

# Innovative Technology<sup>®</sup> SPD Products The I.T. Protector<sup>®</sup>



*I.T. Protector Family of Products*

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# 1 INTRODUCTION

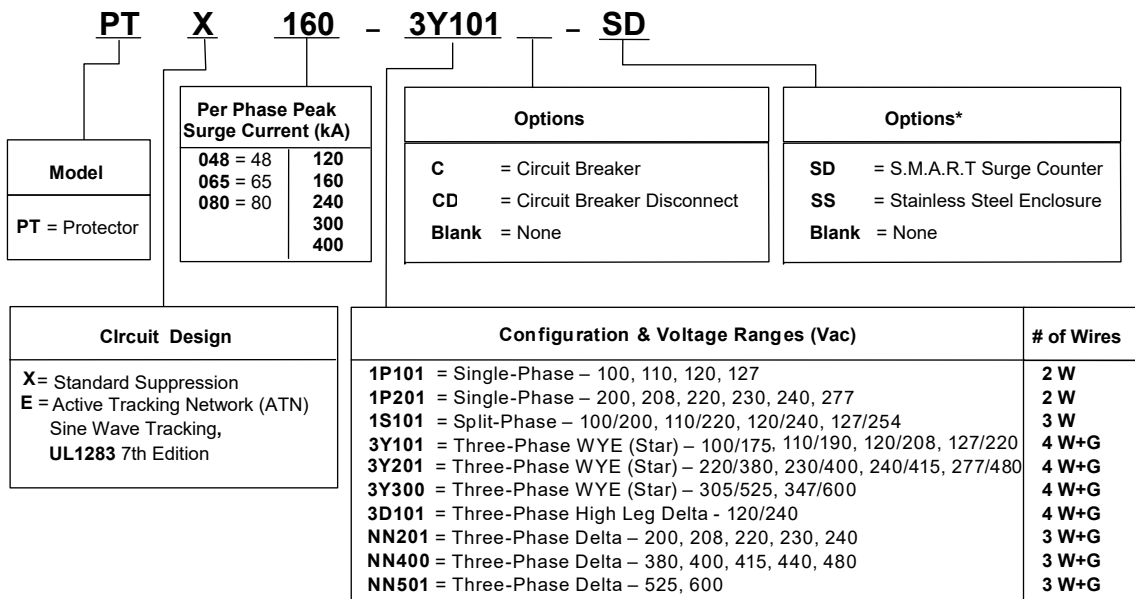
## 1.1 Scope

This installation manual contains the information necessary to install Eaton Corporation's line of I.T. Protector Surge Protective Devices (SPDs) for the following electrical system wiring configurations:

- Single Phase (1P)
- Split Phase (1S)
- 3 Phase Wye (Star) (3Y)
- 3 Phase High-Leg Delta (3D)
- 3 Phase No Neutral (NN)

## 1.2 I.T. Protector Catalog Numbering System

Before connecting the SPD to the electrical system, locate the label attached to the SPD that contains the unit's Catalog Number, and then use the diagram below to verify that the SPD matches the electrical system's voltage and wiring configuration.



\* **Note:** the PEM and PEM-E Options have been discontinued.

In this example, Catalog Number **PTX160-3Y101-SD** identifies a Protector with the following features and ratings:

- Standard Suppression Circuitry
- Surge Current Rating of 160 kA
- Three-Phase WYE configuration
- Voltage Range of 100/175 to 127/220 Vac
- S.M.A.R.T. Surge Counter

### 1.3 Safety Precautions

A licensed/qualified electrician must complete all instructions and measurements described in this instruction in accordance with the U.S. National Electrical Code, state and local codes, or other applicable country codes. The U.S. National Electrical Code and state and local requirements (or other applicable country codes) supersede this instruction.

Read and understand all instructions before beginning the installation.



**WARNING!** The use of the word **WARNING** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, or condition, or the like, which if not correctly performed or adhered to, could result in personal injury or death.

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**CAUTION** The use of the word **CAUTION** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, condition, or the like, which if not correctly performed or adhered to, could result in damage to the equipment.

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**WARNING! SHOCK HAZARDS:**

**IMPROPER INSTALLATION CAN CAUSE DEATH, INJURY AND/OR EQUIPMENT DAMAGE.**

Follow all warnings and cautions. Completely read and understand the information in this document before attempting to install or operate this equipment.

**IMPROPER WIRING COULD CAUSE DEATH, INJURY, AND/OR EQUIPMENT DAMAGE.**

Only licensed/qualified electricians who are trained in the installation and service of electrical devices are to service this equipment.

**USE APPROPRIATE SAFETY PRECAUTIONS AND EQUIPMENT FOR ARC FLASH PROTECTION.**

**DURING NORMAL OPERATION, HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE UNIT.**

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## 2 INSTALLATION

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### 2.1 Before Installation

Perform or plan the following before installing the SPD:

1. Refer to Section 1.2 and verify that the correct SPD model is being installed.



**WARNING! SHOCK HAZARD:** When working inside the SPD as described in any of the following steps, be sure to **follow all safe work practices** to avoid an electrical shock hazard.

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2. For systems with a Neutral wire, there must be a Neutral to Ground/Earth bond present at the SPD. Note that the SPD may be damaged if not connected to ground.
3. Measure the voltage between Neutral and Ground. If this voltage is greater than 5 Vac, then a problem may exist in the electrical system. The SPD can still be installed under this condition, but a licensed electrician should be consulted to correct the problem.
4. The Active Tracking Network (ATN) filter, which is contained in all PTE models, will need to be disconnected if the SPD is being connected to an electrical panel feeding medical patient care equipment, or containing a ground fault circuit interrupting (GFCI) main breaker. Disconnect the ATN filter per Section 2.6.
5. The SPD can be mounted in any position. If necessary, the cover may be rotated 180 degrees to improve readability of the label (not applicable to Circuit Breaker models (with a “C” or “CD” suffix) or models with a hinged cover). When removing the cover, be careful not to damage the indicator light circuit board or wiring attached to the cover.
6. **Isolated Ground:** The SPD’s ground wire is internally bonded to its housing. If the electrical system utilizes an isolated ground, then the SPD’s housing must be isolated from ground using insulated conduit fittings, and its ground wire must be connected to the system’s isolated ground bus. When making this connection, always follow national, state, and local wiring codes.
7. When a NEMA 4X enclosure is used, plan on installing weatherproof (corrosion resistant) conduit and fittings to maintain the enclosure’s 4X rating.
8. Plan to install the SPD as close as possible to the electrical panel. Long lead lengths and sharp bends between the SPD and the electrical panel will degrade the performance of the SPD.
9. Refer to Table 2-1 and determine the wiring size requirements of the SPD model being installed. For example, a Standard PTX160 includes #10 AWG wires that are internally connected to the SPD, while a Standard PTX300 requires that the customer supply wire in the range of #10–1/0 AWG.
10. If necessary, install an overcurrent protective device between the SPD and electrical system per national, state, and local electrical codes as described in Section 2.3.

## 2.2 Wire Requirement

For SPDs that **are not supplied with wire**, the customer must provide wires of the appropriate size and color as specified in Table 2-1 below. These wires are used to connect the SPD to the electrical system as described in Section 2.7.

**Table 2-1. Wire Requirement**

<b>PTE and PTX <sup>①,②</sup> Standard Models</b>	<b>Wire Size Range</b>
048 / 065 / 080 / 120 / 160	#10 AWG (6mm <sup>2</sup> ) <b>Stranded Wire Included</b>
240 / 300 / 400	#10–1/0 AWG (6–50 mm <sup>2</sup> ) <b>Wire Not Included</b>

<b>PTE and PTX Circuit Breaker / Circuit Breaker Disconnect Models</b>	<b>Wire Size Range</b>
	<b>Circuit Breaker / Circuit Breaker Disconnect Models (C &amp; CD suffix)</b>
048 / 065 / 080 / 120 / 160 / 240 / 300 / 400	#10–1/0 AWG (6–50 mm <sup>2</sup> ) <b>Wire Not Included</b>

**Wire Colors:**

**Neutral** = White or Gray  
**Ground** = Green or Green w/Yellow Stripe  
**Phases A, B, and C** = Black

① Factory prewired 18 inches of 10 AWG wire for units with no C or CD suffix.

② Factory prewired 36 inches of 10 AWG wires for Stainless Steel units with no C or CD suffix

## 2.3 Overcurrent Protective Device Requirement

For Type 2 SPD models that **are not supplied with a Circuit Breaker or Circuit Breaker disconnect (without a “C” or “CD” suffix)**, a customer supplied **30 ampere** single-throw circuit breaker must be installed, normally located inside the electrical panel in close proximity to the SPD’s wire-entry point.

For Type 1 SPD models that **are supplied with a Circuit Breaker or Circuit Breaker disconnect (with a “C” or “CD” suffix)**, these models contain an internal Circuit Breaker to protect against short circuit fault conditions within the device.

Refer to Section 2.7 for wiring details.

## 2.4 Conduit Installation Guidelines

The following guidelines should be followed when installing conduit between the SPD and electrical panel:

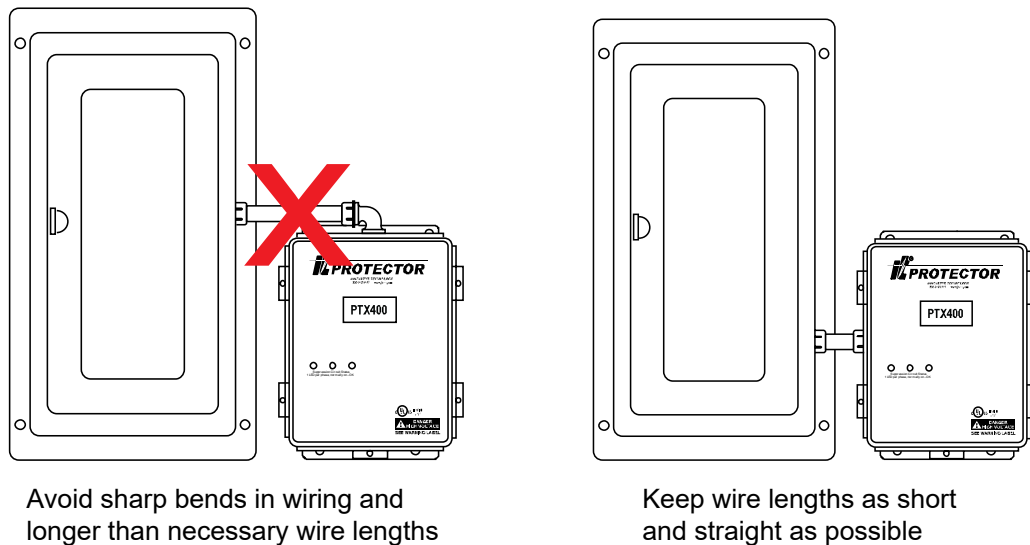
- Avoid using 90° elbows and keep the conduit run as short and straight as possible. See Figure 2-1.
- If the electrical system utilizes an isolated ground, then the SPD's housing must be isolated from ground using insulated conduit fittings.
- When applicable, use weatherproof (corrosion resistant) conduit and fittings to maintain the enclosure's NEMA 4 or 4X rating.
- If the SPD enclosure does not already have a hole for installing conduit, punch or drill a hole of the appropriate size to accommodate the size of conduit being installed.



**CAUTION:** Choose a hole location that will provide the minimum connecting wire length, while also not disturbing or damaging any components inside the SPD.

Be cautious to capture and remove all metal shavings during the drilling process to avoid possible short circuits.

**Figure 2-1. Conduit Installation Guidelines**



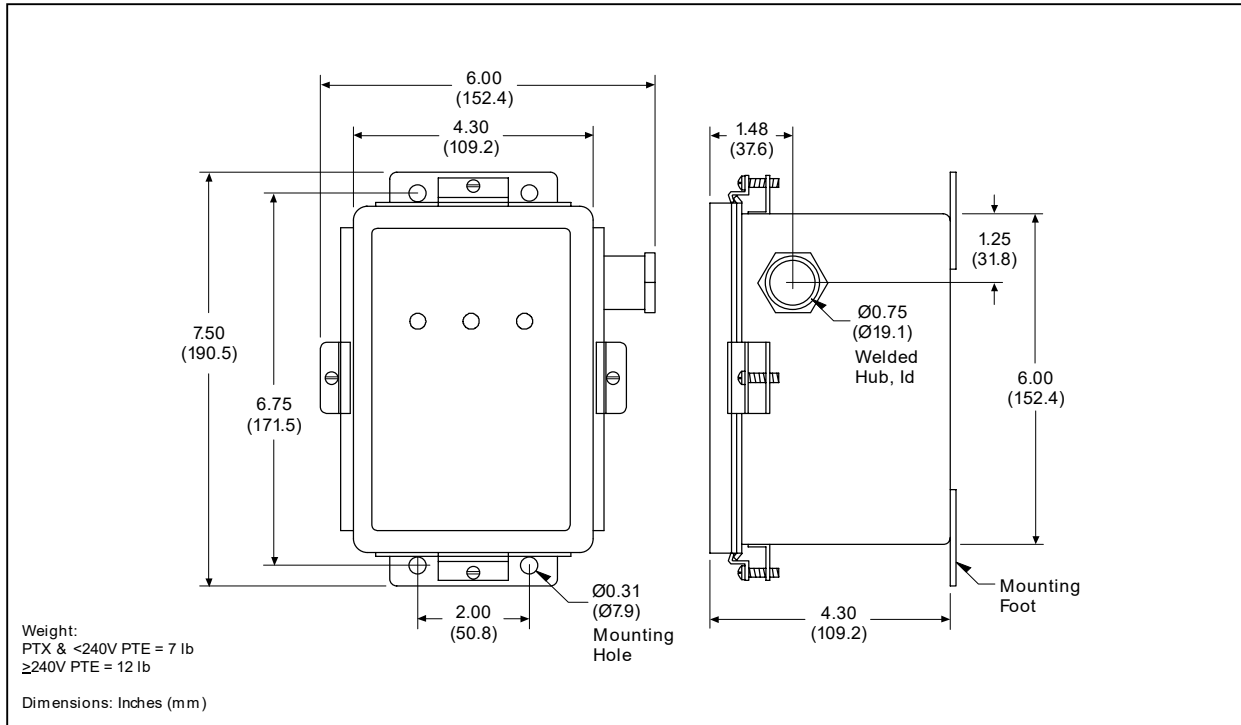
## 2.5 Mounting the SPD

Select a location where the SPD will be mounted based on the internal configuration of the electrical panel and the physical surroundings outside the panel. Choose a mounting location that provides the shortest possible wire length to the overcurrent protective device (when used) and then to the electrical panel's bus bar.

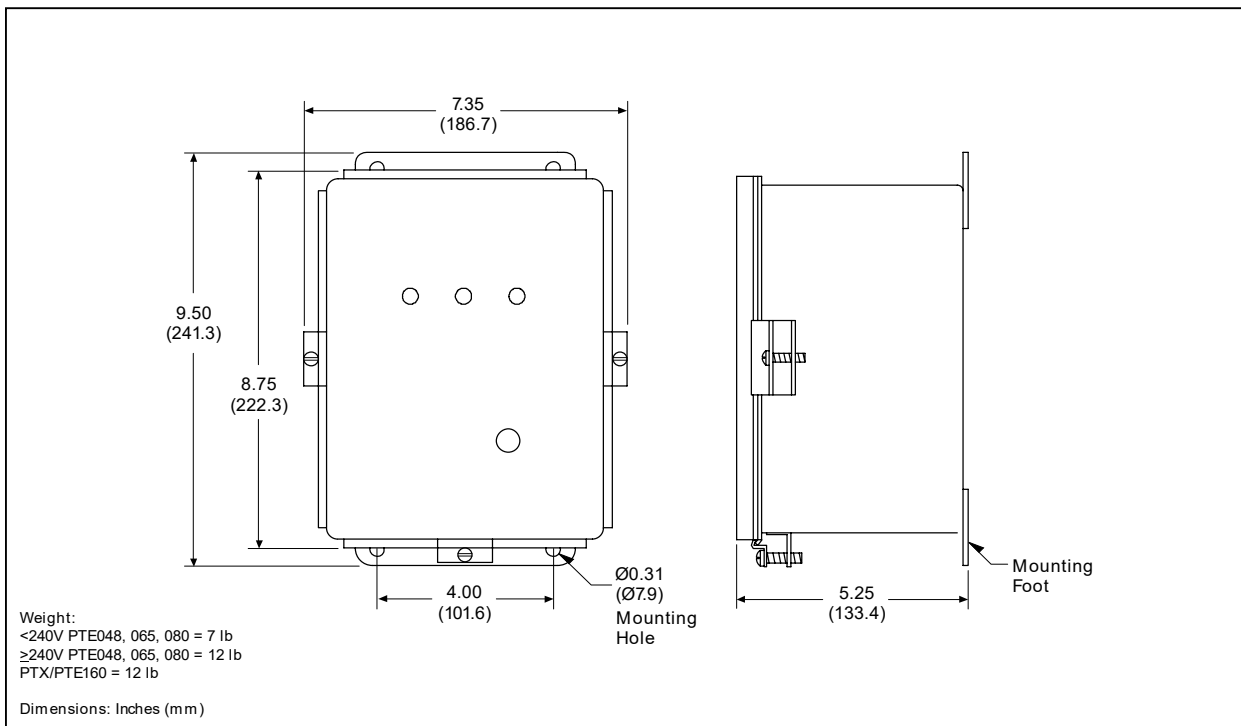
Once a location has been determined, mount the SPD to the nearby supporting surface using the SPD's mounting feet and suitable fasteners. Mounting feet and hole dimensions of each SPD model are shown in Figures 2-2 thru 2-6.

**Tip:** SPD models that are light in weight can be mounted directly on the electrical panel using only a chase nipple and conduit nuts.

**Figure 2-2. PTE048, 065, 080 / Models 1P101, 1S101, 3Y101, 3D101  
 PTX048, 065, 080 / All Models**

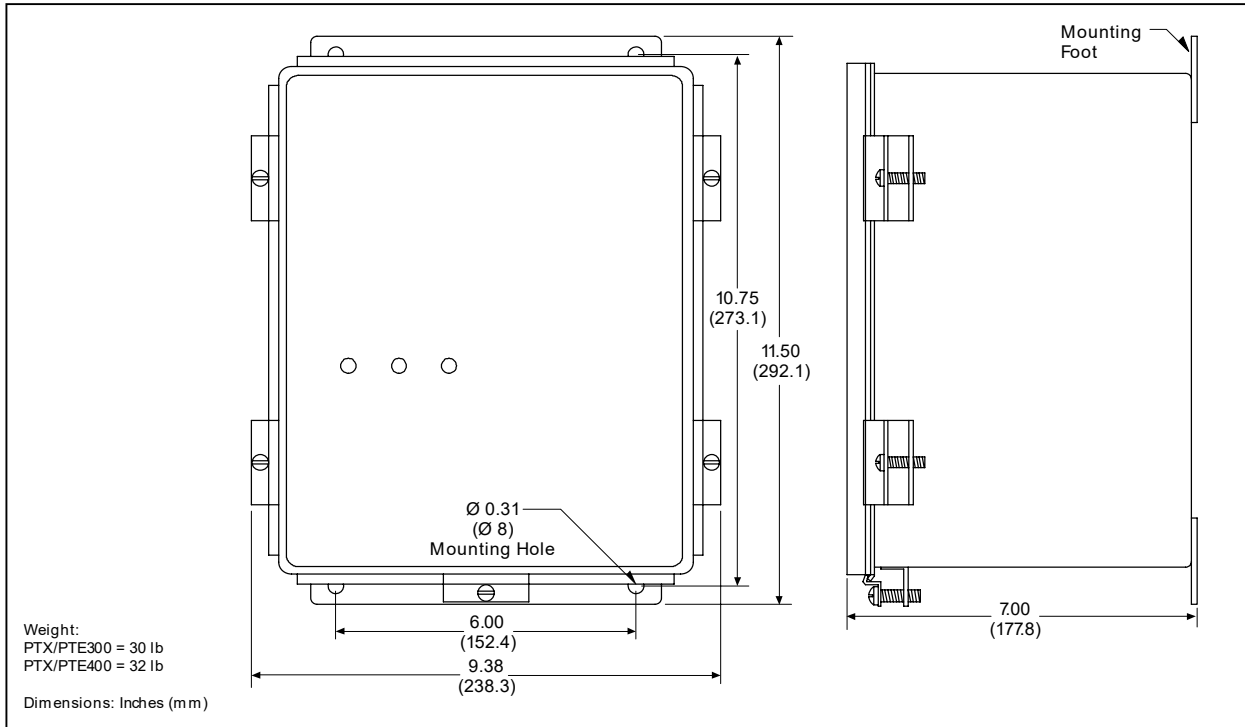


**Figure 2-3. PTE048, 065, 080 / Models 1P201, 3Y201, 3Y300, NN201, NN400, NN501  
 PTX/PTE120, 160 / All Models**





**Figure 2-4. PTX/PTE240, 300, 400 / All Models**



**Figure 2-5. Circuit Breaker (C) & Circuit Breaker Disconnect (CD) Options for 48, 65, 80, 120, 160 240 or 300 kA Models**

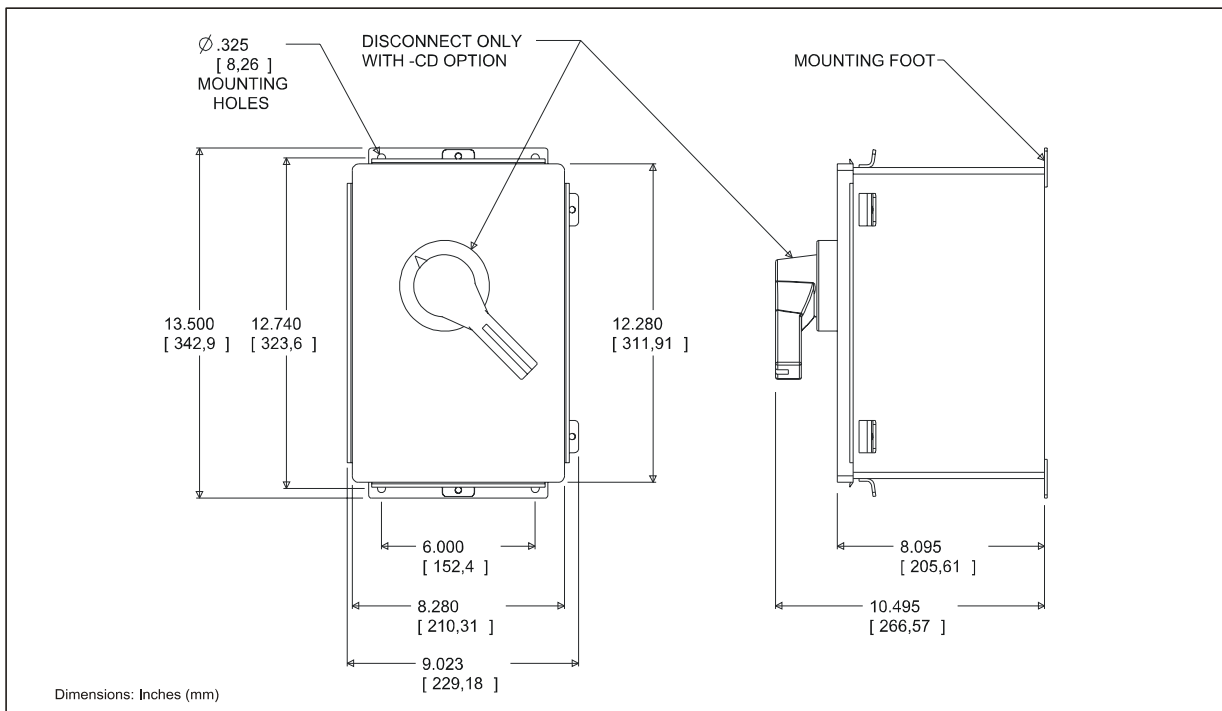


Figure 2-6. Circuit Breaker Disconnect (C and CD) Option for 400 kA Models

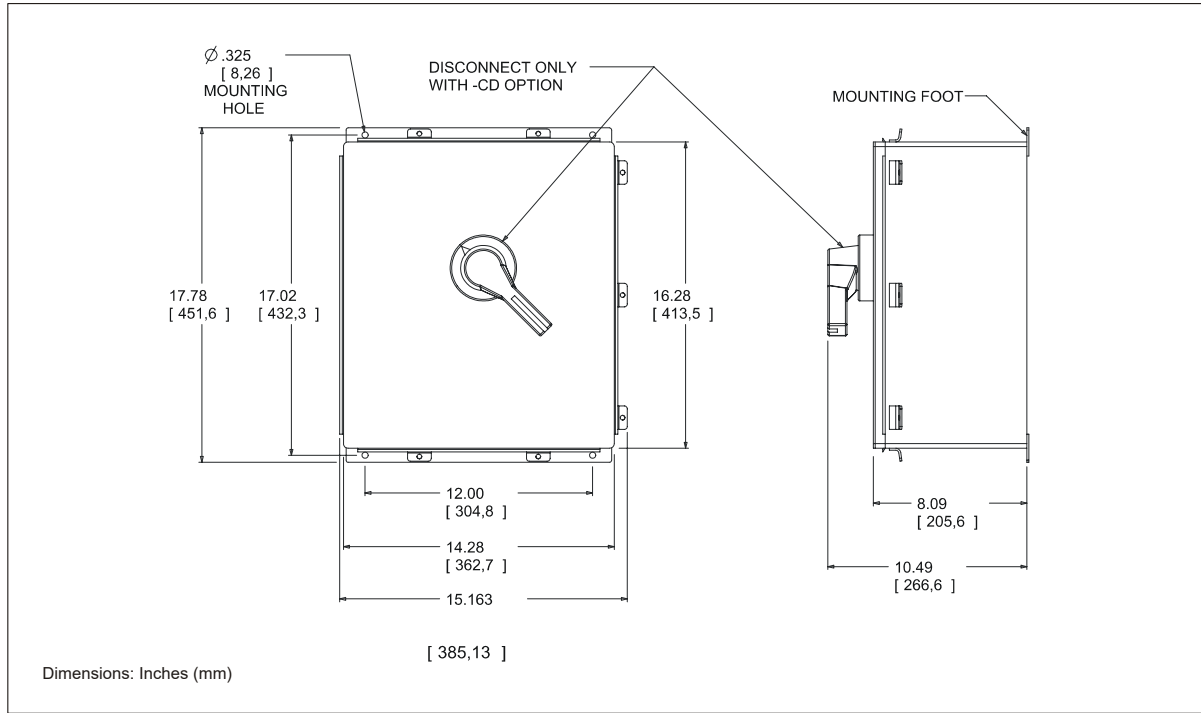
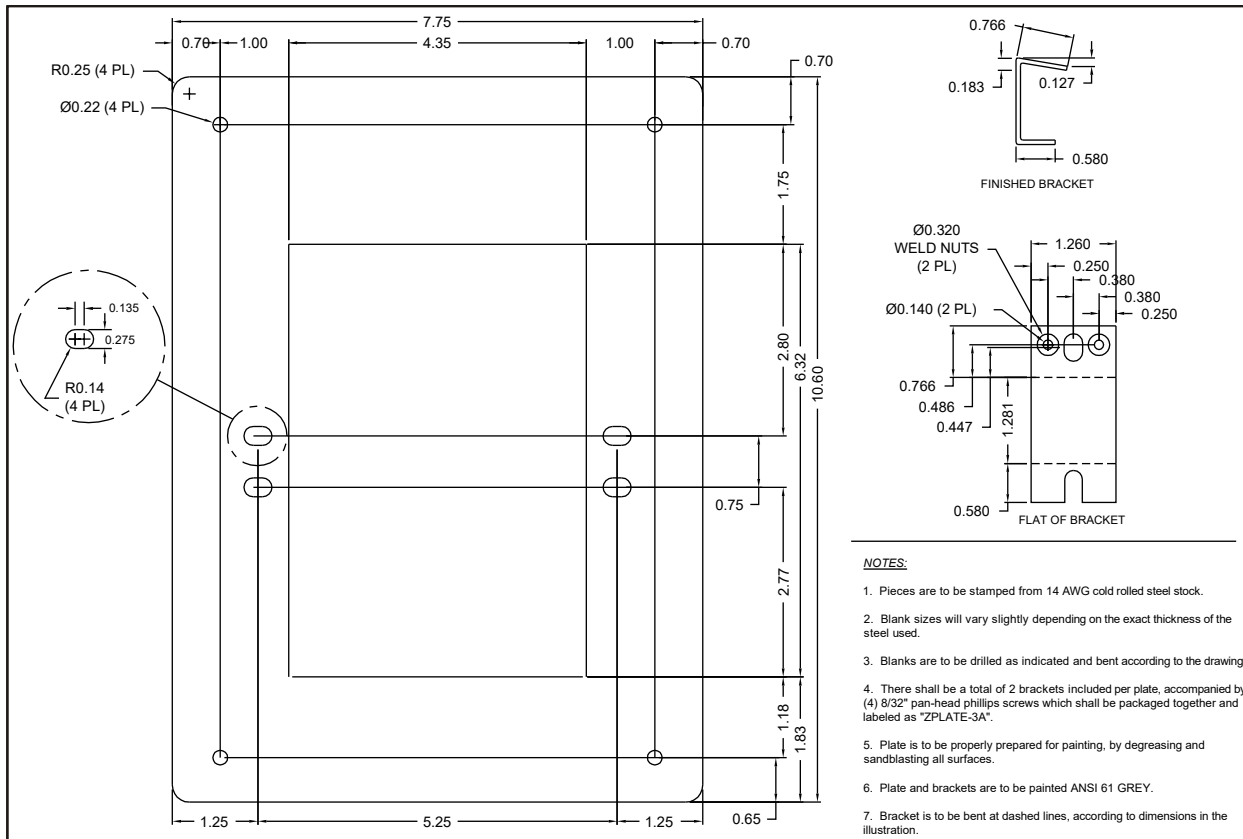
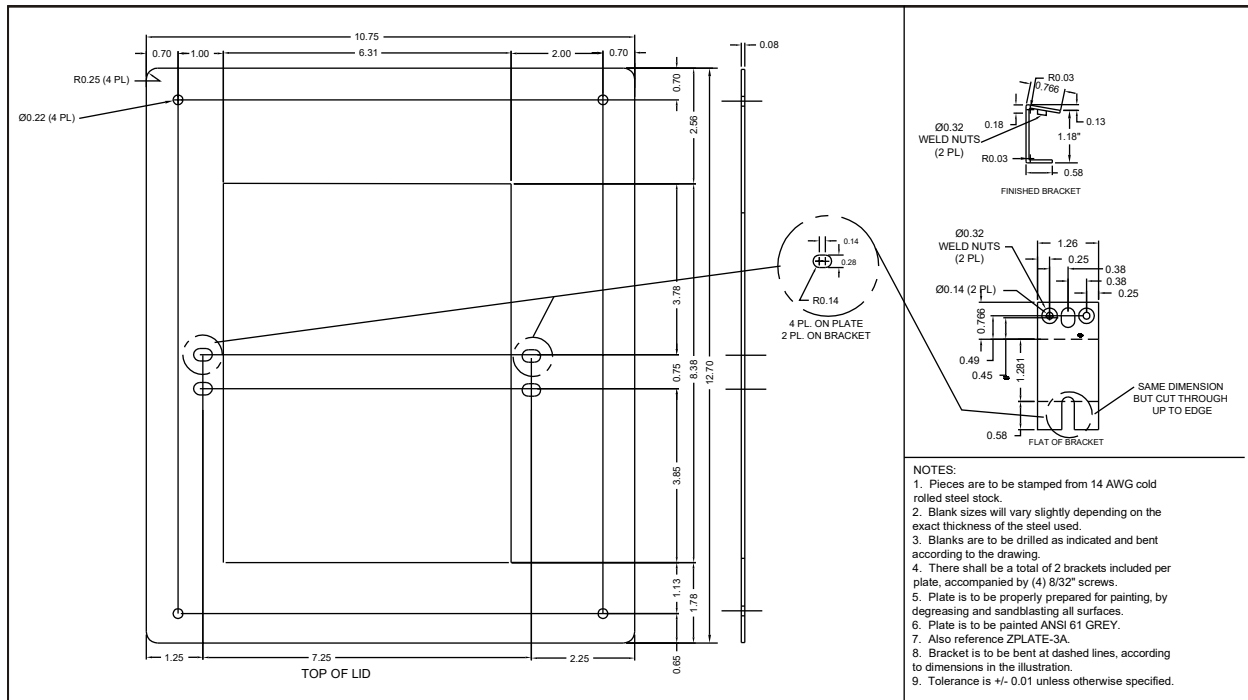


Figure 2-7. Flushmntplate3A PTE/X units 40, 65, 80 kA



**Figure 2-8. Flushmntplate8 PTE/X units 120 and 160 kA**



## 2.6 Disconnecting the ATN Filter

The ATN filter, which is part of all PTE models, should be disconnected if the SPD is connected to an electrical panel feeding medical patient care equipment, or containing a ground fault circuit interrupting (GFCI) main breaker. The ATN filter provides enhanced Neutral to Ground/Earth protection that may cause nuisance tripping of breakers that are part of the above-mentioned applications.

**Note:** *The following procedures disable only the ATN filter. Other protection circuits are not affected.*



**WARNING! SHOCK HAZARD:** When disconnecting the ATN filter, be sure to **de-energize the electrical system and follow safe work practices** to avoid an electrical shock hazard.

**For Standard PTE Models (without a “C” or “CD” suffix):** Open or remove cover on SPD, being careful not to strain the wires or damage the circuit board attached to the cover. Look into the enclosure and locate a green/yellow loop of wire protruding from the encapsulation. Use a wire-cutting tool to cut this wire in the center of the loop. Cap off the ends of each wire using UL listed wire nuts. Close or reinstall cover.

**For Circuit Breaker / Circuit Breaker Disconnect PTE Models (with a “C” or “CD” suffix):** Open or remove cover on SPD, being careful not to strain the wires or damage the circuit board attached to the cover. Next to the Circuit Breaker mounting panel, locate a green/yellow loop of wire. Use a wire-cutting tool to cut this wire in the center of the loop. Cap off the ends of each wire using UL listed wire nuts. Close or reinstall cover.

## 2.7 Wiring SPD to Electrical System



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**WARNING! SHOCK HAZARD:** When working inside the SPD, be sure to **de-energize the electrical system and follow safe work practices** to avoid an electrical shock hazard.

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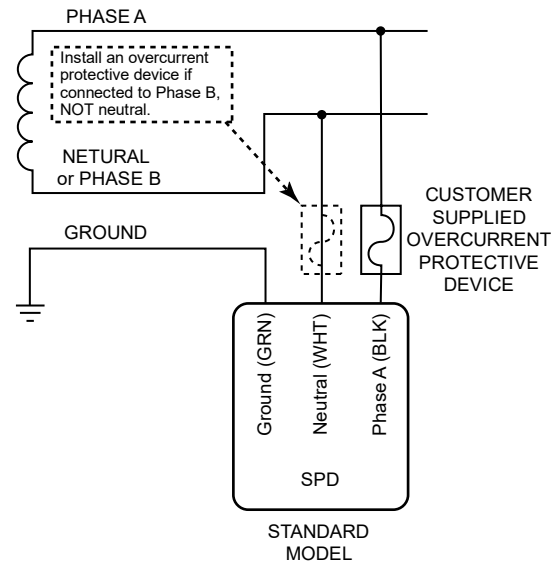
### Important!

- *Keep all connecting leads as short and straight as possible. Additionally, the conductors should be twisted together by approximately one turn every two inches for as much as the wire run as possible to achieve maximum SPD performance.*
- *For all Standard SPD models (without a "C" or "CD" suffix) the SPD must be connected to the electrical system through an external overcurrent protective device. Refer to Section 2.3 for details.*
- *Always connect the SPD to the **load side** of the main disconnect.*
- *If the system utilizes an isolated ground, then the SPD's ground wire must be connected to the system's isolated Ground bus.*

1. Open or remove cover on SPD.
2. Do one of the following:
  - For SPD models that are supplied with wire, identify the Neutral, Ground, and Phase wires. These wires are labeled and/or color coded as follows:
    - Neutral** = White or Gray
    - Ground** = Green or Green w/Yellow Stripe
    - Phase A, B, C** = Black
  - Note that SPDs (models NN201, NN400, and NN501) that are connected to 3-Phase Delta (No Neutral) electrical systems do not contain a Neutral (WHT) wire.
  - For SPD models that are NOT supplied with wire, obtain wire of the correct size and color (refer to Table 2-1 and connect one end of each wire to its designated ring or box terminal inside the SPD. Wire length should be kept as short as possible (18" maximum), but long enough to allow all necessary connections to be made inside the electrical panel.
3. Route the wires from the SPD (through conduit if used) into the electrical panel.
4. On Pages 13 thru 15, locate the wiring diagram of the electrical system to which the SPD is being connected. Perform the procedure associated that wiring diagram to connect the SPD to the electrical panel's bus bars.

• **Single Phase (1P101, 1P201)**

- a. Connect the SPD's Ground (GRN) wire directly to the electrical panel's Ground bus bar.
- b. Do one of the following:
  - **Neutral Connection** – Connect the SPD's Neutral (WHT) wire directly to the electrical panel's Neutral bus bar.
  - **Phase B Line Connection** – Connect the SPD's Neutral (WHT) wire through an over-current protective device (refer to Section 2.3)\* to the electrical panel's Phase B voltage bus bar.
- c. Connect the SPD's Phase A (BLK) wire through an overcurrent protective device (refer to Section 2.3)\* to the electrical panel's Phase A voltage bus bar.

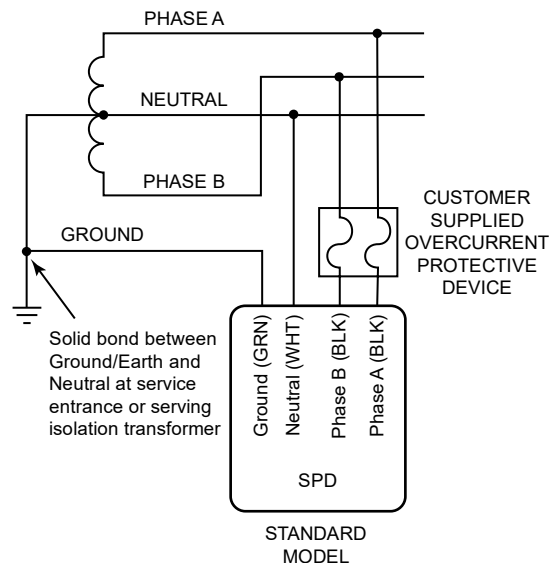


\* **Note:** For Circuit Breaker or Circuit Breaker Disconnect SPD models (with a "C" or "CD" suffix), connect the SPD wires to the electrical panel according to National, State, and Local codes.

• **Split Phase (1S101)**

**Important!** Do not install SPD if the Neutral to Ground (Earth) bond is not present as the SPD may be damaged.

- a. Connect the SPD's Ground (GRN) wire directly to the electrical panel's Ground bus bar.
- b. Connect the SPD's Neutral (WHT) wire directly to the electrical panel's Neutral bus bar.
- c. Connect the SPD's Phase A (BLK) wire through an overcurrent protective device (refer to Section 2.3)\* to the electrical panel's Phase A voltage bus bar.
- d. Repeat Step c to connect the SPD's Phase B (BLK) wire to its associated bus bar.

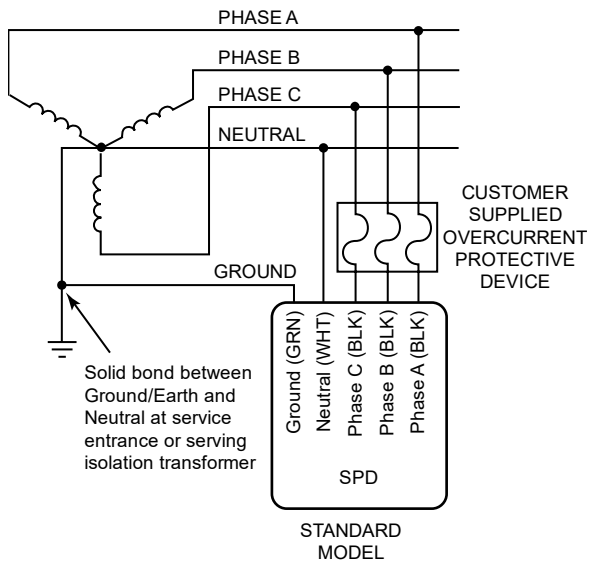


\* **Note:** For Circuit Breaker or Circuit Breaker Disconnect SPD models (with a "C" or "CD" suffix), connect the SPD wires to the electrical panel according to National, State, and Local codes.

• **3-Phase Wye (Star) (3Y101, 3Y201, 3Y300)**

**Important!** Do not install SPD if the Neutral to Ground (Earth) bond is not present as the SPD may be damaged.

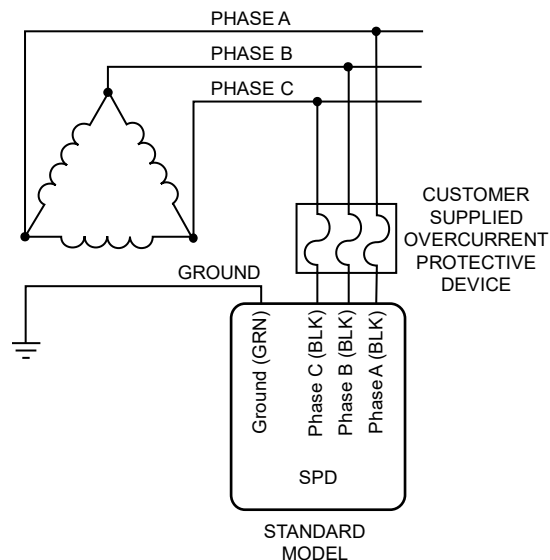
- Connect the SPD's Ground (GRN) wire directly to the electrical panel's Ground bus bar.
- Connect the SPD's Neutral (WHT) wire directly to the electrical panel's Neutral bus bar.
- Connect the SPD's Phase A (BLK) wire through an overcurrent protective device (refer to Section 2.3)\* to the electrical panel's Phase A voltage bus bar.
- Repeat Step c to connect the SPD's Phase B and C (BLK) wires to their associated bus bars.



\* **Note:** For Circuit Breaker or Circuit Breaker Disconnect SPD models (with a "C" or "CD" suffix), connect the SPD wires to the electrical panel according to National, State, and Local codes.

• **3-Phase Delta (No Neutral) (NN201, NN400, NN501)**

- Connect the SPD's Ground (GRN) wire directly to the electrical panel's Ground bus bar.
- Connect the SPD's Phase A (BLK) wire through an overcurrent protective device (refer to Section 2.3)\* to the electrical panel's Phase A voltage bus bar.
- Repeat Step b to connect the SPD's Phase B and C (BLK) wires to their associated bus bars.

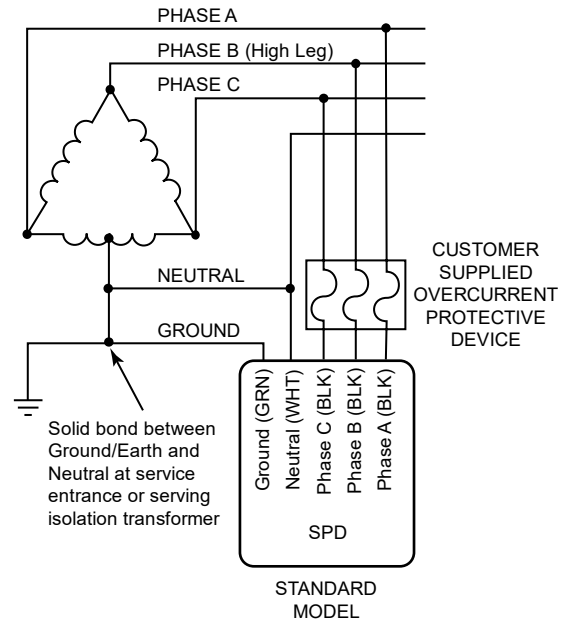


\* **Note:** For Circuit Breaker or Circuit Breaker Disconnect SPD models (with a "C" or "CD" suffix), connect the SPD wires to the electrical panel according to National, State, and Local codes.

• **3-Phase Delta (High-Leg) (3D101)**

**Important!** Do not install SPD if the Neutral to Ground (Earth) bond is not present as the SPD may be damaged.

- a. Connect the SPD's Ground (GRN) wire directly to the electrical panel's Ground bus bar.
- b. Connect the SPD's Neutral (WHT) wire directly to the electrical panel's Neutral bus bar.
- c. Connect the SPD's Phase A (BLK) wire through an overcurrent protective device (refer to Section 2.3)\* to the electrical panel's Phase A voltage bus bar.
- d. Repeat Step c to connect the SPD's Phase B and C (BLK) wires to their associated bus bars.



\* **Note:** For Circuit Breaker or Circuit Breaker Disconnect SPD models (with a "C" or "CD" suffix), connect the SPD wires to the electrical panel according to National, State, and Local codes.

5. If the SPD's Form C relay is to be used for remote alarm purposes, then proceed to Section 2.8 for detailed wiring information.
6. Recheck all connections, and then close or reinstall cover.

## 2.8 Form C Relay Contacts

The SPD's Form C relay (mounted on the cover) provides two sets of dry contacts labeled N/O (Normally Open), N/C (Normally Closed), and COM (Common). The label indicates the position of the contacts when the relay is *energized*.

The relay contacts are rated 125 Vac @ 0.5 A, or 30 Vdc @ 1 A (60 W or 125 VA).

The Form C relay contacts are "fail safe" and only change state when the relay is energized by all phase voltages being present. By connecting a remote alarm to these contacts, the alarm can be made to activate when the relay de-energizes as the result of losing at least one phase voltage.

Connect the SPD's Form C relay contacts to a remote alarm device as follows:



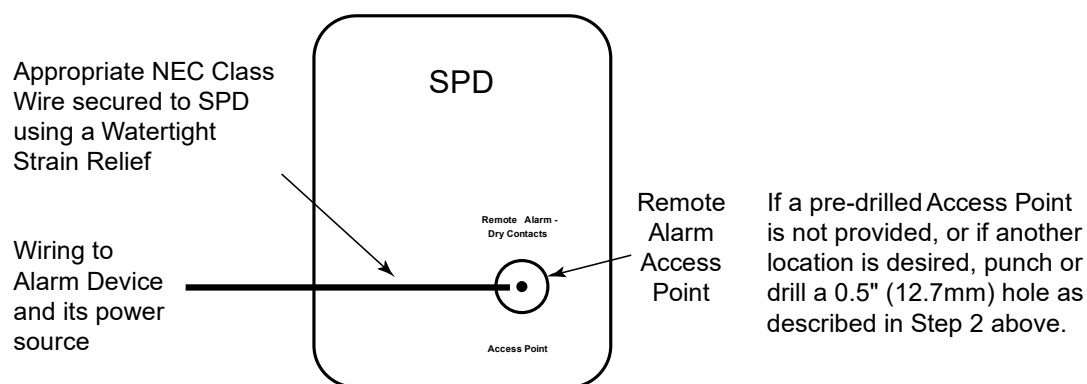
**WARNING! SHOCK HAZARD:** When working inside the SPD, be sure to **de-energize the electrical system and follow safe work practices** to avoid an electrical shock hazard.

1. Open or remove cover on SPD, taking care not to damage the indicator light circuit board and wiring attached to the cover.
2. See Figure 2-9. Punch a hole through the cover's overlay marked "Remote Alarm," if provided, and install a watertight strain relief (e.g. Heyco 3208). If a side, top, or bottom location is required, or if no pre-drilled access point is provided, punch or drill a 0.5" (12.7 mm) diameter hole, centered at 1.125" (28.5 mm) from the lip of the box (cover opened/removed) in a location that will not interfere with the cover clamps or screws. And then install the watertight strain relief.



**CAUTION:** Be cautious to capture and remove all metal shavings during the drilling process to avoid possible short circuits.

**Figure 2-9. Remote Alarm Access Point**



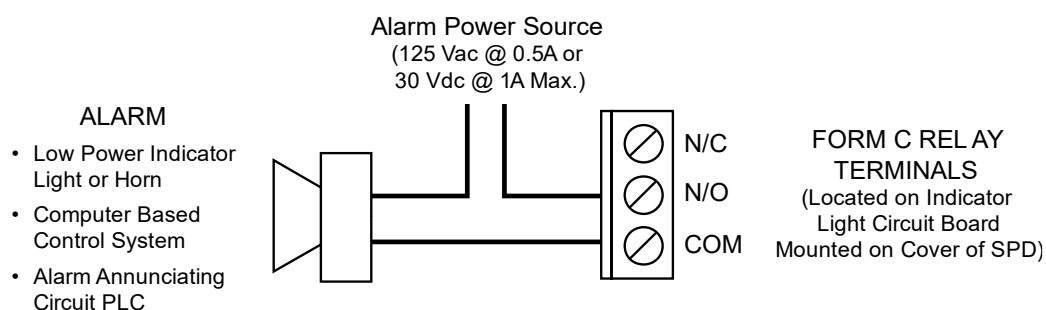


3. Using a small flat-blade screwdriver, connect a customer supplied alarm device (and if required a power source) to the Form C relay's COM and N/C or N/O terminals as necessary for proper device operation. Note that the relay terminals accept AWG #26 to #16 (0.16 to 0.5 mm<sup>2</sup>) wire. Be sure to follow applicable U.S. NEC Articles (or other applicable country codes). Also, follow rules of wiring class used when determining routing of alarm leads. To maintain NEMA 4 (IP66) rating, use appropriate cable and the supplied watertight strain relief.

In the example shown in Figure 2-10, the Form C relay will de-energize if one of the Phase voltages is lost, causing the alarm to activate.

4. Recheck all connections, and then close or reinstall cover.

**Figure 2-10. Typical Alarm Wiring**



## 2.9 Power Up and System Checkout

Apply system power and observe the following:

- The LED(s) visible through the SPD's cover should glow. One LED should glow for each Phase voltage being monitored.

**Tip:** Should there be a **significant** difference in LED brightness, check the phase rotation of the electrical panel and ensure that the SPD's Phase wires are connected to the correct phase. Slight differences in brightness DO NOT indicate a faulty LED, rather specification tolerance differences of the indicator circuit's components. LED brightness symmetry and/or level do not indicate the SPD's operational status.

- With all phase voltages present, the Form C relay should energize causing its contacts to move to their normal position.

### 3.0 Warranty

Eaton warrants these products for a period of 5 years from the date of delivery to the purchaser, 20 years if the product is properly registered with Eaton, to be free from defects in both workmanship and materials. To register visit [www.eaton.com/itvss](http://www.eaton.com/itvss) and click the warranty registration icon. Eaton assumes no risk or liability for results of the use of the products purchased from it, including but without limiting the generality of the foregoing: (1) The use in combination with any electrical or electronic components, circuits, systems, assemblies, or any other materials or substances; (2) Unsuitability of any product for use in any circuit or assembly.

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This warranty does not apply if the product has been misused, abused, altered, tampered with, or used in applications other than specified on the nameplate. At the end of the warranty period, Eaton shall be under no further warranty obligation expressed or implied.

The product covered by this warranty certificate can only be repaired or replaced by the factory. For help on troubleshooting the SPD, or for warranty information, call 1-800-809-2772, Option 4, sub-option 2. Repair or replacement units will be returned collect. If Eaton finds the return to be a manufacturer's defect, the product will be returned prepaid.

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