

# PGR-6100 MANUAL

## GROUND-FAULT & INSULATION MONITOR

Revision 2-C-050818

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## **1. GENERAL**

The PGR-6100 Ground-Fault & Insulation Monitor can detect a motor ground fault whether the motor is running (Online mode) or stopped (Offline mode). The PGR-6100 can also be used to protect a motor that is supplied by a solidly grounded, resistance-grounded or ungrounded system. For ungrounded systems, use only the Offline mode.

Grounded systems use a current transformer (CT) to detect ground-fault currents as low as 10 mA when the motor is running. 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 10 mA to 3 A. Trip time is selectable from <50 ms to 1.0 s. 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, LED power and LED 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 250-k $\Omega$  to 2-M $\Omega$  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-6100 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 a 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-6100 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 is selected (insulation monitoring off). When terminals 27 and 28 are connected, Offline mode is selected (insulation monitoring active).

### **2.2.1 Online Operation**

In Online mode, the PGR-6100 in conjunction with a PGC-5000-series zero-sequence current sensor operates as a ground-fault relay.

### **2.2.2 Offline Operation**

The PGR-6100 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 10 mA to 3 A. 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-6100 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 1.0 s. 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-6100 insulation resistance function has an adjustable alarm range of 250 k $\Omega$  to 2 M $\Omega$ . 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-6100.

To use the PGR-6100 in autoreset mode, connect terminals 18-19 and 21-22. See Fig. 2.

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

### 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 the 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 button.

## 2.4 Front-Panel Indication

### 2.4.1 Power

The green LED labeled "PWR" indicates presence of supply voltage.

### 2.4.2 > ΔI

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

### 2.4.3 CT

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

### 2.4.4 Active

The green LED labeled 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 labeled "<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 button 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-6100.

## 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-6100-series Ground-Fault & Insulation Monitor, a PGC-5000-series CT, and for systems over 1.3 kV, a PGH-5000 or PGH-6000 High Tension Coupler connection, as shown in Fig. 2.

A PGR-6100 can be surface- or DIN-rail mounted. See Fig. 1.

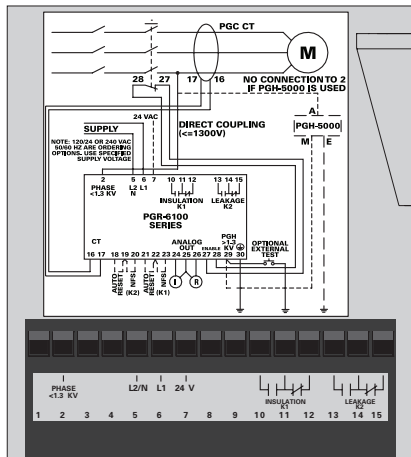
Use terminal 6 (L1) as the line terminal for a 120 or 240 Vac supply. Use terminal 7 as the line terminal for a 24 Vac supply. Use terminal 5 (L2/N) as the neutral terminal. Connect terminal 30 to ground.

Pass the phase conductors through the CT window and position them in the center 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-pair 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.

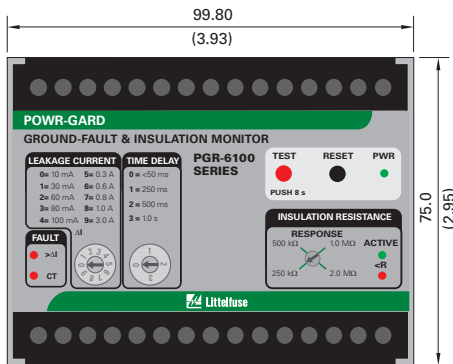
If insulation monitoring is required, connect terminals 27 and 28 to a contact on the motor starter that is normally closed.

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

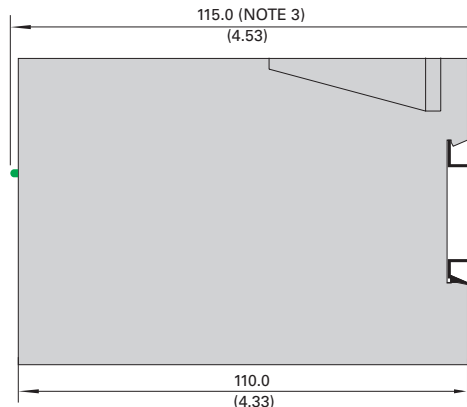
Connect an optional PGA-0500 Analog Current Meter and PGA-0510 Analog Ohm Meter as shown in Fig. 2. Meter outlines, dimensions, and cutout sizes are shown in Figs. 6 and 7.



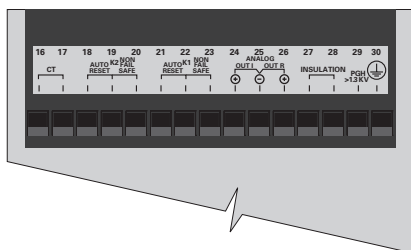
TOP



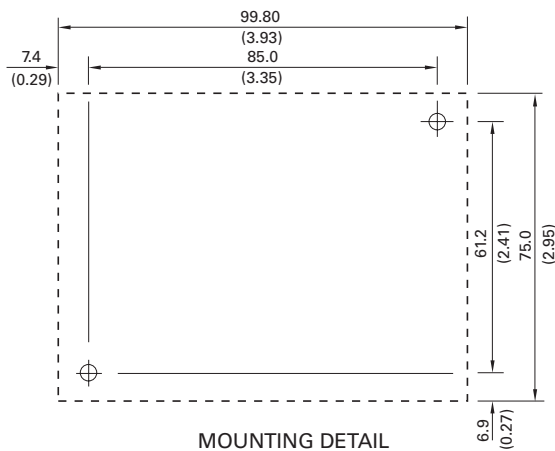
FRONT



SIDE



BOTTOM



MOUNTING DETAIL

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 x 13 OR 8-32 x 0.50.
3. OVERALL DIMENSION WHEN MOUNTED ON DIN EN 50022 35.0 x 7.5 (1.38 x 0.30) TOP-HAT RAIL.
4. 24 V INPUT IS AVAILABLE ONLY FOR THE PGR-6100-120 ORDERING OPTION.

FIGURE 1. PGR-6100 Outline and Mounting Details.

### 3.1 PGH-5000 and PGH-6000

For 5-kV and 6-kV systems, connect the PGR-6100 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-6100 terminal 30, which must be grounded. Connect terminal M to PGR-6100 terminal 29.

For PGR-6100 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 (PGR-6100 terminal 2 is not used). Connect terminal A to one phase on the load side of the motor starter. See Fig. 2. The PGH-5000/PH-6000 includes 915 mm (36") of high-voltage conductor.

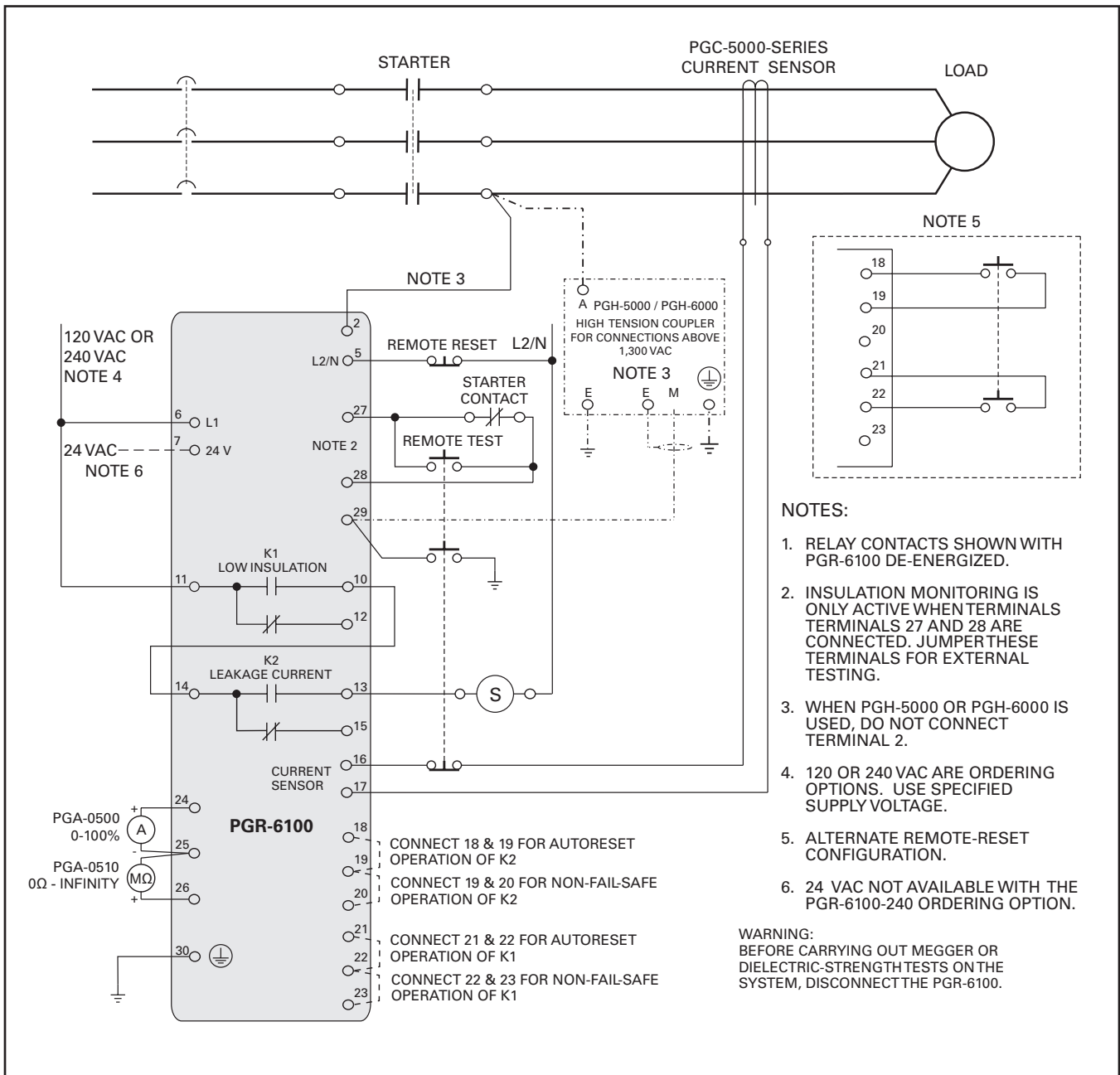


FIGURE 2. Typical Connection Diagram.



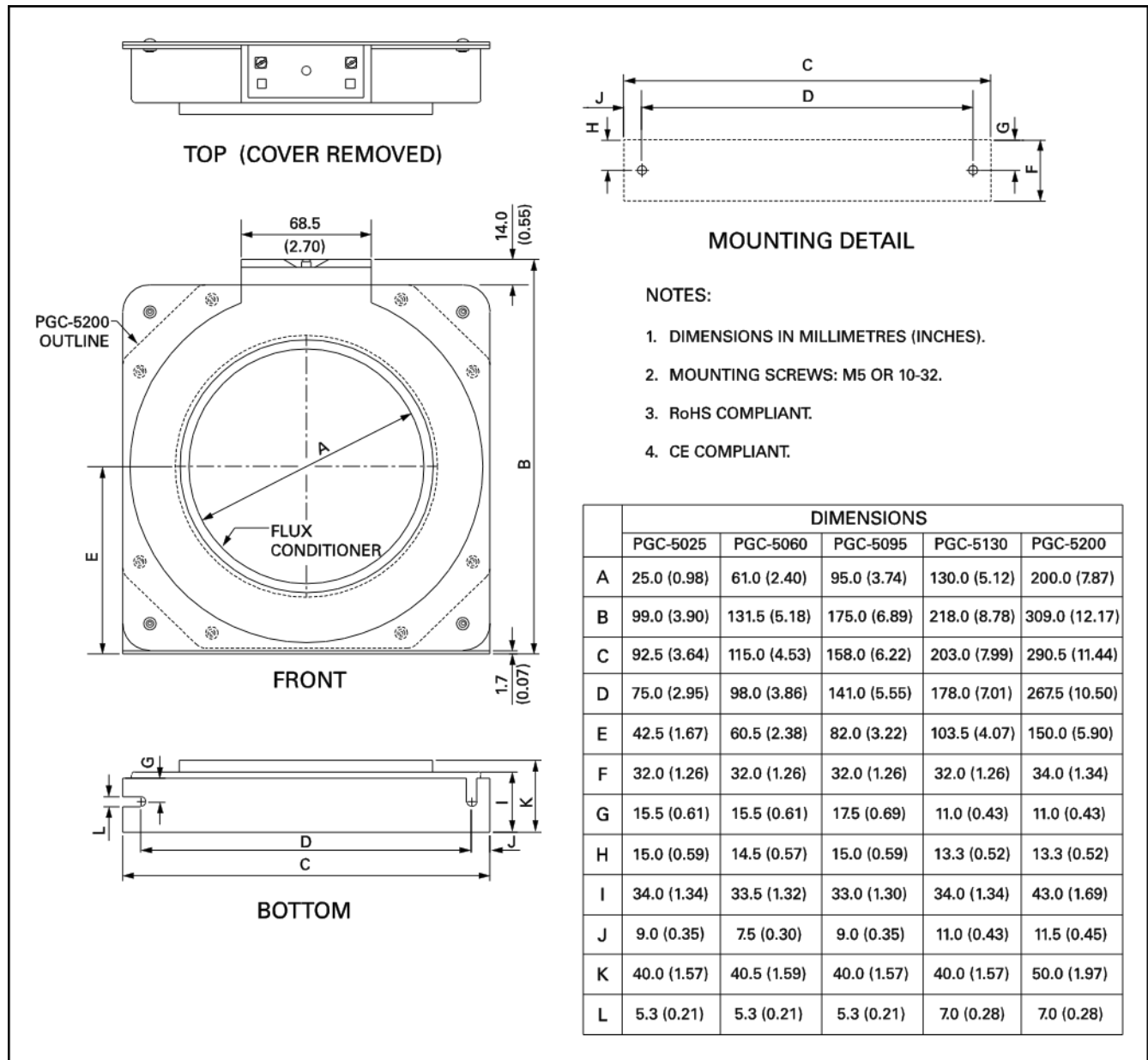


FIGURE 3. PGC-5000-Series Current Sensors.

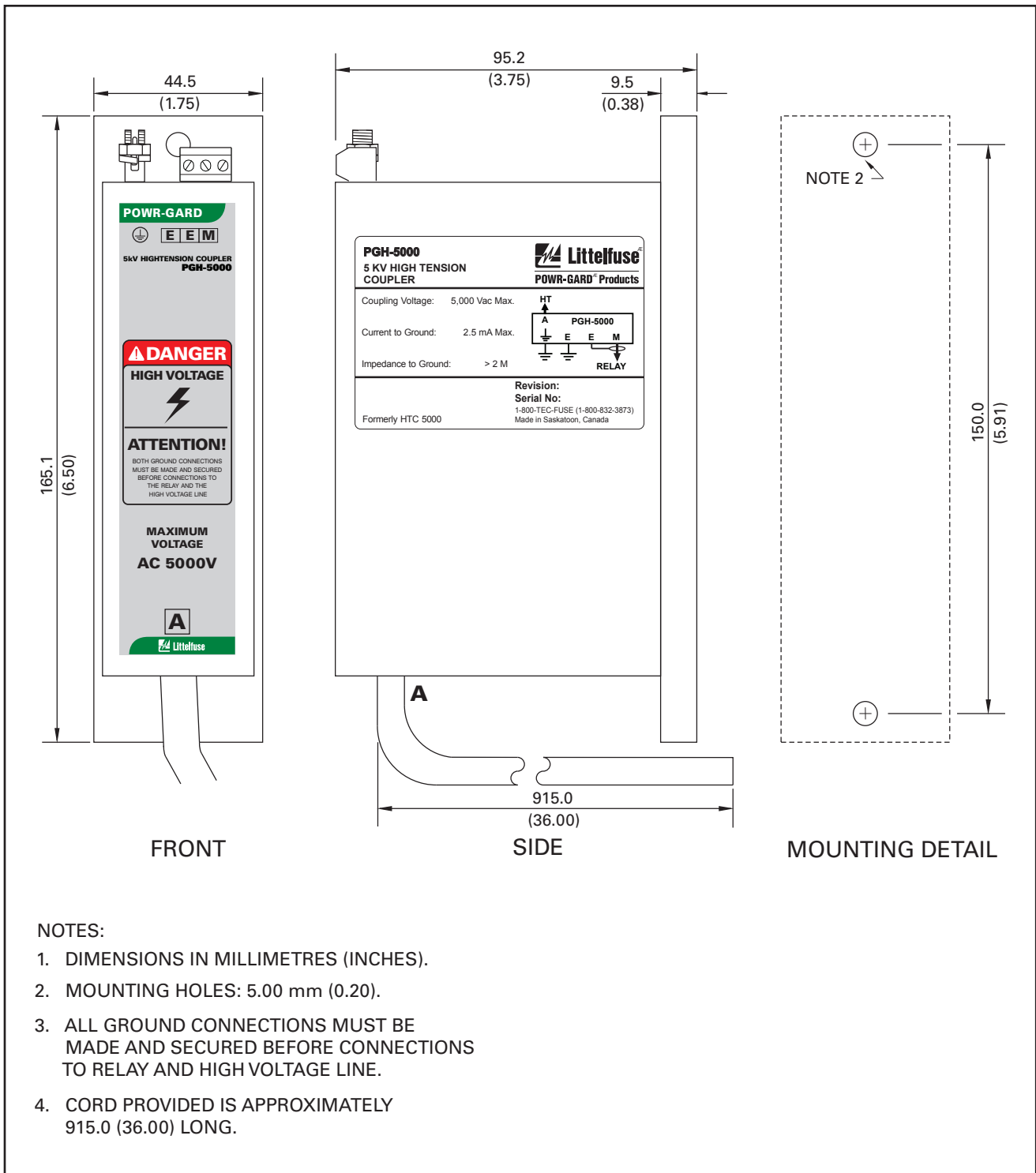


FIGURE 4. PGH-5000 Outline and Mounting Details.

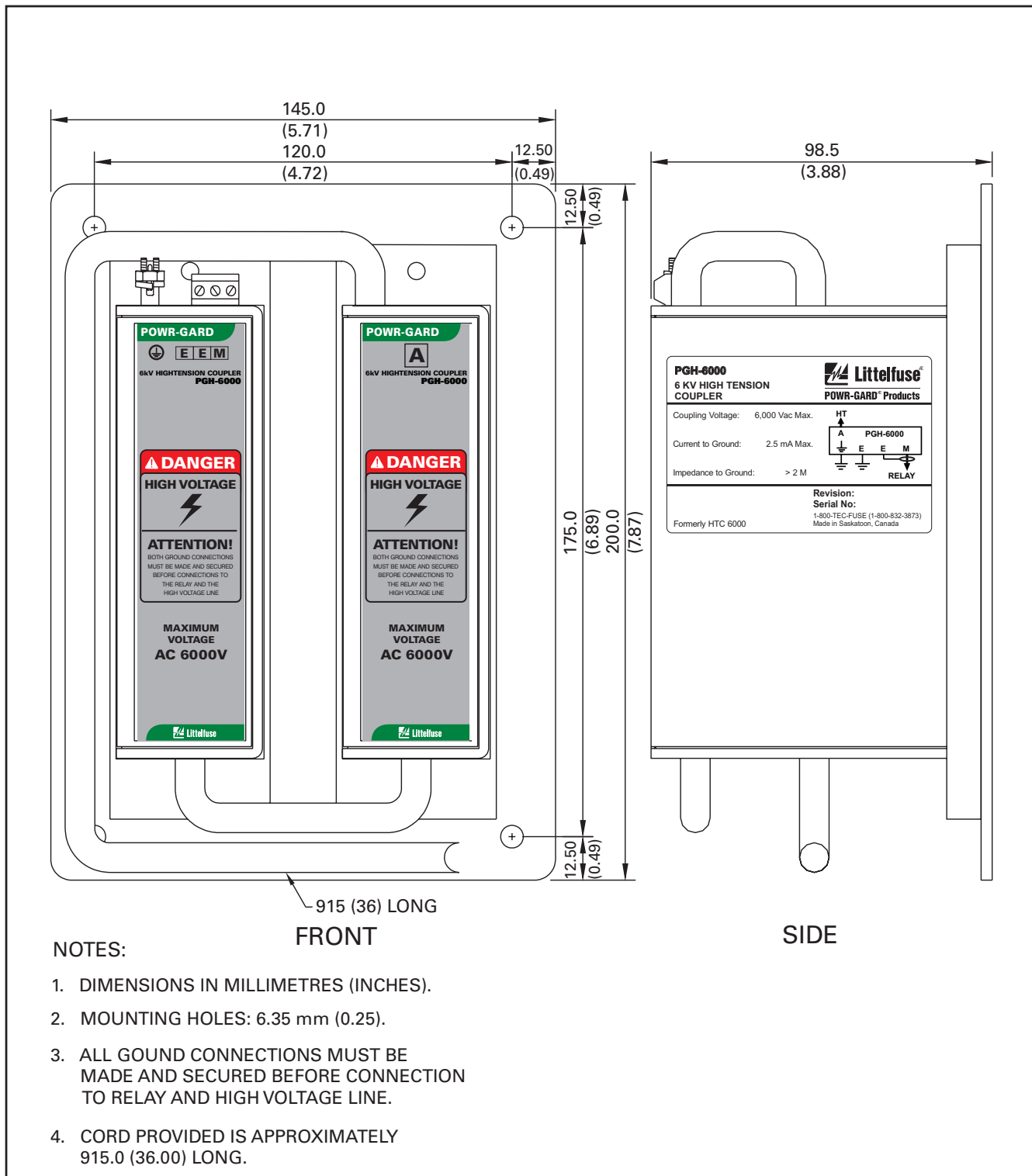


FIGURE 5. PGH-6000 Outline and Mounting Details.

## 4. TECHNICAL SPECIFICATIONS

### 4.1 PGR-6100

#### Supply:

120 Option .....	5 VA, 120/24 Vac, (+10, -15%) 50/60 Hz
240 Option.....	5 VA, 240 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-6100 Online Operation

Trip-Level Settings ( $\Delta I$ ).....	10, 30, 60, 80, 100, 300, 600, 800, 1,000, and 3,000 mA
Trip-Time Settings .....	< 0.050, 0.250, 0.500, 1.0 s

#### 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-6100 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.....	0.250 to 2.0 M $\Omega$
Response Delay.....	< 250 ms

#### 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-6100-**



Supply:

120 – 120- or 24-Vac Supply  
240 – 240-Vac Supply<sup>(1)</sup>

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 (2.40") 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

### NOTES:

<sup>(1)</sup> 240 Vac option is not UL Listed.

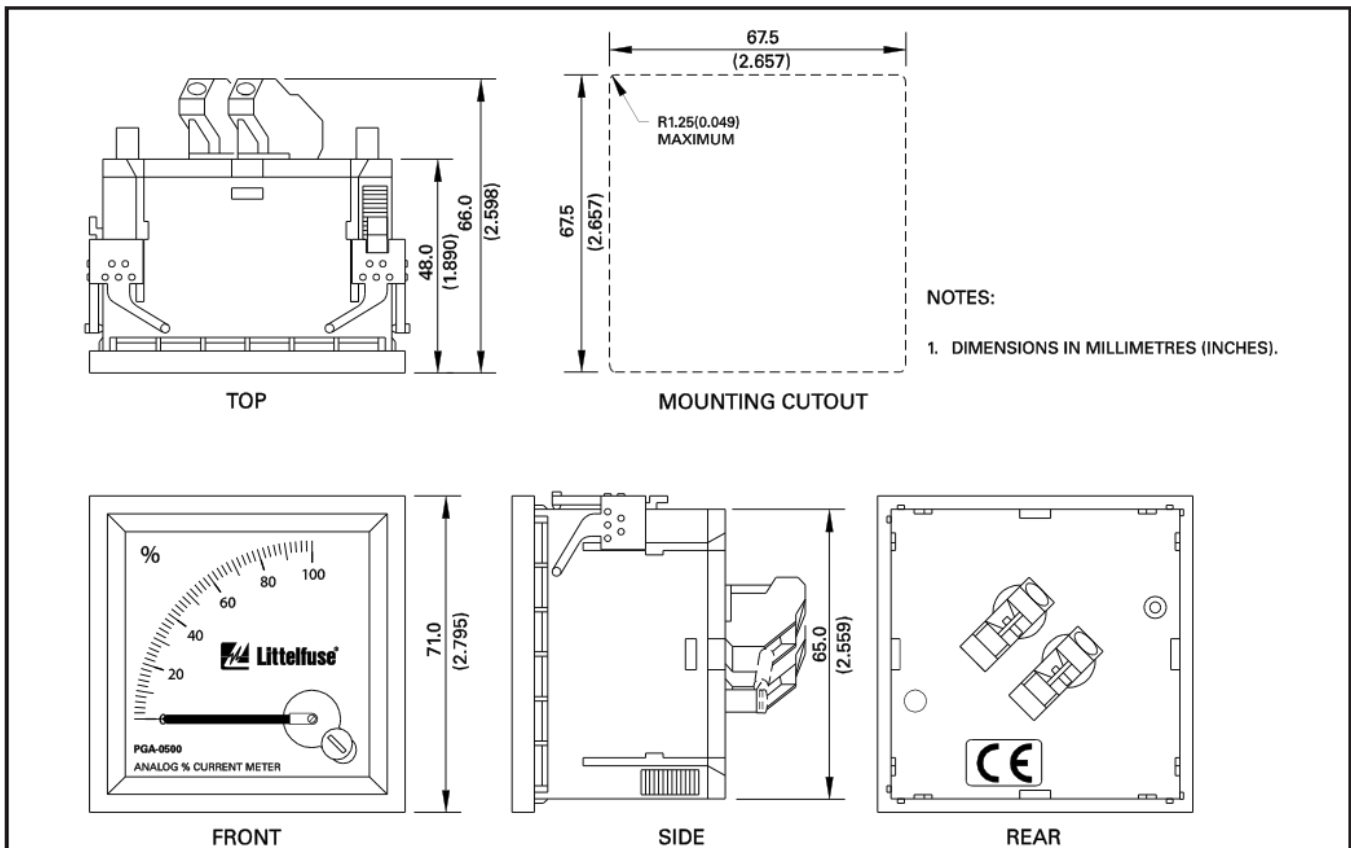


FIGURE 6. PGA-0500 Analog Percent Current Meter.

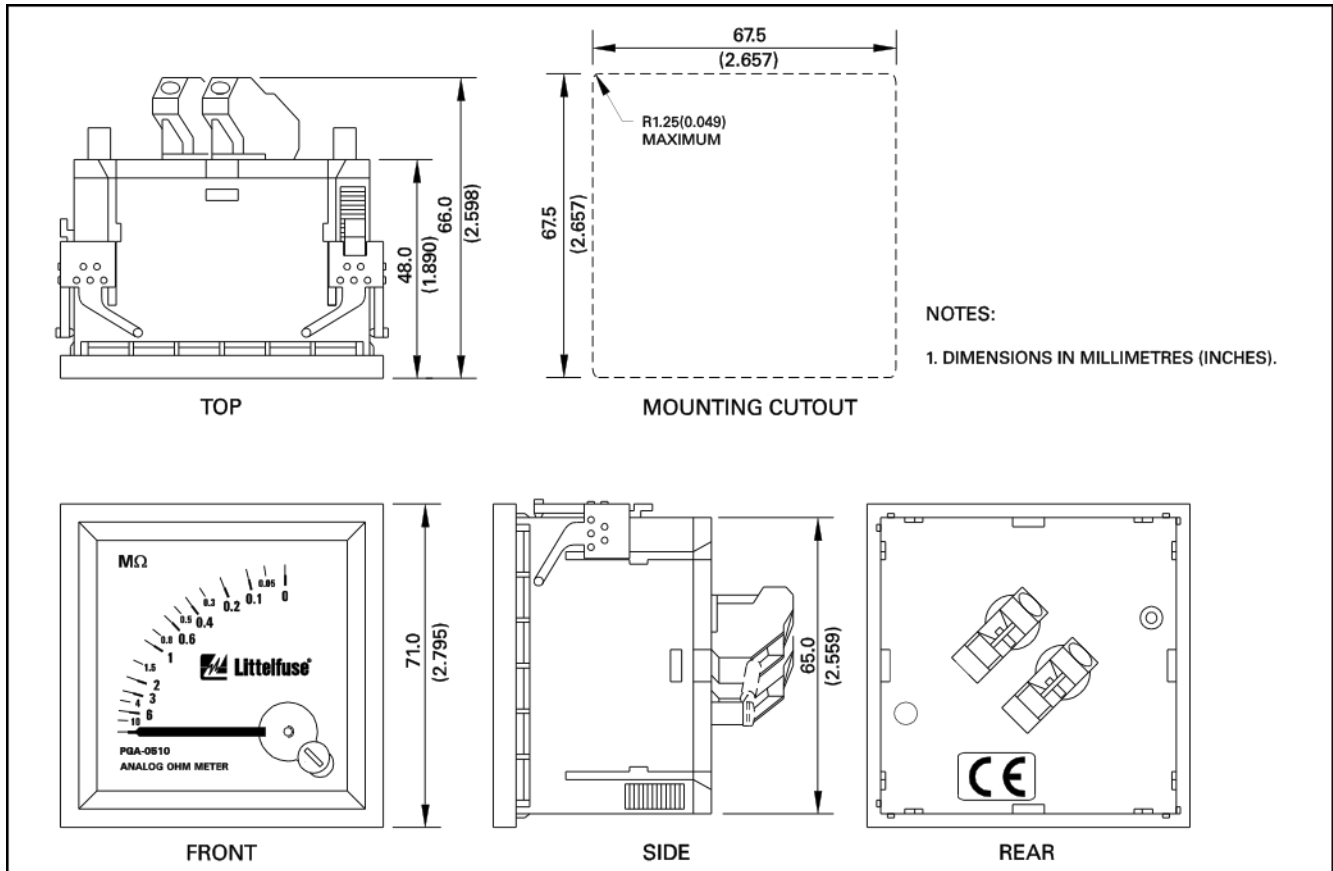


FIGURE 7. PGA-0510 Analog Ohm Meter.

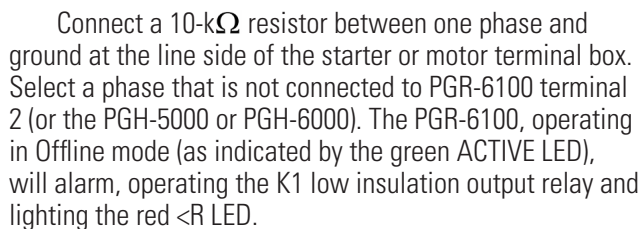
## 6. TESTS

### 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 must be conducted by qualified personnel:

1. Evaluate the interconnected system in accordance with the overall equipment manufacturer's detailed instructions.
2. 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-6100 is not polarity sensitive.
3. Verify that the system is correctly grounded and there are no alternate ground paths bypassing the current sensor. High-voltage testers and resistance bridges can be used to determine the existence of alternate ground paths.
4. 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-6100 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.
5. Record the date and the results of the test on the attached test-record form.

**NOTE:** Do not inject test current directly into CT-input terminals 16 and 17.



Retain this record for the authority having jurisdiction.

## APPENDIX A PGR-6100 REVISION HISTORY

MANUAL RELEASE DATE	MANUAL REVISION	PRODUCT REVISION (REVISION NUMBER ON PRODUCT LABEL)
May 8, 2018	2-C-050818	01
November 10, 2014	2-B-111014	
January 30, 2014	2-A-013014	
January 12, 2010	1	00

### MANUAL REVISION HISTORY

#### REVISION 2-C-050818

##### SECTION 4

Specifications added.

#### REVISION 2-B-111014

##### SECTION 3

Figs. 1 and 2 updated.

##### SECTION 4

PGR-6100 supply options updated.

##### SECTION 5

Ordering information updated.

### APPENDIX A

Revision history updated.

#### REVISION 2-A-013014

##### SECTION 1

Product name changed to PGR-6100 Ground-Fault & Insulation Monitor.

##### SECTION 3

Fig. 3 updated.

##### SECTION 4

UL Certification and contact rating specifications added.

#### REVISION 1

Initial release.

### PRODUCT REVISION HISTORY

#### PRODUCT REVISION 01

UL Certification.

#### PRODUCT REVISION 00

Initial release.