BENDER
The Power in Electrical Safety™

The Power in Electrical Safety

North American Product Catalog, 2017 Edition

BENDER Group

North American Product Catalog
2017 Edition

This edition of the Bender main catalog has been created for North American markets, including but not limited to markets utilizing NFPA (NEC), CSA, UL, and MEIC codes and standards. Not all products manufactured by Bender may appear in this catalog. Additionally, products and solutions created specifically for these markets may only appear in this edition of the catalog. Contact Bender for more information on applications and products that may not appear in this catalog.

Unless otherwise stated, metric units are given as the primary unit of measurement in this document. US Standard units are provided as converted values for convenience.

USA and Central America:
Bender Inc.
420 Eagleview Blvd.
Exton, PA 19341
Tel. 800.356.4266 / 610.383.9200
Fax 610.466.2071
E-mail: info@bender.org
Web: www.bender.org

Canada:
Bender Canada Inc.
5810 Ambler Drive, Unit 1
Mississauga, ON L4W 4J5
Tel. 800.243.2438 / 905.602.9990
Fax 905.602.9960
E-mail: info@bender-ca.com
Web: www.bender-ca.com

Mexico:
Neza Edo de Mexico
Tel. +55 4955 1198
E-mail: info@bender.com.mx
Web: www.bender.com.mx

South America:
Bender Latin America
Santiago de Chile
Tel. +56 2 2933 4211
E-mail: info@bender-latinamerica.com
Web: www.bender-latinamerica.com

The Power in Electrical Safety.




For over sixty years, BENDER has been a global leader in ground fault protection and electrical safety equipment. With over fifty agencies and over 600 employees globally, BENDER provides solutions to meeting the challenges of electrical safety in virtually every industry. Our company is ready to help you from the design phase through the support phase. All over the world, customers trust BENDER to protect their electrical systems.

Ground Fault Detection Equipment

For ungrounded (floating) systems

1-01

Isolated Power Systems Equipment

Isolated power systems and equipment for healthcare facilities

Isolated power panels
Isolation transformers
Line isolation monitors
Clocks and timers
Ground/power modules
Testing equipment

Ground Fault Location Equipment

For ungrounded AC/DC systems and isolated power systems

Ground Fault Products

For grounded and high-resistance grounded systems

Ground fault monitors
Ground fault circuit interrupters
Ground fault relays
Monitoring panels
Multi-branch ground fault monitoring

Protective Relays and Energy Management

Voltage relays
Power quality meters
Current relays
EV charging stations
Continuity relays

Communication and Remote Indication

Communication gateways
Remote indicators
External meters
Measuring instruments
Remote stations
Repeaters and converters

Accessories and System Components

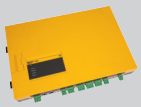
Voltage couplers
Current transformers
Power supply units
Mounting adapters

Ground Fault Detectors for Ungrounded Systems: General Purpose

	IR420 Series	IR425 Series	IR470LY Series	iso685 Series
				

Page		1-17	1-20	1-14	1-06
System voltage type	Three-phase AC			■	■
	Single-phase AC	■	■	■	■
	Mixed AC/DC		■		■
	DC		■		■
Application		General purpose Low voltage AC	General purpose Low voltage AC/DC	General purpose AC main distribution	General purpose AC/DC main distribution
Nominal system voltage		0 - 300 VAC	0 - 300 VAC/DC	0 - 793 VAC Extendable w/ coupler	0 - 690 VAC, 0 - 1000 VDC Extendable w/ coupler
Permissable system leakage capacitance		≤ 20 µF	≤ 20 µF	≤ 20 µF	≤ 1000 µF (varies based on profile)
Alarm value range		1 - 200 kΩ	1 - 200 kΩ	1 - 200 kΩ	1 kΩ - 10 MΩ
Supports fault location					■ (iso685-D-P)
Outputs		2 SPDT contacts	2 SPDT contacts	1 DPDT contact	2 SPDT contacts, Ethernet
Mounting	DIN rail	■	■	■	■
	Screw mount	■	■	■	■
	Panel mount				With FP200

	Type	P.	Applicable Accessories			
Voltage couplers	up to 1760 VDC	7-24				■
	up to 1650 VAC	7-25			■	■
	up to 7200 VAC	7-26			■	■
	up to 12 kV AC	7-27				■
External meters	7204-1421	6-06			■	■
	9604-1421	6-06			■	■
	9620-1421	6-06				■
Remote Stations	MK2430	6-19				■
	MK800	6-14				■
Comm. Gateway	COM465IP	6-24				■
	COM462RTU	6-30				■

	
isoLR275 Series	**iso1685P**
1-23	1-32
■	■
■	■
■	■
■	■
Low insulation systems AC/DC main distribution	Large-scale systems AC/DC main distribution
0 - 793 VAC, 0 - 1100 VDC With AGH-LR coupler	0 - 1000 VAC, 0 - 1500 VDC
≤ 500 µF	≤ 500 µF
200 Ω - 100 kΩ	200 Ω - 1 MΩ
	■
2 SPDT contacts, analog out	2 SPDT contacts
■	
■	■
■	
■	■
■	■
■	■
■	■

Ground Fault Detectors for Ungrounded Systems: Application-Specific

	isoPV	isoPV425	IR420-D6	isoRW425 Series
				

Page		1-27	1-35	1-39	1-54
System voltage type	Three-phase AC	■		■	
	Single-phase AC	■	■	■	■
	Mixed AC/DC	■	■		■
	DC	■	■	■	■
Application		Solar, all array sizes	Solar, arrays 100 kW or less	Offline loads	Rail and transit signaling systems
System voltage range		0 - 793 VAC, 0 - 1100 VDC With AGH-PV coupler	0 - 690 VAC, 0 - 1000 VDC With AGH420 coupler	Offline	AC/DC 0 - 400 V
Permissable system leakage capacitance		≤ 2000 µF	≤ 350 µF	≤ 10 µF	≤ 300 µF
Alarm value range		200 Ω - 100 kΩ	1 - 990 kΩ	100 kΩ - 10 MΩ	1 - 990 kΩ
Onboard data trending					
Outputs		2 SPDT contacts, RS-485, analog out	2 SP N/O contacts, RS-485 (Contacts may be adjusted to alarm on + or - fault)	2 SPDT contacts	2 SP N/O contacts, RS-485 (Contacts may be adjusted to alarm on + or - fault)
Installation	DIN rail	■	■	■	■
	Screw mount	■	■	■	■
	Panel mount				

	Type	P.	Applicable Accessories			
Voltage couplers	up to 1760 VDC	7-24				
	up to 1650 VAC	7-25				
	up to 7200 VAC	7-26			■	
	up to 12 kV AC	7-27				
External meters	7204-1421	6-06				
	9604-1421	6-06				
	9620-1421	6-06	■			
Remote stations	MK2430	6-19	■	■		■
	MK800	6-14	■	■		■
Comm. Gateway	COM465IP	6-24	■	■		■
	COM462RTU	6-30	■	■		■

		
iso165C	**IR155 03/04 Series**	**IR155 10 Series**

1-43	1-46	1-50
■	■	■
Electric vehicles (EV)	Electric vehicles (EV)	Level 3 EV charging stations (EVSE)
0 - 600 VDC	0 - 1000 VDC	12 / 24 VDC
≤ 1 µF	≤ 1 µF	≤ 1 µF
0 - 50 MΩ measuring range 40 kΩ - 2 MΩ alarm range (fixed, configured at factory)	100 kΩ - 10 MΩ measuring range 100 - 200 kΩ alarm range (fixed, configured at factory)	0 - 10 MΩ measuring range 100 - 200 kΩ alarm range (fixed, configured at factory)
CANbus	High/low side driver, PWM	High side driver, PWM
■	■	■

	Applicable Accessories	

iso685 Series

Digital ground fault detector for ungrounded single- and three-phase AC/DC systems

Applications

- Single-phase and three-phase AC and DC systems
- Main distribution systems
- UPS and battery backup systems
- Systems with variable frequency drives (VFDs)
- Systems with power conversion components, including rectifiers and inverters
- Ungrounded systems with higher-than-normal leakage capacitance
- Motor control centers
- Applications requiring fault location

Approvals

c UL us LISTED

PCT AE25

Lloyd's Register TYPE APPROVED

Features

- Fufills requirements of NEC 250.21(B) and CEC 10-106(2) for ground fault detection on ungrounded AC systems
- Fufills 2014 requirements of NEC 250.167(A) for ground fault detection on ungrounded DC systems
- 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 up to 1700 VDC / 12 kV AC
- Detects ground faults by measuring the system's insulation resistance, with two separately adjustable alarm values (1 kΩ - 10 MΩ)
- Detects single, multiple, and symmetrical faults
- 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, including systems with variable frequency drives (VFD / ASD)
- Automatic adaptation to system leakage capacitance to optimize measurement accuracy
- Detailed digital display with multilingual display options
- Advanced trending of system isolation over time via onboard graph - no additional software or devices needed
- History memory storing over 1000 timestamped 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

Advanced display and data trending

- Large, detailed display - backlit and easy to read
- View a graph of the system's isolation to ground onboard the device's display

Simplified installation, setup, and use

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

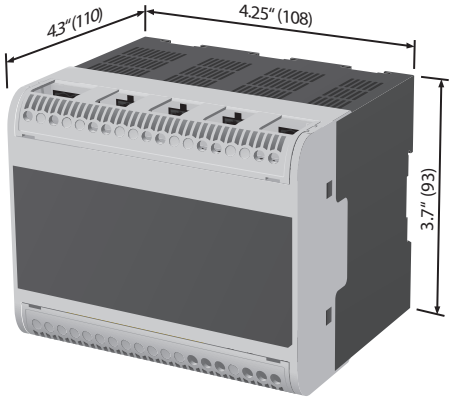
Advanced communication capabilities

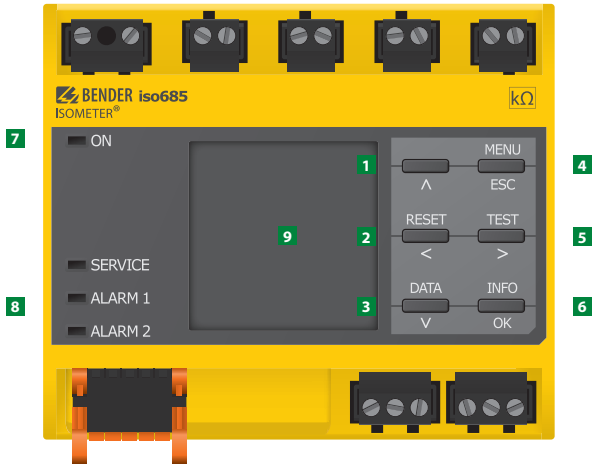
- Built-in web server - connect the iso685 to Ethernet networks and view device status, change settings, and more using a standard web browser
- Modbus/TCP support - integrate the iso685 into modern industrial communication networks

Advanced system options

- Fault location - find ground faults fast and automatically
- Tiebreaker support - monitor multiple systems which can be connected with a tiebreaker
- Detachable faceplate - separate mounting capabilities for the core device and front faceplate to keep higher voltages to the back of electrical cabinets

Dimensions in inches (mm)

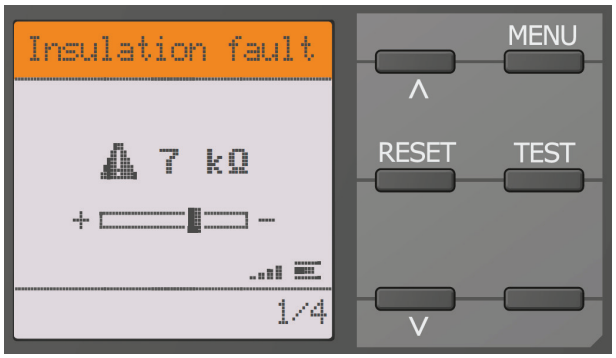




1 "^" button: Up button, increase value in menu
"RESET" button: Resets device in alarm in latched mode
"<" button: Back button, select parameter
3 "DATA" button: Displays data values
"v" button: Down button, decrease value in menu
4 "MENU" button: Enters main menu
"ESC" button: Returns to previous menu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

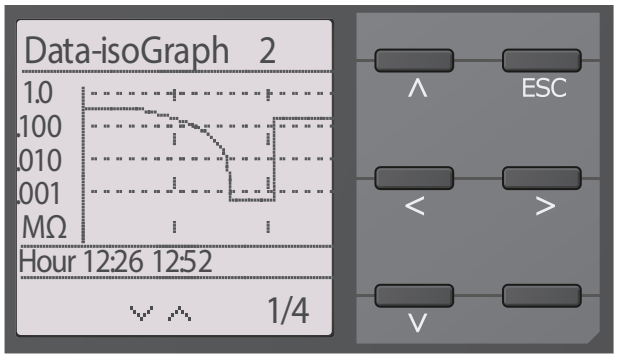
NOTE: For items 1 through 6, only the button labels that are currently available based on the device's location in the menu will be backlit. Not all keypad labels may be visible at once.

Sample screen: Device in alarm



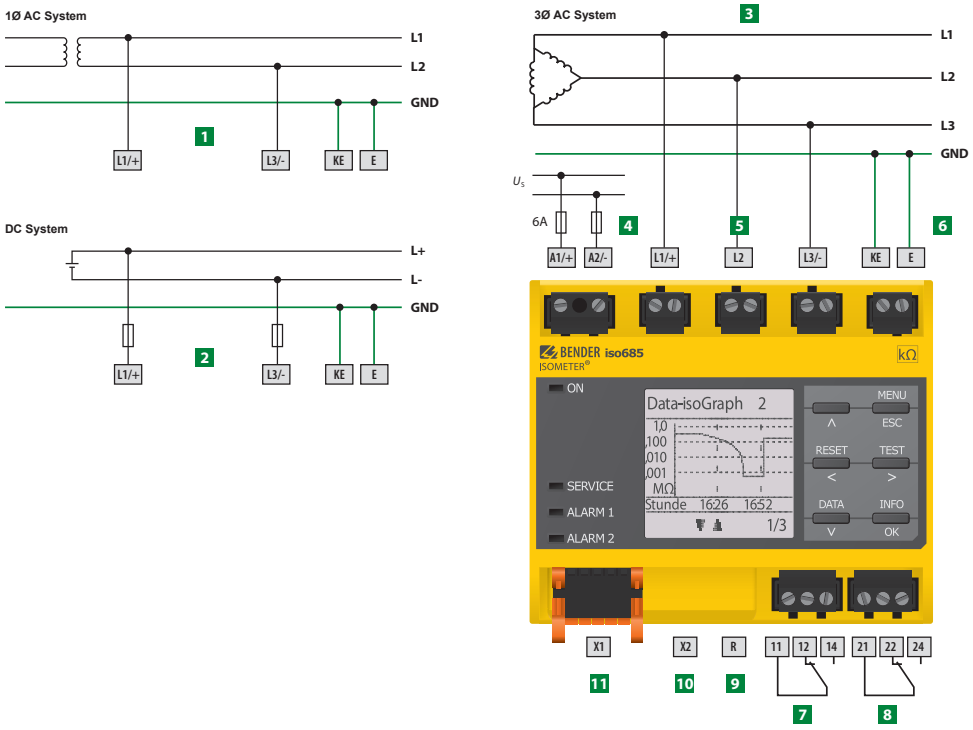
Fault alarms are displayed with the corresponding insulation resistance value. For DC systems or AC systems with large amounts of DC components, if a sufficient shift in DC voltage between positive to ground and negative to ground is detected, the shift will be displayed below the insulation resistance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

Sample screen: Trending graph



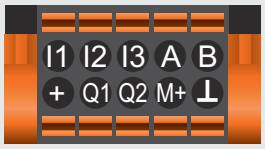
Measured insulation resistance data is trendable over fixed periods of time, allowing for greater assistance in troubleshooting and locating faults. Graphs are accessed onboard the device - no additional software required.

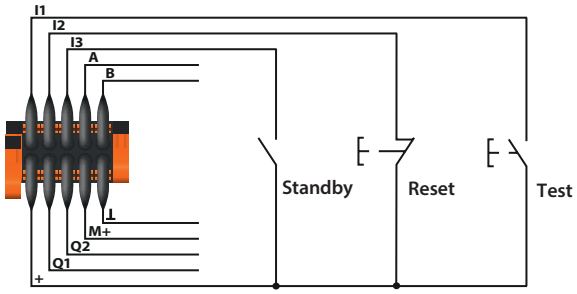
Wiring diagram: Standard models



1 System connections when connecting to single-phase AC system
2 System connections when connecting to DC system
3 System connections when connecting to three-phase AC system
4 Supply voltage connections - 5 A fuse required by UL
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 - for web server and Modbus/TCP connections
11 X1 connector (see below for connections)

Wiring diagram: X1 interface

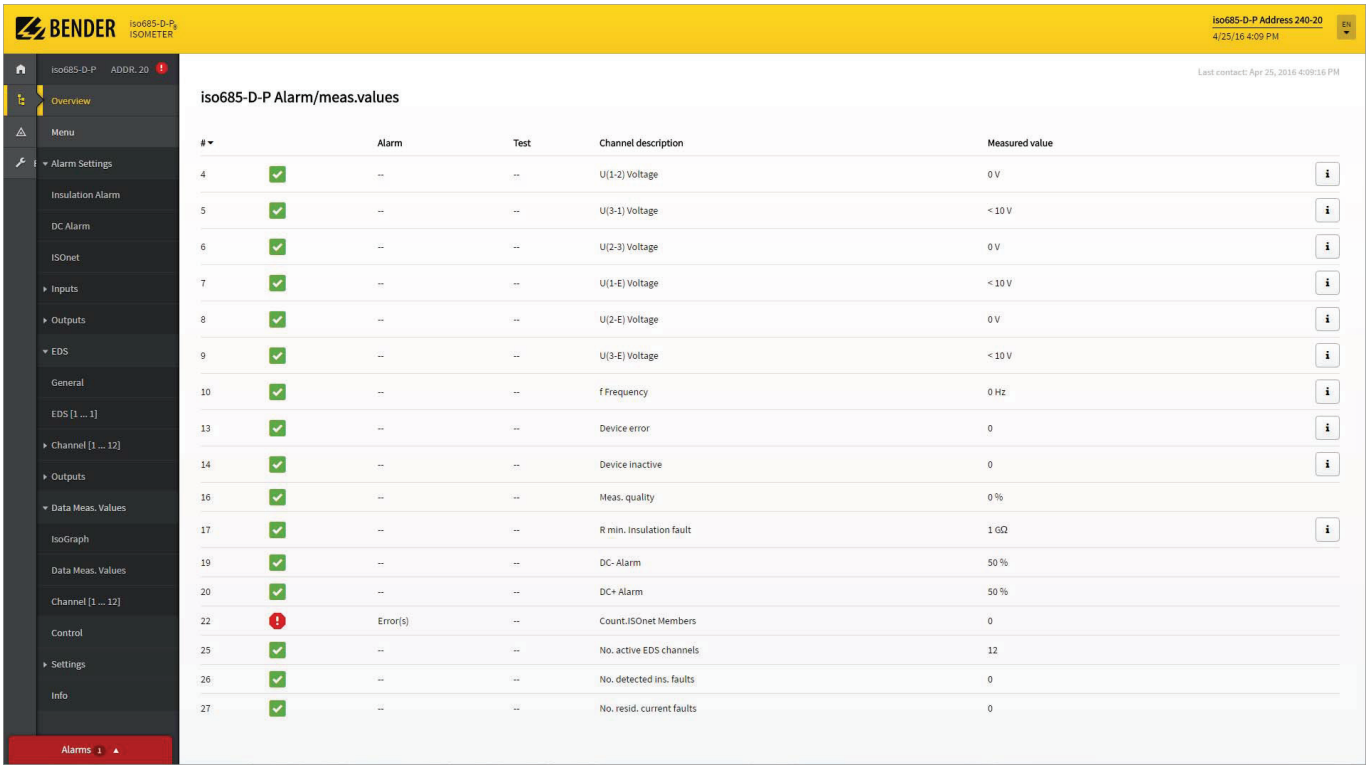
Digital interface	Terminal	Description
 X1	I1	Input 1
	I2	Input 2
	I3	Input 3
	A	RS-485 A
	B	RS-485 B
	+	+24 V
	Q1	Output 1
	Q2	Output 2
	M+	Analog output
	⊥	Ground



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

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

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



The built-in web interface provides interactivity with the iso685, as well as any directly connected accessories, such as EDS440 fault location modules. The web interface shows the status of the device, as well as allowing for the configuration of setttings remotely. Each iso685's web server is accessed individually. Bender's COM465IP and CP700 communication modules allow for the consolidation of iso685 and other Bender devices into a single interface.

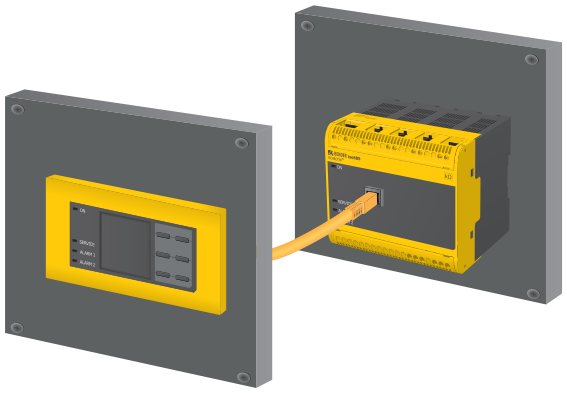
Modbus/TCP support

iso685 devices support integration into Modbus/TCP networks, with full read and write control.

"S" option: External, panel-mounted HMI

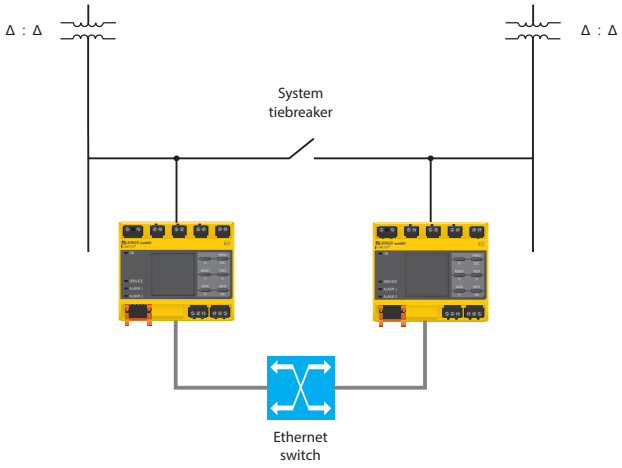
As an alternative to the standard built-in display and controls, "S" models feature an external, panel-mounted HMI module. The FP200 connects to the iso685 via a low-voltage RJ45 cable. The FP200 is easily panel mounted. This option is ideal for applications requiring only low voltage to the front of a cabinet or panel.
This option is available alongside all other iso685 models.*

* Refers to models with "S" option. "D" option models with built-in display are not compatible, and cannot be field-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 with systems may be disconnected via a tiebreaker. "B" option devices work together to ensure that all systems, whether connected or disconnected, are continuously monitored.
iso685-B devices connect to each other via an Ethernet network / switch and automate the process of ensuring systems are monitored properly, regardless of whether a tiebreaker is open or closed. No connection to ther system tiebreaker is necessary - system state detection is automatic.



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 by system voltage and fault magnitude. EDS modules monitor all channels in parallel for this tracer signal. Once the signal is detected by a connected EDS module, an alarm is activated showing which channel has located the fault. Alarm displays 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 electrical system requires the following:

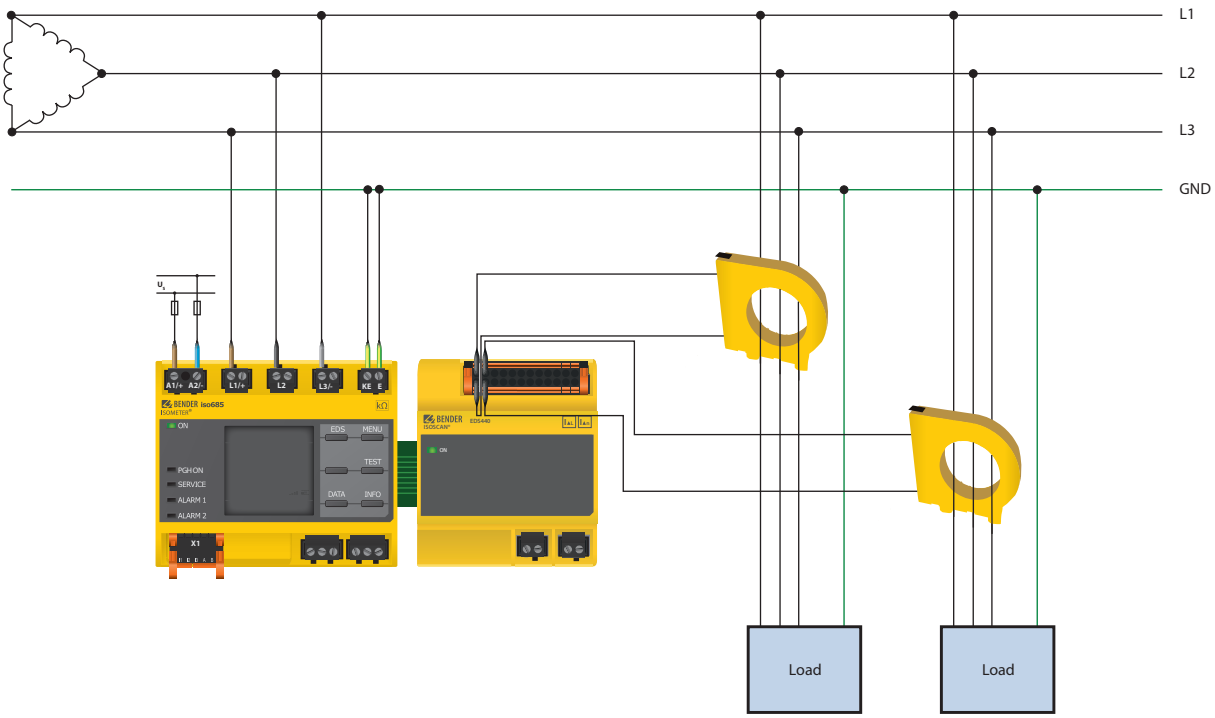
- One iso685-D-P
- One or more EDS440 / EDS441 modules - each monitors up to 12 branches
- One compatible current transformer per branch

Refer to EDS440 / EDS441 datasheet for more information.

Portable ground fault location

iso685-D-P modules are also compatible with Bender's EDS3090 series portable fault location system. Refer to EDS3090 series datasheet for more information.

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



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

Time response

Response time t_{an} at R_F = 0.5 x R_{an} (R_{an} = 10 kΩ) and C_e = 1 µF acc. to IEC 61557-8	profile-dependent, typ. 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 µA
Internal resistance R_i, Z_i	≥ 124 kΩ
Permissible extraneous DC voltage U_{fg}	≤ 1200 V
Permissible system leakage capacitance C_e	dependent on the profile, 0 - 1000 µF

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 µF
Tolerance measurement C_e	± 10 % ± 5 µF
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 kΩ - .20 MΩ

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 kΩ/120 kΩ
Functions	insulation value, DC shift
Current, voltage	0 - 20 mA (< 600 Ω), 4 - 20 mA (< 600 Ω), 0 - 400 µA (< 4 kΩ), 0 - 10 V (>1 kΩ), 2 - 10 V (>1 kΩ)
Tolerance	± 20 %

Interfaces

Field bus:

Interface/protocol	Telnet/HTTP
Data rate	10/100 Mbit/s, autodetect
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)*

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

Connection

Connection type	pluggable srew terminal or push-wire terminal

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^{22}

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

Additional technical data: "B" models

Interfaces

ISOnet:

Maximum qty. of connected devices	5

Additional / varying technical data: "P" models

Monitored system

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

Measuring circuit

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

ISOnet:

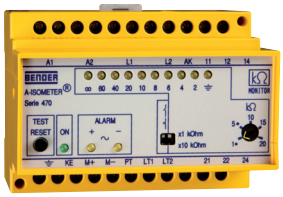
Maximum qty. of connected devices	20

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

IR470LY Series

Ground fault detector for single- and three-phase ungrounded AC systems



Features

- Fufills requirements of NEC 250.21(B) and CEC 10-106(2) for ground fault detection on ungrounded AC systems
- Ground fault detection for ungrounded AC systems, single-phase or three-phase
- Up to 793 VAC, extended up to 7.2 kVAC with voltage coupler accessory
- Response values, adjustable 1 - 200 kΩ
- Connection monitoring, line connections and ground connections
- Power ON LED, Alarm LED
- LED bar graph indicator indicating measured insulation resistance
- Connection for external meter
- Built in test/reset button
- Connection for external test/reset button
- 1 DPDT alarm contact
- Normally energized or de-energized operation, selectable
- Latching or non-latching operation, selectable

Applications

- Single- and three-phase AC systems up to 793 VAC
- General distribution and control systems
- General power distribution
- Motors and motor control centers
- Generators
- Large industrial systems

Approvals

c UL us LISTED

GL

PCT AE25

Lloyd's Register TYPE APPROVED

Ordering information

Supply voltage U_S		Type	Art. No.
DC	AC		
–	230 V	IR470LY-40	B 9104 8007
–	24 V	IR470LY-4011	B 9104 8012
–	42 V	IR470LY-4012	B 9104 8002
–	90 - 132 V[1)]	IR470LY-4013	B 9104 8011
–	400 V	IR470LY-4015	B 9104 8008
–	500 V	IR470LY-4016	B 9104 8018
–	690 V	IR470LY-4017	B 9104 8017
–	440 V	IR470LY-4018	B 9104 8024
9.6 - 84 V[1)]	–	IR470LY-4021	B 9104 8006
77 - 286 V[1)]	–	IR470LY-4023	B 9104 8026

[1)] Absolute values

Accessories

Type designation	Type	Page
External kΩ measuring instruments	7204-1421	6-06
	9604-1421	6-06
Voltage couplers	AGH204S-4	7-25
	AGH520S	7-26

Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 630 V
Rated impulse voltage/pollution degree	6 kV/3

Voltage ranges

Nominal system voltage U_n	AC, 3(N)AC 0 - 793 V
Nominal frequency f_n	40 - 460 Hz
Supply voltage U_S	see ordering information
Operating range of U_S	0.8 - 1.15 x U_S
Frequency range U_S	50 - 460 Hz
Power consumption	≤ 3 VA

Response values

Response value R_{an1} (Alarm 1)	1 - 200 kΩ
Response time t_{an} at R_F = 0.5 x R_{an} and C_e = 1 µF	
10 - 200 kΩ range	≤ 1 s
1 - 10 kΩ range	≤ 3 s

Measuring circuit

Measuring voltage U_m	≤ 40 V
Measuring current I_m (at R_F = 0 Ω)	≤ 200 µA
Internal DC resistance R_i	≥ 200 kΩ
Impedance Z_i at 50 Hz	≥ 180 kΩ
Permissible extraneous DC voltage U_{fg}	≤ 800 V
Permissible system leakage capacitance C_e	≤ 20 µF

Outputs

Test/reset button	internal/external
Current output for measuring instrument (scale centre point = 120 kΩ)	0 - 400 µA
Load	≤ 25 kΩ

Switching elements

Switching elements	1 DPDT contact
Operating principle	Normally energized or de-energized operation
Factory setting	Normally de-energized
Electrical endurance, number of cycles	12000
Contact class	IIB in accordance with DIN IEC 602550-20
Rated contact voltage	AC 250 V/DC 300 V
Making capacity	AC/DC 5 A
Breaking capacity	2 A, AC 230 V, cos phi = 0.4 – 0.2 A, DC 220 V, L/R = 0.04 s
Contact rating at DC 24 V	≥ 2 mA (50 mW)

Environment

Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 ms
Vibration resistance IEC 60068-2-6 (device in operation)	1 g/10 - 150 Hz
Vibration resistance IEC 60068-2-6 (transport)	2 g/10 - 150 Hz
Ambient temperature (during operation/during storage)	-10 - + 55 °C/-40 - + 70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

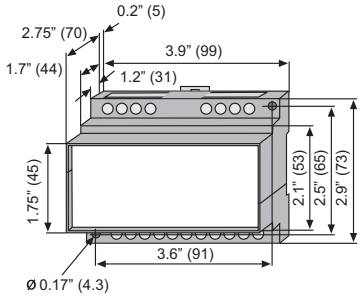
Connection

Connection type	modular terminals
Connection properties	
rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²

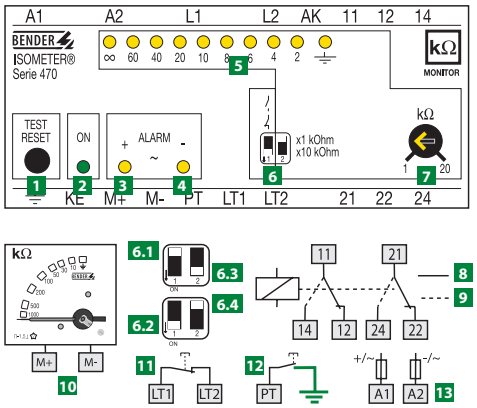
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating manual	TBP104001
Weight	≤ 360 g

Dimensions in inches (mm)



Front plate and control wiring



1 Combined test/reset button "TEST/RESET"; short press (< 1 s) = RESET, hold (> 1 s) = TEST

2 LED Power on "ON"

3 **4** Alarm LEDs "+ ALARM -", yellow, lights when alarm is reached. Flashes during connection error (⏚/KE or L1/L2).

5 LED bar graph indicator

6 Operating principle of the alarm relays and setting range R_{ALARM}

6.1 N/D operation **6.3** x 10 kΩ

6.2 N/E operation **6.4** x 1 kΩ

Changing the setting range from x 1 kΩ to x 10 kΩ automatically changes the indication of the kΩ values on the LED bar graph indicator: Setting range x 1 kΩ: Meter scale point x 1 kΩ.
Setting range x 10 kΩ: Meter scale point has to be multiplied by 10 kΩ.

7 Potentiometer to set the response value R_{ALARM}

8 Alarm relay – N/O operation (factory setting)

9 Alarm relay – N/C operation

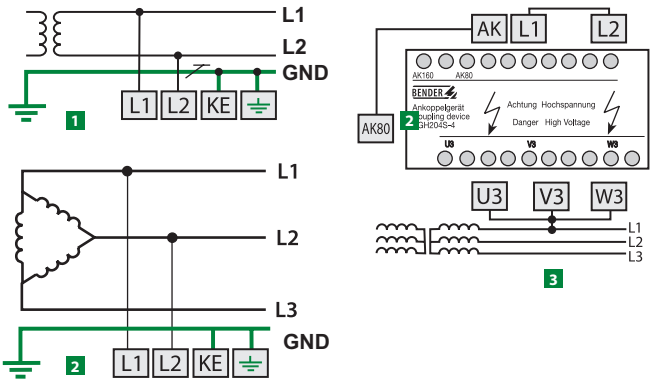
10 External meter connections

11 External reset button "LT1, LT2" or jumper for fault memory

12 External test button "PT"

13 Supply voltage U_S see ordering information, 6 A fuse recommended

System connection wiring



1 System connections, single-phase AC system

2 System connections, three-phase AC system

3 System connections when using AGH204S-4 voltage coupler

IR420 Series

Digital ground fault detector for ungrounded single-phase AC systems

Applications

- Ungrounded AC systems 300 VAC or less
- Low voltage control circuits
- Small ungrounded AC networks

Approvals

Features

- Fufills requirements of NEC 250.21(B) and CEC 10-106(2) for ground fault detection on ungrounded AC systems
- Insulation monitoring for ungrounded AC systems up to 300 V
- Two separately adjustable response values
- Preset function (automatic setting of basic parameters on first startup)
- Connection monitoring for system and ground connections
- LEDs: Power On, Alarm 1, Alarm 2
- Internal/external test/reset button
- Two separate SPDT contact outputs
- Normally energized or normally de-energized operation
- Latching or non-latching capability
- Self monitoring with automatic alarm
- Detailed LCD display showing insulation resistance in real-time
- Adjustable response delay
- Small form factor
- Screw terminals (push-wire terminals available)
- RoHS compliant

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (42 - 460 Hz)	2 SPDT contacts	**IR420-D4-1**	**B 9101 6409**
70 - 300 V	70 - 300 V (42 - 460 Hz)	2 SPDT contacts	**IR420-D4-2**	**B 9101 6405**

[1] Absolute values

Push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	**B 9806 0008**

Technical data

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (L1, L2, E, KE, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	see ordering information
Power consumption	≤ 3 VA

System voltage

Nominal system voltage U_n	AC 0 - 300 V
Nominal frequency f_n	42 - 460 Hz

Response values

Response value R_{an1} (Alarm 1) 1 - 200 kΩ	
Response value R_{an2} (Alarm 2)	1 - 200 kΩ
PreSet mode	$U_n \leq 72$ V R_{an1} (Alarm 1) = 20 kΩ/R_{an2} (Alarm 2) = 10 kΩ
	$U_n > 72$ V R_{an1} (Alarm 1) = 46 kΩ/R_{an2} (Alarm 2) = 23 kΩ
Relative uncertainty 1 - 5 kΩ/5 - 200 kΩ	± 0.5 kΩ/± 15 %
Hysteresis	25%

Time response

Response time t_{an} at $R_F = 0.5$ x R_{an} and $C_e = 1$ µF	≤ 1 s
Start-up delay (start time) t	0 - 10 s (0 s)*
Response delay t_{on}	0 - 99 s (0 s)*

Measuring circuit

Measuring voltage U_m	12 V
Measuring current I_m (at $R_F = 0$ Ω)	≤ 200 µA
Internal DC resistance R_i	≥ 62 kΩ
Impedance Z_i at 50 Hz	≥ 60 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 300 V
Permissible system leakage capacitance C_e	≤ 20 µF

Displays, memory

Display range, measured value	1 kΩ - 1 MΩ
Operating uncertainty 1 - 5 kΩ/5 kΩ - 1 MΩ	± 0.5 kΩ/± 15 %
Password	off/0 - 999 (off)*
Fault memory, alarm relay	on/off*

Outputs

Cable length, test and reset button	≤ 32 ft (10 m)

Switching elements

Number of switching elements					2 SPDT contacts
Operating principle					Normally energized/de-energized (N/E)*
Electrical service life, number of cycles					10000
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	220 V	110 V	24 V
Rated operational current	5 A	3 A	0.1 A	0.2 A	1 A
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-13 - +131 °F (-25 - +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

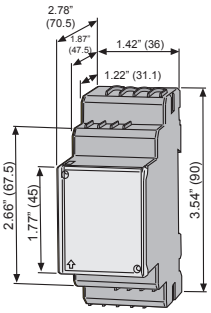
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
Flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
Flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

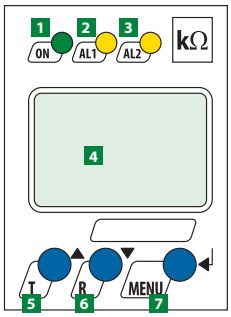
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Operating manual	TBP101012
Weight	≤ 0.35 lb (150 g)

( )* = factory setting

Dimensions in inches (mm)



Displays and controls



1 LED "Power ON," lights during normal operation. Flashes during connection error (L1/L2 or E/KE).

2 Alarm LED "AL1," lights when Alarm 1 is reached. Flashes during connection error (L1/L2 or E/KE).

3 Alarm LED "AL1," lights when Alarm 2 is reached. Flashes during connection error (L1/L2 or E/KE).

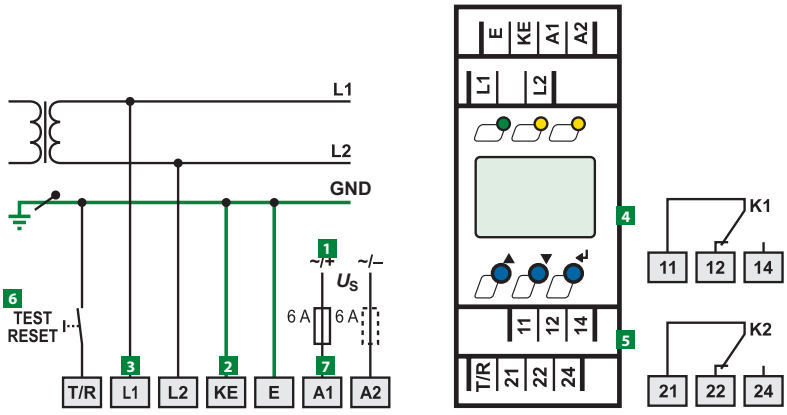
4 LCD display

5 Test button "T": Initiates internal device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 Menu button "MENU": Open's the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 Supply voltage US (see ordering details) via fuse

2 Separate connection to equipment ground

3 Connection to monitored AC system
AC: connect terminals L1, L2 to conductors L1, L2.

4 Alarm relay "K1": Alarm 1

5 Alarm relay "K2": Alarm 2

6 Combined test and reset button "T/R":
Short press (< 1.5 s) = RESET, Hold (> 1.5 s) = TEST

7 Power supply line fuse protection

IR425 Series

Digital ground fault detector for ungrounded single-phase AC/DC systems

Features

- Fufills requirements of NEC 250.21(B) and CEC 10-106(2) for ground fault detection on ungrounded AC systems
- Fufills 2014 requirements of NEC 250.167(A) for ground fault detection on ungrounded DC systems
- Insulation monitoring for ungrounded AC and DC systems up to 300 V
- Two separately adjustable response values
- Preset function (automatic setting of basic parameters on first startup)
- Connection monitoring for system and ground connections
- LEDs: Power On, Alarm 1, Alarm 2
- Internal/external test/reset button
- Two separate SPDT contact outputs
- Option available with selectable analog output, 0(4) - 20 mA, 0 - 10 V
- Normally energized or normally de-energized operation
- Latching or non-latching capability
- Self monitoring with automatic alarm
- Detailed LCD display showing insulation resistance in real-time
- Adjustable response delay
- Small form factor
- Screw terminals (push-wire terminals available)
- RoHS compliant

Applications

- Single-phase AC/DC systems up to 300 V
- Systems with variable frequency drives (VFDs)
- Control circuits
- Portable generators
- General low-voltage small ungrounded circuits

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	IR425-D4-1	B 9103 6403
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	IR425-D4-2	B 9103 6402
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Selectable analog output	IR425-DM-1	B 9103 6416
70 - 300 V	70 - 300 V (15 - 460 Hz)	Selectable analog output	IR425-DM-2	B 9103 6410

[1] Absolute values
Push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (L1, L2, E, KE, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	see ordering information
Power consumption	≤ 3 VA

Monitored system

Nominal system voltage U_n	AC/DC 0 - 300 V
Nominal frequency f_n	DC 15 - 460 Hz

Response values

Response value R_{an1} (Alarm 1) 1 - 200 kΩ	
Response value R_{an2} (Alarm 2)	1 - 200 kΩ
Preset mode	$U_n \leq 72$ V R_{an1} (Alarm 1) = 20 kΩ/R_{an2} (Alarm 2) = 10 kΩ
	$U_n > 72$ V R_{an1} (Alarm 1) = 46 kΩ/R_{an2} (Alarm 2) = 23 kΩ
Relative uncertainty 1 - 5 kΩ/5 - 200 kΩ	± 0.5 kΩ/± 15 %
Hysteresis	25 %

Time response

Response time t_{an} at $R_F = 0.5$ x R_{an} and $C_e = 1$ µF	≤ 2 s
Start-up delay (start time) t	0 - 10 s (0 s)*
Response delay t_{on}	0 - 99 s (0 s)*

Measuring circuit

Measuring voltage U_m	± 12 V
Measuring current I_m (at $R_F = 0$ Ω)	≤ 200 µA
Internal DC resistance R_i	≥ 62 kΩ
Impedance Z_i at 50 Hz	≥ 60 kΩ
Permissible system leakage capacitance	≤ 20 µF

Displays, memory

Display range, measured value	1 kΩ - 1 MΩ
Operating uncertainty 1 - 5 kΩ/5 kΩ - 1 MΩ	± 0.5 kΩ/± 15 %
Password	off/0 - 999 (off)*
Latching behavior, alarm relay	on/off*

Outputs

Cable length test and reset button	≤ 10 m

Switching elements

Number of switching elements					2 SPDT contacts
Operating principle					normally energized or de-energized (N/D)*
Electrical endurance, number of cycles					10000
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	220 V	110 V	24 V
Rated operational current	5 A	3 A	0.1 A	0.2 A	1 A
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-13 - +131 °F (-25 - +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

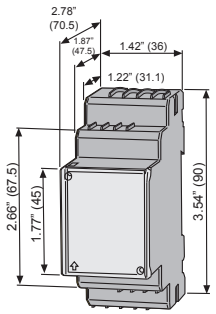
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
Flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
Flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

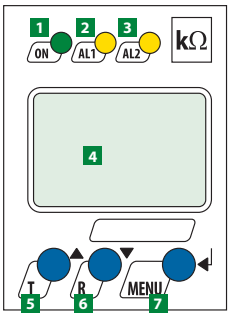
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Operating manual	TBP103005
Weight	≤ 150 g

- ( )* = factory setting

Dimensions in inches (mm)

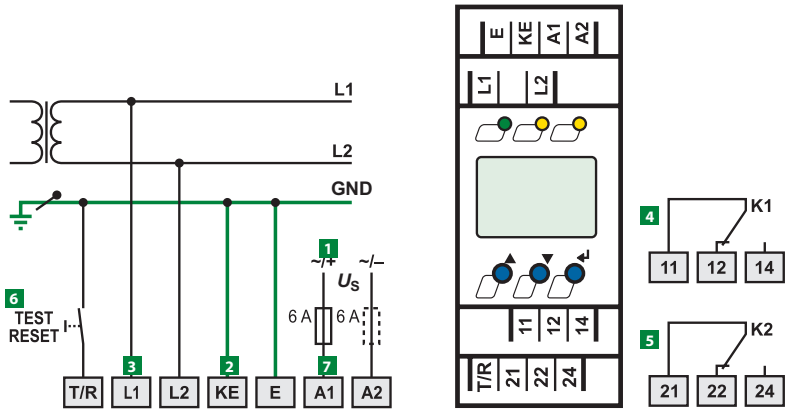


Displays and controls



1. LED "Power ON," lights during normal operation. Flashes during connection error (L1/L2 or E/KE).
2. Alarm LED "AL1," lights when Alarm 1 is reached. Flashes during connection error (L1/L2 or E/KE).
3. Alarm LED "AL1," lights when Alarm 2 is reached. Flashes during connection error (L1/L2 or E/KE).
4. LCD display
5. Test button "T": Initiates internal device self-test.
   Arrow up button: Parameter change, scrolls up in device menu
6. Reset button "R": Resets device (when operating in latching mode)
   Arrow down button: Parameter change, scrolls down in device menu
7. Menu button "MENU": Open's the device's main menu.
   Enter button: Confirms parameter changes.

Wiring diagram



1. Supply voltage US (see ordering details) via fuse
2. Separate connection to equipment ground
3. Connection to monitored AC system
   AC: connect terminals L1, L2 to conductors L1, L2.
   DC: connect terminal L1 to L+ and terminal L2 to L-.
4. Alarm relay "K1": Alarm 1
5. Alarm relay "K2": Alarm 2
6. Combined test and reset button "T/R":
   Short press (< 1.5 s) = RESET, Hold (> 1.5 s) = TEST
7. Power supply line fuse protection

isoLR275 and AGH-LR

Digital ground fault detector for ungrounded single- and three-phase AC/DC systems
For systems with low insulation resistance and large rectifiers / inverters

Applications

- Ungrounded single-phase and three-phase AC and DC systems
- Ungrounded systems with large inverters / rectifiers / variable frequency drives (VFDs)
- Ungrounded systems with very high leakage capacitances (2000 µF)
- Interconnected ungrounded systems / systems connected via a tiebreaker

Features

isoLR275

- Fufills requirements of NEC 250.21(B) and CEC 10-106(2) for ground fault detection on ungrounded AC systems
- Fufills 2014 requirements of NEC 250.167(A) for ground fault detection on ungrounded DC systems
- Ground fault detector for ungrounded single-phase and three-phase AC/DC systems
- Designed for systems with low levels of insulation resistance
- Automatic adaptation to the existing system leakage capacitance
- ***AMP**Plus* measurement method
- Multiple measuring principles available and selectable to meet specific system requirements
- Two separately adjustable alarm values, 0.2 - 100 kΩ
- LCD display
- Automatic device self test
- History memory with real-time clock to store up to 300 timestamped alarms
- RS-485 interface for use with BENDER communication system
- Disconnecting / switching means for interconnected systems and systems with tiebreakers
- Analog current output, 0(4) - 20 mA (electrically isolated)

AGH-LR

- Voltage coupling device required for use with isoLR275
- Connects to systems up to 793 VAC and 1100 VDC
- DIN rail mounting

Ordering information

Supply voltage U_S		Type	Ordering No.
DC	AC		
19.2 - 72 V	–	**isoLR275-327 + AGH-LR-3**	**B 9106 5702W**
77 - 286 V	88 - 264 V	**isoLR275-335 + AGH-LR-3**	**B 9106 5703W**

The AGH-LR coupler is required for operation. The ground fault detector and coupler are sold as a set.

Accessories

Description	Type	Page
External meter	**9620-1421**	**6-06**
Screw mounting kit	**B 990 056**	-

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

Rated insulation voltage for isoLR275-3	AC 250 V
Rated impulse voltage/pollution degree	6 kV/III
Protective separation (reinforced insulation) between	(A1/+, A2/-) - (11,12, 14, 21, 22, 24) - (AK1, AK2, KE, PE, T1, T2, R1, R2, F1, F2, M+, M-, A, B)
Voltage test acc. to IEC 61010-1	3.536 kV
Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3
Basic insulation between:	(11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Voltage ranges

Nominal system voltage U_n	via AGH-LR
isoLR275-335:	
Supply voltage U_S (also see nameplate)	AC 88 - 264 V**
Frequency range U_S	42 - 460 Hz
Power consumption	≤ 16 VA
Supply voltage U_S (also see nameplate)	DC 77 - 286 V**
Power consumption	≤ 8 W
isoLR275-327:	
Supply voltage U_S (also see nameplate)	DC 19.2 - 72 V**
Power consumption	≤ 8 W

Response values

Response value R_{an1}	0.2 - 100 kΩ
Factory setting R_{an1} (Alarm1)	4 kΩ
Response value R_{an2}	0.2 - 100 kΩ
Factory setting R_{an2} (Alarm2)	1 kΩ
Relative uncertainty (7 - 100 kΩ) (acc. to IEC 61557-8)	± 15 %
Relative uncertainty (0.2 - 7 kΩ)	± 1 kΩ
Response time t_{an}	see table TGH1468 from page 39 onwards
Hysteresis	25 %, + 1 kΩ

Measuring circuit

Measuring voltage U_m (peak value)	± 50 V
Measuring current I_m (at R_F = 0 Ω)	≤ 1.5 mA
Internal DC resistance R_i	≥ 35 kΩ
Impedance Z_i at 50 Hz	≥ 35 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 1100 V
Permissible system leakage capacitance C_e	≤ 500 µF (150 µF)*

Displays

Display, illuminated	two-line display
Characters (number/height)	2 x 16/4/mm
Display range measured value	0.2 kΩ - 1 MΩ
Operating uncertainty	±15%, ±1 kΩ

Outputs/Inputs

Test/reset button	internal/external
Cable length test/reset button, external	≤ 10 m
Current output (load)	0/4 - 20 mA (≤ 500 Ω)
Accuracy current output, related to the value indicated (1 - 100 kΩ)	±15 %, ±1 kΩ

Serial interface

Interface/protocol	RS-485/BMS
Connection	terminals A/B
Cable length	≤ 1200 m
Shielded cable (shield to PE on one end)	2-core, ≥ 0.6 mm², e.g. J-Y(St)Y min. 2 x 0.6
Terminating resistor	120 Ω (0.5 W)
Device address, BMS bus	1 - 30 (3)*

Switching elements

Switching elements	2 SPDT contacts: K1 (Alarm 1), K2 (Alarm 2, device error)				
Operating mode K1, K2 (Alarm 1/Alarm 2)	N/E operation/N/D operation (N/D operation)*				
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
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	
not suitable for household and small companies	IEC 61326-2-4 Ed. 1.0
Operating temperature	-25 - +70 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (with condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (with condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (with condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	
for screw mounting with accessories B990056	3M7
for DIN rail mounting	3M4
Transport (IEC 60721-3-2)	2M2
Long term storage (IEC 60721-3-1)	1M3

Connection

Connection	screw-type terminals
Connection properties	
rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²
flexible with ferrules without/with plastic sleeve	0.25 - 2.5 mm²
Tightening torque	0.5 Nm
Conductor sizes (AWG)	24 - 12
Cable length between isoLR275 and AGH-LR	≤ 0.5 m

Other

Operating mode	continuous operation
Mounting	display-oriented
Distance to adjacent devices	≥ 30 mm
Degree of protection, terminals (DIN EN 60529	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529	IP20 (NEMA 1)
Type of enclosure	X112, free from halogen
Screw mounting with mounting clip	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version	D369 V2.1
Weight	≤ 510 g

( )* = factory setting
** Absolute values

Technical data: AGH-LR

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 800 V
Rated impulse voltage/pollution degree	8 kV/3

Voltage ranges

Nominal system voltage U_n	AC, 3(N)AC 0 - 793 V, DC 0 - 1100 V
Nominal frequency f_n	DC, 10 - 460 Hz
Max. AC voltage U~ in the frequency range f_n = 0.1 - 10 Hz	U~max = 110 V/Hz * f_n

Environment/EMC

EMC	IEC 61326-2-4 Ed. 1.0
Operating temperature	-25 - +70 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (with condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (with condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (with condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M7
Transport (IEC 60721-3-2)	2M2
Storage (IEC 60721-3-1)	1M3

Connection

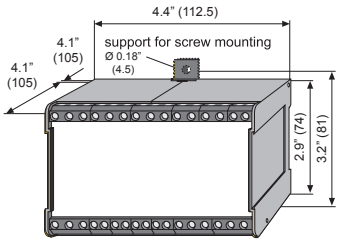
Connection	screw-type terminals
Connection properties	
rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²
flexible with ferrules without/with plastic sleeve	0.25 - 2.5 mm²
Tightening torque	0.5 Nm
Conductor sizes (AWG)	24 - 12
Cable length between isoLR275 and AGH-LR	≤ 0.5 m

Other

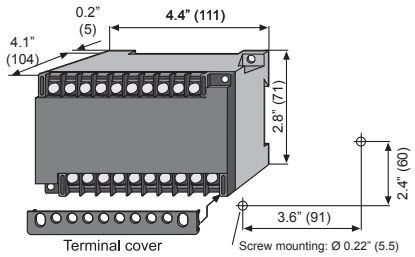
Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically!
Distance to adjacent devices	≥ 30 mm
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Type of enclosure	X200
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Weight	≤ 230 g

Dimensions in inches (mm)

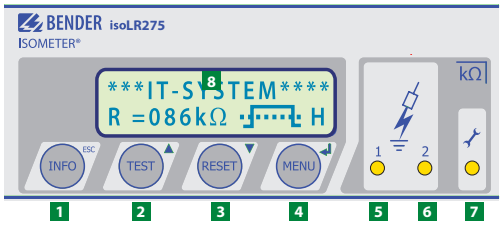
isoLR275



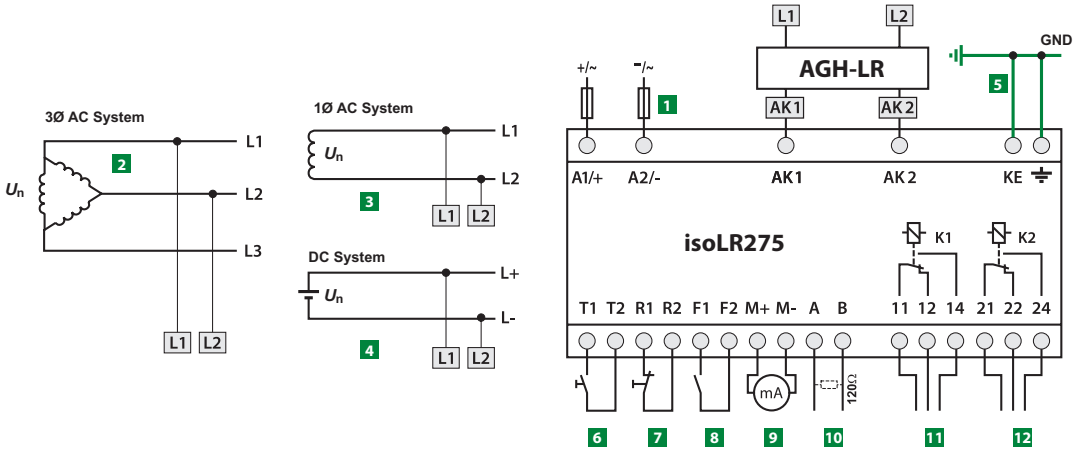
AGH-LR



Display and controls



1. "INFO" button: Cycle through system information
   ESC button: Goes back a step in menu
2. "TEST" button: Initiates self-test
   Arrow up button: Parameter change / up button in menu
3. "RESET" button: Resets device (if in latching mode) and clears alarms
   Arrow down button: Parameter change / down button in menu
4. "MENU" button: Enters main menu
   Enter button: Confirm parameter changes
5. Alarm LED 1, yellow, lights when the value falls below the set response value R_{ALARM1}
6. Alarm LED 2, yellow, lights when the value falls below the set response value R_{ALARM2}
7. Alarm LED, yellow, lights during system / ground connection error or device error
8. LCD display



1 Supply voltage U_S (see ordering information) 6 A fuse recommended; for UL and CSA applications, 5 A fuses are mandatory.

2 Connections to monitored three-phase AC system

3 Connections to monitored single-phase AC system

4 Connections to monitored DC system

5 Separate connection of the equipotential bonding conductor to PE and KE

6* External test button "T1/T2" (N/O contact)

7* External reset button "R1, R2" (N/C contact or wire jumper). Open terminals will cause the unit to automatically reset, unless latching mode is activated in the device's menu.

8* Standby function input "F1, F2":
With the contact in closed position, no insulation measurement takes place (not applicable when using voltage coupler).

9 IRDH275: Currrent output, electrically isolated: 0 - 400 µA
IRDH275B: Currrent output, electrically isolated: 0 - 20 mA or 4 - 20 mA

10 RS-485 interface

11 Alarm relay: Alarm 1

12 Alarm relay: Alarm 2/system

* **the terminal pairs 6, 7 and 8 must be wired electrically isolated and do not have to be connected to ground.**

isoPV and AGH-PV

Ground fault detector for ungrounded solar arrays

Applications

- Ungrounded AC, DC, AC/DC systems
- Large-scale ungrounded solar arrays
- Ungrounded Solar arrays with high leakage capacitances
- Grounded and ungrounded solar arrays requiring initial circuit isolation testing prior to startup

Approvals

c UL us LISTED

AE25

Features

- Fufills ground fault detection requirements of NEC 690.35 and CEC 64-018(1)(e) for ungrounded solar arrays
- Fufills 2014 requirements of NEC 690.5(A)(1) and NEC 690.35(C)(1) for isolation testing of solar arrays (grounded and ungrounded) prior to startup
- Designed specifically for photovoltaic systems
- Insulation monitoring for grounded systems AC, AC/DC up to 793 V, DC up to 1100 V
- Early indication of both AC and DC ground faults on the array side of the system
- May also be used to check PV isolation before system startup on all types of arrays
- Two separately adjustable alarm values, 0.2 - 100 kΩ
- Various ***AMP***^{Plus} measurement methods selectable
- Automatic adaptation to the system leakage capacitance
- Info button to display device settings and system leakage capacitance
- Self monitoring with automatic alarm
- Automatic self test, selectable
- Connection for external meter
- Test and reset button
- External test/reset button terminals
- Two SPDT alarm contacts
- Normally energized or de-energized operation, selectable
- Backlit LCD display
- RS-485 interface

Additional features

- History memory with real-time clock to store up to 300 timestamped alarms
- Electrically isolated RS-485 interface (BMS protocol) for communication with other Bender devices
- Disconnecting / switching means for interconnected arrays / inverters
- Analog current output, 0(4) - 20 mA (electrically isolated)

Ordering information

Supply voltage U_S		Type	Ordering No.
DC	AC		
19.2 - 72 V	–	**isoPV-327 + AGH-PV**	**B 9106 5132W**
77 - 286 V	88 - 264 V (42 - 460 Hz)	**isoPV-335 + AGH-PV**	**B 9106 5133W**

The AGH-PV coupler is required for operation. The ground fault detector and coupler are sold as a set.

Accessories

Description	Type	Page
External meter	**9620-1421**	**6-06**
Screw mounting kit	**B 990 056**	-

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 800 V
Rated impulse withstand voltage/pollution degree	8 kV/3

Voltage ranges

Nominal system voltage U_n	via AGH-PV
isoPV-335:	
Supply voltage U_S (also see nameplate)	AC 88 - 264 V**
Frequency range U_S	42 - 460 Hz
Supply voltage U_S (also see nameplate)	DC 77 - 286 V**
isoPV-327:	
Supply voltage U_S (also see nameplate)	DC 19.2 - 72 V**
isoPV - :	
Power consumption	≤ 8 VA

Response values

Response value R_{an1}	0.2 - 100 kΩ
Factory setting R_{an1} (Alarm1)	4 kΩ
Response value R_{an2}	0.2 - 100 kΩ
Factory setting R_{an2} (Alarm2)	1 kΩ
Relative uncertainty (7 - 100 kΩ) (acc. to IEC 61557-8)	±15 %
Relative uncertainty (0.2 - 7 kΩ)	±1 kΩ
Response time t_{an}	see table THG1454 from page 39 onwards
Hysteresis	25 %, +1 kΩ

Measuring circuit

Measuring voltage U_m (peak value)	± 50 V
Measuring current I_m (at $R_F = 0$ Ω)	≤ 1.5 mA
Internal DC resistance R_i	≥ 35 kΩ
Impedance Z_i at 50 Hz	≥ 35 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 1100 V
Permissible system leakage capacitance C_e	≤ 2000 µF (2000 µF)*

Displays

Display, illuminated	two-line display
Characters (number/height)	2 x 16/4/mm
Display range measured value	0.2 kΩ - 1 MΩ
Operating uncertainty	±15%, ±1 kΩ

Outputs/Inputs

Test/reset button	internal/external
Cable length test/reset button, external	≤ 10 m
Current output (load)	0/4 - 20 mA (≤ 500 Ω)
Accuracy current output, related to the value indicated (1 - 100 kΩ)	±15 %, ±1 kΩ

Serial interface

Interface/protocol	RS-485/BMS
Connection	terminals A/B
Cable length	≤ 1200 m
Cable (twisted in pairs, shield connected to PE)	2-core, ≥ 0.6 mm², recommended: J-Y(St)Y min. 2 x 0.8
Terminating resistor	120 Ω (0.5 W)
Device address, BMS bus	1 - 30 (3)*

Switching elements

Switching elements	2 SPDT contacts: K1 (Alarm 1), K2 (Alarm 2, device error)				
Operating mode K1, K2 (Alarm 1/Alarm 2)	N/E operation/N/D operation (N/D operation)*				
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
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	
not suitable for household and small companies	IEC 61326-2-4: 1.0
Operating temperature	-25 - +70 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (with condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (with condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (with condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	
for screw mounting with accessories 990 056	3M7
for DIN rail mounting	3M4
Transport (IEC 60721-3-2)	2M2
Long term storage (IEC 60721-3-1)	1M3

Connection

Connection	screw-type terminals
Connection properties	
rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²
flexible with ferrules without/with plastic sleeve	0.25 - 2.5 mm²
Tightening torque	0.5 Nm
Conductor sizes (AWG)	24 - 12
Cable length between iso-PV and AGH-PV	≤ 0.5 m

Other

Operating mode	continuous operation
Mounting	display-oriented
Distance to adjacent devices	≥ 30 mm
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Type of enclosure	X112, free from halogen
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version	D351 V2.0
Weight	≤ 510 g

( )* = factory setting
** Absolute values

Technical data: AGH-PV

Voltage ranges

Nominal system voltage U_n	AC, 3(N)AC 0 - 793 V, DC 0 - 1100 V
Nominal frequency f_n	DC, 10 - 460 Hz
Max. AC voltage U~ in the frequency range f_n = 0.1 - 10 Hz	$U_{\sim max}$ = 110 V/Hz * f_n

Environment/EMC

EMC	IEC 61326-2-4 Ed. 1.0
Operating temperature	-25 - +70 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (with condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (with condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (with condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M7
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

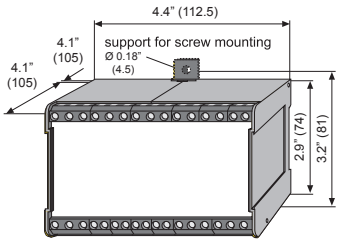
Connection	screw-type terminals
Connection properties	
rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²
flexible with ferrules without/with plastic sleeve	0.25 - 2.5 mm²
Tightening torque	0.5 Nm
Conductor sizes (AWG)	24 - 12
Cable length between iso-PV and AGH-PV	≤ 0.5 m

Other

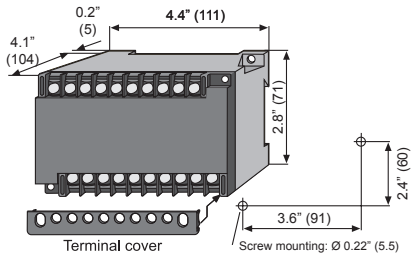
Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically!
Distance to adjacent devices	≥ 30 mm
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529)	IP20
Type of enclosure	X200
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Weight	≤ 230 g

Dimensions in inches (mm)

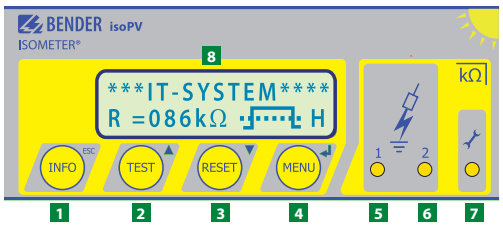
isoPV



AGH-PV



Display and controls



1 "INFO" button: Cycle through system information
ESC button: Goes back a step in menu

2 "TEST" button: Initiates self-test
Arrow up button: Parameter change / up button in menu

3 "RESET" button: Resets device (if in latching mode) and clears alarms
Arrow down button: Parameter change / down button in menu

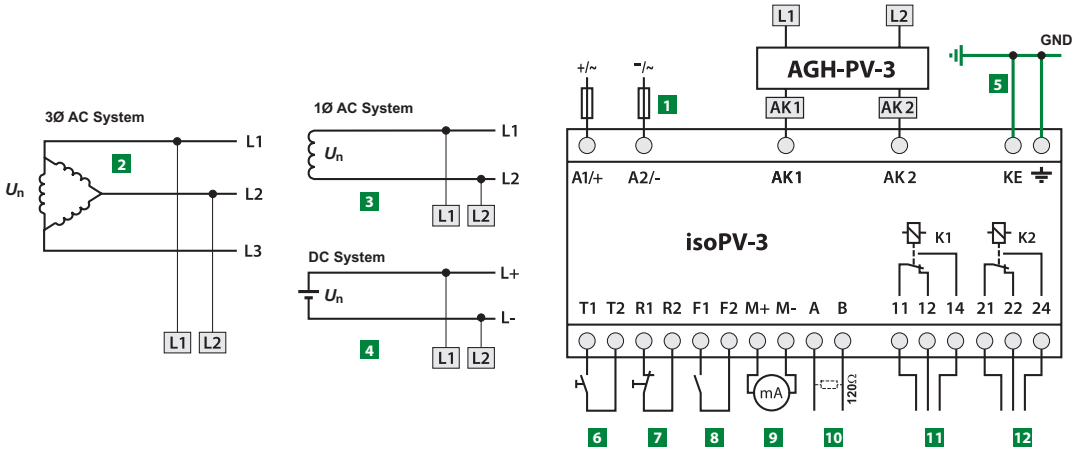
4 "MENU" button: Enters main menu
Enter button: Confirm parameter changes

5 Alarm LED 1, yellow, lights when the value falls below the set response value R_{ALARM1}

6 Alarm LED 2, yellow, lights when the value falls below the set response value R_{ALARM2}

7 Alarm LED, yellow, lights during system / ground connection error or device error

8 LCD display



1 Supply voltage U_S (see ordering information) 6 A fuse recommended; for UL and CSA applications, 5 A fuses are mandatory.

2 Connections to monitored three-phase AC system

3 Connections to monitored single-phase AC system

4 Connections to monitored DC system

5 Separate connection of the equipotential bonding conductor to PE and KE

6* External test button "T1/T2" (N/O contact)

7* External reset button "R1, R2" (N/C contact or wire jumper). Open terminals will cause the unit to automatically reset, unless latching mode is activated in the device's menu.

8* Standby function input "F1, F2":
With the contact in closed position, no insulation measurement takes place (not applicable when using voltage coupler).

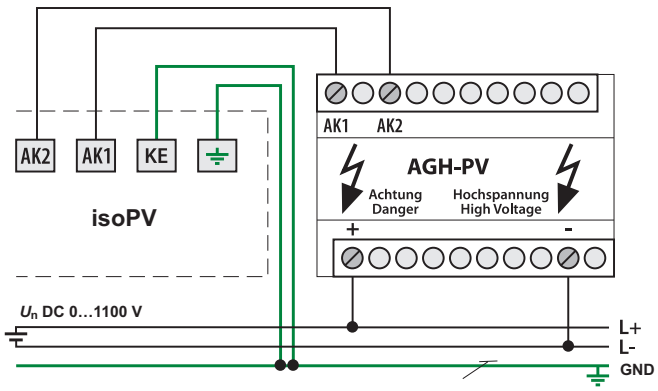
9 IRDH275: Currrent output, electrically isolated: 0 - 400 µA
IRDH275B: Currrent output, electrically isolated: 0 - 20 mA or 4 - 20 mA

10 RS-485 interface

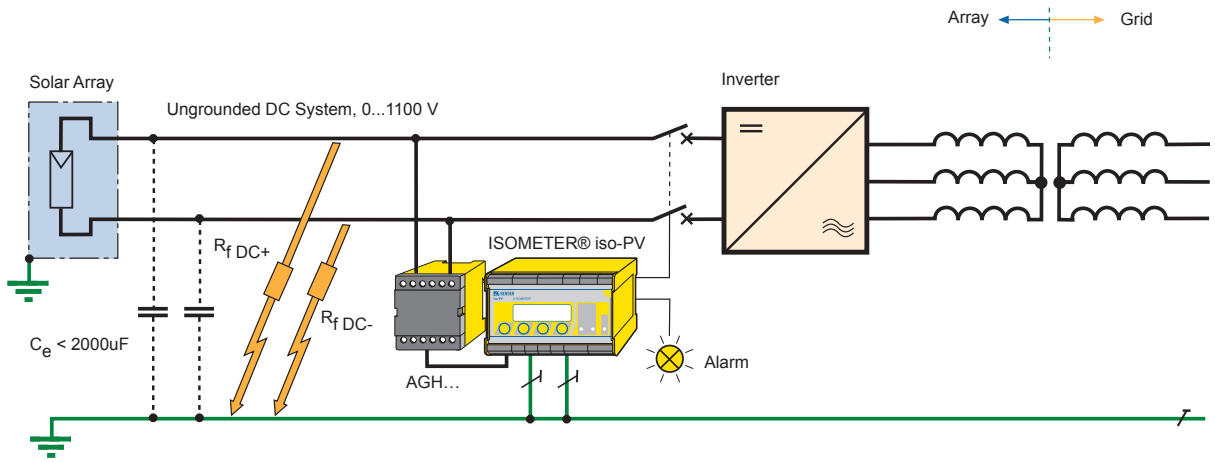
11 Alarm relay: Alarm 1

12 Alarm relay: Alarm 2/system

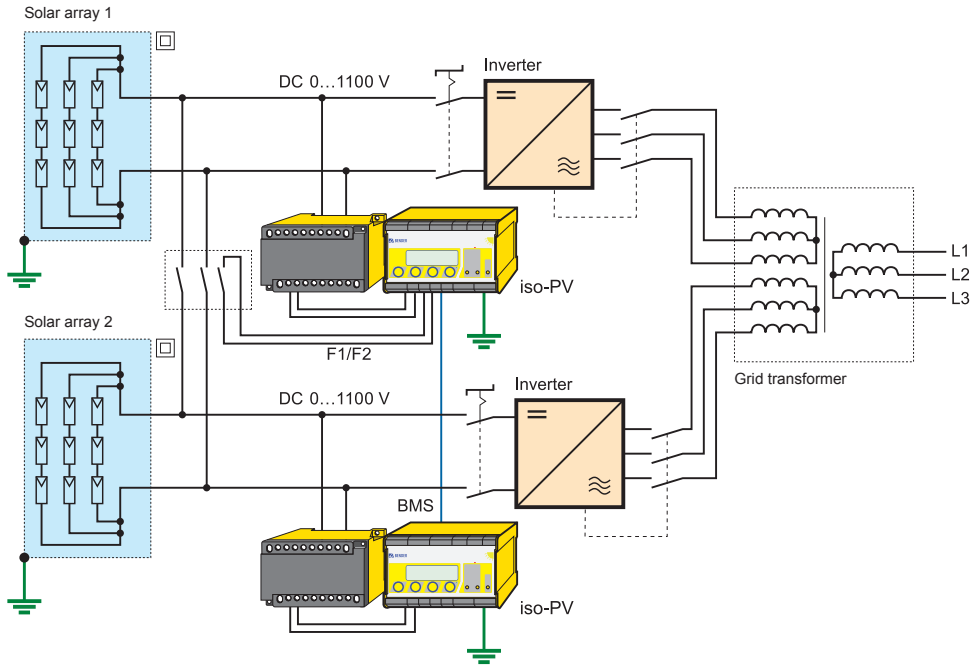
* **the terminal pairs 6, 7 and 8 must be wired electrically isolated and do not have to be connected to ground.**



Wiring of AGH-PV voltage coupler to system and isoPV



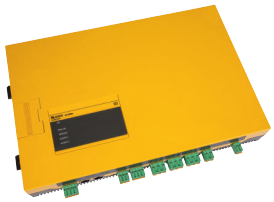
Typical ungrounded PV array with isoPV ground fault detection



Several interconnected PV arrays monitored with multiple isoPV devices connected via RS-485

iso1685P Series

Ground fault detector for large-scale ungrounded AC/DC systems up to 1000 VAC / 1500 VDC



Applications

- Large-scale AC/DC ungrounded systems up to 1000 VAC / 1500 VDC

Features

- Ground fault detection for AC/DC systems up to 1000 VAC / 1500 VDC
- Specifically designed for large-scale electrical systems and measuring low resistance ground faults
- Separately adjustable trip values, 200 Ω - 1 MΩ range
- Measurement of system leakage capacitance
- RS-485 interface
- Pole reversal monitoring in DC systems
- Automatic adaptation to system leakage capacitance
- Two single pole relay alarm outputs
- Compatible with EDS fault location modules to create fault location system
- microSD card for data logging and alarm history storage

Ordering information

Alarm response range	Supply voltage [1] U_S	Type	Ordering No.
200 Ω - 1MΩ	18 - 30 VDC	**iso1685P-425**	**B 9106 5801**

[1] Absolute values

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

Insulation coordination acc. to IEC 60664-1	
Rated insulation voltage	DC 1500 V
Rated impulse voltage/pollution degree	8 kV/2

Voltage ranges

Nominal system voltage U_n	AC 0 - 1000 V/DC 0 - 1500 V
Nominal frequency f_n	0.1 - 460 Hz
Supply voltage U_S (also see nameplate)	DC 18 - 30 V
Power consumption	≤ 7 W
Power consumption	≤ 7.5 VA

Measuring circuit for insulation monitoring

Measuring voltage U_m (peak value)	±50 V
Measuring current I_m (at $R_F = 0\ \Omega$)	≤ 1.5 mA
Internal DC resistance R_i	≥ 70 kΩ
Impedance Z_i at 50 Hz	≥ 70 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 1500 V
Permissible system leakage capacitance C_e	≤ 500 µF (150 µF)*

Response values for insulation monitoring

Reponse value R_{an1} (Alarm 1)	200 Ω - 1 MΩ (10 kΩ)*
Response value R_{an2} (Alarm 2)	200 Ω - 1 MΩ (1 kΩ)*
Upper measurement range limit, with the setting C_{emax} = 500 µF	200 kΩ
Relative uncertainty (10 kΩ - 1 MΩ) (acc. to IEC 61557-8)	±15 %
Relative uncertainty (0.2 - < 10 kΩ)	±200 Ω ±15 %
Response time t_{an}	see table
Hysteresis	25 %

Measuring circuit for fault location (EDS)

Locating current I_L DC	≤ 50 mA
Test pulse/break	2/4 s

Displays, memory

Alarm LEDs for alarms and operating states	2 x green, 3 x yellow
µSD card for history memory and log files	≤ 32 GB

Inputs

Digital inputs DigIn1/DigIn2:	
High level	10 - 30 V
Low level	0 - 0.5 V

Serial interfaces

Interface/protocol	RS-485/BMS
Connection	terminals A/B
Cable length	≤ 3900 ft (1200 m)
Shielded cable (shield to functional earth on one end)	2-core, ≥ 0.6 mm², e.g. J-Y(St)Y 2x0.6
Shield	terminal S
Terminating resistor, can be enabled (term. RS-485)	120 Ω (0.5 W)
Device address, BMS bus	2 - 33 (2)*

Switching elements

Switching components	3 changeover contacts: K1 (insulation fault Alarm 1), K2 (insulation fault Alarm 2), K3 (device error)				
Operating principle K1, K2	N/C operation n.c./N/O operation n.o. (N/C operation n.c.)*				
Operating principle K3	N/C operation n.c., fixed setting				
Contact data acc. to IEC 60947-5-1:					
Utilisation category	AC 13	AC 14	DC-12	DC-12	DC-12
Rated operational voltage	230 V	230 V	24 V	110 V	220 V
Rated operational current	5 A	3 A	1 A	0.2 A	0.1 A
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Connection (except power supply connection)

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

Connection of the system coupling

Connection type	pluggable push-wire terminals
Connection properties	
rigid/flexible	0.2 - 10/0.2 - 6 mm²
flexible with ferrules without/with plastic sleeve	0.25 - 6/0.25 - 4 mm²
Conductor sizes (AWG)	AWG 24 - 8
Stripping length	0.6″ (15 mm)
Opening force	20 - 27 lbf (90 - 120 N)

Environment/EMC

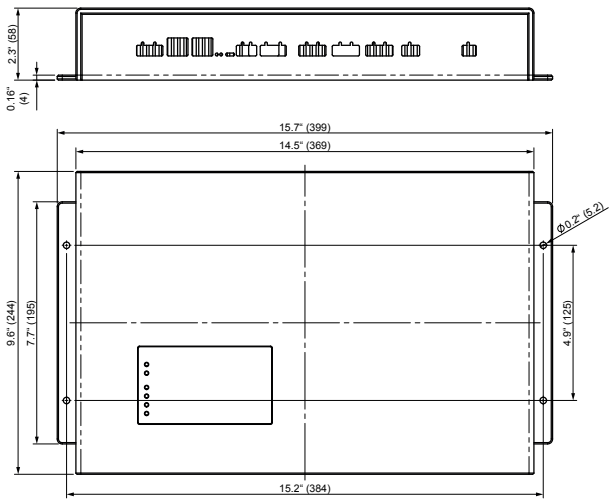
EMC	IEC 61326-2-4 Ed. 1.0
Classification of climatic conditions acc. to IEC 60721:	
Without solar radiation, precipitation, water, icing. Condensation possible temporarily:	
Stationary use (IEC 60721-3-3)	3K5
Transport (IEC 60721-3-2)	2K3
Long-term storage (IEC 60721-3-1)	1K4
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use for iso1685P (IEC 60721-3-3)	3M4
Stationary use for iso1685PW (IEC 60721-3-3)	3M7
Transport (IEC 60721-3-2)	2M2
Long-term storage (IEC 60721-3-1)	1M3
Deviation from the classification of climatic conditions:	
Ambient temperature (during operation)	-40 to +158 °F (-40 to +70 °C)
Ambient temperature (transport)	-40 to +176 °F (-40 to +80 °C)
Ambient temperature (long-term storage)	-13 to +176 °F (-25 to +80 °C)
Relative humidity	10 - 100 %
Air pressure	700 - 1060 hPa (mbar)
Maximum elevation	13000 ft (4000 m)

Other

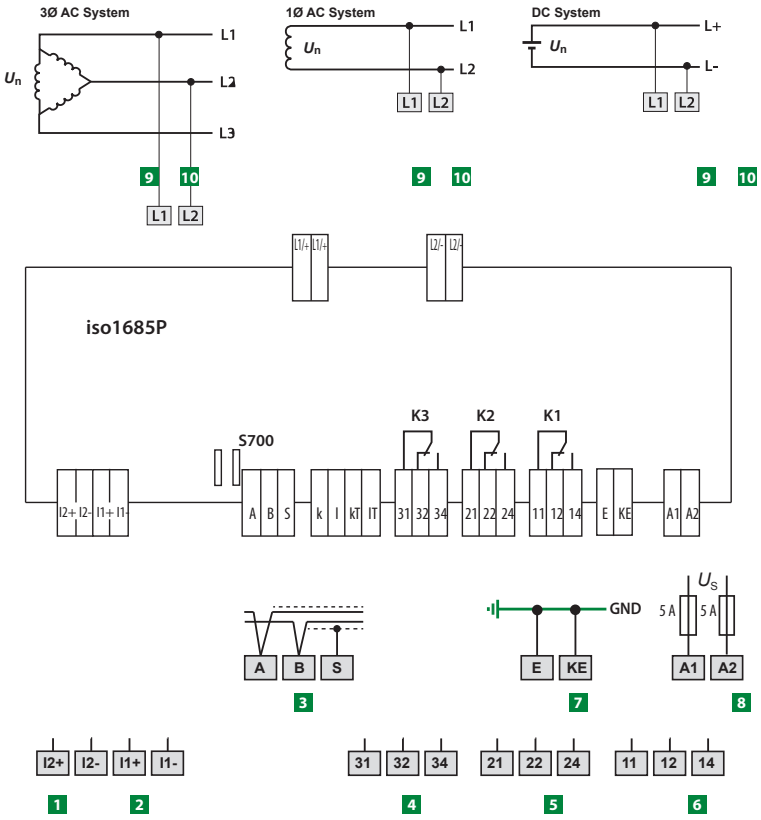
Operating mode	continuous operation
Position of normal use	vertical, power system connection at the top
PCB fixing	lens head screw DIN7985TX
Tightening torque	1.0 - 1.5 Nm
Degree of protection, internal components	IP30
Degree of protection, terminals	IP30
Documentation number	D00003
Weight	1.4 lb (650 g)

( )* = factory setting

Dimensions in inches (mm)



Wiring diagram



1 Provisioned for future use
2 Provisioned for future use
3 Connection to Bender RS-485 (BMS) bus, RS-485, S = shield (connected to GND on one side), can be terminated with S700
4 Alarm relay K3
5 Alarm relay K2
6 Alarm relay K1
7 Separate connections to ground
8 Supply voltage connection, U_S = DC 24 V via fuses
9 System connections
10 System connections

isoPV425 and AGH420

Ground fault detector for ungrounded solar arrays up to 100 kW

Applications

- Ungrounded solar arrays up to 100 kW
- Solar arrays with high system leakage capacitances
- Solar arrays with high but slow voltage fluctuations

Features

- Fufills ground fault detection requirements of NEC 690.35 and CEC 64-018(1)(e) for ungrounded solar arrays
- Fufills 2014 requirements of NEC 690.5(A)(1) and NEC 690.35(C)(1) for isolation testing of solar arrays (grounded and ungrounded) prior to startup
- Ground fault detector for ungrounded solar arrays up to 100 kW
- Works on systems up to 690 VAC, 1000 VDC
- Overvoltage and undervoltage detection available
- Measurement of the system voltage to ground (L+/GND and L-/GND)
- Measurement of the system leakage capacitance
- RS-485 interface
- Distinguish between positive and negative faults to ground with the display and output alarm relays
- Automatic adaptation to the system leakage capacitance up to 600 µF
- Supply voltage range DC 24 - 240 V/AC 100 - 240 V
- Self monitoring with automatic alarm message
- Connection monitoring of system and ground connections
- LEDs: Power On, Alarm 1, Alarm 2
- Internal and external test/reset button
- Two single pole relay alarm outputs
- Normally energized or de-energized operation, selectable
- Latching or non-latching operation, selectable
- Multi-function LCD display
- Adjustable response delay
- Available separately adjustable response values for R_e (resistance) and Z_e (impedance)

Ordering information

Supply voltage [1] U_S		Type	Ordering No.
DC	AC		
24 - 240 V	100 - 240 V (47 - 63 Hz)	**isoPV425-D4 with AGH420**	**B 9103 6303**

[1] Absolute values
Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	**B 9806 0008**

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (AK1, GND, AK2, Up, KE) - (11, 14, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	DC 24 - 240 V, AC 100 - 240 V
Tolerance of U_S	-20 - +15 %
Frequency range	47 - 63 Hz
Power consumption	≤ 3 W, ≤ 6 VA

Monitored system

Nominal system voltage U_n	via AGH420

Response values

Undervoltage detection	30 - 1149 V (off)*
Overvoltage detection	31 - 1150 V (off)*
Hysteresis	5 %
Response value R_{an1} (Alarm 1)	1 - 500 kΩ (10 kΩ)*
Response value R_{an2} (Alarm 2)	1 - 500 kΩ (5 kΩ)*
Relative uncertainty	± 15 %
Hysteresis	25 %

Time response

Response time t_{an} at $R_F = 0.5 \times R_{an}$ and $C_e = 1$ µF IEC 61557-8	≤ 10 s
Start-up delay (start time) t	0 - 10 s (0 s)*
Response delay t_{on}	0 - 99 s (0 s)*

Displays, memory

Display range, measured value insulation resistance	1 kΩ - 1 MΩ
Operating uncertainty 1 - 5 kΩ/5 kΩ - 1 MΩ	± 0.5 kΩ/± 15 %
Display range, measured value nominal system voltage	10 - 1150 V RMS
Operating uncertainty	± 3 V/± 15 %
Display range, measured value system leakage capacitance	1 µF - 500 µF
Operating uncertainty	± 30 %
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/(off)*

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kbit/s
Cable length	0 - 1200 m
Shielded cable (shield connected to PE on one side)	recommended: J-Y(St)Y min. 2 x 0.6
Terminating resistor	120 Ω (0.25 W), can be enabled in the device
Device address, BMS bus	3 - 90 (3)*

Switching elements

Switching elements					2 x 1 N/O contact (single pole)
Operating principle					N/C operation/N/O operation (N/C operation)*
Contact 11-14 indication					Alarm 1
Contact 11-24 indication					Alarm 2
Electrical endurance, number of cycles					10000
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	220 V	110 V	24 V
Rated operational current	5 A	3 A	0.1 A	0.2 A	1 A
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-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

Connection

Connection type	push-wire terminal
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Operating manual	D610009200
Weight	≤ 150 g

( )* = factory setting

Technical data: AGH420

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

Rated insulation voltage	1000 V
Rated impulse voltage/pollution degree	8 kV/3
Protective separation (reinforced insulation) between	(L1/+, L2/-) - (AK1, GND, AK2, Up, E)
Voltage test acc. to IEC 61010-1	4.3 kV

Monitored system

Nominal system voltage U_n	DC 0 - 1000 V, AC 0 - 690 V
Tolerance of U_n	+15 %
Frequency range of U_n	DC, 10 - 460 Hz
Max. AC voltage U~ in the frequency range 0.1 - 10 Hz	U~max = 120 V/Hz * f_n

Measuring circuit

Measuring voltage U_m	± 45 V
Measuring current I_m (at R_f = 0 Ω)	≤ 400 µA
Internal DC resistance R_i	≥ 120 kΩ
Impedance Z_i at 50 Hz	≥ 120 kΩ
Permissible system leakage capacitance	≤ 500 µF

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-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

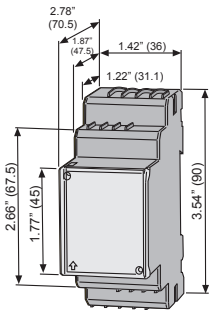
Connection

Connection type	push-wire terminal
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

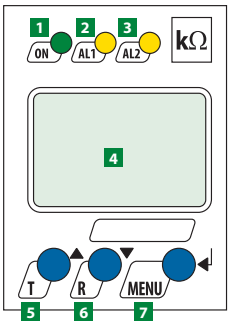
Other

Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically
Distance to adjacent devices, Un > 800V	≥ 30 mm
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Operating manual	D620014900
Weight	≤ 150 g

Dimensions in inches (mm)



Displays and controls



1 LED "Power ON," lights during normal operation. Flashes during connection error (L1/L2 or E/KE).

2 Alarm LED "AL1," lights when Alarm 1 is reached. Flashes during connection error (L1/L2 or E/KE) and overvoltage (when activated).

3 Alarm LED "AL1," lights when Alarm 2 is reached. Flashes during connection error (L1/L2 or E/KE) and undervoltage (when activated).

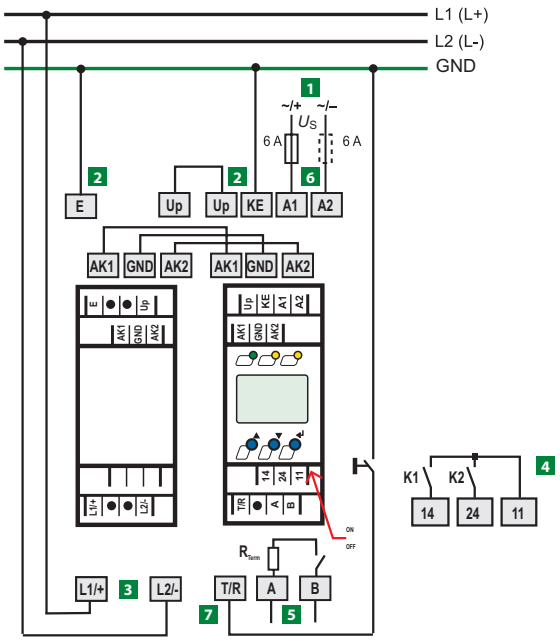
4 LCD display

5 Test button "T": Initiates internal device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 Menu button "MENU": Open's the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 Supply voltage U_S (see ordering information) via fuse

2 Separate connections to ground

3 System connections:
AC: Connect terminals L1(+), L2(-) to conductor L1, L2
DC: Connect terminals L1(+) to L+, and L2(-) to L-

4 Alarm relay K1, K2 with single pole and common

5 Serial interface RS-485 (termination with a 120 Ω resistor, can be enabled in the device) Bender protocol

6 Recommended line protection via fusing

7 External test/reset connections

IR420-D6 Series

Ground fault detector for offline / disconnected loads (grounded and ungrounded systems)

Features

- Ground fault detection for disconnected loads on grounded and ungrounded systems
- Connectable system voltage extendable with voltage coupling device
- Two separately adjustable response values from 100 kΩ to 10 MΩ
- LEDs: Power On LED, LEDs Alarm 1, Alarm 2
- Combined test/reset button
- Two SPDT alarm contacts
- Normally energized or de-energized operation, selectable
- Latching or non-latching operation, selectable

Applications

- Ground fault detection for frequently disconnected loads in grounded and ungrounded systems

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Supply voltage [1] U_S		Type	Ordering No.
DC	AC		
9.6 - 94 V	16 - 72 V (42 - 460 Hz)	**IR420-D6-1**	**B 9101 6415**
70 - 300 V	70 - 300 V (42 - 460 Hz)	**IR420-D6-2**	**B 9101 6407**

Models with push-wire terminals available on request.

[1] Absolute values

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	**B 9806 0008**
Voltage coupler	**AGH520S**

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (AK1, GND, AK2, Up, KE) - (11, 14, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	DC 24 - 240 V, AC 100 - 240 V
Tolerance of U_S	-20 - +15 %
Frequency range	47 - 63 Hz
Power consumption	≤ 3 W, ≤ 6 VA

Monitored system

Nominal system voltage U_n	via AGH420

Response values

Undervoltage detection	30 - 1149 V (off)*
Overvoltage detection	31 - 1150 V (off)*
Hysteresis	5 %
Response value R_{an1} (Alarm 1)	1 - 500 kΩ (10 kΩ)*
Response value R_{an2} (Alarm 2)	1 - 500 kΩ (5 kΩ)*
Relative uncertainty	± 15 %
Hysteresis	25 %

Time response

Response time t_{an} at $R_F = 0.5 \times R_{an}$ and $C_e = 1$ µF IEC 61557-8	≤ 10 s
Start-up delay (start time) t	0 - 10 s (0 s)*
Response delay t_{on}	0 - 99 s (0 s)*

Displays, memory

Display range, measured value insulation resistance	1 kΩ - 1 MΩ
Operating uncertainty 1 - 5 kΩ/5 kΩ - 1 MΩ	± 0.5 kΩ/± 15 %
Display range, measured value nominal system voltage	10 - 1150 V RMS
Operating uncertainty	± 3 V/± 15 %
Display range, measured value system leakage capacitance	1 µF - 500 µF
Operating uncertainty	± 30 %
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/(off)*

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kbit/s
Cable length	0 - 1200 m
Shielded cable (shield connected to PE on one side)	recommended: J-Y(St)Y min. 2 x 0.6
Terminating resistor	120 Ω (0.25 W), can be enabled in the device
Device address, BMS bus	3 - 90 (3)*

Switching elements

Switching elements					2 x 1 N/O contact (single pole)
Operating principle					N/C operation/N/O operation (N/C operation)*
Contact 11-14 indication					Alarm 1
Contact 11-24 indication					Alarm 2
Electrical endurance, number of cycles					10000
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	220 V	110 V	24 V
Rated operational current	5 A	3 A	0.1 A	0.2 A	1 A
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-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

Connection

Connection type	push-wire terminal
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Operating manual	D610009200
Weight	≤ 150 g

( )* = factory setting

Technical data: AGH420

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

Rated insulation voltage	1000 V
Rated impulse voltage/pollution degree	8 kV/3
Protective separation (reinforced insulation) between	(L1/+, L2/-) - (AK1, GND, AK2, Up, E)
Voltage test acc. to IEC 61010-1	4.3 kV

Monitored system

Nominal system voltage U_n	DC 0 - 1000 V, AC 0 - 690 V
Tolerance of U_n	+15 %
Frequency range of U_n	DC, 10 - 460 Hz
Max. AC voltage U~ in the frequency range 0.1 - 10 Hz	U~max = 120 V/Hz * f_n

Measuring circuit

Measuring voltage U_m	± 45 V
Measuring current I_m (at R_f = 0 Ω)	≤ 400 µA
Internal DC resistance R_i	≥ 120 kΩ
Impedance Z_i at 50 Hz	≥ 120 kΩ
Permissible system leakage capacitance	≤ 500 µF

Environment/EMC

EMC	IEC 61326-2-4
Operating temperature	-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

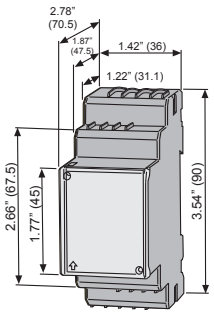
Connection

Connection type	push-wire terminal
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

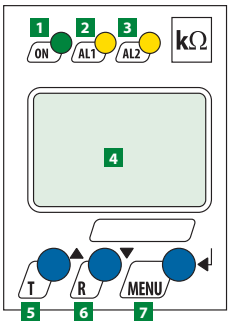
Other

Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically
Distance to adjacent devices, Un > 800V	≥ 30 mm
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Operating manual	D620014900
Weight	≤ 150 g

Dimensions in inches (mm)



Displays and controls



1 LED "Power ON," lights during normal operation. Flashes during connection error (L1/L2 or E/KE).

2 Alarm LED "AL1," lights when Alarm 1 is reached. Flashes during connection error (L1/L2 or E/KE) and overvoltage (when activated).

3 Alarm LED "AL1," lights when Alarm 2 is reached. Flashes during connection error (L1/L2 or E/KE) and undervoltage (when activated).

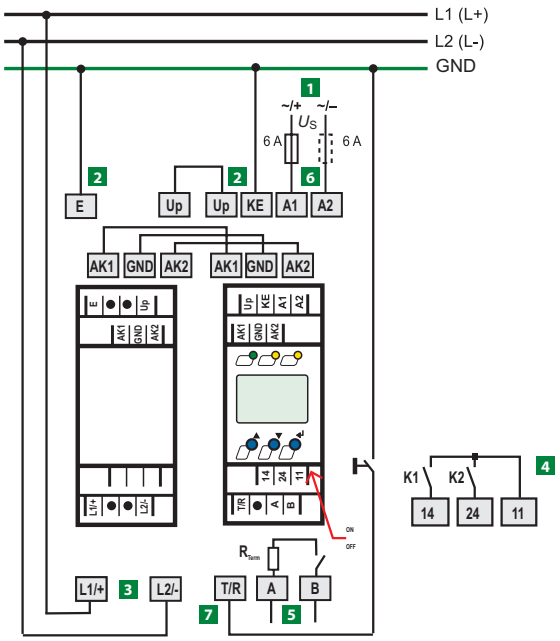
4 LCD display

5 Test button "T": Initiates internal device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 Menu button "MENU": Open's the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 Supply voltage U_S (see ordering information) via fuse

2 Separate connections to ground

3 System connections:
AC: Connect terminals L1(+), L2(-) to conductor L1, L2
DC: Connect terminals L1(+) to L+, and L2(-) to L-

4 Alarm relay K1, K2 with single pole and common

5 Serial interface RS-485 (termination with a 120 Ω resistor, can be enabled in the device) Bender protocol

6 Recommended line protection via fusing

7 External test/reset connections

iso165C

Ground fault detection modules for DC drives for electric vehicles (EV)

Features

- Designed specifically for electric vehicles
- Works on 0 - 600 V (peak) ungrounded DC drive systems
- Continuous measurement of insulation resistance, 0 - 50 MΩ
- Response time ≤ 20 s for measured insulation resistance, using direct current pulse (DCP)
- Automatic adaptation to system leakage capacitance up to 1 µF
- Detects ground faults and loss of chassis ground connection
- Measurement of a secondary voltage
- Operates when:
  - HV (high voltage) is unstable
  - HV is powered off
  - Symmetric or asymmetric faults are present
  - Faults exist between HV and supply voltage
- Galvanic separation of all signals from HV side
- HV coupled network
- CANbus interface
- Lightweight: ≤ 220 g, including housing and connection frame

Typical applications

- Ground fault detection in electric vehicles

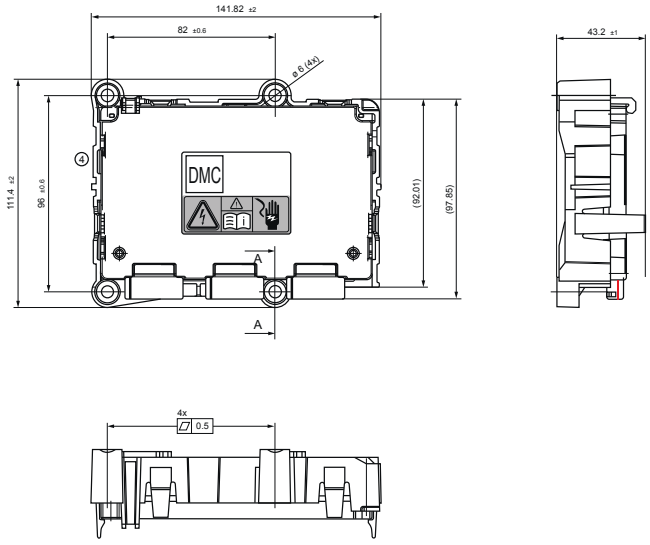
Ordering information

Response value range	Nominal voltage	Supply voltage	Type	Ordering No.
	DC	DC		
Alarm1 (Error): 30 kΩ - 1 MΩ (alarm factory set at 100 kΩ); Alarm2 (Warning): 40 kΩ - 2 MΩ (alarm factory set at 200 kΩ)	0 - 600 V	12 V	iso165C	B 9106 8175
Alarm1 (Error): 30 kΩ - 1 MΩ (specified alarm configured at factory); Alarm2 (Warning): 40 kΩ - 2 MΩ (specified alarm configured at factory)	0 - 600 V	12 V	iso165C	B 9106 8175 C

Accessories

Type	Ordering No.
iso165C connecting kit	B 9106 8503

Dimensions in mm only



Technical Data

Supply voltage

Supply voltage U_S	DC 9 - 16 V
Nominal supply voltage	DC 12 V
Max operational current I_S	300 mA (typ. 185 mA)
Max current I_K	5 A
Power dissipation P_S	< 2.5 W

Monitored system

Rated voltage range U_n	DC 0 - 600 V
Tolerance	+15%
Frequency range	10 Hz - 1 kHz
System leakage capacity C_e	≤ 1 µF
Withstand voltage test	AC 1.9 kV/1 min.

Measuring circuit

Measurement method	Bender DCP technology
Measuring voltage U_m	±40 V
Measuring current I_m at $R_F = 0$	±33 µA
Impedance Z_i at 50 Hz (HV1)	≥ 1.2 MΩ (≥ 2.4 MΩ each line, high resistance in off state)
Internal resistance R_i (HV1)	≥ 1.2 MΩ (≥ 2.4 MΩ each line, high resistance in off state)
Impedance Z_i at 50 Hz (HV2)	≥ 10.5 MΩ (≥ 21 MΩ each line)
Internal resistance R_i (HV2)	≥ 10.5 MΩ (≥ 21 MΩ each line)

Measuring ranges

Insulation resistance range	0 Ω - 50 MΩ
Insulation resistance duration/Pulse (normal operation)	~ 1.6 s (≤ 1 µF / 0 MΩ)
	~ 6 s (≤ 1 µF / 10 MΩ)
Relative error (DCP)	100 kΩ - 5 MΩ, ±15 %
Absolute error (DCP	0 Ω - 100 kΩ, ±15 kΩ
High-voltage range	0 - 600V
High-voltage tolerance	0 - 100 V, ±5 V
	100 - 600 V, ±5 %

Response values

Response Alarm 1 (Error)	30 kΩ - 1 MΩ (default 100 kΩ)
Response Alarm 2 (Warning	40 kΩ - 2 MΩ (default 200 kΩ)
Response uncertainty (according to IEC 61557-8)	±15 %
Hysteresis	25 %
Factor averaging F_{ave}	1 - 10 (default:10)
Response time tan (DCP)	
(Changeover R_F: 10 MΩ – R_{an}/2; at C_e = 1 µF; U_n = 600 V DC)	t_{an} ≤ 20 s (at F_{ave} = 10*)
	during self test t_{an} +10 s
Measurement time after power on (and after HV relays are closed)	≤ 3 s (<1 µF/150 kΩ)
Switch-off time tab (DCP)	
(changeover R_F:R_{an}/2 - 10 MΩ; at C_e = 1 µF; U_n = DC 600 V)	t_{ab} ≤ 40 s (at F_{ave} = 10)
	during self test t_{ab} +10 s

Interface

Protocol	HS-CAN
Data rate	250 kbaud
Terminating resistor	124 Ω internally

Environment/EMC

EMC	IEC 61326-2-4
Overvoltage category	II
Pollution degree	2
Maximum altitude	16000 ft (5000 m)

Connectors (Tyco)

Receptor enclosure type	1719183-1, 1719183-2, 1719183-3 (black, white, blue)
Receptor drawing number	C-1719183
Contact type (tin plated)	5-963715-1
Contact wire range	0.50 - 0.75 mm²
Contact drawing number	929454
Crimp hand tool	539635-1

Other

Operating mode	Continuous operation
Degree of protection	IP5K0
Documentation number	D00154

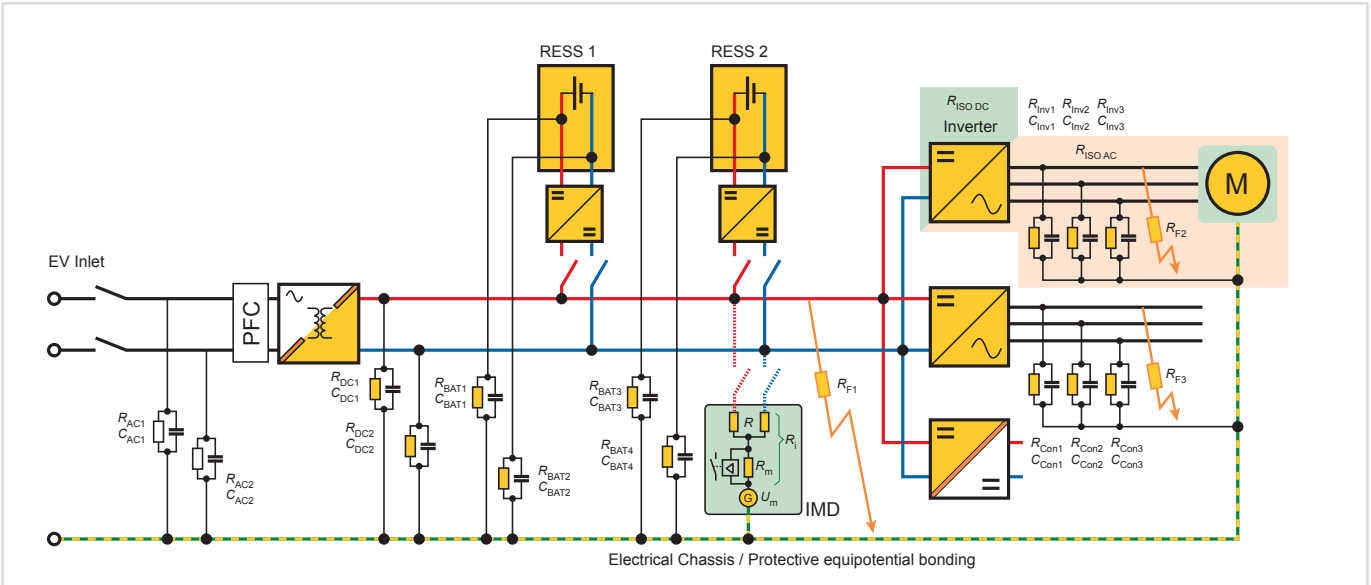
Mounting

Recommended screws for mounting: 4 x M5 (not included).

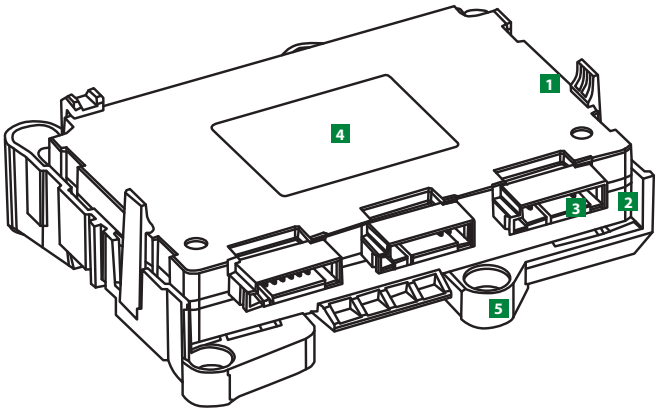
Max. tightening torque of 1.66 ±0.18 lb-ft (2.25 ±0.25 N-m) for screws.

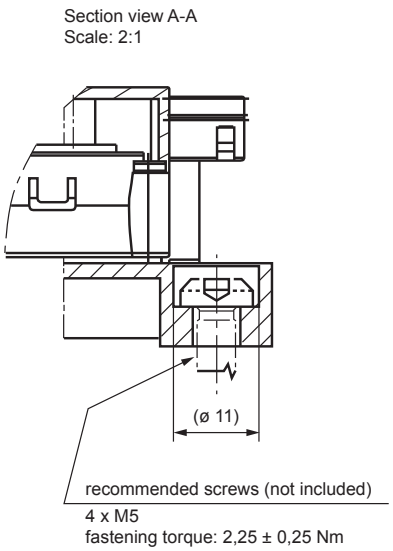
* F_{ave} = 10 is recommended for electric vehicles

Typical application



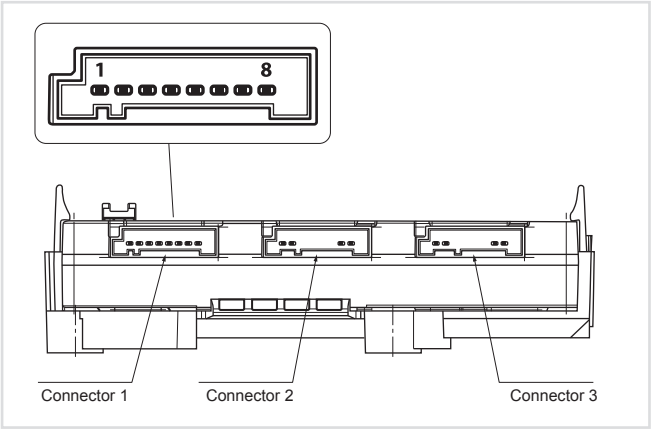
Wiring diagram





1	**Enclosure**	PBT GF30 black, UL Standard: UL94 V0	4	**Label**	White Polyester foil
2	**Cover**	PBT GF30 black, UL Standard: UL94 V0	5	**Bracket**	PBT GF30 black, UL Standard: UL94 V0
3	**Connector pin**	Cu-alloy, tin plated			

Connectivity



Connector [1]	Type	Code	Colour
1	1719183-1	A	Black
2	1719183-2	B	White
3	1719183-3	C	Blue

[1] Please refer to "Technical Data" for detailed connector information.

IR155 03/04 Series

Ground fault detection modules for electric vehicles (EV)

Typical applications

- Ground fault detection in electric vehicles

Features

- Designed specifically for electric vehicles
- Suitable for 12 V and 24 V systems
- Automatic device self test
- Continuous measurement of insulation resistance up to 10 MΩ
- Response time < 2 s after power on for first estimated insulation resistance (SST)
- Response time < 10 s for measured insulation resistance thereafter (DCP)
- Automatic adaptation to the existing systemleakage capacitance (≤1 µF)
- Detection of both ground faults and lost ground connection
- Capability of low voltage detection for voltages below 500 V, configured at factory
- Models with Molex connectors or special automotive rated connector
- Short-circuit proof outputs for:
  – Fault detection (high-side / low-side output, dependent on model)
  – Measured value (PWM 5 - 95 %) and status (f = 10 - 50 Hz) at high or low-side driver (M_{HS}/M_{LS} output)
- Protective coating (SL 1301ECO-FLZ)

Standards

IEC 61557-8	2007-01
IEC 61010-1	2010-06
IEC 60664-1	2004-04
ISO 6469-3	2001-11
ISO 23273-3	2006-11
ISO 16750-1	2006-08
ISO 16750-2	2010-03
ISO 16750-4	2010-04
e1 acc. 72/245/EWG/EEC	2009/19/EG/EC
DIN EN 60068-2-38	Z/AD:2010
DIN EN 60068-2-30	Db:2006
DIN EN 60068-2-14	Nb:2010
DIN EN 60068-2-64	Fh:2009
DIN EN 60068-2-27	Ea:2010

Exclusion of standards

The device went through an automotive test procedure in combination with special customer requirements.

In order to fulfill the requirements of the IEC 61557-8 standard, a visual warning device and a test facility for detecting whether the device is fulfilling its function have to be realised by the customer.

The devices provides no surge and load dump protection above 60 V. Additional central protection is necessary.

Ordering information

Parameters	Response value R_{an}	F_{ave}	Undervoltage detection	Measured value output	Connector type	Type	Ordering No.
Fixed values configured at factory, default module	100 kΩ	10	300 V	Low-side	Samtec / Molex connectors	IR155-3203	B 9106 8138V4
			0 V (inactive)	High-side	Samtec / Molex connectors	IR155-3204	B 9106 8139 V4
Fixed values configured at factory, customer specified	100 kΩ - 1 MΩ	1 - 10	0 V - 500 V	Low-side	Samtec / Molex connectors	IR155-3203	B 9106 8138CV4
				High-side	Samtec / Molex connectors	IR155-3204	B 9106 8139CV4
Fixed values configured at factory, default module	100 kΩ	10	300 V	Low-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4203	B 9106 8141
			0 V (inactive)	High-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4204	B 9106 8142
Fixed values configured at factory, customer specified	100 kΩ - 1 MΩ	1 - 10	0 V - 500 V	Low-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4203	B 9106 8141C
				High-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4204	B 9106 8142C

Accessories

Description	Ordering No.
Mounting kit	B 9106 8500
Connector kit, IR155-32xx	B 9106 8501
Connector kit, IR155-42xx	B 9106 8502

Insulation coordination acc. to IEC 60664-1

Protective separation (reinforced insulation)	
	between (L+/L-) – (Kl. 31, Kl. 15, E, KE, M_{HS}, M_{LS}, OK_{HS})
Voltage test	AC 3500 V/1 min

Supply/System being monitored

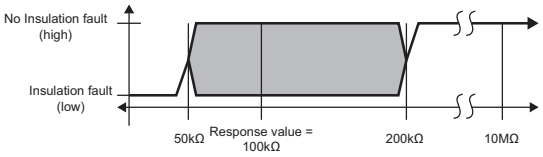
Supply voltage U_S	DC 10 - 36 V
Max. operating current I_S	150 mA
Max. current I_k	2 A
	6 A/2 ms inrush current
HV voltage range (L+/L-) U_n	AC 0 - 1000 V (peak value)
	0 - 660 V rms (10 Hz - 1 kHz)
	DC 0 - 1000 V
Power consumption	< 2 W

Response values

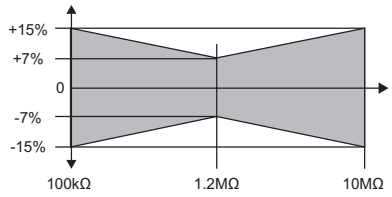
Response value hysteresis (DCP)	25 %
Response value R_{an}	100 kΩ - 1 MΩ
Undervoltage detection	0 - 500 V

Measuring range

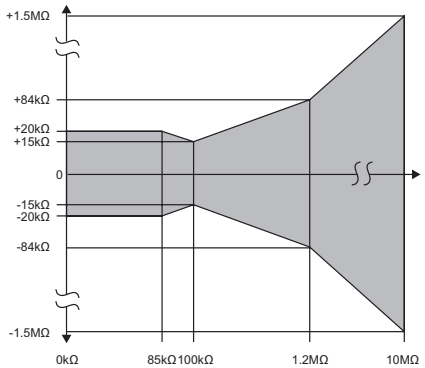
Measuring range	0 - 10 MΩ
Undervoltage detection	0 - 500 V default setting: 0 V (inactive)
Relative uncertainty	
SST (≤ 2 s)	good > 2* R_{an}; bad < 0.5* R_{an}
Relative uncertainty DCP	0 - 85 kΩ ▸ ± 20 kΩ
(default setting 100 kΩ)	100 kΩ - 10 MΩ ▸ ±15%
Relative uncertainty output M (fundamental frequency)	±5 % at each frequency
	(10 Hz; 20 Hz; 30 Hz; 40 Hz; 50 Hz)
Relative uncertainty	
undervoltage detection	U_n ≥ 100 V ▸ ±10 %; at U_n ≥300 V ▸ ±5 %
Relative uncertainty (SST)	"Good condition" ≥ 2* R_{an}
	"Bad condition" ≤ 0.5* R_{an}



Relative uncertainty DCP	100 kΩ - 10 MΩ ± 15 %
	100 kΩ - 1.2 MΩ ▸ ± 15 % to ± 7 %
	1.2 MΩ ▸ ± 7 %
	1.2 - 10 MΩ ▸ ± 7% to ± 15 %
	10 MΩ ▸ ± 15%



Absolute uncertainty	0 - 85 kΩ ▸ ±20 kΩ



Time response

Response time t_{an} (OK_{HS}; SST)	t_{an} ≤2 s (typ. < 1 s at U_n > 100 V)
Response time t_{an} (OK_{HS}; DCP)	
(when changing over from R_F = 10 MΩ to R_{an}/2; at C_e = 1 µF; U_n = DC 1000 V)	
	t_{an} ≤ 20 s (at F_{ave} = 10*)
	t_{an} ≤ 17.5 s (at F_{ave} = 9)
	t_{an} ≤ 17.5 s (at F_{ave} = 8)
	t_{an} ≤ 15 s (at F_{ave} = 7)
	t_{an} ≤ 12.5 s (at F_{ave} = 6)
	t_{an} ≤ 12.5 s (at F_{ave} = 5)
	t_{an} ≤ 10 s (at F_{ave} = 4)
	t_{an} ≤ 7.5 s (at F_{ave} = 3)
	t_{an} ≤ 7.5 s (at F_{ave} = 2)
	t_{an} ≤ 5 s (at F_{ave} = 1)
	during the self test t_{an} + 10 s
Switch-off time t_{ab} (OK_{HS}; DCP	
(when changing over from R_F = 10 MΩ to R_{an}/2; at C_e = 1 µF; U_n = DC 1000 V	
	t_{ab} ≤ 40 s (at F_{ave} = 10)
	t_{ab} ≤ 40 s (bei F_{ave} = 9)
	t_{ab} ≤ 33 s (at F_{ave} = 8)
	t_{ab} ≤ 33 s (at F_{ave} = 7)
	t_{ab} ≤ 33 s (at F_{ave} = 6)
	t_{ab} ≤ 26 s (at F_{ave} = 5)
	t_{ab} ≤ 26 s (at F_{ave} = 4)
	t_{ab} ≤ 26 s (at F_{ave} = 3)
	t_{ab} ≤ 20 s (at F_{ave} = 2)
	t_{ab} ≤ 20 s (at F_{ave} = 1)
	during a self test t_{ab} + 10 s
Duration of the self test	10 s
	(every five minutes; should be added to t_{an}/t_{ab})

Measuring circuit

System leakage capacitance C_e	≤ 1 µF
Smaller measurement range and increased measuring time at C_e	> 1 µF
	(e.g. max. range 1 MΩ @ 3 µF,
	t_{an} = 68 s when changing over from R_F 1 MΩ to R_{an}/2)
Measuring voltage U_M	± 40 V
Measuring current I_M at R_F = 0	±33 µA
Impedance Z_i at 50 Hz	≥ 1.2 MΩ
Internal DC resistance R_i	≥ 1.2 MΩ

Output

Measurement output (M)	
M_{HS} switches to U_S – 2 V (3204)	
(external pull-down resistor to Kl. 31 necessary 2.2 kΩ)	
M_{LS} switches to Kl. 31 + 2 V (3203)	
(external pull-down resistor to U_b reqired 2.2 kΩ	
	0 Hz ▸ Hi > short-circuit to
	U_b + (Kl. 15); Low > IMD off or short-circuit to Kl. 31
	10 Hz ▸ Normal condition
	Insulation measurement DCP;
	starts two seconds after power on;
	First successful insulation measurement at ≤ 17.5 s
	PWM active 5 - 95 %
	20 Hz ▸ undervoltage condition
	Insulation measurement DCP (continuous measurement);
	starts two seconds after power on;
	PWM active 5 - 95 %
	First successful insulation measurement at ≤17.5 s
	Undervoltage detection 0 - 500 V
	(Bender configurable)
	30 Hz ▸ Speed start measurement
	Insulation measurement (only good/bad evaluation)
	starts directly after power on ≤ 2 s;
	PWM 5 - 10 % (good) and 90 - 95 % (bad)
	40 Hz ▸ Device error
	Device error detected; PWM 47.5 - 52.5 %
	50 Hz ▸ Connection fault earth
	Fault detected on the grounding connection (Kl. 31)
	PWM 47.5 - 52.5 %

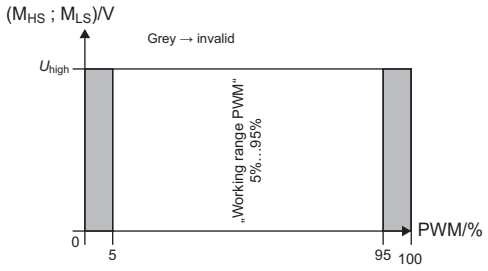
Operating principle PWM driver

- Condition "Normal" and "Undervoltage detected" (10 Hz; 20 Hz)

Duty cycle 5 % = >50 MΩ (∞)
Duty cycle 50 % = 1200 kΩ
Duty cycle 95 % = 0 kΩ

$$R_F = \frac{90\ \% \times 1200\ k\Omega}{dc_{meas} - 5\%} - 1200\ k\Omega$$

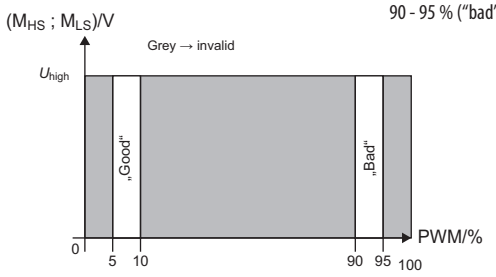
dc_{meas} = measured duty cycle (5 % - 95 %)



Operating principle PWM driver

- Condition "SST" (30 Hz)

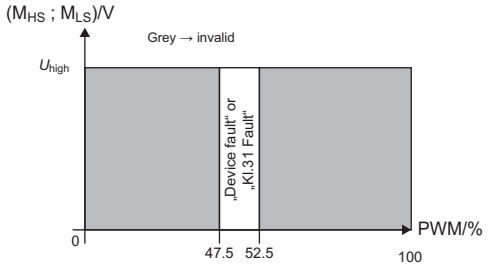
Duty cycle ▸ 5 - 10 % ("good")
90 - 95 % ("bad")



Operating principle PWM driver

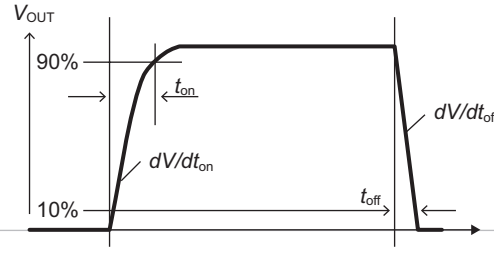
- Condition "Device error" and "Kl.31 fault" (40 Hz; 50 Hz;)

Duty cycle ▸ 47.5 - 52.5 %



Load current I_L	80 mA
Turn-on time ▸ to 90 % V_{out}	max. 125 µs
Turn-on time ▸ to 10 % V_{out}	max. 175 µs
Slew rate on ▸ 10 - 30 % V_{out}	max. 6 V/µs
Slew rate off ▸ 70 - 40% V_{out}	max. 8 V/µs

Timing 3204 (inverse to 3203)



Status output (OK_{HS})

OK_{HS} switches to U_S – 2 V
(external pull-down resistor to Kl. 31 required 2.2 kΩ)

High ▸ No fault; R_F > response value
Low ▸ Insulation resistance ≤ response value detected;
Device error; Fault in the grounding connection
Undervoltage detected or device switched off

EMC

Load dump protection	< 60 V
Measurement method	Bender-DCP technology
Factor averaging	
F_{ave} (output M)	1 - 10 (factory set: 10)

ESD protection

Contact discharge – directly to terminals	≤ 10 kV
Contact discharge – indirectly to environment	≤ 25 kV
Air discharge – handling of the PCB	≤ 6 kV

Connection

Connectors	TYCO-MICRO MATE-N-LOK 1 x 2-1445088-8 (Kl. 31, Kl.15, E, KE, M_{HS}, M_{LS}, OK_{HS}

2 x 2-1445088-2 (L+, L-); The connection between the respective connecting pins at L+ resp. L- may only be used as redundancy. Cannot be used for looping through!

Crimp contacts	TYCO-MICRO MATE-N-LOK Gold 14 x 1-794606-1 Conductor cross section: AWG 20 - 24

General data

Necessary crimp tongs (TYCO)	91501-1
Operating mode/mounting	continuous operation/any position
Temperature range	-40 - +105°C
Voltage failure	≤ 2 ms
Flammability class acc. to	UL94 V-0

Mounting

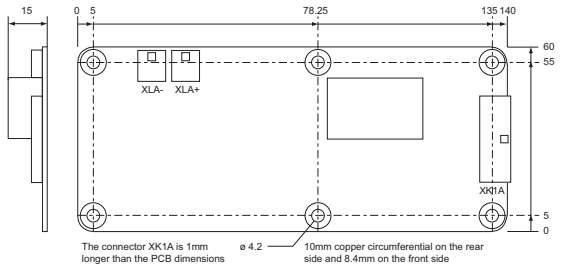
M4 metal screws with locking washers between screw head and PCB. Torx, T20 with a maximum tightening torque of 4 Nm for the screws. Furthermore maximum 10 Nm pressure to the PCB at the mounting points.

Mounting and connector kits are not included in delivery, but are available as accessories. The maximum diameter of the mounting points is10 mm.

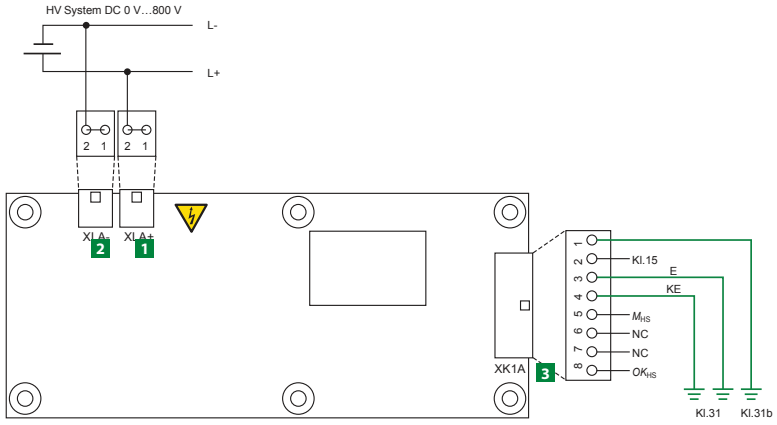
Before mounting the device, ensure sufficient insulation between the device and the vehicle resp. the mounting points (min. 11,4 mm to other parts). If the device is mounted on a metal or conductive subsurface, this subsurface has to get ground potential (Kl.31; vehicle mass).

Deflection	max. 1% of the length resp. width of the PCB
Coating	thick-film-lacquer
Weight	52 g ±2 g

Dimensions in mm



Wiring diagrams



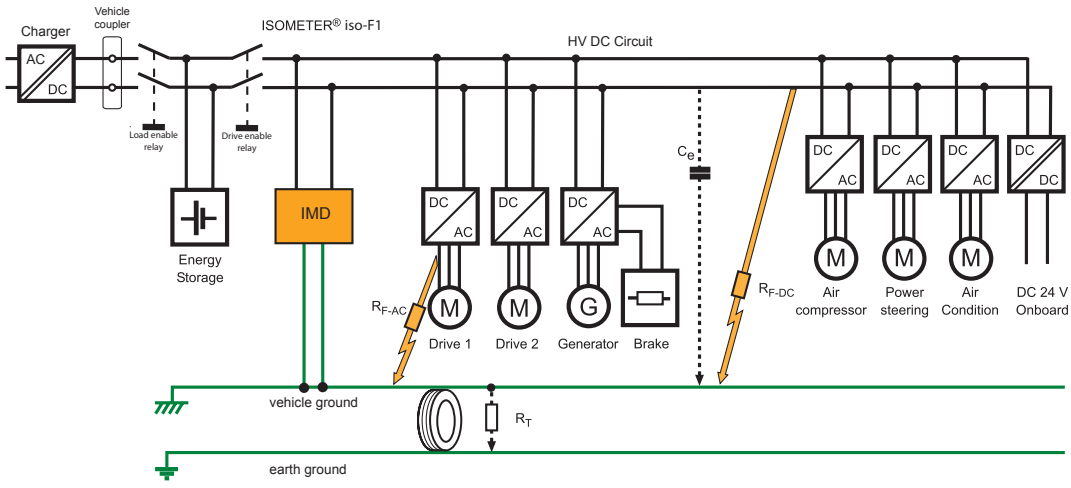
1 **Connectors XLA+**
Pin 1+2 L+ mains voltage

2 **Connectors XLA-**
Pin 1+2 L- mains voltage

3 **Connectors XK1A**

Pin 1	Kl. 31	Ground connection
Pin 2	Kl. 15	Supply voltage
Pin 3	Kl. 31	Ground connection
Pin 4	Kl 31	Ground connection (separate line)
Pin 5	M_{HS}	Measured value output, PWM (High-Side)
Pin 6	M_{LS}	Measured value output, PWM (Low-Side)
Pin 7	n.c.	
Pin 8	OK_{HS}	Status output (High-Side)

Application example



IR155 10 Series

Ground fault detection modules for level 3 electric vehicle charging systems (EVSE)

Applications

- Ground fault detection in level 3 electric vehicle chargers
- UL 2231 recognized component for EV chargers

Approvals

Features

- UL2231 recognized ground fault detection component for level 3 electric vehicle chargers (EVSE)
- Suitable for 12 V and 24 V systems
- Automatic device self test
- Continuous measurement of insulation resistance up to 10 MΩ
- Response time < 2 s after power on for first estimated insulation resistance (SST)
- Response time < 10 s for measured insulation resistance thereafter (DCP)
- Automatic adaptation to the existing systemleakage capacitance (≤1 µF)
- Detection of both ground faults and lost ground connection
- Capability of low voltage detection for voltages below 500 V, configured at factory
- Models with Molex connectors or special automotive rated connector
- Short-circuit proof outputs for:
  – Fault detection (high side output)
  – Measured value (PWM 5 - 95 %) and status (f = 10 - 50 Hz) at high side driver (M_{HS}/M_{LS} output)
- Protective coating (SL 1301ECO-FLZ)

Standards

IEC 61557-8	2007-01
IEC 61010-1	2010-06
IEC 60664-1	2004-04
ISO 6469-3	2001-11
ISO 23273-3	2006-11
ISO 16750-1	2006-08
ISO 16750-2	2010-03
ISO 16750-4	2010-04
e1 acc. 72/245/EWG/EEC	2009/19/EG/EC
DIN EN 60068-2-38	Z/AD:2010
DIN EN 60068-2-30	Db:2006
DIN EN 60068-2-14	Nb:2010
DIN EN 60068-2-64	Fh:2009
DIN EN 60068-2-27	Ea:2010
UL2231-1	2002
UL2231-2	2002

Exclusion of standards

The device went through an automotive test procedure in combination with special customer requirements.

In order to fulfill the requirements of the IEC 61557-8 standard, a visual warning device and a test facility for detecting whether the device is fulfilling its function have to be realised by the customer.

The devices provides no surge and load dump protection above 60 V. Additional central protection is necessary.

Ordering information

Parameters	Response value R_{an}	F_{ave}	Undervoltage detection	Measured value output	Connector type	Type	Ordering No.
Fixed values configured at factory, default module	100 kΩ	10	0 V (inactive)	High-side	Samtec / Molex connectors	IR155-3210	B 9106 8140 V4
Fixed values configured at factory, customer specified	100 - 200 KΩ	1 - 10	0 V - 500 V	High-side	Samtec / Molex connectors	IR155-3210	B 9106 8140C V4
Fixed values configured at factory, default module	100 kΩ	10	0 V (inactive)	High-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4210	B 9106 8143
Fixed values configured at factory, customer specified	100 - 200 KΩ	1 - 10	0 V - 500 V	High-side	Tyco MICRO MATE-N-LOCK automotive rated connector	IR155-4210	B 9106 8142C

Accessories

Description	Ordering No.
Mounting kit	B 9106 8500
Connector kit, IR155-32xx	B 9106 8501
Connector kit, IR155-42xx	B 9106 8502

Insulation coordination acc. to IEC 60664-1

Protective separation (reinforced insulation)	
	between (L+/L-) – (Kl. 31, Kl. 15, E, KE, M_{HS}, M_{LS}, OK_{HS})
Voltage test	AC 3500 V/1 min

Supply/System being monitored

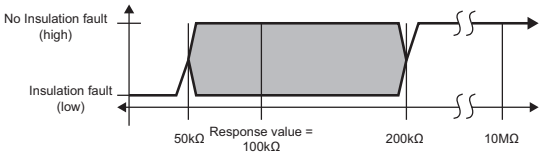
Supply voltage U_S	DC 10 - 36 V
Max. operating current I_S	150 mA
Max. current I_k	2 A
	6 A/2 ms inrush current
HV voltage range (L+/L-) U_n	AC 0 - 1000 V (peak value)
	0 - 660 V rms (10 Hz - 1 kHz)
	DC 0 - 1000 V
Power consumption	< 2 W

Response values

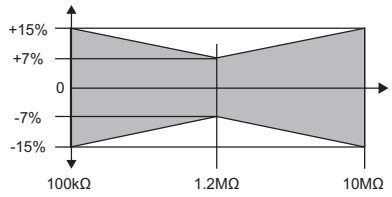
Response value hysteresis (DCP)	25 %
Response value R_{an}	100 kΩ - 1 MΩ
Undervoltage detection	0 - 500 V

Measuring range

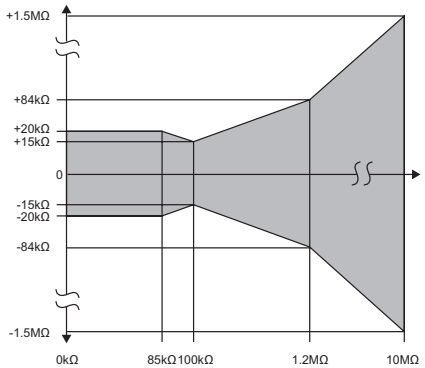
Measuring range	0 - 10 MΩ
Undervoltage detection	0 - 500 V default setting: 0 V (inactive)
Relative uncertainty	
SST (≤ 2 s)	good > 2* R_{an}; bad < 0.5* R_{an}
Relative uncertainty DCP	0 - 85 kΩ ▸ ± 20 kΩ
(default setting 100 kΩ)	100 kΩ - 10 MΩ ▸ ±15%
Relative uncertainty output M (fundamental frequency)	±5 % at each frequency
	(10 Hz; 20 Hz; 30 Hz; 40 Hz; 50 Hz)
Relative uncertainty	
undervoltage detection	U_n ≥ 100 V ▸ ±10 %; at U_n ≥300 V ▸ ±5 %
Relative uncertainty (SST)	"Good condition" ≥ 2* R_{an}
	"Bad condition" ≤ 0.5* R_{an}



Relative uncertainty DCP	100 kΩ - 10 MΩ ± 15 %
	100 kΩ - 1.2 MΩ ▸ ± 15 % to ± 7 %
	1.2 MΩ ▸ ± 7 %
	1.2 - 10 MΩ ▸ ± 7% to ± 15 %
	10 MΩ ▸ ± 15%



Absolute uncertainty	0 - 85 kΩ ▸ ±20 kΩ



Time response

Response time t_{an} (OK_{HS}; SST)	t_{an} ≤2 s (typ. < 1 s at U_n > 100 V)
Response time t_{an} (OK_{HS}; DCP)	
(when changing over from R_F = 10 MΩ to R_{an}/2; at C_e = 1 µF; U_n = DC 1000 V)	
	t_{an} ≤ 20 s (at F_{ave} = 10*)
	t_{an} ≤ 17.5 s (at F_{ave} = 9)
	t_{an} ≤ 17.5 s (at F_{ave} = 8)
	t_{an} ≤ 15 s (at F_{ave} = 7)
	t_{an} ≤ 12.5 s (at F_{ave} = 6)
	t_{an} ≤ 12.5 s (at F_{ave} = 5)
	t_{an} ≤ 10 s (at F_{ave} = 4)
	t_{an} ≤ 7.5 s (at F_{ave} = 3)
	t_{an} ≤ 7.5 s (at F_{ave} = 2)
	t_{an} ≤ 5 s (at F_{ave} = 1)
	during the self test t_{an} + 10 s
Switch-off time t_{ab} (OK_{HS}; DCP	
(when changing over from R_F = 10 MΩ to R_{an}/2; at C_e = 1 µF; U_n = DC 1000 V	
	t_{ab} ≤ 40 s (at F_{ave} = 10)
	t_{ab} ≤ 40 s (bei F_{ave} = 9)
	t_{ab} ≤ 33 s (at F_{ave} = 8)
	t_{ab} ≤ 33 s (at F_{ave} = 7)
	t_{ab} ≤ 33 s (at F_{ave} = 6)
	t_{ab} ≤ 26 s (at F_{ave} = 5)
	t_{ab} ≤ 26 s (at F_{ave} = 4)
	t_{ab} ≤ 26 s (at F_{ave} = 3)
	t_{ab} ≤ 20 s (at F_{ave} = 2)
	t_{ab} ≤ 20 s (at F_{ave} = 1)
	during a self test t_{ab} + 10 s
Duration of the self test	10 s
	(every five minutes; should be added to t_{an}/t_{ab})

Measuring circuit

System leakage capacitance C_e	≤ 1 µF
Smaller measurement range and increased measuring time at C_e	> 1 µF
	(e.g. max. range 1 MΩ @ 3 µF,
	t_{an} = 68 s when changing over from R_F 1 MΩ to R_{an}/2)
Measuring voltage U_M	± 40 V
Measuring current I_M at R_F = 0	±33 µA
Impedance Z_i at 50 Hz	≥ 1.2 MΩ
Internal DC resistance R_i	≥ 1.2 MΩ

Output

Measurement output (M)	
M_{HS} switches to U_S – 2 V (3204)	
(external pull-down resistor to Kl. 31 necessary 2.2 kΩ)	
M_{LS} switches to Kl. 31 + 2 V (3203)	
(external pull-down resistor to U_b reqired 2.2 kΩ	
	0 Hz ▸ Hi > short-circuit to
	U_b + (Kl. 15); Low > IMD off or short-circuit to Kl. 31
	10 Hz ▸ Normal condition
	Insulation measurement DCP;
	starts two seconds after power on;
	First successful insulation measurement at ≤ 17.5 s
	PWM active 5 - 95 %
	20 Hz ▸ undervoltage condition
	Insulation measurement DCP (continuous measurement);
	starts two seconds after power on;
	PWM active 5 - 95 %
	First successful insulation measurement at ≤17.5 s
	Undervoltage detection 0 - 500 V
	(Bender configurable)
	30 Hz ▸ Speed start measurement
	Insulation measurement (only good/bad evaluation)
	starts directly after power on ≤ 2 s;
	PWM 5 - 10 % (good) and 90 - 95 % (bad)
	40 Hz ▸ Device error
	Device error detected; PWM 47.5 - 52.5 %
	50 Hz ▸ Connection fault earth
	Fault detected on the grounding connection (Kl. 31)
	PWM 47.5 - 52.5 %

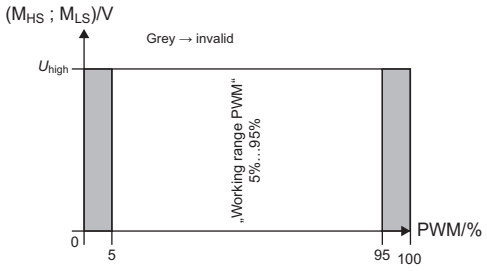
Operating principle PWM driver

- Condition "Normal" and "Undervoltage detected" (10 Hz; 20 Hz)

Duty cycle 5 % = >50 MΩ (∞)
Duty cycle 50 % = 1200 kΩ
Duty cycle 95 % = 0 kΩ

$$R_F = \frac{90\ \% \times 1200\ k\Omega}{dc_{meas} - 5\%} - 1200\ k\Omega$$

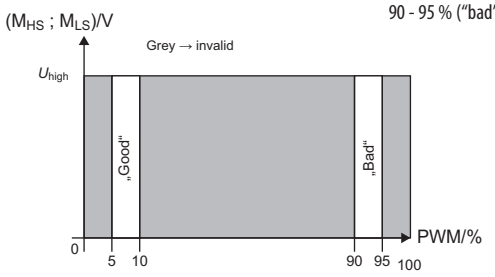
dc_{meas} = measured duty cycle (5 % - 95 %)



Operating principle PWM driver

- Condition "SST" (30 Hz)

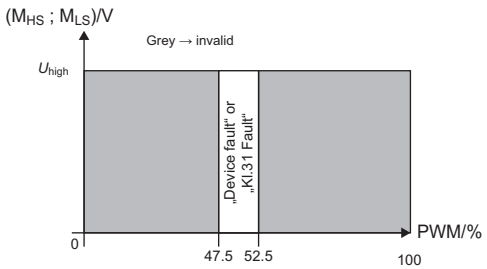
Duty cycle ▸ 5 - 10 % ("good")
90 - 95 % ("bad")



Operating principle PWM driver

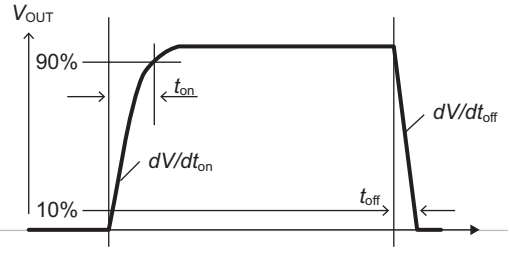
- Condition "Device error" and "Kl.31 fault" (40 Hz; 50 Hz;)

Duty cycle ▸ 47.5 - 52.5 %



Load current I_L	80 mA
Turn-on time ▸ to 90 % V_{out}	max. 125 µs
Turn-on time ▸ to 10 % V_{out}	max. 175 µs
Slew rate on ▸ 10 - 30 % V_{out}	max. 6 V/µs
Slew rate off ▸ 70 - 40% V_{out}	max. 8 V/µs

Timing 3204 (inverse to 3203)



Status output (OK_{HS})

OK_{HS} switches to U_S – 2 V
(external pull-down resistor to Kl. 31 required 2.2 kΩ)

High ▸ No fault; R_F > response value
Low ▸ Insulation resistance ≤ response value detected;
Device error; Fault in the grounding connection
Undervoltage detected or device switched off

EMC

Load dump protection	< 60 V
Measurement method	Bender-DCP technology
Factor averaging	
F_{ave} (output M)	1 - 10 (factory set: 10)

ESD protection

Contact discharge – directly to terminals	≤ 10 kV
Contact discharge – indirectly to environment	≤ 25 kV
Air discharge – handling of the PCB	≤ 6 kV

Connection

Connectors	TYCO-MICRO MATE-N-LOK 1 x 2-1445088-8 (Kl. 31, Kl.15, E, KE, M_{HS}, M_{LS}, OK_{HS}

2 x 2-1445088-2 (L+, L-); The connection between the respective connecting pins at L+ resp. L- may only be used as redundancy. Cannot be used for looping through!

Crimp contacts	TYCO-MICRO MATE-N-LOK Gold 14 x 1-794606-1 Conductor cross section: AWG 20 - 24

General data

Necessary crimp tongs (TYCO)	91501-1
Operating mode/mounting	continuous operation/any position
Temperature range	-40 - +105°C
Voltage failure	≤ 2 ms
Flammability class acc. to	UL94 V-0

Mounting

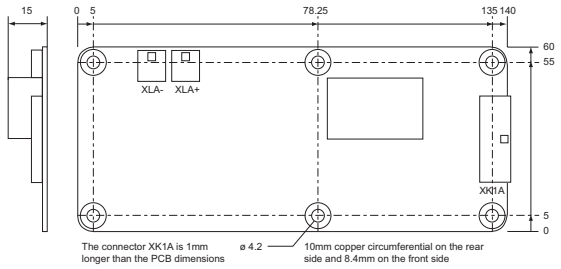
M4 metal screws with locking washers between screw head and PCB. Torx, T20 with a maximum tightening torque of 4 Nm for the screws. Furthermore maximum 10 Nm pressure to the PCB at the mounting points.

Mounting and connector kits are not included in delivery, but are available as accessories. The maximum diameter of the mounting points is10 mm.

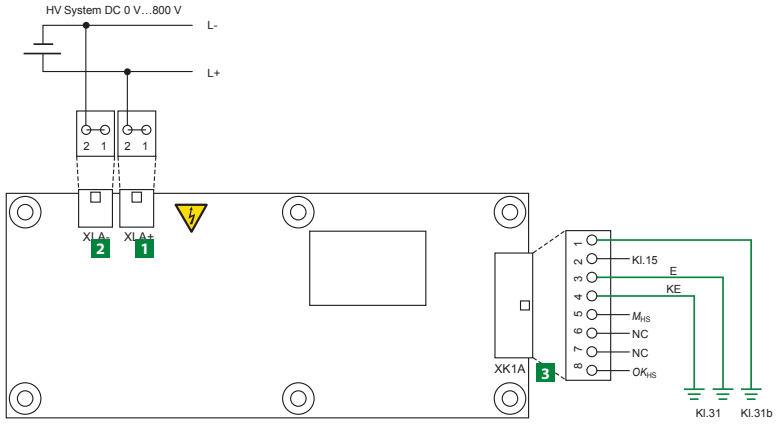
Before mounting the device, ensure sufficient insulation between the device and the vehicle resp. the mounting points (min. 11,4 mm to other parts). If the device is mounted on a metal or conductive subsurface, this subsurface has to get ground potential (Kl.31; vehicle mass).

Deflection	max. 1% of the length resp. width of the PCB
Coating	thick-film-lacquer
Weight	52 g ±2 g

Dimensions in mm



Wiring diagrams



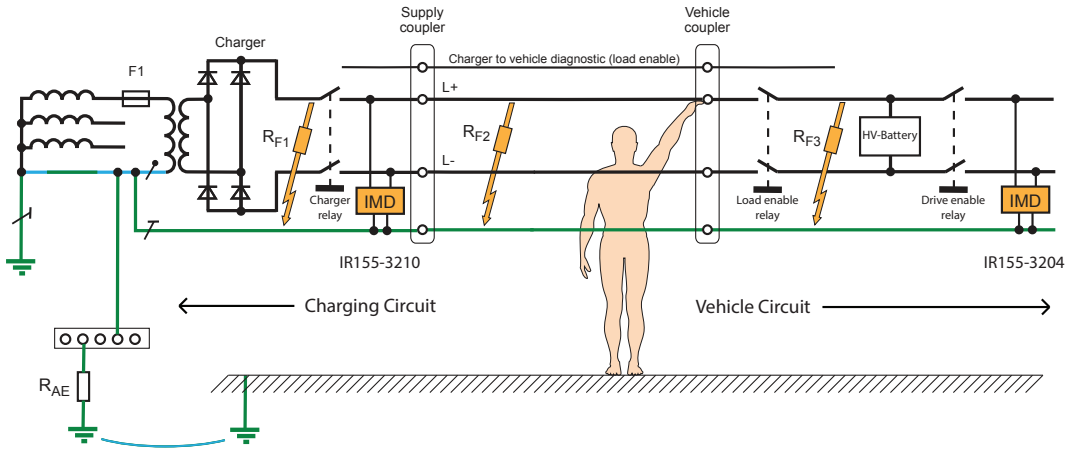
1 **Connectors XLA+**
Pin 1+2 L+ mains voltage

2 **Connectors XLA-**
Pin 1+2 L- mains voltage

3 **Connectors XK1A**

Pin 1	Kl. 31	Ground connection
Pin 2	Kl. 15	Supply voltage
Pin 3	Kl. 31	Ground connection
Pin 4	Kl 31	Ground connection (separate line)
Pin 5	M_{HS}	Measured value output, PWM (High-Side)
Pin 6	M_{LS}	Measured value output, PWM (Low-Side)
Pin 7	n.c.	
Pin 8	OK_{HS}	Status output (High-Side)

Application example



isoRW425 Series

Ground fault detector for ungrounded AC/DC systems in rail and transit applications

Applications

- Ungrounded AC and DC circuits in rail and transit
- Signaling systems

Features

- Ground fault detection for AC/DC systems up to 400 V designed specifically for rail and transit
- Overvoltage and undervoltage detection available
- Measurement of system voltage to ground (L+/GND and L-/GND)
- Measurement of system leakage capacitance
- RS-485 interface
- Distinguish between positive and negative faults to ground with the display and output alarm relays
- Automatic adaptation to the system leakage capacitance up to 300 µF
- Supply voltage range DC 24 - 240 V/AC 100 - 240 V
- Self monitoring with automatic alarm message
- Connection monitoring of system and ground connections
- LEDs: Power On, Alarm 1, Alarm 2
- Internal and external test/reset button
- Two single pole relay alarm outputs
- Normally energized or de-energized operation, selectable
- Latching or non-latching operation, selectable
- Multi-function LCD display
- Adjustable response delay
- Available separately adjustable response values for R_e (resistance) and Z_e (impedance)

Ordering information

Nominal system voltage U_n	Supply voltage [1] U_S		Type	Ordering No.
DC/AC	DC	AC		
0 - 400 V (DC, 10 - 460 Hz)	24 - 240 V	100 - 240 V (47 - 63 Hz)	isoRW425-D4W-4	B 9103 7001W

[1] Absolute values
Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

Technical data

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

Rated insulation voltage	400 V
Rated impulse voltage/pollution degree	4.0 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (L1, L2, E, KE, T/R, A, B) - (11, 14, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	DC 24 - 240 V, AC 100 - 240 V
Tolerance of U_S	-30 - +15 %
Frequency range	47 - 63 Hz
Power consumption	≤ 3 W, ≤ 10 VA

Monitored system

Nominal system voltage U_n	AC/DC 0 - 400 V
Tolerance of U_n	+ 25 %
Nominal frequency f_n	DC, 10 - 460 Hz

Response values

Undervoltage detection	30 - 499 V (off)*
Overvoltage detection	31 - 500 V (off)*
Hysteresis	5 %
Response value Ran1 (Alarm 1)	1 - 990 kΩ (10 kΩ)*
Response value R_{an2} (Alarm 2)	1 - 990 kΩ (5 kΩ)*
Response value Z_{an}	1 - 990 kΩ (off)*
Relative uncertainty	± 15 %
Hysteresis	25%

Time response

Response time t_{an} at R_F = 0.5 x R_{an} and C_e = 1 µF	≤ 5 s
Start-up delay (start time) t	0 - 10 s (0 s)*
Response delay t_{on}	0 - 99 s (0 s)*
Delay on release t_{off}	0 - 99 s (0 s)*

Measuring circuit

Measuring voltage U_m	12 V
Measuring current I_m (at R_F = 0 Ω)	≤ 100 µA
Internal DC resistance R_i	≥ 120 kΩ
Impedance Z_i at 50 Hz	≥ 120 kΩ
Permissible system leakage capacitance	≤ 300 µF

Displays, memory

Display range, measured value	0.5 kΩ - 1 MΩ
Operating uncertainty 0.5 - 5 kΩ/5 kΩ - 1 MΩ	± 0.3 kΩ/± 15 %
Display range, measured value nominal system voltage	10 - 500 VRMS
Operating uncertainty	± 3 V/± 15 %
Display range, measured value system leakage capacitance	1 nF - 300 µF
Relative uncertainty	±1 nF/± 30 %
Password	off / 0 - 999 (off)*
Fault memory, alarm relay	on/off*

Outputs

Cable length test and reset button	≤ 10 m

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kbit/s
Cable length	0 - 1200 m
Shielded cable (shield connected to PE on one side)	recommended: J-Y(St)Y min. 2x0.6
Terminating resistor	120 Ω (0.25 W), can be enabled in the device
Device address, BMS bus	3 - 90 (3)*

Switching elements

Switching elements					2 x 1 N/O contact
Operating principle					N/C operation/N/O operation (N/C operation)*
Electrical endurance, number of cycles					10000
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	220 V	110 V	24 V
Rated operational current	5 A	3 A	0.1 A	0.2 A	1 A
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	EN 50121-3-2/IEC 61326-2-4
Operating temperature	-40 - +70 °C
Classification of mechanical conditions IEC 60721/EN 50125-1	
Stationary use (IEC 60721-3-3)	3K7
Transport (IEC 60721-3-2)	2K4
Long-time storage (IEC 60721-3-1)	1K6
Classification of mechanical conditions IEC 60721/EN 61373	
Stationary use (IEC 60721-3-3)	3M7
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

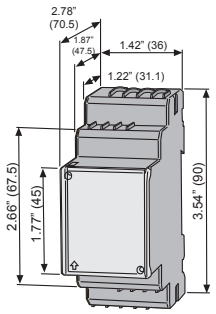
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

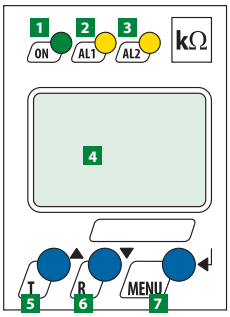
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (IEC 60529)	IP 30
Degree of protection, terminals (IEC 60529)	IP 20
Enclosure material	polycarbonate
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Operating manual	TBP103010
Weight	≤ 150 g

( )* = factory setting

Dimensions in inches (mm)



Displays and controls



1 LED "Power ON," lights during normal operation. Flashes during connection error (L1/L2 or E/KE).

2 Alarm LED "AL1," lights when Alarm 1 is reached. Flashes during connection error (L1/L2 or E/KE) and overvoltage (when activated).

3 Alarm LED "AL1," lights when Alarm 2 is reached. Flashes during connection error (L1/L2 or E/KE) and undervoltage (when activated).

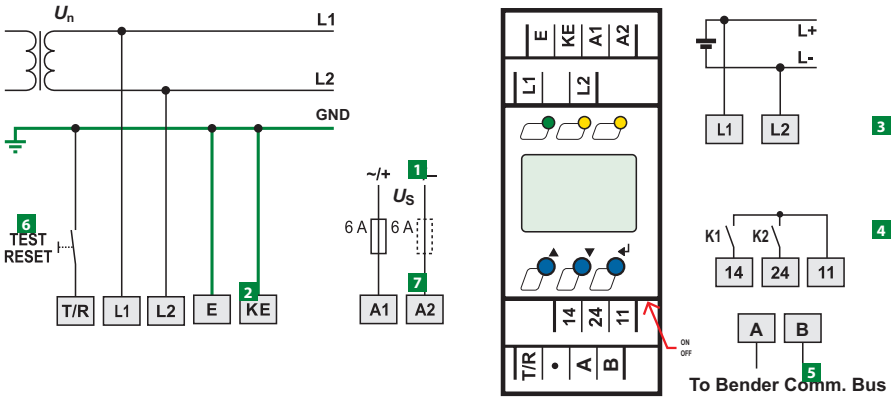
4 LCD display

5 Test button "T": Initiates internal device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 Menu button "MENU": Open's the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 Supply voltage U_S (see ordering information) via fuse

2 Separate connection of E, KE to ground

3 System connections:
AC: Connect terminals L1, L2 to conductor L1, L2.
DC: Connect terminal L1 to L+ and L2 to L-.

4 Alarm relay K1, K2 with single poles and common

5 Serial interface RS-485 (termination with a 120 Ω resistor, can be enabled on the device) Bender protocol

6 Combined test and reset button "T/R"
momuntary push (< 1.5 s) = RESET
hold (> 1.5 s) = TEST

7 Recommended line protection via fusing

FP200

Panel-mounted HMI for compatible iso685 ground fault detectors

Features

- Separate, panel-mounted controls for iso685-S models
- Duplicates all standard iso685 front panel functions
- Connection to iso685-S using low-voltage RJ45 cable
- Maintain low voltage at cabinet / panel front
- Multiple mounting options
- Backlit display and buttons

Applications

- External panel mounting of controls and displays for iso685
- Maintain low voltage at cabinet door

Ordering information

Supply voltage/frequency range U_S	Power consumption	Type	Ordering No.
DC			
24 V (-20 to +25 % tolernace)	3 W (typical)	FP200	B 9106 7904
		FP200W[1)]	B 9106 7904W

[1)] Includes increased shock and vibration resistance

Accessories

Description	Art. No.
FP200 mechanical accessories comprising: 2 screw attachments	B91067907
Front cover 144x72 transparent (for IP65)	B98060005
Patch cable CAT5e (without UL, temperature range 0…+60 °C) Included in the scope of delivery	B91067906
FP200 adapter for front panel mounting IRDH575	B91067905
Front cover 144x96 transparent (for IP65)	B98060007

Technical data

Insulation coordination	
Rated insulation voltage (IEC 60664-1)	50 V
Rated impulse voltage (IEC 60664-1)	500 V
Overvoltage category	III
Pollution degree	3

Supply voltage	
Supply voltage U_S	via iso685-S

Display	
Graphic display	127 x 127 pixels, 1.55" x 1.55" (40 x 40 mm)

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

Interfaces	
Interface/protocol	Bender internal
Cable length	≤ 16 ft (5 m)
REMOTE cable	Patch cable min. CAT5e

Environment/EMC	
EMC	IEC 61326-2-4; EN 50121-3-2; EN 50121-4
Ambient temperatures	
Operation	-40 to +158 °F (-40 to +70 °C)
Transport	-40 to +185 °F (-40 to +85 °C)
Storage	-13 to +158 °F (-25 to +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
Long-term storage (IEC 60721-3-1)	1K4
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-term storage (IEC 60721-3-1)	1M3
Area of application	≤3000 m NN

Connection	
Connection type	plug connectors

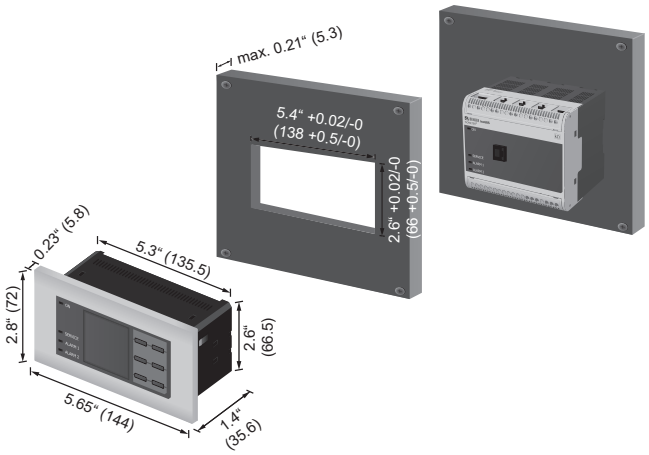
Other	
Operating mode	continuous operation
Mounting	display-oriented, cooling slots must be ventilated vertically
Degree of protection, built-in components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Degree of protection with transparent front cover	IP65
Panel cutout	5.4"W x 2.6"H (138x66 mm)
Permissible tolerance of panel cutout	+0.5/-0
Screw mounting	with mounting brackets
Torque screw mounting	0.3 Nm ±10 %
Enclosure material	polycarbonate
Flammability class	UL94V-0
Dimensions (W x H x D)	5.65"W x 2.8"H x 1.4"D (144 x 72 x 35.6 mm)
Documentation number	D00169
Weight	≤0.4 lb (180 g)

Option "W" data different from the standard version	
Classification of climatic conditions acc. to IEC 60721:	
Staionary 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

Option "W"

Models with the suffix "W" feature increased shock and vibration resistance. Due to a special varnishing, the electronic parts are better protected against mechanical loads and humidity.
When mounting the FP200W, secure screws with thread locking fluid.

Dimensions in inches (mm)



Displays and controls

1 LED "ON" Operation
2 LED indication "SERVICE, ALARM 1, ALARM 2"
3 LCD display

Connection to iso685

Isolated Power Panels for Healthcare Facilities

	Standard IP Panels	IP Panels with Receptacles and Ground Jacks	IP Panels with Circuit Control and Lockout	Dual Voltage Panels	Dual System Panels
					

Page		2-06	2-06	2-06	2-12	2-15
Isolation Transformer	Type	Single system, single voltage isolation transformer	Single system, single voltage isolation transformer	Single system, single voltage isolation transformer	Single system, two voltages isolation transformer	Two separate isolation transformers
	kVA	3, 5, 7.5, 10, 15, 25	3, 5, 7.5, 10	15, 25	25 total (15 for high side, 10 for low side)	3, 5, 7.5, 10 for each system
	Primary voltage	120, 208, 240, 277, 480, 110, 220, 230, 380 V	120, 208, 240, 277, 480, 110, 220, 230, 380 V	120, 208, 240, 277, 480, 110, 220, 230, 380 V	High side: 208, 240, 277, 480, 22, 380 V (low side 120 V)	120, 208, 240, 277, 480, 110, 220, 230, 380 V
	Secondary voltage	120, 208, 240, 110,220, 230 V	120, 208, 240, 110,220, 230 V	120, 208, 240, 110,220, 230 V	208, 240 V	120, 208, 240, 110,220, 230 V
Branch breakers		Qty. 8, field expandable to 16	Qty. 8, field expandable to 16	Qty. 8, field expandable to 16	High side: Qty. 8 Low side: Up to qty. two	Qty. 8, field expandable to 16 for each system
Integrated receptacles / ground jacks			■			
Integrated circuit control / lockout				■		
Supports load monitoring		■	■	■	■	■
Supports integrated fault location		■				■

	Type	P.	Applicable Accessories				
Load CTs	STW3	7-20	■	■	■	■	■
	STW4	7-20	■	■	■	■	■
Remote indicators	MK2000(C)(P)	6-08	■	■	■	■	■
	MK2000CBM	6-08	■	■	■	■	■
	MK2430	6-19	■	■	■	■	■
	MK800	6-14	■	■	■	■	■
Comm. Gateway	COM465IP	6-24	■	■	■	■	■
	COM462RTU	6-30	■	■	■	■	■
Grounding Accessories	HGC Series	2-30		■			
	HGJ Series	2-30		■			

Line Isolation Monitor

LIM2010

Page	2-19
Function	Line isolation monitor
Rated system voltage	100 - 240 VAC
Total hazard current response	2 mA / 5 mA
Load monitoring	■
Transformer overtemperature	■
Overvoltage / undervoltage	■
Insulation resistance / impedance	■
Supports fault location system	■
Supports BENDER communication	■

	Type	P.	Applicable Accessories
Load CTs	STW3	7-20	■
	STW4	7-20	■
Remote indicators	MK2000(C)(P)	6-08	■
	MK2000CBM	6-08	■
	MK2430	6-19	■
	MK800	6-14	■
Comm. Gateway	COM465IP	6-24	■
	COM462RTU	6-30	■
Fault Location	EDS441-L	3-04	■
	EDS151	3-12	■

Isolation Transformers

XM Series

Page	2-24
Available types	Single and dual voltage
Available kVA	3, 5, 7.5, 10, 15, 25 kVA (varies by type)
Maximum leakage current	In compliance with UL 1047 and CSA Z32.2

LIM Testing Equipment

LT3000

Page	2-38
Supported system voltage	Up to 240 VAC

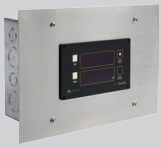
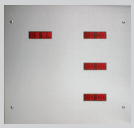
Hospital Grade Ground / Power Modules and Accessories

	 GPM Series	 XRM Series

Page		2-27	2-31
Function		Hospital grade receptacles and ground jacks	Receptacle module for laser and x-ray equipment
Mounting Type	Gang plate	■	
	Wall plate, flush mounted	■	■
	Wall plate, surface mounted	■	■
Qty. available receptacles and/or ground jacks		Up to 8 (any combination)	Single receptacle
Available receptacle types		Single, red Single, ivory Duplex, red Duplex, ivory Twist-to-lock, black	Hubbell IN16494 NEMA 615R NEMA 620R NEMA 630R NEMA 650R NEMA L615R NEMA L620R NEMA L630R
Supports remote indicator			■
Supports remote use limiting			■

	Type	P.	Applicable Accessories	
Ground Accs.	HGC Series	2-30	■	
	HGJ Seires	2-30	■	

Digital Clocks and Timers

	ZT1590	ZT1590RS	ZT1591	ZT1591RS	ZT1594RS
					
Page	2-33	2-33	2-35	2-35	2-37
Function	Dual clock / timer	Dual clock/timer Preassembled in backbox	Clock / timer	Clock / timer Preassembled in backbox	Digital chronometer
12/24 hour clock time	■	■	■	■	
Elapsed timer	■	■	■	■	
Quantity of displays	1 clock, 1 timer	1 clock, 1 timer	1 clock or timer	1 clock or timer	1 clock, 3 timers
Simulatneous clock/timer display	■	■			■
Internal battery backup	■	■	■	■	■
Prebuilt assembly		■		■	■

	Type	P.	Applicable Accessories				
Power	CP-D 12/0.83	7-21	■	Pre-assembled	■	Pre-assembled	Pre-assembled
Remote indicators	MK1550	6-12	■	■	■	■	
	MK1554	6-12					Included
Enclosure Components	B120804	-	■	Pre-assembled	■	■	
	B181804	-					Pre-assembled
	T1410-LIM	-	■	Pre-assembled	■	■	

ISOTROL Standard Isolated Power Panels

Isolated power panels with line isolation monitor for healthcare facilities

Standard IP panel

2

Applications

- Isolated power systems in healthcare facilities conforming to codes and standards such as NFPA 99, CSA Z32, UL 1047, and UL 1022

Approvals

c UL us LISTED

Features

Standard features

- Single-phase isolation transformer, primary and secondary voltages configured at factory, conforming to all applicable standards for isolation transformers in healthcare isolated power systems
- Bender LIM2010 line isolation monitor (LIM), featuring self-testing, self-calibration, and a wide variety of alarms, including total hazard current (THC, configurable for 2 mA or 5 mA), voltage, overload, overtemperature, and more
- Reference ground bus
- Primary circuit breaker
- Branch circuit breakers, qty. 8 standard, field-expandable to 16

Additional options

- Provisions for receptacles and/or ground jacks
- Circuit control and lockout via PLC
- Integrated branch fault location: All fault location wiring is done at factory, simple terminals provided for landing branch connections
- Transformer load monitoring
- Support for BENDER's remote communication system, as well as various remote indicators and remote stations

Standards

- Listed to UL 1047 (standard for isolated power systems equipment)
- Meets requirements for NFPA 99 isolated power systems in wet locations
- LIM2010 listed to UL 1022 (standard for line isolation monitors)

IP panel with receptacles and ground jacks

Features: IP panels with receptacles / ground jacks

- All features of standard IP panels
- Provisions for hospital grade power receptacles and/or ground jacks
- Receptacles available in straight blade (single or duplex) or twist-to-lock style
- Customizable combinations available: each section can accomodate either one duplex or single power receptacle and one ground jack, or two ground jacks
- Supports BENDER HGC series hospital grade ground cords

IP panel with circuit control and lockout

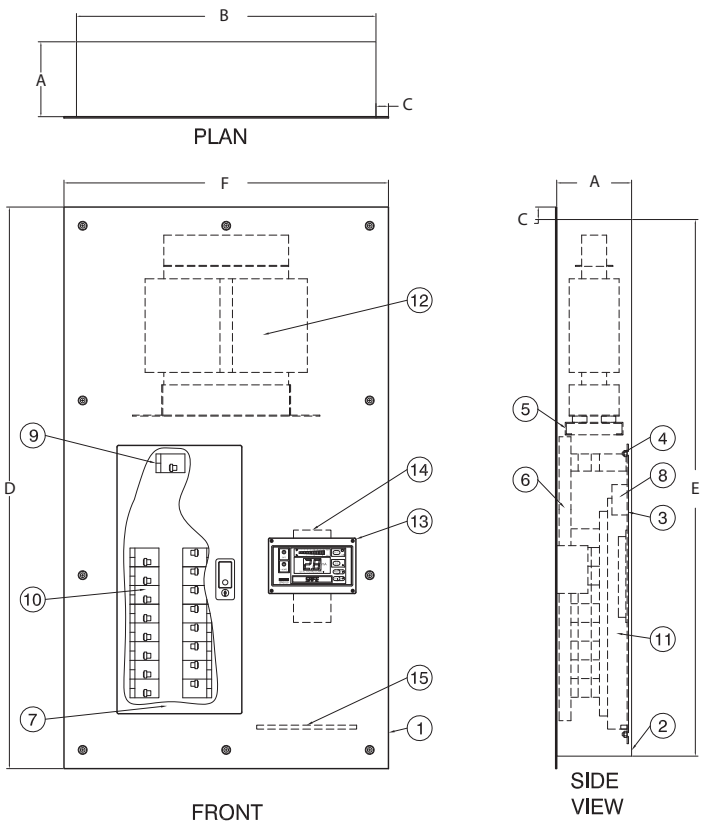
Features: IP panels with circuit control and lockout

- All features of standard IP panels
- Configurable to feed x-ray and laser receptacles at intervals up to 60 A (within power ratings of panel)
- Configurable to supply power for up to twelve (12) circuits.
- Supports use of limit switch used to lock out power to other receptacles connected to panel
- Programmable logic controller (PLC) built-in controls which circuits are available for use by controlling circuit contactors
- Supports BENDER XRM series receptacles modules, which may be configured with "in-use" lamps as well as MK2000 series LIM remote indicators

Build your isolated power system online

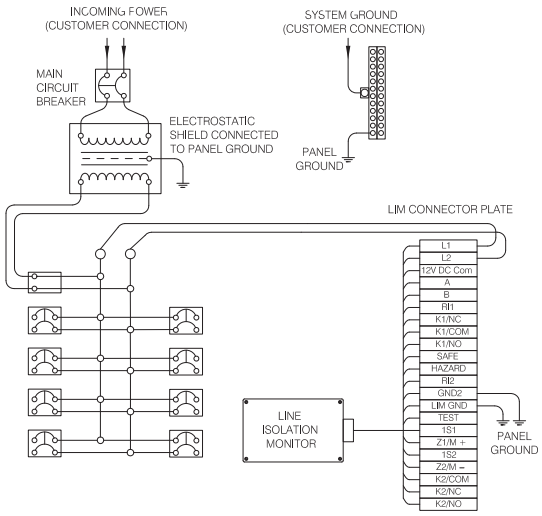
Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

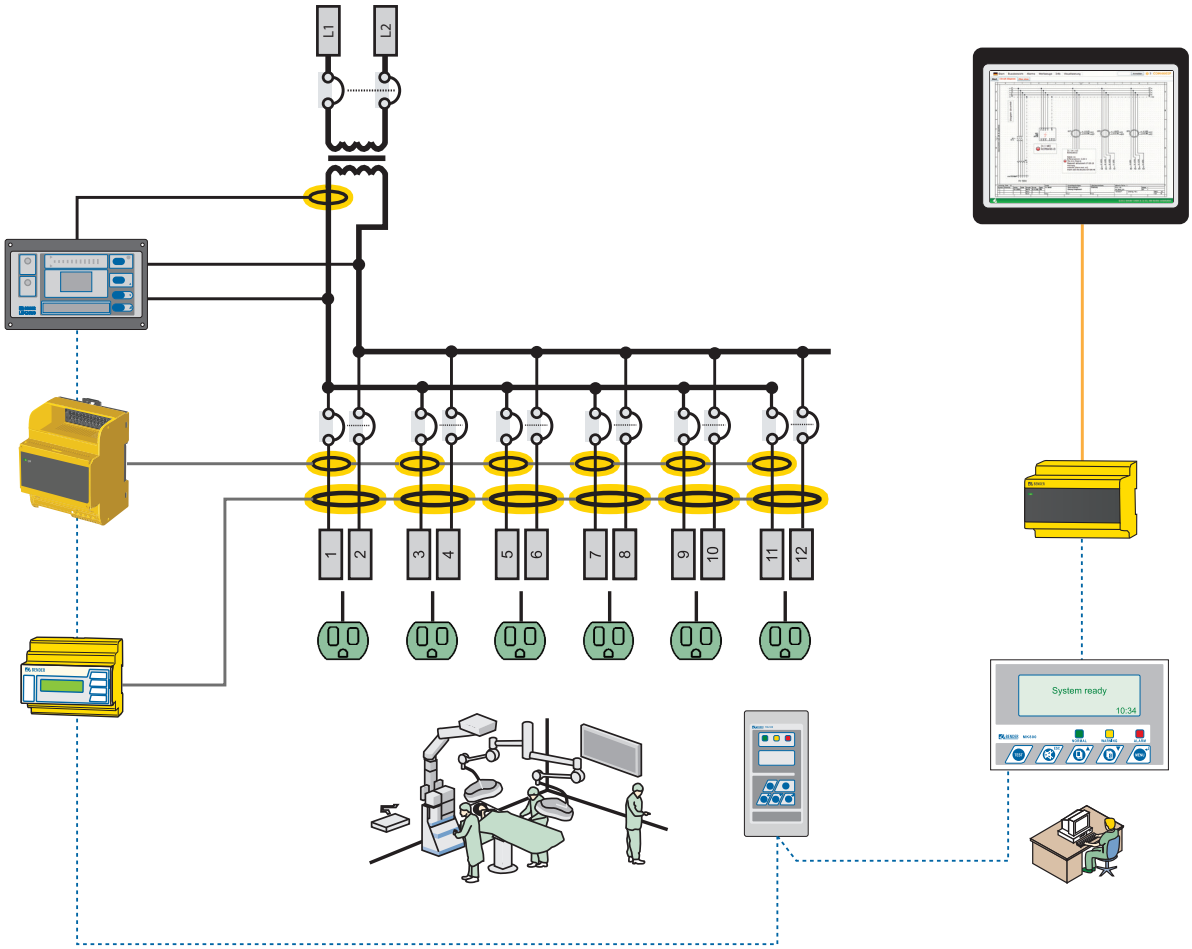
Outline: Standard isolated power panel



1 Stainless steel front trim
2 Backbox, galvanized steel
3 Backplate, galvanized steel
4 Backplate mounting bracket
5 Transformer shelf
6 Circuit breaker deadfront
7 Stainless steel door with lock
8 Distribution block, 2P
9 Circuit breaker, main, 2P
10 Circuit breaker, branch, 2P
11 Loadcenter
12 Isolation transformer, single-phase
13 Line isolation monitor (LIM), single-phase
14 LIM connector plate
15 Ground bus

Wiring: Standard isolated power panel





Ground fault location while the system remains online

- Fast, automated location of ground faults while the system remains online
- Reduced maintenance costs and downtime
- Indication of faulty circuit shown on panel (EDS441), at remote indicating station (MK2430 / MK800), and at remote station through web browser-based GUI or Modbus/TCP (COM465IP)
- Available built into panel, modular design also allows for simple retro fitting / upgrading
- Current transformers for fault location built into panel as option, simple landing terminals provided for branch wiring

Advanced, fast remote communication to hospital staff

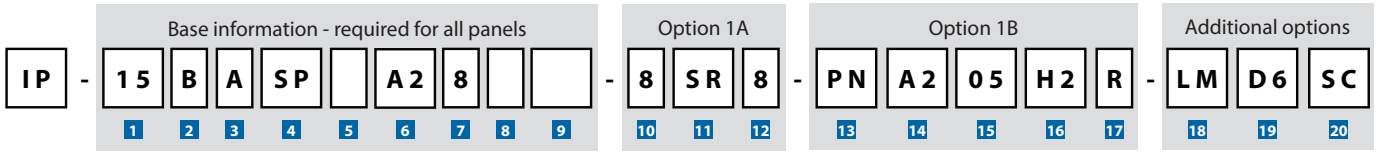
- Notifcation of faults to nurse station
- Multiple isolated power panels may be monitored at a single remote station indicator (MK800 / 2430) with customizable messages
- Connecting BENDER system to COM465IP allows for viewing status of isolated power system via simple web browser based GUI
- COM465IP also connects to Modbus/TCP networks to integrate into existing communication networks

Ordering information

BENDER's complete isolated power panels are comprised of four separate assembly types: The interior (step 1), isolation transformer (step 2), backbox, and front trim (step 3). All BENDER isolated power panels, excluding panels with circuit control (option 1B), contain eight two-pole, 20 A circuit breakers, field expandable to sixteen. Panels with circuit control will have the appropriate number of breakers for facilitating the customized circuit control.

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power system online.

Step 1: Interior (with sample part number)



Base information (required):

1 Panel interior kVA rating:
- 03: 3 kVA
- 05: 5 kVA
- 07: 7.5 kVA
- 10: 10 kVA
- 15: 15 kVA
- 25: 25 kVA

2 Panel interior primary voltage rating
- A: 120 V
- B: 208 V
- C: 240 V
- D: 277 V
- E: 480 V
- G: 110 V
- H: 220 V
- I: 230 V
- J: 380 V
- L: 347 V
- M: 415 V
- N: 600 V

3 Panel interior secondary voltage rating
- A: 120 V
- B: 208 V
- C: 240 V
- G: 110 V
- H: 220 V
- I: 230 V
- K: 127 V

4 Loadcenter / panelboard manufacturer
- SP: Square-D, plug-on (snap-in)
- SB: Square-D, bolt-on
- CP: Cutler-Hammer, Plug-on (snap-in)
- CB: Cutler-Hammer, Bolt-on
- GP: General Electric, Plug-on (snap-in)
- GB: General Electric, Bolt-on

5 Optional secondary main circuit breaker
- Nothing (left blank): No secondary main CB
- Y: Add secondary main CB

6 Branch circuit breaker rating (default is 20 A)
- Nothing (left blank) or A2: 20 A
- A0: 15 A
- A1: 10 A
- A3: 30 A
- A4: 40 A
- A5: 50 A
- A6: 60 A

7 Quantity of branch circuit breakers (01 - 16, default is 8)
- Nothing (left blank): 8
- 01: One (minimum)
- 16: Sixteen (maximum)

8 Ground bus material (default is Aluminum)
- Nothing (left blank): Aluminum
- C: Copper
- U: Chicago Style

9 Ground bus grounding points (default is 20)
- Nothing (left blank): 20
- Two-digit number: Custom quantity

Step 1, Option 1: Interior options

Select EITHER option 1A or 1B (leave blank if not required). Only one may be selected. For option 1B, the amperes per circuit and quantity of simultaneously hot circuits must be rated properly in accordance with the secondary voltage and total kVA of the transformer. Additional or custom configurations are available. BENDER's online isolated power solution builder makes building a circuit control panel simple with all calculations completed automatically.

Step 1, Option 1A: Power and ground outputs (leave blank if not required)

10 Quantity of ground jacks (0 - 8)
- 0: Zero
- 8: Eight (maximum)

11 Type of receptacle
- SR: Single, red
- SI: Single, ivory
- DR: Duplex, red
- DI: Duplex, ivory
- TB: Twist-to-lock, black
- NN: None

12 Quantity of receptacles (0 - 8)
- 0: Zero
- 8: Eight (maximum)

Step 1, Option 1B: Circuit control and lockout (leave blank if not required)

13 Type of control and indication

PU: PLC interlock. Door contactor controlled, individual receptacle modules with in-use lamps

PN: PLC interlock. Door contactor controlled, individual receptacle modules (no in-use lamps)

PR: PLC interlock. Circuit selector pushbutton station located remotely

14 Ampere rating per circuit

A2: 20 A	A3: 30 A
A5: 50 A	A6: 60 A
A0: 15 A	

15 TOTAL quantity of controlled circuits (01 - 12)

01: One	12: Twelve (maximum)

16 Quantity of SIMULTANEOUSLY active circuits

H1: One	H4: Four
H2: Two	H5: Five
H3: Three	H6: Six

17 Optional provisions for laser relay contact

Nothing (left blank): No provisions

Y: Include provisions

2

Step 1, Additional options (leave blank if not required)

18 Load monitoring

Nothing (leave blank): No load monitoring

LM: Secondary mains load monitoring

LMC: Secondary mains and individual branch load monitoring

19 Fault location

Nothing (leave blank): No fault location

L6: Integrated fault location using EDS461-L module

D6: Integrated fault location using EDS461-D module

L9: Integrated fault location using EDS491-L module

D9: Integrated fault location using EDS491-D module

20 Selective coordination

Nothing (leave blank): No selective coordination

SC: Add selective coordination

Step 2: Isolation transformer (with sample part number)

Custom configurations are available. Values must match kVA and voltages selected in Step 1.

XM	-	15	B	A
		1	2	3

1 Transformer kVA rating

03: 3 kVA	10: 10 kVA
05: 5 kVA	15: 15 kVA
07: 7.5 kVA	25: 25 kVA

2 Transformer primary voltage rating

A: 120 V	H: 220 V
B: 208 V	I: 230 V
C: 240 V	J: 380 V
D: 277 V	L: 347 V
E: 480 V	M: 415 V
G: 110 V	N: 600 V

3 Transformer secondary voltage rating

A: 120 V	H: 220 V
B: 208 V	I: 230 V
C: 240 V	K: 127 V
G: 110 V	

Step 3: Backbox and front trim

All dimensions listed below are in inches (mm).

kVA	Backbox size (H x W x D)	Front trim size (H x W)	Mounting	Option Support			Backbox part number	Front trim part number
				Option 1A	Option 1B	Option 1C		
3, 5	43″ x 24″ x 6″ (1092 x 610 x 152)	45″ x 26″ (1143 x 660)	Flush				B432406	T4526
7.5, 10	43″ x 24″ x 8″ (1092 x 610 x 203)	45″ x 26″ (1143 x 660)	Flush				B432408	T4526
15	51″ x 30″ x 12″ (1295 x 762 x 305)	53″ x 32″ (1346 x 813)	Flush		■		B513012	T5332
25	51″ x 30″ x 14″ (1295 x 762 x 356)	53″ x 32″ (1346 x 813)	Flush		■		B513012	T5332
3, 5, 7.5, 10	48″ x 24″ x 8″ (1219 x 610 x 203)	50″ x 26″ (1270 x 660)	Flush	■			B482408	T5026R
3, 5, 7.5, 10	48″ x 24″ x 8″ (1219 x 610 x 203)	50″ x 26″ (1270 x 660)	Flush			■	B482408	T5026E
3, 5	43″ x 24″ x 6″ (1092 x 610 x 152)	43″ x 24″ (1092 x 610)	Surface				B432406S	T4324
7.5, 10	43″ x 24″ x 8″ (1092 x 610 x 203)	43″ x 24″ (1092 x 610)	Surface				B432408S	T4324
15	51″ x 30″ x 12″ (1295 x 762 x 305)	51″ x 30″ (1295 x 762)	Surface		■		B513012S	T5130
25	51″ x 30″ x 14″ (1295 x 762 x 356)	51″ x 30″ (1295 x 762)	Surface		■		B513014S	T5130
3, 5, 7.5, 10	48″ x 24″ x 8″ (1219 x 610 x 203)	48″ x 24″ (1219 x 610)	Surface	■			B482408S	T4824R
3, 5, 7.5, 10	48″ x 24″ x 8″ (1219 x 610 x 203)	48″ x 24″ (1219 x 610)	Surface			■	B482408S	T4824E

ISOTROL Dual Output Voltage Isolated Power Panel

Dual voltage isolated power panels with line isolation monitors for healthcare facilities

2

Applications

- Isolated power systems in healthcare facilities conforming to codes and standards such as NFPA 99, CSA Z32, UL 1047, and UL 1022
- Installations requiring power for both typical hospital equipment, as well as x-ray / laser equipment

Approvals

c UL us LISTED

Features

Standard features

- Two different voltage outputs provided by one isolation transformer
- Single-phase isolation transformer, with dual secondary outputs (typically 208 or 240 V high side, 120 V low side), conforming to all applicable standards for isolation transformers in healthcare isolated power systems
- Two BENDER LIM2010 line isolation monitors (LIM), featuring self-testing, self-calibration, and a wide variety of alarms, including total hazard current (THC, configurable for 2 mA or 5 mA), voltage, overload, overtemperature, and more
- Two reference ground buses
- Primary circuit breaker
- One secondary main circuit breaker for 120 V side
- 8 branch circuit breakers for 120 V side, field-convertable up to 16
- One secondary main circuit breaker for 208 V or 240 V side
- Provisions for two 2-pole branch circuit breakers for 208 V or 240 V side

Additional options

- Transformer load monitoring
- Support for BENDER's remote communication system, as well as various remote indicators and remote stations

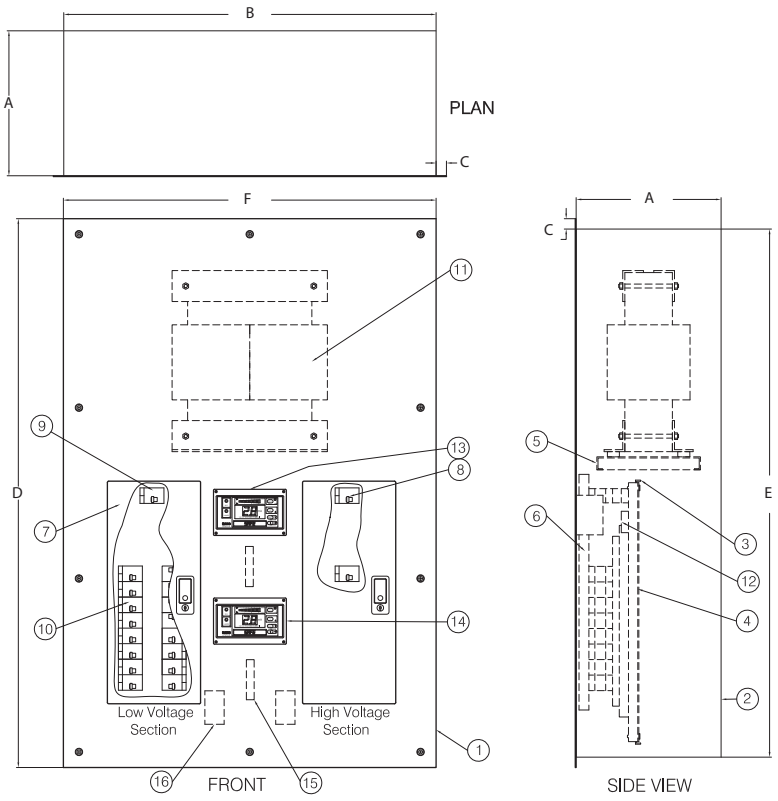
Standards

- Listed to UL 1047 (standard for isolated power systems equipment)
- Meets requirements for NFPA 99 isolated power systems in wet locations
- LIM2010 listed to UL 1022 (standard for line isolation monitors)

Build your isolated power system online

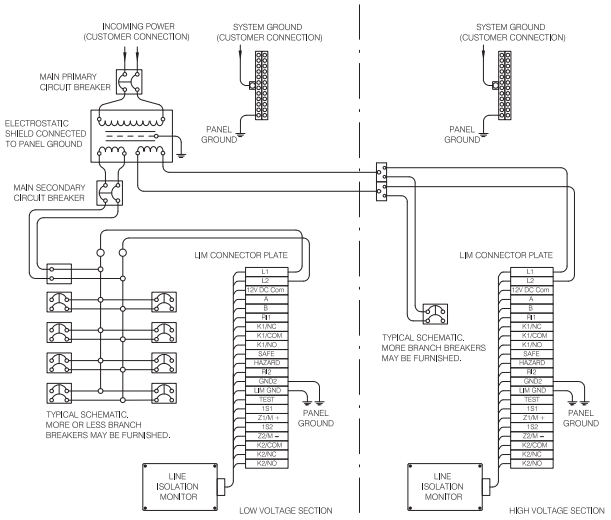
Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

Outline: Dual output voltage isolated power panel



1. Stainless steel front trim
2. Backbox, galvanized steel
3. Backplate, galvanized steel
4. Backplate mounting bracket
5. Transformer shelf
6. Transformer shelf mounting bracket
7. Circuit breaker deadfront
8. Stainless steel door with lock
9. Distribution block, 2P
9. Main primary circuit breaker, 2P
10. Main secondary circuit breaker, 2P
11. Branch circuit breakers, 2P
12. Loadcenter
13. Isolation transformer, dual secondary, single-phase
14. Line isolation monitor (LIM), single-phase
15. LIM connector plate
16. Ground bus
17. Distribution blocks

Wiring: Dual output voltage isolated power panel



Ordering information

BENDER's complete isolated power panels are comprised of four separate assembly types: The interior (step 1), isolation transformer (step 2), backbox, and front trim (step 3). Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power system online.

Step 1: Interior (with sample part number)

ID	-	25	B	B	10	SP	-	A3	2	LM
		1	2	3	4	5		6	7	8

1 Panel interior kVA rating:
25: 25 kVA

2 Transformer primary voltage rating
B: 208 V
C: 240 V
D: 277 V
E: 480 V
H: 220 V
J: 380 V

3 Secondary voltage, high side
B: 208 V
C: 240 V

4 kVA rating, 120 V secondary
10: 10 kVA

5 Loadcenter / panelboard manufacturer
SP: Square-D, plug-on (snap-in)
SB: Square-D, bolt-on
CP: Cutler-Hammer, Plug-on (snap-in)
CB: Cutler-Hammer, Bolt-on
GP: General Electric, Plug-on (snap-in)

6 Branch circuit breaker(s) rating, 208 or 240 V side
A2: 20 A
A3: 30 A
A0: 15 A
A5: 50 A
A6: 60 A

7 Qty. branch circuit breakers, 208 or 240 V side
1: One
2: Two

8 Additional options
Nothing (blank): No additional features
LM: Load monitoring with preinstalled current transformer

Step 2: Isolation transformer (with sample part number)

Custom configurations are available.

XM	25	B	B	10
	1	2	3	4

1 Total transformer kVA rating
25: 25 kVA

2 Transformer primary voltage rating
B: 208 V
C: 240 V
D: 277 V
E: 480 V
H: 220 V
J: 380 V

3 Transformer secondary voltage rating, high side
B: 208 V
C: 240 V

4 kVA rating, 120 V secondary
10: 10 kVA

Step 3: Backbox and front trim

All dimensions listed below are in inches (mm).

Total kVA	Backbox size (H x W x D)	Front trim size (H x W)	Mounting	Backbox part number	Front trim part number
25	51″ x 34″ x 14″ (1295 x 864 x 356)	53″ x 36″ (1346 x 914)	Flush	**B513414**	**T5336**
25	51″ x 34″ x 14″ (1295 x 864 x 356)	51″ x 34″ (1295 x 864)	Surface	**B513414S**	**T5134**

ISOTROL Dual System Isolated Power Panel

Dual system isolated power panels with line isolation monitors for healthcare facilities

Applications

- Isolated power systems in healthcare facilities conforming to codes and standards such as NFPA 99, CSA Z32, UL 1047, and UL 1022
- Locations where space is limited

Approvals

c UL us LISTED

Features

Standard features

- Two independent isolated power systems provided in one panel
- Two single-phase isolation transformers, primary and secondary voltages configured at factory, conforming to all applicable standards for isolation transformers in healthcare isolated power systems
- Two BENDER LIM2010 line isolation monitors (LIM), featuring self-testing, self-calibration, and a wide variety of alarms, including total hazard current (THC, configurable for 2 mA or 5 mA), voltage, overload, overtemperature, and more
- Two reference ground buses
- Two primary circuit breakers
- Branch circuit breakers, qty. 8 standard per system, field-expandable to 16 per system

Additional options

- Integrated branch fault location: All fault location wiring is done at factory, simple terminals provided for landing branch connections
- Transformer load monitoring
- Support for BENDER's remote communication system, as well as various remote indicators and remote stations

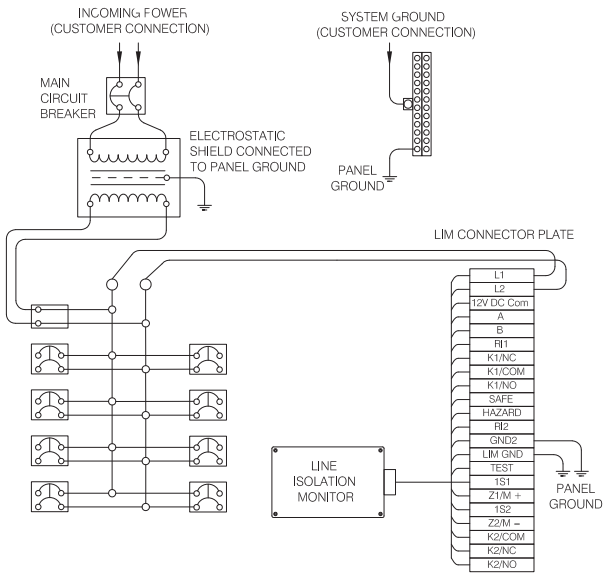
Standards

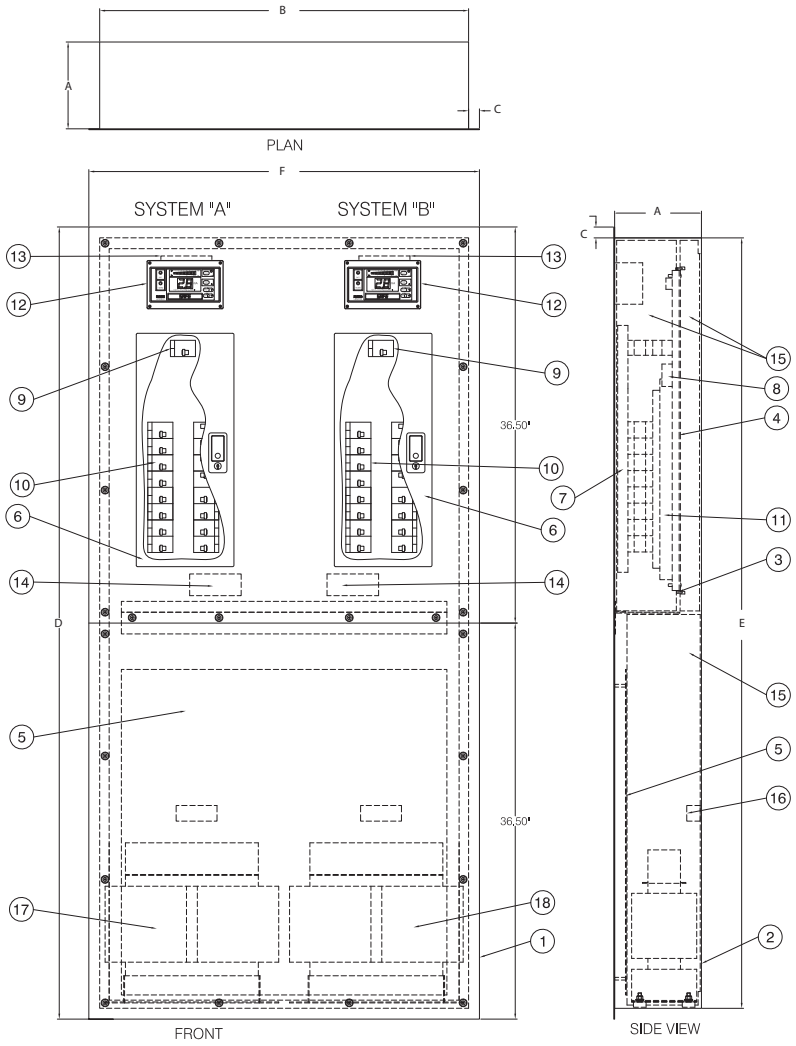
- Listed to UL 1047 (standard for isolated power systems equipment)
- Meets requirements for NFPA 99 isolated power systems in wet locations
- LIM2010 listed to UL 1022 (standard for line isolation monitors)

Build your isolated power system online

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

Wiring: Dual system isolated power panel (one system shown below)



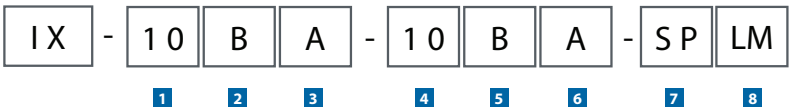


1. Stainless steel front trim (2 pc.)
2. Backbox, galvanized steel
3. Backplate, galvanized steel
4. Backplate mounting bracket
5. Heat shield
6. Stainless steel door w/ lock
7. Breaker deadfront
8. Distribution block
9. Main circuit breaker, 2P
10. Branch circuit breakers, 2P
11. Load center
12. Line isolation monitor, 1 ph.
13. LIM connector plate
14. Ground bus
15. Barriers between systems
16. Terminal blocks
17. Isolation transformer, system A
18. Isolation transformer, system B

Ordering information

BENDER's complete isolated power panels are comprised of four separate assembly types: The interior (step 1), isolation transformer (step 2), backbox, and front trim (step 3). Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power system online.

Step 1: Interior (with sample part number)



1 System A: Panel interior kVA rating:

03: 3 kVA	07: 7.5 kVA
05: 5 kVA	10: 10 kVA

2 System A: Panel interior primary voltage rating

A: 120 V	G: 110 V
B: 208 V	H: 220 V
C: 240 V	I: 230 V
D: 277 V	J: 380 V
E: 480 V	

3 System A: Panel interior secondary voltage rating

A: 120 V	G: 110 V
B: 208 V	H: 220 V
C: 240 V	I: 230 V

4 System B: Panel interior kVA rating:

03: 3 kVA	07: 7.5 kVA
05: 5 kVA	10: 10 kVA

5 System B: Panel interior primary voltage rating

A: 120 V	G: 110 V
B: 208 V	H: 220 V
C: 240 V	I: 230 V
D: 277 V	J: 380 V
E: 480 V	

6 System B: Panel interior secondary voltage rating

A: 120 V	G: 110 V
B: 208 V	H: 220 V
C: 240 V	I: 230 V

7 Both systems: Loadcenter / panelboard manufacturer

SP: Square-D, plug-on (snap-in)
SB: Square-D, bolt-on
CP: Cutler-Hammer, Plug-on (snap-in)
CB: Cutler-Hammer, Bolt-on
GP: General Electric, Plug-on (snap-in)

8 Both systems: Additional options

Nothing (blank): No additional features
LM: Load monitoring with preinstalled current transformer

Step 2: Isolation transformer (with sample part number)

Custom configurations are available. This step must be completed twice - two transformers are required for a complete dual system isolated power panel. Ensure that all specifications match with the specifications selected in step 1.

XM	10	B	A
	1	2	3

1 Transformer kVA rating

- 03: 3 kVA
- 05: 5 kVA
- 07: 7.5 kVA
- 10: 10 kVA

2 Transformer primary voltage rating

- A: 120 V
- B: 208 V
- C: 240 V
- D: 277 V
- E: 480 V
- G: 110 V
- H: 220 V
- I: 230 V
- J: 380 V

3 Transformer secondary voltage rating

- A: 120 V
- B: 208 V
- C: 240 V
- G: 110 V
- H: 220 V
- I: 230 V

Step 3: Backbox and front trim

All dimensions listed below are in inches (mm).

kVA per system	Backbox size (H x W x D)	Front trim size (H x W)	Mounting	Backbox part number	Front trim part number
3, 5, 7.5, 10	71″ x 34″ x 8″ (1803 x 864 x 203)	73″ x 36″ (1854 x 914)	Flush	**B713408**	**T7336**
25	71″ x 34″ x 8″ (1803 x 864 x 203)	71″ x 34″ (1803 x 864)	Surface	**B713408S**	**T7134**

LIM2010

Line isolation monitor for healthcare facilities

Applications

- Isolated power systems in healthcare facilities conforming to codes and standards such as NFPA 99, CSA Z32, UL 1047, and UL 1022
- Retrofits and upgrades to the latest in line isolation monitoring technology

Approvals

c UL us LISTED

Features

- No interference with electrical equipment
- Special phase-locking circuitry for ultimate stability and repeatability
- Works on both 50 and 60 Hz systems (100 - 240 VAC)
- Total hazard current (THC) adjustable, 2 mA / 5 mA per local code requirements
- Additional alarms include transformer overload and overtemperature, overvoltage and undervoltage, ground connection, and insulation resistance / impedance
- Audible (with adjustable volume) and visual alarm indication
- Two programmable voltage-free SPDT contacts
- Digital and analog, colored bar graph displays
- Automatic self-calibration and self-check
- RS-485 communication port
- Connection for external remote indicators
- Provision to monitor multiple LIM2010 devices from one remote station
- Compatible with BENDER's remote communication gateways which support connection to common protocols such as Ethernet and Modbus/TCP
- Compatible with BENDER's ground fault location system - locate faulty branches automatically with compatible ground fault location modules

Build your isolated power system online

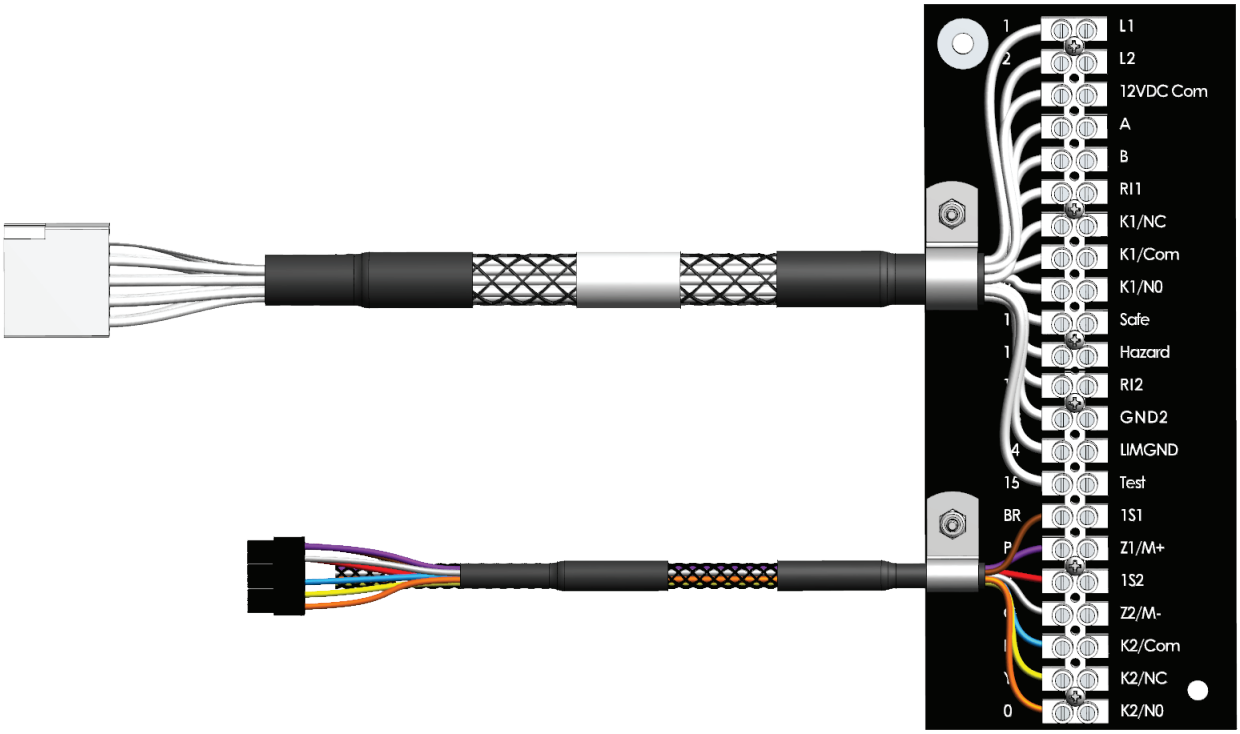
Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

Ordering information

Type	Ordering No.
LIM2010	B 9207 5021

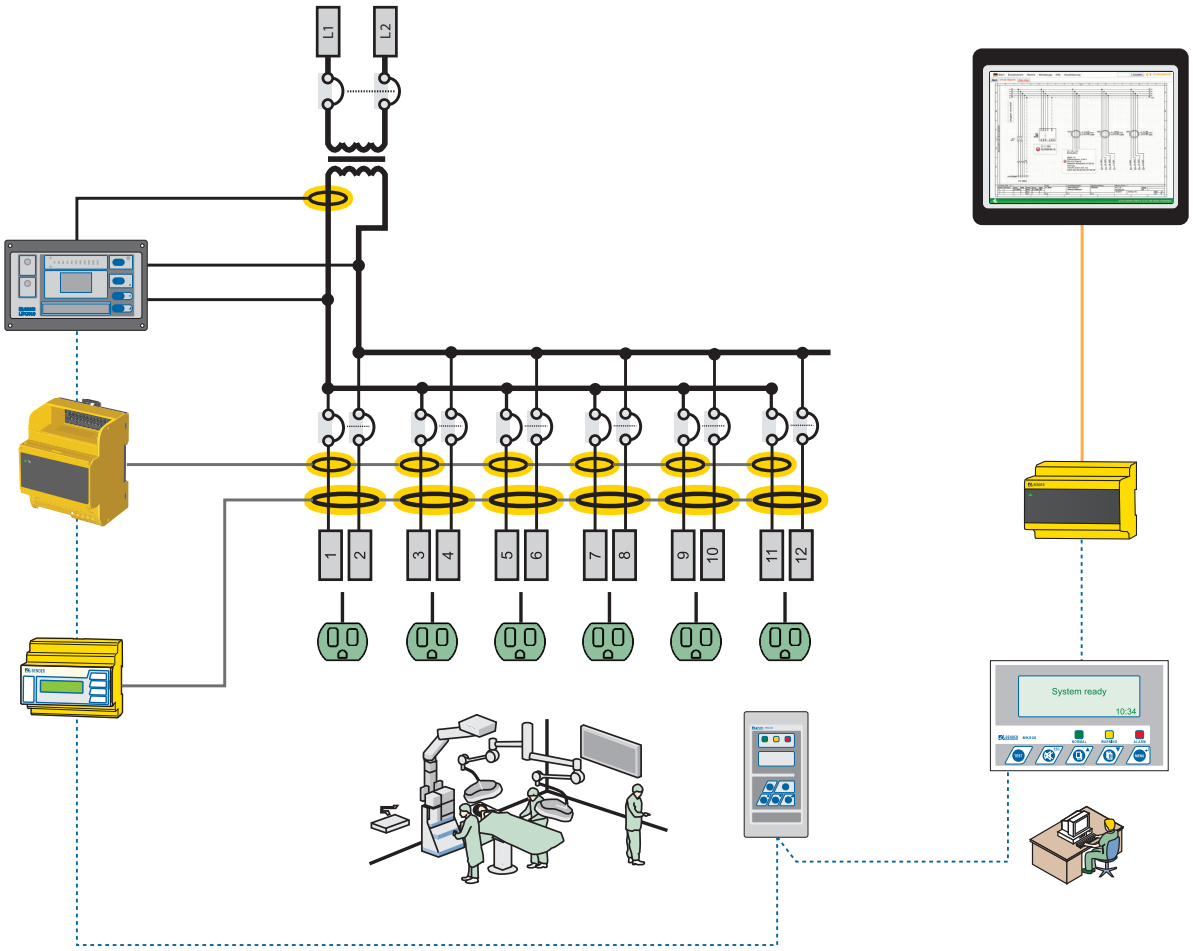
Accessories

Description	Type	Page
Connector plate	CP-LIM2010	-
Single remote indicators	MK2000-G1	6-08
	MK2000P-G1	6-08
	MK2000C-G1	6-08
	MK2000CP-G1	6-08
Remote stations	MK2430 Series	6-19
	MK800 Series	6-14
Load monitoring current transformers	STW3	7-20
	STW4	7-20
Fault location modules	EDS441-L-4	3-04
	EDS151	3-12
External current transformers for fault location	W20-8000	7-06
	W35-8000	7-06
	W60-8000	7-06



Connector plate terminals	
Type	**Description**
L1, L2	Connected to secondary of isolation transformer
12 VDC Com.	Common connection for remote indicators
A, B	RS-485 communication interface
RI1	Test button source for remote indicators
K1/NC	Alarm relay K1, N/C
K1/Common	Alarm relay K1, common
K1/NO	Alarm relay K1, N/O
SAFE	"SAFE" light connection for remote indicators

Connector plate terminals	
Type	**Description**
HAZARD	"HAZARD" light connection for remote indicators
RI2	Local and system muting from LIM and remote indicators
GND2, LIM GND	Separate ground connections
TEST	Connection for remote test
Z1/M+, Z2/M-	Connection for overtemperature sensor or analog meter
K2/Common	Alarm relay K2, common
K2/NC	Alarm relay K2, N/C
K2/NO	Alarm relay K2, N/O



Ground fault location while the system remains online

- Fast, automated location of ground faults while the system remains online
- Reduced maintenance costs and downtime
- Indication of faulty circuit shown on panel (EDS441), at remote indicating station (MK2430 / MK800), and at remote station through web browser-based GUI or Modbus/TCP (COM465IP)
- Available built into panel, modular design also allows for simple retro fitting / upgrading
- Current transformers for fault location built into panel as option, simple landing terminals provided for branch wiring

Advanced, fast remote communication to hospital staff

- Notifcation of faults to nurse station
- Multiple isolated power panels may be monitored at a single remote station indicator (MK800 / 2430) with customizable messages
- Connecting BENDER system to COM465IP allows for viewing status of isolated power system via simple web browser based GUI
- COM465IP also connects to Modbus/TCP networks to integrate into existing communication networks

Insulation coordination acc. to UL 1022 and IEC 60664-1	
Rated insulation voltage	AC 250 V
Rated impulse voltage / pollution degree	2.5 kV / III
Voltage test acc. to UL 1022 and IEC 61010-1	2.0 kV
Supply Voltage	
Supply voltage U_S	$= U_n$
Power consumption	< 22 VA
Isolated Power System Monitored	
Nominal voltage U_n	AC 100 - 240 V
Operating range of U_n	85% - 110%
Frequency range f_n	50 / 60 Hz
Operating range of f_n	± 5%
Insulation and THC monitoring	
Response value: THC	2 mA / 5 mA (5 mA)*
Response Tolerance	1.8 - 2 mA / 4.5 - 5 mA
Hysteresis	20%
Response value Z	10 - 200 kΩ (off)*
Response tolerance	±15%
Hysteresis	25%
Response value R	20 - 200 kΩ (off)*
Response tolerance	± 15%
Hysteresis	25%
Response time t_{an}	< 4 s
Measuring circuit	
Measuring voltage U_m	± 48 V
Measuring current I_m (at $Z_F = 0$ Ω)	< 32 µA
Internal resistance	≥ 1.5 MΩ
Monitor hazard current MHC, 120 V / 240 V	60 µA / 95 µA
When EDS mode is active:	
Monitor Hazard Current MHC	< 950 µA
Test cycle / idle time	2 s / 4 s
Voltage monitoring	
Response value, undervoltage / undervoltage (<U / >U)	80 - 300 V (off)*
Response tolerance	± 5%
Hysteresis	5%
Load current monitoring ("C" option)	
Response value	10 - 200 A (off)*
Response tolerance	± 5%
Hysteresis	5%
Temperature monitoring	
Response value (fixed)	4 kΩ
Release value	1.6 kΩ
PTC resistor acc. to DIN 44081	max. 6 connected in series
Adjustable time delays (does not apply to THC alarm)	
Response delay t_{on}	0 - 99 s (0 s)*
Delay on release t_{off}	0 - 99 s (0 s)*
Displays, memory	
14-segment display	8 digits, multi-functional
Displayable value, THC	0.0 - 9.9 mA
Operating uncertainty, THC	+ 7%, ± 0.1 mA
Measured value, load current (as % of response value)	10 - 199 %
Operating uncertainty, load current (as % of response value)	± 5%, ± 0.2 A
Measured value, load current (in A)	0.5 - 250 A
Operating uncertainty, load current (in A)	± 5%, ± 0.2 A
Measured value, system voltage	10 - 300 V
Operating uncertainty, system voltage	± 5%, ± 2 V
Measured value, insulation impedance Z	0 - 1 MΩ
Operating uncertainty, insulation impedance	± 5%, ± 1 kΩ
Measured value, insulation resistance R	2 kΩ - 1 MΩ
Operating uncertainty, Z ~ R	± 20%, ± 1 kΩ
Measured value, leakage capacitance C	0 - 500 nF
Operating uncertainty, Z ~ X_C	± 20%, ± 5 nF
Condition for separate readings of R and C	Z ≥ 2 kΩ
7-segment display	2 digits, digital THC indication
Bar graph indicator	analog THC indication
History memory	300 data records
Data logger	300 data records
Inputs / Outputs	
Analog current output M+ / M-	0 - 400 µA
Operating uncertainty	± 10%
Output RI1, 12 VDC common	12 V / 200 mA
RI2, SAFE, HAZARD, TEST	Maximum four (4) MK2000(C)(P)
Cable length	≤ 32 ft
Serial Interface	
Interface A-B / Protocol	RS-485 / BMS bus
Baud rate	9600 baud
Cable length	≤ 3900 ft
Recommended cabling	Shielded, twisted pair, one end grounded
Termination resistor	120 Ω (also activated via DIP switch) (off)*
Assignable BMS bus addresses	1 - 90 (1)*

Relays

Number of switching elements					2 SPDT contacts
Operating principle					normally energized or de-energized operation (N/E)*
Electrical service life, number of cycles					10,000
Contact data acc. to IEC 60947-5-1					
Relay 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
Minimum contact load					1 mA at AC / DC 10 V
Relay 2:					
Utilization category			DC-12	DC-12	DC-12
Rated operational voltage			24 V	110 V	220 V
Rated operational current			1.2 A	0.4 A	0.25 A
Minimum contact load					1 mA at AC / DC 10 V
Rated Contact Voltage					AC 125 V / DC 30 V

Environment / EMC	
EMC	IEC 61326
Operating Temperature Range	+ 14 - + 122 °F - 10 - + 50 °C
Storage Temperature	- 13 - + 158 °F - 25 - + 70 °C
Connection	
Connection type	Molex plug 15-pin, type 03-09-2159 and 12-pin, type 43045-1215
General data	
Operating mode	continuous operation
Mounting position	display-oriented
Degree of protection, internal components (EN 60529)	IP30 (NEMA 1)
Enclosure material	polycarbonate
Flammability class	UL94 V-0
Screw fixing	Qty. 4, #4-40 oval head, black oxide finished
Screw torque	(2.6 - 3.5 lb-in) 0.3 - 0.4 N-m
Weight	≤ 1.2 lb

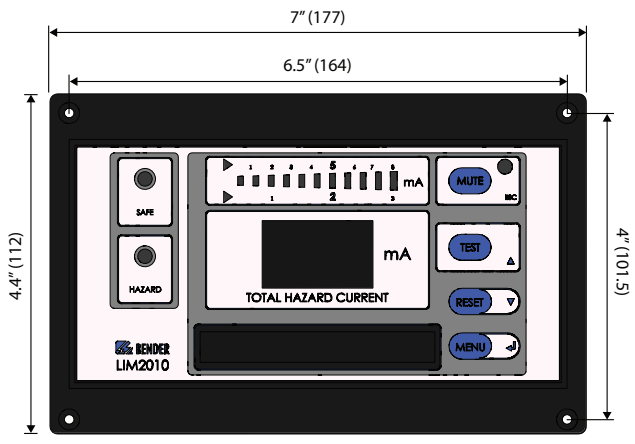
Technical data: CP-LIM2010 connector plate

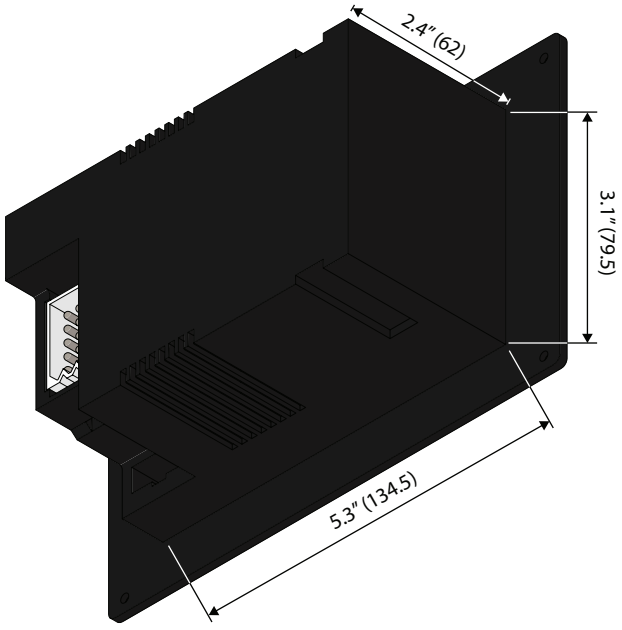
Cable Length	20"	Tightening torque	8 in-lb
Terminal Strip	22 terminals	Mounting Orientation	any
Connector	15 pin Molex	Weight	Approx. 7 oz.
Conductor Size	AWG 22 - 12		

Displays and controls

1 THC setpoint LED markers (amber) - 5 mA or 2 mA
2 TEST button - checks functions of the LIM
3 "SAFE" LED (green) - lights in the normal condition
4 Digital display - shows THC in mA
5 Analog LED bar graph - displays THC in mA
6 "HAZARD" LED (red) - lights in the alarm condition
7 Muting button with LED (amber) - silences alarm buzzer
8 Digital text display for status and menu options

Dimensions in inches (mm)





Hospital Grade Isolation Transformers

For healthcare facilities

Features

- Single-phase, copper-wound transformers with primary and secondary voltages configured at the factory
- Power rating configurable at factory up to 25 kVA
- Class H rated insulation
- Grain-oriented silicon steel cores
- Electrostatic shield between primary and secondary windings, grounded to enclosure
- Sound levels in accordance with NEMA standards
- Maximum leakage current in compliance with UL 1047, tables 30.1 and 30.2, and CSA Z32.2
- Mounting hardware provided for simple installation

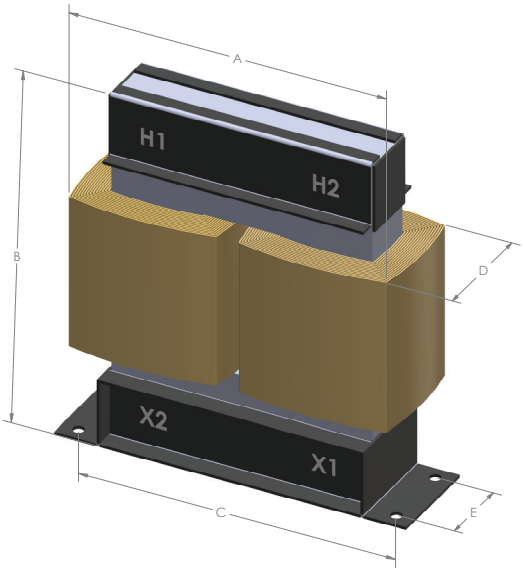
Build your isolated power system online

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

Standard isolation transformer

Technical data and dimensions shown below are for standard isolation transformers (single voltage primary, single voltage secondary up to 25 kVA).

Dimensions



Dimensions in inches (mm)					
kVA	A	B	C	D	E
3	14″ (356)	13.25″ (337)	14″ (356)	4″ (102)	3.25″ (82.5)
5	16″ (406)	14.5″ (368)	14″ (356)	5″ (127)	3.25″ (82.5)
7.5	17″ (432)	14.75″ (375)	14″ (356)	5.5″ (140)	3.25″ (82.5)
10	14″ (356)	14″ (356)	14″ (356)	7″ (178)	3.25″ (82.5)
15	15″ (381)	16″ (406)	11″ (279)	8″ (203)	6.75″ (171.5)
20	17.5″ (444.5)	18″ (457)	11″ (279)	8″ (203)	6.75″ (171.5)
25	17.5″ (444.5)	18″ (457)	11″ (279)	8.5″ (216)	6.75″ (171.5)

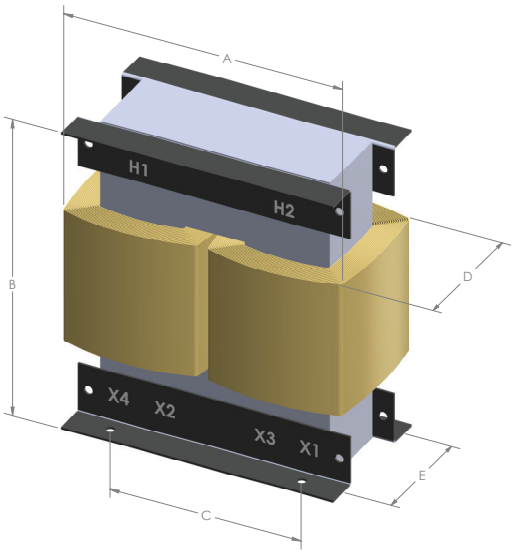
Technical data

kVA	Noise (dB)	Impedance (%)	Regulation (%)	Weight (lb)
1.5	27	4	3.0	50
2, 3	27	4.22	3.0	70
5	27	3.58	3.0	100
7.5	30	3.12	2.4	140
10	30	2.01	1.8	190
15	35	1.34	1.1	250
20	35	1.28	1.05	260
25	35	1.48	1.3	305

Dual secondary voltage isolation transformer

Technical data and dimensions shown below are for isolation transformers with dual voltages on the secondary side.

Dimensions



Dimensions in inches (mm)					
kVA	A	B	C	D	E
15	15″ (381)	16″ (406)	11″ (279)	9″ (229)	6.75″ (171.5)
20	17.5″ (444.5)	18″ (457)	11″ (279)	9″ (229)	6.75″ (171.5)
22.5	17.5″ (444.5)	18″ (457)	11″ (279)	9″ (229)	6.75″ (171.5)
25	17.5″ (444.5)	18″ (457)	11″ (279)	9.5″ (241)	6.75″ (171.5)

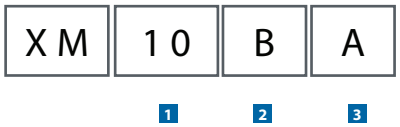
Technical data

kVA	Noise (dB)	Impedance (%)	Regulation (%)	Weight (lb)
15	35	1.37	1.1	275
20	35	1.32	1.05	330
22.5	35	1.25	1.05	345
25	35	1.42	1.2	370

Ordering information

Bender isolation transformers are intended for use as a component of a complete isolated power panel. For more information, consult the previous sections on isolated power panels for healthcare facilities.

Ordering information: Standard isolation transformer (single secondary voltage)



2

1 Transformer kVA rating

03: 3 kVA	07: 7.5 kVA
05: 5 kVA	10: 10 kVA

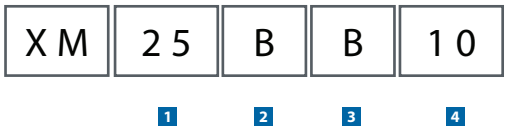
2 Transformer primary voltage rating

A: 120 V	H: 220 V
B: 208 V	I: 230 V
C: 240 V	J: 380 V
D: 277 V	L: 347 V
E: 480 V	M: 415 V
G: 110 V	N: 600 V

3 Transformer secondary voltage rating

A: 120 V	H: 220 V
B: 208 V	I: 230 V
C: 240 V	K: 127 V
G: 110 V	

Ordering information: Dual secondary voltage isolation transformer



1 Total transformer kVA rating

25: 25 kVA

2 Transformer primary voltage rating

B: 208 V	E: 480 V
C: 240 V	H: 220 V
D: 277 V	J: 380 V

3 Transformer secondary voltage rating, high side

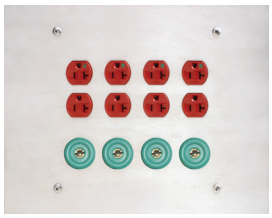
B: 208 V	C: 240 V

3 kVA rating, 120 V secondary

10: 10 kVA

GPM Series

Hospital grade power / ground modules for healthcare facilities



Features

- Hospital grade outlet devices for supply and grounding of portable equipment
- Configurable to contain combination of hospital grade power receptacles, hospital grade ground jacks, and/or aluminum or copper ground buses
- Available with ground bus only to serve as a collection point for room grounding conductors
- Designed in strict compliance with UL467, UL50, NFPA 70, and NFPA 99
- Available with stainless steel wall plates compatible with standard contractor supplied gang boxes
- Available built on a custom front trim for use in BENDER supplied backbox, flush or surface mounted
- Modules customized on wall plate can accomodate either one power receptacle or one ground jack per gang
- Modules customized on front trim can accomodate up to four sections, each section may be configured with: One power receptacle and one ground jack, one power receptacle, or two ground jacks
- Reference ground bus contains lug for use as a connection point to the system's equipotential ground

Build your isolated power system online

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

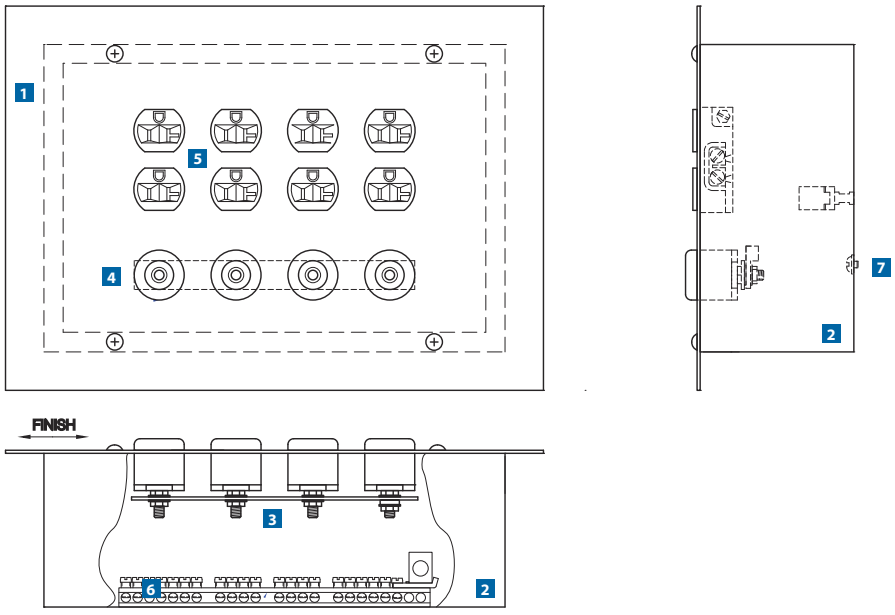
Ordering information

Ordering information is shown on the following pages. Modules built on a front trim must also include the backbox, ordered separately (part number B120804). Modules ordered on a wall plate do not include the gang box and must be supplied separately.

Accessories

Description	Type	Page
Backbox required for front trim modules	**B120804 (flush mounted)**	-
	B120804S (surface mounted)	-
Hospital grade ground cords	**HGC Series**	**2-30**
Hospital grade ground jacks	**HGJ Series**	**2-30**

Sample outline: Module front trim with backbox (example part numbers shown: GPM-F4DR4 and B120804)



1. Stainless steel faceplate, 14" x 10" (356 x 254 mm)
2. Backbox, galvanized steel, 12" x 8" x 4" (305 x 203 x 102 mm)
3. Equipotential grounding bus with lug
4. Hospital grade ground jacks
5. Hospital grade duplex receptacles
6. Ground bus
7. Backbox grounding connection

Ordering information: GPM module on front trim for use with backbox

*The total quantity of ground jacks and receptacles must be eight (8) or less. Additionally, the backbox (part number B120804) must be ordered separately.

GPM	-	F	4	DR	4
		1	2	3	4

1. Mounting
   - F: Flush
   - S: Surface
2. Quantity of ground jacks*
   - 0: Zero
   - 2: Two
   - 4: Four
   - 6: Six
   - 8: Eight
3. Type of receptacle
   - SR: Single, red
   - SI: Single, ivory
   - DR: Duplex, red
   - DI: Duplex, ivory
   - TB: Twist-to-lock, black
   - NN: None
4. Quantity of receptacles*
   - 0: Zero
   - 2: Two
   - 4: Four

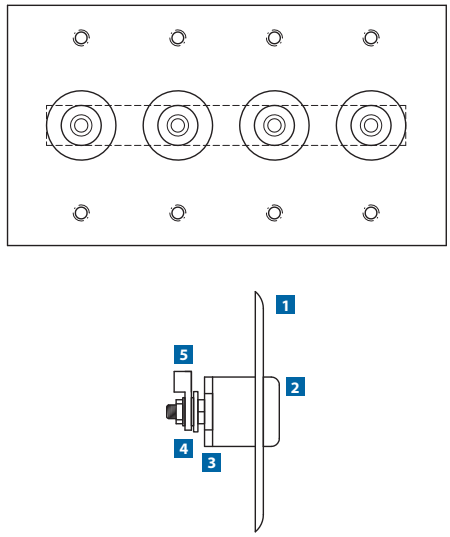
Typical configurations

Description	Part No.	Ordering No.
(4) 30A/250V green ground jacks and (4) 20A/125V red duplex receptacles	GPM-F4DR4	B 5213 00405
(4) 30 A/250V green ground jacks	GPM-F4NN0	B 5213 00349
Ground bus only	GPM-F0NN0	B 5213 01407

Accessories

Description	Type	Page
Backbox required for front trim modules	B120804 (flush mounted)	-
	B120804S (surface mounted)	-
Hospital grade ground cords	HGC Series	2-30
Hospital grade ground jacks	HGJ Series	2-30

Sample outline: Module wall plate (example part number shown: GPM-G4NN0)



1 Stainless steel gang plate, #4 brushed finish, 4-gang
2 Hospital grade ground jack (cap)
3 Hospital grade ground jack (body)
4 Equipotential ground bus
5 Incoming ground lug

Ordering information: GPM module on front trim for use with backbox

*The total quantity of ground jacks and receptacles must be eight (8) or less. Gang boxes are not supplied with the module.

GPM	-	G	4	N N	0
		1	2	3	4

1 Mounting
G: Gang plate

2 Quantity of ground jacks*
0: Zero
2: Two
4: Four
6: Six
8: Eight

3 Type of receptacle
SR: Single, red
SI: Single, ivory
DR: Duplex, red
DI: Duplex, ivory
TB: Twist-to-lock, black
NN: None

4 Quantity of receptacles*
0: Zero
2: Two
4: Four

Typical configurations

Description	Part No.	Ordering No.
4-gang with (4) 30A/250V green ground jacks	GPM-G4NN0	B 5213 01103
8-gang, with (4) 30A/250V green ground jacks and (4) 20A/125V red duplex receptacles	GPM-G4DR4	B 5213 00408

Accessories

Description	Type	Page
Hospital grade ground cords	HGC Series	2-30
Hospital grade ground jacks	HGJ Series	2-30

HGC / HGJ Series

Hospital grade ground jacks and ground cords

Features

- Hospital grade ground cords and ground jacks
- Various length cables available
- Highly flexible wire
- Available with either heavy duty clip or lug on one end (plug on other end)
- UL467 listed

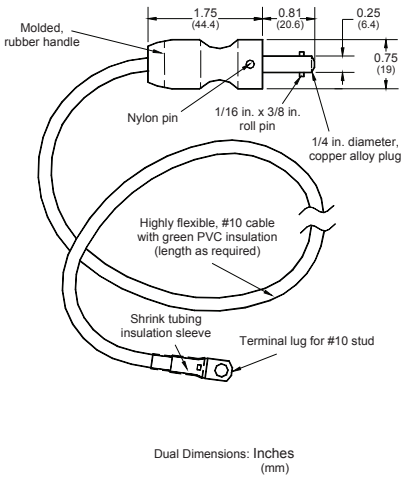
Build your isolated power system online

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

2

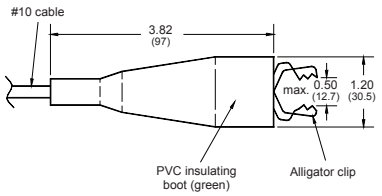
Dimensions in inches (mm)

Ground Cord with Lug End

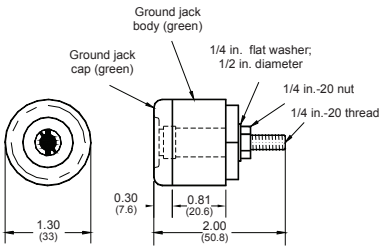


Dual Dimensions: Inches
(mm)

Ground Clip



Ground Jack



Mounting hole for ground jack: 1.00 in. (25 mm) diameter

Ordering information: Ground cords

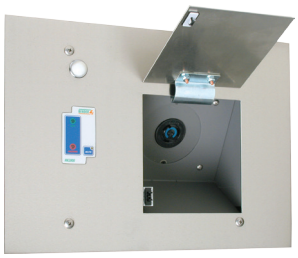
Description	Part No.	Ordering No.
10 ft, with plug and lug for #10 stud	HGC-10L	B 5213 00053
12 ft, with plug and lug for #10 stud	HGC-12L	B 5213 00195
15 ft, with plug and lug for #10 stud	HGC-15L	B 5213 00009
10 ft, with plug and heavy duty clip	HGC-10C	B 5213 01101
12 ft, with plug and heavy duty clip	HGC-12C	B 5123 01102
15 ft, with plug and heavy duty clip	HGC-15C	B 5213 00047

Ordering information: Ground jacks

Description	Part No.	Ordering No.
Hospital grade ground jack, green, 30A/250V	HGJ-1R	B 5213 00010

XRM Series

Hospital grade power receptacle module for x-ray and laser equipment



Features

- Hospital grade outlet for supply of power to x-ray and laser equipment in healthcare facilities
- Includes NEMA rated plug matched to the configuration of the x-ray / laser equipment
- Optional line isolation monitor remote indicator (MK2000 series) built into module
- Optional in-use indicating light
- Door contacts with limit switch
- Works in tandem with BENDER isolated power panel with PLC to activate/deactivate the receptacle
- Designed in strict compliance with UL standards
- Available built on a custom front trim for use in BENDER supplied backbox, flush or surface mounted

Build your isolated power system online

Visit www.bender.org/tools/isolated-power/ to use our simple, automated tools to build your isolated power solution online.

Ordering information

The backbox (part number B120804) must be ordered separately. Refer to remote indicator section of this catalog for detailed remote options.

XRM -	8	B	2	
	1	2	3	4

1 Receptacle type

1: Hubbell #IN16494	5: NEMA #650R
2: NEMA #615R	6: NEMA #L615R
3: NEMA #620R	7: NEMA #L620R
4: NEMA #630R	8: NEMA #L630R

2 Remote indicator type

N: No remote indicator	B: MK2000
C: MK2000C	D: MK2000CP
E: MK2000CBM	

3 Limit type

0: None	2: Door contact limiter, in-use lamp
1: Door contact limiter	

4 Mounting type

Nothing (blank): Flush	S: Surface

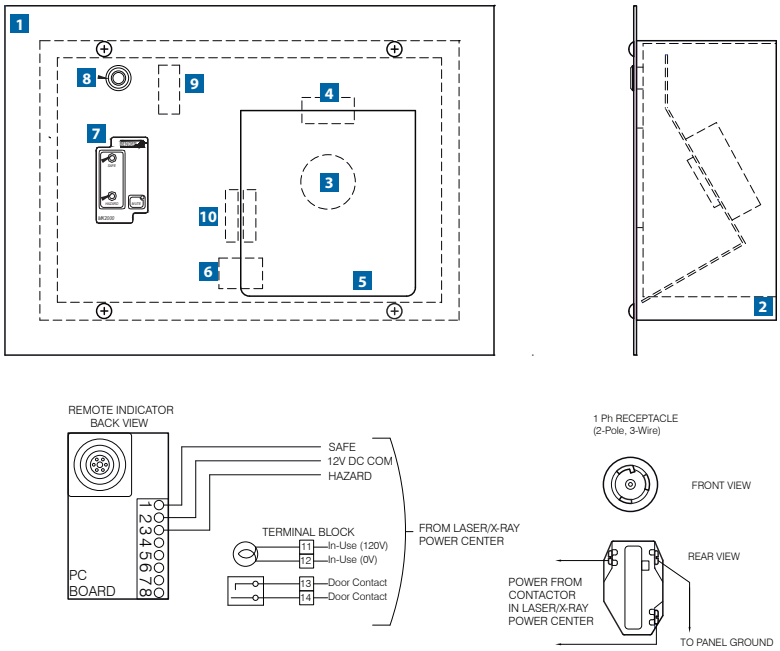
Typical configurations

Description	Part No.	Ordering No.
Hubbell IN16494 60A/240V receptacle, MK2000 remote, door switch control with in-use lamp	XRM-1B2	B 5213 01049
NEMA L6-30R, 30A/250V receptacle, MK2000 remote, door switch control with in-use lamp	XRM-8B2	B 5213 01051
NEMA L6-30R, 30A/250V receptacle, MK2000CBM digital remote, door switch control with in-use lamp	XRM-8E2	B 5213 01068

Accessories

Description	Type	Page
Backbox required for front trim modules	B120804 (flush mounted)	-
	B120804S (surface mounted)	-

Sample outline and wiring diagram: XRM module with remote indicator, door contact, and in-use lamp (sample part number: XRM-8B2)



1. Stainless steel faceplate, 14" x 10" (356 x 254 mm)
2. Backbox, galvanized steel, 12" x 8" x 4" (305 x 203 x 102 mm)
3. Receptacle (example shown: NEMA #L6-30R)
4. Concealed hinge
5. Hinged door
6. Touch latch
7. Remote indicator (example shown: MK2000)
8. In-use indicator
9. Terminal block
10. Magnetic door contact (closed door = open contact)

ZT1590 Series

Dual display digital clock and timer

ZT1590 digital clock and timer

Features

- Dual displays for 12/24 hour clock and elapsed timer
- Elapsed time in minutes/seconds, automatically carried over to hours/minutes
- All device features and setup carried out either by onboard pushbuttons or connected MK1550 clock remote
- Plugable connectors for simple installation
- Utilizes external Class 2 power supply for low voltage power
- Power outage backup for at least 24 hours, no batteries required
- ZT1590RS features complete assembly of clock and power supply, preinstalled in front trim with backbox

Approvals

c UL us LISTED

ZT1590RS clock assembly

Ordering information

Description	Part No.	Ordering No.
Dual digital clock/timer, pre-assembled with front trim, backbox, and power supply	ZT1590RS	B 5213 00297

Clock components and accessories

Description	Part No.	Ordering No.
Dual display digital clock/timer	ZT1590	B 5111 00012
Clock remote for ZT1590	MK1550	B 5111 00019
Backbox for ZT1590, 12″ x 8″ x 4″ (305 x 203 x 102 mm)	B120804	B 5213 00367
304SS front trim for ZT1590, 14″ x 10″ (356 x 254 mm)	T1410-LIM	P 1030 0003
Power supply with DIN rail 100 - 240 VAC input	CP-D 12/0.83	P 1380 0050

Technical data: ZT1590

Supply voltage requirements	Class 2 power supply
Class 2 power supply, voltage rating	12 VDC
Class 2 power supply, power rating	3 VA
Operating temperature	0 - +50 °C
Storage temperature	-10 - +70 °C

Connector

Quantity of connectors	10-pin / 3-pin
Manufacturer	Ria
Manufacturer part numbers	31114110 / 31114103
Conductor sizes	AWG 24 - 16

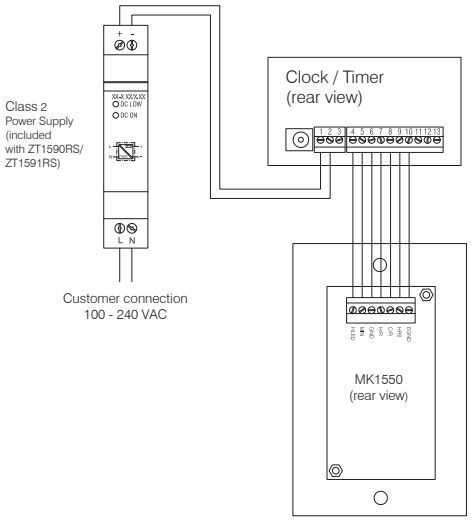
Other / general data

Mounting	Qty. 4, #4-40 oval head, black oxide finished screws
Weight	< 1.3 lb

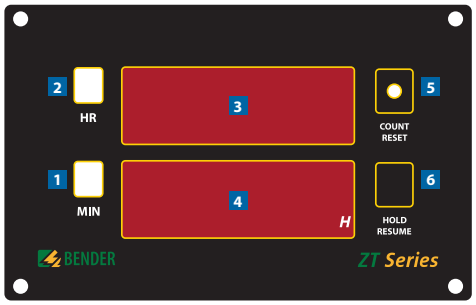
Additional technical data: ZT1590RS assembly

Backbox dimensions (H x W x D)	12″ x 8″ x 4″ (305 x 203 x 102 mm)
Weight	< 7.9 lb
Supply voltage U_s	100 - 240 VAC
Frequency range U_s	47 - 63 VAC
Inrush current (115 VAC / 230 VAC)	< 15 A / < 30 A

Wiring diagram

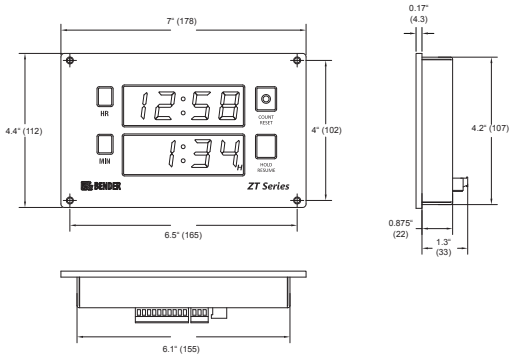


Displays and controls

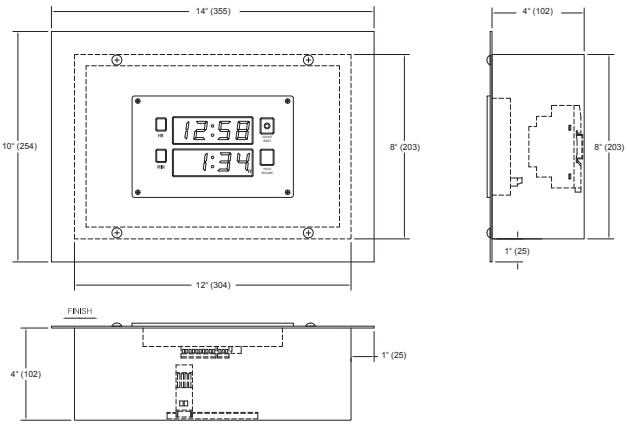


1 Minutes pushbutton
2 Hours pushbutton
3 Clock display, four digits
4 Elapsed timer display, four digits
5 Count and reset pushbutton
6 Hold and resume pushbutton

Dimensions: ZT1590 in inches (mm)



Dimensions: ZT1590RS in inches (mm)



ZT1591 Series
Digital clock / timer

ZT1591 digital clock / timer

Features

- Single, large display switchable between clock and elapsed timer
- 12/24 hour time
- Elapsed time in minutes/seconds, automatically carried over to hours/minutes
- All device features and setup carried out by externally connected MK1550 clock remote
- Plugable connectors for simple installation
- Utilizes external Class 2 power supply for low voltage power
- Power outage backup for at least 24 hours, no batteries required
- ZT1591RS features complete assembly of clock and power supply, preinstalled in front trim with backbox

ZT1591RS clock assembly

Approvals

c UL us LISTED

Ordering information

Description	Part No.	Ordering No.
Digital clock/timer, pre-assembled with front trim, backbox, and power supply	ZT1591RS	B 5213 01416

Clock components and accessories

Description	Part No.	Ordering No.
Dual display digital clock/timer	ZT1591	B 5213 01417
Clock remote for ZT1591	MK1550	B 5111 00019
Backbox for ZT1591, 12″ x 8″ x 4″ (305 x 203 x 102 mm)	B120804	B 5213 00367
304SS front trim for ZT1591, 14″ x 10″ (356 x 254 mm)	T1410-LIM	P 1030 0003
Power supply with DIN rail 100 - 240 VAC input	CP-D 12/0.83	P 1380 0050

Technical data: ZT1591

Supply voltage requirements	Class 2 power supply
Class 2 power supply, voltage rating	12 VDC
Class 2 power supply, power rating	3 VA
Operating temperature	0 - +50 °C
Storage temperature	-10 - +70 °C

Connector

Quantity of connectors	10-pin / 3-pin
Manufacturer	Ria
Manufacturer part numbers	31114110 / 31114103
Conductor sizes	AWG 24 - 16

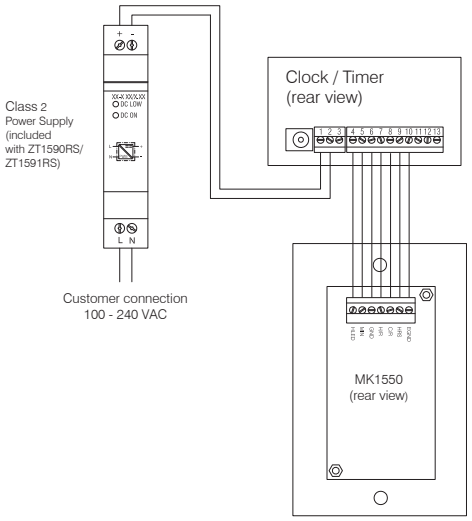
Other / general data

Mounting	Qty. 4, #4-40 oval head, black oxide finished screws
Weight	< 1.3 lb

Additional technical data: ZT1591RS assembly

Backbox dimensions (H x W x D)	12″ x 8″ x 4″ (305 x 203 x 102 mm)
Weight	< 7.9 lb
Supply voltage U_s	100 - 240 VAC
Frequency range U_s	47 - 63 VAC
Inrush current (115 VAC / 230 VAC)	< 15 A / < 30 A

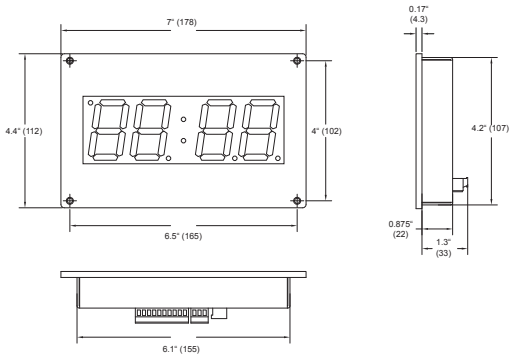
Wiring diagram



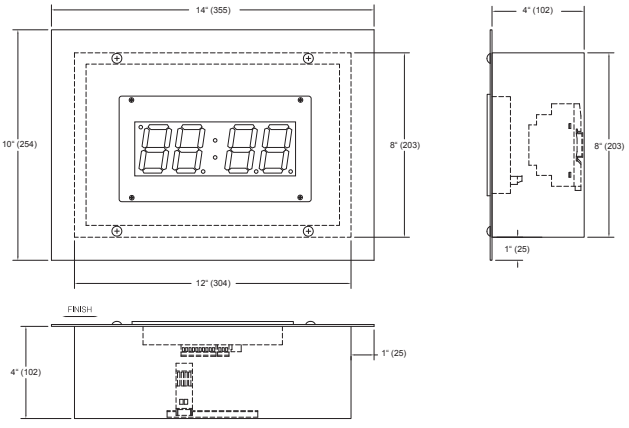
Displays and controls

All controls and setup are carried out using an externally connected MK1550 clock remote. Refer to MK1550 clock remote for more information.

Dimensions: ZT1591 in inches (mm)

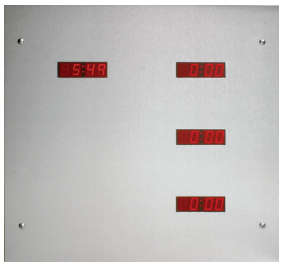


Dimensions: ZT1591RS in inches (mm)



ZT1594 Series

Digital chronometer



Features

- Single clock and three separate elapsed timers
- 12/24 hour time
- Elapsed time in minutes/seconds, automatically carried over to hours/minutes
- All device features and setup carried out by externally connected MK1554 clock remote
- Plugable connectors for simple installation
- Utilizes external Class 2 power supply for low voltage power
- Power outage backup for at least 24 hours, no batteries required
- ZT1594RS features complete assembly of clocks and power supplies, preinstalled in front trim with backbox

Approvals

c UL us LISTED

Ordering information

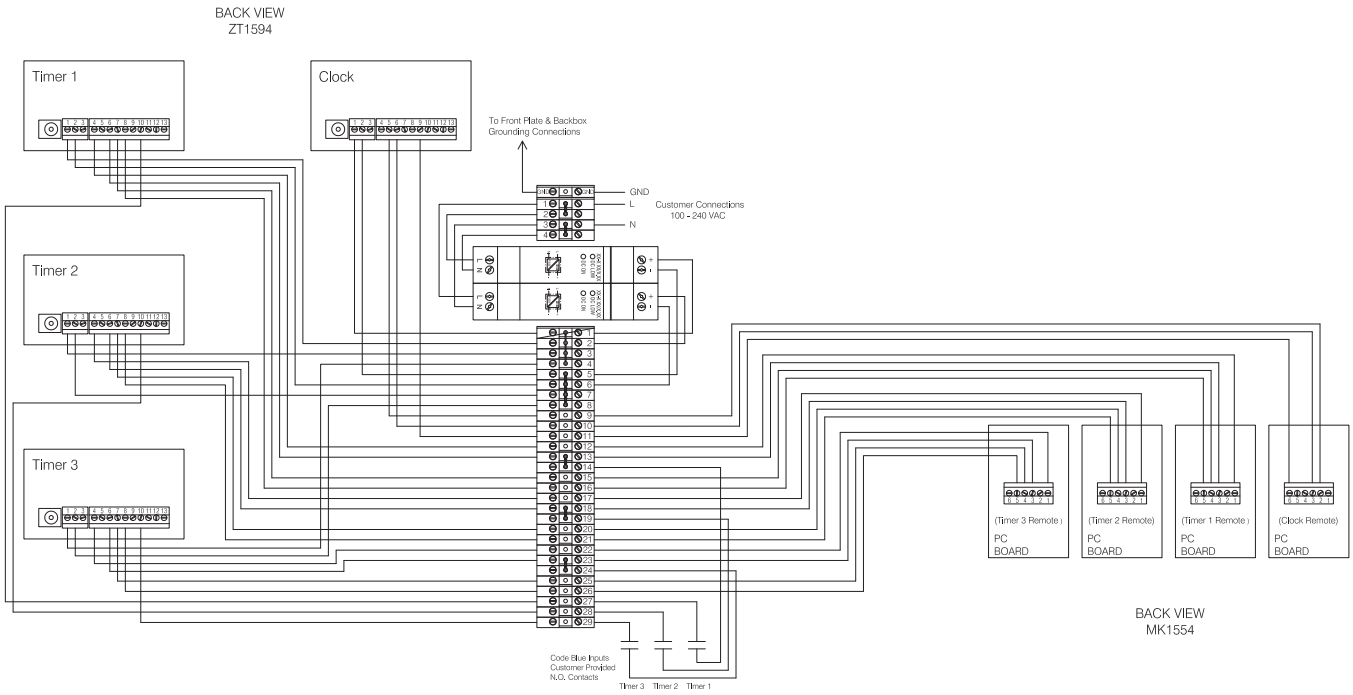
Description	Part No.	Ordering No.
Digital chronometer, preinstalled in backbox, with MK1554 chronometer remote	ZT1594RS	B 5213 00296

Clock components and accessories

Description	Part No.	Ordering No.
Digital chronometer only	ZT1594	B 5213 00293
Chronometer remote for ZT1594	MK1554	B 5213 00294
Backbox for ZT1594, 18" x 18" x 4" (457 x 457 x 102 mm)	B181804	P 1020 0063

Wiring diagram and layout

Most wiring is completed at the factory. Customer connections include 100 - 240 VAC power input to the designated power terminals, as well as connections 9 through 26 for chronometer remote connections. Terminals 27 through 29 are optional customer connections for N/O code blue inputs.



LT3000

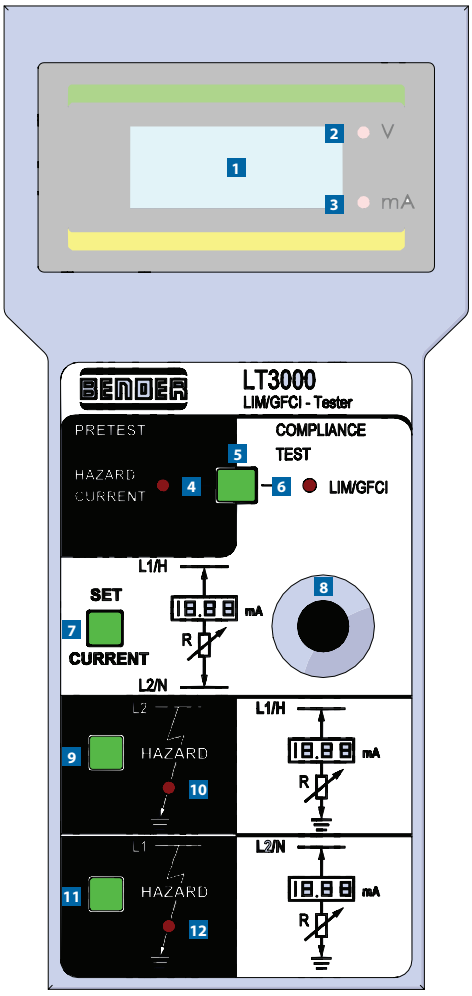
Portable LIM and GFCI tester

Features

- Line isolation monitor tester per NFPA 99 requirements (section 3-4.2.3.3.2)
- Tests total hazard current (THC) alarm level
- Operates on100 - 240 VAC systems, 50/60 Hz
- Plugs into wall outlets up to 240 V
- Large, digital LCD display
- Overload protection with automatic reset
- Easy to clean, rugged lexan front foil
- Twist-to-lock adapter
- Lightweight (less than 1 lb.)

2

Displays and controls



1 LCD display
2 LED "V" - indicates the value shown on the display is voltage (V)
3 LED "mA" - indicates the value shown on the display is current (mA)
4 LED "Hazard Current"
5 Button "Compliance Test"
6 LED "LIM/GFCI"
7 Button "Set Current"
8 10-turn potentiometer dial
9 Button "L2"
10 LED "L2 Hazard"
11 Button "L1"
12 LED "L1 Hazard"

Technical data

System ratings	
Rated system voltage	100 - 240 VAC
Rated system frequency	50 - 60 Hz
Response values	
Current set range (potentiometer) at 120 VAC	1.10 - 9 mA
Current set range (potentiometer) at 240 VAC	1.75 - 9 mA
Current magnitude required to activate HAZARD LEDs	2 or 5 mA internally, set at factory
Display	
Seven-segment display	3 digits, 0.5" size
Display resolution	0.01 mA / 1 V
Current accuracy	2% of reading =/- 0.03 mA
Voltage accuracy	2% of reading =/- 3 V

Plugs and accessories	
Plug type	Hospital grade, 2-pole, 3-wire, 15 A, 125V, straight-blade
Carrying case dimensions	17"W x 12"H x 3.75"D
Adapter accessories	Hospital grade, 2-pole, 3-wire, 20 A, 125V, twist-to-lock
General data	
Operational temperature range	+23 ºF to + 122 ºF (- 5 ºC to + 50 ºC)
Power consumption at 120 VAC	1 W
Power consumption at 240 VAC	2 W
Operation at 120 VAC	Continuous
Operation at voltages ≥ 208 VAC	15 minute intervals

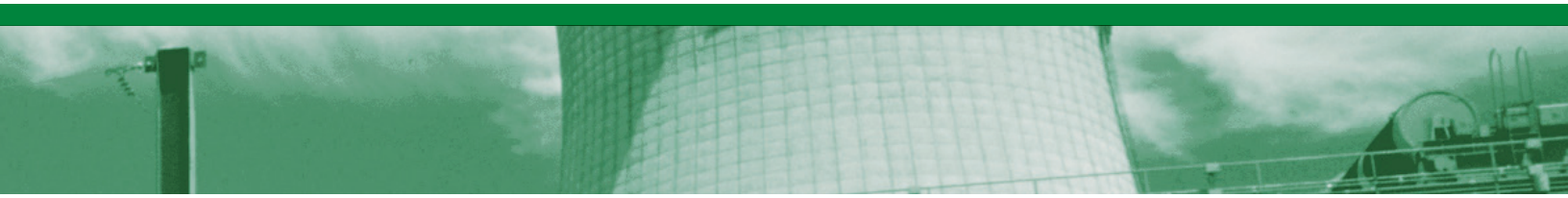
Ordering information

Type	Includes LT3000	Accessories Included	Ordering No.
LT3000 Kit	Yes, terminated with NEMA 5-15P	Carrying case, adapter for 2300HG receptacle	**B 5213 00004**
LT3000 Set	Yes, terminated with NEMA 5-15P	None	**B 5213 00295**

Ground Fault Location Equipment for Ungrounded and Isolated Power Systems

	iso685-D-P	LIM2010	EDS440 / EDS441	EDS151	EDS3090
					

Page		1-06	2-19	3-04	3-12	3-15
Use / Installation		Installed	Installed	Installed	Installed	Portable
For general purpose industrial use, including industrial facilities, ships, and power plants		■		■		■
For use in isolated power systems for healthcare facilities			■	■	■	
Device function		Ground fault detector and installed location system controller	Line isolation monitor and installed location system controller	Branch ground fault location modules	Branch ground fault location module	Portable branch fault location system
Communication compatible		■	■	■	■	
System voltage type	Three-phase AC	■		■		
	Single-phase AC	■	■	■	■	
	Mixed AC/DC	■		■	■	
	DC	■		■	■	
Max. system voltage (U_n), V		dependent on type	100 - 240 VAC (on secondary of isolation transformer)	dependent on type	20 - 276 VAC 20 - 308 VDC	dependent on type
System leakage capacitance (C_e), µF		≤ 500 (varies by profile)	≤ 5	See characteristic curve	See characteristic curve	See characteristic curve
Response value (R_{an}), kΩ		1 kΩ - 10 MΩ	50 - 500 kΩ	See characteristic curve	See characteristic curve	See characteristic curve
Installation	DIN rail	■		■		
	Screw mount	■	■	■	■	
	Panel mount	■				



Accessories for Ground Fault Location Equipment

			Type					
			iso685-D-P	LIM2010	EDS440	EDS441	EDS151	EDS3090
			Page					
			1-06	2-19	3-04	3-04	3-12	3-15
	Type	P.	Applicable Accessories					
Voltage coupler for pulse generator module	AGE185	3-21						■
Connector plate	CP-LIM2010	2-19		■				
External meters Remote indicators Remote stations	MK2000	6-08		■				
	MK800	6-14	■	■	■	■	■	
	MK2430	6-19	■	■	■	■	■	
	CP700	6-32	■	■	■	■	■	
External current transformers	W series	7-06				■		
	W-8000 series	7-06			■			
	WR series	7-13				■		
	WS series	7-15				■		
	STW3	7-20		■				
Power supplies	CP-D 24/0.42	7-21					■	
Comm. gateways	COM465IP	6-24	■	■	■	■	■	
	COM462RTU	6-30	■	■	■	■	■	
Large clamp	PSA3165	3-15						■

EDS440 / 441 Series

Branch ground fault location modules for ungrounded single- and three-phase AC/DC systems

Features

- Ground fault location in ungrounded single- and three-phase AC and DC systems
- Locate ground faults in ungrounded systems while the system remains online
- Up to twelve (12) separate branches / channels monitored in parallel
- Utilizes external current transformers for locating ground faults
- "L" models - multiple devices connected via RS-485
- "S" models - direct connection to iso685-D-P ground fault detector via backbone bus connection
- Tracer signal response sensitivity: EDS440 (2 - 10 mA), EDS441 (0.2 - 1 mA)
- 2 SPDT alarm contacts
- Latching or non-latching operation, selectable
- Connection for external test/reset button
- LED indication for "L" models, "S" models have all indication centralized on connected iso685-D-P
- Supports connection to BENDER remote indicating stations and remote communication system
- Continuous connection monitoring for current transformers
- Simultanously measures for possible AC ground fault current

EDS441 modules as well as current transformers are available as a built-in option in Bender's isolated power panels for healthcare facilities. All related interior wiring is completed at the factory and simple terminals are available for landing branch connections.

Applications

- Online ground fault location in ungrounded single- and three-phase AC and DC systems
- Industrial power distribution
- Ships and offshore plants
- Power plants
- Isolated power systems in health-care facilities

Approvals

c UL us LISTED

PCT AE25

Lloyd's Register TYPE APPROVED

Ordering information

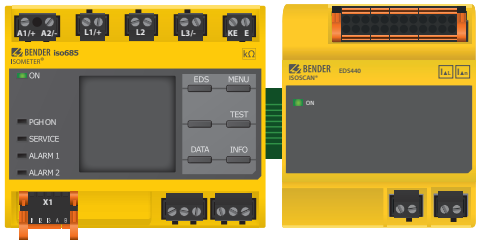
Supply voltage U_S [1] AC/DC	Applications	Tracer signal response value	Compatible fault detectors	Installation type	Type	Ordering no.
24 - 120 V	Main distribution systems	2 - 10 mA	iso685-D-P	Snap-in connection	**EDS440-S-1**	**B 9108 0201**
			iso685-D-P, IRDH575	RS-485	**EDS440-L-4**	**B 9108 0202**
	Control systems, isolated power systems	0.2 - 1 mA	iso685-D-P	Snap-in connection	**EDS441-S-1**	**B 9108 0204**
			iso685-D-P, IRDH575, LIM2010	RS-485	**EDS441-L-4**	**B 9108 0205**

Accessories

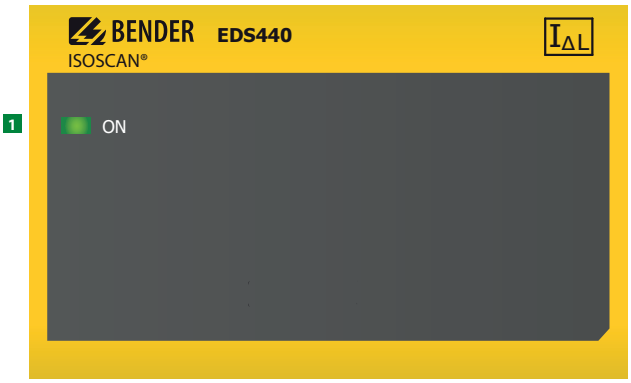
Function	Use	Compatible Devices	Type	Page
Communication gateways	Ethernet and Modbus/TCP	All	**COM465IP**	**6-24**
	Modbus/RTU	All	**COM462RTU**	**6-30**
External current transformers	Fault location measurements	EDS440	**W series**	**7-06**
		EDS441	**W-8000 series**	**7-06**

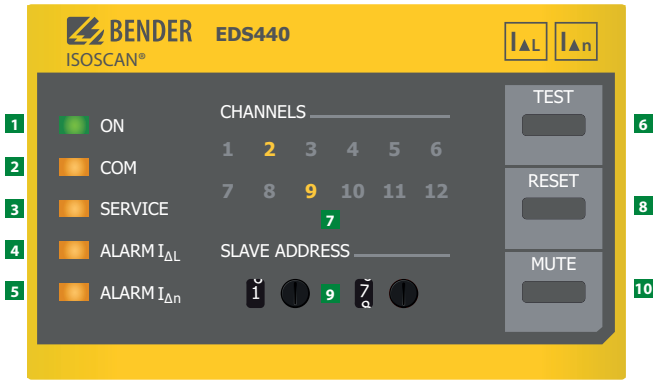
EDS440-S / EDS441-S: Snap-in connection to iso685-D-P ground fault detector

- Simple snap-in connection to iso685 ground fault detector
- Stack multiple EDS devices with snap-in connectors to add additional monitoring channels
- Centralized settings and alarms - all settings and alarm indications shown on connected iso685 or remote communication system
- Ideal for new iso685 installations where devices are located in the same cabinet



Displays and controls





EDS440-S / EDS441-S

For direct connection to iso685-D-P

1. Power "ON" LED (green): Illuminates when device is powered. During startup, LED flashes until device is ready for operation.
2. "COM" LED (yellow): Illuminates when fault location is active and communication is running.
3. "SERVICE" LED (yellow): Flashes when a device error has occured (internal device fault, bad current transformer, connection, etc.).
4. "Alarm IΔL" (yellow): Illuminates when a fault has been located on one of the active channels.
5. "Alarm IΔS" (yellow): Illuminates when the additional ground fault current measurement alarm has activated (factory default 10 A).

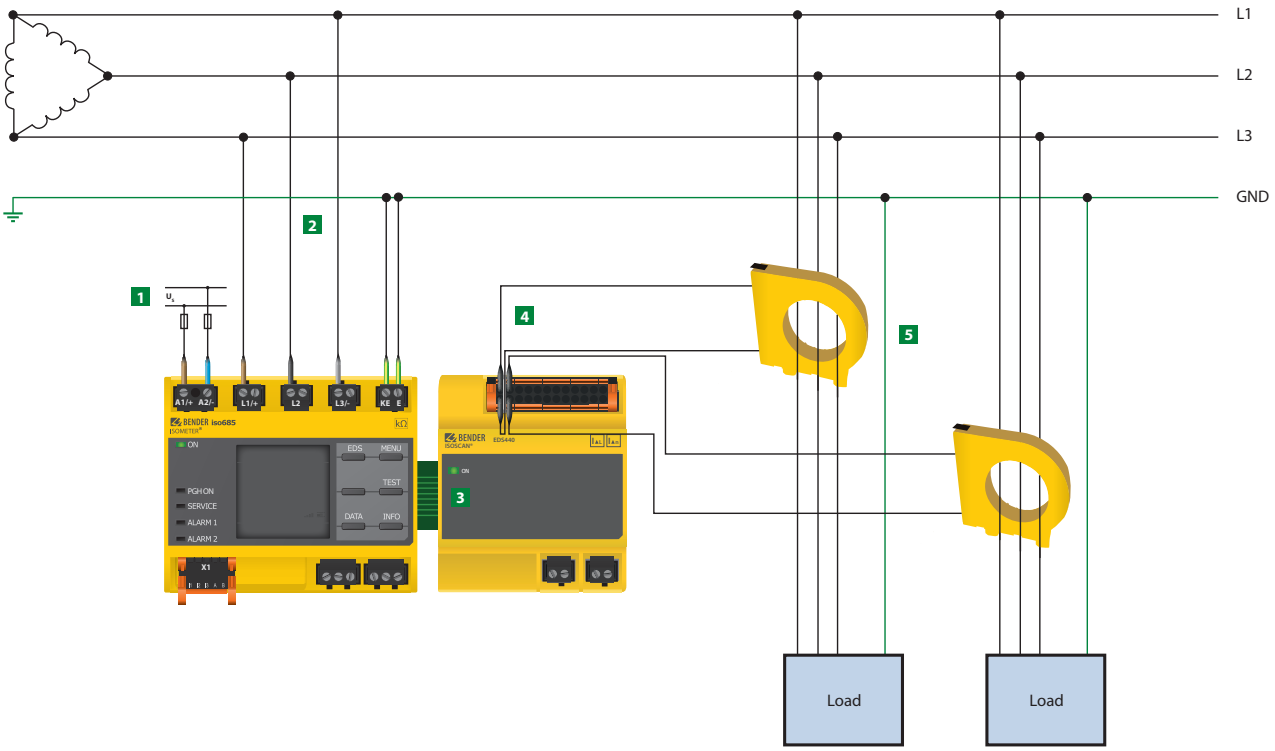
EDS440-L / EDS441-L

For installation with other monitors, or for remote installation

6. "TEST" button: Initiates device self-test.
7. Individual channel LEDs (yellow): Each individual LED illuminates when a ground fault has been detected on the respective channel. In the example shown, ground faults have been detected on channels 2 and 9.
8. "RESET" button: Resets active alarms if the device is set to latching operation and the ground fault has been cleared.
9. "SLAVE ADDRESS": Sets the RS-485 address of the device for the Bender communication bus.
10. "MUTE" button: Muts the audible alarm.

Wiring diagram: Connecting EDS440-S to iso685-D-P using snap-in connector on a three-phase AC system

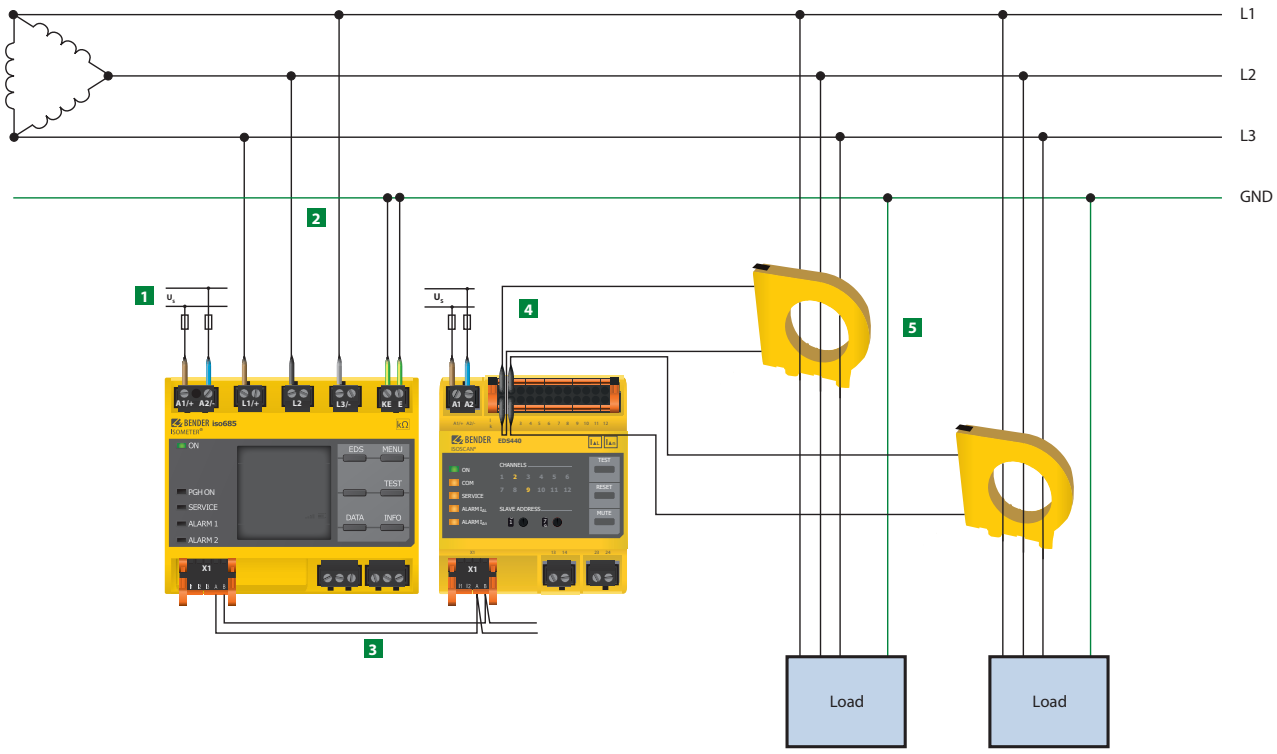
Up to two (2) EDS440-S devices may connect to a single iso685-D-P using the snap-in connector. This connection schematic is ideal for installations where the EDS440 modules will be located in the same cabinet as the iso685.



1. Supply voltage used to power iso685 and connected EDS440-S. Use 24-240 V, AC or DC (42 - 460 Hz). Fusing is required.
2. System connections for iso685
3. Snap-in connection for iso685 and EDS440-S. Up to two (2) EDS440-S devices may connect to a single iso685.
4. Current transformer connections to EDS440. Up to twelve (12) current transformers may connect to a single EDS440.
5. System conductor routings for current transformers. All system conductors must be centrally routed through the single current transformer for each branch. The ground conductor must NOT be routed through the current transformer.

Wiring diagram: Connecting EDS440-L to iso685-D-P on a three-phase AC system

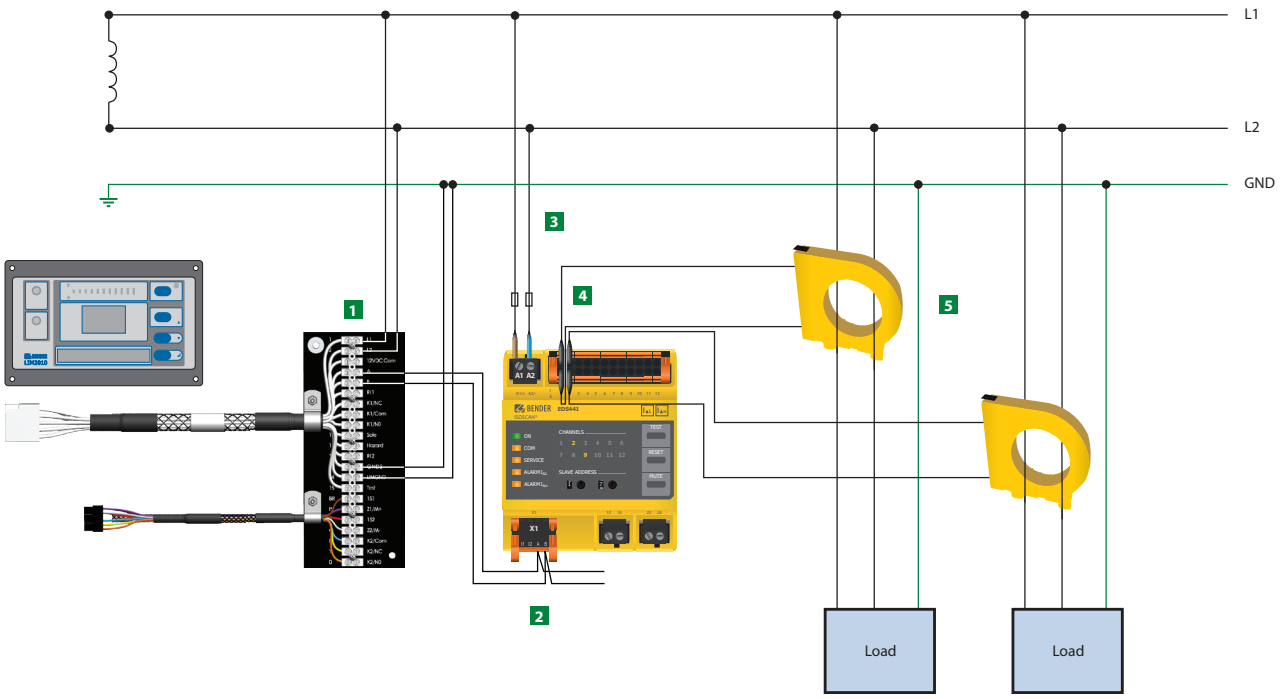
This connection schematic is ideal for installations where the EDS440 is installed in a separate cabinet or location. This device is also utilized with compatible Bender ground fault monitors other than the iso685, such as the IRDH575.



1. Supply voltage used to power iso685 and EDS440-L. Use 24-240 V, AC or DC (42 - 460 Hz). Fusing is required.
2. System connections for iso685
3. RS-485 connection for communication between devices. Additional Bender devices are connected in a daisy chain configuration.
4. Current transformer connections to EDS440. Up to twelve (12) current transformers may connect to a single EDS440.
5. System conductor routings for current transformers. All system conductors must be centrally routed through the single current transformer for each branch. The ground conductor must NOT be routed through the current transformer.

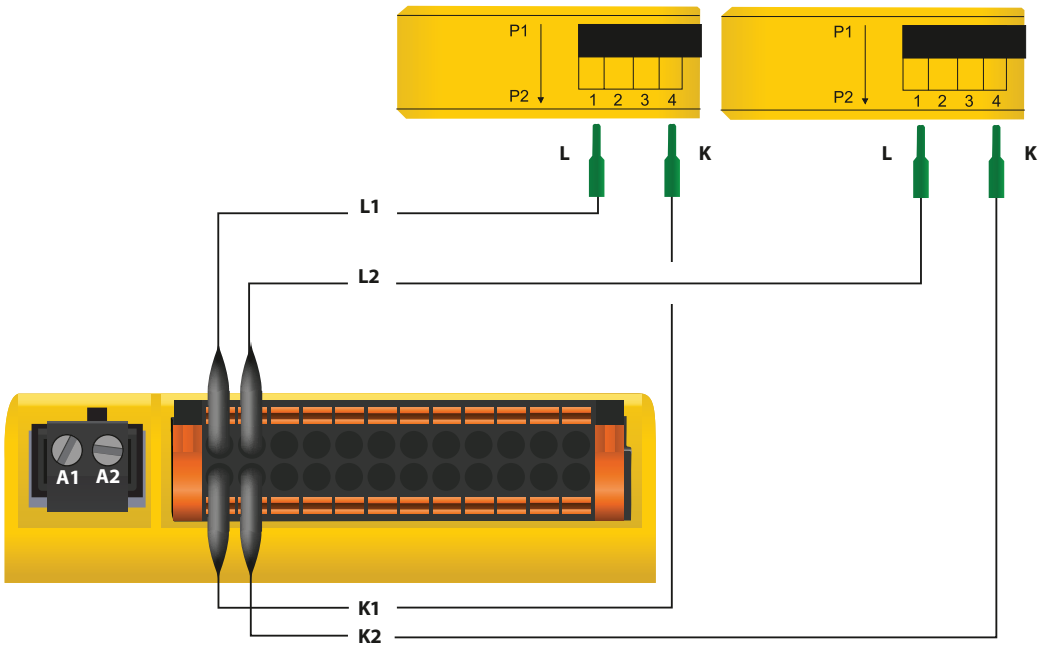
Wiring diagram: Conhnecting EDS441-L to LIM2010 in an isolated power system

Only EDS441-L models and compatible current transformers may be used with the LIM2010. Connections are made through the LIM2010 connector plate. Only basic connetions are shown for LIM2010. When using this device combination, device settings such as active channels and tracer signal alarm levels must be set at the factory. Contact Bender for more infomration.

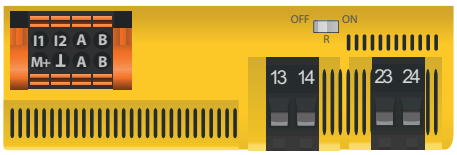


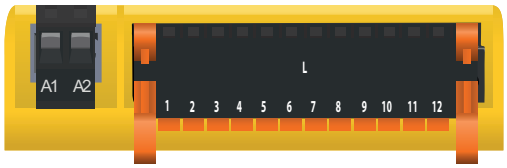
1. System connections for LIM2010 via the connector plate. The device is powered from the monitored system.
2. RS-485 connection for communication between devices. Additional Bender devices are connected in a daisy chain configuration.
3. Supply voltage used to power EDS441-L. Use 24 - 240 V, AC or DC (42 - 460 Hz). Fusing is required. Typical installations power EDS441 modules from the monitored system, as shown in illustration. When powering from an isolated power system, both lines must be fused.
4. Current transformer connections to EDS441. Up to twelve (12) current transformers may connect to a single EDS441.
5. System conductor routings for current transformers. All system conductors must be centrally routed through the single current transformer for each branch. The ground conductor must NOT be routed through the current transformer.

Wiring diagram: Current transformers



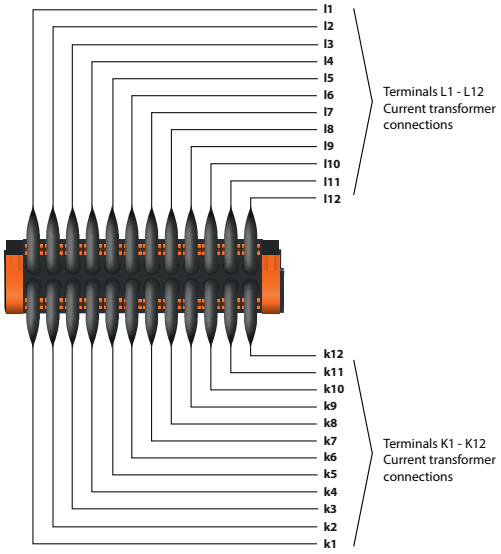
Wiring diagram: X1 interface





I1 Input 1
I2 Input 2
A RS-485 A (Input)
B RS-485 B (Input)

B RS-485 B (Output)
A RS-485 A (Output)
⊥ Ground
M+ Digital Output



3

Insulation coordination

Rated insulation voltage	AC 250 V
Rated impulse withstand voltage	6 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	3.51 kV

Supply voltage

Supply voltage U_S	AC/DC 24 - 240 V
Tolerance	-20 to +15 %
Frequency range	DC, 42 - 460 Hz [1]
Power consumption, typically 50/60 Hz (460 Hz)	3 W/7 VA (4 W, 28 VA)

Response values

Response value, fault location tracer signal ($I_{\Delta L}$) EDS440	2 - 10 mA
Response value, fault location tracer signal ($I_{\Delta L}$) EDS441	0.2 - 1 mA
Relative uncertainty ($I_{\Delta L}$) EDS440	± 30 %, ± 2 mA [2]
Relative uncertainty ($I_{\Delta L}$) EDS441	± 30 %, ± 0.2 mA [2]
Response value, fault current measurement ($I_{\Delta n}$) EDS440	100 mA - 10 A (10 A)*
Response value, fault current measurement ($I_{\Delta n}$) EDS441	100 mA - 1 A (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 %

Response times

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

Measuring circuit

Nominal system voltage U_n EDS440	refer to locating current injector (iso685-D-P)
Nominal system voltage U_n EDS441	AC 20 - 276 V, DC 20 - 308 V
Supported current transformers, EDS440	W - , WR - , WS -
Supported current transformers, EDS441	W - /8000, WS - /8000
Supported current transformers, EDS441-LAB	W - AB
Load EDS440	47 Ω
Load EDS441	1.5 Ω
Rated insulation voltage (current transformer)	800 V

Connection: EDS to current transformers

Single wire ≥ AWG 18 (0.75 mm²)	0 - 3 ft (0 - 1 m)
Single wire, twisted ≥ AWG 18 (0.75 mm²)	10 - 30 ft (1 - 10 m)
Shielded cable ≥ AWG 19 (0.5 mm²)	30 - 130 ft (10 - 40 m)
Recommended cable (shielded, shield connected to GND on one side)	20 J-Y (St) Y min. x 2x0.8

Measuring ranges

Rated system frequency	DC, 42 - 1000 Hz [3]
Measuring range, fault location signal ($I_{\Delta L}$) EDS440	1.5 - 25 mA (50 mA in DC systems)
Measuring range, fault location signal ($I_{\Delta L}$) EDS441	0.15 - 5 mA
Measuring range, fault current measurement ($I_{\Delta n}$) EDS440	100 mA - 20 A
Measuring range, fault current measurement ($I_{\Delta n}$) EDS441	100 mA - 2 A

LEDs

ON (operation LED)	green
COM	yellow
SERVICE	yellow
ALARM $I_{\Delta L}$	yellow
ALARM $I_{\Delta n}$	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, alarm $I_{\Delta L}$, alarm $I_{\Delta n}$, device fault, transformer connection fault, common alarm
Current	0 mA DC inactive, 20 mA DC active
Tolerance	±10 %

Buzzer

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

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. 2x0.8
Connection	X1.A, X1.B
Terminating resistor	120 Ω, can be connected internally
Device address, BMS bus	2 - 90

Switching elements

Number	2 N/O contacts
Operating mode	N/C operation/N/O operation
Function contact 13,14	none, alarm $I_{\Delta L}$, alarm $I_{\Delta n}$, device fault, transformer connection fault, common alarm
Function contact 23,24	none, alarm $I_{\Delta L}$, alarm $I_{\Delta n}$, 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, 50121-3-2, 50121-4
Ambient temperature	
Operating temperature	-40 to +158 °F (-40 to +70 °C)
Transport	-40 to +185 °F (-40 to +85 °C)
Storage	-13 to +158 °F (-25 to +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
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	≤ 3600 ft (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 ferrule 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:	
Conductor sizes	AWG 24-12
Stripping length	10 mm
Rigid/flexible	0.2 - 2.5 mm^2
Flexible with ferrule 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, 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 ferrule with plastic sleeve	0.25 - 0.75 mm^2

Other	
Operating mode	continuous operation
Mounting	at an ambient temperature > 131 °F (55 °C) vertical mounting required at an ambient temperature < 131 °F (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. 0.25 lb (122 g) (EDS44x-S) approx. 0.5 lb (242 g) (EDS44x-L)

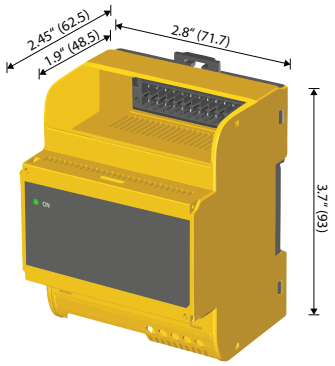
( )* Factory setting

[1] at a frequency >60 Hz, connection of k1 - 12, l1 - 12, M+, GND, I1 and I2 must be insulated.
Min. according to overvoltage category 2 (300 V).

[2] Effect of fault currents > 100 mA results in a greater response uncertainty.

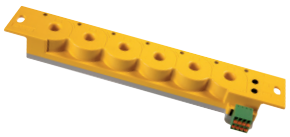
[3] The $I_{\Delta n}$ function of the EDS441 series is suitable for 50/60 Hz only.

Dimensions in inches (mm)



EDS151

Ground fault location module with integrated current transformers for ungrounded AC/DC systems



Applications

- Ground fault location in ungrounded AC/DC systems
- Ground fault location in small ungrounded systems and isolated power systems for healthcare facilities

Approvals

Features

- Ground fault location in ungrounded AC/DC systems and isolated power systems
- Six individual measuring channels with integrated current transformer
- Multiple modules may be interconnected with RS-485
- Response sensitivity EDS150: 5 mA, EDS151 0.5 mA
- A response time of up to 8 s in the AC system acc. to IEC 61557-9
- RS-485 interface
- Ability to connect to BENDER remote indicating stations and remote communication system
- Cyclical self test
- Simultaneously measures for possible AC ground fault current

EDS151 modules are available as a built-in option for BENDER's isolated power panels for healthcare facilities. All related interior wiring is completed at the factory and simple terminals are provided for landing branch connections.

3

Ordering information

Measuring range for tracer signal	Response value for tracer signal	Supply voltage [1] U_S		Type	Ordering No.
		DC	AC		
5 - 25 mA	5 mA	14 - 28 V	17 - 24 V (50/60 Hz)	**EDS150**	**B 9108 0103**
0.5 - 2.5 mA	0.5 mA			**EDS151**	**B 9108 0101**

[1] Absolute values

Accessories

Description	Supply voltage	Output voltage	Explanation	Type	Page
Power supply	AC 90 - 264 V (47 - 63 Hz) / DC 120 - 370 V	DC 24 V, 420 mA	Class 2 power supply for up to 6 EDS150/151 modules	**CP-D 24/0.42**	**7-21**

[1] Absolute values

When used in isolated power systems for healthcare faciltiies, only a Class 2 power supply may be used for supplying power to the EDS151. The model listed above is a Class 2 power supply.

Technical data

Insulation coordination acc. to IEC 60664-1/IEC 60664-3	
Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	6 kV/3

Voltage ranges	
Monitored system:	
Nominal system voltage U_n	see IRDH575, PGH (EDS150) AC 20 - 276 V, DC 20 - 308 V (EDS151)
Nominal frequency f_n	42 - 460 Hz
Supply voltage:	
Supply voltage U_S	AC 17 - 24 V, DC 14 - 28 V
Frequency range of the supply voltage	50 - 60 Hz
Power consumption AC	≤ 3 VA
Power consumption DC	≤ 1.5 VA

Measuring circuit	
Number of measuring channels (per device/system)	6/528
EDS function:	
Response value	EDS150: 5 mA EDS151: 0.5 mA
Relative uncertainty	± 30 %
Rated frequency	42 - 460 Hz
Measuring range EDS function	EDS150: 5 - 25 mA, EDS151: 0.5 - 2.5 mA
Response time in the AC system acc. to IEC 61557-9	≤ 8 s
Scanning time for all channels	approx. 72 s
RCM function:	
Response value	EDS150: 10 A EDS151: 1 A
Relative uncertainty	± 30 %
Frequency range	42 - 68 Hz

Displays	
LEDs:	
ON/COM, green	operation indicator/bus activity
Alarm K1 - K6, yellow	EDS and RCM function

Interface	
Interface/protocol	RS-485/BMS
Connection	terminals A/B
Cable (twisted pair, one end of shield connected to PE)	two-core, recommended: J-Y(St)Y min. 2 x 0.8
Cable length	≤ 1200 m
Terminating resistor	120 Ω (0.25 W)
Device address, BMS bus	3 - 90 (3)*

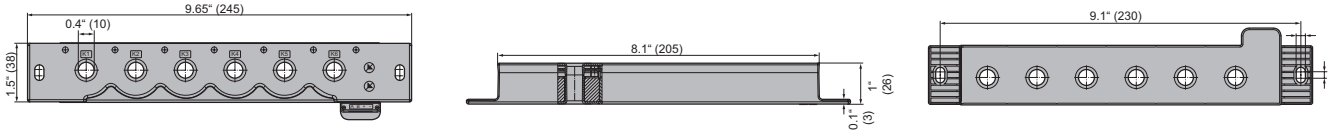
Environment/EMC	
EMC	IEC 61326-2-4
Operating temperature	-25 - +55 °C
For UL application:	
Maximum ambient temperature 55 °C	
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (except condensation 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

Connection	
Connection type	pluggable push-wire terminal
For UL applications:	
Only use 60/75°C copper conductors!	
Connection rigid /flexible/conductor sizes	0.2 - 1.5 mm² (AWG 24 - 16)
Multi-conductor connection (2 conductors of the same cross section)	
rigid	0.2 - 1.5 mm²
flexible	0.2 - 1.5 mm²
flexible with ferrule without plastic sleeve	0.25 - 1.5 mm²
flexible with ferrule with plastic sleeve	0.25 - 0.75 mm²
Stripping length	10 mm

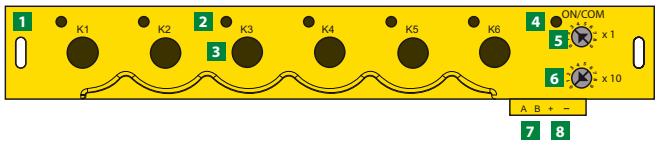
Other	
Operating mode	continuous operation
Position of normal use	any
Enclosure material	polycarbonate
Flammability class	UL94 V-0
Screw mounting	2 x M6
Tightening torque	1.5 Nm
Software version	D353 V1.0x
Weight	≤ 340 g

( )* = factory setting

Dimensions in inches (mm)

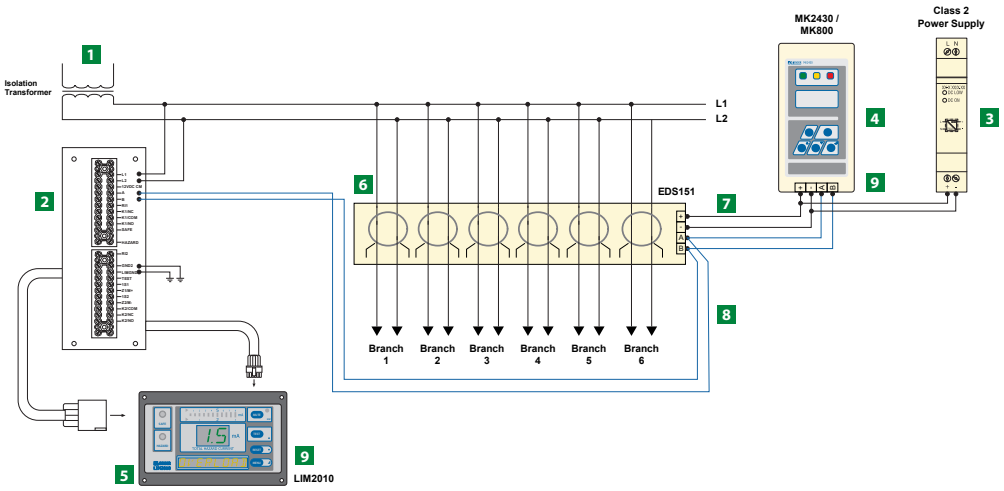


Displays and controls



1 Opening for screw mounting
2 Alarm LEDs measuring channels "K1 - K6"
3 Opening for individual current transformers. All active conductors of the branch must be placed through the opening.
4 "ON/COM" LED: Power On LED and bus activity
5 Set the ones position of the RS-485 address
6 Set the tens position of the RS-485 address
7 Supply voltage connection
8 RS-485 connection

Wiring diagrams and example application - use in isolated power system



1 Isolation transformer
2 Connector plate for line isolation monitor
3 Class 2 power supply
4 MK2430 / MK800 remote indicating station for visual and audible status of EDS151
5 LIM2010 line isolation monitor and fault location system controller
6 EDS151 ground fault location module
7 Supply voltage U_S DC 24 V
8 RS-485 interface
9 Terminating resistor BMS bus (120 Ω, internally connected)

EDS3090 Series

Portable ground fault location system for ungrounded single- and three-phase AC/DC systems

Applications

- Ground fault location in ungrounded AC/DC systems
- Large distribution networks
- Systems with high number of loads
- Systems with or without installed BENDER ground fault detection equipment

Features

- Portable ground fault location system for ungrounded AC (up to 790 VAC, 42 - 460 Hz) and DC (up to 960 V) systems
- Locate ground faults with portable equipment while the system remains online
- Offline fault location also available
- Additionally capable of measuring and locating ground fault current in grounded and HRG systems
- Various size clamps included and available
- Robust aluminium case, convenient to carry
- EDS3090PG and EDS3091PG series kits include pulse generation kit and are designed for completely standalone portable fault location
- EDS3090 and EDS3091 series kits are designed for use with installed Bender equipment, including iso685-D-P / IRDH575 ground detectors and LIM2010 line isolation monitor
- Integrated locating voltage for de-energized / offline systems (PGH186, included with EDS3096PG and EDS3092PG systems)

EDS195P portable fault location evaluator

- Backlit LCD display, 3 x 16 characters
- Connects to varying size clamps and kit types (see ordering information), automatic detection of clamp type
- Rechargable battery with power supply, microUSB connection
- Switch between fault location for ungrounded systems and fault current measurement for grounded and HRG systems

3

Ordering information

Application	Kit type	Nominal voltage U_n		Supply voltage U_S	Supports AGE185 coupler	Type	Ordering No.
		AC	DC	AC			
Main distribution	Works with installed equipment	20 - 575 V (42 - 460 Hz)	20 - 504 V	–		EDS3090	B 9108 2026
	Standalone	20 - 575 V (42 - 460 Hz)	20 - 504 V	230 V (50/60 Hz)	■	EDS3090PG	B 9108 2021
				90 - 132 V (50/60 Hz)	■	EDS3090PG-13	B 9108 2022
Offline systems	Standalone	0 - 575 V (42 - 460 Hz)	0 - 504 V	230 V (50/60 Hz)	■	EDS3096PG	B 9108 2025
				90 - 132 V (50/60 Hz)	■	EDS3096PG-13	B 9108 2029
Small systems, healthcare facilities	Works with installed equipment	20 - 265 V (42 - 460 Hz)	20 - 308 V	–		EDS3091	B 9108 2027
	Standalone	20 - 265 V (42 - 460 Hz)	20 - 308 V	230 V (50/60 Hz)		EDS3091PG	B 9108 2023
				90 - 132 V (50/60 Hz)		EDS3091PG-13	B 9108 2024

Accessories

Description	Nominal voltage U_n		Type	Page
	AC	DC		
115 mm measuring clamp	–	–	PSA3165	–
Voltage couplerto extend range of PGH185 and PGH186	500 - 790 V (42 - 460 Hz)	400 - 960 V	AGE185	3-21
Accessories for fault location in diode-decoupled systems	–	–	EDS165-SET	–

Scope of delivery

Hand-held evaluator	Current injection module	20 mm clamp	52 mm clamp	Type
EDS195P	–	PSA3020	PSA3052	EDS3090
EDS195P	PGH185	PSA3020	PSA3052	EDS3090PG
EDS195P	PGH185-13	PSA3020	PSA3052	EDS3090PG-13
EDS195P	PGH186	PSA3020	PSA3052	EDS3096PG
EDS195P	PGH186-13	PSA3020	PSA3052	EDS3096PG-13
EDS195P	–	PSA3320	PSA3352	EDS3091
EDS195P	PGH183	PSA3320	PSA3352	EDS3091PG
EDS195P	PGH183-13	PSA3320	PSA3352	EDS3091PG-13

Technical data: EDS3090 system

The technical data listed in this chapter apply to the components: PGH18 - , EDS195P, AGH185.

Environment/EMC	
EMC	IEC 61326-2-4
Operating temperature	-10 - +55 °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)
Storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Other	
Operating mode	continuous operation
Position of normal use	any
Operating manual	TGH1420
Weight EDS309 -	≤ 7000 g
Weight EDS309 - with PSA3165	≤ 8500 g
Weight EDS3092	≤ 9000 g
Dimensions W x H x D	430 x 340 x 155 mm

Technical data PGH18 -

Insulation coordination acc. to IEC 60664-1/ IEC 60664-3	
Rated insulation voltage	AC 500 V
Rated impulse withstand voltage/pollution degree	4 kV/3

Nominal system voltage U_n	
PGH183	AC 20 - 265 V, DC 20 - 308 V/42 - 460 Hz
PGH185	3AC, AC 20 - 575 V, DC 20 - 504 V/42 - 460 Hz
PGH186	3AC, AC 0 - 575 V, DC 0 - 504 V/42 - 460 Hz

Voltage supply	
Supply voltage U_S	AC 230 V/50 - 60 Hz
Operating range of U_S	0.85 - 1.15 x U_S
Supply voltage U_S (-13 models)	AC 90 - 132 V/50 - 60 Hz
PGH183, PGH185:	
Power consumption	≤ 3 VA
PGH186:	
Power consumption	≤ 6 VA

Locating current	
PGH183	
Test current, selectable, max.	1/2,5 mA
PGH185/186	
Locating current I_L, selectable, max.	10/25 mA
PGH183/185/186	
Clock pulse	2 s
Idle time	4 s

Measuring voltage U_m	
PGH186	DC 50 V

Other	
Degree of protection, internal components DIN EN 60529 (VDE 0470-1)	IP40
Enclosure material	ABS plastic
Flammability class	UL94 V-0
Weight	≤ 700 g
Dimensions W x H x D	160 x 148 x 81 mm

Technical data: EDS195P

Insulation coordination acc. to IEC 60664-1/IEC 60664-3	
Rated insulation voltage	50 V
Rated impulse withstand voltage/pollution degree	0.8 kV/3

Voltage supply	
Supply voltage U_S	DC 6 V +/± 10 %, external power supply unit
Batteries	3 x LR6 AA – 1.5 V
Accumulators	3 x NiMh ≥ 2000 mAh
Size	AA R6
Power consumption	≤ 0.5 W
Hours of operation (without display illumination)	60 h

Measuring circuit insulation fault location	
Nominal system voltage	conductors uninsulated, including measuring clamp up to 600 V
Rated frequency	DC, 42 - 2000 Hz
Main circuit (I_{Lmax} = 50 mA)	
Measuring range	2 mA - 50 mA
Measuring clamps	PSA3020, PSA3052, PSA3165
Response value $I_{\Delta L}$, adjustable	2 - 10 mA (5 mA)*
Relative uncertainty	±30 %/±2 mA of the reference value
Control circuit	
Measuring range	0,2 mA - 5 mA
Measuring clamps	PSA3320, PSA3352
Response value $I_{\Delta L}$, adjustable	0.2 - 1.0 mA (0.5 mA)*
Relative uncertainty 0.2 - 0.9 mA	±30 %/± 0.2 mA of the reference value
Relative uncertainty 1 - 5 mA	±30 %/± 2 mA of the reference value

Measuring circuit residual current	
with measuring clamps	PSA3020, PSA3052, PSA3165
Measuring range	5 mA - 10 A (crest factor up to 3)
Response value $I_{\Delta L}$, adjustable	10 mA - 10 A (100 mA)*
with measuring clamps	PSA3320, PSA3352
Measuring range	2 mA - 2 A (crest factor up to 3)
Response value $I_{\Delta L}$, adjustable	5 mA - 1 A (100 mA)*
Frequency range	42 - 1000 Hz
Relative uncertainty, 42 - 60 Hz	±5 %
Relative uncertainty, 61 - 1000 Hz	±20 %
Hysteresis	20%
Harmonics, adjustable	1st to 8th harmonic component

Connection	
Type of connection measuring clamp	BNC plug
Power supply unit (DC 5 V)	µUSB plug

Indication	
LCD	3 x 16 characters
LED	Alarm

Other	
Degree of protection, internal components DIN EN 60529 (VDE 0470-1)	IP40
Protection class acc. to IEC 60947-1, DIN EN 60947-1 (VDE 0660-100)	Class III
Enclosure material	ABS plastic
Flammability class	UL94 V-0
Operating manual	TGH1420
Weight	≤ 350 g
Software version	D399 V1.2
Dimensions W x H x D	84 x 197 x 30 mm

( )* = Factory settings

Technical data: Measuring clamps

Electrical safety

Standard	IEC 61010-2-030
Pollution degree	2
Installation category	III
Operating voltage	600 V
Nominal insulation voltage	AC 600 V CAT III resp. AC 300 V CAT IV

Transformation ratio

PSA30 -	10 A/10 mA
PSA33 -	1 A/0.1 mA
PSA3165	10 A/10 mA

Other

Degree of protection, internal components DIN EN 60529 (VDE 0470-1)	IP40
Protection class acc. to IEC 60947-1, DIN EN 60947-1 (VDE 0660-100)	Class III
Test port	BNC plug
Dimensions PSA3052/3352	216 x 111 x 45 mm
Dimensions PSA3020/3320	135 x 65 x 30 mm
Dimensions PSA3165	285 x 179 x 45 mm
Permissible cable diameter PSA3052/3352	52 mm
Permissible cable diameter PSA3052/3320	20 mm
Permissible cable diameter PSA3165	115 mm
Weight PSA3052/3352	≤ 700 g
PSA3020/3320	≤ 300 g
PSA3165	≤ 1300 g

Technical data: AGE185 voltage coupler

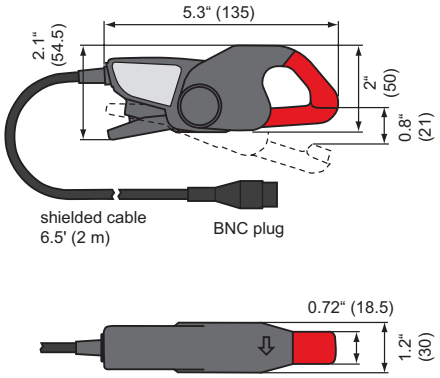
Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 1000 V
Rated impulse voltage/pollution degree	4 kV/3
Nominal system voltage U_n	3AC, AC 500 - 790 V, DC 400 - 960 V/42 - 460 Hz

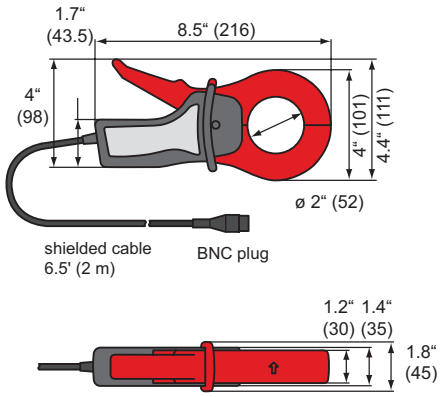
Other

Degree of protection, internal components DIN EN 60529 (VDE 0470-1)	IP30
Type of connection/cable:	safety plug with green-yellow connecting wire 1 mm²
Weight	≤ 400 g
Dimensions W x H x D	84 x 197 x 30 mm
Weight	≤ 200 g
Dimensions W x H x D	88.5 x 42 x 21 mm

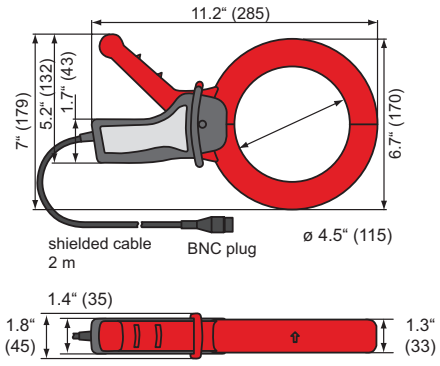
Dimensions: PSA3020/3320 in inches (mm)



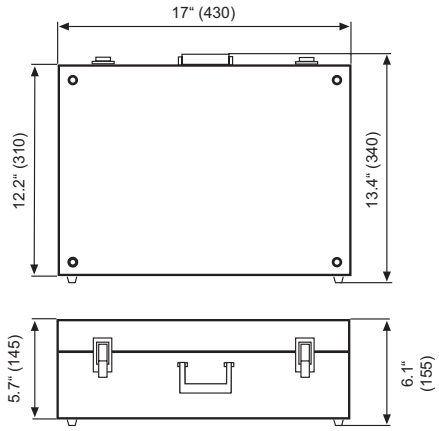
Dimensions: PSA3052/3352 in inches (mm)



Dimensions: PSA3165 in inches (mm)

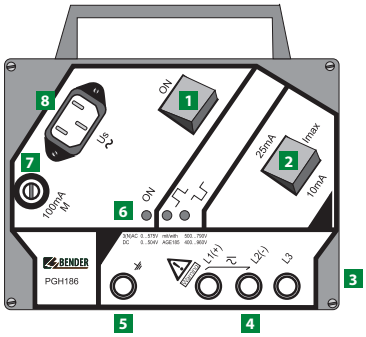


Dimensions: Aluminum carrying case in inches (mm)



3

Display and controls: PGH183/185/186



1 On/Off switch "ON", activates the test current

2 Selector switch for the maximum locating current 25/10 mA or 2.5/1 mA

3 Not visible: Magnetic adhesive strip at the back of the enclosure for fixing to metal parts (e.g. switchboard cabinet)

4 3 sockets for system connections

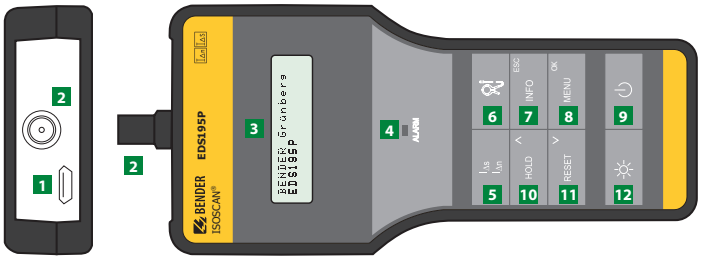
5 Socket for ground connection

6 LED indicators:
"ON" Power On LED
Indication of the positive clock pulse of the locating current
Indication of the negative clock pulse of the locating current

7 Microfuse, 100 mA

8 Outlet plug for supply voltage

Display and controls: EDS195P



1 MicroUSB connection for charging the device's rechargeable battery

2 BNC connection for measuring clamps

3 LCD display, backlit, 3 lines à 16 characters

4 LED "ALARM", lights when the response value is exceeded

5 Button for the selection of the operating mode :
$I_{\Delta S}$ = Standard ground fault location mode ("EDS mode")
$I_{\Delta n}$ = Ground fault current measurement ("RCM mode")

6 Button for transformer selection

for I_{Tmax} = 50 mA:		for I_{Tmax} = 5 mA:
P20	= PSA3020	= PSA3320
P52	= PSA3052	= PSA3352
P165	= PSA3165	----------
W/WR	= W - /WR -	= W - -8000
WS	= WS -	= W - -8000

7 "INFO" button: – device type – software version – current response values $I_{\Delta S}$ and $I_{\Delta n}$ – setup status
ESC button: to exit the menu function without changing parameters

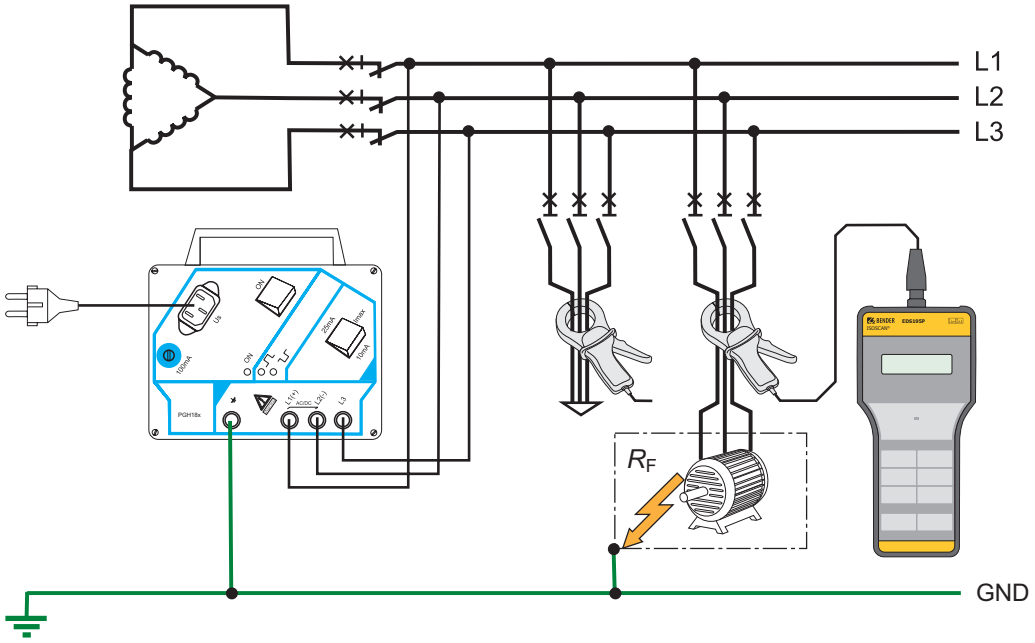
8 "MENU" button
to toggle between the standard display and the menu selection

9 On-Off button

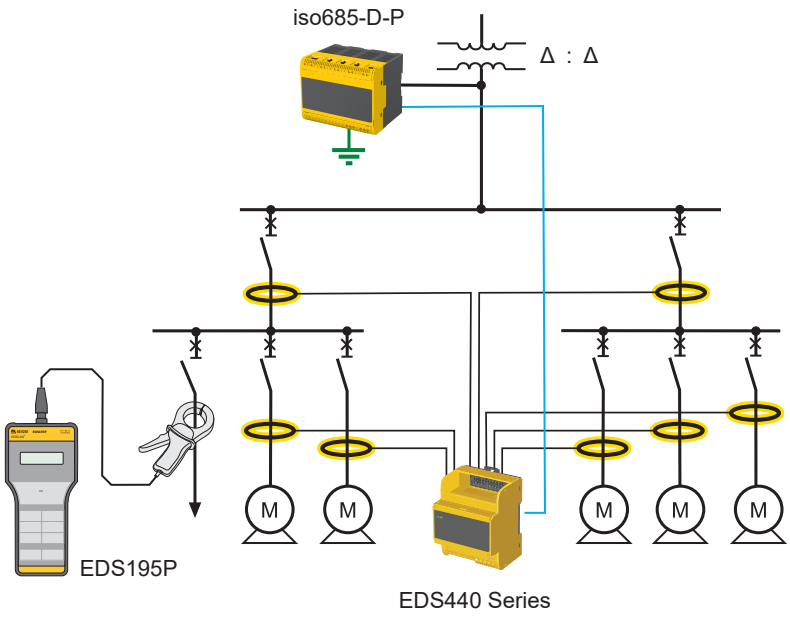
10 "HOLD" button: to store the currently indicated measured value
Arrow up button: Parameter changes, scroll

11 "RESET" button: fault memory acknowledgement
Arrow down button: Parameter changes, scroll

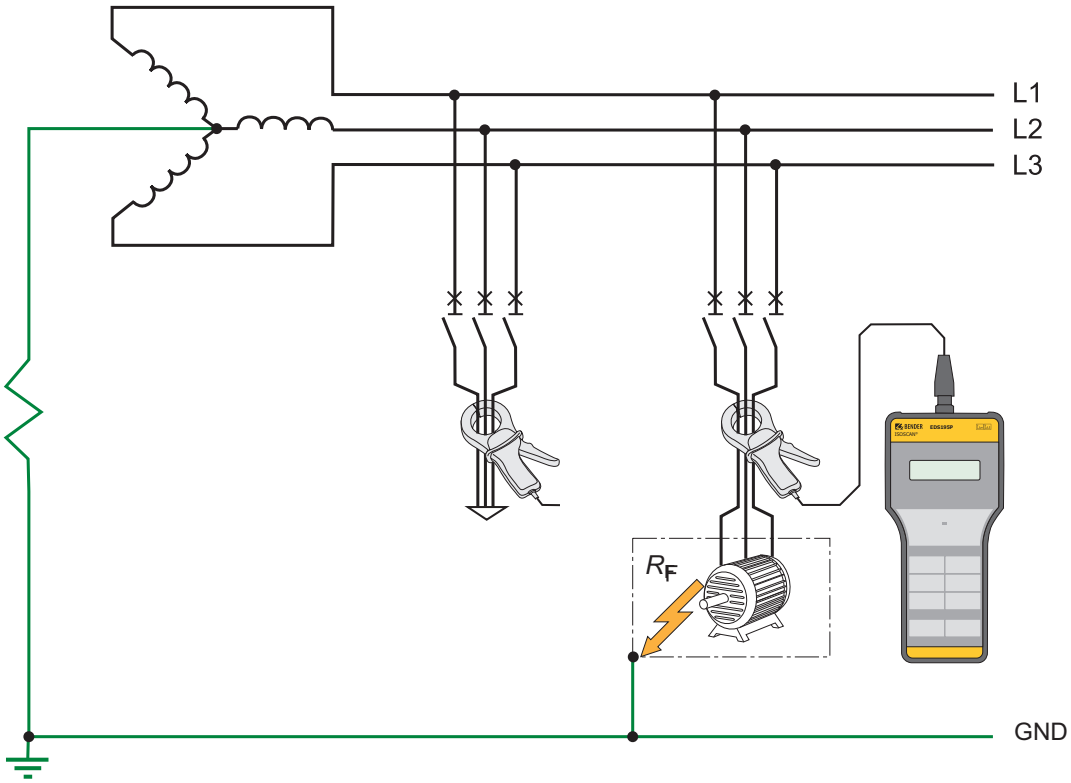
12 Illumination button: to switch on the display lighting



Standalone portable ground fault location (no installed equipment) with EDS3090PG and EDS3091PG series kits, system online and energized



Combining EDS3030 and EDS3091 series kits with installed ground fault location equipment, system online and energized



Using EDS3030 kit for ground fault current measurement and location in grounded and HRG systems

AGE185 Voltage Coupler

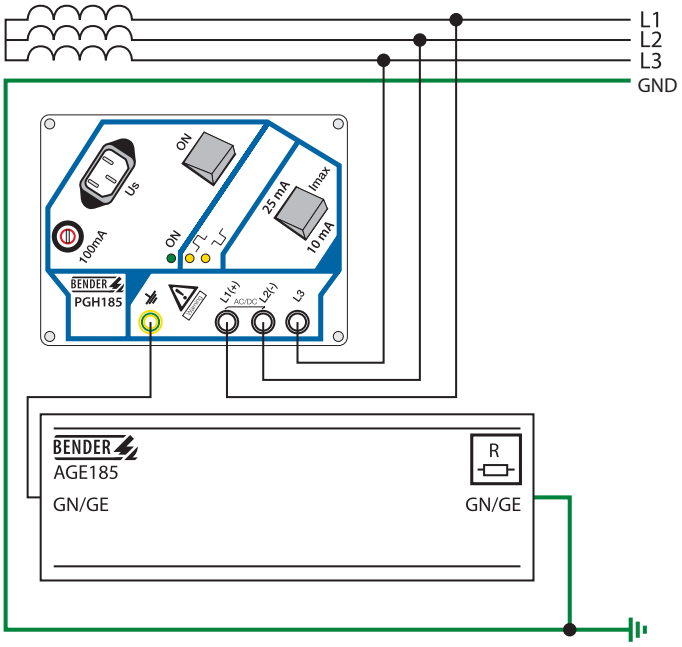
Applications

- Extends voltage range of PGH185 and PGH186 up to 790 VAC and 960 VDC

Ordering information

Nominal system voltage U_S		Type	Ordering No.
Single- and three-phase AC	DC		
500 - 790 V	400 - 960 V	**AGE185**	**B 980 305**

Wiring diagram



Current injection module PGH185 and coupling device AGE185

Ground Fault Detection Equipment

For ungrounded (floating) systems

Isolated Power Systems Equipment

Isolated power systems and equipment for healthcare facilities

Isolated power panels
Isolation transformers
Line isolation monitors
Clocks and timers
Ground/power modules
Testing equipment

Ground Fault Location Equipment

For ungrounded AC/DC systems and isolated power systems

Ground Fault Products

For grounded and high-resistance grounded systems

Ground fault monitors
Ground fault circuit interrupters
Ground fault relays
Monitoring panels
Multi-branch ground fault monitoring

4-01

Protective Relays and Energy Management

Voltage relays
Power quality meters
Current relays
EV charging stations
Continuity relays

Communication and Remote Indication

Communication gateways
Remote indicators
External meters
Measuring instruments
Remote stations
Repeaters and converters

Accessories and System Components

Voltage couplers
Current transformers
Power supply units
Mounting adapters

Ground Fault Monitors / Ground Fault Relays for Grounded and HRG Systems

				
	RCM420 Series	RCM475LY Series	RCMA420 Series	RCMA423 Series

Page		4-06	4-09	4-11	4-14
System type	AC	■	■	■	■
	DC and mixed AC/DC			■	■
Monitoring function		Ground fault	Ground fault	Ground fault	Ground faul
Number of measuring channels		1	1	1	1
Current transformer type		External	Integrated	External	External
Response value	Prealarm	50 - 100% of main alarm		50 - 100% of main alarm	50 - 100% of main alarm
	Main alarm	10 mA - 10 A	10 mA - 10 A	10 - 500 mA	30 mA - 3 A
Response delay t_{on}		0 - 10 s	0 - 10 s	0 - 10 s	0 - 10 s
Start-up delay t		0 - 10 s		0 - 10 s	0 - 10 s
Delay on release t_{off}		0 - 300 s		0 - 99 s	0 - 99 s
Outputs		2 SPDT contacts	1 DPDT contact	2 SPDT contacts	2 SPDT contacts
Additional monitoring features					

	Type	P.	Applicable accessories			
External current transformers	W Series (Circular)	7-06	■			
	WR Series (Rect.)	7-13	■			
	WS Series (Split)	7-15	■			
	WF Series (Rope)	7-17	■			
	WAB Series (Circular)	7-09			■	■
Connector cables	WX Series	7-09			■	■
	WXS Series	7-09				
Comm. Gateway	COM465IP	6-24				
	COM462RTU	6-30				
Power	AN420 Series	7-22				
	MK2430	6-19				
	MK800	6-14				
	RI2000 Series	6-07				

 RCMS460 / 490 Series	 RCMS150	 RCMB20/35-500 Series	 RC48C	 RC48N
4-17	4-23	4-26	4-37	4-40
■	■	■	■	■
■	■	■		
Ground fault	Ground fault	Ground fault	Ground fault + ground continuity	Ground fault + NGR monitoring
12	6	1	1	1
External, one for each branch	Integrated	Integrated	External	External
10 - 100% of main alarm (min. 5 mA)	50 - 100% of main alarm			
6 mA - 20 A (AC only) 10 mA - 10 A (AC/DC)	0 - 300 mA	0 - 500 mA	10 mA - 10 A (ground fault)	10 mA - 10 A (ground fault)
0 - 99 s	0.5 - 600 s		0.1 - 2 s (ground fault)	0.1 - 2 s (ground fault)
0 - 99 s	0 - 600 s			
0 - 999 s	0 - 600 s			
1 DPDT contact (460) 1 DPDT + 12 SPST contacts (490)	Communication	4 - 20 mA analog output	1 DPDT contact	1 DPDT contact
Harmonics analysis			Ground conductor monitoring	Neutral grounding resistor monitoring
Applicable accessories				
■			■	■
■			■	■
■			■	■
■				
■				
■				
■	■			
■	■			
■				
■	■			
■	■			
			■	■

LifeGuard® Series Ground Fault Circuit Interrupters

		
	LifeGuard Series Standard Model	LifeGuard Series Digital Model
Page	4-29	4-29
System voltages available	Standard voltages up to 600 V	Standard voltages up to 600 V
System type	AC or AC/DC (varies by model)	AC/DC
Load ampere ratings available	Up to 100 A (more on request)	Up to 100 A (more on request)
Trip level options available	Fixed 6 mA, fixed 20 mA, steplessly adjustable levels available	Fixed 6 mA, fixed 20 mA
Trip time options available	Inverse time curve (6/20), adjustable time delay options available	Inverse time curve
Display	Power and tripped LED indication	Digital display
Test and reset	Pushbuttons on front of enclosure	Pushbuttons on front of enclosure External connections available
Enclosure	NEMA 4X polycarbonate (NEMA 4X stainless steel available)	NEMA 4X polycarbonate

	Type	P.	Applicable accessories	
Comm. Gateway	COM465IP	6-24		■ (backplate-only models)
	COM462RTU	6-30		■ (backplate-only models)
Remote stations	MK2430	6-19		■ (backplate-only models)
	MK800	6-14		■ (backplate-only models)
	CP700	6-32		■ (backplate-only models)

Monitoring and Protection Panels

		
	GFGC Series	MarinaGuard

Page	4-32	4-34
Function	Ground fault and ground continuity circuit protection	Ground fault monitoring panel for marinas and shore power
System type	AC/DC	AC or AC/DC (varies by model)
Circuit monitoring ratings	Single circuit up to 100 A load current	Versions for monitoring 1, 2, or 3 feeders, as well as up to 12 branches from one panel
Trip level options available	Fixed 6 mA, fixed 20 mA (ground fault), ground continuity and loop resistance	Various steplessly adjustable options available
Trip time options available	Inverse time curve	Adjustable time delay
Display	Power and tripped LED indication	Power and tripped LED indication Alarm strobe light
Test and reset	Pushbuttons on front of enclosure	Pushbuttons on front of enclosure
Enclosure	NEMA 4X polycarbonate (NEMA 4X stainless steel available)	NEMA 4X polycarbonate

	Type	P.	Applicable accessories	
Comm. Gateway	COM465IP	6-24		■ (MG-S or MG-T models)
	COM462RTU	6-30		■ (MG-S or MG-T models)
Remote stations	MK2430	6-19		■ (MG-S or MG-T models)
	MK800	6-14		■ (MG-S or MG-T models)
	CP700	6-32		■ (MG-S or MG-T models)

RCM420 Series

Digital ground fault monitor for grounded and HRG, single- and three-phase AC systems

Applications

- Ground fault monitoring in grounded and HRG AC systems, single- or three-phase
- Motors and motor control centers
- Generators, portable and fixed
- Alarm systems, safety devices
- General industrial systems
- Controls and control systems
- Heat tracing systems
- Marinas

Features

- Ground fault monitoring for grounded and high-resistance grounded AC systems
- Works on both single-phase and three-phase systems
- RMS value measurement (AC)
- Two separately adjustable response values
- Main alarm value adjustable, 10 mA - 10 A
- Prewarning alarm value, 50 - 100% of main alarm
- Frequency range 42 - 2000 Hz
- Start-up delay, response delay and delay on release
- Restart function
- Measured value displayed in real-time on the multi-function LCD display
- Last alarm value accessible in device's menu
- CT connection monitoring
- LEDs: Power On, Alarm 1, Alarm 2
- Internal/external test/reset button
- Two SPDT alarm contacts
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Device self monitoring
- Sealable transparent cover
- RoHS compliant

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

4

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	RCM420-D-1	B 9401 4001
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	RCM420-D-2	B 9401 4002
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Selectable analog output	RCM420-DM-1	B 9401 4005
70 - 300 V	70 - 300 V (15 - 460 Hz)	Selectable analog output	RCM420-D-2	B 9401 4010

Models with push-wire terminals available on request.

[1] Absolute values

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

Compatible current transformers

Description	CT type	Series	Page
External current transformers	circular	W series	7-06
	rectangular	WR series	7-13
	split-core	WS series	7-15
	flexible rope type	WF series	7-17

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (k, l, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage tests according to IEC 61010-1	2.21 kV

Supply voltage

RCM420-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	42 - 460 Hz

RCM420-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	42 - 460 Hz
Power consumption	≤ 4 VA

Measuring circuit

External measuring current transformers type	W - , WR - , WS - , WF -
Load	68 Ω
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristic acc. to IEC 62020	type A
Rated frequency	42 - 2000 Hz
Measuring range	3 mA - 16 A
Relative uncertainty	0 - -20%
Operating uncertainty	0 - 30 %

Response values

Rated residual operating current $I_{\Delta n1}$ (prewarning, AL1)	50 - 100 % x $I_{\Delta n2}$, (50 %)*
Rated residual operating current $I_{\Delta n2}$ (alarm, AL2)	10 mA - 10 A (30 mA)*
Hysteresis	10 - 25% (15 %)*

Time response

Start-up delay t	0 - 10 s (0.5 s)*
Response delay t_{on2} (alarm)	0 - 10 s (0 s)*
Response delay t_{on1} (prewarning)	0 - 10 s (1 s)*
Delay on release t_{off}	0 - 99 s (1 s)*
Operating time t_{ae} at $I_{\Delta n} = 1$ x $I_{\Delta n1/2}$	≤ 180 ms
Operating time t_{ae} at $I_{\Delta n} = 5$ x $I_{\Delta n1/2}$	≤ 30 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms
Number of restart cycles	0 - 100 (0)*

Cable lengths for current transformers

Single wire ≥ 0.75 mm² (AWG 18)	0 - 3 ft (0 - 1 m)
Single wire, twisted ≥ 0.75 mm² (AWG 18)	0 - 32 ft (0 - 10 m)
Shielded cable ≥ 0.75 mm² (AWG 18)	0 - 130 ft (0 - 40 m)
Shielded cable (shield on one side connected to terminal L of the RCM420, not connected to earth)	recommended: J-Y(St)Y min. 2 x 0.8
Connection	screw-type terminals

Displays, memory

Display range, measuring value	3 mA - 16 A
Error of indication	±15 %/± 2 digits
Measured-value memory for alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/off (on)*

Inputs/outputs

Cable length for external test/reset button	0 - 32 ft (0 - 10 m)

Switching elements

Number of switching elements	2 SPDT contacts
Operating principle	Normally energized or de-energized operation (N/E operation)*
Electrical endurance, number of cycles	10000

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 62020
Operating temperature	-13 to +131 °F (-25 to +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

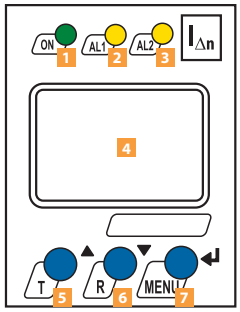
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 12)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	0.4" (10 mm)
Opening force	11 lbf (50 N)
Test opening, diameter	0.08" (2.1 mm)

Other

Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating manual	TGH1410
Weight	≤ 0.3 lb (150 g)

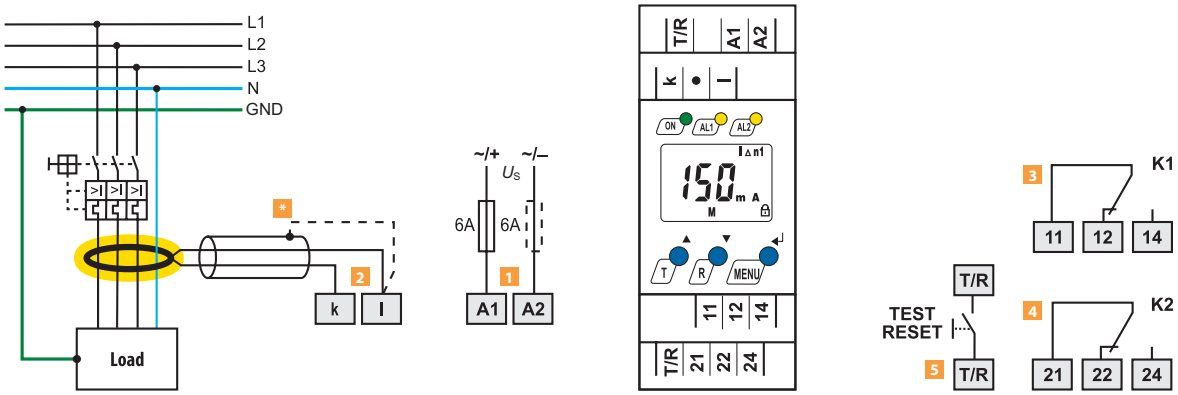
( )* = factory setting

Displays and controls



1. Power On LED "ON" (green), lights when power is applied to the device. Flashes during device fault or CT connection alarm.
2. Alarm LED "AL1" (yellow), lights when the prewarning alarm value is reached. Flashes during device fault or CT connection alarm.
3. AAlarm LED "AL2" (yellow), lights when the main alarm value is reached. Flashes during device fault or CT connection alarm.
4. Multi-functional LCD display
5. Test button "T": Initiates the internal self-test.
   Arrow up button: parameter change, to move up in device menu
6. Reset button "R": Resets device (when set to latching mode)
   Arrow down button: parameter change, to move down in device menu
7. "MENU" button: Enters the device's main menu
   Enter button: to confirm parameter change.
   "ESC" button: press the button "T" > 1.5 s

Wiring diagram

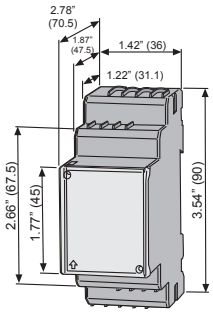


1. Supply voltage U_S see ordering information
2. External current transformer connection
3. Alarm relay K1
4. Alarm relay K2
5. Combined test and reset button "T/R"
   momuntary press (< 1.5 s) = RESET
   hold (> 1.5 s) = TEST

* When shielded cable is used

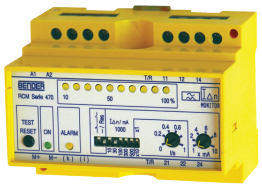
Do not route the ground conductor through the current transformer.

Dimensions in inches (mm)



RCM475LY Series

Ground fault monitor for grounded and HRG, single- and three-phase AC systems



Features

- Ground fault monitoring for grounded and high-resistance grounded AC systems
- Integrated current transformer - no additional monitoring components required
- Works on both single-phase and three-phase systems
- Adjustable response value, 10 mA - 10 A
- Adjustable time delay, 0 - 10 s
- LED bar graph, 0 - 100% of main alarm
- LEDs: Power On, Alarm
- Internal/external test/reset button
- One DPDT alarm contact
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable

Applications

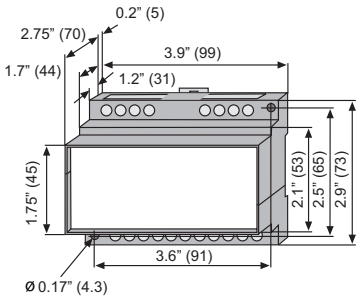
- Ground fault monitoring in grounded and HRG AC systems, single- or three-phase
- Motors and motor control centers
- Generators, portable and fixed
- Alarm systems, safety devices
- General industrial systems
- Controls and control systems
- Heat tracing systems
- Marinas

Approvals

c UL us LISTED

AE25

Dimensions in inches (mm)



Ordering information

Supply voltage U_S		Response value range	Type	Ordering No.
DC	AC			
	230 V (50/60 Hz)	10 mA - 10 A	RCM475LY	B 9401 2018
	90 - 132 V (50/60 Hz) [1]	10 mA - 10 A	RCM475LY-13	B 9401 2035
9.6 - 84 V [1]		10 mA - 10 A	RCM475LY-21	B 9401 2073
	230 V (50/60 Hz)	6 - 600 mA	RCM475LY-71	B 9401 2052
	90 - 132 V (50/60 Hz) [1]	6 - 600 mA	RCM475LY-7113	B 9401 2053
9.6 - 84 V [1]		6 - 600 mA	RCM475LY-7121	B 9401 2070

[1] Absolute values

Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	4 kV/3

Voltage ranges

Supply voltage U_S	See ordering information
Operating range U_S	0.85 - 1.1 x U_S
Frequency range U_S	DC, 50/60 Hz
Power consumption	≤ 3 VA

Measuring circuit / response values

Internal current transformer	Ø 0.7" (18 mm)
Load	180 Ω
Operating characteristic acc. to IEC 62020	type A
Rated frequency	50/60 Hz
Measuring range	10 mA - 10 A / 6 mA - 600 mA
Relative uncertainty	0 - 20%
Response delay	0 - 10 s
Accuracy of response delay	± 20%
Hysteresis	app. 20% of response value
Response time t_{an} at $I\Delta_n = 1$ x $I\Delta_n$ ($t_v = 0$)	< 250 ms
Response time t_{an} at $I\Delta_n = 1$ x $I\Delta_n$ ($t_v = 0$)	≤ 20 ms
Quantity of measuring channels	1

Displays, memory

LED bar graph indicator	0 - 100%
LEDs	Power On, Alarm

Inputs/outputs

Cable length for external test/reset button	0 - 33 ft (0 - 10 m)
Current source for external measuring instrument / max. load	DC 0 - 400 µA / 12.5 kΩ

Switching elements

Number of switching elements					1 DPDT contact
Operating principle	Normally energized or de-energized operation (N/E operation)*				
Electrical endurance, number of cycles					10000
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
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	EN 61543
Operating temperature	-14 to +131 °F (-10 to +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

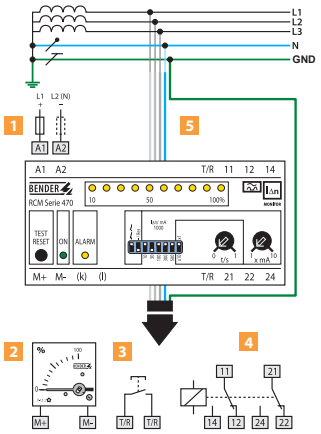
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 12)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	0.4" (10 mm)
Opening force	11 lbf (50 N)
Test opening, diameter	0.08" (2.1 mm)

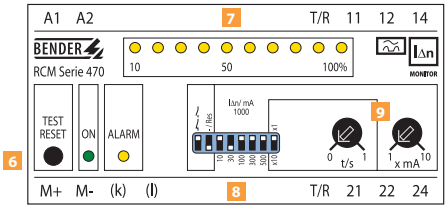
Other

Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating manual	TGH1410
Weight	≤ 0.75 lb (350 g)

( )* = factory setting

Wiring, displays, and controls





1 Supply voltage U_S, see ordering information

2 Optional connection for external meter

3 External test/reset button connection, N/O contact
Momuntary push (< 1.5 s) = RESET
Press and hold (> 1.5 s) = TEST

4 Alarm relay

5 System conductors routed through internal current transformer. All conductors, including the neutral if it is being used, are routed through the current transformer. **Do not route the ground conductor through the current transformer.**

6 Internal test/reset pushbutton, ON LED, Alarm LED

7 LED bar graph indicator

8 DIP switches for adjusting contact behavior, response value

9 Potentiometers for adjusting time delay, response value

RCMA420 Series

Digital ground fault monitor for grounded and HRG, single- and three-phase AC/DC systems

Applications

- Ground fault monitoring in grounded AC (single- and three-phase) and DC systems
- Systems with variable frequency drives (VFDs)
- Battery backup systems
- Generators, portable and fixed
- Motors and motor control centers
- General industrial systems
- Grounded solar inverters, master combiner boxes

Approvals

c UL us LISTED

AE25

Features

- Fufills compliance with upcoming 2014 NEC 250.167(B) for ground fault detection on grounded DC systems
- Ground fault monitoring for grounded and high-resistance grounded AC and DC systems
- Works on AC, DC, and mixed AC/DC systems, including systems with variable frequency drives (VFDs)
- Works on both single-phase and three-phase systems
- RMS value measurement (AC+DC)
- Uses single external current transformer of varying sizes up to 2.4" (60 mm)
- Two separately adjustable response values
- Main alarm value adjustable, 10 - 500 mA
- Prewarning alarm value, 50 - 100% of main alarm
- Frequency range 0 - 2000 Hz
- Start-up delay, response delay and delay on release
- Restart function
- Measured value displayed in real-time on the multi-function LCD display
- Last alarm value accessible in device's menu
- CT connection monitoring
- LEDs: Power On, Alarm 1, Alarm 2
- Internal/external test/reset button
- Two SPDT alarm contacts
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Device self monitoring
- Sealable transparent cover
- Simple connectors for connections from monitor to CT
- RoHS compliant

4

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	RCMA420-D-1	B 9404 3001
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	RCMA420-D-1	B 9404 3002
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Selectable analog output	RCMA420-DM-1	B 9404 3003
70 - 300 V	70 - 300 V (15 - 460 Hz)	Selectable analog output	RCMA420-DM-2	B 9404 3008

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

Compatible current transformers and connector cables

Description	CT type	Series	Page
External current transformers	circular	WAB series	7-09
Connector cable	–	WX series	7-09

NOTE: The RCMA420 only works with the following current transformers: W20AB, W35AB, W60AB. Using larger size WAB series current transformers requires use of the RCMA423 ground fault monitor.

Technical data

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (k, l, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage tests according to IEC 61010-1	2.21 kV

Supply voltage

RCMA420-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	42 - 460 Hz

RCMA420-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	42 - 460 Hz
Power consumption	≤ 4 VA

Measuring circuit

External measuring current transformer	W20AB, W35AB, W60AB series
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristic acc. to IEC 62020 and IEC/TR 60755	Type B
Rated frequency	0 - 2000 Hz
Measuring range AC	0 - 1.5 A
Measuring range DC	0 - 600 mA
Relative uncertainty	0 - -35%
Operating uncertainty	0 - 35 %

Response values

Rated residual operating current $I_{\Delta n1}$ (prewarning, AL1)	50 - 100 % x $I_{\Delta n2}$, (50 %)*
Rated residual operating current $I_{\Delta n2}$ (alarm, AL2)	10 - 500 mA (30 mA)*
Hysteresis	10 - 25% (15 %)*

Time response

Start-up delay t	0 - 10 s (0.5 s)*
Response delay t_{on2} (alarm)	0 - 10 s (0 s)*
Response delay t_{on1} (prewarning)	0 - 10 s (1 s)*
Delay on release t_{off}	0 - 99 s (1 s)*
Operating time t_{ae} at $I_{\Delta n}$ = 1 x $I_{\Delta n1/2}$	≤ 180 ms
Operating time t_{ae} at $I_{\Delta n}$ = 5 x $I_{\Delta n1/2}$	≤ 30 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms

Cable lengths for current transformers

Connection (see ordering information)	connecting cable WX - 1 m/2.5 m/5 m/10 m

Displays, memory

Display range, measured value AC	0 - 1.5 A
Display range, measured value DC	0 - 600 mA
Error of indication	±17.5 %/± 2 digits
Measured-value memory for alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/off (on)*

Inputs/outputs

Cable length for external test/reset button	0 - 32 ft (0 - 10 m)

Switching elements

Number of switching elements					2 SPDT contacts
Operating principle					Normally energized or de-energized operation (N/E operation)*
Electrical endurance, number of cycles					10000
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
Minimum contact rating					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 62020
Operating temperature	-13 to +131 °F (-25 to +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

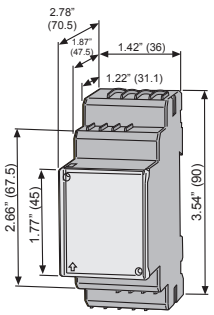
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 12)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	0.4" (10 mm)
Opening force	11 lbf (50 N)
Test opening, diameter	0.08" (2.1 mm)

Other

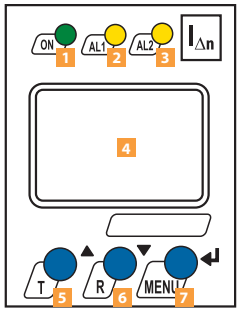
Operating mode	continuous operation
Position of normal use	display-oriented
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Software version	D242 V1.1x
Operating manual	TGH1411
Weight	≤ 033 lb (150 g)

( )* = factory setting

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when power is applied to the device. Flashes during device fault or CT connection alarm.

2 Alarm LED "AL1" (yellow), lights when the prewarning alarm value is reached. Flashes during device fault or CT connection alarm.

3 AAlarm LED "AL2" (yellow), lights when the main alarm value is reached. Flashes during device fault or CT connection alarm.

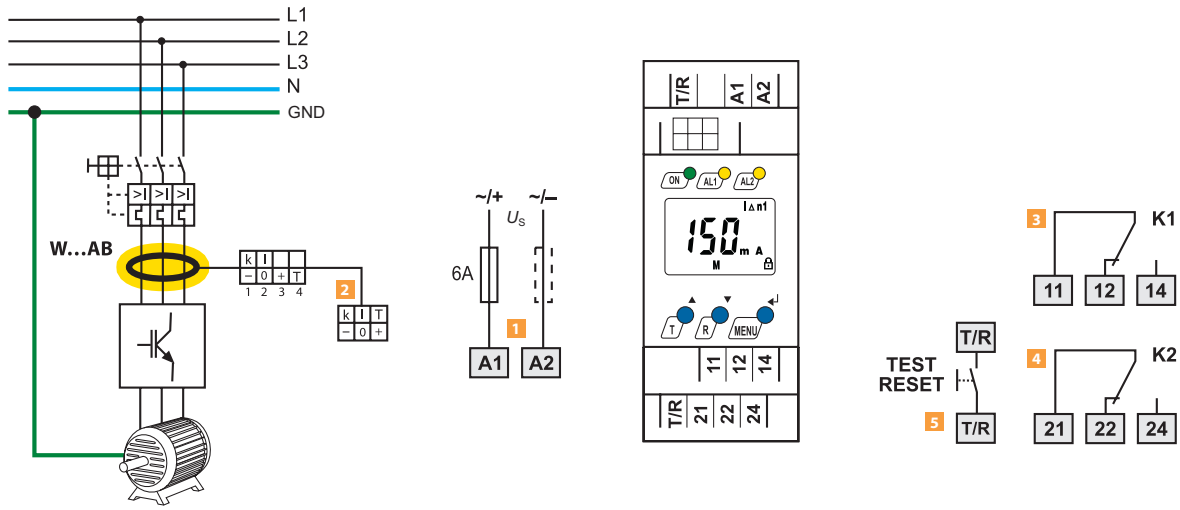
4 Multi-functional LCD display

5 Test button "T": Initiates the internal self-test.
Arrow up button: parameter change, to move up in device menu

6 Reset button "R": Resets device (when set to latching mode)
Arrow down button: parameter change, to move down in device menu

7 "MENU" button: Enters the device's main menu
Enter button: to confirm parameter change.
"ESC" button: press the button "T" > 1.5 s

Wiring diagram



1 Supply voltage U_S see ordering information

2 External current transformer connection

3 Alarm relay K1

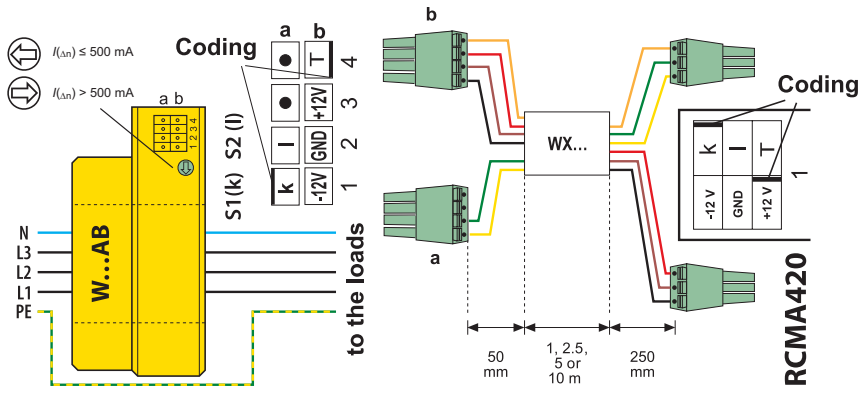
4 Alarm relay K2

5 Combined test and reset button "T/R"
momuntary press (< 1.5 s) = RESET
hold (> 1.5 s) = TEST

* When shielded cable is used

Do not route the ground conductor through the current transformer.

Wiring diagram: Current transformers



RCMA423 Series

Digital ground fault monitor for grounded and HRG, single- and three-phase AC/DC systems

Applications

- Ground fault monitoring in grounded AC (single- and three-phase) and DC systems
- Systems with variable frequency drives (VFDs), medium to large size
- Battery backup systems
- Generators, portable and fixed
- Motors and motor control centers
- General industrial systems
- Grounded solar inverters, master combiner boxes

Approvals

c UL us LISTED

PCT AE25

Features

- Fufills compliance with upcoming 2014 NEC 250.167(B) for ground fault detection on grounded DC systems
- Ground fault monitoring for grounded and high-resistance grounded AC and DC systems
- Works on AC, DC, and mixed AC/DC systems, including systems with variable frequency drives (VFDs)
- Works on both single-phase and three-phase systems
- RMS value measurement (AC+DC)
- Uses single external current transformer of varying sizes up to 8.25" (210 mm)
- Two separately adjustable response values
- Main alarm value adjustable, 30 mA - 3 A
- Prewarning alarm value, 50 - 100% of main alarm
- Frequency range 0 - 2000 Hz
- Start-up delay, response delay and delay on release
- Restart function
- Measured value displayed in real-time on the multi-function LCD display
- Last alarm value accessible in device's menu
- CT connection monitoring
- LEDs: Power On, Alarm 1, Alarm 2
- Internal/external test/reset button
- Two SPDT alarm contacts
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Device self monitoring
- Sealable transparent cover
- Simple connectors for connections from monitor to CT
- RoHS compliant

4

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	RCMA423-D-1	B 9404 3023
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	RCMA423-D-2	B 9404 3025
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Selectable analog output	RCMA423-DM-1	B 9404 3026
70 - 300 V	70 - 300 V (15 - 460 Hz)	Selectable analog output	RCMA423-DM-2	B 9404 3030

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

Compatible current transformers and connector cables

Description	CT type	Series	Page
External current transformers	circular	WAB series	7-09
Connector cable	–	WX series	7-09

Technical data

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (k/l/T/–/GND/+, T/R) - (11, 12, 14) - (21, 22, 24)
Voltage tests according to IEC 61010-1	2.21 kV

Supply voltage

RCMA423-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	42 - 460 Hz

RCMA423-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	42 - 460 Hz
Power consumption	≤ 6.5 VA

Measuring circuit

External measuring current transformer	W20AB, W35AB, W60AB, W120AB, W210AB series
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristic acc. to IEC 62020 and IEC/TR 60755	Type B
Rated frequency	0 - 2000 Hz
Measuring range AC/DC	3 mA - 6 A
Relative uncertainty for f ≤ 2 Hz oder ≥ 16 Hz	0 - -35 %
Relative uncertainty for f > 2 Hz - <16 Hz	-35 to +100 %
Operating uncertainty	0 - 35 %

Response values

Rated residual operating current $I_{\Delta n1}$ (prewarning, AL1)	50 - 100 % of $I_{\Delta n2}$ (50 %)*
Rated residual operating current $I_{\Delta n2}$ (alarm, AL2)	30 mA - 3 A (30 mA)*
Hysteresis	10 - 25% (15 %)*

Time response

Start-up delay t	0 - 10 s (0 s)*
Response delay t_{on1} (prewarning)	0 - 10 s (1 s)*
Response delay t_{on2} (alarm)	0 - 10 s (0 s)*
Delay on release t_{off}	0 - 99 s (1 s)*
Operating time t_{ae} at $I_{\Delta n} = 1 \times I_{\Delta n1/2}$	≤ 180 ms
Operating time t_{ae} at $I_{\Delta n} = 5 \times I_{\Delta n1/2}$	≤ 30 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms

Displays, memory

Display range measured value AC/DC	0 - 6 V
Error of indication	±17.5 %/± 2 digits
Measured-value memory for alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/off (on)*

Inputs/outputs

Cable length for external test/reset button	0 - 10 m

Cable lengths for measuring current transformers

Connecting cable WX - (see ordering information)	1 m/2.5 m/5 m/10 m
Alternatively: single wire 6 x 0.75 mm²	0 - 32 ft (0 - 10 m)

Switching elements

Number of switching elements	2 SPDT contacts				
Operating principle	Normally energized or de-energized operation (N/E operation)*				
Electrical endurance, number of cycles	10000				
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
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	IEC 62020
Operating temperature	-13 to +151 °F (-25 to +55 °C)
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

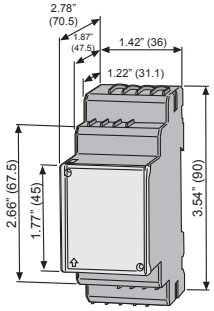
Connection type	push-wire terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	0.4″ (10 mm)
Opening force	11 lbf (50 N)
Test opening, diameter	0.08″ (2.1 mm)

Other

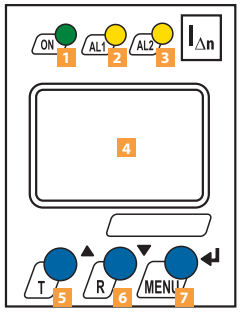
Operating mode	continuous operation
Position of normal use	display-oriented
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Software version	D330 V1.0x
Operating manual	TGH1442
Weight	≤ 0.33 lb (150 g)

( )* = factory setting

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when power is applied to the device. Flashes during device fault or CT connection alarm.

2 Alarm LED "AL1" (yellow), lights when the prewarning alarm value is reached. Flashes during device fault or CT connection alarm.

3 AAlarm LED "AL2" (yellow), lights when the main alarm value is reached. Flashes during device fault or CT connection alarm.

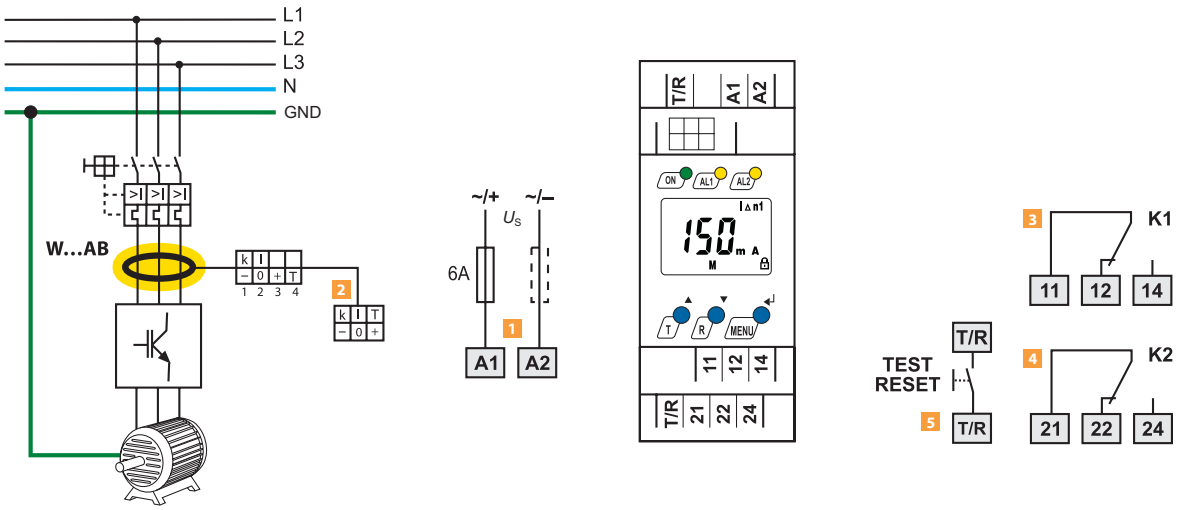
4 Multi-functional LCD display

5 Test button "T": Initiates the internal self-test.
Arrow up button: parameter change, to move up in device menu

6 Reset button "R": Resets device (when set to latching mode)
Arrow down button: parameter change, to move down in device menu

7 "MENU" button: Enters the device's main menu
Enter button: to confirm parameter change.
"ESC" button: press the button "T" > 1.5 s

Wiring diagram



1 Supply voltage U_S see ordering information

2 External current transformer connection

3 Alarm relay K1

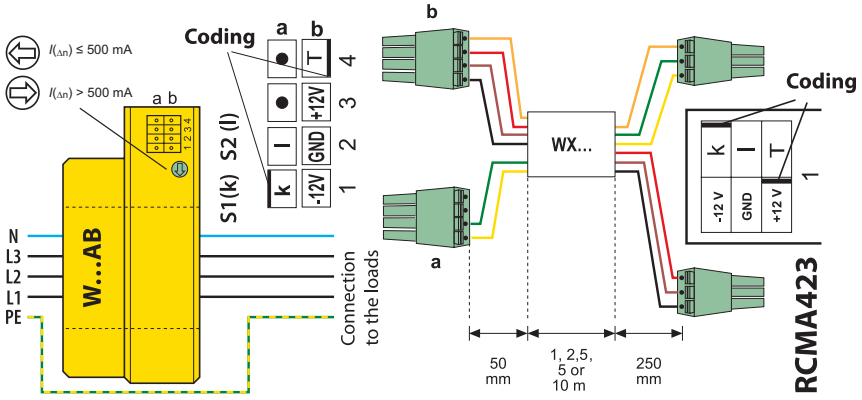
4 Alarm relay K2

5 Combined test and reset button "T/R"
momentary press (< 1.5 s) = RESET
hold (> 1.5 s) = TEST

* When shielded cable is used

Do not route the ground conductor through the current transformer.

Wiring diagram: Current transformers



RCMS460 / RCMS490 Series

Digital multi-channel ground fault monitor for grounded and HRG, single- and three-phase AC/DC systems

Applications

- Ground fault monitoring for grounded and HRG AC/DC systems, single-phase and three-phase
- Motors and motor control centers
- Industrial control systems
- Heat tracing systems
- Controls and control systems
- Pedastal monitoring in marinas
- Solar inverters, individual combiner boxes, master combiner boxes

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Features

- Fufills compliance with upcoming 2014 NEC 250.167(B) for ground fault detection on grounded DC systems
- Selectably monitor either AC, DC, or mixed AC/DC on each separate channel
- True RMS value measurement
- 12 separate monitoring channels, each with its own individual settings adjustments
- Fast parallel scanning for all channels
- Response ranges:
  10 mA - 10 A (0 - 2000 Hz), 6 mA - 20 A (42 - 2000 Hz)
- Preset function
- Adjustable time delays
- Selectable filtering options
- Timestamped history memory for 300 data records
- Data logger for 300 data records/channel
- Harmonics analysis
- One common DPDT alarm contact
- RCMS490: 12 individual SPST alarm contacts, one per channel
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- External test/reset connection
- Detailed, backlit LCD display
- RS-485 interface
- Compatible with BENDER's remote stations and communication systems
- Password protection for device settings
- Continuous CT connection monitoring
- RoHS compliant

Ordering information

System and CT type, response range		Common alarm relay	Alarm relays per channel	Supply voltage [1] U_S		Type	Ordering No.
AC only (W series)	AC/DC (WAB series)			DC	AC		
6 mA - 20 A	10 mA- 10 A	1 DPDT contact	–	16 - 94 V	16 - 72 V (42 - 460 Hz)	RCMS460-D-1	B 9405 3001
				70 - 276 V	70 - 276 V (42 - 460 Hz)	RCMS460-D-2	B 9405 3002
			12 SPST contacts	16 - 94 V	16 - 72 V (42 - 460 Hz)	RCMS490-D-1	B 9405 3005
				70 - 276 V	70 - 276 V (42 - 460 Hz)	RCMS490-D-2	B 9405 3006

[1] Absolute values

Accessories

Description	System type	CT type	Series	Page
External current transformers	AC only	circular	W series	7-06
		rectangular	WR series	7-13
		split-core	WS series	7-15
		flexible rope type	WF series	7-17
	AC/DC	circular	WAB series	7-09
Connector cable for WAB series CTs	–	–	WXS series	7-09
Remote indicating stations	Remote indicating station	–	MK2430	6-19
	Remote station for large systems	–	MK800	6-14
	Touchscreen remote station	–	CP700	6-32
Communication gateways	Ethernet and Modbus/TCP gateway	–	COM465IP	6-24
	Modbus/RTU gateway	–	COM462RTU	6-30
Power supply unit for WAB series CTs	Power supply for up to six (6) WAB series current transformers	–	AN420-1	7-22
		–	AN420-2	7-22

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

Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	6 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (k1, l - k12, R, T/R, T, A, B), (C11, C12, C14), (C21, C22, C24), (11,14), (21,24), (31,34), (41,44), (51,54), (61,64), (71,74), (81,84), (91,94), (101,104), (111,114), (121,124)
Protective separation (reinforced insulation) between	(C11, C12, C14) - (C21, C22, C24) - (11, 14, 21, 24, 31, 34) - (41, 44, 51, 54, 61, 64) - (71,74) - (81,84) - (91,94) - (101,104) - (111,114) - (121,124)
Voltage test acc. to IEC 61010-1	3.536 kV
Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3
Basic insulation between:	k1, l - k12, R, T/R, T, A, B) - (C11, C12, C14), (C21, C22, C24)
Basic insulation between:	(11, 14) - (21, 24) - (31, 34) - (41, 44) - (51, 54) - (61, 64)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Rated supply voltage U_S	see ordering information
Frequency range of U_S	see ordering information
Power consumption	≤ 10 VA (RCMS460) ≤ 12 VA (RCMS490)

Measuring circuit

External measuring current transformer	W - , WR - , WS - , WF - series (Type A) W - AB series (Type B)
CT monitoring	on/off (on)*
Rated burden RCMS - -D/-L	68 Ω
Rated burden RCMS - -D4/-L4 (channels 9 - 12 only)	1 Ω
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristics acc. to IEC 62020 and IEC/TR 60755	Type A and Type B (Type A)* depending on measuring current transformer series
Rated frequency	0 - 2000 Hz (Type B)/42 - 2000 Hz (Type A)
Cut-off frequency	none, IEC, 50 Hz, 60 Hz (none)*
Measuring range RCMS - -D/-L	0 - 30 A (measuring current transformer type A) 0 - 20 A (measuring current transformer type B) crest factor up to 10 A = 4, up to 20 A = 2
Measuring range RCMS - -D4/-L4 (channels 9 - 12 only)	100 mA - 125 A
Rated residual operating current $I_{\Delta n2}$ (alarm)	10 mA - 10 A (Type B) 6 mA - 20 A (Type A) (100 mA overcurrent)*
Rated residual operating current $I_{\Delta n2}$ (alarm) for RCMS - -D4/-L4 (channels 9 - 12 only)	100 mA - 125 A (16 A overcurrent)*
Rated residual operating current $I_{\Delta n1}$ (prewarning)	10 - 100 % x $I_{\Delta n2}$ min 5 mA (50 %)*
Digital input	1 ≙ < 100 Ω, 0 ≙ > 250 Ω
Preset for alarm	I_{Δ} x factor 1 - 99 (3)* Offset 0 - 20 A (30 mA)*
Preset for digital input	0/1 (1)*
Relative uncertainty RCMS - -D/-L	0 - -20 %**
Relative uncertainty RCMS - -D4/-L4 (channels 9 - 12 only)	+10 - -20 %**
Hysteresis	2 - 40 % (20 %)*
Factor for additional CT	1 - 10; x 1 - 250 (x 1)*
Number of measuring channels (per device/system)	12/1080

Time response

Start-up delay t (start-up) per device	0 - 99 s (0 ms)*
Response delay t_{on} per channel	0 - 999 s (200 ms)*
Delay on release t_{off} per channel	0 - 999 s (200 ms)*
Operating time t_{ae} at $I_{\Delta n} = 1$ x $I_{\Delta n1/2}$	≤ 180 ms
Operating time t_{ae} at $I_{\Delta n} = 5$ x $I_{\Delta n1/2}$	≤ 30 ms
Response time t_{an} for residual current measurement	$t_{an} = t_{ae} + t_{on1/2}$
Operating time t_{ae} digital inputs	≤ 3.5 s
Scanning time for all measuring channels (residual current measurement)	≤ 180 ms
Recovery time t_b	500 - 600 ms

Displays, memory

Display range measured value RCMS - -D/-L	0 - 30 A (measuring current transformer type A) 0 - 20 A (measuring current transformer type B)
Display range, measured value RCMS - -D4/-L4 (channels 9 - 12)	0 - 125 A (measuring current transformer type A)
Error of indication	± 10 %
LEDs	ON/ALARM (RCMS - -D -) ON/ALARM/measuring channel 1 - 12 (RCMS - -L -)
LC display	backlit graphical display (RCMS - -D -)
7-segment display	2 x 7.62 mm (RCMS4 - -L)
History memory	300 data records (RCMS - -D -)
Data logger	300 data records per measuring channel (RCMS - -D -)
Password	off/0 - 999 (off)*
Language	D, GB, F (GB)*
Fault memory alarm relay	on/off (off)*

Inputs/outputs

Test/reset button	internal/external
Cable length for external test/reset button	0 - 10 m

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kbit/s
Cable length	0 - 1200 m
Cable (twisted in pairs, one end of shield connected to PE)	recommended: J-Y(St)Y min. 2 x 0.8
Terminating resistor	120 Ω (0.25 W) connectable via DIP switch
Device address, BMS bus	1 - 90 (2)*

Cable lengths for W - , WR - , WS - , WF - series measuring current transformers

Single wire ≥ 0.75 mm²	0 - 1 m
Single wire, twisted ≥ 0.75 mm²	0 - 10 m
Shielded cable ≥ 0.5 mm²	0 - 40 m
Shielded cable (shield to terminal l on one end, not connected to earth)	recommended: J-Y(St)Y min. 2 x 0.8

Cable lengths for W - AB series measuring current transformers

Single wire ≥ 0.75 mm²	0 - 10 m
Connection	plug-in connector, recommended WXS -

Switching elements

Number	1 DPDT contact (RCMS460), 1 DPDT contact, 12 SPST contacts (RCMS490)				
Operating principle	Normally energized or de-energized operation (N/D operation)*				
Electrical endurance, number of cycles	10000				
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 (common alarm relays)	5 A	3 A	1 A	0.2 A	0.1 A
Rated operational current (alarm relay)	2 A	0.5 A	5 A	0.2 A	0.1 A
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	IEC 62020
Operating temperature	-25 °C - + 55 °C
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Technical data (continued)

Connection	
Connection	screw-type terminals
Connection rigid/flexible/conductor sizes	0.2 - 4/0.2 - 2.5 mm² (AWG 24 - 12)
Multi-conductor connection (2 conductors with the same cross section) rigid/flexible	0.2 - 1.5/0.2 - 1.5 mm²
Stripping length	8 - 9 mm
Tightening torque	0.5 - 0.6 Nm

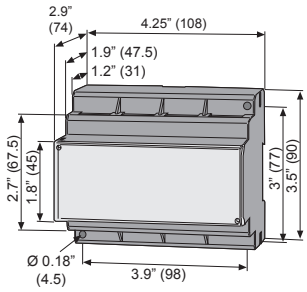
Other	
Operating mode	continuous operation
Mounting	display-oriented
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Operating manual	TGH1393
Weight	≤360 g (RCMS460), ≤510 g (RCMS490)

( )* factory setting

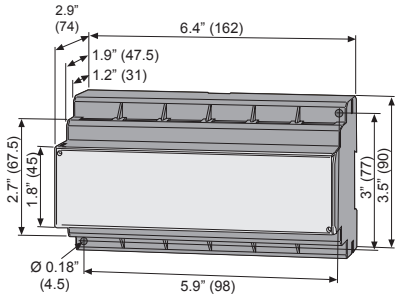
** In the frequency range of <15 Hz, the relative uncertainty is between -35 % and 100 %.

Dimensions in inches (mm)

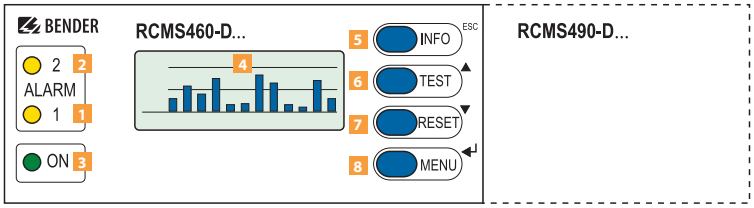
RCMS460



RCMS490

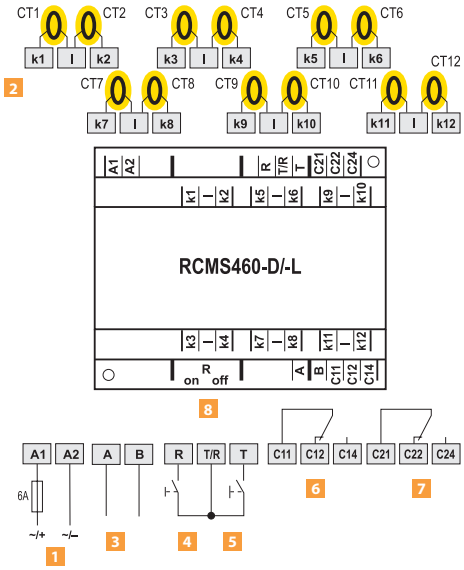


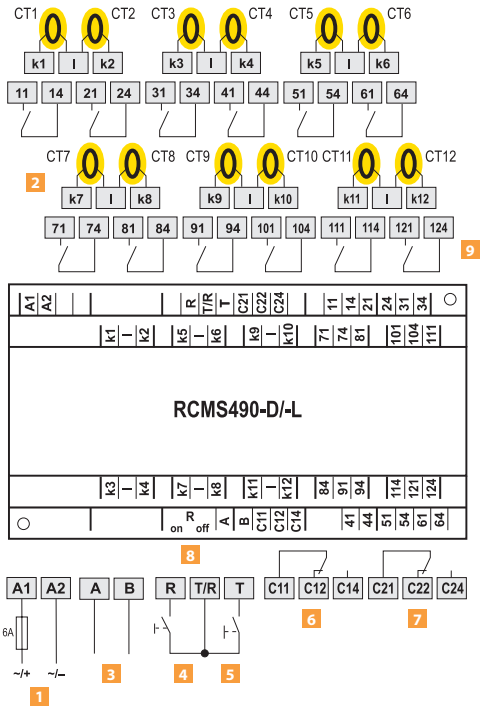
Displays and controls



1. LED ALARM "2" lights when the measured value falls below or exceeds the response value in any measuring channel or an error is indicated by the digital input.
2. LED "ALARM 1" lights if the measured value exceeds or falls below the "Prewarning" response value in a channel or in the event of device error.
3. Power On LED "ON" lights when power is applied to the device
4. Backlit LCD display
5. "INFO" button: Displays system information
   ESC button: to exit the menu, goes back a step in menu
6. Test button "TEST": Initiates device self-test
   Arrow up button: Parameter changes, scroll
7. Reset button "RESET": Resets device (if set to latching mode)
   Arrow down button: Parameter changes, scroll
8. "MENU" button: RCMS460-D/490-D: Toggles between main screen, menu, and alarm messages
   Enter button: to confirm parameter changes

Wiring diagrams





1 Supply voltage U_S (see ordering information)

2 Connection of individual current transformer. WAB series current transformers require an external power supply, of which up to six current transformers may be powered by. WF series rope CTs must be used with the RCC420 signal converter / power supply. Standard current transformers do not require additional equipment.

3 RS-485 interface

4 External reset button "R" (N/O contact)*

5 External test button "T" (N/O contact). Do not wire multiple test connections together,.

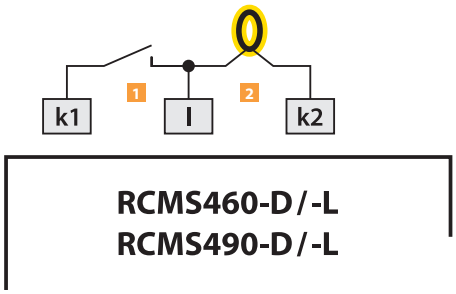
6 Alarm relay K1

7 Alarm relay K2

8 $R_{on/off}$: Activate or deactivate the RS-485 bus termination resistor (120)

9 RCMS490: Alarm relays, 1 per channel

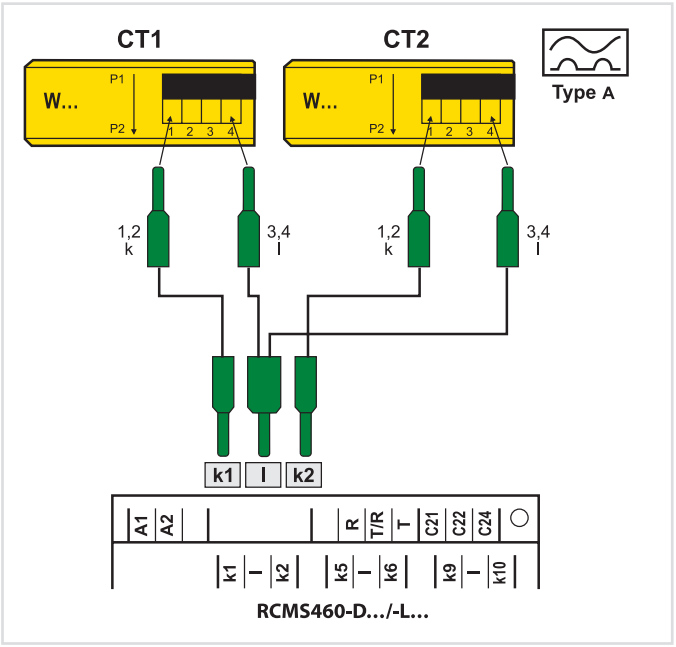
Digital input



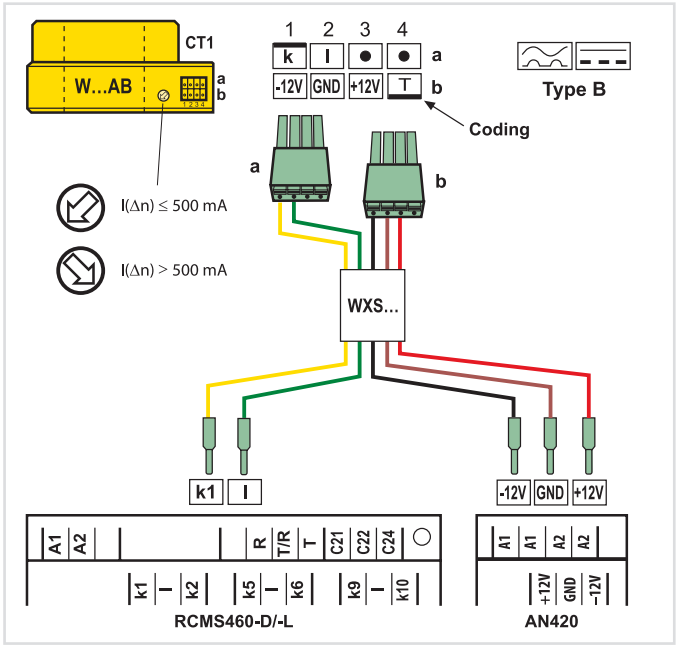
1 Potential-free contact
0 ≙ Resistance between k and l > 250 Ω
l ≙ Resistance between k and l < 100 Ω

2 Current transformer used on other channel (not required for digital input, for example only)

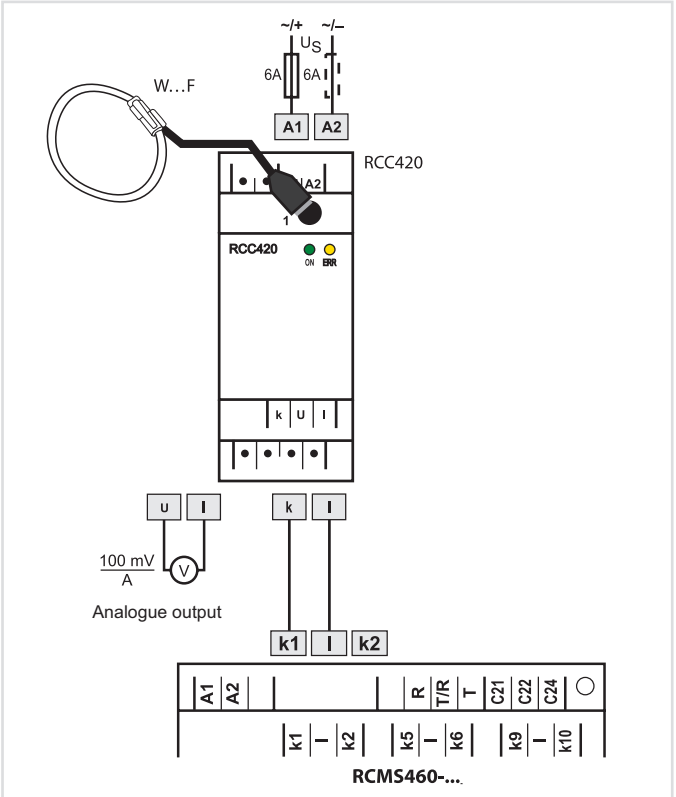
Wiring: W, WR, WS series current transformers (AC only)



Wiring: WAB series current transformers (AC/DC)

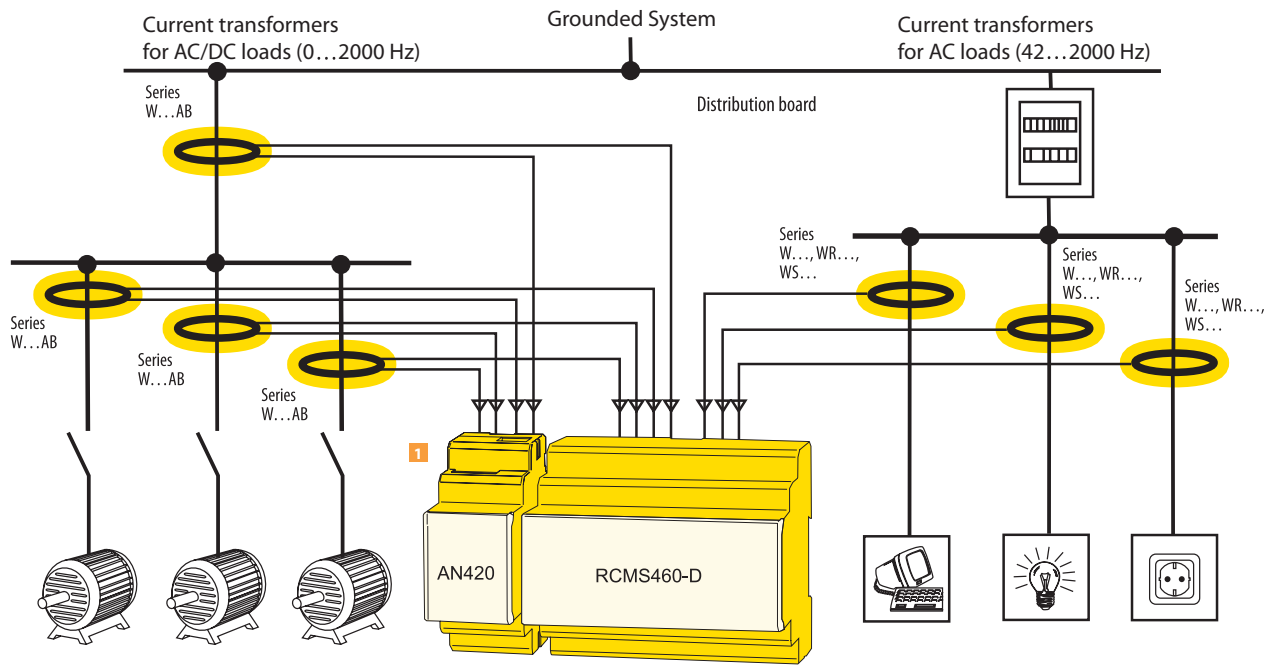


Wiring: WF series current transformers

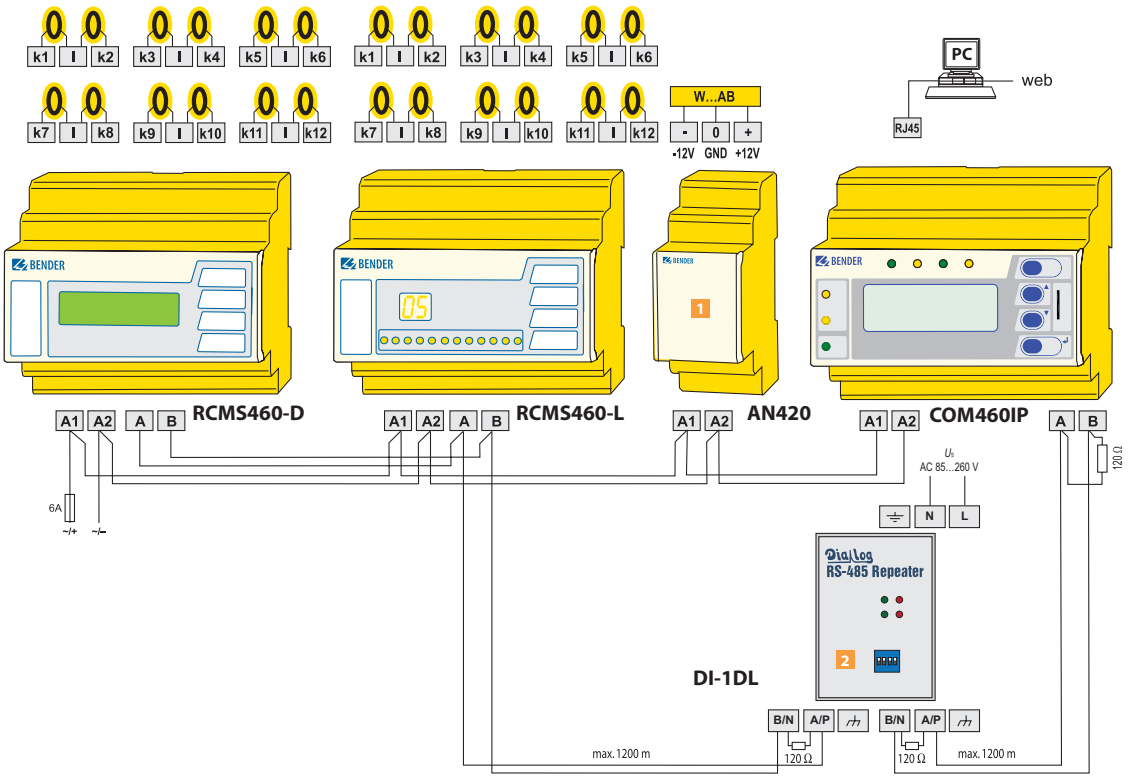


4

Application example: Monitoring multiple load types with single RCMS device



Application example: Connecting multiple RCMS modules to COM460IP communication gateway



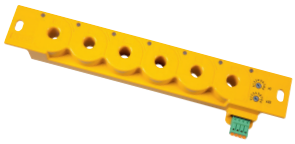
Note:

1 WAB series current transformers require the AN420 power supply. Up to six (6) WAB series current transformers may be powered by one AN420 power supply.

2 The DI-1DL repeater only is required when the length of the cable exceeds 1200 m or when more than 32 devices are connected to the bus.

RCMS150

Multi-channel ground fault monitor with integrated current transformers for grounded and HRG, single- and three-phase AC/DC systems



Features

- Ground fault monitoring for grounded and high-resistance grounded AC systems
- Works on both single-phase and three-phase systems
- RMS value measurement (AC)
- Monitor six channels from a single device
- Integrated current transformers, fully shielded
- Two separately adjustable alarm values, indepentendly adjustable for each channel
- Main alarm value adjustable, 0 - 300 mA
- Prewarning alarm value, 50 - 100% of main alarm
- Frequency range 0 - 1000 Hz
- Start-up delay, response delay and delay on release
- Communication output
- All settings adjustable and all alarm status viewable remotely via Bender COM465IP / CP700
- RoHS compliant

Applications

- Ground fault monitoring in grounded and HRG AC systems, single- or three-phase
- Motors and motor control centers
- Generators, portable and fixed
- Alarm systems, safety devices
- General industrial systems
- Controls and control systems
- Heat tracing systems
- Marinas

Approvals

CE

4

Ordering information

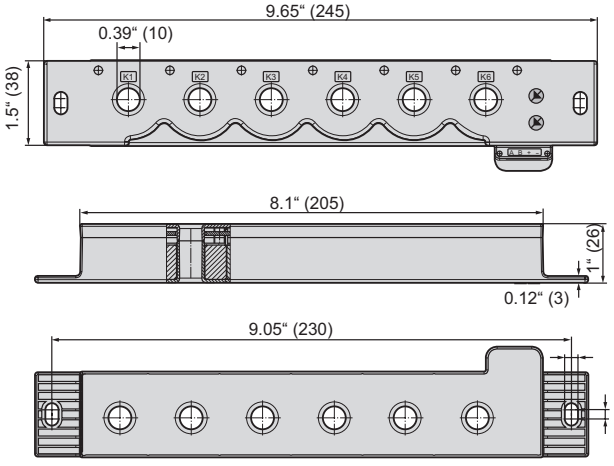
Supply voltage U_S	Type	Ordering No.
DC		
24 V	RCMS150	B 9405 3025

Accessories

Description	Type	Page
Ethernet and Modbus/TCP gateway	COM465IP[1)]	6-24
Ethernet and Modbus/TCP gateway with HMI	CP700[1)]	6-32
RS-485 repeater	DI-1DL	6-35
24 VDC power supply	CP-D 24/0.42	7-21

[1)] Add-on option C required for adjusting device settings

Dimensions in inches (mm)



Insulation coordination according to IEC 60664-1

Monitored primary circuit to output circuit

Output circuit	(+, -, A, B)
Rated insulation voltage	300 V
Overvoltage category	III
Rated impulse withstand voltage monitored circuit/output circuit	4 kV
Range of use	≤ 2000 m AMSL
Rated insulation voltage	250 V
Pollution degree	3
Insulation	BI: Overvoltage category III DI: Overvoltage category II
To achieve double insulation (DI) for overvoltage category III, insulated primary conductors with sufficient rated voltage must be used on the application side.	
Voltage test acc. to IEC 61010-1	AC 2.2 kV

Power supply

Nominal supply voltage U_S with galvanic separation	DC 24 V
Power consumption	< 4 W

Residual current measuring range

Frequency range	0 - 1000 Hz
Measuring range	±500 mA
Resolution, measured value	1 % of set alarm value

Response values

Ground fault current $I_{\Delta N2}$	RMS 0 - 300 mA (30 mA)*
Ground fault current $I_{\Delta N2}$	DC 3 - 300 mA (6 mA)*
Ratio $I_{\Delta N2\ RMS}/I_{\Delta N2\ DC}$	0.2 - 5
Prewarning $I_{\Delta N1\ RMS/DC}$	50 - 100 % (50 %)*
Response tolerance $I_{\Delta N2}$	
DC 10 - 500 Hz	-20 to 0 %
500 Hz - 1 kHz	-20 to +100 %
Hysteresis	10 - 25 % (15 %)

Time response

Start-up delay $t_{start\text{-}up}$	0.5 - 600 s (0.5 s)*
Response delay	
$t_{on1\ RMS/DC}$	0 - 600 s (0 s)*
$t_{on2\ RMS/DC}$	0 - 600 s (0 s)*
Delay on release	
t_{off1} DC	0 - 600 s (1 s)*
t_{off2} RMS	0 - 600 s (1 s)*

Indication (LEDs)

ON

green	indicates normal operation
green (flashing quickly)	indicates internal device error or incorrect RS-485 address
green (flashing slowly)	during normal operation, indicates RS-485 address

ALARM K1 - 6

yellow	$I_\Delta > I_{\Delta n}$
yellow (flashing)	measuring range exceeded

Interface

Interface/protocol	RS-485/BMS
Connection	terminals A/B
Shielded cable (one end of shield connected to PE)	twisted pair, e.g.: J-Y(St)Y 2x0.8
Cable length	≤ 3900 ft (1200 m)
Bus terminating resistor external	120 Ω (0.25 W)
Device address, RS-485 (BMS) bus	2 - 90 (2)*

Environment/EMC

EMC	
immunity	IEC 61000-6-2
emission	IEC 61000-6-3
Operating temperature	-13 to +158 °F (-25 to +70 °C)
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5
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

Connection

Connection type	pluggable push-wire terminal
Connection properties:	
rigid, flexible/conductor sizes AWG	0.2 - 1.5 mm²/AWG 24 - 16
Multi-conductor connection (2 conductors with the same cross section):	
rigid	0.2 - 1.5 mm²
flexible	0.2 - 1.5 mm²
flexible with ferrule without plastic sleeve	0.25 - 1.5 mm²
flexible with ferrule with plastic sleeve	0.25 - 0.75 mm²
Stripping length	10 mm

Other

Operating mode	continuous operation
Position of normal use	any
Enclosure material	polycarbonate
Flammability class	UL94 V-0
Screw mounting to standard distribution panels with 12 TE	2 x M6
DIN rail mounting	mounting clip (accessories)
Tightening torque	1.5 Nm
Documentation number	D00259
Weight	170 g

Integrated current transformers

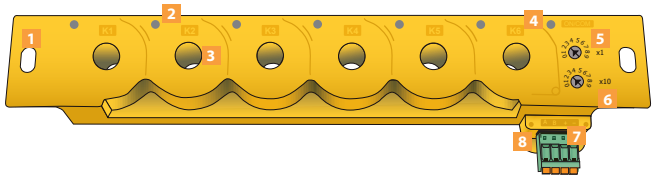
Diameter cable gland	0.4" (10 mm)
Load current	32 A

Bus parameter

Alarm	threshold value exceeded, system fault
Measured value	measured value, DC component, r.m.s. (resolution 0.1 mA)
Times	response delay, delay on release, start-up delay

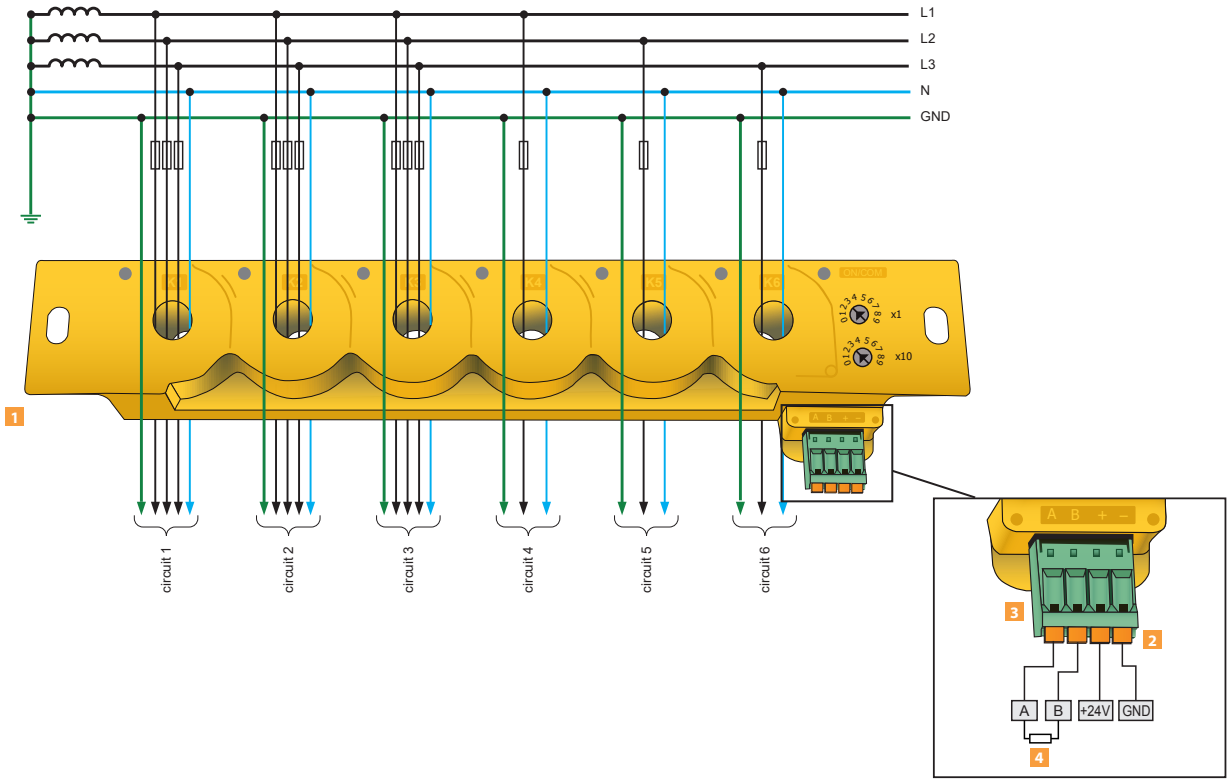
( )* = factory settings

Display and controls



1 Slot for screw mounting
2 Alarm LEDs for individual channels
3 Line feed-through for current transformers
4 ON LED: Power On LED
5 RS-485 address potentiometer (ones position)
6 RS-485 address potentiometer (tens position)
7 Supply voltage connection
8 Bender RS-485 bus connection

Wiring diagram



1 RCMS150
2 Supply voltage, 24 VDC
3 RS-485 interface for Bender communication bus
4 Termination resistor (required at beginning and end of bus)

Note:
Only insulated primary conductors suited for the indicated rated voltages must be used.

RCMB20-500 / RCMB35-500 Series

Integratable AC/DC ground fault detection modules

Applications

- Ground fault monitoring for grounded and HRG AC/DC systems
- Equipment requiring integrated ground fault protection
- Individual VFD-driven motors
- Individual solar combiner boxes

Approvals

c UL us LISTED

Features

- Measures both AC and DC ground faults
- Small form factor, all electronics built into the current transformer - no additional equipment required
- Designed for simple integration into equipment and panels, including frequency converters, VFDs, and combiner boxes for photovoltaic systems
- RMS value measurement (AC+DC)
- 0 - 500 Hz frequency range
- 500 mA measuring range
- Simple connectors
- 24 VDC supply voltage
- 4 - 20 mA analog output
- Full magnetic shielding
- Internal CT connection monitoring using cyclical test current
- Multicolor LED for device status

4

Ordering information

Supply voltage [1] U_S	Inside diameter	Type	Art. No.
DC			
20.4 - 28.8 V	ø 0.79″ (20 mm)	**RCMB20-500-01**	**B 9404 2103**
	ø 1.38″ (35 mm)	**RCMB35-500-01**	**B 9404 2104**

[1] Absolute values

Scope of delivery

The connection set supplied consists of the following individual parts:

For type	Accessories	Dimensions	Units
RCMB20-500-01	Single conductor with integrally moulded ferrule (black, white, red, blue)	45 cm	4
	PVC insulating tube	45 cm	1
RCMB35-500-01	Single conductor with integrally moulded ferrule (black, white, red, blue)	80 cm	4
	PVC insulating tube	80 cm	1
RCMB20-500-01 RCMB35-500-01	Push-wire plug, four-pole, encoded	–	2
	Mounting brackets	–	1
	Ferrule (mm^2 x mm)	0.5 x 6	4
	Cable ties (mm x mm)	100 x 2.5	2
	Lens head screw	M6 x 12	2
	Spring washer	M6	2

Technical data

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

Rated insulation voltage	AC 800 V
Rated impulse voltage/pollution degree	12 kV/2
Overvoltage category	CAT III
Protective separation (reinforced insulation) between	primary conductor and measurement electronics
Voltage tests according to IEC 61010-1	6.88 kV

Supply voltage

Supply voltage U_S	DC 24 V
Operating range of U_S	20.4 - 28.8 V
Ripple U_S	≤ 1 %
Power consumption	≤ 2.5 VA

Measuring circuit

Measuring current transformer RCMB20/RCMB35, inside diameter	20 mm/35 mm
Rated insulation voltage (measuring current transformer)	800 V
Characteristics according to IEC 62020 and IEC/TR 60755	AC/DC sensitive, Type B
Frequency range	0 - 500 Hz
Measuring range $I_{\Delta n}$	AC/DC 0 - 500 mA
Nominal current at 3NAC (RCMB20/RCMB35)	32 A/80 A
Operating uncertainty	± 4 %
Operating uncertainty at 10 - 30 Hz	+3 % - -15 % *
Operating uncertainty at 30 - 400 Hz	± 3 % *
Operating uncertainty at 400 - 500 Hz	± 10% *
Resolution measuring circuit	2 mA
Test winding	yes

Time response

Response delay t_{on}	0 s
Delay on release t_{off} (if outside the measuring range)	≤ 1 s
Operating time t_{ae} at I_{Δ}	≤ 180 ms
Response time t_{an}	= t_{ae} + t_{on}
Recovery time t_b	≤ 1s

Displays

LED	lights constantly green = operation indicator flashes red = fault (output current > 20 mA)

Outputs

Current output, proportional to the residual current	DC 4 - 20 mA
Current output, resolution	$I_{\Delta n}$ = 31,25 x (analogue output current - 4 mA)
Load	≤ 300 Ω

Environment/EMC

EMC	IEC 60947-2 Annex M
Operating temperature	-25 - 70 °C

For UL application:

Maximum ambient temperature	70 °C

Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M3
Long-time storage (IEC 60721-3-1)	1M3
Chemical stresses acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3C4

Connection

Primary conductor:	
RCMB20	≤ 4 x 6 mm² or 3 x 10 mm²
RCMB35	≤ 4 x 35 mm² or 3 x 50 mm²
Connector XK1:	
Connection type	pluggable push-wire terminals, 2 x four-pole

For UL application:

Use at least 60/75 °C copper lines!

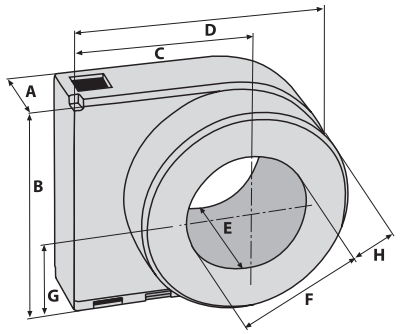
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N

General data

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Enclosure material	polycarbonate
Flammability class	UL94 V-0
Screw mounting	M5 with mounting brackets
DIN rail mounting acc. to	IEC 60715
Software version RCMB20-500-01	D378 V1.0
Software version RCMB35-500-01	D379 V1.0
Weight RCMB20	200 g
Weight RCMB35	250 g

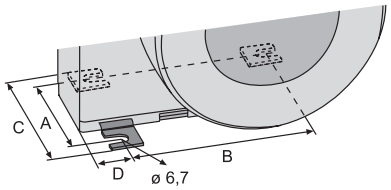
* of full scale value of the measuring range

Dimensions



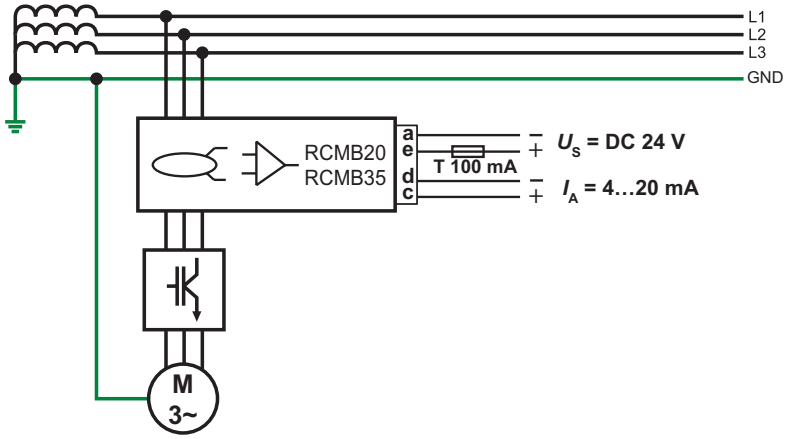
Dimensions in inches (mm)								
Type	A	B	C	D	E	F	G	H
RCMB20	1.18″ (30)	2.22″ (56.3)	1.97″ (50)	3″ (76.4)	1.91″ (48.5)	ø 0.79″ (20)	1.17″ (29.8)	0.65″ (16.4)
RCMB35	1.18″ (30)	3.12″ (79.2)	2.44″ (62)	3.92″ (99.5)	2.17″ (55)	ø 1.38″ (35)	1.64″ (41.7)	0.79″ (20)

Screw mounting

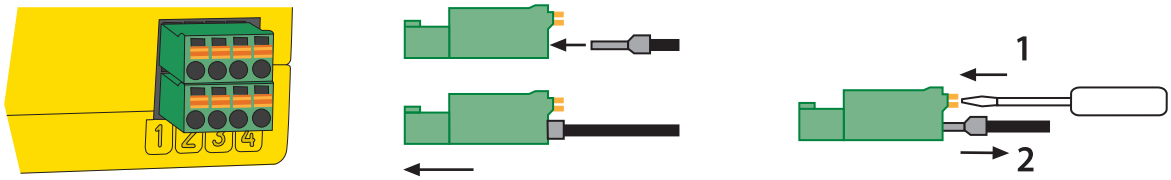


Dimensions in inches (mm)				
Type	A	B	C	D
RCMB20 (mounting with 2 angles diagonal)	1.85″ (47)	1.14″ (29)	2.48″ (63)	0.8″ (20.35)
RCMB35 (mounting with 2 angles diagonal)	1.85″ (47)	1.91″ (48.5)	2.48″ (63)	0.51″ (12.85)

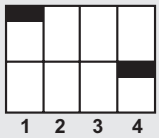
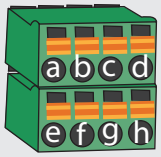
Example wiring diagram



Connectors



Connector legend

Coding socket	Pluggable push-wire terminal	Terminal	Colour	RCMB20/RCMB35
		A	black	GND (U_S)
		B	–	–
		C	white	DC 4 - 20 mA
		D	blue	GND (DC 4 - 20 mA)
		E	red	+24 V (U_S)
		F	–	–
		G	–	–
		H	–	–

XK1

LifeGuard Series

Ground fault circuit interrupters

Approvals

c UL us LISTED

c ETL us Intertek

Features

- Complete GFCI package for grounded and high-resistance grounded systems
- Detects ground faults and interrupts power to the system
- Voltage options up to 600 V
- Works on single-phase or three-phase systems
- Works on systems with DC components and systems with variable frequency drives (VFDs)
- 6 mA trip level available for personnel protection, 20 mA for equipment protection
- Option available for steplessly adjustable trip level
- Inverse time curve for nuisance trip prevention
- Option available for adjustable time delay
- Built-in ON and TRIPPED indication
- TEST and RESET pushbuttons on front of enclosure
- Various enclosure types available, also available with no enclosure, pre-built on backplate for integration
- Digital option: Digital display on front of enclosure showing measured ground fault current in real-time; digital option on backplate only supports connection to BENDER's remote communication system
- Models with applicable voltages up to 100 A are listed to UL 943 as Class A devices

Ordering information (with sample part number)

LG2	-	100	-	480	-	3/3	-	A	-	4X - P	-	D
		1		2		3		4		5		6

Code 1: Load ampere rating (choose one)	
Code	Description
20	20 A
40	40 A
60	60 A
80	80 A
100	100 A

Other ratings available upon request.

Code 2: System voltage, line-to-line (choose one)	
Code	Description
120	120 V
208	208 V
240	240 V
277	277 V
480	480 V
575	575 V
600	600 V

Other ratings available upon request.

Code 3: Phases (choose one)	
Code	Description
1/2	Single-phase, two-wire (L1, N)
2/2	Single-phase, two-wire (L1, L2)
2/3	Single-phase, three-wire (L1, L2, N)
3/3	Three-phase, three-wire (L1, L2, L3)
3/4	Three-phase, four-wire (L1, L2, L3, N)

Code 4: Trip level (choose one)			
Code	Trip level	Fault detection	Trip timing
A	6 mA (fixed)	AC / DC	Inverse time curve
B	20 mA (fixed)	AC / DC	Inverse time curve
C	6-30 mA (fixed at factory)	AC / DC	Inverse time curve
D	10 - 500 mA (adjustable)	AC / DC	0 - 10 s (adjustable)
E	10 mA - 10 A (adjustable)	AC only	0 - 10 s (adjustable)

Code 5: Enclosure (choose one)	
Code	Description
4X-P-CH	NEMA 4X polycarbonate enclosure
4X-SS-CH	NEMA 4X stainless steel enclosure
N	No enclosure (backplate only)

Code 6: Additional options (choose one)	
Code	Description
Nothing (blank)	No additional options
S	Start-stop button
D	Digital option**

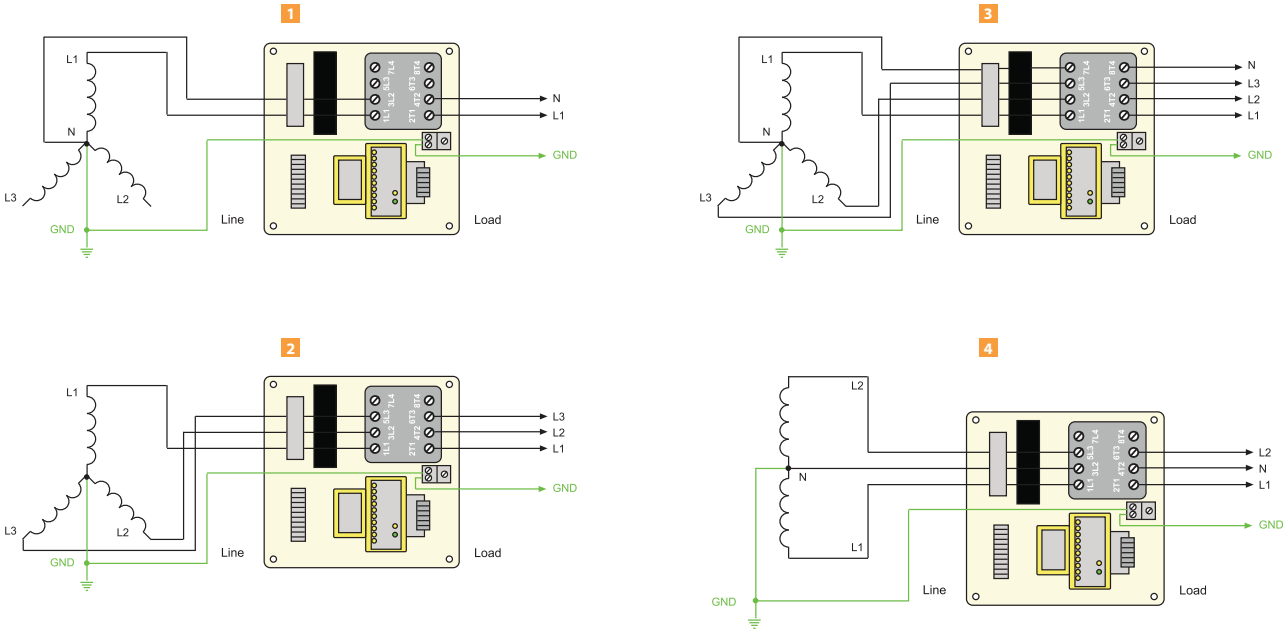
** Digital option is only available with trip level options A, B, and C under code 4. For models with an enclosure, a door-mounted digital remote replaces the test and reset pushbuttons normally included on the standard version (the remote includes test and reset buttons). For backplate-only models, the digital version includes ground fault modules capable of connecting to BENDER's remote communication system.

Displays and controls: Standard enclosure

1 POWER LED / RESET button: Lights when the GFCI has received power and the device has not tripped / Resets the GFCI if faults have been cleared (momentary push).

2 TRIPPED LED / TEST button: Lights when the GFCI has tripped / Performs a functional test of the GFCI (hold for > 2 s).

Example wiring diagrams



Other configurations are available on request.

1 Single-phase, two-wire configurations

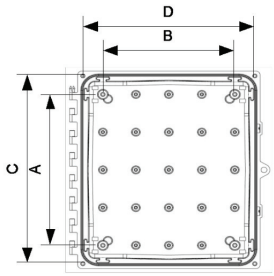
2 Three-phase, three-wire configurations

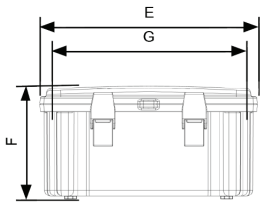
3 Three-phase, four-wire configurations

4 240Y/120 configurations

Dimensions

Dimensions shown below are for the NEMA 4X polycarbonate enclosure. Other enclosure types available upon request.





Dimensions in inches (mm)							
GFCI type	Enclosure type	A x B	C	D	E	F	G
Compact	8x6x4	6.25″ x 4.25″ (159 x 108)	8.75″ (222.5)	6.75″ (171.5)	9.4″ (239)	5.7″ (145)	8.3″ (211)
Standard < 100 A	12x10x6	10.25″ x 8.25″ (260.5 x 209.5)	12.75″ (324)	10.75″ (273)	13.4″ (340)	7.7″ (195.5)	12.3″ (312.5)
100 A models	14x12x6	12.25″ x 10.25″ (311 x 260.5)	14.75″ (375)	12.75″ (324)	15.4″ (391)	7.7″ (195.5)	14.3″ (363)

GFGC Series

Ground fault and ground continuity protection panel

Features

- Simultaneous ground fault protection and ground continuity protection
- Universal voltage selection between 120 VAC and 600 VAC for standard voltages
- System power interruption on either a ground fault, loss of ground conductor, or poor ground conductor quality
- Ground fault protection at 6 mA trip level with inverse time curve per UL 943
- Complete loss of ground detected, as well as ohmic quality of ground with adjustable trip level (0.1 - 100 Ω)
- NEMA 4/12 painted steel enclosure
- External test and reset buttons
- External POWER and TRIPPED LEDs
- Internal monitoring equipment features digital displays with real-time readings of ground fault current and loop resistance of ground conductor for simple troubleshooting

Applications

- Ground fault and ground continuity protection for grounded systems up to 600 V
- Systems with trailing cables
- Trailer and loading docks
- Systems with ground conductor quality issues
- Motors and motor control centers
- Systems with variable frequency drives (VFDs)

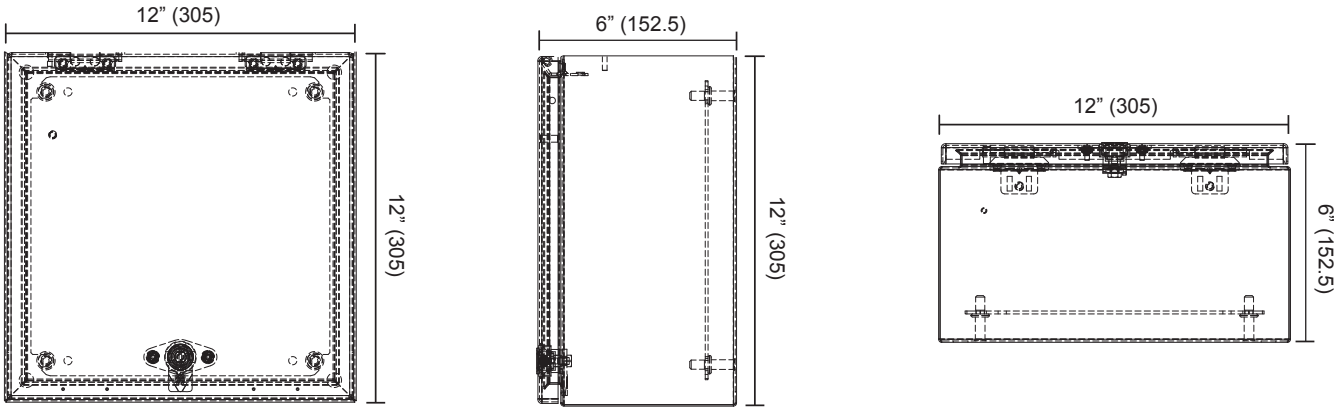
Approvals

c UL us LISTED

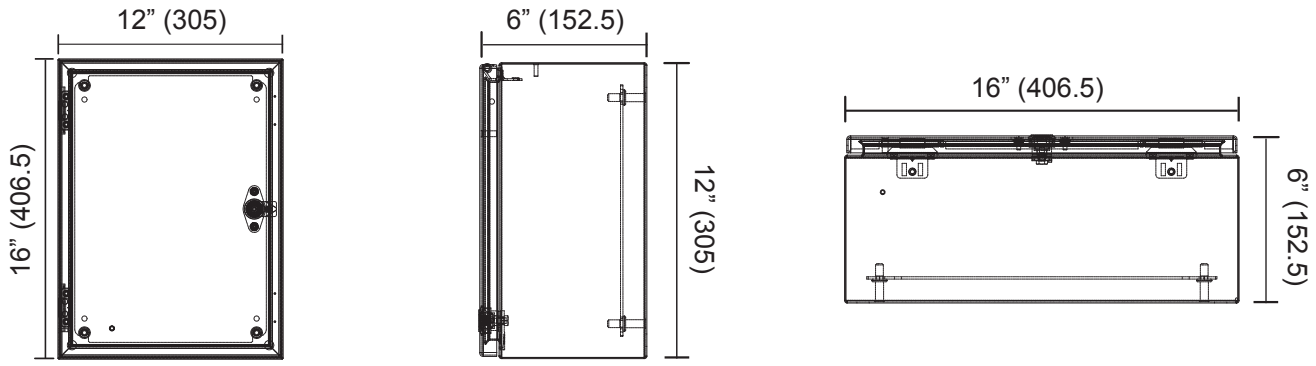
Ordering information

Description	Part No.	Ordering No.
30 A rated load current	GFGC-30	B 5413 00044
60 A rated load current	GFGC-60	B 5413 00045
100 A rated load current	GFGC-100	B 5413 00046

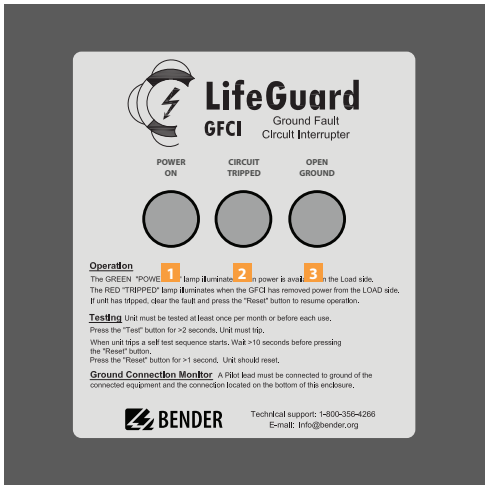
Dimensions: GFGC-30 in inches (mm)



Dimensions: GFGC-60, GFGC-100 in inches (mm)



Displays and controls



1 POWER ON LED / RESET Pushbutton: Lights when power is applied to the panel / Resets the panel if it has tripped and faults have been cleared (hold > 1.5 s).

2 TRIPPED LED / TEST Pushbutton: Lights when the panel has tripped on either alarm. If the Open Ground light is not illuminated, the ground fault alarm is active / Initiates internal self test (Hold for > 2 s).

3 OPEN GROUND LED: Lights when the open ground alarm is active. Pushing the button runs a test on the open ground light only.

MarinaGuard Series

Ground fault monitoring panel for marinas and shore power

Features

- Satisfies requirements of NEC 555.3, "Ground-Fault Protection"
- Ground fault monitoring panels for marinas and shore power
- Options for single feeder monitoring, multiple feeder monitoring, and multiple branch monitoring
- Preset to 100 mA trip level, steplessly adjustable down to 10 mA for feeder protection, 6 mA for branch protection
- TEST and RESET pushbuttons on front of enclosure
- POWER and TRIPPED LEDs on front
- Strobe light for easily visible alarm notification
- Contact outputs for remote notification or connection to feeder shunt trip breaker
- NEMA 4X rated, lockable enclosure
- Multi-channel versions support connection to BENDER communication gateways to standard protocols such as Ethernet and Modbus/TCP

Approvals

c UL us LISTED

Ordering information

Type	Quantity of feeders / branches	Adjustable trip level	Contact outputs	Supports comm. gateway
MG-1	1	10 mA - 10 A*	1 individual	
MG-2	2		2 individual	
MG-3	3		3 individual	
MG-S	12	6 mA - 20 A	1 common	■
MG-T	12		1 common, 12 individual	■

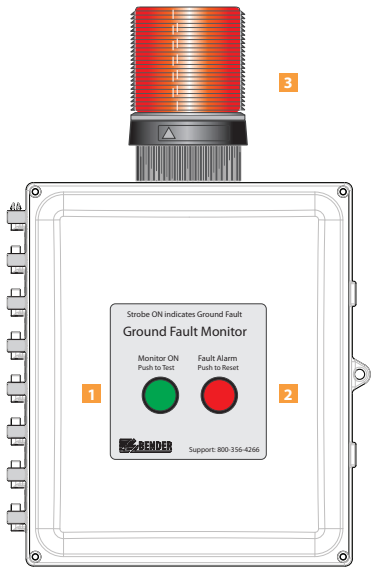
* Alternate adjustable trip level range of 6 - 600 mA available. Contact manufacturer or representative for more information.

Compatible current transformers

Description	CT type	Series	Page
External current transformers	circular	W series	7-06
	rectangular	WR series	7-13
	split-core	WS series	7-15
	flexible rope type	WF series*	7-17

* WF series flexible current transformers are only compatible with MG-S and MG-T model panels.

Displays and controls



1 POWER LED / RESET button: Lights when power is applied and no alarms are present / Resets the panel if faults have been cleared (momuntary push).

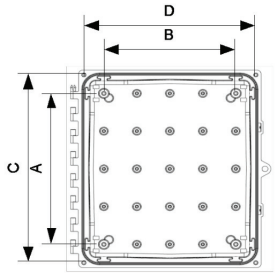
2 TRIPPED LED / TEST button: Lights when the panel has tripped / Performs a functional test of the panel (hold for > 2 s).

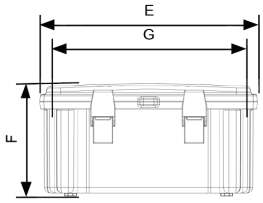
2 Strobe light: Lights when any alarms are detected.

4

Dimensions

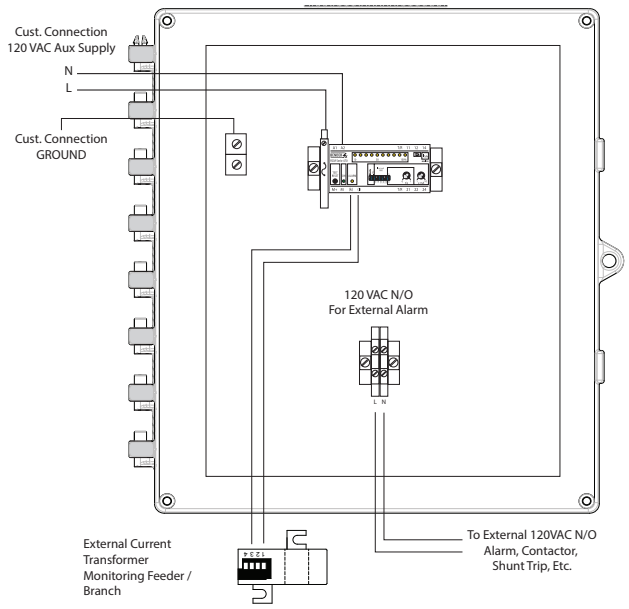
The mounted strobe light adds an additional 4.9" (125 mm) to the height of the enclosure.



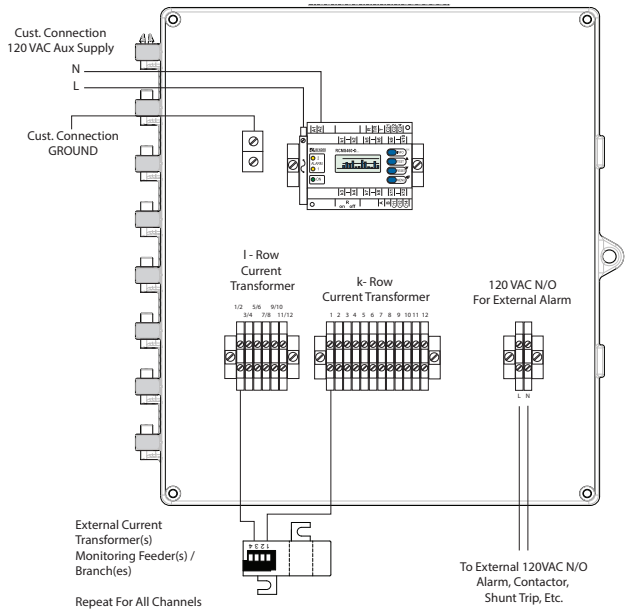


Dimensions in inches (mm)						
Enclosure type	A x B	C	D	E	F	G
12x10x6	10.25" x 8.25" (260.5 x 209.5)	12.75" (324)	10.75" (273)	13.4" (340)	7.7" (195.5)	12.3" (312.5)

Sample wiring diagram - MG-1



Sample wiring diagram - MG-S



RC48C

Ground fault and ground continuity monitor

Applications

- Ground fault monitoring for grounded and HRG AC systems
- Monitoring integrity of trailing cable
- Mining applications
- Systems which must satisfy the requirements of CSA M421 and other mining standards

Approvals

c UL us LISTED

Features

- Satisfies requirements of CSA M421 and other mining standards
- Combined ground fault and ground continuity monitoring in one device
- Works on single-phase and three-phase AC systems
- Adjustable ground fault trip value, 10 mA - 10 A
- Continuously monitors the trailing grounding line for continuity
- Ground continuity monitoring detects both series and cross resistance conductor faults
- Switchable band pass filter to measure only for 50/60 Hz ground fault currents
- Built-in test and reset buttons
- Connection for external test and reset functionality
- Two SPDT alarm contacts
- Optional remote indication / test and reset control with external device

Variable frequency drives (VFDs)

For systems with mining equipment which utilizes rectifiers or variable frequency drives (VFDs), BENDER recommends use of the RCMA423 or RCMS series ground fault monitors. These monitors are ideally suited for this purpose. Refer to page 138 for more information.

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
60 - 264 V	60 - 264 V	2 SPDT contacts	RC48C-935	B 9401 3002

Accessories: Remotes

Description	Type	Page
Remote Indicator	RI2000GC	6-07

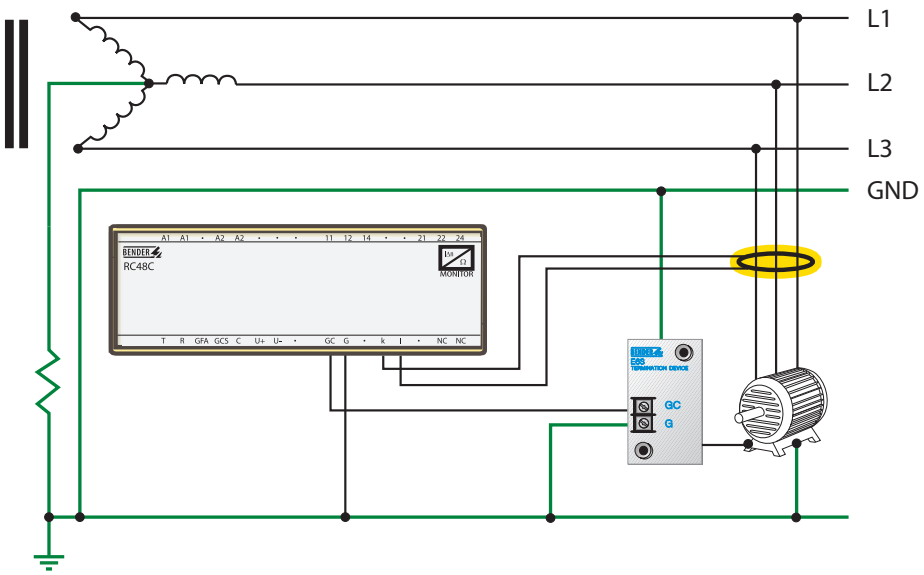
Accessories: Termination modules

Description	Type	Ordering No.
Termination modules	E6	B 9401 3008
	E6S	B 9401 3006
	E6S-T	B 9401 3007

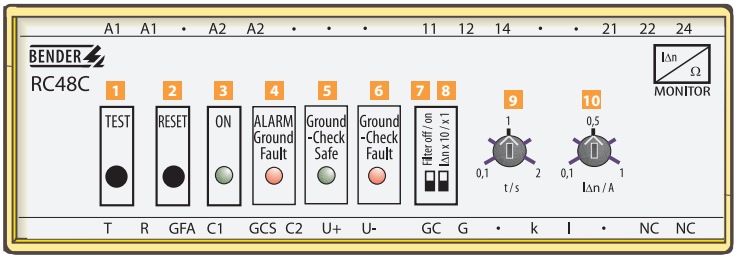
Compatible current transformers

Description	CT type	Series	Page
External current transformers	circular	W1-S35 - W5-S210	7-04
	rectangular	WR series	7-13
	split-core	WS series	7-15

Wiring diagram

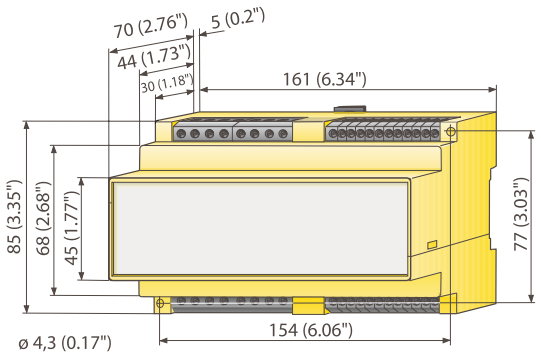


Displays and controls

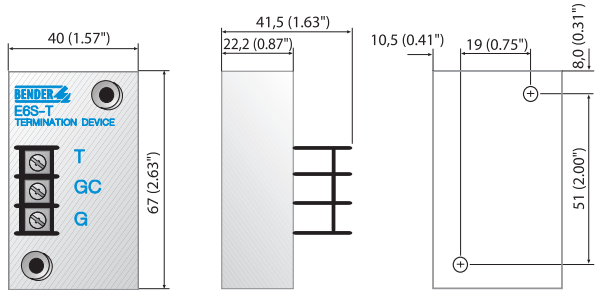


1. TEST button: Initiates internal self-test
2. RESET button: Resets device when in the alarm state
3. POWER ON LED: Illuminates green when power is applied to the device
4. "ALARM Ground Fault" LED: Illuminates red when the ground fault alarm is active
5. "Ground-Check Safe" LED: Illuminates green when the ground continuity alarm is not active
6. "Ground-Check Fault" Alarm: Illuminates red when the ground continuity alarm is active
7. "Filter On/Off" DIP switch: When DIP switch is set to ON, only 50/60 Hz ground fault current is detected by the monitor
8. IΔn x1/x10: When set to x10, the ground fault current trip level set by potentiometer "IΔn/A" is multipled by 10
9. "t/s" potentiometer: Adjusts the time delay (0.1 - 2 s)
10. "IΔn/A" potentiometer: Adjusts the ground fault trip value.

Dimensions: RC48C



Dimensions: E6S, E6S-T



Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3

Voltage ranges

Supply voltage U_S	AC/DC 60 - 264 V
Frequency range U_S	DC, 50/60 Hz
Power consumption	≤ 8.5 VA

Ground fault current monitoring

Response value	10 mA - 10 A
Accuracy	0 - - 25%
Response delay	0.1 - 2 s
Accuracy of response delay	± 20%
Short circuit current	200 A continuous, 2500 A for 2 s
Operating mode	Latching

Ground continuity monitoring

Response value, series resistance fault	40 Ω
Accuracy	± 10 Ω
No-load voltage	12 VDC
Output impedance	240 Ω
Rated current, measuring loop	25 VAC continuous
Protection against stray voltage	120 VAC for 3 s
Delay on release	1.5 s
Response time, series resistance faults	0.2 s
Response time, cross resistance faults	0.2 s
Accuracy, response time	± 20 %
Operating mode	Non-latching

Connection to current transformer

Single wire ≥ 0.75 mm² (AWG 18)	0 - 1 m
Single wire, twisted ≥ 0.75 mm² (AWG 18)	0 - 10 m
Shielded cable ≥ 0.75 mm² (AWG 18)	0 - 25 m

Inputs/outputs

Cable length for external test/reset button	0 - 33 ft (0 - 10 m)
Current source for external measuring instrument / max. load	DC 0 - 400 µA / 12.5 kΩ

Switching elements

Number of switching elements	2 SPDT contacts				
Operating principle	Normally energized or de-energized operation (N/E operation)*				
Electrical endurance, number of cycles	10000				
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
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	EN 50081
Operating temperature	-40 - +60 °C
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 12)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Weight	≤ 360 g

RC48N

Ground fault and neutral grounding resistor monitor

Applications

- Ground fault monitoring for grounded and HRG AC systems
- Monitoring integrity of neutral grounding resistor (NGR)
- Mining applications
- Systems which must satisfy the requirements of CSA M421 and other mining standards

Approvals

c UL us LISTED

Features

- Satisfies requirements of CSA M421 and other mining standards
- Combined ground fault and neutral grounding resistor (NGR) monitoring in one device
- Works on single-phase and three-phase AC systems
- Adjustable ground fault trip value, 10 mA - 10 A
- Adjustable response value for NGR monitoring
- Continuously monitors the integrity of the neutral grounding resistor (NGR)
- NGR monitoring works on system voltages up to 1000 VAC
- Switchable band pass filter to measure only for 50/60 Hz ground fault currents
- Built-in test and reset buttons
- Connection for external test and reset functionality
- Two SPDT alarm contacts
- Optional remote indication / test and reset control with external device

Variable frequency drives (VFDs)

For systems with mining equipment which utilizes rectifiers or variable frequency drives (VFDs), BENDER recommends use of the RCMA423 or RCMS series ground fault monitors. These monitors are ideally suited for this purpose. Refer to page 138 for more information.

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
60 - 264 V	60 - 264 V	2 SPDT contacts	RC48N-935	B 9401 3005

Accessories: Remotes

Description	Type	Page
Remote Indicator	RI2000GC	6-07

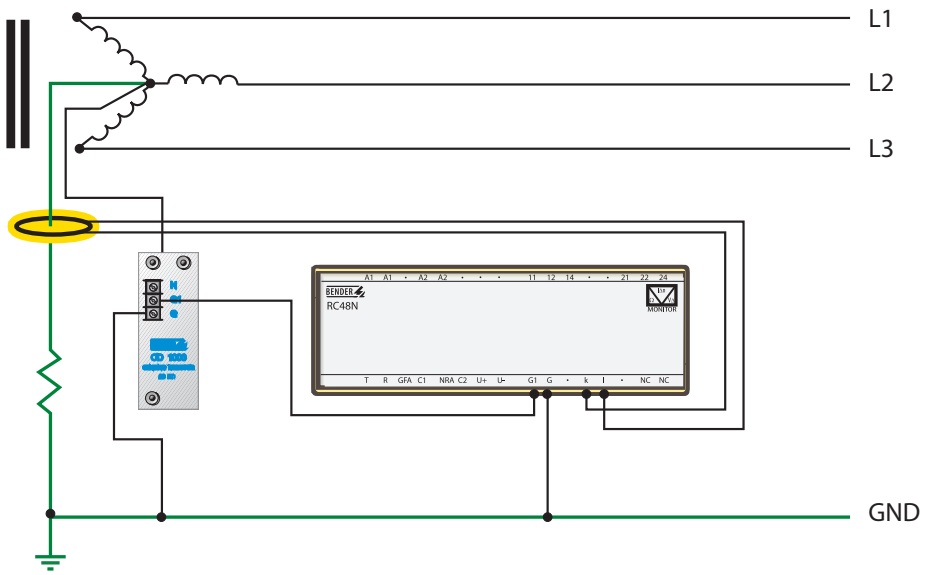
Accessories: Termination modules

Description	Type	Ordering No.
Termination modules	E6	B 9401 3008
	E6S	B 9401 3006
	E6S-T	B 9401 3007

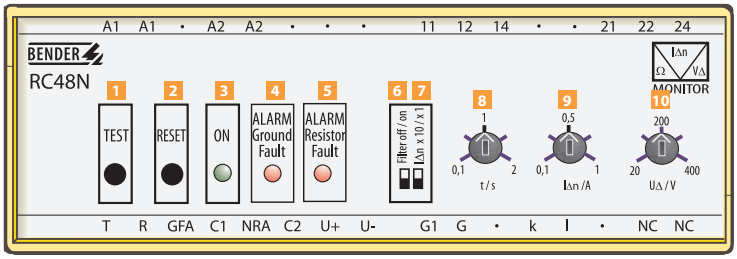
Compatible current transformers

Description	CT type	Series	Page
External current transformers	circular	W1-S35 - W5-S210	7-04
	rectangular	WR series	7-13
	split-core	WS series	7-15

Wiring diagram



Displays and controls

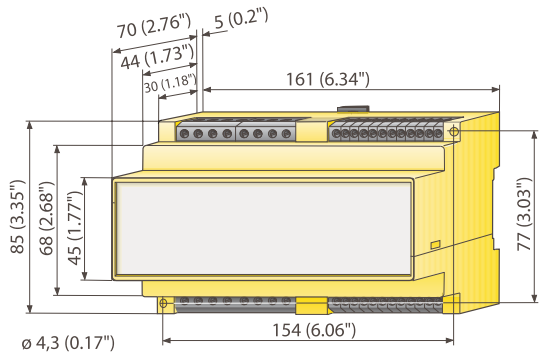


1. TEST button: Initiates internal self-test
2. RESET button: Resets device when in the alarm state
3. POWER ON LED: Illuminates green when power is applied to the device
4. "ALARM Ground Fault" LED: Illuminates red when the ground fault alarm is active
5. "Alarm Resistor Fault" LED: Illuminates red when the NGR alarm exceeds the response value or when the NGR's resistance exceeds 2 kΩ
6. "Filter On/Off" DIP switch: When DIP switch is set to ON, only 50/60 Hz ground fault current is detected by the monitor
7. IΔn x1/x10: When set to x10, the ground fault current trip level set by potentiometer "IΔn/A" is multipled by 10
8. "t/s" potentiometer: Adjusts the time delay (0.1 - 2 s)
9. "IΔn/A" potentiometer: Adjusts the ground fault trip value
10. "UΔ/V" potentiometer: Adjusts the response value for voltages across the NGR from 20 to 400 V (see example below)

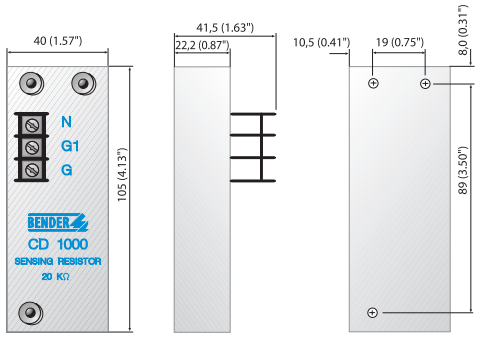
Adjusting the NGR response value

The response value for adjusting the neutral grounding resistor response value is E = R * I, where E = response value, U = RC48N ground fault response value, and R = NGR resistance. For example, a 5 A rated NGR on a 480 V system (55 Ω NGR resistance value), with a ground fault response value of 2 A, would be set to an NGR voltage response value of 2 * 55 = 110 V minimum.

Dimensions: RC48N



Dimensions: CD1000



Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3

Voltage ranges

Supply voltage U_S	AC/DC 60 - 264 V
Frequency range U_S	DC, 50/60 Hz
Power consumption	≤ 8.5 VA

Ground fault current monitoring

Response value	10 mA - 10 A
Accuracy	0 - - 25%
Response delay	0.1 - 2 s
Accuracy of response delay	± 20%
Short circuit current	200 A continuous, 2500 A for 2 s
Operating mode	Latching

NGR monitoring

Response value, voltage measurement	20 - 400 V
Accuracy	± 10 Ω
Response value, NGR at U_N = 0 V	2 kΩ
Accuracy	+ 5% - - 2% of coupling resistance
Response time	5 s
Accuracy, response time	± 20 %
Operating mode	Latching

Connection to current transformer

Single wire ≥ 0.75 mm² (AWG 18)	0 - 1 m
Single wire, twisted ≥ 0.75 mm² (AWG 18)	0 - 10 m
Shielded cable ≥ 0.75 mm² (AWG 18)	0 - 25 m

Inputs/outputs

Cable length for external test/reset button	0 - 33 ft (0 - 10 m)
Current source for external measuring instrument / max. load	DC 0 - 400 µA / 12.5 kΩ

Switching elements

Number of switching elements	2 SPDT contacts				
Operating principle	Normally energized or de-energized operation (N/E operation)*				
Electrical endurance, number of cycles	10000				
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
Minimum contact rating	1 mA at AC/DC ≥ 10 V				

Environment/EMC

EMC	EN 50081
Operating temperature	-40 - +60 °C
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 12)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (DIN EN 60529)	IP30 (NEMA 1)
Degree of protection, terminals (DIN EN 60529)	IP20 (NEMA 1)
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Weight	≤ 360 g

General Protective Relays

	 VME420	 VME421H	 VMD420	 VMD421H	
Page		5-06	5-09	5-12	5-15
Function		Voltage, frequency	Voltage, frequency	Voltage, frequency, phase loss, phase sequence	Voltage, frequency, phase loss, phase sequence
System type		Single-phase AC and DC systems up to 300 V	Single-phase AC and DC systems up to 300 V	Three-phase AC systems up to 500 V L-L	Three-phase AC systems up to 500 V L-L
System type	Single-phase AC	■	■		
System type	Three-phase AC			■	■
System type	DC	■	■		
Voltage	Overvoltage	6 - 300 V	9.6 - 150 V (VME421H-D-1) 70 - 300 V (VME421H-D-2)	6 - 500 V (L-L) 6 - 288 V (L-N)	70 - 500 V (L-L) 70 - 288 V (L-N)
Voltage	Undervoltage	6 - 300 V	9.6 - 150 V (VME421H-D-1) 70 - 300 V (VME421H-D-2)	6 - 500 V (L-L) 6 - 288 V (L-N)	70 - 500 V (L-L) 70 - 288 V (L-N)
Frequency	Overfrequency	10 - 500 Hz	15 - 460 Hz	10 - 500 Hz	15 - 460 Hz
Frequency	Underfrequency	10 - 500 Hz	15 - 460 Hz	10 - 500 Hz	15 - 460 Hz
Asymmetry/phase failure				■	■
Phase sequence				■	■
Current monitoring	Overcurrent				
Current monitoring	Undercurrent				
Loop resistance					
Installation	DIN rail	■	■	■	■
Installation	Screw mount	■	■	■	■

5

			
VMD258	**CME420**	**CMD420/CMD421**	**GM420**
5-18	**5-22**	**5-25**	**5-28**
Voltage	Current	Current	Ground continuity, loop monitoring
Three-phase AC up to 690 VAC L-L	Single-phase AC systems	Three-phase AC systems	AC systems
	■		■
■		■	■
105 - 130% of rated system voltage			
70 - 95% of rated system voltage			
	0.1 - 16 A directly connected, up to 999 A using x/5 ratio CT	0 - 1 A (connect up to 2000:1 ratio CT, CMD420) 0 - 5 A (connect up to 2000:5 ratio CT, CMD421)	
	0.1 - 16 A directly connected, up to 999 A using x/5 ratio CT	0 - 1 A (connect up to 2000:1 ratio CT, CMD420) 0 - 5 A (connect up to 2000:5 ratio CT, CMD421)	
			0 - 100 Ω
	■	■	■
	■	■	■

Power Quality Meters

	 PEM735

Page		5-34
Function		Class A power quality monitoring (per EN 61000-4-30)
System type		Three-phase AC systems up to 690 V
System type	Single-phase AC	■
	Three-phase AC	
	DC	
System type		Grounded and ungrounded
Accuracy class		0.2 S
Inputs	Voltage	5
	Current	4
Flicker measurement		■
Transient detection		■
Sampling rate		512 samples/cycle
Mounting		Panel mount
Communication	Modbus/TCP	■
	Modbus/RTU	■
	Bender COM465IP/CP700	■

EV Charge Controllers

	 CC612

Page		5-31
Function		IEC compliant mode 3 EV charrging control per IEC 61851-22
System type		Single-phase and three-phase EVSE up to 80 A
System type	Single-phase AC	■
	Three-phase AC	■
	DC	
EVSE classification compatibility		Mode 3
Smart grid functionality		OCPP 1.5 compliant
Ground fault monitoring		6 mA DC
Meter interface		RJ45
Communication	Local	USB
	Network	Ethernet / web server
	Power line	Optional ISO 15118 power line communication
	Cellular	2.5G EDGE / 3G (4G coming soon)

VME420 Series

Digital voltage and frequency relay for single-phase AC and DC systems Using external supply voltage

Applications

- Voltage and frequency monitoring of single-phase AC systems
- Voltage monitoring in DC systems
- Battery systems
- Transfer switches
- Generators

Approvals

Features

- Overvoltage, undervoltage, overfrequency, and underfrequency monitoring
- For single-phase AC/DC systems up to 300 V
- Any combination of alarm functions may be enabled/disabled
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Option with 0(4)-20 mA or 0-10 V analog output
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- External supply voltage connections

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	VME420-D-1	B 9301 0001
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	VME420-D-2	B 9301 0002
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Galvanically isolated, selectable analog output	VME420-DM-1	B 9301 0015
70 - 300 V	70 - 300 V (15 - 460 Hz)	Galvanically isolated, selectable analog output	VME420-DM-2	B 9301 0016

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	250 V
Overvoltage category/pollution degree	III/3
Rated impulse voltage	4 kV
Protective separation (reinforced insulation) between:	
	(A1, A2) - (U1/+, U2/-) - (11-12-14) - (21-22-24)

Supply voltage

VME420-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	15 - 460 Hz

VME420-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	15 - 460 Hz
Power consumption	≤ 4 VA

Measuring circuit

Measuring range (r.m.s. value)	AC/DC 0 - 300 V
Rated frequency f_n	DC, 15 - 460 Hz
Frequency display range	10 - 500 Hz

Response values

Undervoltage < *U* (Alarm 2)	AC/DC 6 - 300 V
Overvoltage > *U* (Alarm 1)	AC/DC 6 - 300 V
Resolution of setting *U* 6.0 - 49.9 V	0.1 V
Resolution of setting *U* 50 - 300 V	1 V

Preset function:

Undervoltage < *U* = (0.85 U_n):*	
for U_n = 230/120/60/24 V	196/102/51/20.4 V
Overvoltage > *U* = (1.1 U_n):*	
for U_n = 230/120/60/24 V	253/132/66/26.4 V
Relative uncertainty voltage at 50/60 Hz	± 1.5 %, ± 2 digits
Relative uncertainty, voltage in the range of 15 - 460 Hz	± 3 %, ± 2 digit
Hysteresis *U*	1 - 40 % (5 %)*
Underfrequency < Hz	10 - 500 Hz**
Overfrequency > Hz	10 - 500 Hz**
Resolution of setting *f* 10.0 - 99.9 Hz	0.1 Hz
Resolution of setting *f* 100 - 500 Hz	1 Hz

Preset function:

Underfrequency for f_n = 400/60/50/16.7 Hz	399/59/49/15.7 Hz
Overfrequency for f_n = 400/60/50/16.7 Hz	401/61/51/17.7 Hz
Hysteresis frequency Hys Hz	0.1 - 2 Hz (0.2 Hz)*
Relative uncertainty, frequency range 15 - 460 Hz	± 0.2 %, ± 1 digit

Time response

Start-up delay *t*	0 - 300 s (0 s)*
Response delay $t_{on1/2}$	0 - 300 s (0 s)*
Delay on release t_{off}	0 - 300 s (0.5 s)*
Resolution of setting *t*, $t_{on1/2}$, t_{off} (0 - 10 s)	0.1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (10 - 99 s)	1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (100 - 300 s)	10 s
Operating time, voltage t_{ae}	DC/AC 16.7 Hz: ≤ 130 ms, AC 42 - 460 Hz: ≤ 70 ms
Operating time frequency t_{ae}	AC 15 - 460 Hz: ≤ 310 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range measured value	AC/DC 0 - 300 V
Operating uncertainty at 50/60 Hz	± 1.5 %, ± 2 digits
Operating uncertainty, voltage in the range of 15 - 460 Hz	± 3 %, ± 2 digits
Operating uncertainty, frequency in the range of 15 - 460 Hz	± 0.2 %, ± 1 digit
History memory (HiS) for the first alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory (M) alarm relay	on/off/con (on)*

Switching elements

Number	2 SPDT contacts (standard model) (K1, K2)
Operating principle	Normally energized or de-energized operation
	K2: Err, < *U*, > *U*, < Hz, > Hz, S.AL (undervoltage < *U*: N/D operation n.c.)*
	K1: Err, < *U*, > *U*, < Hz, > Hz, S.AL (overvoltage > *U*: N/E operation n.o.)*
Electrical endurance, number of cycles	10000

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-25 - +55 °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-time 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

Connection

Connection type	screw terminals
Connection properties:	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

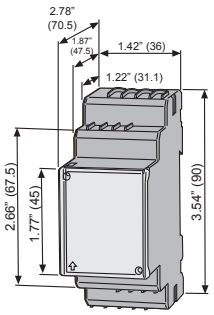
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529	IP20
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version	D235 V2.2x
Operating manual	TGH1399
Weight	≤ 150 g

( )* = factory setting

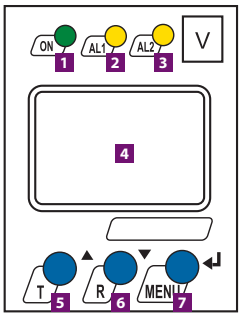
** = The technical data applies to the operating range of the rated frequency 15 - 460 Hz only

5

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.

2 Alarm LED "AL1" (yellow), lights when overvoltage or frequency alarms activate. Flashes during device fault.

3 Alarm LED "AL2" (yellow), lights when undervoltage or frequency alarms activate. Flashes during device fault.

4 Multifunctional LCD display

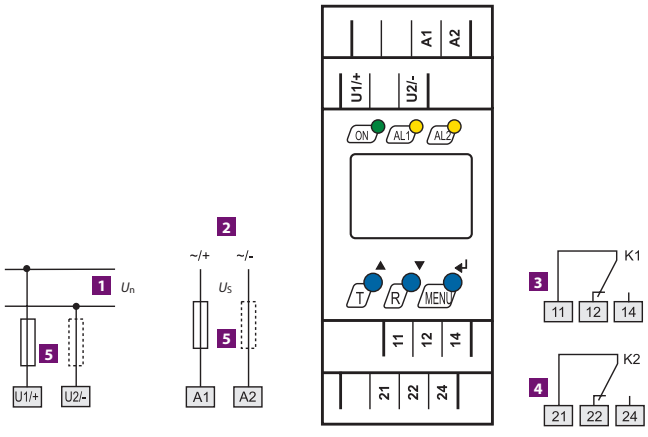
5 Test button "T": Initiates device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 "MENU" button: Opens the device's main menu.
Enter button: Confirms parameter changes.

When the menu item LEd is activated, the alarm LED "AL1" indicates that K1 is in the alarm state. When "AL2" lights up, K2 is in the alarm state.

Wiring diagram



1 System connections

2 Supply voltage U_S (see ordering information)

3 Alarm relay K1

4 Alarm relay K2

5 Power supply line fuse protection

VME421H Series

Digital voltage and frequency relay for single-phase AC and DC systems
Line powered

Applications

- Voltage and frequency monitoring of single-phase AC systems
- Voltage monitoring in DC systems
- Battery systems
- Transfer switches
- Generators

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Features

- Overvoltage, undervoltage, overfrequency, and underfrequency monitoring
- For single-phase AC/DC systems up to 300 V
- Any combination of alarm functions may be enabled/disabled
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Option with 0(4)-20 mA or 0-10 V analog output
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- Powered from monitored line, no external supply voltage connections required

Ordering information

Nominal system voltage [1] U_n		Type	Ordering No.
DC	AC		
9.6 - 150 V	9.6 - 150 V (15 - 460 Hz)	VME421H-D-1	B 9301 0003
70 - 300 V	70 - 300 V (15 - 460 Hz)	VME421H-D-2	B 9301 0004

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

5

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between:	(U1/+, U2/-) - (11-12-14) - (21-22-24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

VME421H-D-1:

Supply voltage U_S	none (internally supplied by U_n)

VME421H-D-2:

Supply voltage U_S	none (internally supplied by U_n)
Power consumption	≤ 6 VA

Measuring circuit

Measuring range (r.m.s. value) (VME421H-D-1)	AC/DC 0 - 150 V
Measuring range (r.m.s. value) (VME421H-D-2)	AC/DC 0 - 300 V
Rated frequency f_n	DC, 15 - 460 Hz
Frequency display range	10 - 500 Hz

Response values

VME421H-D-1:

Undervoltage < *U* (Alarm 2)	AC/DC 9.6 - 150 V
Overvoltage > *U* (Alarm 1)	AC/DC 9.6 - 150 V
Preset function:	
Undervoltage < *U* (0.85 U_n)* for U_n = 120/60/24 V	102/51/20.4 V
Overvoltage > *U* (1.1 U_n)* for U_n = 120/60/24 V	132/66/26.4 V
Resolution of setting *U* 9.6 - 49.9 V	0.1 V
Resolution of setting *U* 50 - 150 V	1 V

VME421H-D-2:

Undervoltage < *U* (ALARM 2)	AC/DC 70 - 300 V
Overvoltage > *U* (ALARM 1)	AC/DC 70 - 300 V
Resolution of setting *U* 70 - 300 V	1 V
Preset function:	
Undervoltage < *U* (0.85 U_n)* for U_n = 230/120 V	196/102 V
Overvoltage > *U* (1.1 U_n)* for U_n = 230/120 V	253/132 V

VME421H - :

Relative uncertainty voltage at 50/60 Hz	1.5 %, 2 digits
Relative uncertainty voltage in the range 15 - 460 Hz	± 3 %, ± 2 digit
Hysteresis *U*	1 - 40 % (5 %)*
Underfrequency < Hz	10 - 500 Hz**
Overfrequency > Hz	10 - 500 Hz**
Resolution of setting *f* 10.0 - 99.9 Hz	0.1 Hz
Resolution of setting *f* 100 - 500 Hz	1 Hz
Preset function:	
Underfrequency for f_n = 400/60/50/16.7 Hz	399/59/49/15.7 Hz
Overfrequency for f_n = 400/60/50/16.7 Hz	401/61/51/17.7 Hz
Hysteresis frequency Hys Hz	0.1 - 2 Hz (0.2 Hz)*
Relative uncertainty, frequency in the range of 15 - 460 Hz	± 0.2 %, ± 1 digit

Time response

Start-up delay *t*	0 - 300 s (0 s)*
Response delay $t_{on1/2}$	0 - 300 s (0 s)*
Delay on release t_{off}	0 - 300 s (0.5 s)*
Resolution of setting *t*, $t_{on1/2}$, t_{off} (0 - 10 s)	0.1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (10 - 99 s)	1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (100 - 300 s)	10 s
Operating time, voltage t_{ae}	DC/AC 16.7 Hz: ≤ 130 ms, AC 42 - 460 Hz: ≤ 70 ms
Operating time frequency t_{ae}	AC 15 - 460 Hz: ≤ 310 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Discharging time energy backup on power failure (VME421H-D-1)	3 s
Discharging time energy backup on power failure (VME421H-D-1)	2.5 s at f_n < 42 Hz
Discharging time energy backup (VME421H-D-2)	≥ 4 s at DC 70 V ≥ 6 s at DC 80 V/AC 70 V
Charging time energy backup (VME421H-D-1)	60 s
Charging time energy backup (VME421H-D-2)	120 s
Recovery time t_b	≤ 300 ms

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range measured value (VME421H-D-1)	AC/DC 0 - 150 V
Display range measured value (VME421H-D-2)	AC/DC 0 - 300 V
Operating uncertainty at 50/60 Hz	± 1.5 %, ± 2 digits
Operating uncertainty voltage in the range of 15 - 460 Hz	± 3 %, ± 2 digits
Operating uncertainty in the frequency range 15 - 460 Hz	± 0.2 %, ± 1 digit
History memory (HiS) for the first alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory (M) alarm relay	on/off/con (on)*

Switching elements

Number	2 SPDT contacts (K1, K2)
Operating principle	Normally energized or de-energized operation
	K2: Err, < *U*, > *U*, < Hz, > Hz, S.AL (undervoltage < *U*: N/E operation n.c.)*
	K1: Err, < *U*, > *U*, < Hz, > Hz, S.AL (overvoltage > *U*: N/D operation n.o.)*
Electrical endurance, number of cycles	10000

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-25 - +55 °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-time 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

Connection

Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

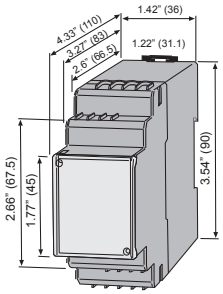
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529	IP20
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version VME421H-D-1	D236 V2.2x
Software version VME421H-D-2	D237 V2.2x
Operating manual	TGH1403
Weight	≤ 240 g

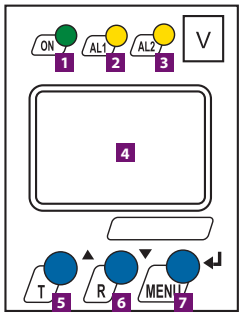
( )* = factory setting

** = The technical data applies to the operating range of the rated frequency 15 - 460 Hz only.

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.

2 Alarm LED "AL1" (yellow), lights when overvoltage or frequency alarms activate. Flashes during device fault.

3 Alarm LED "AL2" (yellow), lights when undervoltage or frequency alarms activate. Flashes during device fault.

4 Multifunctional LCD display

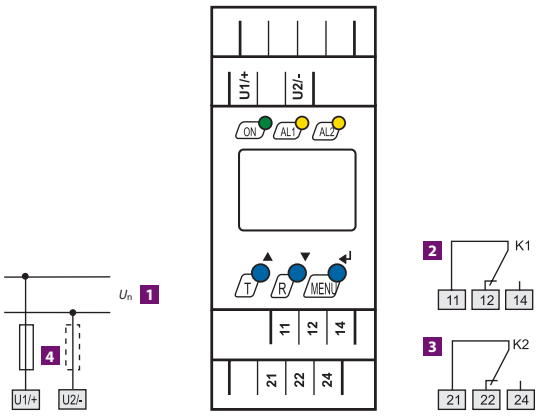
5 Test button "T": Initiates device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 "MENU" button: Opens the device's main menu.
Enter button: Confirms parameter changes.

When the menu item LEd is activated, the alarm LED "AL1" indicates that K1 is in the alarm state. When "AL2" lights up, K2 is in the alarm state.

Wiring diagram



1 System connetions

2 Alarm relay K1

3 Alarm relay K2

4 Power supply and line fuse protection

5

VMD420 Series

Digital voltage, frequency, phase loss and phase sequence relay for three-phase AC systems Using external supply voltage

Applications

- Voltage, frequency, and phase loss monitoring on three-phase AC systems
- Generators, transfer switches
- Voltage and phase loss protection for motors

Approvals

c UL us LISTED

PCT AE25

Lloyd's Register TYPE APPROVED

Features

- Overvoltage, undervoltage, overfrequency, and underfrequency monitoring
- For three-phase AC systems up to 500 V (L-L) or 288 V (L-N)
- Asymmetry, phase loss and phase sequence monitoring
- Any combination of alarm functions may be enabled/disabled
- Select between monitoring and alarming on L-L voltage or L-N voltage
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Option with 0(4)-20 mA or 0-10 V analog output
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- External supply voltage connections

Ordering information

Supply voltage [1] U_S		Outputs	Type	Ordering No.
DC	AC			
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	2 SPDT contacts	VMD420-D-1	B 9301 0005
70 - 300 V	70 - 300 V (15 - 460 Hz)	2 SPDT contacts	VMD420-D-2	B 9301 0006
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	Galvanically isolated, selectable analog output	VMD420-DM-1	B 9301 0017
70 - 300 V	70 - 300 V (15 - 460 Hz)	Galvanically isolated, selectable analog output	VMD420-DM-2	B 9301 0018

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Art. No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	400 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (N, L1, L2, L3) - (11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1:	
(N, L1, L2, L3) - (A1, A2), (11, 12, 14)	3.32 kV
(N, L1, L2, L3) - (21, 22, 24)	2.21 kV
(A1, A2) - (11, 12, 14) - (21, 22, 24)	2.21 kV

Supply voltage

VMD420-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	15 - 460 Hz

VMD420-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	15 - 460 Hz
Power consumption	≤ 4 VA

Measuring circuit

Measuring range (r.m.s. value) (L-N)	AC 0 - 288 V
Measuring range (r.m.s. value) (L-L)	AC 0 - 500 V
Rated frequency f_n	15 - 460 Hz
Frequency display range	10 - 500 Hz

Response values

Type of distribution system	3(N)AC/3AC (3AC)*
Undervoltage < *U* (Alarm 2) (measurement method:	AC 6 - 500/6 - 288 V
Overvoltage > *U* (Alarm 1) (measurement method: 3Ph/3n)	AC 6 - 500/6 - 288 V
Resolution of setting *U*	1 V

Preset function for L-L measurement:

Undervoltage < *U* (0.85 U_n)* for U_n = 400/208 V	340/177 V
Overvoltage > *U* (1.1 U_n)* for U_n = 400/208 V	440/229 V

Preset function for L-N measurement:

Undervoltage < *U* (0.85 U_n)* for U_n = 230/120 V	196/102 V
Overvoltage > *U* (1.1 U_n)* for U_n = 230/120 V	253/132 V
Asymmetry	5 - 30 % (30 %)*
Phase failure	by setting the asymmetry
Phase sequence	clockwise/anticlockwise rotation (off)*
Relative uncertainty, voltage at 50/60 Hz	± 1.5 %, ± 2 digits
Relative uncertainty, voltage in the range 15 - 460 Hz	± 3 %, ± 2 digits
Hysteresis *U*	1 - 40 % (5 %)*
Underfrequency < Hz	10 - 500 Hz**
Overfrequency > Hz	10 - 500 Hz**
Resolution of setting *f* (10.0 - 99.9 Hz)	0.1 Hz
Resolution of setting *f* (100 - 500 Hz)	1 Hz

Preset function:

Underfrequency for f_n = 400/60/50/16.7 Hz	399/59/49/15.7 Hz
Overfrequency for f_n = 400/60/50/16.7 Hz	401/61/51/17.7 Hz
Hysteresis, frequency Hys Hz	0.1 - 2 Hz (0.2 Hz)*
Relative uncertainty, frequency range 15 - 460 Hz	± 0.2 %, ± 1 digit

Time response

Start-up delay *t*	0 - 300 s (0 s)*
Response delay $t_{on1/2}$	0 - 300 s (0 s)*
Delay on release t_{off}	0 - 300 s (0.5 s)*
Resolution of setting *t*, $t_{on1/2}$, t_{off} (0 - 10 s)	0.1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (10 - 99 s)	1 s
Resolution of setting *t*, $t_{on1/2}$, t_{off} (100 - 300 s)	10 s
Operating time, voltage t_{ae}	≤ 140 ms
Operating time, frequency t_{ae}	≤ 335 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range measured value	AC/DC 0 - 500 V
Operating uncertainty, voltage at 50 Hz/60 Hz	1.5 %, 2 digits
Operating uncertainty voltage in the range of 15 - 460 Hz	± 3 %, ± 2 digits
Operating uncertainty, frequency in the range of 15 - 460 Hz	± 0.2 %, ± 1 digit
History memory (HiS) for the first alarm value	data record measured values
Password	off/0 - 999 (off/ 0)*
Fault memory (M) alarm relay	on/off/con (on)*

Switching elements

Number	2 SPDT contacts (K1, K2)
Operating principle	Normally energized or de-energized operation
	K2: Err, < *U*, > *U*, Asy, < Hz, > Hz, PHS, S.AL (undervoltage < U, asymmetry Asy, N/E operation n.c.)*
	K1: Err, < *U*, > *U*, Asy, < Hz, > Hz, PHS, S.AL (overvoltage >U, asymmetry Asy, N/D operation n.o.)*
Electrical endurance, number of cycles	10000

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC61326-1
Operating temperature	-25 - +55 °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-time 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

Connection

Connection type	push-wire terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

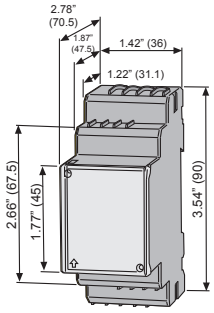
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529	IP20
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version	D238 V2.2x
Operating manual	TGH1396
Weight	≤ 150 g

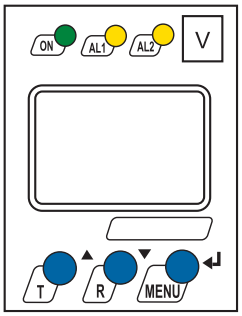
( )* = factory setting

** = The technical data can only be ensured in the operating range of the nominal frequency 15 - 460 Hz.

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.

2 Alarm LED "AL1" (yellow), lights when overvoltage, frequency, asymmetry, or phase alarms activate. Flashes during device fault.

3 Alarm LED "AL2" (yellow), lights when undervoltage, frequency, asymmetry, or phase alarms activate. Flashes during device fault.

4 Multifunctional LCD display

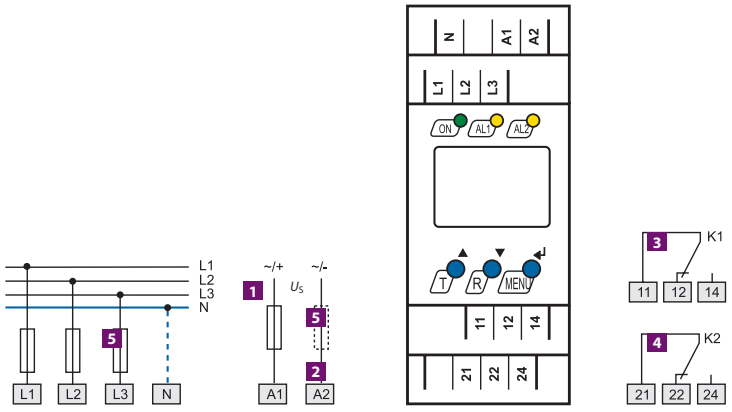
5 Test button "T": Initiates device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 "MENU" button: Opens the device's main menu.
Enter button: Confirms parameter changes.

When the menu item LEd is activated, the alarm LED "AL1" indicates that K1 is in the alarm state. When "AL2" lights up, K2 is in the alarm state.

Wiring diagram



1 System connections

2 Supply voltage U_S (see ordering information)

3 Alarm relay K1

4 Alarm relay K2

5 Power supply and line fuse protection

VMD421H Series

Digital voltage, frequency, phase loss and phase sequence relay for three-phase AC systems Using external supply voltage

Applications

- Voltage, frequency, and phase loss monitoring on three-phase AC systems
- Generators, transfer switches
- Voltage and phase loss protection for motors

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Features

- Overvoltage, undervoltage, overfrequency, and underfrequency monitoring
- For three-phase AC systems up to 500 V (L-L) or 288 V (L-N)
- Asymmetry, phase loss and phase sequence monitoring
- Any combination of alarm functions may be enabled/disabled
- Select between monitoring and alarming on L-L voltage or L-N voltage
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Option with 0(4)-20 mA or 0-10 V analog output
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- Powered from monitored line, no external supply voltage connections required

Ordering information

Nominal system voltage [1] U_n	Type	Ordering No.
Three-phase AC (L-L)		
70 - 500 V (15 - 460 Hz)	VMD421H-D-3	B 9301 0007

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	400 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	
(N, L1, L2, L3) - (11, 12, 14) - (21, 22, 24)	
Voltage test acc. to IEC 61010-1:	
(N, L1, L2, L3) - (11, 12, 14)	3.32 kV
(N, L1, L2, L3) - (21, 22, 24)	2.21 kV

Supply voltage

Supply voltage U_S	none (internally supplied by U_n)
Power consumption	≤ 6 VA

Measuring circuit

Measuring range (r.m.s. value) (L-N)	AC 0 - 288 V
Measuring range (r.m.s. value) (L-L)	AC 0 - 500 V
Rated frequency f_n	15 - 460 Hz
Frequency display range	10 - 500 Hz

Response values

Type of distribution system	3(N)AC/3AC (3AC)*
Undervoltage < *U* (Alarm 2) (measurement method: 3Ph/3n)	AC 70 - 500/70 - 288 V
Overvoltage > *U* (Alarm 1) (measurement method: 3Ph/3n)	AC 70 - 500 V/70 - 288 V
Resolution of setting *U*	1 V
Preset function for 3AC measurement:	
Undervoltage < *U* (0.85 U_n)* for U_n = 400/208 V	340/177 V
Overvoltage > *U* (1.1 U_n)* for U_n = 400/208 V	440/229 V
Preset function for 3(N)AC measurement:	
Undervoltage < *U* (0.85 U_n)* for U_n = 230/120 V	196/102 V
Overvoltage > *U* (1.1 U_n)* for U_n = 230/120 V	253/132 V
Asymmetry	5 - 30 % (30 %)*
Phase failure	by setting the asymmetry
Phase sequence	clockwise/anticlockwise rotation (off)*
Relative uncertainty, voltage at 50/60 Hz	± 1.5 %, ± 2 digits
Relative uncertainty voltage in the range 15 - 460 Hz	±3 %, ±2 digits
Hysteresis *U*	1 - 40 % (5 %)*
Underfrequency < Hz	10 - 500 Hz
Overfrequency > Hz	10 - 500 Hz
Resolution of setting *f* 10.0 - 99.9 Hz	0.1 Hz
Resolution of setting *f* 100 - 500 Hz	1 Hz
By preset function :	
Underfrequency for f_n = 400/60/50/16.7 Hz	399/59.5/49.5/16.2 Hz
Overfrequency for f_n = 400/60/50/16.7 Hz	401/60.5/50.5/17.2 Hz
Hysteresis frequency Hys Hz	0.2 - 2 Hz (0.2 Hz)*
Relative uncertainty, frequency in the range of 15 - 460 Hz	±0.2 %, ±1 digit

Time response

Start-up delay t	0 - 99 s (0 s)*
Response delay $t_{on1/2}$	0 - 99 s (0 s)*
Delay on release t_{off}	0 - 99 s (0.5 s)*
Operating time, voltage t_{ae}	≤ 140 ms
Operating time, frequency t_{ae}	≤ 335 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Discharging time energy backup on power failure	2.5 s
Charging time energy storage	60 s
Recovery time t_b	≤ 300 ms

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range measured value	AC/DC 0 - 500 V
Operating uncertainty, voltage at 50/60 Hz	±1.5 %, ±2 digits
Operating uncertainty voltage in the range of 15 - 460 Hz	±3 %, ±2 digits
Operating uncertainty, frequency in the range of 15 - 460 Hz	±0.2 %, ±1 digit
History memory (HiS) for the first alarm value	data record measured values
Password	Off/0 - 999 (OFF)*
Fault memory (M) alarm relay	on/off/con (on)*

Switching elements

Number	2 SPDT contacts (K1, K2)
Operating principle	Normally energized or de-energized operation
	K2: Err, < U, > U, Asy, < Hz, > Hz, PHS (undervoltage < U, asymmetry Asy, N/E operation n.c.)*
	K1: Err, < U, > U, Asy, < Hz, > Hz, PHS (overvoltage > U, asymmetry Asy, N/D operation n.o.)*
Electrical endurance, number of cycles	10000
Fault memory	on/off (on)*

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-25 - +55 °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

Connection

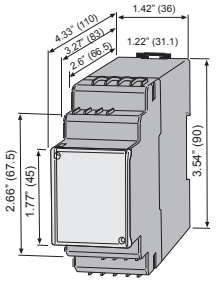
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

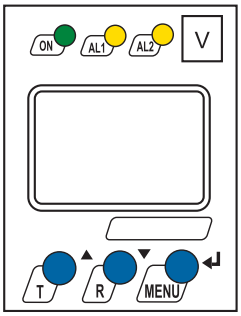
Operating mode	continuous operation
Mounting position	vertically, see dimension diagram
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating manual	TGH1405
Weight	≤ 240 g

( )* = factory setting

Dimensions in inches (mm)



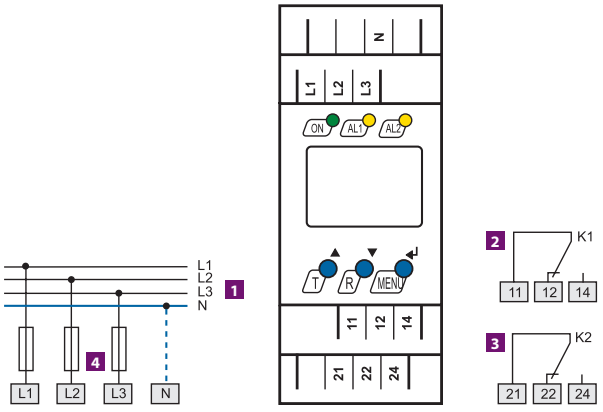
Displays and controls



1. Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.
2. Alarm LED "AL1" (yellow), lights when overvoltage, frequency, asymmetry, or phase alarms activate. Flashes during device fault.
3. Alarm LED "AL2" (yellow), lights when undervoltage, frequency, asymmetry, or phase alarms activate. Flashes during device fault.
4. Multifunctional LCD display
5. Test button "T": Initiates device self-test.
   Arrow up button: Parameter change, scrolls up in device menu
6. Reset button "R": Resets device (when operating in latching mode)
   Arrow down button: Parameter change, scrolls down in device menu
7. "MENU" button: Opens the device's main menu.
   Enter button: Confirms parameter changes.

When the menu item LEd is activated, the alarm LED "AL1" indicates that K1 is in the alarm state. When "AL2" lights up, K2 is in the alarm state.

Wiring diagram



1. System connections
2. Alarm relay K1
3. Alarm relay K2
4. Power supply and line fuse protection

5

VMD258 Series

Overvoltage and undervoltage relay for three-phase AC systems

Features

- Undervoltage and overvoltage relay for three-phase AC systems up to 690 VAC
- Analog-only device, non-microprocessor controlled; perfect for utilities and other mission critical areas
- Overvoltage and undervoltage alarms operate simultaneously
- Adjustable undervoltage alarm, 70 - 95% of rated system voltage
- Adjustable overvoltage alarm, 105 - 130% of rated system voltage
- Adjustable time delay, 0 - 5 seconds
- 2 DPDT contact outputs, normally energized or de-energized depending on alarm type
- Line-powered, no separate supply voltage required
- Optional external energy backup module, provides power to the relay for min 5 seconds in case of loss of system power (P/N ES258)

Applications

- Undervoltage and overvoltage monitoring on three-phase AC systems up to 690 VAC
- Utilities and other areas requiring non-microprocessor controlled monitoring devices
- Three-phase motors, pumps, generators

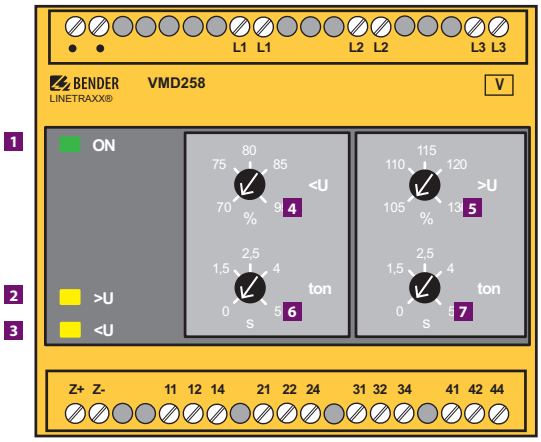
Ordering information

Rated system voltage (3ϕ, L-L)	Type	Ordering No.
100 VAC	VMD258 3AC 100 V	B 9301 0060
110 VAC	VMD258 3AC 110 V	B 9301 0061
230 VAC	VMD258 3AC 230 V	B 9301 0062
400 VAC	VMD258 3AC 400 V	B 9301 0063
440 VAC	VMD258 3AC 440 V	B 9301 0064
480 VAC	VMD258 3AC 480 V	B 9301 0065
500 VAC	VMD258 3AC 500 V	B 9301 0066
690 VAC	VMD258 3AC 690 V	B 9301 0067

Accessories

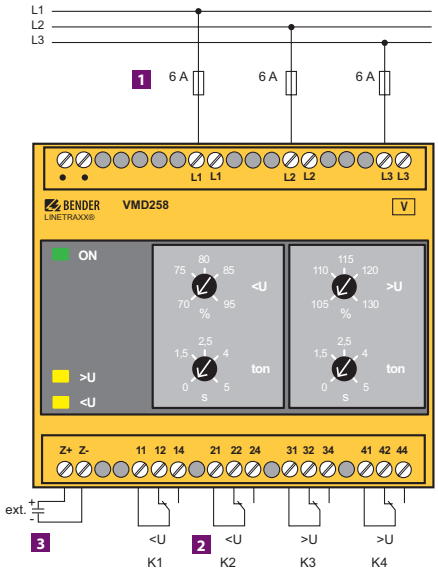
Description	Ordering number
Additional mounting clips for screw mounting	B 9806 0008
External energy backup module (P/N ES258)	B 9301 0068

Displays and controls



1 Power On LED "ON" (green)
2 Alarm LED ">U" (yellow): lights when the overvoltage alarm is active
3 Alarm LED "<U" (yellow): lights when the undervoltage alarm is active
4 Undervoltage alarm adjustment potentiometer
5 Overvoltage alarm adjustment potentiometer
6 Time delay adjustment potentiometer for undervoltage alarm
7 Time delay adjusment potentiometer for overvoltage alarm

Wiring diagram



1 Connection to system; fuses recommended
2 Alarm contact outputs
3 Connection for optional ES258 energy backup module

Technical data

Insulation coordination acc. to DIN EN 60255-27

Supply voltage U_S AC (V)	690	480/500	400/440	230	100/110
Rated voltage AC (V)	1000	1000	600	300	150
Rated impulse voltage (kV)	12	12	8	6	4
Pollution degree					3
Overvoltage category					III

Voltage ranges

Frequency range of U_S								45 - 66 Hz
Operating range								0.5 - 1.5 x U_S
Nominal supply voltage U_S 3AC (V)	690	500	480	440	400	230	110	100
Power consumption at 50 Hz, 1,3 x U_S (VA)	19	15	12	14	9	16	15	10
Power consumption at 60 Hz, 1,3 x U_S (VA)	11	9	8	8	6	9	9	7

Measuring circuit

Nominal system voltage U_n	3AC 690/500/480/440/400/230/110/100 V
Setting range	0.7 - 1.3 x U_n
Frequency range f_n	45 - 66 Hz
Max. permissible measuring voltage	1.5 x U_n
Response value U_n adjustable	>U, <U

Response values

Undervoltage <*U* (alarm)	0.7 - 0.95 x U_n
Overvoltage >*U* (alarm)	1.05 - 1.3 x U_n
Relative uncertainty at the setting limits	45 - 66 Hz: ±3 %
	47,5 - 63 Hz: ±2 %
Hysteresis	< 3 %
Repetition accuracy	±1 %
LED ON	LED (green)
Alarm for <*U*	LED (yellow)
Alarm for >*U*	LED (yellow)

Time response

Start-up delay *t*	500 ms ±20 %
Response delay t_{on}	0 - 5 s ±10 %
Delay on release t_{off}	100 ms ±20 %
Operating time t_{ae} at overvoltage	60 ms* ±20 %
Operating time t_{ae} at undervoltage	100 ms**±20 %
Response time t_{an}	$t_{an} = t_{ae} + t_{on}$
Long-term influence	–10 %
Overshoot time tov	< 60 ms

Connection for external energy storage device

U_{min}	DC 24 V
U_{max}	DC 68 V
U_{typ} at 1.0 x U_n	42 - 47 V ±15 %
Short-circuit proof (Z+, Z-)	short time yes

Switching elements

Number of switching elements	2 x 2 changeover contacts
Operating mode	N/C operation (undervoltage)
	N/O operation (overvoltage)
Electrical endurance, number of cycles	10000
Contact data acc. to IEC 60947-5-1	
Rated operational voltage AC	230 V/230 V
Utilisation category	AC-13/AC-14
Rated operational current AC	5 A/3 A
Rated operational voltage DC	220/110/24 V
Utilisation category	DC12
Rated operational current DC	1/0.2 /0.1 A
Minimum current	1 mA at AC/DC > 10 V

Environment/EMC

EMC immunity	acc. to IEC 60255-26
EMC emission	acc. to IEC 60255-25
Operating temperature	-20 - +70 °C
Climatic class acc. to DIN IEC 60721-3-3	
Stationary use	3K5
Transport	2K3
Long-term storage	1K4
Classification of mechanical conditions acc. to IEC 60721	
Stationary use	3M4
Transport	2M2
Long-term storage	1M3
Requirements acc. to IEC 60255	Class 2

Connection

Connection	screw terminals
Connection properties	
rigid/flexible	0.2 - 2.5 mm²
flexible with connector sleeve	0.25 - 2.5 mm²
without/with plastic sleeve	0.25 - 2.5 mm²
Conductor sizes (AWG)	24 - 13
Tightening torque	0.5 - 0.6 Nm
Current through L1L1, L2L2 , L3L3	each max. 3 A

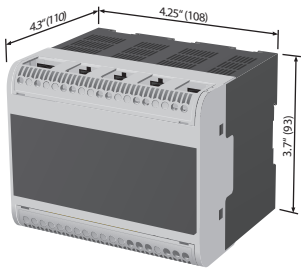
Other

Operating mode	continuous operation
Position	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529)	IP20
Enclosure material	polycarbonate
Flammability class	UL94 V-0
DIN rail mounting acc. to	IEC 60715
Screw mounting	4 x M4
Documentation number	D00068
Weight	825 g

* Operating time **t_{ae} overvoltage**
Increase from 100 % to 130 %, switching threshold at 105 %

** Operating time **t_{ae} undervoltage**
Decrease from 100 % to 0 %, switching threshold at 95 %

Dimensions in inches (mm)



ES258

Energy backup module for VMD258 voltage relay

Applications

- Optional energy backup module for VMD258 series voltage relay

Ordering information

Type	Art. No.
ES258	B 9301 0068

Technical data

Insulation coordination according to IEC 60664-1

Rated insulation voltage	DC 100 V
Rated impulse voltage/pollution degree	800 V/3
Overvoltage category	II

Output Z1/Z2

Supply voltage	DC 41 - 47 V (±30 %)
Storage capacity to supply the undervoltage and overvoltage relays	min. 5 s (± 0.5 s)
Recovery time	≤ 60 s
Internal fuse, triggered in case of incorrect connection	yes

Environment/EMC

EMC immunity	acc. to IEC 61000-6-2
EMC emission	acc. to IEC 61000-6-4

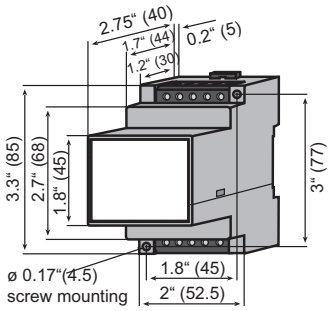
Connection

Connection	screw -type terminal
Connection properties	
single wire	2 x (0.5 - 4) mm²
flexible with end ferrule	2 x (0.5 - 2.5) mm²

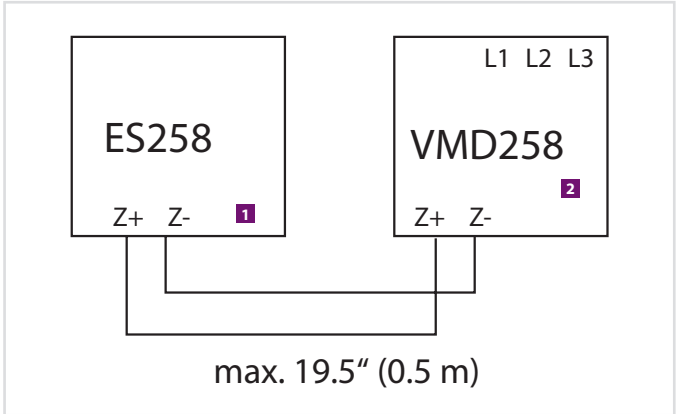
Other

Operating mode	continuous operation
Mounting	any position
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Documentation number	D00086
Weight	≤ 160 g

Dimensions in inches (mm)



Wiring diagram



1 Energy backup module

2 Voltage relay

5

CME420 Series

Digital overcurrent and undercurrent relay for single-phase AC systems

Applications

- Overcurrent and/or undercurrent monitoring on single-phase AC systems
- Current monitoring on motors, pumps, and cranes
- Lighting and heat trace

Approvals

c UL us LISTED

PCT AE25

Lloyd's Register TYPE APPROVED

Features

- Undercurrent and/or overcurrent monitoring on single-phase AC systems
- Monitor 0.1 - 16 A when directly connecting device to system
- Monitor up to 999 A when connecting an X:5 ratio current transformer (up to 2000:5)
- Enter the ratio of the CT into the device and read current values on the primary in real-time on the device's LCD display; program in primary values (no calculations required)
- Any combination of alarm functions may be enabled/disabled
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- External supply voltage connections

Ordering information

Supply voltage [1] U_S		Type	Ordering No.
DC	AC		
9.6 - 94 V	16 - 72 V (42 - 460 Hz)	CME420-D-1	B 9306 0001
70 - 300 V	70 - 300 V (42 - 460 Hz)	CME420-D-2	B 9306 0002

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

5

Technical data

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

Rated insulation voltage	250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	
	(A1, A2) - (k, l) - (11, 12, 14) - (21, 22, 24)
Maximum rated voltage of the system being monitored (conductor to be monitored directly connected)	
With protective separation AC 230 V	
Without protective separation	AC 400 V
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	see ordering information
Power consumption	≤ 4 VA

Measuring circuit

Rated frequency	42 - 460 Hz
Measuring range	AC 0.05 - 16 A
Overload capability, continuous	17.6 A
Overload capability < 1 s	40 A
Frequency display range	10 - 2000 Hz

Response values

Undercurrent (alarm 2)	direct connection: AC 0.1 - 16 A (1 A)*
Overcurrent (alarm 1)	direct connection: AC 0.1 - 16 A (10 A)*
	current transformer x/5 A: 0.1 x n - 999 A (10 A)*
Transformation ratio n	1 - 2000 (1)*
Relative uncertainty in the range of 50/60 Hz	± 3 % ± 2 digit
Relative uncertainty in the range of 40 - 460 Hz	± 5 % ± 2 digits
Hysteresis	1 - 40% (15 %)*

Time response

Start-up delay t	0 - 99 s (0.5 s)*
Response delay t_{on1}	0 - 99 s (1 s)*
Response delay t_{on2}	0 - 99 s (0 s)*
Delay on release t_{off}	0 - 99 s (0.1 s)*
Operating time t_{ae}	≤ 70 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms

Displays, memory

Display range measured value	AC 0.01 - 16 A x n
Operating uncertainty in the range of 50/60 Hz	± 3 % ± 2 digit
Operating uncertainty in the range of 40 - 460 Hz	± 5 % ± 2 digit
Measured-value memory for alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory alarm relay	on/off (on)*

Switching elements

Number					2 SPDT contacts
Operating principle					normally energized/de-energized operation (N/D operation)*
Electrical endurance, number of cycles					10000
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
Minimum contact load/gold-plated relay contacts					1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-25 - +55 °C
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

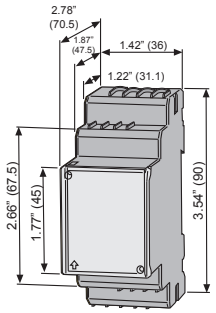
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

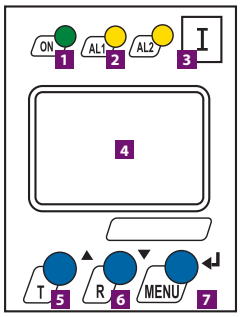
Operating mode	continuous operation
Position of normal use	any
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Operating manual	TGH1400
Weight	≤ 160 g

( )* factory setting

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.

2 Alarm LED "AL1" (yellow), lights when alarm AL1 activates. Flashes during device fault.

3 Alarm LED "AL2" (yellow), lights when alarm AL2 activates. Flashes during device fault.

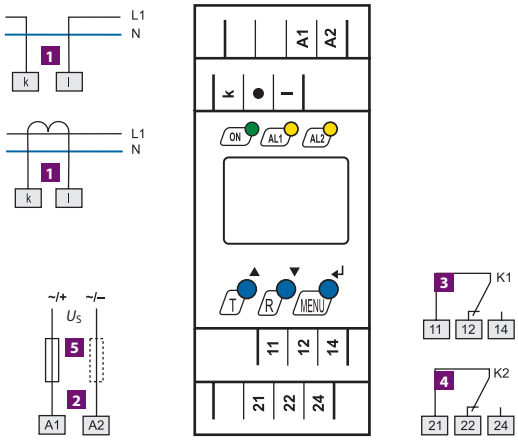
4 Multifunctional LCD display

5 Test button "T": Initiates device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 "MENU" button: Opens the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 System connections (with and without CT)

2 Supply voltage U_S (see ordering information)

3 Alarm relay K1

4 Alarm relay K2

5 Power supply and line fuse protection

5

CMD420/CMD421 Series

Digital overcurrent and undercurrent relays for three-phase AC systems

Applications

- Overcurrent and/or undercurrent monitoring on single-phase AC systems
- Current monitoring on motors, pumps, and cranes
- Lighting and heat trace
- General three-phase distribution

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Features

- Undercurrent and/or overcurrent monitoring on single-phase AC systems
- CMD420: 0 - 1 A alarm range, Connect X:1 ratio current transformers (up to 2000:1 ratio)
- CMD421: 0 - 5 A alarm range, connect X:5 ratio current transformers (up to 2000:5 ratio)
- Enter the ratio of the CT into the device and read current values on the primary in real-time on the device's LCD display
- Any combination of alarm functions may be enabled/disabled
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- RMS value measurement (AC+DC)
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Available option with selectable analog output, 0(4) - 20 mA, 0 - 10 V
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- External supply voltage connections

Ordering information

Current transformer type	Response value	Outputs	Supply voltage [1] U_S		Type	Ordering No.
			DC	AC		
1 A secondary up to 2000:1	0.1 - 1 A x n*	2 SPDT contacts	9.6 - 94 V	16 - 72 V (15 - 460 Hz)	CMD420-D-1	B 9306 0006
			70 - 300 V	70 - 300 V (15 - 460 Hz)	CMD420-D-2	B 9306 0007
		Selectable analog output	9.6 - 94 V	16 - 72 V (15 - 460 Hz)	CMD420-DM-1	B 9306 0010
			70 - 300 V	70 - 300 V (15 - 460 Hz)	CMD420-DM-2	B 9306 0011
5 A secondary up to 2000:5	0.5 - 5 A x n*	2 SPDT contacts	9.6 - 94 V	16 - 72 V (15 - 460 Hz)	CMD421-D-1	B 9306 0008
			70 - 300 V	70 - 300 V (15 - 460 Hz)	CMD421-D-2	B 9306 0009
		Selectable analog output	9.6 - 94 V	16 - 72 V (15 - 460 Hz)	CMD421-DM-1	B 9306 0012
			70 - 300 V	70 - 300 V (15 - 460 Hz)	CMD421-DM-2	B 9306 0013

[1] Absolute values

Models with push-wire terminals available on request.

* "n" denotes the transformer ratio as a whole number ratio, regardless of the type of device used. For example, for a 200:1 ratio current transformer for the CMD420, n = 200. For a 200:5 ratio current transformer for the CMD421, n = 40. The CMD420 supports values of n up to 2000 (2000:1), while the CMD421 supports values of n up to 400 (2000:5).

Accessories

Type designation	Art. No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	6 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (k, l) - (11, 12, 14) - (21, 22, 24)
Protective separation (reinforced insulation) between	(k1, I1, k2, I2, k3, I3) - (11, 12, 14)
Voltage test acc. to IEC 61010-1	3.536 kV
Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3
Basic insulation between:	(k1, I1, k2, I2, k3, I3) - (A1, A2), (21, 22, 24)
Basic insulation between:	(11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

CMD420-D-1, CMD421-D-1:

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency range U_S	15 - 460 Hz

CMD420-D-2, CMD421-D-2:

Supply voltage U_S	AC/DC 70 - 300 V
Frequency range U_S	15 - 460 Hz
Power consumption	≤ 4 VA

Measuring circuit CMD420

Nominal measuring range (r.m.s. value) n = 1	AC 0 - 1 A
Overload capability, continuous	2 A
Overload capability < 5 s	5 A
Load per measuring input	50 mΩ
Rated frequency f_n	42 - 460 Hz

Response values CMD420

Undercurrent Lo < / (Alarm 2) n = 1	AC 0.1 - 1 A (0.3 A)*
Undercurrent Lo < / (Alarm 1) n = 1	100 - 200 % (150 %)*
	Take a maximum nominal current of 1 A into consideration!
Overcurrent Hi > / (Alarm 2) n = 1	AC 0.1 - 1 A (0.3 A)* (Hi)*
Overcurrent Hi > / (Alarm 1) n = 1	50 - 100 % (50 %)* (Hi)*
Window I_n > / (Alarm 2) n = 1	AC 0.1 - 1 A (0.3 A)*
Window I_n < / (Alarm 1) n = 1	50 - 100 % (50 %)*
External current transformer	x/1 A
Transformation ratio n	1 - 2000 (1)*
Relative uncertainty in the range of 42 - 460 Hz	± 5 %, ± 2 digits
Hysteresis	3 - 40% (15 %)*

Measuring circuit CMD421

Nominal measuring range (r.m.s. value)	AC 0 - 5 A
Overload capability, continuous	7.5 A
Overload capability < 5 s	with screw-type terminal connection: 20 A
	with push-wire terminals: 12 A
Load per measuring input	3 mΩ
Rated frequency fn	42 - 460 Hz

Response values CMD421

Undercurrent Lo < / (Alarm 2) n = 1	AC 0.5 - 5 A (1.5 A)*
Undercurrent Lo < / (Alarm 1) n = 1	100 - 200 % (150 %)*
	Take a maximum nominal current of 5 A into consideration!
Overcurrent Hi > / (Alarm 2) n = 1	AC 0.5 - 5 A (1.5 A)* (Hi)*
Overcurrent Hi > / (Alarm 1) n = 1	50 - 100 % (50 %)* (Hi)*
Window I_n > / (Alarm 2) n = 1	AC 0.5 - 5 A (1.5 A)*
Window I_n < / (Alarm 1) n = 1	50 - 100 % (50 %)*
External current transformer	x/5 A
Transformation ratio n	1 - 2000 (1)*
Relative uncertainty in the range of 42 - 460 Hz	± 5 %, ± 2 digits
Hysteresis	3 - 40% (15 %)*

Time response

Start-up delay t	0 - 300 s (0.5 s)*
Response delay t_{on1}	0 - 300 s (1 s)*
Response delay t_{on2}	0 - 300 s (0 s)*
Delay on release t_{off}	0 - 300 s (1 s)*
Resolution of setting t, $t_{on1/2}$, t_{off} (0 - 10 s)	0.1 s
Resolution of setting t, $t_{on1/2}$, t_{off} (10 - 99 s)	1 s
Resolution of setting t, $t_{on1/2}$, t_{off} (100 - 300 s)	10 s
Operating time t_{ae}	≤ 130 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Device release time t_{re}	≤ 135 ms
Release time t_{off}	$t_{off} = t_{re} + t_{off}$
Recovery time t_b	≤ 300 ms

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range, measured value (r.m.s. value) x transformation ratio n	CMD420: AC 0 - 1 A x n
	CMD421: AC 0 - 5 A x n
Operating uncertainty in the range of 42 - 460 Hz	± 5 %, ± 2 digit
Measured-value memory (HiS) for the first alarm value	data record measured values
Password	on/off/0 - 999 (OFF)*
Fault memory (M) alarm relay	on/off/con (on)*

Switching elements

Number	2 SPDT contacts (K1, K2)
Operating principle	Normally energized / de-energized operation (N/D)*
	K1: Err, I1, I2, tES
	(device error Err, overcurrent prewarning > I1, test button tES)*
	K2: Err, I1, I2, tES
	(device error Err, overcurrent alarm > I2, test button tES)*
Electrical endurance, number of cycles	10000

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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-25 - +55 °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)
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

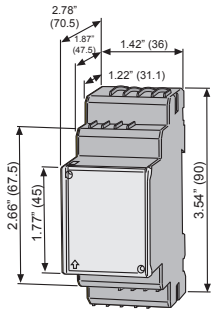
Connection

Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

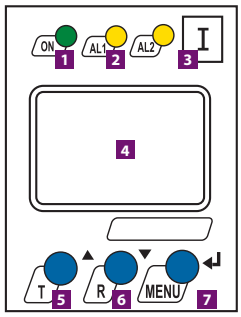
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
Flammability class	UL94 V-0
DIN rail mounting acc. to	IEC 60715
Screw mounting	2 x M4 with mounting clip
Software version CMD420	D287 V1.1x
Software version CMD421	D294 V1.1x
Weight	≤ 150 g

Dimensions in inches (mm)



Displays and controls



1 Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.

2 Alarm LED "AL1" (yellow), lights when alarm AL1 activates. Flashes during device fault.

3 Alarm LED "AL2" (yellow), lights when alarm AL2 activates. Flashes during device fault.

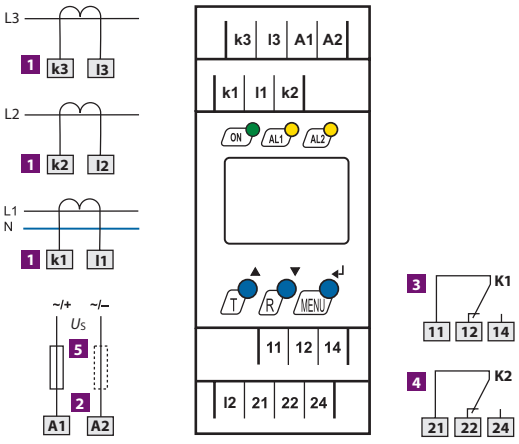
4 Multifunctional LCD display

5 Test button "T": Initiates device self-test.
Arrow up button: Parameter change, scrolls up in device menu

6 Reset button "R": Resets device (when operating in latching mode)
Arrow down button: Parameter change, scrolls down in device menu

7 "MENU" button: Opens the device's main menu.
Enter button: Confirms parameter changes.

Wiring diagram



1 Current transformer connections

2 Supply voltage U_S (see ordering information)

3 Alarm relay K1

4 Alarm relay K2

5 Power supply and line fuse protection

5

GM420 Series

Ground continuity and loop monitor for AC systems

Applications

- Ground conductor monitoring in AC systems
- Equipment grounding connections
- Trailing cable, docks

Approvals

Features

- Ground continuity monitoring in AC systems
- Monitor for break in ground conductor as well as quality of connection (0 - 100 Ω, adjustable alarm)
- Measuring circuit provides a high resistance against extraneous voltages and indication of extraneous voltages
- Start-up delay, response delay and delay on release
- Adjustable switching hysteresis
- Measured value displayed in real-time on the multi-function LCD display
- Preset function (automatic setting of basic parameters on initial startup)
- LEDs: Power On, Alarm 1, Alarm 2
- Last alarm value accessable in device's menu
- Continuous self monitoring
- Built-in test/reset button
- Two SPDT contacts, any combination of alarms may activate each contact
- Normally energized or de-energized operation, selectable
- Latching or non-latching behavior, selectable
- Password protection for device settings
- Transparent cover
- RoHS compliant
- External supply voltage connections

Ordering information

Supply voltage [1] U_S		Type	Ordering No.
DC	AC		
9.6 - 94 V	16 - 72 V (15 - 460 Hz)	GM420-D-1	B 9308 2001
70 - 300 V	70 - 300 V (15 - 460 Hz)	GM420-D-2	B 9308 2002

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Ordering No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

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

Rated insulation voltage	400 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between:	
	(A1, A2) - (E, KE) - (11-12-14) - (21-22-24)
Voltage test acc. to IEC 61010-1:	
(E, KE) - [(A1-A2), (11-12-14)]	3.32 kV
(E, KE) - (21-22-24)	2.21 kV
(A1- A2) - (11-12-14) - (21-22-24)	2.21 kV

Supply voltage

Supply voltage U_S	see ordering information
Frequency range U_S	see ordering information
Power consumption	≤ 4 VA

Measuring circuit

Loop resistance R_m:

Measuring range R_m	0 - 100 Ω
Measuring current I_m	DC 20 mA
Measuring voltage U_m	≤ DC 24 V

Extraneous voltage U_f:

Measuring range U_f	AC 0 - 50 V
Rated frequency f_n	42 - 460 Hz
Disconnection of the measuring loop at U_f	≥ 12 V
Reconnection of the measuring loop	≤ 10 V
Permissible extraneous voltage U_f	≤ 440 V
Permissible extraneous DC voltage, without influence on the measurement	DC 0 V

Response values

Loop resistance > R (Alarm 1)	0.1 - 100 Ω
Resolution of setting R = 0 - 10 Ω	0.1 Ω
Resolution of setting R = 10 - 100 Ω	1 Ω

Preset function:

Loop resistance (> R) =	((R_m + 0.5 Ω) x 1.5)*
Relative uncertainty 0 - 1 Ω	±20 %, ±1 digit
Relative uncertainty 1 - 100 Ω	±5 %, ±1 digit
Hysteresis > R	1 - 40 % (25 %)*
Extraneous voltage > U (Alarm 2)	1 - 50 V (25 V)*
Resolution of setting U_f 1 - 50 V	0.5 V
Relative uncertainty Uf (> U) in the range of 50/60 Hz	±2 %, ±1 digit
Relative uncertainty U_f (> U) in the range of 42 - 460 Hz	±10 %, ±1 digit
Hysteresis > U	1 - 40 % (5 %)*

Time response

Start-up delay t	0 - 99 s (0 s)*
Response delay $t_{on1/2}$	0 - 99 s (0 s)*
Delay on release t_{off}	0 - 99 s (0.5 s)*

Operating time

In the case of loop interruption (R > 50 kΩ) t_{ae}	≤ 40 ms
In the case of closed loop (> R) t_{ae}	≤ 500 ms
in case of extraneous voltage (> U) and overload (OL) t_{ae}	≤ 100 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Recovery time t_b	≤ 300 ms
Recovery time t_b after safety shutdown	≤ 1 s

Displays, memory

Display	LCD display, multifunctional, not illuminated
Display range, measuring value R_m	0 - 100 Ω
Display range, measuring value U_f	AC 0 - 50 V
Operating uncertainty, loop resistance 0 - 1 Ω	±20 %, ±1 digit
Operating uncertainty loop resistance 1 - 100 Ω	±5 %, ±1 digit
Operating uncertainty voltage in the range of 50/60 Hz	±2 %, ±1 digit
Operating uncertainty voltage in the range of 42 - 460 Hz	±10 %, ±1 digits
History memory (HiS) for the first alarm value	data record measured values
Password	off/0 - 999 (off)*
Fault memory (M) alarm relay	on/off (on)*

Switching elements

Number	2 SPDT contacts (K1, K2)
Operating principle	Normally energized or de-energized operation K1: Err, > R, OL, > U, tES (device error, loop resistance, measuring current disconnection: N/D operation n.o.)* K2: Err, > R, OL, > U, tES (overvoltage: N/D operation n.o.)*
Electrical endurance, number of cycles	10000

Contact data acc. to IEC 60947-5-1

Utilization category	AC13	AC14	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

Minimum contact rating	1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC	IEC 61326
Operating temperature	-25 - +55 °C
Climatic class 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 time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

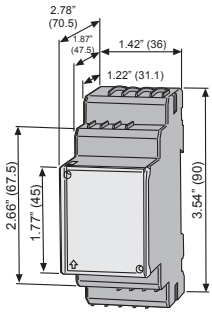
Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

Other

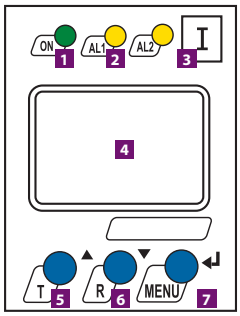
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Software version	D268 V1.0x
Weight	≤ 150 g

( )* = factory setting

Dimensions in inches (mm)

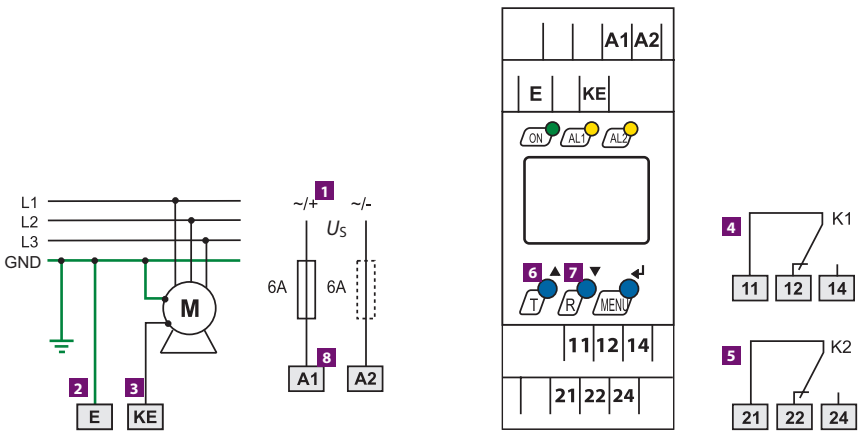


Displays and controls



1. Power On LED "ON" (green), lights when supply voltage is applied. Flashes during device fault.
2. Alarm LED "AL1" (yellow), lights when alarm AL1 activates. Flashes during device fault.
3. Alarm LED "AL2" (yellow), lights when alarm AL2 activates. Flashes during device fault.
4. Multifunctional LCD display
5. Test button "T": Initiates device self-test.
   Arrow up button: Parameter change, scrolls up in device menu
6. Reset button "R": Resets device (when operating in latching mode)
   Arrow down button: Parameter change, scrolls down in device menu
7. "MENU" button: Opens the device's main menu.
   Enter button: Confirms parameter changes.

Wiring diagram and example application: monitoring continuity of motor grounding



1. Supply voltage U_S (see ordering details)
2. Connection to ground
3. Pilot wire connection
4. Alarm relay K1
5. Alarm relay K2
6. Test button "T"
7. Reset button "R"
8. Power supply and line fuse protection

CC612

Charge controller for IEC-compliant electric vehicle charging stations (EVSE)

Applications

- Electric vehicle charging stations

Approvals

CE

Features

- Charge controller per IEC 61851-22 mode 3
- Configured as master or slave
- Supports integration into single- or three-phase systems up to 80 A
- Smart Grid enabled using standard OCPP functionality (OCPP 1.5 compliant) and is compatible with all electric vehicles on the market
- Supports 2.5G Edge and 3G UMTS mobile networks (4G coming soon)
- Optional integrated modem
- Two USB interfaces - one for local configuration (CONFIG) and the other for use as an extension port for peripheral USB devices (Ethernet/WiFi home applications)
- Control-pilot and proximity signal management
- Universal charge plug control (support for different vendors' sockets)
- Configurable support for one additional household socket
- eHZ meter or Modbus meter interface
- User interface board for customer-specific applications
- Configurable 3-channel input/output extension interface for additional functionality
- Optional integrated DC sensor
- Internal temperature sensors
- Peer group mechanism - a set current is shared between a group of charge controllers
- Optional integrated ISO/IEC 15118 power line communication (PLC) for plug & charge and load management systems
- Local and remote configuration

Ordering information

Supply voltage U_S	6 mA sensor	Type	Ordering No.
DC			
12 V	■	CC612-1M3PR	B 9406 0001

Accessories

Description	Ordering No.
RFID110-L1 (RJ45 cable (length 500mm) included)	B 9406 0110
Current transformer W15BS (cable length 1500mm)	B 9808 0065
Current transformer W15BS-02 (cable length 180mm)	B 9808 0067

Insulation coordination acc. to IEC 60664-1/IEC 60664-3	
Rated voltage	12.5 V
Overvoltage category/Pollution degree	III/3
Rated impulse withstand voltage	800 V
Maximum altitude	6500 ft (2000 m)

Supply voltage	
Nominal supply voltage U_S	DC 12 V
Operating range of the supply voltage	DC 11.4 - 12.6
Nominal current	1 A

Measuring range, DC sensor	
Measuring range	100 mA
Response values:	
Ground fault current $I_{\Delta n}$	DC 6 mA
Response tolerance $I_{\Delta n}$	-50 - 0 %
Restart sequence value:	
DC 6mA	< 3 mA

Wireless parameters	
Frequency bands	850/900/1800/1900 MHz
Antenna gain	≤ 2.5 dBi
Impedance	50 Ω
Data rate	GPRS: UL 85.6 kBit/s; DL 85.6 kBit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA: UL 5.76 Mbit/s; DL 14.4 Mbit/s
Specified antenna	Phoenix Contact model PSI-GSM /UMTS-QB-ANT-2313371

Inputs/outputs and operation	
LED ALARM	yellow
LED READY	green
LED PLC	green
USB Extension interface (Ethernet, WiFi®, -)	USB socket type A
CONFIG (Configuration interface)	Micro socket type AB
SIM card	micro SIM
Terminal A:	
A1	Actuator IN
A2	Actuator +
A3	Actuator pull-up output
A4	Actuator -
Terminal B:	
B1	+12 V IN
B2	0 V
B3	Relay 1 NO
B4	Relay 1 NO
Terminal C:	
C1	Proximity PP
C2	Control Pilot (optional Powerline Communication PLC acc. to ISO/IEC 15118)
C3	Relay 2 NO
C4	Relay 2 NO
C5	Input 1-
C6	Input 1+
C7	Input 2-
C8	Input 2+
CT	Current transformer
Input 1 and 2 :	
Input voltage	DC 11.4 - 25.2 V
Input current	1.72 - 3.81 mA
Meter	Meter interface
User interface	User interface RJ45

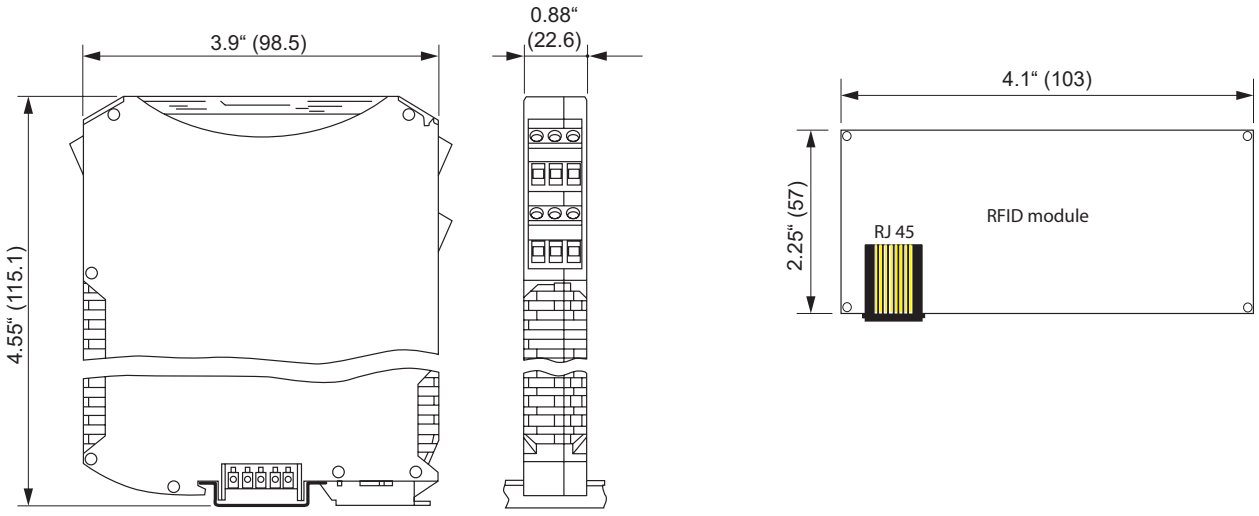
Switching elements	
Relay 1	configurable
Relay 2	charging contactor
Switching elements	2 x 1 N/O contacts
Operating principle	N/C operation
Electrical service life	10,000 switching cycles
Contact data acc. to IEC 60947-5-1:	
Rated operational voltage U_e	30 V
Rated operational current I_e	1 A
Minimum contact rating	1 mA at≥ 10 V
Rated voltage U_i	32 V

Environment/EMC	
EMC	IEC 61851-1, IEC 61851-22, ETSI EN 301 489-1, ETSI EN 301 489-7
Operating temperature	-30 - +70°C
Climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (except condensation, water and formation of ice)
Transport (IEC 60721-3-2)	2K3
Storage (IEC 60721-3-1)	1K4
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

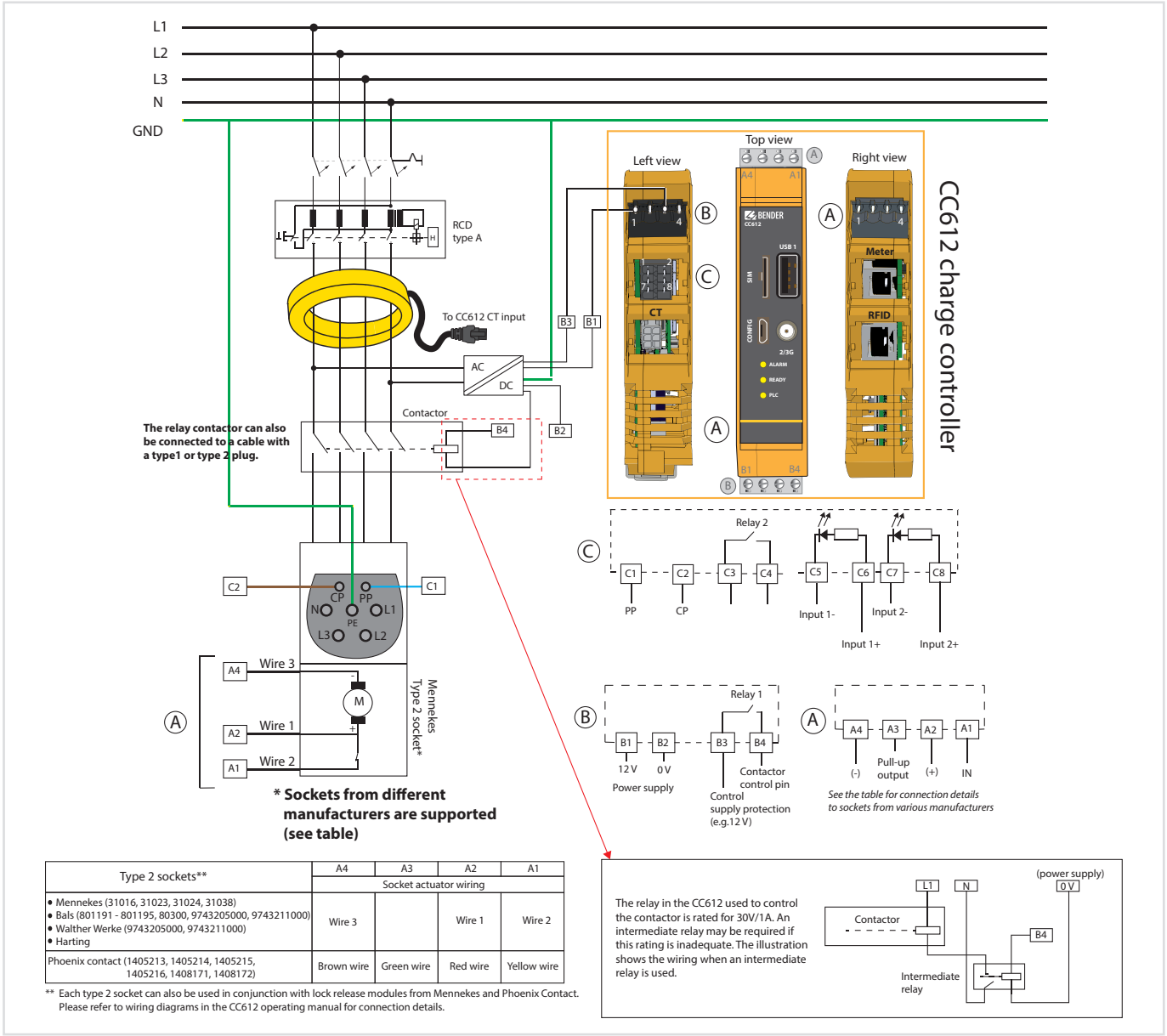
Connection	
Connection type (terminal block C)	**push-in terminal**
Connection properties:	
rigid/flexible	0.2 - 1.5 mm² (AWG 24 - 16)
flexible with ferrule without plastic sleeve	0.25 - 1.5 mm² (AWG 24 - 16)
flexible with ferrule with plastic sleeve	0.25 - 0.75 mm² (AWG 24 - 20)
Stripping length	10 mm
Opening force	0.5 - 0.6 Nm (4 - 5 lb-in)
Connection type (terminal blocks A and B)	**screw terminal**
Connection properties:	
rigid/flexible	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule without plastic sleeve	0.25 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule with plastic sleeve	0.25 - 1.5 mm² (AWG 24 - 16)
Stripping length	7 mm

Other	
Operating mode	continuous operation
Degree of protection	IP 20
DIN rail mounting	IEC 60715
Documentation number	D00254
Weight	160 g

Dimensions in inches (mm)



Wiring diagram



Type 2 sockets**	A4	A3	A2	A1
	Socket actuator wiring			
• Mennekes (31016, 31023, 31024, 31038) • Bals (801191 - 801195, 80300, 9743205000, 9743211000) • Walther Werke (9743205000, 9743211000) • Harting	Wire 3		Wire 1	Wire 2
Phoenix contact (1405213, 1405214, 1405215, 1405216, 1408171, 1408172)	Brown wire	Green wire	Red wire	Yellow wire

** Each type 2 socket can also be used in conjunction with lock release modules from Mennekes and Phoenix Contact. Please refer to wiring diagrams in the CC612 operating manual for connection details.

The relay in the CC612 used to control the contactor is rated for 30V/1A. An intermediate relay may be required if this rating is inadequate. The illustration shows the wiring when an intermediate relay is used.

5

PEM735

Power quality meter

Applications

- Continuous power quality monitoring
- High resolution waveform analysis

Approvals

CE

Features

- Class A power quality analyzer, certified to EN 61000-4-30
- Voltage quality monitoring per DIN EN 50160
- 0.2 S accuracy class per IEC 62053-22
- 5.7" TFT color display (640x480)
- Modbus/TCP and Modbus/RTU communication
- 4 current inputs
- 5 voltage inputs
- 1 GB internal memory
- Panel mountable
- Integrated web server - view device status from a web browser over an Ethernet network
- Data export via FTP: comtrade, PQDIF
- Flicker measurement
- Transient detecting and recording (40 us)
- Sampling rate: 512 samples/cycle
- Freely configurable recorders for waveform, consumption and long-term recording

Ordering information

Nominal system voltage Three-phase AC	Current input	Type	Ordering No.
100 - 690 V	5 A	**PEM735**	**B 9310 0735**

5

Technical data

Insulation coordination

Measuring circuit	
Rated insulation voltage	600 V
Overvoltage category	III
Pollution degree	2
Supply circuit	
Rated insulation voltage	300 V
Overvoltage category	II
Pollution degree	2

Supply voltage

Rated supply voltage U_S	95 - 250 V
Frequency range of U_S	DC, 44 - 440 Hz
Power consumption	≤ 14 VA

Measuring circuit

Measuring voltage inputs	
$U_{L1-N,L2-N,L3-N}$	400 V
$U_{L1-L2,L2-L3,L3-L1}$	690 V
Measuring range	10 - 120 % U_n
CT transformation ratio	
Primary	1 - 1,000,000 V
Secondary	100 - 690 V ULL (1 - 3)
Secondary	1 - 400 V (U4)
Internal resistance (L-N)	> 6 MΩ
Measuring current inputs	
External measuring current transformer	must comply with accuracy class 0.2 S
Burden	N/A, internal current transformers
Measuring range	0.1 - 120 % I_N
Transducer ratio, secondary	1 - 5 A
Transducer ratio, primary	1 - 30000 A

Accuracy (of measured value/of full scale value)

Phase voltage U_{L1-N}, U_{L2-N}, U_{L3-N}	±0.1 % of measured value
Current	±0.1 % of measured value, +0.05 % of full scale value
Neutral current I_4	0.5 % v. S.
Frequency	±0.005 Hz
Phase position	±1 °
Active energy measurement acc. to	DIN EN 62053-22 (VDE 0418 Part 3-22)
R.m.s. voltage measurements acc. to	DIN EN 61557-12 (VDE 0413-12), chapter 4.7.6
R.ms. phase current measurements acc. to	DIN EN 61557-12 (VDE 0413-12), chapter 4.7.5
Frequency measurements acc. to	DIN EN 61557-12 (VDE 0413-12), chapter. 4.7.4
Measurement of the harmonics acc. to	DIN EN 61000-4-7 class A

Interface

Interface/protocol				2 x RS-485, Modbus RTU
Baud rate				1.2 - 19.2 kbits/s
Maximum cable length				3900 ft (1200 m)
Shielded cable ((shield connected to PE on one side)				recommended: J-Y(St)Y min. 2x0.8
Interface				Ethernet
Protocol				Modbus TCP
Baud rate				100 MBit/s

Switching elements

2 electronic outputs (DO)				max. 80 V
				I_{max} 50 mA
Outputs (RO)				4 x N/O contacts
Operating principle				normally de-energized operation
Rated operational voltage	AC 230 V	DC 24 V	AC 110 V	DC 12 V
Rated operational current	5 A	5 A	6 A	5 A
Minimum contact rating				1 mA at AC/DC ≥ 10 V
Inputs				8 electrically separated digital inputs
I_{min}				2.4 mA
U_{DI}				DC 24 V

Environment/EMC

EMC	IEC 61326-1
Operating temperature	-13 to +131 °F (-25 to +55 °C)
Classification of climatic conditions acc. to DIN EN 60721	
stationary use	3K5
Classification of mechanical conditions acc. to IEC 60721	
stationary use	3M4
Maximum altitude	13000 ft (4000 m)

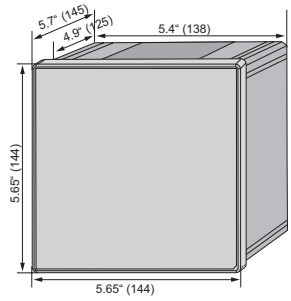
Connection

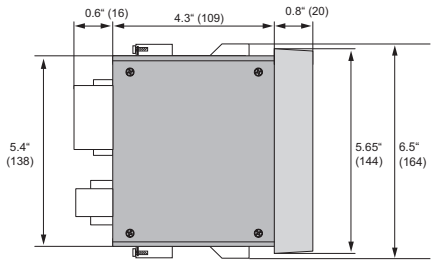
Connection	screw-type terminals

Other

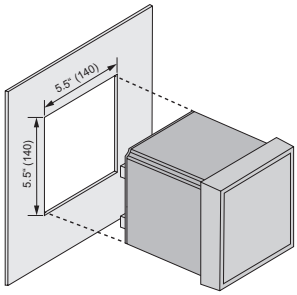
Degree of protection, installation	IP20
Degree of protection, front	IP52
Documentation number	D00084
Weight	≤ 4.4 lb (2000 g)

Dimensions in inches (mm)



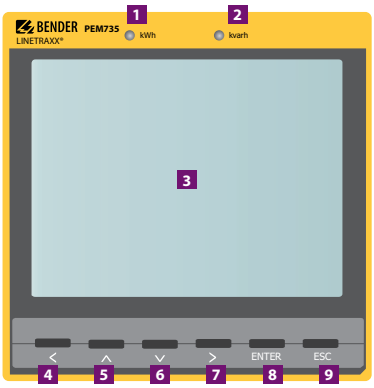


Panel cutout in inches (mm)



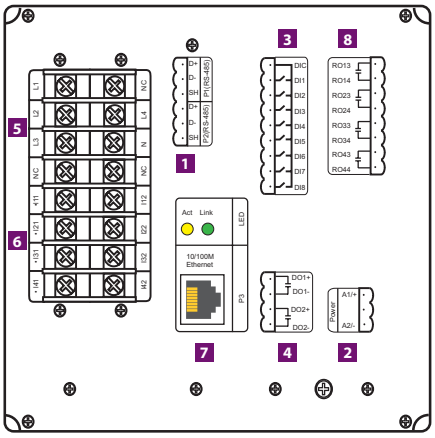
5

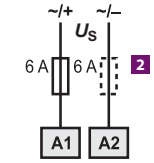
Displays and controls

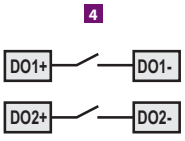


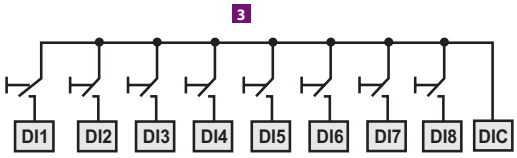
1 Pulse LED: kWh
2 Pulse LED: kvarh
3 Display
4 "<" button: Selection (in main menu)
5 "^" button: Up (in main menu)
6 "v" button: Down (in main menu)
7 ">" button: Selection (in main menu)
8 "ENTER" button: Confirm
9 "ESC" button: Cancel / go back

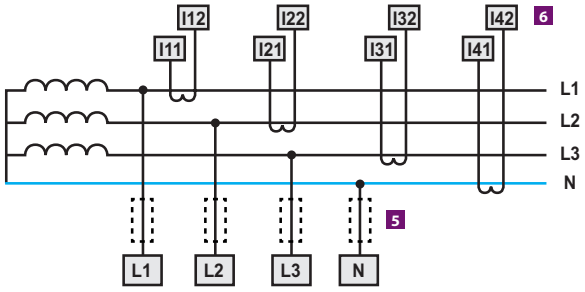
Wiring diagram





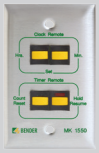






1 RS-485 connection
2 Supply voltage connection, fuses required
3 Digital inputs
4 Digital outputs (N/O contacts)
5 Measuring voltage inputs, fuses required
6 System connections
7 Ethernet connection
8 Relay output

Remotes and Remote Indicators

		 7204 / 9604 Series	 RI2000 Series	 MK2000 Series	 MK2000CBM	 MK1550 / MK1554	 MK1500D
Page		6-06	6-07	6-08	6-08	6-12	6-13
For use with	IR470LY series	■					
	iso685	■					
	isoPV / isoLR275						
	isoPV425 / isoRW425						
	EDS440-L / EDS441-L						
	EDS460 / EDS490 / EDS151 series						
	RCMS series						
	RC48C / RC48N		■				
	RCMA421/426H-DCB models						■
	MarinaGuard (MG-S / MG-T)						
	LIM2010 / Isolated power panels			■	■		
	ZT1590 / ZT1591 series					■	
Quantity of devices per remote		One	One	One	One	One	One
Comm.	RS-485 bus (BMS)				■		■
	Ethernet bus (BCOM)						
Display features	Analog meter display	■					■
	LED alarm indication		■	■	■		■
	Audible alarm indication			■	■		
	Digital display with reading				■		■
Onboard pushbutton features			Test, Reset	Test, Mute	Test, Mute	Clock control	Test, reset
Alarm timestamped data logger							
Customizable alarm messages							
External supply voltage							AC 120 V
Mounting		Flush mounted	Screw mounted to standard gang box	Screw mounted to standard gang box, available on front trim (RAS)	Screw mounted to standard gang box, available on front trim (RAS)	Screw mounted to standard gang box	Flush mounted

Remote Stations

			
	MK800	MK2430	CP700

	Page	6-14	6-19	6-32
For use with	IR470LY series			
	iso685	■ 1)	■ 1)	■ 1)
	isoPV / isoLR275	■	■	■
	isoPV425 / isoRW425	■	■	■
	EDS440-L / EDS441-L	■ 1)	■ 1)	■ 1)
	EDS460 / EDS490 / EDS151 series	■	■	■
	RCMS series	■	■	■
	RC48C / RC48N			
	RCMA421/426H-DCB models	■	■	■
	MarinaGuard (MG-S / MG-T)	■	■	■
	LIM2010 / Isolated power panels	■	■	■
	ZT1590 / ZT1591 series			
Quantity of devices per remote		Up to 150 (x 99)	Up to 150	Varies by protocol
Comm.	RS-485 bus (BMS)	■	■	■
	Ethernet bus (BCOM)			■
Display features	Analog meter display	■	■	
	LED alarm indication			■
	Audible alarm indication			■
	Digital display with reading			
Onboard pushbutton features				Test
Alarm timestamped data logger		Up to 1000 records	Up to 250 records	
Customizable alarm messages		■	■	■
External supply voltage		AC/DC 24 V	AC/DC 24 V	DC 24 V
Mounting		Flush / surface mounted, available prebuilt in front trim with backbox	Flush / surface mounted, available prebuilt in front trim with backbox	Flush mounted

1) Remote indicator / gateway functionality may be limited for certain devices when using RS-485 connectivity.

Communication Gateways and System Integrators

			
	COM465IP	COM462RTU	CP700

	Page	6-24	6-30	6-32
	Application	Ethernet / Modbus/TCP	Modbus/RTU	Ethernet / Modbus/TCP / Onboard
Input	RS-485 bus (BMS)	■	■	■
	Ethernet bus (BCOM)	■		■
Output	Ethernet (web server)	■		■
	Modbus/TCP	■		■
	Modbus/RTU		■	
Accessibility	Web browser on computer	■		■
	Web browser on smartphone	■		■
	Modbus interface	■ (Modbus/TCP)	■ (Modbus/RTU)	■
	Onboard touchscreen			■
Interface features	Display	LED	LCD/LED	7″ color touchscreen
	Alarm messages	■ [1, 2)]	■ [2)]	■ [1, 2, 3)]
	Real-time measurements	■ [1, 2)]	■ [2)]	■ [1, 2, 3)]
	Device settings	■ [1)]	■ [2)]	■ [1)]
	Alarm list	■ [1)]		■ [1, 3)]
	History memory	■ [1)]		■ [1)]
	Diagrams	■ [1)]		■ [1, 3)]
	Building visualization	■ [1)]		■ [1)]
	Virtual setpoints	■ [1)]		■ [1)]
	Third party device integration	■ [1)]		■ [1)]
	E-mail notifications	■ [1)]		■ [1)]
	Remote device test initiation	■ [1, 2)]		■ [1, 2)]
	Data logger	■ [1)]		■ [1)]

[1)] Available via web browser interface from network connected computer
[2)] Available via applicable Modbus protocol
[3)] Available on the device's onboard display

Communication Interfacing Accessories

	 DI-1DL	 DI-2USB

Page		6-35	6-36
Application		BENDER RS-485 bus repeater	BENDER RS-485 bus / USB converter
Input	Input	RS-485	RS-485
	Connection	screw-type terminal	screw-type terminal
	Cable length	≤ 1200 m	≤ 1200 m
Output	Output	RS-485	USB
	Connection	screw-type terminal	USB Type B
	Cable length	≤ 1200 m	≤ 5 m
	Expansion of bus devices	Standard RS-485 node repeater	
Supply voltage U_S		85 - 260 VAC	
Other features			Driver CD included

7204/7220/9604/9620

External meters for Bender ground fault detectors

Features

- Panel-mounted analog indication of insulation resistance reading of Bender ground fault detectors
- 7204/7220 dimensions: 2.8″ x 2.8″ (72 x 72 mm)
- 9604/9620 dimensions: 3.75″ x 3.75″ (96 x 96 mm)
- “S” option for increased shock and vibration resistance

Applications

- Panel mount analog metering for IR470LY / IRDH / iso685 series ground fault detectors for ungrounded systems

Ordering information

Suitable ground fault detector	Input current	Dimensions in inches (mm)	Type	Ordering No.
IR470LY series IRDH275 / IRDH375 iso685	0 - 400 µA	2.8″ x 2.8″ (72 x 72)	**7204-1421**	**B 986 763**
			7204S-1421	**B 986 804**
		3.75″ x 3.75″ (96 x 96)	**9604-1421**	**B 986 764**
			9604S-1421	**B 986 784**
IRDH275B / IRDH375B / IRDH575 iso685	0 - 20 mA	3.75″ x 3.75″ (96 x 96)	**9620-1421**	**B 986 841**
			9620S-1421	**B 986 842**
	0 - 20 mA	2.8″ x 2.8″ (72 x 72)	**7220-1421**	**B 986 844**
			7220S-1421	**B 986 848**

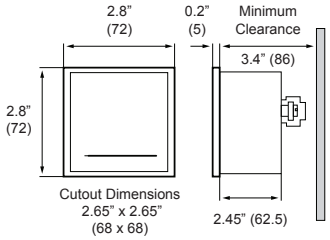
Technical data

Test voltage	3 kV
Accuracy class acc. to DIN 43780	1.5
Normal position	vertical +5°
Temperature range	-25 - +40 °C

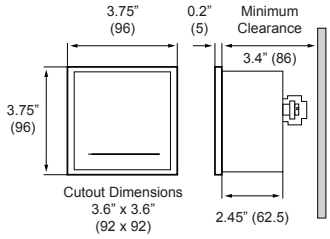
Protection class	
Enclosure	IP52 (NEMA 12)
Terminals	IP00
Terminals with contact protection	IP20 (NEMA 1)

Dimensions in inches (mm)

7204/7220



9604/9620



RI2000 Series

Remote indicators for use with RC48C / RC48N combination ground fault monitors

RI2000GC remote indicator

Features

- Visual indication of ground fault monitor status
- RI2000GC: Red ground fault alarm LED, green ground continuity OK LED
- RI2000NC: Red ground fault alarm LED, reg NGR alarm LED
- Test and reset pushbuttons
- Mounts to standard gang electrical box
- Screw terminal strip for connections
- Easy-to-clean rugged stainless steel Lexan front foil

Applications

- Remote monitoring of RC48C and RC48N monitors in mining applications

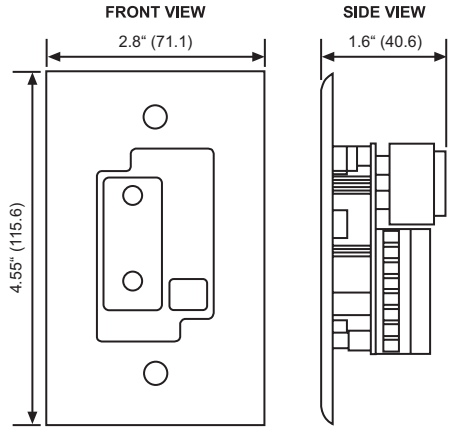
Approvals

c UL us LISTED

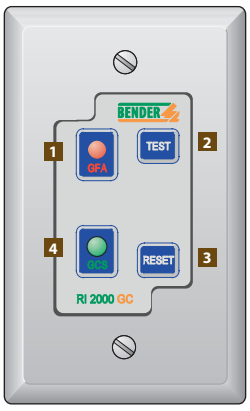
Ordering information

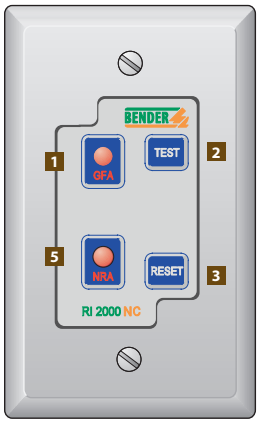
For use with	Size	Type	Ordering No.
RC48C	One gang	RI2000GC	B 9407 1000
RC48N	One gang	RI2000NC	B 9407 1001

Dimensions in inches (mm)



Displays and controls: RI2000GC (left) and RI2000NC (right)





1 Red "Ground Fault Alarm" LED
2 TEST button
3 RESET button
4 Green "Ground Continuity" LED (RI2000GC only)
5 Red "NGR" Alarm (RI2000NC only)

MK2000 Series

Remote indicators for LIM2010 and isolated power systems in healthcare facilities

MK2000CP remote indicator

MK2000CBM digital remote indicator

Features

- Visual and audible indication of line isolation monitor status
- All options include green SAFE LED and red HAZARD LED, audible alarm MUTE button and amber LED
- Options to duplicate functions on connected LIM2010 line isolation monitor, including test button, overload LED, and digital display showing total hazard current (THC) and overload
- LED display for long life
- No interference with medical equipment
- Uses low voltage wiring (AC/DC 12 V)
- Mounts to standard gang electrical box
- Screw terminal strip for connections
- Easy-to-clean rugged stainless steel Lexan front foil

Applications

- Remote monitoring and control of connected LIM2010 line isolation monitor in healthcare facilities

Approvals

c UL us LISTED

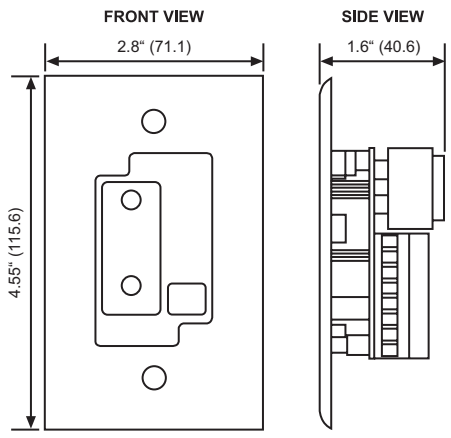
Ordering information

Safe and hazard LEDs	Mute button and LED	Test button	Overload LED	Digital display for THC and overload	Size	Type	Ordering No.
■	■				One gang	MK2000-G1	B 5213 00002
■	■				Two gang	MK2000-G2	B 5213 00007
■	■	■			One gang	MK2000P-G1	B 5213 00188
■	■		■		One gang	MK2000C-G1	B 5213 00020
■	■	■	■		One gang	MK2000CP-G1	B 5213 00021
■	■	■	■	■	Two gang	MK2000CBM	B 5213 00022
■	■				Two gang	MK2000-2G2*	B 5213 00099

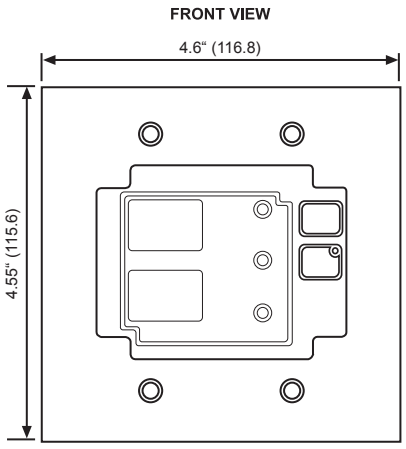
* MK2000-2G2 models are two separate MK2000 series remotes built into one gang plate. It is designed for use with two LIM2010 line isolation monitors.

Dimensions in inches (mm)

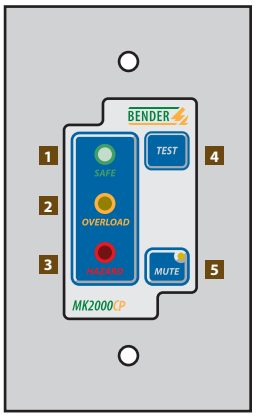
MK2000-G1 / MK2000P-G1 / MK2000C-G1 / MK2000CP-G1

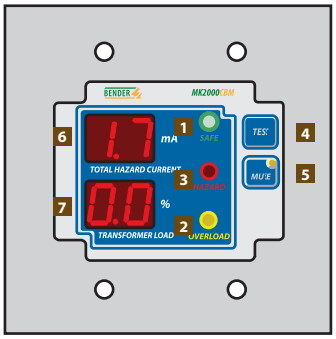


MK2000CBM



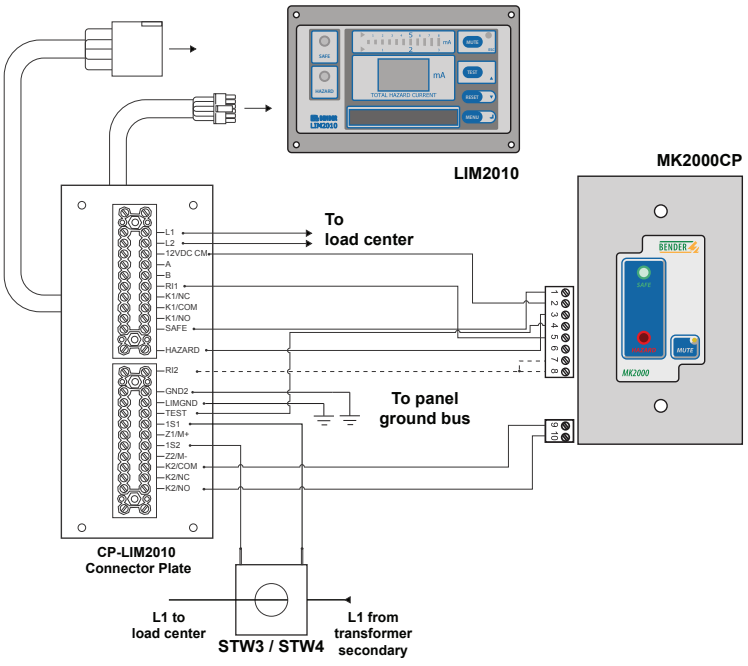
Displays and controls (examples shown: MK2000CP-G1 and MK2000CBM)





1 Green "SAFE" LED
2 Amber "OVERLOAD" LED ("C" option and MK2000CBM only)
3 Red "HAZARD" LED
4 TEST button ("P" option and MK2000CBM only)
5 MUTE button with amber LED
6 Digital display showing total hazard current in real-time (MK2000CBM only)
7 Digital display showing transformer overload percent in real-time (MK2000CBM only)

Sample wiring diagram (example shown: MK2000CP)



RAS Series

Remote annunciator station for LIM2010 and isolated power systems in healthcare facilities

RAS-04B remote annunciator station

Features

- Contains multiple MK2000 series remotes for centralized monitoring of isolated power systems
- Contains all features of installed MK2000 series remote indicators
- Prebuilt on front trim with backbox
- Flush or surface mounted available

Applications

- Central remote monitoring and control of connected LIM2010 line isolation monitor in healthcare facilities

Central Remote Stations

BENDER additionally provides digital remote stations where the status of all connected line isolation monitors may be viewed from a single screen. Refer to the MK2430 and MK800 for more information.

Ordering information

Backbox is ordered as a separate line item. See table below for more information. Flush mounted configurations will have a front trim which extends 1" (25.4 mm) on all sides. Surface mounted configurations will have a front trim which exactly matches the height and width of the backbox.

RAS	-	08	B	
		1	2	3

1 Quantity of remote indicators

02: Two	10: Ten
04: Four	12: Twelve
06: Six	14: Fourteen
08: Eight	16: Sixteen

2 Remote indicator type (see below for available configurations)

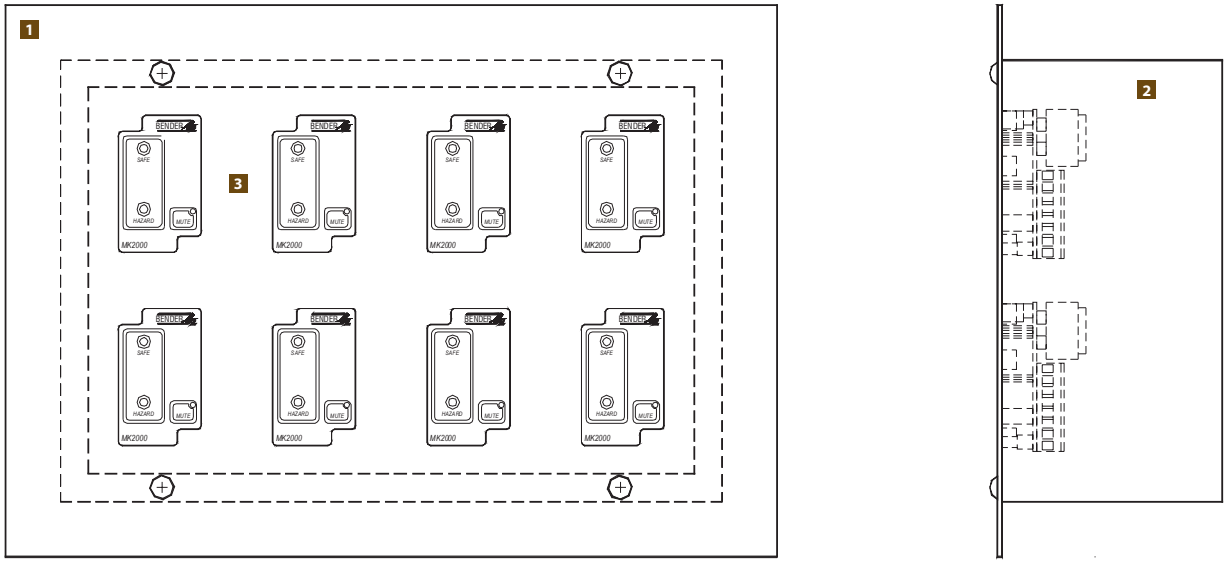
A: MK2000P	D: MK2000CP
B: MK2000	E: MK2000CBM
C: MK2000C	

3 Mounting type

Blank (nothing): Flush	S: Surface

Available configurations and backbox ordering information

Supported remote indicators	Supported quantities	Backbox dimensions in inches (mm)	Backbox part number (for flush mounting)	Backbox part number (for surface mounting)
MK2000, MK2000P, MK2000C, MK2000CP	2, 3, 4, 5, 6, 7, 8	12" x 8" x 4" (305 x 203 x 102)	**B120804**	**B120804S**
MK2000, MK2000P, MK2000C, MK2000CP	9, 10, 11, 12	12" x 12" x 4" (305 x 305 x 102)	**B121204**	**B121204S**
MK2000, MK2000P, MK2000C, MK2000CP	13, 14, 15, 16	12" x 16" x 4" (305 x 406 x 102)	**B121604**	**B121604S**
MK2000CBM	2, 3, 4	12" x 8" x 4" (305 x 203 x 102)	**B120804**	**B120804S**
MK2000CBM	5, 6	12" x 12" x 4" (305 x 305 x 102)	**B121204**	**B121204S**
MK2000CBM	7, 8, 9	16" x 12" x 4" (406 x 305 x 102)	**B161204**	**B161204S**
MK2000CBM	10, 11, 12	18" x 12" x 4" (457 x 305 x 102)	**B181204**	**B181204S**
MK2000CBM	13, 14, 15, 16	18" x 18" x 4" (457 x 457 x 102)	**B181804**	**B181804S**



1 Stainless steel faceplate
2 Backbox, galvanized steel
3 MK2000 series remote indicator

MK1550 / MK1554 Series

Clock and chronometer remotes

MK1550 clock remote

Features

- Duplicates all pushbutton and setup functions of ZT1590 clock
- Controls functions and setup for ZT1591 clock
- MK1550 remote fits into standard single gang contractor box
- MK1554 remote provides function for clock and all three timers on one four-gang plate
- Hours, Minutes, Count/Reset, and Hold/Resume pushbuttons
- No additional power supply required
- Simple connectors on back of remote

Applications

- Controlling Bender digital clocks, timers, and chronometers

Ordering information:

Compatible clocks / timers	Type	Ordering No.
ZT1590(RS) and ZT1591(RS)	**MK1550**	**B 5111 00019**
ZT1594	**MK1554**	**B 5111 00294**

Dimensions: MK1550 in inches (mm)

The MK1550 uses standard single-gang dimension of 2.75"W x 4.5"H (70 mm W x 114 mm H).

Displays and controls

1 Hours pushbutton
2 Minutes pushbutton
3 Count and reset pushbutton
4 Hold and resume pushbutton

Technical data

Operating voltage	5 VDC
Maximum current draw	20 mA
Operating class	continuous operation
Ambient temperature	
Operation	0 - +50 °C
Storage	-10 - +70 °C

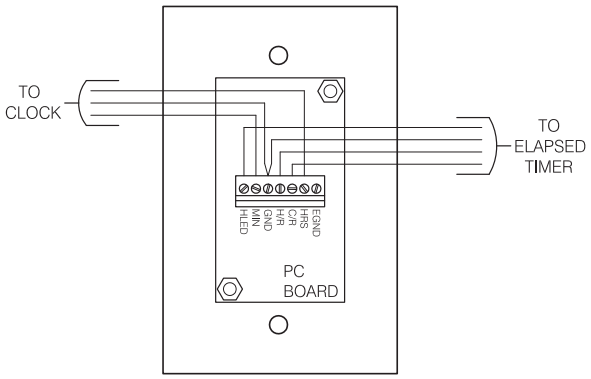
Connectors

Number of connections	7
Manufacturer	Ria
Manufacturer part number	31114107
Maximum conductor size	AWG 16

Other / general data

Mounting	#6 -32 oval head machine screw, stainless steel
Weight	< 0.25 lb

Wiring diagram



6

MK1500-D

Digital remote for RCMA421/RCMA426H-DCB series ground fault modules

MK1500-D digital remote

Features

- Duplicates functionality of pushbuttons and display of RCMA421/RCMA426H-DCB ground fault modules
- Digital display showing measured ground fault current in real-time
- LED bar graph in percent showing how close the ground fault module is to the trip level
- Test and reset pushbuttons
- External N/O connections for test and reset
- Simple plug-in connectors on back of remote

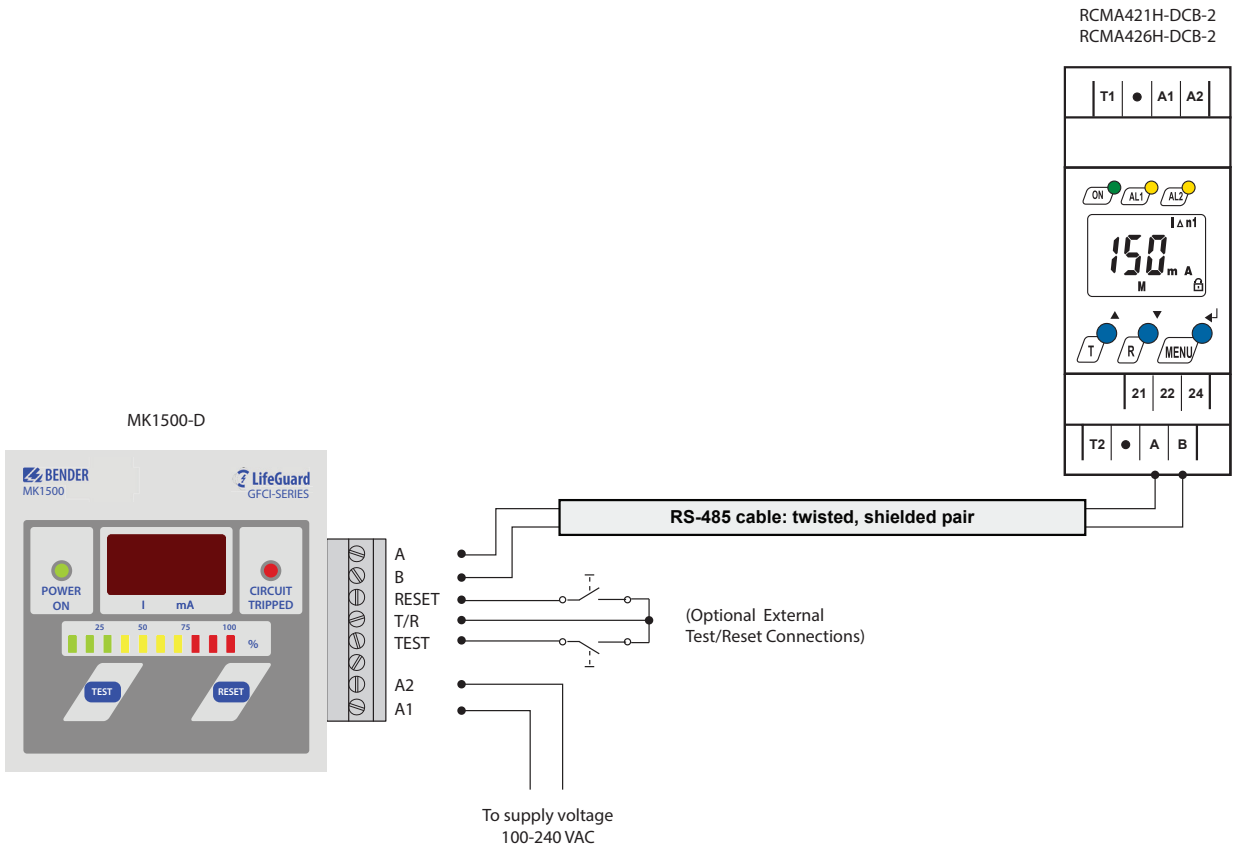
Applications

- Remote indication and control of Bender RCMA421H/RCMA426H-DCB series ground fault modules

Approvals

c UL us LISTED

Wiring diagram



MK800 Series

Digital remote station

MK800 remote station

MK800-11RS remote station mounted to front trim with backbox

Features

- Fully-featured remote station for operating status, warnings, and alarm messages for Bender equipment
- Compatible with Bender equipment with RS-485 capability, including LIM2010, IRDH, EDS, and RCMS series ground fault monitors and detectors, as well as RCMA421H/RCMA426H-DCB series ground fault modules
- Large backlit LCD display
- Visual and audible alarm indication
- Internal and external RS-485 buses: Internal bus connects up to 150 devices, and up to 99 internal buses may be connected to the external bus
- Up to 1000 customizable alarm messages
- Simple parameter setting via PC software with USB connection
- Memory with real-time clock to store up to 1000 timestamped alarm messages
- Optional 16 digital inputs
- Many different self-installed options available, including flush mounted, surface mounted, and built-in type without enclosure (additional accessories required, including mounting frames and power supplies)
- Pre-built assembly available with stainless steel front trim, frame, backbox and power supply, assembled at factory - ideal for healthcare facilities
- Ideal choice for monitoring large electrical safety networks at a centralized station

Applications

- Visual and audible indication of alarms in large systems of Bender electrical safety equipment
- Centralized notification of alarms

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information: Self-installed versions for general purpose use

Ordering information below is for self-installed versions of the MK800. Refer to "Ordering information: Pre-built assemblies" for information on MK800 modules preassembled with front trim, backbox, and applicable power supply.

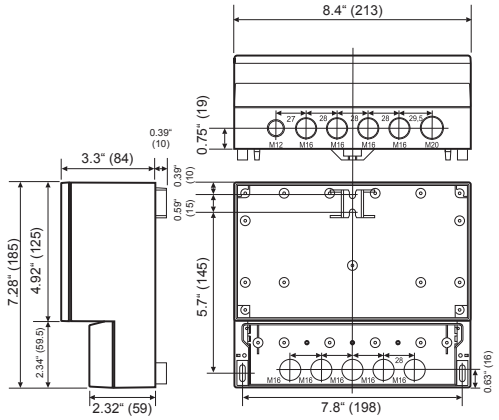
Enclosure	Digital inputs/relay outputs	Type	Ordering No.
Flush mount	16/1	MK800-11	B 9510 0100
	–	MK800-12	B 9510 0101
Surface mount	16/1	MK800A-11	B 9510 0102
	–	MK800A-12	B 9510 0103
Door mounted (surface mount)	16/1	MK800AF-11	B 9510 0104
	–	MK800AF-12	B 9510 0105
Built-in type without enclosure	16/1	MK800E-11	B 9510 0106NA
	–	MK800E-12	B 9510 0107NA

Accessories

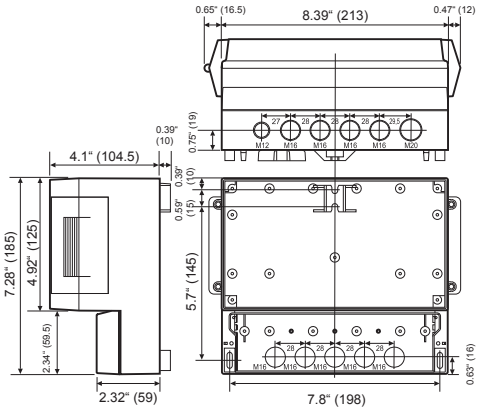
Description	Type	Ordering No.
Setup and configuration software	TMK-SET V3.xx	B 9602 0087
Flush-mounting enclosure for MK800	UP800	B 9510 0110
Bezel frame silver for MK800	BR800-1	B 9510 0111
Bezel frame white for MK800	BR800-2	B 9510 0112
Class 2 power supply	CP-D 24/0.42	P 1380 0049

Dimensions: MK800 self-installed versions in inches (mm)

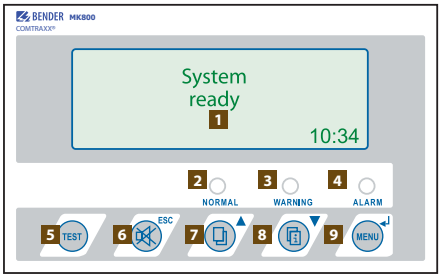
MK800A-11/MK800A-12, surface-mounting



MK800AF-11/MK800AF-12, surface-mounting with door

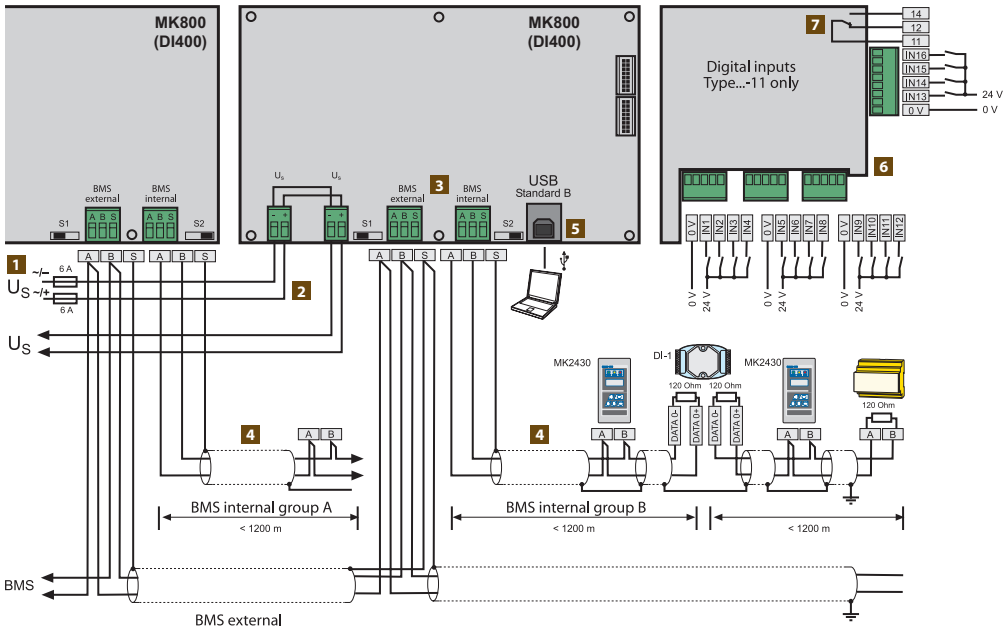


Displays and controls



1. Backlit LCD display
2. LED "NORMAL": Power On indicator
3. LED "WARNING": Warning messages
4. LED "ALARM": Alarm messages
5. Test button "TEST": to activate the test for connected and assigned BENDER equipment
6. "Mute" button:
   in standard mode: Mutes the audible alarm
   In menu mode: ESC function
7. "Scroll" button: In operating mode: to scroll messages.
   In menu mode: scrolls down
8. "Add. text" button: In operating mode: additional information.
   In menu mode: scrolls down
9. "MENU" button: In operating mode: enter's device menu
   In menu mode: enter button

Wiring diagram



1 Supply voltage: 24 VDC (recommended CP-D 24/0.42 class 2 power supply)

2 Redundant supply voltage terminals

3 Switch S1, S2 for RS-485 bus termination (terminating resistor 120 Ω)

4 Wiring between the MK800 and BENDER devices which are RS-485 bus compatible

5 USB connection for connecting to computer for programming

6 Digital inputs
The digital inputs may controlled either via voltage-free contacts or voltage signals.

When the inputs are activated via an external voltage, the common 0(-) is connected to terminal 0 and the 1(+)-signal is connected to the respective input IN1 - IN16.

7 Programmable contact for device errors, external device test device failure, and common alarm message

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 250 V
Rated impulse withstand voltage/pollution degree	4 kV/3

Supply voltage

Supply voltage U_S	AC/DC 24 V
Frequency range U_S	AC 40 - 60 Hz, DC
Operating range U_S	AC 18 - 28 V/DC 18 - 30 V
Power consumption	≤ 5 VA

Displays and LEDs

Four-line display, (MK800 only)	4 x 20 characters
Standard message texts in	21 languages
Alarm addresses configurable	250
Programmable text messages	1000
History memory (messages)	1000
Standard text message	3 x 20 characters
Additional text message (press button to access)	3 x 20 characters
Indication LEDs (three different colours)	NORMAL (green) WARNING (yellow) ALARM (red)
Menu texts	German/ English
Buttons	5 (Isometer test, buzzer mute, additional text, scroll, menu)

Buzzer

Buzzer message	can be acknowledged, with new value operation
Buzzer interval	configurable
Buzzer frequency	configurable
Buzzer repetition	configurable

Inputs (MK800-11/DI400-11 only)

Digital inputs	16 (IN1 - IN16)
Galvanically isolated	
Control of digital inputs via voltage-free contacts/ extraneous voltage	
Operating principle: N/O, N/C operation, off, selectable for each input	
Factory setting	off
Voltage range (high)	AC/DC 10 - 30 V
Voltage range (low)	AC/DC 0 - 2 V

Interface internal/external

Interface/protocol	2 x RS-485/BMS
Baud rate internal/external (default setting)	9.6 kbit/s/57.6 kbit/s
Cable length	≤ 1200 m
Cable (twisted in pairs, one end of shield connected to PE)	recommended: J-Y(St)Y min. 2 x 0.8
Terminating resistor	120 Ω (0.25 W) connectable via DIP switch
Device address, BMS bus internal/external	1(- 150)/1 - 99
Factory setting device address internal/external	1 (master)

Programming

Interfaces	RS-485/BMS/USB
Software TMK-SET	V 4.0 or higher
Factory setting password query	activated

Cable length when the power supply for the MK800 is taken from AN450

0.28 mm²	50 m
0.5 mm²	90 m
0.75 mm²	150 m
1.5 mm²	250 m
2.5 mm²	400 m

Colors

MK800

Front foil	RAL 7035 (light grey); RAL 7040 (basalt grey)
Marking	RAL 5005 (ultramarine blue)
Front plate	RAL 7035 (light grey)

DI400

Front foil	RAL 7035 (light grey)/RAL 7012 (basalt grey)
Marking buttons	RAL 5002 (ultramarine blue), lettering: RAL 7035 (light grey)
Front plate	RAL 7035 (light grey)

Switching elements (MK800-11/DI400-11 only)

Number			1
Operating principle			N/C or N/O operation (programmable)
Electrical endurance, number of cycles			10000
Contact data acc. to IEC 60947-5-1			
Utilization category	AC-13	AC-14	DC-12
Rated operational voltage	24 V	24 V	24 V
Rated operational current	5 A	3 A	1 A
Minimum contact rating			1 mA at AC/DC > 10 V

Environment/EMC

EMC immunity	IEC 61000-6-2
EMC emission	IEC 61000-6-3
Operating temperature	-5 - +55 °C
Classification of climatic conditions acc. to IEC 60721	
Stationary use	3K5
Transport	2K3
Storage	1K4
Classification of mechanical conditions acc. to IEC 60721	
Stationary use	3M4
Transport	2M2
Storage	1M3

Connection

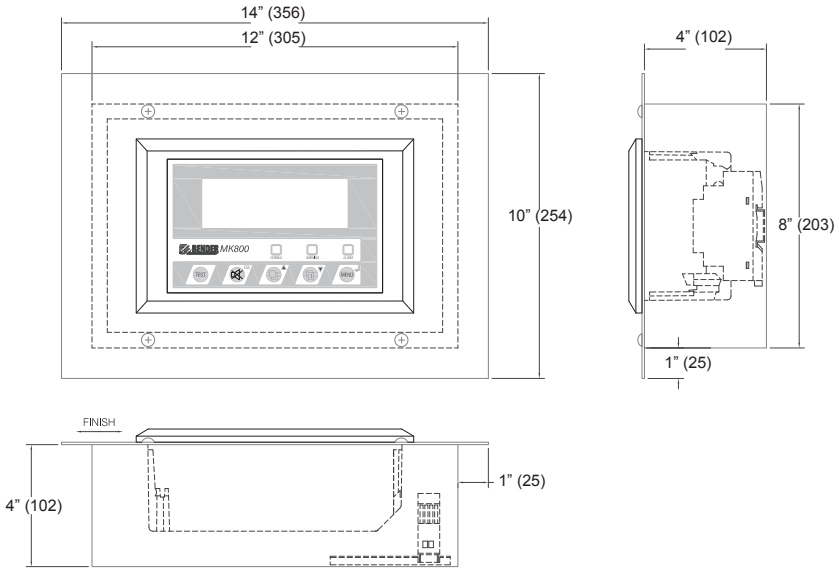
Connection pluggable screw terminals	
Connection properties (supply voltage, BMS bus)	
rigid/flexible/conductor sizes	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule without/with plastic sleeve	0.25 - 2.5 mm²
Connection properties (inputs)	
rigid/flexible/conductor sizes	0.08 - 1.5 mm² (AWG 28 - 16)
flexible with ferrule without/with plastic sleeve	0.25 - 1.5/0.25 - 0.5 mm²
Stripping length	7 mm
Tightening torque	0.5 - 0.6 Nm

Other

Operating mode	continuous operation
Mounting	display-oriented
Degree of protection, internal components (IEC 60529)	IP50
Degree of protection, terminals (IEC 60529)	IP30
Flammability class	UL94 V-0
Operating manual	TGH1408
Weight	
Flush-mounting/cavity wall (MK800)	< 950 g
Surface-mounting (MK800A/DI400)	< 880 g
Surface-mounting (MK800AF)	< 1150 g

Dimensions: MK800 pre-installed assemblies in inches (mm)

MK800-11RS and MK800-12RS models are pre-built assemblies at the factory, with the MK800 mounted on a 304SS front trim, with backbox. A class 2 power supply is pre-installed.



Ordering information: Pre-installed assembly

Ordering information below is for self-installed versions of the MK800. Refer to "Ordering information: Pre-built assemblies" for information on MK800 modules preassembled with front trim, backbox, and applicable power supply.

Description	Digital inputs/relay outputs	Type	Ordering No.
MK800, preassembled with front trim, bezel frame, backbox, and power supply	16/1	MK800-11RS	B 5213 01093
	–	MK800-12RS	B 5213 01094

Assembly components and accessories

Description	Type	Ordering No.
Remote station with 16 digital inputs, no enclosure type	MK800E-11	B 9510 0106NA
Remote station, no enclosure type	MK800E-12	B 9510 0107NA
Flush-mounting enclosure for MK800	UP800	B 9510 0110
Bezel frame white for MK800	BR800-2	B 9510 0112
Backbox for MK800 12" x 8" x 4" (305 x 203 x 102)	B120804	B 5213 00367
304SS fron trim for MK800 14" x 10" (356 x 254)	T1410-MK800	P 1030 0196
Class 2 power supply with DIN rail (100 - 240 VAC input)	CP-D 24/0.42	P 1380 0049
Setup and configuration software	TMK-SET V3.xx	B 9602 0087

MK2430 Series

Digital remote indicating station

MK2430 remote indicating station

MK2430-11RS remote indicating station mounted to front trim with backbox

Features

- Fully-featured remote station for operating status, warnings, and alarm messages for Bender equipment
- Compatible with Bender equipment with RS-485 capability, including LIM2010, IRDH/iso, EDS, and RCMS series ground fault monitors and detectors, as well as RCMA421H/RCMA426H-DCB series ground fault modules
- Backlit LCD display
- Visual and audible alarm indication
- Connects to up to 150 devices via RS-485
- Up to 200 customizable alarm messages
- Memory with real-time clock to store up to 250 timestamped alarm messages
- Configurable with PC software
- Optional 16 digital inputs
- Flush and surface mounted self-installed versions available (additional accessories required, including mounting kit and power supplies)
- Pre-built assembly available with stainless steel front trim, frame, backbox and power supply, assembled at factory - ideal for healthcare facilities
- Ideal choice for centralizing alarm notifications for many devices

Applications

- Visual and audible indication of alarms in systems of Bender electrical safety equipment
- Centralized notification of alarms

Approvals

c UL us LISTED

AE25

Ordering information: Self-installed versions for general purpose use

Ordering information below is for self-installed versions of the MK2430. Refer to "Ordering information: Pre-built assemblies" for information on MK2430 modules preassembled with front trim, backbox, and applicable power supply.

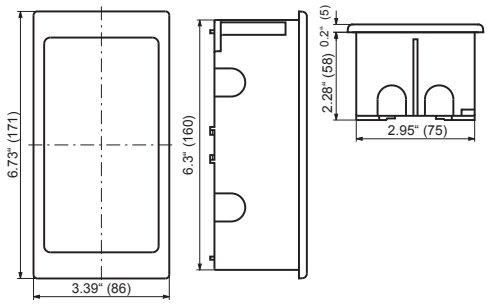
Enclosure	Digital inputs/relay outputs	Type	Ordering No.
Flush mount	16/1	MK2430-11	B 9510 0031NA
	–	MK2430-12	B 9510 0032NA
Surface mount	16/1	MK2430A-11	B 9510 0035
	–	MK2430A-11	B 9510 0036

Accessories

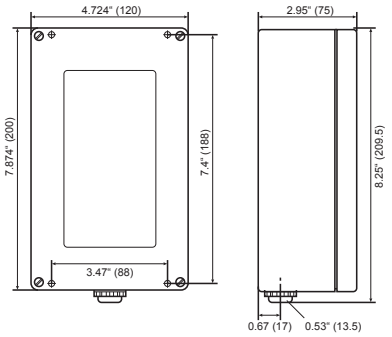
Description	Type	Ordering No.
Setup and configuration software	TMK-SET V3.xx	B 9602 0087
Complete mounting kit	--	B 9510 1000
Class 2 power supply	CP-D 24/0.42	P 138 00049

Dimensions: Self-installed version in inches (mm)

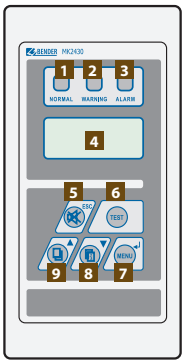
Flush-mounting type



Surface-mounting type



Displays and controls



1 LED "NORMAL": operating mode display

2 LED "WARNING": Warning messages

3 LED "ALARM": Alarm messages

4 LCD: Display of operating and alarm messages

5 Mute button
In operating mode:to mute the buzzer
In menu mode: ESC function

6 "TEST" button: to activate the test for connected and assigned insulation monitoring devices.

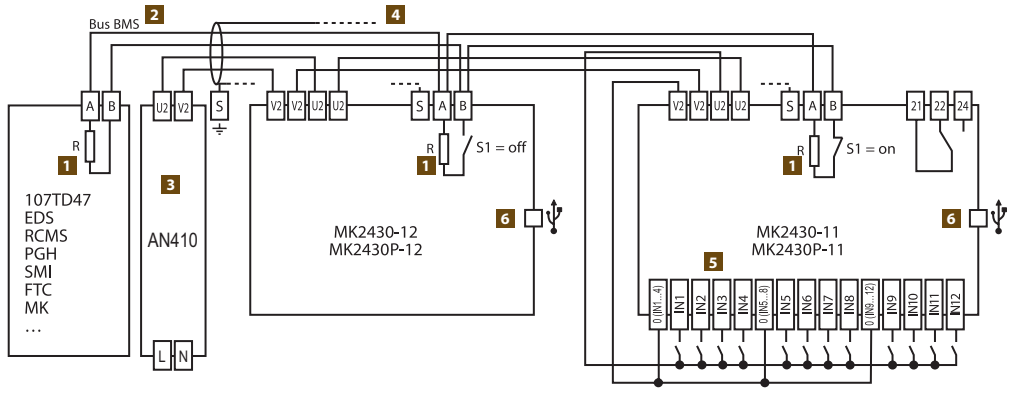
7 "MENU" button
In operating mode: to call up the menu mode.
In menu mode: Enter function

8 Additional text button
In operating mode: additional text
In menu mode: Down button

9 Scroll button
In operating mode: to scroll messages
In menu mode: Up button

6

Wiring diagram



1 Terminating resistor BMS bus (120 Ω)
2 Connection to RS-485 bus
3 Supply voltage connections (class 2 power supply recommended)
4 Internal RS-485 bus
5 Digital inputs
6 USB connection to computer for programming

Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 250 V
Rated impulse withstand voltage/pollution degree	4 kV/3

Supply voltage

Supply voltage U_S	AC/DC 24 V
Frequency range U_S	0/40 - 60 Hz
Operating range U_S	AC 18 - 28/DC 18 - 30 V
Power consumption	≤ 3 VA
Voltage failure without reset	≤ 15 s

Displays and LEDs

Display, characters	four lines, 4 x 20 characters
Standard message texts in	20 languages
Alarm addresses configurable	150
Programmable text messages	200
History memory (messages)	250
Standard text message	3 x 20 characters
Additional text message (press button to access)	3 x 20 characters
Alarm LEDs (three different colours)	NORMAL (green), WARNING (yellow), ALARM (red)
Menu texts	German/English
Buttons	5 (Isometer test, buzzer mute, additional text, scroll, menu)

Buzzer

Buzzer message	can be acknowledged, with new value operation
Buzzer interval	configurable
Buzzer frequency	configurable
Buzzer repetition	configurable

Inputs (MK2430 - -11 only)

Digital inputs	12 (IN1 - IN12)
Galvanic separation	yes
Activation of the digital inputs	via potential-free contacts/extraneous voltage
Operating principle	N/O or N/C operation individually selectable for each input
Factory setting	N/O operation
Voltage range (high)	AC/DC 10 - 30 V
Voltage range (low)	AC/DC 0 - 2 V
Cable	recommended: J-Y(St)Y min. n x 0.8
Cable length	≤ 500 m
Interfaces	
Interfaces	RS-485 and USB (V2.0/V1.1)

Technical data for the RS-485 interface:

Protocol	BMS
Baud rate	9.6 kbit/s
Cable length	≤ 1200 m
Cable (twisted in pairs, one end of shield connected to PE)	recommended: J-Y(St)Y min. 2 x 0.8
Terminating resistor	120 Ω (0.25 W) connectable via DIP switch
Device address, BMS bus	DIP switch 1 - 150
Factory setting device address	1 (master)

Programming

Interfaces	RS-485 or USB (V2.0/V1.1), USB cable: Type A plug on type B plug
Software	TMK-SET, V 4.0 or higher
Factory setting password	activated

Max. cable length in case of power supply of 1/2/3 MK24 - from one AN450

0.28 mm² (e.g. J-Y(St)Y n x 0.6)	160/40/– m
0.5 mm² (e.g. J-Y(St)Y n x 0.8)	250/70/– m
0.75 mm²	400/100/– m
1.5 mm²	800/210/10 m
2.5 mm²	1300/360/20 m

Max. cable length in case of power supply of 1/2/3 MK24 - from one CP-D 24/0.42

0.28 mm² (e.g. J-Y(St)Y n x 0.6)	300/150/100 m
0.5 mm² (e.g. J-Y(St)Y n x 0.8)	500 /250/150 m
0.75 mm²	750/375/250 m
1.5 mm²	1500/750/500 m
2.5 mm²	2500/1200/750 m

Colors

Front foil	RAL 7035 (light grey); RAL 7040 (basalt grey)
Marking	RAL 5005 (ultramarine blue)
Front plate	RAL 7035 (light grey)

Switching elements (MK2430 - -11 only)

Number	1 changeover contact		
Function	programmable		
Operating principle	N/C or N/O operation (programmable)		
Electrical endurance, number of cycles	10000		
Contact data acc. to IEC 60947-5-1			
Utilization category	AC-13	AC-14	DC-12
Rated operational voltage	24 V	24 V	24 V
Rated operational current	5 A	3 A	1 A
Minimum contact rating	1 mA at AC/DC > 10 V		

Environment/EMC

EMC immunity	EN 61000-6-2
EMC emission	EN 61000-6-3
Classification of climatic conditions acc. to IEC 60721:	
Stationary use	3K5
Transport	2K3
Long-term storage	1K4
Operating temperature	-5 - +55 °C
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use	3M4
Transport	2M2
Long-term storage	1M3

Connection

Connection	pluggable screw terminals

Connection properties (supply voltage, BMS bus):

Connection of single conductors	
rigid/flexible/conductor sizes	0.2 - 2.5 mm² (AWG 24 - 12)
flexible with ferrule without/with plastic sleeve	0.25 - 2.5 mm²
Multi-conductor connection (2 conductors of the same cross section)	
rigid/flexible	0.2 - 1/0.2 - 1.5 mm²
flexible with ferrule without plastic sleeve	0.25 - 1 mm²
flexible with TWIN ferrules with plastic sleeve	0.5 - 1.5 mm²

Connection properties (inputs):

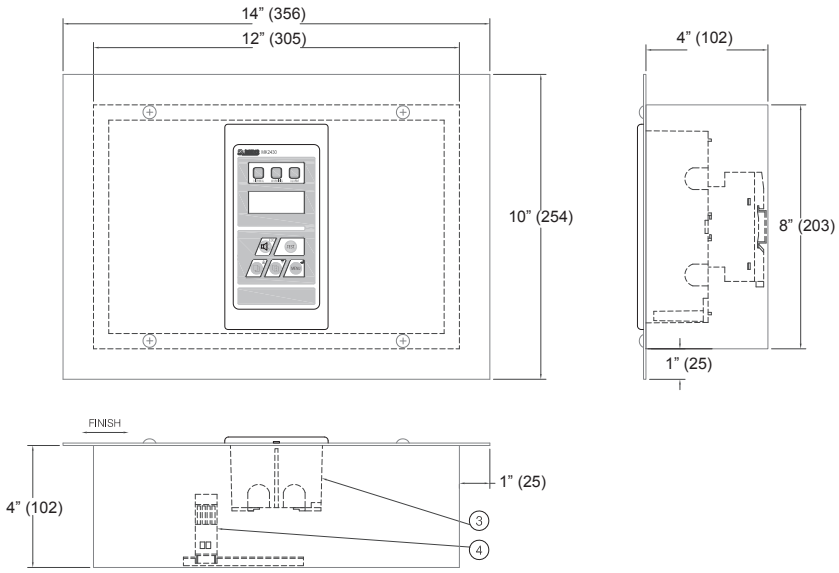
Connection of single conductors	
rigid/flexible/conductor sizes	0.08 - 1.5 mm² (AWG 28 - 16)
flexible with ferrule without/with plastic sleeve	0.25 - 1.5/0.25 - 0.5 mm²
Multi-conductor connection (2 conductors with the same cross section):	
rigid/flexible	0.08 - 0.5 mm²
flexible with ferrules without plastic sleeve	0.25 - 0.34 mm²
flexible with TWIN ferrule with plastic sleeve	0.5 mm²
Stripping length	7 mm
Tightening torque	0.5 - 0.6 Nm

Other

Operating mode	continuous operation
Mounting	display-oriented
Degree of protection, internal components (DIN EN 60529	IP50 (surface-mounting type: IP54)
Degree of protection, terminals (IEC 60529)	IP20
Flammability class	UL94V-0
Weight	flush mounting ≤ 210 g, surface mounting ≤ 400 g

Dimensions: MK2430 pre-installed assemblies in inches (mm)

MK2430-11RS and MK2430-12RS models are pre-built assemblies at the factory, with the mk2430 mounted on a 304SS front trim, with backbox. A class 2 power supply is pre-installed.



Ordering information: Pre-installed assembly

Ordering information below is for self-installed versions of the MK800. Refer to "Ordering information: Pre-built assemblies" for information on MK800 modules preassembled with front trim, backbox, and applicable power supply.

Description	Digital inputs/relay outputs	Type	Ordering No.
MK2430, preassembled with front trim, bezel frame, backbox, and power supply	16/1	MK2430-11RS	B 5213 01095
	–	MK2430-12RS	B 5213 01096

Assembly components and accessories

Description	Type	Ordering No.
Remote station with 16 digital inputs, no enclosure type	MK2430-11	B 9510 0031NA
Remote station, no enclosure type	MK2430-12	B 9510 0032NA
Backbox for MK2430 12" x 8" x 4" (305 x 203 x 102)	B120804	B 5213 00367
304SS fron trim for MK2430 14" x 10" (356 x 254)	T1410-MK2430	P 1030 0195
Class 2 power supply with DIN rail (100 - 240 VAC input)	CP-D 24/0.42	P 1380 0049
Setup and configuration software	TMK-SET V3.xx	B 9602 0087

COM465IP

Ethernet and Modbus/TCP communication gateway for Bender equipment

Applications

- Centralization of management of Bender equipment
- Simple, easy-to-use interfacing for notifcation of alarms and modification of settings
- Notification access via connected PCs or smartphones
- E-mail and SMS alarm notifications
- Connecting Bender equipment to modern Modbus/TCP networks
- System visualization
- Fast modifications and management of settings from a central location

Approvals

c UL us LISTED

Lloyds Register TYPE APPROVED

Features overview

- Modular, expandable gateway between compatible Bender devices and Ethernet / Modbus TCP networks
- Gateway between compatible Bender devices and Ethernet with web browser-based interface
- A complete range of options and packages available through software options
- Configurable to be accessed through LAN or WiFi with connected smartphone / tablet

Standard and optional features

Basic device

- Easy to use GUI, displaying status information of all connected Bender devices, viewed through standard web browsers on connected PCs
- Modern HTML5-based interface for use on both desktop and mobile*
- Indication of current measured values, operational and alarm messages
- Time synchronization for all compatible Bender devices
- Integrated Ethernet switch: 2 x RJ45, 10/100 Mbit/s
- Onboard LCD display and pushbuttons for internal device settings
- Supports both static IP addressing or DHCP (dynamic)
- Modbus/TCP data access for up to ten (10) connected Bender devices
- Create a virtual device with up to 16 measuring channels - create custom alarms using multiple devices and alarm types, and use custom calculations / mathematical operations
- Integrate third party Modbus/TCP devices and measure up to 50 data points, integratable into virtual setpoints
- Password-protected device menu

Option A: Customizable messages and data logging

- Customizable messages for devices and monitoring points / alarms
- Timestamped data logging of events
- E-mail notifications to different user groups in the event of alarms and system faults
- Monitoring for device failure
- Data reporting function with PDF export

Option B: Expanded Modbus/TCP gateway

- Access data for Bender devices on both external and internal RS-485 buses (up to 150 devices on internal bus, up to 99 internal buses on external bus)
- "Modbus control commands" menu item contained in browser-based GUI allows for Modbus commands configured to Bender equipment to be simply copied / pasted to external Modbus applications

Option C: Device admin station (remote device configuration)

- Fast, simple settings modification for compatible connected Bender devices from browser-based GUI (for devices connected on internal RS-485 bus)
- Data reporting function with PDF export

Option D: System / site visualization

- Supports importing of system schematics / drawings / floor plans
- Fast and simple system overview visualization, no programming knowledge required. Measured values and alarms can be arranged on a visual floor plan, simplifying location and notification of alarms
- Multiple page views and system overviews supported

Option E: Expanded virtual device support

- Create up to 100 virtual devices, each with up to 16 measuring channels - create custom alarms using multiple devices and alarm types, and use custom calculations / mathematical operations

Option F: Expanded third party device integration

- Integrate third party Modbus/TCP devices and measure up to 1,600 data points, additionally integratable into virtual setpoints

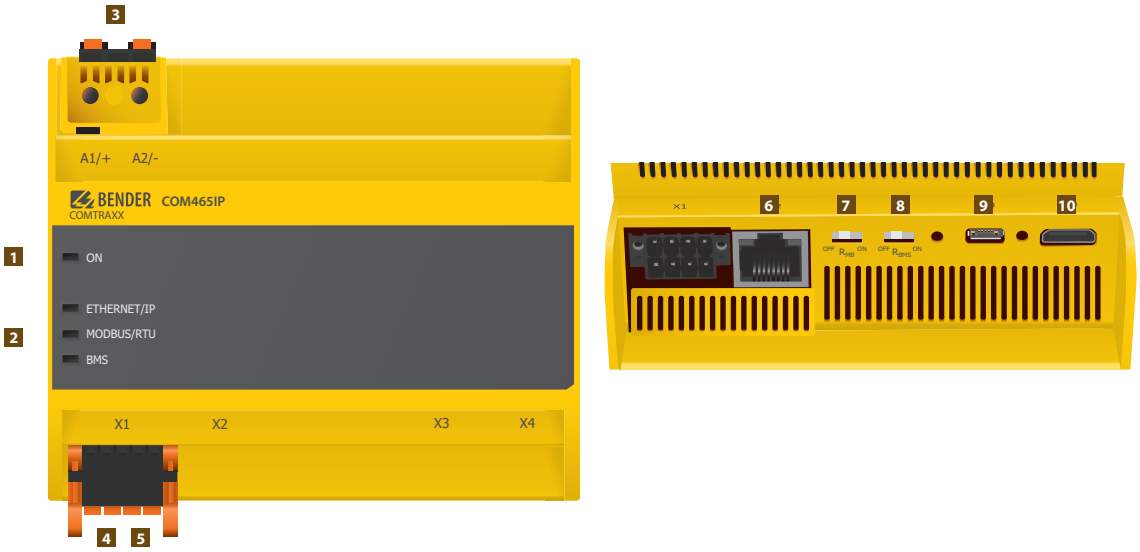
* Some features, such as virtual setpoints, visualizations, and adding third-partry Modbus devices require use of Internet Explorer with Silverlight installed.

Compatible Bender devices

Connected devices	Description	Supported connections to COM465IP		
		Ethernet (BCOM)	RS-485 (BMS)	Ethernet (Modbus/TCP)
iso685 and connected EDS440-S / EDS441-S	Ground fault detector	■	■*	■
RCMS460 / 490	Multi-channel ground fault monitors		■	
IRDH275 / 375 / 575 "B" models	Ground fault detectors		■	
LIM2010	Line isolation monitor		■	
EDS460 / 490 / 461 / 491 / 441	Ground fault location modules		■	
EDS440 / 441 "L" models	Ground fault location modules		■*	
RCMA421 / RCMA426 "DCB" models	GFCI modules (LifeGuard)		■	
PEM735	Power quality meter			■

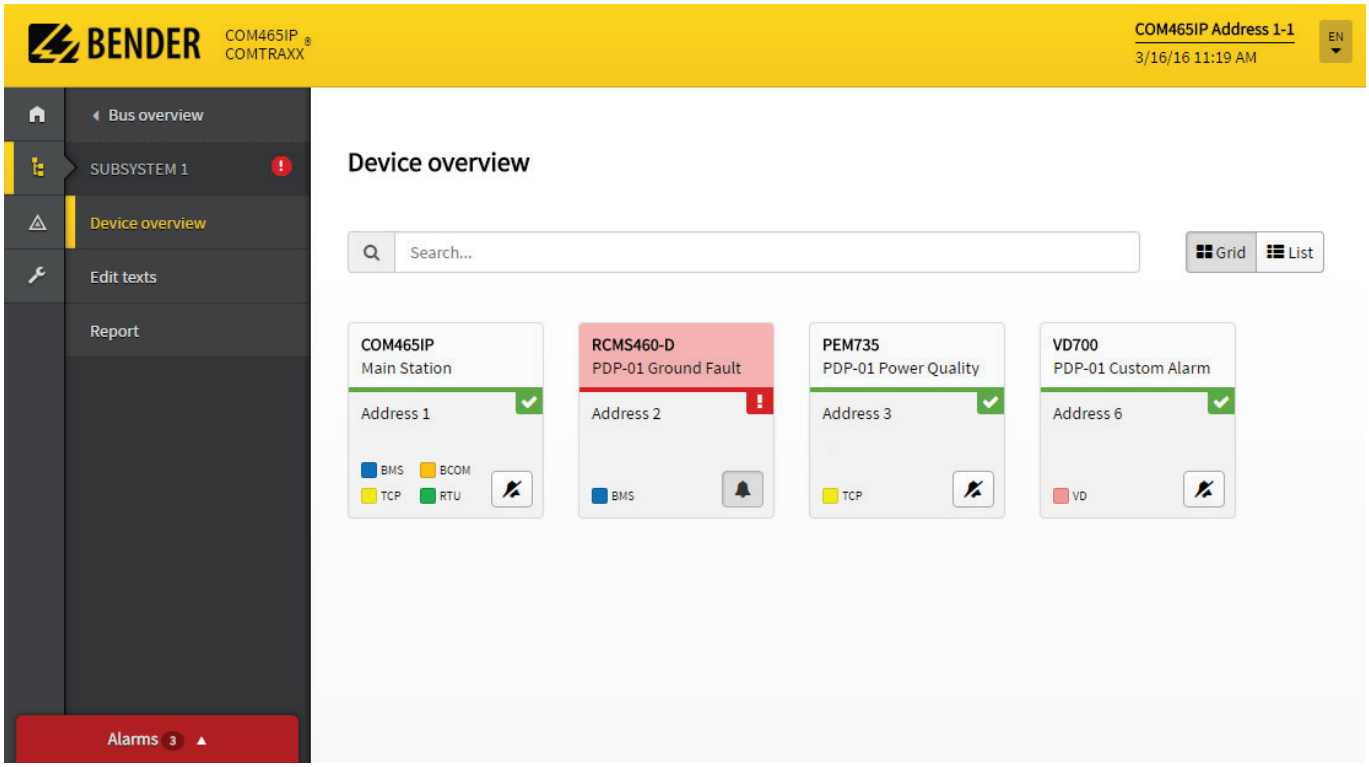
* Functionality is limited when using iso685 and EDS440 / 441 devices over the Bender RS-485 bus. Contact Bender for more details.

Displays, controls, and connections

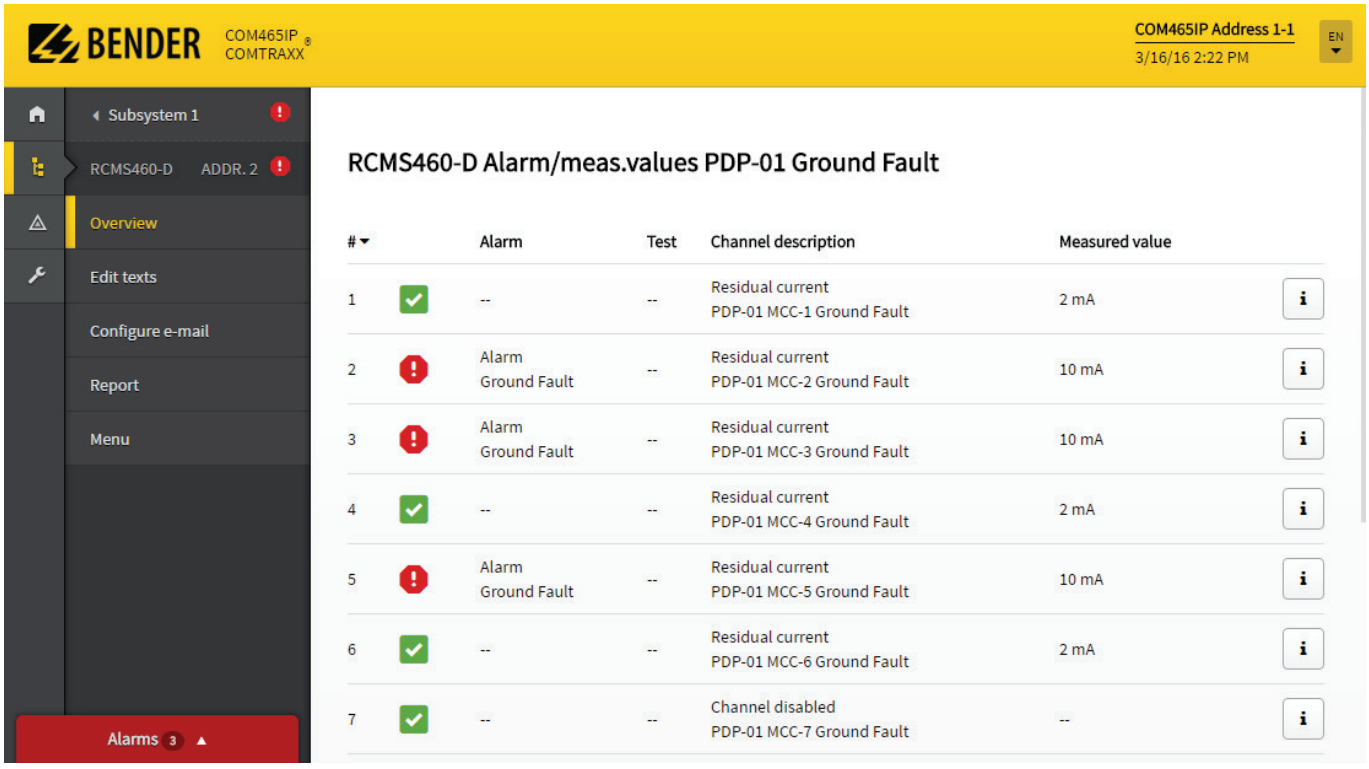


1. LED "ON" - Flashes during startup, solid during normal operation
2. Status LEDs "Ethernet/IP," "Modbus/RTU", "BMS" - flash during respective interface activity
3. Supply voltage connections - see ordering information
4. Modbus/RTU interface (X1 connector) - Used with select Bender devices
5. Bender RS-485 bus interface (BMS, X1 connector) - connects select Bender devices to gateway
6. Ethernet (RJ45) port - connects COM465IP to Ethernet and Modbus/TCP networks
7. Termination resistor switch for Modbus/RTU connections
8. Termination resistor switch for Bender RS-485 bus connections
9. Provisioned for future use
10. Provisioned for future use

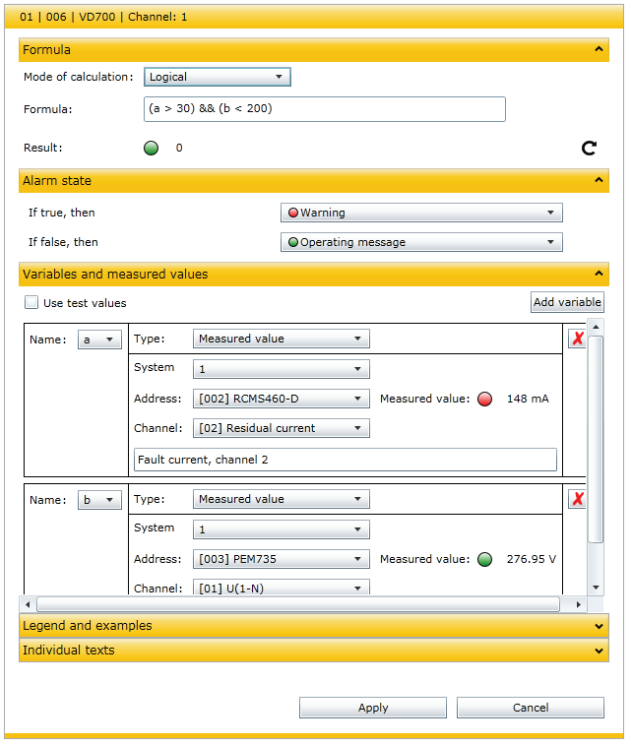
Web interface - main status screen



Web interface - Detailed device status

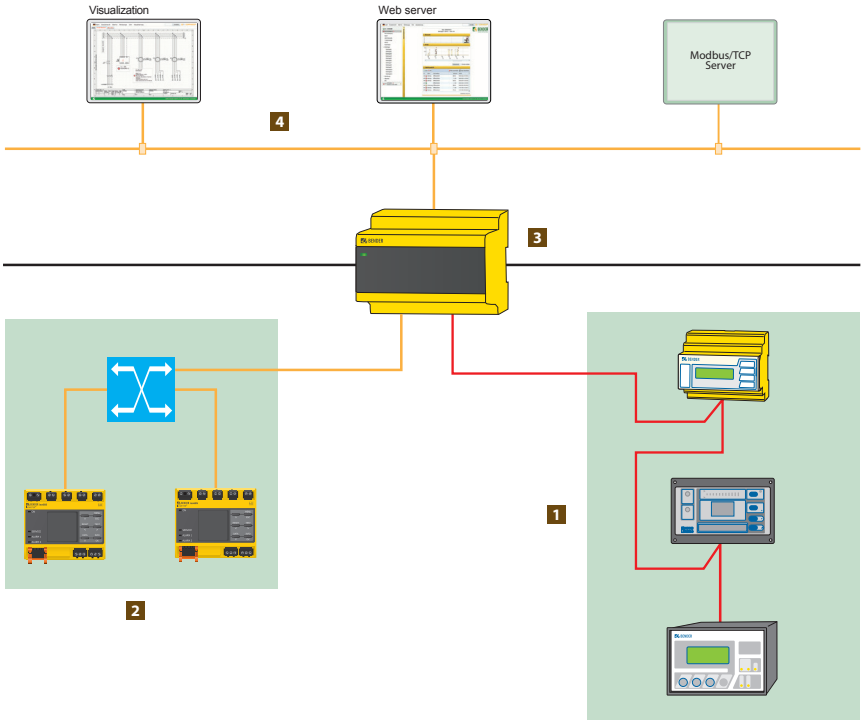


Virtual setpoints



- Create custom alarms using mathematical operations or combining multiple devices
- Combine any of the following to create application tailored alarms:
  - Alarms from multiple devices - combine ground fault alarms, voltage measurements, and many more
  - Mathematical operations - activate alarms based on calculations using measured values
  - Logical operations - Use boolean logic to create alarms from multiple inputs
  - Integrate alarms from third party Modbus/TCP devices
- Virtual setpoints appear as standard devices on the alarm overview screen, simplifying use for technicians and staff

Communication topology sample



1 Bender RS-485 bus (BMS)
2 iso685 devices connected to Ethernet switch (BCOM)
3 COM465IP gateway
4 Building Ethernet or Modbus/TCP network

6

Insulation coordination acc. to IEC 60664-1/IEC 60664-3 (For model B95061065)

Rated insulation voltage	AC 250 V
Rated impulse voltage/Overvoltage category	4 kV/III
Pollution degree	3
Protective separation (reinforced insulation) between	(A1/+, A2/-) - [(AMB, BMB), (ABMS, BBMS), (X2), (X3, X4)]

Insulation coordination acc. to IEC 60664-1/IEC 60664-3 (For model B95061066)

Rated insulation voltage	AC 50 V
Rated impulse voltage/Overvoltage category	0.5 kV/III
Pollution degree	3

Supply voltage

Supply voltage U_S	see ordering information
Frequency range U_S	see ordering information
Power consumption	see ordering information

Indications

LEDs:

ON	operation indicator
ETHERNET IP	data traffic Ethernet
MODBUS RTU	data traffic Modbus
BMS	data traffic BMS
Ethernet (terminal X2)	lights during network connection, flashes during data transfer

Memory

E-mail configuration (function module A only) and device failure monitoring	max. 250 entries
Individual texts (function module A only)	unlimited number of texts with 100 characters each
Number of data points for third-party devices on Modbus TCP and Modbus RTU	50

Quantity

Data loggers	30
Number of data points per data logger	10,000
Number of history memory entries	1,000

Visualisation

Number of pages	20
Size of the background image	50 kByte (scaled down if larger)
Data points (per page)	50 devices or channels, 150 text elements

Interfaces

Ethernet

Port	RJ45
Data rate	10/100 MBit/s, autodetect
DHCP	on/off (on)*
t_{off} (DHCP)	5 - 60 s (30 s)*
IP address	nnn.nnn.nnn.nnn, can always be reached over: 192.168.0.254, (169.254.0.1)*
Subnet mask	nnn.nnn.nnn.nnn (255.255.0.0)*
Protocols (depending on the function module selected)	TCP/IP, Modbus TCP, Modbus RTU, DHCP, SMTP, NTP

SNMP

Versions	1, 2c, 3
Supported devices	Querying all devices (channels) possible (no trap functionality)

BMS bus (internal/external)

Interface/protocol	RS-485/BMS internal or BMS external (BMS internal)*
Operating mode	master/slave (master)*
Baud rate BMS	internal 9.6 kBit/s external 19.2; 38.4; 57.6 kBit/s
Cable length	≤1,200 m
Cable: twisted pair, shielded, one end of shield connected to PE	recommended: J-Y(St)Y min. 2x0.8
Connection	X1 (ABMS, BBMS)
Connection type	refer to connection "push-wire terminal X1"
Terminating resistor	120 Ω (0.25 W), can be connected internally
Device address, BMS bus external/internal	1 - 99 (2)*

BCOM

Interface/protocol	Ethernet/BCOM
BCOM subsystem address	1 - 99 (1)*
BCOM device address	1 - 99 (2)*

Modbus TCP

Interface/protocol	Ethernet/Modbus TCP
Operating mode	client for associated PEM and "third-party devices"
Operating mode	server for access to the process image and for Modbus control commands

Modbus RTU

Interface/protocol	RS-485/Modbus RTU
Operating mode	master
Baud rate	9.6 - 57.6 kBit/s
Cable length	≤1,200 m
Connection	X1 (AMB, BMB)
Connection type	refer to connection "push-wire terminal X1"
Terminating resistor	120 Ω (0.25 W), can be connected internally
Supported Modbus RTU slave addresses	2 - 247

Environment/EMC

EMC	EN 61326-1
Ambient temperatures:	
Operation	-25 - +55 °C
Transport	-40 - +85 °C
Long-term 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
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

Option "W" data different from the standard version

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

Technical data (continued)

Connection	
Connection type	pluggable push-wire terminals
Push-wire terminals	
Conductor sizes	AWG 24-12
Stripping length	10 mm
rigid/flexible	0.2 - 2.5 mm²
flexible with ferrule, with/without plastic sleeve	0.25 - 2.5 mm²
Multiple conductor, flexible with TWIN ferrule with plastic sleeve	0.5 - 1.5 mm²
Push-wire terminal X1	
Conductor sizes	AWG 24-16
Stripping length	10 mm
rigid/flexible	0.2 - 1.5 mm²
flexible with ferrule without plastic sleeve	0.25 - 1.5 mm²
flexible with TWIN ferrule with plastic sleeve	0.25 - 0.75 mm²

Other	
Operating mode	continuous operation
Mounting	front-oriented, cooling slots must be ventilated vertically
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
DIN rail mounting acc. to	IEC 60715
Screw fixing	2 x M4
Enclosure type	J460
Enclosure material	polycarbonate
Flammability class	UL94V-0
Dimensions (W x H x D)	107.5 x 93 x 62.9 mm
Documentation number	D00216
Weight	≤ 240 g

( )* = factory setting

Ordering information - base module

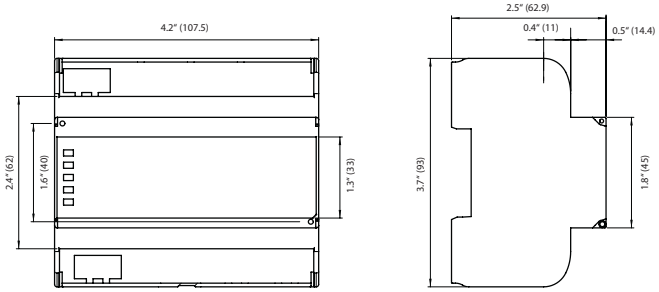
Supply voltage		Power consumption	Type	Ordering No.
AC	DC			
24 - 240 V, 50/60 Hz	24 - 240 V	max. 6.5VA / 4W	**COM465IP-230V**	**B 9506 1065**
-	24 V	max. 3W	**COM465IP-24V**	**B 9506 1066**

Ordering information: additional options

Optional add-ons listed below are separate line items in addition to the base module.

Description	Type	Ordering No.
Custom labels and e-mail notifications	**Option A**	**B 7506 1011**
Full Modbus/TCP communication	**Option B**	**B 7506 1012**
Remote device settings and configuration	**Option C**	**B 7506 1013**
System visualizations	**Option D**	**B 7506 1014**
Full virtual device support	**Option E**	**B 7506 1015**
Full third party device integration	**Option F**	**B 7506 1016**

Dimensions in inches (mm)



COM462RTU

Modbus/RTU communication gateway for Bender equipment

Features

- Modbus/RTU gateway module for up to 150 Bender devices
- Time syncronization for connected Bender equipment
- Addressing and other settings carried out and displayed via built-in digital display
- Read measured values and other information using external Modbus/RTU master
- Operates as master or slave on Bender RS-485 bus, slave on Modbus/RTU bus

Applications

- Connection of Bender equipment to Modbus/RTU networks
- Integration of Bender equipment into existing standard communication networks

Approvals

c UL us LISTED

Ordering information

Supply voltage U_S [1]		Power consumption	Type	Ordering No.
AC	DC			
76 - 250 V (42 - 460 Hz) (Draw 10 - 35 mA)	76 - 250 V (Draw 6 - 21 mA)	3.5 - 40 VA	**COM462RTU**	**B 9506 1022**

[1] Absolute values

Technical Data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3

Supply voltage

Supply voltage U_S	see ordering information
Frequency range U_S	see ordering information
Power consumption	see ordering information

LED indicators

ALARM	internal device error
COM	data traffic on BENDER RS-485 bus
ON	operation indicator

Interfaces

BMS bus internal:

Interface/protocol	RS-485/BMS bus internal
Operating mode	master/slave (slave)*
Baud rate BMS internal	9600 baud
Cable length	≤ 1200 m
Cable (twisted pair, shielded, shield connected to GND on one side)	recommended: J-Y(St)Y 2x0.8
Connection	terminals A, B
Terminating resistor	120 Ω (0.25 W)
Device address	1 - 99 (2)*

Modbus/RTU:

Interface/protocol	RS-485/Modbus/RTU
Operating mode	slave
Baud rate	9600 - 57600 baud
Cable length	≤ 1200 m
Cable (twisted pair, shielded, shield connected to GND on one side)	recommended: J-Y(St)Y 2x0.8
Connection	terminals D+, D-
Terminating resistor	120 Ω (0.25 W)
Device address	2 - 247 (2)*

General data

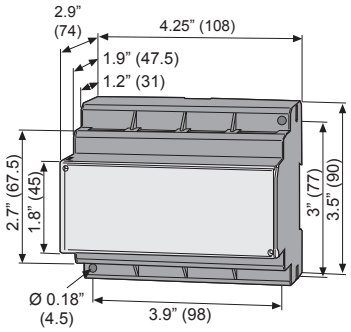
EMC	EN 61326-1
Classification of climatic conditions acc. to IEC 60721:	
Stationary use	3K5
Transport	2K3
Long-term storage	1K4
Operating temperature	-10 - +55 °C
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use	3M4
Transport	2M2
Long-term storage	1M3
Operating mode	continuous operation
Mounting	display oriented

Connection

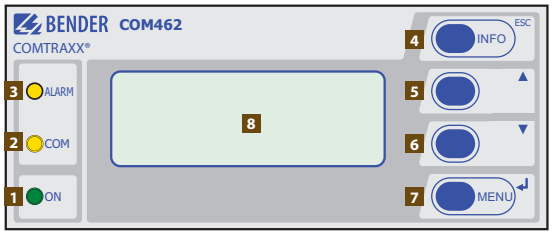
Connection	screw-type terminals
Connection properties:	
Rigid/flexible	0.2 - 4/0.2 - 2.5 mm² (AWG 24 - 12)
Multi-conductor connection (2 conductors with the same cross section):	
rigid/flexible	0.2 - 1.5 0.2 - 1.5 mm²
Stripping length	8 - 9 mm
Tightening torque	0.5 - 0.6 Nm
Degree of protection, internal components (IEC 60529)	IP30 (NEMA 1)
Degree of protection, terminals (IEC 60529)	IP20 (NEMA 1)
Type of enclosure	X460
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Software version	D402 V1.0x
Weight	≤ 310 g

( )* = factory setting

Dimensions in inches (mm)

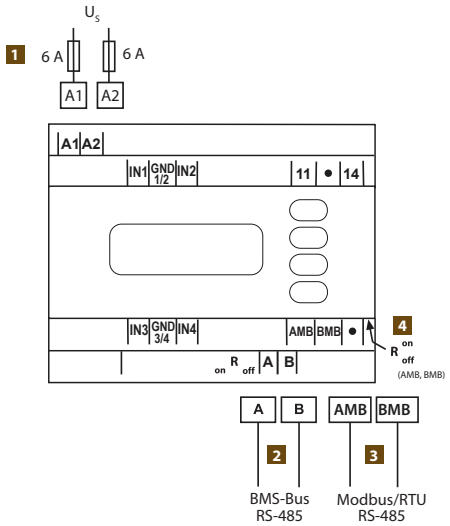


Displays and controls



1 "ON" LED: Lights when power is applied to the device
2 "COM" LED lights: Flashes when gateway is communicating with the BENDER RS-485 bus
3 "ALARM" LED: Lights when an internal device error occurs
4 "INFO" button: View COM460IP-specific information
ESC: Exit menu without changing parameters
5 "▲" button: Move up in the menu, to increase the parameter value
6 "▼" button: <ove down in the menu, to decrease values
7 "MENU" button for starting and exiting the menu
"↵" button to confirm parameter change
8 LCD display for standard and menu mode

Wiring diagram



1 Supply voltage connections (5 A fuses required)
2 RS-485 connection to BENDER internal RS-485 network
3 RS-485 connection to Modbus/RTU network
4 Switch for RS-485 bus termination, turn ON when at beginning or end of internal BENDER RS-485 chain.

CP700

Touchscreen HMI and Ethernet and Modbus/TCP communication gateway

Applications

- Device status of connected Bender equipment from clear, easy-to-use 7" touchscreen
- Centralization of management of Bender equipment
- Includes all features of the COM465IP gateway
- Visualization of status of connected Bender equipment via web-browser based GUI combined with centralized remote station
- E-mail and SMS notification
- Connection of Bender equipment to modern Modbus/TCP networks combined with centralized remote station
- Remote parameter setting of connected Bender equipment

Features oreview

- Communication gateway and HMI for Bender devices
- 7" TFT WVGA color display
- Resistive touch screen
- Small mounting depth
- Fanless operation
- Integrated gateway to Ethernet (TCP/IP), 10/100/1000 Mbit/s
- Remote access via LAN, WAN or Internet

Feature details

Basic device

- Easy to use GUI, displaying status information of all connected Bender devices, viewed through standard web browsers on connected PCs
- Modern HTML5-based interface for use on both desktop and mobile*
- Indication of current measured values, operational and alarm messages
- Time synchronization for all compatible Bender devices
- Integrated Ethernet switch: 2 x RJ45, 10/100 Mbit/s
- Onboard LCD display and pushbuttons for internal device settings
- Supports both static IP addressing or DHCP (dynamic)
- Modbus/TCP data access for up to ten (10) connected Bender devices
- Create a virtual device with up to 16 measuring channels - create custom alarms using multiple devices and alarm types, and use custom calculations / mathematical operations
- Integrate third party Modbus/TCP devices and measure up to 50 data points, integratable into virtual setpoints
- Password-protected device menu
- Customizable messages for devices and monitoring points / alarms
- E-mail notifications to different user groups in the event of alarms and system faults
- Monitoring for device failure
- Access data for up to 150 BENDER devices using integrated Modbus/TCP server
- Fast, simple settings modification for compatible connected BENDER devices from browser-based GUI (for devices connected on internal RS-485 bus)
- Data reporting function with PDF export
- Supports importing of system schematics / drawings / floor plans
- Fast and simple system overview visualization, no programming knowledge required. Measured values and alarms can be arranged on a visual floor plan, simplifying location and notification of alarms
- Multiple page views and system overviews supported

Option E: Expanded virtual device support

- Create up to 100 virtual devices, each with up to 16 measuring channels - create custom alarms using multiple devices and alarm types, and use custom calculations / mathematical operations

Option F: Expanded third party device integration

- Integrate third party Modbus/TCP devices and measure up to 1,600 data points, additionally integratable into virtual setpoints

Ordering information - base module

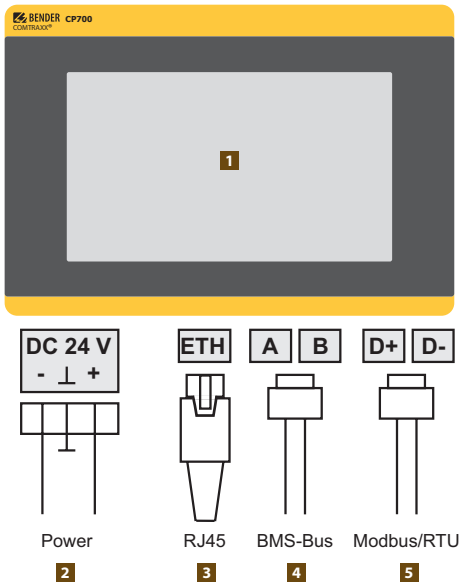
Supply voltage U_S	Power consumption	Type	Ordering No.
DC			
24 V/± 25 %	24 W	**CP700**	**B 9506 1030**

Ordering information: additional options

Optional add-ons listed below are separate line items in addition to the base module.

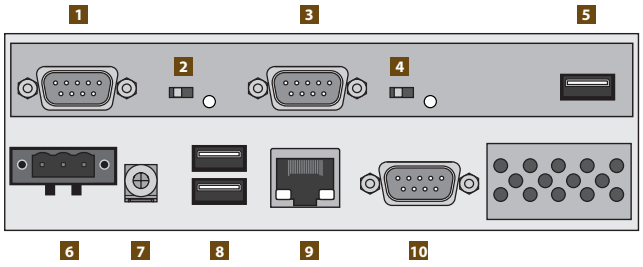
Description	Type	Ordering No.
Full virtual device support	**Option E**	**B 7506 1015**
Full third party device integration	**Option F**	**B 7506 1016**

Displays, controls, and wiring diagram



1 Touchscreen display
2 Connection to supply voltage (24 VDC)
3 RJ45 connection for Ethernet and Modbus/TCP connection
4 BENDER RS-485 bus connection (cable included)
5 Modbus/RTU connection for special equipment (cable included)

Interfaces



1 Modbus/RTU interface (for connection to special equipment)
2 Switch and LED master/slave for Modbus/RTU interface
3 BENDER RS-485 interface
4 Switch and LED master/slave for BENDER RS-485 bus
5 USB interface (currently inactive)
6 Connection of supply voltage (DC 24 V)
7 Functional ground
8 USB interfaces (currently inactive)
9 Ethernet 10/100/1000 port
10 RS-232 interface (currently inactive)

Technical data

Insulation coordination acc. to IEC 60664-1	
Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3

Supply voltage	
Supply voltage U_S	24 VDC
Supply voltage tolerance	± 25%
Power consumption	<= 24 W

Displays, memory	
Display	7" TFT WVGA Color
LEDs	Power, CF, Link, Run, Master/Slave
Button	Power, Reset
Buzzer	yes
Memory card for special device functions (CF card)	4 GB
E-mail configuration and device failure monitoring	max. 250 entries
Individual texts	max. 1200 texts with 100 characters each
Devices that can be displayed	max. 247

Interfaces

BMS bus:	
Interface/protocol	RS-485/BMS internal
Operating mode (max. one CP700 per bus)	master/slave (slave)*
Device address, BMS bus	1 - 99 (2)*
Baud rate BMS	9600 baud

Modbus/RTU:	
Interface/protocol	RS-485/Modbus/RTU
Operating mode	master
Baud rate Modbus/RTU	1200 baud - 57600 baud
Cable length	≤ 1200 m
Cable (twisted pairs, shielded, shield connected to PE on one side)	recommended: J-Y(St)Y min. 2x0.8
Connection, BMS	terminals A, B
Connection, Modbus/RTU	terminals D+, D-
Terminating resistor	120 Ω (0.25 W)

Ethernet:	
Connection	RJ45
Data rate	10/100/1000 Mbit/s, autodetect
DHCP	on/off (on)*
t_{off} (DHCP)	5 - 60 s (30 s)*
IP address	nnn.nnn.nnn.nnn (192.168.0.254)*
Netmask	nnn.nnn.nnn.nnn (255.255.0.0)*
Protocols	TCP/IP, Modbus/TCP, DHCP, SMTP, NTP
Additional interface protocols	connection to SCADA systems and/or PLC via OPC, BACnet or other protocols on request

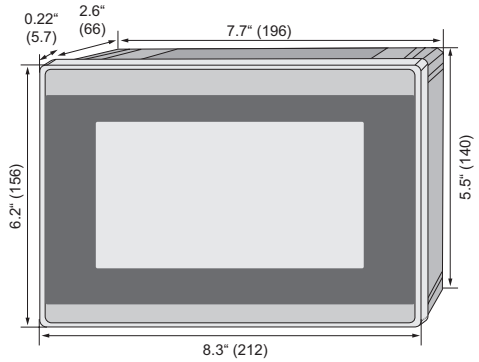
Environment/EMC	
EMC	EN 61326-1
Classification of climatic conditions acc. to IEC 60721:	
Stationary use	3K5
Transport	2K3
Long-term storage	1K4
Operating temperature	0 - +55 °C
Ventilation	fanless
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use	3M4
Transport	2M2
Long-term storage	1M3

Connection	
Connection	plug connectors

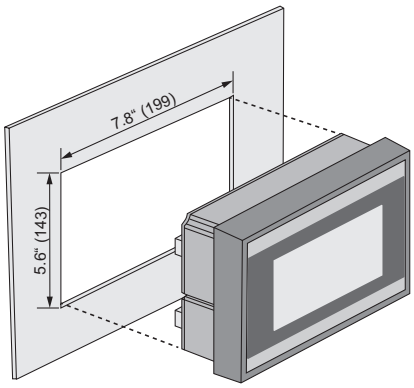
General data	
Operating mode	continuous operation
Mounting	display oriented
Degree of protection, on the front (IEC 60529)	IP65 (NEMA 12)
Degree of protection, on the rear (IEC 60529)	IP20 (NEMA 1)
Type of enclosure	panel mounting
Control panel cut-out	199x143 mm
Screw mounting	with mounting brackets
Flammability class	UL94V-0
Weight	≤ 1200 g

( )* = factory setting

Dimensions in inches (mm)



Control panel cutout in inches (mm)



DI-1DL

Interface repeater for Bender RS-485 bus extension

Features

- Plastic enclosure for DIN rail mounting
- Dynamic baud rate setting
- Galvanic separation between the input and output circuit and the power supply
  – overvoltage protection

Applications

- Extends RS-485 bus length by 1200 m and possible bus nodes by 31
- Protection against spikes by galvanic separation between the input and output circuit and the power supply

Ordering information

Supply voltage U_S	Type	Ordering No.
AC		
85 - 260 VAC (50/60 Hz)	DI-1DL	B 9501 2047

Technical data

Supply voltage

Supply voltage U_S	AC 85 - 260 V, 50 - 60 Hz
Power consumption	0.1 A/7 W

Interfaces

BMS

Interface/protocol	2 x RS-485/BMS
Baud rate	dynamic
Cable length	≤ 1200 m
Cable (twisted in pairs, one end of shield connected to PE)	recommended: J-Y(St)Y min. 2 x 0.8
Data direction switchover	automatically
Cascading option	yes
Number of bus devices:	31 additional bus devices per repeater, cascading allows a virtually unrestricted number of connections
Integrated terminating resistor adjustable by a switch or externally	
Device address, BMS bus	–
Alarm LEDs	activity indication: direction, faults (green) internal operating voltage (red)

Environment

Operating temperature	0 - +70 °C

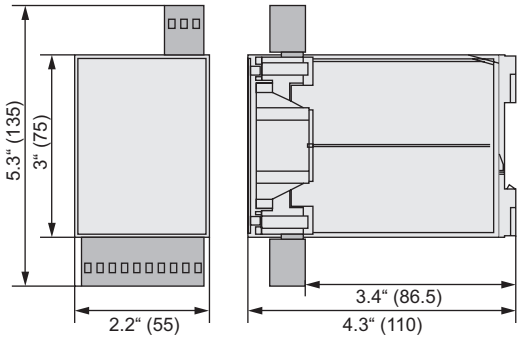
Connection

Connection	push-wire/plug-in terminals

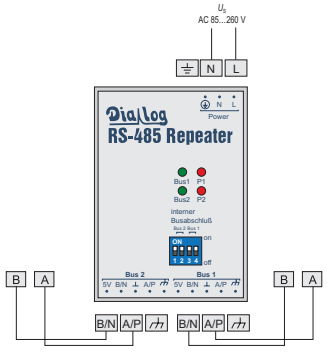
Other

Operating mode	continuous operation
Mounting	any position
Enclosure	for standard DIN rail 32 mm (approx.110 x 75 x 55)
Operating manual	DiaLog RS-485 repeater type CN-2-1
Weight approx. 90 g	

Dimensions in inches (mm)



Wiring diagram



Note:
Take the BMS bus termination into account: When the terminating resistors are switched on with the DIP switches, additional resistors will be connected. Address 1 of the BMS bus makes these resistors available. Since only one resistor is required for each bus segment, it is recommended to use only external resistors in the bus segment where the device with address 1 is located.

DI-2USB

RS-485 to USB interface converter

Features

- Plastic enclosure
- Electrical separation between the input and output circuit
- Power supply via USB port
- USB cable and driver CD included

Ordering information

Supply voltage	Type	Ordering No.
supplied by USB port, no additional power supply required	DI-2USB	B 9501 2045

Technical data

Insulation coordination acc. to IEC 60664-1

Rated voltage	
Rated impulse voltage/pollution degree	3 kV/3

Supply voltage

Supply voltage U_S	see ordering information
Power consumption	95 mVA

Interfaces

BMS

Interface/protocol	1 x RS-485/–
Baud rate	9.6 - 115.2 kbit/s
Cable length	≤ 1200 m
Cable (twisted in pairs, one end of shield connected to PE)	recommended: J-Y(St)Y min. 2 x 0.8
Mode	–
Connection	A, B
Integrated terminating resistors, selectable via jumper, factory setting	terminating resistors included
Device address, BMS bus	–
Serial interface	1 x USB
Alarm LEDs	ON (yellow), R x Data (green), T x Data (red)

Environment/EMC

EMC immunity/EMC emission	EN 61000-6-2/EN 61000-6-4
Classification of climatic conditions acc. to IEC 60721	
Stationary use	3K5
Transport	2K3
Long-time storage	1K4
Ambient temperature, operation	-10 - +55 °C
Classification of mechanical conditions acc. to IEC 60721	
Stationary use	3M4
Transport	2M2
Long-time storage	1M3

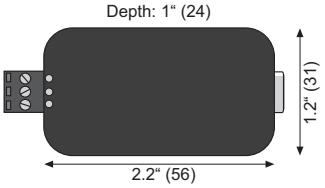
Connection

Connection	screw-type terminals/USB plug Type B
Connection rigid/flexible/conductor sizes	0.5 - 2.5 mm² (AWG 22 - 12)

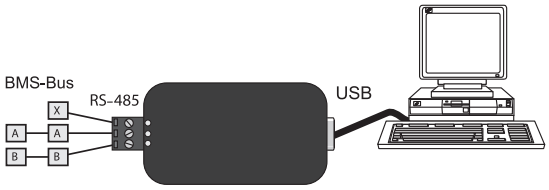
Other

Operating mode	continuous operation
Mounting	any position
Screw mounting	2 x M3
DIN rail mounting acc. to	IEC 60715
Operating manual	manual of third-party manufacturer
Weight	≤ 25 g

Dimensions in inches (mm)



Wiring diagram



DI-2USB to connect a personal computer utilising a USB interface to a BMS network.

Note:
Consider BMS bus termination

Voltage couplers

	 AGH150W-4	 AGH204S-4	 AGH520S	 AGH676S-4

Page		7-24	7-25	7-26	7-27
Rated system voltage		0 - 1150 VAC, 0 - 1760 VDC	AC 0 - 1300 V (with rectifiers)/ AC 0 - 1650 V (no rectifiers)	0 - 7200 VAC	0 - 12 kV AC
Compatibility	IR470LY		■	■	
	IRDH275/375	■	■	■	■
	iso685 (no EDS)	■	■	■	■

External current transformers

	 W0-S20 - W5-S210 series	 W series, W-8000 series	 WAB series

Page		7-04							7-06								7-09					
Construction		circular, closed							circular, closed								circular, closed					
Terminals		screw terminals							cage clamp terminals								pre-wired slim connectors					
Mounting		screw mounted							screw mounted (DIN rail adapter available)								screw mounted (DIN rail adapter available)					
CT type		W10/600	W0-S20	W1-S35	W2-S70	W3-S105	W4-S140	W5-S210	W20	W35	W60	W120	W210	W20-8000	W35-8000	W60-8000	W20AB	W35AB(P)	W60AB(P)	W120AB	W210AB	
Dimensions (mm)	Inside diameter	10	20	35	70	105	140	210	20	35	60	120	210	20	35	60	20	35	60	120	210	
	Width x height																					
	Strip length																					
Compatibility	EDS460/490	■	■	■	■	■	■	■	■	■	■	■	■									
	EDS461/491													■	■	■						
	RCM420	■	■	■	■	■	■	■	■	■	■	■	■									
	RCMA420																■	■	■			
	RCMA423																■	■	■	■	■	
	RCMS460/490	■	■	■	■	■	■	■	■	■	■	■	■				■	■	■	■	■	

Power supplies

	 CP-D	 AN420
Page	**7-21**	**7-22**
Application	For 12 VDC and 24 VDC powered devices	For RCMS + WAB series CT
Output voltage	DC 24 V	DC ± 12 V
Supply voltage U_S	90- 264 VAC 20 - 370 V VDC	16 - 72 VAC; 9.6 - 94 VDC AC/DC 70 - 276 V

WR series

WS series

WF series

7-13				7-15				7-17				
rectangular, closed				rectangular, split-core, screw terminals				flexible, split				
screw terminals				screw terminals				screw terminals + special connector				
screw mounted				screw mounted				DIN rail or screw mounted (signal converter)				
WR70x175S(P)	WR115x305S(P)	WR150x350S(P)	WR200x500S(P)	WS50x80S	WS80x80S	WS80x120S	WS80x160S	WF170	WF250	WF500	WF800	WF1200
70 x 175	115 x 305	150 x 350	200 x 500	50 x 80	80 x 80	80 x 120	80 x 160					
								170	250	500	800	1200
■	■	■	■	■	■	■	■					
■	■	■	■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■	■	■	■

W0-S20 - W5-S210 Series

AC current transformers for use with RCM, RCMS, and EDS series equipment

Current transformer W0-S20

Current transformer W1-S35

Applications and features

- RCM series ground fault monitors for grounded AC systems
- RCMS series multi-channel ground fault monitors for grounded AC systems
- EDS460 / EDS490 / EDS440 series ground fault location modules for AC/DC ungrounded systems
- Two-wire connection to monitor via screw terminals
- Screw mounted
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Approvals

GL · cULus LISTED · PCT AE25

Ordering information

Inside diameter in inches (mm)	Type	Ordering No.
0.78″ (20)	W0-S20	B 911 787
1.35″ (35)	W1-S35	B 911 731
2.75″ (70)	W2-S70	B 911 732
4.1″ (105)	W3-S105	B 911 733
5.5″ (140)	W4-S140	B 911 734
8.25″ (210)	W5-S210	B 911 735

Technical data

Insulation coordination acc. to IEC 60044-1	
Highest system voltage for electrical equipment U_m	AC 720 V
Rated impulse withstand voltage U_{isol}	3 kV

Measuring circuit	
Rated transformation ratio	600/1
Rated burden	180 Ω (18 Ω at 100 A)
Phase displacement	<4°
Rated primary current	≤10 A (100 A)
Rated primary current	≥10 mA
Nominal power	50 mVA
Rated frequency	15 - 400 Hz
Internal resistance	5 - 8 Ω
Secondary overvoltage protection	with suppressor diode P6KE6V8CP
Accuracy class	3
Rated continuous thermal current	100 A
Rated short-time thermal current	14 kA 1 s
Rated dynamic current	35 kA 30 ms

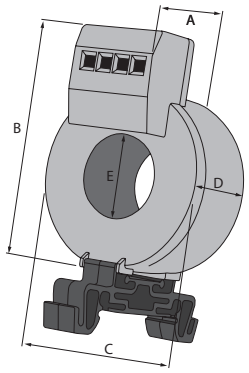
Environment	
Standard	IEC 60044-1
Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 ms
Virbation resistance IEC 60068-2-6 (device in operation)	
W1-S35 - W3-S105	1 g/10 - 150 Hz
W4-S140, W5-S210	1 g/10 - 150 Hz/0.075 mm
Vibration resistance IEC 60068-2-6 (device not in operation)	2 g/10 - 150 Hz
Ambient temperature (during operation/during storage)	-10 - + 50 °C/-40 - + 70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

Connection	
Connection	screw-type terminals
Connection	
rigid/flexible	0.2 - /4/0.2 - 2.5 mm²
flexible with ferrules with/without plastic sleeve	0.25 - 2.5 mm²
Conductor sizes (AWG)	24 - 12
Connection to the evaluator	
single wire ≥ 0.75 mm²	0 - 1 m
single wire, twisted ≥ 0.75 mm²	0 - 10 m
shielded cable ≥ 0.6 mm²	0 - 40 m
Shielded cable (shield connected to PE on one side)	recommended cable J-Y(St)Y min. 2 x 0.6

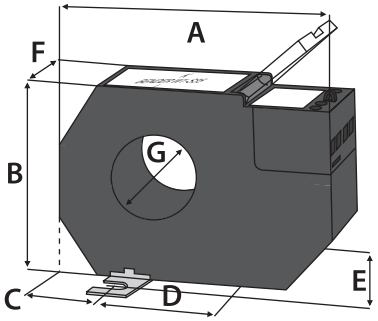
Other	
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Screw mounting	M5
Flammability class	UL94 V-0
Operating manual	TBP409009

Dimensions

W0-S20



W1-S35 - W5-S210



Type	Dimensions in inches (mm)							Weight
	A	B	C	D	E	F	G	
W0-S20	1.3″ (32.4)	2.35″ (60)	ø 1.8″ (46)	0.9″ (23.2)	ø 0.78″ (20)	–	–	0.15 lb (70 g)
W1-S35	3.9″ (100)	3.1″ (79)	1″ (26)	1.9″ (48.5)	1.3″ (33)	1.8″ (46)	ø 1.35″ (35)	0.5 lb (250 g)
W2-S70	5.1″ (130)	4.3″ (110)	1.25″ (32)	2.6″ (66)	1.3″ (33)	1.8″ (46)	ø 2.75″ (70)	0.8 lb (380 g)
W3-S105	6.7″ (170)	5.75″ (146)	1.5″ (38)	3.7″ (94)	1.3″ (33)	1.8″ (46)	ø 4.1″ (105)	1.5 lb (700 g)
W4-S140	8.5″ (220)	7.7″ (196)	1.9″ (48.5)	4.8″ (123)	1.3″ (33)	1.8″ (46)	ø 5.5″ (140)	3 lb (1500 g)
W5-S210	11.7″ (299)	11.1″ (284)	2.7″ (69)	6.3″ (161)	1.3″ (33)	1.8″ (46)	ø 8.25″ (210)	5.5 lb (2500 g)

W and W-8000 Series

AC current transformers for use with RCM, RCMS, and EDS series equipment

Applications and features

- RCM series ground fault monitors for grounded AC systems
- RCMS series multi-channel ground fault monitors for grounded AC systems
- EDS460 / EDS490 / EDS440 series fault location modules for ungrounded systems
- W-8000 series: EDS461 / EDS491 / EDS441 series fault location modules for AC/DC ungrounded systems
- Two-wire connection to monitor via cage clamp terminals
- Screw mounted (DIN rail mounting adapter available)
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Mounting	Inside diameter in inches (mm)	Compatibility				Type	Ordering No.
		RCM420	RCMS460/490	EDS460/490/440	EDS461/491/441		
Screw mounted, DIN rail mountable with adapter	0.78″ (20)	■	■	■		W20	B 9808 0003
					■	W20-8000	B 9808 0009
	1.35″ (35)	■	■	■		W35	B 9808 0010
					■	W35-8000	B 9808 0017
	2.35″ (60)	■	■	■		W60	B 9808 0018
					■	W60-8000	B 9808 0027
Screw mounted	4.7″ (120)	■	■	■		W120	B 9808 0028
	8.25″ (210)	■	■	■		W210	B 9808 0034

Accessories

Description	Width in inches (mm)	Ordering No.
Snap-on mounting for W20-W35, W20-W35-8000	1.7″ (43.5)	B 9808 0501
Snap-on mounting for W60, W60-8000	2″ (50)	B 9808 0502

Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	800 V
Rated impulse voltage/pollution degree	8 kV/3

CT circuit: W series

Rated primary ground fault current	10 mA - 10 A
Rated secondary ground fault current	0.0167 A
Rated transformation ratio K_n	10/0.0167 A
Rated burden	≤ 180 Ω*
Nominal power	0.05 VA
Frequency range	42 Hz - 3 kHz
Rated continuous thermal current I_{cth}	40 A
Rated short-time thermal current I_{th}	60 x I_{cth} = 2.4 kA/1 s
Rated dynamic current I_{dyn}	2.5 x I_{th} = 6.0 kA/40 ms

CT circuit: W-8000 series

Rated primary ground fault current	1 A
Rated secondary ground fault current	0.125 mA
Rated transformation ratio K_n	1 A/0.125 mA
Rated burden	2400 Ω
Nominal power	0.0375 VA
Frequency range	42 Hz - 3 kHz
Rated continuous thermal current I_{cth}	6 A
Rated short-time thermal current I_{th}	60 x I_{cth} = 0.36 kA/1 s
Rated dynamic current I_{dyn}	2.5 x I_{th} = 0.9 kA/40 ms

Environment

Operating temperature	-25 - +70 °C
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K5 (except condensation and formation of ice)
Long-time storage (IEC 60721-3-1)	1K5 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

Connection	cage clamp spring terminal
Connection	
rigid/flexible/conductor sizes	0.08 - 2.5/0.08 - 2.5 mm² (AWG 28 - 12)
Stripping length	8 - 9 mm

Connection (To EDS and RCMS series devices)

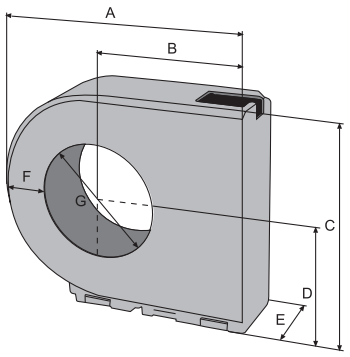
Single wire ≥ 0.75 mm²	0 - 1 m
Single wire, twisted ≥ 0.75 mm²	0 - 10 m
Shielded cable ≥ 0.5 mm²	0 - 40 m
Shielded cable (shield on one side connected to L-conductor, not connected to earth)	recommended: J-Y(St)Y min. 2 x 0.8

Other

Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (IEC 60529)	IP20
Screw mounting	lens head screw M5 acc. to DIN 7985 with mounting bracket
Flammability class	UL94 V-0
Operating manual W - , W - -8000	TBP409013
Approvals and certifications	UL under development

* The rated burden may vary depending on the respective device data sheet.

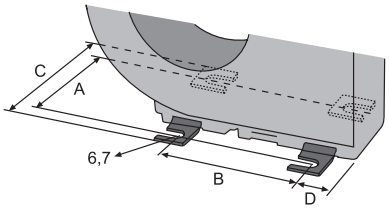
Dimensions



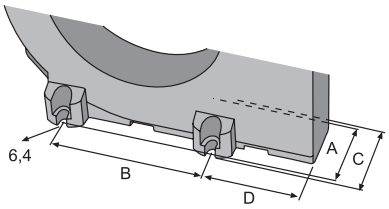
Dimensions in inches (mm)								Weight
Type	A	B	C	D	E	F	G	
W20	3″ (76.4)	2″ (50)	2.2″ (56.3)	1.1″ (29.8)	1.2″ (30)	0.65″ (16.4)	ø 0.78″ (20)	0.3 lb (130 g)
W35	3.9″ (99.5)	2.4″ (62)	3.1″ (79.2)	1.65″ (41.7)	1.2″ (30)	0.78″ (20)	ø 1.35″ (35)	0.4 lb (175 g)
W60	5.3″ (135)	3.1″ (79)	4.6″ (116.4)	2.4″ (60.4)	1.5″ (37)	0.94″ (24)	ø 2.4″ (60)	0.7 lb (315 g)
W120	8.25″ (210)	4.6″ (116.5)	7.5″ (191.5)	3.85″ (98)	1.5″ (37)	1.3″ (33.5)	ø 4.7″ (120)	2.1 lb (960 g)
W210	12.7″ (323)	6.8″ (173)	12″ (304.5)	6.1″ (154.5)	1.8″ (45)	1.8″ (45)	ø 8.25″ (210)	6.4 lb (2900 g)
W20-8000	3″ (76.4)	2″ (50)	2.2″ (56.3)	1.1″ (29.8)	1.2″ (30)	0.65″ (16.4)	ø 0.78″ (20)	0.35 lb (150 g)
W35-8000	3.9″ (99.5)	2.4″ (62)	3.1″ (79.2)	1.65″ (41.7)	1.2″ (30)	0.78″ (20)	ø 1.35″ (35)	0.45 lb (205 g)
W60-8000	5.3″ (135)	3.1″ (79)	4.6″ (116.4)	2.4″ (60.4)	1.5″ (37)	0.94″ (24)	ø 2.4″ (60)	0.8 lb (355 g)

Screw mounting

Screw mounting with mounting brackets:
W20, W35, W60 and W20-8000, W35-8000, W60-8000

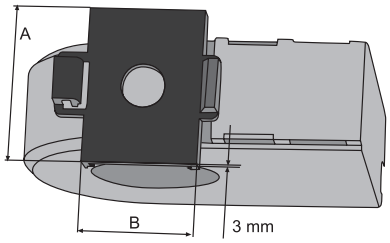


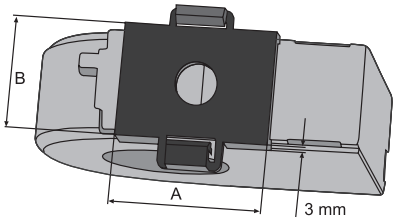
Screw mounting: W120, W210



Snap-on (DIN rail) mounting with adapter

Snap-on mounting on DIN rail, for vertical or horizontal mounting:
W20, W35, W60 and W20-8000, W35-8000, W60-8000



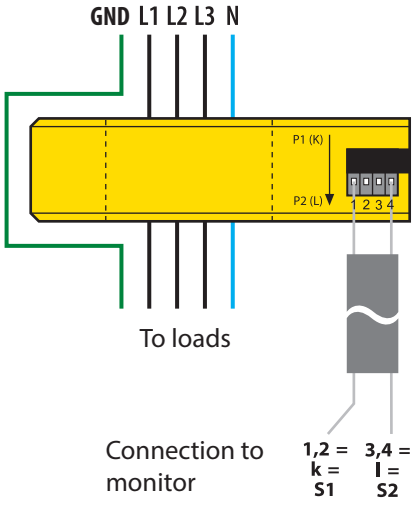


Dimensions (mm)				
Type	**A**	**B**	**C**	**D**
W20/W20-8000 (fixing with two mounting brackets, diagonally)	49	31.4	65	18.6
W35/W35-8000 (fixing with two mounting brackets, diagonally)	49	49.8	65	12.1
W60/W60-8000 (fixing with four mounting brackets)	56	66	72	17.7
W120 (screw mounting)	51	103	60.6	65
W210 (screw mounting)	59	180	68.6	83

Tolerance for screw mounting with mounting brackets: ± 1.5 mm

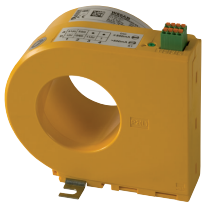
Dimensions (mm)		
Type	**A**	**B**
W20/W20-8000	43.5	32
W35/W35-8000	43.5	32
W60/W60-8000	50	39

Wiring diagram



WAB Series

AC/DC current transformers for use with RCMA and RCMS series ground fault monitors



Applications and features

- RCMA420 series ground fault monitors for grounded AC/DC systems (W20AB/W35AB/W60AB)
- RCMA423 series ground fault monitors for grounded AC/DC systems
- RCMS series multi-channel ground fault monitors for grounded AC/DC systems
- W35ABP and W60ABP feature additional shielding for systems with known high inrush currents
- Simple connections using pre-wired slim connectors
- Screw mounted (DIN rail mounting adapter available)
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Mounting	Inside diameter in inches (mm)	Compatibility and features				Type	Ordering No.
		RCMA420	RCMA423	RCMS460/490	Additional shielding		
Screw mounted, DIN rail mountable with adapter	0.78″ (20)	■	■	■		W20AB	B 9808 0008
	1.35″ (35)	■	■	■		W35AB	B 9808 0016
		■	■	■	■	W35ABP	B 9808 0051
	2.35″ (60)	■	■	■		W60AB	B 9808 0026
		■	■	■	■	W60ABP	B 9808 0052
Screw mounted	4.7″ (120)		■	■		W120AB	B 9808 0041
	8.25″ (210)		■	■		W210AB	B 9808 0040

Connector cables

For device	Length	Type	Ordering No.
RCMA420/423	3 ft (1 m)	WX-100	B 5111 00033
	8 ft (2.5 m)	WX-250	B 5111 00032
	16 ft (5 m)	WX-500	B 5111 00031
	32 ft (10 m)	WX-1000	B 5111 00034
RCMS460/490	3 ft (1 m)	WXS-100	B 5111 00028
	8 ft (2.5 m)	WXS-250	B 5111 00029
	16 ft (5 m)	WXS-500	B 5111 00030
	32 ft (10 m)	WXS-1000	B 5111 00035

Additional lengths available on request.

Accessories

Description	For device	Ordering No.
Snap-on (DIN rail) mounting	W20AB, W35AB(P)	B 9808 0501
	W60AB(P)	B 9808 0502

Power supplies (used with RCMS only)

Description	Type	Page
Power supply units (when used with RCMS460 / RCMS490 monitors)	AN420-1	7-22
	AN420-2	7-22

Technical data

Insulation coordination acc. to IEC 60664-1/IEC 60664-3	
Rated insulation voltage	800 V
Rated impulse voltage/pollution degree	8 kV/3

Supply voltage	
Supply voltage U_S	DC ± 12 V
Operating range of U_S	0.95 - 1.05 x U_S
Power consumption	≤ 2.5 VA

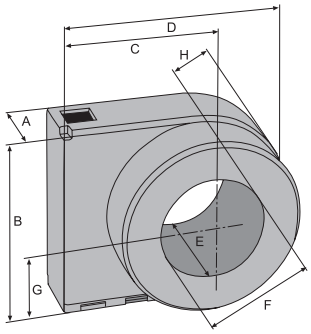
CT circuit	
Rated primary ground fault current: W20AB	10 - 500 mA
Rated primary ground fault current: W35AB, W60AB, W120AB	10 mA - 10 A
Rated primary ground fault current: W210AB	300 mA - 10 A
Rated primary ground fault current: W35ABP and W60ABP	10 mA - 10 A
Rated continuous thermal current I_{cth}	40 A
Rated short-time thermal current I_{th}	2.4 kA/1 s
Rated dynamic current I_{dyn}	6.0 kA/40 ms

Environment/EMC	
EMC	IEC 62020
Ambient temperature, operation	-10 - +55 °C
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K5 (except condensation and formation of ice)
Long-time storage (IEC 60721-3-1)	1K5 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection	
Type of connection	plug-in connectors
Connection to RCMA/RCMS series devices	see table "connector cables"

Other	
Degree of protection, internal components (IEC 60529)	IP40
Degree of protection, terminals (IEC 60529)	IP20
Screw mounting	lens head screw M5 acc. to DIN 7985 with mounting bracket
DIN rail mounting (W20AB, W35AB(P), W60AB(P) only)	with snap-on mounting
Flammability class	UL94 V-HB
Operating manual	TBP409012

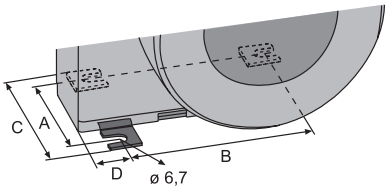
Dimensions



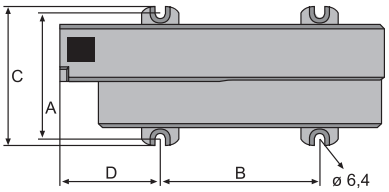
Dimensions in inches (mm)									Weight
Type	A	B	C	D	E	F	G	H	
W20AB	1.2″ (30)	2.2″ (56.3)	2″ (50)	3″ (76.4)	1.9″ (48.5)	ø 0.78″ (20)	1.2″ (29.8)	0.65″ (16.4)	0.4 lb (180 g)
W35AB(P)	1.2″ (30)	3.1″ (79.2)	2.45″ (62)	3.9″ (99.5)	2.2″ (55)	ø 1.35″ (35)	1.6″ (41.7)	0.78″ (20)	0.75 lb (350 g)
W60AB(P)	1.45″ (37)	4.6″ (116.4)	3.1″ (79)	5.3″ (135)	2.6″ (67)	ø 2.4″ (60)	2.4″ (60.4)	0.95″ (24)	1.25 lb (570 g)
W120AB	1.45″ (37)	7.5″ (191.5)	4.6″ (116.5)	8.25″ (210)	2.6″ (67)	ø 4.7″ (120)	3.85″ (98)	1.3″ (33.5)	4.2 lb (1920 g)
W210AB	1.75″ (45)	12″ (304.5)	2.85″ (173)	12.7″ (323)	3.15″ (80)	ø 8.25″ (210)	6.1″ (154.5)	1.75″ (45)	12.8 lb (5800 g)

Screw mounting

Screw mounting with mounting brackets: W20AB, W35AB(P), W60AB(P)

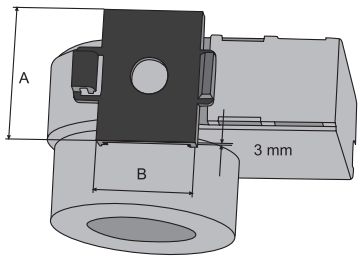


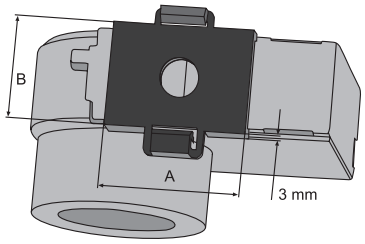
Screw mounting: W120AB, W210AB



Snap-on mounting

Snap-on mounting on DIN rail for vertical or horizontal mounting: W20AB, W35AB(P), W60AB(P)





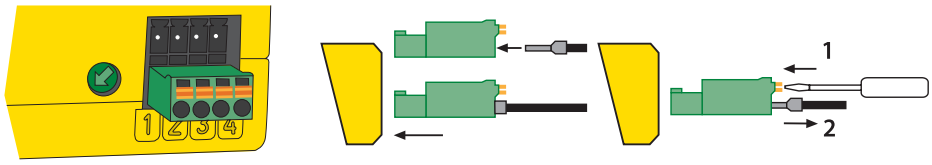
Dimensions (mm)				
Type	A	B	C	D
W35 (mounting with 2 mounting brackets diagonal)	49	31.4	65	18.6
W35AB(P) (mounting with 2 mounting brackets diagonal)	49	49.8	65	12.1
W60AB(P) (mounting with 3 mounting brackets diagonal)	56	66	72	17.7
W120AB (screw mounting)	81	103	90.6	65
W210AB (screw mounting)	98	180	117.1	83

Dimensions in mm

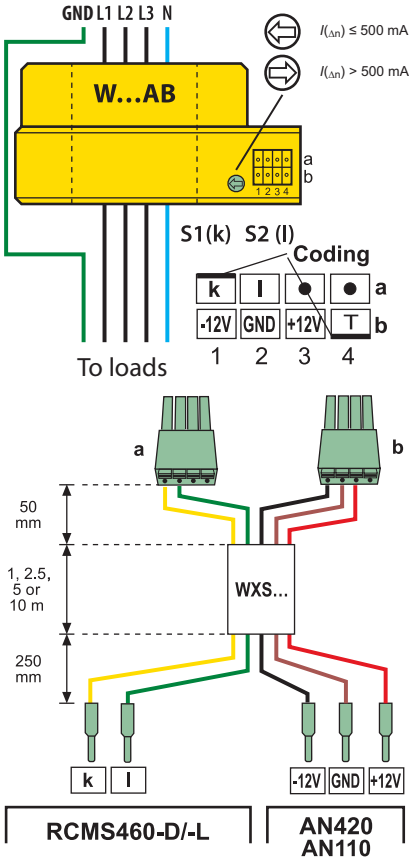
Tolerance for screw mounting with mounting brackets: ± 1.5 mm

Dimensions (mm)		
Type	A	B
W20AB	43.5	32
W35AB(P)	43.5	32
W60AB(P)	50	39

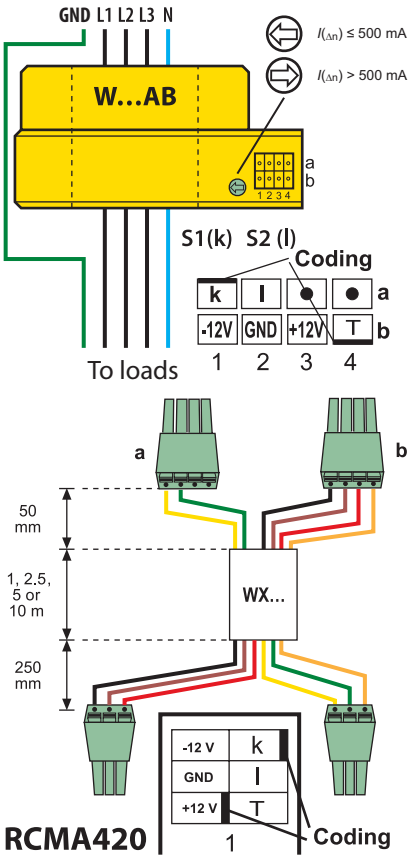
Connector usage



7



Wiring diagram to RCMS460 / 490 and AN420 power supply using WXS series cable



Wiring diagram to RCMA420 / 423 using WX series cable

7

WR Series

Rectangular AC current transformers for use with RCM, RCMS, and EDS series equipment

Current transformers WR70x175S(P)

Current transformers WR200x500S(P)

Applications and features

- RCM series ground fault monitors for grounded AC systems
- RCMS series multi-channel ground fault monitors for grounded AC systems
- EDS460 / EDS490 / EDS440 series ground fault location modules for AC/DC ungrounded systems
- Two-wire connection to monitor via screw terminals
- Screw mounted
- WR(SP) models feature additional shielding for use in busbar systems and large systems with known high inrush currents
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Approvals

Ordering information

Shielding / screening	Internal dimensions in inches (mm)	Type	Ordering No.
Standard	2.75″ x 6.9″ (70 x 175)	WR70x175S	B 911 738
	4.5″ x 12″ (115 x 305)	WR115x305S	B 911 739
	5.9″ x 13.8″ (150 x 350)	WR115x350S	B 911 740
	7.9″ x 19.7″ (200 x 500)	WR200x500S	B 911 763
Additional shielding / screening	2.75″ x 6.9″ (70 x 175)	WR70x175SP	B 911 790
	4.5″ x 12″ (115 x 305)	WR115x305SP	B 911 791
	5.9″ x 13.8″ (150 x 350)	WR150x350SP	B 911 792
	7.9″ x 19.7″ (200 x 500)	WR200x500SP	B 911 793

Approvals

Type	UL	GL
WR70x175S(P)	■	■
WR115x305S(P)	■	■
WR150x350S(P)	■	–
WR200x500S(P)	–	–

Technical data

Insulation coordination acc. to IEC 60044-1	
Highest system voltage for electrical equipment U_m	AC 720 V
Rated impulse withstand voltage U_{isol}	3 kV

Measuring circuit	
Rated transformation ratio	600/1
Rated burden	180 Ω
Rated primary current	≤ 10 A (100 A)
Rated primary current	≥ 10 mA
Nominal power	50 mVA
Rated frequency	50 - 400 Hz
Internal resistance	5 - 8 Ω
Secondary overvoltage protection	suppressor diode P6KE6V8CP
Accuracy class	5
Rated continuous thermal current	100 A
Rated short-time thermal current	14 kA/1 s
Rated dynamic current	35 kA/30 ms

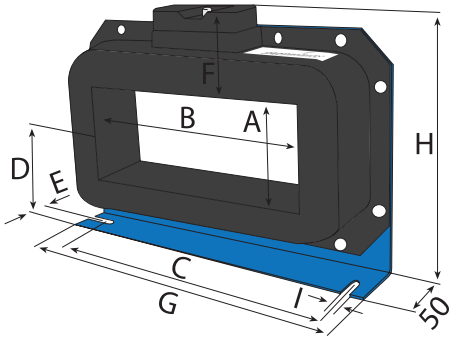
Environment	
Standard	IEC 60044-1
Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 s
Vibration resistance IEC 60068-2-6 (device in operation)	1 g/10 - 150 Hz
Vibration resistance IEC 60068-2-6 (transport)	2 g/10 - 150 Hz
Ambient temperature (during operation)	-10 - +50 °C
Ambient temperature (during storage)	-40 - +70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

Connection	
Connection	screw-type terminals
Connection	
rigid/flexible	0.2 - 4/0.2 - 2.5 mm²
flexible with ferrules with/without plastic sleeve	0.25 - 2.5 mm²
Conductor sizes (AWG)	24 - 12
Connection to monitor	
single wire ≥ AWG 18 (0.75 mm²)	0 - 1 m
single wire, twisted ≥ AWG 18 (0.75 mm²)	0 - 10 m
shielded cable ≥ AWG 19 (0.6 mm²)	0 - 40 m
Shielded cable (shield on one side connected to PE)	recommended: J-Y(St)Y min. 2 x 0.6

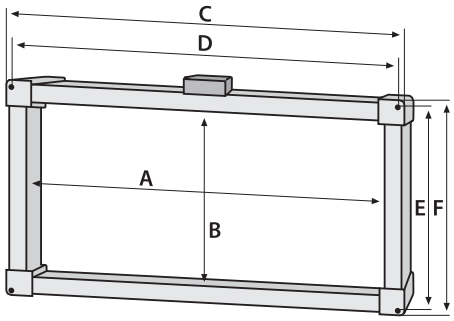
Other	
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Screw mounting	M5
Flammability class	UL94 V-0
Operating manual	TBP409004

Dimensions

WR70x175S(P) - WR150x350S(P)



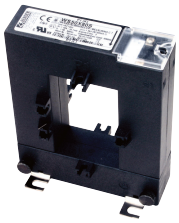
WR200x500S(P)



Type	Dimensions (mm)									Weight
	A	B	C	D	E	F	G	H	I	
WR70x175S(P)	2.75″ (70)	6.9″ (175)	8.9″ (225)	3.3″ (85)	0.87″ (22)	1.8″ (46)	10.2″ (261)	6.9″ (176)	0.3″ (7.5)	6.4 lb (2900 g)
WR115x305S(P)	4.5″ (115)	12″ (305)	14.2″ (360)	4.6″ (116)	1″ (25)	2.2″ (55)	15.8″ (402)	9.4″ (240)	0.3″ (8)	13.9 lb (6300 g)
WR150x350S(P)	5.9″ (150)	13.8″ (350)	16.3″ (415)	5.5″ (140)	1.1″ (28)	2.2″ (55)	17.3″ (460)	11.2″ (285)	0.3″ (8)	18.2 lb (8250 g)
WR200x500S(P)	19.7″ (500)	7.9″ (200)	23″ (585)	22.4″ (568.5)	10.5″ (268.5)	11.2″ (285)	–	–	–	20 lb (9000 g)

WS Series

Split-core AC current transformers for use with RCM, RCMS, and EDS series equipment



Measuring current transformer WS50x80S

Measuring current transformer WS80x160S

Applications and features

- RCM series ground fault monitors for grounded AC systems
- RCMS series multi-channel ground fault monitors for grounded AC systems
- EDS460 / EDS490 / EDS440 series ground fault location modules for AC/DC ungrounded systems
- Two-wire connection to monitor via screw terminals
- Screw mounted
- Split-core type current transformer for simple installation and retrofits
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Approvals

Ordering information

Internal dimensions in inches (mm)	Type	Ordering No.
2″ x 3.1″ (50 x 80)	WS50x80S	B 911 741
3.1″ x 3.1″ (80 x 80)	WS80x80S	B 911 742
3.1″ x 4.7″ (80 x 120)	WS80x120S	B 911 743
3.1″ x 6.3″ (80 x 160)	WS80x160S	B 911 755

Approvals

Type	UL	GL
WS50x80S	■	■
WS80x80S	■	■
WS80x120S	■	■
WS80x160S	–	–

Technical data

Insulation coordination acc. to IEC 60044-1	
Highest system voltage for electrical equipment U_m	AC 720 V
Rated impulse withstand voltage U_{isol}	3 kV

Measuring circuit	
Rated transformation ratio	600/1
Rated burden	180 Ω
Rated primary current	≤ 10 A (100 A)
Rated primary current	≥ 10 mA
Nominal power	50 mVA
Rated frequency	50 - 400 Hz
Internal resistance	5 - 8 Ω
Secondary overvoltage protection	with suppressor diode P6KE6V8CP
Accuracy class	5
Rated continuous thermal current	100 A
Rated short-time thermal current	14 kA/1 s
Rated dynamic current	35 kA/30 ms

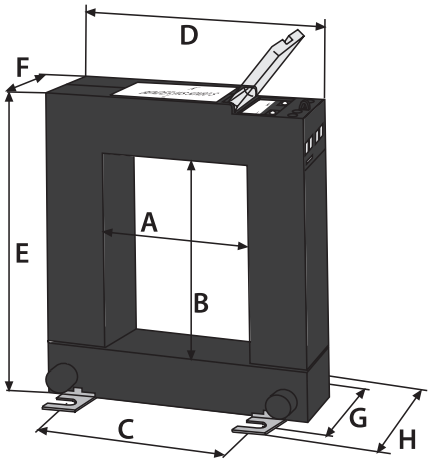
Environment	
Standard	IEC 60044-1
Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 s
Vibration resistance IEC 60068-2-6 (device in operation)	1 g/10 - 150 Hz
Vibration resistance IEC 60068-2-6 (transport)	2 g/10 - 150 Hz
Ambient temperature (during operation)	-10 - +50 °C
Storage temperature range	-40 - +70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

Connection	
Connection	screw-type terminals
Connection	
rigid/flexible	0.2 - 4/0.2 - 2.5 mm²
flexible with ferrules with/without plastic sleeve	0.25 - 2.5 mm²
Conductor sizes (AWG)	24 - 12
Connection to monitor	
single wire ≥ AWG 18 (0.75 mm²)	0 - 1 m
single wire, twisted ≥ AWG 18 (0.75 mm²)	0 - 10 m
shielded cable ≥ AWG 19 (0.6 mm²)	0 - 40 m
Shielded cable (shield on one side connected to PE)	recommended: J-Y(St)Y min. 2 x 0.6

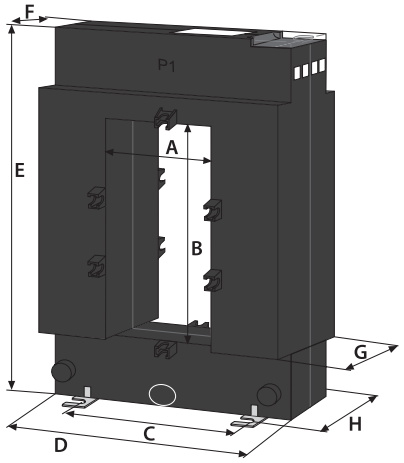
Other	
Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Screw mounting	M5
Flammability class	UL94 V-0
Operating manual	TBP409005

Dimensions

WS50x80S - WS80x120S



WS80x160S



Type	Dimensions (mm) A	B	C	D	E	F	G	H	Weight
WS50x80S	2″ (50)	3.1″ (80)	3.1″ (78)	4.5″ (114)	5.7″ (145)	1.25″ (32)	1.8″ (45)	2.3″ (59)	2 lb (900 g)
WS80x80S	3.1″ (80)	3.1″ (80)	4.25″ (108)	5.7″ (144)	5.7″ (145)	1.25″ (32)	1.8″ (45)	2.3″ (59)	2.3 lb (1050 g)
WS80x120S	3.1″ (80)	4.7″ (120)	4.25″ (108)	5.7″ (144)	7.3″ (185)	1.25″ (32)	1.8″ (45)	2.3″ (59)	2.75 lb (1250 g)
WS80x160S	3.1″ (80)	6.3″ (160)	4.7″ (120)	7.2″ (184)	8.9″ (225)	1.25″ (32)	2″ (52)	2.3″ (59)	5.6 lb (2550 g)

WF Series

Flexible AC current transformers for use with RCM and RCMS series equipment

Applications and features

- RCM420 series ground fault monitors for grounded AC systems
- RCMS series multi-channel ground fault monitors for grounded AC systems
- Flexible measuring current transformer in different lengths
- Space-saving design, quick installation
- Simple installation and retrofitting with opening cable, no conductor disconnection required
- Connection monitoring between CT and signal converter
- Additional analog output available for external measurement
- RCC420 signal converter provides simple connection between CT and monitor, DIN rail or screw mounted
- Visit bender.org/tools/ct/ to automatically select a current transformer for your applicable ground fault relay.

Ordering information

Cable straight length / circumference when connected	Supply voltage for RCC420 signal converter U_S[1]		Type	Ordering No.
	DC	AC		
6.7" (170 mm)	9.6 - 94 V	16 - 72 V (42 - 460 Hz)	WF170-1	B 9808 0201
	70 - 300 V	70 - 300 V (42 - 460 Hz)	WF170-2	B 9808 0202
9.8" (250 mm)	9.6 - 94 V	16 - 72 V (42 - 460 Hz)	WF250-1	B 9808 0203
	70 - 300 V	70 - 300 V (42 - 460 Hz)	WF250-2	B 9808 0204
19.7" (500 mm)	9.6 - 94 V	16 - 72 V (42 - 460 Hz)	WF500-1	B 9808 0205
	70 - 300 V	70 - 300 V (42 - 460 Hz)	WF500-2	B 9808 0206
31.5" (800 mm)	9.6 - 94 V	16 - 72 V (42 - 460 Hz)	WF800-1	B 9808 0207
	70 - 300 V	70 - 300 V (42 - 460 Hz)	WF800-2	B 9808 0208
47.2 "(1200 mm)	9.6 - 94 V	16 - 72 V (42 - 460 Hz)	WF1200-1	B 9808 0209
	70 - 300 V	70 - 300 V (42 - 460 Hz)	WF1200-2	B 9808 0210

[1] Absolute values

Models with push-wire terminals available on request.

Accessories

Description	Type	Ordering No.
Mounting clip for screw mounting (1 piece per device)	XM420 (RCC420)	B 9806 0008

Technical data

Electrical safety

Standard: RCC420	IEC 61010-2-030: 2004-05-01
Pollution degree	3
Rated insulation voltage	250 V
Standard: WF -	IEC 61010-1 and IEC 61010-2-032 CAT III
Pollution degree	2
Rated insulation voltage (CAT III)	1000 V_{rms} or DC

Supply voltage

Supply voltage U_S	see ordering information
Power consumption	≤ 3 VA

Measuring circuit

Measuring range	100 mA - 20 A
Rated transformation ratio	K_n (U - I): 100 mV/A, K_N (k - I): 1.67 mA/A
Rated burden (signal output k, l)	68 Ω
Rated frequency	42 - 2000 Hz
Rated continuous thermal current I_{cth}	1 kA
Rated short-time thermal current I_{th}	60 kA/1 s
Rated dynamic current I_{dyn}	150 kA/40 ms

Environment/EMC

EMC	IEC 62020
Operating temperature	- 25 - + 55 °C
Climatic class 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-time 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
Long-time storage (IEC 60721-3-1)	1M3

Connection (RCC420)

Connection type	screw terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm
Connection measuring current transformer W - F	PS/2 plug
Cable length WF -	2 m

Connection lengths (RCC420 to monitor)

Single wire ≥ 0.75 mm²	0 - 1 m
Single wire, twisted ≥ 0.75 mm²	0 - 10 m
Shielded cable ≥ 0.5 mm²	0 - 40 m
Shielded cable (shield to terminal l, not connected to earth)	recommended: J-Y(St)Y min. 2 x 0.8

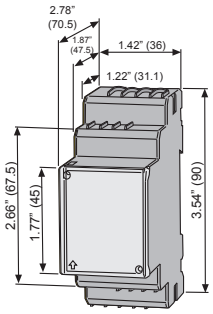
Other

Operating mode		continuous operation
Mounting		any position
Degree of protection, internal components (IEC 60529)		IP30
Degree of protection, terminals (IEC 60529)		IP30
Enclosure material RCC420		polycarbonate
Screw mounting		2 x M4 with mounting clip
DIN rail mounting acc. to		IEC 60715
Flammability class		UL94V-0
Operating manual		TBP409020
Weight	RCC 420 ≤ 160 g	WF500 ≤ 200 g
	WF170 ≤ 160 g	WF800 ≤ 230 g
	WF250 ≤ 180 g	WF1200 ≤ 310 g

Note: The measuring current transformer is adapted to the associated signal converter RCC420.

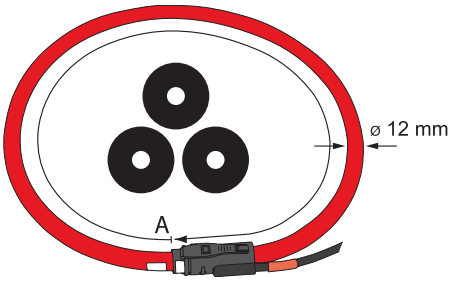
Dimensions in inches (mm)

RCC420



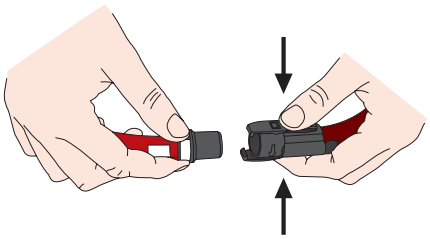
WF series current transformers

A = Circumference of opening / length of cable when not connected.
Refer to ordering information for length.

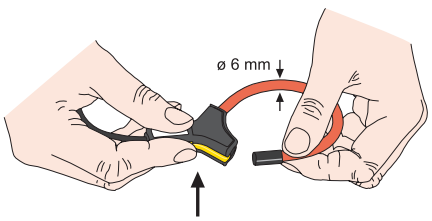


Locking mechanism

Locking connector measuring current transformer WF500 - WF1200
Keep the locking connector clean

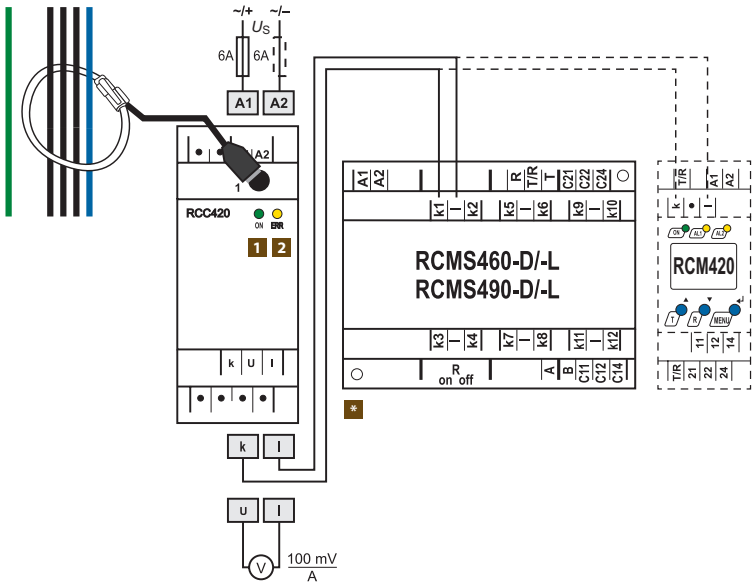


Locking connector WF170 - WF250



7

Wiring diagram



Connection to either RCMS460/490 multi-channel ground fault monitor or to RCM420 ground fault monitor

1 Power On LED "ON": Lights when RCC420 signal converter is powered.

2 Alarm LED "ERR": Lights when CT connection is interrupted

***** When using software version D233 V 2.21 or an earlier version, CT connection monitoring must be turned off.

When using software version D233 V 2.31 or higher, CT type must be set to "Flex" in menu options

STW3 / STW4

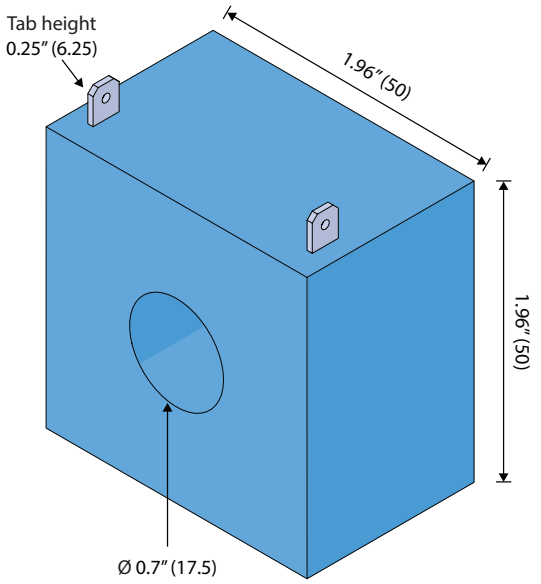
Load current monitoring current transformers for use with LIM2010

Features

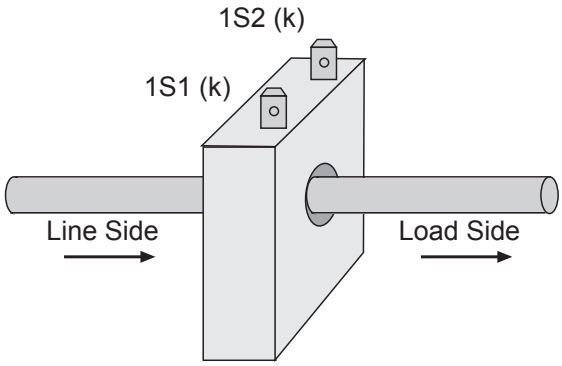
- For use with LIM2010 line isolation monitor for monitoring load current / transformer overload
- Monitors up to 100 A (STW3) or 200 A (STW4)
- Simple two-wire installation from CT connectors to LIM2010 connector plate

Approvals

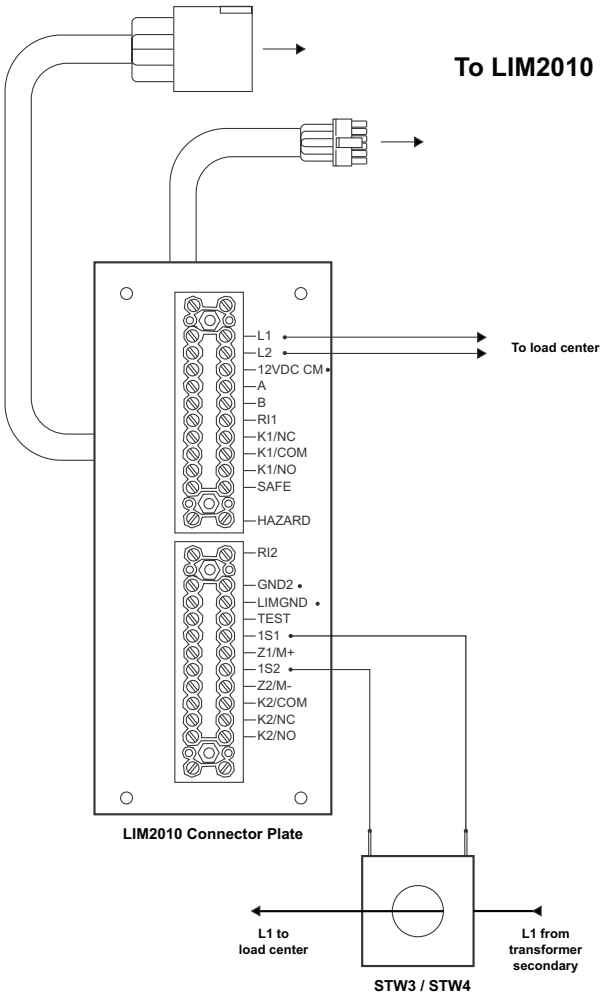
Dimensions in inches (mm)



Passing conductor through STW3 / STW4



Wiring diagram



7

Class 2 Power Supplies

Class 2 power supply units for 12 VDC and 24 VDC

Device features

- Class 2 power supplies with AC power input and DC power output to supply Bender equipment
- 100-240 VAC (50/60 Hz) input
- 12 VDC output version (0.83 A max) for supplying equipment such as clocks and timers
- 24 VDC version (0.42 A max) for supplying equipment such as MK800/MK2430 remotes and EDS151 modules
- Protected against idle running, overload and continuous short-circuits
- DIN rail strip included with order

Applications

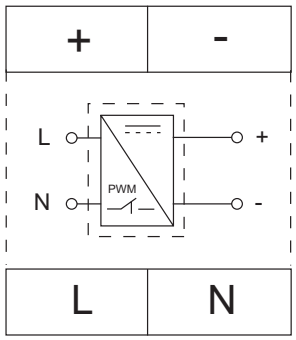
- Supply power to Bender devices requiring 12 VDC or 24 VDC (non bipolar)

Approvals

Ordering information

Rated input voltage U_{IN}	Rated output voltage	Type	Ordering No.
AC	DC		
100 - 240 V (50/60 Hz)	24 V	CP-D 24/0.42	P 1380 0049
	12 V	CP-D 12/0.83	P 1380 0050

Wiring diagram



L, N: input voltage
+, -: output voltage

AN420

Power supply unit for WAB series current transformers

Applications

- Power supply for WAB series current transformers when used with RCMS series ground fault monitor
- DIN rail mounted or screw mounted (with additional clip)

Approvals

c UL us LISTED

AE25

Ordering information

Supply voltage [1] U_S	Output voltage / current rating	Type	Ordering No.
DC/AC	DC		
9.6 - 94 VDC, 16 - 72 VAC (50/60 Hz)	± 12 V/400 mA	AN420-1	B 9405 3099
70 - 276 V (42 - 460 Hz)	± 12 V/400 mA	AN420-2	B 9405 3100

Models with push-to-open terminals available on request.

[1] Absolute values

Accessories

Description	Art. No.
Mounting clip for screw mounting (1 piece per device)	B 9806 0008

Applicable current transformers and connector cables

Description	Type	Page
Measuring current transformers	WAB series	243
Connector cables for current transformer + RCMS	WXS-100	243
	WXS-250	243
	WXS-500	243
	WXS-1000	243

Technical data

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

AN420-1:

Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	2.5 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (+ 12 V, GND, - 12 V)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	AC 16 - 72 V/DC 9.6 - 94 V
Frequency rangeU_S	DC, AC 42 - 66 Hz
Power consumption	≤ 30 VA

AN420-2:

Rated insulation voltage	AC 250 V
Rated impulse voltage/pollution degree	4 kV/3
Protective separation (reinforced insulation) between	(A1, A2) - (+ 12 V, GND, - 12 V)
Voltage test acc. to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage U_S	AC/DC 70 - 276 V
Frequency range U_S	DC, AC 42 - 460 Hz
Power consumption	≤ 30 VA

Output power supply unit

Output voltage U_{out}	DC ± 12 V, short-circuit proof
Operating range	11.9. - 12.1 V
Rated output	9 W

Cable length

Recommended cable	WXS100 - WXS1000 (see ordering information)

Environment/EMC

EMC	IEC61204-3
Operating temperature	-25 - +55 °C
Climatic class 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-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)
Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

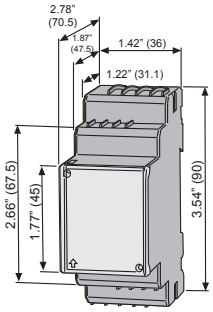
Connection

Connection type	screwless-type terminals
Connection properties	
rigid	0.2 - 2.5 mm² (AWG 24 - 14)
flexible without ferrule	0.2 - 2.5 mm² (AWG 24 - 14)
flexible with ferrule	0.2 - 1.5 mm² (AWG 24 - 16)
Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

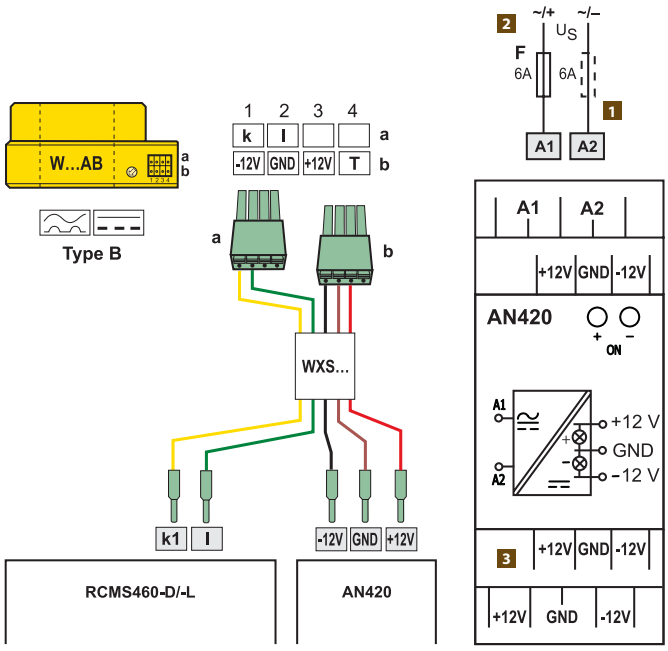
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP30
Enclosure material	polycarbonate
Screw mounting	2 x M4 with mounting clip
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating Manual	BP409017
Weight	≤ 140 g

Dimensions in inches (mm)



Wiring diagram



1 Supply voltage U_S

2 Short-circuit protection for U_S, 6 A fuse recommended

3 Bipolar output voltage

7

AGH150W-4

DC voltage coupler for BENDER ground fault detectors up to 1760 VDC

Applications

- Extends DC voltage range of IRDH275 / IRDH375 / iso685 series ground detectors to 1760 VDC

Approvals

c UL us LISTED

PCT AE25

Lloyd's Register TYPE APPROVED

Ordering information

Nominal system voltage U_S		Type	Ordering No.
DC	AC		
0 - 1760 V	0 - 1150 V	AGH150W-4	B 9801 8006

Technical data

Insulation coordination acc. to DIN EN 61800-5-1 (VDE 0160-105-1)

Rated insulation voltage	AC 1600 V

Voltage test acc. to DIN EN 61800-5-1 (VDE 0160-105-1)

Voltage impulse test (basic insulation)	≥ AC 11 kV
AC voltage test (basic insulation	≥ AC 6.6 kV

Voltage ranges

Nominal system voltage U_n	AC 0 - 1150 V, DC 0 - 1760 V
Overvoltage category/rated impulse voltage	CAT III/≥11 kV
Internal DC resistance R_i	≥160 kΩ

Environment

Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 ms
Vibration resistance IEC 60068-2-6 (device in operation)	1 g/10 - 150 Hz
Vibration resistance IEC 60068-2-6 (transport)	2 g/10 - 150 Hz
Ambient temperature (during operation)	-10 - +55 °C
Ambient temperature (during storage)	-40 - +70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

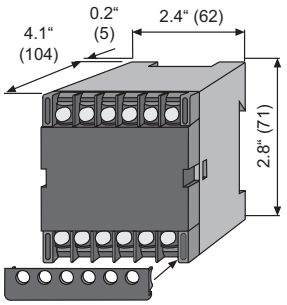
Connection

Connection	flat terminals
Connection properties rigid/flexible	0.2 - 4/0.2 - 2.5 mm²

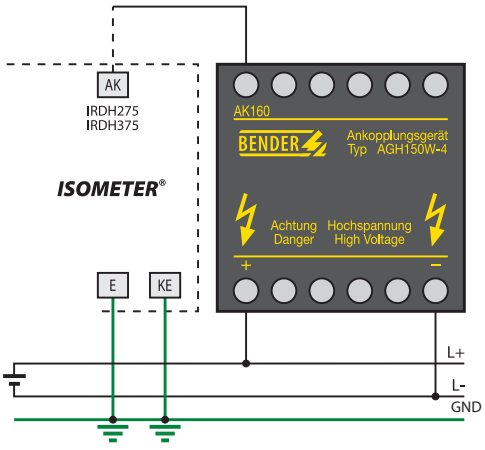
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529)	IP20
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94 V-0
Operating manual	BP109001
Weight	≤ 900 g

Dimensions in inches (mm)



Wiring diagram



AGH204S-4

AC voltage coupler for BENDER ground fault detectors up to 1600 VAC

Applications

- Extends AC voltage range of IR470LY / IRDH275 / IRDH375 / iso685 series ground detectors to 1300 VAC (systems with rectifiers) or 1650 VAC (systems without rectifiers), single-phase or three-phase

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Nominal system voltage U_S AC	Type	Ordering No.
0 - 1650 VAC (w/o rectifiers) /0 - 1300 V (with rectifiers)	**AGH204S-4**	**B 914 013**

Technical data

Insulation coordination acc. to DIN EN 61800-5-1 (VDE 0160-105-1)

Rated insulation voltage	AC 1500 V

Voltage test acc. to DIN EN 61800-5-1 (VDE 0160-105-1)

Impulse voltage test (basic insulation)	≥ AC 10.4 kV
AC voltage test (basic insulation)	≥ AC 5 kV
Partial discharge test	≥ 3 kV

Voltage ranges

Nominal system voltage U_n (including DC components)	0 - 1300 V
Nominal system voltage U_n (AC only)	0 - 1650 V
Nominal frequency f_n	50 - 400 Hz
Overvoltage category/rated impluse voltage	III/≥10.4 kV

Internal DC resistance R_i

Coupling to AK80	80 kΩ
Coupling to AK160	160 kΩ

Environment

Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 ms
Vibration resistance IEC 60068-2-6 (device in operation)	1 g/10 - 150 Hz
Vibration resistance IEC 60068-2-6 (transport)	2 g/10 - 150 Hz
Ambient temperature (during operation)	-10 - +55 °C
Ambient temperature (during storage)	-40 - +70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K5

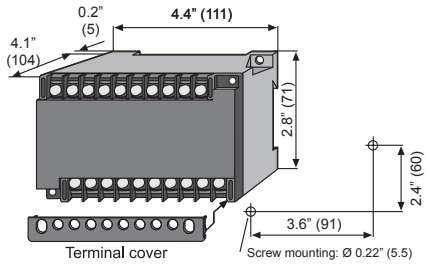
Connection

Connection	screw-type terminals
Connection properties rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²
Tightening torque	0.5 Nm
Conductor sizes (AWG)	24 - 12
Length of the connecting lead between the ISOMETER® and AGH	≤0.5 m

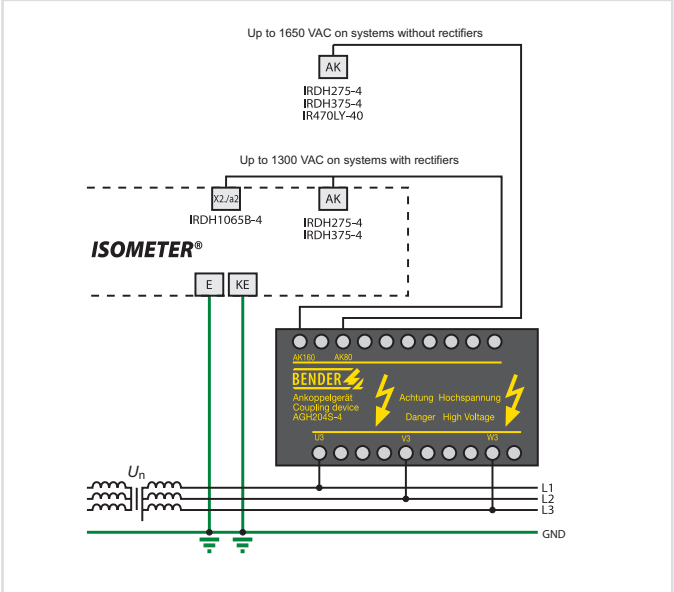
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529)	IP20
Type of enclosure	X112, free from halogen
Screw mounting	2 x M4
DIN rail mounting	DIN EN 60715/IEC 60715
Flammability class	UL94 V-HB
Weight	≤ 1350 g

Dimensions in inches (mm)



Wiring diagram



AGH520S

Three-phase AC voltage coupler for BENDER ground fault detectors up to 7200 VAC

Applications

• Extends AC voltage range to 7200 VAC (three-phase)for IR470LY, IRDH275 / 375, and iso685 series ground fault detectors

Approvals

c UL us LISTED

AE25

Lloyd's Register TYPE APPROVED

Ordering information

Nominal system voltage U_S	Type	Ordering No.
Three-phase AC		
0 - 7200 V	AGH520S	B 913 033

Technical data

Insulation coordination acc. to DIN EN 61800-5-1

Rated insulation voltage	AC 6.3 k V

Voltage test acc. to DIN EN 61800-5-1

Voltage impulse test (basic insulation)	35 kV
AC voltage test (basic insulation)	AC 17.5 kV
Partial discharge test	≥ 12 kV

Voltage ranges

Nominal system voltage U_n	AC, 3(N)AC 0 - 7.2 kV
Nominal frequency f_n	50 - 400 Hz
Internal DC resistance R_i	≥ 80 kΩ
Impedance Z_i at 7.2 kV and 50 Hz	≥ 6 MΩ

Environment

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
Ambient temperature (during operation)	-10 - +55 °C
Ambient temperature (during storage)	-20 - +70 °C
Climatic class acc. to IEC 60721-3-3	3K5

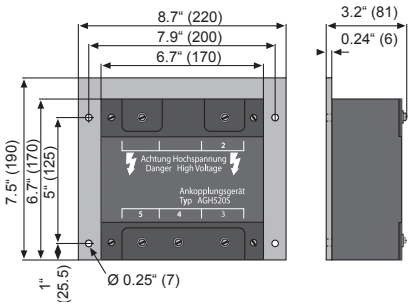
Connection

Connection terminal 2 (medium voltage)	screw-type terminal
Connection terminals 3, 4, 5	screw-type terminals
Connection properties rigid/flexible	0.2 - 4 mm²/0.2 - 2.5 mm²

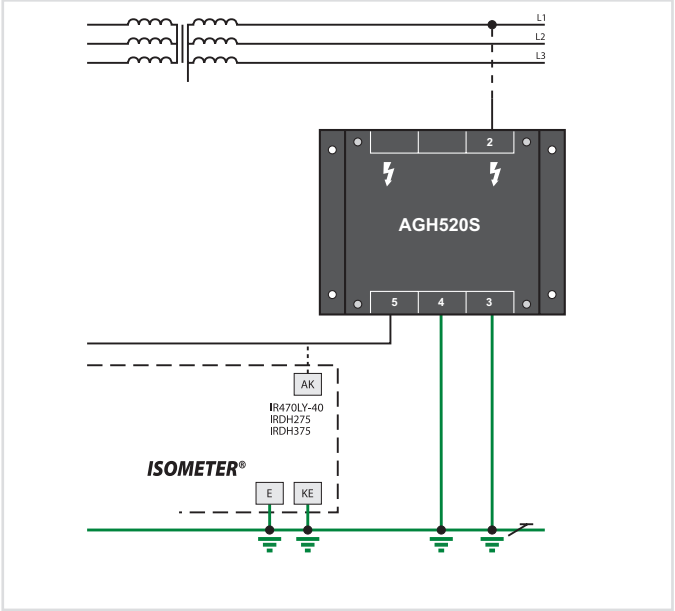
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP64
Degree of protection, terminals (DIN EN 60529)	IP20
Type of enclosure	resin-encapsulated block
Screw mounting	4 x M5
Flammability class	UL94 V-HB
Weight	≤ 4500 g

Dimensions in inches (mm)



Wiring diagram



7

AGH676S-4

Three-phase AC voltage coupler for BENDER ground fault detectors up to 12 kV AC

Applications

- Extends AC voltage range of IRDH275 / IRDH375 / iso685 series ground detectors to 12 kV AC (three-phase)

Approvals

c UL us LISTED

Ordering information

Nominal system voltage U_S	Type	Ordering No.
Three-phase AC		
0 - 12 kV	AGH676S-4	B 913 055

Technical data

Insulation coordination acc. to IEC 61800-5-1

Rated insulation voltage	AC 12 kV

Voltage test acc. to IEC 61800-5-1

Type test

Voltage impulse test	≥ AC 75 kV
AC voltage test	≥ AC 45 kV
Partial discharge test	≥ 16.5 kVeff

Routine test

AC voltage test, rate of increase < 2 kV/s	AC 25 kV

Voltage ranges

Nominal system voltage Un	AC / 3(N)AC 0...12 kV
Nominal frequency fn	50...460 Hz
Internal DC resistance Ri	≥ 160 kΩ
Impedance Zi at 12 kV and 50 Hz	≥ 12 MΩ

Environmental conditions

Shock resistance IEC 60068-2-27 (during operation)	15 g/11 ms
Bumping IEC 60068-2-29 (during transport)	40 g/6 ms
Vibration resistance IEC 60068-2-6 (during operation)	1 g / 10…150 Hz
Vibration resistance IEC 60068-2-6 (during transport)	2 g / 10…150 Hz
Ambient temperature, during operation	-10…+55 °C
Storage temperature range	-40…+70 °C
Climatic class acc. to IEC 60721-3-3	3K5

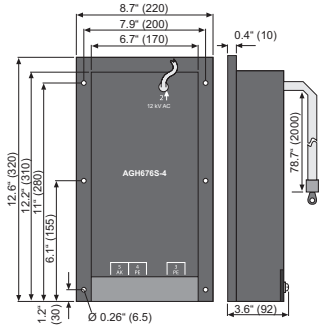
Connection

Connection medium voltage	high-voltage cable (encapsulated on the device side)
Connection, flexible with ring terminal	M8
Connection terminals 3, 4, 5	screw terminals
Connection properties rigid/flexible	0.2…4 mm²/0.2…2.5 mm²

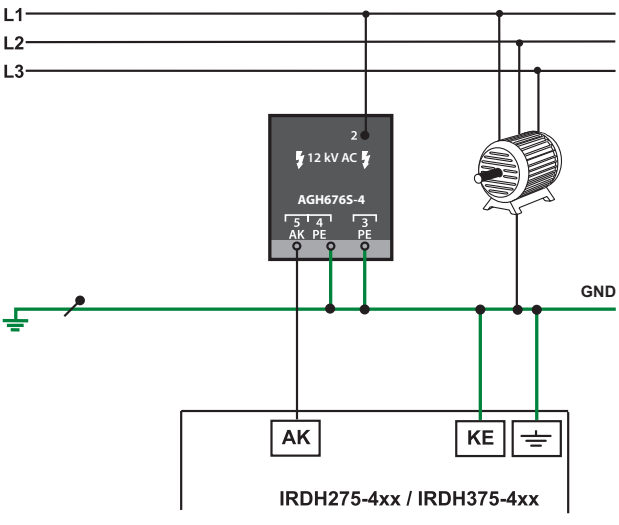
Other

Operating mode	continuous operation
Position	any position
Degree of protection, internal components (DIN EN 60529)	IP64
Degree of protection, terminals (DIN EN 60529)	IP20
Type of enclosure	resin-encapsulated block
Screw fixing	M5
Flammability class	UL94 V-0
Documentation number	D00096
Weight	≤ 8400 g

Dimensions in inches (mm)



Wiring diagram



Annex

Standards and code reference guide

Index of products

Related Standards, Code, and Requirements - Reference Guide

General Purpose

Name	Description	Recommended Products	Notes	Refer To
NEC 250.21(B): USA **CEC 10-106(2): Canada** **NOM-001-SEDE-2012 250-21(b): Mexico**	Ground fault detection for ungrounded AC systems	IR420 / IR425 Series	For systems less than 300 VAC	1-17
		iso685 Series	Main distribution networks & VFDs	1-06
		isoLR275 Series	Large systems / high leakage capacitance	1-23
NEC 250.167(A): USA	Ground fault detection for ungrounded DC systems	IR425 Series	For systems less than 300 V	1-20
		iso685 Series	Main DC distribution	1-06
NEC 250.167(B): USA	Ground fault detection for grounded DC systems	RCMA420 / RCMA423 Series	General grounded DC power	4-11
		RCMS Series	Multi-channel DC protection	4-17
NEC 427.22: USA **CEC 18-120(2): Canada** **NOM-001-SEDE-2012 427-22: Mexico**	Ground fault protection for electrical heat tracing systems	RCM420 Series	Single channel monitoring	4-06
		RCMS Series	Multi-channel monitoring	4-17
		LifeGuard Series	Detection and interruption panel	4-29
Requirements where ground fault circuit interrupters (GFCI) are required	Use of ground fault circuit interrupters (GFCI) in various applications	LifeGuard Series	Many options available	4-29
UL 943	Ground fault circuit interrupters (GFCI)	LifeGuard Series	Many options available	4-29

Solar / Photovoltaic

Name	Description	Recommended Products	Notes	Refer To
NEC 690.5(A): USA **CEC 64-018(1)(e): Canada** **NOM-001-SEDE-2012 690-5(a): Mexico**	Ground fault protection for ungrounded solar arrays	isoPV425 Series	Ungrounded arrays less than 100 kW	1-35
		isoPV Series	All size ungrounded solar arrays	1-27
NEC 690.35(C): USA **NOM-001-SEDE-2012 690-35(c): Mexico**	Ground fault protection for grounded solar arrays	RCMA420 / RCMA423 Series	Single channel monitoring	4-11
		RCMB20-500 / RCMB35-500 Series	Combiner box monitoring	4-26
		RCMS Series	Master combiner box monitoring	4-17
NEC 690.5(A)(1) and NEC 690.35(C)(1): USA	Array isolation testing prior to startup for grounded and ungrounded arrays	isoPV Series	Works for both grounded and ungrounded arrays for startup isolation testing	1-27
UL 1741	Inverters for use in solar applications	RCMA278P-S	For inverters 10 kW or less	--
		RCMA420 / RCMA423 Series	For inverters greater than 10 kW	4-11

Hospitals and Healthcare Facilities

Name	Description	Recommended Products	Notes	Refer To
NEC 517.160: USA **CEC 24-200: Canada** **NOM-001-SEDE-2012 517-160: Mexico**	Installation and monitoring requirements for isolated power systems in healthcare facilities	Isolated Power Panels LIM2010	Complete solutions for isolated power systems available	2-06
NFPA 99: USA **CSA Z32: Canada**	Requirements for use of isolated power systems in healthcare facilities	Isolated Power Systems Equipment	Complete solutions for isolated power systems available	2-06
UL 1022	Standard for line isolation monitors (LIM) in healthcare facilities	LIM2010	--	2-19
UL 1047	Standard for isolated power panels in healthcare facilities	Isolated Power Panels	--	2-06

Electric Vehicle Charging Stations

Name	Description	Recommended Products	Notes	Refer To
UL 2231-2	Protection devices used in electric vehicle charging systems (EVSE)	RCMB101	Level 2 EV chargers	--
		IR155-10 Series	Level 3 EV chargers	1-50

Marinas and Shore Power

Name	Description	Recommended Products	Notes	Refer To
NEC 555.3: USA **NOM-001-SEDE-2012 555-3: Mexico**	Ground fault protection for marina shore power	MarinaGuard Series	--	4-34

Common national code and standards bodies include, but are not limited to the following:

- National Fire Protection Association (NFPA): Standards and requirements body in the United States
- Canadian Standards Association (CSA): Standards and requirements body body in Canada
- National Electrical Code (NEC, NFPA 70): Electrical installation code for the United States (2017 most recent as of print)
- Canadian Electrical Code (CEC, C22.1-12): Electrical installation code for Canada (2012 most recent as of print)
- Mexico Electrical Installation Code (NOM-001-SEDE-2012): Electrical installation code for Mexico (2012 most recent as of print)
- Underwriters Laboratories (UL, cUL): Standards body for products for the United States and Canada

Alphabetical Index of Products

	Type	Description	Page
RC	RC48C	AC GROUND FAULT + CONTINUITY	4-37
	RC48N	AC GROUND FAULT + NGR MONITOR	4-40
RCM	RCM420	AC GROUND FAULT MONITOR	4-06
	RCM475LY		4-09
RCMA	RCMA420	AC/DC GROUND FAULT MONITOR	4-11
	RCMA423		4-14
RCMB	RCMB20-500	GROUND FAULT MODULE	4-26
	RCMB35-500		4-26
RCMS	RCMS150	MULTI-CHANNEL GF MONITOR	4-23
	RCMS460		4-17
	RCMS490		4-17
VMD	VMD258	THREE-PHASE VOLTAGE RELAY	5-18
	VMD420		5-12
	VMD421H		5-15

	Type	Description	Page
VME	VME420	SINGLE-PHASE VOLTAGE RELAY	5-06
	VME421H		5-09
W	W0-S20 - W5-S210	CURRENT TRANSFORMERS	7-04
	W AND W-8000 SERIES		7-06
	WAB SERIES		7-09
	WF SERIES		7-17
	WR SERIES		7-13
	WS SERIES		7-15
XM	XM SERIES	ISOLATION TRANSFORMERS	2-24
XRM	XRM SERIES	X-RAY / LASER RECEPTACLE MODULES	2-31
ZT	ZT1590	CLOCKS AND TIMERS	2-33
	ZT1590RS		2-33
	ZT1591		2-35
	ZT1591RS		2-35
	ZT1594RS		2-37

BENDER
The Power in Electrical Safety™

USA and Central America
Exton, PA • 800-356-4266 / 610-383-9200
info@bender.org • www.bender.org

Canada • Mississauga, ON • 800-243-2438 / 905-602-9990
info@bender-ca.com • www.bender-ca.com

Mexico • Neza Edo de Mexico • +55 4955 1198
info@bender.com.mx • www.bender.com.mx

South America • Santiago de Chile • +56 2 2933 4211
info@bender-latinamerica.com • www.bender-latinamerica.com

Your local contact: