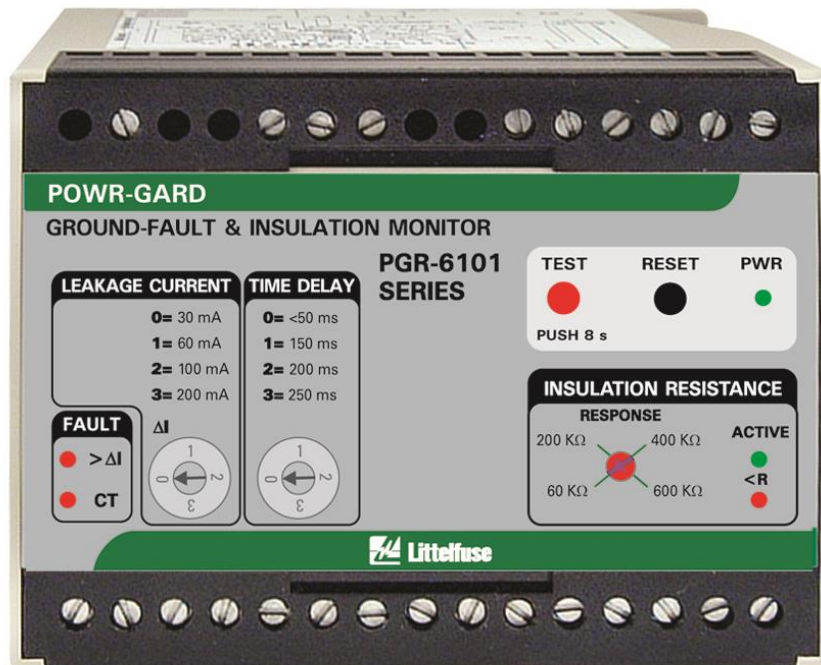


# PGR-6101 MANUAL

## GROUND-FAULT & INSULATION MONITOR

Revision 0-C-041918



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## 1. GENERAL

The PGR-6101 Ground-Fault & Insulation Monitor can detect a motor ground fault whether the motor is running (Online mode) or stopped (Offline mode), and can be used to protect a motor supplied by a solidly grounded, resistance-grounded, or ungrounded system. On an ungrounded system, use only the Offline mode.

On grounded systems, a current transformer (CT) is used to detect ground-fault current as low as 30 mA when the motor is running, and insulation resistance is measured to detect a fault when the motor is stopped. Online or Offline mode is selected with a digital input connected to a starter auxiliary contact.

In the Online mode, ground-fault current is sensed by a PGC-5000-series zero-sequence CT. The trip level of the ground-fault circuit is selectable from 30 to 200 mA. Trip time is selectable from <50 to 250 ms. Additional current-detection features include harmonic filtering, a relay output that can operate in the fail-safe or non-fail-safe mode, CT-connection detection, LED trip, power, and open-CT indication, autoreset or latching trips with front-panel and remote reset, a test button, and a 0- to 1-mA-analog output.

In the Offline mode, insulation-resistance monitoring is enabled, with a selectable 60- to 600-k $\Omega$  alarm-setting range. Additional insulation-monitoring features include a relay output that can operate in the fail-safe or non-fail-safe mode, LED active and low-resistance indication, and a 0- to 1-mA-analog output.

The PGR-6101 can be directly connected to a supply up to 1.3 kV. For systems from 1.3 to 5 kV, use a PGH-5000 High Tension Coupler. For systems from 5 kV to 6 kV, use a PGH-6000 High Tension Coupler.

## 2. OPERATION

### 2.1 OUTPUT RELAY OPERATING MODE

In the fail-safe mode the output relays energize when power is applied and the ground-fault and insulation-resistance circuits are not tripped. Fail-safe mode is the factory setting.

For non-fail-safe operation connect terminals 19-20 and 22-23. The respective output relay will energize when a fault occurs. See Fig. 2.

### 2.2 PGR-6101 OPERATING MODE

Connect terminals 27 and 28 to a normally closed (Form B) auxiliary starter contact. When terminals 27 and 28 are open, Online mode (insulation monitoring off) is selected and when terminals 27 and 28 are connected, Offline mode (insulation monitoring active) is selected.

### 2.2.1 ONLINE OPERATION

When the monitor is running, the PGR-6101 in conjunction with a PGC-5000-series zero-sequence current sensor operates as a sensitive ground-fault relay.

### 2.2.2 OFFLINE OPERATION

The PGR-6101 changes mode by means of an auxiliary contact on the main contactor when the motor is off. It becomes an insulation-resistance monitor and imposes a small dc voltage to the motor windings and supply cable from the motor starter. Leakage to ground is detected.

## 2.3 FRONT-PANEL CONTROLS

### 2.3.1 GROUND-FAULT TRIP LEVEL

The Leakage Current  $\Delta I$  selector switch is used to set the ground-fault trip level from 30 to 200 mA. For ground-fault detection, the switch setting must be set substantially below the prospective ground-fault current. To avoid sympathetic tripping, the switch setting must be above the charging current of the protected feeder.

### 2.3.2 GROUND-FAULT TRIP TIME

The PGR-6101 has a definite-time trip characteristic. In tripping systems, the TIME DELAY selector is used to set the ground-fault trip time for coordination with upstream and downstream ground-fault devices. Trip time is selectable from < 50 ms to 250 ms. Coordination requires the same trip level for all ground-fault devices in a system and the trip time to progressively increase upstream. The amount of equipment removed from the system will be a minimum if the first ground-fault device to operate is the one immediately upstream from the fault.

### 2.3.3 INSULATION RESISTANCE RESPONSE

The PGR-6101 insulation resistance function has an adjustable alarm range of 60 to 600 k $\Omega$ . There is no selectable time delay. The unit will operate in less than three seconds.

### 2.3.4 RESET

The front-panel RESET button is used to reset latching trips. After a fault has been cleared, cycling the supply voltage will also reset the PGR-6101.

To use the PGR-6101 in autoreset mode, connect terminals 18-19 and 21-22. See Fig. 2.

The reset function is not instantaneous. Press the RESET button for several seconds.

### 2.3.5 TEST

The TEST button will test both leakage-current and insulation-resistance circuits regardless of the selected operating mode. Press the TEST button for at least eight seconds to complete test. All LED's will light and relay contacts will change to fault/alarm state. In the default mode (latching), the tripped state will remain until reset. Allow eight seconds before operating the RESET push button.

## 2.4 FRONT-PANEL INDICATION

### 2.4.1 POWER

The green LED labelled PWR indicates presence of supply voltage.

### 2.4.2 >ΔI

The red LED labelled >ΔI indicates a ground-fault trip.

### 2.4.3 CT

The red LED labelled CT indicates that a PGC-5000-series current sensor is not connected. See Section 2.8.

### 2.4.4 ACTIVE

The green LED labelled ACTIVE indicates that the Offline monitoring function is active. The insulation monitoring or lockout function is active when terminals 27 and 28 are connected. See Section 2.2.

### 2.4.5 <R

The red LED labelled <R indicates a low resistance.

## 2.5 ANALOG OUTPUTS

### 2.5.1 OUT I

A non-isolated, 0- to 1-mA output (terminals 24 and 25) indicates ground-fault current sensed by the CT. The full-scale value corresponds to the ground-fault trip setting. For example, if the ground-fault trip setting is 30 mA, then 1 mA output will be indicated when the measured current is 30 mA. The output is linear between zero and full scale. See Figs. 2 and 6.

### 2.5.2 OUT R

A non-isolated, 0- to 1-mA output (terminals 25 and 26) indicates insulation resistance. The metering output relates to an insulation-resistance range of 0 to infinity. See Figs. 2 and 7.

## 2.6 REMOTE TEST

Use external switches to test the current-sensor detection, insulation-monitoring activation, and insulation-monitoring functions. See Fig. 2. Response to a test input can take several seconds.

## 2.7 REMOTE RESET

For remote reset, connect a switch or pushbutton with a normally closed contact between the neutral side of the supply voltage and terminal 5. See Fig. 2.

For an alternate configuration, connect a normally open, double-pole, single-throw switch across terminals 18 and 19, and terminals 21 and 22. A momentary connection across these terminals will reset the PGR-6101.

## 2.8 CT VERIFICATION

A ground-fault trip will occur and the red CT LED will light when a PGC-5000-series CT is not connected to terminals 16 and 17.

## 3. INSTALLATION

**NOTE:** Mounting, terminal block connections and wiring must conform to applicable local electrical codes. Check all applicable codes prior to installation.

This ground-fault monitoring system consists of a PGR-6101-series Ground-Fault & Insulation Relay, a PGC-5000-series CT, and for systems over 1.3 kV, a PGH-5000 or PGH-6000 High Tension Coupler connected as shown in Fig. 2.

A PGR-6101 can be surface or DIN-rail mounted. See Fig. 1.

Use terminal 6 (L1) as the line terminal for a 120 or 240 Vac supply. Use terminal 7 as the line terminal for a 24 Vac supply. Use terminal 5 (L2/N) as the neutral terminal. Connect terminal 30 to ground.

Pass the phase conductors through the CT window and position them in the centre of the opening (for four-wire and single-phase systems, also pass the neutral conductor through the CT window). Do not pass ground conductors through the CT window. In applications that require shields or drain wires to pass through the CT window, return them through the CT window before connecting them to ground. CT connections are not polarity sensitive. Applications in electrically noisy environments require twisted- or shielded-twisted-pair CT-secondary conductors. Connect the CT-secondary leads to terminals 16 and 17, and connect the shield to terminal 17. See Fig. 3 for PGC-5000-series CT dimensional drawings.

If insulation monitoring is required, connect terminals 27 and 28 to a normally closed contact on the motor starter.

For systems up to 1.3 kV connect terminal 2 to one phase of the load side of the starter.

Connect optional PGA-0500 Analog Current Meter and PGA-0510 Analog Ohm Meter as shown in Fig. 2. Meter outline, dimensions, and cutout size are shown in Figs. 6 and 7.



**3.1 PGH-5000 AND PGH-6000**

For 5-kV and 6-kV systems, connect the PGR-6101 to the monitored circuit with a PGH-5000 and PGH-6000 respectively. See Fig. 4 for PGH-5000 outline and mounting details. See Fig. 5 for PGH-6000 outline and mounting details.

Connect protective-ground terminal (⊕) to ground. Connect terminal E to ground or to PGR-6101 terminal 30, which must be grounded. Connect terminal M to PGR-6101 terminal 29.

(PGR-6101 terminal 2 is not used.) For PGR-6101 to PGH-5000/PGH-6000 distances greater than 10 m (30'), use shielded cable, and connect the cable shield to the second PGH-5000/PGH-6000 terminal E. Connect terminal A to one phase on the load side of the motor starter. See Fig. 2. The PGH-5000/PHG-6000 includes 915 mm (36") of high-voltage conductor.

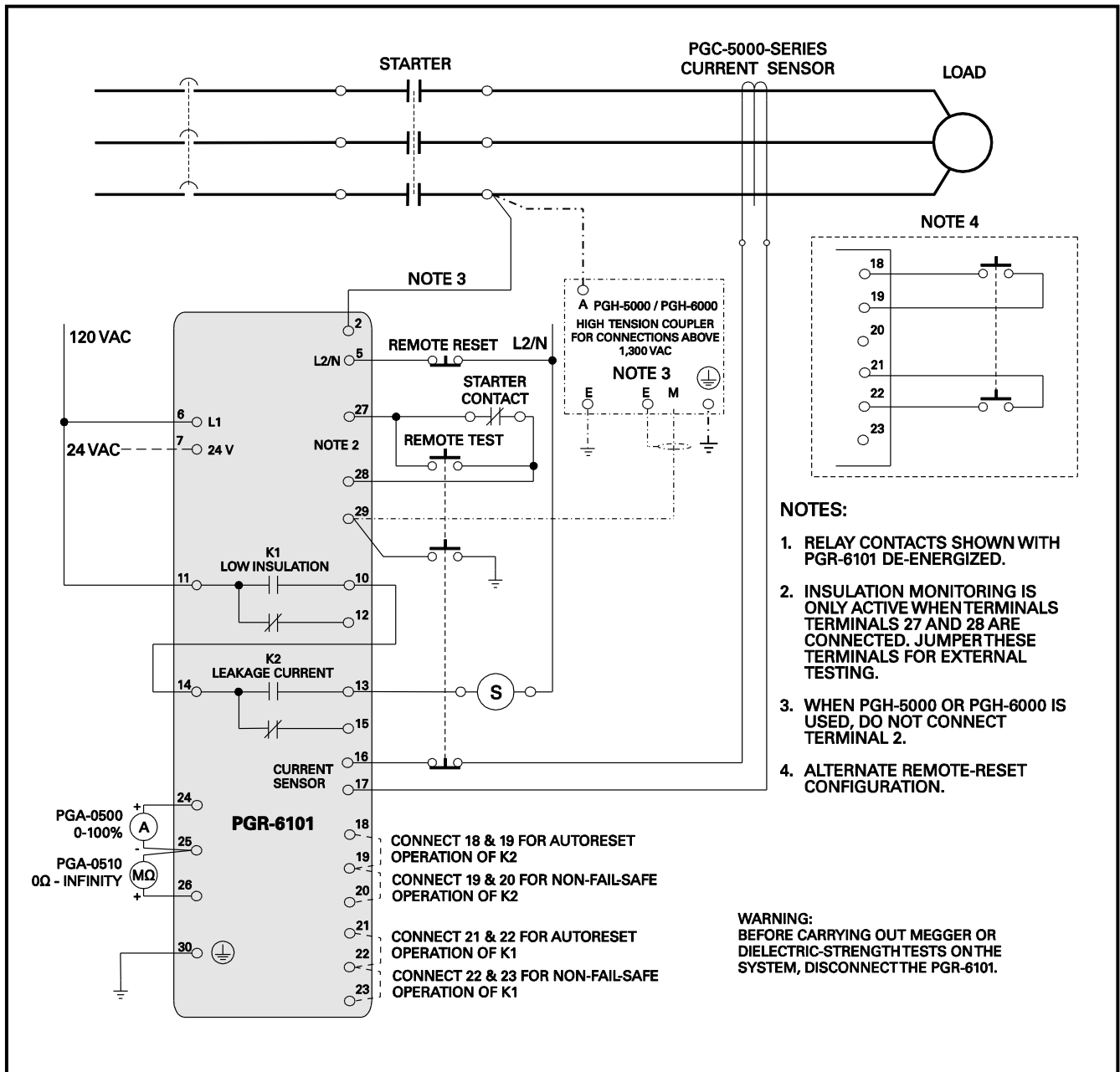


FIGURE 2. Typical Connection Diagram.



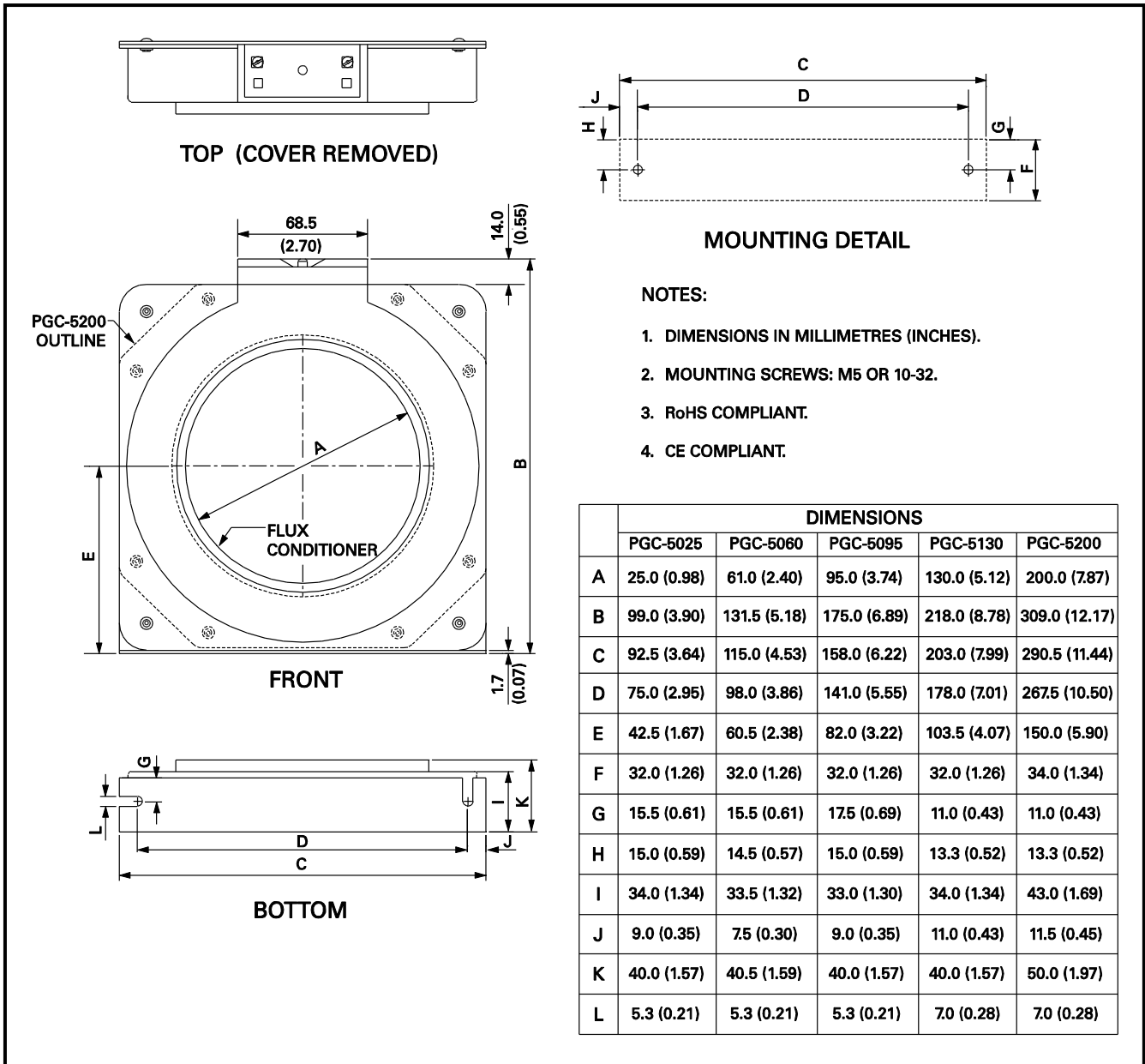


FIGURE 3. PGC-5000-Series Current Sensors.

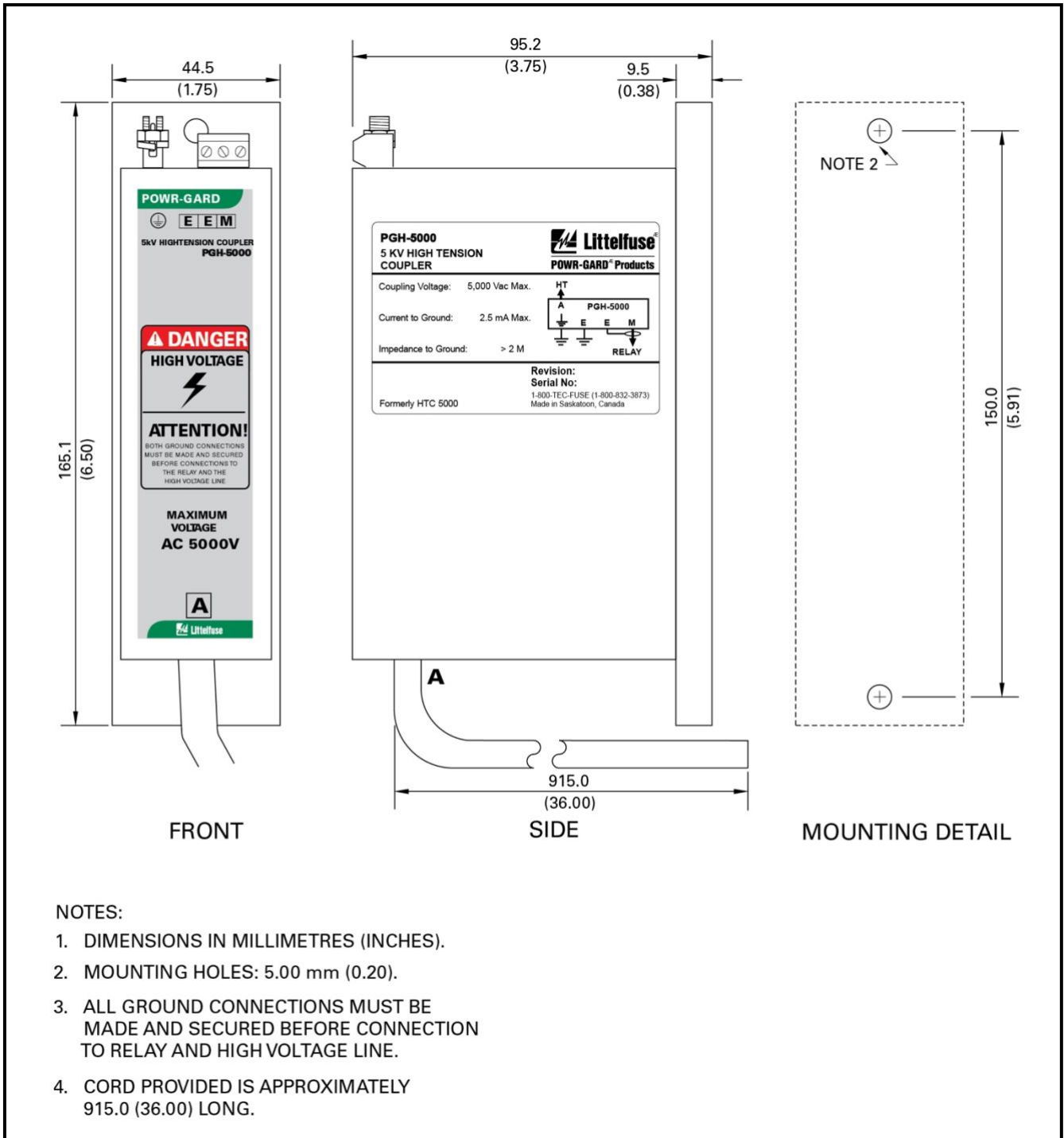


FIGURE 4. PGH-5000 Outline and Mounting Details.

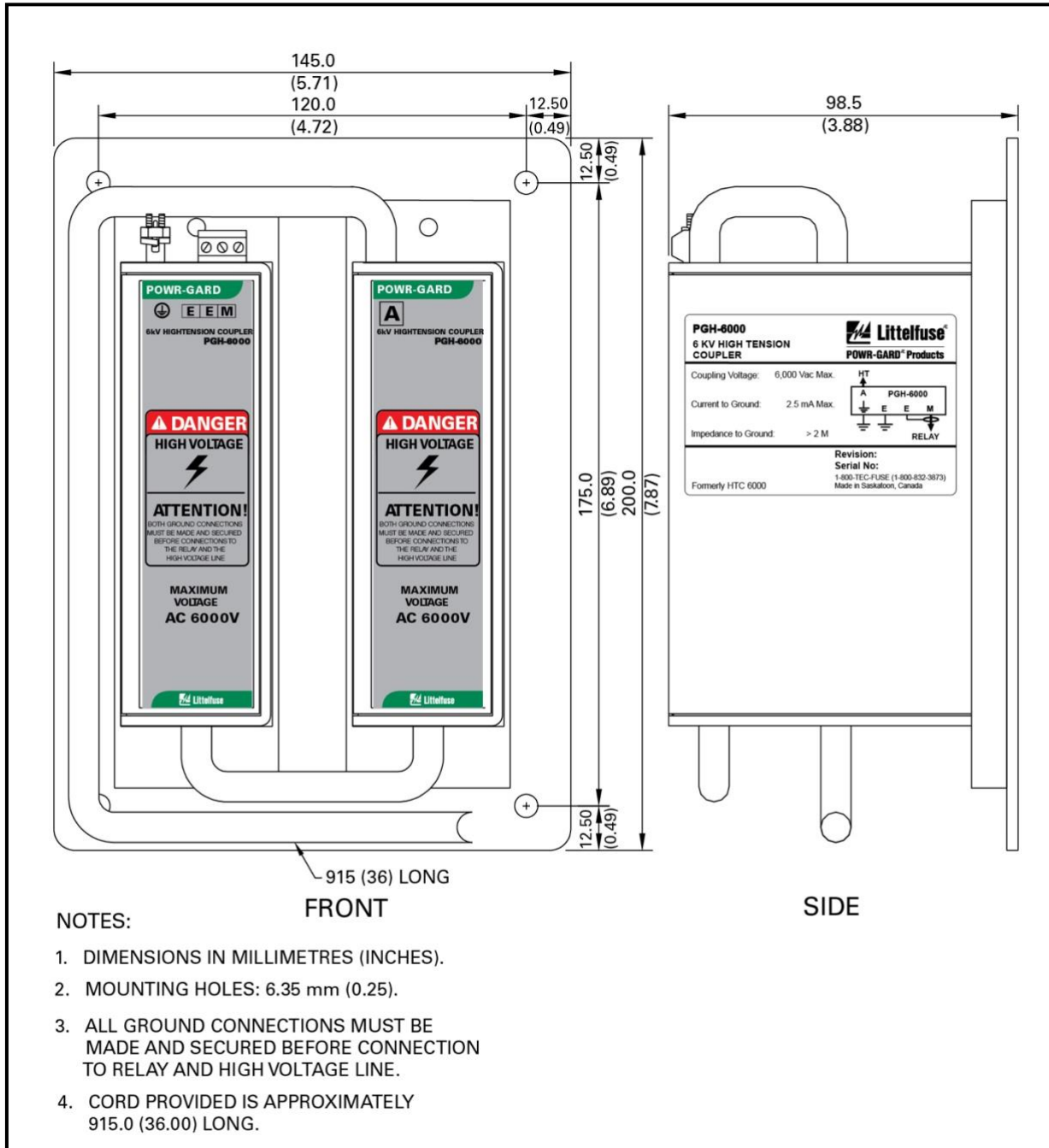


FIGURE 5. PGH-6000 Outline and Mounting Details.

## 4. TECHNICAL SPECIFICATIONS

### 4.1 PGR-6101

Supply:

120 Option ..... 5 VA, 120/24 Vac,  
(+10, -15%) 50/60 Hz

Operation Class ..... Continuous

K1 and K2 Relay Contacts:

Configuration ..... N.O. and N.C. (Form C)

Operating Mode ..... Fail-Safe or  
Non-Fail-Safe

UL Contact Rating ..... 5 A Resistive, 125 Vac

Switching Capacity ..... 625 VA

Supplemental Contact Ratings:

Carry Continuous ..... 5 A, maximum

Break:

30 Vdc ..... 5 A

110 Vdc ..... 0.3 A

Trip Mode ..... Latching or Autoreset

Reset ..... Front-Panel Button and  
Remote N.C. Contact

Test ..... Front-Panel Button and  
Remote Contacts

Terminals ..... Wire Clamping,  
12-22 AWG  
(0.3 to 2.5 mm<sup>2</sup>)  
conductors

Tightening Torque ..... 0.40 N·m (3.54 lbf·in)

Conductor Type ..... Copper, Solid or  
Stranded with  
Ferrules

Conductor Rating ..... 60/75°C

Dimensions:

Height ..... 75 mm (3.0")

Width ..... 100 mm (3.9")

Depth ..... 113 mm (4.4")

Including DIN rail ..... 115 mm (4.5")

Shipping Weight ..... 0.45 kg (1 lb)

Environment:

Operating Temperature ..... -10 to 60°C (14 to  
140°F)

Storage Temperature ..... -40 to 80°C (-40 to  
176°F)

Humidity ..... 85% Non-Condensing

Enclosure Rating ..... IP20

Altitude ..... 2,000 m (6,562 ft)  
maximum

Overvoltage Category ..... II

Pollution Degree ..... 2

Certification ..... UL Listed



UL508 Industrial Control  
Equipment



#### 4.1.1 PGR-6101 ONLINE OPERATION

Trip-Level Settings ( $\Delta I$ ) ..... 30, 60, 100, and  
200 mA

Trip-Time Settings ..... <50, 150, 200, and  
250 ms

Input:

CT ..... PGC-5000-Series

CT Detection ..... Open-Circuit Detection

Analog Output:

Mode ..... Self Powered

Range ..... 0 - 1 mA

Output impedance ..... 5 k $\Omega$  maximum

#### 4.1.2 PGR-6101 OFFLINE OPERATION

Maximum System Voltage:

Direct Connection ..... 1,300 V

With PGH-5000 ..... 5,000 V

With PGH-6000 ..... 6,000 V

Measuring Voltage ..... 12 Vdc

Measuring Current ..... 20  $\mu$ A maximum

DC Resistance ..... 600 k $\Omega$

AC impedance at 50-60 Hz ..... > 1 M $\Omega$

Response-Level Settings ..... 60 to 600 k $\Omega$

Response Delay ..... < 3 s

Maximum Leakage

Capacitance to Ground ..... < 1  $\mu$ F

Maximum Stray Voltage ..... 1,000 Vdc

Analog Output:

Mode ..... Self Powered

Range ..... 0 - 1 mA

Impedance ..... 5 k $\Omega$  maximum

**4.2 PGH HIGH TENSION COUPLERS**

Maximum Line Voltage:

- PGH-5000 .....5,000 Vac
- PGH-6000 ..... 6,000 Vac

Current to Ground ..... 2.5 mA maximum

Terminal M Maximum

Voltage..... 50 Vac

Terminals:

E, E, and M ..... Wire Clamping,  
22 to 12 AWG  
(0.2 to 2.5 mm<sup>2</sup>)  
conductors



..... Wire Clamping,  
10 AWG (5.26 mm<sup>2</sup>)  
maximum

High Tension Lead A ..... 8 AWG (8.36 mm<sup>2</sup>),  
40 kVdc, 915 mm (36")

**5. ORDERING INFORMATION**

**PGR-6101-**

**Supply:**  
**120 – 120- or 24- Vac Supply**

- PGA-0500 .....Analog Percent Current Meter
- PGA-0510 .....Analog Ohm Meter
- PGC-5025 .....Current Sensor,  
25.0 mm (0.98") window
- PGC-5060 .....Current Sensor,  
60.8 mm (2.39") window
- PGC-5095 .....Current Sensor,  
95.0 mm (3.74") window
- PGC-5130 .....Current Sensor,  
130.0 mm (5.12") window
- PGC-5200 .....Current Sensor,  
200.0 mm (7.87") window
- PGH-5000.....5 kV High Tension Coupler
- PGH-6000.....6 kV High Tension Coupler

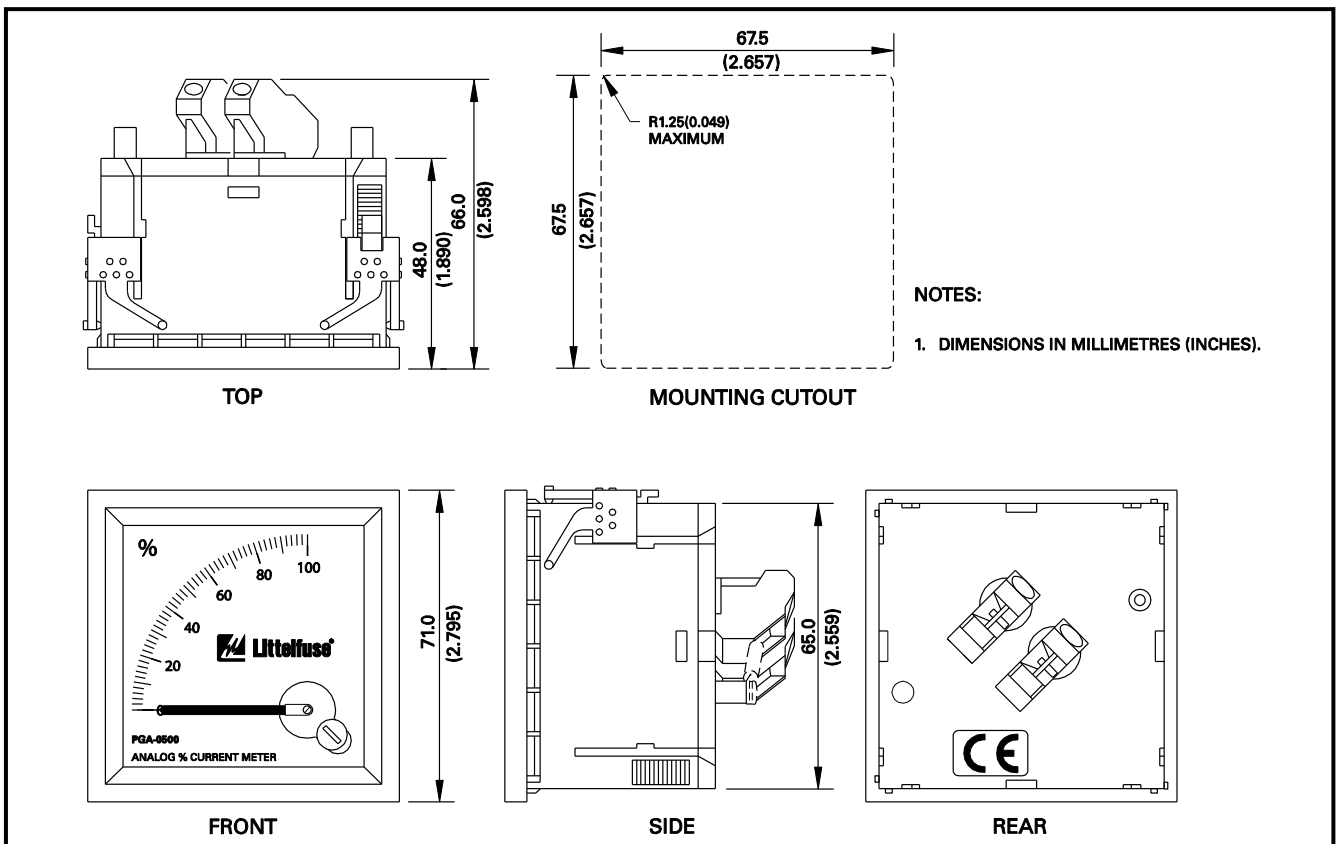


FIGURE 6. PGA-0500 Analog Percent Current Meter.

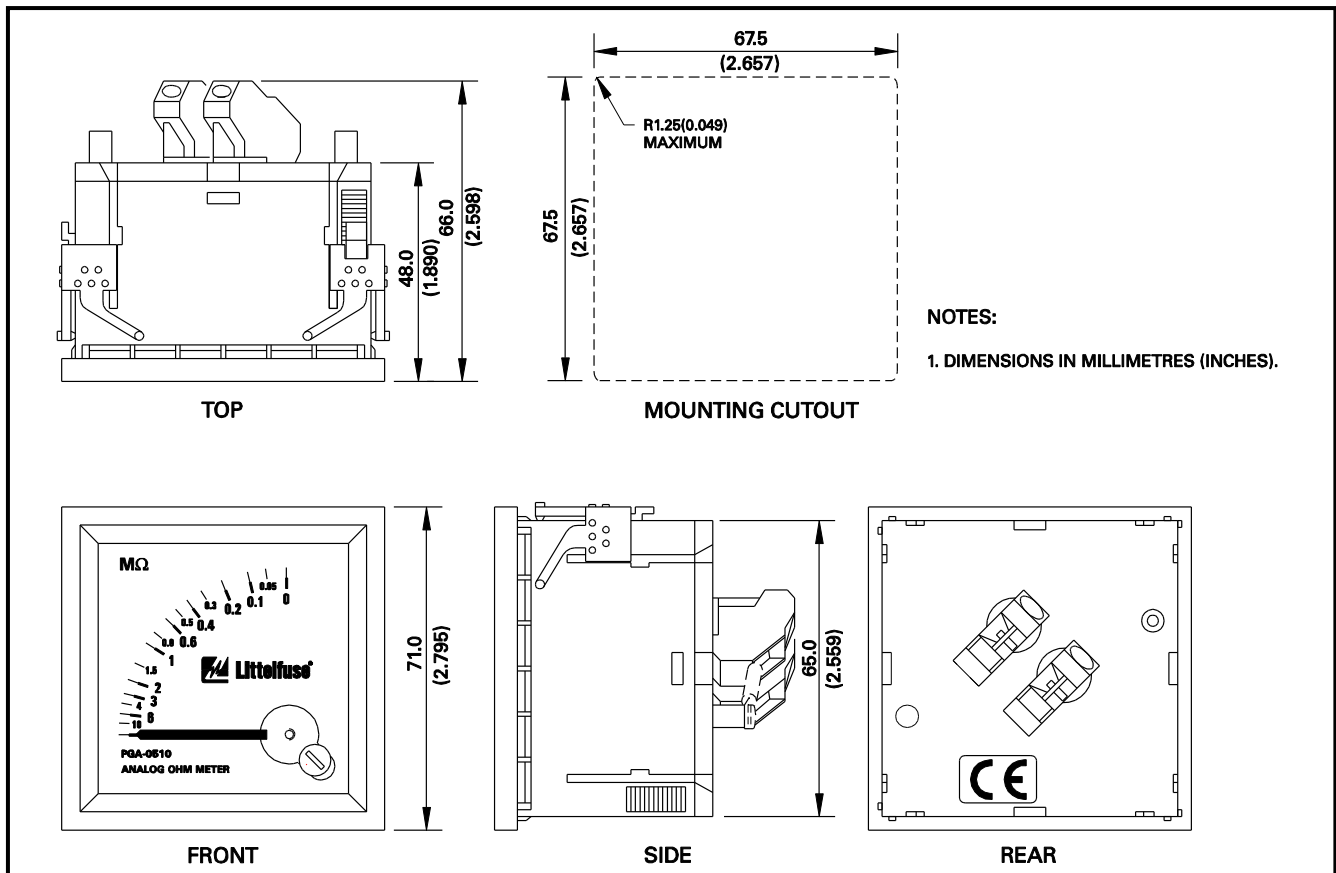


FIGURE 7. PGA-0510 Analog Ohm Meter.

## 6. PERFORMANCE TESTS

### 6.1 GROUND-FAULT TEST

Some jurisdictions require periodic ground-fault performance tests. A test record form is provided for recording the date and the result of the performance tests. The following ground-fault system tests are to be conducted by qualified personnel.

- Evaluate the interconnected system in accordance with the overall equipment manufacturer's detailed instructions.
- Verify proper location of the PGC-5000-series CT. Ensure the cables pass through the CT window. This check can be done visually with knowledge of the circuit. The connection of the current-sensor secondary to the PGR-6101 is not polarity sensitive.
- Verify that the system is correctly grounded and that alternate ground paths do not exist that bypass the current sensor. High-voltage testers and resistance bridges can be used to determine the existence of alternate ground paths.
- Verify proper reaction of the circuit-interrupting device in response to a simulated or controlled ground-fault current. To simulate ground-fault current, use CT-primary current injection. Fig. 8 shows a test circuit using the SE-400 Ground-Fault-Relay Test Unit. The SE-400 has a programmable output of 0.5 to 9.9 A for a duration of 0.1 to 9.9 seconds. Fig. 8 shows the use of resistors that reduce the injected current to 10% of the SE-400 setting. Set the test current to 120% of the PGR-6101 setting. Inject the test current through the CT window for at least 2.5 seconds. Verify that the circuit under test has reacted properly. Correct any problems and re-test until the proper reaction is verified.



**APPENDIX A  
PGR-6101 REVISION HISTORY**

<b>MANUAL RELEASE DATE</b>	<b>MANUAL REVISION</b>	<b>PRODUCT REVISION (REVISION NUMBER ON PRODUCT LABEL)</b>
April 19, 2018	0-C-041918	01
February 6, 2014	0-B-020614	
November 22, 2013	0-A-112213	00

**MANUAL REVISION HISTORY**

**REVISION 0-C-041918**

**SECTION 4**

Specifications added.

**REVISION 0-B-020614**

**SECTION 3**

Fig. 3 updated.

**SECTION 4**

UL Certification and contact rating specifications added.

**REVISION 0-A-112213**

Initial release.

**PRODUCT REVISION HISTORY**

**PRODUCT REVISION 01**

UL Certification.

**PRODUCT REVISION 00**

Initial release.