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POWR-GARD®
Motor Protection
PGR-6100 SERIES
Motor Ground-Fault & Insulation Relay

PGR-6100 MANUAL

MOTOR GROUND-FAULT & INSULATION RELAY

January 12, 2010

Revision 1

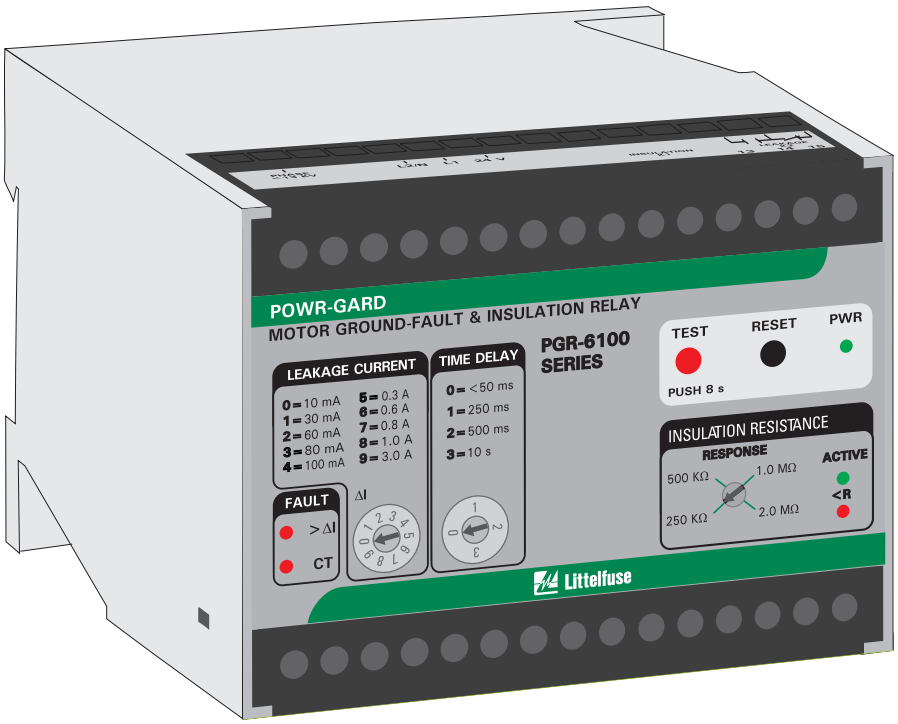

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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1. GENERAL

The PGR-6100 can detect a motor ground fault whether the motor is running (On-Line mode) or stopped (Off-Line 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 Off-Line mode. A current transformer (CT) is used to detect ground-fault current as low as 10 mA when the motor is running, and insulation resistance is measured to detect a fault when the motor is stopped. On-Line or Off-Line mode is selected with a digital input connected to a starter auxiliary contact.

In the On-Line 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 10 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, power, and open-CT indication, autoreset or latching trips with front-panel and remote reset, a test switch, and a 0- to 1-mA-analog output.

In the Off-Line mode, insulation-resistance monitoring is enabled, with a selectable 250-kΩ to 2-MΩ 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 1.3 to 5 kV, use a PGH-5000 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-6100 Operating Mode

Connect terminals 27 and 28 to an N.C. (Form B) auxiliary starter contact. When terminals 27 and 28 are open, On-Line mode (insulation monitoring off) is selected and when terminals 27 and 28 are connected, Off-Line mode (insulation monitoring active) is selected.

2.2.1 On-Line Operation

When the monitor is running, the PGR-6100 in conjunction with a PGC-5000-series zero-sequence current transformer operates as a sensitive ground-fault relay.

2.2.2 Off-Line 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 ΔI 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 kΩ to 2 MΩ. There is no time delay.

2.3.4 Reset

The front-panel RESET switch 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 connect terminals 18-19 and 21-22. See Fig. 2.

The reset function is not instantaneous. Press 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 8 s 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 8 s before operating the RESET push 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 transformer is not connected. See Section 2.8.

2.4.4 Active

The green LED labeled ACTIVE indicates that the Off-Line 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 5.

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 6.

2.6 Remote Test

Use external switches to test the current-transformer 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.

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 Motor Ground-Fault & Insulation Relay, a PGC-5000-series CT, and for systems over 1.3 kV, a PGH-5000 High Tension Coupler connected as shown in Fig. 2.

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

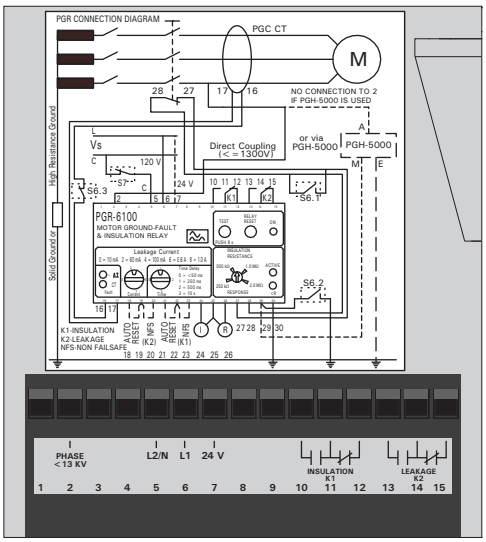
Use terminal 6 (L1) as the line terminal for a 120- or 240-Vac supply. Use terminal 7 as the line terminal for a 24 Vac supply. Use terminal 5 (L2/N) as the neutral terminal. Connect terminal 30 to ground.

Pass the phase conductors through the CT window and position them in the centre of the opening (for 4-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 terminal 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.

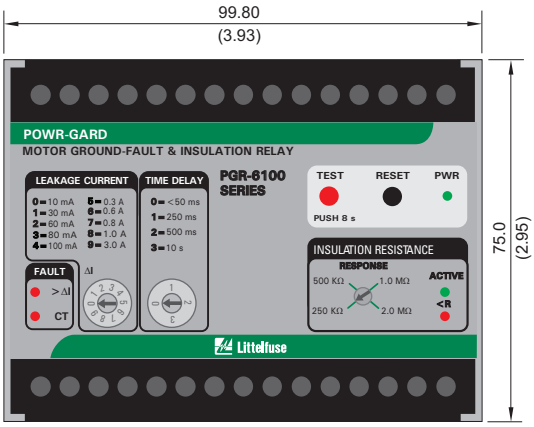
Connect optional PGA-0500 Ammeter and PGA-0510 Megaohmmeter as shown in Fig. 2. Meter outline, dimensions, and cutout size are shown in Figs. 5 and 6.



TOP

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 EN50022 35 mm x 7.5 mm TOP-HAT RAIL.



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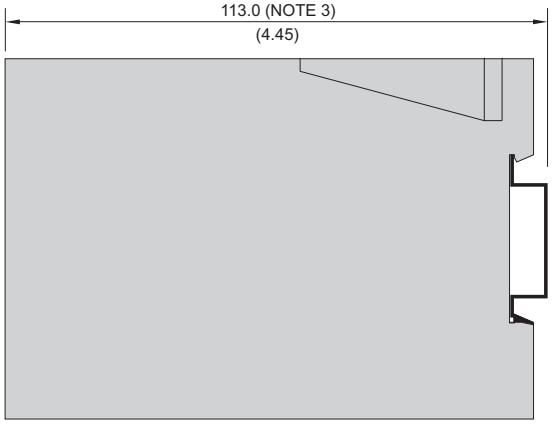

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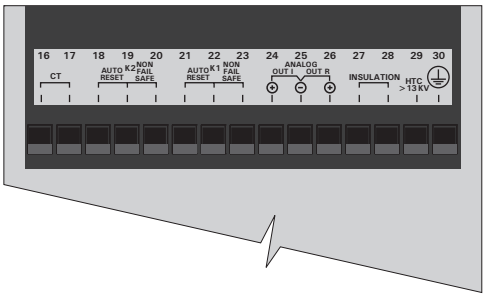

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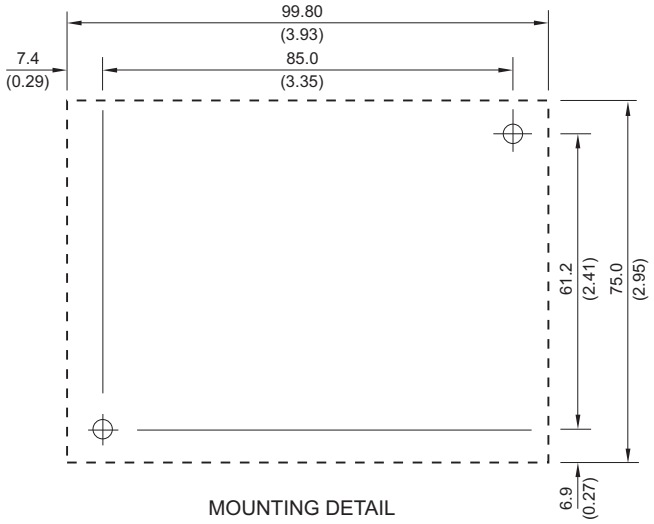


MOUNTING DETAIL

FIGURE 1. PGR-6100 Outline and Mounting Details.

3.1 PGH-5000

For application on systems from 1.3 to 5 kV, connect the PGR-6100 to the main circuit with a PGH-5000. See Fig. 4 for PGH-5000 outline and mounting details.

Connect protective-ground terminal (⏚) to ground. Connect the first terminal E to ground or to PGR-6100 terminal 30, which must be grounded. Connect terminal M to PGR-6100 terminal 29. (PGR-6100 terminal 2 is not used.)

For PGR-6100 to PGH-5000 distances greater than 10 m (30'), use shielded cable, and connect the cable shield to the second PGH-5000 terminal E. Connect terminal A to one phase of the load side of the motor starter. The PGH-5000 includes 915 mm (3') of high-voltage conductor.

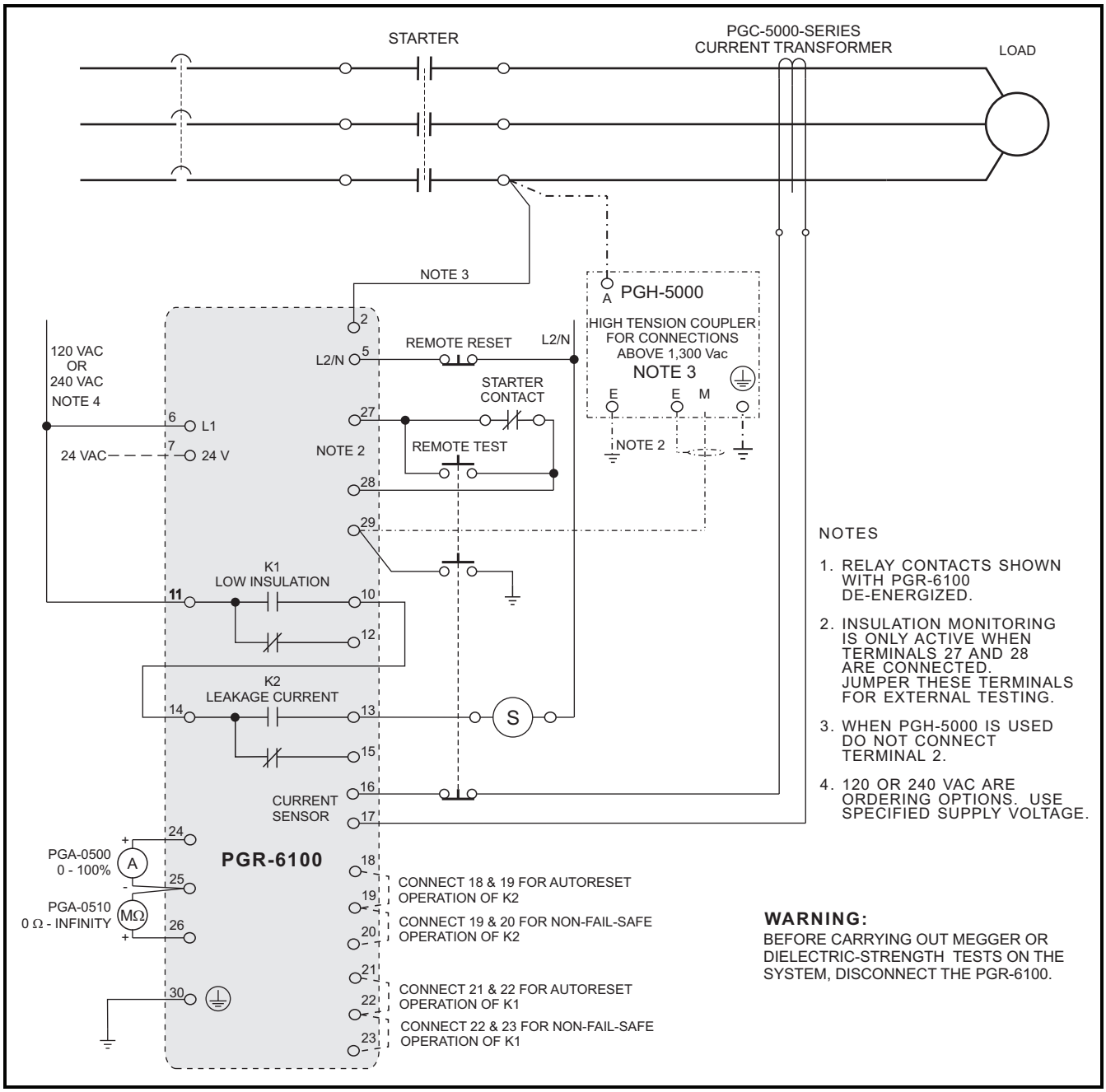
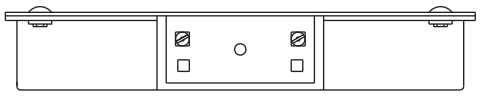


FIGURE 2. Typical Connection Diagram.



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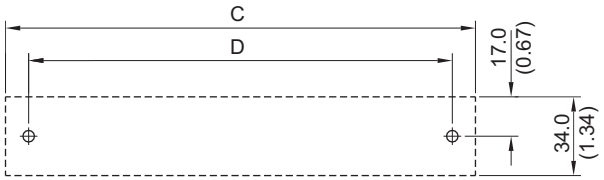

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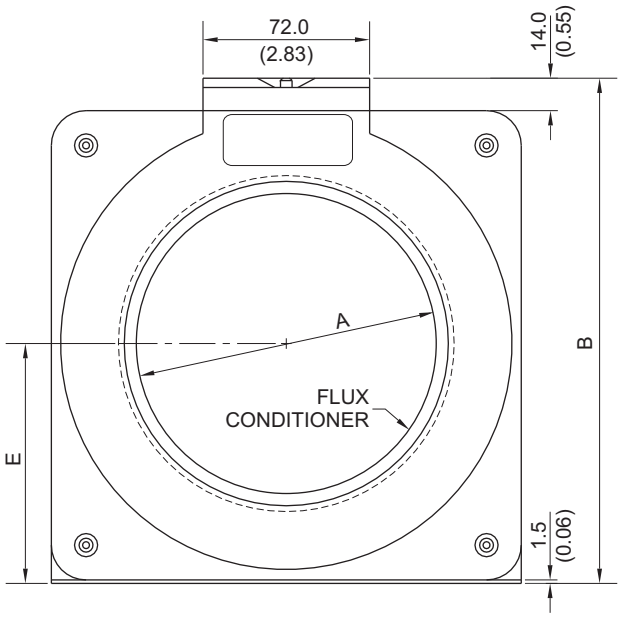

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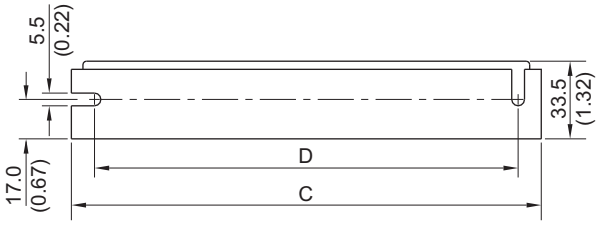


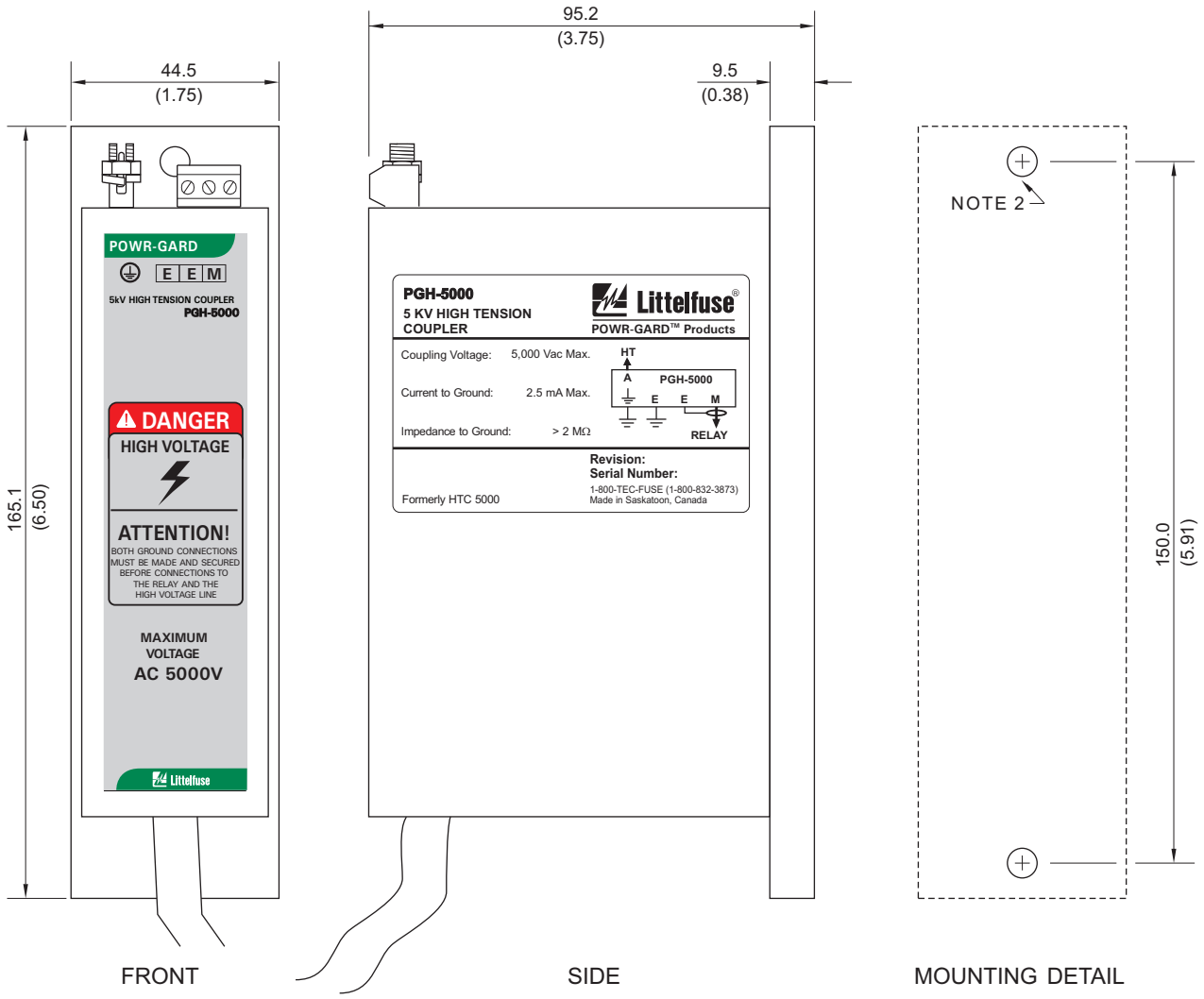
BOTTOM

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M5 OR 10-32.

PART NUMBER	DIMENSIONS				
	A	B	C	D	E
PGC-5025	25.0 (0.98)	99.0 (3.90)	92.0 (3.62)	75.0 (2.95)	42.0 (1.65)
PGC-5060	60.8 (2.39)	132.0 (5.20)	115.0 (4.53)	98.0 (3.86)	60.5 (2.38)
PGC-5095	95.0 (3.74)	175.0 (6.89)	158.0 (6.22)	141.0 (5.55)	82.0 (3.22)
PGC-5130	130.0 (5.12)	218.0 (8.58)	203.0 (7.99)	183.0 (7.20)	103.5 (4.07)
PGC-5200	200.0 (7.87)	309.0 (12.17)	290.0 (11.41)	270.0 (10.63)	150.0 (5.90)

FIGURE 3. PGC-5000-Series Current Transformers.



NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING HOLES: 6.35 mm (0.25).
3. ALL GROUND CONNECTIONS MUST BE MADE AND SECURED BEFORE CONNECTION TO RELAY AND HIGH VOLTAGE LINE.
4. CORD PROVIDED IS APPROXIMATELY 915 mm (3') LONG.

FIGURE 4. PGH-5000 Outline and Mounting Details.

4. TECHNICAL SPECIFICATIONS

Supply:
- 120 Option ..... 5 VA, 120 Vac, 24 V ac, (±15%) 50/60 Hz
- 240 Option ..... 5 VA, 240 Vac, 24 Vac, (±15%) 50/60 Hz

Nominal AC Insulation Voltage ..... 660 Vac
Insulation Ground to UL 1053
IEC 1010 and VDE 0110 ..... Class C
Test Voltage ..... 1,000 Vac
Operation Class ..... Continuous

K1 and K2 Relay Contacts:
- Configuration ..... N.O. and N.C (Form C)
- Switching Capacity ..... 1,200 VA

Supplemental Contact Ratings:
- Carry Continuous ..... 5 A
- Break:
  - dc (Resistive) ..... 0.3 A, 110 Vdc, L/R = 0
  - ac ..... 3 A, 240 Vac P.F. = 0.4

Relay Function ..... Fail-Safe, Non-Fail-Safe

Operating Mode ..... Latching or Autoreset

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

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

PGR-6100 On-Line Operation

Trip-Level Settings (ΔI) ..... 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 kΩ maximum

PGR-6100 Off-Line Operation

Maximum System Voltage:
- Direct Connection ..... 1,300 V
- With PGH-5000 ..... 5,000 V

Measuring Voltage ..... 12 Vdc
Measuring Current ..... 20 μA maximum
DC Resistance ..... 600 kΩ
AC impedance at 50-60 Hz .... > 1MΩ

Response-Level Settings ..... 0.250, 0.500, 1.0, 2.0 MΩ
Response Delay ..... < 250 ms

Maximum Leakage Capacitance to Ground ..... < 1μF
Maximum Stray Voltage ..... 1,000 Vdc

Analog Output:
- Mode ..... Self Powered
- Range ..... 0 – 1 mA
- Impedance ..... 5 kΩ maximum

Terminals ..... Wire Clamping, 12-22 AWG (0.3 to 2.5 mm^2) conductors

Dimensions:
- Height ..... 75 mm (3.0")
- Width ..... 100 mm (3.9")
- Depth ..... 115 mm (4.5")

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

Environment:
- Operating Temperature ... -10°C to +60°C
- Storage Temperature ..... -40°C to +80°C
- Humidity ..... 85% Non-Condensing

5. ORDERING INFORMATION

PGR-6100-☐

- 120 120- or 24-Vac Supply
- 240 240- or 24-Vac Supply

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

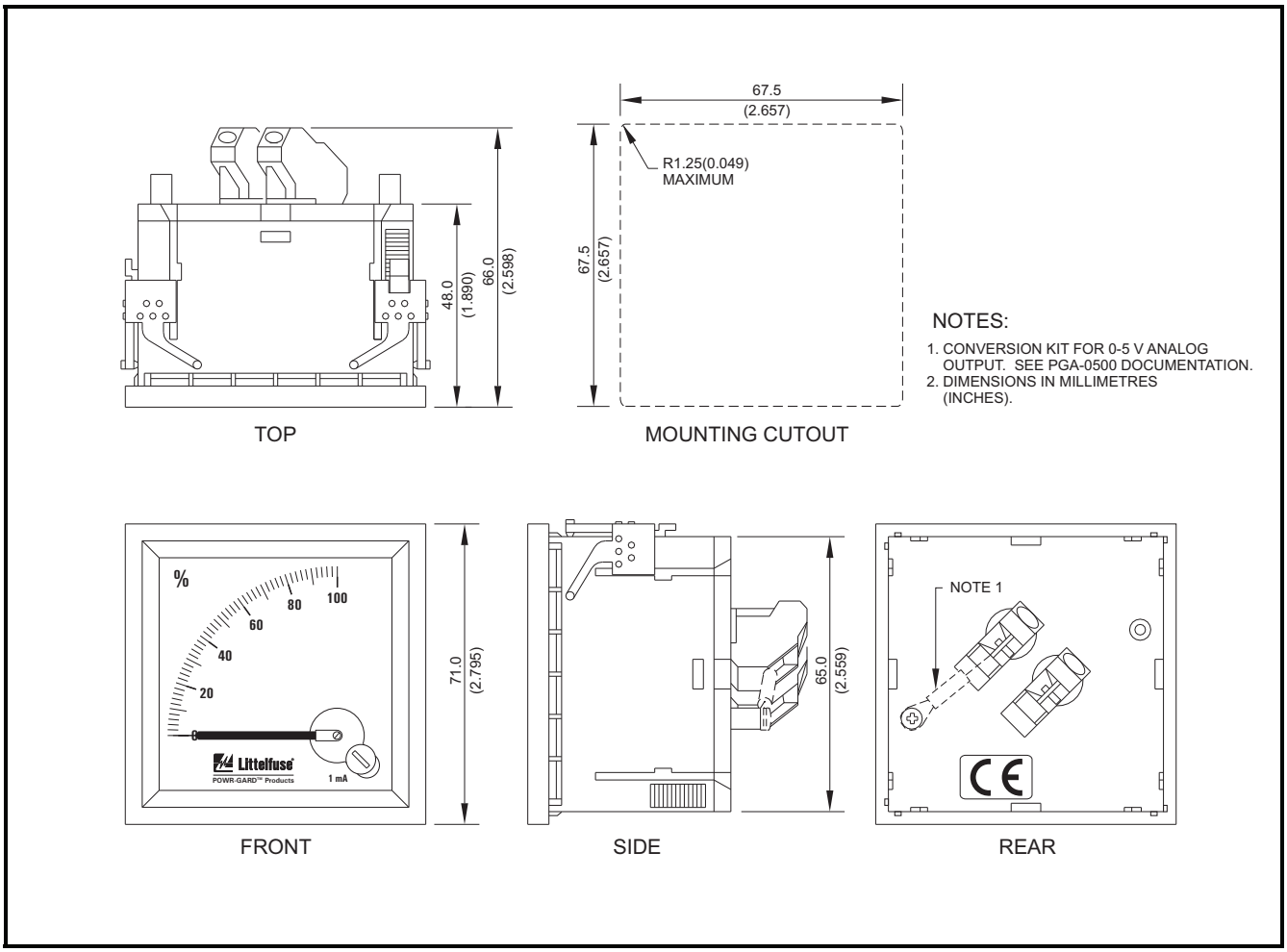


FIGURE 5. PGA-0500 Analog Percent Current Meter.

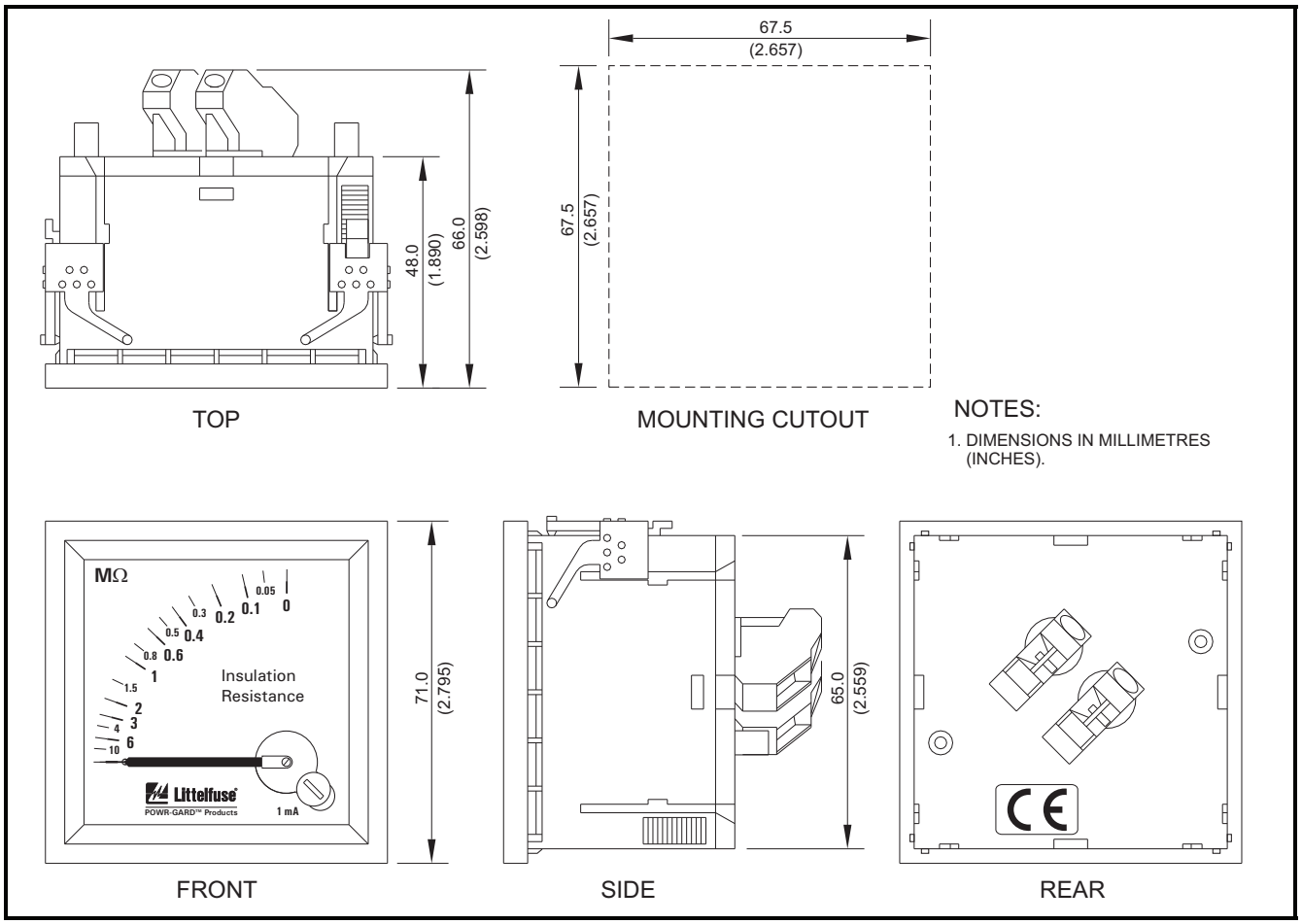


FIGURE 6. PGA-0510 Analog Ohm Meter

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 are to be conducted by qualified personnel.

a) Evaluate the interconnected system in accordance with the overall equipment manufacturer's detailed instructions.

b) 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-transformer secondary to the PGR-6100 is not polarity sensitive.

c) Verify that the system is correctly grounded and that alternate ground paths do not exist that bypass the current transformer. High-voltage testers and resistance bridges can be used to determine the existence of alternate ground paths.

d) 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. 6 shows a test circuit using the PGT-0400 Ground-Fault-Relay Test Unit. The PGT-0400 has a programmable output of 0.5 to 9.9 A for a duration of 0.1 to 9.9 seconds. Fig. 6 shows the use of resistors that reduce the injected current to 10% of the PGT-0400 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.

e) 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.

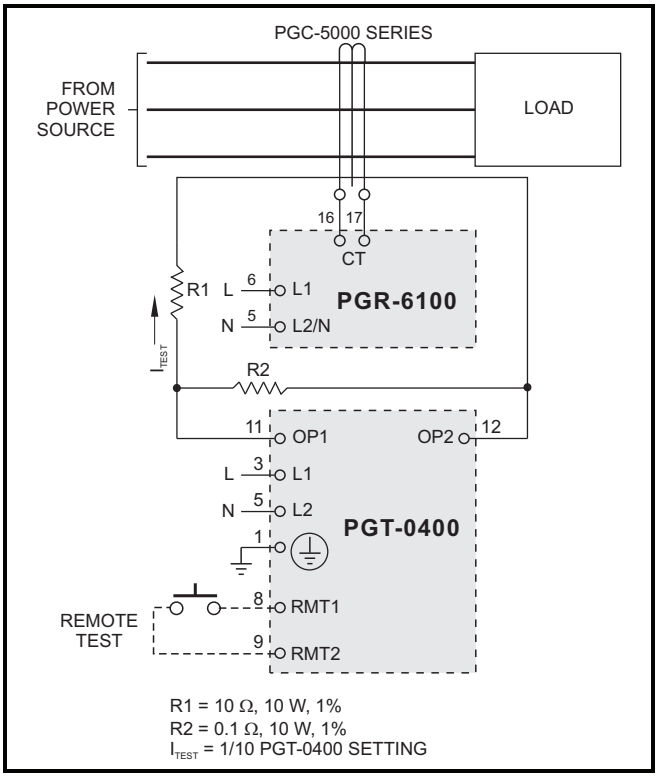


FIGURE 7. Ground-Fault-Test Circuit.

TABLE 1. Ground-Fault-Test Record

DATE	TEST RESULTS

Retain this record for the authority having jurisdiction.

6.2 Insulation Test

Perform this test with the starter open and appropriate lock-out procedures.

Connect a 10-kΩ resistor between one phase and ground at the line side of the starter or motor terminal box. Select a phase that is not connected to PGR-6100 terminal 2 (or the PGH-5000). The PGR-6100, operating in Off-Line mode as indicated by the green ACTIVE LED, will alarm, operating the K1 low insulation output relay and lighting the red <R LED.