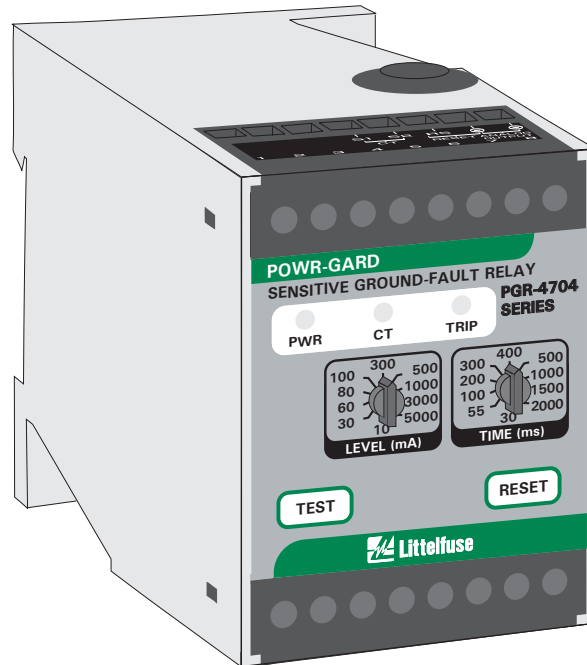


PGR-4704 MANUAL
SENSITIVE GROUND-FAULT RELAY

JUNE 8, 2009

REVISION 3



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DISCLAIMER

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1. GENERAL

The PGR-4704 is a microprocessor-based ground-fault relay for ac power supply systems that require ground-fault detection as low as 10 mA. It is uniquely suited for very sensitive ground-fault protection on systems with significant harmonic content. Its output relay can operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications. The PGR-4704 has one output relay with isolated normally open and normally closed contacts for use in independent control circuits. Additional features include LED trip and power indication, autoreset or latching trips with front-panel and remote reset, trip memory, test switch, self diagnostics, 0- to 1-mA and 0- to 5-V analog outputs, CT verification with LED indication, digital selector switches, and switch-selectable algorithms for fixed-frequency or variable-frequency applications.

Ground-fault current is sensed by a PGC-5000-series core-balance ground-fault current transformer. The trip level of the ground-fault circuit is digital-switch selectable from 10 to 5,000 mA. Trip time is digital-switch selectable from 30 to 2,000 ms.

2. OPERATION

2.1 Configuration-Switch Settings

See Fig. 1.

2.1.1 Relay Operating Mode

Switch 1 is used to set the operating mode of the output relay. In the fail-safe mode, the output relay energizes when the ground-fault circuit is not tripped. In the fail-safe mode, non-volatile memory retains the trip status of the PGR-4704. If tripped, and the supply voltage is cycled, the PGR-4704 will remain tripped, with the trip relay de-energized and the TRIP LED on, until reset.

In the non-fail-safe mode, the output relay energizes when a ground-fault trip occurs. In the non-fail-safe mode, trip status is not retained in non-volatile memory.

2.1.2 Filter Selection

Switch 2 is used to select the filtering algorithm for settings less than 1,000 mA. The selections are for fixed-frequency (50/60 Hz) or variable-frequency applications. The FIXED FREQUENCY setting uses a DFT filter that allows lower trip levels to be used by rejecting harmonics that can cause nuisance tripping.

The VARIABLE FREQUENCY setting uses a peak-detection algorithm with a wider band width for fault detection in variable-frequency drive applications.

The peak-detection algorithm is used for settings greater than 500 mA.

2.1.3 CT Verification

Switch 3 is used to enable CT verification. In the ON position, a trip will occur if the PGC-5000-series current transformer is disconnected.

2.1.4 Reset Mode

Switch 4 is used to select autoreset or latching trips. See Section 2.2.3.

2.1.5 Analog Output

Switch 5 is used to select analog-output scaling. Selecting % OF 5 A results in full scale output (1 mA or 5 V) when ground-fault current is 5 A. Selecting % OF SETTING results in full scale output when ground-fault current equals the trip-level setting.

2.2 Front-Panel Controls

2.2.1 Ground-Fault Trip Level

The LEVEL (mA) selection switch is used to set the ground-fault trip level. For ground-fault detection, the ground-fault trip level must be substantially below the prospective ground-fault current. To avoid sympathetic tripping, the trip level must be above the charging current of the protected feeder.

2.2.2 Ground-Fault Trip Time

The PGR-4704 has a definite-time trip characteristic. The TIME (ms) selector switch is used to set the ground-fault trip time for coordination with upstream and downstream ground-fault devices. 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.

2.2.3 Reset

If the Reset Mode switch is in the LATCHING position, a trip remains latched until the RESET switch is pressed or the remote-reset terminals (6 and 7) are momentarily connected. In the non-fail-safe relay operating mode, cycling the supply voltage will also reset the PGR-4704.

If the Reset Mode switch is in the AUTORESET position, a trip will reset when the fault is removed.

The reset circuit responds only to a momentary closure so that a jammed or shorted switch will not prevent a trip. The front-panel RESET switch is inoperative when the remote-reset terminals are connected.

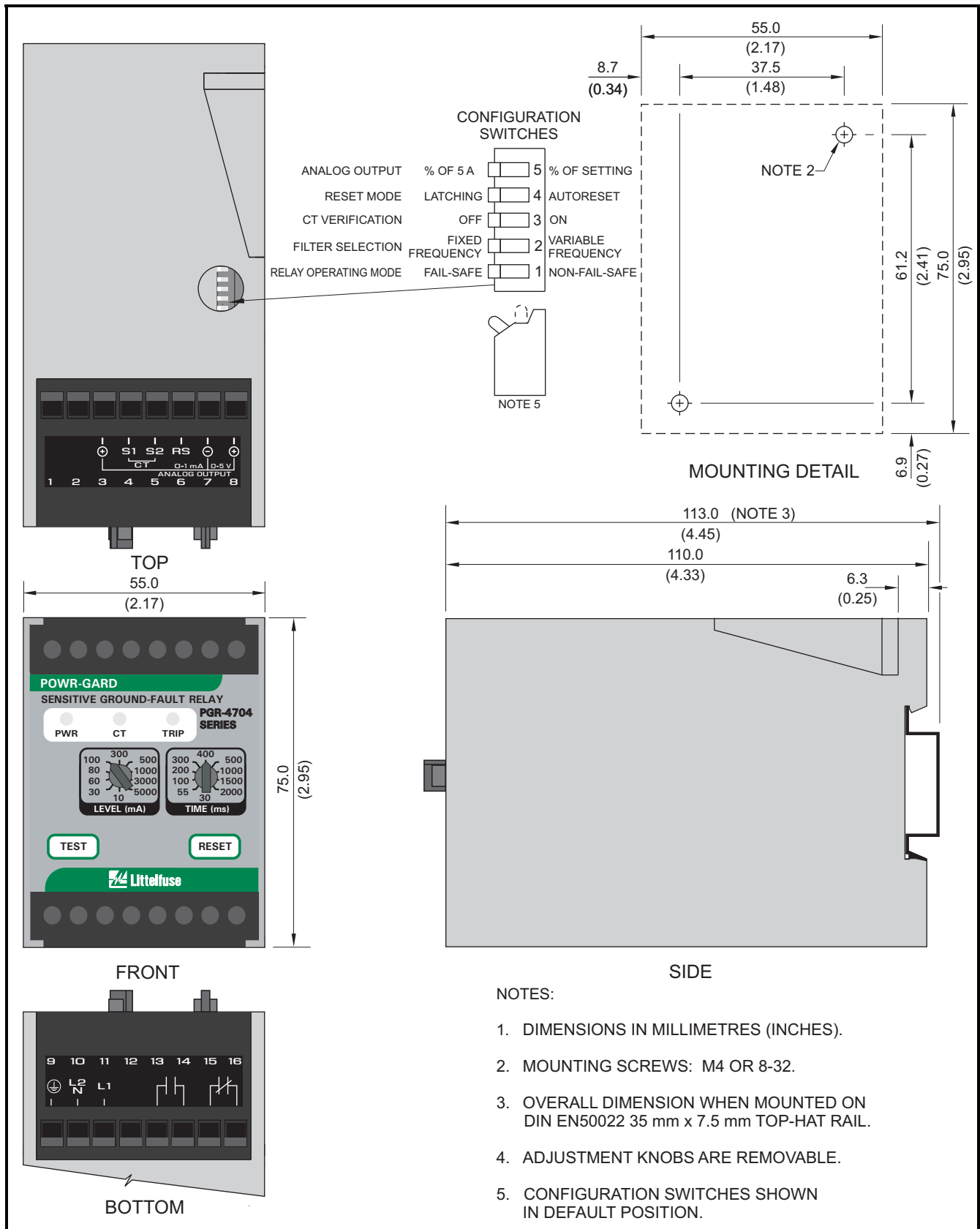


FIGURE 1. PGR-4704 Outline and Mounting Details.

2.2.4 Test

The TEST switch is used to test the ground-fault circuit, the indication, and the output relay. When the TEST switch is pressed for one second, a test signal is applied to the ground-fault-detection circuit, the circuit will trip, the TRIP LED will light, and the output relay will operate.

2.3 Front-Panel Indication

2.3.1 Power

The green LED labeled PWR indicates presence of supply voltage.

2.3.2 Trip

The red LED labeled TRIP indicates a trip. A solid red LED indicates a ground-fault trip and a flashing LED indicates a trip initiated by a CT fault. Two fast flashes of the TRIP LED indicate a diagnostic trip. See Section 2.5.

2.3.3 CT Verification

The green LED labeled CT indicates that a PGC-5000-series current transformer is connected, even if CT verification is disabled.

2.4 Analog Outputs

Non-isolated, 0- to 1-mA (terminal 3) and 0- to 5-V (terminal 8) analog outputs indicate ground-fault current sensed by the CT.

2.5 Self Diagnostics

A diagnostic trip is indicated by two fast flashes of the TRIP LED. It can be caused by a problem detected by the watchdog timer, or from an incorrect reading from non-volatile memory. Press RESET or cycle supply voltage. If the problem persists, consult the factory.

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-4704 ground-fault relay and a PGC-5000-series CT connected as shown in Fig. 2.

A PGR-4704 can be surface or DIN-rail mounted. See Fig. 1. Panel mounting requires a PGK-0055 or PGK-0060 Panel-Mount Adapter. See Figs. 4 and 5.

Use terminal 11 (L1) as the line terminal on ac systems or the positive terminal on dc systems. Use terminal 10 (L2/N) as the neutral terminal on ac systems or the negative terminal on dc systems. Connect terminal 9 (⊕) 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. Connect a PGC-5000-series CT to terminals 4 and 5, connect the shield to terminal 5, and ground terminal 5. See Fig. 3 for PGC-5000-series CT dimensional drawings.

Remove the connection to terminal 9 for dielectric-strength testing—all inputs and outputs have ANSI/IEEE C37.90 surge-protection circuits that conduct above 300 Vac.

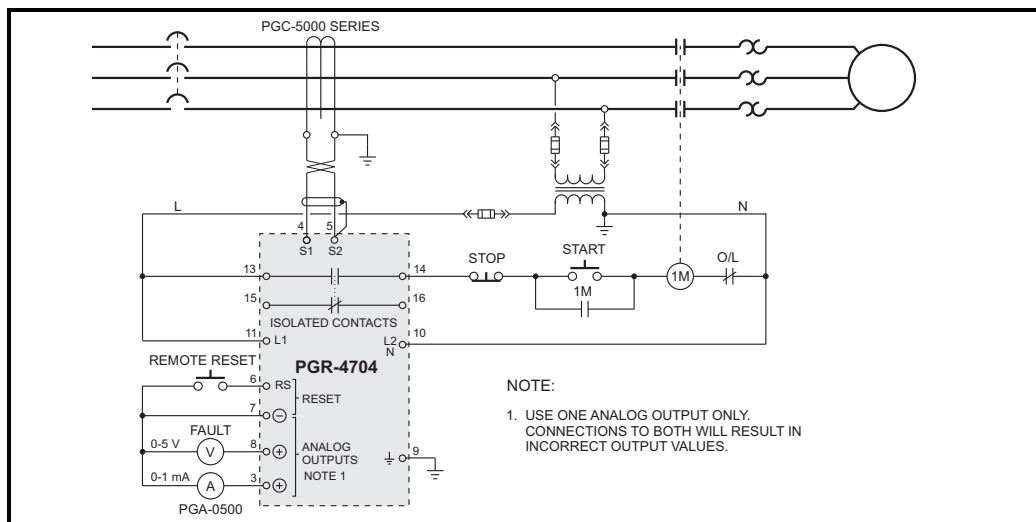


FIGURE 2. Typical Connection Diagram.

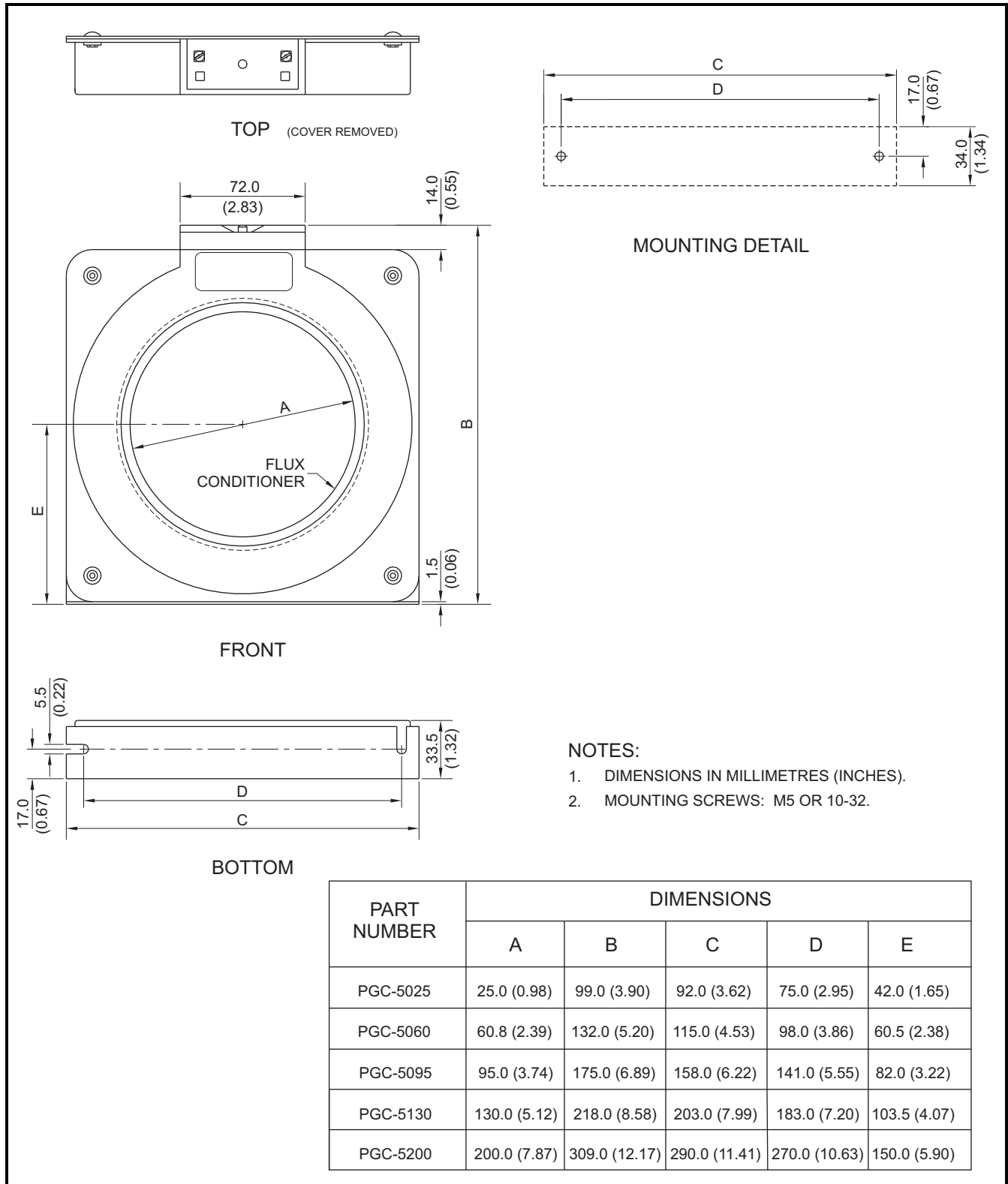


FIGURE 3. PGC-5000-Series Current Transformers.

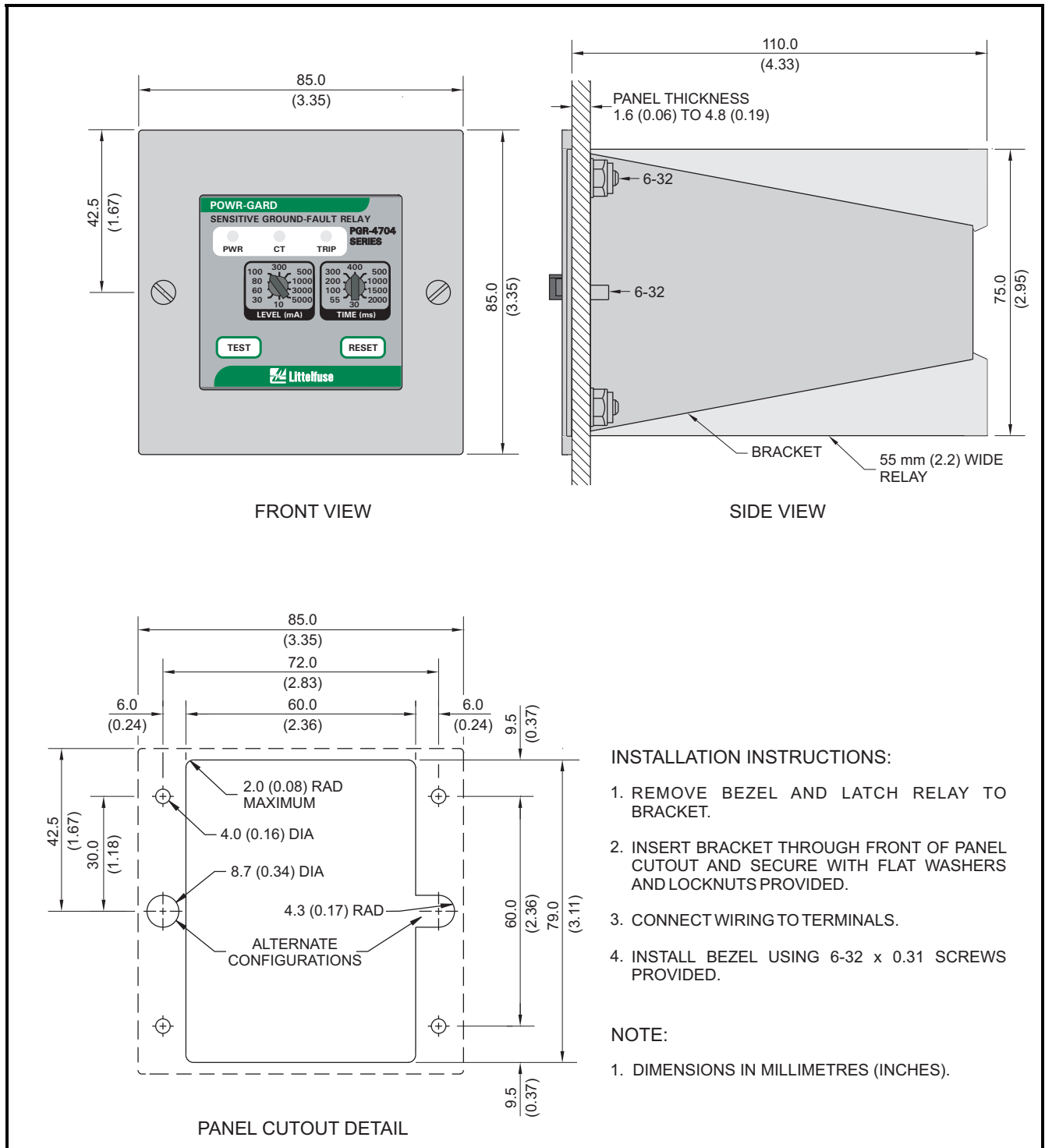


FIGURE 4. PGK-0055 Panel-Mount Adapter.

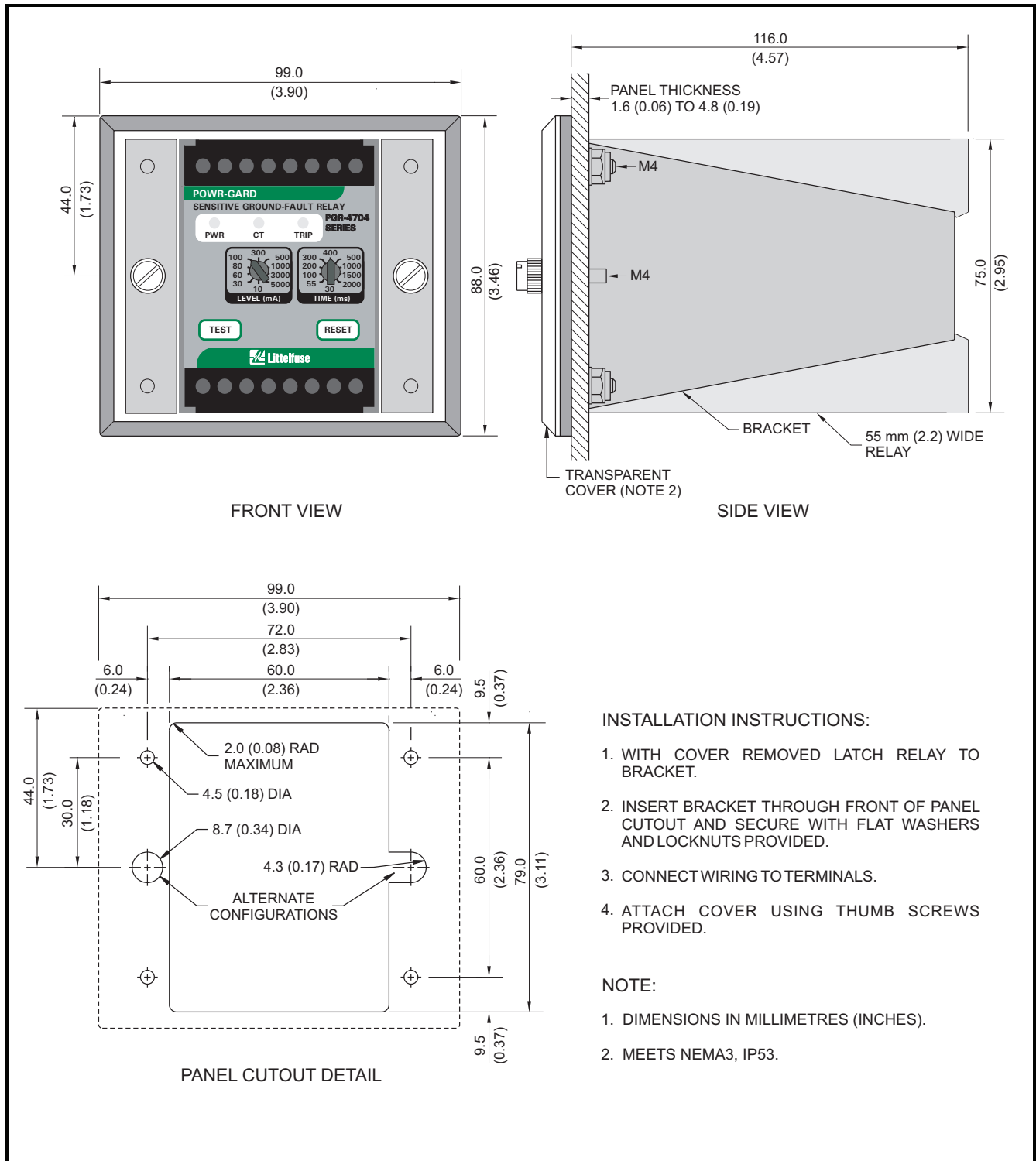


FIGURE 5. PGK-0060 Panel-Mount Adapter.

4. TECHNICAL SPECIFICATIONS

Supply:

0U Option	2.5 VA, 120 to 240 Vac, (+20, -55%) 50/60 Hz, 2.0 W, 100 to 240 Vdc, (+20, -25%)
0D Option	2.0 W, 12 to 30 Vdc, (+20, -25%)
0T Option	2.0 W, 40 to 55 Vdc, (+20, -25%)

Trip-Level Settings	10, 30, 60, 80, 100, 300, 500, 1,000, 3,000, and 5,000 mA
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Trip-Time Settings	30, 55, 100, 200, 300, 400, 500, 1,000, 1,500, and 2,000 ms
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Accuracies: ^(1,2)
Trip Level: ^(3,4)

1,000 to 5,000 mA	+2, -10% (60 Hz) +0, -12% (50 Hz)
60 to 500 mA	+0, -10%, 10 mA min
30 mA	+0, -6 mA
10 mA	2 mA

Trip Time ⁽⁵⁾	5% of Setting, 20 ms min
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Input:

Algorithms ⁽⁶⁾ DFT Digital or Peak

DFT 3 dB Frequency Response	32 to 86 Hz ($<1,000$ mA)
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Peak 3 dB Frequency Response	20 to 420 Hz ($<1,000$ mA)
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Peak 3 dB Frequency Response	20 to 120 Hz ($\geq 1,000$ mA)
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CT PGC-5000-Series CT
 CT Detection Open-Circuit Detection

Thermal Withstand:

Continuous	25-A Ground-Fault Current
1-Second	400-A Ground-Fault Current

Analog Output:

Modes % of 5 A or % of Trip-
 Level Setting

Range:

Terminal 3	0 to 1 mA
Terminal 8	0 to 5 Vdc

Output Impedance:

Terminal 3	4,970 Ω
Terminal 8	220 Ω

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

Functional Test Front-Panel Switch

Output Relay:

Contact Configuration Isolated N.O. and N.C.
 Operating Mode Fail-Safe or Non-Fail-
 Safe

CSA/UL Rating 8 A Resistive, 250 Vac,
 8 A Resistive, 30 Vdc

Supplemental Contact Ratings:

Make/Carry 0.2 s 20 A
 Carry Continuous 8 A

Break:

dc	30 W Resistive, 15 W Inductive (L/R = 0.04)
ac	2,000 VA Resistive 1,400 VA Inductive (PF = 0.4)

Subject to maximums of 8 A and
 250 V (ac or dc).

Operating Mode Latching or Autoreset

Terminals Wire Clamping,
 24 to 12 AWG
 (0.2 to 2.5 mm²)
 Conductors

Dimensions:

Height	75 mm (3.0")
Width	55 mm (2.2")
Depth	115 mm (4.5")

Shipping Weight 0.45 kg (1 lb)

Environment:

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

- (1) Detection limit (A) = (setting in mA – 5,610) / -1.4.
- (2) At 50 or 60 Hz unless otherwise noted.
- (3) PGC-5000-series CT included.
- (4) Maximum lead resistance of 2 Ω .
- (5) Trip time at 3 x trip-level setting.
- (6) Peak algorithm for trip-level settings $\geq 1,000$ mA.

Surge Withstand	ANSI/IEEE 37.90.1-1989 (Oscillatory and Fast Transient)
EMC Tests:	
Verification tested in accordance with EN 50263:2000 Electrostatic Discharge	IEC 61000-4-2, EN 61000-4-2, 6 kV Contact Discharge 8 kV Air Discharge
Radiated RF.....	IEC 61000-4-3, EN 61000-4-3 10 V/m, 80-1,000 MHz, 80% AM (1 kHz) 10 V/m, 900 MHz, 200 Hz Pulse Modulated
Fast Transient.....	IEC 61000-4-4, EN 61000-4-4 ±2 kV Common Mode ±1 kV Differential Mode
Surge Immunity.....	IEC 61000-4-5, EN 61000-4-5 ±2.0 kV Common Mode ±1.0 kV Differential Mode
Conducted RF.....	IEC 61000-4-6, EN 61000-4-6 10 Vrms, 0.15-80 MHz, 80% AM (1 kHz)
Magnetic Field	IEC 61000-4-8, EN 61000-4-8 50 Hz, 30 A/m (continuous) 50 Hz, 300 A/m (1 to 3 seconds)
Voltage Interruption	IEC 255-22-11, EN 60255-11 100% for 2, 5, 10, 20, 50, 100, & 200 ms

MHz Burst	IEC 255-22-1, EN 60255-22-1 1 kV Differential Mode 2.5 kV Common Mode
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RFI Compliance	FCC Part 15, Subpart B, Class A – Unintentional Radiators
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Certification	CSA (Canada and USA)
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CE (European Union)



Complies to IEC 61010-1:2001 (2nd Edition);
 EN 61010-1:2001 (2nd Edition) Safety Requirements
 for Electrical Equipment for Measurement,
 Control, and Laboratory Use – Part 1

5. ORDERING INFORMATION

PGR-4704-0	<input type="checkbox"/>
	└─ U Universal 120/240-Vac/Vdc Supply
	D 12/24-Vdc Supply
	T 48-Vdc Supply

PGA-0500	Analog Percent Current 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
PGK-0055	Panel-Mount Adapter, NEMA 1
PGK-0060	Panel-Mount Adapter, NEMA 3, IP53
PGK-0003	Adapter Plate, GEC/MCGG

Consult factory for custom mounting adapters.

6. PERFORMANCE 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-transformer secondary to the PGR-4704 is not polarity sensitive.
- 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.
- 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-4704 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.
- 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 4 and 5.

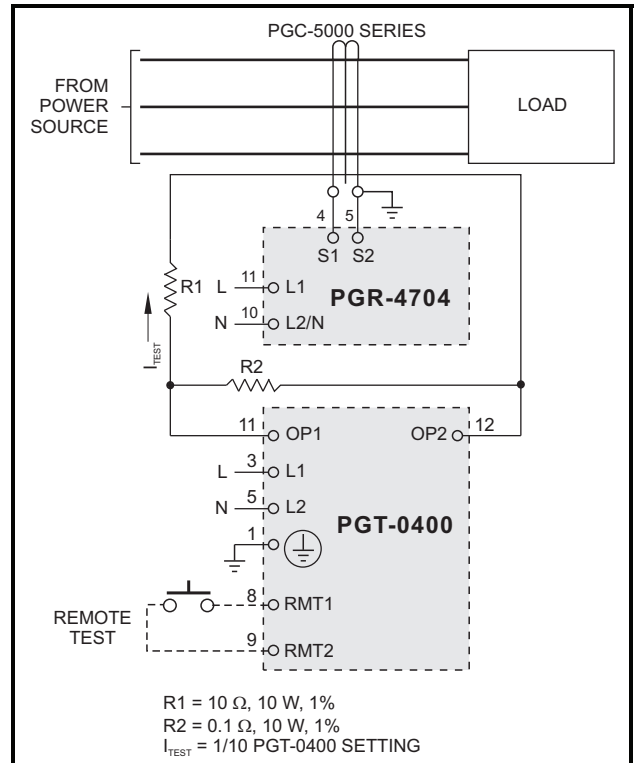


FIGURE 6. Ground-Fault-Test Circuit.

TABLE 1. Ground-Fault-Test Record

DATE	TEST RESULTS

Retain this record for the authority having jurisdiction.

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