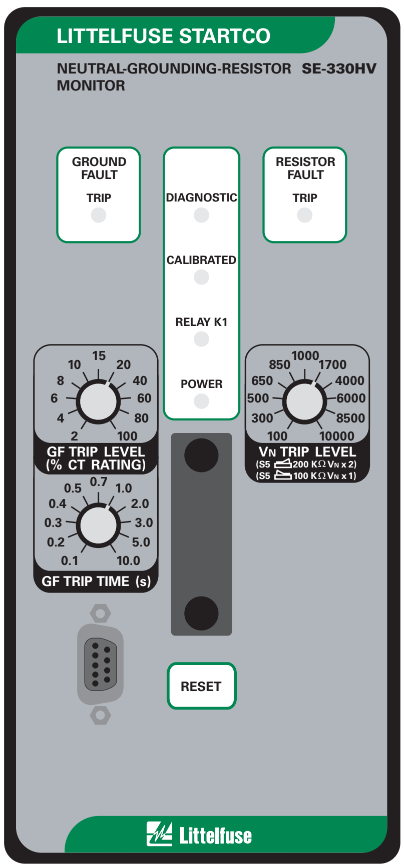
Littelfuse®
STARTCO

3714 Kinnear Place Saskatoon, SK Canada S7P 0A6 Ph: (306) 373-5505 Fx: (306) 374-2245 www.littelfuse.com/relayscontrols

SE-330HV MANUAL

NEUTRAL-GROUNDING-RESISTOR MONITOR

REVISION 4-A-112913



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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.

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 ten 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 twelve 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-330HV NGR MONITORING

The SE-330HV is a microprocessor-based neutral-grounding-resistor monitor that detects NGR failures and ground faults in resistance-grounded systems. The SE-330HV measures NGR resistance, NGR current, and transformer or generator neutral-to-ground voltage. The components required to monitor an NGR are an SE-330HV, a 100- or 200-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-330HV NGR monitoring. These elements include single-phase grounding transformers, grounded-wye-primary PT's, and grounded-wye-primary power transformers.

The SE-330HV continuously measures NGR resistance in an unfaulted system, and 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-330HV 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-330HV measures neutral voltage. If neutral voltage exceeds the V_N TRIP LEVEL setting, and if NGR current is less than 5% of the CT rating, the SE-330HV 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-330HV has four output relays. Relay K1 is the trip relay. Relays K2 and K3 provide ground-fault and resistor-fault indication. K4 is a solid-state relay that provides UNIT HEALTHY indication. Relay K1 will operate on either a resistor fault or a ground fault, and it can be set to operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications.

Additional features include LED trip indication, trip memory, front-panel and remote reset, 4–20-mA analog output, RS-232 local communications, data logging, and optional network communications.

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-330HV 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, 4, 6, 8, 10, 15, 20, 40, 60, 80, or 100) of the CT-primary rating. Inputs are provided for 5-, 1-, and 0.05-A-secondary CT's. Typical values for 15-, 25-, and 100-A tripping systems are shown in Table 1. Ground-fault trip levels for selected CT's are shown in Table 2. Refer to the NGR Monitor Set-Point Assistant at www.littelfuse.com/protectionrelays for other systems.

2.1.3 V_N TRIP LEVEL

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

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. The V_N TRIP LEVEL range is 100 to 10,000 V with switch S5 in the 100-kΩ (Vx1) position, and the range is 200 to 20,000 V with switch S5 in the 200-kΩ (Vx2) position. See Fig. 1 and Section 2.1.4.5.

If neutral voltage is greater than the V_N TRIP LEVEL setting for 12 seconds and ground-fault current is less than 5% of the CT rating, the SE-330HV 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.

Typical values for 15-, 25- and 100-A tripping systems are shown in Table 1. Refer to the NGR Monitor Set-Point Assistant at www.littelfuse.com/protectionrelays for other systems.

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	Neutral-Grounding Resistor		Sensing Resistor		Ground-Fault Trip Level	V_N Trip Level
	Current	Resistance	Model	Resistance		
(Volts)	(Amperes)	(Ohms)		(Switch S5 Setting)	(Amperes)	(Volts)
7,200	15	277	ER-15KV	100 kΩ	3.0	850
14,400	15	554	ER-15KV	100 kΩ	3.0	1,700
7,200	25	166	ER-15KV	100 kΩ	5.0	850
14,400	25	332	ER-15KV	100 kΩ	5.0	1,700
25,000	25	577	ER-25KV	100 kΩ	5.0	4,000
35,000	25	808	ER-35KV	100 kΩ	5.0	6,000
72,000	100	420	ER-72KV	200 kΩ	20.0	6,000 x 2 = 12,000

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

GF TRIP LEVEL (%)	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
15	0.75	4.50	7.5	15	30	60
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

* Setting not recommended.

2.1.4 CONFIGURATION SETTINGS

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

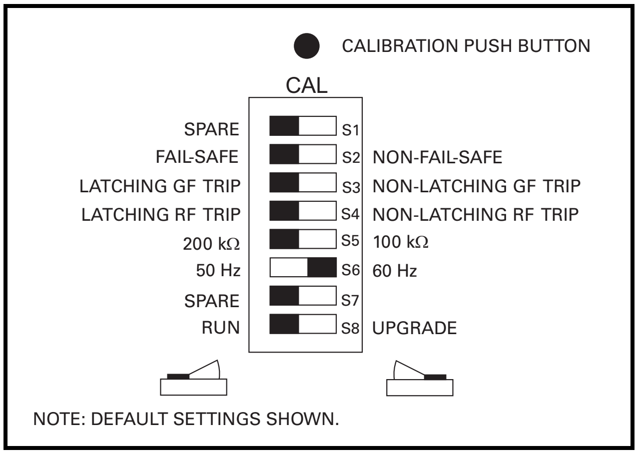


FIGURE 1. Configuration Switches.

2.1.4.1 SPARE (S1)

2.1.4.2 TRIP-RELAY MODE AND TRIP MEMORY (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-330HV 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-330HV trips are not reset when supply voltage is cycled.

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

2.1.4.3 GROUND-FAULT-TRIP LATCH (S3)

Set switch S3 to select latching or non-latching ground-fault-circuit operation. See Section 2.3.

2.1.4.4 RESISTOR-FAULT-TRIP LATCH (S4)

Set switch S4 to select latching or non-latching resistor-fault-circuit operation. See Section 2.3

2.1.4.5 SENSING-RESISTOR SELECTION (S5)

Set switch S5 to the resistance of the sensing resistor. For the ER-15KV, ER-25KV, and ER-35KV, select 100 kΩ. For the ER-72KV select 200 kΩ. Switch S5 sets the resistor-fault trip value and the V_N TRIP LEVEL range. See Section 2.1.3.

2.1.4.6 FREQUENCY (S6)

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

2.1.4.7 SPARE (S7)

2.1.4.8 UPGRADE ENABLE (S8)

Set switch S8 to RUN for normal operation or to UPGRADE to enable firmware upgrades. Changes in switch S8 settings are recognized only when supply voltage is cycled. Protection is disabled after supply voltage is cycled with S8 in the UPGRADE position. See Section 4.1.3.

2.2 CALIBRATION

The SE-330HV measures the resistance change of the NGR relative to the NGR-resistance value determined at the time of calibration. Calibrate the SE-330HV on new installations, if the NGR is changed, or if the sensing resistor is changed.

NOTE: If the SE-330HV is not calibrated and is supplied from the load side of the breaker (non-fail-safe mode), calibrate within 12 seconds of power-up or it may trip and interrupt its supply.

The CALIBRATION push 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-330HV connected to the sensing resistor and NGR of the installed system.

To calibrate, press and hold the CALIBRATION push 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 2.7.

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 Trip Indication and Reset

Red LED's and indication relays indicate ground-fault and resistor-fault trips—indication relays K2 and K3 are energized on trip. When a trip occurs with latching operation selected, the SE-330HV remains tripped until reset. See Sections 2.1.4.3 and 2.1.4.4. 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 switch does not prevent a trip. The front-panel RESET switch 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. Automatic reset time is 2.8 s maximum.

The red DIAGNOSTIC LED annunciates latched calibration-error and remote trips. See Section 2.7.

When supply voltage is applied with switch S2 set to FAIL-SAFE, the SE-330HV returns to its state prior to loss of supply voltage. When supply voltage is applied with switch S2 set to NON-FAIL-SAFE, SE-330HV 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 can take up to 3 s after SE-330HV power up.

2.4 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. 18. Connect them as shown in Fig. 3. RK-332 components are not polarity sensitive.

Network-enabled SE-330HV’s can be remotely tripped and reset by the network master. The red DIAGNOSTIC LED indicates a network-initiated trip. See Section 2.7. Refer to the appropriate SE-330 communications manual.

2.5 Relay K1 LED

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

2.6 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 output changes state momentarily during a processor reset.

NOTE: K4-contact rating is 100 mA maximum.

2.7 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.

Calibration-Error Trip (1 short):
The calibration resistance of the NGR is outside the calibration range. See Section 6.1.

Remote Trip (2 short):
The SE-330HV has been tripped by a remote-trip command from the communications interface.

EEPROM-Error Trip (3 short):
An EEPROM error has been detected.

A/D-Converter-Error Trip (4 short):
An A/D-converter error has occurred.

Software-Interrupt Trip (5 short):
CPU reset was caused by a software interrupt.

Illegal-Opcode Trip (6 short):
CPU reset was caused by an illegal Opcode.

Watchdog Trip (7 short):
CPU reset was caused by the watchdog.

Clock-Failure Trip (8 short):
CPU reset was caused by an internal clock failure.

CPU Trip (9 short):
This code is displayed if the supply is cycled after one of the previous four errors occurred.

Resistor-fault trips occur with all of the above trips. Ground-fault trips occur with all of the above trips except the calibration-error trip and the A/D-converter-error trip.

See Troubleshooting Section 5.

2.8 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.

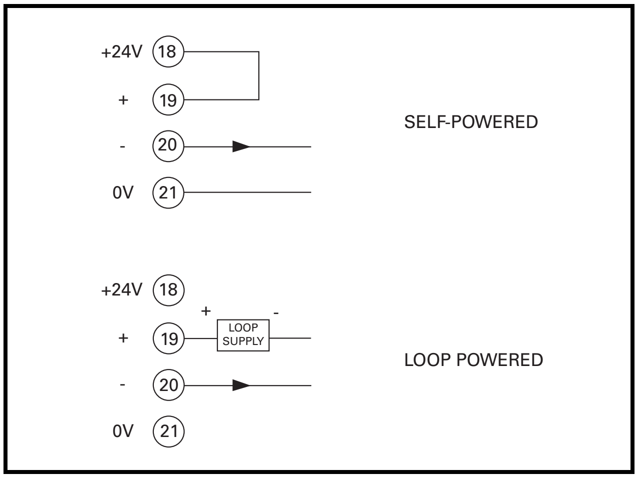


FIGURE 2. Analog-Output Connections.

3. INSTALLATION

3.1 SE-330HV

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

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

Outline dimensions and mounting details for surface mounting the SE-330HV are shown in Fig. 5. Fasten the 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-330HV.

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. Connect terminal 4 (SPG) to terminal 5 (SPGA). Remove the terminal-4-to-5 connection for dielectric-strength testing.

NOTE: When the terminal-4-to-5 connection is removed, protective circuits inside the SE-330HV are disconnected to allow dielectric strength testing of a control panel without having to disconnect wiring to the SE-330HV. Ensure that the terminal-4-to-5 connection is replaced after testing.

3.2 SENSING RESISTOR

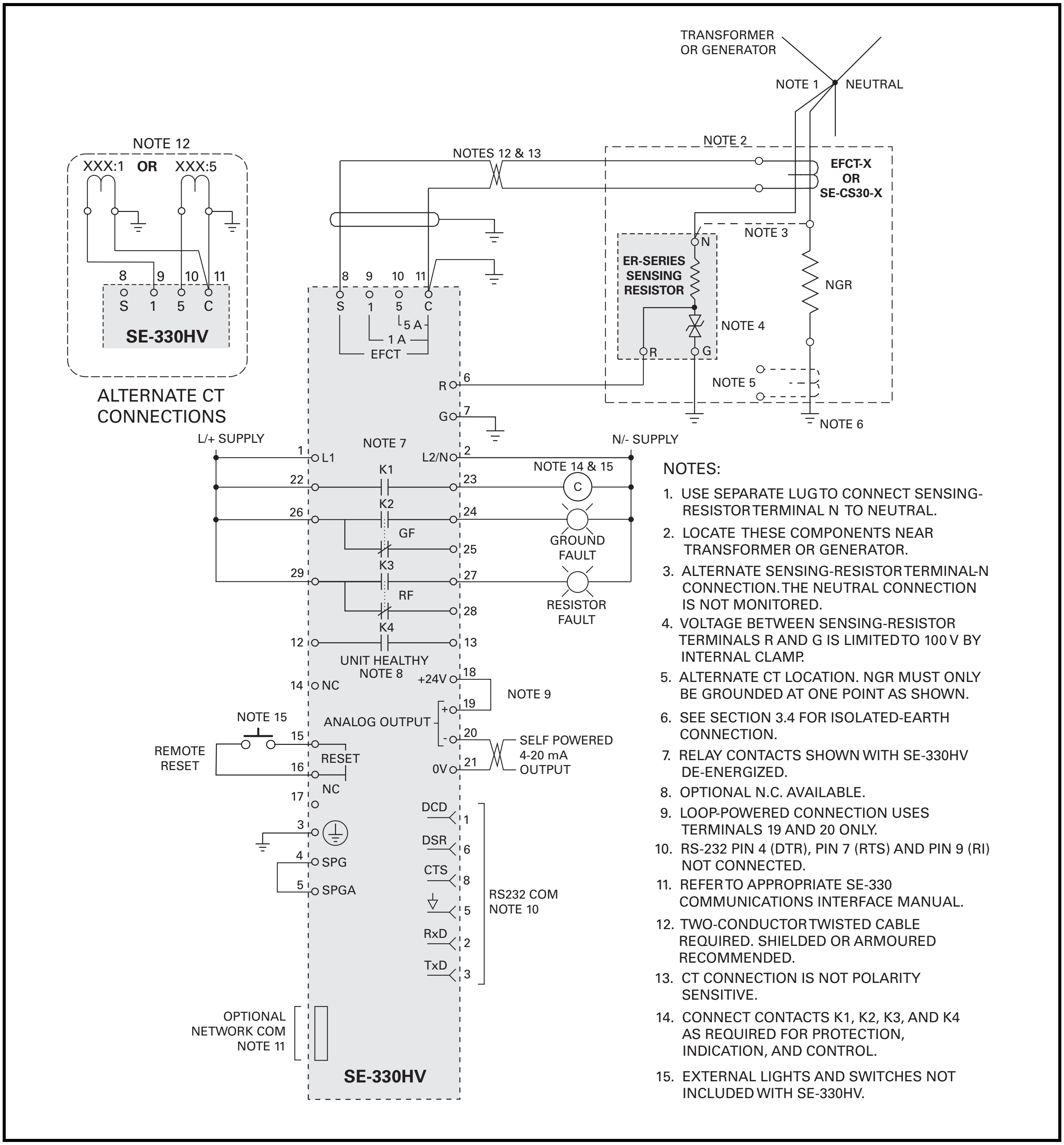
Outline and mounting details for ER-15KV, ER-25KV, ER-35KV and ER-72KV sensing resistors are shown in Figs. 8, 9, 10, 11 and 12. Locate the NGR and the sensing resistor near the transformer or generator. When located outdoors, a sensing resistor must be installed in a suitable enclosure. Ground sensing-resistor 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.

Outline and mounting details for the ER-1000HV Sensing Resistor are shown in Fig. 13. This sensing resistor can be used to monitor a low-voltage very-high-resistance NGR. See the simplified diagram in Fig. 14.

CAUTION: 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. Sensing-resistor terminal R and its connection to SE-330HV terminal R, including interposing terminal blocks, must remain dry.

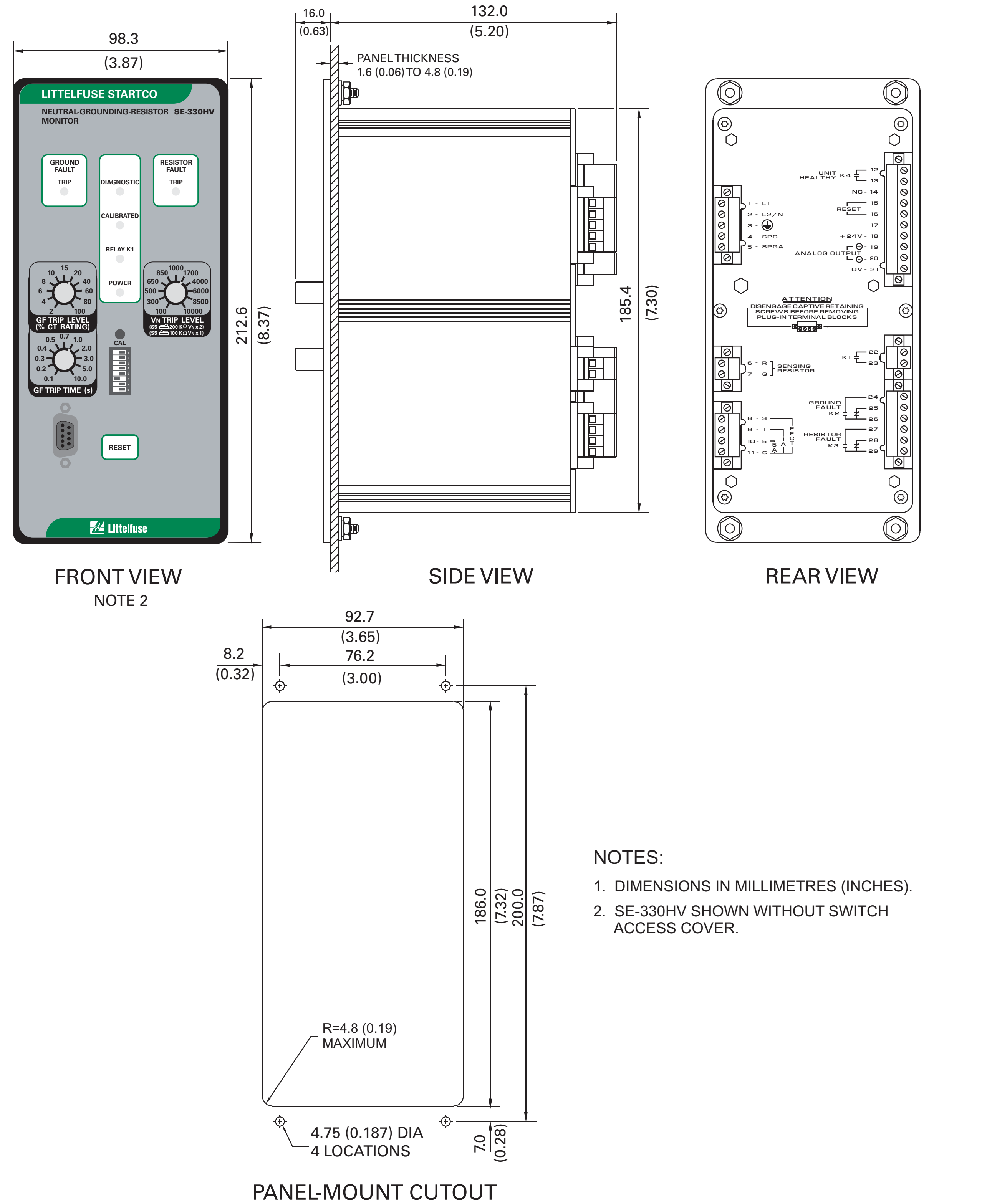
NOTE: The neutral-to-sensing-resistor-terminal-N connection is not a neutral conductor as defined in Canadian Electrical Code Section 10-1108 and National Electrical Code Section 250.36(B). It is not required to be 8 AWG or larger. Since current through this conductor is always less than 250 mA, a 14 AWG conductor insulated to the system voltage is more than sufficient.



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. ALTERNATE CT LOCATION. NGR MUST ONLY BE GROUNDED AT ONE POINT AS SHOWN.
6. SEE SECTION 3.4 FOR ISOLATED-EARTH CONNECTION.
7. RELAY CONTACTS SHOWN WITH SE-330HV DE-ENERGIZED.
8. OPTIONAL N.C. AVAILABLE.
9. LOOP-POWERED CONNECTION USES TERMINALS 19 AND 20 ONLY.
10. RS-232 PIN 4 (DTR), PIN 7 (RTS) AND PIN 9 (RI) NOT CONNECTED.
11. REFER TO APPROPRIATE SE-330 COMMUNICATIONS INTERFACE MANUAL.
12. TWO-CONDUCTOR TWISTED CABLE REQUIRED. SHIELDED OR ARMOURED RECOMMENDED.
13. CT CONNECTION IS NOT POLARITY SENSITIVE.
14. CONNECT CONTACTS K1, K2, K3, AND K4 AS REQUIRED FOR PROTECTION, INDICATION, AND CONTROL.
15. EXTERNAL LIGHTS AND SWITCHES NOT INCLUDED WITH SE-330HV.

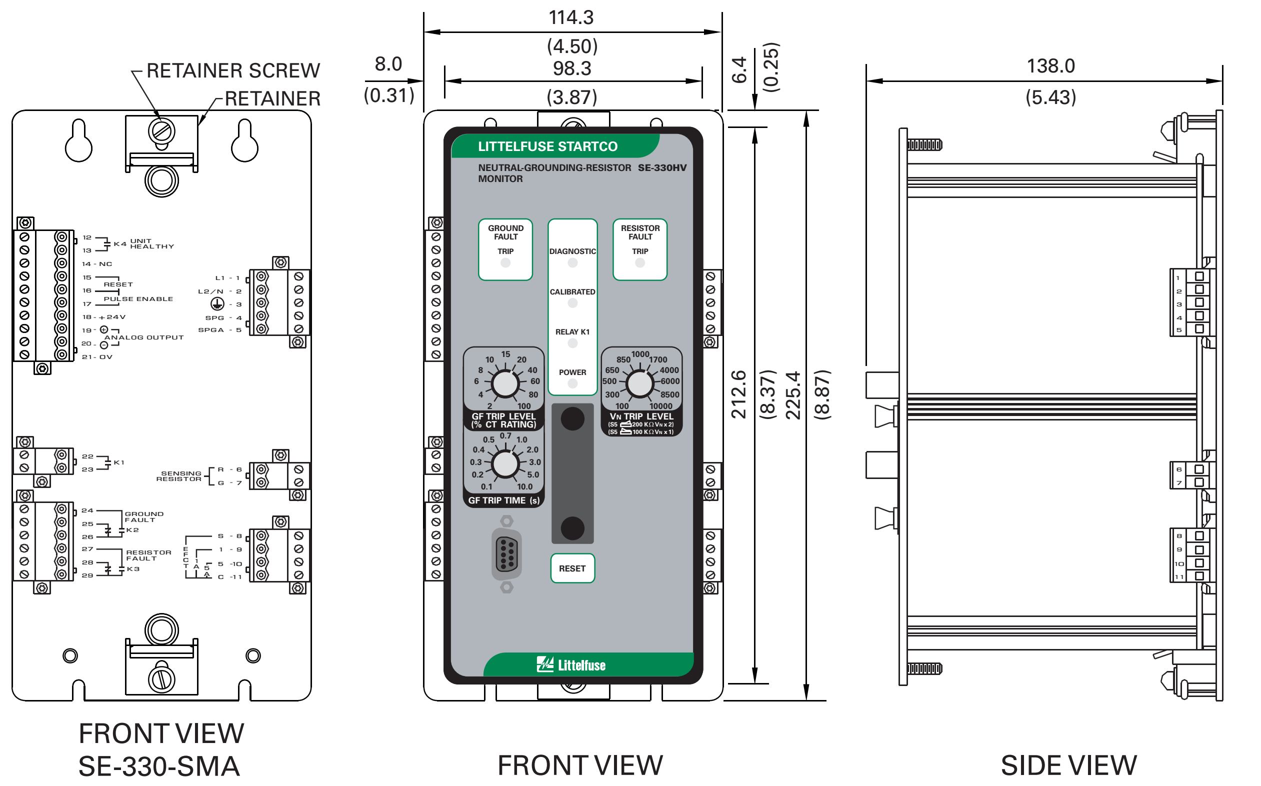
FIGURE 3. SE-330HV Connection Diagram.

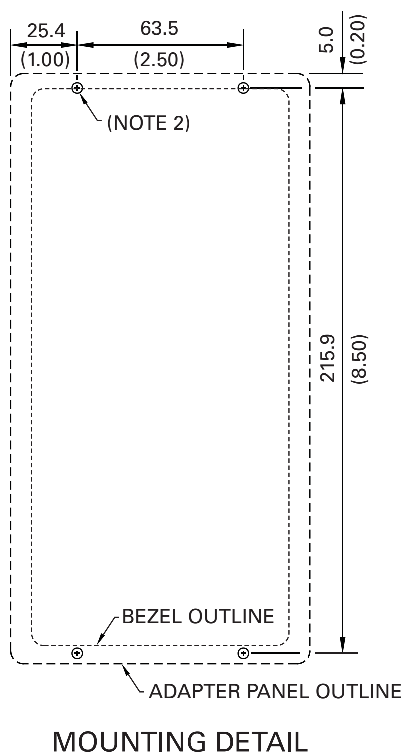


NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. SE-330HV SHOWN WITHOUT SWITCH ACCESS COVER.

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





NOTES:

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

MONITOR 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.

MONITOR REMOVAL

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

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

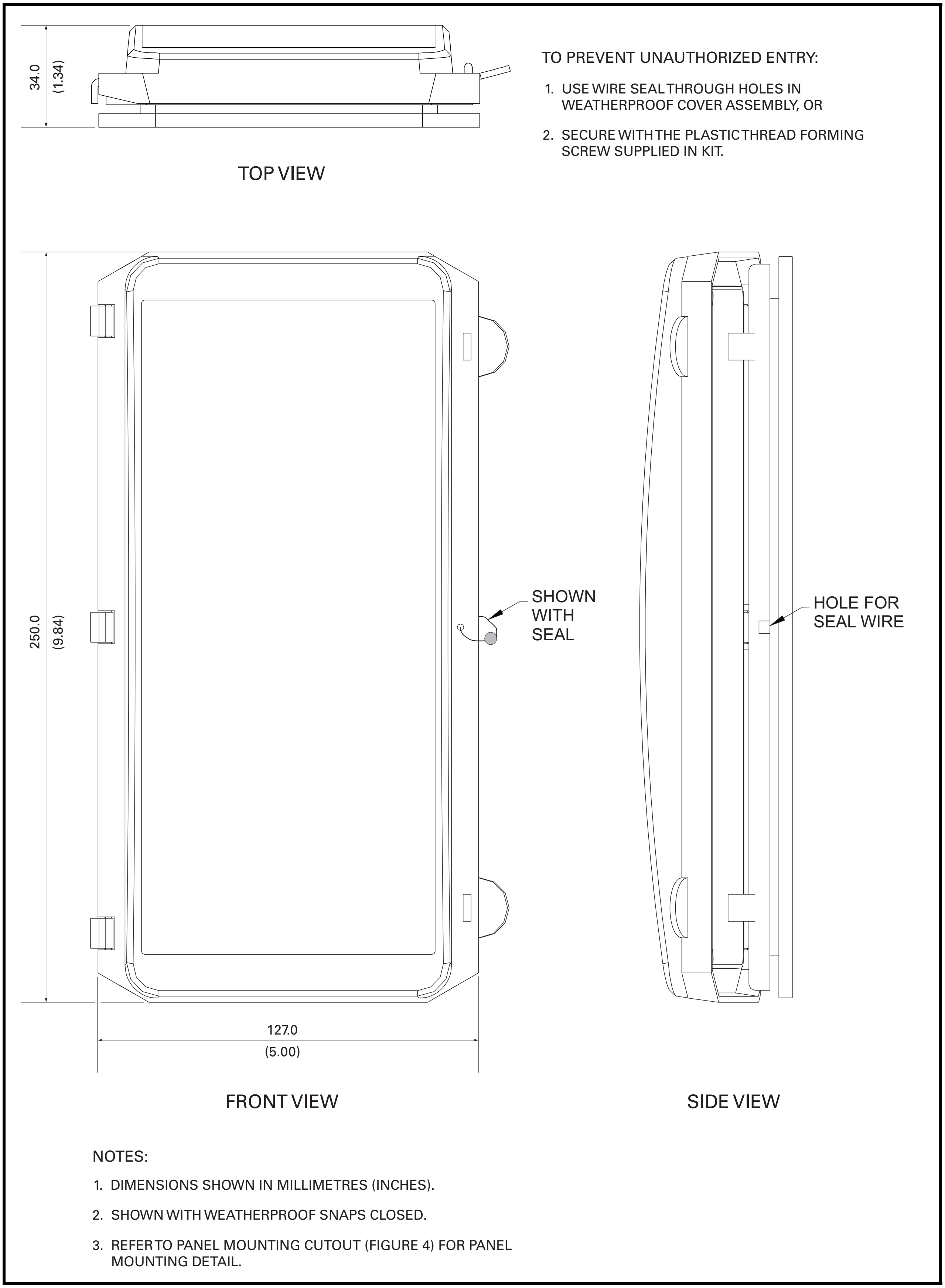


FIGURE 6. SE-IP65CVR-G Weatherproof Cover Outline.

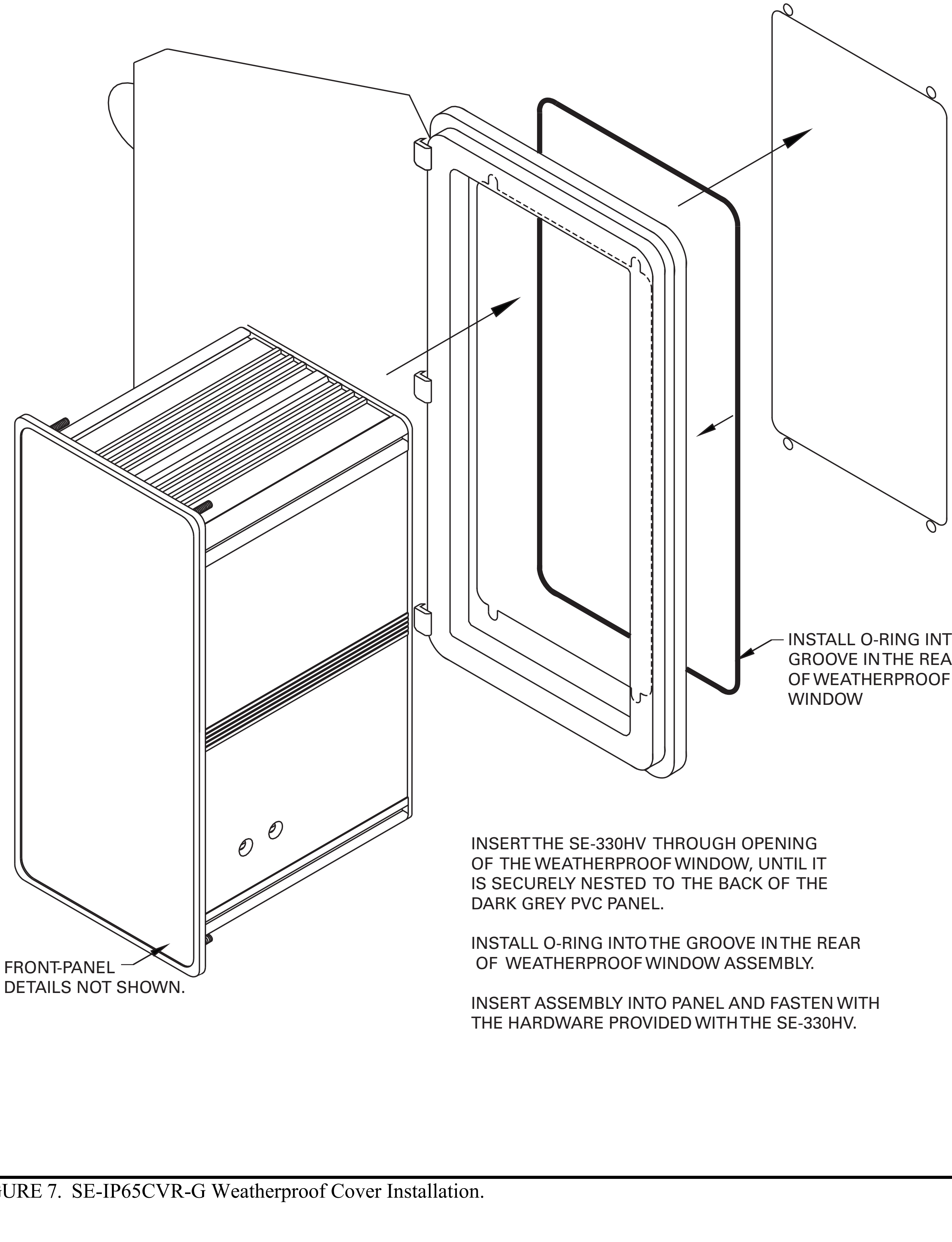


FIGURE 7. SE-IP65CVR-G Weatherproof Cover Installation.

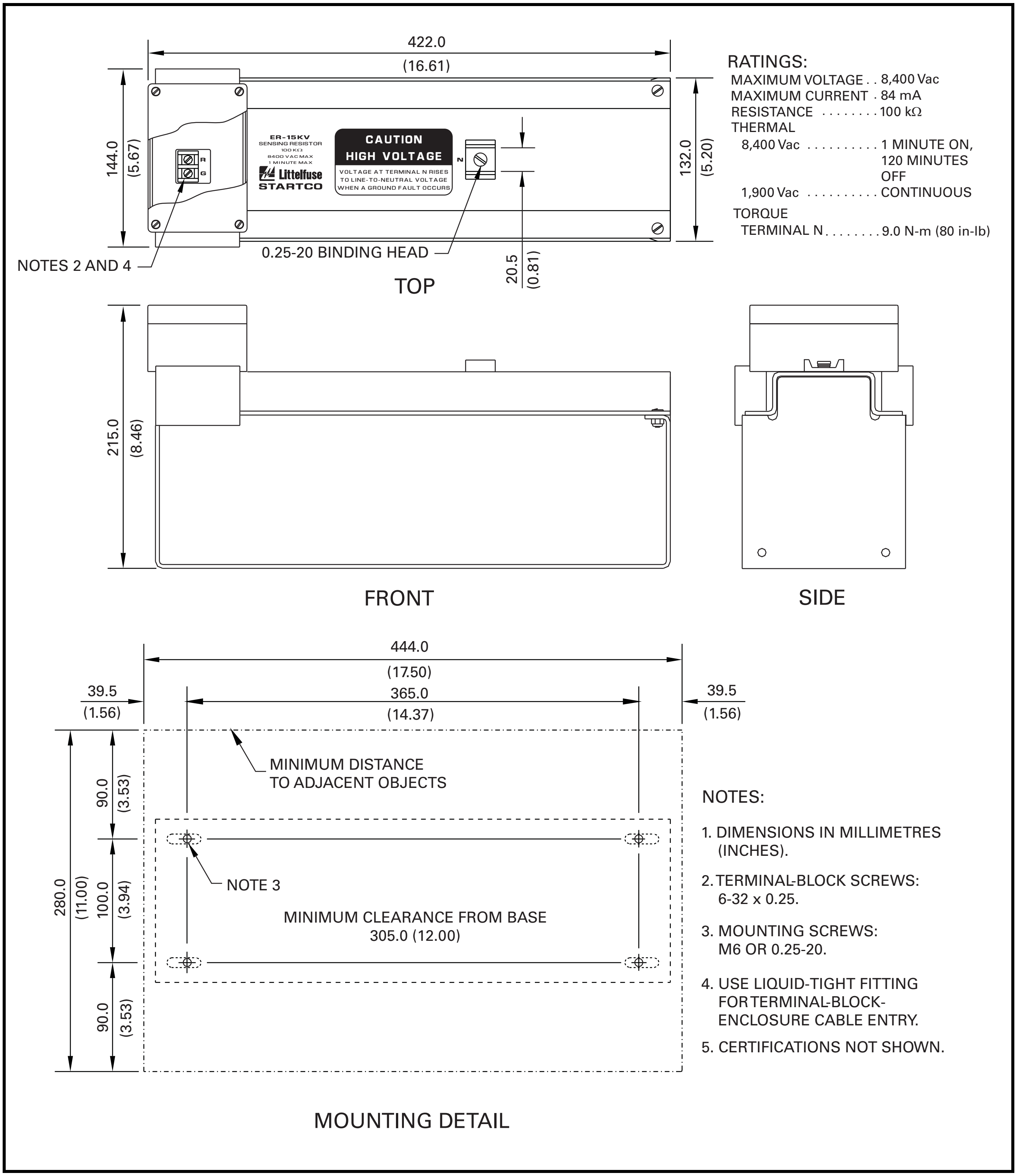


FIGURE 8. ER-15KV Sensing Resistor.

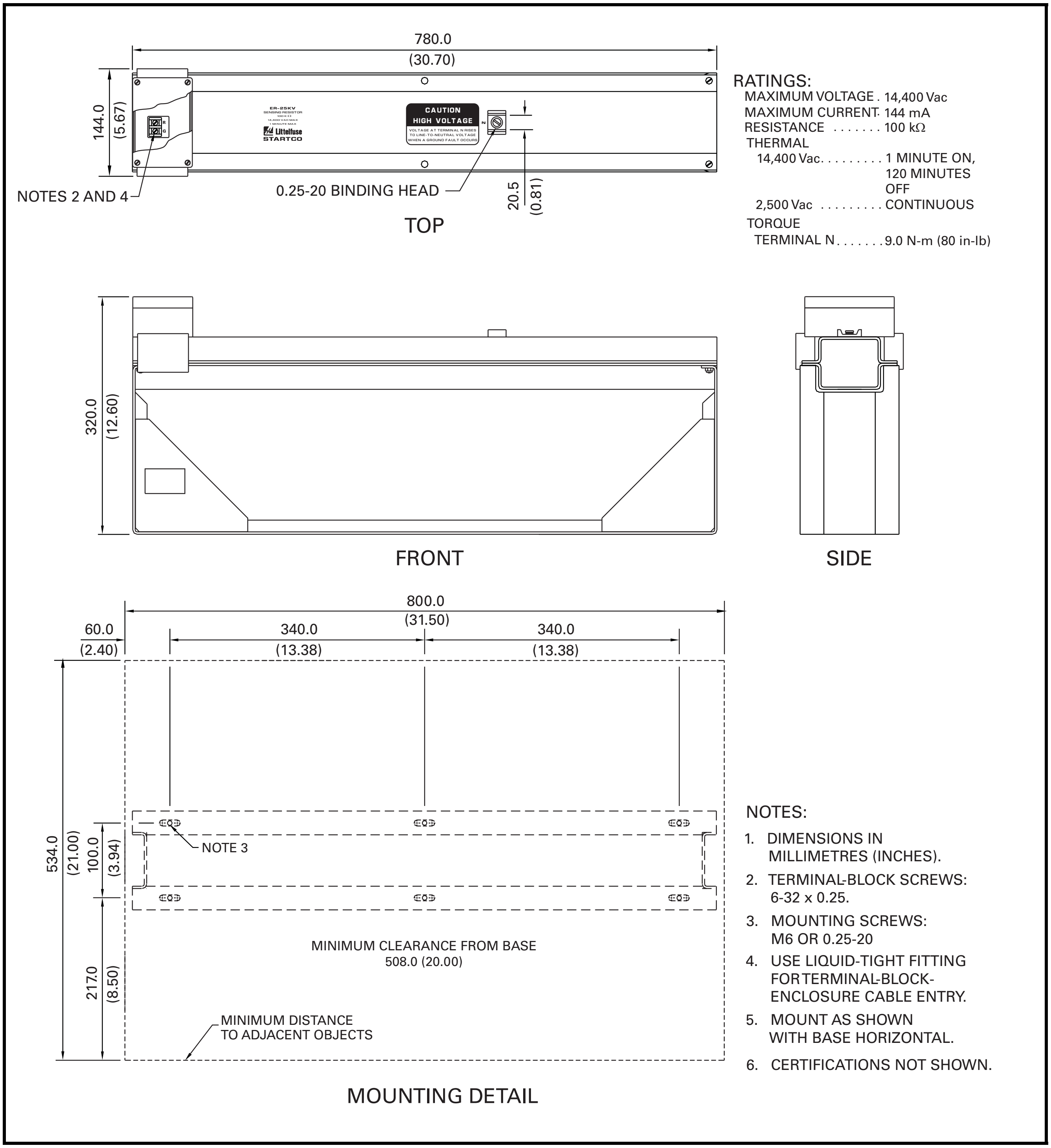
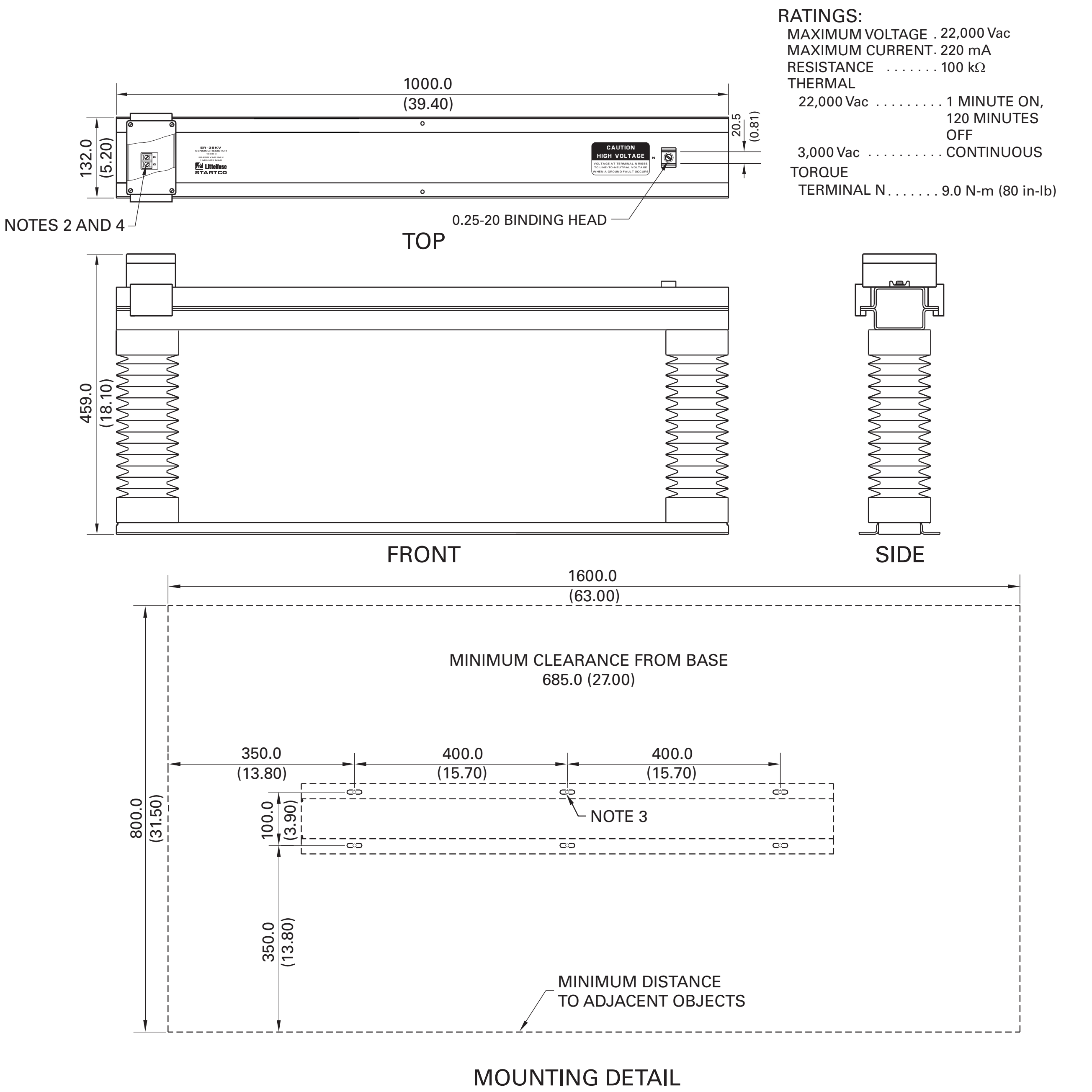


FIGURE 9. ER-25KV Sensing Resistor.



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 10. ER-35KV Sensing Resistor.

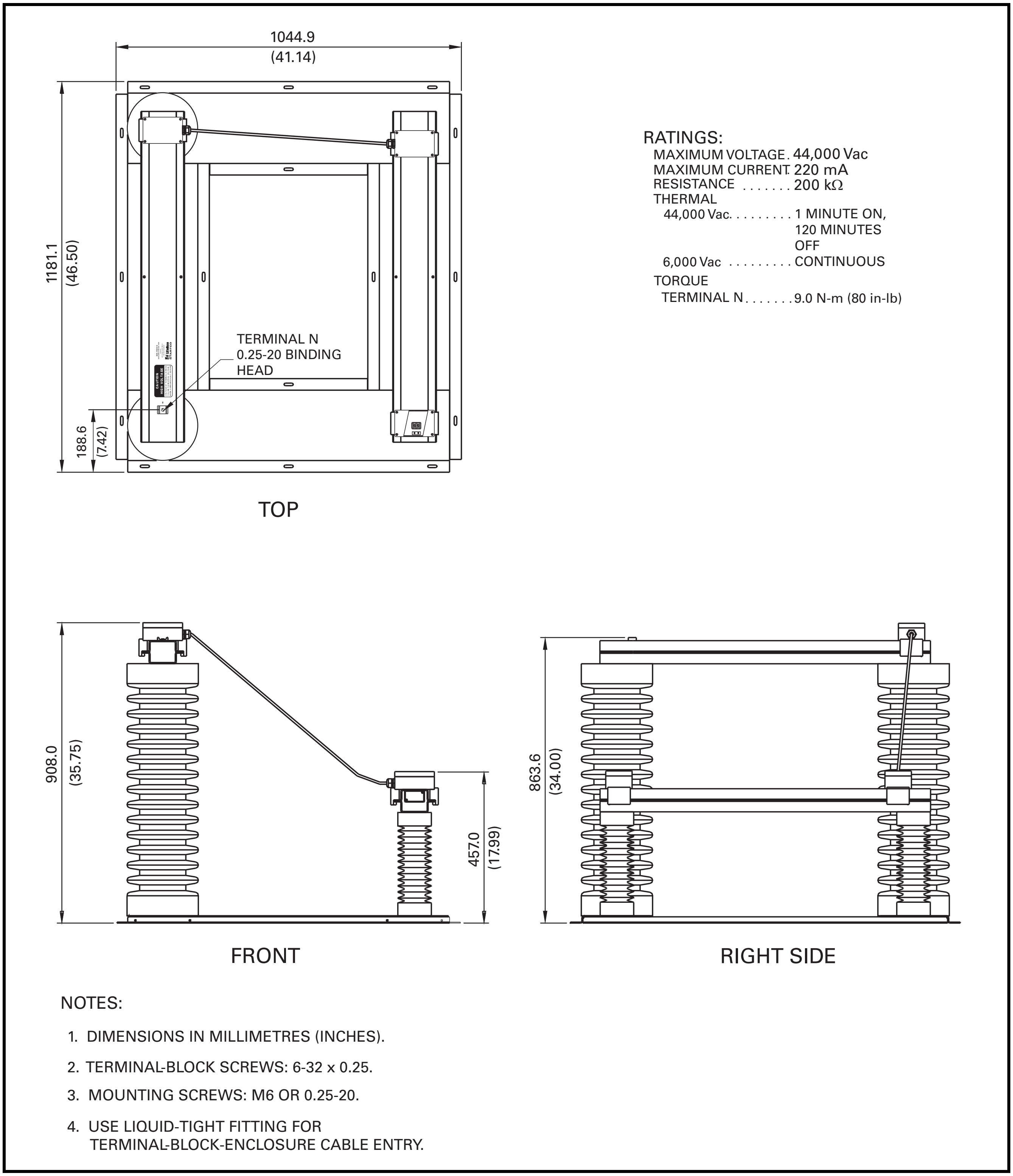
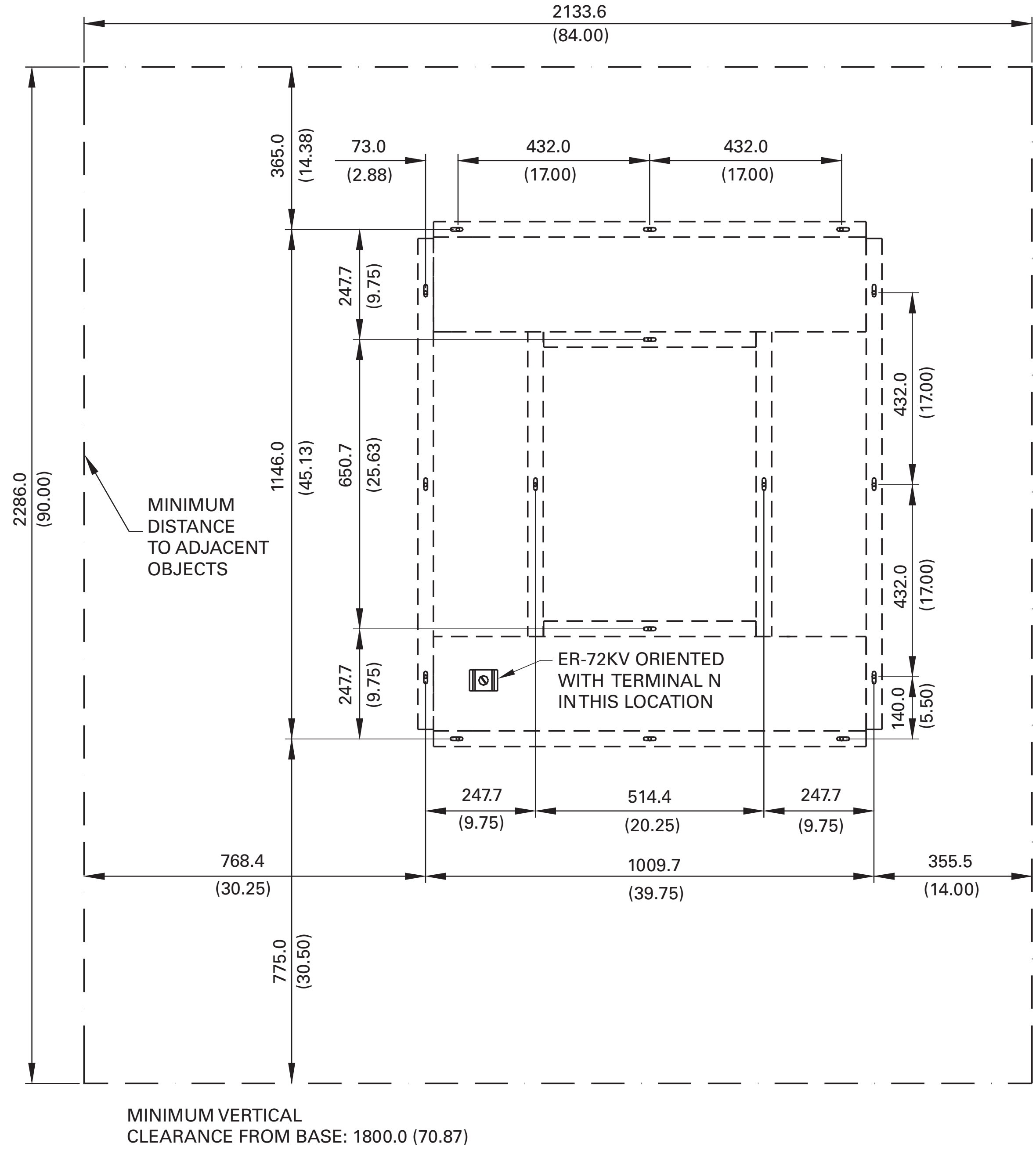


FIGURE 11. ER-72KV Sensing Resistor Outline.



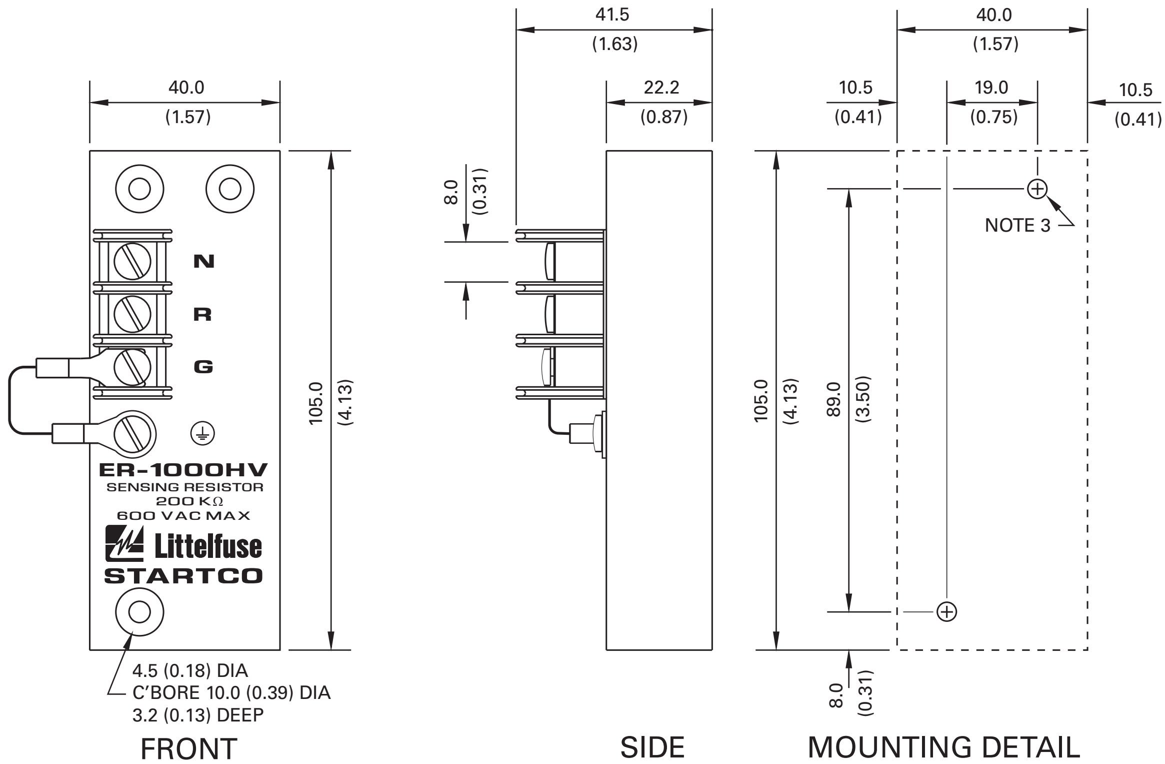
NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M6 OR 0.25-20.

FIGURE 12. ER-72KV Sensing Resistor Mounting Details.

RATINGS:

MAXIMUM VOLTAGE . 600 Vac
MAXIMUM CURRENT. 3 mA
RESISTANCE .... 200 kΩ
THERMAL .... CONTINUOUS



NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. TERMINAL-BLOCK SCREWS: 6-32 x 0.25.
3. MOUNTING SCREWS: M4 OR 8-32.
4. 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.

FIGURE 13. ER-1000HV Sensing Resistor

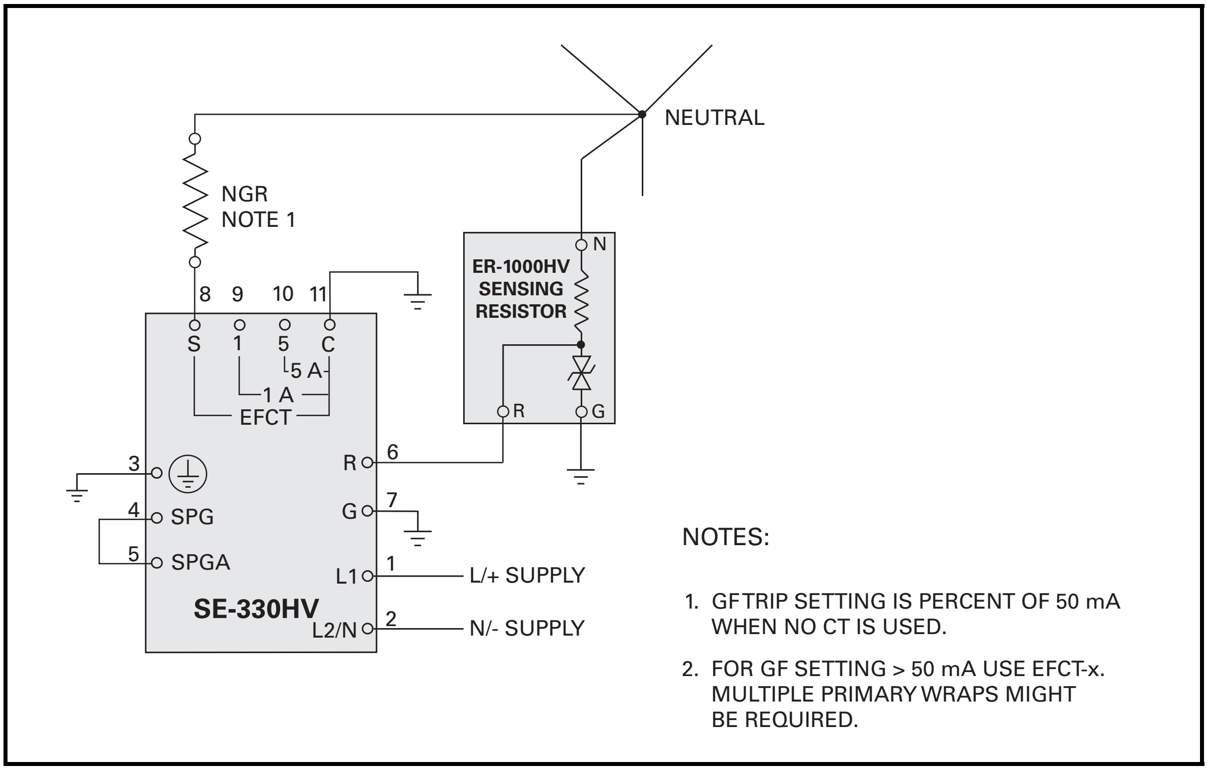


FIGURE 14. ER-1000HV Simplified Connection Diagram.

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 approximately equal 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 2.8.

Outline and mounting details for the EFCT- and SE-CS30-series current sensors are shown in Figs. 15, 16, and 17. Ground-fault-CT connections and the preferred ground-fault-CT location are shown in Fig. 3. If a ground fault in the NGR is unlikely, a minimal loss of protection will result if the ground-fault CT monitors the NGR connection to ground rather than its connection to neutral. A minimal loss of protection will also result if the sensing-resistor-to-neutral connection does not pass through the CT window. This alternate CT location is shown in Fig. 3.

The accuracy of a typical current transformer 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-transformer insulation class is of no consequence if its secondary is grounded and the conductors through its window are insulated for the system voltage. Bushing type CT's are required for applications using bare conductors on the NGR's neutral side.

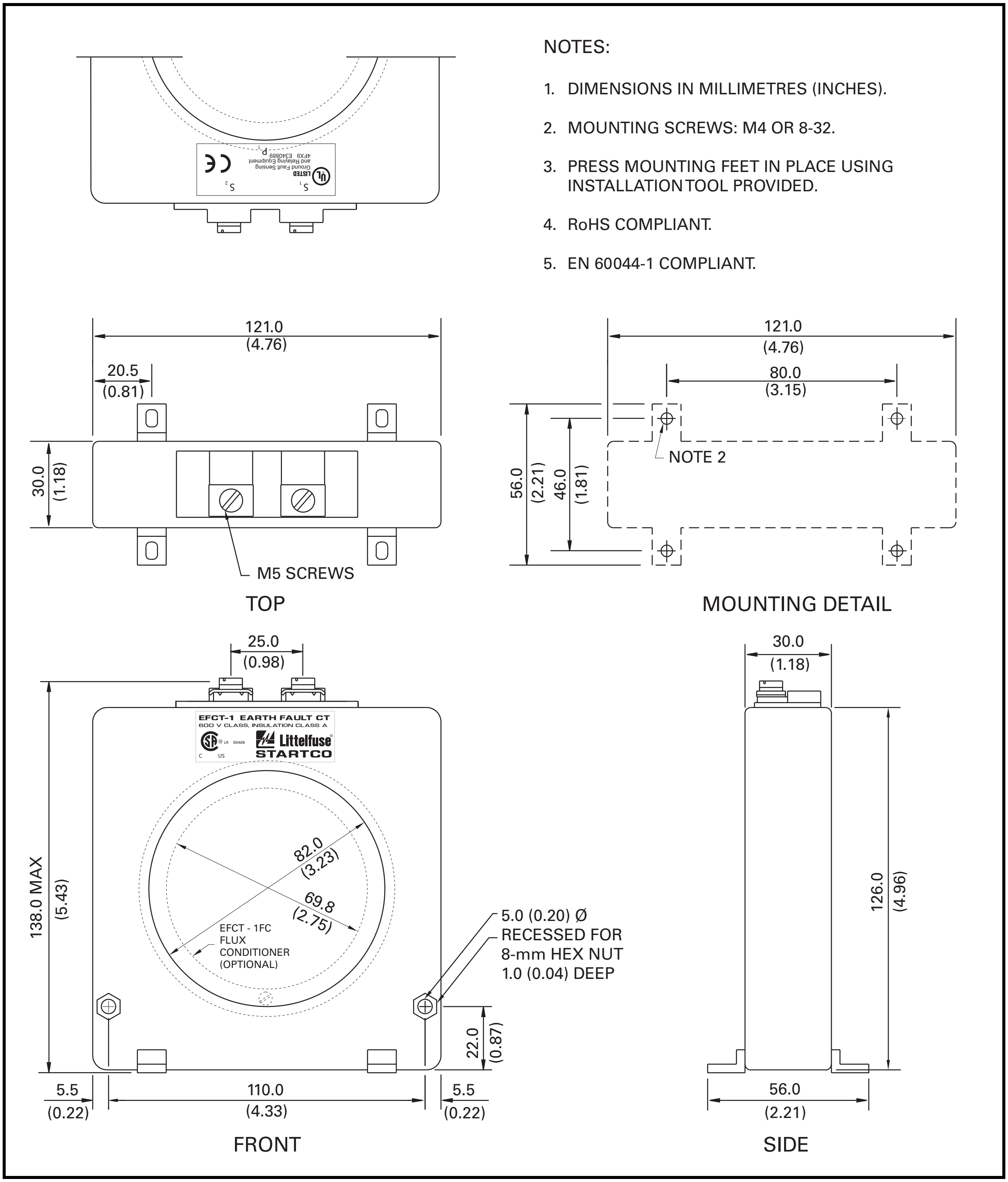


FIGURE 15. EFCT-1 Ground-Fault Current Sensor.

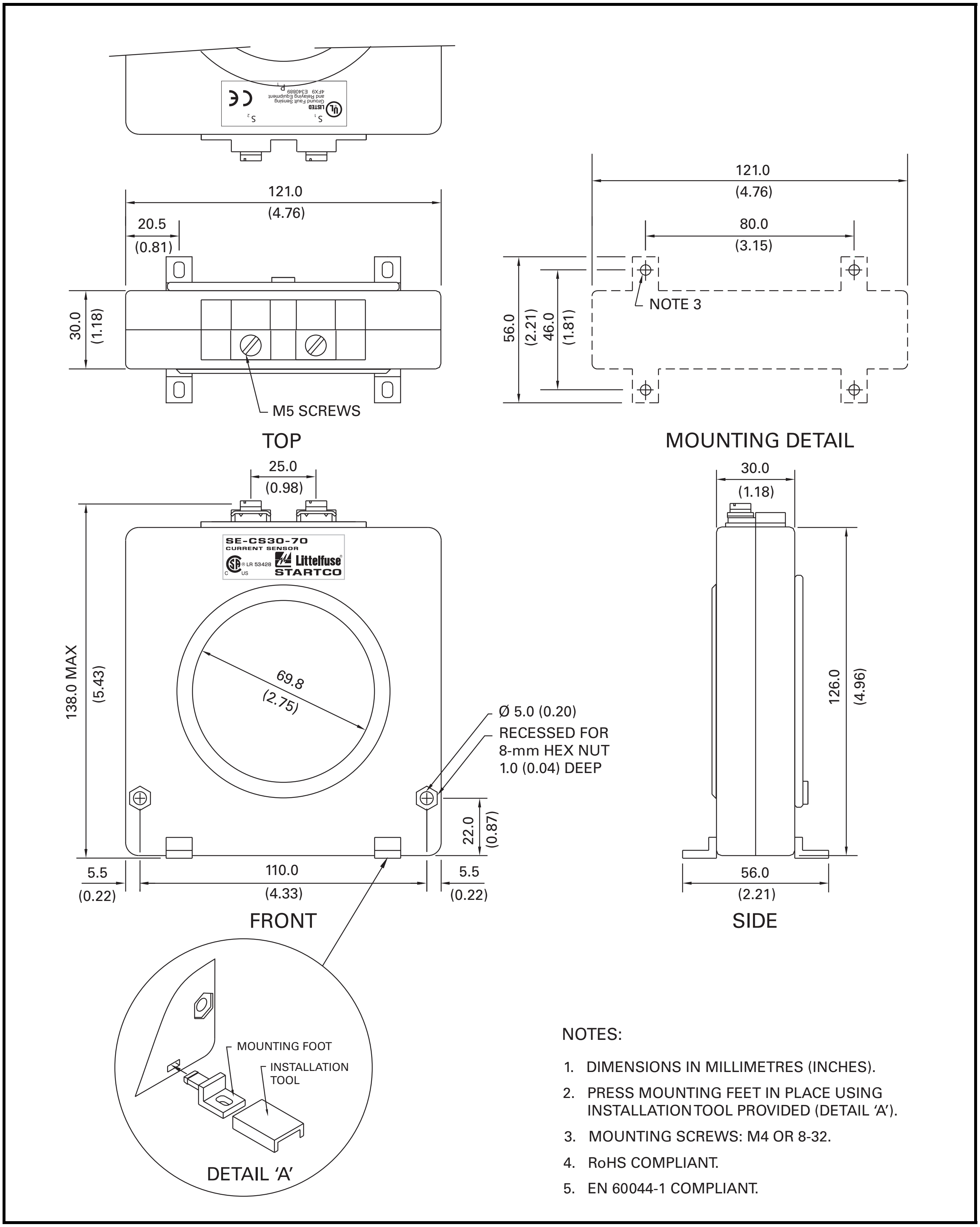


FIGURE 16. SE-CS30-70 Ground-Fault Current Sensor.

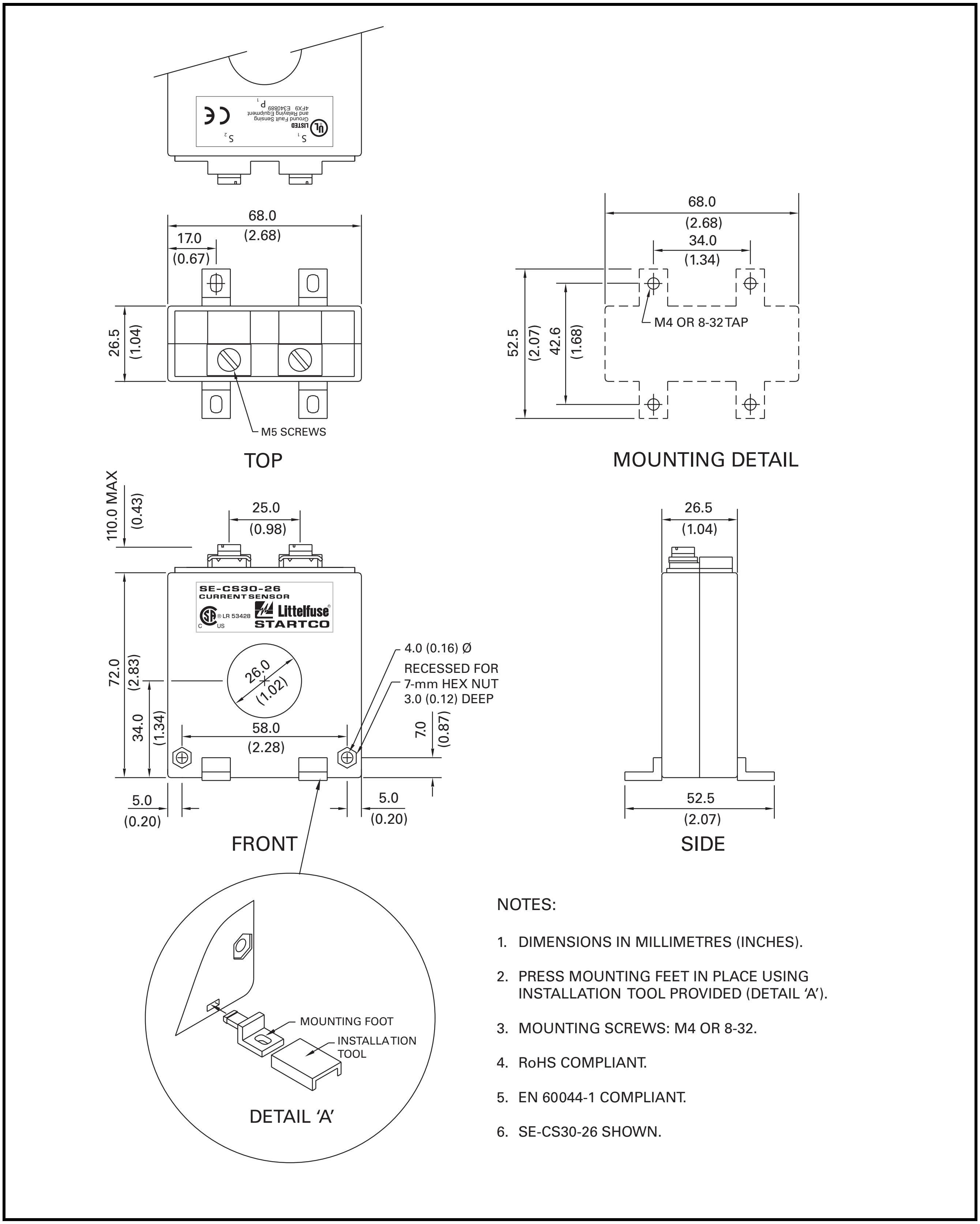


FIGURE 17. EFCT-26 and SE-CS30-26 Ground-Fault Current Sensors.

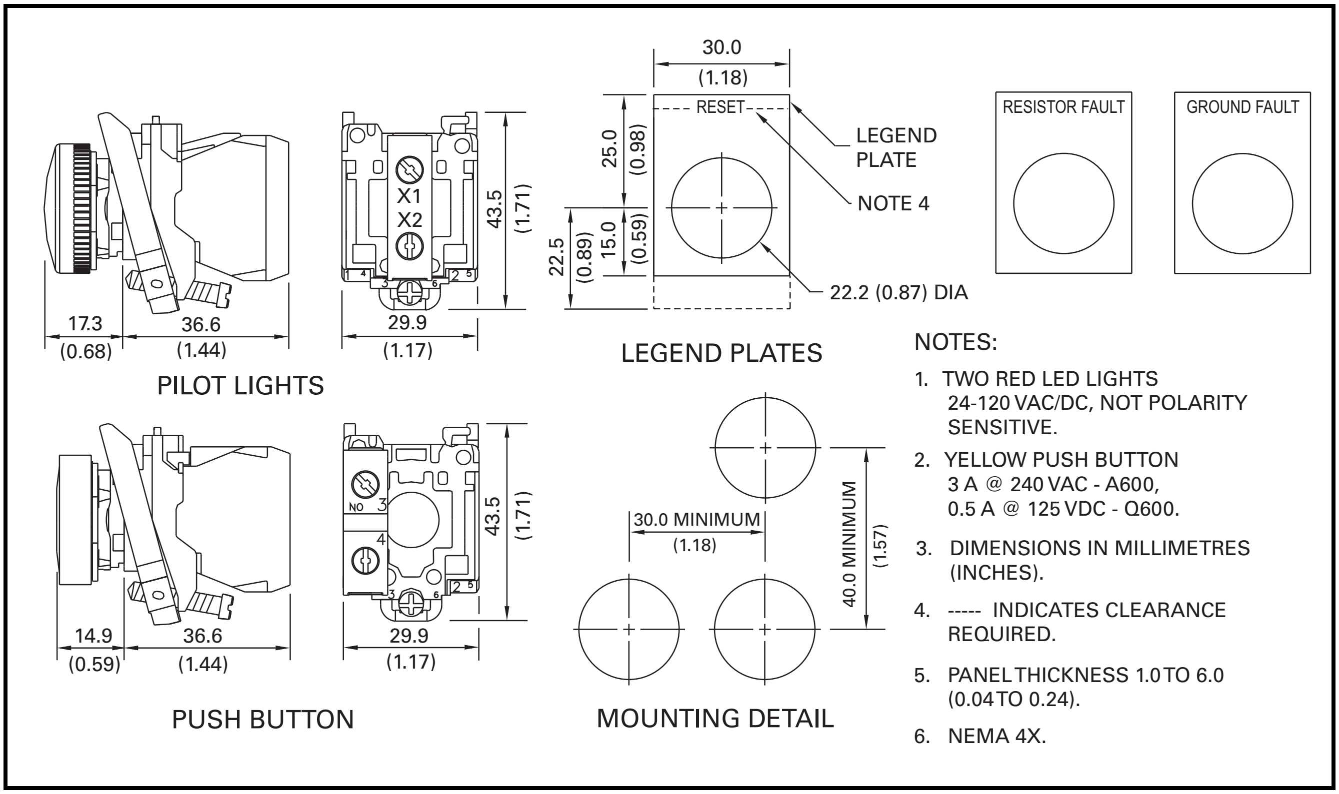


FIGURE 18. RK-332 Remote Indication and Reset.

3.4 Isolated Ground Connection

An isolated ground bed can prevent a ground potential rise (GPR) from being transferred to remote equipment. If the G terminals on the sensing resistor and the SE-330HV are connected to an isolated ground, the SE-330HV will be exposed to the GPR. If the GPR is greater than the terminal-block rating, the SE-330HV must be isolated from station ground and precautions must be taken with the power supply and the trip contacts. See Technical Note RG-1 “NGR Monitoring with Isolated Ground Beds” at www.littelfuse.com/protectionrelays.

An alternate configuration which allows an SE-330HV to be connected to station ground is shown in Fig. 19. The SE-330HV monitors the series combination of the NGR and the two ground beds. This configuration is acceptable provided the series resistance of the NGR and the ground beds is within the NGR calibration range and ground-bed-resistance changes remain within the trip range. See Section 6.1.

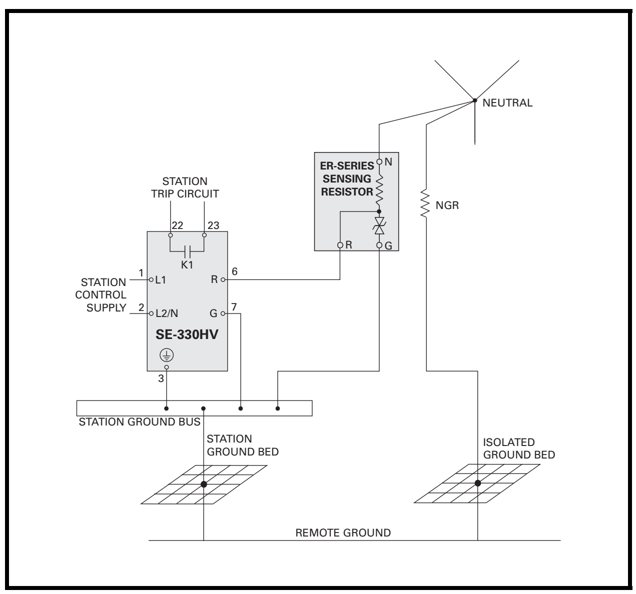


FIGURE 19. Simplified Isolated-Ground Connection.

4. COMMUNICATIONS

4.1 LOCAL COMMUNICATION PORT

The SE-330HV has an RS-232 local communications port which is designed for use with firmware-upgrade and system-monitoring software running on a PC.

The RS-232 port is non-isolated and operates as a DCE device with the connector (socket contacts) pin-out listed in Table 3. This port allows direct connection to a PC using standard DB-9 connector cables. Cable length should not exceed 10 metres.

TABLE 3. RS-232 DB-9 TERMINALS

PIN #	SIGNAL NAME	COMMENTS
1	DCD	470 Ω connected to +12 V
2	RD	Output to DTE from SE-330HV
3	TD	Input from DTE to SE-330HV
4	DTR	Not connected
5	SG	Signal Ground
6	DSR	470 Ω connected to +12 V
7	RTS	Not connected
8	CTS	470 Ω connected to +12 V
9	RI	Not connected

4.1.1 LOCAL DATA ACQUISITION

The SE-330HV outputs a data packet every second. Data output is in the standard UART data format of eight data bits and one stop bit. The baud rate is fixed at 38,400 bits per second. Use PC program SE-MON330 to display the following data:

- SE-330HV settings and switch states.
- Neutral voltage and current.
- Resistance change.
- Trip status.
- Pending trips.
- Relay and LED status.
- NGR calibration value.
  - Expected 100-kΩ value: R_{NGR} to (R_{NGR}-4,000)
  - Expected 200-kΩ value: R_{NGR} to (R_{NGR}-8,000)
- Firmware revision level.
- The last ten trip records. Each record contains the trip cause and the pre-trip NGR current, voltage, and resistance values.

Data can be logged to a PC file at user-defined time intervals for future analysis.

4.1.2 LOCAL COMMUNICATIONS COMMANDS

As of firmware revision 10, the SE-330HV supports basic commands through the local RS-232 communications port. Commands are input as standard ASCII characters. The latest revision of SE-MON330 supports the following commands:
‘d’ – Read event records.
‘c’ – Clear event records.

4.1.3 FIRMWARE UPGRADE

The local port can be used to upgrade the SE-330HV firmware. Upgrade procedure:

1) Remove supply voltage.
2) Set switch S8 to UPGRADE.
3) Apply supply voltage. The DIAGNOSTIC LED will be on and all relays will be de-energized.
4) Run SE-FLASH and follow the instructions.
5) Remove supply voltage.
6) Set switch S8 to RUN.
7) Apply supply voltage.

SE-MON330 and SE-FLASH are available at www.littelfuse.com/protectionrelays.

4.2 NETWORK COMMUNICATIONS

The SE-330HV interface for optional communications modules supports DeviceNet™, PROFIBUS®, and Ethernet:

DeviceNet™:
- DeviceNet Slave.
- DeviceNet specification Vol 1:2.0, Vol 2:20.

PROFIBUS®:
- PROFIBUS-DP Slave according to IEC 61158.

Ethernet:
- Modbus TCP Class 0, 1.
- Ethernet/IP Level 2 I/O Server CIP (ControlNet and DeviceNet)
- WebServer, on-board selection of IP address.

Communications options allow the user to:
- Read SE-330HV settings.
- Read neutral voltage and current.
- Read resistance change.
- Read trip status.
- Reset trips.
- Perform a remote trip.
- Access the last ten trip records. Each trip record contains the cause of trip and the pre-trip NGR current, voltage, and resistance values.
- Clear event records.

Refer to the appropriate SE-330 communications-interface manual.

5. TROUBLESHOOTING

PROBLEM	SOLUTION
POWER LED off.	Check if supply voltage is present on terminals 1 and 2. If present, an overvoltage may have caused the power supply to shutdown. Cycle supply voltage. If POWER LED remains off, return unit for repair.
POWER LED flashes.	A power-supply overload has occurred. Cycle supply voltage. If problem persists, consult Littelfuse Startco.
Calibration-Error Trip DIAGNOSTIC LED flash code = L-S-L...*	The total resistance of the NGR and sensing-resistor circuit is outside the calibration range. Verify that switch S5 is set to match the resistance of the sensing resistor, check the resistance of the NGR, and verify the sensing-resistor circuit. See Section 9.2 for sensing-resistor tests. Repeat the calibration procedure after the open or shorted condition has been corrected.
Remote Trip DIAGNOSTIC LED flash code = L-S-S-L…*	The SE-330HV was tripped by a signal from network communications. Press RESET to clear the trip.
EEPROM-Error Trip DIAGNOSTIC LED flash code = L-S-S-S-L…*	An error was detected in the EEPROM. Press RESET to clear the trip. If the problem persists, consult Littelfuse Startco.
A/D-Converter-Error Trip DIAGNOSTIC LED flash code = L-S-S-S-S-L…*	An A/D-converter error was detected. Press RESET to clear the trip. If the problem persists, consult Littelfuse Startco.
Software-Interrupt Trip DIAGNOSTIC LED flash code = L-S-S-S-S-S-L…* **Illegal-Opcode Trip** DIAGNOSTIC LED flash code = L-S-S-S-S-S-S-L…* **Watchdog Trip** DIAGNOSTIC LED flash code = L-S-S-S-S-S-S-S-L…* **Clock-Failure Trip** DIAGNOSTIC LED flash code = L-S-S-S-S-S-S-S-S-L…*	These four errors result in a processor reset. During reset, UNIT HEALTHY relay K4 will be de-energized. After a reset, UNIT HEALTHY relay K4 will be energized. Press RESET to clear the trip. If the problem persists, consult Littelfuse Startco. When supply voltage is cycled, the specific error code is lost but the CPU Trip Code will be displayed.
CPU Trip DIAGNOSTIC LED flash code = L-S-S-S-S-S-S-S-S-S-L…*	This code is displayed if the supply is cycled after one of the previous four errors occurred. Press RESET to clear the trip.
DIAGNOSTIC LED = Solid Red	Switch S8 is in the UPGRADE position. If firmware upgrade is not required, set switch S8 to RUN and cycle supply.
	SE-330HV processor failed to start. Cycle supply. Consult Littelfuse Startco if problem persists.
Pressing RESET does not clear trips.	Trip condition is still present. Locate and correct.
	The face-plate RESET button is disabled if remote-reset terminals 15 and 16 are connected. Replace shorted remote-reset switch or issue Reset command from the communications network.
UNIT HEALTHY relay K4 momentarily changes state.	Occurs when processor is reset.
GROUND-FAULT and RESISTOR-FAULT LED's flash during reset.	Normal operation.
No analog-output current.	The output at terminals 19 and 20 requires a voltage source. See Fig. 2 for analog-output connections. See Section 9.3 for the analog-output tests.

*L = long pause, S = short flash.

6. TECHNICAL SPECIFICATIONS

6.1 SE-330HV

Supply
- Option 0 .... 30 VA, 120 to 240 Vac (+10, -45%) 50/60 Hz; 20 W, 110 to 250 Vdc (+10, -25%)
- Option 2 .... 20 W, 48 Vdc (+50, -25%) 35 VA, 48 Vac (+10, -45%) 50/60 Hz

Power-Up Time .... 250 ms at 120 Vac

AC Measurements .... Discrete Fourier Transform. 16 samples per cycle, 50 or 60 Hz

Resistor-Fault Circuit:
- Neutral-To-Ground Voltage Trip Levels:
  - ER-15KV to ER-35KV .... 100; 300; 500; 650; 850; 1,000; 1,700; 4,000; 6,000; 8,500; 10,000 Vac
  - ER-72KV .... 200; 600; 1,000; 1,300; 1,700; 2,000; 3,400; 8,000; 12,000; 17,000; 20,000 Vac
  - Accuracy .... 5% of setting
  - 3 dB Frequency Response ..
    - S6 = 50 Hz .... 25-85 Hz
    - S6 = 60 Hz .... 30-90 Hz
- NGR Calibration Range:
  - ER-15KV to ER-35KV .... 0 to 10 kΩ
  - ER-72KV .... 0 to 20 kΩ
- Trip Resistance, $V_N = 0$:
  - ER-15KV to ER-35KV .... 2.5-kΩ change ± 1 kΩ
  - ER-72KV .... 5-kΩ change ± 2 kΩ
- DC-Voltage Rejection:
  - ER-15KV to ER-35KV .... 125 Vdc
  - ER-72KV .... 250 Vdc
- Trip Time .... 12 ± 1 s
- Trip Hold-Off Level .... 5% of CT-Primary Rating
- Operating Mode .... Latching/Non-Latching

Ground-Fault Circuit:
- Trip Level .... 2, 4, 6, 8, 10, 15, 20, 40, 60, 80, 100% of CT-Primary Rating
- Trip Time .... 0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 1.0, 2.0, 3.0, 5.0, 10.0 s
- Trip-Level Accuracy .... 1% of CT-Primary Rating
- Trip-Time Accuracy .... 10% of Setting
- 3 dB Frequency Response ....
  - S6 = 50 Hz .... 25-85 Hz
  - S6 = 60 Hz .... 30-90 Hz

Maximum CT lead resistance:
- EFCT & SE-CS30 .... 5 Ω,
- Other CT's .... Consult CT Curve

- CT-Input Burden:
  - 5-A Input .... < 0.01 Ω
  - 1-A Input .... < 0.05 Ω
  - EFCT Input .... < 10 Ω
- Thermal Withstand:
  - 1-A and 5-A Input:
    - Continuous .... 2 x CT Rating
    - 1-Second .... 20 x CT Rating
  - EFCT Input:
    - Continuous .... 10 x CT Rating
    - 1-Second .... 25 x CT Rating
- Measurement Range .... 25 x CT-Primary Rating
- Operating Mode .... Latching/Non-Latching

Trip Relay K1 Contacts:
- Configuration .... N.O. (Form A)
- Operating Mode .... Fail-Safe or Non-Fail-Safe
- CSA/UL Contact Ratings .... 8 A resistive 250 Vac, 5 A resistive 30 Vdc
- Supplemental Contact Ratings:
  - Make/Carry 0.2 s .... 30 A
  - Break:
    - dc .... 75 W resistive, 35 W inductive (L/R = 0.04)
    - ac .... 2,000 VA resistive, 1,500 VA inductive (PF = 0.4)
  - Subject to maximums of 8 A and 250 V (ac or dc).

GF (K2) and RF (K3) Relay Contacts:
- Configuration .... N.O. and N.C. (Form C)
- Operating Mode .... Non-Fail-Safe
- CSA/UL Contact Ratings .... 8 A resistive 250 Vac, 8 A resistive 30 Vdc
- Supplemental Contact Ratings:
  - Make/Carry 0.2s .... 20 A
  - Break:
    - dc .... 50 W resistive, 25 W inductive (L/R = 0.04)
    - ac .... 2,000 VA resistive, 1,500 VA inductive (PF = 0.4)
  - Subject to maximums of 8 A and 250 V (ac or dc).

Unit Healthy Output K4 (Option 0):
- Configuration .... N.O. (Form A)
- Operating Mode .... Closed when Healthy
- Ratings .... 100 mA, 250 V (ac or dc)
- Closed Resistance .... 30 to 50 Ω

Unit Healthy Output K4 (Option 1):
- Configuration .... N.C. (Form B)
- Operating Mode .... Open when Healthy
- Ratings .... 100 mA, 250 V (ac or dc)
- Closed Resistance .... 25 to 50 Ω maximum

Auto-reset time .... 2.8 s maximum

4–20-mA Analog Output:

Type	Self Powered and Loop Powered
Range	4 to 22 mA
Loop Voltage	8 to 36 Vdc
Load	500 Ω (maximum with 24-Vdc supply)
Isolation	120 Vac
Parameter	NGR Current

RS-232 Communications:

Baud Rate	38.4 kb/s
Protocol	Proprietary

Terminal-Block Ratings	10 A, 300 Vac, 12 AWG (2.5 mm^2)
PWB Conformal Coating	MIL-1-46058 qualified, UL QMJU2 recognized
Mounting Configurations	Panel Mount and Surface Mount
Shipping Weight	2.0 kg (4.4 lb)

Environment:

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

Surge Withstand	ANSI/IEEE C37.90.1-1989 (Oscillatory and Fast Transient)
EMC	EN 55011:1998
Certification	CSA, Canada and USA

® LR 53428

C US

UL Listed

LISTED

Ground Fault Sensing
and Relaying Equipment
4FX9 E340889

Australia[1]

NOTES:

[1] See Ordering Information.

6.2 Sensing Resistors

Environment:

Operating Temperature	-40 to 60°C (-40 to 140°F)
Storage Temperature	-55 to 80°C (-67 to 176°F)

ER-15KV:

Maximum Voltage	8,400 Vac
Maximum Current	84 mA
Resistance	100 kΩ
Thermal:	
8,400 Vac	1 minute on, 120 minutes off
1,900 Vac	Continuous
Torque (Terminal N)	9.0 N-m (80 in-lb)
Shipping Weight	5.0 kg (11 lb)

ER-25KV:

Maximum Voltage	14,400 Vac
Maximum Current	144 mA
Resistance	100 kΩ
Thermal:	
14,400 Vac	1 minute on, 120 minutes off
2,500 Vac	Continuous
Torque (Terminal N)	9.0 N-m (80 in-lb)
Shipping Weight	20 kg (44 lb)

ER-35KV:

Maximum Voltage	22,000 Vac
Maximum Current	220 mA
Resistance	100 kΩ
Thermal:	
22,000 Vac	1 minute on, 120 minutes off
3,000 Vac	Continuous
Torque (Terminal N)	9.0 N-m (80 in-lb)
Shipping Weight	40 kg (88 lb)

ER-72KV:

Maximum Voltage	44,000 Vac
Maximum Current	220 mA
Resistance	200 kΩ
Thermal:	
44,000 Vac	1 minute on, 120 minutes off
6,000 Vac	Continuous
Torque (Terminal N)	9.0 N-m (80 in-lb)
Shipping Weight	95 kg (210 lb)

ER-1000HV:

Maximum Voltage	600 Vac
Maximum Current	3 mA
Resistance	200 kΩ
Thermal	600 Vac Continuous
Shipping Weight	300 g (0.7 lb)

Certification.............................. CSA, Canada and USA

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LISTED
Ground Fault Sensing
and Relaying Equipment
4FX9 E340889

CE, European Union[1]

NOTES:
[1] CE certification for the ER-72KV is not available.

6.3 CURRENT SENSORS

Environment:
Operating Temperature...........-40 to 60°C (-40 to 140°F)
Storage Temperature..............-55 to 80°C (-67 to 176°F)

EFCT-1:
Current Ratio........................ 5:0.05 A
Insulation.............................. 600-V Class
Window Diameter .... 82 mm (3.2")
Shipping Weight................... 0.9 kg (2.0 lb)

Certifications........................ CSA, UL, CE
Compliance .... RoHS, IEC 60044-1
Extended Operating
Temperature ....-55 to 60°C (-67 to 140°F)[1]
Supplemental
Specifications:
Trip Level Accuracy:
≤ 1 A ....1% of CT-Primary Rating
> 1 A ....3% of CT-Primary Rating

EFCT-26:
Current Ratio........................ 5:0.05 A
Insulation.............................. 600-V Class
Window Diameter .... 26 mm (1.0")
Shipping Weight................... 0.45 kg (1.0 lb)
Certifications........................ CSA, UL, CE
Compliance .... RoHS, IEC 60044-1
Extended Operating
Temperature ....-55 to 60°C (-67 to 140°F)[1]
Supplemental
Specifications:
Trip Level Accuracy:
≤ 1 A ....1% of CT-Primary Rating
> 1 A ....3% of CT-Primary Rating

SE-CS10-2.5:
Current Ratio......................... 1,000:5 A
Insulation............................... 600-V Class
Window Diameter .... 63 mm (2.5”)
Shipping Weight.................... 0.7 kg (1.5 lb)
Certifications......................... CE
Compliance .... IEC 60044-1

SE-CS30-26:
Current Ratio........................30:0.05 A
Insulation ....600-V Class
Window Diameter ....26 mm (1.0”)
Shipping Weight ....0.45 kg (1.0 lb)
Certifications........................CSA, UL, CE
Compliance ....RoHS, IEC 60044-1

SE-CS30-70:
Current Ratio........................30:0.05 A
Insulation ....600-V Class
Window Diameter ....70 mm (2.7”)
Shipping Weight ....1.2 kg (2.5 lb)
Certifications........................CSA, UL, CE
Compliance ....RoHS, IEC 60044-1

CT200:
Current Ratio........................200:5 A
Insulation ....600-V Class
Window Diameter ....56 mm (2.2”)
Shipping Weight ....1 kg (2.2 lb)
Certifications........................CSA, UL
Compliance ....RoHS

NOTES:
[1] Electrical specifications have been verified at a Littelfuse lab.

7. ORDERING INFORMATION

SE-330HV- □□-□□

- K4 Contact:
  - 0 N.O. UNIT HEALTHY Contact
  - 1 N.C. UNIT HEALTHY Contact
- Options:
  - 0 No Options
  - 1 C-Tick Compliance
- Network Communications
  - 0 None
  - 1 DeviceNet™
  - 2 PROFIBUS®
  - 3 Ethernet
- Supply:
  - 0 Universal ac/dc Supply
  - 2 48 V

NOTE: Please refer to the SE-330 Product Change Notice (PCN) document for updated ordering information and new revision details, available at www.littelfuse.com/se-330hv.

NOTE: Each SE-330 includes an SE-330-SMA Surface Mount Adapter.

Sensing Resistors:

- ER-15KV .... For system voltages up to 15 kVac
- ER-25KV .... For system voltages up to 25 kVac
- ER-35KV .... For system voltages up to 35 kVac
- ER-72KV .... For system voltages up to 72 kVac
- ER-1000HV .... For system voltages up to 1 kVac

Current Transformers:

- EFCT-1 .... Ground-Fault CT, 5-A-primary rating, 82-mm (3.2") window, 6m (19.5') of 22 AWG shielded cable included
- EFCT-26 .... Ground-Fault CT, 5-A-primary rating, 26-mm (1.0") window, 6m (19.5') of 22 AWG
- SE-CS30-26 .... Ground-Fault CT, 30-A-primary rating, 26-mm (1.0") window
- SE-CS30-70 .... Ground-Fault CT, 30-A-primary rating, 70-mm (2.7") window

Accessories:

- RK-332 .... Remote Indication and Reset, Includes two 120-V pilot lights, a reset push button, and legend plates
- SE-IP65CVR-G .... Hinged transparent cover, IP65
- SE-MRE-600 .... Moisture-resistant enclosure for ER-1000HV

Software: (1)

- SE-FLASH .... Firmware Upgrade Program
- SE-MON330 .... SE-330 Data-Display Program for PC
- NGR Monitor Set-Point Assistant .... Setting Guide

NOTES:

(1) Available at www.littelfuse.com/relayscontrols.

8. WARRANTY

The SE-330HV Neutral-Grounding-Resistor 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-330HV 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.

9. TEST PROCEDURES

9.1 RESISTOR-FAULT TESTS

Perform tests with system de-energized and supply voltage applied to the SE-330HV.

9.1.1 CALIBRATION AND OPEN TEST

Test Equipment: 100-kΩ and 200-kΩ, 1/4-watt, 1% calibration resistors (calibration resistors supplied with SE-330HV).

Procedure:

- Remove connections to terminals 6 and 7.
- Connect the 100-kΩ resistor to terminals 6 and 7.
- Set switch S5 to the 100-kΩ position.
- Perform calibration as per Section 2.2.
- The CALIBRATED LED should be on. Press RESET.
- Remove the 100-kΩ resistor and wait for 12 seconds.
  PASS: The SE-330HV should trip on resistor fault.
- Connect the 200-kΩ resistor to terminals 6 and 7.
- Set switch S5 to the 200-kΩ position.
- Perform calibration as per Section 2.2.
  The CALIBRATED LED should be on.
- Press RESET.
- Remove the 200-kΩ resistor and wait for 12 seconds.
  PASS: The SE-330HV should trip on resistor fault.

NOTE: Resistor-fault-trip reset can take up to one second.

9.1.2 VOLTAGE TEST

Test Equipment: 0 to 250 Vac voltage source and multimeter.

NOTE: Use an isolation transformer if the test-voltage source does not provide dc continuity for the SE-330HV resistance-measuring circuit.

NOTE: Applying the test voltage to the R and G terminals will damage the SE-330HV and the ER sensing resistor. The V_N TRIP LEVEL is the trip voltage at terminal N, not terminal R.

Procedure:

- Check the ER sensing resistor connection to the SE-330HV.
- Disconnect the wire from sensing-resistor terminal N. A resistor-fault will occur.
- Set the voltage source to 0 V.
- Connect the voltage source between sensing resistor N and G terminals.
- Set the V_N TRIP LEVEL (VAC) to 100.
- Press RESET.
- The RESISTOR FAULT TRIP LED should be off.
- Increase the test voltage to 120 Vac for 100-kΩ sensors or 240 Vac for 200-kΩ sensors and wait 12 seconds
  PASS: The SE-330HV should trip on RESISTOR FAULT. A time-delayed ground-fault trip follows the resistor-fault trip if neutral voltage persists after the resistor fault.

9.2 SENSING-RESISTOR TEST

Test Equipment: Multimeter.

Procedure:

- Disconnect the sensing resistor.
- Measure the resistance between sensing-resistor terminals R and N.
  PASS: Resistance should be between 98 and 102 kΩ for 100-kΩ sensing resistors. Resistance should be between 196 and 204 kΩ for 200-kΩ sensing resistors.
- Measure the resistance between sensing-resistor terminals R and G in both directions.
  PASS: Resistance should be greater than 10 MΩ in both directions.

9.3 ANALOG-OUTPUT TEST

Test Equipment: Multimeter with a mAdc scale.

Procedure:

- Connect the 4–20-mA output as a self-powered output as shown in Fig. 3. Measure the current from terminal 20 to terminal 21.
  PASS: With no CT current, the analog output should be 4 mA.
- Output is linear to 20 mA. Output is 20 mA when CT-primary current is equal to the CT-primary rating.

9.4 GROUND-FAULT PERFORMANCE TEST

To meet the requirements of the National Electrical Code (NEC), as applicable, the overall ground-fault protection system requires a performance test when first installed. A written record of the performance test is to be retained by those in charge of the electrical installation in order to make it available to the authority having jurisdiction. A test-record form is provided for recording the date and the final results of the performance tests. The following ground-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 ground-fault current transformer. Ensure the cables pass through the ground-fault-current-transformer window. This check can be done visually with knowledge of the circuit. The connection of the current-transformer secondary to the SE-330HV is not polarity sensitive.

c) 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.

d) 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. 20 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. Set the test current to 120% of GF TRIP LEVEL. Inject the test current through the current-transformer 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 8, 9, 10, and 11.

NOTE: For accurate trip-time measurement, the fault current should not be re-applied for the time defined by the GF TRIP TIME setting to allow the trip accumulator to initialize.

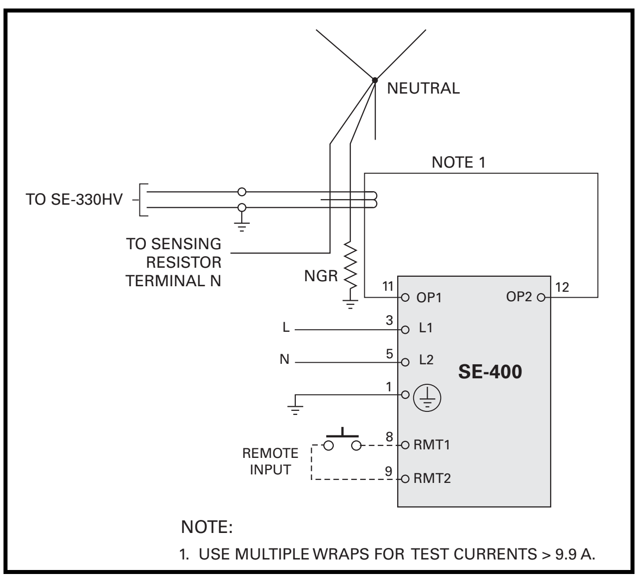

FIGURE 20. Ground-Fault-Test Circuit.

TABLE 4. GROUND-FAULT-TEST RECORD

DATE	TEST RESULTS

Retain this record for the authority having jurisdiction.

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