Littelfuse
STARTCO

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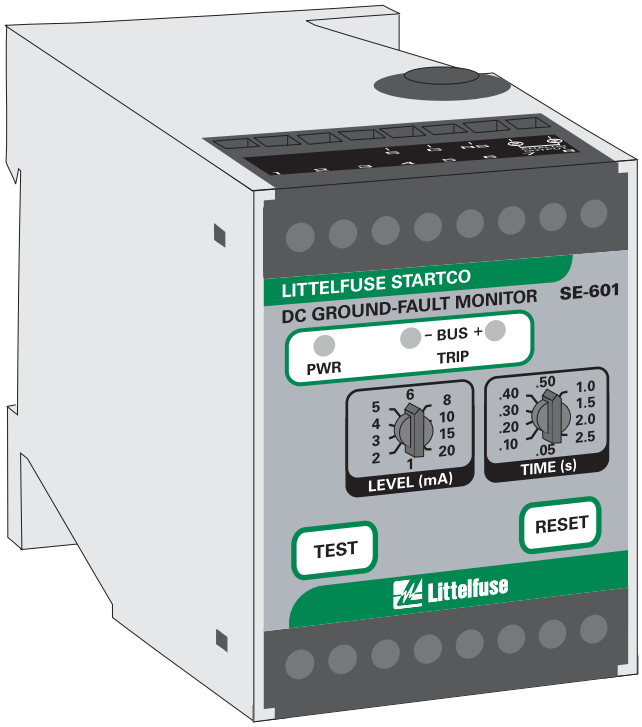
SE-601 MANUAL

DC GROUND-FAULT MONITOR

REVISION 2-B-073014



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DISCLAIMER

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1. GENERAL

The SE-601 is a microprocessor-based ground-fault monitor for ungrounded dc systems. Its output relay can operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications. The SE-601 has one output relay with isolated normally open and normally closed contacts for use in independent control circuits. Additional features include LED power and faulted-bus indication, autoreset or latching trips with front-panel and remote reset, trip memory, test button, self diagnostics, 0- to 5-V analog output, and digital selector switches. The SE-601 can be DIN-rail, surface, or panel mounted.

Ground-fault current is sensed using an SE-GRM-series Ground-Reference Module—a resistor network that limits ground-fault current to 25 mA. The trip level of the ground-fault circuit is selectable from 1 to 20 mA. Trip time is selectable from 0.05 to 2.5 s.

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 SE-601 is energized and the ground-fault circuit is not tripped. If tripped, and the supply voltage is cycled, the SE-601 will remain tripped, with the trip relay de-energized and a TRIP LED on, until reset.

In the non-fail-safe mode, the output 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 RESET MODE

Switch 2 is used to select autoreset or latching trips. See Section 2.2.3.

2.2 FRONT-PANEL CONTROLS

2.2.1 GROUND-FAULT TRIP LEVEL

The LEVEL (mA) selector switch is used to set the ground-fault trip level.

Ground-fault current is a function of fault resistance, system voltage, and the SE-GRM-series Ground-Reference Module. Table 1 lists the SE-601 trip levels and fault-resistance values for 24-, 48-, 125-, 250-, 500-, 780-, and 1000-Vdc systems.

2.2.2 GROUND-FAULT TRIP TIME

The SE-601 has a definite-time trip characteristic. The TIME (s) selector switch is used to set the ground-fault trip time.

2.2.3 RESET

If the Reset Mode switch is in the LATCHING position, a trip remains latched until the RESET button is pressed or the remote-reset terminals (6 and 7) are momentarily connected. In the non-fail-safe mode, cycling the supply voltage will also reset the SE-601.

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

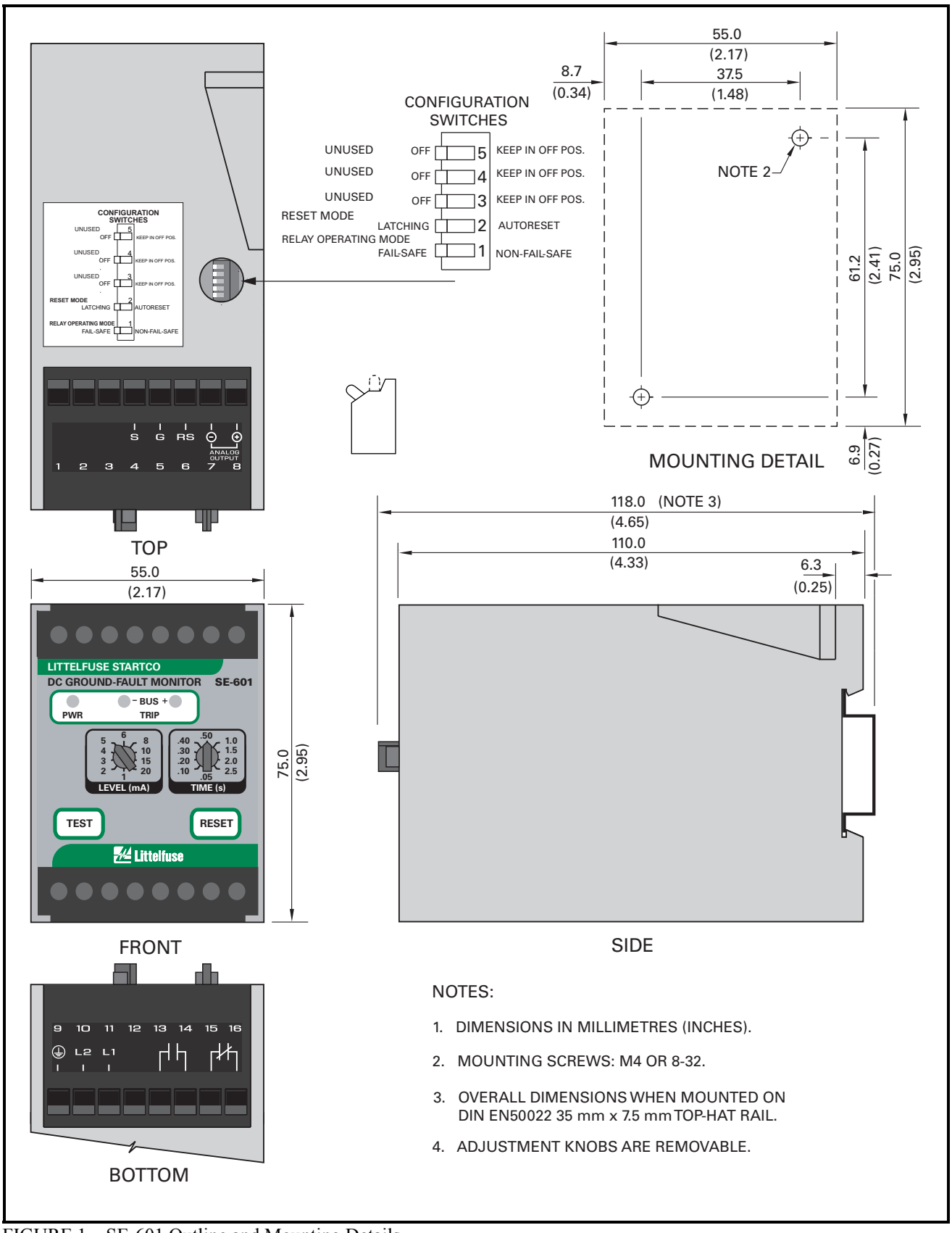
The reset circuit responds only to a momentary closure so that a jammed or shorted button will not prevent a trip. The front-panel RESET button is inoperative when remote-reset terminals are connected.

2.2.4 TEST

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

TABLE 1. SE-601 TRIP LEVELS AND FAULT-RESISTANCE VALUES

	FAULT RESISTANCE (kΩ)						
TRIP LEVEL (mA)	24-Vdc SYSTEM SE-GRM024	48-Vdc SYSTEM SE-GRM048	125-Vdc SYSTEM SE-GRM125	250-Vdc SYSTEM SE-GRM250	500-Vdc SYSTEM SE-GRM500	780-Vdc SYSTEM SE-GRM780	1000-Vdc SYSTEM SE-GRM1000
1	11.5	22.3	60.0	120.0	240.0	374.2	480.0
2	5.5	11.0	28.7	57.5	115.0	179.2	230.0
3	3.5	7.0	18.3	36.6	73.3	114.2	146.7
4	2.5	5.0	13.1	26.2	52.5	81.7	105.0
5	1.9	3.8	10.0	20.0	40.0	62.2	80.0
6	1.5	3.0	7.9	15.8	31.7	49.2	63.3
8	1.0	2.0	5.3	10.6	21.3	32.9	42.5
10	0.7	1.4	3.7	7.5	15.0	23.2	30.0
15	0.3	0.6	1.6	3.3	6.7	10.2	13.3
20	0.1	0.2	0.6	1.2	2.5	3.7	5.0



NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.
3. OVERALL DIMENSIONS WHEN MOUNTED ON DIN EN50022 35 mm x 7.5 mm TOP-HAT RAIL.
4. ADJUSTMENT KNOBS ARE REMOVABLE.

FIGURE 1. SE-601 Outline and Mounting Details.

2.3 FRONT-PANEL INDICATION

2.3.1 POWER

The green LED labelled PWR indicates presence of the supply voltage.

2.3.2 TRIP

The red TRIP LED's indicate a ground-fault trip. The "-BUS" TRIP LED indicates a ground fault on the negative dc bus. The "+BUS" TRIP LED indicates a ground fault on the positive dc bus. Two fast flashes indicate a diagnostic trip. See Section 2.5

2.4 ANALOG OUTPUT

The non-isolated, 0- to 5-V analog output indicates ground-fault current. The output is 5 V when ground-fault current is 20 mA. Use a PGA-0500 Analog Percent Current Meter with the PGA-05CV Voltage Converter to indicate ground-fault current. See Figs. 2 and 8.

2.5 SELF DIAGNOSTICS

A diagnostic trip is indicated by two fast flashes of the TRIP LED's. It can be caused by a diagnostic problem detected by an incorrect reading from non-volatile memory. Press RESET or cycle supply voltage. If problems persist, contact Littelfuse Startco.

3. INSTALLATION

3.1 SE-601

An SE-601 can be surface or DIN-rail mounted. See Fig. 1. Panel mounting requires a PMA-55 or PMA-60 Panel-Mount Adapter. See Figs. 6 and 7.

Connect the SE-601 DC Ground-Fault Monitor and SE-GRM-series Ground-Reference Module as shown in Fig. 2.

Remove the connection to terminals 5 and 9 for dielectric-strength testing—all inputs and outputs have ANSI/IEEE C37.90 surge-protection circuits that conduct above 300 Vac.

3.2 GROUND-REFERENCE MODULES

Outline and mounting dimensions for the SE-GRM-series Ground-Reference Modules are provided in Figs. 3, 4, and 5.

The SE-GRM780 and SE-GRM1000 dissipate approximately 9.6 and 12.5 W respectively under normal conditions and 19.2 and 25.0 W respectively at maximum when a ground fault is present at 780 V or 1000 V. If the system is to be operated for more than two minutes with a ground fault present, an additional heat sink is required. This can be achieved by applying thermal compound (silicone grease) to the Ground-Reference Module's mounting surface, then securely fastening it to an aluminum panel with minimum dimensions of 300 mm (12") x 300 mm (12") x 3 mm (0.120")

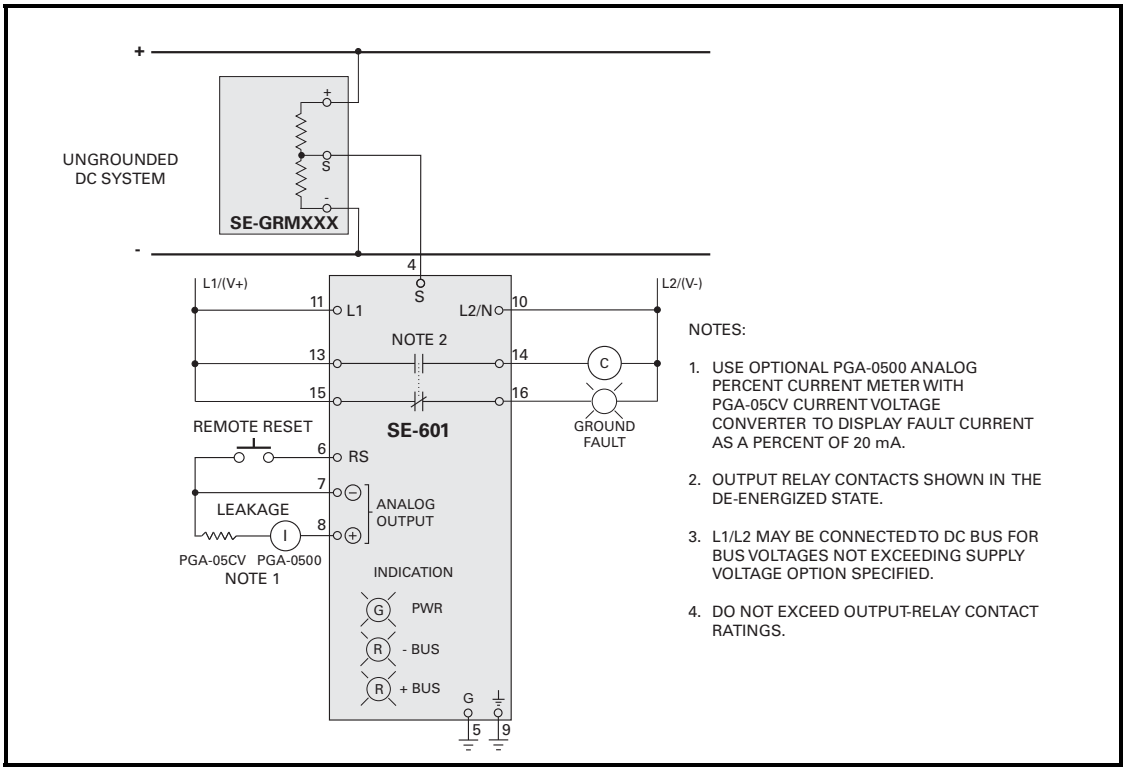
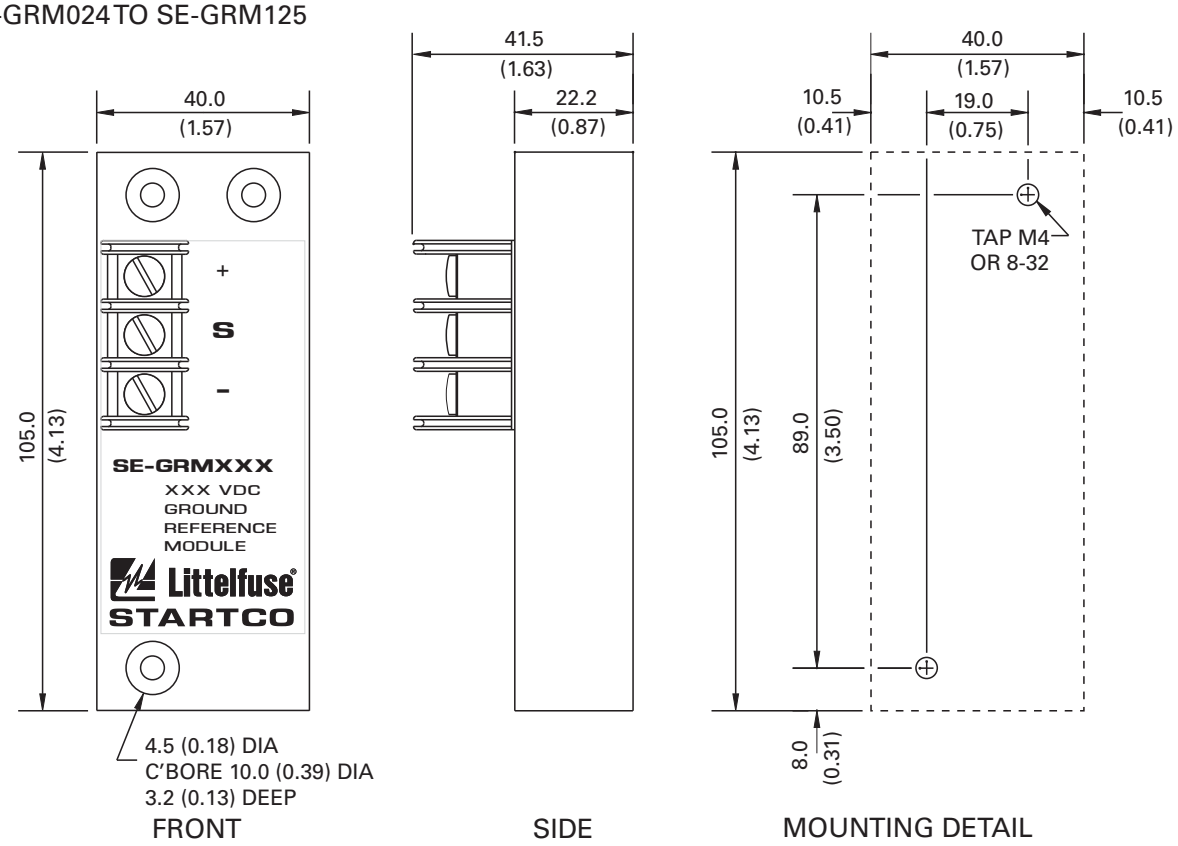


FIGURE 2. Typical Connection Diagram.

SE-GRM024 TO SE-GRM125



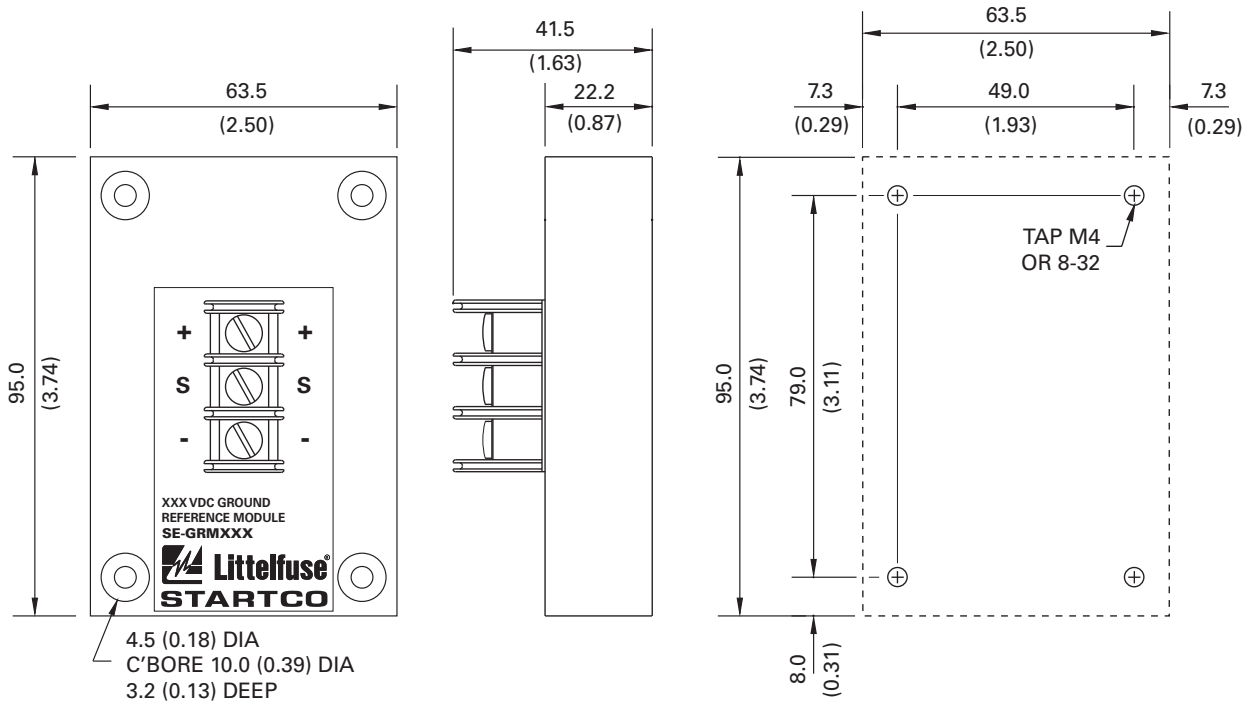
MODULE	UNFAULTED	GROUND FAULT	FAULT CURRENT	DUTY CYCLE
SE-GRM024	0.3 W	0.6 W MAX	24 mA	CONTINUOUS
SE-GRM048	0.6 W	1.2 W MAX	24 mA	CONTINUOUS
SE-GRM125	1.6 W	3.2 W MAX	24 mA	CONTINUOUS
CONTACT FACTORY FOR OTHER VOLTAGES				

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.

FIGURE 3. SE-GRM-Series Ground-Reference Modules – 24 to 125 V.

SE-GRM250 TO SE-GRM600



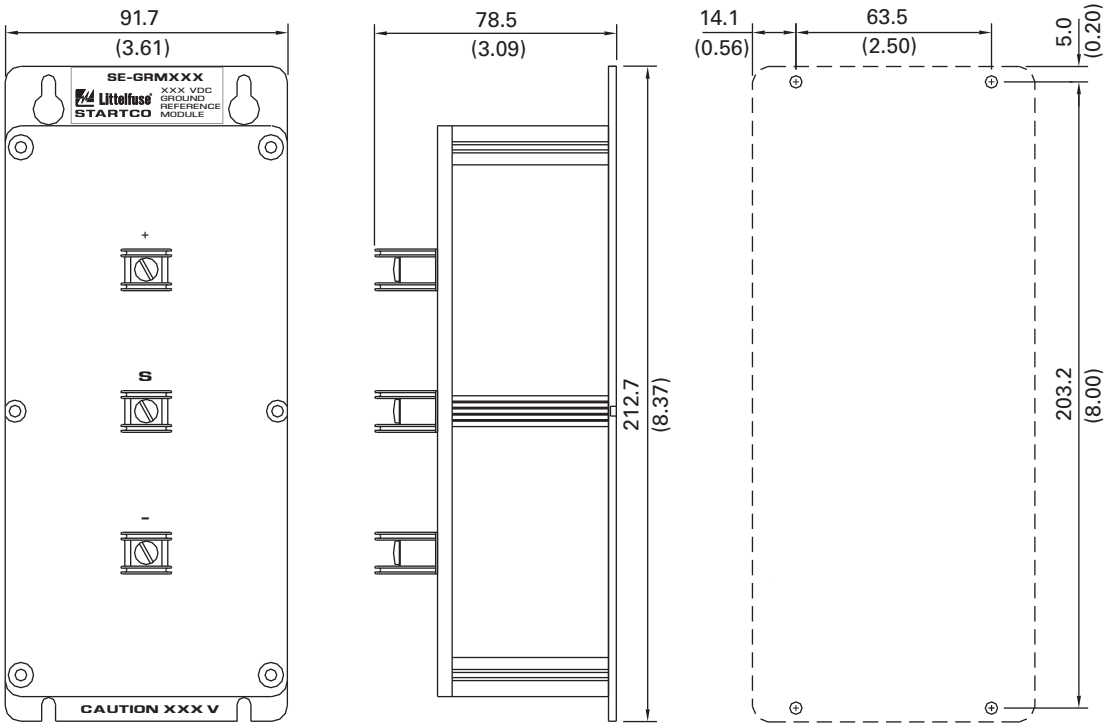
MODULE	UNFAULTED	GROUND FAULT	FAULT CURRENT	DUTY CYCLE
SE-GRM250	3.1 W	6.3 W MAX	25 mA	CONTINUOUS
SE-GRM300	3.6 W	7.2 W MAX	24 mA	CONTINUOUS
SE-GRM400	4.4 W	8.9 W MAX	22 mA	CONTINUOUS
SE-GRM500	6.3 W	12.5 W MAX	25 mA	CONTINUOUS
SE-GRM600	7.2 W	14.4 W MAX	24 mA	CONTINUOUS
CONTACT FACTORY FOR OTHER VOLTAGES				

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 x 25 OR 8-32 x 1.00.

FIGURE 4. SE-GRM-Series Ground-Reference Modules – 250 to 600 V.

SE-GRM780 TO SE-GRM1000



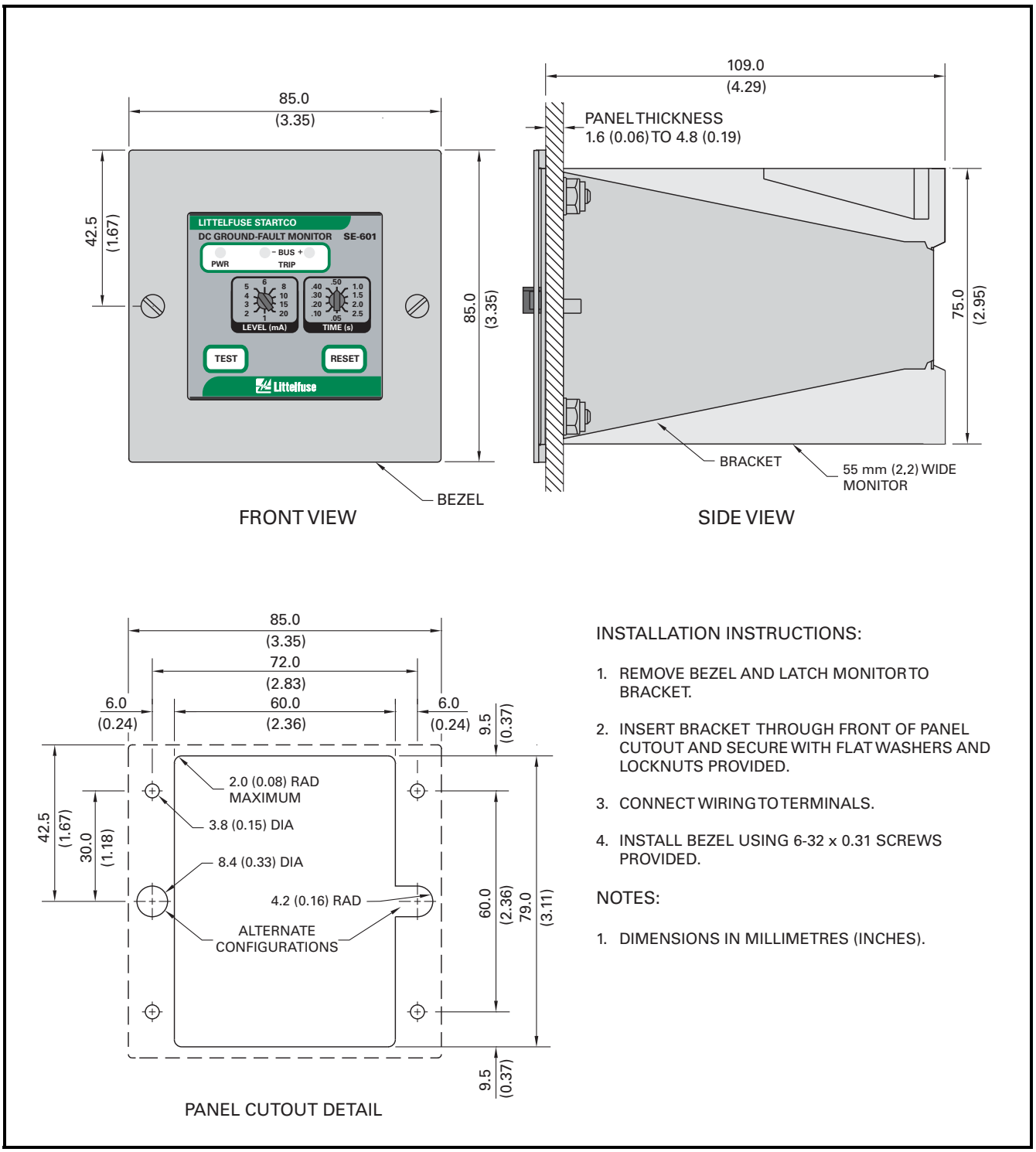
FRONT SIDE MOUNTING DETAIL

MODULE	UNFAULTED	GROUND FAULT	FAULT CURRENT	DUTY CYCLE
SE-GRM780	9.6 W	19.2 W MAX	24.6 mA	CONTINUOUS
SE-GRM1000	12.5 W	25 W MAX	25 mA	CONTINUOUS
CONTACT FACTORY FOR OTHER VOLTAGES				

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.
3. ADDITIONAL HEAT SINK REQUIRED IF OPERATED MORE THAN TWO MINUTES WITH A GROUND FAULT.

FIGURE 5. SE-GRM-Series Ground-Reference Modules – 780 to 1,000 V.



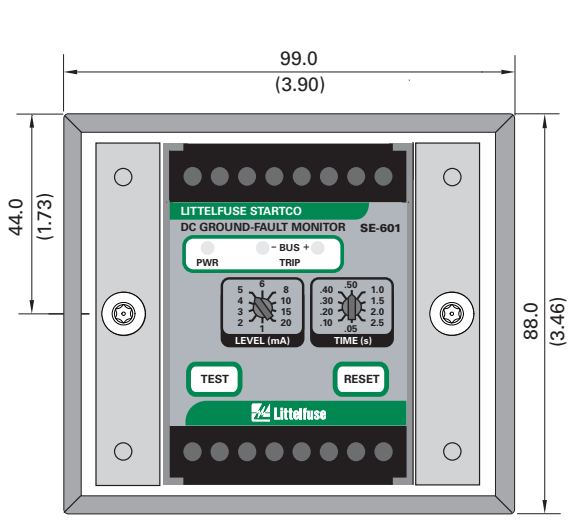
INSTALLATION INSTRUCTIONS:

1. REMOVE BEZEL AND LATCH MONITOR TO BRACKET.
2. INSERT BRACKET THROUGH FRONT OF PANEL CUTOUT AND SECURE WITH FLAT WASHERS AND LOCKNUTS PROVIDED.
3. CONNECT WIRING TO TERMINALS.
4. INSTALL BEZEL USING 6-32 x 0.31 SCREWS PROVIDED.

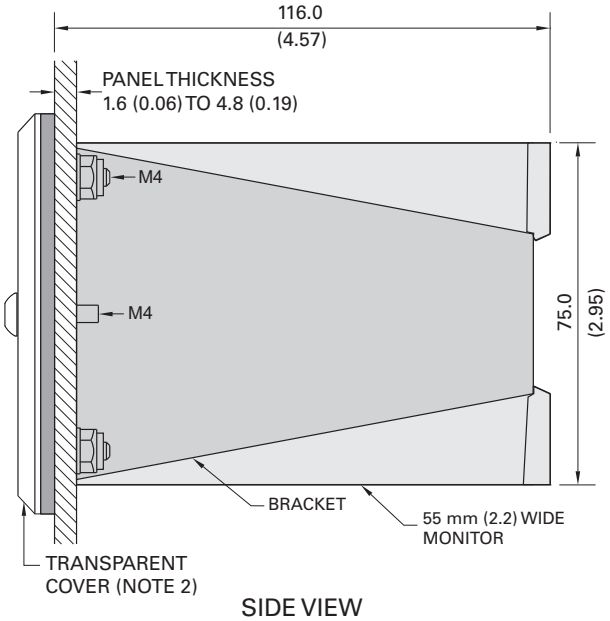
NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).

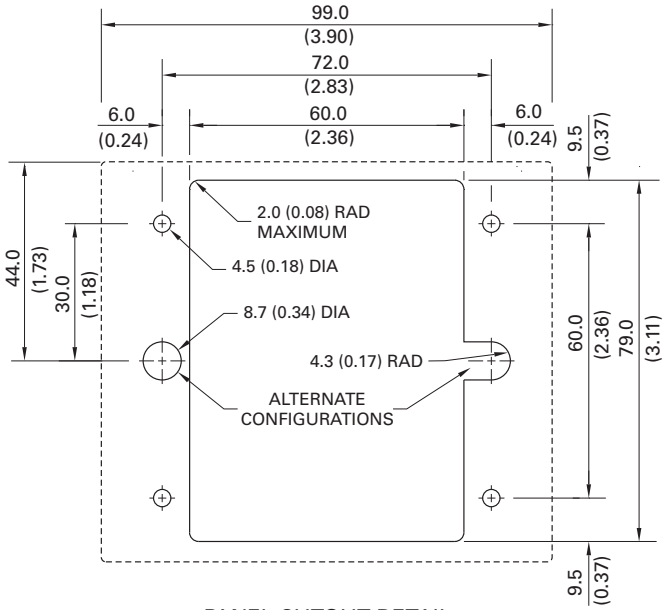
FIGURE 6. PMA-55 Panel-Mount Adapter.



FRONT VIEW



SIDE VIEW



PANEL CUTOUT DETAIL

INSTALLATION INSTRUCTIONS:

1. WITH COVER REMOVED LATCH MONITOR TO BRACKET.
2. INSERT BRACKET THROUGH FRONT OF PANEL CUTOUT AND SECURE WITH FLAT WASHERS AND LOCKNUTS PROVIDED.
3. CONNECT WIRING TO TERMINALS.
4. ATTACH COVER USING SECURITY SCREWS OR THUMB SCREWS PROVIDED.

NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MEETS NEMA3, IP53.
3. INCLUDES TWO TR20 TAMPER-RESISTANT TORX SCREWS (M4-0.7x16 mm, INSTALLED) AND TWO THUMB SCREWS.

FIGURE 7. PMA-60 Panel-Mount Adapter.

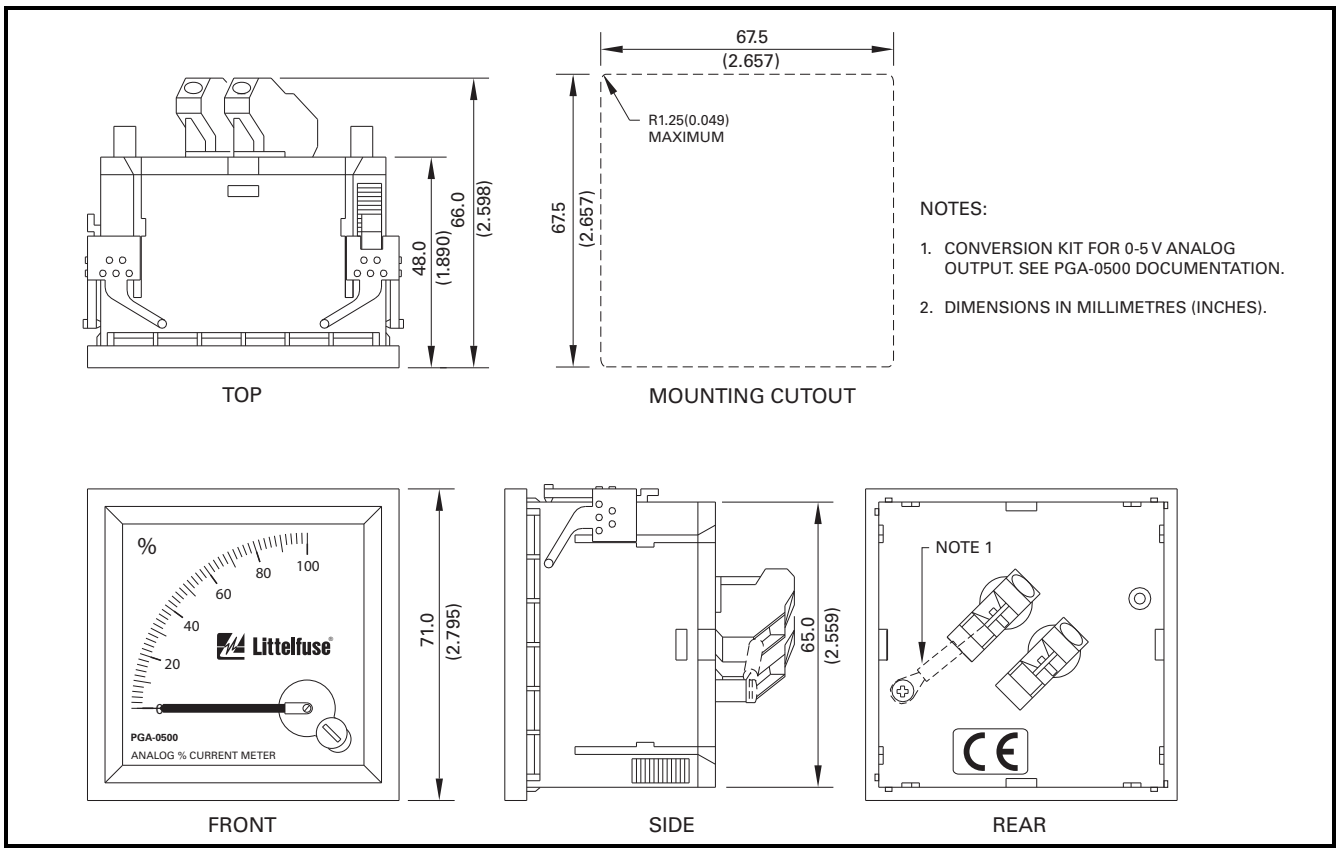


FIGURE 8. PGA-0500 Analog Percent Current Meter.

4. SE-601 COMPATIBILITY

The current SE-601 has been enhanced with the addition of non-volatile trip memory for the fail-safe relay operating mode. Prior to hardware revision 01, a mechanical flag was used instead of non-volatile memory. The current revision of the SE-601 can directly replace previous revision-00 units. The hardware-revision number is listed on the SE-601 model/serial-number label affixed to the SE-601 enclosure. Both generations are compared in Table 2.

TABLE 2. TRIP-FEATURES COMPARISON

		HARDWARE REVISION	
		00	≥ 01
LED trip indication		Yes	Yes
Mechanical flag trip indication		Yes	No
Non-volatile trip memory		No	Yes
Device state after supply voltage cycled when tripped (ground-fault removed)	Fail-safe	Trip LED: Off Trip relay: Energized Trip flag: Red	Trip LED: On Trip relay: De-energized
	Non-fail-safe	Trip LED: Off Trip relay: De-energized Trip flag: Red	Trip LED: Off Trip relay: De-energized

5. TECHNICAL SPECIFICATIONS

5.1 SE-601

Supply:
- 0U Option ..... 5 VA, 120 to 240 Vac (+20, -55%), 50/60 Hz, 2 W, 100 to 240 Vdc (+20, -25%)
- 0D Option ..... 2 W, 12 to 30 Vdc (+20, -25%)
- 0T Option..... 2 W, 40 to 55 Vdc (+20, -25%)

Trip-Level Settings..... 1, 2, 3, 4, 5, 6, 8, 10, 15, and 20 mA

Trip-Time Settings ..... 0.05, 0.10, 0.20, 0.30, 0.40, 0.50, 1.0, 1.5, 2.0, and 2.5 s

Accuracies: (1)
- Trip Level ..... 5% of setting, 0.15 mA minimum
- Trip Time (2) ..... 5% of setting, 15 ms minimum

Trip Mode ..... Latching or Autoreset

Analog Output:
- Range ..... 0 to 5 V, 0.25 V per mA
- Output Impedance ..... 220 Ω

Reset..... Front-Panel Button and Remote, N.O. Momentary Contact

Functional Test ..... Front-Panel Button

Relay Contacts:
- 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
  0.25 HP, 120/240 Vac
- Supplemental Contact Ratings:
  - Carry Current..... 8 A, maximum
  - Break:
    - 30 Vdc..... 240 W Resistive, 170 W Inductive (L/R = 7 ms)
    - 120 Vdc..... 24 W Resistive, 17 W Inductive (L/R = 7 ms)
    - ac ..... 2,000 VA Resistive, 875 VA Inductive (PF = 0.4)

    (Subject to maximums of 8 A and 250 Vac/ 30 Vdc or 200 mA at 120 Vdc)

Terminals..... Wire-clamping 24 to 12 AWG (0.2 to 2.5 mm^2) conductors

Dimensions:
- Height..... 75 mm (3.0”)
- Width..... 55 mm (2.2”)
- Depth..... 113 mm (4.5”)

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

Environment:
- Operating Temperature:
  - Altitude:
    - ≤ 1,000 m (3,281’)..... -40 to 60°C (-40 to 140°F)
    - 3,000 m (9,843’)..... -40 to 55°C (-40 to 131°F)
    - 5,000 m (16,404’)..... -40 to 50°C (-40 to 122°F)
- Storage Temperature ..... -55 to 80°C (-67 to 160°F)
- Humidity ..... 85% Non-Condensing
- Altitude ..... 5,000 m (16,404’) maximum

PWB Conformal Coating..... MIL-1-46058 qualified
UL QMJU2 recognized

Surge Withstand ..... ANSI/IEEE 37.90.1-1989 (Oscillatory and Fast Transient)

Vibration ..... EN60255-21-1 (Vibration, Shock, and Seismic)
EN60255-21-2 (Shock and Bump)

EMC Tests:
Verification tested in accordance with EN 50263:2000
- Radiated and Conducted Emissions..... CISPR 11:2009, CISPR 22:2008, EN55022:2010 Class A
- Current Harmonics and Voltage Fluctuation..... IEC 61000-3-2 and IEC 61000-3-3 Class A

Electrostatic Discharge..... IEC 61000-4-2
± 6 kV contact discharge (direct and indirect)
± 8 kV air discharge

Radiated RF Immunity..... IEC 61000-4-3
10 V/m, 80-1000 MHz, 80% AM (1 kHz)
10 V/m, 900 MHz, 200 Hz pulse modulated

Fast Transient..... IEC 61000-4-4
±4 kV on AC mains and I/O lines

Surge Immunity..... IEC 61000-4-5
Zone B
± 1 kV differential mode
± 2 kV common mode

Conducted RF Immunity .... IEC 61000-4-6
10 V, 0.15-80 MHz, 80% AM (1 kHz)

Magnetic Field Immunity ... IEC 61000-4-8
50 Hz and 60 Hz , 30 A/m and 300 A/m

Voltage Interruption ..... IEC 61000-4-11, IEC 61000-4-29,
0% for 5, 10, 20, 50, 100 & 200 ms 3x each

Power Frequency ..... IEC 61000-4-16
Zone A: differential mode 150 Vrms
Zone A: common mode 300 Vrms

1 MHz Burst ..... IEC 61000-4-18
± 1 kV differential mode (line-to-line)
± 2.5 kV common mode

RFI Compliance ..... FCC Part 15, Subpart B, Class A – Unintentional Radiators

Certification .....CSA, Canada and USA

C SA® LR 53428 US

UL Listed

UL LISTED Ground Fault Sensing and Relaying Equipment 4FX9 E340889

Australia

N11659

FCC

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.

NOTES:

(1) Over operating temperature range of -40 to 60°C (-40 to 140°F).

(2) Trip time at 3 × trip-level setting.

5.2 GROUND REFERENCE MODULES

Nominal Current.....12.5 mA

Maximum Fault Current.....25 mA

Duty Cycle .....Continuous

Environment:

- Operating Temperature .....−40 to 60°C (-40 to 140°F)
- Storage Temperature.....−55 to 80°C (-67 to 160°F)
- Humidity .....85% Non-Condensing

SE-GRM024:

- Power Dissipation
  - At 24 Vdc.....Unfaulted 0.3 W, Ground Fault 0.6 W maximum
- Shipping Weight.....300 g (0.7 lb)

SE-GRM048:

- Power Dissipation
  - At 48 Vdc.....Unfaulted 0.6 W, Ground Fault 1.2 W maximum
- Shipping Weight.....300 g (0.7 lb)

SE-GRM125:
Power Dissipation
At 125 Vdc .....Unfaulted 1.6 W, Ground Fault 3.2 W maximum
Shipping Weight.....300 g (0.7 lb)

SE-GRM250:
Power Dissipation
At 250 Vdc .....Unfaulted 3.1 W, Ground Fault 6.3 W maximum
Shipping Weight.....500 g (1.6 lb)

SE-GRM300:
Power Dissipation
At 300 Vdc .....Unfaulted 3.6 W, Ground Fault 7.2 W maximum
Shipping Weight.....500 g (1.6 lb)

SE-GRM400:
Power Dissipation
At 400 Vdc .....Unfaulted 4.4 W, Ground Fault 8.9 W maximum
Shipping Weight.....500 g (1.6 lb)

SE-GRM500:
Power Dissipation
At 500 Vdc .....Unfaulted 6.3 W, Ground Fault 12.5 W maximum
Shipping Weight.....500 g (1.6 lb)

SE-GRM600:
Power Dissipation
At 600 Vdc .....Unfaulted 7.2 W, Ground Fault 14.4 W maximum
Shipping Weight.....500 g (1.6 lb)

SE-GRM780:
Power Dissipation
At 780 Vdc .....Unfaulted 9.6 W, Ground Fault 19.2 W maximum
Shipping Weight.....2.1 kg (4.5 lb)

SE-GRM1000:
Power Dissipation
At 1000 Vdc .....Unfaulted 12.5 W, Ground Fault 25.0 W maximum
Shipping Weight.....2.1 kg (4.5 lb)

6. ORDERING INFORMATION

SE-601-0□-□□

Conformal Coating:
Blank – Partial Conformal Coating
CC – Full Conformal Coating
Supply:
U – Universal 120/240-Vac/Vdc Supply
D – 12/24-Vdc Supply
T – 48-Vdc Supply

SE-GRM024 ..... Ground-Reference Module for 24-Vdc system
SE-GRM048 ..... Ground-Reference Module for 48-Vdc system
SE-GRM125 ..... Ground-Reference Module for 125-Vdc system
SE-GRM250 ..... Ground-Reference Module for 250-Vdc system
SE-GRM300 ..... Ground-Reference Module for 300-Vdc system
SE-GRM400 ..... Ground-Reference Module for 400-Vdc system
SE-GRM500 ..... Ground-Reference Module for 500-Vdc system
SE-GRM600 ..... Ground-Reference Module for 600-Vdc system
SE-GRM780 ..... Ground-Reference Module for 780-Vdc system
SE-GRM1000 ..... Ground-Reference Module for 1000-Vdc system
Consult factory for other ground-reference modules.

PGA-0500 ..... Analog Percent Current Meter, 0 to 100% range (PGA-05CV included)
PMA-55 ..... Panel-Mount Adapter NEMA 1
PMA-60 ..... Panel-Mount Adapter, NEMA 3, IP53. Includes two TR20 tamper-resistant Torx screws and two thumb screws.
Consult factory for custom mounting adapters

7. WARRANTY

The SE-601 DC Ground-Fault Monitor is warranted to be free from defects in material and workmanship for a period of five years from the date of purchase.

Littelfuse Startco will (at Littelfuse Startco's option) repair, replace, or refund the original purchase price of an SE-601 that is determined by Littelfuse Startco to be defective if it is returned to the factory, freight prepaid, within the warranty period. This warranty does not apply to repairs required as a result of misuse, negligence, an accident, improper installation, tampering, or insufficient care. Littelfuse Startco does not warrant products repaired or modified by non-Littelfuse Startco personnel.

8. GROUND-FAULT PERFORMANCE TEST

A test record form is provided for recording the date and the final results of the performance tests. The following ground-fault system test is to be conducted by qualified personnel.

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

b) Verify proper reaction of the device in response to a simulated or complete system test.

c) To simulate a ground fault, power down the entire system and remove the connection to terminal 4 (S). Ensure that terminal 5 is connected to ground. Using a 24 Vdc source, 50 kΩ variable resistor, fixed 1 kΩ resistor, and an ammeter, connect the circuit as shown in Fig. 9. Select a trip current on the SE-601, and slowly vary the resistance until the monitor trips. Never exceed 30 mA through the monitor.

d) For a system ground-fault test, install a fixed or variable resistance and switch that is suitably rated for the system. Install a fuse rated to protect the test circuit. The fixed test resistance can be sized to cause a ground-fault current just above the trip level setting. See Fig. 10. For a reference of fault-resistance values, see Table 1.

e) Record the date and the results of the test on the attached test record form.

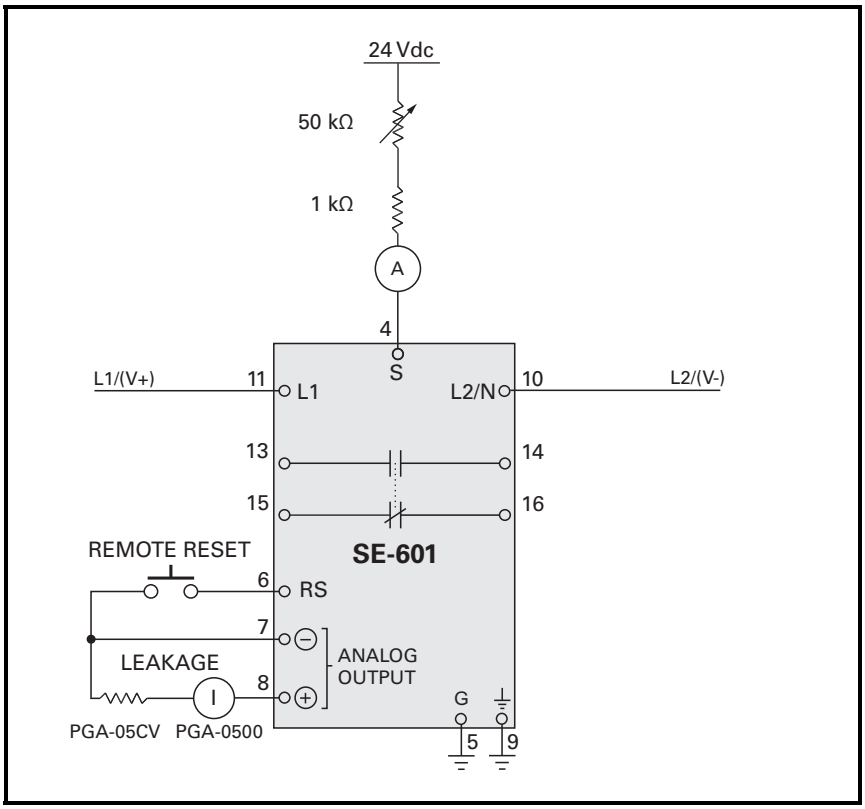


FIGURE 9. Ground-Fault Test Circuit.

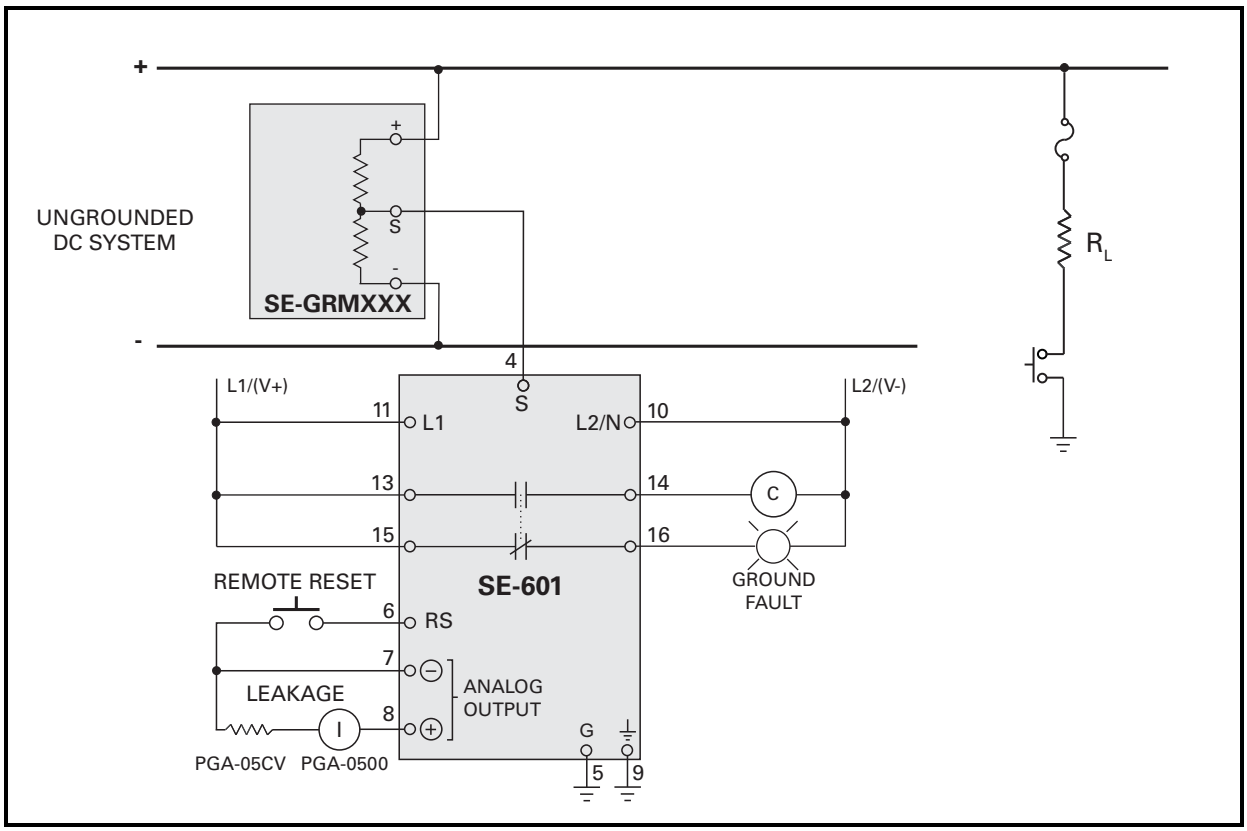


FIGURE 10. System Ground-Fault Test.

TABLE 3. GROUND-FAULT-TEST RECORD

DATE	TEST RESULTS

Retain this record for the authority having jurisdiction.

APPENDIX A
SE-601 REVISION HISTORY

MANUAL RELEASE DATE	MANUAL REVISION	PRODUCT REVISION (REVISION NUMBER ON PRODUCT LABEL)
July 30, 2014	2-B-073014	03
April 19, 2013	2-A-041913	

MANUAL REVISION HISTORY

REVISION 2-B-073014

SECTION 5

Updated to include altitude and vibration specifications.

SECTION 8

Ground-fault performance test added.

APPENDIX A

Revision history updated.

REVISION 2-A-041913

SECTION 3

Fig. 2 updated to include PGA-05CV.

SECTION 5

Environment section updated to include Fahrenheit temperature range. SE-601 dimensions added.

APPENDIX A

Revision history added.

PRODUCT REVISION HISTORY

REVISION 03

Firmware: Improved operation of front-panel test button.

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