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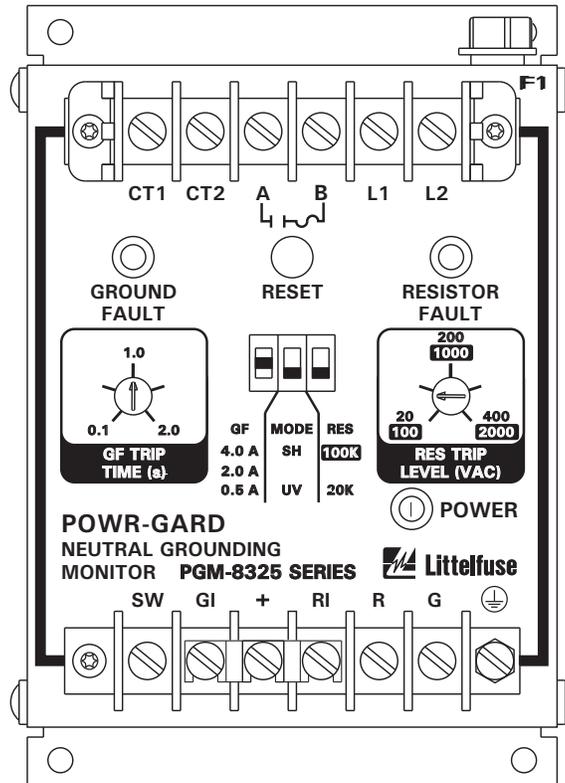
POWR-GARD[®]
Supplemental Monitoring
PGM-8325 SERIES
Neutral Grounding Monitor

PGM-8325 MANUAL

NEUTRAL GROUNDING MONITOR

JULY 2, 2009

REVISION 10



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1. GENERAL

1.1 Modern Resistance-Grounded Systems

A high-resistance-grounded system uses a neutral-grounding resistor (NGR) with a low let-through current to limit ground-fault current. High-resistance grounding is gaining popularity because a ground-fault flash hazard exists in low-resistance- or solidly grounded systems and a ground fault can result in substantial point-of-fault damage. High-resistance grounding eliminates these problems and modern ground-fault protection operates reliably at these levels. Furthermore, the probability of an arc-flash incident is significantly reduced in a high-resistance-grounded system.

NGR selection depends on system charging current and whether the system is an alarm-only or a tripping system. Alarm-only systems are usually restricted to system voltages up to 5 kV with NGR let-through currents of 5 A or less. Occasionally, alarm-only systems up to 15 kV and up to 10 A are used; however, they are not common because a ground fault on such a system tends to escalate to a phase-to-phase fault before the ground fault can be located and cleared.

System charging current is the capacitive current that flows to ground when a bolted ground fault occurs. This current can be calculated or measured. For small systems, the magnitude of charging current is typically $\frac{1}{2}$ A per 1,000 kVA on low-voltage systems and 1 A per 1,000 kVA on medium-voltage systems.

In an alarm-only system or in a tripping system without selective coordination, choose an NGR with a let-through current larger than the system charging current and set the pick-up current of ground-fault devices at or below 50% of the NGR let-through current.

In a tripping system with selective coordination, use ground-fault devices with a definite-time characteristic to achieve time coordination. Use the same pick-up current for all ground-fault devices—this value must be larger than the charging current of the largest feeder. Select an NGR with a let-through current between five and ten times the pick-up current of the ground-fault devices.

Do not use a grounding transformer with a low-voltage resistor:

- The combined cost of a transformer and a low-voltage resistor is more than the cost of a resistor rated for line-to-neutral voltage.
- A transformer saturated by a ground fault through a rectifier can make ground-fault protection inoperative.
- Transformer inrush current up to twelve times rated current can cause a ground-fault voltage larger than expected.
- A parallel transformer winding makes it difficult to monitor NGR continuity.
- A transformer can provide the inductance necessary to cause ferroresonance if the NGR opens.

Following these guidelines will reduce the flash hazard, reduce point-of-fault damage, achieve reliable ground-fault protection, and ensure a stable system not subject to ferroresonance.

1.2 PGM-8325 NGR Monitoring

The PGM-8325 is a neutral-grounding-resistor monitor for resistance-grounded systems up to 25 kVac. It measures current in a transformer or generator neutral, neutral-to-ground voltage, and continuity of the neutral-grounding resistor. The PGM-8325 coordinates these three measurements to detect a failed NGR or a ground fault and provides one output contact for shunt or undervoltage operation in a main-breaker trip circuit. Trips are latched and indicated by LED's.

Ground-fault current is sensed by a PGC-2056 window-type current transformer. Either CT input can be grounded to meet electrical codes. A trip level of 0.5, 2.0, or 4.0 A is switch selectable for use with a 5-, 15-, or 25-A grounding resistor. Trip time is adjustable from 0.1 to 2.0 seconds.

Neutral-to-ground voltage and continuity of the neutral-grounding resistor are continuously measured through an PGE-series external sensing resistor connected to the neutral. A resistor fault will be detected if ground-fault current is not detected and neutral-to-ground voltage exceeds the trip-level setting, or if NGR resistance exceeds the trip resistance. A resistor-fault hold-off circuit prevents nuisance trips in alarm-only systems.

For additional information on neutral-grounding-resistor monitoring, see "Monitoring Neutral-Grounding Resistors" at www.littelfuse.com.

2. OPERATION

2.1 Settings

2.1.1 GF Trip Time

Ground-fault trip time is adjustable from 0.1 to 2.0 seconds. Time-coordinated ground-fault protection requires this setting to be longer than the trip times of downstream ground-fault devices.

2.1.2 GF

The ground-fault-circuit trip level is 0.5, 2.0, or 4.0 A when current is sensed with a PGC-2056 current transformer. Since the ground-fault-circuit trip level should not be greater than 20% of the grounding resistor let-through current, these levels are appropriate for use with 5-, 15-, or 25-A grounding resistors. See Table 1. For other applications, the trip level of the ground-fault circuit is 0.25, 1.0, or 2.0% of the primary rating of the 5-A-secondary current transformer.

2.1.3 Mode

In the shunt-trip mode (SH), the output relay energizes and its contact closes if a resistor-fault or ground-fault trip occurs. The shunt-trip mode is not fail-safe because shunt-trip devices do not operate if supply voltage fails.

In the undervoltage mode (UV), the output relay energizes and its contact closes if the resistor-fault and ground-fault circuits are not tripped. The undervoltage mode is referred to as fail-safe because undervoltage devices release if supply voltage fails.

2.1.4 RES

This switch setting must correspond to the resistance of the external sensing resistor. For the PGE-600V and PGE-05KV, select 20K. For the PGE-15KV and PGE-25KV, select 100K.

2.1.5 RES Trip Level

Neutral-to-ground trip voltage is adjustable from 20 to 400 Vac with a 20-k Ω sensing resistor, and 100 to 2,000 Vac with a 100-k Ω sensing resistor. To prevent false resistor-fault trips, the RES TRIP LEVEL should be set higher than the voltage across the neutral-grounding resistor when neutral-to-ground current is equal to the operating value of the ground-fault circuit. Typical values for 5-, 15-, and 25-A tripping systems are shown in Table 1. For other systems, refer to the NGR Monitor Set-Point Assistant at www.littelfuse.com.

TABLE 1. Settings for Typical Systems

System Voltage (Volts)	Neutral-Grounding Resistor		Sensing Resistor		Ground-Fault Trip Level (Amperes)	Res Trip Level (Volts)
	Let Through (Amperes)	Resistance (Ohms)	Model	Resistance (Ohms)		
480	5	55	PGE-600V	20,000	0.5	30
600	5	69	PGE-600V	20,000	0.5	40
2,400	5	277	PGE-05KV	20,000	0.5	140
4,160	5	480	PGE-05KV	20,000	0.5	240
480	15	18	PGE-600V	20,000	2.0	40
600	15	23	PGE-600V	20,000	2.0	50
2,400	15	92	PGE-05KV	20,000	2.0	190
4,160	15	160	PGE-05KV	20,000	2.0	320
7,200	15	277	PGE-15KV	100,000	2.0	600
14,400	15	554	PGE-15KV	100,000	2.0	1,100
7,200	25	166	PGE-15KV	100,000	4.0	700
14,400	25	332	PGE-15KV	100,000	4.0	1,400
25,000	25	577	PGE-25KV	100,000	4.0	2,000

2.2 Indication and Reset

The green POWER LED indicates that the internal power supply is on. Red LED's indicate ground-fault and resistor-fault trips. When a trip occurs, the PGM-8325 remains latched until the reset switch is pressed or supply voltage is cycled. Terminals are provided for remote indication and reset as shown in Fig. 1.

2.3 Fusing

The output contact is protected by fuse F1 (4.0 A, time delay).

3. INSTALLATION

3.1 PGM-8325

PGM-8325 outline and mounting details are shown in Fig. 2. Typical connections are shown in Fig. 1. Connect supply voltage to L1 and L2. For a 120-Vac supply, connect supply neutral to L2. Connect chassis-bonding terminal \perp to ground.

Connect contact terminals A and B as required.

Face-plate LED's are driven in series with remote-indication LED's. When remote-indication LED's are not used, terminals GI, +, and RI must be connected for the face-plate LED's to operate. These jumpers are installed at the factory.

Install the upper terminal-block cover to prevent inadvertent contact with line terminals.

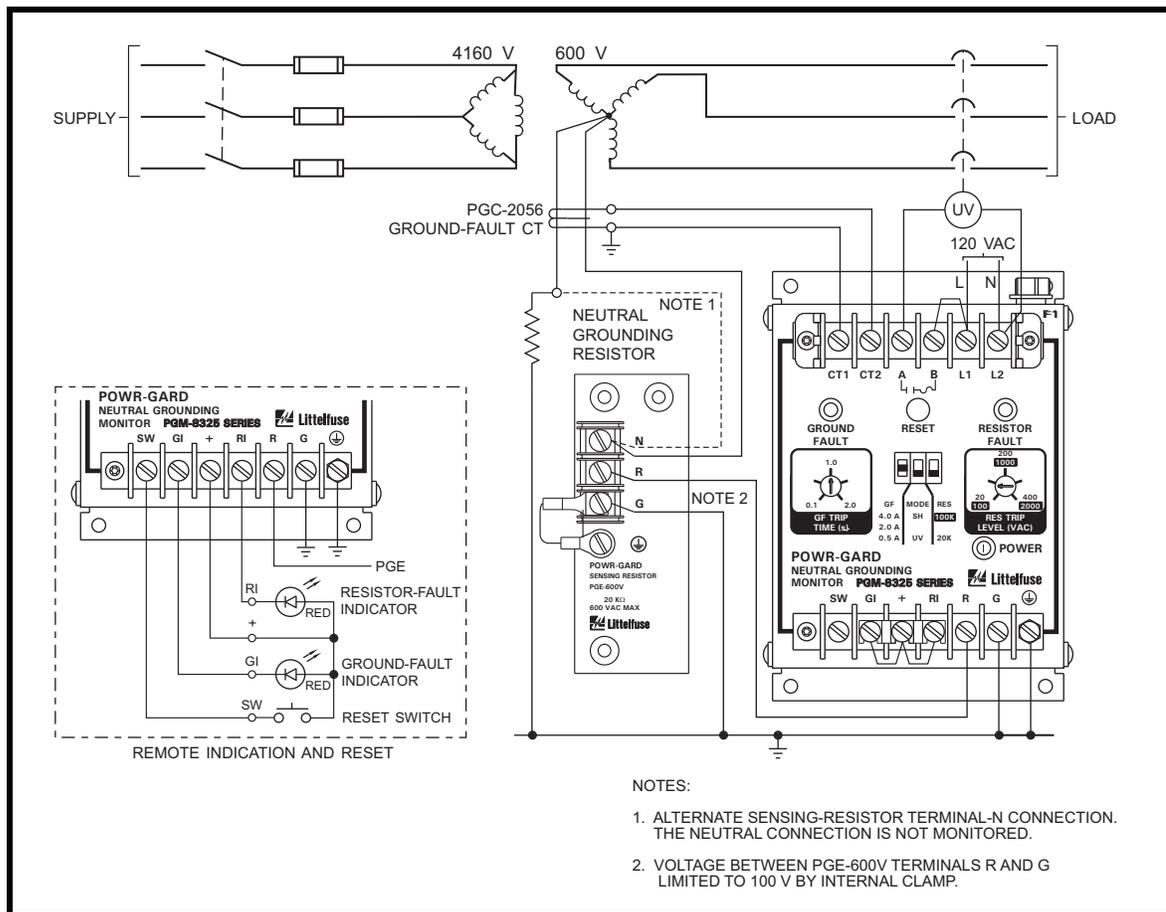


FIGURE 1. Typical Application.

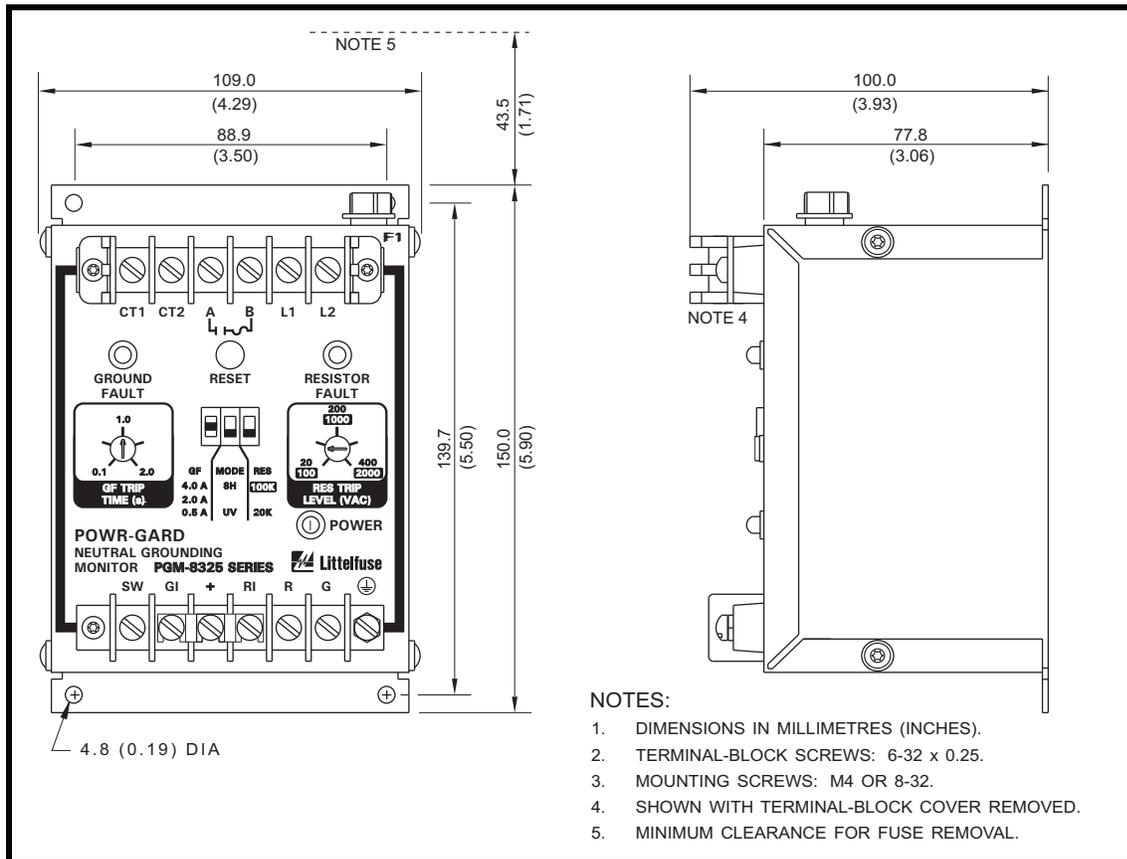


FIGURE 2. PGM-8325 Outline and Mounting Details.

3.2 Ground-Fault CT

Outline and mounting details for PGC-2056 and PGC-2089 current transformers are shown in Fig. 3. Ground-fault-CT connections and the typical ground-fault-CT location are shown in Fig. 1.

Connect the secondary of the ground-fault CT to PGM-8325 terminals CT1 and CT2. The CT connection to the PGM-8325 is not polarity sensitive. Ground one side of the CT secondary. For electrically noisy environments or lead lengths in excess of 10 m (30 ft), use shielded, twisted-pair cable.

3.3 Sensing Resistor

Outline and mounting details for PGE-600V, PGE-05KV, PGE-15KV, and PGE-25KV sensing resistors are shown in Figs. 4, 5, 6, and 7. Locate the NGR and the sensing resistor near the transformer or generator. When located outdoors, a sensing resistor must be installed in a suitable enclosure. Ground sensing-resistor terminal G. Pass the sensing-resistor-to-neutral conductor and the NGR-to-neutral conductor through the ground-fault-CT window as shown in Fig. 1. Separately connect sensing-resistor terminal N and the NGR to the neutral to include neutral connections in the monitored loop. If a ground fault in the sensing-resistor conductor is unlikely, a minimal loss of protection will result if it does not pass through the ground-fault-CT window.

Caution: Voltage at terminal N rises to line-to-neutral voltage when a ground fault occurs. The same clearances are required for sensing resistors as for NGR's.

Note: The neutral-to-sensing-resistor connection is not a neutral conductor as defined in Canadian Electrical Code Section 10-1108 and National Electrical Code Section 250.36(B). It is not required to be 8 AWG or larger. Since current through this conductor is always less than 150 mA, a 14 AWG conductor insulated to the system voltage is more than sufficient.

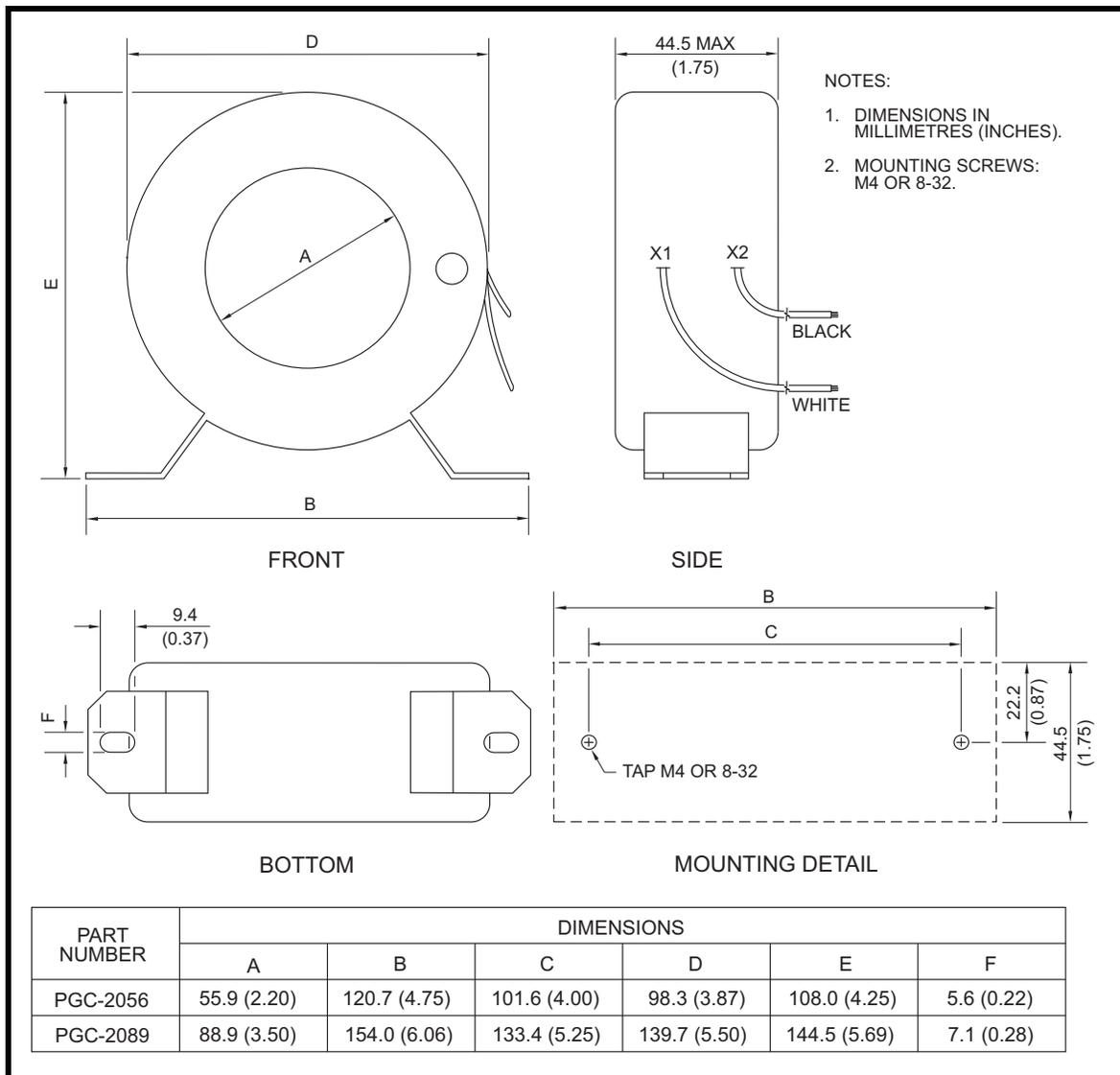


FIGURE 3. Current Transformers.

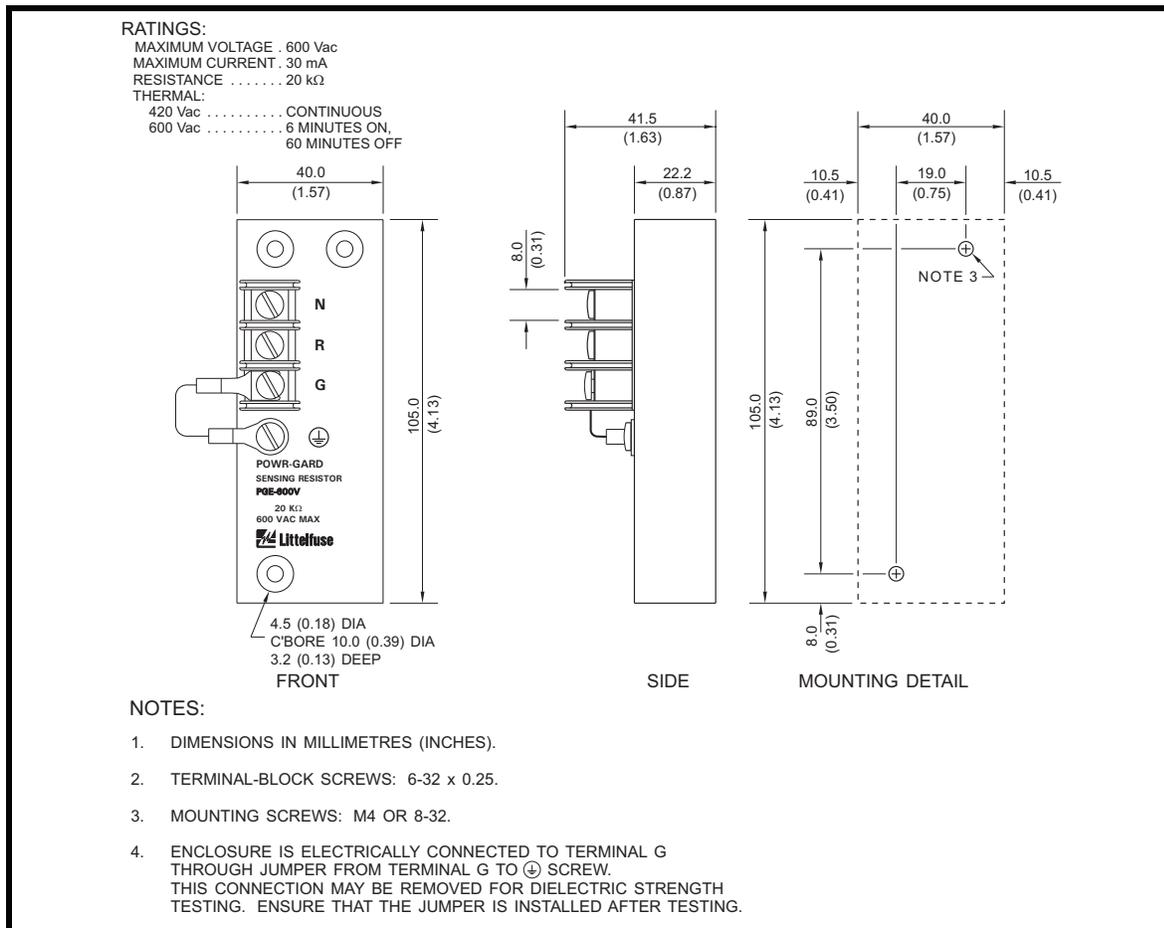


FIGURE 4. PGE-600V Sensing Resistor.

3.4 Isolated-Ground Connection

The PGM-8325 is intended for use in installations where the NGR is connected to local ground. Some installations require the NGR to be isolated from local ground. See Technical Information 3.1 “NGR Monitoring with Isolated Ground Beds” at www.littelfuse.com.

3.5 Overhead Lines

In overhead-line applications, atmospheric conditions can cause false resistor-fault trips. A PGR-5330 NGR Monitor is recommended for these applications.

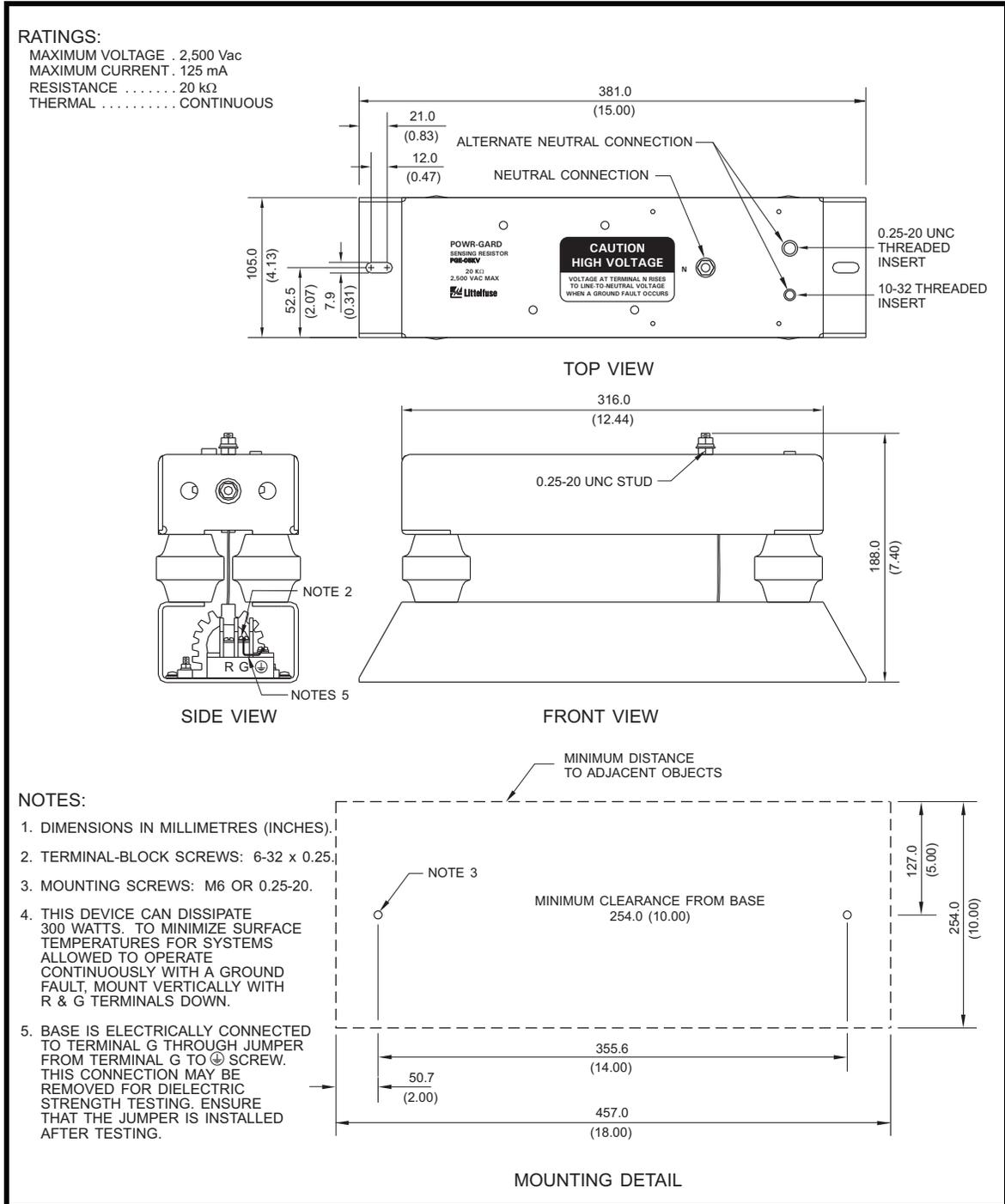


FIGURE 5. PGE-05KV Sensing Resistor.

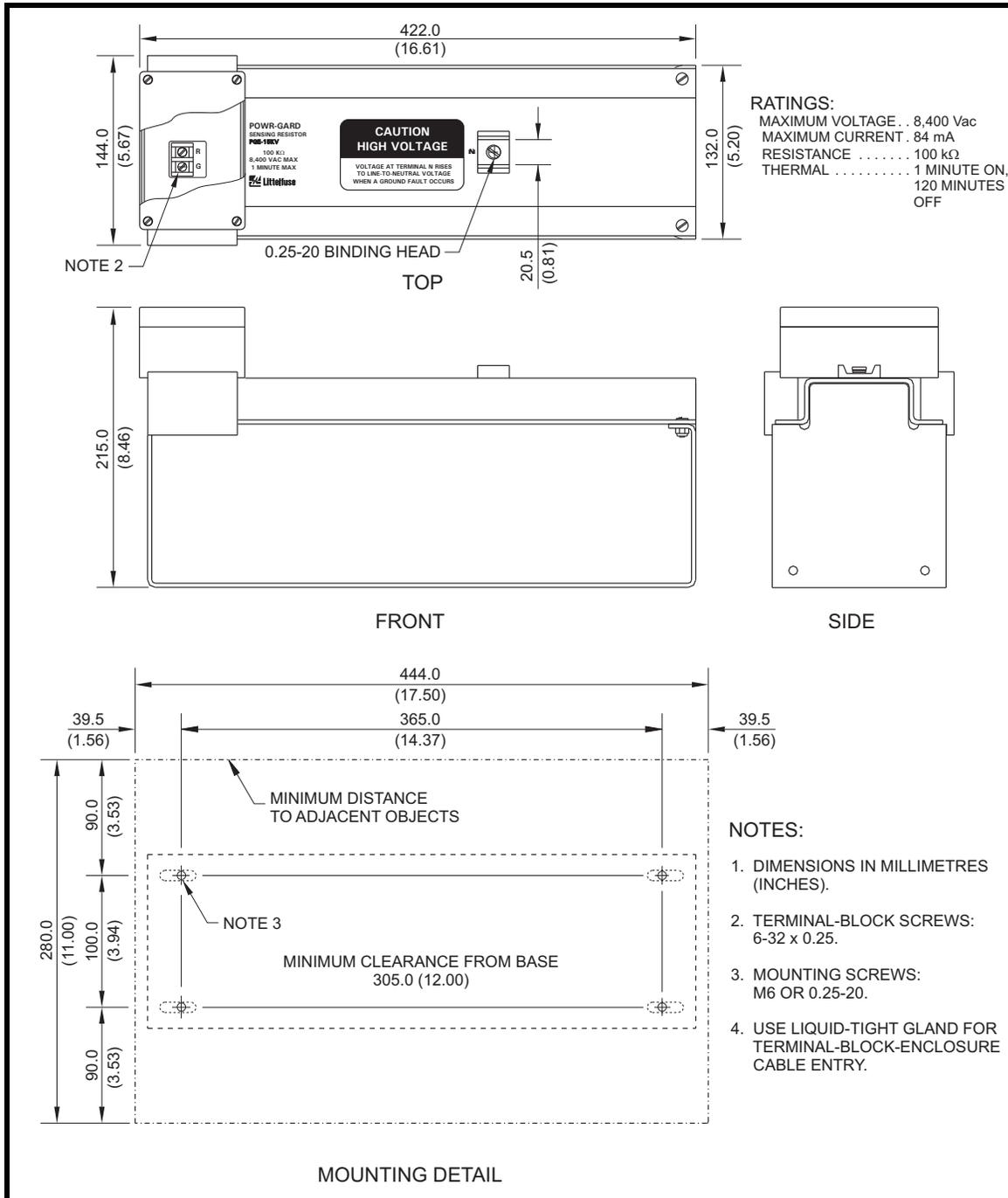


FIGURE 6. PGE-15KV Sensing Resistor.

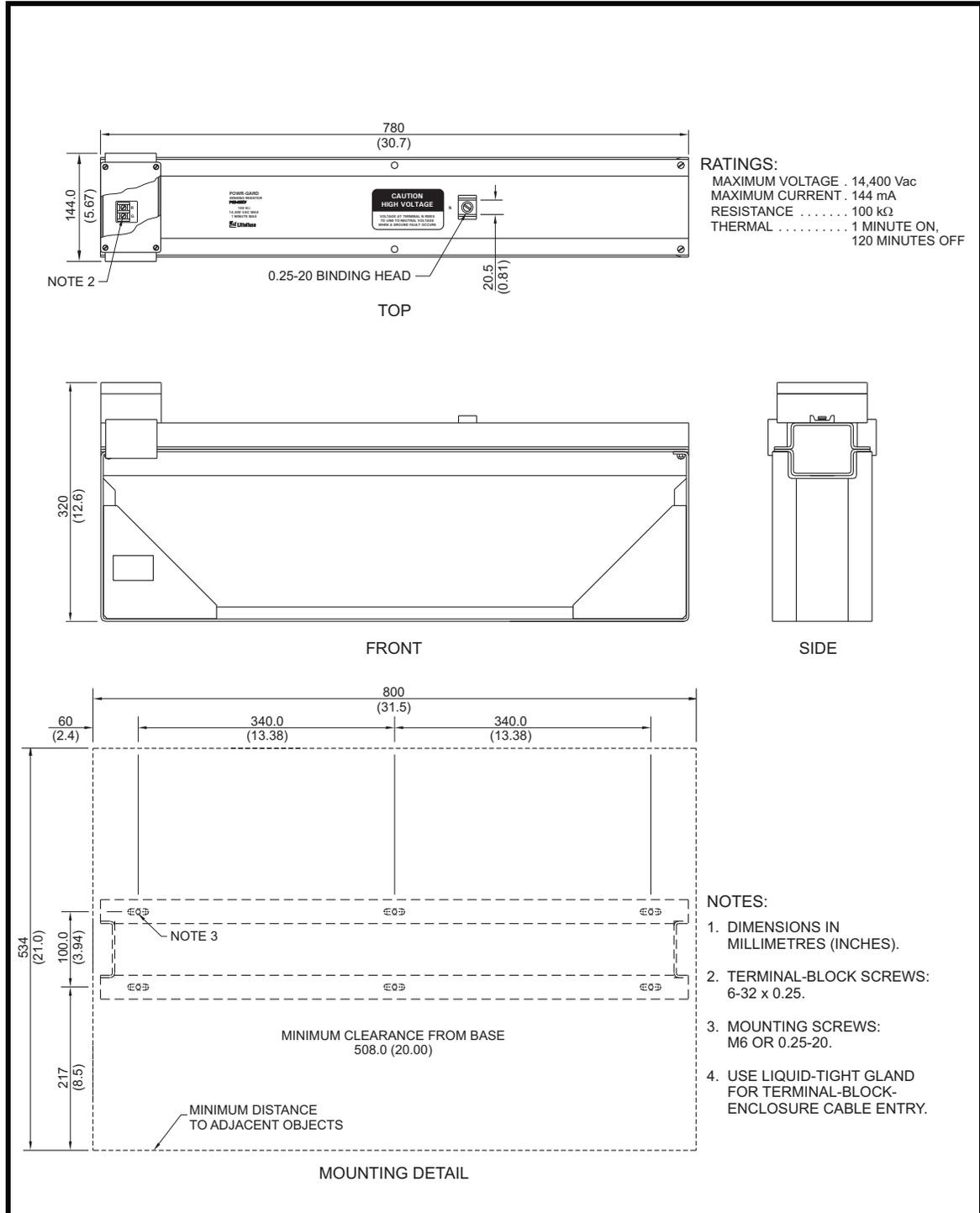


FIGURE 7. PGE-25KV Sensing Resistor.

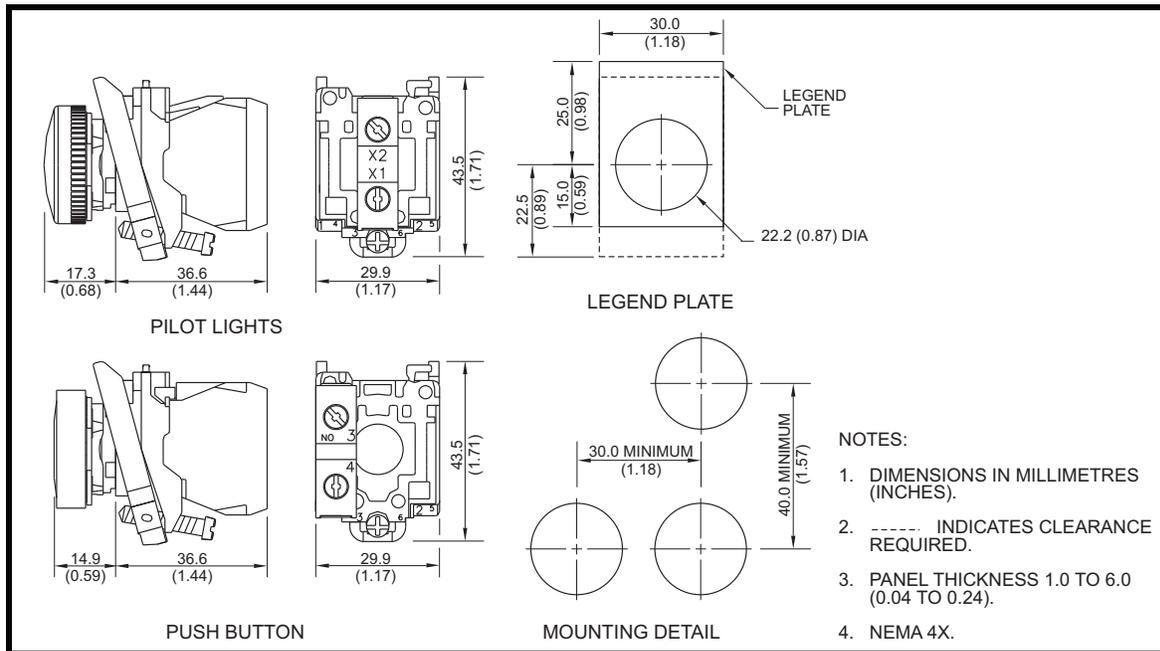


FIGURE 8. PGB-0302 Remote Indication and Reset.

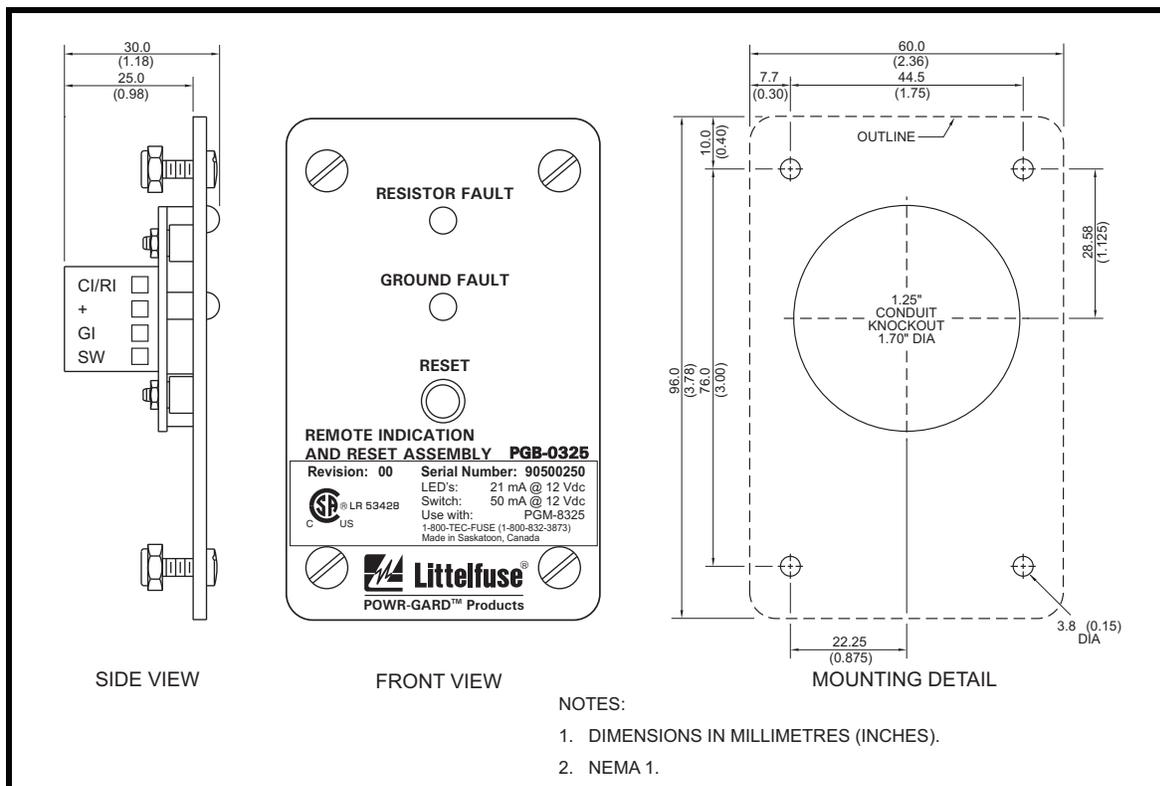


FIGURE 9. PGB-0325 Remote Indication-and Reset Assembly.

3.6 Remote Operation

Terminals SW, GI, +, and RI are provided for remote LED indication and remote reset as shown in Fig. 1. Remote LED's are driven in series with the front-panel LED's.

Remove factory-installed jumpers from terminals GI, +, and RI, and connect a remote kit as shown in Fig. 1. Optional remote kits are shown in Figs. 8 and 9. Standard LED indicator lamps are not compatible with the PGM-8325.

For general-purpose applications, use the PGB-0325 Remote Indication and Reset Assembly. Connect terminals SW, GI, +, and RI to remote-kit terminals SW, GI, +, and CI/RI.

For 22-mm-component PGB-0302 applications, connect terminal X2 of the red ground-fault indicator to GI, terminal X2 of the red resistor-fault indicator to RI, and connect indicator X1 terminals to +. For remote reset, connect the normally open push-button switch across terminals + and SW.

3.7 Ground-Fault Testing

Use CT-primary current injection to test the ground-fault circuit. Fig. 10 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.

A test-record form is provided in Section 7 of this manual. Record the test results and test dates on this form to meet the requirements of the National Electrical Code (NEC). Retain the form so that the test data can be made available to the authority having jurisdiction.

4. TECHNICAL SPECIFICATIONS

4.1 PGM-8325

Supply:

ac..... 120 or 240 Vac (+10, -50%), 50/60 Hz, 10 VA

Note: Voltage between supply terminals (L1, L2) and ground terminal (G) must not exceed 300 Vac continuous or 1,250 Vac under transient conditions.

Dimensions:

Height..... 150 mm (5.9")
Width..... 109 mm (4.3")
Depth..... 100 mm (4.0")

Shipping Weight..... 1 kg (2.2 lb)

Environment:

Operating Temperature..... -40 to 60°C
Storage Temperature..... -55 to 80°C
Humidity..... 85% Non-Condensing

Ground-Fault Circuit:

CT Ratio..... 200:5
CT Input Burden..... 0.02 Ω
Trip Level⁽¹⁾..... 0.5, 2.0, or 4.0 A
Frequency Response..... 25 to 110 Hz
Trip Time..... 0.1 to 2.0 s
Thermal Withstand⁽¹⁾..... 200 A Continuous, 2,500 A for 2 s
Trip-Level Accuracy..... +10, -20%
CT Lead Resistance Limit⁽²⁾
 0.5 A Trip Level..... 2 Ω
 2 A Trip Level..... 5 Ω
 4 A Trip Level..... 5 Ω
Trip-Time Accuracy..... 10%
Operating Mode..... Latching

(1) Currents referred to primary of PGC-2056 for prospective ground-fault currents less than 4,000 A.

(2) Typical maximum CT lead resistance to meet specified trip level accuracy.

Resistor-Fault Circuit:**Neutral-To-Ground**Trip Voltage (V_N)..... 20 to 2,000 Vac Adjustable**NGR Trip Resistance, $V_N = 0$** PGE-600V or PGE-05KV 2 k Ω PGE-15KV or PGE-25KV 6 k Ω ,**Neutral-To-Ground DC-Voltage Rejection:**

PGE-600VC or PGE-05KV .. 1.2 V

PGE-15KV or PGE-25KV ... 0.7 V

Trip-Resistance Accuracy +5, -2% of Sensing Resistor Resistance

Trip Time..... 5 \pm 0.5 s

Operating Mode..... Latching

Output Relay:

UL/CSA Contact Rating 1 mA to 4 A Resistive, 240 Vac or 28 Vdc

Supplemental Contact Ratings:

Make/carry 0.2 s 10 A

Carry continuous 4 A

Break:

dc..... 20 W resistive, 10 W inductive (L/R = 0.04 s)

ac..... 960 VA resistive, 700 VA inductive (PF = 0.4)

Subject to maximums of 4 A and 240 V (ac or dc)

Contact Configuration N.O. (Form A)

Fuse Rating (F1) 4.0 A, 250 Vac, Time Delay

Fuse Part Number Littelfuse 313.004 or

Bussman MSL-4

Operating Mode UV (Fail-Safe) or

SH (Non-Fail-Safe)

Remote Indication:

+ 12 Vdc

GI/RI..... Current Sink,
560 Ω InternalPWB Conformal Coating MIL-1-46058 qualified,
UL QMJU2 recognized

4.2 Sensing Resistors

PGE-600VC:

Maximum Voltage.....	600 Vac
Maximum Current.....	30 mA
Resistance.....	20 kΩ
Thermal:	
420 Vac.....	Continuous
600 Vac.....	6 minutes on, 60 minutes off
Shipping Weight	300 g (0.7 lb)

PGE-05KV:

Maximum Voltage.....	2,500 Vac
Maximum Current.....	125 mA
Resistance.....	20 kΩ
Thermal.....	Continuous
Shipping Weight	5.0 kg (11 lbs)

PGE-15KV:

Maximum Voltage.....	8,400 Vac
Maximum Current.....	84 mA
Resistance.....	100 kΩ
Thermal.....	1 minute on, 120 minutes off
Shipping Weight	5.0 kg (11 lbs)

PGE-25KV:

Maximum Voltage.....	14,400 Vac
Maximum Current.....	144 mA
Resistance.....	100 kΩ
Thermal.....	1 minute on, 120 minutes off
Shipping Weight	20 kg (44 lbs)

4.3 Current Transformer

PGC-2056:

Current Ratio	200:5 A
Insulation	600-V Class
Window Diameter	56 mm (2.2")
Shipping Weight	1 kg (2.2 lbs)

CertificationCSA, USA and Canada



5. ORDERING INFORMATION

PGM-8325 120 Vac 50/60 Hz, 10 VA Control Power
PGM-8325-E..... 240 Vac 50/60 Hz, 10 VA Control Power

Sensing Resistors:

PGE-600V For system voltages up to 1 kVac
PGE-05KV For system voltages up to 5 kVac
PGE-15KV For system voltages up to 15 kVac
PGE-25KV For system voltages up to 25 kVac

Ground-Fault CT:

PGC-2056 56 mm (2.2") Window

Remote Indication and Reset:

PGB-0302..... Includes two LED pilot lights, a reset push button,
and legend plates
PGB-0325 Indication-and-Reset Assembly

7. TEST PROCEDURES

7.1 Ground-Fault Performance Test

To meet the requirements of the National Electrical Code (NEC), as applicable, the overall ground-fault protection system requires a performance test when first installed. A written record of the performance test is to be retained by those in charge of the electrical installation in order to make it available to the authority having jurisdiction. A test-record form is provided for recording the date and the final results 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 ground-fault current transformer. Ensure the cables pass through the ground-fault-current-transformer window. This check can be done visually with knowledge of the circuit. The connection of the current-transformer secondary to the PGM-8325 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. 10 shows a test circuit using a POWR-GARD 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. Set the test current to 0.6, 2.3, or 4.6 A for PGM-8325 units set at 0.5, 2.0, or 4.0 A respectively. Inject the test current through the current-transformer 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.

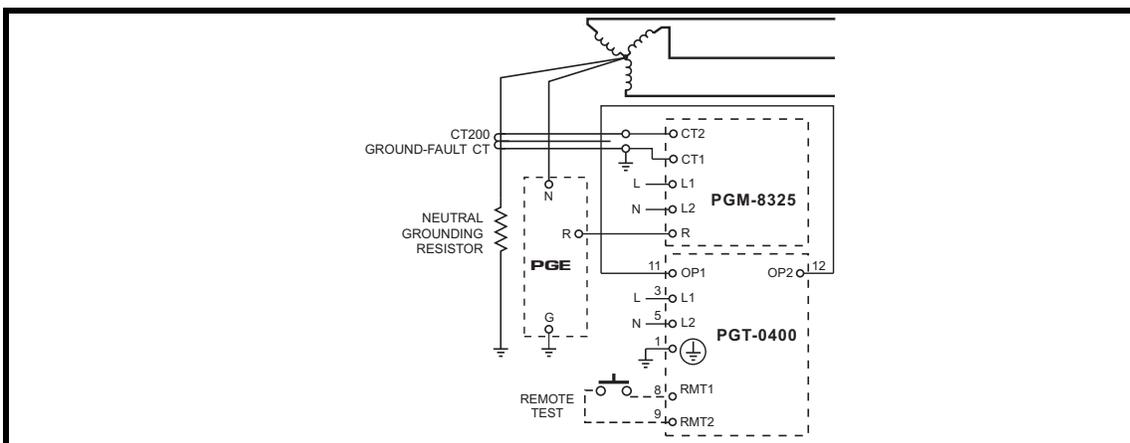


FIGURE 10. Ground-Fault-Test Circuit.

To test the connected wiring, sensing resistor, and NGR:

- Reconnect PGM-8325 R and G connections.
- Set the RES switch to match sensing resistor.
- Press RESET.
PASS: The RESISTOR FAULT LED should be off.

7.2.2 Voltage Test

Test Equipment: 0 to 120 Vac voltage source and multimeter.

Note: Applying the test voltage to the R and G terminals will damage the PGM-8325 and the PGE sensing resistor. The RES TRIP LEVEL is the trip voltage at terminal N, not terminal R.

Procedure:

- Check the PGE sensing resistor connection to the PGM-8325.
- Disconnect the wire from sensing resistor terminal N.
- Set the voltage source to 0 V.
- Connect the voltage source between sensing resistor N and G terminals.
- Set the RES TRIP LEVEL (VAC) to 20.
- Press RESET.
- The RESISTOR-FAULT LED should be off.
- Increase the test voltage to 25 Vac for 20-k Ω sensors or 120 Vac for 100-k Ω sensors and wait 5 seconds.
PASS: The PGM-8325 should trip on RESISTOR FAULT.

7.3 Sensing-Resistor Test

Test Equipment: Multimeter.

Procedure:

- Disconnect the sensing resistor.
- Measure the resistance between sensing-resistor terminals R and N.
PASS: Resistance should be between 19.6 and 20.4 k Ω for 20-k Ω sensing resistors. Resistance should be between 98 and 102 k Ω for 100-k Ω sensing resistors.
- Measure the resistance between sensing-resistor terminals R and G in both directions.
PASS: Resistance should be greater than 10 M Ω in both directions.