltage (IEC 60664-1)	1000 V
Rated impulse voltage (IEC 60664-1)	8 kV
Overvoltage category	III
Pollution degree ($U_n < 690$ V)	3
Pollution degree ($U_n < 1000$ V)	2
Protective separation (reinforced insulation) between (A1, A2) - (11, 12, 14) - (21, 22, 24) - [(L1/+, L2, L3/-), (E, KE), (X1, X2)]	
Voltage test (IEC 61010-1)	4.3 kV

Supply voltage

Supply via A1/+, A2/-:

Supply voltage U_S	AC/DC 100 - 240 V
Tolerance U_S	AC -15 - +10 % DC -15 - +15 %
Frequency range of U_S	DC, 46 - 460 Hz
Power consumption, typically 60 Hz (460 Hz)	5.7 W/20 VA (7.9 W/45.5 VA)

Supply via X1:

Supply voltage U_S	DC 24 V
Tolerance U_S	DC -20 ... +25 %

Monitored system

Nominal system voltage range U_n	AC 0 - 690 V
Nominal system voltage range U_n	DC 0 - 1000 V
Tolerance of U_n	AC/DC +15 %
Frequency range U_n	DC, 1 - 460 Hz

Response values

Response value R_{an1} (Alarm 1)	1 k Ω - 10 M Ω (40 k Ω)*
Response value R_{an2} (Alarm 2)	1 k Ω - 10 M Ω (10 k Ω)*
Relative uncertainty (acc. to IEC 61557-8)	dependent on the profile, ± 15 %, mind. ± 1 k Ω
Hysteresis	25 %, mind. 1 k Ω

Time response

Response time t_{an} at $R_f = 0.5 \times R_{an}$ ($R_{an} = 10$ k Ω) and $C_e = 1$ μ F acc. to IEC 61557-8	profile-dependent, typ. 4 s
Startup delay $T_{startup}$	0 - 120 s (0 s)*

Measuring circuit

Measuring voltage U_m	profile-dependent, ± 10 V, ± 50 V
Measuring current I_m	≤ 403 μ A
Internal resistance R_i, Z_i	≥ 124 k Ω
Permissible extraneous DC voltage U_{f0}	≤ 1200 V
Permissible system leakage capacitance C_e	dependent on the profile, 0 - 1000 μ F

Measuring ranges

Measuring range f_n	10 - 460 Hz
Tolerance measurement f_n	± 1 % ± 0.1 Hz
Voltage range measurement f_n	AC > 25 V
Measuring range U_n	AC/DC 25 - 1000 V
Tolerance measurement U_n	± 5 % ± 5 V
Measuring range C_e	0 - 1000 μ F
Tolerance measurement C_e	± 10 % ± 5 μ F
Voltage range measurement C_e	AC > 25 V

Display

Display	Graphic display 127 x 127 pixels, 40 x 40 mm
Display range measured value	0.1 k Ω - 20 M Ω

LEDs:

LED "On" (operation LED)	green
SERVICE	yellow
ALARM 1	yellow
ALARM 2	yellow

Digital inputs

Number	3
Operating mode, adjustable	active high, active low
Functions	none, test, reset, start measurement, deactivate device
Voltage	Low DC -3 - 5 V, High DC 11 - 32 V

Digital outputs

Number	2
Operating mode, adjustable	active, passive
Functions	none, Alarm 1, Alarm 2, connection fault, Alarm DC-, Alarm DC+, symmetrical insulation fault, device error, common alarm, measurement complete, device inactive
Voltage	passive DC 0 - 32 V, active DC 0/19.2 - 32 V
Max. current internal sum X1	max. 200 mA
Max. current external per channel	max. 1 A

Analog output

Number	1
Operating mode	linear, midscale 28 k Ω /120 k Ω
Functions	insulation value, DC shift
Current, voltage	0 - 20 mA (< 600 Ω), 4 - 20 mA (< 600 Ω), 0 - 400 μ A (< 4 k Ω), 0 - 10 V (> 1 k Ω), 2 - 10 V (> 1 k Ω)
Tolerance	± 20 %

Interfaces

Field bus:

Interface/protocol	Telnet/HTTP
Data rate	10/100 Mbit/s, autotdetect
Cable length	≤ 100 m
Connection	RJ45
IP address	DHCP/manual* 192.168.0.5*
Network mask	255.255.255.0*
Function	service interface

Sensor bus:

Interface/protocol	RS-485/BS
Data rate	9.6 kBaud/s
Cable length	≤ 1200 m
Recommended cable (shielded, shield connected to PE on one side)	min. J-Y(St)Y 2x0.6
Connection	terminals X1.A, X1.B
Terminating resistor	120 Ω , can be connected internally
Device address, BMS bus	1 - 90 (3)*

Technical data (continued): iso685 (standard)

Switching elements

Switching elements	2 changeover contacts
Operating mode	N/C operation*/N/O operation
Contact 11-12-14	none, Alarm 1, Alarm 2, connection fault, Alarm DC-, Alarm DC+, symmetrical insulation fault, device error, common alarm, measurement complete, device inactive
Contact 21-22-24	none, Alarm 1, Alarm 2, connection fault, Alarm DC-, Alarm DC+, symmetrical insulation fault, device error, common alarm, measurement complete, device inactive
Electrical endurance, number of cycles	10.000
Contact data acc. to IEC 60947-5-1	
Utilization category	AC-13
AC-14	DC-12
DC-12	DC-12
Rated operational voltage	230 V
230 V	24 V
110 V	220 V
Rated operational current	5 A
3 A	1 A
0.2 A	0.1 A
Rated insulation voltage ≤ 2000 m NN	250 V
Rated insulation voltage ≤ 3000 m NN	160 V
Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-2-4; EN 50121-3-2; EN 50121-4**
Ambient temperatures:	
Operation	-25 - +55 °C
Transport	-40 - +85 °C
Storage	-25 - +70 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (except condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Storage (IEC 60721-3-1)	1M3
Area of application	≤ 3000 m NN

Additional technical data: iso685, "B" option

Interfaces

ISOnet:

Maximum qty. of connected devices	5
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Additional / varying technical data: iso685, "P" option

Monitored system

Max. AC voltage in frequency range f_n 1 - 10 Hz	110 * f_n
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Measuring circuit

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

Maximum qty. of connected devices	20
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Connection

Connection type	pluggable screw terminal or push-wire terminal
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Screw-type terminals:

Tightening torque	0.5 - 0.5 Nm
Conductor sizes	AWG 24 - 12
Stripping length	7 mm
rigid/flexible	0.2 - 2.5 mm ²
flexible with ferrule 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:

Conductor sizes	AWG 24 - 12
Stripping length	10 mm
rigid/flexible	0.2 - 2.5 mm ²
flexible with ferrule 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 terminal X1:

Conductor sizes	AWG 24 - 16
Stripping length	10 mm
rigid/flexible	0.2 - 1.5 mm ²
flexible with ferrule without plastic sleeve	0.25 - 1.5 mm ²
flexible with ferrule with plastic sleeve	0.25 - 0.75 mm ²

Other

Operating mode	continuous operation
Mounting	display oriented, cooling slots must be ventilated vertically
Degree of protection internal components	IP40
Degree of protection terminals	IP20
DIN rail mounting acc. to	IEC 60715
Screw mounting	3 x M4 with mounting clip
Enclosure material	polycarbonate
Flammability class	V-0
Dimensions (B x H x T)	108 x 93 x 110 mm
Documentation number	D00022
Weight	≤ 450 g

* = Factory setting

Technical data: FP200

Refer to FP200 datasheet for technical information.

Ordering Information

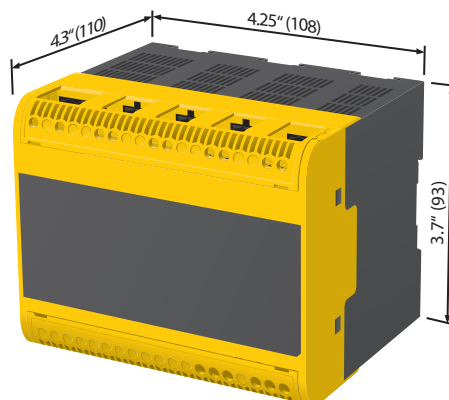
Rated system voltage		Additional features				Type	Ordering No.
AC	DC	Built-in display / controls	Panel-mounted display / controls	Tiebreaker system switching support	Fault location compatible		
0 - 690 V (1 - 460 Hz)	0 - 1000 V	■				iso685-D	B 9106 7010
0 - 690 V (1 - 460 Hz)	0 - 1000 V		■			iso685-S + FP200	B 9106 7210
0 - 690 V (1 - 460 Hz)	0 - 1000 V	■		■		iso685-D-B	B 9106 7020
0 - 690 V (1 - 460 Hz)	0 - 1000 V		■	■		iso685-S-B + FP200	B 9106 7220
0 - 690 V* (1 - 460 Hz)	0 - 1000 V*	■		■	■	iso685-D-P	B 9106 7030
0 - 690 V* (1 - 460 Hz)	0 - 1000 V*		■	■	■	iso685-S-P + FP200	B 9106 7230

Accessories

Description	Type	Ordering No.
External meters	7204-1421	B 986 763
	9604-1421	B 986 764
	9620-1421	B 986 841
Voltage couplers	AGH150W-4	B 9801 8006
	AGH204S-4	B 914 013
	AGH520S	B 914 033
	AGH676S-4	B 913 055

Dimensions

Dimensions in inches (mm)





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