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SE-330 MANUAL

NEUTRAL-GROUNDING-RESISTOR MONITOR

REVISION 10-P-101817

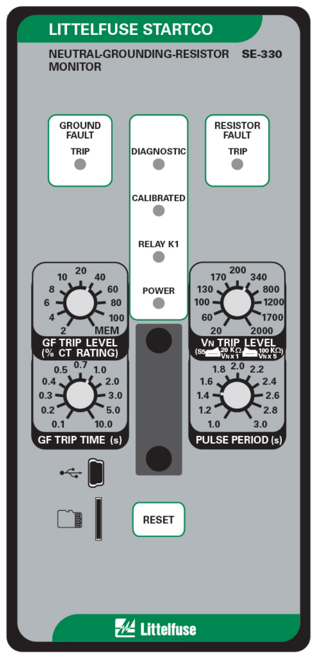

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DISCLAIMER

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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. This is an improvement over low-resistance or solidly-grounded systems because, in those systems, a ground-fault flash hazard exists 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 low current 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. Consult CEC 10-1102, NEC 250.36, and NEC 250.186 for application details.

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 can be conservatively estimated as ½ 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 10 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 12 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 SE-330 NGR MONITORING

The SE-330 is a microprocessor-based neutral-grounding-resistor monitor that detects NGR failures and ground faults in resistance-grounded systems. The SE-330 measures NGR resistance, NGR current, and transformer or generator neutral-to-ground voltage. The components required to monitor an NGR are an SE-330, a 20- or 100-kΩ ER-series sensing resistor, and a current transformer (CT).

Power-circuit elements, other than neutral-connected NGR's, that purposefully connect the power system to ground are often not compatible with SE-330 NGR monitoring. These elements include single-phase grounding transformers, grounded-wye-primary potential transformers (PT's), and grounded-wye-primary power transformers.

The SE-330 continuously measures NGR resistance in an unfaulted system. It will trip on resistor fault if NGR resistance varies from its calibrated value. When a ground fault occurs, voltage is present on the neutral and NGR current will flow if the NGR is healthy. The SE-330 will trip on ground fault if fault current exceeds the GF TRIP LEVEL setting for an interval equal to the GF TRIP TIME setting. However, if the NGR fails open during a ground fault, it is possible for fault resistance to satisfy the NGR resistance measurement. To detect this double-fault condition, the SE-330 measures neutral voltage. If neutral voltage exceeds the V_N TRIP LEVEL setting and if NGR current is less than 5% of the current transformer (CT) rating, the SE-330 will trip on resistor fault. If the resistor-fault circuit is tripped and the neutral voltage exceeds the V_N TRIP LEVEL setting for an interval greater than the GF TRIP TIME setting, the ground-fault circuit will also trip.

Ground-fault current is sensed by a CT with a 1- or 5-A secondary, or by a CT (EFCT-x or SE-CS30-x) with a 50-mA secondary. The trip level of the ground-fault circuit is adjustable from 2 to 100% of the CT rating and trip time is adjustable from 0.1 to 10.0 seconds.

The SE-330 has four output relays. Relay K1 can be assigned a trip or a pulsing function. Relays K2 and K3 provide ground-fault and resistor-fault indication. K4 is a solid-state relay that provides UNIT HEALTHY indication. When relay K1 is assigned the trip function, it will operate on either a resistor fault or ground fault, and it can be set to operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications. When the pulsing function is selected, relay K1 is used to control a contactor to assist in locating faults.

Additional features include LED trip indication, trip memory, front-panel and remote reset, 4-20-mA analog output, trip event recorder, USB local communications, microSD™ data logging, and optional network communications.

The SE-330 provides additional features over the SE-330 legacy model (revision 04 or less):

- When the trip level is set to MEM, the ground-fault trip setting is defined by an internal non-volatile memory variable. Range is 2 to 100% in 1% increments of the CT-primary rating.
- Indication relays can be set to fail-safe or non-fail-safe.
- The number of trip records has been increased to 100 and includes date and time stamping.
- A microSD™ card interface can be used for long-term data logging and firmware updates. A microSD™ card and a microSD-to-SD adapter is included. See Section 4.1.
- For ease of connection to new devices, the RS-232 interface has been replaced by a Mini B USB port.
- Dual Ethernet ports are available with support for fiber-optic and RJ45 interfaces.
- The IEC 61850 protocol has been added.

2. OPERATION

2.1 SETTINGS

2.1.1 GF TRIP TIME

GF TRIP TIME (definite time) is adjustable from 0.1 to 10.0 seconds. Time-coordinated ground-fault protection requires this setting to be longer than the trip times of downstream ground-fault devices.

A trip-time accumulator provides a ground-fault memory function for detection of intermittent faults. The accumulated time increases when a ground fault is detected and decreases when a ground fault is not detected. A trip will eventually occur when the time for fault current above the trip level is greater than the time for fault current below the trip level.

2.1.2 GF TRIP LEVEL

The SE-330 uses a Discrete-Fourier Transform (DFT) Algorithm to measure the fundamental component of NGR current.

Choose an NGR let-through current and a ground-fault trip level according to the guidelines in Section 1.1. Set the ground-fault trip level as a percentage (2 to 100) of the CT-primary rating. When the GF Trip Level is set to MEM, the ground-fault setting stored in non-volatile memory is used. This parameter must be set using a PC running the SE-MON330 software connected to the USB interface. The setting range is 2 to 100% of CT primary rating in 1% increments. The default value is 15%. Inputs are provided for 5-, 1-, and 0.05-A-secondary CT's. Typical values for 5-, 15-, and 25-A tripping systems are shown in Table 1. Ground-fault trip levels for selected CT's are shown in Table 2. For other systems, refer to the NGR Monitor Set-Point Assistant at www.littelfuse.com/relayscontrols. The Set-Point Assistant is included with the SE-MON330 software.

2.1.3 V_N TRIP LEVEL

The SE-330 uses a DFT algorithm to measure the fundamental component of neutral voltage (V_N).

If neutral voltage is greater than the V_N TRIP LEVEL setting for the duration of the resistor-fault trip time and ground-fault current is less than 5% of the CT rating, the SE-330 will trip on resistor fault. If the resistor-fault circuit is tripped and the neutral voltage exceeds the V_N TRIP LEVEL setting for an interval greater than the GF TRIP TIME setting, the ground-fault circuit will also trip.

The V_N TRIP LEVEL range is 20 to 2,000 V with switch S5 in the 20-kΩ (Vx1) position, and the range is 100 to 10,000 V with switch S5 in the 100-kΩ (Vx5) position. Calculate the voltage across the NGR when NGR current is equal to the pick-up current of the ground-fault circuit. Set the V_N TRIP LEVEL at the next largest value. See Fig. 1 and Section 2.1.5.5.

Typical values for 5-, 15-, and 25-A tripping systems are shown in Table 1. For an NGR resistance greater than 2 kΩ, use a 100-kΩ sensing resistor. For other systems, refer to the NGR Monitor Set-Point Assistant at www.littelfuse.com/relayscontrols.

NOTE: A resistor-fault trip is held off if the ground-fault current is above 5% of the CT rating.

TABLE 1. TYPICAL VALUES FOR TRIPPING SYSTEMS

SYSTEM VOLTAGE (LINE-LINE)	NEUTRAL-GROUNDING RESISTOR		SENSING RESISTOR		GROUND-FAULT TRIP LEVEL	V_N TRIP LEVEL
(VOLTS)	CURRENT (AMPERES)	RESISTANCE (OHMS)	MODEL	RESISTANCE (SWITCH S5 SETTING)	(AMPERES)	(VOLTS)
480	5	55	ER-600VC	20 kΩ	1.0	60
600	5	69	ER-600VC	20 kΩ	1.0	100
2,400	5	277	ER-5KV	20 kΩ	1.0	340
4,160	5	480	ER-5KV	20 kΩ	1.0	800
480	15	18	ER-600VC	20 kΩ	3.0	60
600	15	23	ER-600VC	20 kΩ	3.0	100
2,400	15	92	ER-5KV	20 kΩ	3.0	340
4,160	15	160	ER-5KV	20 kΩ	3.0	800
7,200	15	277	ER-15KV	100 kΩ	3.0	170x5=850
14,400	15	554	ER-15KV	100 kΩ	3.0	340x5=1,700
4,160	25	96	ER-5KV	20 kΩ	5.0	800
7,200	25	166	ER-15KV	100 kΩ	5.0	170x5=850
14,400	25	332	ER-15KV	100 kΩ	5.0	340x5=1,700
25,000	25	577	ER-25KV	100 kΩ	5.0	800x5=4,000
35,000	25	808	ER-35KV	100 kΩ	5.0	1,200x5=6,000

TABLE 2. GROUND-FAULT TRIP LEVELS FOR SELECTED CT'S

GF TRIP LEVEL(1) (%)	EFCT-x 5:0.05 (AMPERES)	SE-CS30-x 30:0.05 (AMPERES)	50:1 50:5 (AMPERES)	100:1 100:5 (AMPERES)	200:1 200:5 (AMPERES)	400:1 400:5 (AMPERES)
2	0.10	0.60	*	*	*	*
4	0.20	1.20	*	*	*	16
6	0.30	1.80	*	*	12	24
8	0.40	2.40	*	8	16	36
10	0.50	3.00	5	10	20	40
20	1.00	6.00	10	20	40	80
40	2.00	12.0	20	40	80	160
60	3.00	18.0	30	60	120	240
80	4.00	24.0	40	80	160	320
100	5.00	30.0	50	100	200	400

(1) When set to MEM, range is 2 to 100% in 1% increments.
* Setting not recommended.

2.1.4 PULSE-PERIOD ADJUSTMENT

Pulse period is the cycle time of relay K1 when the SE-330 is configured for pulsing operation. Pulse period is adjustable from 1.0 to 3.0 seconds with a fixed duty cycle of 50%. For example, with the 1.0-s setting, relay K1 will alternately be energized for 0.5 seconds and de-energized for 0.5 seconds when pulsing is enabled.

See Section 2.3 for detailed pulsing operation information.

NOTE: For pulsing configuration, set switch S1 to K1 = PULSING and install an external pulse-enable switch.

2.1.5 CONFIGURATION SETTINGS

Eight configuration switches (S1 to S8) and a calibration button are located behind the access cover on the front panel. See Fig. 1.

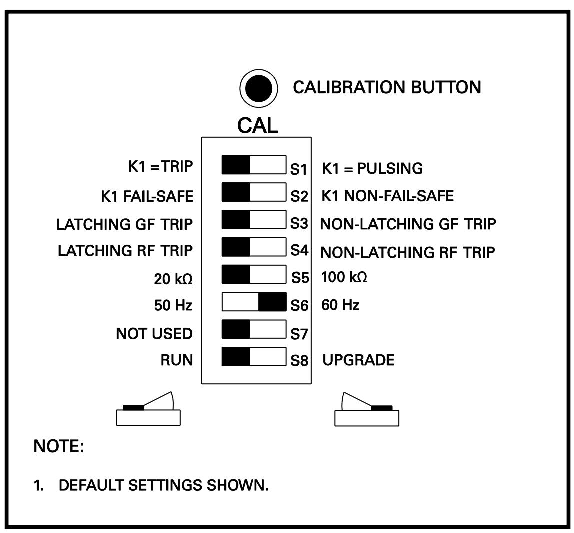


FIGURE 1. Configuration Switches.

2.1.5.1 RELAY K1 FUNCTION (S1)

Set switch S1 to K1 = TRIP to assign the trip function to relay K1 and to activate switch S2. Relay K1 will change state when a resistor-fault or ground-fault trip occurs.

Set switch S1 to K1 = PULSING to configure relay K1 for pulsing operation. See Section 2.3.

2.1.5.2 TRIP-RELAY MODE AND TRIP-MEMORY MODE (S2)

Set switch S2 to select the operating mode of trip relay K1. In the non-fail-safe mode, relay K1 energizes and its contact closes when a trip occurs. The non-fail-safe mode can be used to trip shunt-trip circuit breakers. In the non-fail-safe mode, SE-330 trips are reset when supply voltage is cycled.

In the fail-safe mode, relay K1 energizes and its contact closes if there are no trips. Contacts open if there is a trip, a loss of supply voltage, or a processor failure. In the fail-safe mode, SE-330 trips are not reset when supply voltage is cycled.

NOTE: Switch S2 does not affect the operating modes of relays K2, K3, and K4.

NOTE: Switch S2 only affects relay K1 operating mode when K1 is assigned the trip function (switch S1 set to K1 = TRIP). Trip memory is enabled when K1 is set to the fail-safe mode, regardless of the switch S1 setting.

2.1.5.3 GROUND-FAULT-TRIP LATCH (S3)

Set switch S3 to select latching or non-latching ground-fault-circuit operation. Non-latching operation defeats ground-fault-trip memory. See Sections 2.1.5.2 and 2.4.

2.1.5.4 RESISTOR-FAULT-TRIP LATCH (S4)

Set switch S4 to select latching or non-latching resistor-fault-circuit operation. Non-latching operation defeats resistor-fault-trip memory. See Sections 2.1.5.2 and 2.4

2.1.5.5 SENSING-RESISTOR SELECTION (S5)

Set switch S5 to the resistance of the sensing resistor. For the ER-600VC, ER-5KV, and ER-5WP, select 20 kΩ. For the ER-15KV, ER-25KV, and ER-35KV, select 100 kΩ. Switch S5 sets the resistor-fault trip value and the V_N TRIP LEVEL range. See Section 2.1.3.

2.1.5.6 FREQUENCY (S6)

Set switch S6 to 50 or 60 Hz to tune the digital filter to the line frequency of the monitored system.

2.1.5.7 UPGRADE MODE (S8)

The microSD™ card is used for firmware upgrades. See Section 4.1.2 for upgrade instructions.

NOTE: An upgrade causes an SE-330 restart and this may cycle the output relays.

2.1.6 RESISTOR-FAULT TRIP TIME

The resistor-fault trip time can be adjusted from 12 (default) to 60 seconds using the SE-MON330 software or via network communications.

2.1.7 RESISTOR-FAULT TRIP LEVEL

The resistor-fault trip level can be adjusted using the SE-MON330 software or via network communications. See Section 6.1.

2.1.8 GEO-MAGNETIC FILTER

A low-frequency ground current can be caused by the Earth's magnetic field and from charged clouds passing overhead during a thunderstorm. In some rare conditions, this can cause a false resistor-fault trip. Enabling the geo-magnetic filter and increasing the resistor-fault trip time can help counteract these effects.

A trip time of 30 seconds is recommended when the geo-magnetic filter is enabled.

The geo-magnetic filter is disabled by default, but can be enabled using the SE-MON330 software or via network communications.

2.2 CALIBRATION

The SE-330 measures the resistance change of the NGR relative to the NGR-resistance value determined at the time of calibration. When the resistance change is greater than a threshold amount (500 Ω for 20-kΩ systems, 2,500 Ω for 100-kΩ systems), a resistor-fault trip occurs. Calibrate the SE-330 on new installations, if the NGR is changed, or if the sensing resistor is changed.

NOTE: If the SE-330 is not calibrated and is supplied from the load side of the breaker (non-fail-safe mode), calibrate within the resistor-fault trip time after power-up or it may trip and interrupt its supply. See Section 2.1.6.

The CALIBRATION button is located behind the access cover on the front panel, and it is recessed to prevent inadvertent activation.

NOTE: Calibration must be performed with the SE-330 connected to the sensing resistor and NGR of the installed system.

To calibrate, press and hold the CALIBRATION button until the green CALIBRATED LED turns off and returns to on (if the LED is already off, press and hold until the LED turns on). Calibration takes approximately two seconds. If calibration is not successful, a resistor-fault trip occurs, the RESISTOR FAULT TRIP LED will be on, the CALIBRATED LED will be off, and the DIAGNOSTIC LED will flash the calibration-error code. See Section 2.8.

The SE-330 may be calibrated remotely using the SE-MON330 software with the USB interface or the communications options.

If latching resistor fault (switch S4) is selected, the calibration-error code flashes until RESET is pressed even if the CALIBRATED LED is on.

The calibration value is stored in non-volatile memory.

2.3 Pulsing Operation

If switch S1 is set to K1 = PULSING, pulsing occurs when terminal 16 is connected to terminal 17. Relay K1 operates at a 50% duty cycle and cycle time is adjustable from 1.0 to 3.0 seconds. When terminals 16 and 17 are not connected, K1 is not energized and its contact is open.

Relay K1 can be used to control a contactor rated for use at the line-to-neutral voltage. The contactor causes changes in neutral-to-ground resistance by adding or shorting portions of the NGR. See Section 3.5. Pulsing ground-fault current appears as zero-sequence current upstream from the fault.

Pulsing ground-fault current is distinguishable from charging current and noise, and it can be traced with a clip-on ammeter or current probe. If pulsing current is detected on a cable or conduit, the fault is downstream. Systematic testing allows faults to be located without isolating feeders or interrupting loads.

Stop pulsing when a fault is located.

2.4 Trip Indication and Reset

Red LED's and indication relays indicate ground-fault and resistor-fault trips. The indication relays K2 (GF) and K3 (RF) operate in fail-safe or non-fail-safe mode. The default is non-fail-safe mode. In this mode, the relays are energized when a fault occurs. The relay mode setting is stored in non-volatile memory and can be set using the SE-MON330 software or network communications.

When a trip occurs with latching operation selected, the SE-330 remains tripped until reset with the front panel button or the remote-reset input. See Sections 2.1.5.3 and 2.1.5.4. Terminals 15 and 16 are provided for remote reset as shown in Fig. 3. The reset circuit responds only to a momentary closure so that a jammed or shorted button does not prevent a trip. The front-panel RESET button is inoperative when terminal 15 is connected to terminal 16. If non-latching operation is selected, trips and corresponding indication automatically reset when the fault clears and power-up trip memory is defeated even when configuration switch S2 is set to fail-safe. The maximum automatic reset time is 2.8 s.

The red DIAGNOSTIC LED annunciates latched calibration-error and remote trips. See Section 2.8.

When supply voltage is applied with switch S2 set to FAIL-SAFE, the SE-330 returns to its state prior to loss of supply voltage unless switch S3 or S4 is set to non-latching. When supply voltage is applied with switch S2 set to NON-FAIL-SAFE, SE-330 trips are reset. When a local, remote, or network reset is issued, both trip LED's will flash if they are off.

Resistor-fault-trip reset can take up to one second. Resistor-fault trip-memory trip can take up to three seconds after SE-330 power up.

2.5 Remote Operation

Relays K2 and K3 can be used for remote indication, and terminals 15 and 16 are provided for remote reset. RK-332 Remote Indication and Reset components are shown in Fig. 19. Connect them as shown in Fig. 3. RK-332 components are not polarity sensitive.

Indication relays can be set to fail-safe or non-fail-safe operation using the SE-MON330 software or network communications. The default mode is non-fail-safe. In non-fail-safe mode, relays energize on fault.

Network-enabled SE-330's can be remotely tripped and reset by the network master. The red DIAGNOSTIC LED indicates a network-initiated trip. See Section 2.8. Refer to the appropriate SE-330 communications manual.

2.6 Relay K1 LED

The yellow RELAY K1 LED follows the state of relay K1 and is on when K1 is energized (contact closed).

2.7 Unit Healthy Output

UNIT HEALTHY relay K4 is energized when the processor is operating. It can be ordered with N.O. or N.C. contacts. See Section 7.

NOTE: The K4 output changes state momentarily during a processor reset.

NOTE: K4-contact rating is 100 mA maximum.

2.8 Diagnostic LED

The DIAGNOSTIC LED is used to annunciate trips without individual LED indication. The number of short LED pulses between pauses indicates the cause of the trip.

By default, both critical and non-critical diagnostic flash codes are shown. Non-critical diagnostic codes include SD Card status and USB Error status. All other diagnostic codes are considered critical.

Starting with SE-330 firmware version 2.60 and SE-MON330 software version 3.8, the SE-330 can be configured to show only critical diagnostic codes. In this configuration, non-critical diagnostic codes will not be indicated with the DIAGNOSTIC LED.

Diagnostic messages are always visible with the SE-MON330.

See Sections 4.2 and 5.

2.9 ANALOG OUTPUT

An isolated 4–20-mA output indicates NGR current with full-scale output corresponding to the CT rating. An internal 24-Vdc supply allows the analog output to be connected as a self-powered output. Power from an external supply is required for loop-powered operation. See Fig. 2. A PGA-0520 analog meter can be panel-mounted to display the NGR current. See Fig. 20 and Section 7.

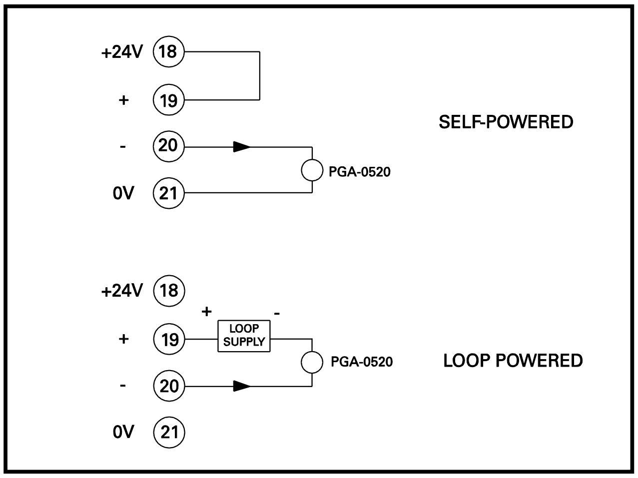


FIGURE 2. Analog-Output Connections.

3. INSTALLATION

3.1 SE-330

Outline and panel-cutout dimensions for the SE-330 are shown in Fig. 4. To panel mount the SE-330, insert it through the panel cutout and secure it with the four included 8-32 locknuts and flat washers.

If an optional SE-IP65CVR-G Hinged Cover is used, follow the included installation instructions. See Figs. 6 and 7.

All connections to the SE-330 are made with plug-in, wire-clamping terminal blocks. Each plug-in terminal block can be secured to the SE-330 by two captive screws for reliable connections.

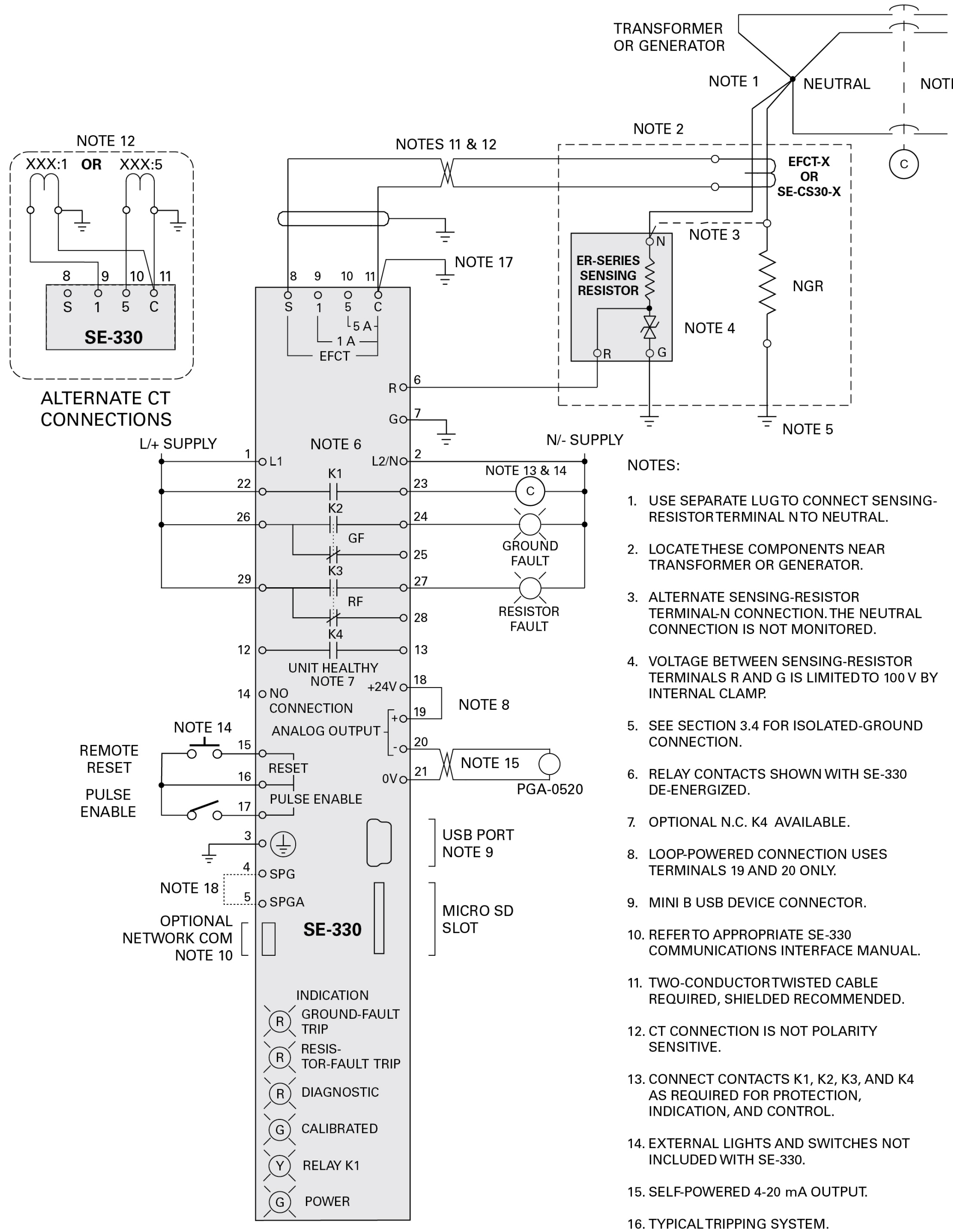
Outline dimensions and mounting details for surface mounting the SE-330 are shown in Fig. 5. Fasten the optional surface-mount adapter to the mounting surface and make connections to the adapter terminal blocks. Follow Fig. 5 instructions to mount or remove the SE-330.

Ground terminal 7 (G) and connect terminal 6 (R) to the sensing-resistor R terminal.

Use terminal 1 (L1) as the line terminal on ac systems, or the positive terminal on dc systems. Use terminal 2 (L2/N) as the neutral terminal on ac systems or the negative terminal on dc systems. Connect terminal 3 (⏚) to ground.

NOTE: Disconnect terminal 1 (L1) and terminal 2 (L2/N) before performing dielectric strength testing of the control panel.

NOTE: Connections to terminals 4 (SPG) and 5 (SPGA) are not required when using the SE-330 hardware revision 10 and higher. However, it is recommended to connect terminal 4 to terminal 5 to maintain backwards compatibility with the older SE-330 series (hardware revision 04A and lower).



NOTES:

1. USE SEPARATE LUG TO CONNECT SENSING-RESISTOR TERMINAL N TO NEUTRAL.
2. LOCATE THESE COMPONENTS NEAR TRANSFORMER OR GENERATOR.
3. ALTERNATE SENSING-RESISTOR TERMINAL-N CONNECTION. THE NEUTRAL CONNECTION IS NOT MONITORED.
4. VOLTAGE BETWEEN SENSING-RESISTOR TERMINALS R AND G IS LIMITED TO 100 V BY INTERNAL CLAMP.
5. SEE SECTION 3.4 FOR ISOLATED-GROUND CONNECTION.
6. RELAY CONTACTS SHOWN WITH SE-330 DE-ENERGIZED.
7. OPTIONAL N.C. K4 AVAILABLE.
8. LOOP-POWERED CONNECTION USES TERMINALS 19 AND 20 ONLY.
9. MINI B USB DEVICE CONNECTOR.
10. REFER TO APPROPRIATE SE-330 COMMUNICATIONS INTERFACE MANUAL.
11. TWO-CONDUCTOR TWISTED CABLE REQUIRED, SHIELDED RECOMMENDED.
12. CT CONNECTION IS NOT POLARITY SENSITIVE.
13. CONNECT CONTACTS K1, K2, K3, AND K4 AS REQUIRED FOR PROTECTION, INDICATION, AND CONTROL.
14. EXTERNAL LIGHTS AND SWITCHES NOT INCLUDED WITH SE-330.
15. SELF-POWERED 4-20 mA OUTPUT.
16. TYPICAL TRIPPING SYSTEM.
17. GROUND CURRENT SENSOR AT TERMINAL 11 ONLY.
18. CONNECTION NOT REQUIRED. SEE SECTION 3.1 FOR COMPATABILITY WITH OLDER SE-330 SERIES.

FIGURE 3. SE-330 Connection Diagram.

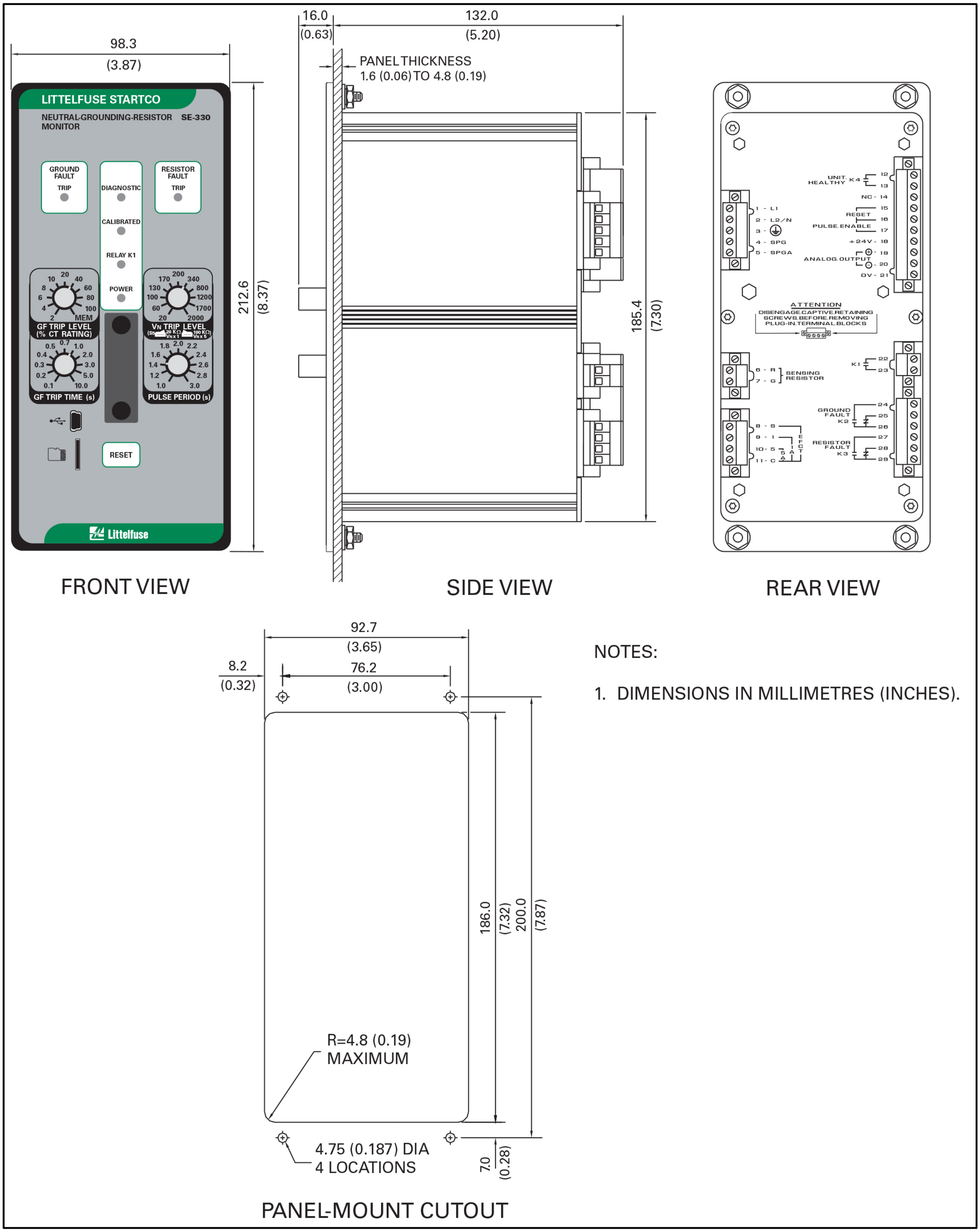
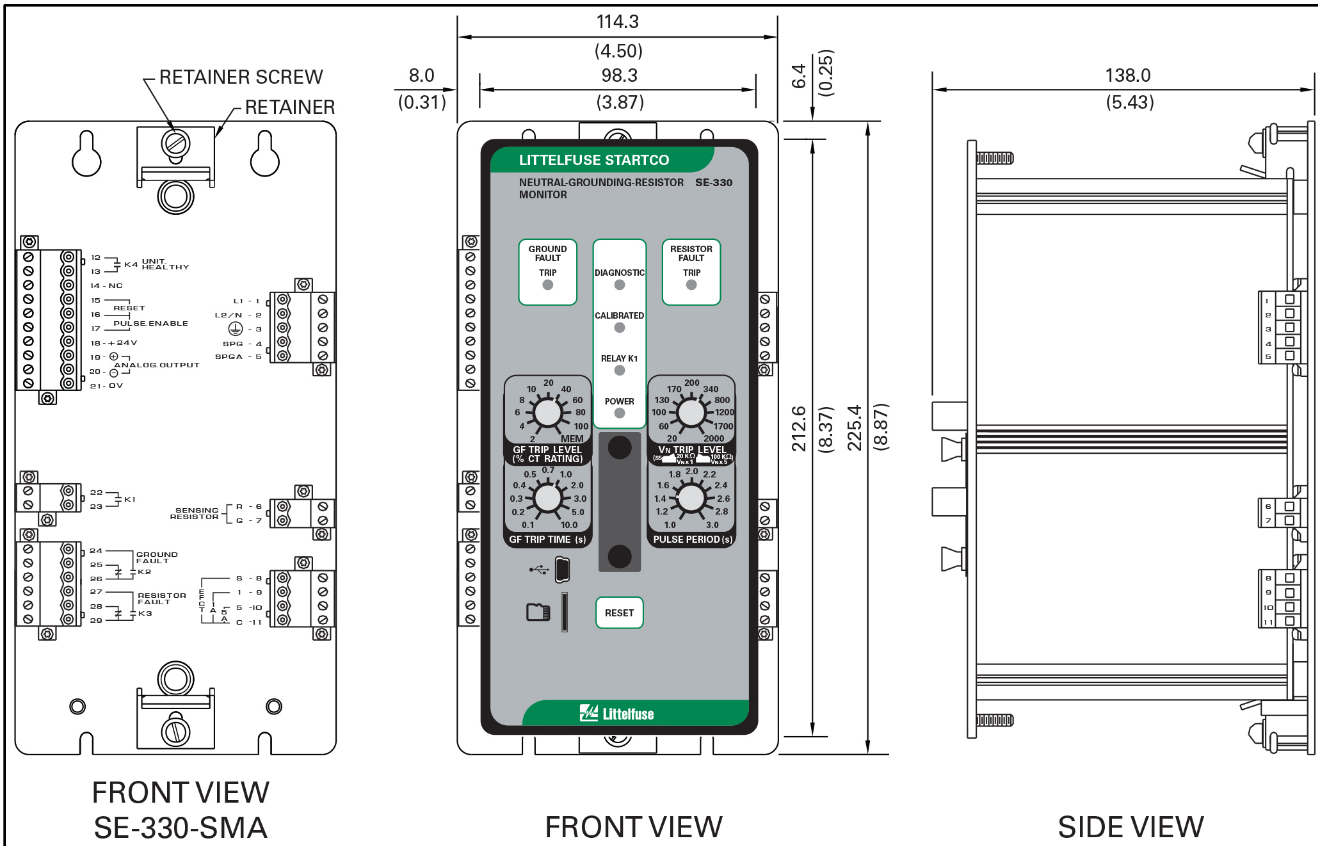
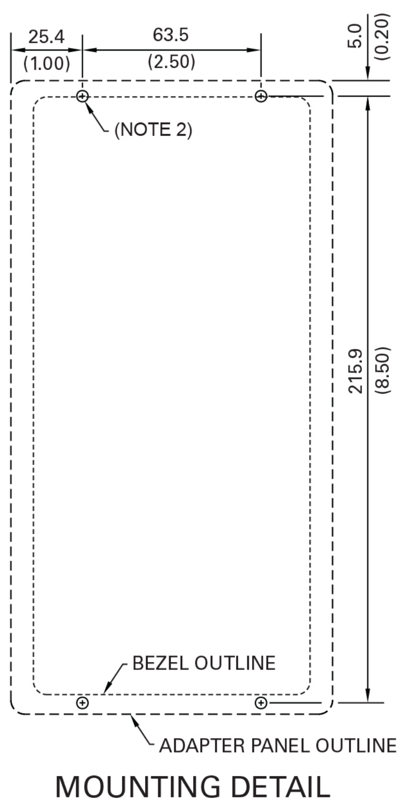


FIGURE 4. SE-330 Outline and Panel-Mounting Details.





NOTES:

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

INSTALLATION

1. LOOSEN RETAINER SCREWS, MOVE RETAINERS OUTWARD AND TIGHTEN RETAINER SCREWS.
2. MATE MONITOR WITH ADAPTER PLUG-IN TERMINALS. LOOSEN RETAINER SCREWS TO LET RETAINERS SNAP OVER MONITOR BACKPLATE.
3. ENSURE THAT RETAINERS ARE AGAINST MONITOR BODY AND TIGHTEN RETAINER SCREWS.

REMOVAL

1. LOOSEN RETAINER SCREWS, SLIDE RETAINERS AWAY FROM MONITOR BODY AND TIGHTEN RETAINER SCREWS.
2. PULL MONITOR FORWARD.

FIGURE 5. SE-330 Outline and Surface-Mounting Details.

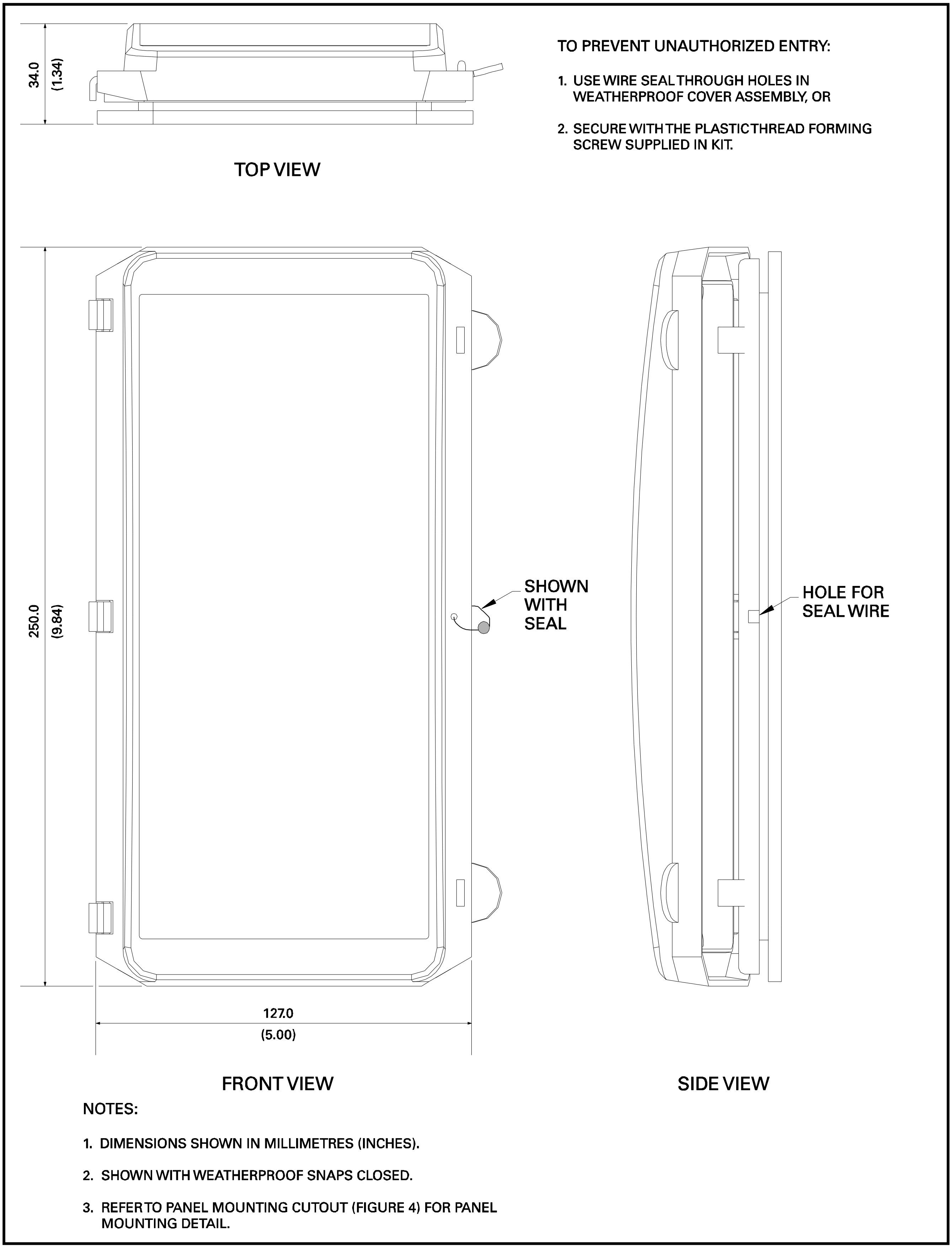


FIGURE 6. SE-IP65CVR-G Weatherproof Cover Outline.

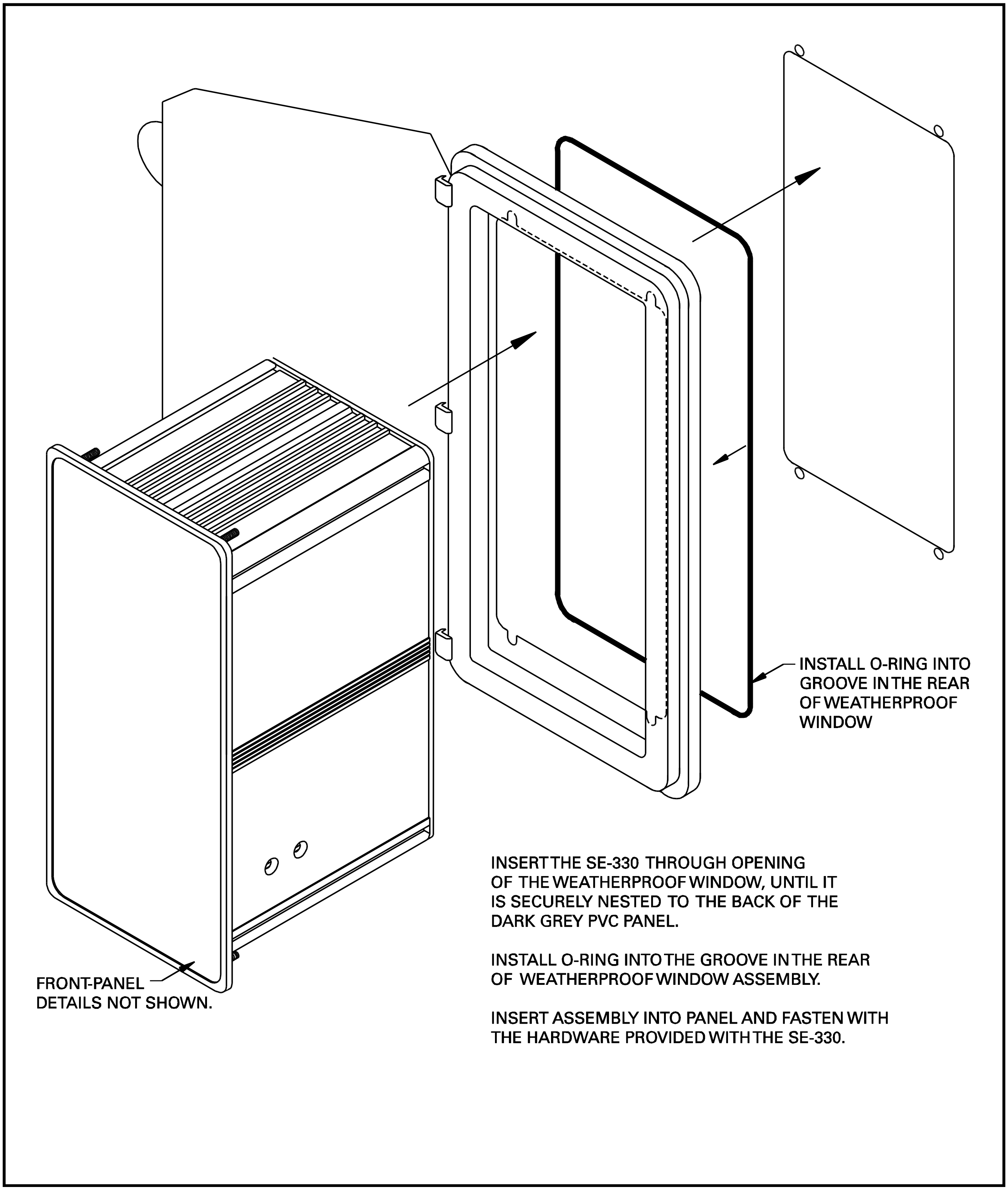


FIGURE 7. SE-IP65CVR-G Weatherproof Cover Installation.

3.2 SENSING RESISTOR

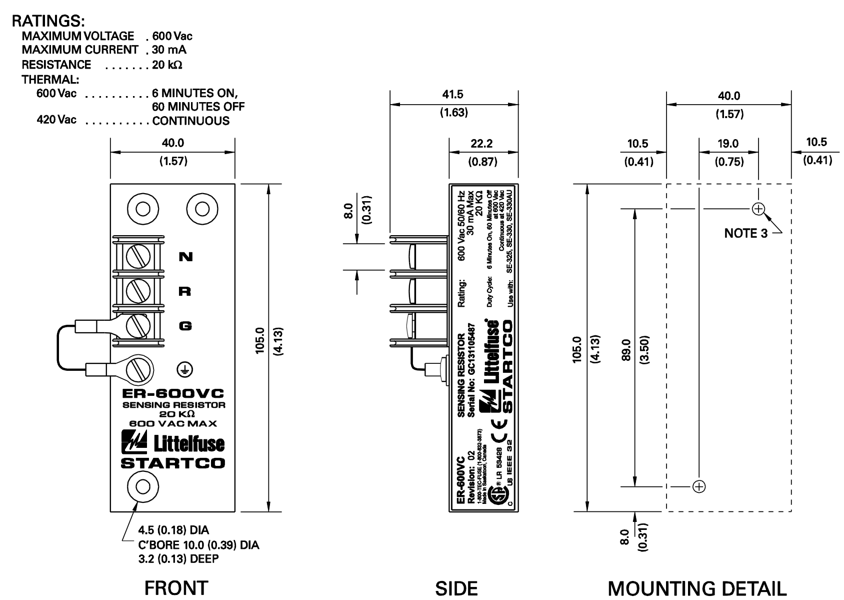
Outline and mounting details for the ER-600VC, ER-5KV, ER-5WP, ER-15KV, ER-25KV, and ER-35KV sensing resistors are shown in Figs. 8, 11, 12, 13, 14, and 15. Install the NGR and the sensing resistor near the transformer or generator. When installed outdoors, a sensing resistor must be installed in a suitable enclosure. An optional SE-MRE-600 Moisture-Resistant Enclosure is available for applications which may expose an ER-600VC to moisture. See Figs. 9 and 10. The weather-protected ER-5WP shown in Fig. 12 is an ER-5KV with moisture-resistant terminal covers. Use an ER-5WP in applications in which it might be exposed to moisture. The ER-15KV, ER-25KV, and ER-35KV include moisture-resistant terminal covers. Use suitable water-tight fittings. 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. 3. Separately connect sensing-resistor terminal N and the NGR to the neutral to include neutral connections in the monitored loop. Alternately, if the NGR connection to system neutral need not be monitored, connect terminal N to the NGR neutral terminal.

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. See Note 3 in Fig. 3.

NOTE: 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: A parallel ground path created by moisture can result in a false resistor-fault trip. Moisture sources include wind-driven rain or snow, and condensation. Sensing-resistor terminal R and its connection to SE-330 terminal R, including interposing terminal blocks, must remain dry.

NOTE: The neutral-to-sensing-resistor-terminal-N 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 (8.36 mm^2) or larger. Since current through this conductor is always less than 250 mA, a 14 AWG (2.08 mm^2) conductor insulated to the system voltage is more than sufficient.



NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. TERMINAL-BLOCK SCREWS: 6-32 x 0.25.
3. MOUNTING SCREWS: M4 OR 8-32.
4. ON REVISION 2 UNITS ENCLOSURE IS ELECTRICALLY CONNECTED TO TERMINAL G THROUGH JUMPER FROM TERMINAL G TO ⏚ SCREW. THIS CONNECTION MAY BE REMOVED FOR DIELECTRIC STRENGTH TESTING. ENSURE THAT THE JUMPER IS INSTALLED AFTER TESTING.
5. ON REVISION 1 UNITS, ⏚ SCREW IS NOT PRESENT AND ENCLOSURE IS ELECTRICALLY CONNECTED TO TERMINAL G.
6. NOT ALL CERTIFICATIONS SHOWN.

FIGURE 8. ER-600VC Sensing Resistor.

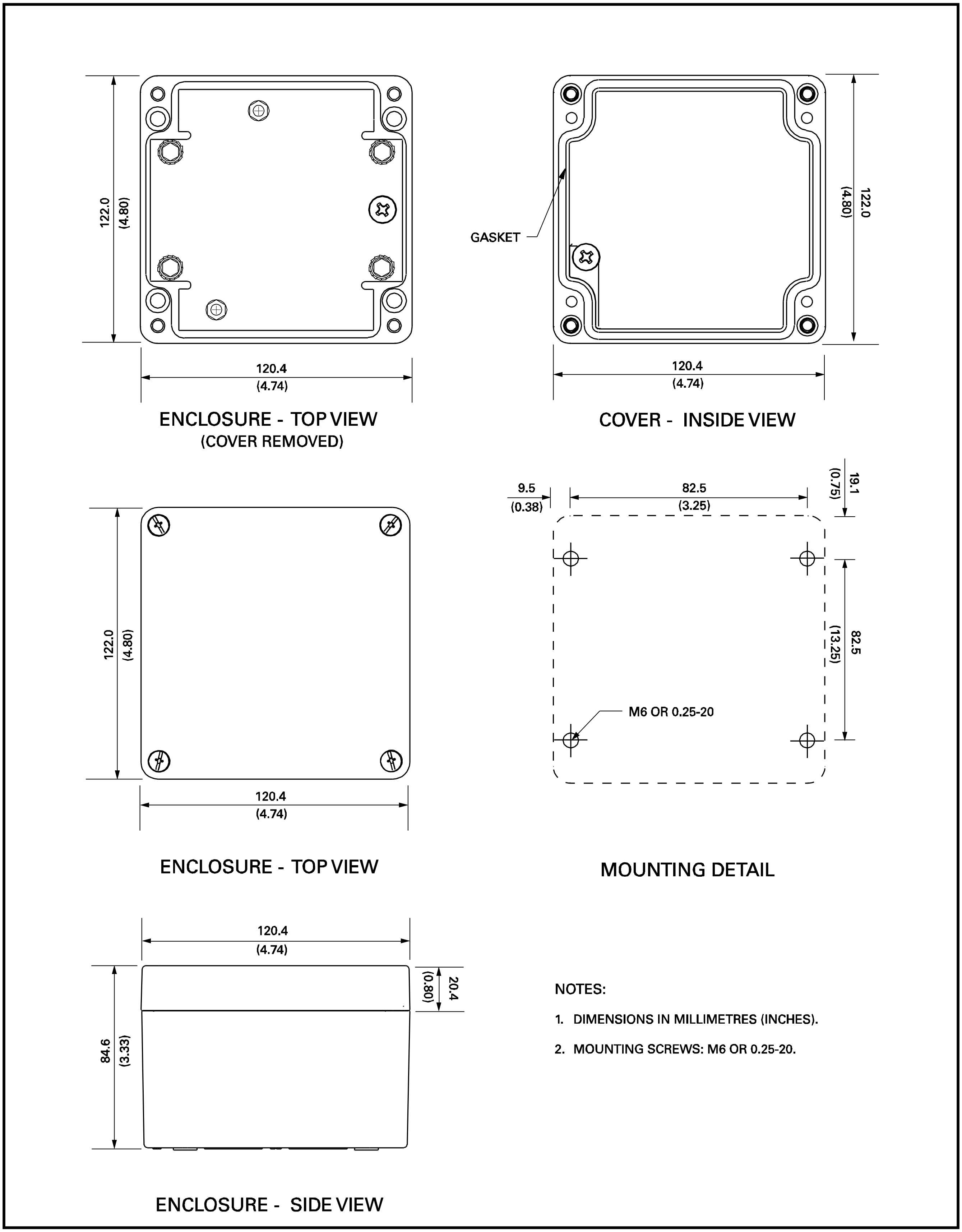
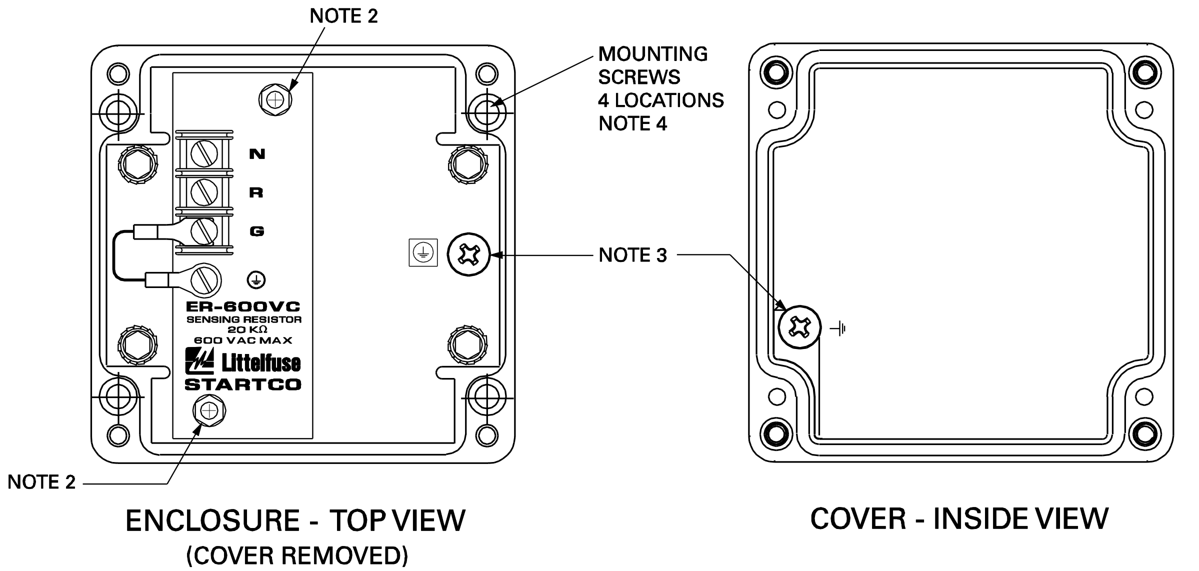


FIGURE 9. SE-MRE-600 Moisture-Resistant Enclosure Outline.



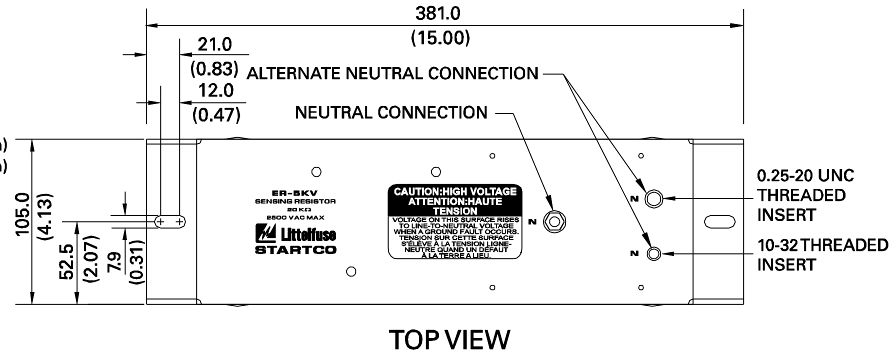
ASSEMBLY INSTRUCTIONS

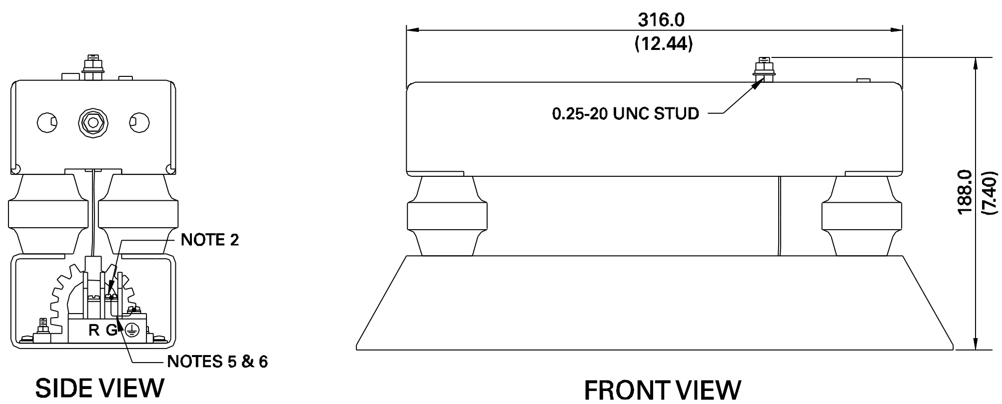
1. DRILL HOLE FOR ENCLOSURE WIRE ENTRY. USE LIQUID-TIGHT FITTING.
2. REMOVE NYLON NUTS AND WASHERS. INSERT ER-600VC INTO ENCLOSURE. REPLACE NUTS AND WASHERS.
3. ATTACH GROUND WIRE FROM ENCLOSURE TO COVER AND TO ER-600VC TERMINAL G.
4. MOUNT SE-MRE-600 IN PLACE USING M6 OR 0.25-20.
5. COMPLETE OTHER WIRING AND REPLACE COVER.

FIGURE 10. ER-600VC Installed in SE-MRE-600.

RATINGS:

MAXIMUM VOLTAGE . 2,500 Vac
MAXIMUM CURRENT. 125 mA
RESISTANCE . . . . 20 kΩ
THERMAL . . . . CONTINUOUS
TORQUE
TERMINAL N (3 LOCATIONS)
10-32 INSERT. . . . . 5.6 N·m (50 lbf·in)
OTHERS . . . . 9.0 N·m (80 lbf·in)





NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. TERMINAL-BLOCK SCREWS: 6-32 x 0.25.
3. MOUNTING SCREWS: M6 OR 0.25-20.
4. THIS DEVICE CAN DISSIPATE 300 WATTS. TO MINIMIZE SURFACE TEMPERATURES FOR SYSTEMS ALLOWED TO OPERATE CONTINUOUSLY WITH A GROUND FAULT, MOUNT VERTICALLY WITH R & G TERMINALS DOWN.
5. ON REVISION 2 UNITS BASE IS ELECTRICALLY CONNECTED TO TERMINAL G THROUGH JUMPER FROM TERMINAL G TO ⏚ SCREW. THIS CONNECTION MAY BE REMOVED FOR DIELECTRIC STRENGTH TESTING. ENSURE THAT THE JUMPER IS INSTALLED AFTER TESTING.
6. ON REVISION 0 & 1 UNITS ⏚ SCREW IS NOT PRESENT AND BASE IS ELECTRICALLY CONNECTED TO TERMINAL G.
7. CERTIFICATIONS NOT SHOWN.

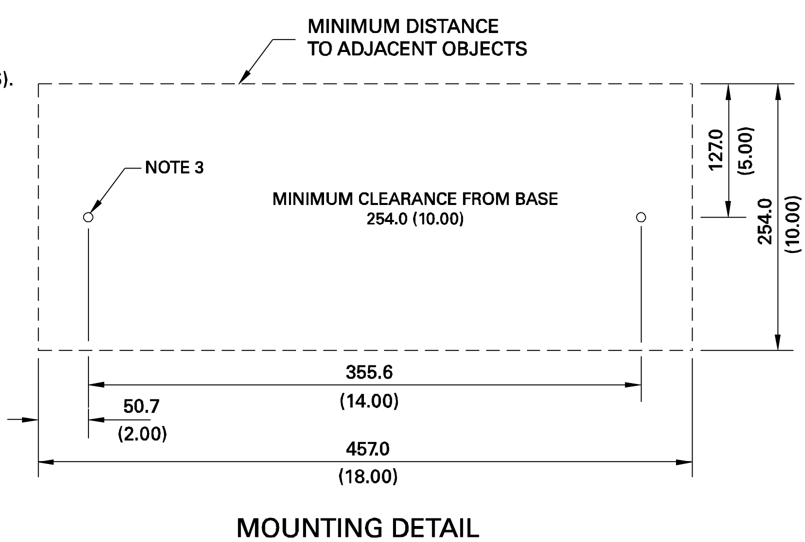


FIGURE 11. ER-5KV Sensing Resistor.

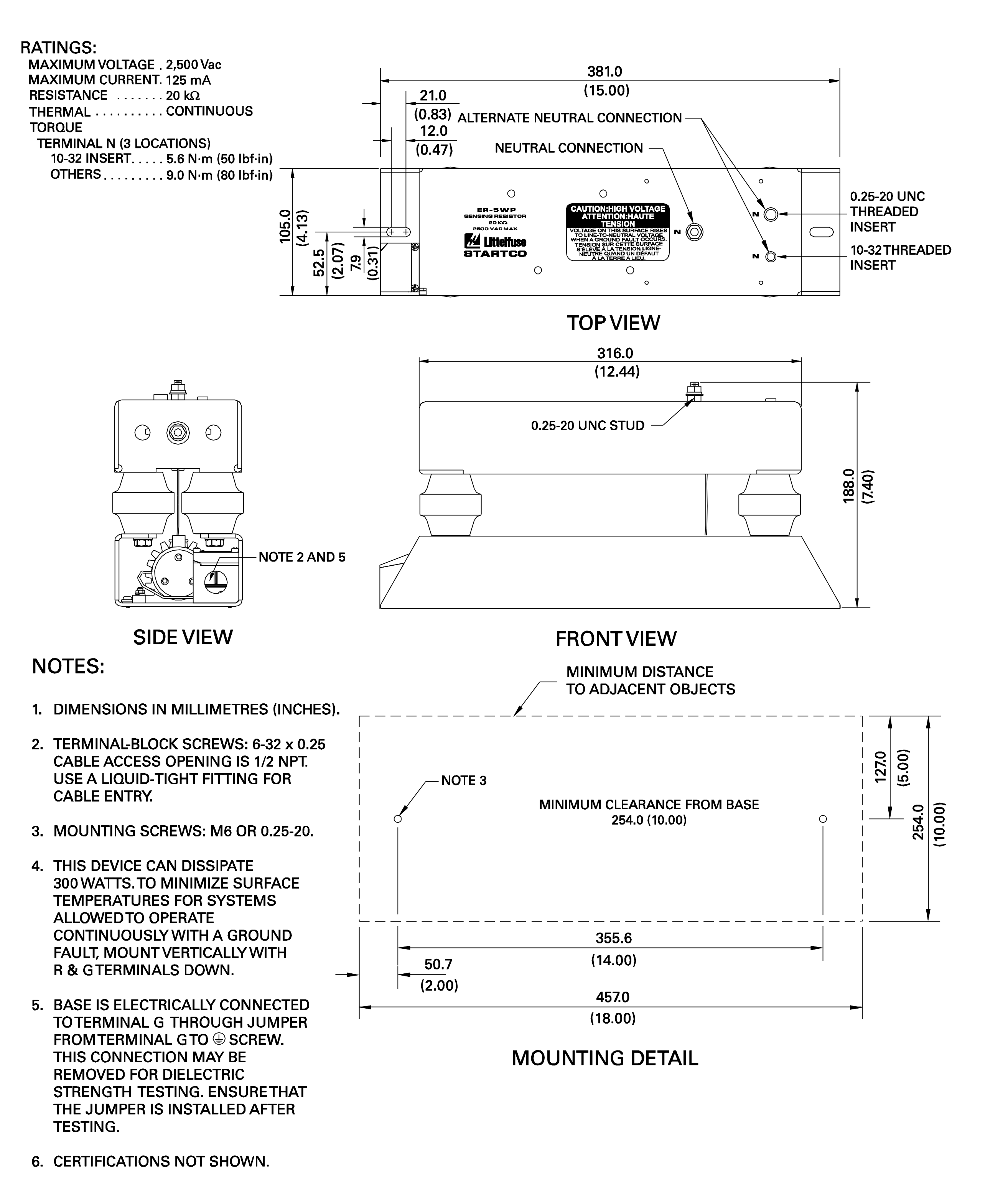


FIGURE 12. ER-5WP Sensing Resistor.

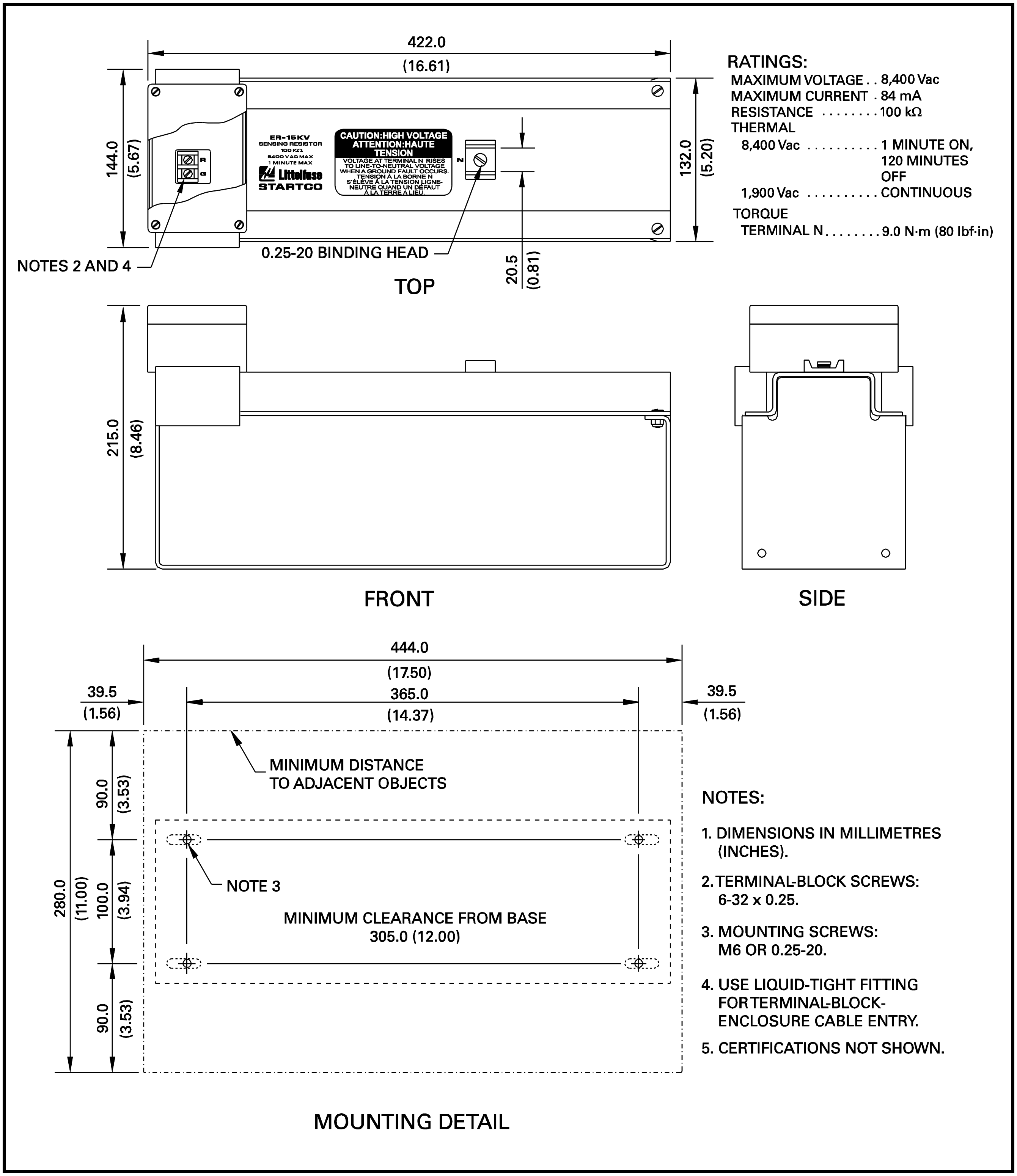


FIGURE 13. ER-15KV Sensing Resistor.

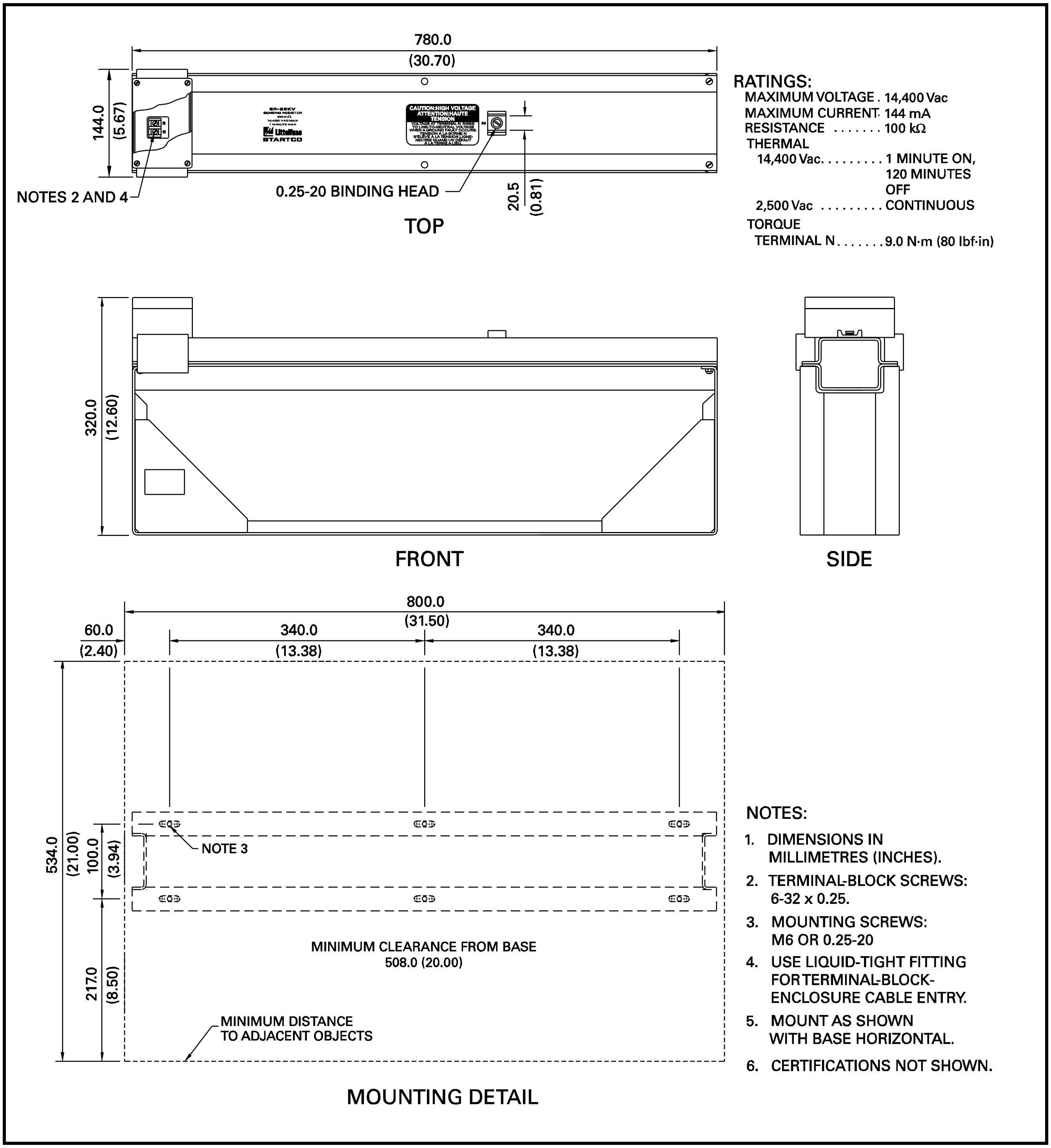
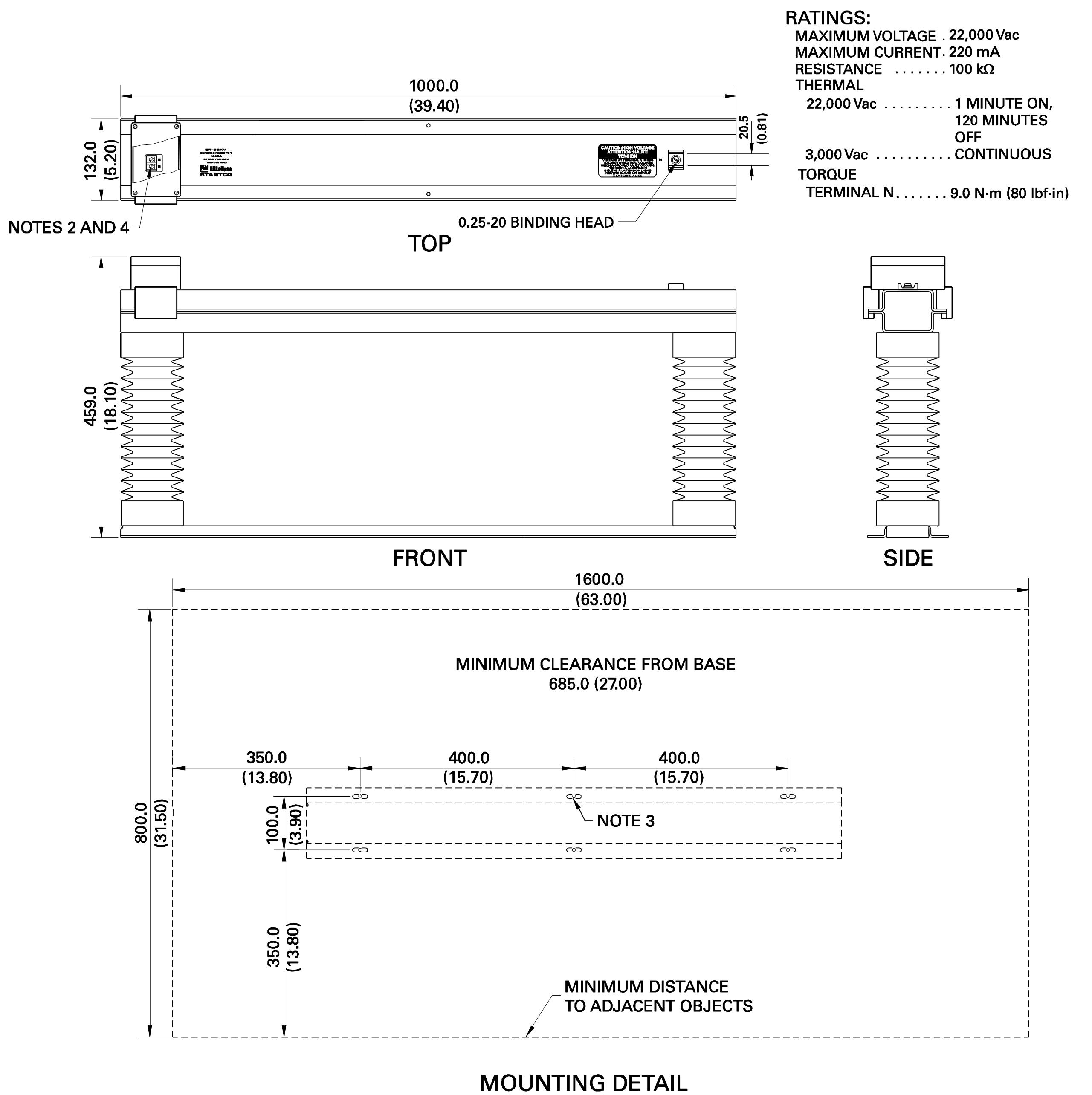


FIGURE 14. ER-25KV Sensing Resistor.



NOTES:
1. DIMENSIONS IN MILLIMETRES (INCHES).
2. TERMINAL-BLOCK SCREWS: 6-32 x 0.25.
3. MOUNTING SCREWS: M6 OR 0.25-20.
4. USE LIQUID-TIGHT FITTING FOR TERMINAL-BLOCK-ENCLOSURE CABLE ENTRY.
5. MOUNT AS SHOWN WITH BASE HORIZONTAL.
6. CERTIFICATIONS NOT SHOWN.

FIGURE 15. ER-35KV Sensing Resistor.

3.3 GROUND-FAULT CT

Select and install a ground-fault CT that will provide the desired trip level. Typically, the CT-primary rating should be approximately equal to the NGR let-through-current rating. This provides an appropriate GF TRIP LEVEL setting range and analog-output scaling. See Sections 2.1.2 and 2.9.

Outline and mounting details for the EFCT- and SE-CS30-series current sensors are shown in Figs. 16, 17, and 18. Ground-fault-CT connections and the typical ground-fault-CT location are shown in Fig. 3.

For SE-325 replacement applications, the existing CT200 current sensor will typically have to be replaced. However, where replacement is not necessary or possible, the CT200 can be connected to either the 1- or 5-A input. This CT has a 200:5 current ratio. If connected to the 1-A input, the ground-fault trip level will be a percentage of 40 A. See Section 2.1.2.

The accuracy of a typical current sensor, including the CT200, decreases below 5% of its current rating. CT-primary current-injection testing is recommended to verify trip levels below 5% of the CT-primary rating. See Section 9.4. Littelfuse Startco current sensors are designed for use at low levels and respond linearly to 2% current rating.

NOTE: The current-sensor insulation class is of no consequence if its secondary is grounded and the conductors through its window are insulated for the system voltage. Medium-voltage systems may require a bushing-type CT.

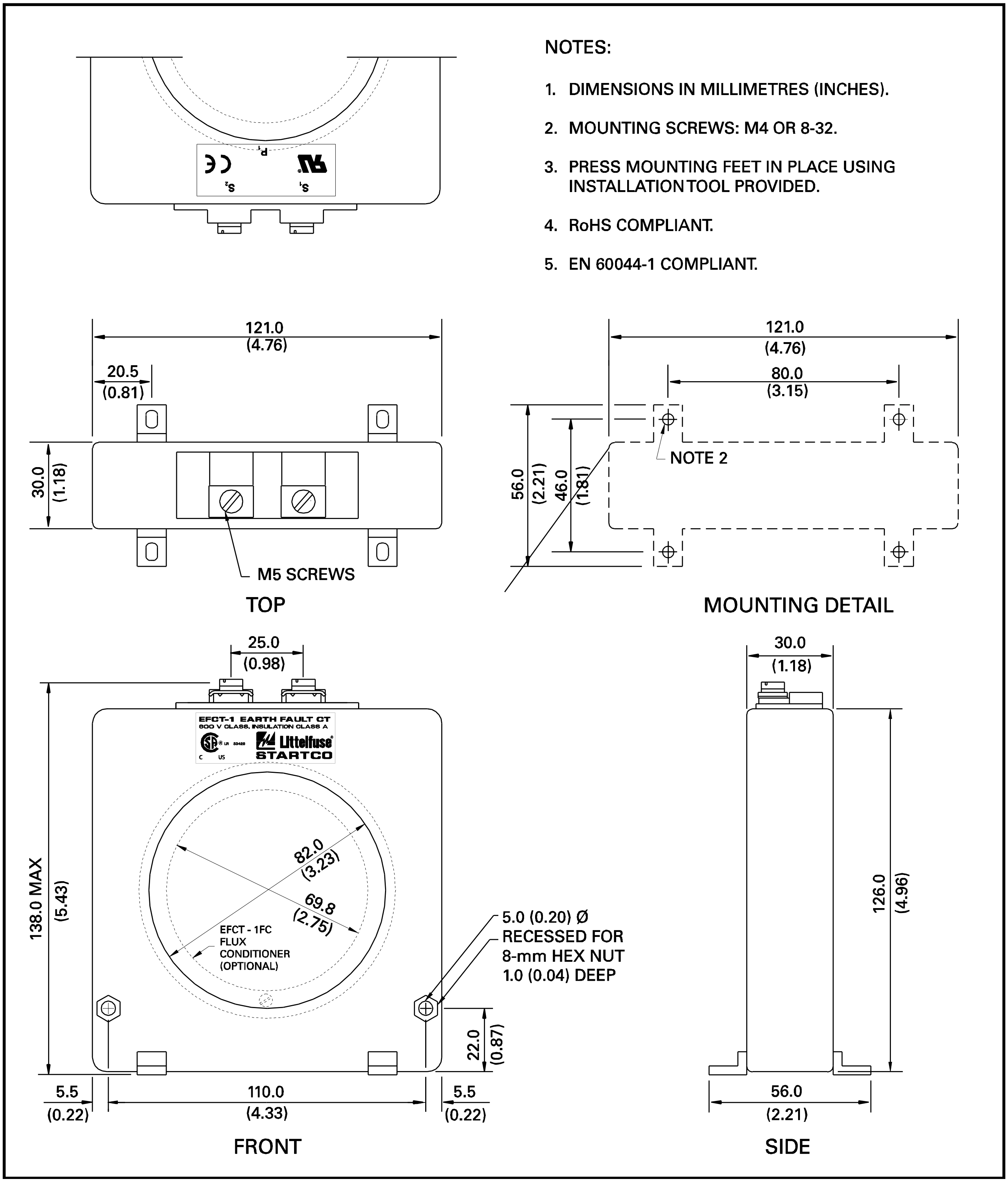


FIGURE 16. EFCT-1 Ground-Fault Current Sensor.