

LIM2010

Line Isolation Monitor (LIM)



Line Isolation Monitor

LIM2010



Device features

- No interference with electrical equipment
- Special phase-locking circuitry for ultimate stability and repeatability
- 2 programmable voltage-free SPDT contacts for external alarms
- Provision for remote indicators
- Easy to clean rugged front foil
- Digital and analog bar graph displays
- Automatic self-calibration and self-check
- Audible alarm volume adjustable via menu
- Transformer load monitoring (optional)
- Transformer overtemperature monitoring (optional)
- RS-485/BMS communication port
- Provision to control several line isolation monitors via one intelligent remote
- Additional communication devices available:
 - Web browser based
 - E-mail and SMS
- Controls optional ground fault location system

Product Description

The LIM2010 Line Isolation Monitor (LIM) measures the Total Hazard Current (THC) in an isolated (ungrounded) AC system. The Total Hazard Current is calculated by measuring the system's leakage impedance to ground. Alarm indication is displayed on a seven-segment display, LED bar graph, and digital display.

The LIM2010 operates on systems from 100 to 240 V, 50 or 60 Hz. No auxiliary supply voltage is required.

Two separate ground connections are provided for ground connection monitoring. A break in either of these connections will activate the connection alarm.

The LIM2010 features many different alarms, including:

- Total Hazard Current (THC)
- Transformer overload
- Transformer overtemperature
- Overvoltage and undervoltage
- Ground connection
- Isolation resistance and impedance
- Ground fault location (when used with BENDER EDS location system)

The LIM2010 is ideal for retrofit applications regardless of the make or type of the existing product. No metal needs to be cut and simple instructions will generally facilitate a change-over in less than one hour.

Operational Information

Generally, the impedance between each isolated conductor and ground is different, resulting in a different current flowing through a person making physical contact between any one of the isolated conductors and ground. The LIM calculates and displays the true maximum value of the Total Hazard Current (THC). The BENDER LIM performs this function using a patented measurement technique.

The THC is shown on the seven-segment display and the LED bar graph. In the normal condition, the green "SAFE" LED is illuminated, the display shows a low leakage value (green) and the bar graph is in the non-alarm, or normal, green zone. THC levels will increase as additional loads are connected to the system, and/or when a line-to-ground fault has suddenly occurred or is slowly developing. A visual and audible alarm is generated when the THC exceeds the LIM setting of either 2 mA or 5 mA (red). Two programmable relay output contacts are available, which can be wired into a circuit to trigger an external alarm.

The red "HAZARD" LED remains illuminated for the duration of the alarm condition. The audible alarm may be silenced by pushing the "MUTE" button at the discretion of personnel. When the "MUTE" button is activated, the built-in amber LED in the "MUTE" button is illuminated to indicate a muted condition. After the fault is removed, the LIM will automatically reset to the normal condition.

THC	THC display	Text display	SAFE LED	HAZARD LED	Buzzer
< 2 (5) mA	value (green)	SAFE	ON	OFF	OFF
≥ 2 (5) mA	value (red)	HAZARD	OFF	flashing	ON
> 9.9 mA	EF (red)	HAZARD	OFF	flashing	ON

The audible alarm volume level is adjustable via the configuration menu.

Activate the test button to check the LIM operation. This test does not add to the hazard current of a system in use, nor does the test include the effect of the line-to-ground stray impedance of the system.

The LIM has provisions to connect one or more remote indicators, with or without a digital meter. The remote indicators duplicate the audible and visible alarm signals of the LIM.

Communication

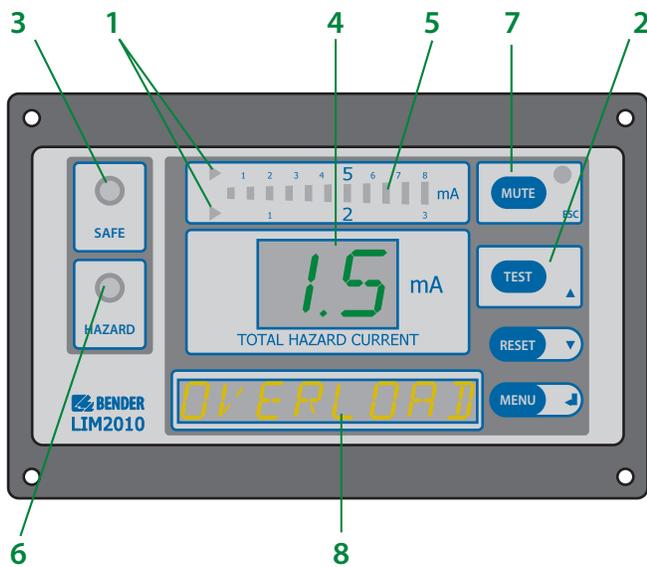
The BMS communication interface enables the LIM2010 to work with several intelligent remote control panels. Bender provides a variety of BMS bus devices to set up large, sophisticated systems. The LIM2010's BMS bus may also control the EDS series ground fault location devices. EDS series devices reduce time and cost in locating isolation faults.

BENDER BMS bus gateway modules provide connectivity to standard information protocols, including Ethernet, MODBUS, and SCADA systems.

Standards

The BENDER LIM2010 Series LIM complies with UL 1022 and CSA-C22.2 No. 204-M1984. The intent is to include the LIM as part of an isolated power system that conforms with the applicable requirements of ANSI/NFPA 99, ANSI/NFPA 70, and CAN/CSA-C22.2 No. 29-M1989.

Display and Operating Elements



- 1 - THC Set Point LED Markers (amber) – 5 mA or 2 mA
- 2 - “TEST” Button – Checks functions of the LIM
- 3 - “SAFE” LED (green) – Lit unless LIM is in alarm mode
- 4 - Digital Display – Displays THC in mA
- 5 - Analog LED Bar Graph – Displays THC in mA
- 6 - “HAZARD” LED (red) – Dark unless THC > Set Point
- 7 - “MUTE” Button w/built-in LED (amber) – Silences alarm buzzer
- 8 - Digital text display for status and menu options

Ordering Information

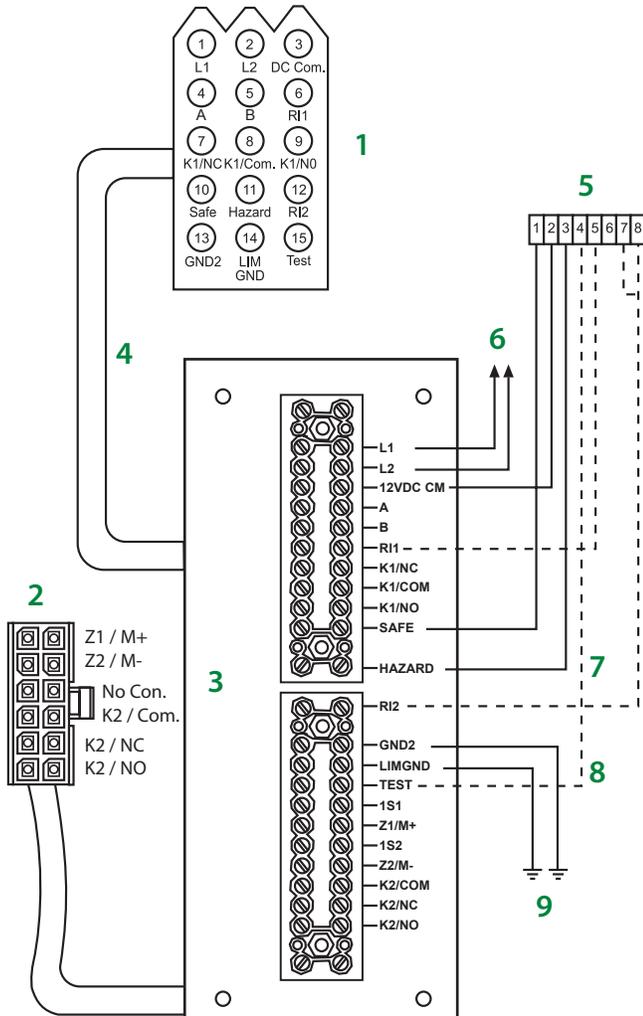
Line Isolation Monitor			
Product Type	Description	Approval	Article No.
LIM2010	100 – 240 V / 1-Phase	c us	B 9207 5021

Remote Indicators			
Product Type	Description	Approval	Article No.
MK2000-G1	Mute	c us	B 5213 00002
MK2000P-G1	Mute + Test	c us	B 5213 00188
MK2000C-G1	Mute + Overload	c us	B 5213 00020
MK2000CP-G1	Mute + Test + Overload	c us	B 5213 00021
MK2430	Digital Remote Station	c us	*
MK800	Digital Remote Station	c us	*

* Multiple versions of these devices are available. See the respective technical bulletins for more information.

Connector Plate			
Product Type	Description	Approval	Article No.
CP-LIM2010	LIM and remote connections	c us	B 5111 00001

Current Transformer (CT)			
Product Type	Description	Approval	Article No.
STW3	Up to 100 A load current	c us	B 9802 1000
STW4	Over 100 A load current	c us	B 9802 1001
SWL-100A	Up to 100 A load current (split core)	c us	B 9802 1002

Wiring diagram: Standard wiring for connector plate

1 - Connector, to LIM2010 (Viewed from mating end)

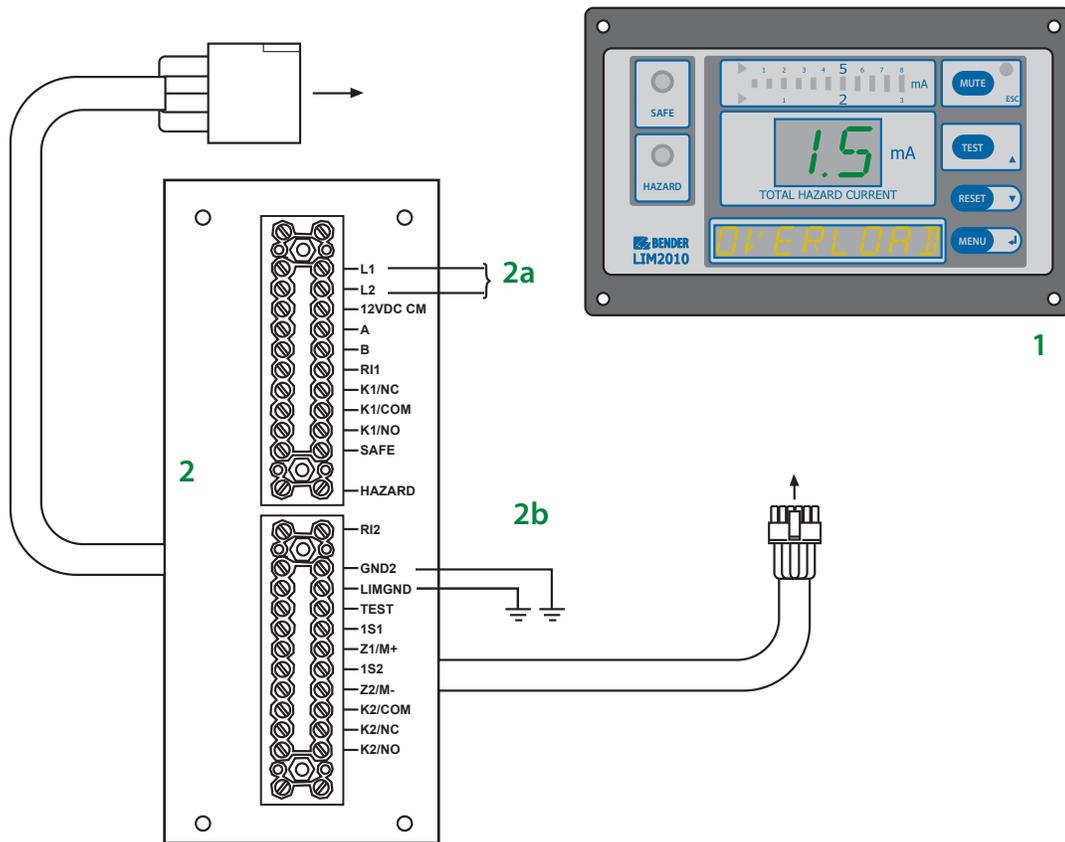
L1, L2	To secondary of isolation transformer
12 V DC Com.	Common connection
A, B	RS-485 (BMS) communication interface
RI1	Test button source
K1/NC	Alarm relay K1, N/C
K1/Common	Alarm relay K1, common
K1/NO	Alarm relay K1, N/O
Safe	"Safe" light connection for external remote indicator
Hazard	"Hazard" light connection for external remote indicator
RI2	Local and system muting from LIM and remote indicator
GND2, LIM GND	Separate ground connections
Test	Connection for remote test

2 - Connector, to LIM2010

Z1/M+, Z2/M-	Connection for overtemperature sensor or external analog meter
K2/Common	Alarm relay K2, common
K2/NC	Alarm relay K2, N/C
K2/NO	Alarm relay K2, N/O

3 - Connector Plate CP-LIM2010
4 - Wiring Harness
5 - MK2000 LIM Remote Indicator Terminals
6 - To L1 and L2 of isolated power system
7 - Connection for optional system muting
8 - Connection for optional remote test
9 - Separate connections to ground

Wiring diagram



- 1 - LIM2010
- 2 - Connector plate CP-LIM2010
 - 2a - Isolated power system connections
 - 2b - Panel ground or ground bus

Technical Data: LIM2010**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 k Ω (off)*
Response tolerance	± 15%
Hysteresis	25%
Response value R	20...200 k Ω (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 $Z_f = 0 \Omega$)	< 32 μ A
Internal resistance	≥ 1.5 M Ω
Monitor hazard current MHC, 120 V / 240 V	60 μ A / 95 μ A
When EDS mode is active:	
Monitor Hazard Current MHC	< 950 μ A
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 k Ω
Release value	1.6 k Ω
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 M Ω
Operating uncertainty, insulation impedance	± 5%, ± 1 k Ω
Measured value, insulation resistance R	2 k Ω ...1 M Ω
Operating uncertainty, Z ~ R	± 20%, ± 1 k Ω
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 k Ω
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 μ A
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
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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
Weight	≤ 1.2 lb

Technical Data: Connector Plates
LIM2010 Connector Plate – CP-LIM2010

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

Technical Data: MK2000-G1 / MK2000-G2 / MK2000P-G1 / MK2000C-G1 / MK2000CP-G1 / MK2000CBM

Operating voltage	12V DC or 12V AC
Max. current	50 mA
(MK2000CBM)	100 mA)
Operation class	continuous operation
Ambient temperature	
when operating	+32° F to +122° F 0° C to +50°
when stored	-13° F to +158° F -25° C to +70° C
Connection	screw terminal block
Conductor size	AWG 30...12
Tightening torque	5...7 lb In.
Mounting	by screws
Weight	
MK2000-G1 / MK2000P-G1 / MK2000C-G1 / MK2000CP-G1	0.25 lb
MK2000-G2 / MK2000CBM	0.32 lb

Technical Data: STW3, STW4, STW-100A
Insulation coordination according to IEC 60664-1:

Rated voltage U_m	AC 720 V / AC 720 V / AC 600 V
Rated impulse voltage U_{isol}	4 kV / 4 kV / 2.2 kV

Measuring circuit

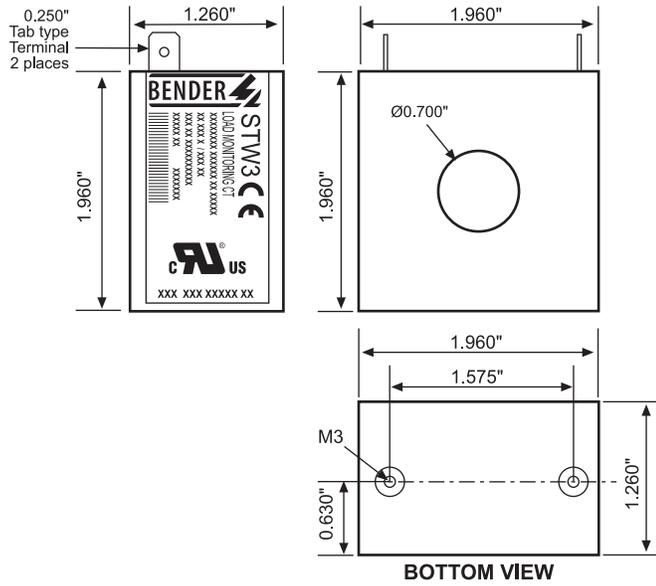
Max. rated primary current	100 A / 200 A / 100 A
Min. rated primary current	1 A / 2 A / 0.1 A
Nominal frequency	50...400 Hz

General data

Ambient temperature, during operation	+32° F to +122° F 0° C to +50° C
Operating mode	continuous operation
Position	any position
Connection	Faston plug 6.3 x 0.8 mm / screw terminals
Type of connection to the measuring current transformer	
Single wires \geq AWG 18	up to 3 ft
Single wires, twisted \geq AWG 18	up to 30 ft
Screened cable \geq AWG 20 (single-ended connection to ground) e.g. J-Y(St)Y 2 x 0.8	up to 130 ft
Mounting	Screw Mounting M3 / zip ties
Flammability class	UL94V-0

Dimensions: Load Monitoring CT STW3/STW4

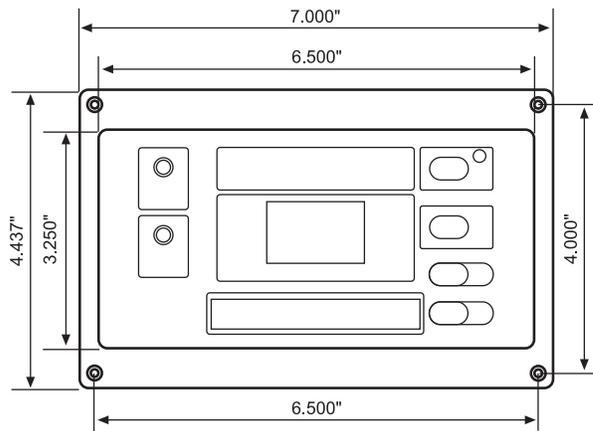
(Dimensions in inches)



Dimensions: LIM2010

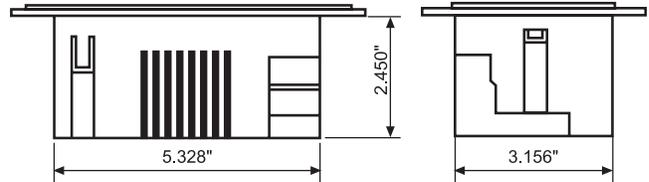
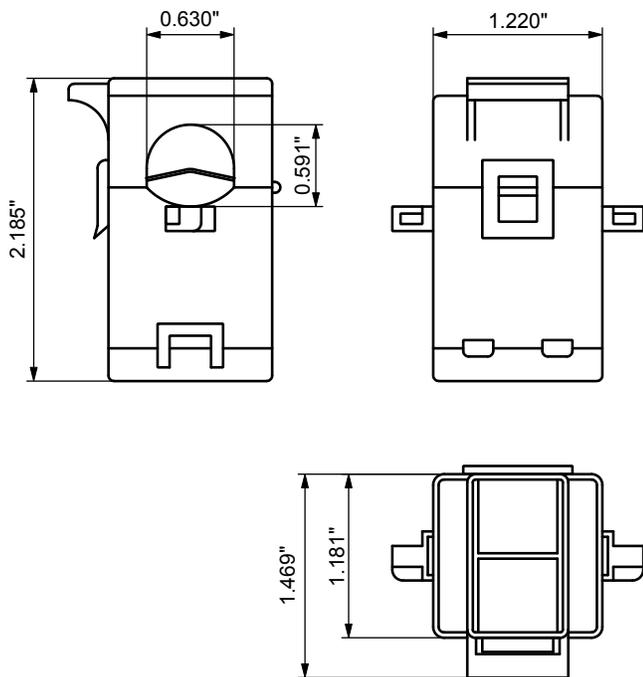
(Dimensions in inches)

The LIM is less than 2-1/2" deep. Cut-out needed for new flush panel mounting is 7" -x 4-7/16" (+0,-1/32"). Cut-out needed for surface panel mounting is 5-3/8" -x 3-1/4" (+0,-1/32"). Mounting holes are on 4" and 6-1/2" centers. A 15-pin female connector and a 12-pin female Molex connector are built into the back of the LIM2010.

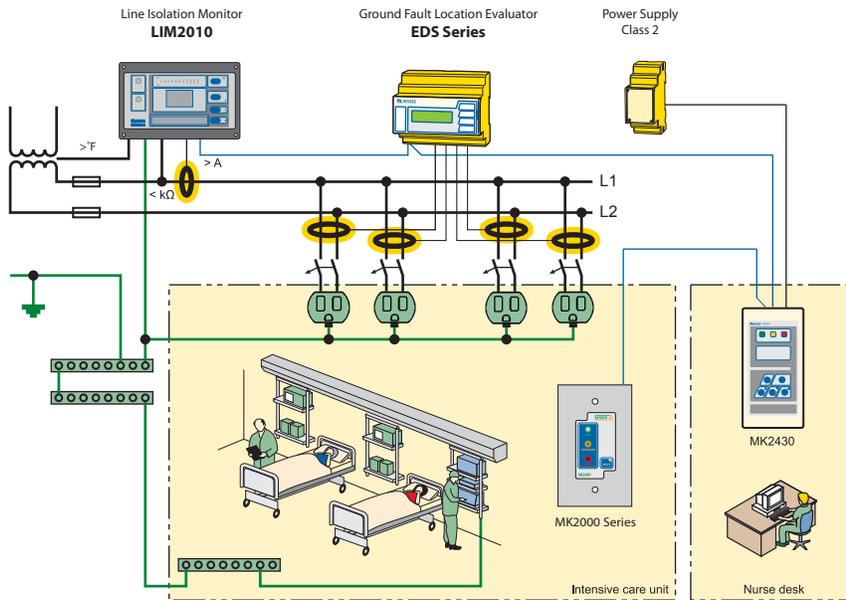


Dimensions: Load Monitoring CT SWL-100A

(Dimensions in inches)



A complete ground fault location system for hospitals



Ground fault location in isolated power systems with EDS series devices

BENDER's complete ground fault location system for hospitals helps increase the reliability of your system, reduce costs, and create predictive maintenance by locating ground faults quickly and easily. The EDS series extends the capabilities of the LIM2010 Line Isolation Monitor to not only know that there is a problem, but to find it as well. The EDS series assists in automating the process of finding faults by connecting to subfeeders or loads and providing notification when a fault has been located. Remote indicators also work in conjunction with this system to notify nurse and technical stations quickly when a problem has occurred.

Complete system including LIM, EDS ground fault location, and remote indication

Advantages:

- Ground fault location while the system remains online
- Fast location of faults
- Reduced maintenance costs
- Indication of faulty circuit shown on LCD displays at both the location device and remote indicators

System functions:

- Indication of faulty branch circuits
- Modular design allows for simple retrofitting/upgrading
- Current transformers for fault detection available in many different shapes and sizes
- Up to 708 sub circuits can be monitored
- Communication via two-wire connection
- Universally applicable for most types of ungrounded systems

Function

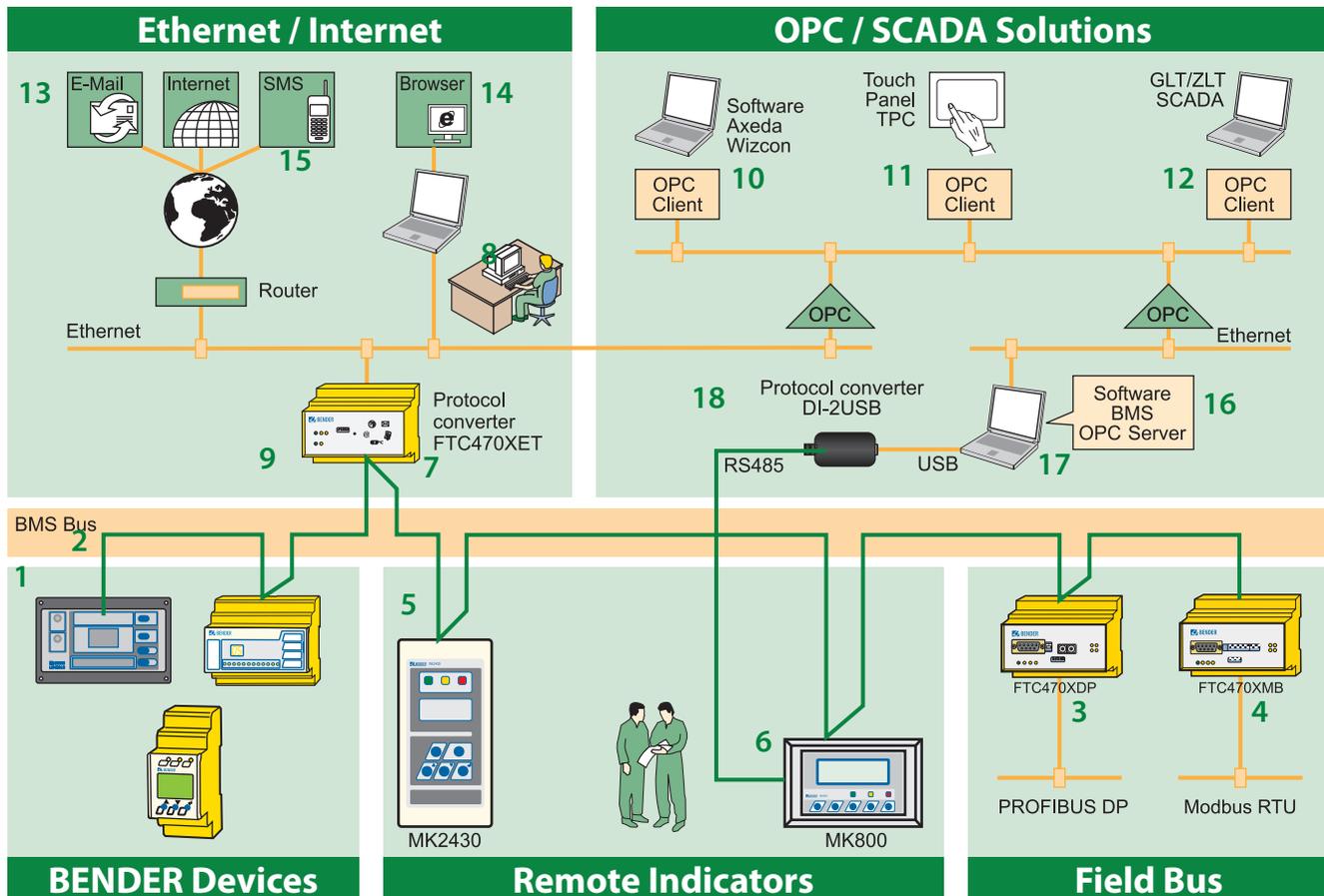
The EDS series works in conjunction with the LIM2010 to create a complete ground fault location system. After an alarm is generated by the LIM2010, the EDS series system activates (this can happen automatically or be manually controlled). A test device generates a test signal for a set period of time. Its amplitude and duration are limited. The signal flows through the location of the ground fault. Current transformers placed around each subfeeder or load will pick up on this test signal. The EDS series device will then evaluate the results. The location of the fault is displayed on the EDS series via either a digital display or an LED bar graph. Special remote indicators connected to the system may also display the location of the fault.

Remote indication and communication solutions

Device communication

BENDER's line of communication products allow for fast notification of personnel when a problem has occurred. Critical systems monitored by BENDER equipment may be connected to a variety of remote indicators to notify personnel of the current status of the system. Communication gateways bring your electrical safety network into the 21st century by displaying system information via several standard protocols, such as Ethernet, MODBUS, and

PROFIBUS. The Ethernet gateway device additionally features an easy-to-use status page, accessible through a web browser. E-mail and SMS messaging when an alarm has occurred is also available. Utilizing this communication system allows for timely and cost-effective deployment of service personnel and can help avoid equipment damage or failure.



Communication possibilities with Bender systems and devices

- | | |
|--|--|
| <ul style="list-style-type: none"> 1 - Line isolation monitor LIM2010 2 - Bender BMS bus (internal) 3 - Protocol converter FTC470XDP, BMS bus / PROFIBUS DP 4 - Protocol converter FTC470XMB, BMS bus / Modbus RTU 5 - Remote alarm indicator and test combination MK2430 6 - Bender BMS bus (external) 7 - Protocol converter FTC470XET, BMS bus / Ethernet (TCP / IP), Web server, OPC interface 8 - PC with web browser (Internet Explorer, Firefox, Opera etc.) 9 - OPC server in FTC470XET 10 - OPC client: Axeda Wizcon visualization software | <ul style="list-style-type: none"> 11 - OPC client: Touch Panel TPC 12 - OPC client: Scada software 13 - FTC470XET functionality: E-mail notification via Internet 14 - FTC470XET functionality: Operation of Bender systems via Web browser 15 - FTC470XET functionality: text messaging to mobile phones 16 - BMS OPC server 17 - PC with software BMS OPC server 18 - Protocol converter DI-2USB BMS bus (RS-485) / USB |
|--|--|

Systems and Accessories



Isolated Power Panels

BENDER Isolated Power Panels are designed to provide isolated power to electrical systems in operating rooms and other critical areas. Designed in strict compliance with UL 1047, UL 1022, and UL 50, IP series panels offer the most up-to-date technology for all isolated power distribution requirements. Additional options include provisions for receptacles and/or ground jacks, as well as branch circuit control via a PLC.

MK2000 Series Remote Indicators

The MK2000 series provides visible and audible alarm indications in a remote location for the line isolation monitor. The standard model features alarm status LEDs, a mute button, and LED mute indication. A wide variety of options are available, including remote test button and transformer overload indication.

MK2000 series indicators are supplied with stainless steel wallplates for flush mounting.



Communication Solutions

BENDER provides complete communication solutions to keep your facility continuously notified of electrical issues. Advanced remote indicators for nurse stations and electrical stations provide simple and customizable notifications to personnel. Gateway devices provide integration into existing communication networks.



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