

# Eaton SPD Series for Mounting External to Electrical Distribution Equipment

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**EATON**

*Powering Business Worldwide*

## 1.0 Introduction

### 1.1 Manual Organization

This Installation Manual describes the safe installation, testing and operation of the Eaton® SPD Series Surge Protective Device (SPD).

This manual is organized into seven sections, as follows:

- 1.0 Introduction
- 2.0 Installation
- 3.0 Operating Features
- 4.0 Troubleshooting
- 5.0 Specifications
- 6.0 Ordering Guidelines
- 7.0 Warranty

### 1.2 Product Overview

The Eaton SPD Series protects critical electrical and electronic equipment from damage by power surges. This is done by shunting high energy lightning surges (and other transient disturbances) away from the equipment being protected. It does this in nanoseconds by providing a low impedance surge path to ground while supporting power frequency voltage.

The Eaton SPD Series is designed to mount on the wall (or other vertical surface) as close as possible to the electrical cabinet. The SPD Series is available in voltage ratings from 120-600V AC, surge current capacity ratings from 50kA to 400kA, and NEMA 1, NEMA 4 or NEMA 4X enclosures..

The Eaton SPD Series is available in three feature packages (Basic, Standard, and Standard with Surge Counter), as described in Section 3, "Operating Features." Each model is available in Delta, Wye, and Split Phase wiring configurations.

All Eaton SPD Series models have been tested and certified by Underwriter's Laboratory (UL®), to comply with UL Standard 1449, 3<sup>rd</sup> Edition.

### 1.3 Safety Precautions

A licensed/qualified electrician must complete all instructions in this manual in accordance with the National Electric Code (NEC®), state, and local codes, or other applicable country codes. All applicable local electrical codes supersede these instructions.

#### **⚠WARNING**

**IMPROPER INSTALLATION COULD CAUSE DEATH, INJURY AND EQUIPMENT DAMAGE. FOLLOW ALL WARNINGS AND CAUTIONS. COMPLETELY READ AND UNDERSTAND THE INFORMATION IN THIS INSTRUCTION MANUAL 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 SERVICES ARE TO INSTALL AND SERVICE THIS EQUIPMENT.**

**HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE SPD DURING NORMAL OPERATION. FOLLOW ALL SAFE WORK PRACTICES TO AVOID ELECTRICAL SHOCK.**

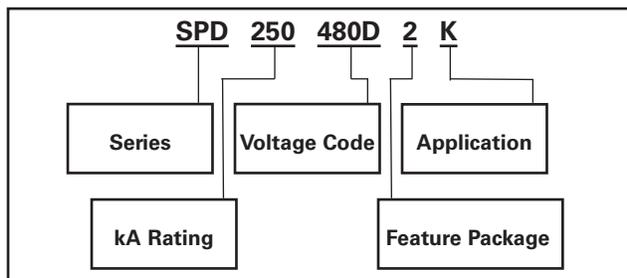
#### **⚠WARNING**

**ARC FLASH DURING INSTALLATION COULD CAUSE INJURY. USE APPROPRIATE SAFETY PRECAUTIONS AND EQUIPMENT FOR ARC FLASH PROTECTION.**

### 1.4 Catalog Numbering System

Each Eaton SPD Series unit has a name plate that identifies the parameters used for manufacture. These parameters are expressed in letters and numbers, to reflect the Series, kA Rating, Voltage Code, Feature Package, and Application as shown in Table 1.

**Table 1. Catalog Numbering System**



For example, a 480 volt Delta (3-wire plus Ground) for use in an NEMA 1 application requires an SPD model SPD 250480D2K, where:

SPD = SPD model,

250 = the kA rating (50 – 400 kA),

480D = the voltage,

2 = the feature package (Basic, Standard, Standard With Surge Counter), and,

K = the Application Suffix (such as NEMA 1 or NEMA 4 with internal disconnect).

These numbers appear as part of the product label attached to the front left side of the SPD. See Figure 1.



**Figure 1. Product Label**

## 1.5 Equipment Testing

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### **⚠WARNING**

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**CONDUCTING DIELECTRIC, MEGGER, OR HI-POTENTIAL TESTING WITH THE SPD INSTALLED WILL CAUSE INTERNAL DAMAGE TO THE SPD. THE SPD WILL ALSO CAUSE THE TEST TO FAIL.**

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Every Eaton SPD Series unit is tested at the factory for dielectric breakdown. No further SPD testing is required for installation.

If you desire to test distribution equipment by performing dielectric, megger, or hi-potential tests, any installed SPD **must** be disconnected from the power distribution system to prevent damage to the unit.

Follow this procedure to safely disconnect the SPD:

1. For SPDs connected to a circuit breaker or fuse:
  - a. 3-wire delta SPDs: Turn off the circuit breaker or remove the fuses from the fuse holder to isolate the SPD.
  - b. Wye and Split phase SPDs: Turn off the circuit breaker or remove the fuses from the fuse holder to isolate the SPD and remove the Neutral connection on Wye connected SPDs.

## 2.0 Installation

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### **⚠WARNING**

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**INSTALLING AN SPD THAT IS IMPROPERLY RATED FOR THE ELECTRICAL SYSTEM VOLTAGE COULD CREATE A POTENTIALLY HAZARDOUS CONDITION, RESULTING IN INJURY OR EQUIPMENT DAMAGE.**

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### 2.1 Preparation for Installation

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#### **⚠CAUTION**

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**EATON SPD SERIES PRODUCTS MUST BE INSTALLED OR REPLACED BY A QUALIFIED ELECTRICIAN TO AVOID INJURY OR EQUIPMENT DAMAGE.**

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Before installing an Eaton SPD Series unit, do the following:

- Verify that the area is clear of any dirt, debris or clutter that may hamper the installation process.
- Verify that there is enough space to install the SPD. See Section 2.3, "Installation Procedures" for dimensions.
- Confirm that all tools and equipment needed for the installation are available.
- Confirm that the system voltage and wiring configuration is the same as the SPD you are installing. Check the voltage rating label on the side of the SPD.

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### **⚠WARNING**

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**TURN OFF THE POWER SUPPLY BEFORE WORKING IN ANY ELECTRICAL CABINET OR ON ANY CIRCUIT BREAKER PANEL. FAILURE TO DO SO COULD RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK.**

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### **NOTICE**

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**A POOR GROUND, OR GROUNDING/BONDING VIOLATIONS, COULD PREVENT THE SPD FROM PERFORMING AS SPECIFIED.**

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**DO NOT USE THE SPD TO CARRY OR PASS THROUGH GROUND TO OTHER DEVICES OR LEADS. DAMAGE TO THE EQUIPMENT MAY RESULT.**

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- Check the facility grounding system. All grounding, bonding, and earthing must meet the NEC and any other national, state and local electrical codes.

### 2.2 Installation Locations

Eaton's SPD Series can be installed next to, above, or below any existing electrical enclosure.

The ideal mounting location for the Eaton SPD Series is as close as possible to the electrical enclosure. The Eaton SPD Series should be mounted in such a way as to minimize any sharp bends in the wiring conduit.

### 2.3 Installation Procedures

1. Before mounting the SPD first determine the ideal location and ensure that the mounting surface is sufficient to support the weight of the SPD (See Figures 2, 3, 4, 5, and 6 on pages 4, 5, and 6 for model weights). The SPD should be mounted as close a possible to the electrical enclosure and as close as possible to the wiring connection point within the enclosure. This will ensure a minimum wire length and maximum SPD performance.
2. Lay out the four enclosure mounting holes using the enclosure dimensions provided in Figures 2, 3, 4, 5 and 6 on pages 4, 5 and 6. Drill the appropriate holes per the product dimensions. Note: NEMA 1 enclosures require a #10 fastener and NEMA 4 and 4X enclosures require a 1/4 inch fastener.
3. Determine the correct length and install metal conduit onto the SPD. NEMA 1 SPDs have a 3/4 inch trade size chase nipple and NEMA 4 and NEMA 4X SPDs have 3/4 inch trade size hubs. Route all Phase, Neutral (where applicable), Ground and Form C (where applicable) wires through the conduit.
4. Determine the hole location on the receiving electrical enclosure and either remove the knock-out provided or drill the appropriate size hole at this location. Route the SPD wires through the enclosure hole and mount the SPD enclosure.
5. Select the correct wiring diagram for the SPD you are installing. You must refer to this diagram while wiring the SPD. See Figures 8 - 13. SPD Series Type 1 and Type 2 units do not require over current protection devices, fuses or circuit breakers to operate correctly. All local and national electric codes must be followed during installation and these codes may require protection of the conductors leading to the SPD unit.
6. Determine the wire length required to make the SPD Phase connections and cut the wires to the appropriate length. (To maximize SPD performance, wire length should be as short as possible). Connect the Phase wires.

**Note:** For wire lengths longer than 4 inches, Phase wires should be twisted once for each 4 inches of wire length to maximize SPD performance.

7. Determine the wire length for the Ground and Neutral (where applicable) wires and cut these wires as needed. Again, keep these wires as short as possible to maximize SPD performance.
8. Standard and Standard with Surge Counter SPDs also provide wiring for Form C relay contacts. This connection can be used for remote monitoring of the SPD. The Form C contacts are rated at 150V AC or 125V DC at 1A. Make the remote monitoring connections per the Form C wiring diagram in Figure 7. Follow all national, state and local electrical codes when making these connections.

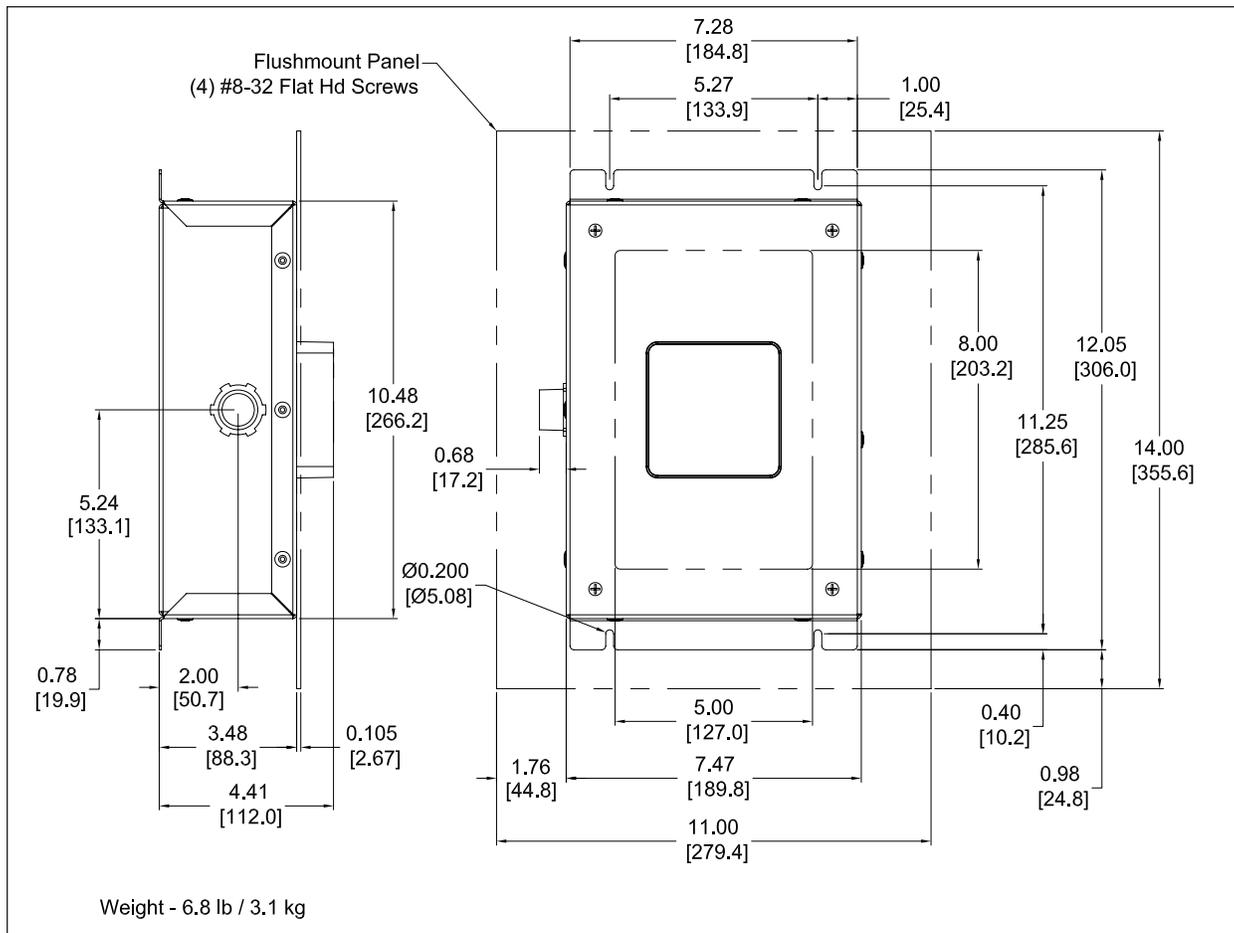


Figure 2. NEMA 1 (With Flushmount) (Suffix L)

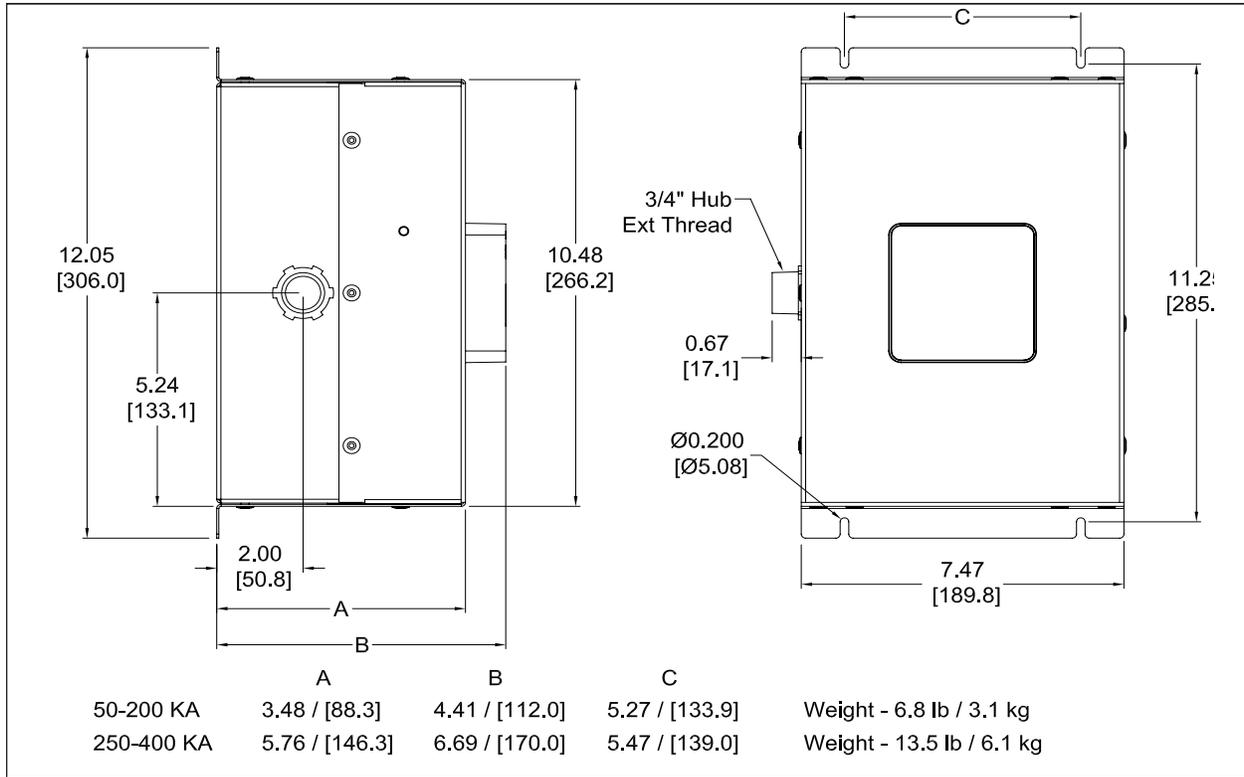


Figure 3. NEMA 1 (Suffix K)

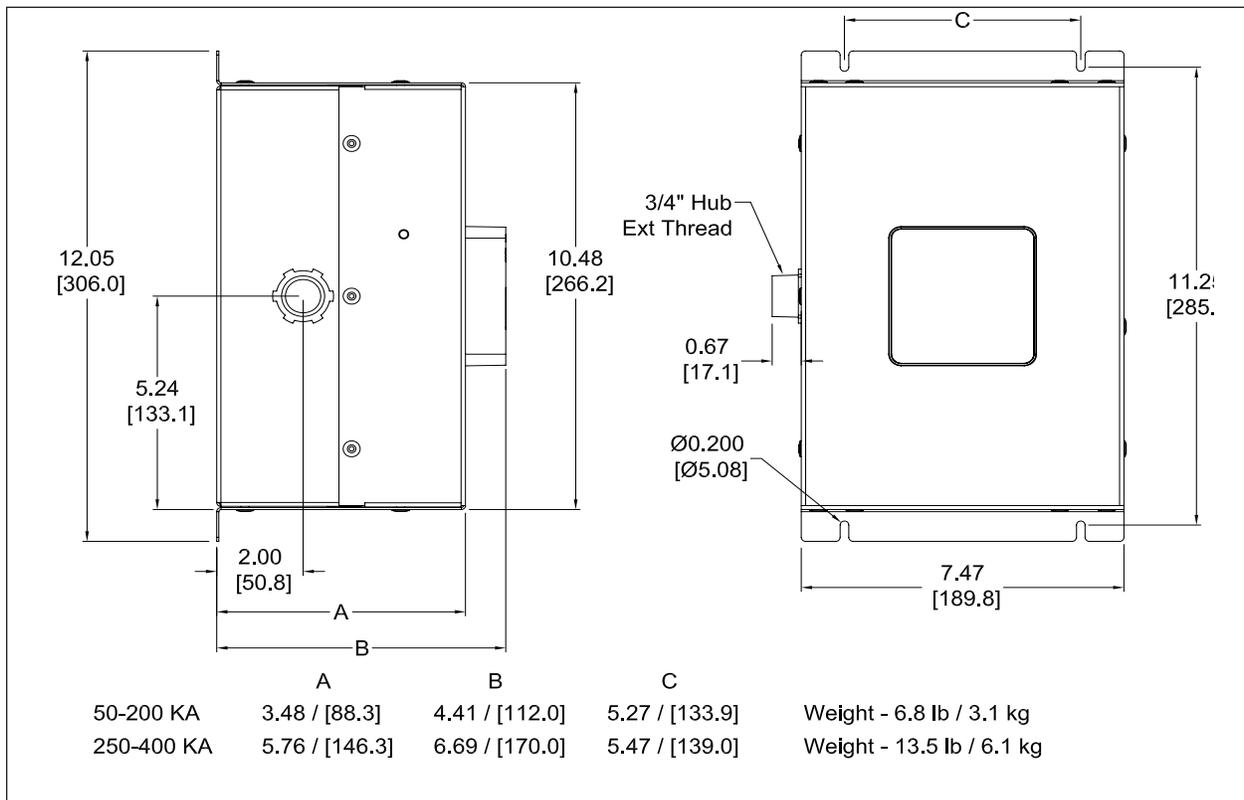


Figure 4. NEMA 4 - 4X (Suffix N, P)

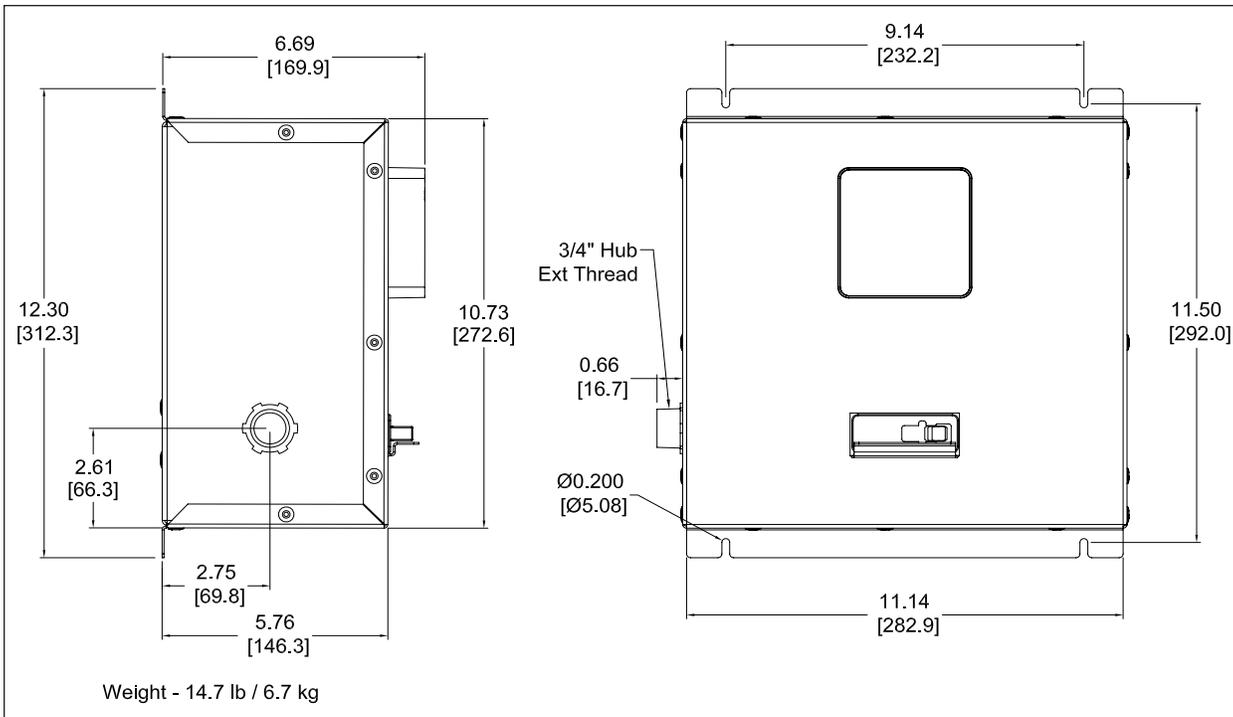


Figure 5. NEMA 1 (With Disconnect) (Suffix M)

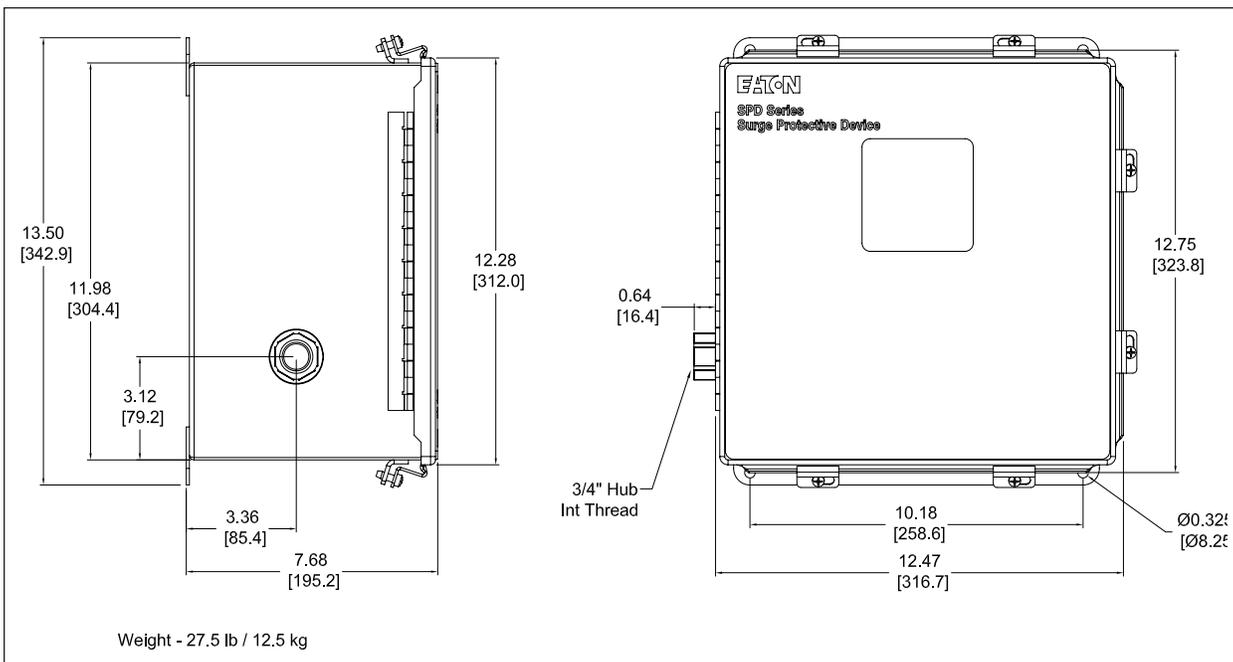


Figure 6. NEMA 4-4X (With Disconnect) (Suffix O, Q)

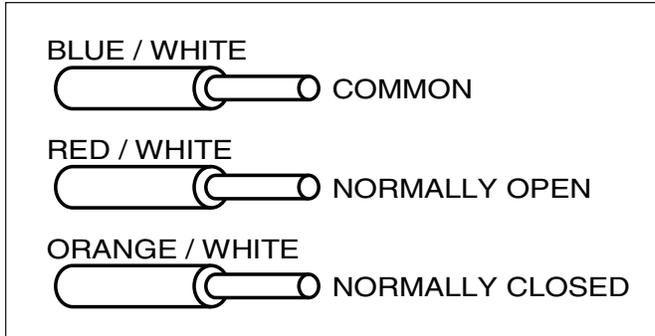


Figure 7. Sidemount Form C Wires

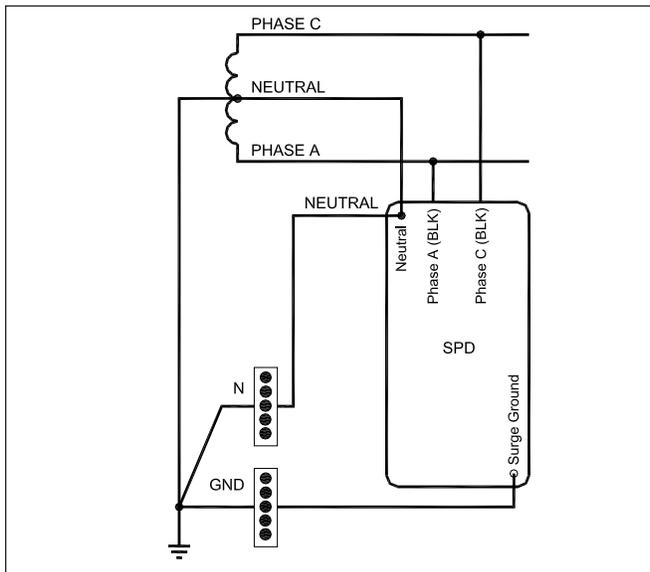


Figure 8. Split Phase Units

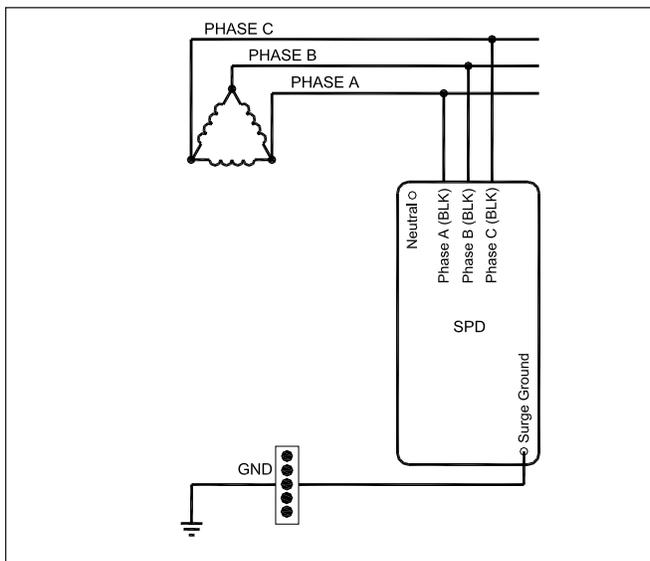


Figure 9. 3-Phase Delta

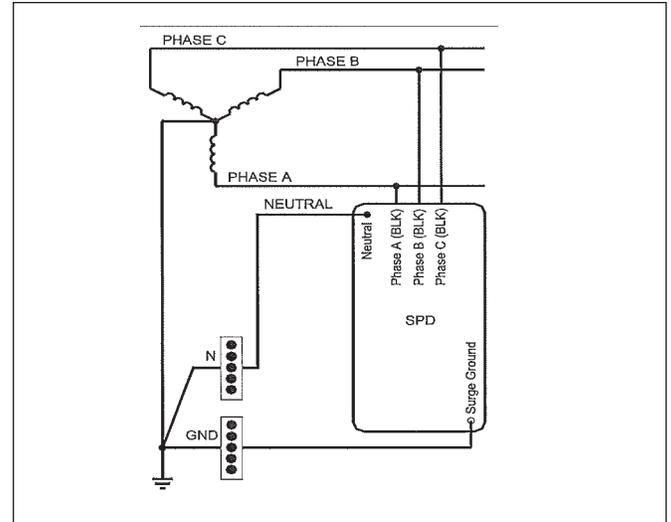


Figure 10. 3-Phase Wye Units

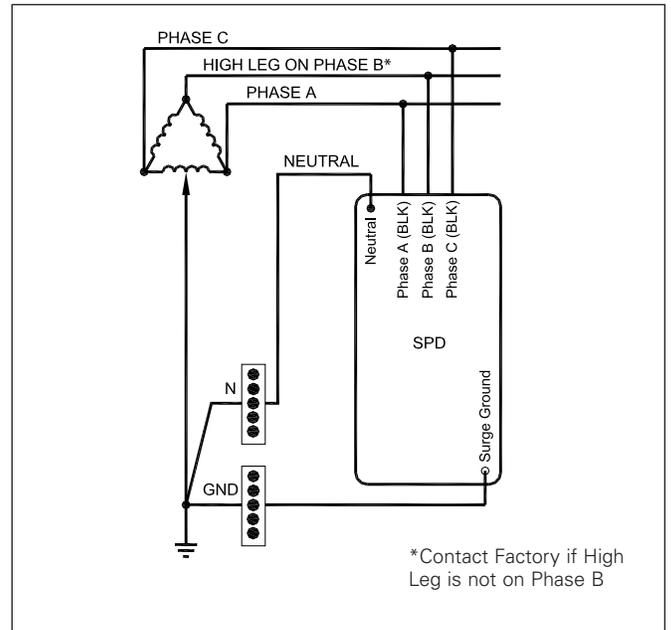


Figure 11. High Leg Delta Units

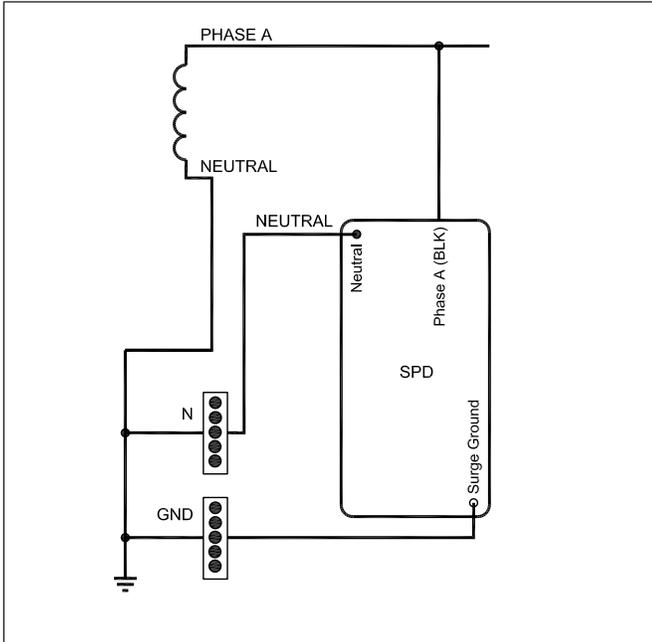


Figure 12. Wiring - Single Phase Units (230 L)

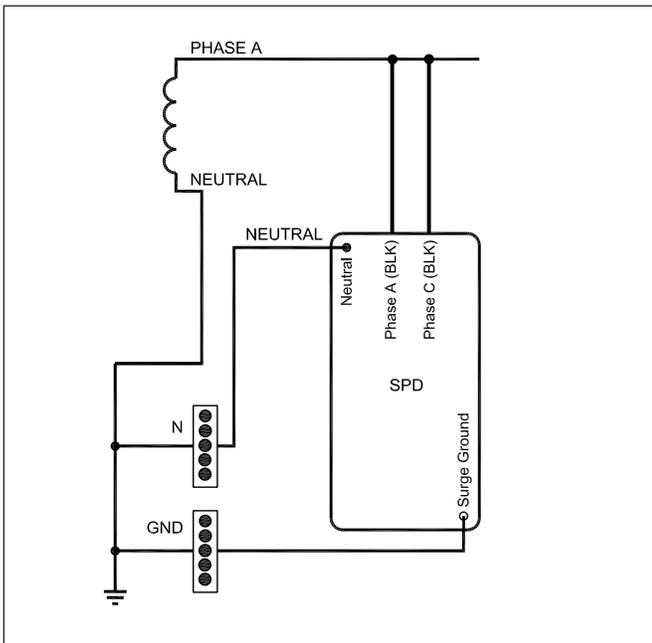


Figure 13. Wiring - Single Phase Units (240S) for 120V Single Phase Applications

### 3.0 Operating Features

#### 3.1 General

The Eaton SPD Series comes in three feature packages: Basic, Standard, and Standard with Surge Counter. The operating specifics of each feature package are described below.

The Eaton SPD Series requires no operator involvement, other than to monitor the display panel to determine status of the SPD.

After system power is applied, the SPD automatically begins protecting downstream electrical equipment from voltage transients.

Some SPD units have a Form C relay contact that allows for the remote indication of SPD status. Form C contact wires are permanently connected to the SPD.

#### 3.2 Displays and Indicators

All Eaton SPD Series units (Basic, Standard, and Standard With Surge Counter) use a display panel to indicate system status. The display panel is slightly different for each feature package.

Each display has both green and red light emitting diodes (LEDs) to indicate the status of the protection on each phase. Green indicates the phase is fully protected. Red indicates a loss of protection. Wye, Split Phase and High-Leg Delta units have an additional set of green/red LEDs to indicate status of Neutral/Ground protection.

When the LEDs turn red, an audible alarm will also sound on units equipped with an audible alarm.

Specific operating conditions displayed for each Eaton SPD Series Feature Package are described below.

##### 3.2.1 Basic Feature Package

The Eaton SPD Basic Feature Package display is shown in Figure 14.



Figure 14. Basic Feature Package Display

The Basic Feature Package has the following features:

- Green LEDs: Illumination indicates the phase is fully protected, and operating normally, with all protection active and available. Green LEDs also indicate Neutral to Ground protection on units with a Neutral wire. Green LEDs do not indicate on/off status of power.
- Red LEDs: Illumination indicates a loss of protection, and that one or more protective devices are now inactive and unavailable for that Phase. Red LEDs also indicate Neutral to Ground protection on units with a Neutral wire. Red LEDs do not indicate on/off status of power.

### 3.2.2 Standard Feature Package

The Eaton SPD Series Standard Feature Package display is shown in Figure 15.



**Figure 15. Standard Feature Package Display**

The Standard Feature Package has the following features:

- All features of the Basic Feature Package.
- One Form C relay contact rated at 150Vac or 125Vdc @1A.
  - Normal operating conditions. N.O. = OPEN. N.C = CLOSED.
  - Loss of protection on any phase or loss of power. N.O. = CLOSED. N.C. = OPEN.
- Audible alarm with Reset push button.
- EMI/RFI filtering.

### 3.2.3 Standard With Surge Counter Feature Package

The Eaton SPD Series Standard With Surge Counter Feature Package display is shown in Figure 16.



**Figure 16. Standard With Surge Counter Feature Package Display**

The Standard With Surge Counter Feature Package has the following features:

- All features of the Standard Feature Package.
- LCD screen that displays surge count.
- Reset button to RESET the surge counter to zero.

### 3.2.4 SPD Display Rotation

The SPD display can be rotated on the SPD enclosure, up to 360 degrees. This allows you to position the display for the best visibility regardless of the position in which the SPD is installed.

Rotations are at 90, 180, and 270 degrees.

Reposition the SPD display as follows:

1. Remove power from the unit.
2. Remove and discard the perforated overlay material at the two opposite corners of the display.
3. Remove the two phillips head screws that hold the display.
4. Rotate the display to the desired position. Be careful not to overstress the display ribbon cable.
5. Place the display back onto the SPD enclosure. Again, be careful not to overstress or crimp the ribbon cable.
6. Replace the two phillips head screws. Tighten screws to 1.35 Nm (12 in-lbs).
7. Restore power to the unit.

## 4.0 Troubleshooting

Many SPD failures result from improper installation. Once the SPD is installed properly, it is a highly reliable unit.

If the SPD does not function properly, first confirm that it is installed properly. See Section 2, "*Installation.*"

If the SPD malfunctions after it has been operating routinely, refer to Table 2, *Troubleshooting Chart*. This Troubleshooting Chart identifies possible causes and solutions to the malfunction. Further assistance may be obtained by calling Eaton's Applications Engineers, at 1-800-809-2772, option 4, sub-option 2, including being directed to the warranty process if applicable.

**Table 2. Troubleshooting Chart**

| Condition  | Probable Cause  | Solution  |
|--|---|---|
| Green LEDs ON (1 per phase) and one Green LED ON for Neu/Gnd Protection                                    | Normal operation  | N/A.  |
| Audible Alarm OFF, Form C (N.C.) contact in the CLOSED state   | Normal operation  | N/A.  |
| Phase Green LED is OFF, same Phase Red LED is ON, Audible Alarm is ON                                      | Phase protection compromised or lost<br>Extended Temporary Overvoltage (TOV)<br>Significant surge event   | Replace SPD<br>Check electrical system for TOV sources, correct, replace SPD<br>Replace SPD   |
| Neu/Gnd Green LED is OFF, Neu/Gnd Red LED is ON, Audible Alarm is ON (for models with Neutral connections) | Neu/Gnd protection is compromised or lost<br>Significant surge event  | Replace SPD<br>Replace SPD  |
| All phase Green LEDs OFF, all phase RED LEDs ON, Audible Alarm is ON                                       | All phase protection is compromised or lost<br>SPD <u>rated</u> voltage is less than <u>system</u> voltage<br>Extended Temporary Overvoltage (TOV)<br>Significant surge event | Replace SPD<br>Replace SPD with correct voltage model<br>Check electrical system for TOV sources, correct, replace SPD<br>Replace SPD |
| One of the display Red LEDs is ON. Audible Alarm is OFF  | Audible Alarm Silence button has been depressed and Alarm is silenced   | Normal operation<br>If power is cycled and a fault condition still exists, the Audible Alarm will reactivate                          |
| All Green and Red LEDs are OFF, LCD display (on Surge Counter models) is OFF                               | SPD is not connected to a power source  | Check system voltage at SPD connection<br>Check SPD connections   |

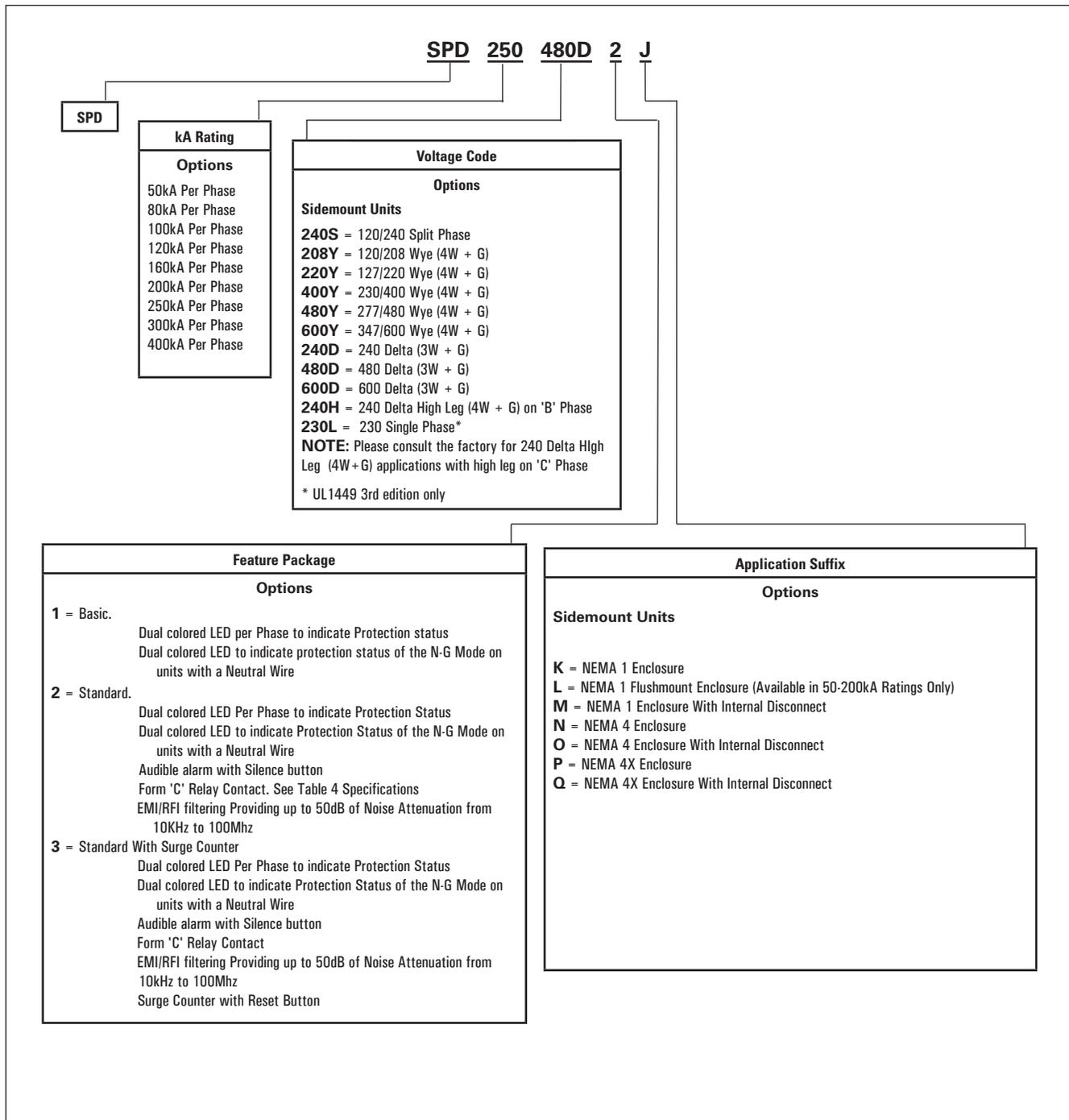
## 5.0 Specifications

**Table 3. Specifications**

| Description  | Specification  |
|--|--|
| Surge current capacity per phase   | 50, 80, 100, 120, 160, 200, 250, 300, 400 kA ratings available   |
| Nominal discharge current (I <sub>n</sub> )  | 20kA   |
| Short circuit current rating (SCCR)  | 200kA  |
| SPD Type   | Basic feature package = Type 1 (can also be used in Type 2 applications)<br>Standard and Standard with Surge Counter feature packages = Type 2   |
| Enclosure Types  | NEMA 1, NEMA 4, NEMA 4X (304 SST)  |
| Standard split phase voltages available  | 120/240  |
| Single phase   | 230  |
| Three phase wye system voltages available  | 120/208, 127/220, 230/400, 277/480, 347/600  |
| Three phase delta system voltages  | 240, 480, 600  |
| Three phase high leg delta system voltages   | 120/240  |
| Phase wire length  | 48" of 10AWG extend beyond the conduit hub   |
| Relay wire length (optional)   | 48" of 14AWG extend beyond the conduit hub   |
| RoHS Compliant   | Yes  |
| Internal Disconnect (optional)   | Eaton 30 Amp FDC Circuit Breaker, Type MCCB  |
| Input Power Frequency  | 50/60 Hz   |
| Power consumption (Basic units)<br>208Y, 220Y, 230L, 240S, 240D, and 240H voltage codes                                    | 0.5W   |
| 400Y and 480Y and 480D voltage codes   | 1.1W   |
| 600Y and 600D voltage codes  | 1.3W   |
| Power consumption (Standard and Standard with Surge Counter units)<br>208Y, 220Y, 230L, 240S, 240D, and 240H voltage codes | 0.6W   |
| 400Y, 480Y, and 480D Basic voltage codes   | 1.7W   |
| 600Y and 600D voltage codes  | 2.1W   |
| Protection modes   | Single split phase ...L-N, L-G, N-G, L-L Single phase... L-N, L-G, N-G Three phase delta...L-G, L-L<br>Three phase Wye.....L-N, L-G, N-G, L-L Three phase high leg delta....L-N, L-G, N-G, L-L |
| Maximum continuous operating voltage (MCOV)<br>208Y, 220Y, 240S, 240D, and 240H voltage codes                              | 150 L-N, 150 L-G, 150 N-G, 300 L-L   |
| 230L, 400Y and 480Y voltage codes  | 320 L-N, 320 L-G, 320 N-G, 640 L-L   |
| 600Y voltage code  | 420 L-N, 420 L-G, 420 N-G, 840 L-L   |
| 240 D voltage code   | 320 L-G, 320 L-L   |
| 480 D voltage code   | 640L- L-G, 640 L-L   |
| 600D voltage code  | 840 L-G, 840 L-L   |
| Ports  | 1  |
| Operating temperature  | -40F to 122F (-40C to 50C)   |
| Operating humidity   | 5% through 95%, non-condensing   |
| Weight   | Reference Figures 2, 3, 4, 5, and 6 on pages 4, 5 and 6  |
| Form C relay contact ratings   | 150 Vac or 125 Vdc, 1A maximum   |
| Form C relay contact logic   | Power on, normal state - NO contact = OPEN, NC contact = CLOSED<br>Power off, fault state, - NO contact = CLOSED, NC contact = OPEN  |
| EMI/RFI filtering attenuation (Standard and Standard With Surge Counter  | Up to 50 dB from 10 kHz to 100 MHz   |
| Agency certifications and approvals  | UL1449 3rd Edition listed, CSA (excludes 230L voltage code)<br>UL1283 (Type 2 SPDs only).  |
| Warranty   | 10 Years, 15 Years if the product is properly registered with Eaton.   |

## 6.0 Ordering Guidelines

Table 4. Eaton SPD Series



Example: SPD 250480D2K = SPD Series, 250kA Per Phase, 480D Voltage, Standard Feature Package, NEMA 1 Sidemount Application.

## 7.0 Warranty

Eaton warrants these products for a period of 10 years from the date of delivery to the purchaser, 15 years if the product is properly registered with Eaton, to be free from defects in both workmanship and materials. 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.

Purchaser's rights under the warranty shall consist solely of requiring Eaton to repair, or at Eaton's sole discretion, replace, free of charge, F.O.B. factory, and defective items received at said factory within said term determined by Eaton to be defective. The giving of or failure to give any advice or recommendations by Eaton shall not constitute any warranty by or impose any liability upon Eaton. The foregoing constitutes the sole and exclusive liability of Eaton AND IS IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESSED, IMPLIED OR STATUTORY AS TO THE MERCHANTABILITY, FITNESS FOR PURPOSE SOLD, DESCRIPTION, QUALITY, PRODUCTIVENESS OR ANY OTHER MATTER.

In no event shall Eaton be liable for special or consequential damages or for delay in performance of the warranty.

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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