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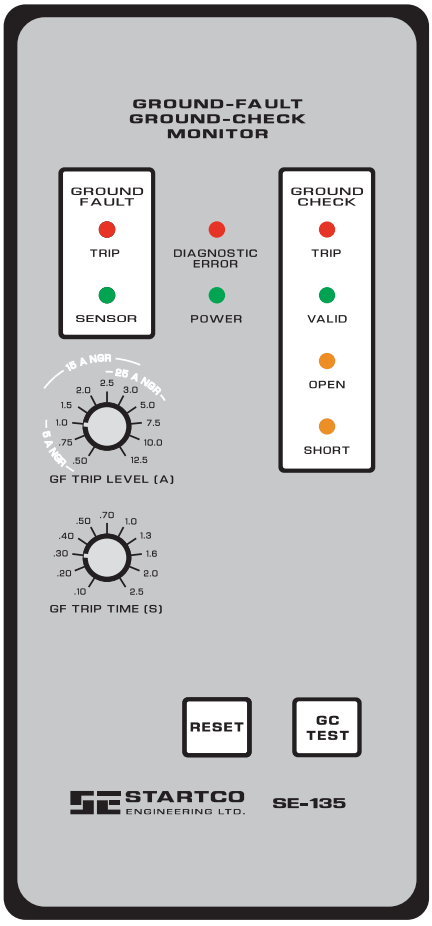
# SE-135 MANUAL

# GROUND-FAULT GROUND-CHECK MONITOR

**AUGUST 14, 2001**

**REVISION 1**



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# 1. GENERAL

The SE-135 is a microprocessor-based, combination ground-fault and ground-check monitor for resistance-grounded systems. It has a switching power supply that accepts a wide range of ac and dc voltages, its specifications apply over an industrial temperature range at high humidity, and it meets the IEEE surge-withstand-capability tests (oscillatory and fast-transient) for protective relays and relay systems. All operating conditions are clearly indicated and two Form C contacts are provided for remote indication. Isolated, normally open and normally closed contacts are provided for contactor control or for shunt or undervoltage operation in a breaker-trip circuit. The SE-135 is housed in an anodized extruded-aluminum enclosure, and all connections are made with plug-in, wire-clamping terminal blocks.

The ground-fault circuit detects fundamental-frequency, zero-sequence current with a window-type current sensor and it verifies that the current sensor is connected and not shorted. A definite-time characteristic with 11 trip levels and 11 trip times allows coordination in virtually any resistance-grounded system. Although other current sensors may satisfy the verification circuit, only SE-CS10's have characteristics that meet system specifications. Current-sensor verification can be disabled in a ground-check-only application.

The ground-check circuit has an open-circuit voltage of 30 Vdc so it is not a hazard to personnel, and it has an output drive current above 100 mA for optimum performance in slip-ring, commutated-load, and high-induced-ac applications. Features include an externally accessible ground-check fuse, a resistance-insertion test, 3-kV isolation between the ground-check loop and the monitor electronics, and a PPI-600V accessory for parallel-ground-path rejection. The PPI-600V will also eliminate intermachine arcing and prevent stray ac and dc currents from flowing in the monitored ground wire. Unlike ground-check circuits using other termination devices, and especially those with phase-reversal switches, a ground-check circuit using a termination device with a Zener characteristic is capable of loop measurements that are independent of current in the phase conductors. The SE-135 ground-check circuit recognizes the SE-TA12A 12-volt Zener characteristic as a valid end-of-line completion. This is the only passive characteristic that will satisfy the ground-check circuit's multi-level drive, allow induced currents to circulate in the ground-check loop, survive a phase-to-ground-check fault, and clamp the ground-check voltage during the fault. Although a standard 12-volt Zener diode may engage the SE-135's ground-check circuit, only an SE-TA12A has the compensation required to meet system specifications.

# 2. OPERATION

## 2.1 GROUND-FAULT CIRCUIT

The ground-fault circuit has a definite-time characteristic with 11 settings from 0.1 to 2.5 seconds. Time-coordinated ground-fault protection requires the trip time to be longer than the trip time of downstream ground-fault devices. The trip level of the ground-fault circuit is switch selectable with 11 settings from 0.5 to 12.5 A. A minimum tripping ratio of 5 is recommended to achieve at least 80% winding protection, and this requires the trip level to be less than 20% of the grounding resistor let-through current. Suggested trip-level ranges for 5-A, 15-A, and 25-A neutral-grounding resistors are indicated on the faceplate.

If the SE-135 is used in a ground-fault-only application, an SE-TA12A must be connected to the ground-check and cable-ground terminals to validate the ground-check circuit.

## 2.2 GROUND-CHECK CIRCUIT

The ground-check circuit is protected by a 1.5-A time-delay fuse (F1), and it recognizes an SE-TA12A as a valid end-of-line completion. When the ground-check loop is valid, the ground-check circuit can be tested by pressing the GC TEST switch or by shorting the GC TEST terminals. This test invalidates the loop by inserting 47 Ω in the ground-check loop and a trip should occur in less than 250 ms.

The ground-check circuit is usually operated in the non-latching mode; however, it can be operated in the latching mode by connecting terminals 14 and 15. If the SE-135 is operated in a ground-check-only application and an SE-CS10 is not connected, connect terminals 17 and 18 to disable sensor verification.

## 2.3 RESET

Ground-fault trips are latching and ground-check trips can be latching or non latching. To reset ground-fault trips or latching ground-check trips, press the RESET switch or short the RESET terminals. Cycling the supply voltage will also reset ground-fault trips; however, if the ground-check circuit is configured for latching fail-safe operation, the ground-check circuit will trip when supply voltage is applied. The reset circuit responds only to a momentary closure so that a jammed or shorted switch will not maintain a reset signal.

## 2.4 TRIP RELAY

Isolated, normally open (Trip A, terminals 24 and 25) and normally closed (Trip B, terminals 22 and 23) contacts are provided for use in a contactor- or breaker-control circuit. With no connection between terminals 12 and 13, the SE-135 trip relay operates in the fail-safe

mode. This mode is used with undervoltage devices where the trip relay energizes and its normally open contact closes if the ground-fault and ground-check circuits are not tripped. This mode is recommended because:

- Undervoltage devices release if supply voltage fails.
- Undervoltage ground-check circuits do not allow cable couplers to be energized until the ground-check loop is verified.

The fail-safe mode of operation of the SE-135 trip relay can be used for shunt-trip circuits with a stored-energy trip source. In this case, the normally closed trip contact is used—the contact opens when the SE-135 is energized and the ground-fault and ground-check circuits are not tripped. Care must be taken to ensure safe and correct operation during power up and power down.

Connect terminals 12 and 13 for non-fail-safe trip relay operation with shunt-trip devices. In this mode, the normally open trip contact is used—the trip contact is closed when a ground-fault or ground-check trip is indicated on the SE-135.

Shunt-trip circuits are not fail safe and are not recommended because:

- Shunt-trip devices do not operate if supply voltage fails.
- Shunt-trip ground-check circuits allow open cable couplers to be energized for a short interval after supply voltage is applied.

## 3. INDICATION

### 3.1 GROUND FAULT

A red LED indicates a ground-fault trip and the remote-indication relay GF is energized when the ground-fault circuit is not tripped. A green LED indicates a current sensor is correctly connected. If the current sensor is disconnected or shorted, the green LED will go out and the ground-fault circuit will trip. If the sensor fault is intermittent, the ground-fault circuit will trip and the green LED will flash indicating that the trip was initiated by a sensor fault.

### 3.2 GROUND CHECK

A red LED indicates a ground-check trip. A green LED indicates a valid ground-check loop and the remote-indication relay GC is energized when the ground-check loop is valid. Two yellow LED's indicate an invalid ground-check loop. OPEN indicates the loop resistance exceeds the trip resistance and SHORT indicates the ground-check conductor is shorted to the ground conductor. A flashing yellow LED indicates the cause of a latched ground-check trip.

### 3.3 POWER

This green LED indicates that the internal power supply is on.

### 3.4 DIAGNOSTIC ERROR

This red LED indicates that an internal error caused the SE-135 to trip. Return the SE-135 to the factory if a reset does not clear the error.

## 4. INSTALLATION

### 4.1 GENERAL

This ground-fault ground-check monitoring system consists of an SE-135 Monitor, an SE-CS10 Current Sensor, and an SE-TA12A Termination Assembly connected as shown in Fig. 1.

### 4.2 MONITOR

Outline and panel-cutout dimensions for the SE-135 are shown in Fig. 2. To panel mount the SE-135, insert it through the panel cutout and secure it with four 8-32 locknuts and flat washers.

All connections to the SE-135 are made through plug-in, wire-clamping terminal blocks. Each plug-in terminal block can be secured to the monitor by two captive screws for reliable connections in high-vibration applications.

Outline dimensions and mounting details for surface mounting the SE-135 are shown in Fig. 3. Fasten the surface-mount adapter to the mounting surface and make connections to the adapter terminal blocks. Follow the instructions on Fig. 3 to mount or remove the SE-135.

The power supply operates from 60 to 265 Vac and 80 to 370 Vdc. Use terminal 2 (L2) as the neutral terminal on ac systems or the negative terminal on dc systems. Connect terminal 3 (Surge Protection Ground) to terminal 4 (Monitor Chassis) and connect terminal 4 to ground. Remove the terminal-3 connection for dielectric strength testing.

### 4.3 CURRENT SENSORS

Outline dimensions and mounting details for the SE-CS10's are shown in Fig. 4. Pass only phase conductors through the sensor window as shown in Fig. 1. If a shield, ground, or ground-check conductor enters the sensor window, it must be returned through the window before it is terminated. Connect the current sensor to terminals 16 and 17. Ground terminal 17.

### 4.4 TERMINATION ASSEMBLY

Outline dimensions and mounting details for the SE-TA12A are shown in Fig. 5. Install the SE-TA12A at the load to complete the ground-check loop as shown in Fig. 1. Connect terminal G of the SE-TA12A to the equipment frame so that the ground-conductor-to-equipment-frame connection will be included in the monitored loop.

### 4.5 PARALLEL-PATH ISOLATION

A PPI-600V can be used for parallel-path rejection. A PPI-600V will also eliminate intermachine arcing and prevent stray ac and dc currents from flowing in the monitored ground wire. See Figs. 6 and 7. Contact Startco for application details.

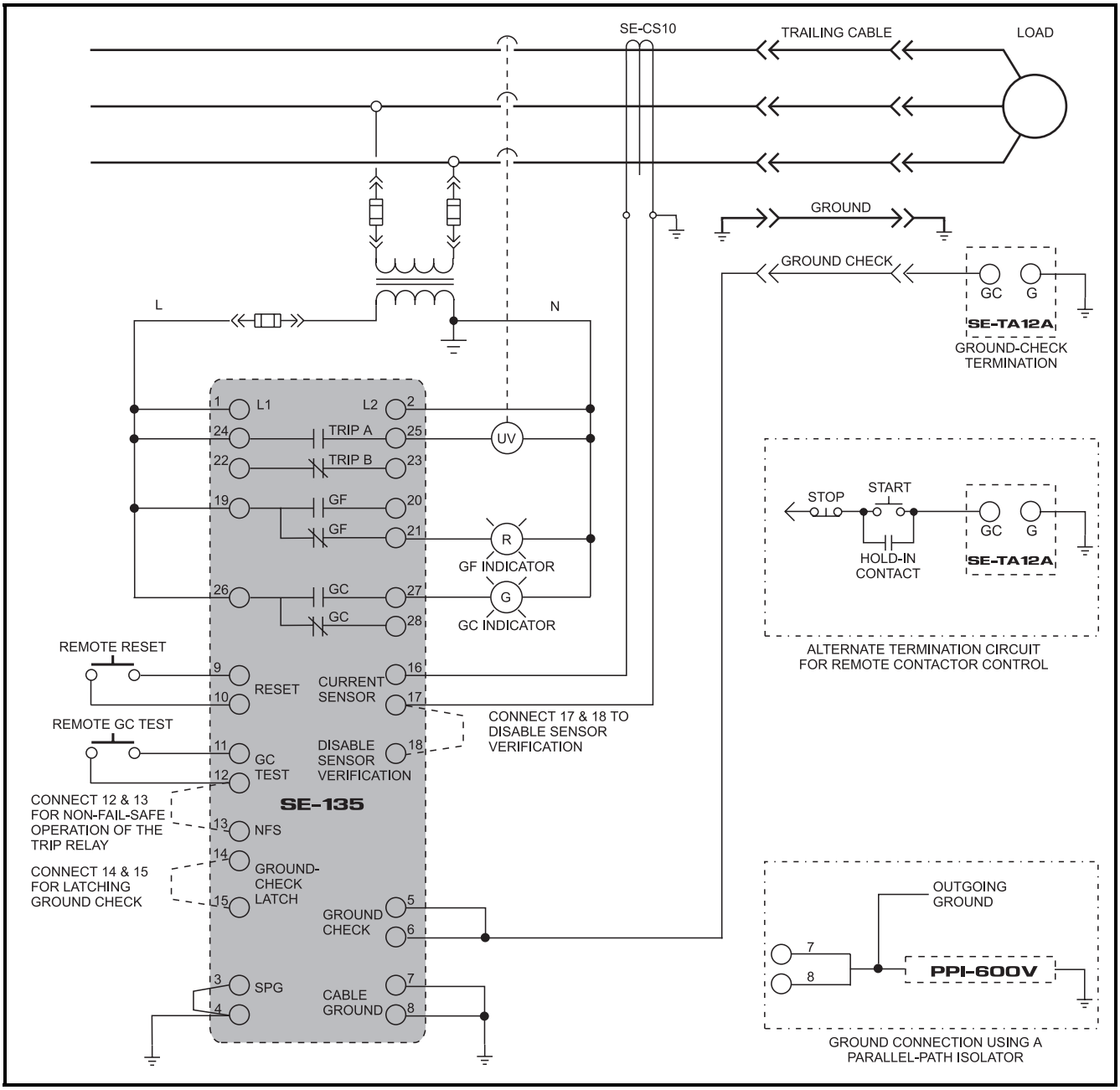



FIGURE 1. SE-135 Typical Application.

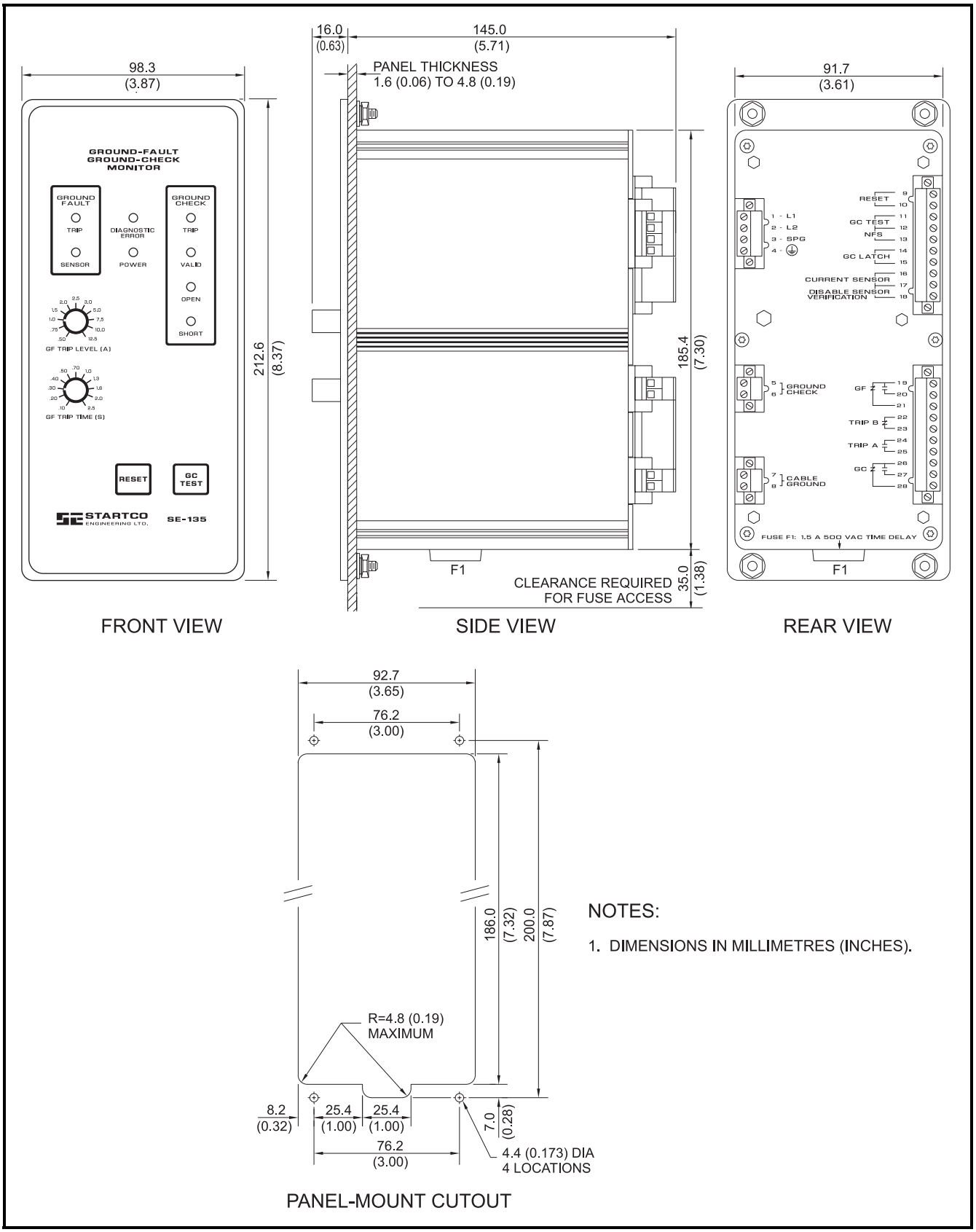
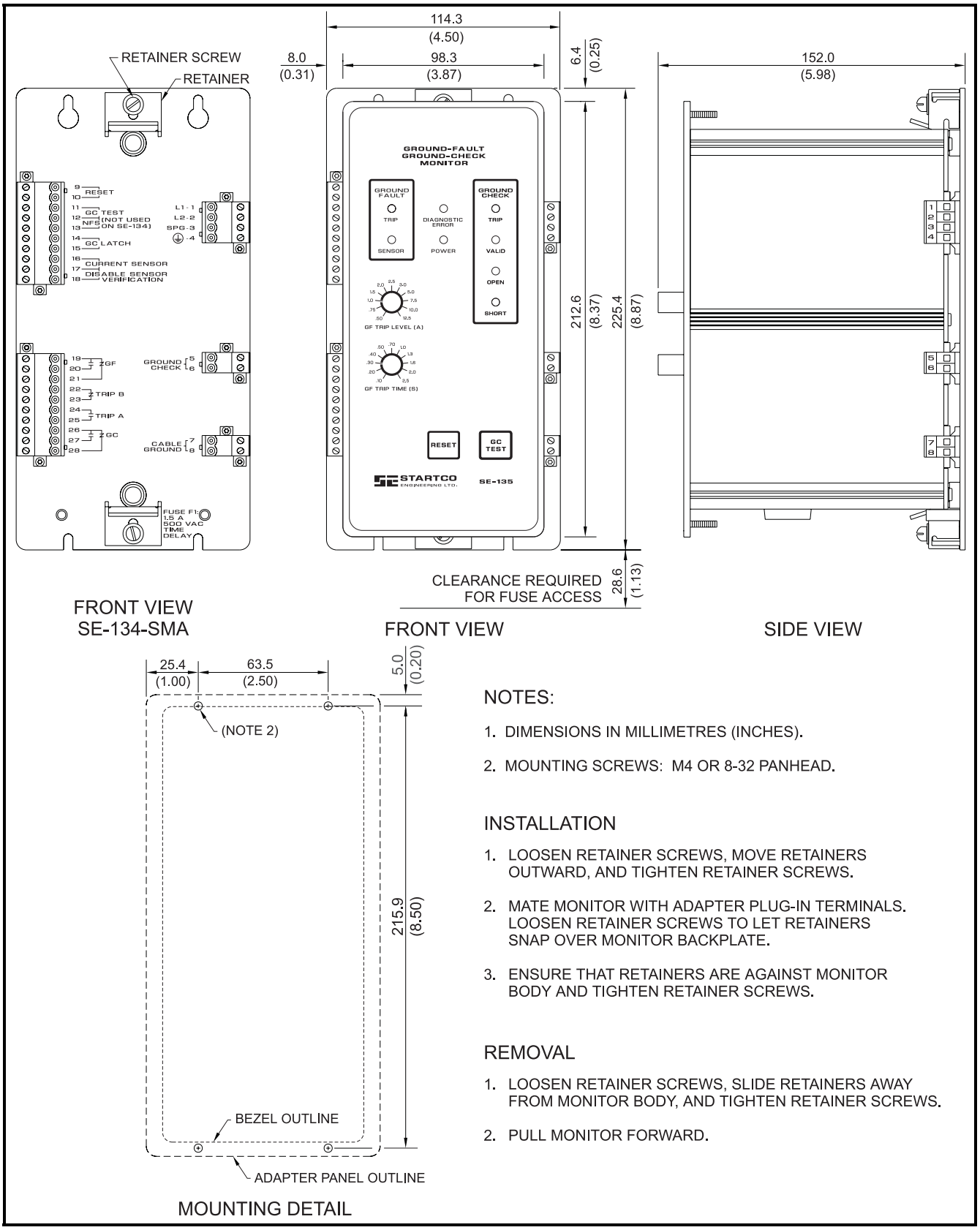



FIGURE 2. SE-135 Outline and Panel-Mounting Details.




NOTES:

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

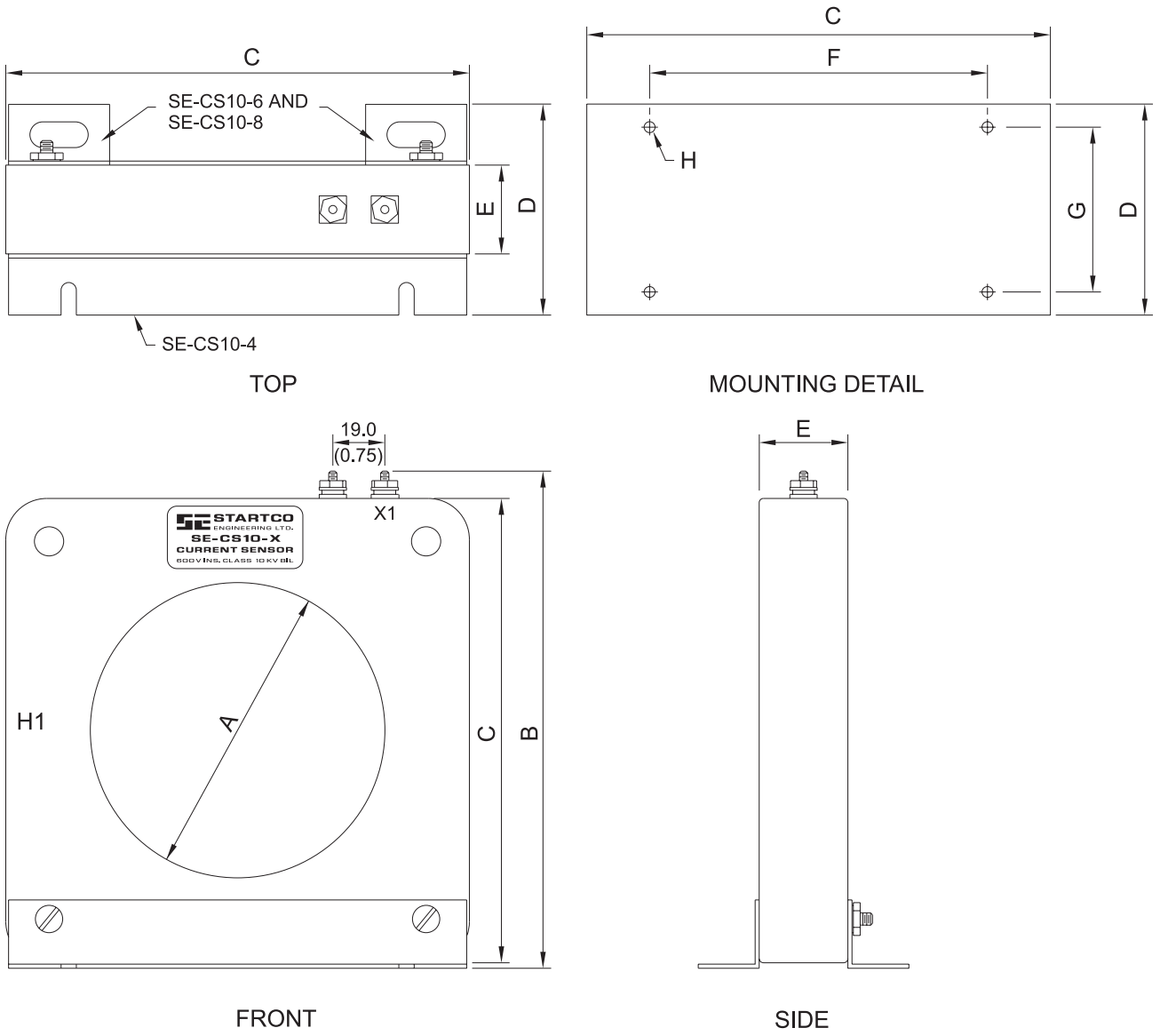
INSTALLATION

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

REMOVAL

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

FIGURE 3. SE-135 Outline and Surface-Mounting Details.




NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).

| PART NUMBER | DIMENSIONS | | | | | | | MOUNTING SCREW H |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | |
| SE-CS10-4 | 108.0 (4.25) | 184.0 (7.24) | 169.9 (6.69) | 77.2 (3.04) | 32.5 (1.28) | 123.7 (4.87) | 60.5 (2.38) | M4 (8-32) |
| SE-CS10-6 | 160.3 (6.31) | 229.0 (9.00) | 215.9 (8.50) | 101.6 (4.00) | 31.8 (1.25) | 165.0 (6.50) | 73.2 (2.88) | M10 (0.375) |
| SE-CS10-8 | 209.5 (8.25) | 279.5 (11.00) | 266.7 (10.50) | 108.7 (4.28) | 38.9 (1.53) | 225.0 (8.86) | 80.0 (3.15) | M10 (0.375) |

FIGURE 4. SE-CS10 Current Sensors.

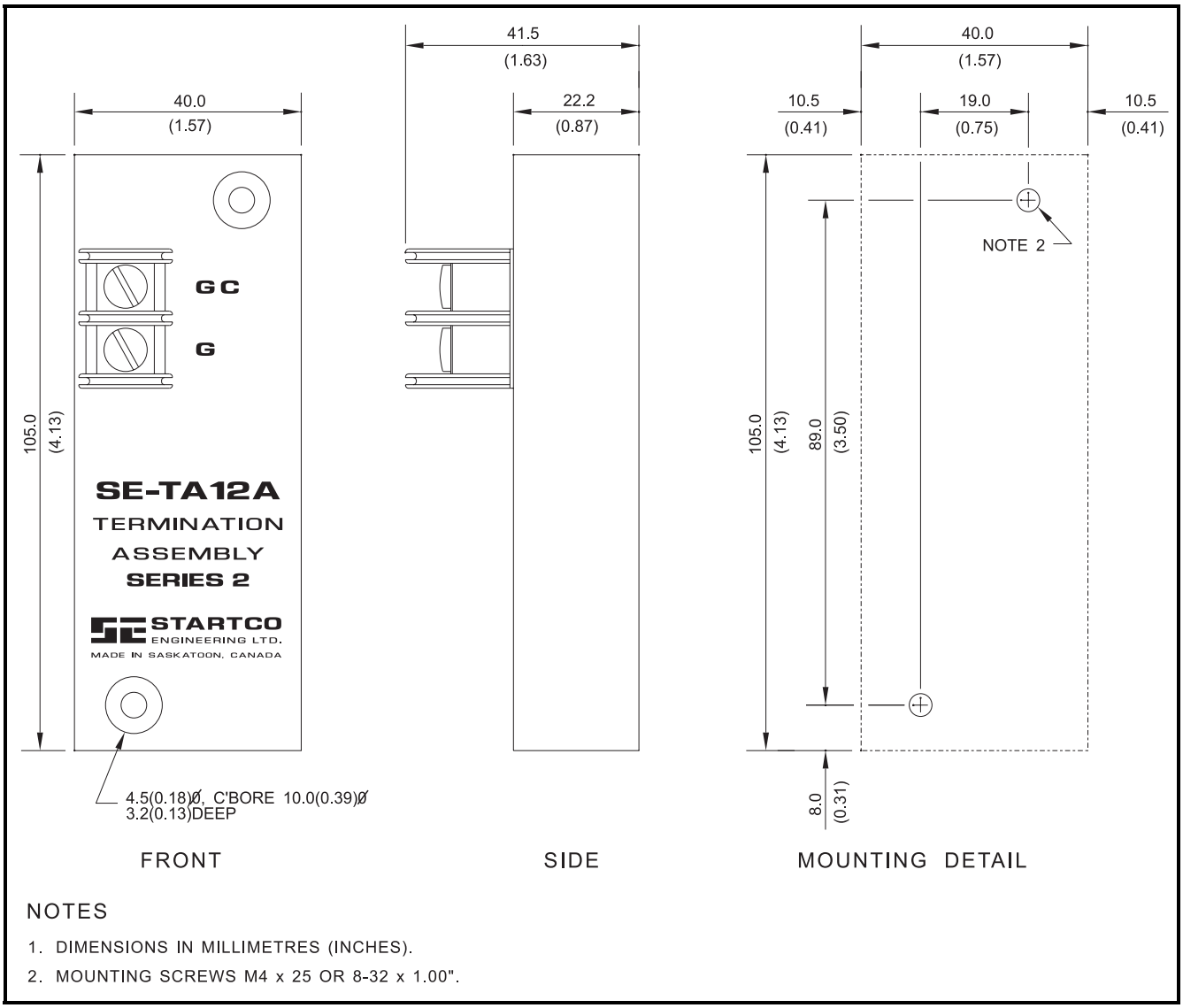



FIGURE 5. SE-TA12A Termination Assembly.

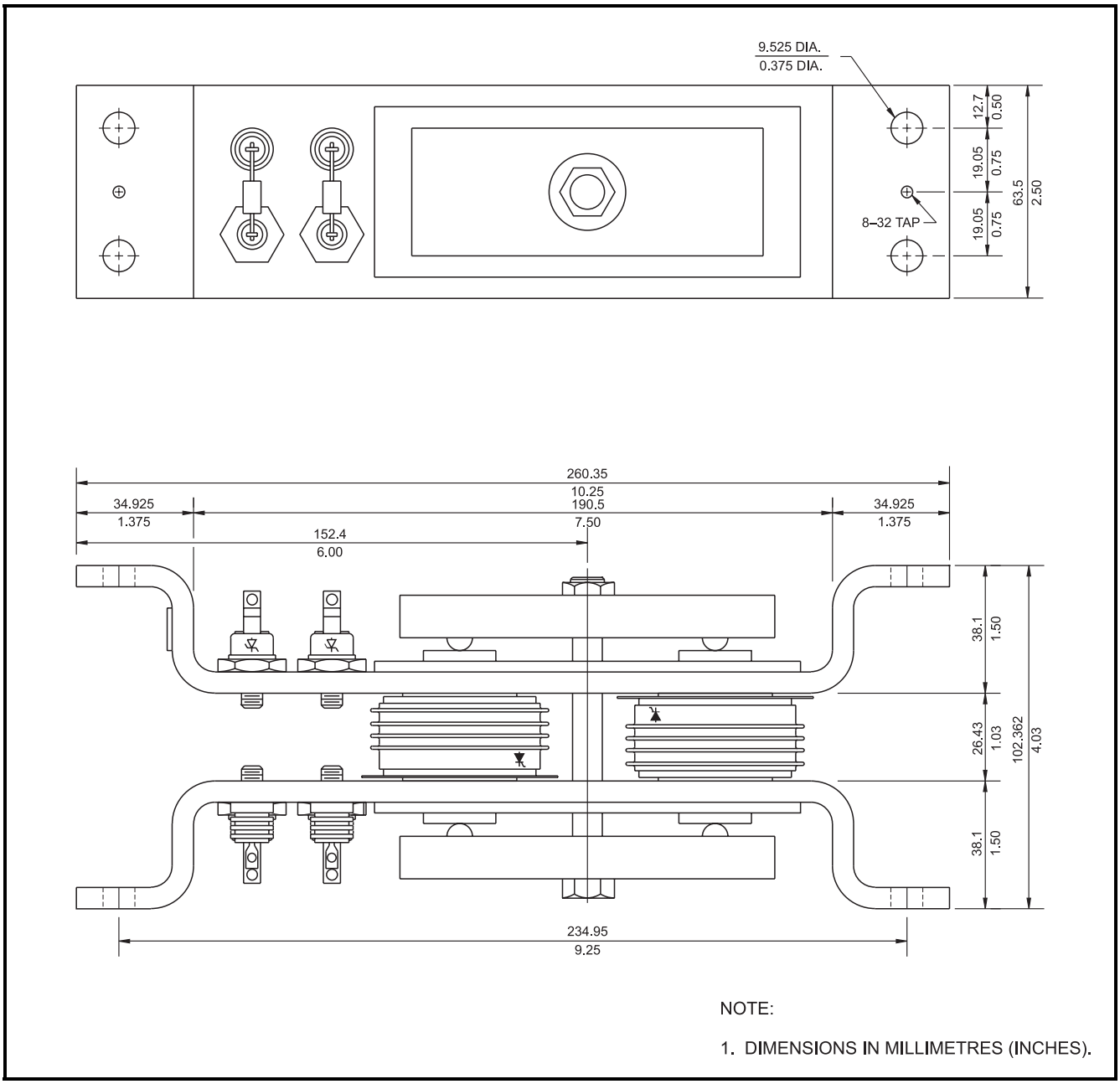
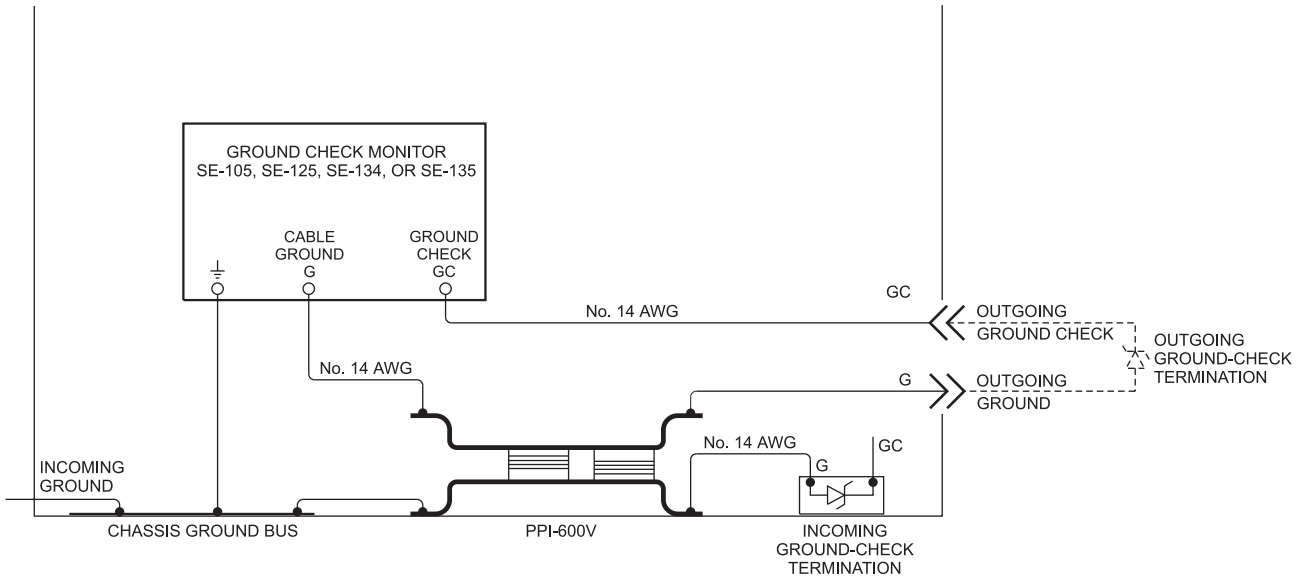



FIGURE 6. PPI-600V Parallel-Path Isolator.




NOTES:

1. PARALLEL-PATH ISOLATOR IS NOT POLARIZED. EITHER FLANGE CAN BE CONNECTED TO CHASSIS.

2. THE OUTGOING GROUND MUST NOT BE SHORTED TO THE CHASSIS GROUND BUS. IF A FLANGE-MOUNTED RECEPTACLE IS USED, VERIFY THAT THE FLANGE IS ISOLATED FROM THE GROUND PIN, AND

   - USE A MATING PLUG WITH A NON-METALLIC HOUSING, OR

   - ISOLATE THE FLANGE FROM THE CHASSIS IF THE MATING PLUG HAS A METALLIC HOUSING.

3. CABLE PLUGS AND RECEPTACLES WITH GROUNDED METAL HOUSINGS MUST BE ISOLATED FROM EARTH TO PREVENT PARALLEL GROUND PATHS.

FIGURE 7. PPI-600V Typical Installation.

## 5. TECHNICAL SPECIFICATIONS

Supply:
- 60 to 265 Vac, 47 to 440 Hz, 25 VA
- 80 to 370 Vdc, 15 W

Ground-Fault Circuit:
- Digital Filter ..... 50 to 60 Hz, Bandpass
- Trip-Level Settings ..... 0.5, 0.75, 1.0, 1.5, 2.0, 2.5, 3.0, 5.0, 7.5, 10.0, and 12.5 A
- Trip-Time Settings ..... 0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 1.0, 1.3, 1.6, 2.0, and 2.5 s
- Thermal Withstand ..... 150 A Continuous; 1000 A for 2.5 s (Ground-Fault Current)
- Trip-Level Accuracy ..... ± 5% or 0.1 A
- Trip-Time Accuracy ..... +50, -15 ms
- Sensor Verification ..... Enabled or Disabled
- Operating Mode ..... Latching

Ground-Check Circuit:
- Open-Circuit Voltage ..... 30 Vdc
- Output Impedance ..... 136 Ω
- Loop Current ..... 105 mA
- Induced ac Withstand ..... 60 Vac Continuous, 120 Vac for 10 s, 250 Vac for 0.25 s
- Pull-in Time ..... ≤ 1.5 s
- Trip Time @ 50 Ω ..... 220 ± 30 ms
- GC-Loop Trip Resistance ... 28 ± 5 Ω
- Isolation ..... 3 kV, 60 Hz, 1 s
- Test ..... Front-Panel Switch and Remote, N.O. Contact
- Fuse Rating (F1) ..... 1.5 A, 500 Vac, Time Delay
- Fuse Part Number ..... FNQ 1½ Buss Fusetron
- Operating Mode ..... Latching or Non-Latching

Trip Relay:
- CSA/UL Contact Rating ..... 8 A Resistive 250 Vac,
- Supplemental Contact Ratings:
  - Make/Carry (0.2 s) ..... 30 A
  - Break dc ..... 75 W Resistive, 35 W Inductive (L/R < 0.04)
  - Break ac ..... 2000 VA Resistive, 1500 VA Inductive (PF > 0.4)
  - Subject to maximums of 8 A and 250 V (ac or dc)
- Contact Configuration ..... Isolated N.O. and N.C. Contacts
- Operating Mode ..... Fail-Safe or Non-Fail-Safe

Remote-Indication Relays:
- CSA/UL Contact Rating ..... 8 A Resistive 250 Vac,
- Supplemental Contact Ratings:
  - Make/Carry (0.2 s) ..... 20 A
  - Break dc ..... 50 W Resistive, 25 W Inductive (L/R < 0.04)
  - Break ac ..... 2000 VA Resistive, 1500 VA Inductive (PF > 0.4)
  - Subject to maximums of 8 A and 250 V (ac or dc)
- Contact Configuration ..... Form C
- Operating Mode ..... Fail-Safe

Terminal Block Rating ..... 10 A, 300 Vac, 12 AWG

Dimensions (Panel Mount):
- Height ..... 213 mm (8.4")
- Width ..... 99 mm (3.9")
- Depth:
  - Behind Panel ..... 145 mm (5.7")
  - In Front of Panel ..... 16 mm (0.7")

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

Surge Withstand ..... ANSI/IEEE 37.90.1-1989 (Oscillatory and Fast Transient)

## 6. ORDERING INFORMATION

SE-135 ..... Ground-Fault Ground-Check Monitor complete with SE-134-SMA Surface Mount Adapter

SE-TA12A ..... Termination Assembly

SE-CS10-4 ..... Current Sensor, 108 mm (4.2") Window
SE-CS10-6 ..... Current Sensor, 160 mm (6.3") Window
SE-CS10-8 ..... Current Sensor, 209 mm (8.2") Window

PPI-600V ..... Parallel-Path Isolator.