User Manual

LIM2010

Line Isolation Monitor

Power in electrical safety

TGH1436en / NAE2025010

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1. Introduction

1.1 The LIM2010 Line Isolation Monitor

The Line Isolation Monitor (LIM) LIM2010 measures the impedance of the connected isolated power system to ground. The LIM then uses this value to calculate the maximum Total Hazard Current, which is displayed on the front of the LIM continuously in mA. Total Hazard Current is the calculated maximum fault current passing through a human body to ground if live conductors of the isolated power system were touched.

In addition to the continuously operating digital display, a colored LED bar graph provides indication of Total Hazard Current in the system. The words "SAFE" and "HAZARD" are displayed prominently on the face of the device, coupled with green and red LEDs.

The device is designed to monitor isolated power systems with voltages of 100...240V AC at 50Hz or 60Hz without the use of a separate supply voltage.

1.2 Bus Capability

References to devices with "bus capability" will appear throughout this manual.The LIM2010, as well as some remote indicators, feature a two-way RS-485 communication system utilizing a proprietary protocol called the BMS bus. Devices utilizing the BMS bus generally require less connections and can communicate more information remotely.
If you are utilizing remote indicators with the LIM2010, certain instructions may change based on whether the remote has or does not have bus capability. Ensure that you are following the proper instructions when wiring and setting up the device.

Remotes with no bus capbility: MK2000(C)(P) series (any combination)
Remotes with bus capability: MK2000CBM, MK2430, MK800

For more information on this topic, refer to the wiring diagram specific to the remote being utilized.

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2. Safety Instructions

DANGER

Hazard of Electric Shock, Burn, or Explosion

Only qualified maintenance personnel shall operate or service this equipment. These instructions should not be viewed as sufficient for those who are not otherwise qualified to operate or service this equipment. This document is intended to provide accurate information only. No responsibility is assumed by BENDER for any consequences arising from use of this document.

Turn OFF all sources of electrical power before performing any inspections, tests, or service on this equipment. Assume all circuits are live until they have been properly de-energized, tested, grounded, and tagged. Failure to observe these precautions will result in equipment damage, severe personal injury, or death.

Proper operation of this equipment depends on proper installation. Neglecting fundamental installation techniques will result in equipment damage, severe personal injury, or death.

Do not make any modifications to the equipment. Failure to observe this precaution will result in equipment damage or personal injury.

Only use manufacturer's and manufacturer recommended accessories with this equipment. Failure to do so may damage the equipment beyond repair.

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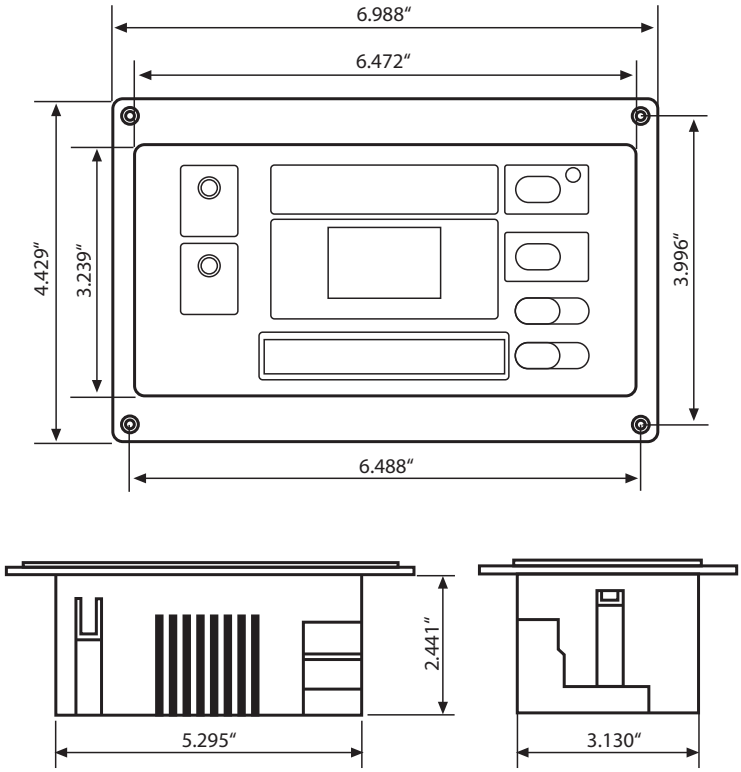
3. Installation and connection

3. 1 Screw mounting LIM2010

The front plate provides four holes with a diameter of 1/8" (3.2 mm) for screw mounting. Use the provided #4-40 oval head, black oxide finished screws. Before mounting, plug the connector plate into the LIM.



3. 2 Wiring

The LIM2010 connects to a connector plate assembly. Follow these instructions to ensure proper connection and installation of the LIM.
Units that are labeled as having "bus capability" have the ability to connect to the LIM2010 via a two-way RS-485 communication protocol.

DANGER
When applying power to the LIM, do not apply a voltage higher than 240 VAC. Failure to observe this precaution will result in equipment damage, severe personal injury, or death.

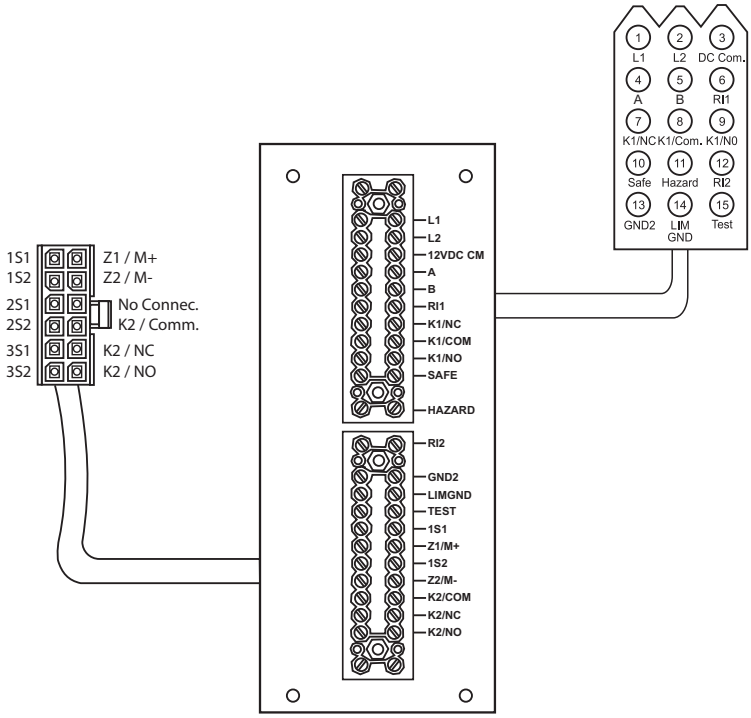
- Locate the proper wiring diagram from the table below. Take note of which remote indicator and which connector plate that have been supplied. Wiring varies depending on these components.
- Before mounting the LIM, plug the connector plate into the LIM.
- Make the connections according to the wiring diagram for the components required.
- Turn ON power to the LIM. If no error messages are displayed, the LIM is operating properly. See Section 4 - Operation and Settings for more detailed information.

Device combination of LIM2010 and ...	**Bus compatible**	**Wiring diagram**
No remote	–	page 13
MK2000	–	page 14
MK2000**C**	–	page 15
MK2000**CBM**	yes	page 16
MK2000**CP**	–	page 17
MK2000**P**	–	page 18
MK2430	yes	page 19

NOTE: The connector plate must only be installed in a grounded, metallic enclosure.

3.2.1 Connector plate: CP-LIM2010

NOTE: Connector plate must only be installed in a grounded, metallic enclosure.



Terminal	Description
L1, L2	Connection to the isolated power system to be monitored. Protection of L1, L2 via separate fuses or circuit breakers. Recommended: 3AG 0.25 x 1.25 inch Ceramic Slow Blow Fuse 2 A
12 V DC Com.	Common connection for MK... alarm indicator and test combinations, up to four (200 mA)
A, B	RS-485 interface, BMS bus
RI1	+12 V connection for the test button of the MK... alarm indicator and test combination or voltage supply of MK2000CBM
K1/NC K1/Common K1/NO	N/C contact of alarm relay K1 Common contact of K1 N/O contact of K1
Safe	"Safe" signal for MK... alarm indicator and test combination which do not have bus compatibility
Hazard	"Hazard" signal for MK... alarm indicator and test combination which do not have bus compatibility
RI2	MUTE function for MKs which do not have bus compatibility
GND2 LIM GND	**Separate** connections to ground
TEST	Connection for testing the LIM2010 from any MK... that does not have bus compatibility

Terminal	Description
K2/Common K2/NC K2/NO	Common contact of alarm relay K2 N/C contact of K2 N/O contact of K2
1S1, 1S2	Connection for current transformer CT1 * Only use these CT types: STW3, STW4, SWL-100A
2S1, 2S2	Connection for current transformer CT2 * Only use these CT types: STW3, STW4, SWL-100A
3S1, 3S2	Connection for current transformer CT3 * Only use these CT types: STW3, STW4, SWL-100A
Z1/M+, Z2/M-	Connection Z1/Z2 for overtemperature sensor or connection M+/M- for external measuring instrument for the indication of the THC
* = Conductors being monitored shall be placed centrally through the current transformer.	

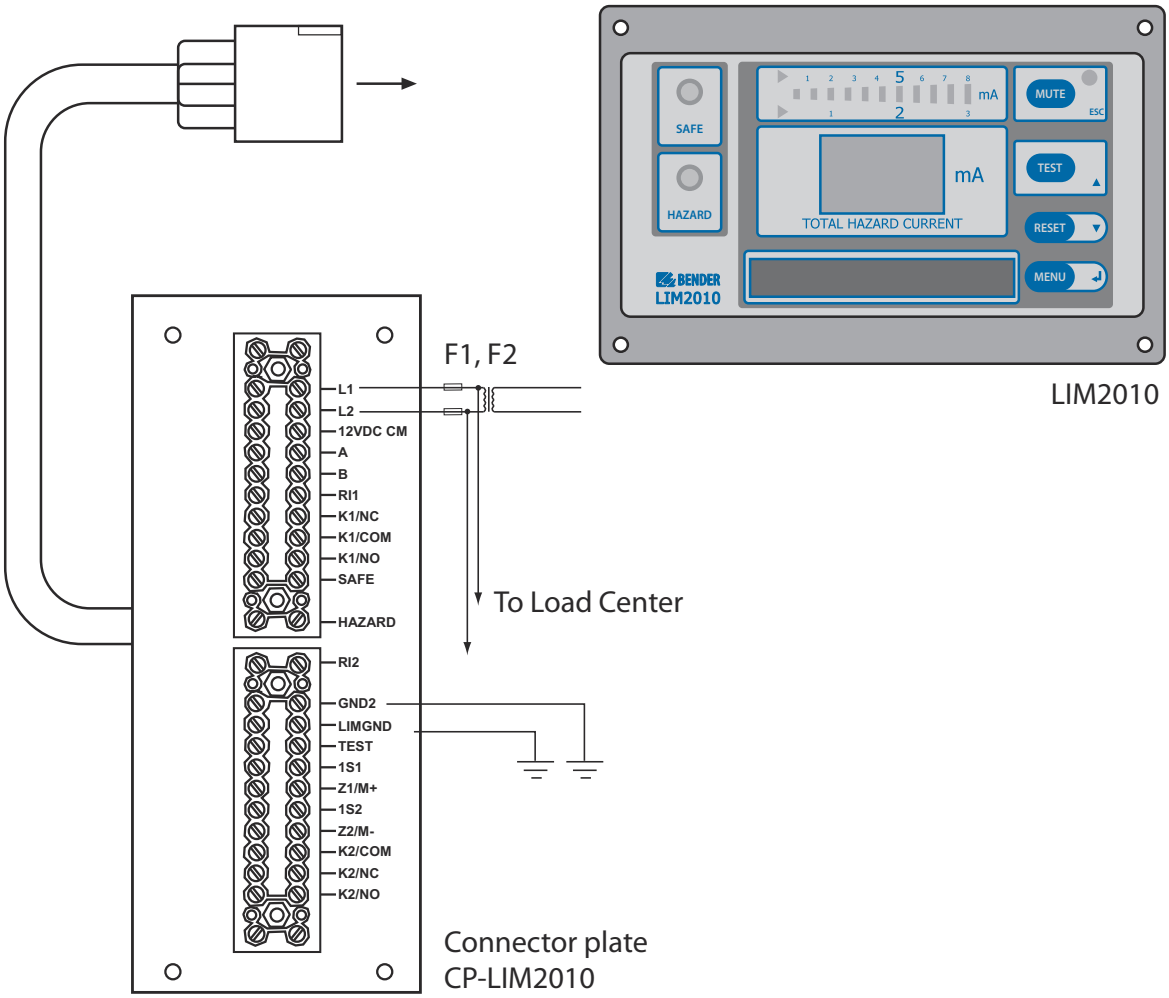
3.2.2 Terminal RI2 for remote annunciation and testing (for remotes with no bus capability)

Remote indicators that do not have bus capability may be muted collectively by connecting terminals 7 and 8 on the remote to terminal RI2 on the LIM2010. No matter how the wiring is configured, each respective device is able to mute itself. Wiring between the remote and the LIM2010 will affect whether a particular device will mute more than itself. See the table below for details:

LIM2010	MK2000 (C) (P) (M)		Mute function
Terminal RI2	Terminal 7	Terminal 8	
–	–	–	Only the local device will be muted
X	X	–	LIM mute button mutes LIM and MK
X	–	X	MK mute button mutes LIM and MK
X	X	X	Both mute buttons will mute both devices
X = Terminal connected			

3.2.3 Wiring diagram for LIM2010

No remote indication is provided with this connection method.



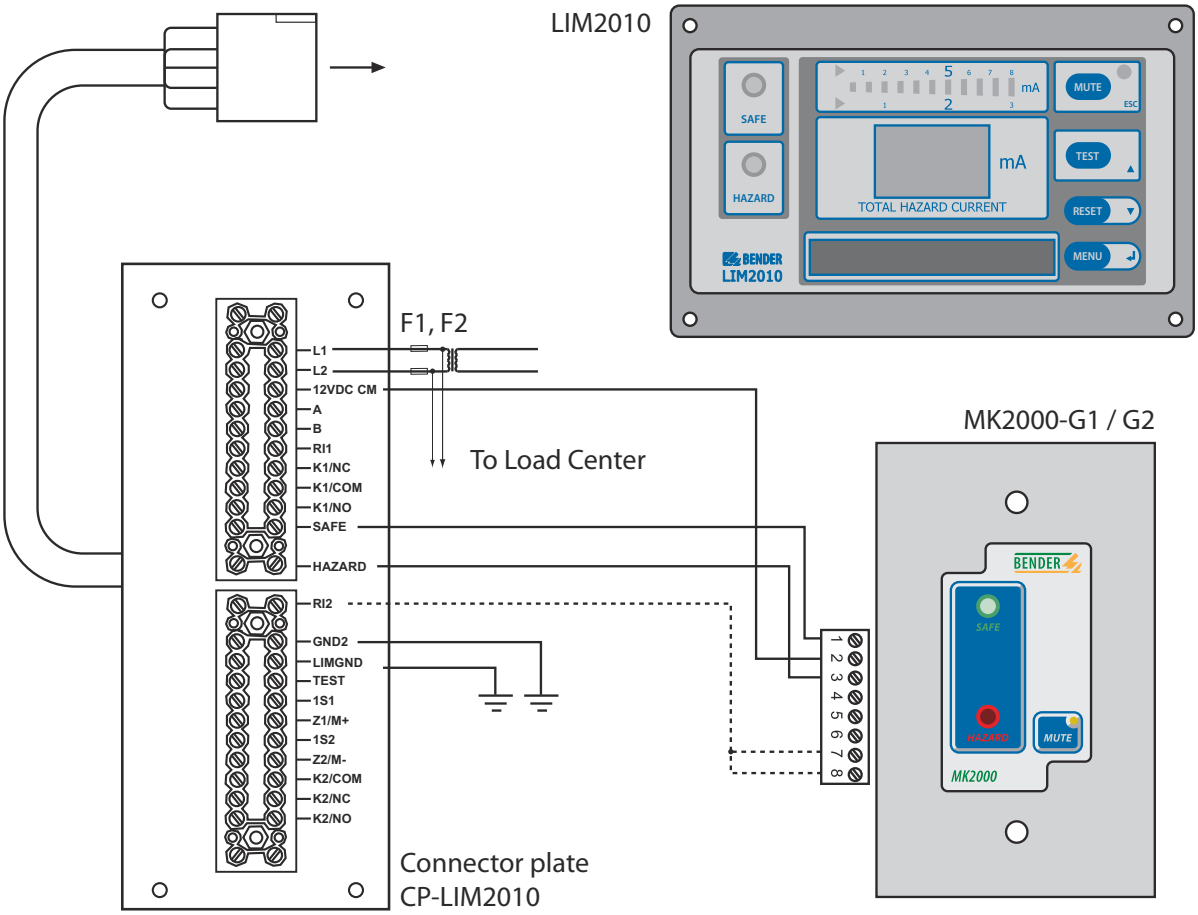
Connection Legend:

- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.

3.2.4 Wiring diagram for MK2000 and LIM2010

This remote provides a SAFE LED, a HAZARD LED, and a mute button and LED.



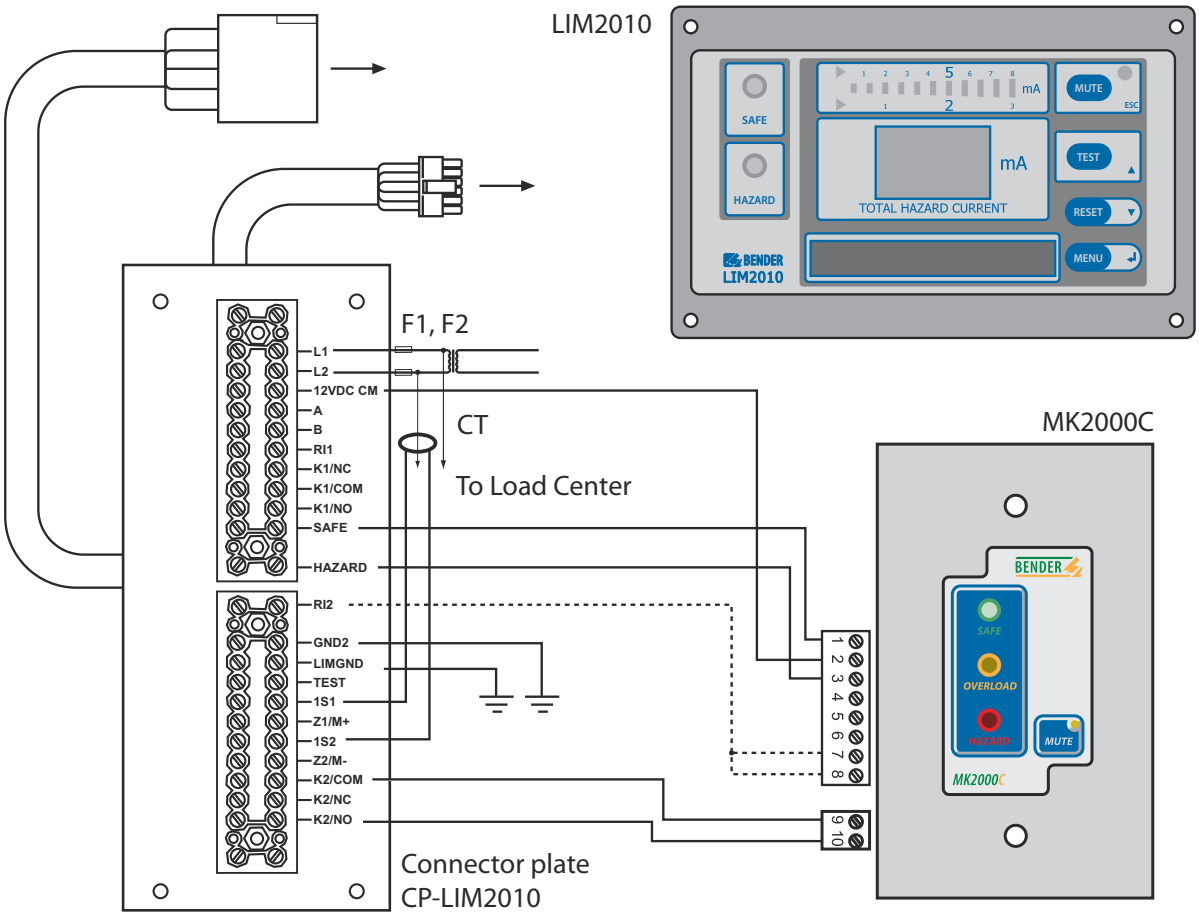
Connection Legend:

- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.
- Connector plate Safe, Hazard, and 12VDC CM connect to the respective terminals on the remote.
- Connector plate RI2 connection is required for system muting.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.

3.2.5 Wiring diagram for MK2000C and LIM2010

This remote provides a SAFE LED, a HAZARD LED, a transformer overload LED, and a mute button and LED.



Connection Legend:

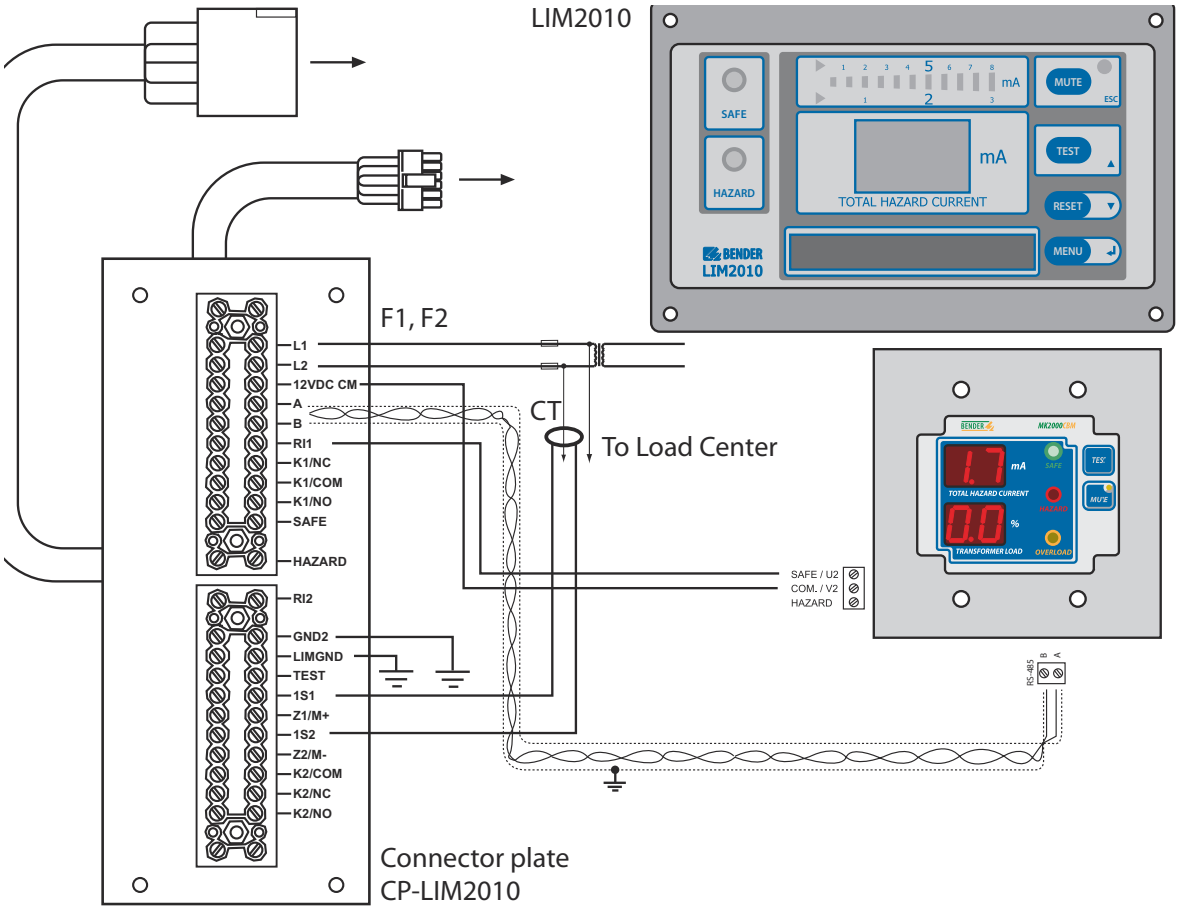
- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.
- Connector plate Safe, Hazard, and 12VDC CM connect to the respective terminals on the remote.
- Connector plate RI2 connection is required for system muting.

- Only current transformer types STW3, STW4, and SWL-100A may be used.
- The factory setting for the current transformer type in the LIM2010 is STW3.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.

3.2.6 Wiring diagram for MK2000CBM and LIM2010

This remote provides a SAFE LED, a HAZARD LED, two digital displays with total hazard current and transformer overload, a mute button and LED, and a test button.
Note: Up to two MK2000CBM may be connected to one LIM2010.



Connection Legend:

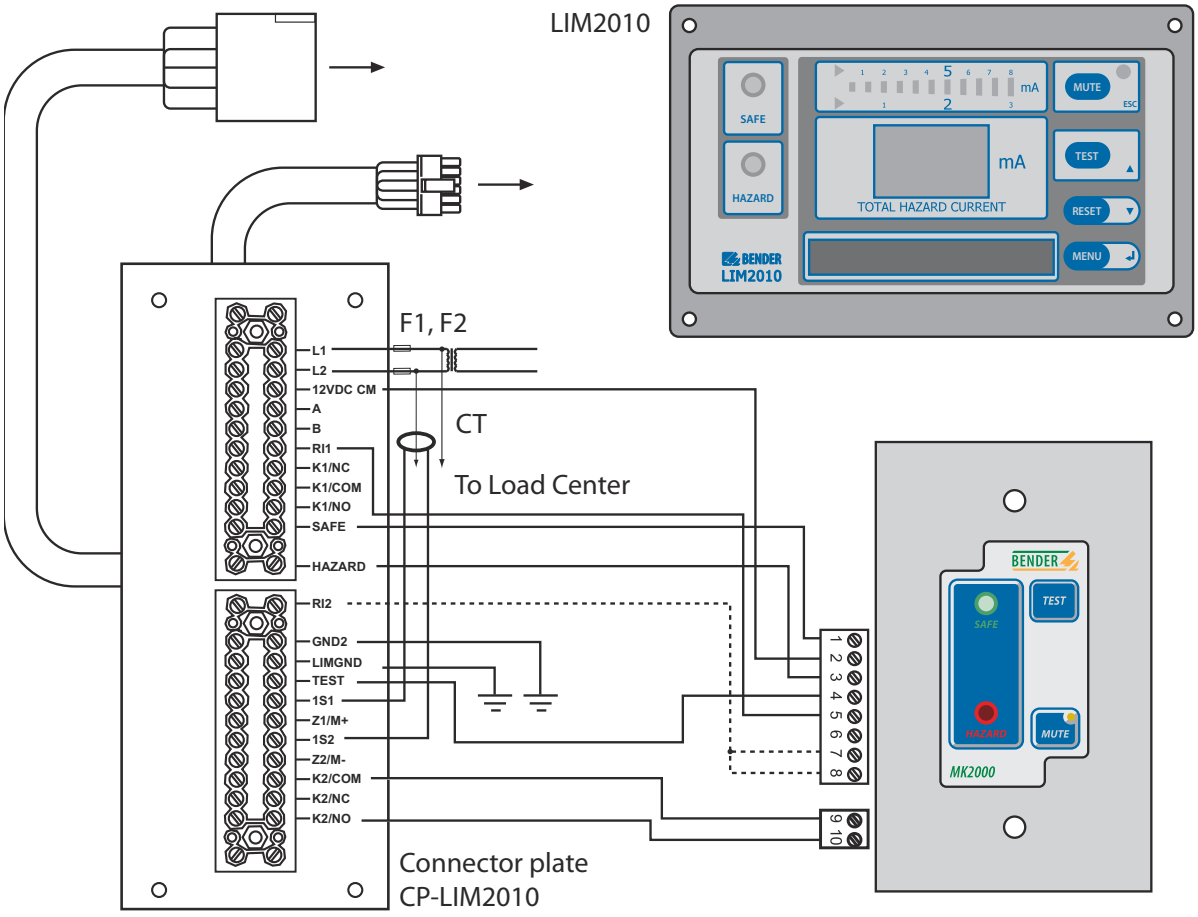
- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.
- Connector plate Safe, Hazard, and 12VDC CM connect to the respective terminals on the remote.
- Connector plate RI2 connection is required for system muting.
- Connector plate Test and RI1 are required for the remote test function.

- Only current transformer types STW3, STW4, and SWL-100A may be used.
- The factory setting for the current transformer type in the LIM2010 is STW3.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.
- Refer to page 20 for configuring an RS-485 communication bus.

3.2.7 Wiring diagram for MK2000CP and LIM2010

This remote provides a SAFE LED, a HAZARD LED, a transformer overload LED, a mute button and LED, and a test button.



Connection Legend:

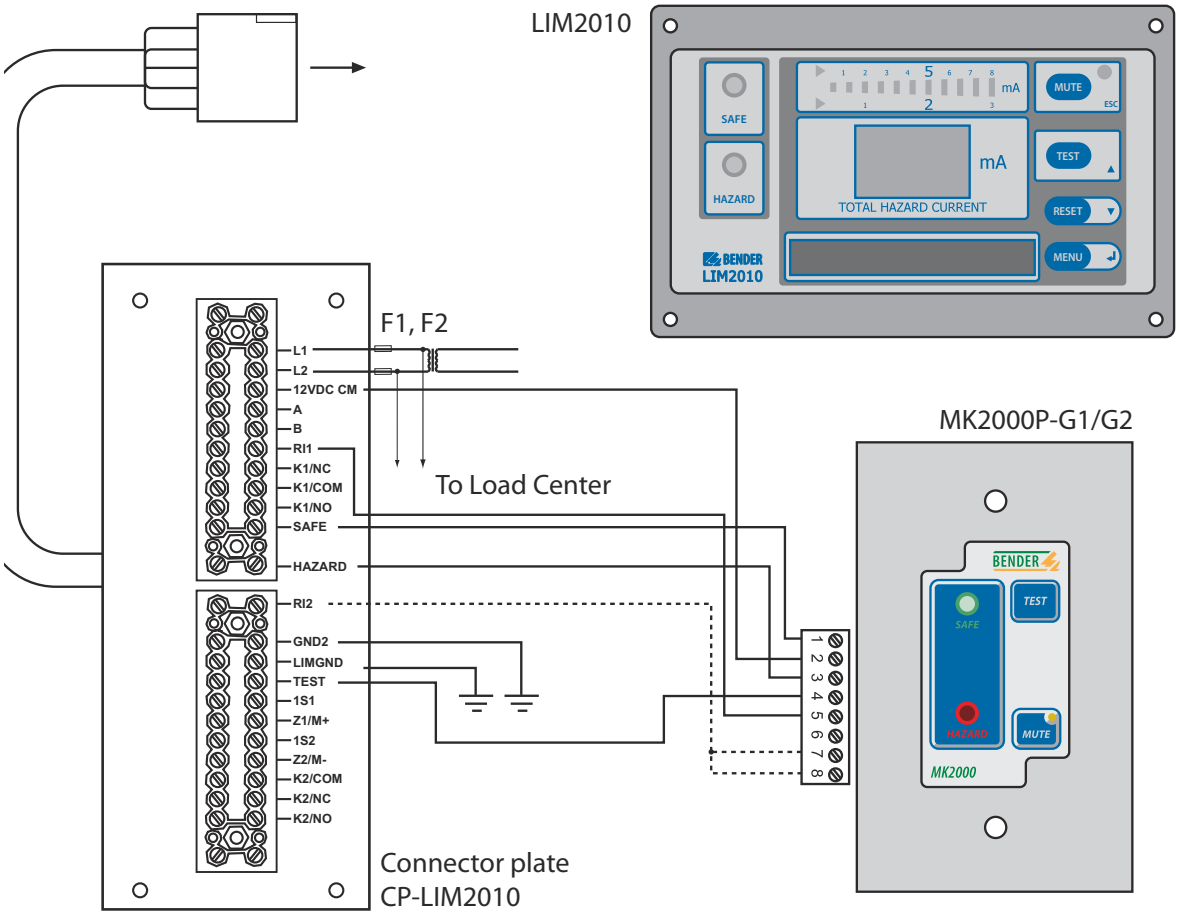
- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.
- Connector plate Safe, Hazard, and 12VDC CM connect to the respective terminals on the remote.
- Connector plate RI2 connection is required for system muting.
- Connector plate Test and RI1 are required for the remote test function.

- Only current transformer types STW3, STW4, and SWL-100A may be used.
- The factory setting for the current transformer type in the LIM2010 is STW3.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.

3.2.8 Wiring diagram for MK2000P and LIM2010

This remote provides a SAFE LED, a HAZARD LED, a mute button and LED, and a tes t button.

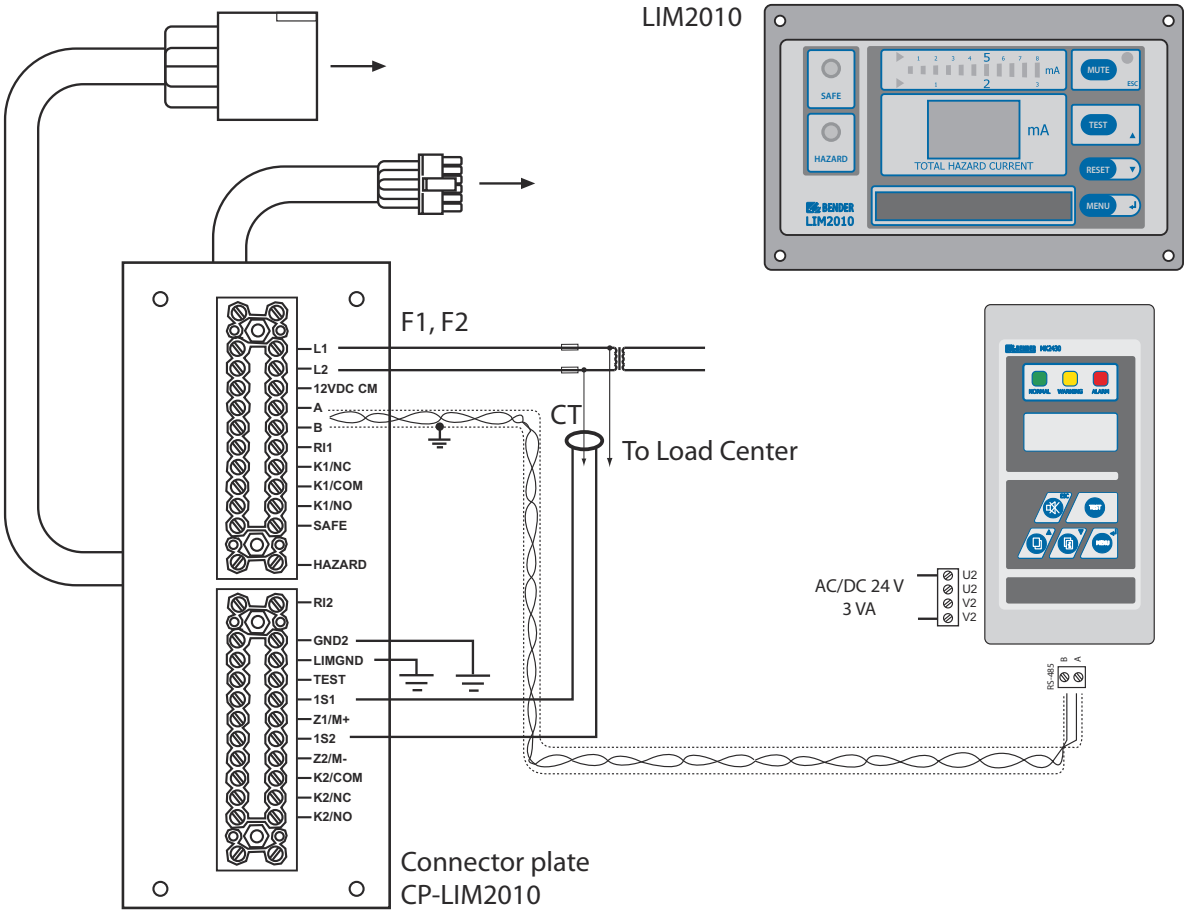


Connection Legend:

- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.
- Connector plate Safe, Hazard, and 12VDC CM connect to the respective terminals on the remote.
- Connector plate RI2 connection is required for system muting.
- Connector plate Test and RI1 are required for the remote test function.

- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.

3.2.9 Wiring diagram for MK2430 and LIM2010



Connection Legend:

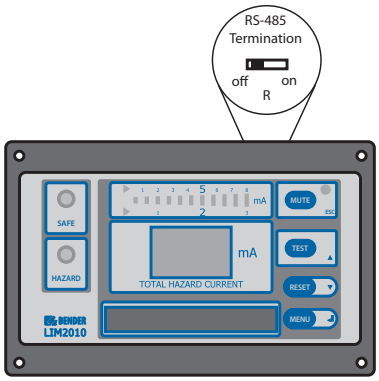
- Connector plate L1 and L2 connect to the main lines of the system.
- Connector plate LIMGND and GND2 are **SEPARATE** connections to the system ground.

- Only current transformer types STW3, STW4, and SWL-100A may be used.
- The factory setting for the current transformer type in the LIM2010 is STW3.

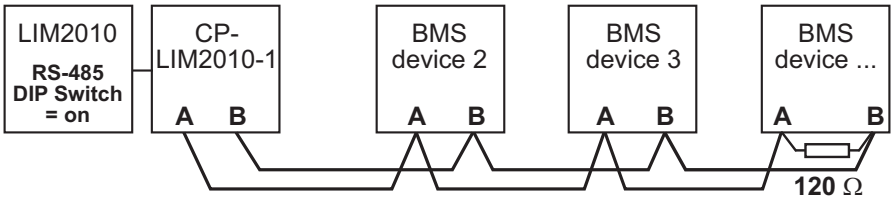
- Line fuses are optional, recommended at 3AG 0.25 x 1.25" ceramic slow blow fuses, 2 A.
- Detailed descriptions of connector plate terminals are found on page 11 and 12.
- Refer to page 20 for configuring an RS-485 communication bus.

3. 3 RS-485 communication bus termination

NOTE: This section only applies when using remote indicators that have bus capability.
If there is a LIM2010 at the beginning or the end of a bus, the terminating switch set to on.
The factory setting is off.



If several bus devices are connected with each other, the interfaces are to be wired according to the schematic diagram. Depending on the device, the termination is carried out via the RS-485 DIP switch or a 120-Ω resistor connected in parallel.

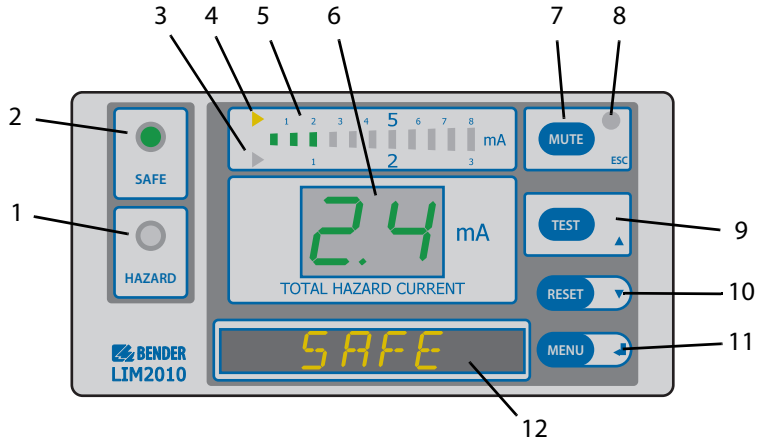


If more than two devices are connected via RS-485, only the first and last devices in the chain require termination.

4. Operation and settings

4. 1 Front panel display - Normal Condition

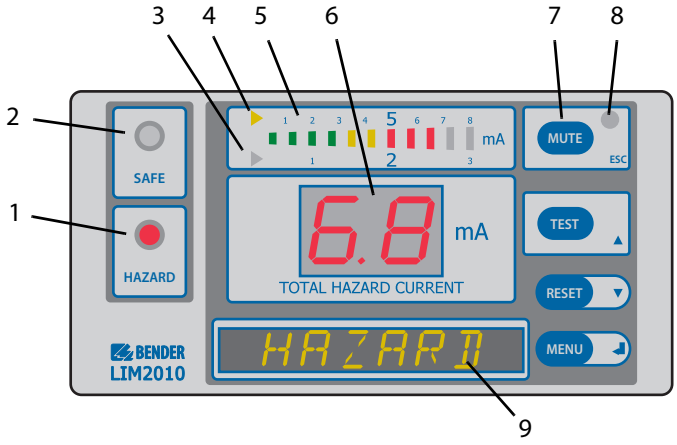
The illustration below shows the LIM2010 in the normal condition, with all possible indications.



1	HAZARD LED (red): Not illuminated.
2	SAFE LED lights (green): Illuminated. Will be in normal condition when the displayed Total Hazard Current is below the response value (2 mA for CA, 5 mA for USA)
3	The measuring range indicator is not illuminated: The THC response value 2 mA is not active.
4	Measuring range indicator lights (yellow): The THC response value 5 mA is active.
5	LED bar graph: In a normal condition, only the green bars are illuminated.
6	Seven-segment display of currently read Total Hazard Current: Green in color for a normal condition.
7	MUTE button ESC key: To jump to a higher level in the menu
8	MUTE LED: Not illuminated in a safe condition.
9	TEST button: Activates self-test UP key: To move up in the menu and to increase values
10	DOWN key: To move down in the menu and to decrease values
11	MENU key: To start the menu mode Enter key: To confirm entries
12	Digital display: Reads "SAFE" in the normal condition. Also displays menu options when in the device's menu.

4. 2 Front plate display - Alarm Condition

When the measured Total Hazard Current exceeds the set response value, the LIM will go into an alarm condition. When this happens, the audible alarm will activate, as well as the following:



1	HAZARD LED: Flashes red.
2	SAFE LED: Not illuminated.
3	The measuring range indicator is not illuminated: The THC response value 2 mA is not active.
4	Measuring range indicator lights (yellow): The THC response value 5 mA is active.
5	LED bar graph: Indicates total hazard current. In the alarm condition, the red bars will be illuminated.
6	Seven-segment display of currently read Total Hazard Current: Illuminates as red in color for the alarm condition.
7	MUTE button: Pressing the MUTE button will silence the audible alarm and activate the yellow MUTE LED.
8	MUTE LED: Will illuminate yellow after the MUTE button has been pressed, and the fault is still on the system.
9	Digital display: Reads "HAZARD" in the alarm condition.

Procedure - Press the MUTE button to silence the audible alarms. The yellow MUTE LED will illuminate. When the fault is cleared, the LIM will go back to the safe condition.

4. 3 Displaying measured values

The Total Hazard Current is displayed in real-time on the numeric display in the middle of the device. For retrieving other measured values, such as load current or impedance, refer to the menu item "1.Values“. For details about the submenu VALUES, refer to page 28.

4. 4 Procedure for Functional Test of LIM2010

The LIM2010 may be tested while the isolated power system is online. Press the TEST button for approimately 2 s to start a functional test. The following will occur:

- The entire LED bar graph will illuminate.
- The digital display at the bottom of the front plate will display "**TEST**."
- The digital indicator will flash.
- The audible buzzer will sound.
- The HAZARD LED will illuminate.
- If no fault exists, the text "***OK***" will appear in the text field. The device will then return to the safe condition. The text "**SAFE**" will display on the digital display and the SAFE LED will illuminate.

BENDER recommends pressing the TEST button monthly to ensure proper operation of the line isolation monitor.

4. 5 Factory settings

Parameter description	Display		Value range	Factory setting
Total Hazard Current	*GENERAL*	*THC*	2 mA, 5 mA	5 mA
Current Transformer Type	*GENERAL*	*CT*	off, STW3, STW4, SWL	off
Maximum Load Current	*GENERAL*	*LOAD*	off, 10A...200A	off
Undervoltage	*GENERAL*	*U<*	off, 80V...300V	off
Overvoltage	*GENERAL*	*U>*	off, 80V...300V	off
Isolation Impedance	*GENERAL*	*Z*	off, 10kΩ...200kΩ	off
Isolation Resistance	*GENERAL*	*R*	off, 20kΩ...200kΩ	off
Temperature Monitoring	*GENERAL*	*TEMP*	off, on	off
Fault Location	*GENERAL*	*F.LOC*	off, auto	off
Response Delay t_{on}	*GENERAL*	*T.on*	0s...99s	0s
Release Delay t_{off}	*GENERAL*	*T.off*	0s...99s	0s
Test Cycle	*GENERAL*	*TEST*	1h...24h	1h
Relay 1 Operation *	*REL. NO .1*		N/O, N/O-T, N/C, N/C-T	N/C-T
Relay 1 Alarm THC	*REL. NO .1*	*THC*	off, on	on
Relay 1 Alarm Overload	*REL. NO .1*	*LOAD*	off, on	off
Relay 1 Alarm Undervoltage	*REL. NO .1*	*U<*	off, on	off
Relay 1 Alarm Overvoltage	*REL. NO .1*	*U>*	off, on	off
Relay 1 Alarm Impedance	*REL. NO .1*	*Z*	off, on	off
Relay 1 Alarm Resistance	*REL. NO .1*	*R*	off, on	off
Relay 1 Alarm Temperature	*REL. NO .1*	*TEMP*	off, on	off
Relay 1 Alarm System (Device Error)	*REL. NO .1*	*SYS*	off, on	off
Relay 2 Operation *	*REL. NO .2*		N/O, N/O-T, N/C, N/C-T	N/C-T
Relay 2 Alarm THC	*REL. NO .2*	*THC*	off, on	off
Relay 2 Alarm Overload	*REL. NO .2*	*LOAD*	off, on	on
Relay 2 Alarm Undervoltage	*REL. NO .2*	*U<*	off, on	on
Relay 2 Alarm Overvoltage	*REL. NO .2*	*U>*	off, on	on
Relay 2 Alarm Impedance	*REL. NO .2*	*Z*	off, on	on
Relay 2 Alarm Resistance	*REL. NO .2*	*R*	off, on	on
Relay 2 Alarm Temperature	*REL. NO .2*	*TEMP*	off, on	on
Relay 2 Alarm System (Device Error)	*REL. NO .2*	*SYS*	off, on	on
Buzzer Volume	*BUZZER*	*VOL*	High, Low	High
System Mute	*BUZZER*	*SY.MU*	off, on	on
Buzzer Alarm Overload	*BUZZER*	*LOAD*	off, on	on
Buzzer Alarm Undervoltage	*BUZZER*	*U<*	off, on	on
Buzzer Alarm Overvoltage	*BUZZER*	*U>*	off, on	on

Parameter description	Display		Value range	Factory setting
Buzzer Alarm Impedance	*BUZZER*	*Z*	off, on	on
Buzzer Alarm Resistance	*BUZZER*	*R*	off, on	on
Buzzer Alarm Temperature	*BUZZER*	*TEMP*	off, on	on
Buzzer Alarm System (Device Error)	*BUZZER*	*SYS*	off, on	on
Data logger Channel THC Change	*DATALOG*	*CHAN.THC*	0%...100%	10%
Data logger Channel THC Overwrite	*DATALOG*	*CHAN.THC*	no, yes	no
Data logger Channel U.12 Change	*DATALOG*	*CHAN.U.12*	0%...100%	10%
Data logger Channel U.12 Overwrite	*DATALOG*	*CHAN.U.12*	no, yes	no
Data logger Channel U.1E Change	*DATALOG*	*CHAN.U.1E*	0%...100%	10%
Data logger Channel U.1E Overwrite	*DATALOG*	*CHAN.U.1E*	no, yes	no
Data logger Channel U.2E Change	*DATALOG*	*CHAN.U.2E*	0%...100%	10%
Data logger Channel U.2E Overwrite	*DATALOG*	*CHAN.U.2E*	no, yes	no
Data logger Channel Z Change	*DATALOG*	*CHAN.Z*	0%...100%	10%
Data logger Channel Z Overwrite	*DATALOG*	*CHAN.Z*	no, yes	no
Data logger Channel R Change	*DATALOG*	*CHAN.R*	0%...100%	10%
Data logger Channel R Overwrite	*DATALOG*	*CHAN.R*	no, yes	no
Data logger Channel I.1 Change	*DATALOG*	*CHAN.I.1*	0%...100%	10%
Data logger Channel I.1 Overwrite	*DATALOG*	*CHAN.I.1*	no, yes	no
Data logger Channel I.2 Change	*DATALOG*	*CHAN.I.2*	0%...100%	10%
Data logger Channel I.2 overwrite	*DATALOG*	*CHAN.I.2*	no, yes	no
Data logger Channel I.3 Change	*DATALOG*	*CHAN.I.3*	0%...100%	10%
Data logger Channel I.3 Overwrite	*DATALOG*	*CHAN.I.3*	no, yes	no
BMS Address	*INTRFCE*	*ADR.*	1...90	1 (Master)
Daylight-Saving-Time change	*CLOCK*	*DST*	off, auto	auto
Password	*PASSWRD*	*PSWD****	0...999	807
Password Status (Lock)	*PASSWRD*	*LOCK*	off, on	on

4. 6 Settings - LIM2010 in menu mode

4.6.1 Operating elements and displays for menu mode

The display and operating elements illustrated below are used to carry out settings in the menu.

	MENU: Starting the menu Enter: Selection of the next menu level, confirming entries
	UP key: To move up in the menu, to increase values
	DOWN key: To move down in the menu, to decrease values
	ESC key: To jump to a higher level in the menu, to discard entries
	Text field for the menu mode

4.6.2 Navigation through the menu

How to access the main menu

Hold the "MENU" button for at least one second. The device will enter into menu mode. The first item in the menu, "VALUES," will appear. The number "1" will flash.

Entering the password prior to navigation through the menu

The majority of the submenus may be password protected. Follow the below procedure to enter the password:

1. A flashing number illustrates the current focus.
2. Use the UP/DOWN key to select the first correct number.
3. Confirm with Enter.
4. Proceed in the same way until the last number is confirmed.
5. Settings may be modified until the menu is exited. Reentering the menu will require a re-entry of the password.

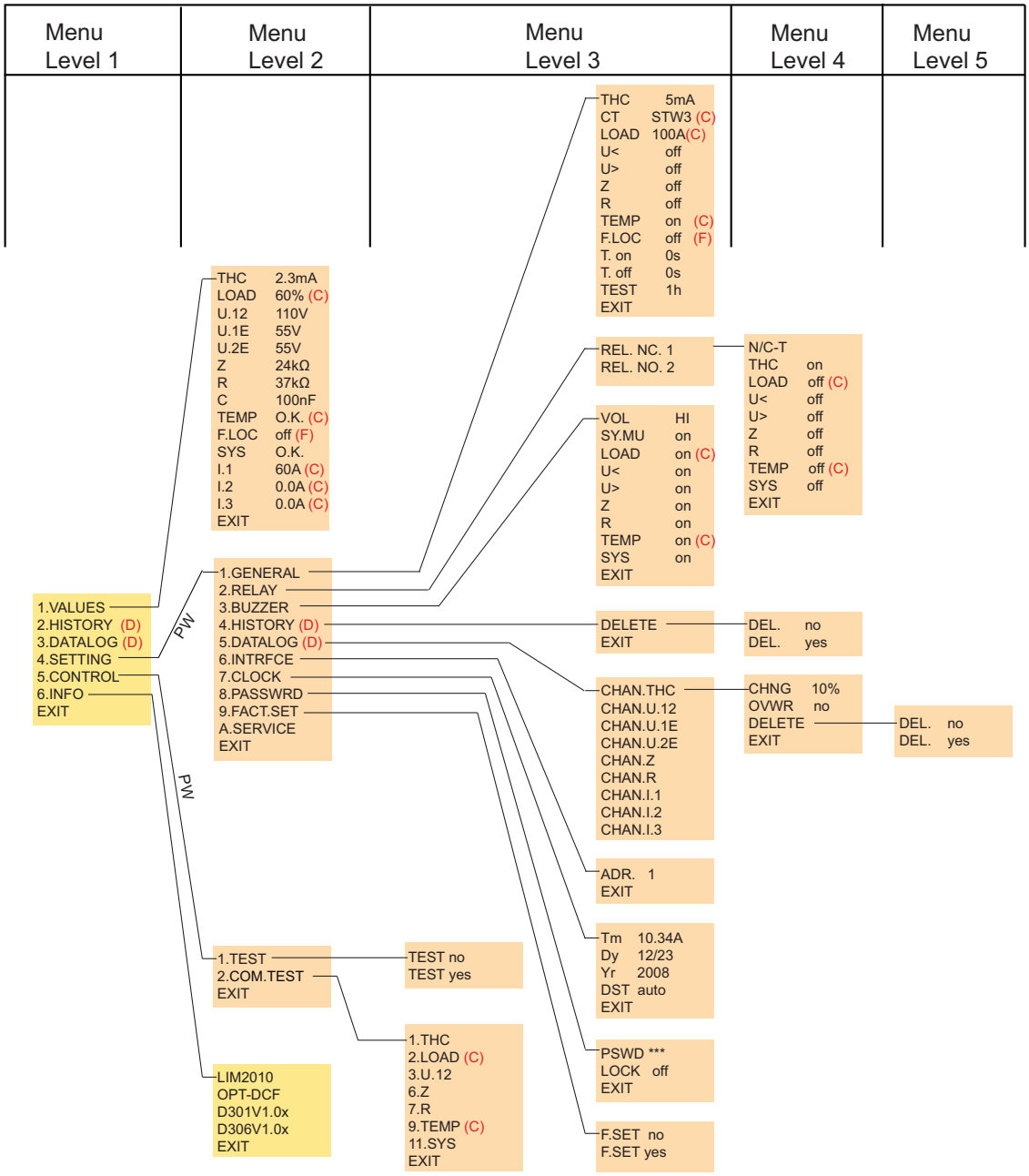
When a parameter is changed and confirmed with the ENTER key, the change will have an immediate effect. The LIM2010 will continue to operate while settings are changed.

Exiting the menu

Press the ESC key to return to the last step in the menu. Repeat this step until the display is back to the main screen.

If the LIM2010 is idle in the menu for 5 minutes, the system will automatically return to the main screen.

4.6.3 Menu structure



(C) = Option C
(D) = Option D
(F) = Option F
PW = Password protected

4.6.4 Main menu

To go back a step in the menu, press the MUTE/ESC key.

MENU Level 1	Meaning	Page
EXIT		
1. VALUES	Display all measured values in real-time	41
2. HISTORY	Display history of alarm messages	29
3. DATALOGGER	Data logging of selected parameters	43
4. SETTING	Change settings	30
5. CONTROL	Begin BMS or device test	36
6. INFO	Display device information	37
EXIT		

4.6.5 Menu: VALUES

This menu indicates the values being read in real-time.

MENU Level 1	MENU Level 2		Meaning
	EXIT		
1. VALUES	**THC**	**2.3mA**	Total Hazard Current
	LOAD	60%	Max. load current [%]
	U.12	110V	Voltage between L1 and L2
	U.1E	55V	Voltage between L1 and ground
	U.2E	55V	Voltage between L2 and ground
	Z	24kΩ	Isolation impedance
	R	37kΩ	Isolation resistance
	C	100nF	Leakage capacitance
	TEMP	O.K.	Transformer temperature indication
	F.LOC	off	Status of the location test generator
	SYS	O.K.	Status of the device
	I.1	60A	Load current measured from CT 1
	I.2	0.0A	Load current measured from CT 2
	I.3	0.0A	Load current measured from CT 3
	EXIT		

4.6.6 Menu: HISTORY

This option displays a record of timestamped alarms.
After opening the menu option, the most up-to-date alarm will appear. Pressing the UP and DOWN arrow keys will scroll through the various information available. Pressing the ENTER key again will display additional information regarding the alarm.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
2. HISTORY	**AL125. THC**	**START.THC**	THC alarm with the consecutive number 125/ Start of the alarm:
		10 / 24 / 09	Date
		11.45 am	Time
		QUIT.THC	Mute of the alarm:
		10 / 24 / 09	Date
		11.45 am	Time
		END.THC	End of the alarm:
		10 / 25 / 09	Date
		9.30 am	Time
		MIN. 6.0mA	Min. value of THC
		MAX. 9.9mA	Max. value of THC
		EXIT	

4.6.7 Menu: DATALOG (Logging for up to 300 data records)

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
3. DATALOG	**CHAN. THC**	**289.THC 2mA**	Last value change
		11 / 30 / 09	Date
		03.45 am	Time
		288.THC 4mA	2nd to last value
		09 / 15 / 09	Date
		11.14 am	Time
		...	...
		...	...
		...	...
		1.THC 1mA	First stored value
		05 / 23 / 09	Date
		11.55 am	Time
		EXIT	

4.6.8 Menu: SETTING

This is the main settings menu.All changes to the device are made here.

WARNING
Only qualified maintenance personnel shall modify the settings listed below. Improper settings may render the LIM2010 inoperable, cause damage to equipment, or cause personal injury.

MENU Level 1	MENU Level 2	Meaning
	EXIT	
4. SETTING	**1. GENERAL**	Change response values
	2. RELAY	Change relay operation
	3. BUZZER	Change buzzer settings
	4. HISTORY	Erase history memory
	5. DATALOG	Set logging parameters
	6. INTERFACE	Change the LIM bus address
	7. CLOCK	Change time and date
	8. PASSWORD	Enable/disable/change the password
	9. FACT.SET	Reset to factory defaults
	A. SERVICE	Only for manufacturer service
	EXIT	

4.6.9 Menu: SETTING/GENERAL

Changes to the response values are made here, such as THC, load monitoring, undervoltage, etc. The additional alarms may be turned ON or OFF along with any trip level settings made.

MENU Level 1	MENU Level 2	MENU Level 3		Meaning
		EXIT		
4. SETTING	**1. GENERAL**	**THC**	**2mA**	Total Hazard Current: 2mA / 5mA
		CT	off	Current transformer type: off / STW3 / STW4 / SWL
		LOAD	off	Load current: off, 10...200A
		U<	off	Undervoltage: off, 80...300V
		U>	off	Overvoltage: off, 80...300V
		Z	off	Isolation impedance: off, 10...200kΩ
		R	off	Isolation resistance: off, 20...200kΩ
		TEMP	off	Transformer temperature control: off / on (off = current output, refer to page 15)
		F.LOC	off	Start and stop conditions for EDS systems: test currrent generator off / auto
		T.ON	0s	Response delay: 0...99s
		TOFF	0s	Release delay: 0...99s
		TEST	1h	Self test interval: 1…24h
		EXIT		

4.6.10 Menu: SETTING/RELAY

Settings related to the contact outputs are changed here. Each type of alarm may be set to trip the output contact. If an alarm is set to ON, it will change the state of the contact in the event of an alarm. If it is set to OFF, then it will not change the state of the contact.
Additionally, the operation of the output relay may be changed here. The following denotes the options available and their meaning:

- N/C mode: "Failsafe" or "Normally energized" mode. The LIM2010 will trip in the event of an alarm or a loss of power to the device.
- N/C-T mode: "Failsafe" or "Normally energized" mode with test enabled. The LIM2010 will trip in the event of an alarm, a test, or a loss of power to the device.
- N/O mode: "Non-failsafe" or "Normally de-energized" mode. The LIM2010 will trip only in the event in an alarm.
- N/O-T mode: "Non-failsafe" or "Normally de-energized" mode with test enabled. The LIM2010 will trip in the event of an alarm or a test.

MENU Level 1	MENU Level 2	MENU Level 3	MENU Level 4	Meaning
			EXIT	
4. SETTING	**2. RELAY**	**REL. NO. 1**	**N/C-T**	"Failsafe" operation: The contact will trip in the event of an alarm, a test, or a loss of power to the device.
			THC on	Relay 1 switches when a THC alarm occurs
			LOAD off	Relay 1 does not switch in the event of a LOAD alarm
			U< off	Relay 1 does not switch in the event of an undervoltage alarm
			U> off	Relay 1 does not switch in the event of an overvoltage alarm
			Z off	Relay 1 does not switch in the event of an insulation impedance alarm
			R off	Relay 1 does not switch in the event of an insulation resistance alarm
			TEMP off	Relay 1 does not switch in the event of an temperature alarm
			SYS off	Relay 1 does not switch in the event of a device error
			EXIT	

4.6.11 Menu: SETTING / BUZZER

Settings here relate to the buzzer of the LIM2010. If a type of alarm is set to ON, it will activate the buzzer when it goes into alarm. If it is set to OFF, the alarm will not activate the buzzer.

MENU Level 1	MENU Level 2	MENU Level 3		Meaning
		EXIT		
4. SETTING	**3. BUZZER**	**VOL**	**HI**	Buzzer volume: High or Low
		SY.MU	on	System mute: on/off
		LOAD	on	Buzzer sounds in the event of an LOAD alarm
		U<	on	Buzzer sounds in the event of an undervoltage alarm
		U>	on	Buzzer sounds in the event of an overvoltage alarm
		Z	on	Buzzer sounds in the event of an insulation impedance alarm
		R	on	Buzzer sounds in the event of an insulation resistance alarm
		TEMP	on	Buzzer sounds in the event of an temperature alarm
		SYS	on	Buzzer sounds in the event of an device error
		EXIT		

4.6.12 Menu: SETTING / HISTORY

Selecting YES will erase the history of alarms on the device.

MENU Level 1	MENU Level 2	MENU Level 3	MENU Level 4	Meaning
		EXIT		
4. SETTING	**4. HISTORY**	**DELETE**	**DEL. no**	Erase history memory: yes or no
		EXIT		

CAUTION

Once it is erased, the history cannot be recovered.

4.6.13 Menu: SETTING / DATALOG

This menu controls how often data is recorded in the history of the LIM2010. The number of records is controlled by changing the minimum percentage difference between two values to warrant recording to the history.
Example: if the "CHNG" item is set to 10%, a difference between two values of 10% or greater will record an event to the history log.

MENU Level 1	MENU Level 2	MENU Level 3	MENU Level 4	MENU Level 5	Meaning
			EXIT		
4. SETTING	**5. DATALOG**	**CHAN. THC**	**CHNG 10%**		Change in limiting value: 5...100 %
		CHAN. U.12	OVWR no		Overwrite full memory: yes or no
		CHAN. U.1E	DELETE	DEL. no	delete data logger: yes or no
		CHAN. U.2E	EXIT		
		CHAN. Z			
		CHAN. R			
		CHAN. I.1			
		CHAN. I.2			
		CHAN. I.3			

4.6.14 Menu: SETTING / INTERFACE (Bus address)

This menu controls the BMS bus address of the LIM2010. In most cases, this option should be set to 1.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
4. SETTING	**6. INTRFCE**	**ADR. 1**	setting range: 1...90
		EXIT	

4.6.15 Menu: SETTING / CLOCK

Settings here relate to the time and date.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
4. SETTING	**7. Clock**	**Tm 10.34 A**	Time: am/pm
		Dy 12/23	Date: month/day
		Yr 2009	Year
		DST auto	Daylight saving time: auto/off (North America time zones only)
		EXIT	

4.6.16 Menu: SETTING / PASSWORD

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
4. SETTING	**8. PASSWRD**	**PSWD *****	Password range: 000...999 Factory setting 807
		LOCK off	Password protection activated (on) or deactivated (off)
		EXIT	

4.6.17 Menu: SETTING / FACTORY SETTING

This menu option will reset the device back to factory defaults.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
4. SETTING	**9. FACT.SET**	**F.SET no**	Factory setting deactivated
		F.SET yes	Factory setting will be restored

WARNING

Once the device is reset to factory defaults, it cannot be restored to any previous state automatiically. Any important changes to settings must be re-entered.

4.6.18 Menu: SETTING / SERVICE

This menu is intended for manufacturer service only.

4.6.19 Menu: CONTROL / TEST (carrying out tests via the menu)

By means of this menu all MKs with bus capability are able to enforce a device self test on the LIM2010.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
5. CONTROL	**1. TEST**	**TEST no**	test deactivated
		TEST yes	Test will be activated

4.6.20 Menu: CONTROL / COMMUNICATION TEST (carrying out tests via the menu)

This function enables testing of the RS-485 communication bus between the LIM2010 and other bus compatible devices.

MENU Level 1	MENU Level 2	MENU Level 3	Meaning
		EXIT	
5. CONTROL	**2. COM.TEST**	**1.THC**	Sending THC alarm message via BMS bus
		2.LOAD	Sending overload alarm message via BMS bus
		3.U.12	Sending overvoltage alarm message via BMS bus
		6.Z	Sending low impedance alarm message via BMS bus
		7.R	Sending low resistance alarm message via BMS bus
		9.TEMP	Sending overtemperature alarm message via BMS bus
		11.SYS	Sending system fault alarm message via BMS bus
		EXIT	

4.6.21 Menu: INFO

This menu option displays important information regarding the LIM2010's hardware and software.

MENU Level 1	MENU Level 3	Meaning
	EXIT	
6. INFO	**LIM2010**	Device type
	OPT -DCF	Option of the device
	D301 V1.0x	Software version of measurement technique
	D306 V1.0x	Communication software version
	EXIT	

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5. Periodic Testing

BENDER recommends annual testing of the LIM2010 and the isolated power system it protects. Consult the manufacturer or a local representative for more information.

Additionally, BENDER recommends pressing the TEST button monthly to ensure proper operation of the line isolation monitor.

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6. Messages from the BMS (RS-485) communication bus

6. 1 Alarm messages

Alarm messages are created when one or more of the alarms become active. Depending on the type of device, these may be alarm values, a device's status, or an error message. These messages are controlled by the device in the system designated as the master. For details about error codes, refer to page 47.

Channel	Meaning
1	Total hazard current, in mA
1	Bad ground connection
1	Bad system connection
2	Transformer overload, in %
2	Short circuit at CT connection
2	Bad CT connection
3	Undervoltage between L1 and L2, in V
3	Overvoltage between L1 and L2, in V
6	Impedance Z_F in kΩ
7	Resistance R_F in kΩ
9	Transformer overtemperature
10	Ground fault location in operation
11	Internal device error

6. 2 Operating status messages

Operating status messages contain general status information about the system. These messages are continuously generated. These messages are interpreted by the device in the system designated as the master.

Channel	Meaning
1	Total hazard current, in mA
2	Transformer overload in %
3	Voltage between L1 and L2, in V
4	Voltage between L1 and Ground, in V
5	Voltage between L2 and Ground, in V
6	Impedance Z_F in kΩ
7	Resistance R_F in kΩ
8	Leakage capacitance in nF

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7. Technical data

7.1 LIM2010

( )* = Factory setting

Insulation coordination acc. to IEC 60664-1/ UL1022

Rated insulation voltage ..... AC 250 V
Rated impulse voltage / pollution degree ..... 2.5 kV / III
Voltage test acc. to IEC61010-1 and UL1022 ..... 2.0 kV

Supply voltage

Supply voltage U_s ..... = U_n
Power consumption ..... < 22 VA

Isolated power system being monitored

Nominal voltage U_n ..... AC100…240V
Operating range of U_n ..... 85 %...110 %
Rated frequency 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
EDS mode:
Monitor Hazard Current MHC ..... < 950 µA
Test cycle/idle time ..... 2 s / 4 s

Voltage monitoring

Response value undervoltage/ overvoltage (< U/>U) ..... 80…300 V (off)*
Response tolerance ..... ±3 %
Hysteresis ..... 5 %

Load current monitoring ("C" option)

Response value ..... 10…200 A (off)*
Response tolerance ..... ±5 %
Hysteresis 4%

Temperature monitoring

Response value (permanently set) ..... 4 kΩ
Release value ..... 1.6 kΩ
PTC resistor acc. to DIN 44081 ..... max. 6 connected in series

Adjustable time delays (do 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, multifunctional
Measured value THC ..... 0.0…9.9 mA
Operating uncertainty ..... +7 %, ±0.1 mA
Measured value load current (as a percentage of the set response value) 10…199 %
Operating uncertainty ..... ±5%, ±0.2 A
Measured value mains voltages ..... 10…300 V
Operating uncertainty ..... ±5%, ±2 V
Measured value impedance Z ..... 0…1000 kΩ
Operating uncertainty ..... ±5 %, ±1 kΩ
Measured value resistance R ..... 2…1000 kΩ
Operating uncertainty Z ~ R ..... ±20%, ±1 kΩ
Measured value leakage capacitance C ..... 0…500 nF
Operating uncertainty Z ~ X_C ..... ±20 %, ±5 nF
(at Z < 2 kΩ ==> no indication of R and C !)
Measured value load current ..... 0.5A…250 A
Operating uncertainty ..... ±5%, ±0.2 A
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

Current output M+/M- for measuring instruments MK2000M… ..... 0…400 µA
Operating uncertainty ..... ±10 %
Output RI1, 12VDC COM ..... 12 V / 200 mA
RI2, SAFE, HAZARD, TEST ..... max. 4 x MK2000(C)(P)
Cable length ..... ≤ 32.8 ft

Serial interface

Interface A-B / Protocol ..... RS-485 / BMS
Baud rate ..... 9.6 kBit/s
Cable length ..... ≤ 3937 ft
Recommended cable (shielded, twisted pair, 1 end grounded) .... J-Y(St)Y 2x0.8
Terminating resistor ..... 120 Ω(0,25 W) connectable via DIP switch (off)*
Device address, BMS bus ..... 1…90, (1)*

Switching elements

Number ..... 2 SPDT contacts
Operating principle ..... Normally energized or de-energized (N/E operation)*
Electrical endurance ..... 10,000 cycles
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 rating ..... 1 mA at AC / DC ≥ 10 V
Relay 2:
Utilization category DC-12DC-12DC-12
Rated operational voltage ..... AC250 V24 V110 V220 V
Rated operational current ..... 2 A1.2 A0.4 A0.25 A
Minimum contact rating ..... 1 mA at AC / DC ≥ 10 V

Environment/EMC

EMC ..... IEC 61326
Operating temperature ..... -10 °C...+50 °C
..... +14 °F...+122 °F
Storing temperature ..... -25 °C...+70 °C
..... -13 °F...+158 °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

Connection type ..... Molex plug
..... 15-pole, type 03-09-2159
..... 12-pole, 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
Type of enclosure ..... enclosure for panel mounting
Screw fixing ..... Qty. 4 #4-40 Oval head Black Oxide Finished
Software version D301 V1.0x
Software version D306 V1.0x
Weight ..... ≤ 1.21 lb
( )* = Factory setting

7. 2 Connector plate

CP-LIM2010

Cable length ..... 20″
Terminal strip ..... 22 terminals
Connector ..... 15 pin Molex and 12 pin Molex
Conductor size ..... 22…12 AWG
Screw fixing ..... 6-32 x 1/2 slotted oval head machine screw SS
Tightening torque ..... 8 lb In.
Mounting orientation ..... as desired
Weight ..... approx. 7 oz.

7. 3 Current transformers STW3, STW4, SWL-100A

Insulation coordination according to IEC 60664-1:

Rated voltage U_m (STW3/4)..... AC 720 V
Rated voltage U_m (SWL-100A) ..... AC 600 V
Rated impulse voltage U_{isol} (STW3/4) ..... 4 kV
Rated impulse voltage U_{isol} (SWL-100A) ..... 2.2 kV

Measuring circuit

Max. rated primary current (STW3/4) ..... 100 A / 200 A
Max. rated primary current (SWL-100A) ..... 100 A
Min. rated primary current (STW3/4) ..... 1 A / 2 A
Min. rated primary current (SWL-100A) ..... 0.1 A
Nominal frequency ..... 50…400 Hz

General data

Ambient temperature, during operation (STW3/4) ..... 0 °C…+85 °C
Ambient temperature, during operation (SWL-100A) ..... -20 °C…+50 °C
Operating mode ..... continuous operation
Position ..... any position
Connection ..... Faston plug 6.3 x 0.8 mm / screw terminals

Type of connection to current transformer

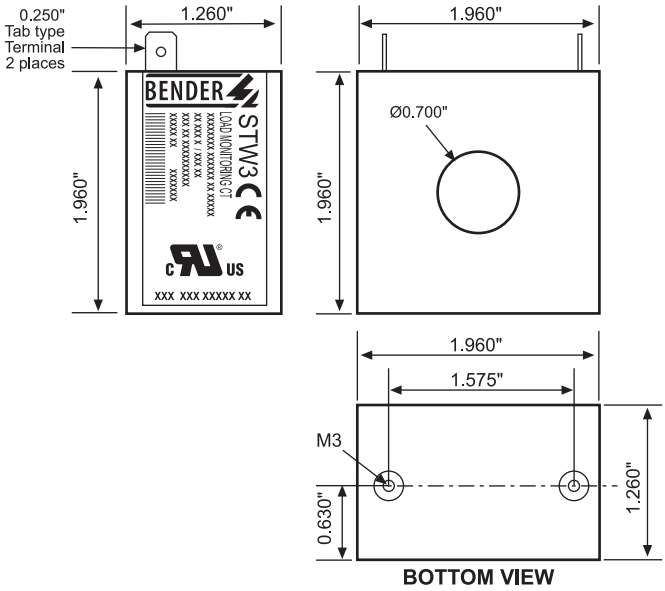
Single wires ≥ AWG 18 (0.75 mm^2)..... up to 3 ft
Single wires, twisted ≥ AWG 18 (0.75 mm^2) ..... up to 32 ft
Shielded cable ≥ AWG 19 (0.6 mm^2) (1 end grounded) ..... up to 131 ft
Mounting ..... screw fixing M3 / zip ties
Flammability class UL94V-0

7. 4 Error codes and troubleshooting

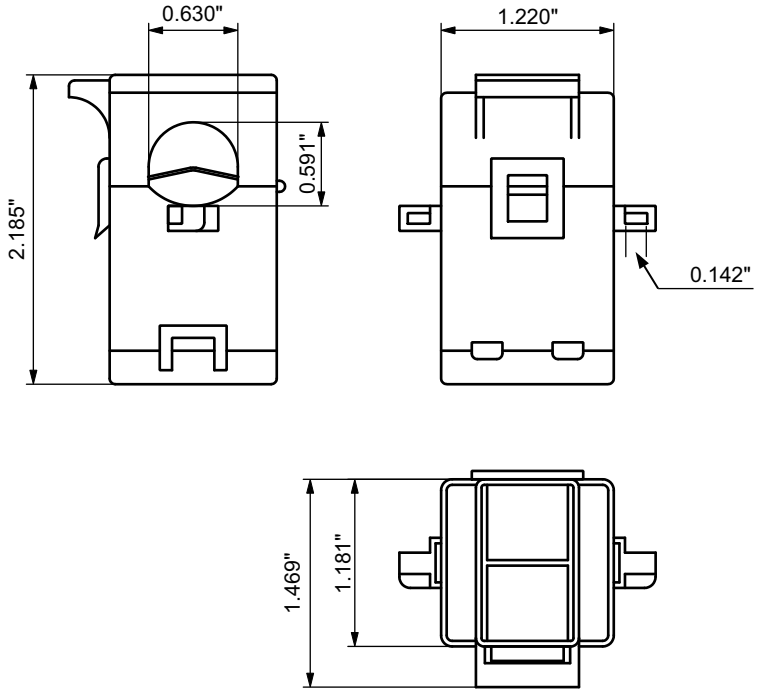
Error code	Meaning
ERROR 0.10	BAD CT CONNECTION CT interruption Action: Check the connection of the current transformer to the connector plate. NOTE: The STW-100A current transformer does not activate this alarm. Ensure proper connections if this device is being used. The error will automatically clear itself when the error is resolved.
ERROR 0.20	CT SHORT CURCUIT Short circuit CT Action: Check the current transformer for a possible short circuit. The error will automatically clear itself when the error is resolved.
ERROR 0.30	BAD GROUND CONNECTION LIM GND/GND2 monitoring Action: Ensure that both the LIMGND and GND2 connections are not interrupted. The error will automatically clear itself when the error is resolved.
ERROR 0.40	BAD SYSTEM CONNECTION Indicates the system voltage does not fall within the threshold required by the LIM2010, and that one of the following has occured: < 85 V, > 265 V Nominal frequency fault at 50 Hz or 60 Hz: ≥ ±3% Action: Ensure that L1 and L2 are properly connected to the system. Ensure that the voltage and frequency of the system being monitored fall within the limits of the LIM2010. The error will automatically clear itself when the error is resolved.
ERROR 2.10	NO MASTER No BMS (communication bus) master exists. Even if RS-485 communication is not being used, the LIM2010 must be assigned an address of 1. Action: If the LIM2010 is connected to a BMS bus network, ensure that there is one approved device on the network set to address 1. If RS-485 communication is not being employed, set the LIM2010 to address 1. Note: The MK2000CBM remote may not be set to address 1. The error will automatically clear itself when the error is resolved.
ERROR 2.20	RS-485 ERROR BMS bus error. Action: Ensure that no two devices on the RS-485 network have the same BMS address set. Check RS-485 wiring. The error will automatically clear itself when the error is resolved.
ERROR 8.80	BATTERY LOW The backup battery for the built-in clock is discharged. Action: Enter the main menu. Check the time and date settings, and reset them if required. The battery will then recharge during normal operation. The error will automatically clear itself when the error is resolved.
ERROR ...	All other error codes Action: Contact the manufacturer.

7. 5 Dimensions: STW3, STW4, SWL-100A

STW3 / STW4
All dimensions in inches



SWL-100A
All dimensions in inches



7.6 Ordering information

Product Type	Description	Approval	Article No.
LIM2010	100...240 V / 1-phase	UL Listed	B 9207 5021
Remote indicator			
MK2000-G1	Mute	UL Listed	B 5213 00002
MK2000-G2	Mute	UL Listed	B 5213 00007
MK2000P-G1	Mute + Test	UL Listed	B 5213 00188
MK2000P-G2	Mute + Test	UL Listed	B 5213 00268
MK2000C-G1	Mute + Overload	UL Listed	B 5213 00020
MK2000CP-G1	Mute + Overload + Test	UL Listed	B 5213 00021
MK2000CBM-G2	Mute + Overload + Test + Digital Metering	UL Listed	B 5213 00022
Connector plate			
CP-LIM2010	LIM and remote connections	UL Recognized	B 5111 0000 1
Current transformer			
STW3	Up to 100 A load current	UL Recognized	B 9802 1000
STW4	Over 100 A load current	UL Recognized	B 9802 1001
SWL-100A	Up to 100 A load current (split-core type)	UL Recognized	B 9802 1002
Accessories			
LIM/GFCI Tester LT3000	Device for LIM testing		B 5213 00004

Local Service Representative

Name: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ _ Fax: _____

Note: These instructions must be framed and placed in a location recommended by the local inspection authority for quick reference.

Bender Inc.

USA:
700 Fox Chase
Coatesville, PA 19320
Toll Free: 800-356-4266
Phone: 610-383-9200
Fax: 610-383-7100

Canada:
5 Edvac Drive, Unit 14
Brampton, ON L6S 5P3
Toll Free: 800-243-2438
Phone: 905-799-0840
Fax: 905-799-3051

E-mail: info@bender.org
Web: http://www.bender.org

BENDER