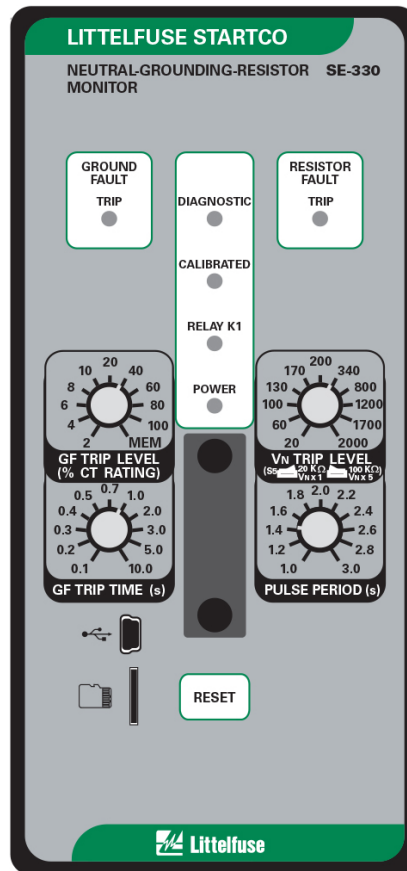


# MANUAL FOR

## SE-330 NEUTRAL-GROUNDING-RESISTOR MONITOR SE-330HV NEUTRAL-GROUNDING-RESISTOR MONITOR SE-330AU NEUTRAL-EARTHING-RESISTOR MONITOR

REVISION 11-B-121520



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## 1. General

This is a combined manual for the following products:

- SE-330 Neutral-Grounding-Resistor Monitor
- SE-330HV Neutral-Grounding-Resistor Monitor
- SE-330AU Neutral-Earthing-Resistor Monitor

The features described in this manual are common to all monitors unless otherwise indicated. Resistance-grounded systems require a neutral-grounding resistor (NGR), also known as a neutral-earthing resistor (NER) in some regions. Both terms may be shown in this manual.

The SE-330 and SE-330HV (firmware version 3.01 and higher) are compliant with the 2018 CE Code.

The SE-330AU (firmware version 3.10 and higher) is compliant with AS/NZS 2081.6:2011 and AS/NZS 2081.8:2011.

PC software SE-MON330 version 4.1 or higher is required to configure the SE-330 series. For more details about SE-MON330, refer to Appendix A. SE-MON330 can be found at [www.littelfuse.com/relayscontrols](http://www.littelfuse.com/relayscontrols).

### 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 from low-resistance and solidly-grounded systems, which do not use NGRs and therefore have a ground-fault flash hazard that can cause substantial point-of-fault damage. High-resistance grounding eliminates these problems. Modern ground-fault protection reliably operates 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 Canadian Electrical (CE) Code rule 10-302, National Electrical Code (NEC)\* 250.36, and NEC

250.186 for application details (applies to SE-330 and SE-330HV).

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  $\frac{1}{2}$  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. 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, which 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 Series NGR Monitoring

The SE-330 microprocessor-based neutral-grounding-resistor monitor series detect NGR failures and ground faults in resistance-grounded systems. The SE-330



series measure NGR resistance, NGR current, and transformer or generator neutral-to-ground voltage. The components required to monitor an NGR are an SE-330 series monitor, a 20- or 100-k $\Omega$  ER-series sensing resistor (100- or 200-k $\Omega$  sensing resistor for the SE-330HV), and a current transformer (CT).

Power-circuit elements (other than neutral-connected NGRs) 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, 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. 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 CT rating, the SE-330 series 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 (SE-330 or SE-330HV only), or by one of the following sensitive CTs:

- ELCT5-x or ELCT30-x for the SE-330 and SE-330HV
- EFCT-x or SE-CS30-x for the SE-330AU

For the SE-330 and SE-330HV, 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.

For the SE-330AU, the trip level of the earth-fault circuit is adjustable from 0.125 to 5 A for the EFCT-x and 0.75 to 30 A for the SE-CS30-x. Trip time is adjustable from 0.1 to 0.5 seconds. Open-CT detection is provided with a fixed 2-second time delay.

The SE-330 series has four output relays. With firmware version 3.00 or higher, relays K1, K2, and K3 (K2 and K3

for the SE-330AU) can be assigned to one of the following functions (using SE-MON 330):

- Ground Fault (GF);
- Resistor Fault (RF);
- Enhanced Health Status (HEALTH);
- GF + RF;
- GF + RF + HEALTH;
- RF (Short Only);
- RF (Open Only); or
- DISABLED.

For the SE-330 only, regardless of the K1 assignment, K1 can also be assigned to a pulsing function. This can control a contactor to assist in locating faults.

For the SE-330 and SE-330HV, relays K1, K2, and K3 can be set to operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications.

For the SE-330AU, relay K1 is the trip relay and operates in the fail-safe mode for undervoltage applications. Relays K2 and K3 can be set to operate in the fail-safe or non-fail-safe mode for undervoltage or shunt-trip applications.

Relay K4 is a solid-state relay that provides basic UNIT HEALTH indication.

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 series provides these additional features over the legacy models:

- NGR sensitive short and open detection capability
- Assignable relay functions (K1, K2, K3 for the SE-330 and SE-330HV, and K2, K3 for the SE-330AU)
- 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 short-term data logging and firmware updates. 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.

### 1.3 NGR Sensitive Open and Short Detection

(firmware version 3.10 and higher)

The SE-330 and SE-330HV can be configured to trip if the NGR resistance decreases to a value less than 10 to 70% of the Nominal NGR Resistance value, or if the NGR resistance increases to a value greater than 120 to 1000% of the Nominal NGR Resistance value.

The SE-330AU can be configured to trip if the NER resistance decreases to a value less than 50 to 70% of the Nominal NER Resistance value, or if the NER resistance increases to a value greater than 130 to 200% of the Nominal NER Resistance value.

The Nominal NGR Resistance value, NGR Short Trip Level, and several other values can be configured using SE-MON330. For more details about how to change these values, refer to Appendix A.

## 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 for the SE-330 and SE-330HV, and from 0.1 to 0.5 seconds for the SE-330AU. 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.

A non-accumulating mode can also be selected. In this mode, a trip occurs if the fault current remains higher than the ground-fault trip level for the duration of the ground-fault trip time.

#### 2.1.2 GF Trip Level

The SE-330 series 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.

For the SE-330 and SE-330HV, set the ground-fault trip level as a percentage (2 to 100) of the CT-primary rating.

For the SE-330AU, the earth-fault trip level is adjustable from 0.125 to 5 A for the EFCT-X and 0.75 to 30 A for the SE-CS30-x.

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%.

For the SE-330 and SE-330HV, inputs are provided for 5-, 1-, and 0.05-A-secondary CTs.

Typical values for 5-, 15-, and 25-A tripping systems are shown in Tables 1 and 2. Ground-fault trip levels for selected CTs are shown in Table 3. For other systems, refer to the NGR Monitor Set-Point Assistant at <http://www.littelfuse.com/relayscontrols>. The Set-Point Assistant is included with the SE-MON330 software.

#### 2.1.3 VN Trip Level

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

The SE-330 series will trip and indicate a resistor fault 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. 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.

For the SE-330 and SE-330AU, the  $V_N$  TRIP LEVEL range is 20 to 2,000 V with switch S5 in the 20-k $\Omega$  ( $V_{x1}$ ) position, and the range is 100 to 10,000 V with switch S5 in the 100-k $\Omega$  ( $V_{x5}$ ) position.

For the SE-330HV, the  $V_N$  TRIP LEVEL range is 100 to 10,000 V with switch S5 in the 100-k $\Omega$  (Vx1) position, and the range is 200 to 20,000 V with switch S5 in the 200-k $\Omega$  (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 Tables 1 and 2. For an NGR resistance greater than 2 k $\Omega$ , use a 100-k $\Omega$  sensing resistor. For other systems, refer to the NGR Monitor Set-Point Assistant at [www.littelfuse.com/relayscontrols](http://www.littelfuse.com/relayscontrols).

**Table 1. Typical Values for Tripping Systems (SE-330 and SE-330HV)**

SYSTEM VOLTAGE (LINE-LINE)	NEUTRAL-GROUNDING RESISTOR		SENSING RESISTOR		GROUND-FAULT TRIP LEVEL (AMPERES)	V <sub>N</sub> TRIP LEVEL (VOLTS)
	CURRENT (AMPERES)	RESISTANCE (OHMS)	MODEL	RESISTANCE (SWITCH S5 SETTING)		
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
72,000	100	420	ER-72KV	200 kΩ	20.0	6,000 x 2 =12,000

**Table 2. Typical Values for Tripping Systems (SE-330AU)**

SYSTEM VOLTAGE (VOLTS)		NEUTRAL-EARTHING RESISTOR		EARTH-FAULT TRIP LEVEL (AMPERES)		V <sub>N</sub> TRIP LEVEL (VOLTS)	SENSING RESISTOR	S5
LINE TO LINE	LINE TO NEUTRAL	CURRENT (AMPERES)	RESISTANCE (OHMS)	EFCT-X (5-A RATING)	SE-CS30-X (30-A RATING)			
110 (3)	55	5	11	0.5	(1)	20	ER-600VC	20 kΩ
110	64	5	13	0.5	(1)	20	ER-600VC	20 kΩ
240 (3)	120	5	24	0.5	(1)	20	ER-600VC	20 kΩ
240	139	5	28	0.5	(1)	20	ER-600VC	20 kΩ
415	240	5	48	0.5	(1)	60	ER-600VC	20 kΩ
433	250	5	50	0.5	(1)	60	ER-600VC	20 kΩ
690	398	5	80	0.5	(1)	60	ER-600VC	20 kΩ
1,000	575	5	115	0.5	(1)	60	ER-5KV	20 kΩ
1,050	605	5	121	0.5	(1)	100	ER-5KV	20 kΩ
1,100	635	5	127	0.5	(1)	100	ER-5KV	20 kΩ
3,300	1,905	5	381	0.5	(1)	200	ER-5KV	20 kΩ
6,600	3,810	5	762	0.5	(1)	500	ER-15KV	100 kΩ
6,600	3,810	10	381	1.0	0.75	500	ER-15KV	100 kΩ
6,600	3,810	25	152	2.0	1.5	500	ER-15KV	100 kΩ
11,000	6,350	5	1,270	0.5	(1)	650	ER-15KV	100 kΩ
11,000	6,350	10	635	1.0	0.75	650	ER-15KV	100 kΩ
11,000	6,350	20	318	2.0	1.5	650	ER-15KV	100 kΩ
11,000	6,350	25	254	2.0	2.4	650	ER-15KV	100 kΩ
22,000	12,700	5	2,540	0.5	(1)	1,700	ER-25KV	100 kΩ
22,000	12,700	10	1,270	1.0	0.75	1,700	ER-25KV	100 kΩ
22,000	12,700	20	635	2.0	1.5	1,700	ER-25KV	100 kΩ
22,000	12,700	25	508	2.0	2.4	1,700	ER-25KV	100 kΩ
22,000	12,700	50	254	(2)	24	8,500	ER-25KV	100 kΩ
33,000	19,050	50	380	(2)	24	10,000	ER-35KV	100 kΩ

(1) Minimum setting is 0.75 A. Use EFCT-x for AS/NZS 2081:2011 compliance.

(2) Maximum setting is 5 A.

(3) Single phase, centre tap.

**Table 3. Ground-Fault Trip Levels for Selected CTs (SE-330 and SE-330HV)**

<b>GF TRIP LEVEL<sup>(1)</sup> (%)</b>	<b>EFCT-x 5:0.05 (AMPERES)</b>	<b>SE-CS30-x 30:0.05 (AMPERES)</b>	<b>50:1 50:5 (AMPERES)</b>	<b>100:1 100:5 (AMPERES)</b>	<b>200:1 200:5 (AMPERES)</b>	<b>400:1 400:5 (AMPERES)</b>
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

<sup>(1)</sup> When set to MEM, range is 2 to 100% in 1% increments.

\* Setting not recommended.



### 2.1.4 Pulse Period Adjustment (SE-330 only)

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 percent. For example, with the 1.0-s setting, relay K1 will 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 Figures 1, 2, and 3.

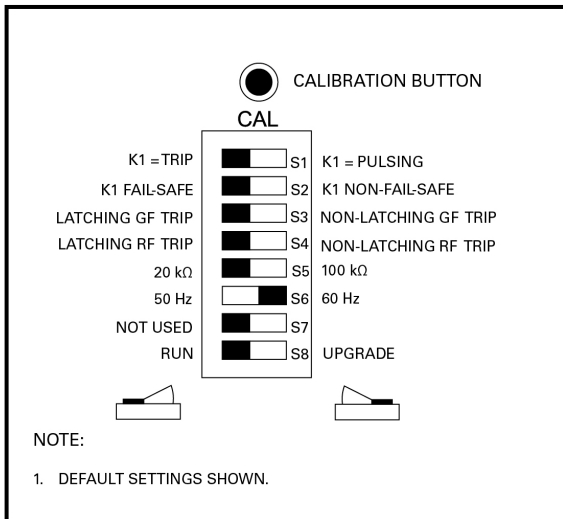


FIGURE 1. SE-330 Configuration Switches.

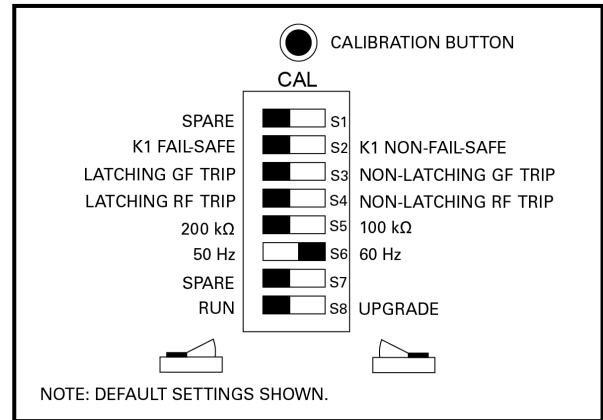


FIGURE 2. SE-330HV Configuration Switches.

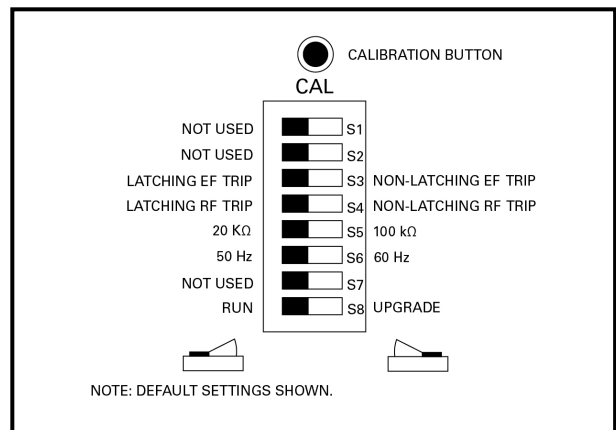


FIGURE 3. SE-330AU Configuration Switches.

#### 2.1.5.1 Relay K1 Function (S1, SE-330 ONLY)

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. Other trip functions can be assigned to K1 (SE-330 and SE-330HV only) using SE-MON330 software or via network communications.

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, SE-330 AND SE-330HV ONLY)

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. The contacts will open in the event of a trip, a loss of supply voltage, or a processor failure. In the fail-safe mode, SE-330 trips are not reset when the 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 overrides 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 overrides 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 k $\Omega$ . For the ER-15KV, ER-25KV, and ER-35KV, select 100 k $\Omega$ . For the ER-72KV and ER-1000V, select 200 k $\Omega$ . 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 the SE-330 series to 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. The resistor-fault trip time is fixed at 10 seconds for the SE-330AU.

### 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.

The geo-magnetic filter is always enabled for firmware v3.10 and higher. This specialized filter will help prevent nuisance tripping if a continuously changing open-resistance and short-resistance pattern is detected.

If this resistance-detection pattern is detected for longer than 12 seconds:

- SE-MON330 will indicate a Geo-Magnetic Interference diagnostic status in the Detailed Status tab
- If an SD card is inserted, the datalogging file will indicate Geo-Magnetic Interference in the Diagnostic column

## 2.2 Calibration

The SE-330 series 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  $\Omega$  for 20-k $\Omega$  systems, 2,500  $\Omega$  for 100-k $\Omega$  systems, 5,000  $\Omega$  for 200-k $\Omega$  systems), a resistor-fault trip occurs. The SE-330 must be calibrated on new installations, or if the NGR or the sensing resistor is changed.

NOTE: If the SE-330 series 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 series 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 then turns 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 series may be calibrated remotely using the SE-MON330 software with the USB interface or the communications options.

For firmware v3.10 or higher, the CALIBRATED LED will briefly flash every ten seconds when the following is configured:

- For the SE-330 and SE-330HV, the NGR Short Mode must be set to Sensitive, and the monitor must be successfully calibrated.
- For the SE-330AU, the NER Short Mode and NER Open Mode must be set to Sensitive, and the monitor must be successfully calibrated.

If the 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 (SE-330 only)

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. The duration of each cycle 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 that is 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 LEDs and indication relays indicate ground-fault and resistor-fault trips. The indication relays K2 (default is GF) and K3 (default is RF) operate in either 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 series 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 Figures 5, 6, and 7. 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 (SE-330 and SE-330HV only), trips and corresponding indication will automatically reset when the fault clears. In addition, the power-up trip memory will be ignored even when configuration switch S2 (SE-330 and SE-330HV only) 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 (SE-330 and SE-330HV only) 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. SE-330 and SE-330HV trips reset when the supply voltage is applied with

switch S2 set to NON-FAIL-SAFE. When a local, remote, or network reset is issued, both trip LEDs will flash if they are off.

Resistor-fault-trip reset can take up to one second. A resistor-fault trip-memory trip can take up to three seconds after the monitor powers 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. 29. Connect them as shown in Figures 5, 6, and 7. 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-330s 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

The UNIT HEALTHY relay K4 provides a basic status of processor health, which is energized when the processor is operating. It can be ordered with N.O. or N.C. contacts. See Section 7. An ENHANCED HEALTH Status can be assigned to relays K1, K2, and K3. See Section 2.9.

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, only 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 Enhanced Health Status

The Enhanced Health Status can be assigned to relays K1, K2, and K3 (firmware version 3.00 and higher). The assigned relay(s) will trip when a critical diagnostic code occurs. See Section 5 for a list of critical diagnostic codes.

## 2.10 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. 4. A PGA-0520 analog meter can be panel-mounted to display the NGR current. See Fig. 30 and Section 7.

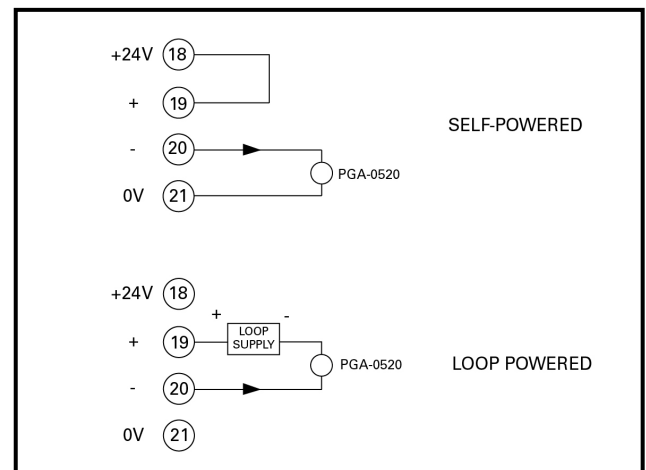


FIGURE 4. Analog-Output Connections.

### 3. Installation

#### 3.1 SE-330 Series

Outline and panel cut-out dimensions for the SE-330 series are shown in Fig. 8. To panel mount the SE-330, insert it through the panel cut-out 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 Figures 10 and 11.

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

Outline dimensions and mounting details for surface mounting the SE-330 are shown in Fig. 9. Fasten the optional surface-mount adapter to the mounting surface and make connections to the adapter terminal blocks. Follow Fig. 9 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).

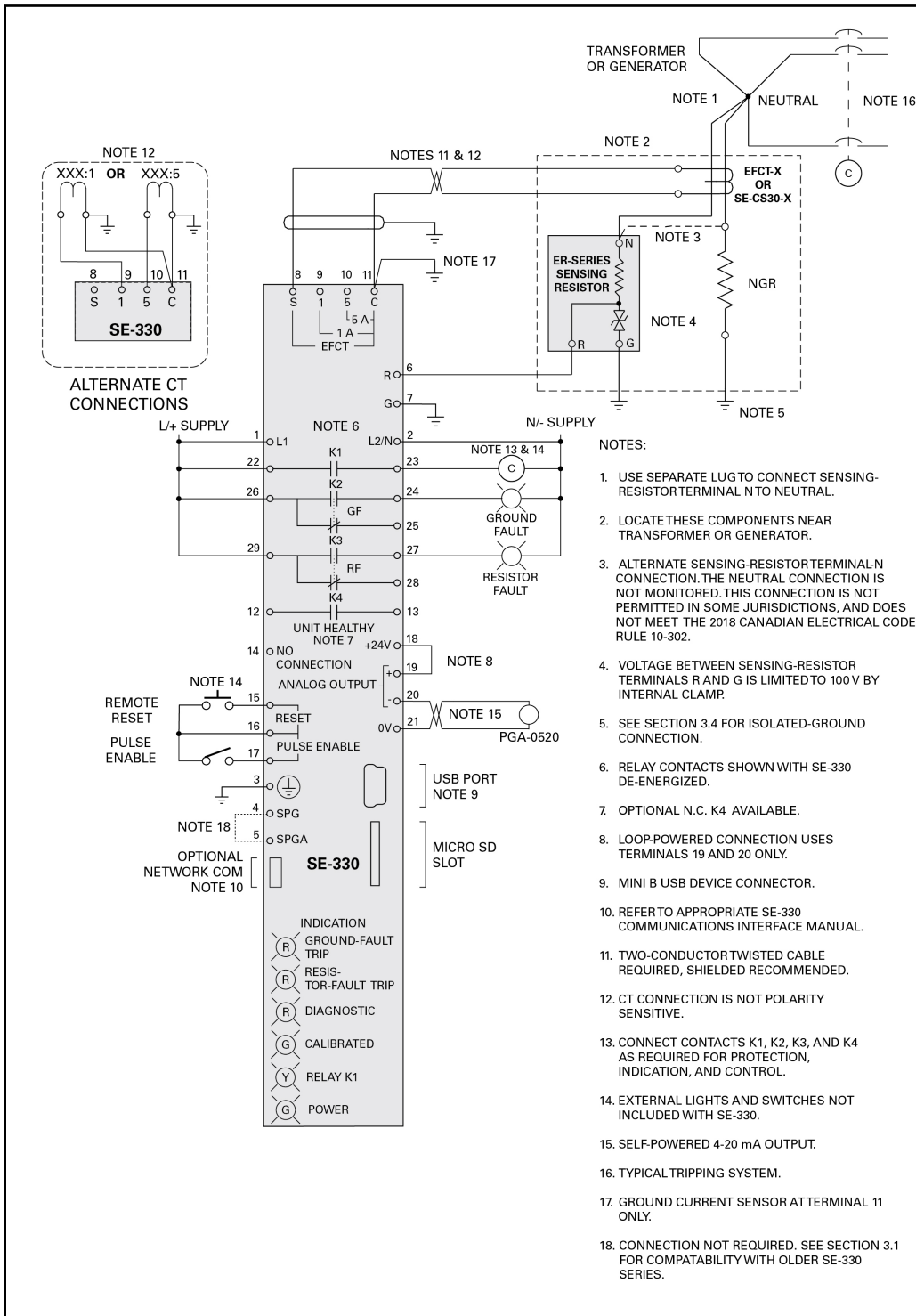


FIGURE 5. SE-330 Connection Diagram.



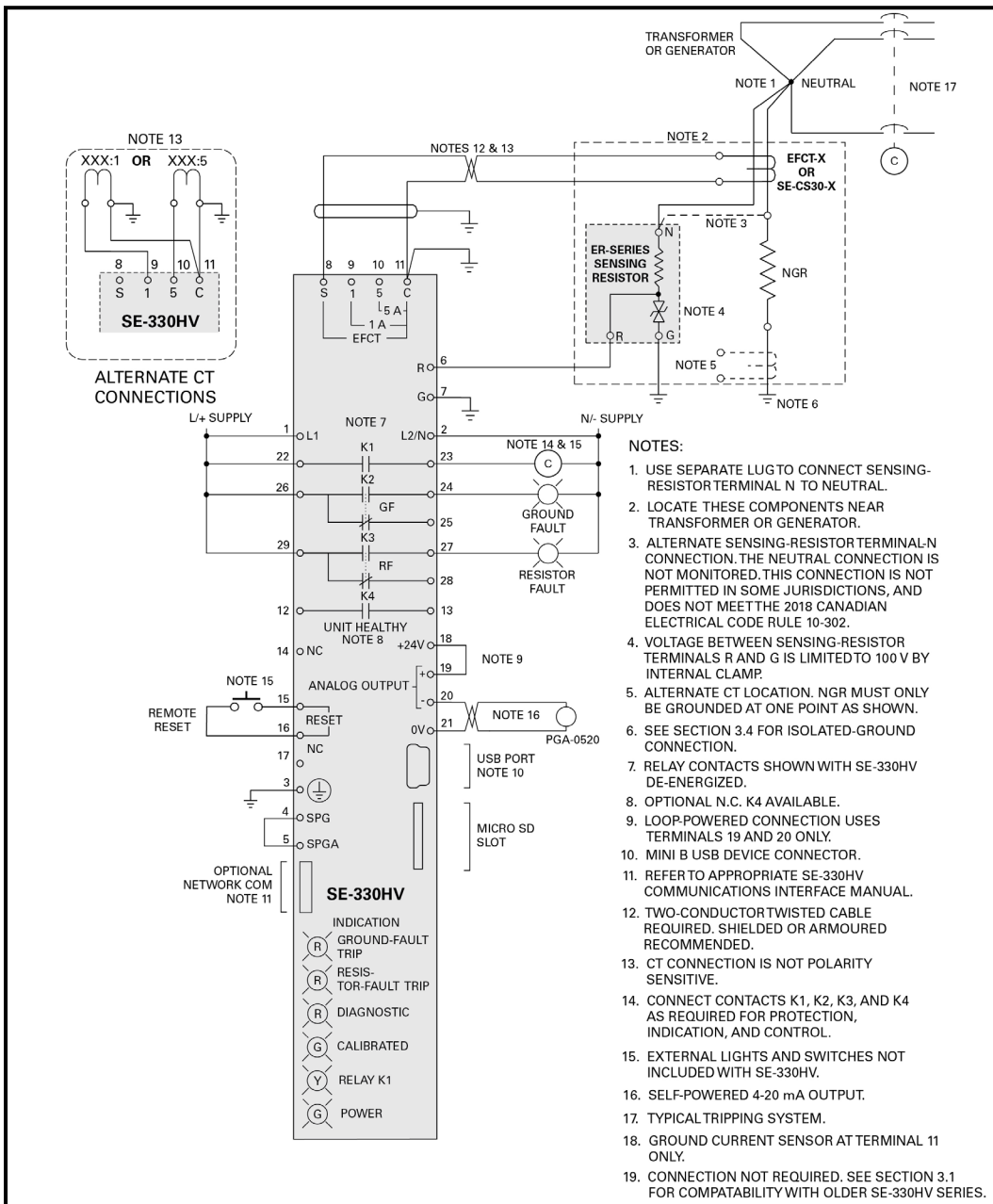


FIGURE 6. SE-330HV Connection Diagram.

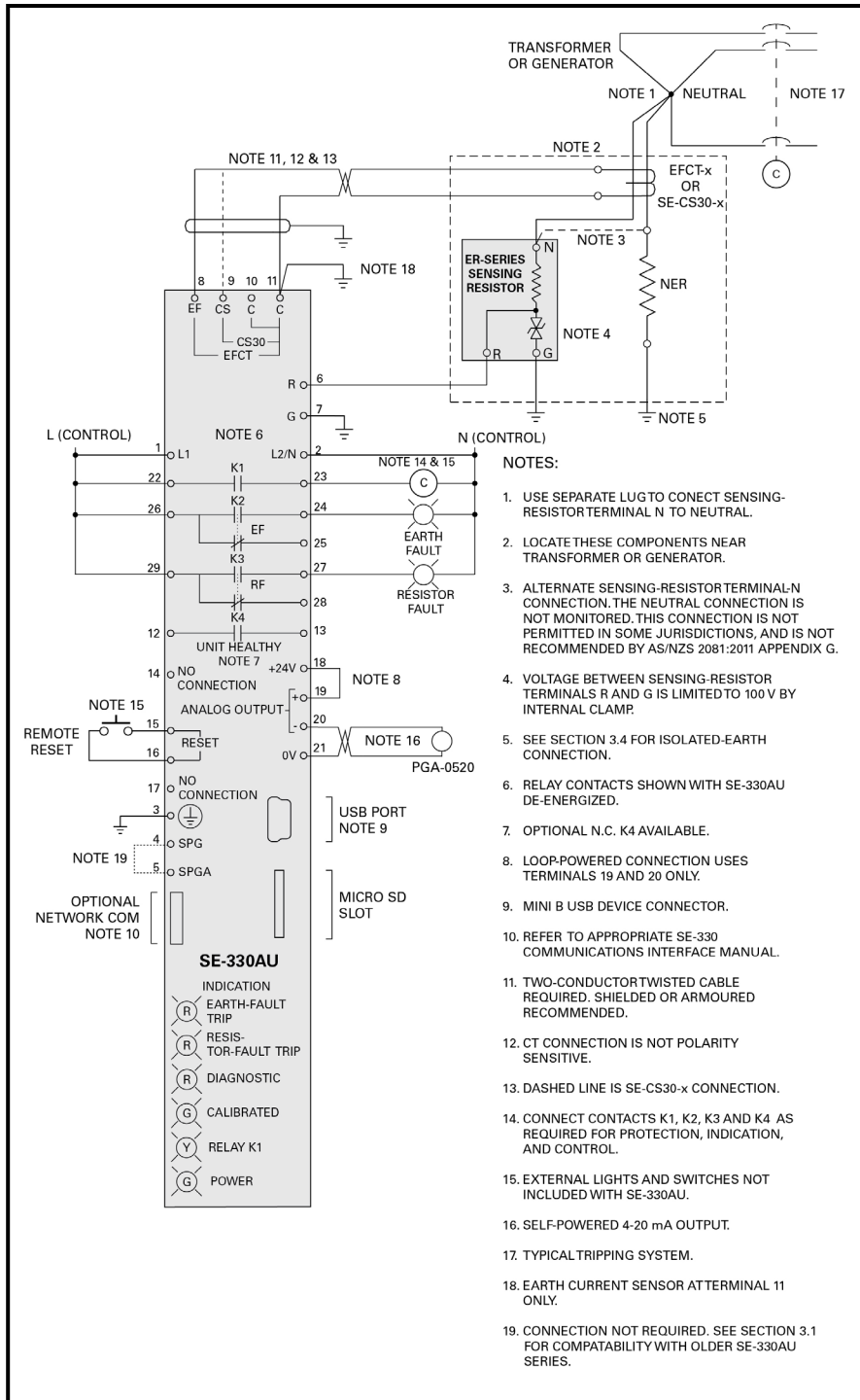


FIGURE 7. SE-330AU Connection Diagram

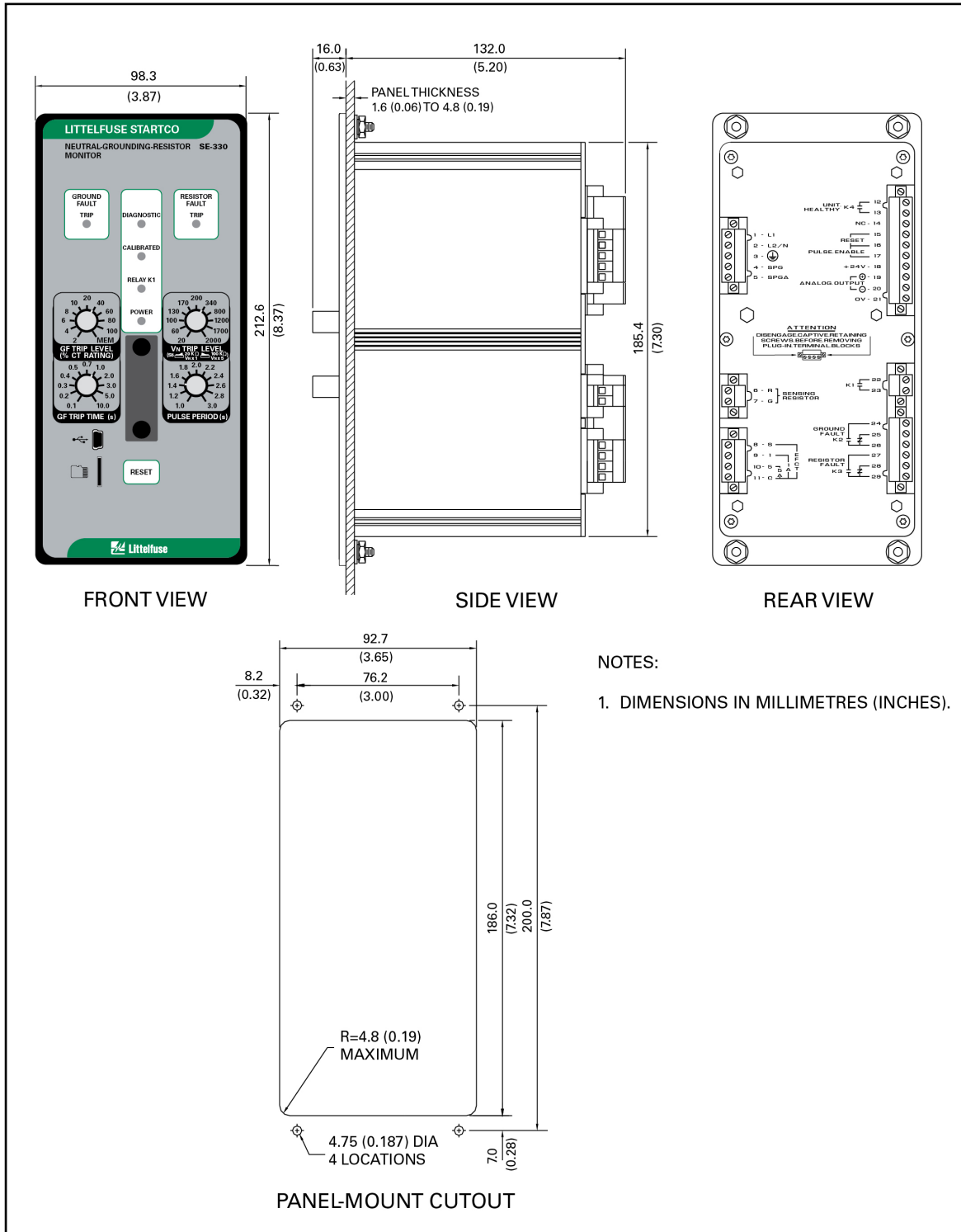


FIGURE 8. SE-330 Outline and Panel-Mounting Details.

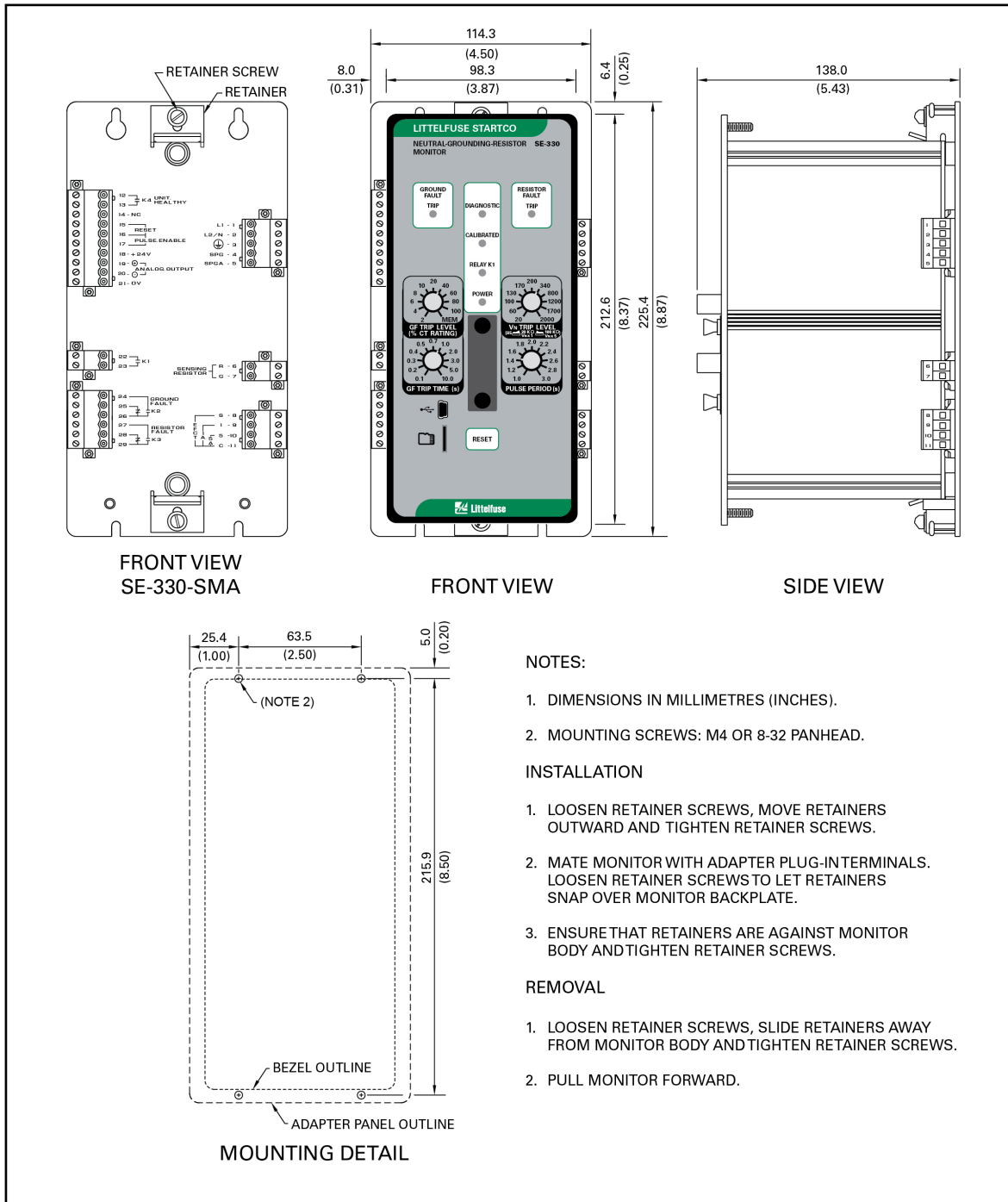


FIGURE 9. SE-330 Outline and Surface-Mounting Details.

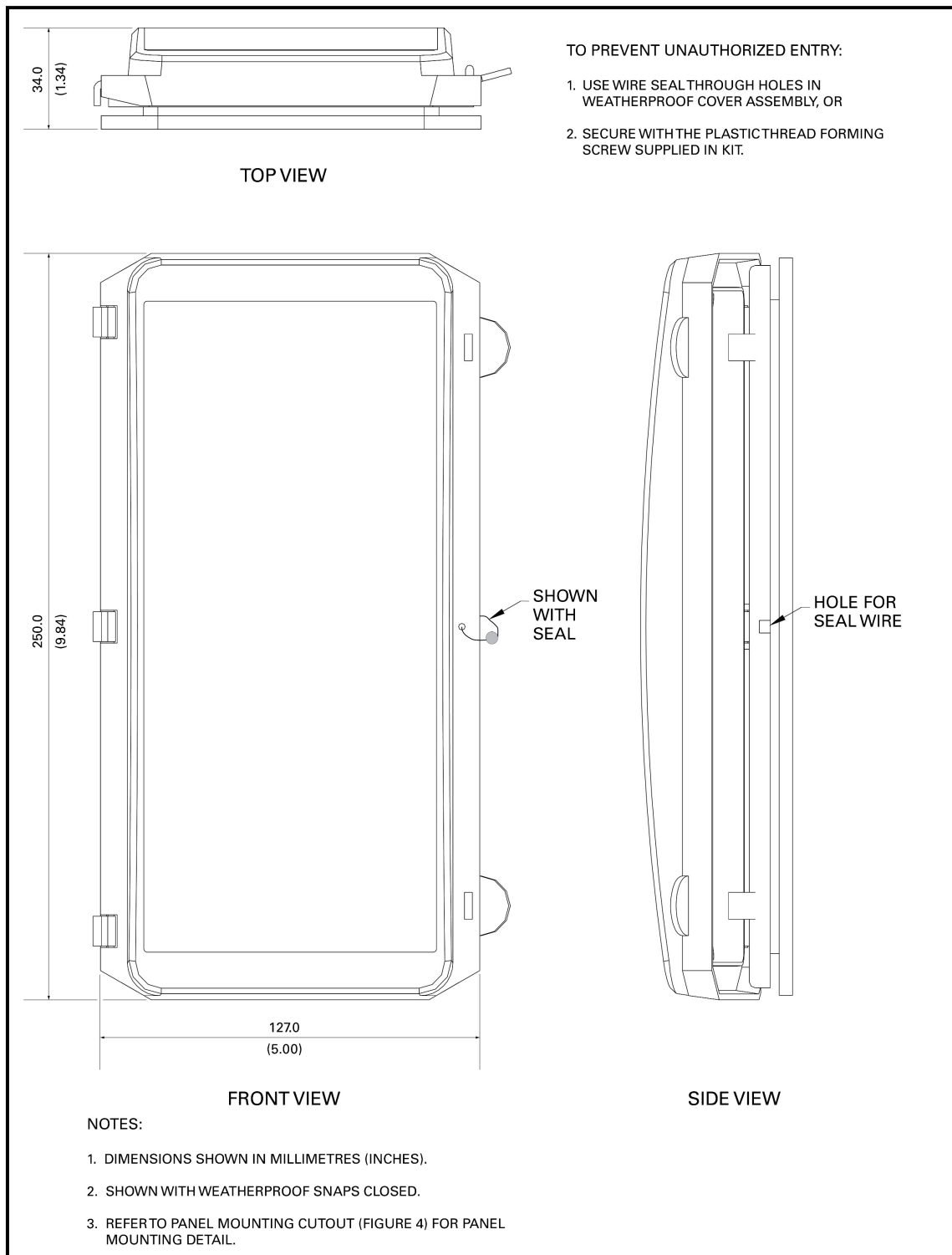


FIGURE 10. SE-IP65CVR-G Weatherproof Cover Outline

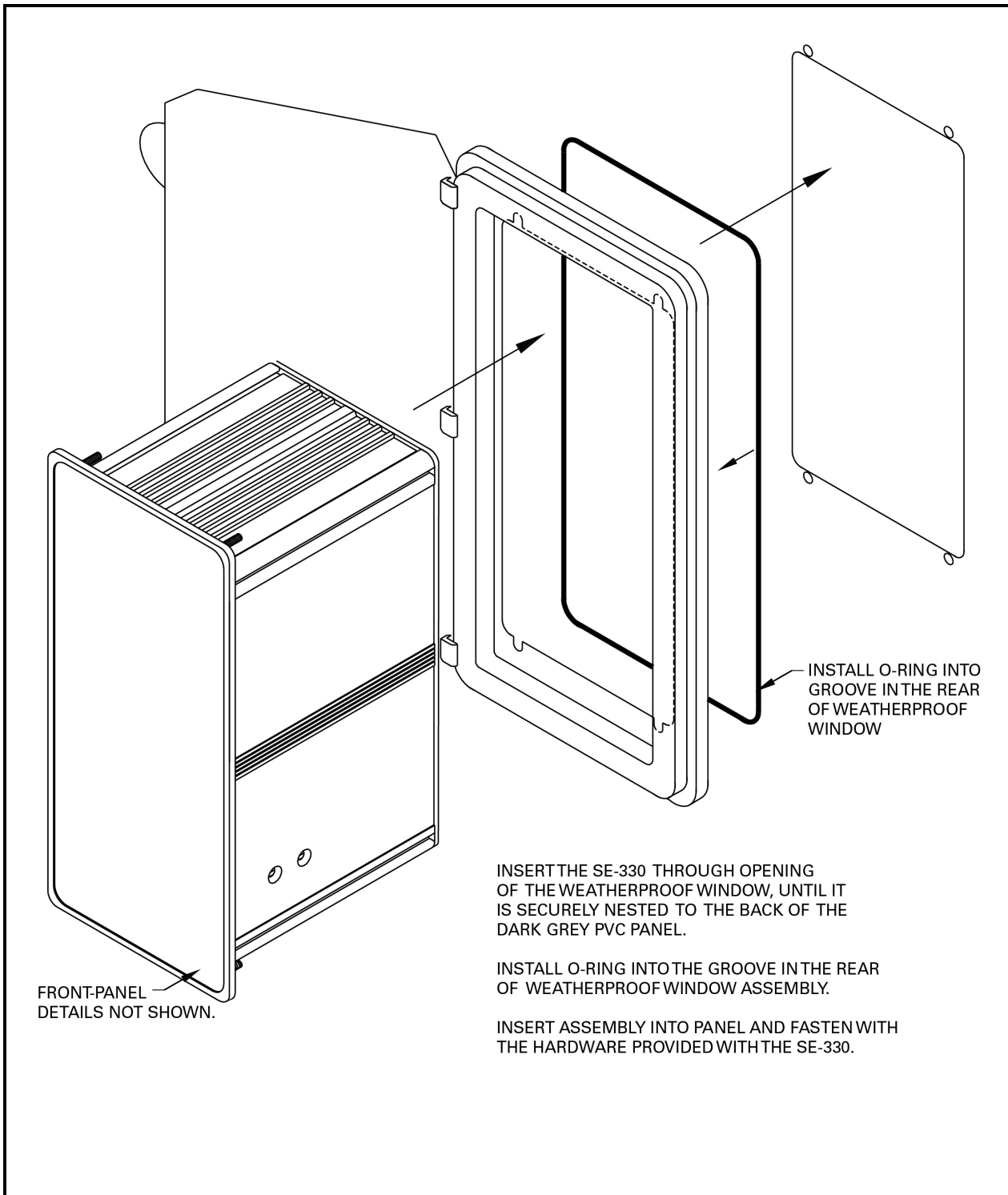


FIGURE 11. SE-IP65CVR-G Weatherproof Cover Installation



### 3.2 Sensing Resistor

Outline and mounting details for the ER-600VC, ER-5KV, ER-5WP, ER-15KV, ER-25KV, ER-35KV, ER-72KV, and ER-1000HV sensing resistors are shown in Figures 12, 15, 16, 17, 18, 19, 20, and 22. 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 or ER-1000HV to moisture. See Figs. 13 and 14. The weather-protected ER-5WP shown in Fig. 16 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, ER-35KV, and ER-72KV 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 Figures 5, 6, and 7. 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 Figures 5, 6, and 7.

**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 NGRs.

**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.

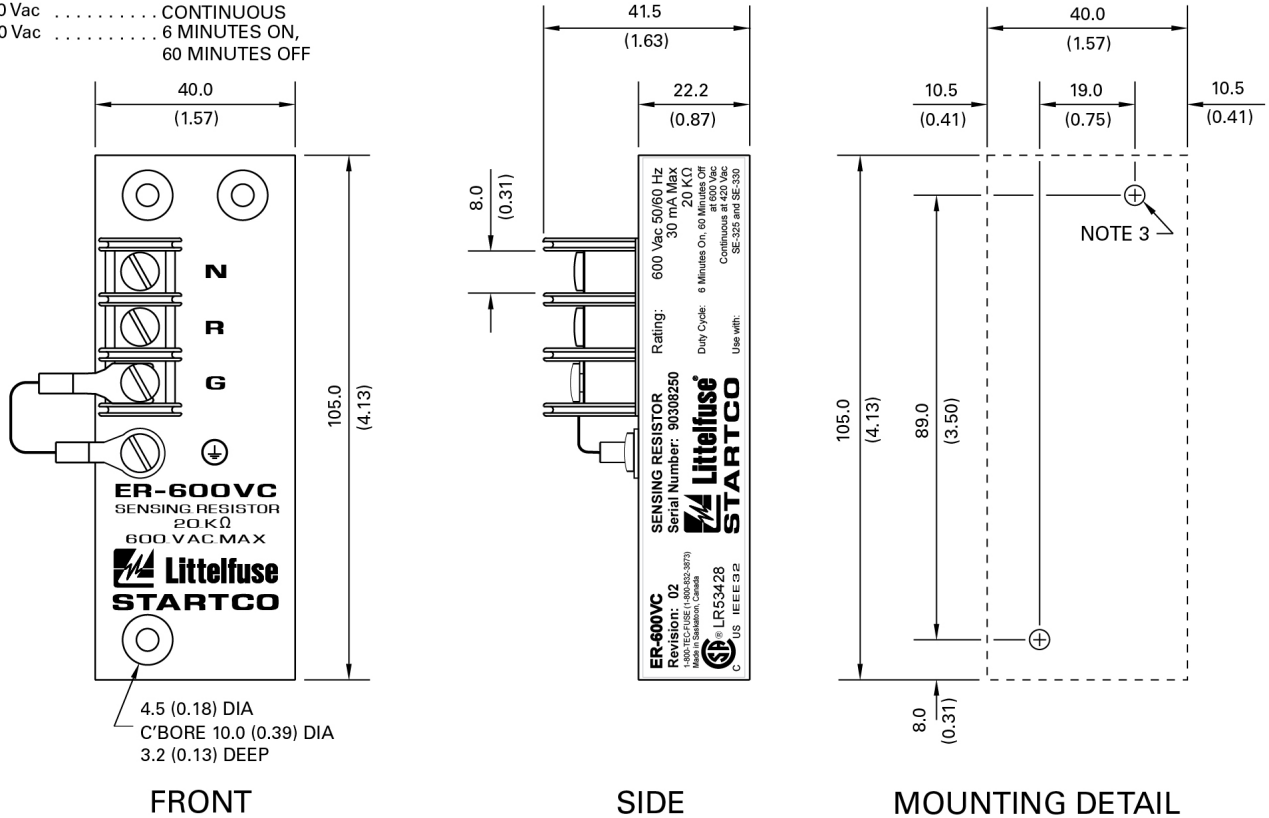
**NOTE:** The neutral-to-sensing-resistor-terminal-N connection is not a neutral conductor as defined in Canadian Electrical Code Rule 10-308 and National Electrical Code Section 250.36(B). It is not required to be 8 AWG (8.36 mm<sup>2</sup>) or larger. Since current through this conductor is always less than 250 mA, a 14 AWG (2.08 mm<sup>2</sup>) conductor insulated to the system voltage is sufficient.

**RATINGS:**

MAXIMUM VOLTAGE . . . 600 Vac  
MAXIMUM CURRENT . . . 30 mA  
RESISTANCE . . . . . 20 k $\Omega$

**THERMAL:**

420 Vac . . . . . CONTINUOUS  
600 Vac . . . . . 6 MINUTES ON,  
60 MINUTES OFF



**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  $\oplus$  SCREW. THIS CONNECTION MAY BE REMOVED FOR DIELECTRIC STRENGTH TESTING. ENSURE THAT THE JUMPER IS INSTALLED AFTER TESTING.
5. ON REVISION 1 UNITS,  $\oplus$  SCREW IS NOT PRESENT AND ENCLOSURE IS ELECTRICALLY CONNECTED TO TERMINAL G.
6. NOT ALL CERTIFICATIONS SHOWN.

FIGURE 12. ER-600VC Sensing Resistor.

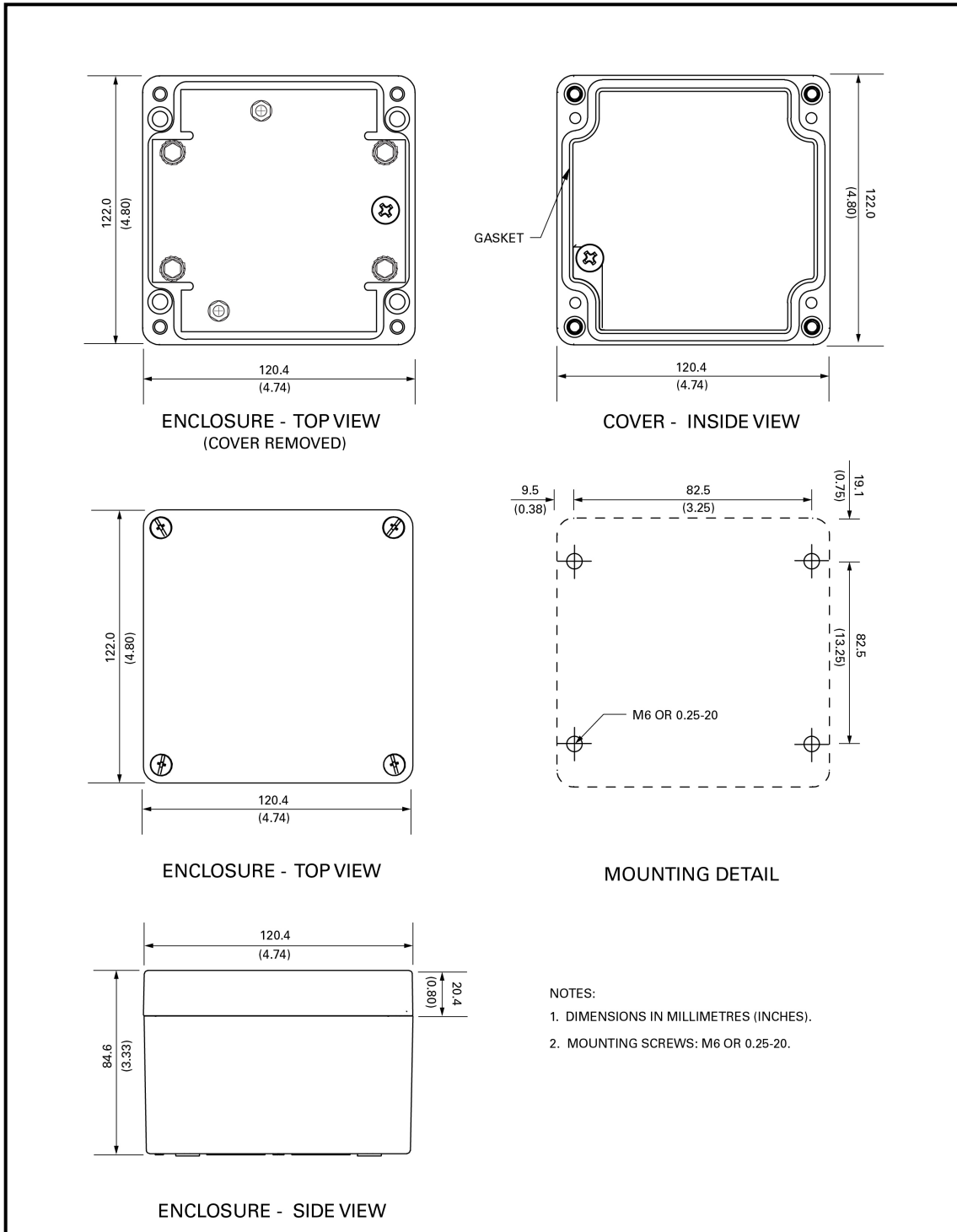


FIGURE 13. SE-MRE-600 Moisture-Resistant Enclosure Outline

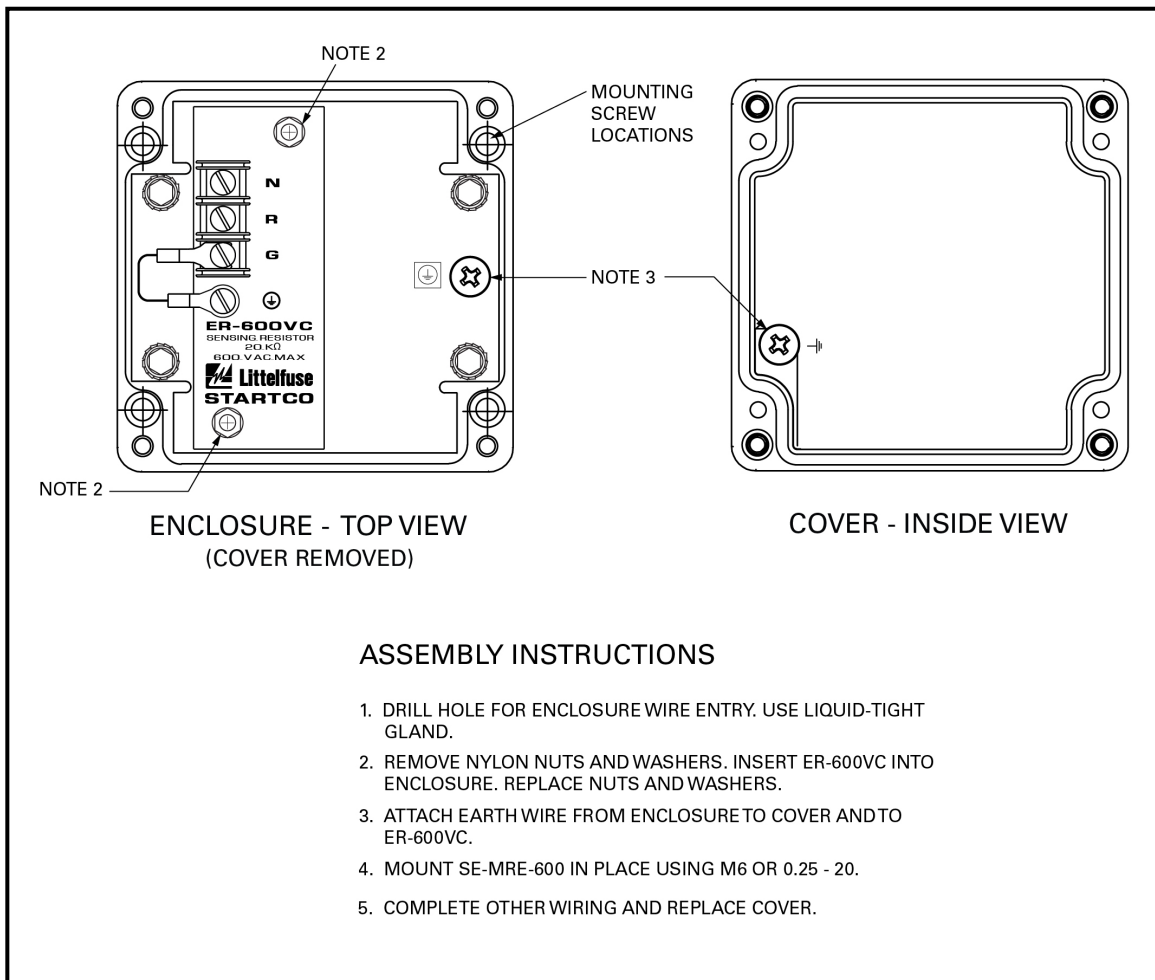


FIGURE 14. ER-600VC Installed in SE-MRE-600

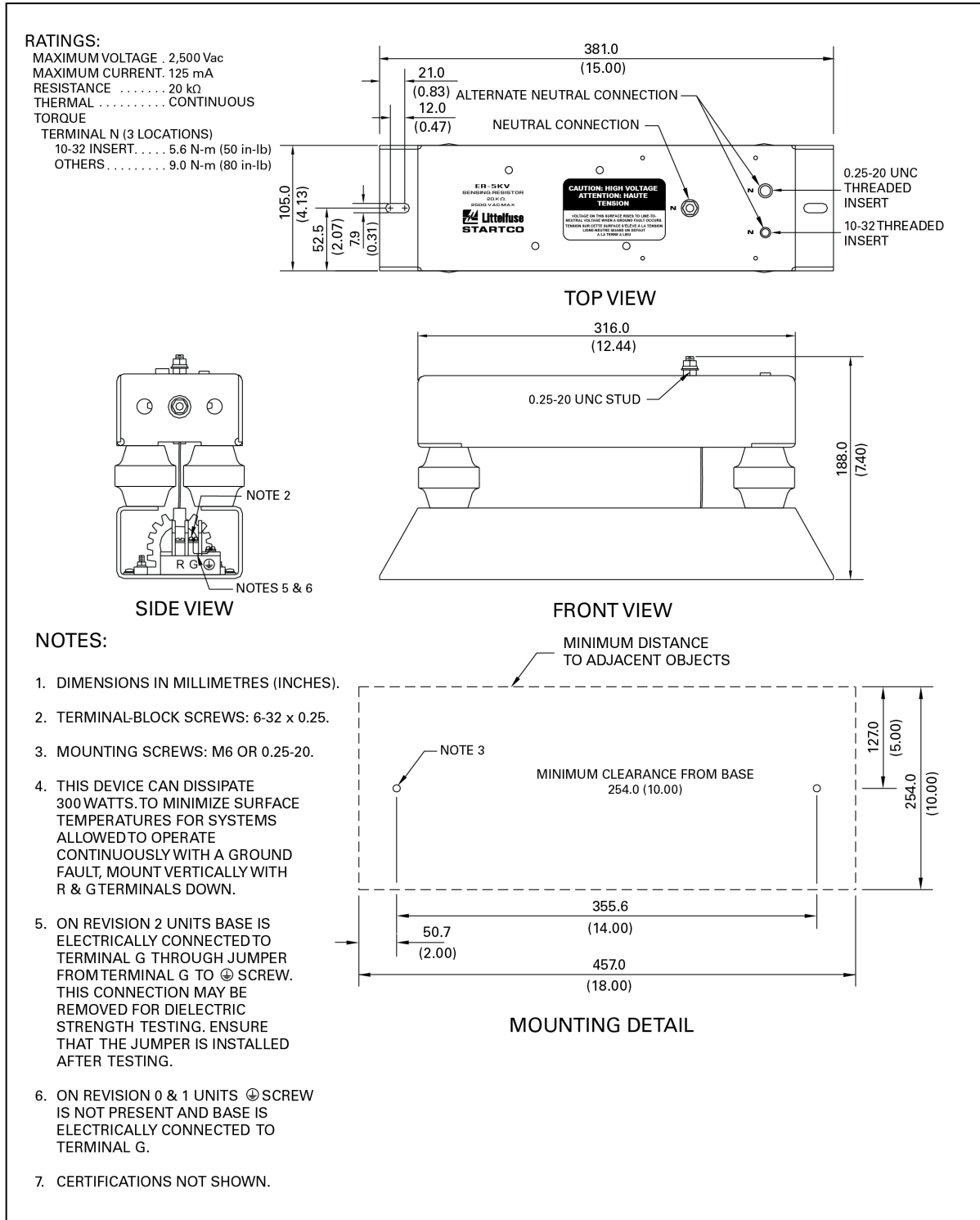


FIGURE 15. ER-5KV Sensing Resistor.

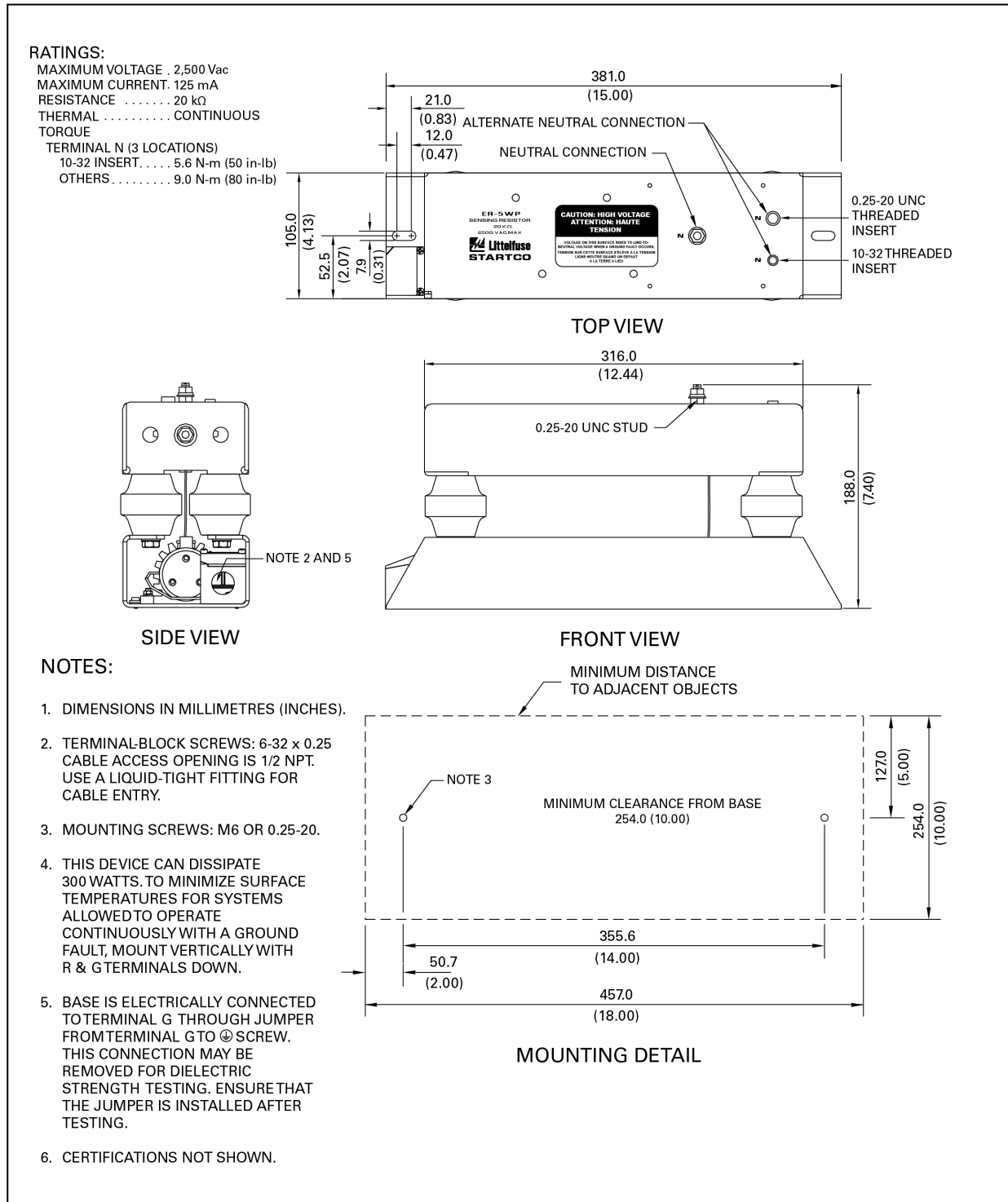


FIGURE 16. ER-5WP Sensing Resistor



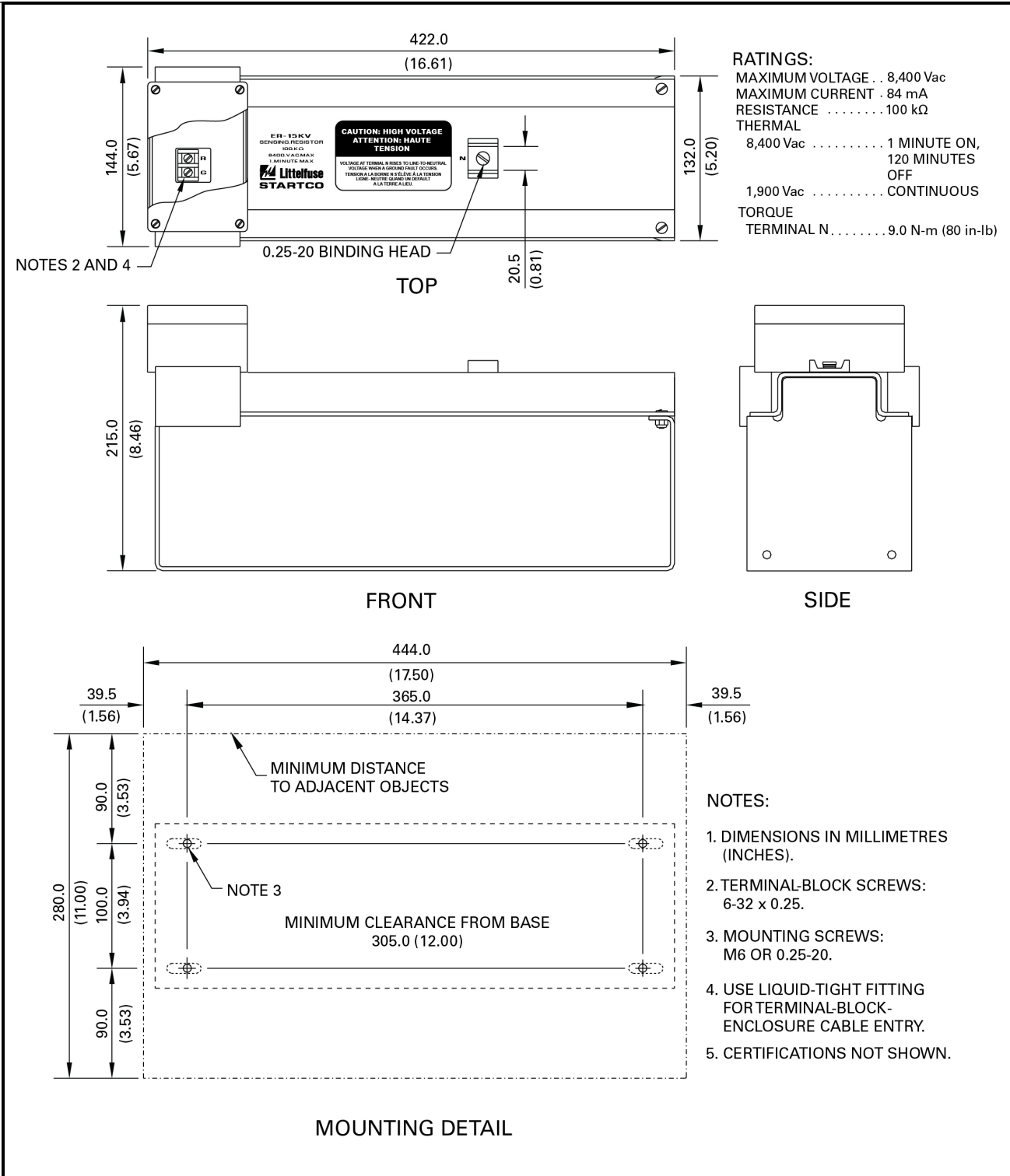


FIGURE 17. ER-15KV Sensing Resistor.

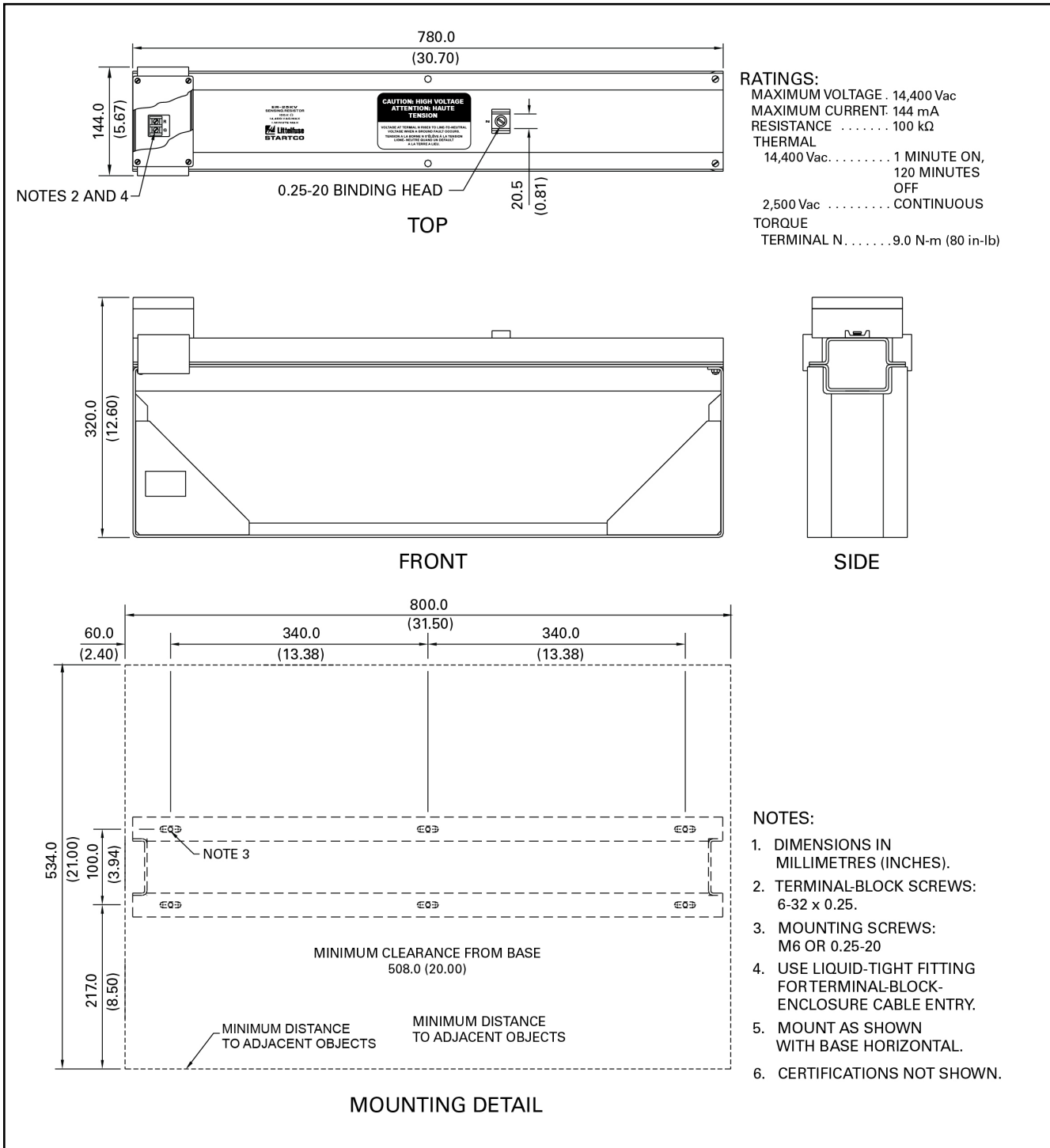


FIGURE 18. ER-25KV Sensing Resistor.

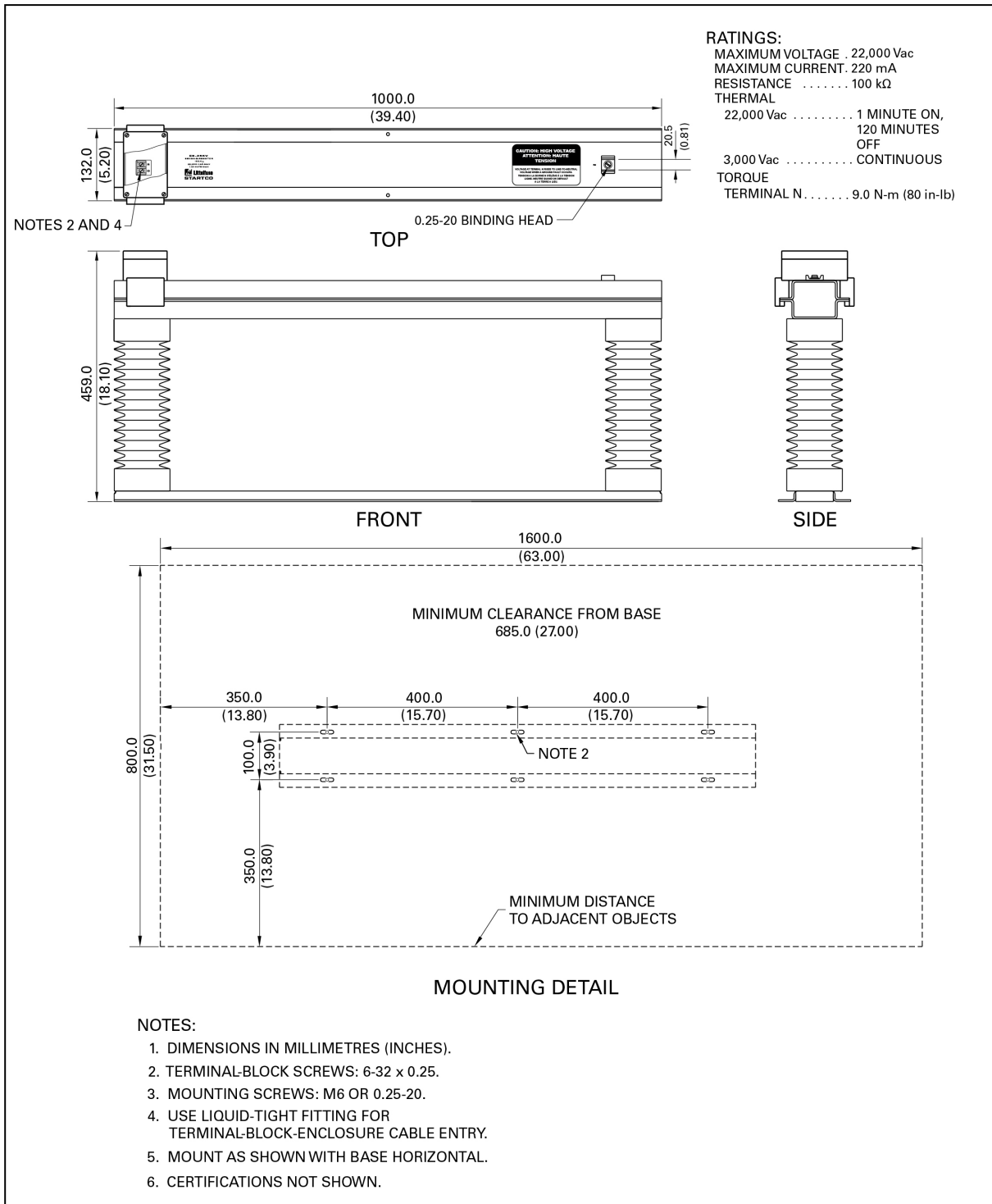


FIGURE 19. ER-35KV Sensing Resistor.

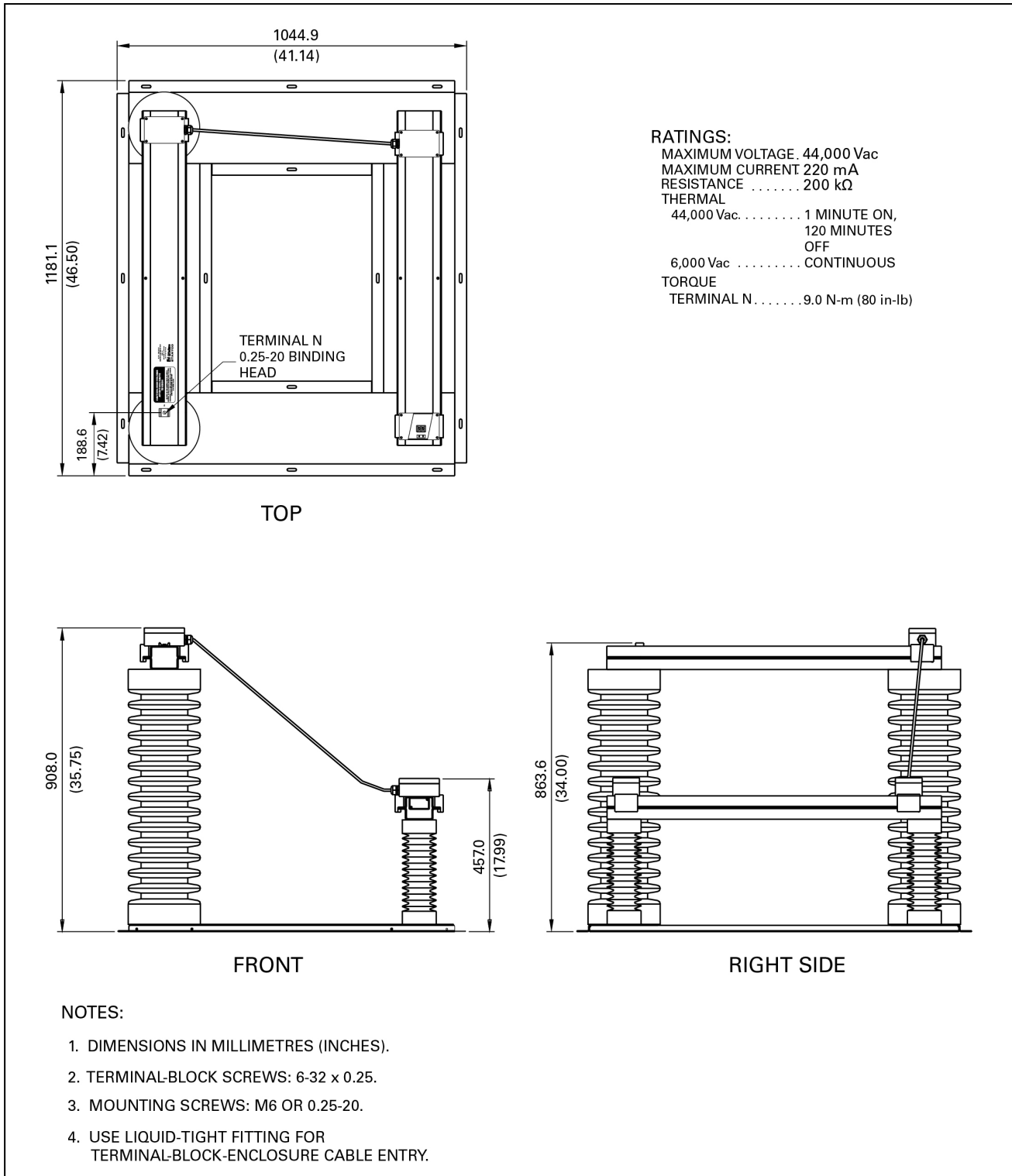


FIGURE 20. ER-72KV Sensing Resistor Outline.

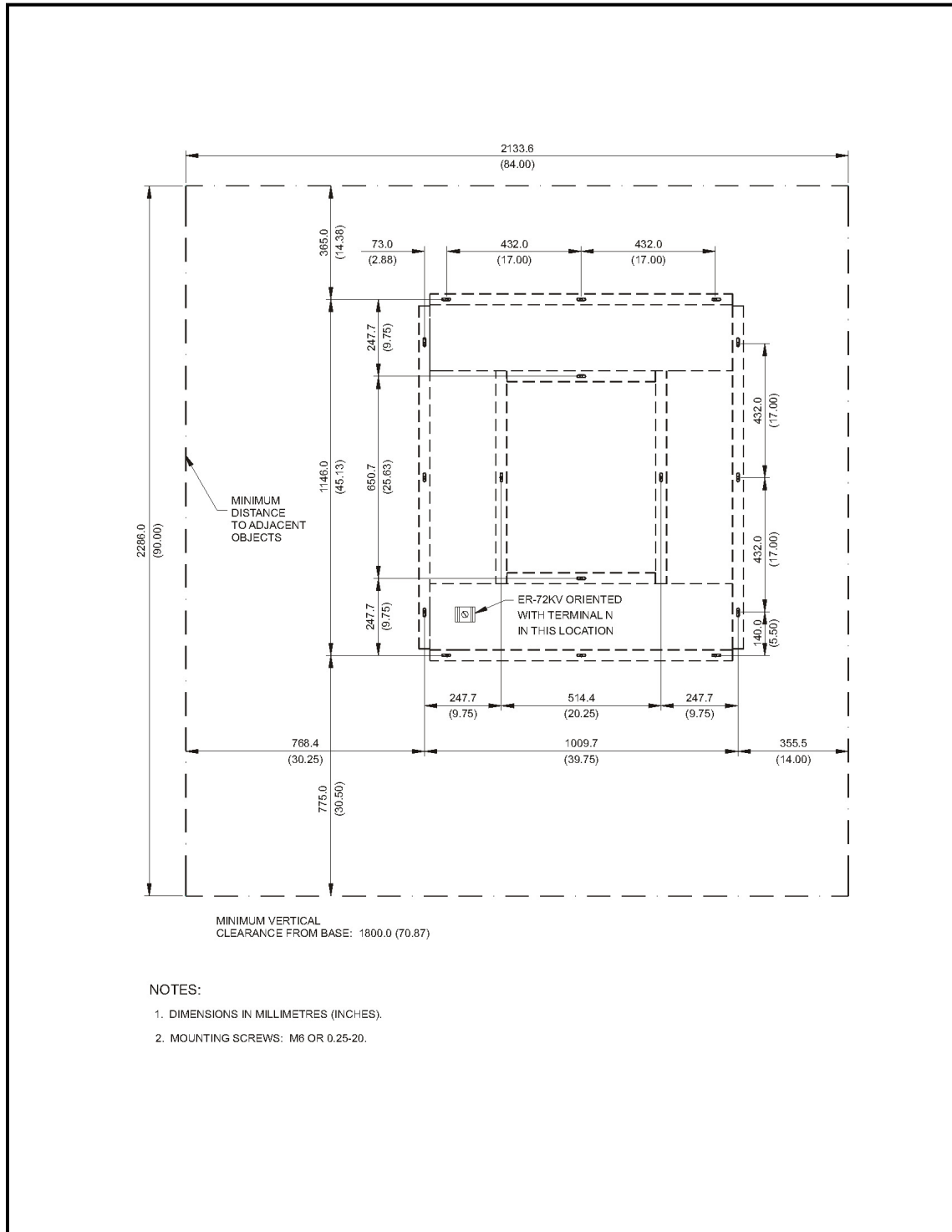
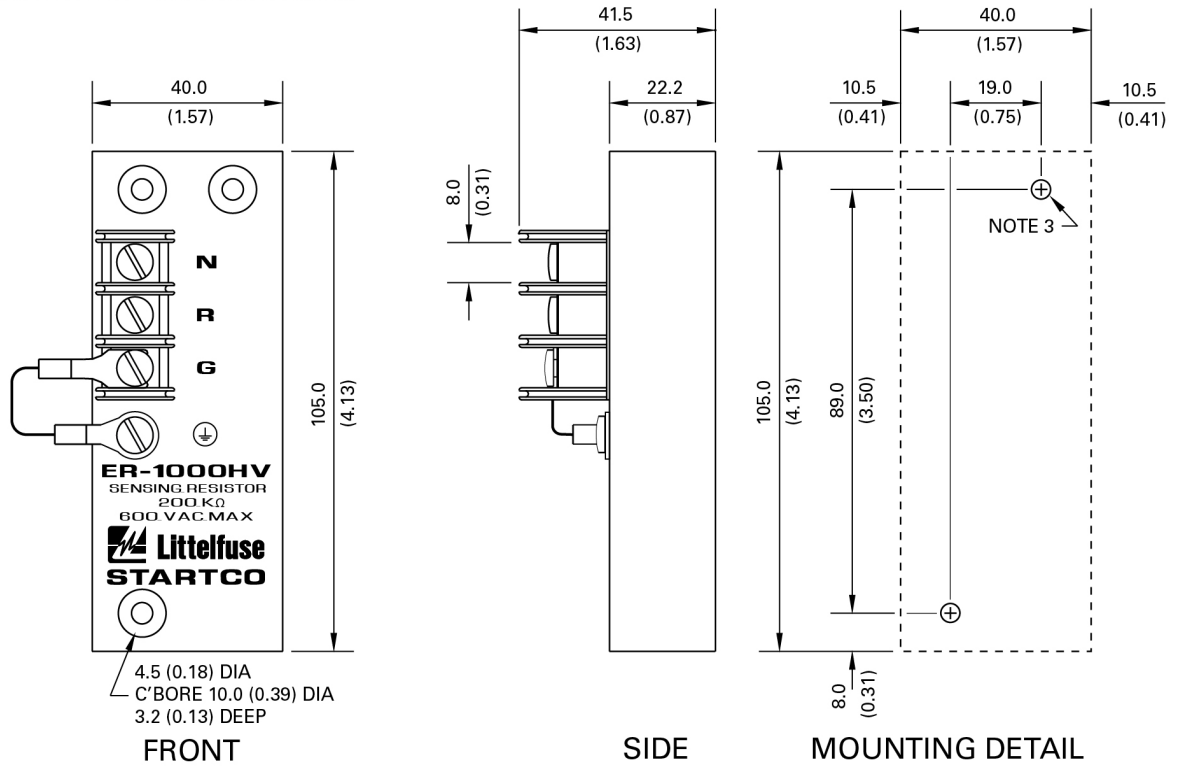


FIGURE 21. ER-72KV Sensing Resistor Mounting Details.

**RATINGS:**

MAXIMUM VOLTAGE . 600 Vac  
MAXIMUM CURRENT. 3 mA  
RESISTANCE . . . . . 200 kΩ  
THERMAL . . . . . 600 Vac 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 22. ER-1000HV Sensing Resistor.

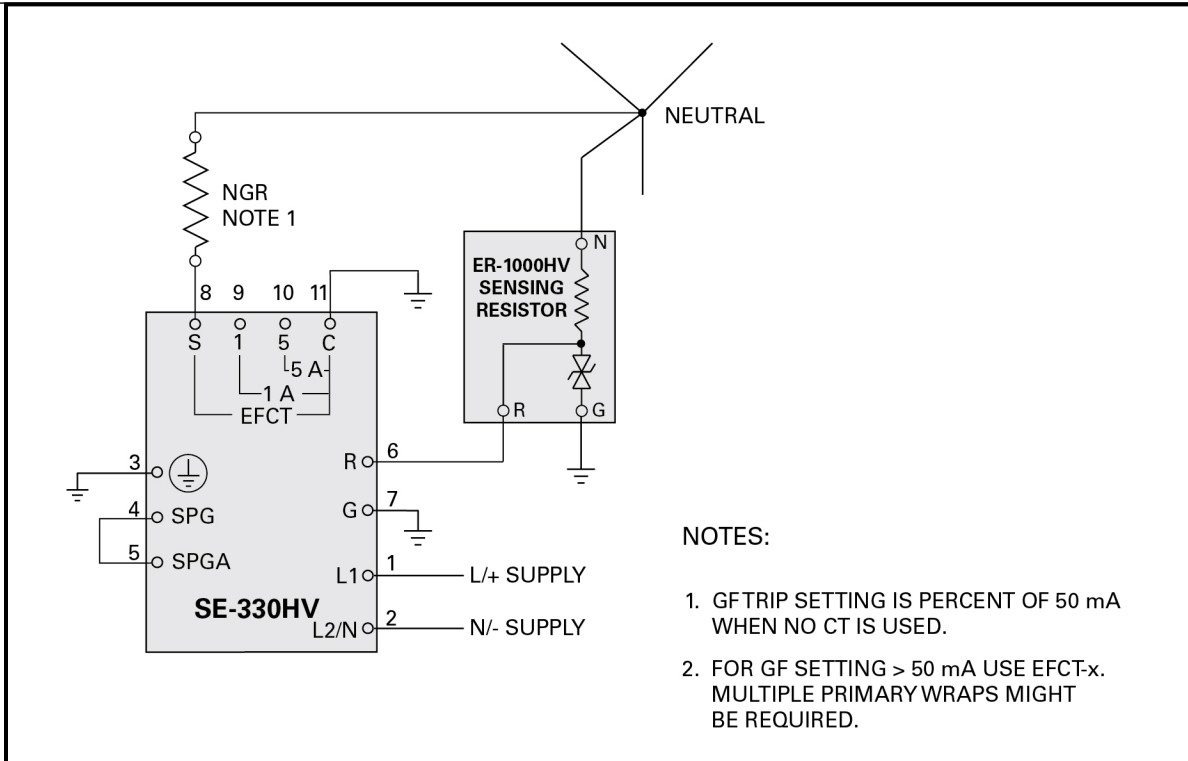


FIGURE 23. ER-1000HV Simplified Connection Diagram

### 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 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 ELCT5- and ELCT30-series current sensors are shown in Figures 24 and 25 (SE-330 and SE-330HV only).

Outline and mounting details for the EFCT- and SE-CS30-series current sensors are shown in Figures 26, 27, and 28 (compatible with SE-330 and SE-330HV, but must be used with SE-330AU).

Ground-fault-CT connections and the typical ground-fault-CT location are shown in Figures 5, 6, and 7.

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 SE-330 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, will decrease 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 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.



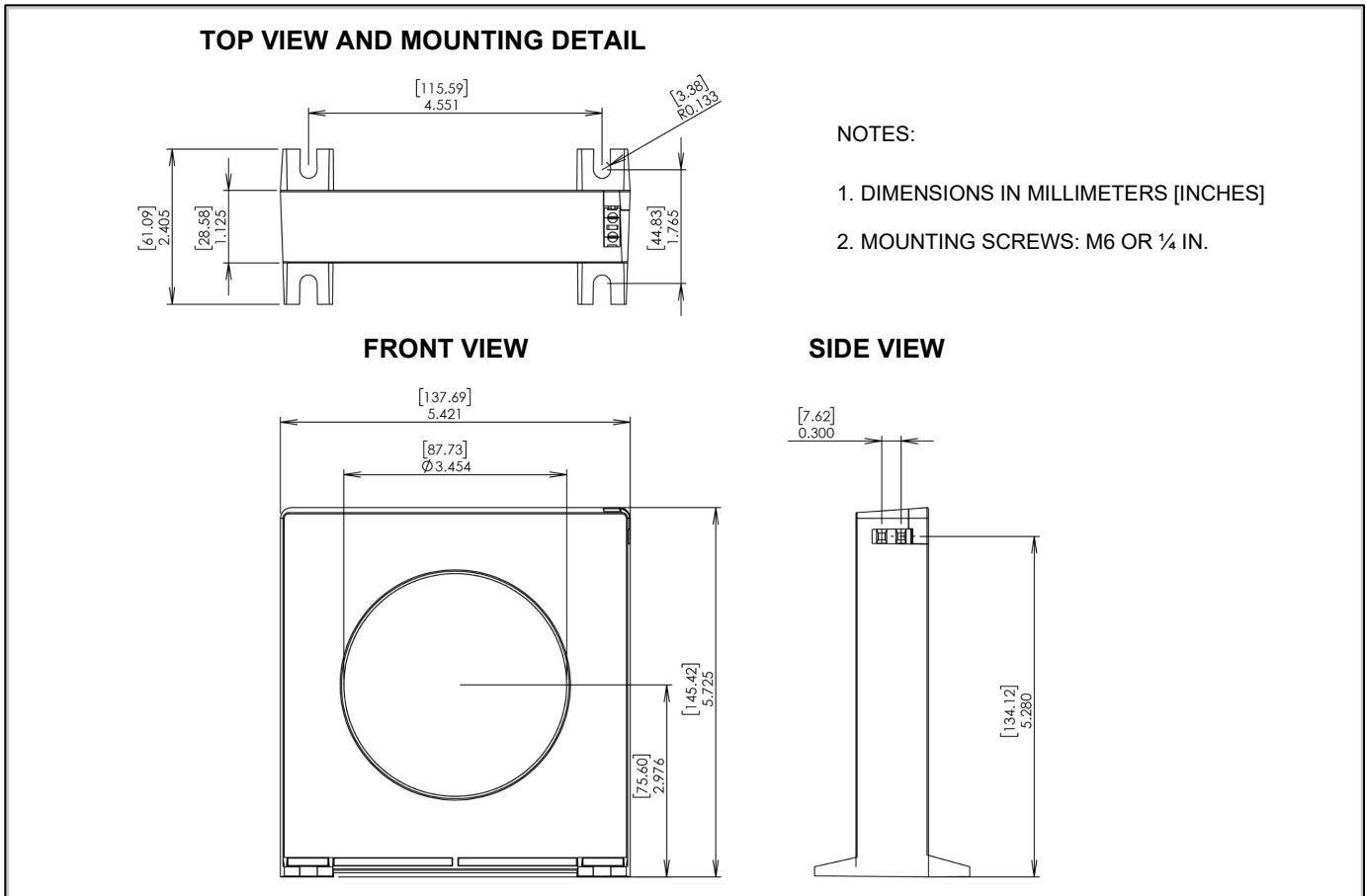


FIGURE 24. ELCT5-88 and ELCT30-88 Ground-Fault Current Sensors

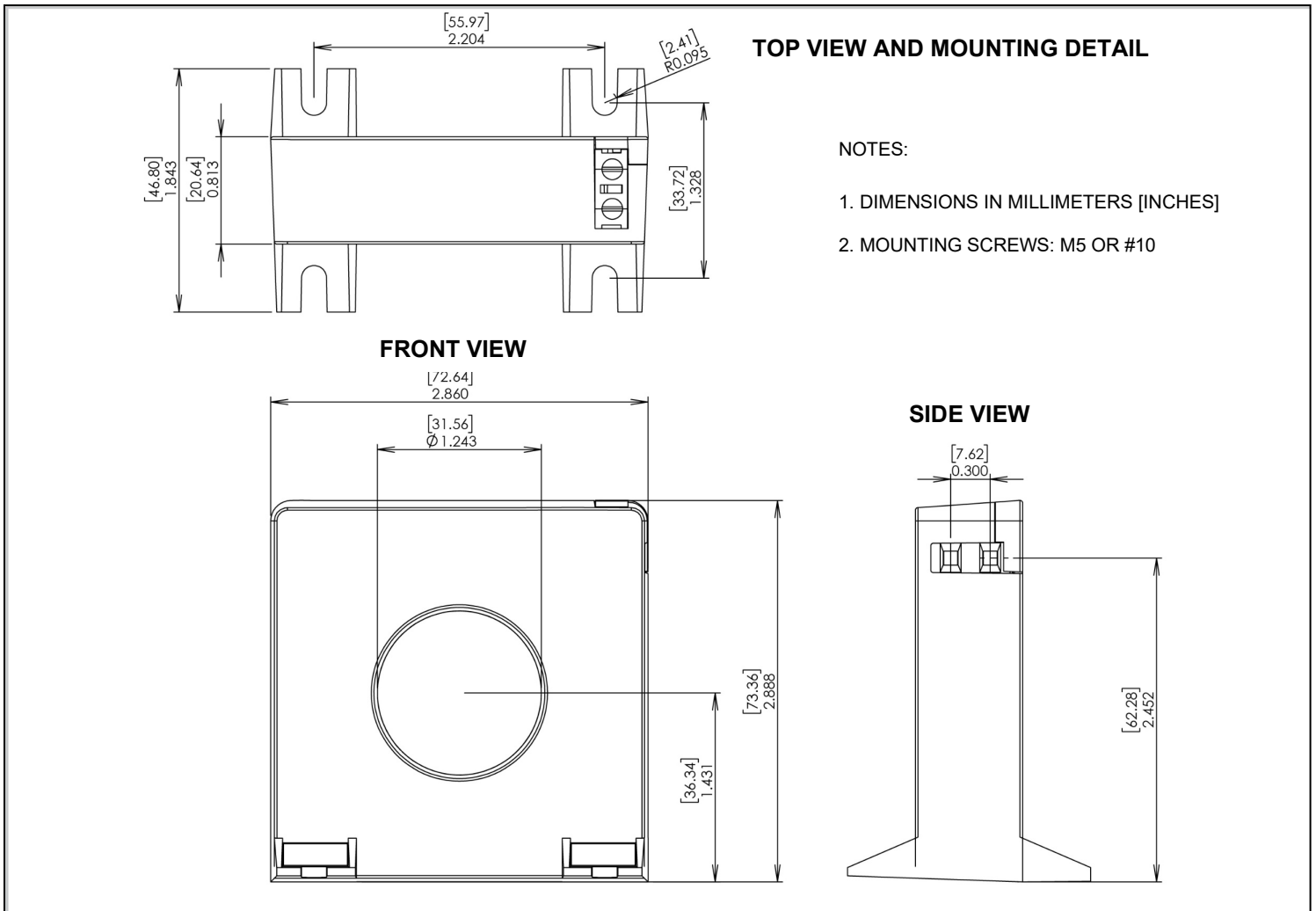


FIGURE 25. ELCT5-31 and ELCT30-31 Ground-Fault Current Sensors.

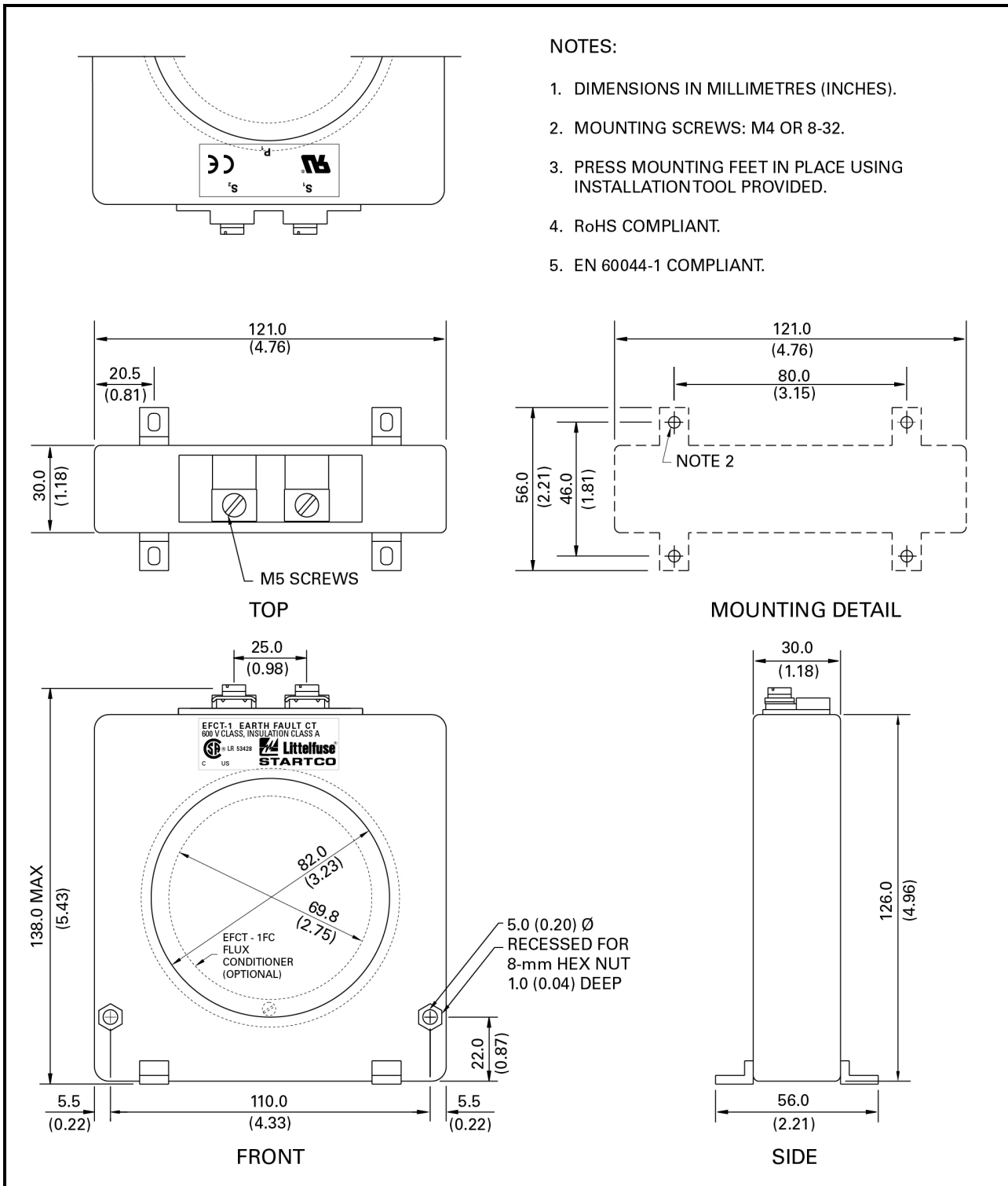


FIGURE 26. EFCT-1 Ground-Fault Current Sensor.

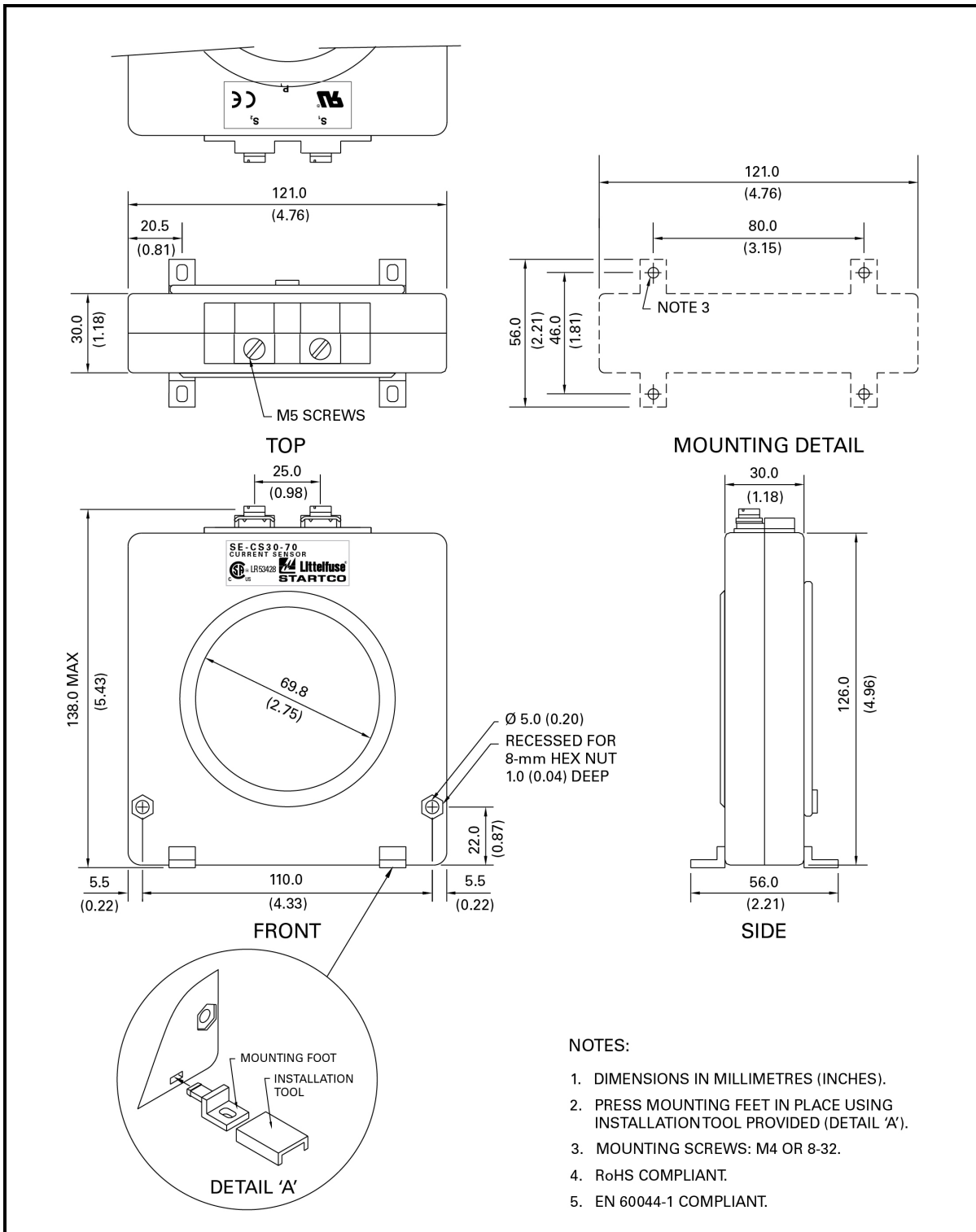


FIGURE 27. SE-CS30-70 Ground-Fault Current Sensor

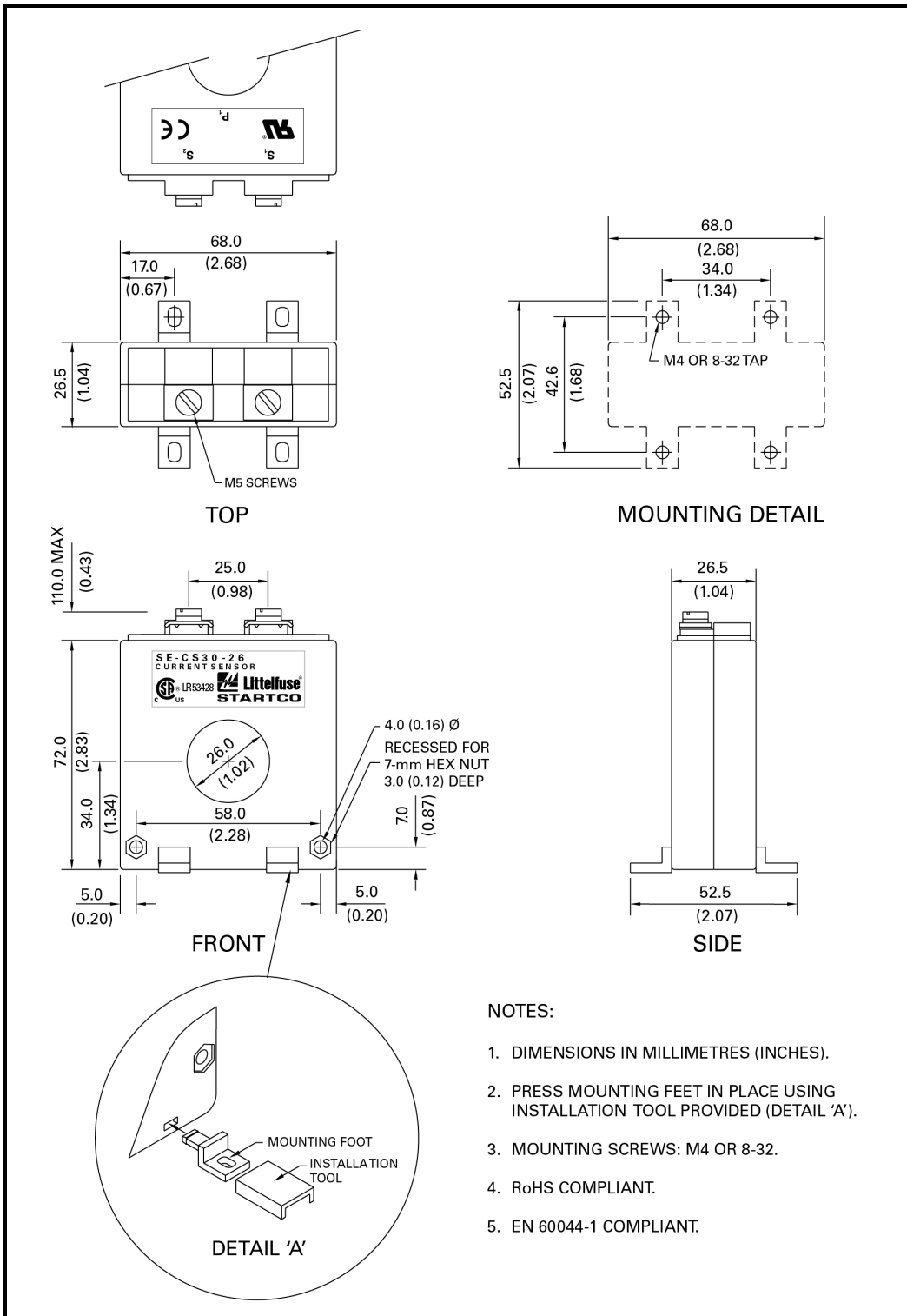


FIGURE 28. EFCT-26 and SE-CS30-26 Ground-Fault Current Sensors

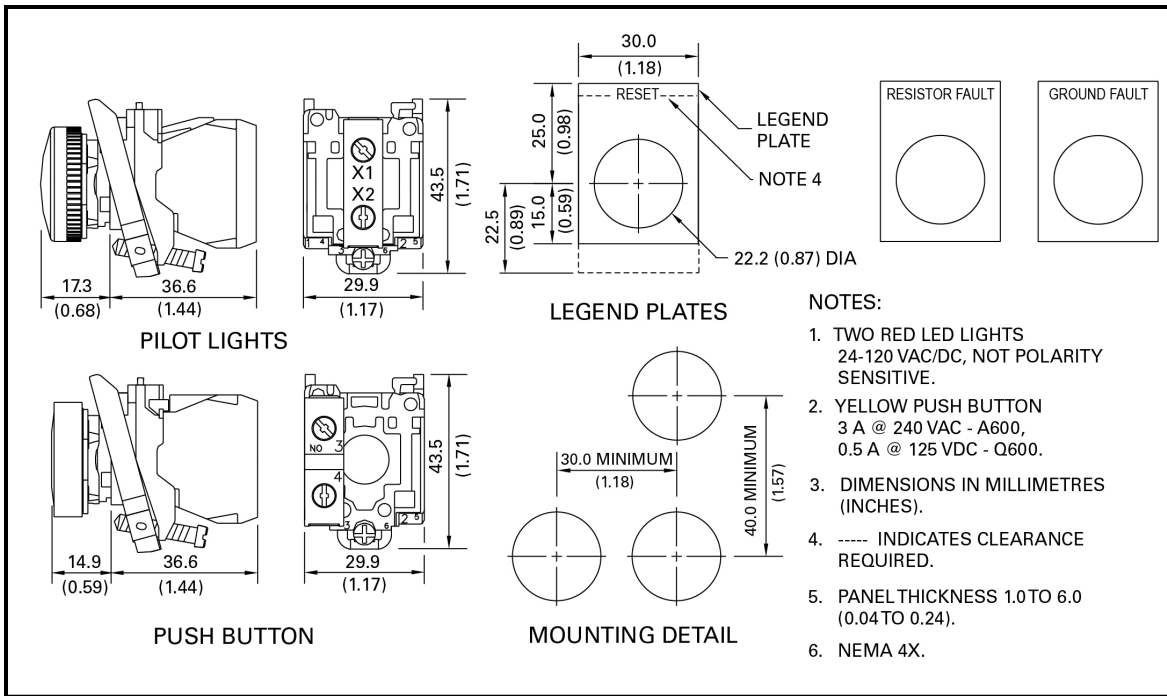


FIGURE 29. RK-332 Remote Indication and Reset.

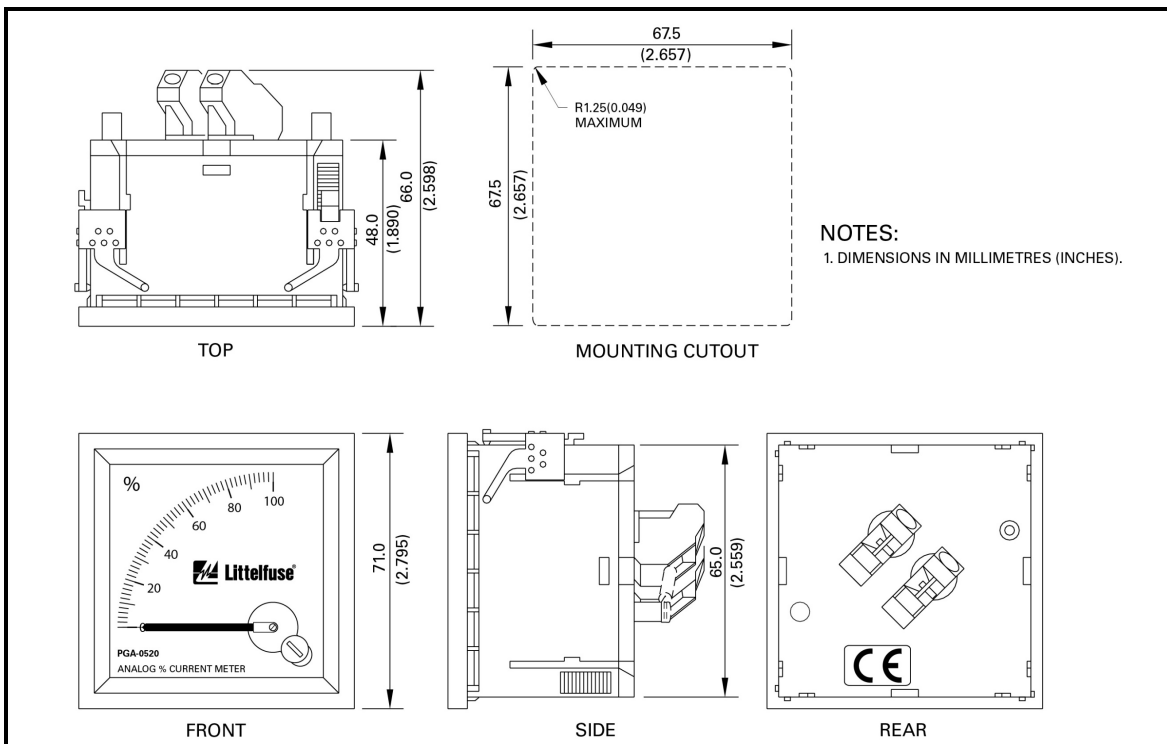


FIGURE 30. PGA-0520 Analog Percent Current Meter.

### 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-330 series are connected to an isolated ground, the SE-330 series will be exposed to the GPR. If the GPR is greater than the terminal-block rating, the SE-330 series 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 <http://www.littelfuse.com/relayscontrols>.

A configuration which allows an SE-330 series to be connected to station ground is shown in Fig. 31. The SE-330 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.

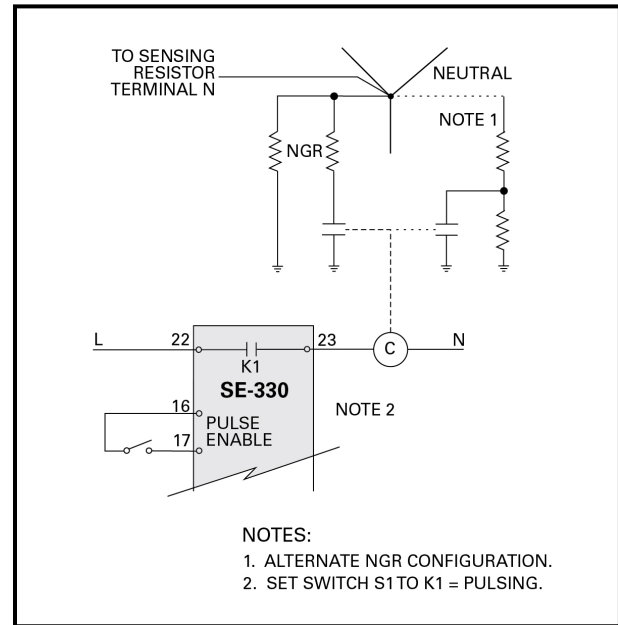


FIGURE 32. Simplified Pulsing Connection.

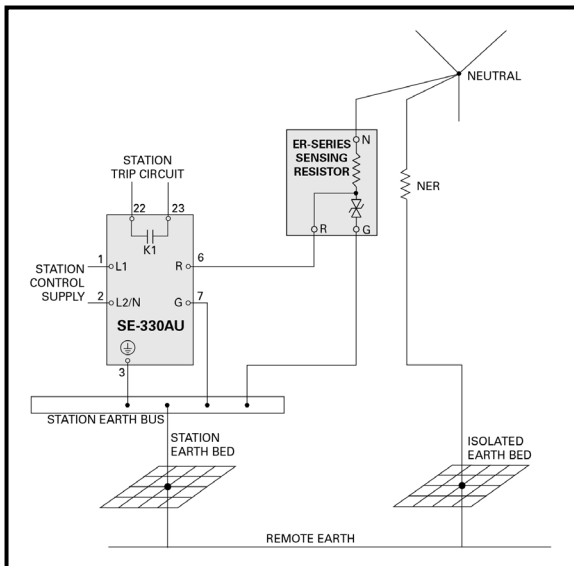


FIGURE 31. Simplified Isolated-Ground Connection.

### 3.5 Pulsing Connection (SE-330 only)

Set switch S1 to K1 = PULSING and use an external switch as shown in Fig. 32 to use relay K1 to control a pulsing contactor. Relays K2 and K3 can be used for tripping and can be configured in the fail-safe or non-fail-safe mode using the SE-MON330 software.



## 4. Data Interfaces

### 4.1 SD Card

The SE-330 series supports microSD data storage. The microSD card port is located on the front panel just below the USB port. The microSD card is used for short-term data logging of measured values and for firmware upgrades.

NOTE: SD card performance may vary by manufacturer, model, and with varying environmental conditions. The included microSD card has a temperature rating of -25 to 85°C (-13 to 140°F). For applications colder than -25°C (-13°F), use an Industrial-Grade microSD card.

NOTE: SD card usage is intended for use with the SE-330 series only. Do not store other data on the SD card – files may be automatically deleted.

#### 4.1.1 Datalogging

When a microSD card is installed, data logging will automatically start after the card is indexed (indexing may take several minutes depending on the size of the card and the number of files).

Log files will be placed in a two-digit folder (01-12) representing the current month (the real-time clock must be properly set). A maximum of two months of most recent data will be stored.

The log is updated every two seconds and includes measured values, configuration parameters, and trip status. A new log file is created at the start of each day.

The red DIAGNOSTIC LED may indicate an SD Card error. See Sections 2.8 and 5.

#### 4.1.2 Firmware Upgrade

Firmware upgrades are performed using a microSD card in conjunction with configuration switch S8. See Section 2.1.5.7. The SE-Flash software is not required.

To upgrade the SE-330 series firmware, insert a microSD card containing the firmware upgrade file (.S19 format) in the root directory of the SD card and set switch S8 to UPGRADE within 5 to 30 seconds of card installation. If S8 is switched to UPGRADE after 30

seconds, the upgrade process will not occur. If the microSD card is inserted after S8 is switched to UPGRADE, switch S8 to RUN and then back to UPGRADE. The SE-330 evaluates firmware upgrade files found in the root directory of the microSD card and uses the first valid file.

Ensure that the DIAGNOSTIC LED is off before beginning the firmware upgrade process.

The red DIAGNOSTIC LED blinks rapidly while the firmware upgrade is running and the SE-330 may reset multiple times during the upgrade process. Do not remove the SD card or power off the SE-330 until the DIAGNOSTIC LED has stopped blinking rapidly for at least 30 seconds. If the upgrade is not successful, the DIAGNOSTIC LED will indicate an SD Upgrade Error. See Section 5. Set switch S8 back to RUN for normal operation. If a firmware upgrade fails, the existing firmware is not overwritten.

A record of the upgrade can be found in “upgrade log\_<SN>.txt” on the microSD card. This file is updated each time an upgrade is performed.

NOTE: The maximum microSD card storage capacity is 32 GB for SE-330 series hardware revision 16 and higher. The maximum microSD card storage capacity is 4 GB for SE-330 hardware revision 15 and lower.

### 4.2 USB Interface

Use the SE-MON330 software to access set-points, measured values, and trip records through the Mini-B USB interface located on the front panel. For more details about how to change these values, refer to Appendix A. The following data can be viewed:

- Front-panel and configuration-switch settings
- Neutral voltage and neutral current
- Resistance change from the calibrated value
- Trip status
- Trip records, 100 date and time stamped
- Firmware version and serial number

The following values can be viewed and adjusted:

- Ground-fault trip setting (when front-panel GF Trip Level is set to MEM)

- K1, K2, K3 relay assignment
- K2 ground-fault relay output operating mode
- K3 resistor-fault relay output operating mode
- NGR Short Detection (multiple settings)
- Clock settings
- Trip records can be cleared
- Remote calibration
- Resistor-fault trip time
- Resistor-fault trip level
- Critical and non-critical diagnostic codes

Ensure the real-time clock is set to the correct time prior to normal operation. Trip records and on-board datalogging information include date and time readings from the clock. Refer to the SE-MON330 software help file for further information.

**NOTE:** SE-330 hardware revisions 10 and later include an internal rechargeable battery that powers the real-time clock. Please consult local regulations regarding the use of batteries in electrical equipment. The SE-330, SE-330HV, and SE-330AU battery is not designed for user service or removal; please contact Littelfuse with any questions regarding battery removal.

### 4.3 Network Communications

The optional communications interfaces include a single CAN port and dual Ethernet ports supporting cable, fiber<sup>(1)</sup>, or both cable and fiber. Protocols include:

- DeviceNet over CAN (ordering option 1)
- EtherNet/IP over cable or fiber (ordering options 3, 4, and 5)
- Modbus TCP over cable or fiber (ordering options 3, 4, and 5)
- IEC 61850 over cable or fiber (ordering options 6, 7, and 8)

Refer to the appropriate SE-330 series communications-interface manual for details.

<sup>(1)</sup> Uses the plug-in style SC connector.

## 5. Troubleshooting

PROBLEM	DIAGNOSTIC LED FLASH CODE <sup>(1)</sup>	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.
Calibration-Error Trip DIAGNOSTIC LED flash code	1 L - 1 S - 1 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.  Critical diagnostic code. GF LED <sup>(2)</sup> : No Change, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip
Remote Trip DIAGNOSTIC LED flash code	1 L - 2 S - 1 L	The SE-330 was tripped by a signal from network communications. Press RESET to clear the trip.  Critical diagnostic code. GF LED <sup>(2)</sup> : ON, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip
CT-Detection-Error Trip DIAGNOSTIC LED flash code	1 L - 3 S - 1 L	The CT connection to the SE-330AU is open. Correct the problem and press RESET.  Critical diagnostic code.
A/D-Converter-Error Trip DIAGNOSTIC LED flash code	1 L - 4 S - 1 L	An A/D-converter error was detected. Press RESET to clear the trip. If the problem persists, consult Littelfuse.  Critical diagnostic code. GF LED <sup>(2)</sup> : No Change, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip
SD Card DIAGNOSTIC LED flash code	1 L - 5 S - 1 L	SD Card is full or a write error occurred. Delete files or use a different microSD™ card.  Non-critical diagnostic code. GF LED <sup>(2)</sup> : No Change, RF LED <sup>(2)</sup> : No Change, Assigned Relay:No Change  If this diagnostic was caused during an attempt to upgrade the firmware, follow this alternate process: - remove supply from SE-330 - insert a microSD card containing the firmware upgrade file in the root directory of the SD card - power on the SE-330 - set switch S8 to UPGRADE within 30 seconds - the upgrade should continue as described in Section 4.1.2
Watchdog Trip DIAGNOSTIC LED flash code	1 L - 6 S - 1 L	A watchdog trip results 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.  Critical diagnostic code. GF LED <sup>(2)</sup> : ON, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip

PROBLEM	DIAGNOSTIC LED FLASH CODE <sup>(1)</sup>	SOLUTION
CPU Trip DIAGNOSTIC LED flash code	1 L - 7 S - 1 L	The CPU has detected a system fault. Press RESET to clear the trip. Critical diagnostic code. GF LED <sup>(2)</sup> : ON, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip
Non-Volatile Memory Error Trip DIAGNOSTIC LED flash code	1 L - 8 S - 1 L	An error was detected in the Non-Volatile Memory. Press RESET to clear the trip. If the problem persists, consult Littelfuse. Critical diagnostic code. GF LED <sup>(2)</sup> : ON, RF LED <sup>(2)</sup> : ON, Assigned Relay:Trip
SD Upgrade Error DIAGNOSTIC LED flash code	1 L - 9 S - 1 L	An error occurred during the flash-memory upgrade procedure. Ensure that the firmware upgrade file is correct or use a different microSD card. Critical diagnostic code. GF LED <sup>(2)</sup> : No Change, RF LED <sup>(2)</sup> : No Change, Assigned Relay:No Change
USB Error DIAGNOSTIC LED flash code	1 L - 10 S - 1 L	A USB algorithm timeout has been detected. Remove and reconnect the USB cable and cycle supply voltage. If the problem persists, contact Littelfuse. Non-critical diagnostic code. GF LED <sup>(2)</sup> : No Change, RF LED <sup>(2)</sup> : No Change, Assigned Relay :No Change
DIAGNOSTIC LED = Solid Red		SE-330 processor failed to start. Cycle supply. If problem persists, consult Littelfuse. K1: De-energized.
Pressing RESET does not clear trips.		Trip condition is still present. Locate and correct.  The 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.
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.

NOTES:

<sup>(1)</sup> L = long pause, S = short flash.

<sup>(2)</sup> When LED is on, corresponding indication relay is energized when in the non-fail-safe mode or de-energized when in the fail-safe mode.

## 6. Technical Specifications

### 6.1 SE-330 Series (unless otherwise stated)

#### Supply:

Option 0.....	30 VA, 120 to 240 V ac (+10, -45%), 50/60 Hz; 20 W, 110 to 250 V dc (+10, -25%)
Option 2.....	20 W, 48 V dc (+50, -25%); 35 VA, 48 V ac (+10, -45%), 50/60 Hz
Power-Up Time .....	3 s at 120 V ac
AC Measurements.....	Discrete Fourier Transform.16 samples per cycle, 50 or 60 Hz

#### Resistor-Fault Circuit:

Neutral-To-Ground Voltage Trip Levels <sup>(1)</sup> :	
ER-600VC or ER-5KV .....	20; 60; 100; 130; 170; 200; 340; 800; 1,200; 1,700; 2,000 V ac
ER-15KV to ER-35KV.....	100; 300; 500; 650; 850;1,000; 1,700; 4,000; 6,000; 8,500; 10,000 V ac
ER-1000HV, ER-72KV.....	200; 600; 1,000; 1,300; 1,700; 2,000; 3,400; 8,000;12,000; 17,000; 20,000 Vac
Accuracy .....	10% of setting
3 dB Frequency Response:	
S6 = 50 Hz .....	25 to 85 Hz
S6 = 60 Hz .....	30 to 90 Hz
NGR Calibration Range:	
ER-600VC, ER-5KV, or ER-5WP .....	0 to 2 k $\Omega$
ER-15KV to ER-35K .....	0 to 10 k $\Omega$
ER-1000HV, ER-72KV .....	0 to 20 k $\Omega$
Trip Resistance, $V_N = 0$ :	
ER-600VC, ER-5KV, or ER-5WP:	
Range <sup>(5)</sup> .....	250 to 750- $\Omega$ change $\pm$ 200 $\Omega$
Default.....	500- $\Omega$ change

#### ER-15KV to ER-35KV:

Range <sup>(5)</sup> .....	1.25 to 3.75-k $\Omega$ change $\pm$ 1 k $\Omega$
Default.....	2.5-k $\Omega$ change

#### ER-1000HV, ER-72KV:

Range <sup>(5)</sup> .....	2.5 to 7.5-k $\Omega$ change $\pm$ 2 k $\Omega$
Default .....	5-k $\Omega$ change

#### Neutral-To-Ground DC-Voltage Rejection:

ER-600VC, ER-5KV, or ER-5WP .....	25 Vdc
ER-15KV to ER-35KV .....	125 Vdc
ER-1000HV, ER-72KV .....	250 Vdc

#### Trip Time

SE-330 and SE-330HV .....	12 to 60 s $\pm$ 1 s
SE-330AU .....	10 s maximum

#### Trip Mode

SE-330 and SE-330HV .....	Latching/Non-Latching
SE-330AU .....	Latching only

#### Resistor-Fault Detection (SE-330):

##### NGR Short Detection:

NGR Short Mode .....	Sensitive or Standard
Sensitive Trip Level.....	10 to 70% of Nominal NGR Resistance, 10% default

##### Standard Trip Level:

20 k $\Omega$ Sensing Resistor.....	250 to 750 $\Omega$ , 500 $\Omega$ default
100 k $\Omega$ Sensing Resistor.....	1250 to 3750 $\Omega$ , 2500 $\Omega$ default

##### NGR Open Detection:

NGR Open Mode .....	Sensitive or Standard
Sensitive Trip Level.....	120 to 1000% of Nominal NGR Resistance, 1000% Default

##### Standard Trip Level:

20 k $\Omega$ Sensing Resistor.....	250 to 750 $\Omega$ , 500 $\Omega$ Default
100 k $\Omega$ Sensing Resistor .....	1250 to 3750 $\Omega$ , 2500 $\Omega$ default

##### Default NGR Resistance...

69  $\Omega$

##### Minimum and Maximum NGR Resistance:

##### 20 k $\Omega$ Sensing Resistor:

Temperature 0 to 40°C.....	15 $\Omega$ minimum
Temperature -40 to 60°C.....	22 $\Omega$ minimum

Max NGR Resistance..... 2000  $\Omega$

##### 100 k $\Omega$ Sensing Resistor:

Temperature 0 to 40°C ..... 50 Ω minimum  
 Temperature -40 to 60°C ..... 75 Ω minimum  
 Max NGR Resistance ..... 10000 Ω

Resistor-Fault Detection (SE-330HV):

NGR Short Detection:

NGR Short Mode ..... Sensitive or Standard  
 Sensitive Trip Level ..... 10 to 70% of Nominal NGR  
 Resistance, 10% default

Standard Trip Level:

100 kΩ Sensing Resistor ..... 1250 to 3750 Ω, 2500 Ω default  
 200 kΩ Sensing Resistor ..... 2500 to 7500 Ω, 5000 Ω  
 default

NGR Open Detection:

NGR Open Mode ..... Sensitive or Standard  
 Sensitive Trip Level ..... 120 to 1000% of  
 Nominal NGR  
 Resistance, 1000%  
 default

Standard Trip Level:

100 kΩ Sensing Resistor ..... 1250 to 3750, 2500 Ω default  
 200 kΩ Sensing Resistor ..... 2500 to 7500 Ω, 5000 Ω default

Default NGR Resistance ..... 277 Ω

Minimum and Maximum NGR Resistance:

100 kΩ Sensing Resistor: .....  
 Temperature 0 to 40°C ..... 50 Ω minimum  
 Temperature -40 to 60°C ..... 75 Ω minimum  
 Max NGR Resistance ..... 10000 Ω

200 kΩ Sensing Resistor:

Temperature 0 to 40°C ..... 150 Ω minimum  
 Temperature -40 to 60°C ..... 225 Ω minimum

Max NGR Resistance ..... 20000 Ω

Resistor-Fault Detection (SE-330AU):

NGR Short Detection:

NGR Short Mode ..... Sensitive or Standard  
 Sensitive Trip Level ..... 50 to 70% of Nominal  
 NGR Resistance, 50%  
 default

Standard Trip Level:

20 kΩ Sensing Resistor ..... 250 to 750 Ω, 500 Ω default  
 100 kΩ Sensing Resistor ..... 1250 to 3750 Ω, 2500 Ω default

NGR Open Detection:

NGR Open Mode ..... Sensitive or Standard

Sensitive Trip Level ..... 130 to 200% of  
 Nominal NGR  
 Resistance, 200%  
 default

Standard Trip Level:

20 kΩ Sensing Resistor ..... 250 to 750 Ω, 500 Ω default  
 100 kΩ Sensing Resistor ..... 1250 to 3750 Ω, 2500 Ω default

Default NGR Resistance ..... 48 Ω

Minimum and Maximum NGR Resistance:

20 kΩ Sensing Resistor: .....  
 Temperature 0 to 40°C ..... 30 Ω minimum  
 Temperature -20 to 60°C ..... 44 Ω minimum  
 Max NGR Resistance ..... 2000 Ω

100 kΩ Sensing Resistor:

Temperature 0 to 40°C ..... 110 Ω minimum  
 Temperature -20 to 60°C ..... 150 Ω minimum  
 Max NGR Resistance ..... 10000 Ω

Accuracy:

ER-600VC, ER-5KV, ER-5WP:

0 to 40° C ..... ±5 Ω typical, ±10 Ω maximum  
 40 to 60° C ..... ±12 Ω typical, ±20 Ω maximum

ER-15KV, ER-25KV, ER-35KV:

0 to 40° C ..... ±30 Ω typical, ±50 Ω maximum  
 -40 to 60° C ..... ±60 Ω typical, ±100 Ω maximum

ER-72KV, ER-1000V:

0 to 40° C ..... ±60 Ω typical, ±100 Ω maximum  
 -40 to 60° C ..... ±120 Ω typical, ±200 Ω  
 maximum

Optimum Calibration

Temperature ..... Midpoint of local/installed  
 temperature range.

Ground-Fault Circuit:

SE-330 and SE-330HV:

Trip Level ..... 2, 4, 6, 8, 10, 20, 40, 60,  
 80, 100% of CT-  
 Primary Rating or 2 to  
 100% using MEM  
 parameter  
 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 Mode ..... Latching or Non-Latching

SE-330AU:

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

EFCT-x.....0.125, 0.25, 0.30, 0.40,  
0.50, 1, 2, 3, 4, 5 A

SE-CS30-x .....0.75, 1.5, 1.8, 2.4, 3.0,  
6.0, 12.0, 18.0, 24.0,  
30.0 A

Trip Time .....0.10, 0.12, 0.14, 0.16,  
0.18, 0.20, 0.25, 0.30,  
0.35, 0.40, 0.50 s

Trip-Level Accuracy.....±10% of setting

Trip-Time Accuracy .....+0, -20% of setting

Trip Mode.....Latching

3 dB Frequency Response:

S6 = 50 Hz .....25 to 85 Hz

S6 = 60 Hz .....30 to 90 Hz

Maximum CT lead resistance:

EFCT & SE-CS30.....5 Ω

Other CTs .....Consult CT Curve.

CT-Input Burden:

SE-330 and SE-330HV:

5-A Input.....< 0.01 Ω

1-A Input.....< 0.05 Ω

EFCT Input.....< 10 Ω

SE-330AU:

EFCT Input.....11 Ω

CS30 Input .....10 Ω

CT Detection Threshold.....15 Ω

Thermal Withstand:

1-A and 5-A Inputs:

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

Pulsing Circuit (SE-330 only):

Pulse Period.....1.0 to 3.0 s, 0.2-s Increments

Duty Cycle.....50%

Time Accuracy .....10% of Setting

Trip/Pulsing Relay K1 Contacts:

Configuration ..... N.O. (Form A)

Operating Mode:

SE-330 and SE-330HV ..... Fail-Safe or Non-Fail-Safe

SE-330AU ..... Fail-Safe only

CSA/UL Contact Ratings..... 8 A resistive 250 V ac,  
5 A resistive 30 V dc

Supplemental Contact Ratings:

Make/Carry 0.2 s..... 30 A

Break:

dc..... 75 W resistive  
35 W inductive  
(L/R = 0.004 s)

ac..... 2,000 VA resistive  
1,500 VA inductive  
(PF = 0.4)

Subject to maximums of 8 A at 250 Vac, 8 A  
resistive at 30 V dc, and 0.4 A resistive at 150 V dc.

GF (K2) and RF (K3) Relay Contacts:

Configuration ..... N.O. and N.C. (Form C)

Operating Mode (5) ..... Non-Fail-Safe or Fail-Safe

CSA/UL Contact Ratings..... 8 A resistive 250 V ac  
8 A resistive 30 V dc

Supplemental Contact Ratings:

Make/Carry 0.2 s..... 30 A

Break:

dc..... 75 W resistive  
35 W inductive  
(L/R = 0.004 s)

ac..... 2,000 VA resistive  
1,500 VA inductive  
(PF = 0.4)

Subject to maximums of 8 A at 250 Vac, 8 A  
resistive at 0 Vdc, and 0.4 A resistive at 150 Vdc.

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)	Tightening Torque .....	0.5 to 0.6 N·m (4.4 to 5.3 lbf·in)
Operating Mode .....	Open when Healthy	PWB Conformal Coating .....	MIL-1-46058 qualified, UL QMJU2 recognized
Ratings.....	100 mA, 250 V (ac or dc)	Mounting Configurations .....	Panel Mount and Optional Surface Mount
Closed Resistance .....	25 to 50 Ω	Dimensions:	
Auto-reset time (SE-330 and SE-330HV only): .....	2.8 s maximum	Height .....	213 mm (8.4 in.)
4-20-mA Analog Output:		Width .....	99 mm (3.9 in.)
Type .....	Self Powered and Loop Powered	Depth .....	132 mm (5.2 in.)
Range .....	4 to 22 mA	Shipping Weight.....	2.0 kg (4.4 lb)
Loop Voltage.....	8 to 36 V dc	Environment:	
Load .....	500 Ω (maximum with 24-V dc supply)	Operating Temperature.....	-40 to 60° C (-40 to 140°F)
Isolation.....	120 V ac	Storage Temperature .....	-55 to 80° C (-67 to 176°F)
Parameter .....	NGR Current, 20 mA = CT Primary Current	Humidity.....	85% Non-Condensing
USB Communications:		IP Rating .....	IP30
Baud Rate.....	12 Mbit/s	Surge Withstand .....	ANSI/IEEE C37.90.1- 1989 (Oscillatory and Fast Transient)
Protocol.....	USB Device	EMC Tests:	
Connector .....	Mini B	Verification tested in accordance with IEC 60255-26:2013.	
SD Memory Card:		Radiated and Conducted Emissions .....	CISPR 11:2009, CISPR 22:2008, EN 55022:2010 Class A
Type .....	Standard Grade	Current Harmonics and Voltage Fluctuations.....	IEC 61000-3-2 and IEC 61000-3-3 Class A
Form Factor.....	microSD <sup>(3)</sup> and microSDHC <sup>(3)</sup>	Electrostatic Discharge .....	IEC 61000-4-2 ± 6 kV contact discharge (direct and indirect) ± 8 kV air discharge
Format.....	FAT32	Radiated RF Immunity .....	IEC 61000-4-3 10 V/m, 80-1,000 MHz, 80% AM (1kHz) 10 V/m, 1.0 to 2.7 GHz, 80% AM (1 kHz)
Capacity:		Fast Transient.....	IEC 61000-4-4
SE-330 Series Hardware Revision 16 and higher.....	512 MB to 32 GB		
SE-330 Series Hardware Revision 15 and lower .....	512 MB to 4 GB		
Operating Temperature:			
Standard Grade (Included) .....	-25 to 85° C (-13 to 140° F)		
Industrial Grade.....	-40 to 85° C (-40 to 140° F)		
Real-Time Clock:			
Power-Off Operation .....	approx. 6 months at 20°C (68° F)		
Battery included only in hardware revision 10 and higher			
Terminals:			
Type	Wire Clamping		
Conductor Size.....	24 to 12 AWG (0.2 to 3.3 mm <sup>2</sup> )		



	Zone B ± 2 kV (power supply port), ± 1 kV (all other ports)
Surge Immunity.....	IEC 61000-4-5
	Zone B ± 1 kV differential mode ± 2 kV common mode
Conducted RF Immunity.....	IEC 61000-4-6 10 V, 0.15-80 MHz, 80% AM (1 kHz)
Magnetic Field Immunity.....	IEC 61000-4-8 50 Hz and 60 Hz 30 A/m and 300 A/m
Power Frequency <sup>(4)</sup> .....	IEC 61000-4-16 Zone A: differential mode 100 V <sub>rms</sub> Zone A: common mode 300 V <sub>rms</sub>
1 MHz Burst .....	IEC 61000-4-18 ± 1 kV differential mode (line-to-line) ± 2.5 kV common mode
Voltage Interruption .....	IEC 61000-4-11, IEC 61000-4-29 0% for 10, 20, 30, 50 ms (dc) 0% for 0.5, 1, 2.5, 5 cycles (60 Hz) IEC 61000-4-17 Level 4, 15% of rated dc value



CE, European Union



FCC



CSA C22.2 No. 14 Industrial Control Equipment  
UL 508 Industrial Control Equipment  
UL 1053 Ground Fault Sensing and Relaying Equipment  
Australia, Regulatory Compliance Mark (RCM)  
CE Low Voltage Directive  
IEC 61010-1:2010 (3<sup>rd</sup> Edition) + AMD 1:2016  
FCC CFR47, Part 15, Subpart B,  
Class A – Unintentional Radiators

SE-330AU..... Australia



CE, European Union



FCC



Australia, Regulatory Compliance Mark (RCM)  
CE Low Voltage Directive  
IEC 61010-1:2010 (3<sup>rd</sup> Edition) + AMD 1:2016  
FCC CFR47, Part 15, Subpart B,  
Class A – Unintentional Radiators  
Compliance:  
AS/NZS 2081.6:2011 – Earth Fault Protection Devices  
AS/NZS 2081.8:2011 – NER Integrity Protection Devices

Certification

SE-330 and SE-330HV.....CSA, Canada and USA



UL Listed



Australia

NOTES:

- (1) See sensing resistor specifications for applicable voltage limits.
- (2) Accuracy included for EFCT-x and SE-CS30-x current sensors only.
- (3) microSD™ and microSDHC™ are trademarks of SD-3C, LLC.
- (4) Remote-reset and pulse-enable wiring is limited to 10 m (32').

<sup>(5)</sup> This value can only be modified using SE-MON330 software. See Section 4.2.

<sup>(6)</sup> Use sensitive mode for AS/NZS 2081.8:2011 compliance.

<sup>(7)</sup> Standard mode is available when using NER

resistance values lower than the minimum shown. This mode is not AS/NZS 2081.8:2011 compliant.

## 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)

### Extended Operating

Temperature.....-55 to 60°C (-67 to 140°F)<sup>(1)</sup>

### ER-600VC:

Maximum Voltage .....600 V ac

Maximum Current .....30 mA

Resistance .....20 kΩ

### Thermal:

420 V ac .....Continuous

600 V ac .....6 minutes on, 60 minutes off

Shipping Weight .....300 g (0.7 lb)

### ER-5KV:

Maximum Voltage .....2,500 Vac

Maximum Current .....125 mA

Resistance .....20 kΩ

Thermal .....Continuous

### Torque:

#### Terminal N:

10-32 Insert .....5.6 N·m (50 lbf·in)

Others .....9.0 N·m (80 lbf·in)

Shipping Weight .....5.0 kg (11 lb)

### ER-5WP:

Maximum Voltage .....2,500 Vac

Maximum Current .....125 mA

Resistance .....20 kΩ

Thermal .....Continuous

### Torque:

#### Terminal N:

10-32 Insert .....5.6 N·m (50 lbf·in)

Others .....9.0 N·m (80 lbf·in)

Shipping Weight .....5.0 kg (11 lb)

### 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 lbf·in)

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 lbf·in)

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 lbf·in)

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 lbf·in)

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)

Window Diameter.....26 mm (1.0 in.)  
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)<sup>(1)</sup>

Supplemental Specifications:

Trip Level Accuracy:

≤ 1 A .....1% of CT-Primary Rating  
> 1 A .....3% of CT-Primary Rating

Certification .....CSA, Canada and USA



UL Listed



Australia



CE, European Union



NOTES:

<sup>(1)</sup> Electrical specifications have been verified at a Littelfuse lab.

**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 in.)  
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)<sup>(1)</sup>

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

SE-CS30-26:

Current Ratio .....30:0.05 A  
Insulation .....600-V Class  
Window Diameter.....26 mm (1.0 in.)  
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)<sup>(1)</sup>

SE-CS30-70:

Current Ratio .....30:0.05 A  
Insulation .....600-V Class  
Window Diameter.....70 mm (2.7 in.)  
Shipping Weight.....1.2 kg (2.5 lb)  
Certifications .....CSA, UL, CE  
Compliance.....RoHS, IEC 60044-1  
Extended Operating Temperature ..-55 to 60° C (-67 to 140° F)<sup>(1)</sup>

CT200:

Current Ratio .....200:5 A  
Insulation .....600-V Class  
Window Diameter.....56 mm (2.2 in.)  
Shipping Weight.....1 kg (2.2 lb)  
Certifications .....CSA, UL  
Compliance.....RoHS  
Extended Operating Temperature ..-55 to 60° C (-67 to 140° F)<sup>(1)</sup>

ELCT30-31

Current Ratio .....30:0.05 A  
Insulation .....600-V Class  
Window Diameter.....31 mm (1.22 in.)  
Shipping Weight.....0.45 kg (2.2 lb)  
Certifications .....cUL, CE

ELCT30-83

Current Ratio.....30:0.05 A  
Insulation.....600-V Class  
Window Diameter.....88 mm (3.46 in.)  
Shipping Weight.....0.91 kg (2 lb)  
Certifications .....cUL, CE

ELCT5-31

Current Ratio.....5:0.05 A  
Insulation.....600-V Class  
Window Diameter.....31 mm (1.22 in.)  
Shipping Weight.....0.45 kg (2.2 lb)  
Certifications .....cUL, CE


ELCT5-88


Current Ratio.....5:0.05 A  
Insulation.....600-V Class  
Window Diameter.....88 mm (3.46 in.)  
Shipping Weight.....0.91 kg (2 lb)  
Certifications .....cUL, CE


NOTES:

<sup>(1)</sup>Electrical specifications have been verified at a Littelfuse lab.

**7. Ordering Information**

- SE-330-** 
- K4 Contact:
    - 0 N.O. UNIT HEALTHY Contact
    - 1 N.C. UNIT HEALTHY Contact
  - Options:
    - 0 No Options
  - Network Communications:<sup>(1)</sup>
    - 0 None
    - 1 DeviceNet™
    - 3 Ethernet (Dual RJ45)<sup>(2)</sup>
    - 4 Ethernet (SC Fiber & RJ45)<sup>(2)</sup>
    - 5 Ethernet (Dual SC Fiber)<sup>(2)</sup>
    - 6 IEC 61850 (Dual RJ45)<sup>(3)</sup>
    - 7 IEC 61850 (SC Fiber & RJ45)<sup>(3)</sup>
    - 8 IEC 61850 (Dual SC Fiber)<sup>(3)</sup>
  - Supply:
    - 0 Universal ac/dc Supply
    - 2 48 Vdc Supply

- SE-330HV-** 
- K4 Contact:
    - 0 N.O. UNIT HEALTHY Contact
    - 1 N.C. UNIT HEALTHY Contact
  - Options:
    - 0 No Options
  - Network Communications:<sup>(1)</sup>
    - 0 None
    - 1 DeviceNet™
    - 3 Ethernet (Dual RJ45)<sup>(2)</sup>
    - 4 Ethernet (SC Fiber & RJ45)<sup>(2)</sup>
    - 5 Ethernet (Dual SC Fiber)<sup>(2)</sup>
    - 6 IEC 61850 (Dual RJ45)<sup>(3)</sup>
    - 7 IEC 61850 (SC Fiber & RJ45)<sup>(3)</sup>
    - 8 IEC 61850 (Dual SC Fiber)<sup>(3)</sup>
  - Supply:
    - 0 Universal ac/dc Supply
    - 2 48 Vdc Supply

- SE-330AU-** 
- K4 Contact:
    - 0 N.O. UNIT HEALTHY Contact
    - 1 N.C. UNIT HEALTHY Contact
  - Options:
    - 0 No Options
  - Network Communications:<sup>(1)</sup>
    - 0 None
    - 1 DeviceNet™
    - 3 Ethernet (Dual RJ45)<sup>(2)</sup>
    - 4 Ethernet (SC Fiber & RJ45)<sup>(2)</sup>
    - 5 Ethernet (Dual SC Fiber)<sup>(2)</sup>
    - 6 IEC 61850 (Dual RJ45)<sup>(3)</sup>
    - 7 IEC 61850 (SC Fiber & RJ45)<sup>(3)</sup>
    - 8 IEC 61850 (Dual SC Fiber)<sup>(3)</sup>
  - Supply:
    - 0 Universal ac/dc Supply
    - 2 48 Vdc Supply

**NOTE:** Please refer to the SE-330 Product Change Notice (PCN) document for updated ordering information and new revision details, available at [Littelfuse.com/SE-330](http://Littelfuse.com/SE-330).

**NOTE:** The SE-330-SMA Surface Mount Adapter is available as an accessory only.

**Sensing Resistors:**

- ER-600VC ..... For system voltages up to 1 kVac
- ER-5KV ..... For system voltages up to 5 kVac
- ER-5WP ..... For system voltages up to 5 kVac, weather protected
- 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 Sensors:

EFCT-1 .....	Current Sensor, 5-A-primary rating, 82-mm (3.2 in.) Window, 6 m (19.5 ft.) of 22 AWG (3.3 mm <sup>2</sup> ) shielded cable included	7SHT-301-E .....	Current Sensor, 300-A-primary rating, 64-mm (2.5 in.) window
ELCT5-31 .....	Current sensor, 31-mm (1.22 in.) window	SHT-401-E .....	Current Sensor, 400-A-primary rating, 64-mm (2.5 in.) window
ELCT5-88 .....	Current sensor, 88-mm (3.46in) window		
ELCT30-31 .....	Current sensor, 31-mm (1.22in) window		
ELCT30-88 .....	Current sensor, 88-mm (3.46in) window		
EFCT-26 .....	Current Sensor, 5-A-primary rating, 26-mm (1.0 in.) Window, 6 m (19.5 ft.) of 22 AWG (3.3 mm <sup>2</sup> ) shielded cable included		
SE-CS30-26 .....	Current Sensor, 30-A-primary rating, 26-mm (1.0 in.) window		
SE-CS30-70 .....	Current Sensor, 30-A-primary rating, 70-mm (2.7 in.) window		
CT200 .....	Current Sensor, 200-A-primary rating, 56-mm (2.2 in.) window		
5SHT-101-E .....	Current Sensor, 100-A-primary rating, 40-mm (1.6 in.) window		
5SHT-151-E .....	Current Sensor, 150-A-primary rating, 40-mm (1.6 in.) window		
5SHT-500-E .....	Current Sensor, 50-A-primary rating, 40-mm (1.6 in.) 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-600VC
PGA-0520.....	Percent Analog Meter
SE-330-SMA.....	Surface Mount Adapter

Software:<sup>(4)</sup>

SE-MON330 Software .....	SE-330 Data-Display Program for PC, version 4.1 or higher
NGR Monitor Set-Point Assistant .....	Setting Guide

NOTES:

- (1) Profibus models only available on legacy SE-330.
- (2) Includes Modbus TCP and EtherNet/IP protocols.
- (3) Includes IEC 61850 protocol only.
- (4) Available at [Littelfuse.com/relayscontrols](http://Littelfuse.com/relayscontrols)

## 8. Warranty

The following products are warranted to be free from defects in material and workmanship for a period of five years from the date of purchase:

SE-330 Neutral-Grounding Resistor Monitor

SE-330HV Neutral-Grounding Resistor Monitor

SE-330AU Neutral-Earthing Resistor Monitor

Littelfuse will (at Littelfuse option) repair, replace, or refund the original purchase price of the SE-330 that is determined by Littelfuse to be defective if it is returned to Littelfuse, 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 does not warrant products repaired or modified by non-Littelfuse personnel.

## 9. Test procedures

**NOTE:** Ensure the real-time clock is set. See Section 4.2.

### 9.1 Resistor-Fault Tests

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

#### 9.1.1 Calibration, Open and Short Tests

Test Equipment: 20-k $\Omega$  and 100-k $\Omega$  calibration resistors, two 100- $\Omega$  resistors, two 200- $\Omega$  resistors, two 500- $\Omega$  resistors (for SE-330HV only) 1/4-watt, 1% (calibration resistors are supplied with SE-330 and SE-330AU, other resistors purchased separately)

The following test is for the SE-330 and SE-330AU only (firmware v3.10 or higher):

- a) Remove connections to terminals 6 and 7.
- b) Connect the 20 k $\Omega$  resistor in series with R1 (100- $\Omega$ ) and R2 (100- $\Omega$ ) resistors, then connect the resistor combination to terminals 6 and 7.
- c) Short R2 so that the total resistance is 20100  $\Omega$ .

- d) Set switch S5 to the 20-k $\Omega$  position.
- e) Ensure that the settings (using SE-MON330) are as follows: Nominal NGR Resistance set to 100  $\Omega$ , NGR Short Trip Level (% Nominal) at 50%, NGR Short Mode set to Sensitive, NGR Open Trip Level (% Nominal) at 150%, and NGR Open Mode set to Sensitive.
- f) Perform calibration as per Section 2.2.
- g) The CALIBRATED LED should be on (this LED will also flash every 10 s if calibrated and the NGR Short Mode is set to Sensitive).
- h) Press RESET.
- i) Remove the short across R2 (resistance total is 20200  $\Omega$ ) and wait for the resistor-fault trip time.
- j) **PASS:** The SE-330 should trip on resistor fault.
- k) Short R2 (resistance total is 20100  $\Omega$ ).
- l) Press RESET.
- m) Short R1 (resistance total is 20000  $\Omega$ ) and wait for the resistor-fault trip time.
- n) **PASS:** The SE-330 should trip on resistor fault.

The following test is for the SE-330, SE-330HV, and SE-330AU (firmware v3.10 or higher):

- a) Connect the 100-k $\Omega$  resistor in series with R1 (200  $\Omega$ ) and R2 (200  $\Omega$ ) resistors, then connect the resistor combination to terminals 6 and 7.
- b) Short R2 so that the total resistance is 100200  $\Omega$ .
- c) Set switch S5 to the 100-k $\Omega$  position.
- d) Ensure that the settings (using SE-MON330) are as follows: Nominal NGR Resistance set to 200  $\Omega$ , NGR Short Trip Level (% Nominal) at 50%, NGR Short Mode set to Sensitive, NGR Open Trip Level (% Nominal) at 150%, and NGR Open Mode set to Sensitive.
- e) Perform calibration as per Section 2.2.
- f) The CALIBRATED LED should be on (this LED will also flash every 10 s if calibrated and the NGR Short Mode is set to Sensitive).
- g) Press RESET.



- h) Remove the short across R2 (resistance total is 100400  $\Omega$ ) and wait for the resistor-fault trip time.
- i) **PASS:** The SE-330 should trip on resistor fault.
- j) Short R2 (resistance total is 100200  $\Omega$ ).
- k) Press RESET.
- l) Short R1 (resistance total is 100,000  $\Omega$ ) and wait for the resistor-fault trip time.
- m) **PASS:** The SE-330 should trip on resistor fault.

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

### 9.1.2 Voltage Test (SE-330 and SE-330AU only)

Test Equipment: 0 to 120 Vac voltage source, multimeter, and ER sensing resistor.

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

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

The following test is for the SE-330HV only (firmware v3.10 or higher):

- a) Connect the 200-k $\Omega$  resistor in series with R1 (500  $\Omega$ ) and R2 (500  $\Omega$ ) resistors, then connect the resistor combination to terminals 6 and 7.
- b) Short R2 so that the total resistance is 200,500  $\Omega$ .
- c) Set switch S5 to the 200-k $\Omega$  position.
- d) Ensure that the settings (using SE-MON330) are as follows: Nominal NGR Resistance set to 500  $\Omega$ , NGR Short Trip Level (% Nominal) at 50%, NGR Short Mode set to Sensitive, NGR Open Trip Level (% Nominal) at 150%, and NGR Open Mode set to Sensitive.
- e) Perform calibration as per Section 2.2.
- f) The CALIBRATED LED should be on (this LED will also flash every 10 s if calibrated and the NGR Short Mode is set to Sensitive).
- g) Press RESET.
- h) Remove the short across R2 (resistance total is 201,000  $\Omega$ ) and wait for the resistor-fault trip time.
- i) **PASS:** The SE-330 should trip on resistor fault.
- j) Short R2 (resistance total is 200,500  $\Omega$ ).
- k) Press RESET.
- l) Short R1 (resistance total is 200,000  $\Omega$ ) and wait for the resistor-fault trip time.
- m) **PASS:** The SE-330HV should trip on resistor fault.

Procedure:

- a) Connect the ER sensing resistor to the SE-330 and calibrate the SE-330.
- b) Disconnect the wire from sensing-resistor terminal N. A resistor-fault trip will occur.
- c) Set the voltage source to 0 V.
- d) Connect the voltage source between sensing resistor N and G terminals.
- e) Set the  $V_N$  TRIP LEVEL (VAC) to 20.
- f) Press RESET.
- g) The RESISTOR FAULT TRIP LED should be off.
- h) Increase the test voltage to 25 Vac for 20-k $\Omega$  sensors or
- i) 120 Vac for 100-k $\Omega$  sensors and wait for the resistor-fault trip time.
- j) **PASS:** The SE-330 should trip on RESISTOR FAULT. A time-delayed ground-fault trip follows the resistor-fault trip if neutral voltage persists after the resistor fault. For legacy units with firmware revision 6 or less, this does not apply.

### 9.1.3 Voltage Test (SE-330HV only)

Test Equipment: 0 to 250 Vac voltage source, multimeter, and ER sensing resistor.

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:

- a) Connect the ER sensing resistor to the SE-330HV and calibrate the SE-330.
- b) Disconnect the wire from sensing-resistor terminal N. A resistor-fault trip will occur.
- c) Set the voltage source to 0 V.
- d) Connect the voltage source between sensing resistor N and G terminals.
- e) Set the  $V_N$  TRIP LEVEL (VAC) to 100.
- f) Press RESET.
- g) The RESISTOR FAULT TRIP LED should be off.
- h) Increase the test voltage to 120 Vac for 100-k $\Omega$  sensors or 240 Vac for 200- k $\Omega$  sensors and wait for the resistor-fault trip time.
- i) **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. For legacy units with firmware revision 6 or less, this does not apply.

### 9.2 Sensing-Resistor Test

Test Equipment: Multimeter.

Procedure:

- a) Disconnect the sensing resistor.

- b) Measure the resistance between sensing-resistor terminals R and N.
- c) **PASS:** Resistance should be between 19.6 and 20.4 k $\Omega$  for 20-k $\Omega$  sensing resistors. Resistance should be between 98 and 102 k $\Omega$  for 100-k $\Omega$  sensing resistors. Resistance should be between 196 and 204 k $\Omega$  for 200-k $\Omega$  sensing resistors.
- d) Measure the resistance between sensing-resistor terminals R and G in both directions.
- e) **PASS:** Resistance should be greater than 10 M $\Omega$  in both directions.

### 9.3 Analog-Output Test

Test Equipment:..... Multimeter with a mAdc scale.

Procedure:

- a) 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.
- b) **PASS:** With no CT current, the analog output should be 4 mA.
- c) 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 installation of the ground-fault current sensor. Ensure the cables pass through the ground-fault-current-sensor window. This check can be done visually with knowledge of the circuit. The connection of the current-sensor secondary to the SE-330 is not polarity sensitive.
- c) Verify that the system is correctly grounded and that alternate ground paths do not exist that bypass the current sensor. 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 (does not apply for bushing-type CTs). Fig. 33a 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. Fig. 33b shows a test circuit using an SE-100T Ground-Fault-Relay Tester. The SE-100T provides a test current of 0.65 or 2.75 A for testing 0.5- and 2.0-A trip levels. Inject the test current through the current-sensor window for at least 2.5 seconds. Verify that the circuit under test has reacted properly. Correct any problems and re-test until the proper reaction is verified.
- e) Record the date and the results of the test on the attached test-record form.

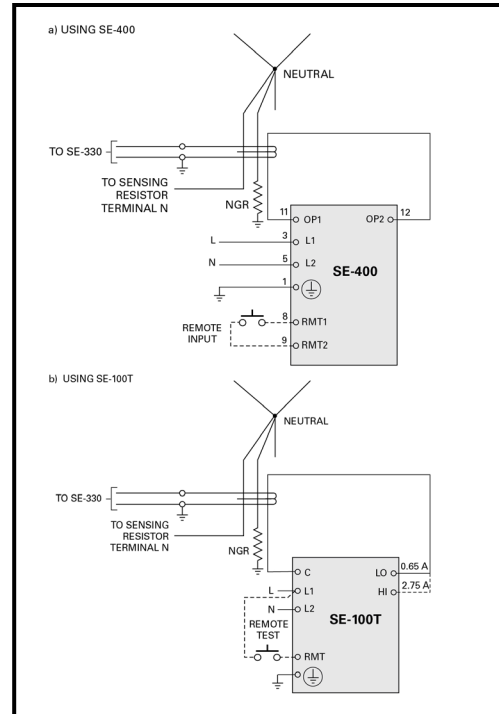


FIGURE 33. Ground-Fault-Test Circuits.

**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.



## A2.1 Initial Configuration Tab

The Initial Configuration tab is shown when connecting to an SE-330 (firmware version 3.10 or higher) for the first time (Fig. 35). This screen shows important settings that must be reviewed and configured before proceeding with other settings.

For SE-330 version 3.10 and higher, several Resistor-Fault parameters including Nominal NGR Resistance (ohms), NGR Short Mode, NGR Sensitive Short Trip Level (% Nominal), NGR Open Mode, and NGR Sensitive Open Trip Level (% Nominal) are shown. These new parameters are described in Section A2.4.

Once these parameters are confirmed, set the Essential Settings Verified parameter to Settings Verified.

## A2.2 Summary Tab

The Summary tab displays several set-point values, metered values, configuration-switch settings, and trip status (Fig. 36).

The bottom status line displays the selected COM port, ONLINE or OFFLINE mode, the SE-330 series type, firmware version, trip status, diagnostic status, and the real-time clock value read from the SE-330.



FIGURE 34. Communication Tab.

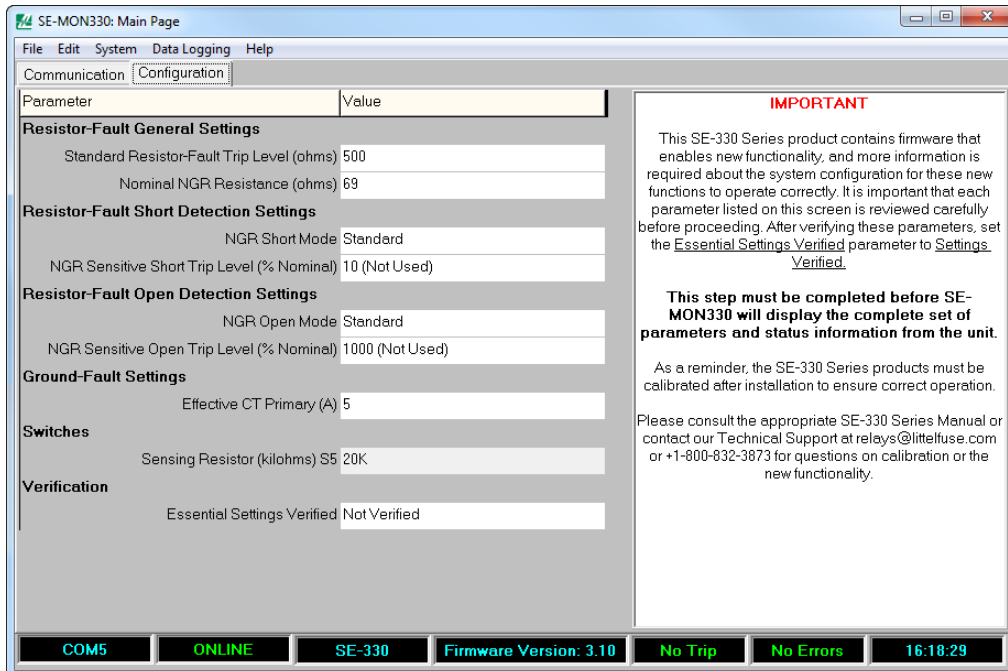


FIGURE 35. Initial Configuration Tab



FIGURE 36. Summary Tab

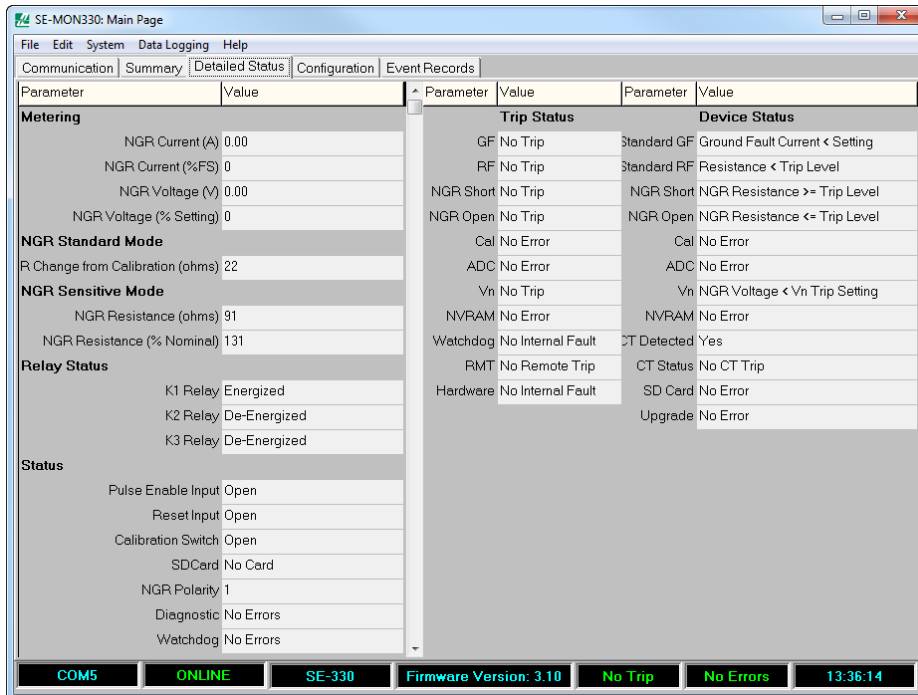


FIGURE 37. Detailed Status Tab.

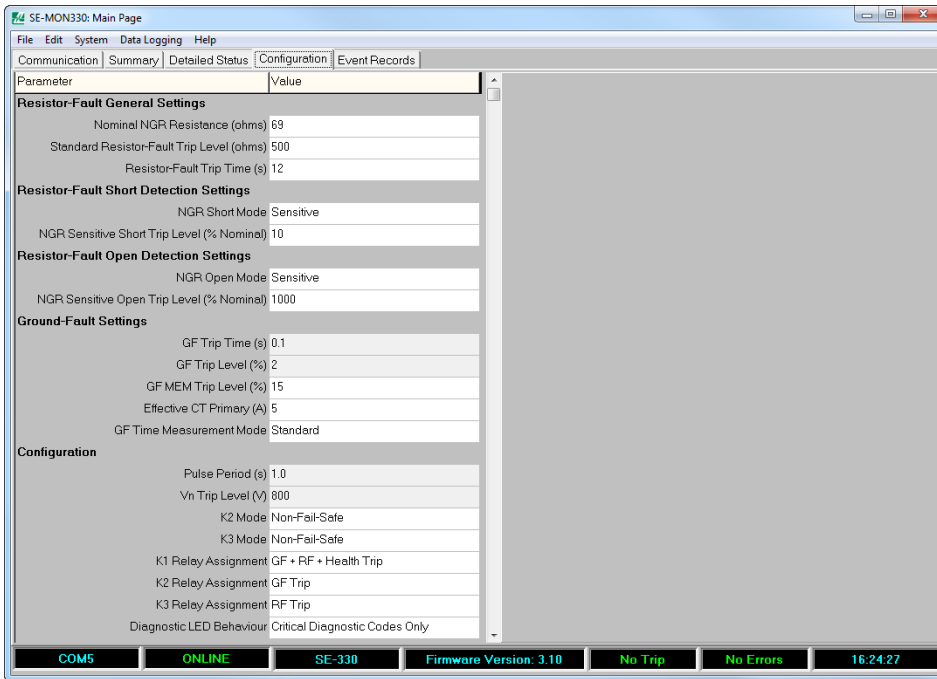


FIGURE 38. Configuration Tab



### A2.3 Detailed Status Tab

The Detailed Status Tab (Fig. 37) displays information from the following categories:

**Metering** displays NGR Current (A), NGR Current (% FS), NGR Voltage (V), and NGR Voltage (% Setting).

**NGR Standard Mode** displays the resistance change (ohms) based on the most recent successful calibration with the system.

**NGR Sensitive Mode** displays the effective NGR resistance (ohms). The effective NGR resistance is based on the active measurement of the SE-330 detection circuitry regardless of the energization state of the transformer. If both the NGR Current (% FS) and NGR Voltage (% Setting) values are greater than 3%, the effective NGR resistance value will display the resistance calculation based on the NGR Voltage (V) and NGR Current (A) values. NGR resistance (% Nominal) is also displayed.

**Relay Status** will display the current state of relays K1, K2, and K3.

**Status** will display trip, device, and general status information.

**System Info** will display the date, time, serial number, hardware revision, and communications type (if applicable) from the connected SE-330.

**Factory Diagnostics** will display additional status information from the SE-330 which can assist with testing and troubleshooting.

### A2.4 Configuration tab

The configuration tab displays all available items that can be configured for the connected SE-330 (fig. 38).

#### A2.4.1 Resistor fault

The nominal NGR resistance is the nominal resistance value of the neutral-grounding resistor. Ensure that the correct value is configured and the SE-330 is calibrated.

Standard Resistor-Fault Trip Level defaults to 500 ohms for 20 kohm sensing resistors, 2500 ohms for 100 kohm sensing resistors, and 5000 ohms for 200 kohm sensing resistors. This trip level can be adjusted within the range specified by each product manual.

RF Trip Time can be set within a range of 12 to 60 s (fixed at 10 s for the SE-330AU).

The NGR Short Mode allows NGR Short Detection to be enabled. Select Sensitive to enable the NGR Sensitive Short Trip Level (% Nominal) setting, or select Standard to use only the Standard Resistor-Fault Trip Level setting.

The NGR Sensitive Short Trip Level (% Nominal) allows a selection between 10 and 70 percent of the nominal NGR resistance (50 to 70 percent for the SE-330AU). If the nominal NGR resistance falls below this level for longer than the RF Trip Time setting, an NGR Short Trip will occur.

Several selections are available for NGR Open Mode. Select Sensitive to enable the NGR Sensitive Open Trip Level (% Nominal) setting, or select Standard to use only the Standard Resistor-Fault Trip Level setting.

The NGR Sensitive Open Trip Level (% Nominal) allows a selection between 130 and 1000 percent of the nominal NGR resistance (130 to 200 percent for the SE-330AU). If the nominal NGR resistance stays above this level for longer than the RF Trip Time setting, an NGR Open Trip will occur.

For firmware v3.10 or higher, the CALIBRATED LED will briefly flash every 10 s when the following is configured:

For the SE-330 and SE-330HV, the NGR Short Mode must be set to Sensitive, and the monitor must be successfully calibrated.

For the SE-330AU, the NER Short Mode and NER Open Mode must be set to Sensitive, and the monitor must be successfully calibrated.

#### A2.4.2 Ground Fault

The GF Trip Time is set on the front-panel of the SE-330.

The GF Trip Level is set on the front-panel of the SE-330 or SE-330HV as a percentage of the CT-primary rating (2 to 100).

The EF Trip Level is set on the front-panel of the SE-330AU with one of the following ranges:

- 0.125 to 5 A using the EFCT series CT
- 0.75 to 30 A using the SE-CS30 series CTs or the ELCT30 series CTs

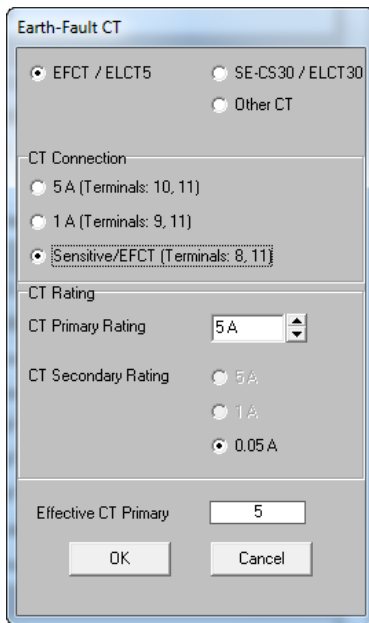
For the new revision of the SE-330 series the GF Trip Level can also be set to MEM.

When the GF Trip Level front-panel dial is set to MEM, the GF MEM Trip Level (%) can be set from 2 to 100% in

1% increments. The drop-down list displays the percentage along with the equivalent trip level current. The default setting is 15%.

The Effective CT Primary is based on the type of earth-fault CT used, and the connection to the SE-330.

The following selection screen will be shown when configuring this value:



The Standard GF Time Measurement Mode uses a trip-time accumulator for detection of intermittent faults. If the Non-Accumulating Mode is selected, a ground-fault trip will occur if the measured ground-fault value is above the ground-fault trip level for the duration of the ground-fault trip time setting. See the SE-330 manual for more details.

### A2.4.3 Configuration

The Pulse Period (SE-330 only) and the Vn Trip Level settings are front-panel selectable.

A fail-safe or non-fail-safe mode can be selected for relays K2 and K3.

The K1, K2, and K3 Relay Assignment configuration allows each relay to be assigned to one or more functions as shown below:

For the SE-330 and SE-330HV (K1, K2, K3) and SE-330AU (K2, K3)

For the SE-330AU, the K1 Relay Assignment is limited to



The K1 relay has a default setting of GF + RF + Health Trip. The K2 relay has a default setting of GF Trip, and the K3 relay has a default setting of RF Trip.

The SE-330 can be configured to show critical diagnostic flash codes (default) or all diagnostic flash codes.

The Geo-Magnetic filter is always enabled for firmware version 3.10 or higher. If a geo-magnetic pattern is detected after 12 s, the term “Geo-Magnetic Interference” will be indicated in Status – Diagnostic in the Detailed Status tab. It will also be recorded in the Diagnostic column when datalogging to an SD card.

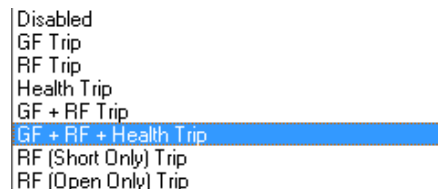
### A2.4.4 Networking

Available network settings will be displayed if available. The settings will vary based on the type of network installed.

**NOTE:** For Ethernet options, ensure that each port is configured with a unique IP address even if not used.

### A2.4.5 SNTP Client

For the IEC 61850 protocol, synchronizing to a time server is necessary. The SE-330 includes an SNTP client and can be configured to synchronize with the system NTP server. These settings are located in the SNTP Settings area.



Enable the SNTP Client and set the NTP Server IP Address to the address of the system NTP server to synchronize to system time. For troubleshooting connection problems with the NTP Server, monitor the SNTP Client status. The status indicates problems such as NTP Server not found, NTP Server not running, and timeout, and will display SNTP Synced when operating correctly.

The Poll Period is the time between queries to the NTP server. The default value is 60 s which is typically sufficient to maintain time synchronization to 1 ms accuracy, but it can be configured for periods as low as 1 s.

The Timeout is the maximum time that the SNTP Client will wait for a response from the NTP Server. The default value is 5 s, and the minimum time is 1 s. If a request fails, no change is made to the SE-330 internal clock.

### **A2.5 Event Records Tab**

The SE-330 series stores up to 100 events (10 events for the previous revision SE-330) with the most recent events on page one as shown in Fig. 39.

Clear Records will clear all event records from the unit.

Save as Text will save all the events from the unit to a text file.

SE-MON330: Main Page

File Edit System Data Logging Help

Communication Summary Detailed Status and Config Event Records IEC 61850

25 Records, Newest at the top.

Date (D/M/Y)	Time	NGR Current (% FS)	NGR Voltage (% Setting)	NGR Change (ohms)	Trip Status	Setpoint Status
2/3/2015	16:14:37	0	0	6	Remote Trip	None
2/3/2015	16:14:28	0	0	5	Remote Trip	None
2/3/2015	16:14:24	0	0	4	Remote Trip	None
2/3/2015	16:14:22	0	0	2	Remote Trip	None
2/3/2015	16:14:20	0	0	2	Remote Trip	None
2/3/2015	16:14:18	0	0	5	Remote Trip	None
2/3/2015	16:14:18	0	0	5	Remote Trip	None
2/3/2015	16:14:14	0	0	1	Remote Trip	None
2/3/2015	16:14:05	0	0	1	Remote Trip	None
2/3/2015	16:14:01	0	0	3	Remote Trip	None
2/3/2015	16:13:57	0	0	7	Remote Trip	None
2/3/2015	16:13:54	0	0	5	Remote Trip	None
2/3/2015	16:13:52	0	0	1	Remote Trip	None
2/3/2015	16:13:44	0	0	2	Remote Trip	None
2/3/2015	16:13:42	0	0	3	Remote Trip	None
2/3/2015	16:13:38	0	0	2	Remote Trip	None
2/3/2015	16:13:35	0	0	3	Remote Trip	None

Refresh Clear Records Save as Text

COM14 ONLINE SE-330 Firmware Version: 2.40 No Trip No Errors 14:41:35

FIGURE 39. Event Records Tab.

## **A2.6 System Menu**

### **A2.6.1 Earth-Fault CT**

From the system drop-down menu, select earth-fault CT to choose the CT type and the connection being used with the SE-330.

### **A2.6.2 Voltage Setting**

The Vn trip level can be entered for an SE-330 (previous version) with the RS-232 serial port. From the system drop-down menu, select voltage setting to specify the Vn trip level being used on the SE-330. Note that on the SE-330 with USB, the voltage setting is updated automatically when the SE-330 is connected.

### **A2.6.3 Set Date/Time**

To set the date and time (new revision SE-330 series only), connect to the SE-330 using the USB connection. Select set date/time from the system menu. The unit will be set to the same date and time as the computer.

### **A2.6.4 Reset to Defaults**

The SE-330 can be configured to its default settings by choosing reset to defaults from the system menu.

### **A2.6.5 Remote Calibration**

To initiate a remote calibration (new revision SE-330 series only), select Remote Calibration from the System menu. Select the Detailed Status and Config tab and confirm that the calibration trip state displays “No Error”. In most cases, the Calibration Value will change from the previous value.



FIGURE 40. System Parameters Menu

## A2.7 Using Set-Point Assistant

Selecting the Set-Point Assistant from the Help menu opens the Set-Point Assistant in a web browser as shown in Figure 41. Using the System Parameters, the Set-Point Assistant recommends a sensing resistor type, ground-fault trip level, a  $V_N$  trip level, and the RES switch setting.

Users can select between four monitors: SE-325, SE-330, SE-330AU, and SE-330HV.

Enter the system's line-to-line voltage or line-to-neutral voltage. Once it has been entered, the other system voltage field will populate automatically.

Enter either the let-through current of the neutral-grounding resistor or the resistance of the neutral-grounding resistor. Once one field has been entered, the other field will populate automatically.

Select indoor or outdoor location.

If an SE-330, SE-330AU, or SE-330HV is selected, the primary rating of the connected CT must be defined before a ground-fault-trip setting is recommended. Select this parameter using the CT Selection drop-down menu.

Several recommendations are provided: the sensing resistor hardware, the ground-fault trip level, the minimum  $V_N$  Trip Level, and the S5 configuration. Users can select a different sensing resistor or ground-fault trip level and the other recommendation fields will update accordingly.

**NGR Monitor Model**

- SE-325 Economical NGR monitor for systems up to 25 kV
- SE-330 NGR monitor detecting open or shorted resistors up to 35 kV
- SE-330AU Australian NER monitor meeting requirements of AS/NZS 2081.6:2011 and 2081.8:2011 (firmware v3.10 and higher)
- SE-330HV High-voltage NGR monitor for 15- to 72-kV systems

**System Parameters**

**System Voltage**

Line-to-Line  Volts

Line-to-Neutral  Volts

**Neutral-Grounding Resistor**

Let Through Current  Amps

Resistance  Ohms

Location

**Recommendations**

Sensing Resistor

Ground-Fault Trip Level

ResTrip Level (Minimum)   
\*Do not set above line-to-neutral voltage

RES switch setting

Version 2.5

FIGURE 41. Set-Point Assistant.

**Appendix B - SE-330, SE-330HV, SE-330AU Revision History**

**SE-330, SE-330HV, SE-330AU REVISION HISTORY**

<b>MANUAL RELEASE DATE</b>	<b>MANUAL REVISION</b>	<b>HARDWARE REVISION (REVISION NUMBER ON PRODUCT LABEL)</b>	<b>FIRMWARE REVISION</b>
Dec 15, 2020	11-B-121520	17A	3.10

**SE-330 REVISION HISTORY (REFERENCE ONLY)**

<b>MANUAL RELEASE DATE</b>	<b>MANUAL REVISION</b>	<b>HARDWARE REVISION (REVISION NUMBER ON PRODUCT LABEL)</b>	<b>FIRMWARE REVISION</b>
June 30, 2018	11-A-063018	17A	3.01 3.00 2.60
October 18, 2017	10-P-101817	17	2.60
December 7, 2016	10-N-120716	16	2.55
September 21, 2016	10-M-092116		2.54 2.53
June 30, 2016	10-L-063016		2.52
September 8, 2015	10-K-090815	15	2.50
June 22, 2015	10-J-062215		2.40
May 20, 2015	10-I-052015		2.31 2.30
March 3, 2015	10-H-030315		2.20
July 7, 2014	10-G-070714	14	2.10
April 14, 2014	10-F-041414	13	2.08
January 8, 2014	10-E-010814	12 11	
November 29, 2013	10-D-112913	10A	2.07
October 8, 2013	10-C-100813		2.07
September 12, 2013	10-B-091213		2.07
August 30, 2013	10-A-083013		10



**SE-330HV REVISION HISTORY (REFERENCE ONLY)**

<b>MANUAL RELEASE DATE</b>	<b>MANUAL REVISION</b>	<b>HARDWARE REVISION (REVISION NUMBER ON PRODUCT LABEL)</b>	<b>FIRMWARE REVISION</b>
June 30, 2018	5-N-063018	17A	2.60
October 18, 2017	5-M-101817	17	
December 7, 2016	5-L-120716	16	2.55
September 21, 2016	5-K-092116		2.54
June 30, 2016	5-J-063016		2.53
September 11, 2015	5-I-091115		2.52
June 22, 2015	5-H-062215	15	2.50
May 20, 2015	5-G-052015		2.40
March 3, 2015	5-F-030315		
July 8, 2014	5-E-070814	14	2.31 2.30
April 14, 2014	5-D-041414	13	2.20
January 9, 2014	5-C-010914	12	
		11	
November 29, 2013	5-B-112913	10A	2.10
October 8, 2013	5-A-100813	10A	2.08

**SE-330AU REVISION HISTORY (REFERENCE ONLY)**

<b>MANUAL RELEASE DATE</b>	<b>MANUAL REVISION</b>	<b>HARDWARE REVISION (REVISION NUMBER ON PRODUCT LABEL)</b>	<b>FIRMWARE REVISION</b>	
June 30, 2018	4-J-063018	17A	2.61 2.60	
October 18, 2017	4-I-101817	17	2.60	
December 7, 2016	4-H-120716	16	2.55	
September 21, 2016	4-G-092116		2.54 2.53	
June 30, 2016	4-F-063016		2.52	
September 15, 2015	4-E-091515		15	2.50
June 22, 2015	4-D-062215	2.40		
May 20, 2015	4-C-052015	14		2.31
March 3, 2015	4-B-030315			
July 8, 2014	4-A-070814			

## Manual Revision History

### Revision 11-B-121520

Manual Updated to Include SE-330, SE-330HV, SE-330AU, and SE-MON330 Content.  
New Features Added for SE-330-Series Firmware V3.10.

### Revision 11-A-063018

#### General

Manual Format and Many Sections Have Been Updated.

#### Section 1

Descriptions for NGR Short Detection and Assignable Relays Added.

#### Section 2

Enhanced Health Status Added.

#### Section 6

NGR Short Detection Specifications Added.

### Revision 10-P-101817

#### Section 2

New Features Described in Section 2.8.

#### Section 3

Updated Installation Instructions.

#### Section 4

Sd Card Note Added.

#### Section 5

Troubleshooting Information Added.

#### Section 7

Ordering Information Updated.

### Revision 10-N-120716

#### Appendix A

Revision History Updated.

### Revision 10-M-092116

#### Section 4

Updated Firmware Upgrade Instructions.

#### Appendix A

Revision History Updated.

### Revision 10-L-063016

**Section 4**

Section 4.1.2 Updated.

**Section 6**

MicroSD™ Storage Capacity Increased To 32 Gb.  
RCM Certification Added.

**Revision 10-K-090815**

**Section 4**

Section 4.1.2 Updated.

**Section 5**

SD Card Diagnostic Troubleshooting Updated.

**Revision 10-J-062215**

**Section 2**

Section 2.1.7 Added.

**Section 4**

SD Card Approximate Yearly Data Logging Usage Updated.  
SE-MON330 Software Version Updated.

**Section 6**

Resistor-Fault Trip Level Ranges Added.

**Revision 10-I-030315**

**Section 4**

SD Card Storage Capacity Updated.

**Section 6**

SDCard Storage Capacity Specification Updated.

**Revision 10-H-030315**

**Section 2**

Sections 2.1.6 And 2.1.7 Added.

**Section 4**

4.2 New Features Added.

**Section 6**

Resistor-Fault Circuit Trip Time Update

**Revision 10-G-070714**

**Section 6**

Added CE, C-Tick, And FCC Information.

**Revision 10-F-041414**

**Appendix A**

Hardware Revision Updated.

**Revision 10-E-010814**

**Section 6**

Extended Operating Temperatures Added to All Sensing Resistors and SE-CS30 Current Sensors.

**Revision 10-D-112913**

**Section 6**

CE Added to Sensing Resistors.

**Section 7**

Ordering Information Updated.

**Revision 10-C-100813**

**Section 2**

Section 2.8 Updated.

**Section 4**

Real Time Clock Note Added in Section 4.2.

**Section 5**

Led and Relay Status Added to Troubleshooting Solutions.

**Section 7**

Ordering Information Updated.

**Revision 10-B-091213**

**Appendix A**

Hardware Revision Updated.

**Revision 10-A-083013**

**Section 1**

Faceplate Updated.

New Features Added.

**Section 2**

Communications Options Updated.

Configuration Switches Updated.

Indication Relays Explanation Added.

Non-Volatile-Memory Error Added.

**Section 3**

Connection Drawing Updated.

**Section 4**

Section Heading Changed to Data Interfaces.

Updated with MicroSD™ And USB Interfaces.

Upgrade Procedure Added.

## **Section 5**

Non-Volatile-Memory Error Added.  
Switch S8 Diagnostic Led Error Removed.

## **Section 6**

Ground-Fault Circuit Trip Level Updated.  
USB Communications Specifications Added.  
Resistor-Fault Accuracy Changed.  
MicroSD™ Memory Card Specifications Added.

## **Section 7**

Ordering Information Updated.  
SE-330-Sma Surface Mount Adapter Is Now Listed as An Accessory Only.

## **Appendix A**

Added Revision History.

## **Hardware Revision History**

### **Hardware Revision 17A**

Additional EMC Filter Capacitors Added.

### **Hardware Revision 17**

Enhanced Transient Protection Added.

### **Hardware Revision 16**

MicroSD™ Storage Capacity Increased To 32 Gb.

### **Hardware Revision 15**

RTC Circuit Updated.

### **Hardware Revision 14**

Added CE and C-Tick Compliance.

### **Hardware Revision 13**

Reduced ESD Sensitivity of Front-Panel Dials.

### **Hardware Revision 12**

Improved Fiber Ethernet Support.

### **Hardware Revision 11**

Reduced ESD Sensitivity of USB And SD Card Connectors.

### **Hardware Revision 10A**

Update to RTC Circuit.

### **Hardware Revision 10**

Updated SE-330 Platform to Include USB And MicroSD™ Interfaces, Programmable Trip Level (Mem) Feature, and ability to add future options.  
Real-Time Clock Added.  
Added Dual Cable and Fiber Ethernet Ports.

## Firmware Revision History

### Firmware Revision 3.10

All Models:

NGR Short Mode and NGR Open Mode Now Have Sensitive and Standard Selections.

Added Additional Assignable Functions for K1, K2, And K3.

Diagnostic Led Flash Mode Indicates When Unit Is Calibrated and NGR Short Mode Is Set to Sensitive.

SD Card Datalogging Now Limited to A Maximum of Two Months of Most Recent Data.

SE-330AU Only:

CT Detection Algorithm Improved.

Compliant to AS/NZS 2081.6:2011 and AS/NZS 2081.8:2011.

Diagnostic Led Flash Mode Indicates When Unit Is Calibrated, And NER Short and NER Open Modes Are Set to Sensitive.

### Firmware Revision 3.01

### Firmware Revision 3.00

Added NGR Short Detection Functionality.

Added Assignable Functions for K1, K2 And K3.

Ground-Fault Trip Time Algorithm Includes Standard and Non-Accumulating Selections.

UTC Offset Added to SNTP Client Functionality.

SD card logging limited to two most recent months of data.

### Firmware Revision 2.60

Added Option to Display Only Critical Diagnostic Codes with DIAGNOSTIC LED.

### Firmware Revision 2.55

Corrected IEC 61850 Network Watchdog Resets.

### Firmware Revision 2.54

NAND Flash Bit-Error-Correction Update to Prevent Solid-Red DIAGNOSTIC LED Error When Bit Errors Are Correctable.

Resistor-Fault Trip Level Added to Web Interface.

Corrected Modbus<sup>®</sup> TCP/IP Write Response Byte Count.

TCP Keep Alive Network Setting No Longer Resets To 5s After Power Cycle.

### Firmware Revision 2.53

Fixed NAND Flash Bit Error Correction Code to Prevent Solid-Red Diagnostic Error.

### Firmware Revision 2.52

Improved Compatibility with Internet Explorer<sup>™</sup> Web Browser.

### Firmware Revision 2.50

Added Support for Adjustable Resistor-Fault Trip Level.

Web Page Functionality Re-Enabled for Ethernet Options.

#### **Firmware Revision 2.40**

- Added Support for Geo-Magnetic Filter.
- Added Support For 12 To 60 s Resistor-Fault Trip Time.
- Improved Log File Descriptions.
- IEC 61850 GOOSE Network Input Support Now Always Enabled.
- Improved Compatibility for Modbus TCP.
- Web Page Disabled for Ethernet Options. This Will Be Enabled in A Future Firmware Release.
- IP Setting Changes for Ethernet Options Now Require Power Cycle to Take Effect.

#### **Firmware Revision 2.31**

- SD Card and USB Diagnostic Events No Longer Cause A Trip.

#### **Firmware Revision 2.30**

- Remote Calibration Feature Added.

#### **Firmware Revision 2.20**

- Added Support for Ethernet/IP Protocol.
- LED Name Now Reported Correctly Through IEC 61850 Interface.
- Ethernet/Ip And Modbus Communications Card Led Status Updated.
- Hardware Version Viewable in the SE-MON330 Software and through the Modbus and IEC 61850 Servers.

#### **Firmware Revision 2.10**

- Added Support for IEC 61850 And DeviceNET Protocols.

#### **Firmware Revision 2.08**

- Added Support for Communications Options.

#### **Firmware Revision 2.07**

- Updated Firmware to Include USB And MicroSD™ Interfaces, Datalogging, And Firmware Update Via MicroSD™.
- K2 And K3 Indication Relays Can Be Configured for Fail-Safe or Non-Fail-Safe Operation.
- Trip Records Increased to 100 with Date and Time Stamping.

#### **NOTES:**

- (1) "A" suffix denotes the addition of EMC filter capacitors.
- (2) "B" suffix denotes the addition of EMC filter capacitors.