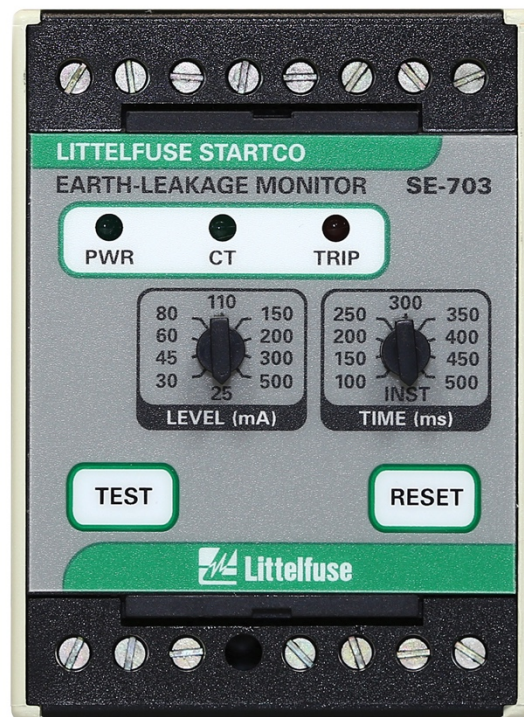


## SE-703 MANUAL EARTH-LEAKAGE MONITOR

REVISION 12-B-092117



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## DISCLAIMER

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## 1. GENERAL

The SE-703 is a microprocessor-based earth-leakage monitor for ac power supply systems incorporating earth-fault current limitation. The SE-703 has two isolated Form-C relays for use in independent control circuits. Additional features include LED trip and power indication, latching trips with front-panel and remote reset, trip memory, test button, self diagnostics, 0 to 5-V analog output, CT verification with LED indication, digital selector switches, and switch-selectable algorithms for fixed-frequency or variable-frequency applications.

Earth-leakage current is sensed by an EFCT-series core-balance earth-fault current transformer (CT). The trip level of the earth-leakage circuit is digital-switch selectable from 25 to 500 mA. Trip time is digital-switch selectable from INST (instantaneous) to 500 ms.

Ordering option SE-703-0x-00 is AS/NZS 2081:2011 compliant. Its output relays operate in the fail-safe mode for undervoltage applications.

Ordering option SE-703-0x-02 is AS/NZS 2081:2002 compliant. Its output relays operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications.

## 2. OPERATION

### 2.1 CONFIGURATION-SWITCH SETTINGS

See Figs. 1A, 1B and 1C.

#### 2.1.1 RELAY OPERATING MODE

The output relays for ordering option SE-703-0x-00 operate only in the fail-safe mode for undervoltage applications.

The output relays for ordering option SE-703-0x-02 operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications.

Switch 1 is used to set the operating mode of the output relays (for SE-703-0x-02 only).

In the fail-safe mode, the output relays energize when the earth-leakage circuit is not tripped. Non-volatile memory retains the trip status of the SE-703. If tripped, and the supply voltage is cycled, the SE-703 will remain tripped, with the trip relay de-energized and the TRIP LED on, until reset.

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

#### 2.1.2 FILTER SELECTION

Switch 2 is used to select the filtering algorithm for a fixed-frequency (50/60 Hz) or variable-frequency application. 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 bandwidth for fault detection in variable-frequency drive applications.

## 2.2 FRONT-PANEL CONTROLS

### 2.2.1 EARTH-LEAKAGE TRIP LEVEL

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

### 2.2.2 EARTH-LEAKAGE TRIP TIME

The SE-703 has a definite-time trip characteristic. The TIME (ms) selector switch is used to set the earth-leakage trip time for coordination with upstream and downstream earth-fault devices. Coordination requires the same trip level for all earth-leakage 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 earth-leakage device to operate is the one immediately upstream from the fault.

### 2.2.3 RESET

A trip remains latched until the RESET button is pressed or the remote-reset terminals (6 and 7) are momentarily connected.

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 the remote-reset terminals are connected.

### 2.2.4 TEST

The TEST button is used to test the earth-leakage circuit, the indication, and the output relays. When the TEST button is pressed for one second, a test signal is applied to the earth-leakage-detection circuit, the circuit will trip, the TRIP LED will light, and the output relays will operate.

## 2.3 FRONT-PANEL INDICATION

### 2.3.1 POWER

The green LED labelled PWR indicates presence of supply voltage.

### 2.3.2 TRIP

The red LED labelled TRIP indicates a trip. A solid red LED indicates an earth-leakage 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 labelled CT indicates that an EFCT-series sensor is connected.

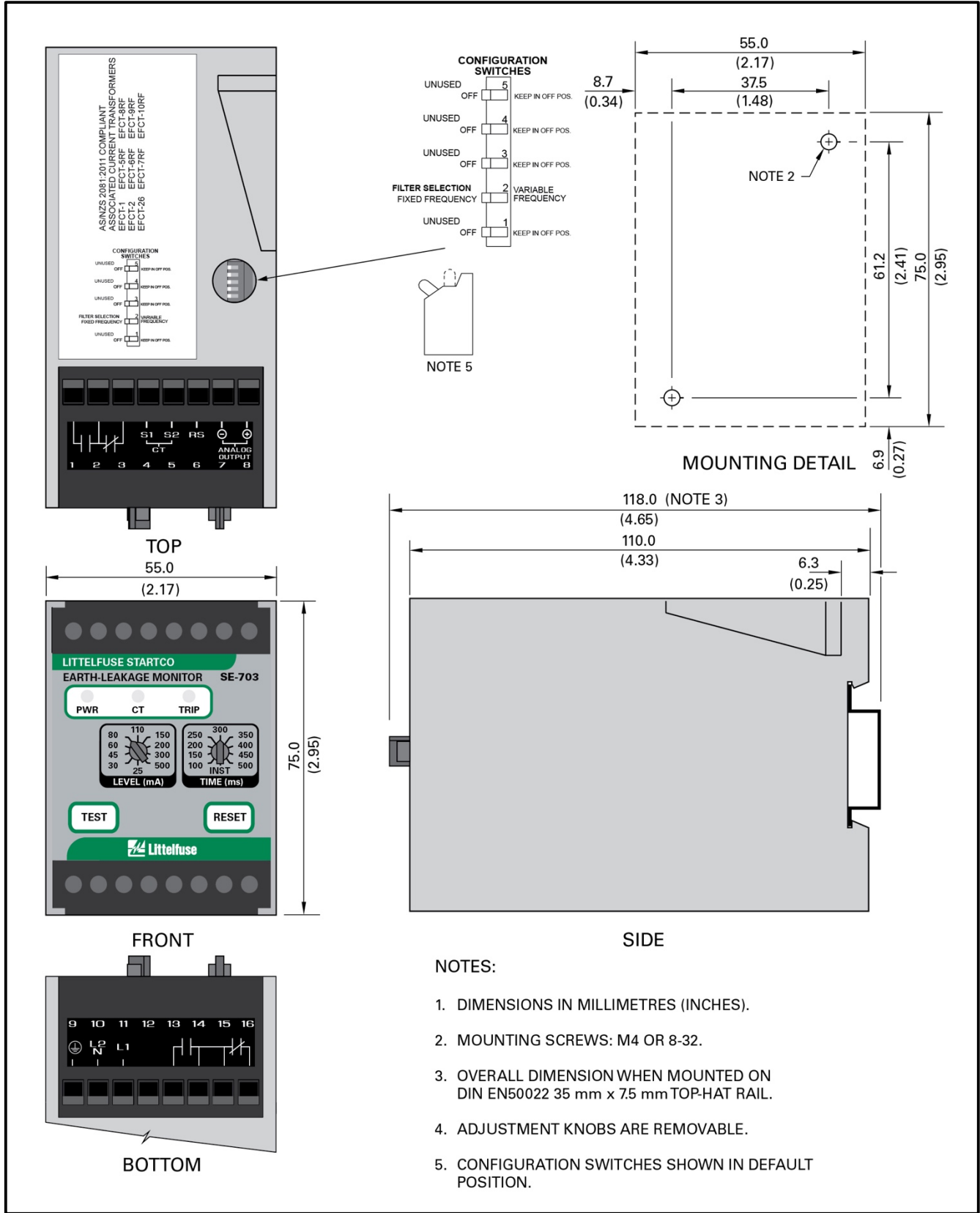


FIGURE 1A. SE-703-0X-00 Outline and Mounting Details.

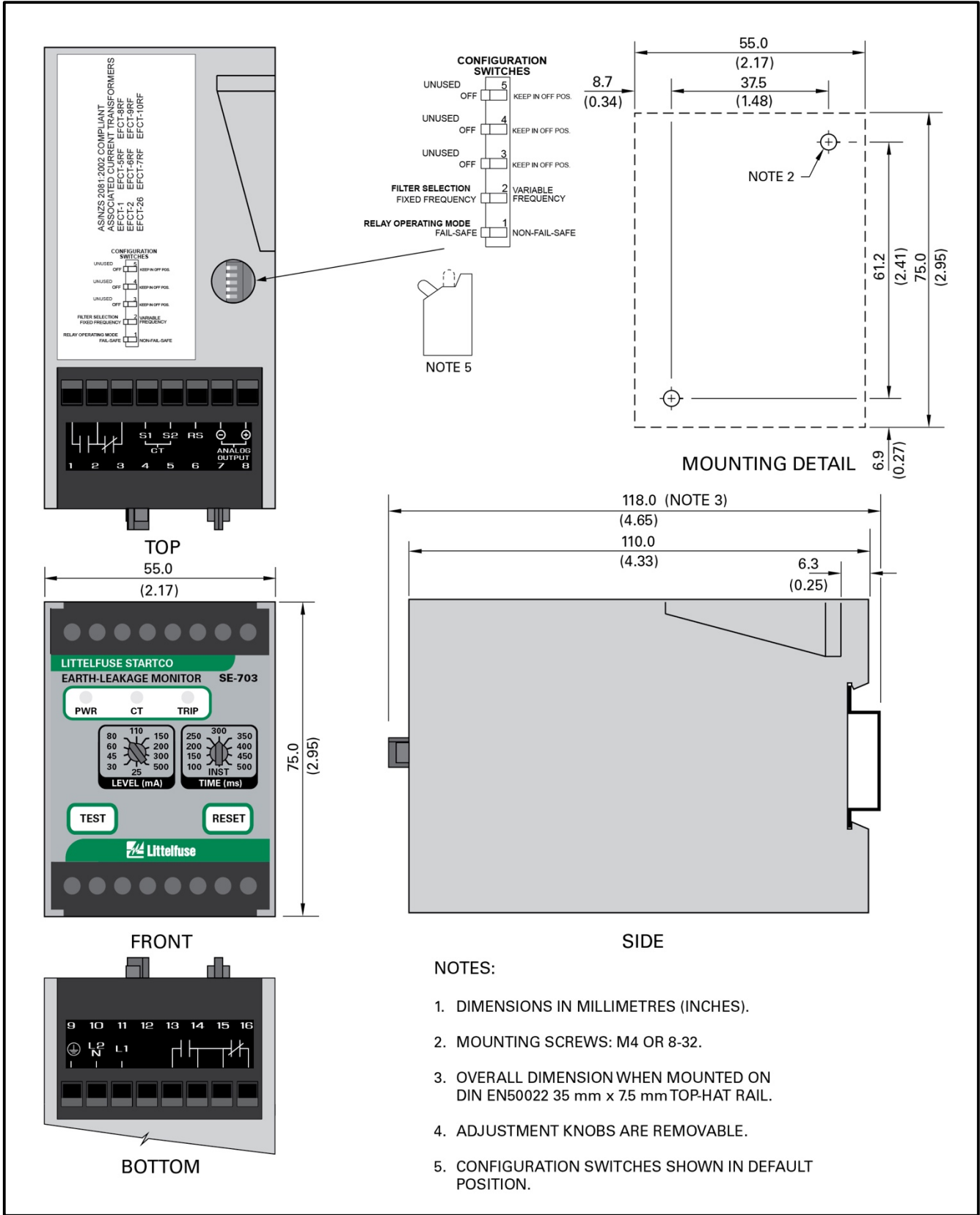


FIGURE 1B. SE-703-0X-02 Outline and Mounting Details.

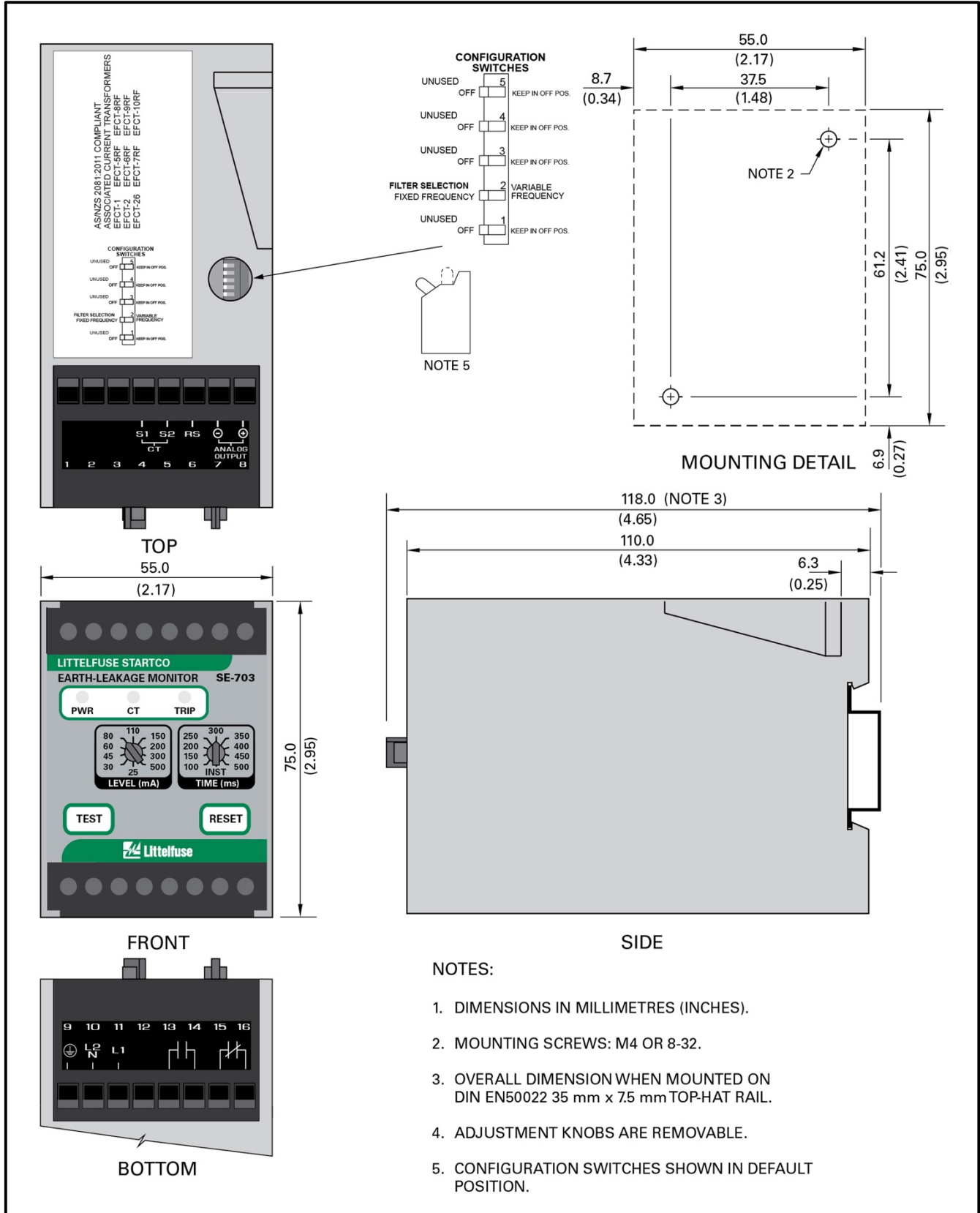


FIGURE 1C. SE-703-0X Outline and Mounting Details.



**2.4 ANALOG OUTPUT**

The non-isolated, 0- to 5-V analog output indicates earth-leakage current sensed by the EFCT. The output is 5 V when earth-leakage current is 500 mA. Use a PGA-0500 Analog Percent Current Meter with the PGA-05CV Voltage Converter to indicate earth-leakage current. See Figs. 2, 3, and 9.

**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 an incorrect reading from non-volatile memory. Press RESET or cycle supply voltage. If the problem persists, consult Littelfuse Startco.

**3. INSTALLATION**

**NOTE:** Mounting, terminal-block connections, and wiring must conform to applicable local electrical codes. Check all applicable codes prior to installation

This earth-leakage monitoring system consists of an SE-703 Earth-Leakage Monitor and an EFCT-series current sensor connected as shown in Figs. 2 and 3.

An SE-703 can be surface or DIN-rail mounted. See Figs. 1A, 1B and 1C. Panel mounting requires a PMA-55 or PMA-60 Panel-Mount Adapter. See Figs. 7 and 8. A PMA-60 meets the AS/NZS 2081:2011 IP53 requirement and includes tamper-resistant security screws to prevent changes to the SE-703 front-panel settings.

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 earth.

Pass the phase conductors through the EFCT window and position them in the centre of the opening—for 4-wire and single-phase systems, also pass the neutral conductor through the EFCT window, as shown in Figs. 2 and 3. Do not pass earth conductors through the EFCT window. In applications that require shields or drain wires to pass through the EFCT window, return them through the EFCT window before connecting them to earth. Connect the EFCT current sensor to terminals 4 and 5, connect the shield to terminal 5, and earth terminal 5. See Figs. 4, 5, and 6 for EFCT-series current-sensor dimensional drawings.

Remove the connection to terminal 9 for dielectric-strength testing.

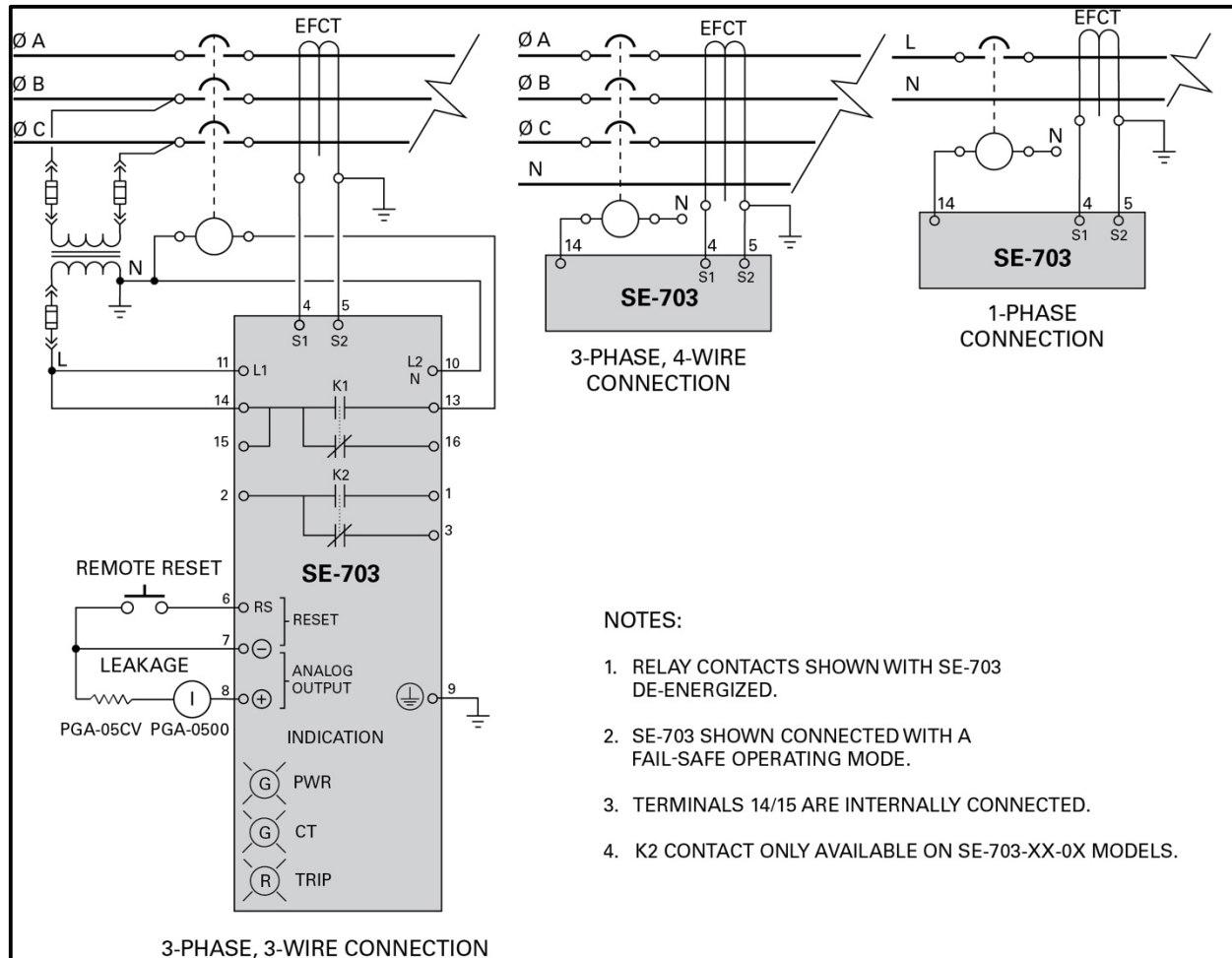


FIGURE 2. Typical Connection Diagrams.

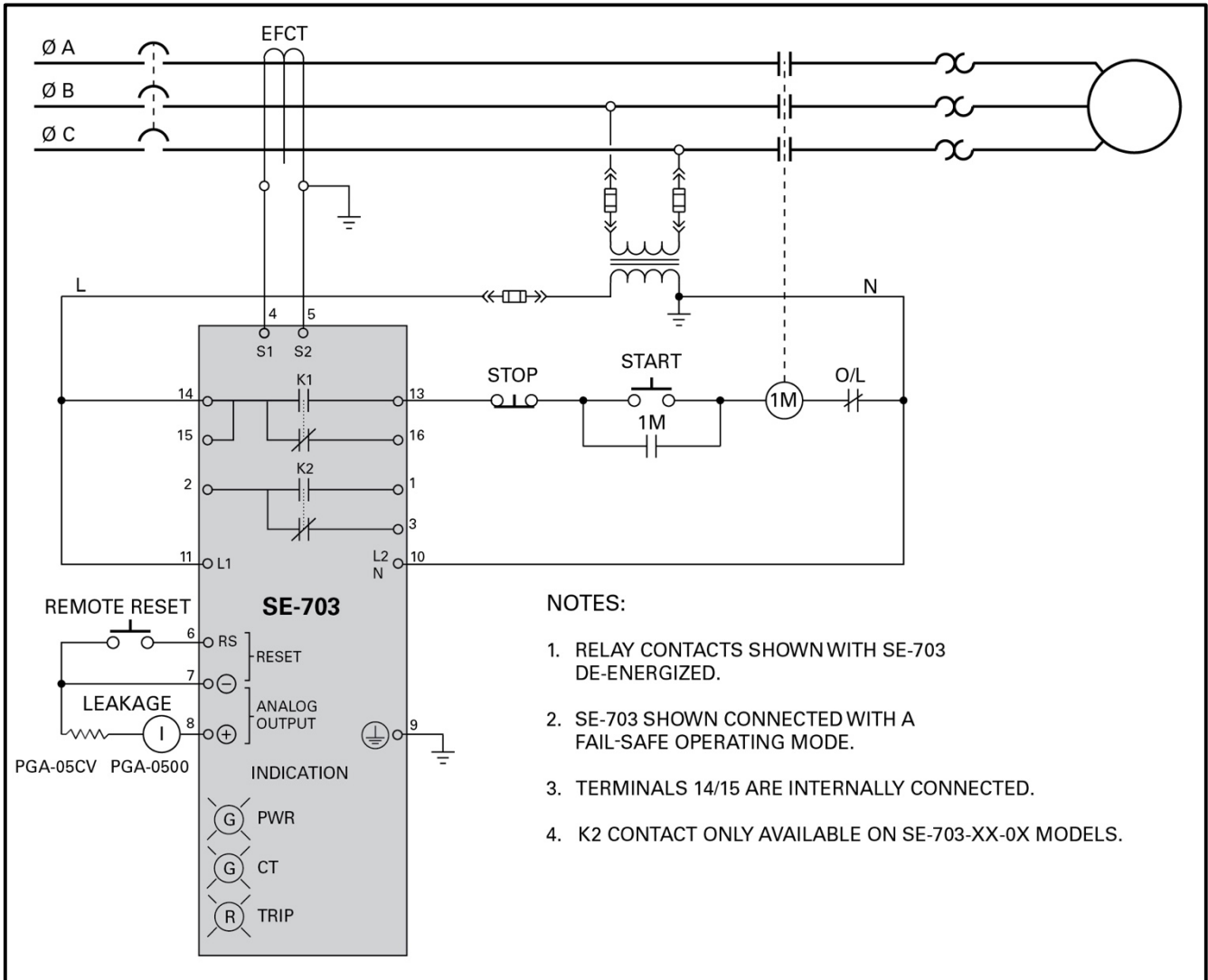


FIGURE 3. Typical Three-Phase Starter Connection.

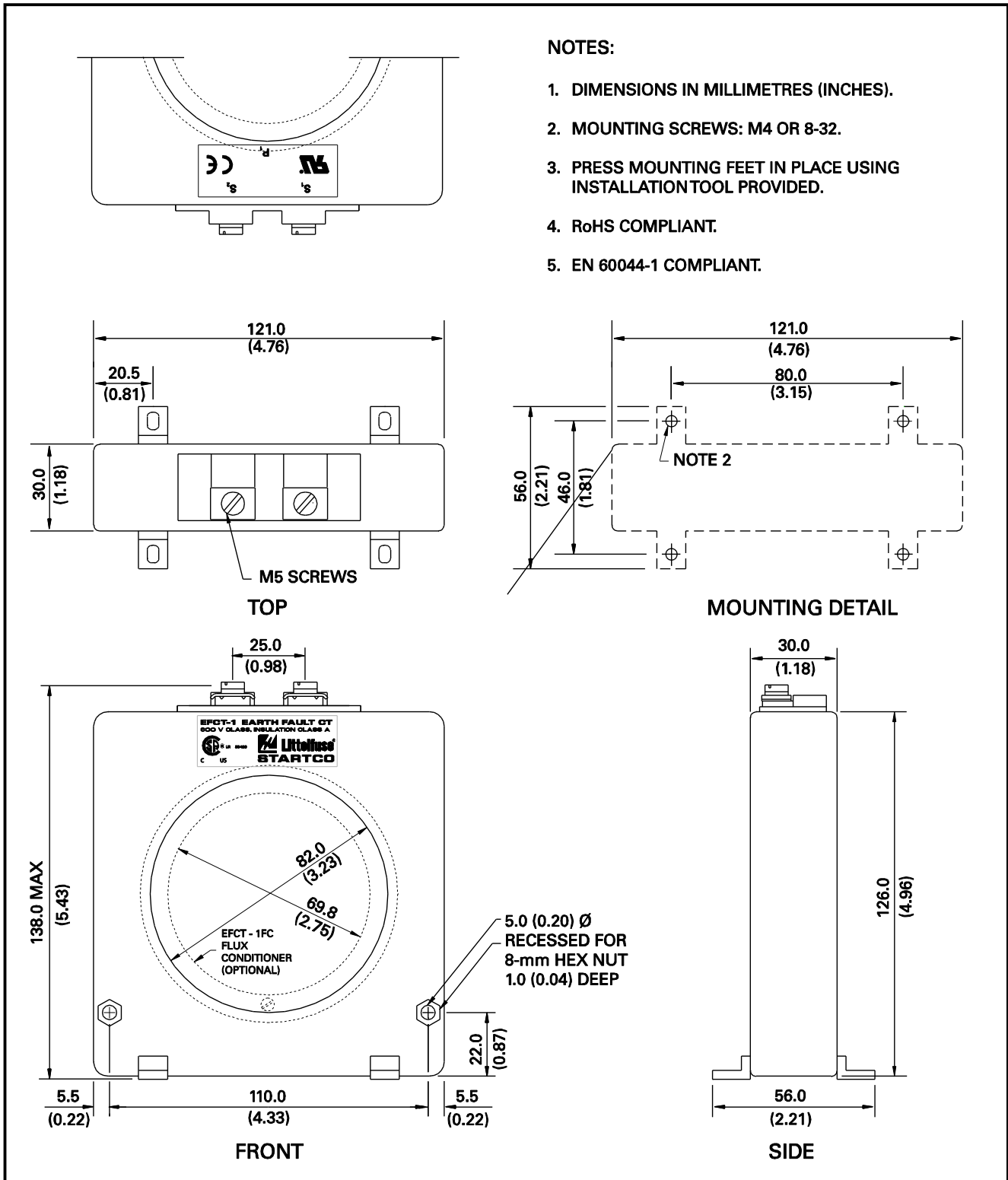


FIGURE 4. EFCT-1 Outline and Mounting Details.

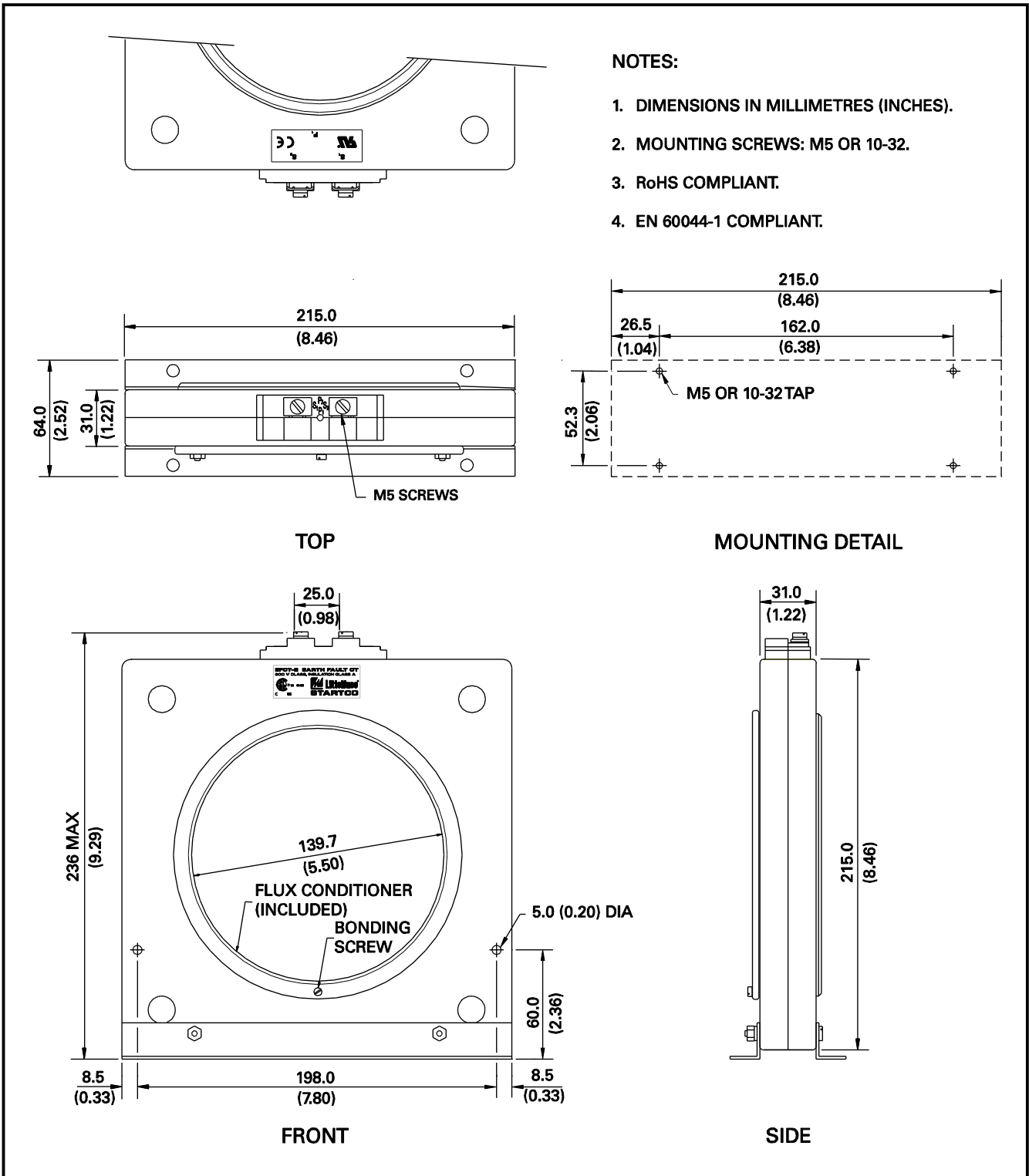


FIGURE 5. EFCT-2 Outline and Mounting Details.

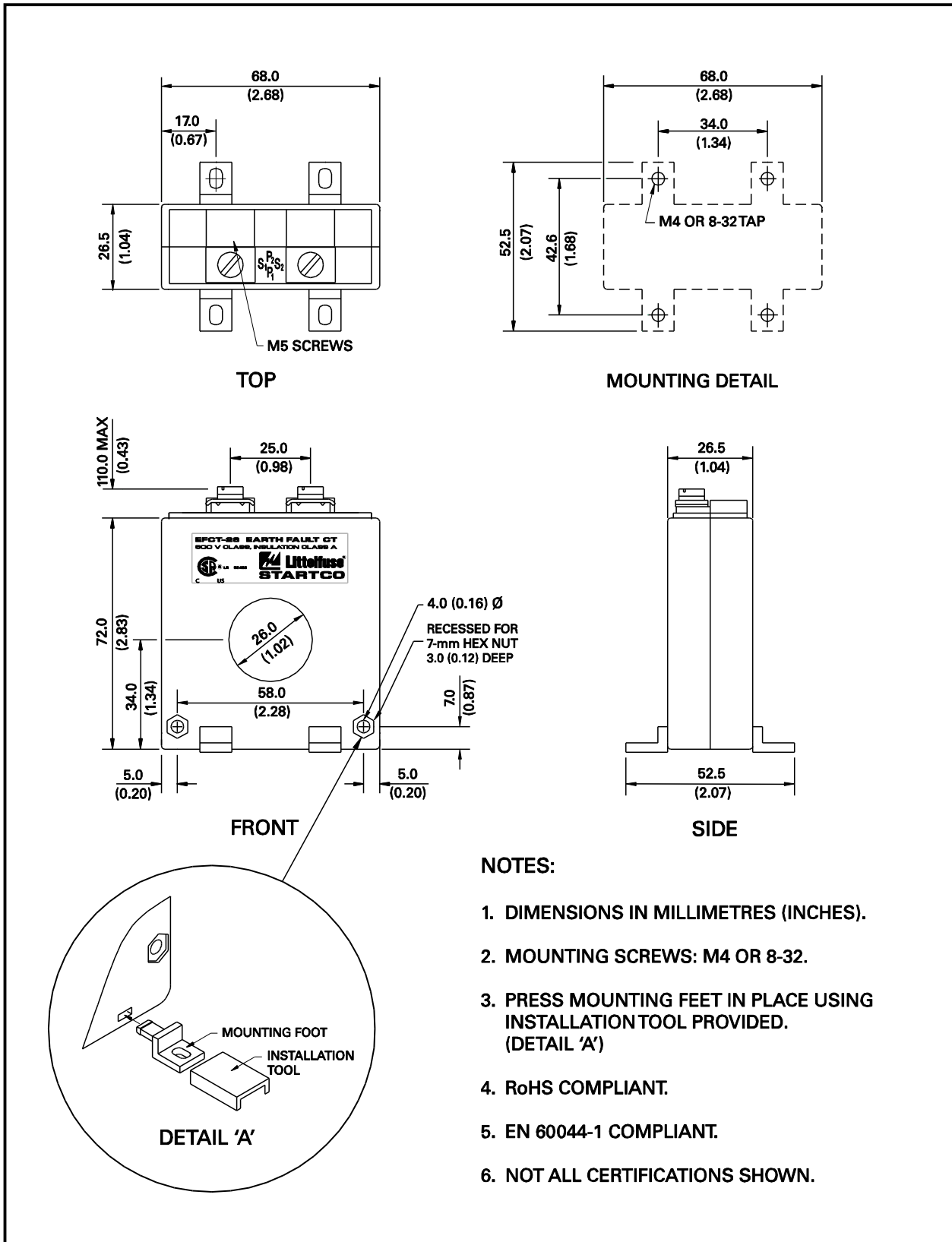


FIGURE 6. EFCT-26 Outline and Mounting Details.

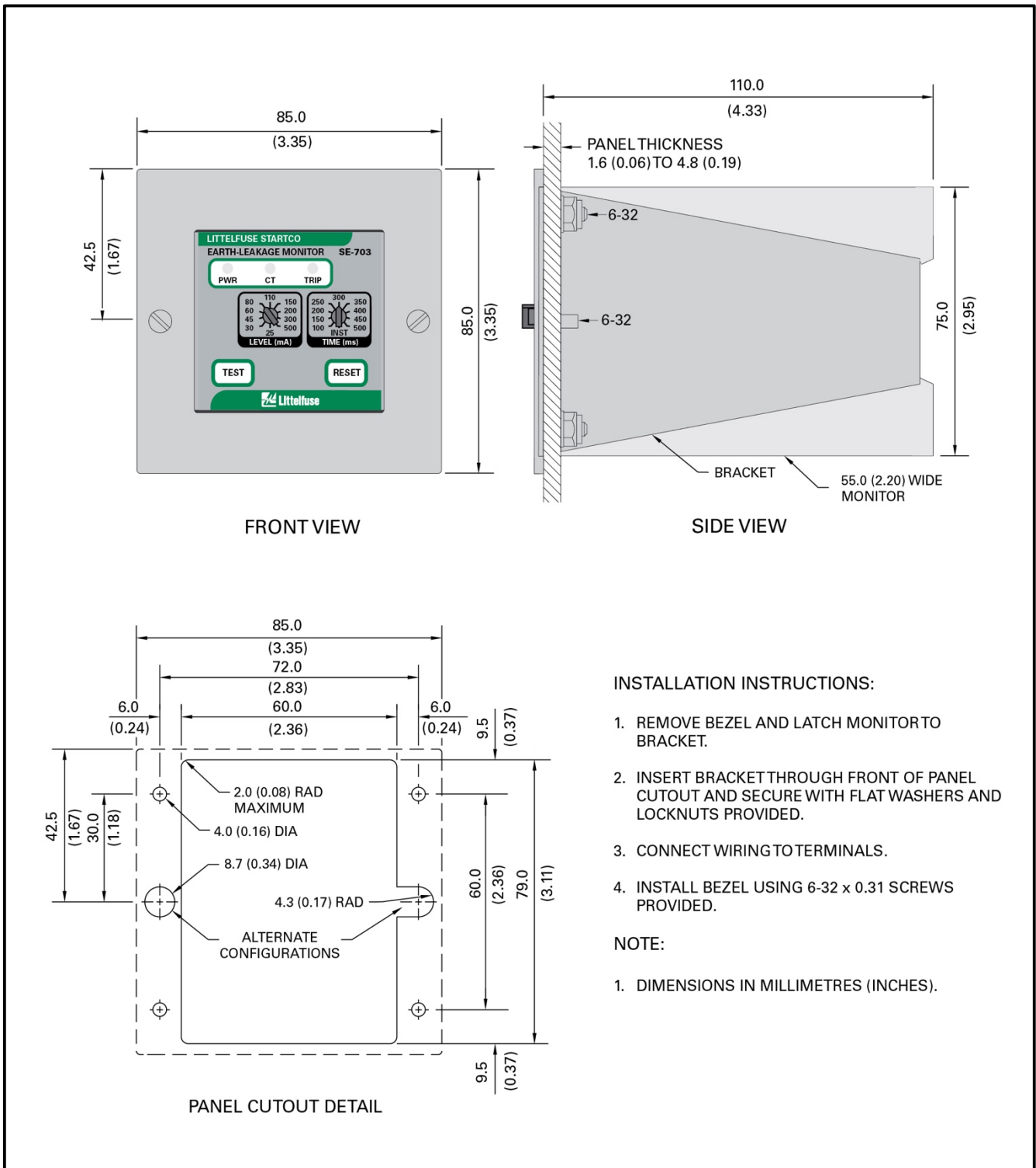


FIGURE 7. PMA-55 Panel-Mount Adapter.

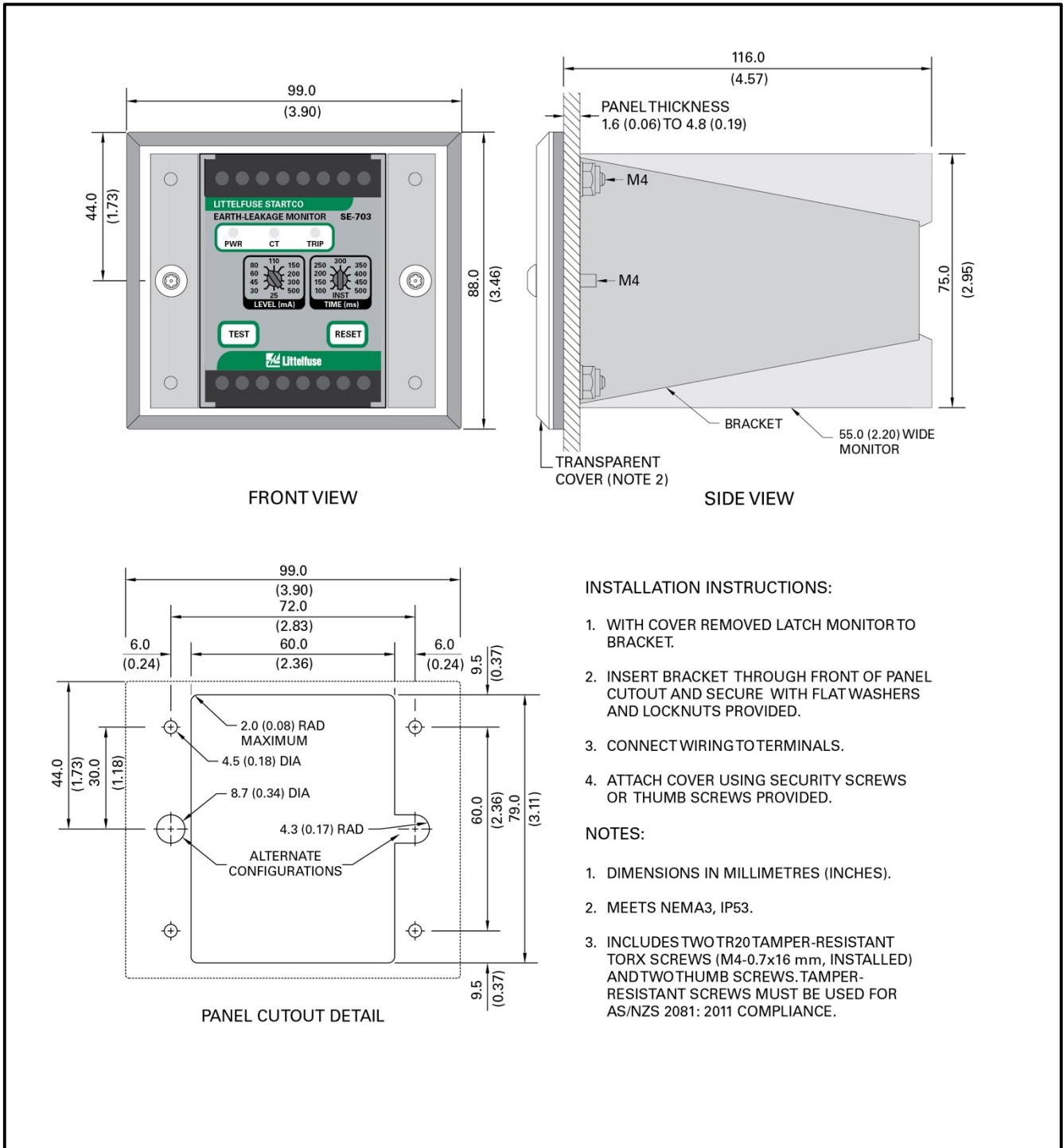


FIGURE 8. PMA-60 Panel-Mount Adapter.

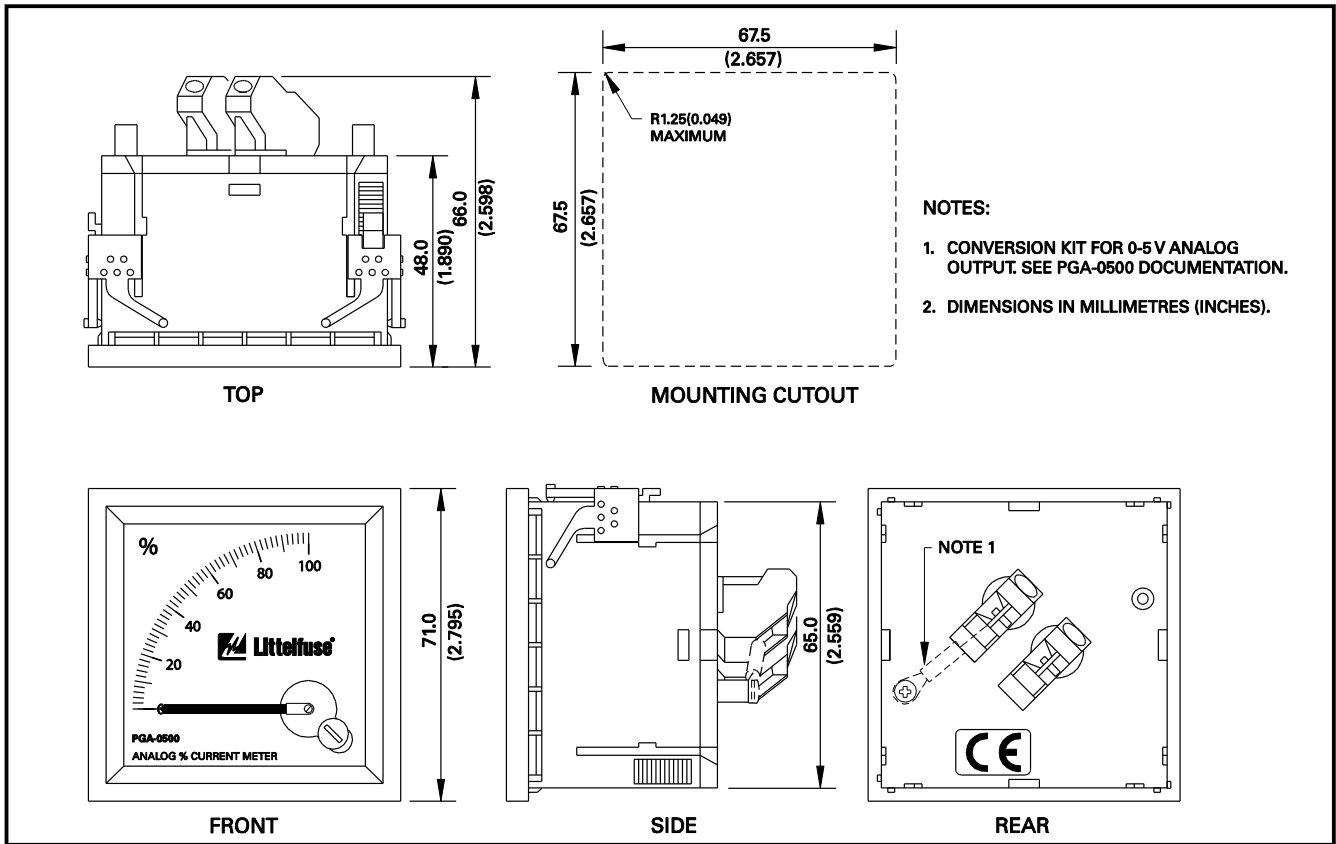


FIGURE 9. PGA-0500 Analog Percent Current Meter.

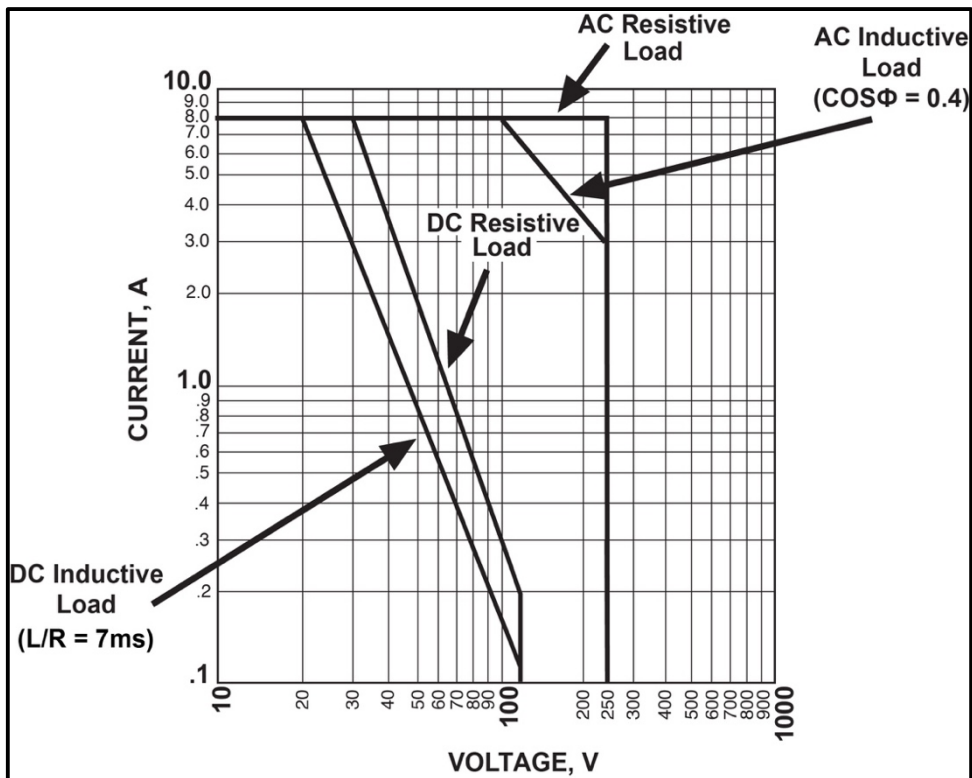


FIGURE 10. TRIP Relays Maximum Switching Capacity.



#### 4. TECHNICAL SPECIFICATIONS

##### 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%)
03 Option .....	2.5 VA, 24 Vac, (+15%, -40%), 50/60 Hz
Trip-Level Settings.....	25, 30, 45, 60, 80, 110,150, 200, 300, and 500 mA

Trip-Time Settings .....	INST, 100, 150, 200, 250, 300, 350, 400, 450, and 500 ms
--------------------------	--

##### Accuracies: <sup>(1)</sup>

##### Trip Level: <sup>(2)</sup>

SE-703-0x.....	10% of setting
SE-703-0x-00 .....	10% of setting
SE-703-0x-02 .....	+0, -20% of setting

Trip Time <sup>(3)</sup> .....	+0, -20% of setting
INST Setting .....	< 50 ms

Discrimination Time .....	≥ 75% of trip time setting, Minimum off time 25 ms
---------------------------	---

##### Input:

Algorithms .....	DFT Digital or Peak
DFT 3 dB	
Frequency Resp.....	32 to 86 Hz
Peak 3 dB	
Frequency Resp.....	20 to 420 Hz
CT .....	EFCT Series
Thermal Withstand:	
Continuous .....	25 A Earth-Fault Current
1-Second .....	400 A Earth-Fault Current

##### Analog Output:

Range .....	0 to 5 V, 10 mV per mA
Output Impedance .....	220 Ω

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

Functional Test.....	Front-Panel Button
----------------------	--------------------

##### Output Relay 1 and Relay 2:

##### Contact Configuration

SE-703-0x.....	Relay 1 only, Isolated N.O. and N.C.
SE-703-0x-00, SE-703-0x-02 .....	N.O. and N.C. (Form-C), Isolated

##### Operating Mode

SE-703-0x.....	Fail-Safe
SE-703-0x-00 .....	Fail-Safe
SE-703-0x-02 .....	Fail-Safe or Non-Fail-Safe

CSA/UL Contact Rating .....	8 A General Use, 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	

Trip Mode .....	Latching
Terminals .....	Wire Clamping, 24 to 12 AWG (0.2 to 2.5 mm <sup>2</sup> ) conductors
Tightening Torque.....	0.40 N·m (3.54 lbf·in)






##### Dimensions:

Height .....	75 mm (3.0")
Width .....	55 mm (2.2")
Depth .....	113 mm (4.5")

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

##### Environment:

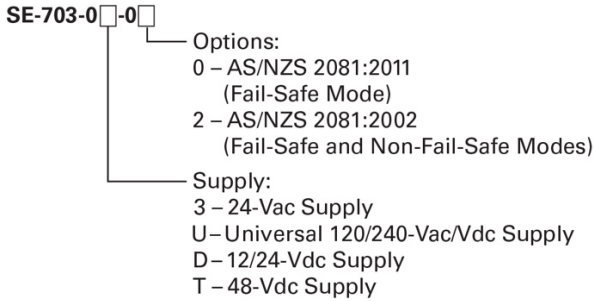
Operating Temperature:	
Altitude:	
≤ 1,000 m (3,281') .....	-40 to 60°C (-40 to 140°F)
3,000 m (9,843') .....	-40 to 55°C (-40 to 131°F)
5,000 m (16,404') .....	-40 to 50°C (-40 to 122°F)
Storage Temperature .....	-55 to 80°C (-67 to 160°F)

Humidity .....	93% Non-Condensing	Magnetic Field Immunity.....	IEC 61000-4-8 50 Hz and 60 Hz , 30 A/m and 300 A/m
Altitude .....	5,000 m (16,404') maximum	Voltage Interruption .....	IEC 61000-4-11, IEC 61000-4-29, 0% for 5, 10, 20, 50, 100 & 200 ms 3x each
Overvoltage Category .....	II	Power Frequency .....	IEC 61000-4-16 Zone A: differential mode 150 Vrms Zone A: common mode 300 Vrms
Pollution Degree.....	2	1 MHz Burst.....	IEC 61000-4-18 ± 1 kV differential mode (line-to-line) ± 2.5 kV common mode
Enclosure Rating .....	IP20	RFI Compliance .....	FCC Part 15, Subpart B, Class A – Unintentional Radiators
PWB Conformal Coating.....	MIL-1-46058 qualified UL QMJU2 recognized	Compliance:	
Surge Withstand .....	ANSI/IEEE 37.90.1-1989 (Oscillatory and Fast Transient)	Option SE-703-0x.....	AS/NZS 2081:2011
Vibration .....	EN60255-21-1 (Vibration, Shock, and Seismic) EN60255-21-2 (Shock and Bump)	Option SE-703-0x-00 .....	AS/NZS 2081:2011
EMC Tests:		Option SE-703-0x-02 .....	AS/NZS 2081:2002
Verification tested in accordance with IEC 60255-26:2013		Certification .....	CSA, Canada and USA
Radiated and Conducted			UL Listed
Emissions .....	CISPR 11:2009, CISPR 22:2008, EN55022:2010 Class A		Ground Fault Sensing and Relaying Equipment 4FX9 E340889 Australia
Current Harmonics and			FCC
Voltage Fluctuation .....	IEC 61000-3-2 and IEC 61000-3-3 Class A		CE, European Union
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		CSA C22.2 No.14 Industrial Control Equipment UL 508 Industrial Control Equipment UL 1053 Ground Fault Sensing and Relaying Equipment Australia, Regulatory Compliance Mark (RCM) CE Low Voltage Directive IEC 61010-1:2010/AMD1:2016 FCC CFR47, Part 15, Subpart B, Class A – Unintentional Radiators
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)		

**NOTES:**

- (1) At 50 or 60 Hz.
- (2) Maximum lead resistance of 2 Ω.
- (3) Trip Time at 1.5 x trip-level setting.

**5. ORDERING INFORMATION**



EFCT-1 .....	Earth-Fault Current Sensor, 82 mm (3.2") window
EFCT-2 .....	Earth-Fault Current Sensor, with Flux Conditioner 139 mm (5.5") window
EFCT-26 .....	Earth-Fault Current Sensor, 26 mm (1.0") window
EFCT-1FC .....	Flux Conditioner, 70 mm (2.7") window
PGA-0500 .....	Analog Percent Current Meter (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 <sup>(1)</sup> and two thumb screws.
AC700-HW-00 .....	TR20 tamper-resistant Torx, 0.25" insert bit
AC700-HW-01 .....	TR20 tamper-resistant Torx driver
PMA-3 .....	Adapter Plate, GEC/MCGG
PMA-6 .....	Adapter Plate, FPL-GFRM
PMA-15 .....	Adapter Plate, MGFR
Consult factory for custom mounting adapters.	

**Startco Pty. Australian Current Sensors**

EFCT-5RF .....	Earth-Fault Current Sensor, 60 mm (2.4") window
EFCT-6RF .....	Earth-Fault Current Sensor, 85 mm (3.3") window
EFCT-7RF .....	Earth-Fault Current Sensor, 112 mm (4.4") window
EFCT-8RF .....	Earth-Fault Current Sensor, 140 mm (5.5") window
EFCT-9RF .....	Earth-Fault Current Sensor, 160 mm (6.3") window
EFCT-10RF .....	Earth-Fault Current Sensor, 200 mm (7.9") window

For additional information and to order EFCT-XRF sensors, contact sales@startco.com.au.

**NOTES:**

- <sup>(1)</sup> Tamper-resistant screws must be used for AS/NZS 2081:2011 compliance.

**6. WARRANTY**

The SE-703 Earth-Leakage 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-703 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.

**7. EARTH-FAULT PERFORMANCE TEST**

Some jurisdictions require periodic earth-fault performance tests. A test-record form is provided for recording the date and the results of the performance tests. The following earth-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 earth-fault current sensor. Ensure the cables pass through the earth-fault-current-sensor window. This check can be done visually with knowledge of the circuit. The connection of the current-sensor secondary to the SE-703 is not polarity sensitive.
- c) Verify that the system is correctly earthed and that alternate earth paths do not exist that bypass the current sensor. High-voltage testers and resistance bridges can be used to determine the existence of alternate earth paths.
- d) Verify proper reaction of the circuit-interrupting device in response to a simulated or controlled earth-fault current. To simulate earth-fault current, use CT-primary current injection. Fig. 11 shows a test circuit using an 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. 11 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 SE-703 setting. Inject the test current through the current-sensor 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 4 and 5.

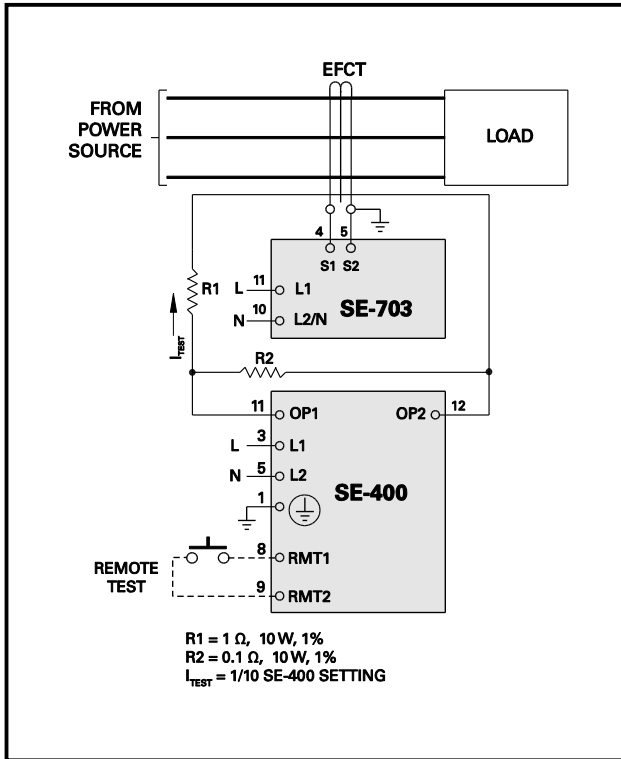


FIGURE 11. Earth-Fault-Test Circuit.

TABLE 1. EARTH-FAULT-TEST RECORD

DATE	TEST RESULTS

Retain this record for the authority having jurisdiction.

## APPENDIX A SE-703 REVISION HISTORY

MANUAL RELEASE DATE	MANUAL REVISION	PRODUCT REVISION (REVISION NUMBER ON PRODUCT LABEL)
September 21, 2017	12-B-092117	08
March 10, 2017	12-A-031017	
March 10, 2016	11-C-031016	07
August 28, 2014	11-B-082814	
April 21, 2014	11-A-042114	
April 23, 2013	10-A-042313	06

### MANUAL REVISION HISTORY

#### REVISION 12-B-092117

##### SECTION 4

##### SECTION 5

Updated certification information.

#### REVISION 12-A-031017

##### SECTION 2

Added Figs. 1A, 1B and 1C.

##### SECTION 3

Updated Figs. 2 and 3.

Added Fig. 10.

##### SECTION 4

Added ordering option details.

##### SECTION 5

Added ordering options.

##### SECTION 7

Added Fig. 11.

#### REVISION 11-C-031016

##### SECTION 5

Terminal torque specification added.

RCM certification added.

#### REVISION 11-B-082814

##### SECTION 3

EFCT-x figures updated.

##### SECTION 4

EMC Test specifications updated.

#### REVISION 11-A-042114

AS/NZS 2081:2011 compliance added.

Section 4 removed.

##### SECTION 3

Figs. 2, 3, 4, 5, 6, and 9 updated.

##### SECTION 4

Update to include altitude and vibration specifications.

FCC certification added.

##### SECTION 5

Ordering information updated.

##### SECTION 7

Fig. 10 updated.

#### REVISION 10-A-042313

##### SECTION 3

Figs. 2 and 3 updated to include PGA-05CV.

##### SECTION 5

Environment section updated to include Fahrenheit temperature range.

**APPENDIX A**

Revision history added.

**PRODUCT REVISION HISTORY****REVISION 08**

Firmware: Trip levels updated for compliance with AS/NZS 2081:2011 (ordering option SE-703-0x-00) and AS/NZS 2081:2002 (ordering option SE-703-0x-02).

Hardware: Added two Form-C relays. RoHS2 compliance.

**REVISION 07**

Firmware: Trip levels updated for compliance with AS/NZS 2081:2011.

Hardware: Full conformal coating on all PCB's.

**REVISION 06**

Firmware: Improved operation of front-panel test button.