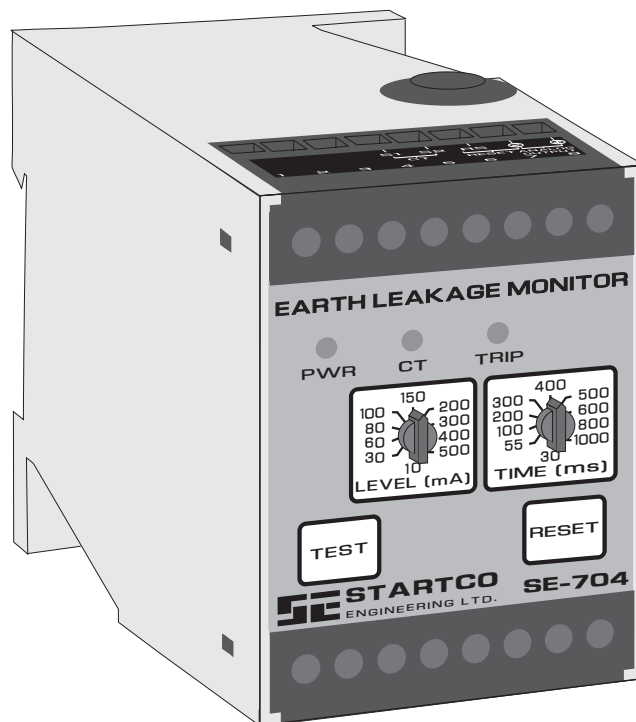


**SE-704 MANUAL**  
**EARTH-LEAKAGE MONITOR**

January 18, 2008

REVISION 2



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## 1. GENERAL

The SE-704 is a microprocessor-based earth-leakage monitor for ac power supply systems that require earth-leakage detection as low as 10 mA. It is uniquely suited for very sensitive earth-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 SE-704 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 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 SE-CS30-series core-balance earth-fault current transformer. The trip level of the earth-leakage circuit is digital-switch selectable from 10 to 500 mA. Trip time is digital-switch selectable from 30 to 1,000 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 earth-leakage circuit is not tripped. In the fail-safe mode, non-volatile memory retains the trip status of the SE-704. If tripped, and the supply voltage is cycled, the SE-704 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 an earth-leakage 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 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 band width for fault detection in variable-frequency drive applications.

#### 2.1.3 CT VERIFICATION

Switch 3 is used to enable CT verification. In the ON position, a trip will occur if the SE-CS30 current sensor is disconnected.

#### 2.1.4 RESET MODE

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

## 2.2 FRONT-PANEL CONTROLS

### 2.2.1 EARTH-LEAKAGE TRIP LEVEL

The LEVEL (mA) selection 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-704 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

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 SE-704.

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.

### 2.2.4 TEST

The TEST switch is used to test the earth-leakage circuit, the indication, and the output relay. When the TEST switch 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 relay will operate.

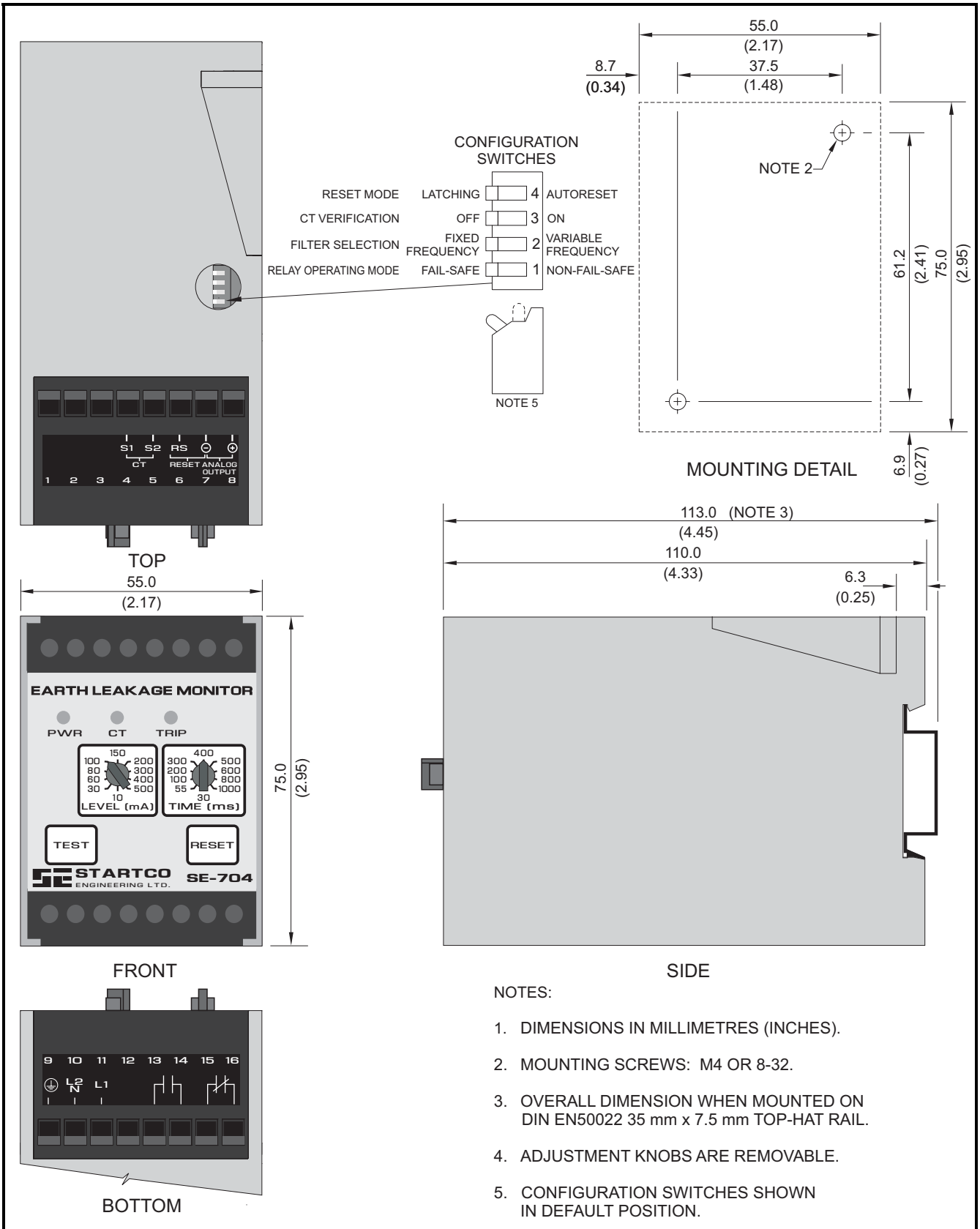


FIGURE 1. SE-704 Outline and Mounting Details.





#### 4. SE-704 COMPATIBILITY

The current SE-704 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 trip memory. The current revision of the SE-704 can directly replace previous revision-00 units. The hardware-revision number is listed on the SE-704 model/serial-number label affixed to the SE-704 enclosure. Both generations of SE-704 are compared in Table 1.

The SE-704 was previously available with SE-704-01 120-Vac and SE-704-02 240-Vac control-voltage options. These have been discontinued. An SE-704-0U universal 120/240-Vac/Vdc unit can directly replace an SE-704-01 or SE-704-02.

TABLE 1. 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 (earth 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

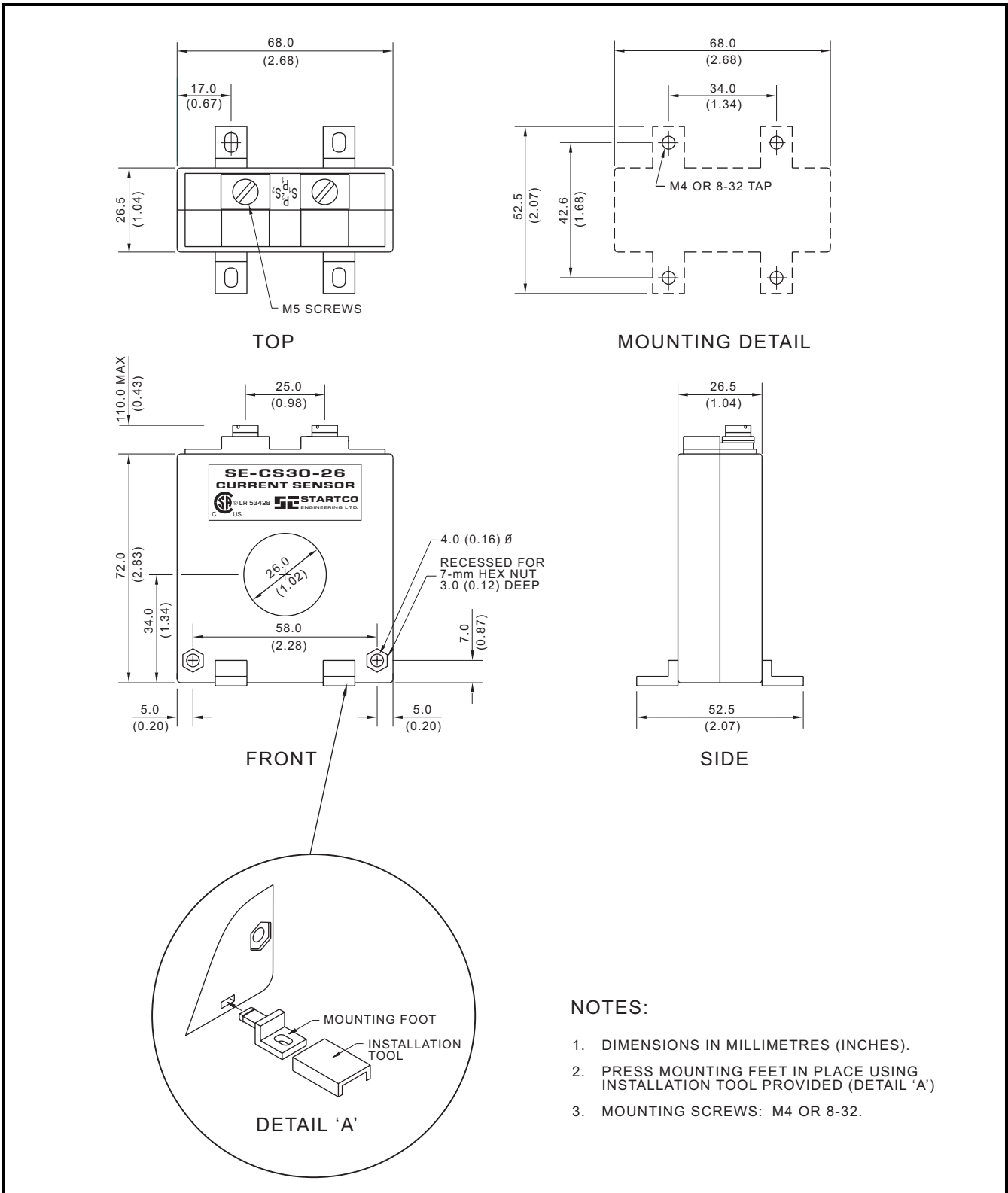


FIGURE 3. SE-CS30-26 Current Sensor.

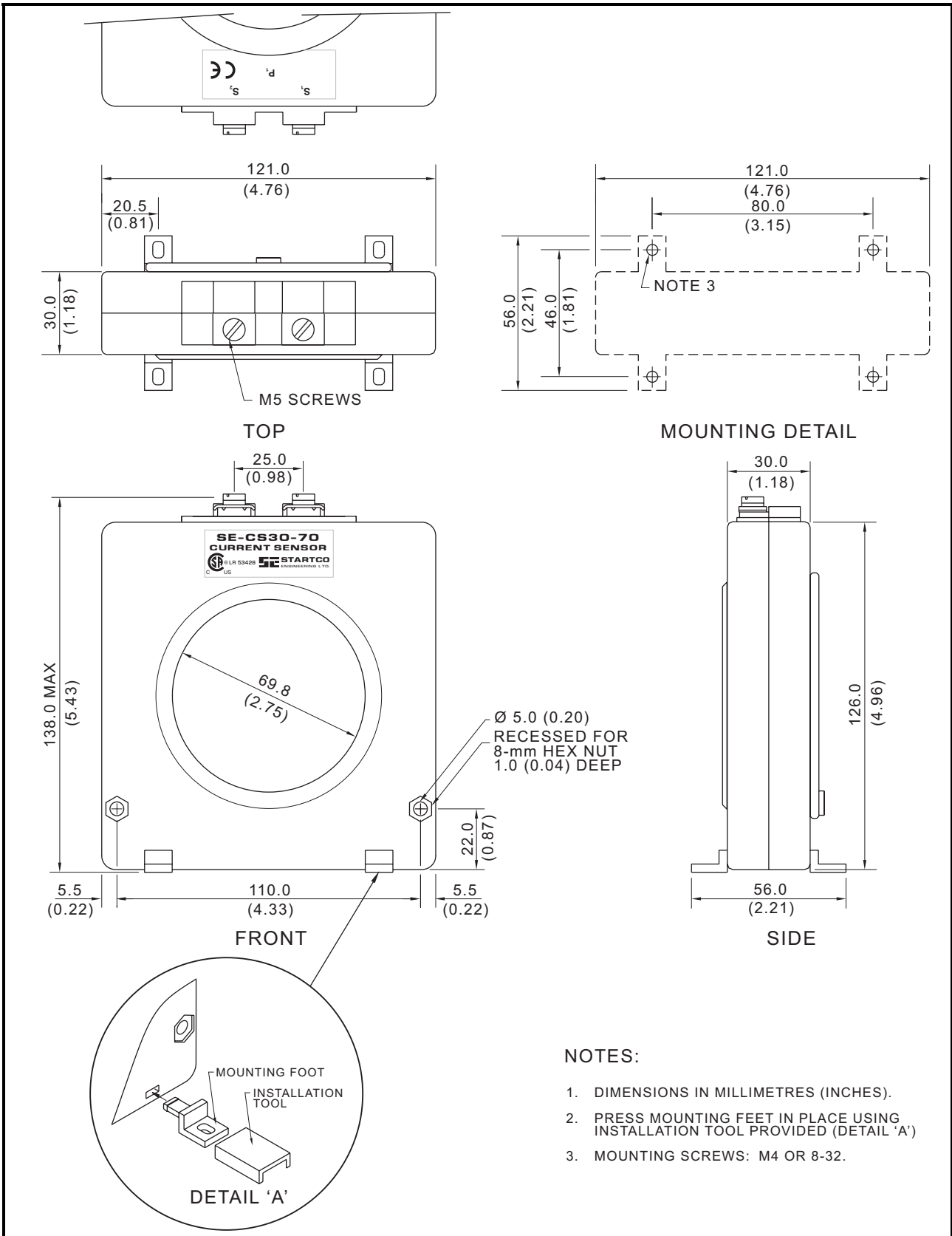


FIGURE 4. SE-CS30-70 Current Sensor.

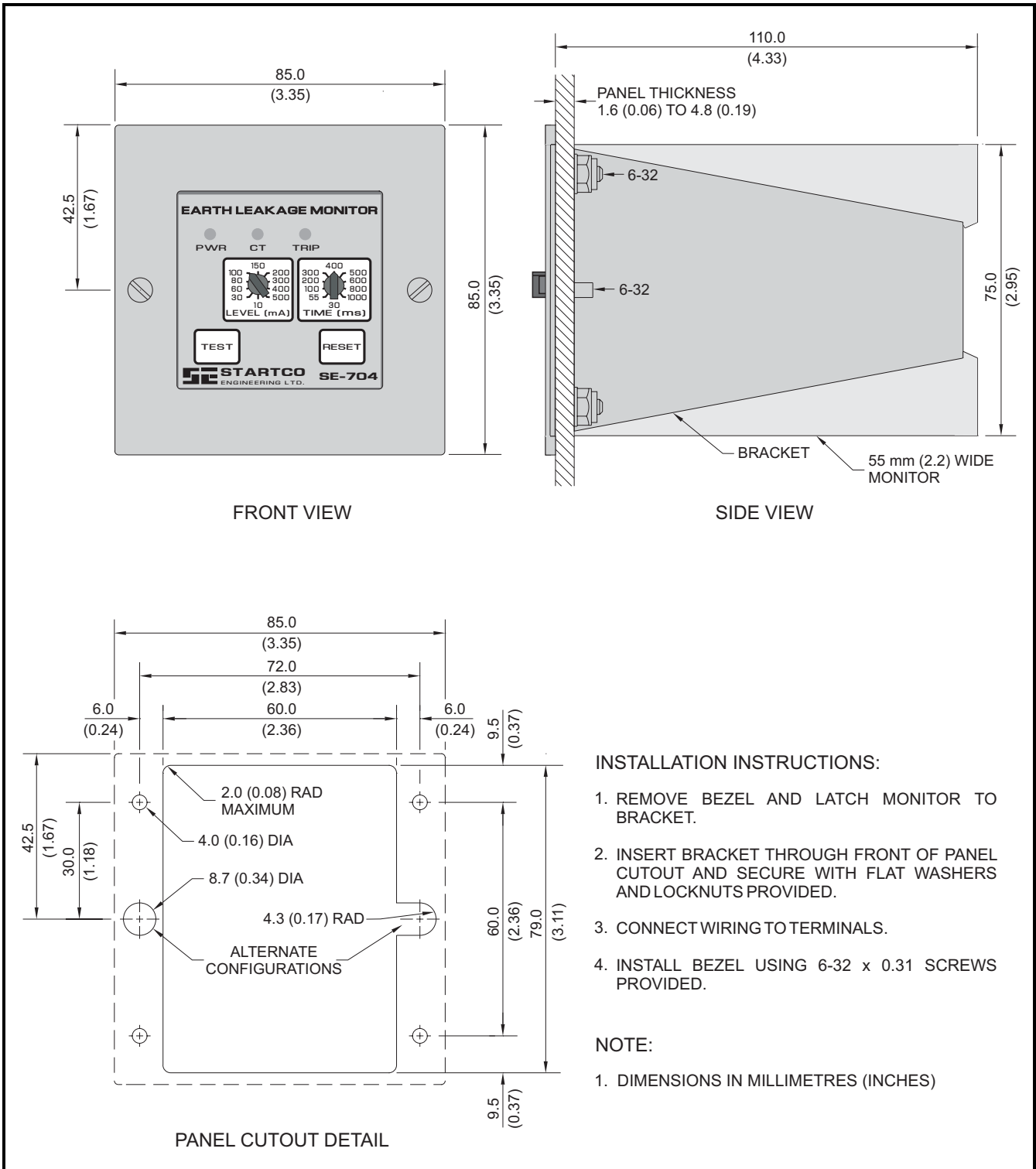


FIGURE 5. PMA-55 Panel-Mount Adapter.

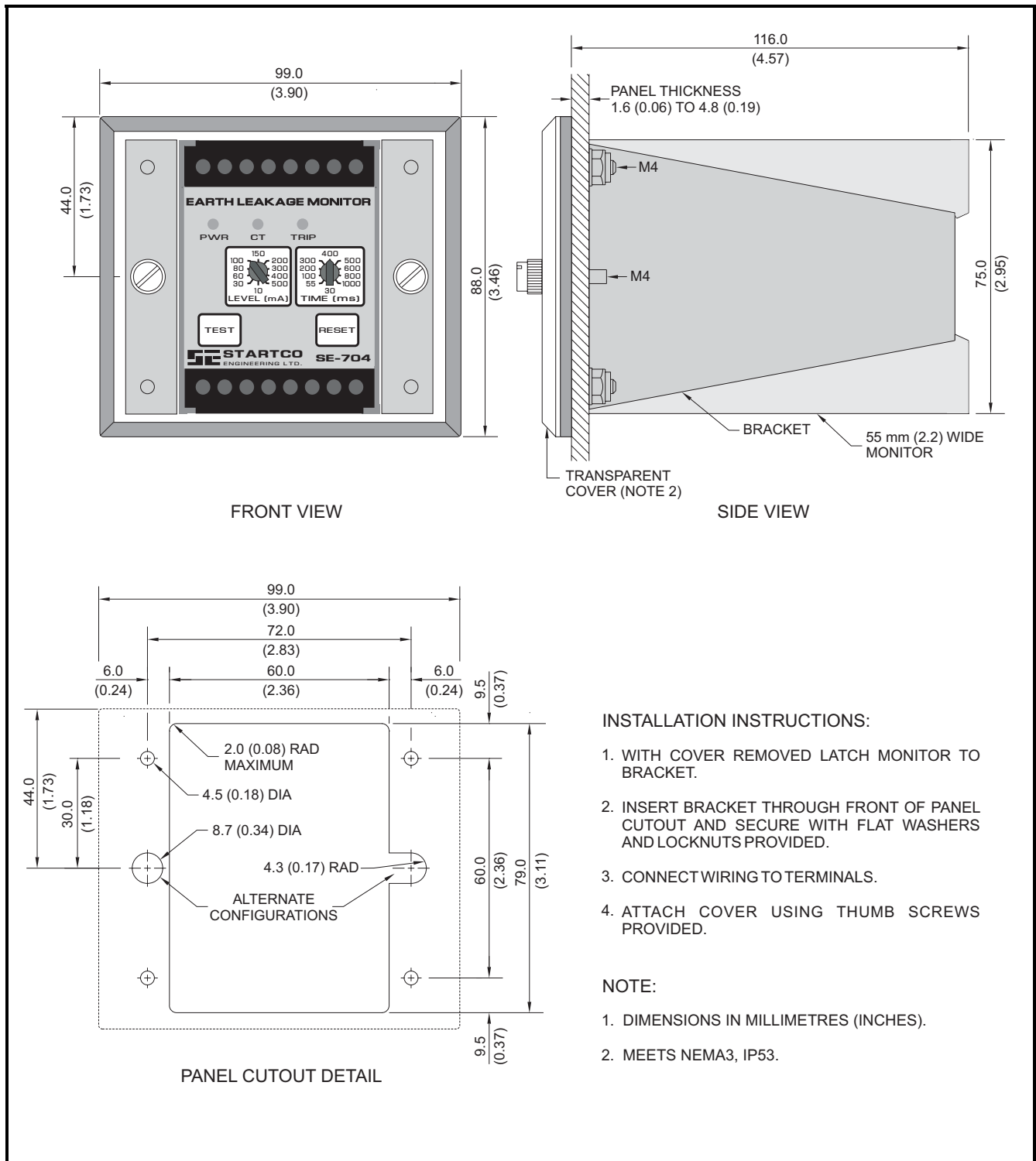


FIGURE 6. PMA-60 Panel-Mount Adapter.



## 5. 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%)
03 Option.....	2.5 VA, 24 Vac, (+15%, -40%), 50/60 Hz

Trip-Level Settings.....	10, 30, 60, 80, 100, 150, 200, 300, 400, and 500 mA
--------------------------	---

Trip-Time Settings.....	30, 55, 100, 200, 300, 400, 500, 600, 800, and 1,000 ms
-------------------------	---

### Accuracies: <sup>(1,2)</sup>

#### Trip Level: <sup>(3,4)</sup>

> 60 mA.....	+ 0, -10%
= 60 mA.....	+ 0, -10 mA
= 30 mA.....	+ 0, -6 mA
= 10 mA.....	2 mA

Trip Time <sup>(5)</sup> .....	10 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 .....	SE-CS30 Current Sensor
CT Detection .....	Open-Circuit Detection

#### Thermal Withstand:

Continuous .....	25 A Earth-Fault Current
1-Second.....	400 A Earth-Fault Current

### Analog Output:

Range.....	0 to 5 Vdc, 10 mV per mA
Output Impedance.....	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 mm <sup>2</sup> ) 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



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, 80-1000 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 10Vrms, 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
RFI Compliance .....	FCC Part 15, Subpart B, Class A – Unintentional Radiators
Certification .....	CSA (Canada and USA)  LR 53428 C US Australia 

## 6. ORDERING INFORMATION

SE-704-0		U Universal 120/240-Vac/Vdc Supply
		D 12/24-Vdc Supply
		T 48-Vdc Supply
		3 24-Vac Supply

SE-CS30-26 .....	Current Sensor, 26.0 mm (1.02") Window
SE-CS30-70 .....	Current Sensor c/w Flux Conditioner, 69.8 mm (2.75") Window
PMA-55 .....	Panel-Mount Adapter, NEMA 1
PMA-60 .....	Panel-Mount Adapter, NEMA 3, IP53
PMA-3.....	Adapter Plate, GEC/MCGG
PMA-6.....	Adapter Plate, FPL-GFRM
PMA-15 .....	Adapter Plate, MGFR

Consult factory for custom mounting adapters.

## 7. WARRANTY

The SE-704 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.

Startco Engineering Ltd. will (at Startco's option) repair, replace, or refund the original purchase price of an SE-704 that is determined by Startco to be defective if it is returned to the Startco 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. Startco Engineering Ltd. does not warrant products repaired or modified by non-Startco Engineering Ltd. personnel.

- (1) For earth-fault current in kA < 150 divided by the trip setting in mA. [ $I_e < (150/\text{level}) \times 1,000 \text{ A}$ ]
- (2) At 50 or 60 Hz.
- (3) SE-CS30-series CT included.
- (4) Maximum lead resistance of 2 Ω.
- (5) Trip Time at 3 x trip-level setting.





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