Surge Protection (SPD) & Power Conditioning Products

Contents

Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

CSI Format:	1995	2010
SPD Series Integrated	**Section 16671A**	**Section 26 43 13**
SPD Series Side Mount	**Section 16671B**	**Section 26 43 16**

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Eaton Surge Protection Family

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Facility-Wide Protection

A Facility-Wide Protection Strategy Should be Employed to Address Power Quality Issues

Why Coordinated (Cascaded) Facility-Wide Protection?

As recommended in the IEEE® *Emerald Book*, a cascaded or staged protection approach should be developed and executed to reduce external/internal impulse waveforms to harmless levels. Eaton surge protection solutions are available in all common voltages and configurations, in surge current capacity ratings up to 800 kA and with a variety of optional features such as EMI/FFI filtering, audible alarm, Form C contacts and surge counters. Eaton's complete offering of surge protective devices ensures there is a solution for any application in a cascaded facility-wide protection strategy.

A surge device equipped with filtering should be installed at the main service entrance and key distribution or branch panelboards to eliminate ringing and impulse disturbances, as well as high frequency EMI/RFI noise. Filtering is available on the SPD, SPC and SPM Series models.

Eaton surge devices are coordinated to work on a "system basis". Surge units installed at each level in the system work together to isolate and remove externally/internally generated disturbances, creating superior facility-wide performance and reliability. Integrated SPD Series units maximize flexibility, space and protection and are available in switchboards, switchgear, panelboards, motor control centers and automatic transfer switches. Integrating the surge device into the electrical assembly maximizes protection by keeping installation leads as short as possible.

Benefits of Facility-Wide Surge Protection

- High amplitude lightning impulses reduced to negligible levels
- The electrical distribution's noise attenuation is significantly enhanced

The coordinated design ensures effective current sharing between main and branch surge devices. Installing appropriately rated surge protection at locations throughout a facility provides a layered defense solution and helps ensure complete protection of critical equipment.

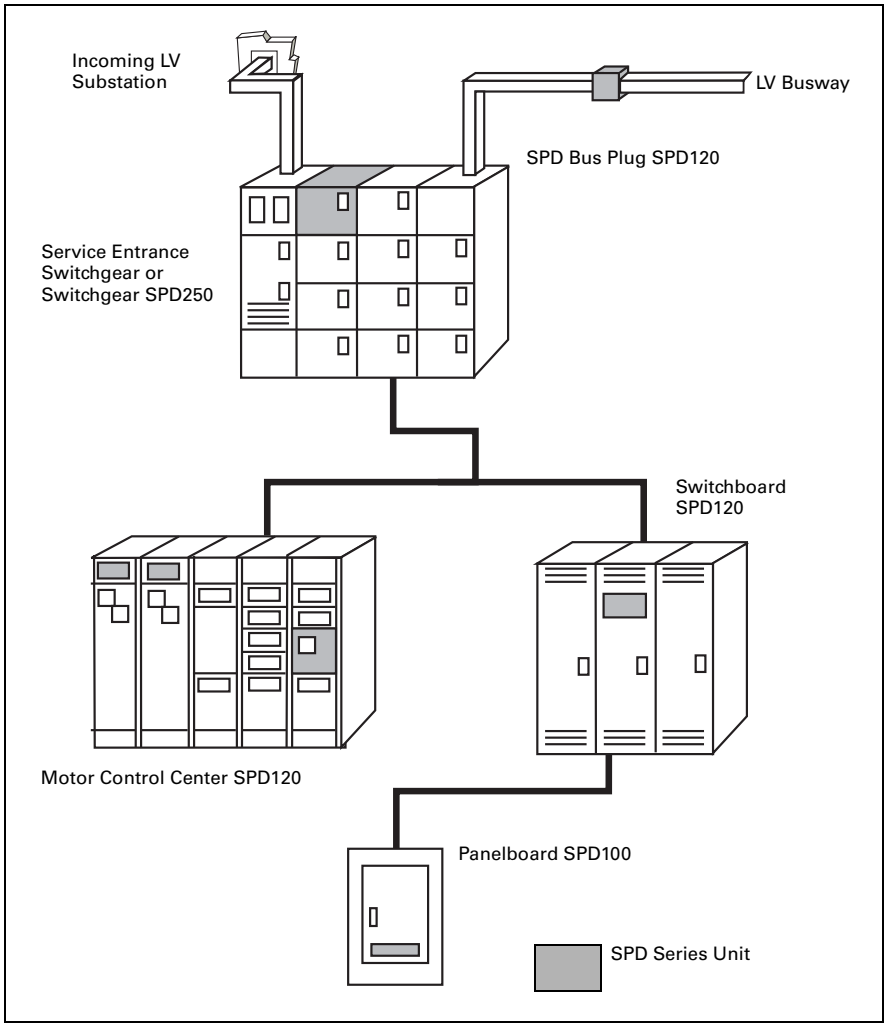

Figure 34.1-1. Cascaded Performance

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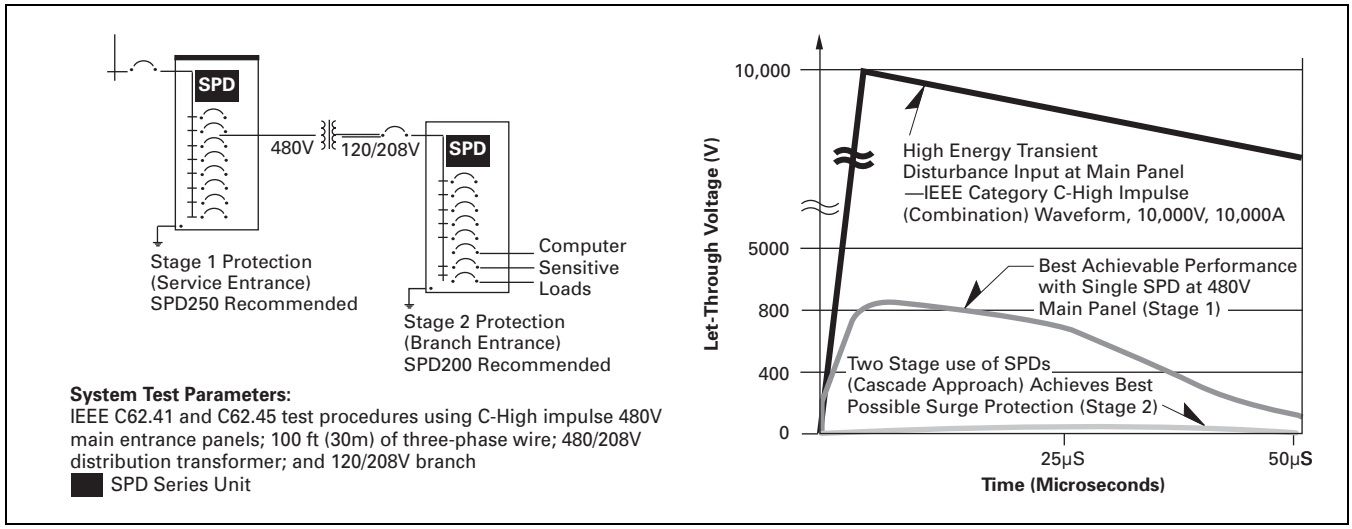

Figure 34.1-2. *IEEE Emerald Book* Recommends a Cascaded (or Two-Stage) Approach

System Application

The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B and A environments.

Surge Current Capacity

The minimum surge current capacity that the device is capable of withstanding shall be as shown in **Table 34.1-1**.

SPD Type

All SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

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Table 34.1-1. Surge Current Capacity

Minimum Surge Current Capacity Based on ANSI/IEEE C62.41 Location Category			
Category	**Application**	**Per Phase**	**Per Mode**
C	Service entrance locations (switchboards, switchgear, MCC, main entrance)	250 kA	125 kA
B	High exposure roof top locations (distribution panelboards)	160 kA	80 kA
A	Branch locations (panelboards, MCCs, busway)	120 kA	60 kA

Features

Table 34.1-2. Eaton Surge Protection Model Features

Product Series	L to N Protection Mode	L to G and N to G Protection Modes	Per Phase kA Range	EMI/RFI Filtering Attenuation	Nominal Discharge Current (I_n)	Short-Circuit Current Rating (SCCR)	Alarm Contacts (Option)	Audible Alarm (Option)	Surge Counter (Option)	Warranty (Years)	Enclosure Options (NEMA Types)	Disconnect (Option)	Integrated Mounting (Option)
SPD	Yes	Yes	50–400	50 dB	20 kA	200 kA	Yes	Yes	Yes	15 ④	1, 4 & 4X	Yes	Yes
SPM	Yes	Yes	100–800	50 dB	20 kA	200 kA	Yes	Yes	Yes	20 ④	4 & 4X	Yes	No
SPC	Yes	Yes	50–200	40 dB	20 kA	200 kA	Yes	Yes	No	10 ④	4X	No	No
CVX	Yes	Yes ①	50–100	No	20 kA ②	100 kA	No	No	No	5	4X	No	No
SP1	Yes	No	50 only	No	20 kA ③	200 kA	No	No	No	2	4	No	No
SP2	Yes	No	45 only	No	10 kA	200 kA	No	No	No	2	4X	No	No

① 100 kA units only.
② 480L, 600D, and 600Y units rated 10 kA I_n.
③ 600Y and 600D units rated 10 kA I_n.
④ With on-line product registration.

Integrated Surge Protection

Eaton was the first to introduce the "Direct-On™ bus bar" connect SPD that provides customers with the lowest system let-through voltage at the bus bar when compared to traditional cable connected surge protectors.

By using a direct bus bar connection, the SPD Series achieves the industry's lowest let-through voltage—effectively suppressing both high and low energy transient events providing protection for all connected electronic loads. This design provides superior suppression ratings and eliminates poor performance that results from cable connections and/or long lead lengths.

Other Products

Other surge suppressor manufacturers' measurements are made at the SPD module or the suppressor's terminals, not at the electrical distribution equipment's bus bar. The distance between module or suppressor terminals and the distribution equipment bus bar is often 14.00 inches (355.6 mm) or more. The impedance associated with cabling required to connect the surge suppressor to the electrical distribution equipment (also referred to as lead length) significantly effects the overall performance of the surge suppressor and results in an increase in let-through voltage.

SPD Series Unit Integrated Within an Eaton Pow-R-Line 1a Panelboard

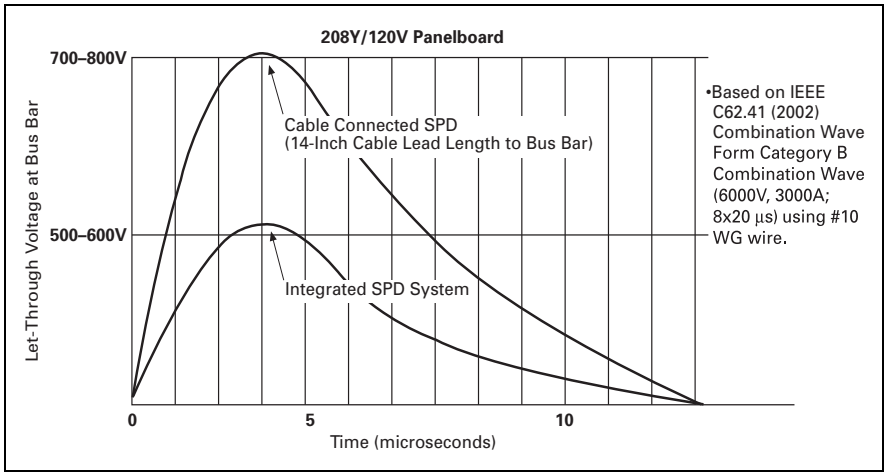
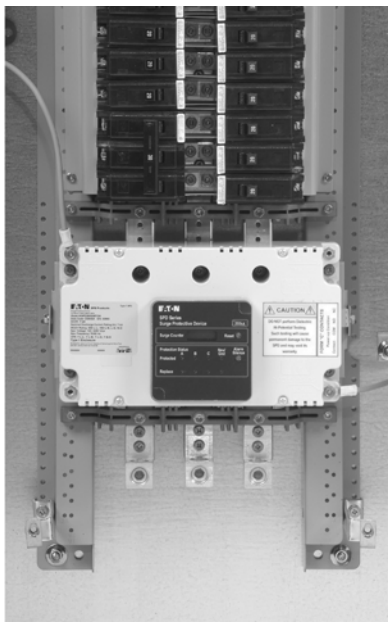
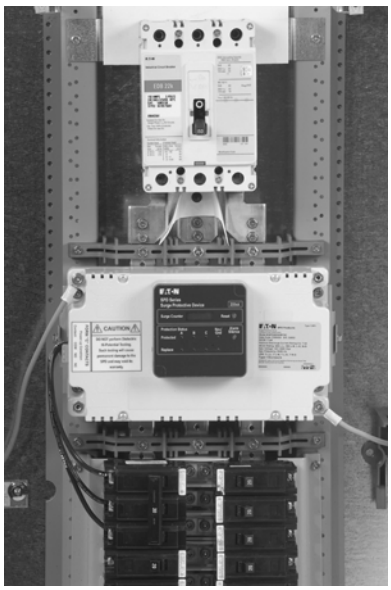


Figure 34.1-3. 120V/208Y Panelboard—Integrated SPD vs. Cable Connected

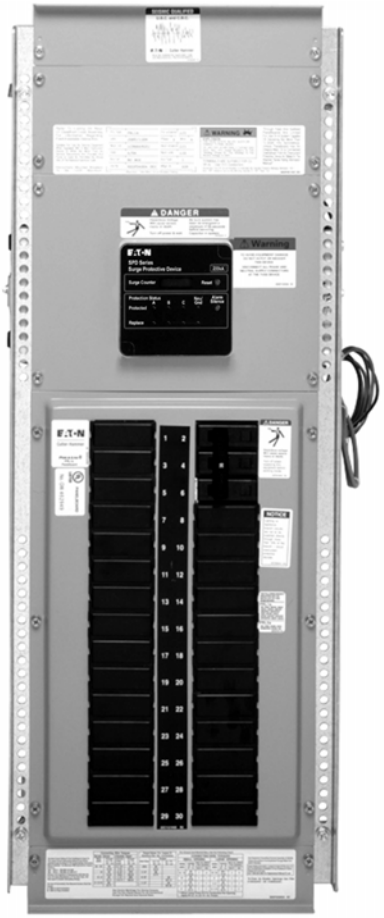


In this installation, the SPD Series is mounted directly to the panelboard's bus bars. This type of installation will provide the best possible surge protection by minimizing the connected lead length.



The SPD Series is also available as an integrated unit interfaced via a circuit breaker resident in the electrical assembly. This installation keeps connected lead lengths short while providing a means of disconnecting power to the unit quickly and easily.

Integrated Panelboard SPD

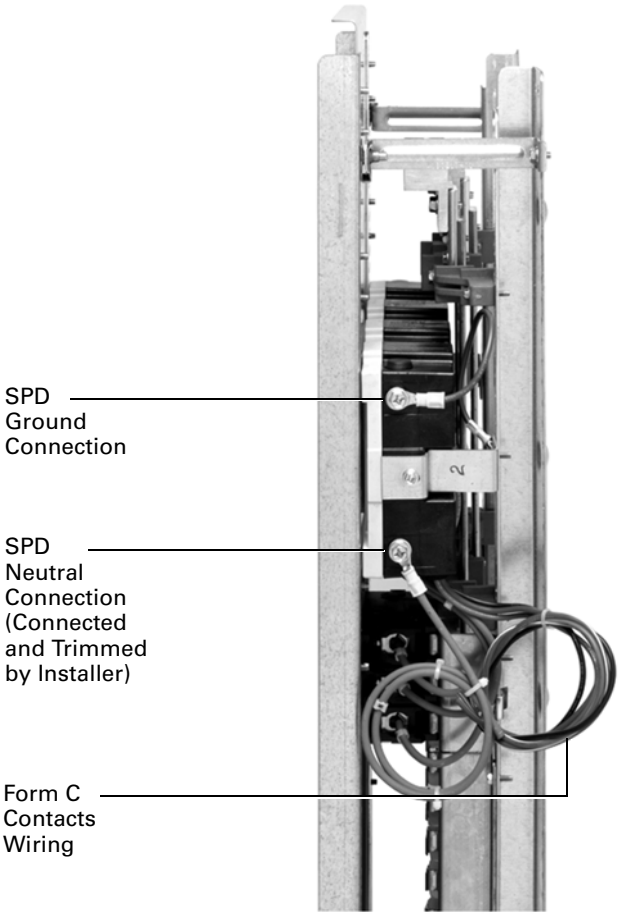


Integrated SPD Series Unit in PRL1a Panel (Shown with Option SPD Integral Disconnect)

Integral Disconnect Option—For PRL1a, 2a, 3a, and 3E panelboards.

For applications where load interruptions are intolerable, an internal dedicated SPD circuit breaker disconnect option is available. SPD is cable connected via a three-pole 30 A circuit breaker. (Breaker rating and type dependent on panel type.)

Note: The addition of the SPD circuit breaker adds 100 V to the published SPD let-through voltage ratings. See **Page 34.1-5**.



Direct Bus Mounted SPD Series Unit in a PRL1a Panel

Another distinct advantage that Eaton integrated SPDs offer is the availability of neutral and ground connections on both sides of the unit. This enables both the neutral and ground wires to be kept as short as possible. Only one neutral and ground connection is required, with the connection point chosen for each being the one that is in closest proximity to the neutral and ground bars.

In a sidemount installation, either the neutral or ground wire connection will be very long, decreasing the installed performance of the unit. When a sidemount SPD is installed, its wires enter on one side of the panel. If that point of entry is closest to the panel's ground bar, the ground wire is short and the neutral wire must stretch to the opposite side of the panel where the neutral bar is located. If the SPD's wires enter on the side of the panel where the neutral bar is located, the neutral wire is kept short but the ground wire will be much longer.

The presence of neutral and ground connections on both sides of an integrated unit keeps both leads as short as possible, increasing the installed performance of the unit.

Retrofit Installation Recommendations to Reduce Let-Through Voltage

When installing a surge suppressor in a retrofit environment, it is important to mount the suppressor as close to the electrical equipment as possible, keep the wiring (lead length) between the electrical equipment and the suppressor as short as possible (less than 14.00 inches (355.6 mm) is recommended), and twist/wire tie the conductors to reduce inductive effects. Eaton SPD, SPC, SPM, CVX, SP1 and SP2 Series offer side-mount surge protection.

As shown in **Figure 34.1-4** below, installation lead length reduces the performance of any surge suppressor. For each inch of wiring (installation lead length), add 15 V to 25 V to the surge suppressor's published let-through value (e.g., suppressor let-through at 400 V and installation of 3 ft (0.9 m) of cable = 1000 V installed rating).

Eaton SPD, SPC, SPM, CVX, SP1 and SP2 Series devices passed UL 1449 4th edition testing without an external overcurrent protection device (OCPD) and therefore do not require an OCPD unless otherwise required by NEC, UL and local electrical requirements to protect electrical conductors. NEC Article 310.15 (B) (16) defines the maximum rating of the OCPD required to protect the electrical conductors. NEC shows #10 AWG conductors at 60 °C typically requiring a single-pole (for single-phase systems), two-pole (for split-phase systems) or three-pole (for three-phase systems) 30 A branch circuit breaker to protect SPD conductors.

Sidemount Installation Recommendations

SPD Series Sidemount Unit

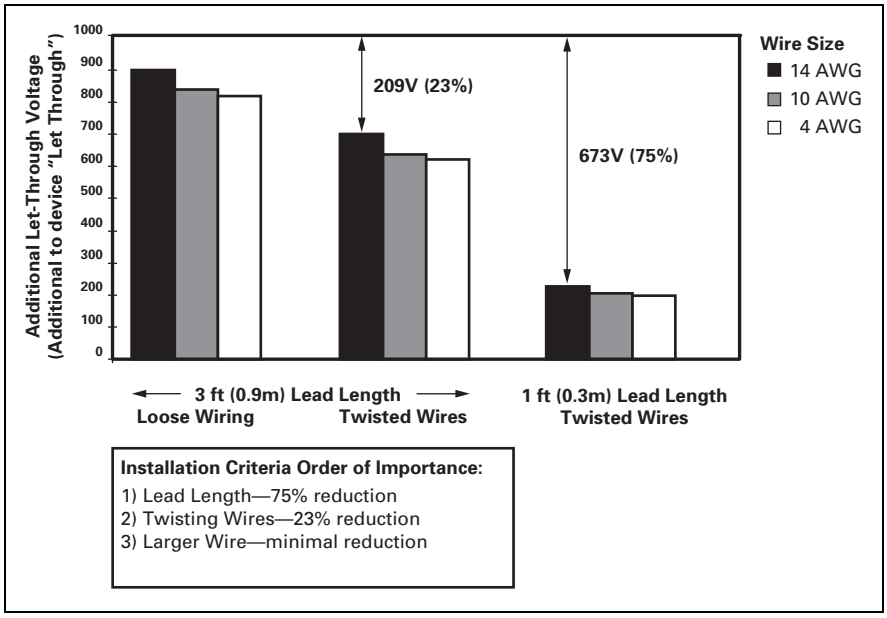


Figure 34.1-4. Let-Through Graph

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SPD Series Sidemount Units

SPD Series Sidemount Units

General Description

Eaton's SPD Series surge protective devices are the latest and most advanced UL® 1449 4th Edition certified surge protectors. Units are available integrated within Eaton electrical assemblies, including panelboards, switchboards, motor control centers, switchgear, automatic transfer switches and bus plugs.

SPD Series Integrated Units

A complete offering of sidemount units designed for mounting external to electrical distribution equipment is also available. Application of SPD Series units throughout a facility will ensure that equipment is protected with the safest and most reliable surge protective devices available. SPD Series units are available in all common voltages and configurations and also in a variety of surge current capacity ratings from 50 through 400 kA. Three feature package options are also available to choose from, ensuring the proper unit is available for a variety of applications.

Features, Benefits and Functions

- Uses thermally protected metal oxide varistor (MOV) technology
- Three feature package options
- True protection status indicators report the status of the protection elements, not the status of the applied power
- Available integrated within the following Eaton electrical assemblies: panelboards, switchboards, motor control centers, switchgear, automatic transfer switches and bus plugs
- 10-year warranty (15-year with registration)

Safety Features

- All units use thermally protected metal oxide varistor technology (MOV) as their core surge suppression component. Usage of this technology ensures safe operation when the unit is subjected to abnormal conditions such as temporary overvoltage or high fault current conditions. Under such conditions, the thermally protected MOVs are removed from the circuit quickly and safely before a potentially unsafe condition can occur
- SPD Series units contain no replaceable parts such as surge modules, fuses, or surge counter memory backup batteries. This prevents potential arc flash and shock hazards, as the units require no periodic service or user intervention after installation
- Integrated versions of the unit are factory installed and sidemount versions are factory sealed. These important safety measures further enhance user safety

Three Feature Package Options Available

The SPD Series provides users with the option of selecting between three feature packages. These feature packages are the basic, standard and standard with surge counter. The proper feature package can be selected based on the requirements of the application or specification. A side by side comparison of the individual features found in each package is below.

Basic Feature Package
The basic feature package is perfect for applications where basic, cost-effective, safe and reliable surge protection is required, but budgets don't allow for extra, additional features. Rather than sacrifice performance or safety due to cost, SPD Series units with the basic feature package provide you with high-performing surge protection without sacrificing safety or reliability. The basic feature package provides the same level of surge protection and safety provided by the standard and standard with surge counter feature packages minus some of the features found in them. The package contains dual-colored protection status LEDs that report the true status of the protection in each phase/mode. All four-wire plus ground units also contain an additional set of dual-colored protection status LEDs that report the status of the protection in the neutral/ground mode.

Standard Feature Package
The standard feature package includes all of the features found in the basic feature package, plus an audible alarm with silence button, EMI/RFI filtering, and a Form C relay contact that can be used for remote annunciation of the SPD's status. The audible alarm activates and the Form C relay contact changes state when any loss of protection is detected or a fault condition exists with the unit. Should such a condition occur, the audible alarm can be silenced by pressing the silence button. The EMI/RFI filter provides up to 50 dB of noise attenuation over the range of 10 kHz through 100 MHz.

Standard with Surge Counter Feature Package

The standard with surge counter feature package includes all of the features found in the standard feature package plus a six-digit surge counter with a reset button. The surge counter indicates the ongoing count of the number of surges the unit has been exposed to and stores them in nonvolatile memory. Should power to the SPD Series unit be completely interrupted, the surge counter will recall and display the surge count prior to the interruption when power is restored. Unlike many surge protectors, the SPD Series' surge counter memory feature does not require a backup battery that would require periodic replacement in order to achieve its memory functionality.

Table 34.1-3. Side-By-Side Comparison of the SPD Series' Available Feature Packages

Feature Package Comparison	Basic	Standard	Standard with Surge Counter
UL 1449 4th Edition Type	■	■	■
Surge protection using thermally protected MOV technology	■	■	■
Dual-colored protection status indicators for each phase	■	■	■
Dual-colored protection status indicators for the N–G protection mode	—	■	■
Audible alarm with silence button	—	■	■
Form C relay contact	—	■	■
EMI/RFI filtering, providing up to 50 dB of noise attenuation from 10 kHz to 100 MHz	—	■	■
Surge counter with reset button	—	—	■

Standards and Certifications

- Integrated versions of the unit are UL 1449 4th Edition recognized components for the United States and Canada, covered by Underwriters Laboratories certification and follow-up service
- Sidemount versions are UL 1449 4th Edition listed devices and are also CSA® approved

Technical Data and Specifications

- 20 kA nominal discharge current (I_n) rating (maximum rating assigned by UL)
- 50 through 400 kA surge current capacity ratings
- 200 kA short-circuit current rating (SCCR)

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Table 34.1-4. Integrated Product Applications

Switchboard	Switchgear	Motor Control Centers
		
Features: ■ The SPD can be integrated into any switchboard ■ Specifiers have the flexibility to install the SPD in any location within the switchboard ■ Disconnect switch is a standard feature ■ Unique design minimizes installation impedance	**Features:** ■ Available on all switchgear designs ■ Disconnect switch is a standard feature ■ Unique design minimizes installation impedance ■ SPD250 ideal for critical industrial switchgear applications	**Features:** ■ Ideal protection for PLCs, sensors, drives, electronic starters, or other digital equipment ■ SPD is designed to fit in Freedom 2100 in a standard (3X) size 18-inch (457.2 mm) compartment ■ May be used in new/aftermarket applications ■ Ideal for water treatment, petrochemical and other industrial applications
Safety Standards: ■ UL 891 (Switchboard) ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)	**Safety Standards:** ■ UL 1558 (Switchgear) ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)	**Safety Standards:** ■ UL 845 (MCC) ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)

Panelboards	Busway	Retrofit
		
Features: ■ The SPD is used extensively on branch panelboards for computer rooms, laboratories, schools, hospitals and industrial applications ■ 200% rated neutral is provided for non-linear loads ■ Cost-effective branch protection (assumes main panel protection employed)	**Features:** ■ Ideal for busway fed distribution systems ■ Easy to install SPD units fit in standard bus plug assembly ■ Isolates critical busway sections from nearby disturbance producing loads ■ Designed for new and existing facilities ■ Integral disconnect	**Features:** ■ SPD units can be externally mounted to existing distribution equipment ■ Standard NEMA 1, 4 or 4X enclosures ■ Requires field installation ■ SPD Retrofit 50–400 kA/phase units
Safety Standards: ■ UL 67 (Panelboards) ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)	**Safety Standards:** ■ UL 857 (Busway) ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)	**Safety Standards:** ■ UL 1449 4th Edition (Surge Suppressor) ■ UL 1283 5th Edition (EMI/RFI Filter) ■ CSA C22.2 Certified (Suppressor)

Note: The SPD Surge components can be integrated into safety switches, automatic transfer switches (ATS) and other assemblies. Contact your local Eaton sales office.

Catalog Numbering System

Table 34.1-5. SPD Series Units Mounted Internal to Electrical Distribution Equipment (Integrated Units)

SPD 250 480D 2 J

Series	kA Rating	Voltage Code	Application—Integrated Units ②	Feature Package
SPD = Surge protective device	**050** = 50 kA per phase **080** = 80 kA per phase **100** = 100 kA per phase **120** = 120 kA per phase **160** = 160 kA per phase **200** = 200 kA per phase **250** = 250 kA per phase **300** = 300 kA per phase **400** = 400 kA per phase	**240S** = 120/240 single split-phase **208Y** = 120/208 wye (4W+G) **220Y** = 127/220 wye (4W+G) **400Y** = 230/400 wye (4W+G) **480Y** = 277/480 wye (4W+G) **600Y** = 347/600 wye (4W+G) **240D** = 240 delta (3W+G) **480D** = 480 delta (3W+G) **600D** = 600 delta (4W+G) **240H** = 240 high-leg delta (4W+G) on 'B' phase ①	**A** = Panelboards (PRL1a, 2a, 3a, 3E), direct bus mounted **B** = Switchgear (includes remote display) **C** = Panelboards (PRL1a, 2a, 3a, 3E, 4), switchboards, busway **J** = Motor control centers	**1** = Basic **2** = Standard **3** = Standard + surge counter

① Please consult the factory for 240 high-leg delta (4W+G) applications with high leg on 'C' phase.

② Units used in PRL1a, 2a, 3a and 3E panelboard applications are available in 50–200 kA ratings only. Use the 'C' option for PRL1a, 2a, 3a and 3E panelboard applications when unit is connected through a circuit breaker.
Example: SPD250480D2J = SPD Series, 250 kA per phase, 480D voltage, standard feature package, motor control center application.

Table 34.1-6. SPD Series Units for Mounting External to Electrical Distribution Equipment (Sidemount Units)

SPD 250 480D 2 K

Series	kA Rating	Voltage Code	Application—Sidemount Units	Feature Package
SPD = Surge protective device	**050** = 50 kA per phase **080** = 80 kA per phase **100** = 100 kA per phase **120** = 120 kA per phase **160** = 160 kA per phase **200** = 200 kA per phase **250** = 250 kA per phase **300** = 300 kA per phase **400** = 400 kA per phase	**240S** = 120/240 single split-phase **208Y** = 120/208 wye (4W+G) **220Y** = 127/220 wye (4W+G) **400Y** = 230/400 wye (4W+G) **480Y** = 277/480 wye (4W+G) **600Y** = 347/600 wye (4W+G) **240D** = 240 delta (3W+G) **480D** = 480 delta (3W+G) **600D** = 600 delta (4W+G) **240H** = 240 high-leg delta (4W+G) on 'B' phase ③	**K** = NEMA 1 enclosure **L** = NEMA 1 flushmount enclosure ④ **M** = NEMA 1 enclosure with internal disconnect **N** = NEMA 4 enclosure **O** = NEMA 4 enclosure with internal disconnect **P** = NEMA 4X enclosure (stainless steel) **Q** = NEMA 4X enclosure with internal disconnect (stainless steel)	**1** = Basic **2** = Standard **3** = Standard + surge counter

③ Please consult the factory for 240 high-leg delta (4W+G) applications with high leg on 'C' phase.

④ NEMA 1 flushmount units are available in 50–200 kA ratings only.
Example: SPD250480D2K = SPD Series, 250 kA per phase, 480D voltage, standard feature package, housed in NEMA 1 enclosure.

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Dimensions in Inches (mm)

Standard Dimensions —Integrated Units

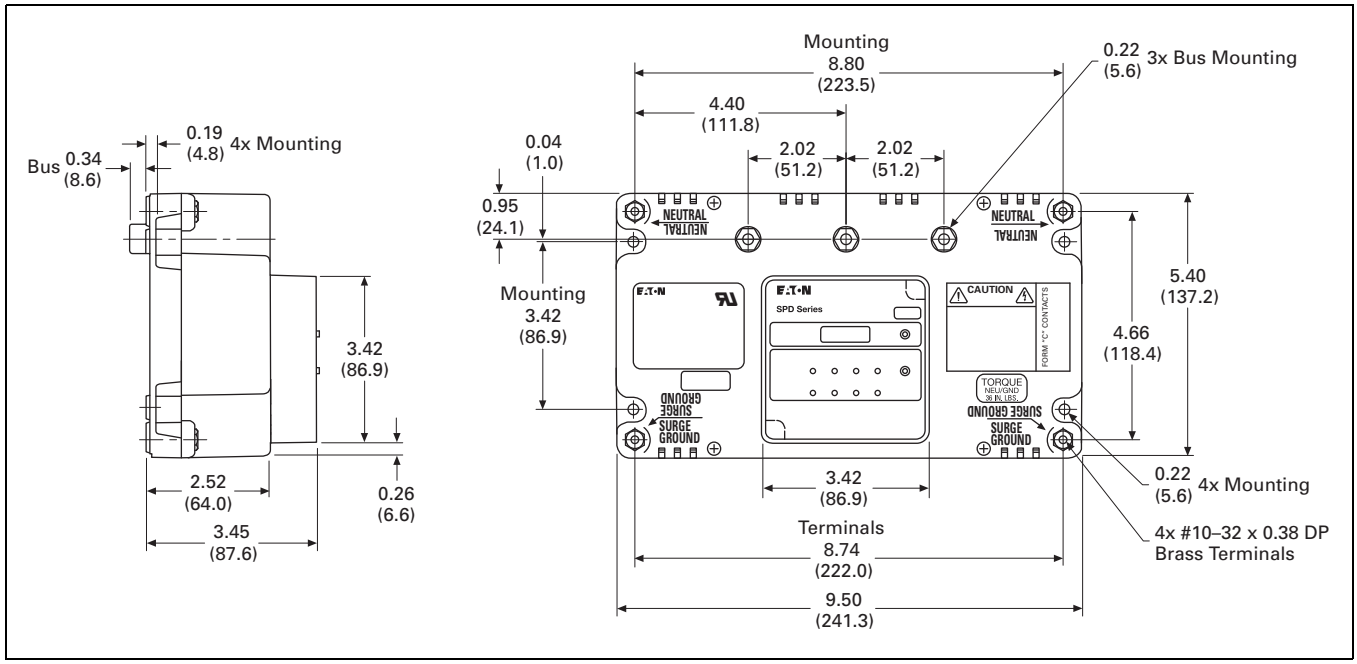

Figure 34.1-5. 50–200 kA Integrated Units

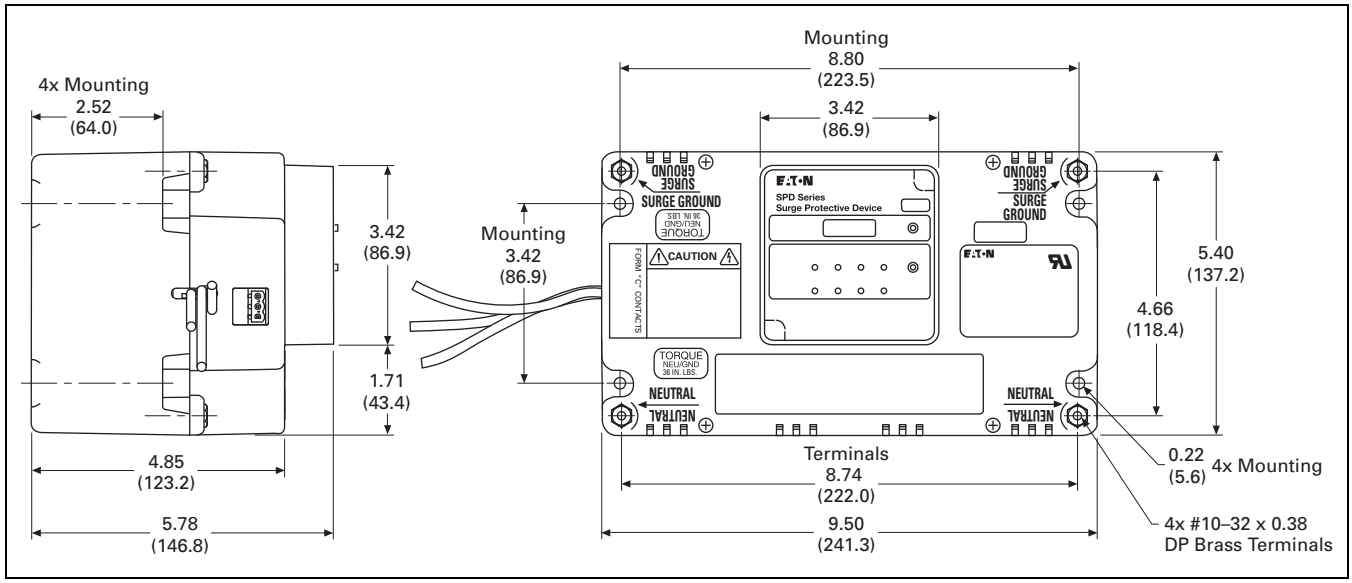

Figure 34.1-6. 250–400 kA Integrated Units

Weights

- 50–200 kA units approximately 3.5 lb (1.6 kg)
- 250–400 kA units approximately 7.0 lb (3.2 kg)

Standard Dimensions—Sidemount Units

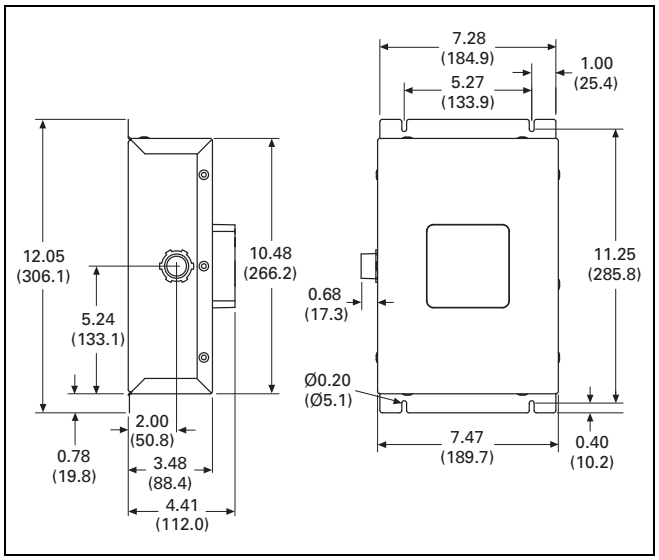

Figure 34.1-7. 50–200 kA Units in a NEMA 1 Rated Enclosure, Weight = 6.8 lb

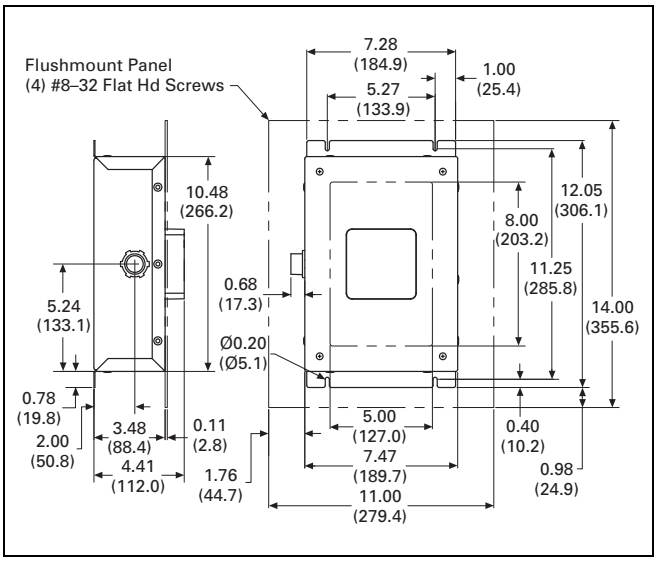

Figure 34.1-9. 50–200 kA Units in a NEMA 1 Rated Flushmount Enclosure, Weight = 6.8 lb

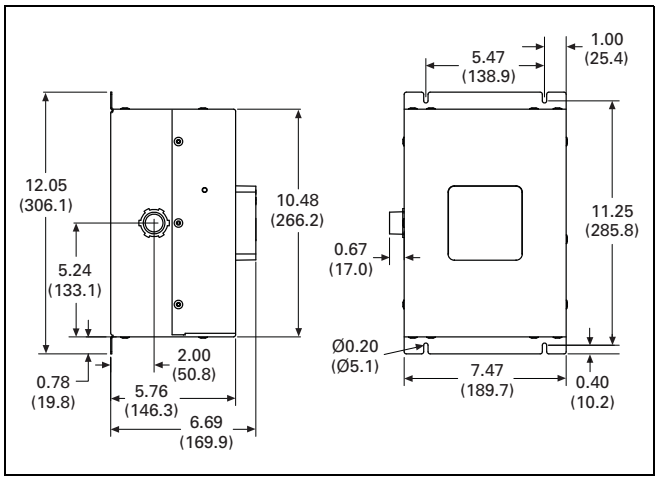

Figure 34.1-8. 250–400 kA Units in a NEMA 1 Rated Enclosure, Weight = 13.5 lb

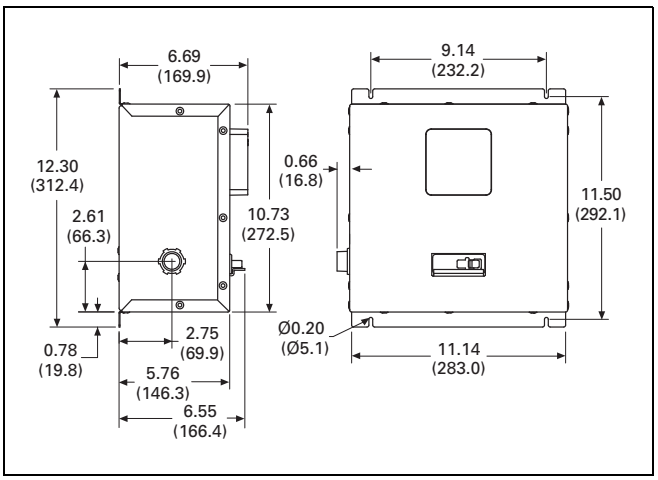

Figure 34.1-10. 50–400 kA Units in a NEMA 1 Rated Enclosure with Internal Disconnect, Weight = 14.7 lb

Standard Dimensions—Sidemount Units

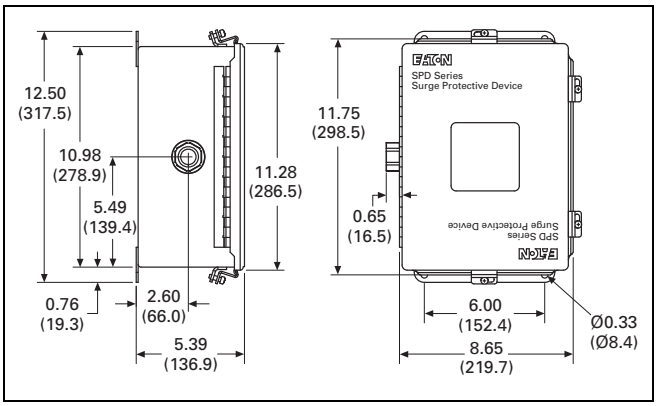

Figure 34.1-11. 50–200 kA Units in a NEMA 4 or 4X Rated Enclosure, Weight = 14.6 lb

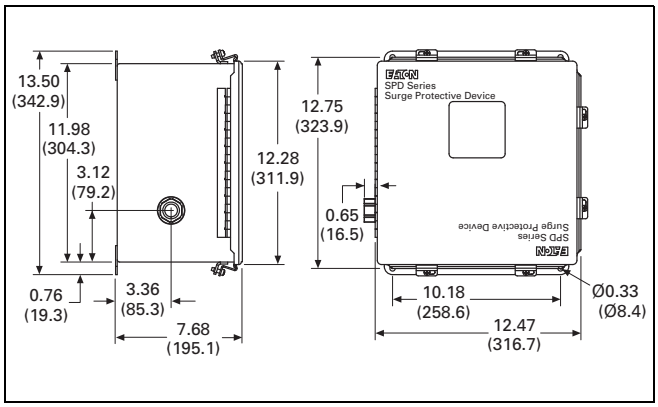

Figure 34.1-13. 50–400 kA Units in a NEMA 4 or 4X Rated Enclosure with Internal Disconnect, Weight = 27.5 lb

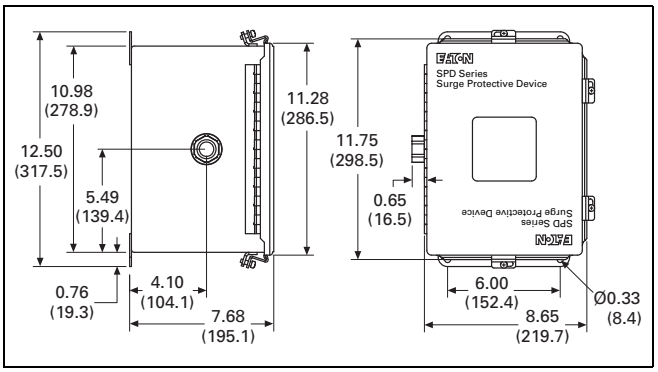

Figure 34.1-12. 250–400 kA Units in a NEMA 4 or 4X Rated Enclosure, Weight = 14.6 lb

Technical Data

Table 34.1-7. SPD Series Specifications

Description	Specification	
Surge capacity ratings available	50, 80, 100, 120, 160, 200, 250, 300, 400 kA per phase	
Nominal discharge current (I_n)	20 kA (maximum rating assigned by UL)	
Short-circuit current rating (SCCR)	200 kA	
SPD type	Basic feature package = Type 1 (can also be used in Type 2 applications) Standard and standard with surge counter feature packages = Type 2	
Single split-phase voltages available	120/240	
Three-phase wye system voltages available	120/208, 127/220, 230/400, 277/480, 347/600	
Three-phase delta system voltages available	240, 480, 600	
Input power frequency	50/60 Hz	
Power consumption (basic units): 208Y, 220Y, 240S, 240D and 240H voltage codes 400Y, 480Y and 480D voltage codes 600Y and 600D voltage codes	 0.5 W 1.1 W 1.3 W	
Power consumption (standard and standard with surge counter units): 208Y, 220Y, 240S, 240D and 240H voltage codes 400Y, 480Y and 480D basic voltage codes 600Y and 600D voltage codes	 0.6 W 1.7 W 2.1 W	
Protection modes	Single split-phase Three-phase wye Three-phase delta Three-phase high-leg delta	L-N, L-G, N-G, L-L L-N, L-G, N-G, L-L L-G, L-L L-N, L-G, N-G, L-L
Maximum continuous operating voltage (MCOV): 240S, 208Y, 220Y and 240H MCOV 400Y and 480Y MCOV 600Y MCOV 240D MCOV 480D MCOV 600D MCOV	 150 L-N, 150 L-G, 150 N-G, 300 L-L 320 L-N, 320 L-G, 320 N-G, 640 L-L 420 L-N, 420 L-G, 420 N-G, 840 L-L 320 L-G, 320 L-L 640 L-G, 640 L-L 840 L-G, 840 L-L	
Ports	1	
Operating temperature	–40 °F through 122 °F (–40 °C through 50 °C)	
Operating humidity	5% through 95%, noncondensing	
Operating altitude	Up to 16,000 ft (5000 m)	
Seismic withstand capability	Meets or exceeds the requirements specified in IBC 2006 and CBC 2007	
Form C relay contact ratings	150 Vdc or 125 Vac, 1A maximum	
Form C relay contact logic	Power ON, normal state—NO contact = open, NC contact = closed Power OFF or fault state—NO contact = closed, NC contact = open	
EMI/RFI filtering attenuation	Up to 50 dB from 10 kHz to 100 MHz	

Voltage Protection Rating (VPR)

The measured limiting voltage test in UL 1449 4th Edition uses a 6 kV/3 kA combination wave surge to determine the voltage protection rating (VPR) of the SPD. This test is similar to the suppressed voltage rating (SVR) as performed in UL 1449 2nd Edition. The key difference between the tests in the 2nd Edition and the 4th Edition is that the magnitude of the current used for the test is six times greater in the 4th Edition versus the 2nd Edition. This much higher current level will mean that the measured limiting voltage will likely be significantly higher for the higher current level. For example, the VPR for an SPD will likely be much higher than the SVR of an identical SPD. With higher current levels come higher limiting voltages. Please note that VPR ratings fall into predefined voltage categories as outlined in the UL 1449 4th Edition. The standard VPR voltages are shown in the following table.

Table 34.1-8. Voltage Protection Ratings

Measured Limiting Voltage	Minimum Voltage Protection Rating (VPR)
330 V or Less 331 V to 400 V 401 V to 500 V	330 400 500
501 V to 600 V 601 V to 700 V 701 V to 800 V	600 700 800
801 V to 900 V 901 V to 1000 V 1001 V to 1200 V	900 1000 1200
1201 V to 1500 V 1501 V to 1800 V 1801 V to 2000 V	1500 1800 2000
2001 V to 2500 V 2501 V to 3000 V 3001 V to 4000 V	2500 3000 4000

Therefore, if an SPD is tested with a 6 kV/3 kA combination wave surge and the let-through voltage is measured to be 610 V, the SPD is given a VPR of 700 V. The SPD is given the same 700 V VPR if the same test results in a let-through voltage measurement of 698 V. Additionally, if the let-through voltage is measured to be 2005 V, the SPD is given a VPR of 2500 V.

It is important that users are familiar with the difference in testing methods and the subsequent effect on the value of the VPR. Without considering or understanding the differences in the level of currents used in the test, one might assume that a UL 1449 4th Edition device with a VPR of 700 V has a higher limiting voltage than a UL 1449 2nd Edition device with an SVR of 400 V. Such a conclusion would be inaccurate.

The higher VPR rating of 700 V is likely caused by the higher level of surge current during the measured limiting voltage test. In order to make an accurate assessment of devices, the VPR rating of one device must be compared with the VPR rating of another device. Comparing a VPR rating to an SVR rating yields no useful or conclusive information.

Table 34.1-9. VPR Ratings for 80–400 kA Units Rated 120/240 V Single Split-Phase ①

Type (All Voltage Code 240S)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ② Integrated circuit breaker connected Sidemount NEMA 1	500 700 700	600 700 800	500 700 700	900 1000 1200
Sidemount NEMA 1 with breaker Sidemount NEMA 4/4X Sidemount NEMA 4/4X with breaker	800 900 900	900 900 900	700 700 700	1500 1200 1500

① Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

② Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-10. VPR Ratings for 80–400 kA Units Rated 120/208 V Wye (4W + G) and 127/220V Wye (4W +G) ③

Type (All Voltage Code 208Y and 220Y)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ④ Integrated circuit breaker connected Sidemount NEMA 1	500 700 700	600 700 800	500 700 700	900 1000 1200
Sidemount NEMA 1 with breaker Sidemount NEMA 4/4X Sidemount NEMA 4/4X with breaker	800 900 900	1200 900 900	700 700 700	1500 1500 1500

③ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

④ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-11. VPR Ratings for 80–400 kA Units Rated 230/400 V Wye (4W + G) and 277/480 V Wye (4W +G) ⑤

Type (All Voltage Code 400Y and 480Y)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ⑥ Integrated circuit breaker connected Sidemount NEMA 1	1000 1200 1200	1200 1200 1200	1000 1200 1200	1800 1800 2500
Sidemount NEMA 1 with breaker Sidemount NEMA 4/4X Sidemount NEMA 4/4X with breaker	1500 1200 1200	1500 1200 1500	1200 1200 1200	2500 2500 2500

⑤ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

⑥ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-12. VPR Ratings for 80–400 kA Units Rated 347/600 V Wye (4W + G) ①

Type (All Voltage Code 600Y)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ②	1200	1500	1500	2500
Integrated circuit breaker connected	1500	1500	1500	2500
Sidemount NEMA 1	1500	1500	1500	2500
Sidemount NEMA 1 with breaker	1500	1500	1500	2500
Sidemount NEMA 4/4X	1500	1500	1500	2500
Sidemount NEMA 4/4X with breaker	1500	1500	1500	2500

① Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

② Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-13. VPR Ratings for 80–400 kA Units Rated 240 V Delta (3W +G) ③

Type (All Voltage Code 240D)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ④	N/A	1000	N/A	900
Integrated circuit breaker connected	N/A	1200	N/A	1200
Sidemount NEMA 1	N/A	1000	N/A	1000
Sidemount NEMA 1 with breaker	N/A	1000	N/A	1000
Sidemount NEMA 4/4X	N/A	1000	N/A	1000
Sidemount NEMA 4/4X with breaker	N/A	1000	N/A	1000

③ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

④ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-14. VPR Ratings for 80–400 kA Units Rated 480 V Delta (3W +G) ⑤

Type (All Voltage Code 480D)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ⑥	N/A	1800	N/A	1800
Integrated circuit breaker connected	N/A	2000	N/A	2000
Sidemount NEMA 1	N/A	2500	N/A	2500
Sidemount NEMA 1 with breaker	N/A	2500	N/A	2500
Sidemount NEMA 4/4X	N/A	2500	N/A	2500
Sidemount NEMA 4/4X with breaker	N/A	2500	N/A	2500

⑤ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

⑥ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-15. VPR Ratings for 80–400 kA Units Rated 600 V Delta (3W +G) ⑦

Type (All Voltage Code 600D)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ⑧	N/A	2500	N/A	2500
Integrated circuit breaker connected	N/A	2500	N/A	2500
Sidemount NEMA 1	N/A	3000	N/A	2500
Sidemount NEMA 1 with breaker	N/A	3000	N/A	2500
Sidemount NEMA 4/4X	N/A	3000	N/A	2500
Sidemount NEMA 4/4X with breaker	N/A	2500	N/A	2500

⑦ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

⑧ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

Table 34.1-16. VPR Ratings for 80–400 kA Units Rated 240 V High-Leg Delta (4W +G) ⑨

Type (All Voltage Code 240H)	Protection Mode			
	L-N	L-G	N-G	L-L
Integrated direct bus connected ⑩	500	600	500	900
Integrated circuit breaker connected	700	700	700	1000
Sidemount NEMA 1	700	800	700	1200
Sidemount NEMA 1 with breaker	800	900	700	1500
Sidemount NEMA 4/4X	900	900	700	1500
Sidemount NEMA 4/4X with breaker	900	900	700	1500

⑨ Highest VPR shown for each model and mode. Specific units may have lower VPR ratings based upon options used. Refer to specific VPR ratings shown in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

⑩ Direct bus connected not available above 200 kA.

Note: VPR ratings of 50 kA units and ratings of each specific configuration can be found in TD01005006E for integrated SPDs and TD01005025E for sidemount SPDs.

SPD MAX Series Surge Protection

SPD MAX Series

General Description

Eaton's SPD MAX Series side-mounted surge protective devices are the latest and most advanced UL 1449 4th Edition certified surge protectors. Applying SPD MAX Series units at main service entrances and critical loads will ensure that equipment is protected with the safest and most reliable surge protective devices (SPDs) available. Units are available in all common voltages and configurations, and also in a variety of surge current capacity ratings from 100 kA through 800 kA. Additionally, you may choose from two feature package options.

Application Description

The breadth of the SPD MAX Series' features, options, and configurations ensures that the correct unit is available for all electrical applications, including service entrances, main switchgear, motor control centers, distribution switchboards, panelboards, and point-of-use applications.

Standards and Certifications

- UL 1449 4th Edition
- UL 1283 5th Edition
- Canadian Standards Association (CSA)
- Built in an ISO® 9001 facility
- Designed and tested in accordance with:
  - IEEE C62.41.1
  - IEEE C62.41.2
  - IEEE C62.43-2005
  - IEEE C62.45-2002
  - IEEE C62.48-2005
  - IEEE C62.62-2010

Features, Benefits and Functions

- Uses thermally protected metal oxide varistor (MOV) technology
- Lockout and tagout provisions
- Safety barriers
- 20 kA nominal discharge current (I_n) rating (maximum rating assigned by UL)
- 100 kA through 800 kA surge current capacity ratings
- Installation flexibility, #10 to 1/0 wire may be used
- Two feature package options
- 200 kA short-circuit current rating (SCCR) (maximum rating assigned by UL)
- Field serviceable
- 15-year warranty standard, additional 5 years with product registration

Feature Package Options

The SPD MAX Series provides users with the option of selecting between two feature packages: basic and standard with surge counter. The proper feature package can be selected based on the application's requirements or specifications. See **Table 34.1-17**.

Enclosure Options, Dimensions and Weights

There are two enclosure options for the SPD MAX Series, painted steel NEMA 4 or stainless steel NEMA 4X. The maximum weight of the SPD MAX Series is 52 lb.

Performance Data

Table 34.1-18 contains representative voltage protection rating (VPR) data for all SPD MAX Series voltage ratings, but the VPR varies based on the feature package, kA rating, number of modules, and enclosure option. The UL website contains the actual VPR for every possible configuration.

Table 34.1-17. Feature Package Comparison

Feature Package Comparison	Basic	Standard with Surge Counter
Surge protection using thermally protected MOV technology	■	■
Dual-colored protection status indicators for each phase	■	■
Dual-colored protection status indicators for the N–G protection mode	■	■
Audible alarm with silence button	—	■
Form C relay contact	—	■
EMI/RFI filtering that provides up to 50 dB of noise attenuation from 10 kHz to 100 MHz	—	■
Surge counter with reset button	—	■

Table 34.1-18. ANSI/UL 1449 4th Edition Voltage Protection Ratings

Nominal Voltage	L–G VPR	L–L VPR	L–N VPR	N–G VPR	H–G VPR	H–L VPR	H–N VPR
208Y	800	1200	900	900	—	—	—
220Y	800	1200	900	900	—	—	—
230L	1500	—	1500	1200	—	—	—
240D	1200	1200	—	—	—	—	—
240H	800	1200	900	900	1500	2000	1500
240S	800	1200	900	900	—	—	—
400Y	1500	2000	1500	1200	—	—	—
480D	1500	2000	—	—	—	—	—
480Y	1500	2000	1500	1200	—	—	—
600D	1500	2500	—	—	—	—	—
600Y	1500	2500	1800	1500	—	—	—

Catalog Numbering System

Table 34.1-19. SPD MAX Series Catalog Numbering System

SPM 250 480D 3 R

SPM

kA Rating Options

100 = 100 kA per phase
120 = 120 kA per phase
160 = 160 kA per phase
200 = 200 kA per phase
250 = 250 kA per phase
300 = 300 kA per phase
320 = 320 kA per phase
400 = 400 kA per phase
600 = 600 kA per phase
800 = 800 kA per phase

Voltage Code Options

240S = 120/240 split-phase
208Y = 120/208 wye (4W + G)
220Y = 127/220 wye (4W + G)
400Y = 230/400 wye (4W + G)
600Y = 347/600 wye (4W + G)
240D = 240 delta (3W + G)
480D = 480 delta (3W + G)
600D = 600 delta (3W + G)
240H = 240 delta high leg (4W + G) on B phase
230L = 230 single-phase

Feature Package Options ①

1 = Basic
Dual-colored LED per phase to indicate protection status.
Dual-colored LED to indicate protection status of the N–G mode on units with a neutral wire.
3 = Standard with surge counter.
Dual-colored LED per phase to indicate protection status.
Dual-colored LED to indicate protection status of the N–G mode on units with a neutral wire.
Audible alarm with silence button.
Form C relay contact.
EMI/RFI filtering that provides up to 50 dB of noise attenuation from 10 kHz to 100 MHz.
Surge counter with alarm silence (reset) button.

Application Suffix

R = 1 module, NEMA 4 enclosure with internal circuit breaker
S = 2 module, NEMA 4 enclosure with internal circuit breaker
T = 1 module, NEMA 4 enclosure with internal terminal block
U = 2 module, NEMA 4 enclosure with internal terminal block
V = 1 module, NEMA 4X enclosure with internal circuit breaker
W = 2 module, NEMA 4X enclosure with internal circuit breaker
X = 1 module, NEMA 4X enclosure with internal terminal block
Y = 2 module, NEMA 4X enclosure with internal terminal block

① Please consult the factory for 240 delta high leg (4W+G) applications with high leg on C phase.

Example: SPD250480D3R = SPD MAX Series, 250 kA per phase, 480 D voltage, standard with counter features package, NEMA 4 enclosure with internal circuit breaker.

Table 34.1-20. Valid Module and Enclosure Configurations per kA

kA per Phase	Number of Surge Modules	Available Enclosure Options
100 kA	Single module only	R, T, V, X enclosures
120 kA	Single module only	R, T, V, X enclosures
160 kA	Single module only	R, T, V, X enclosures
200 kA	Single or dual module	All enclosures
250 kA	Single module only	R, T, V, X enclosures
300 kA	Single module only	R, T, V, X enclosures
320 kA	Dual module only	S, U, W, Y enclosures
400 kA	Single or dual module	All enclosures
500 kA	Dual module only	S, U, W, Y enclosures
600 kA	Dual module only	S, U, W, Y enclosures
800 kA	Dual module only	S, U, W, Y enclosures

Technical Data and Specifications

Table 34.1-21. SPD MAX Series Specifications

Description	Specification
Surge current capacity per phase	100 kA, 120 kA, 160 kA, 200 kA, 250 kA, 300 kA, 320 kA, 400 kA, 600 kA, 800 kA ratings available
Nominal discharge current (I_n)	20 kA
Short-circuit current rating (SCCR)	200 kA
SPD type	Basic feature package = Type 1 (can also be used in Type 2 applications)
	Standard with surge counter feature package = Type 2
Enclosure types	NEMA 4, NEMA 4X enclosure
Circuit breaker—30 A	Eaton catalog number: FDC3030L
Circuit Breaker Load and Line	
Terminal torque specifications	#10 AWG 35 lb-in; #8 AWG 40 lb-in; #6–#4 AWG 45 lb-in; #3–1/0 AWG 50 lb-in (SPD maximum wire range #10–1/0 AWG)
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 high leg phase wire will be identified with a tag from the factory
Input power frequency	50/60 Hz
Power Consumption (Standard with Surge Counter Units)	
208 Y, 220 Y, 230 L, 240 S, 240 D, and 240 H voltage codes	0.6 W
400 Y, 480 Y, and 480 D basic voltage codes	1.7 W
600 Y and 600 D voltage codes	2.1 W
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, 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)	
230 V single-phase	320 V L–N, 320 V L–G, 320 V N–G
127 V/220 V wye, 120 V/240 V single split phase	150 V L–N, 150 V L–G, 150 V N–G, 300 V L–L
120 V/240 V hi leg	150 V L–N, 150 V L–G, 150 V N–G, 300 V L–L, 320 V H–N, 320 V H–G, 470 V H–L
230 V/400 V wye, 277 V/480 V wye	320 V L–N, 320 V L–G, 320 V N–G, 640 V L–L
347 V/600 V wye	420 V L–N, 420 V L–G, 420 V N–G, 840 V L–L
240 V delta	300 V L–G, 300 V L–L
480 V delta	640 V L–G, 640 V L–L
600 V delta	840 V L–G, 840 V L–L
Ports	1 or 2
Operating temperature and humidity	–20 °C through +50 °C (–4 °F through +122 °F), 5% through 95%, noncondensing
Storage temperature	–20 °C through +50 °C (–4 °F through +122 °F)
Operating altitude	Up to 16,000 ft (5000 m)
Weight	Not to exceed 52 lb
Form C relay contact ratings	Maximum 0.46 A, 150 Vac, 1 A, 30 Vdc
Form C terminal block ratings	Rated 300 V, 16 A, 30–12 AWG solid or stranded wire. Torque range 5–7 lb-in
Form C relay contact logic	Power on, normal state—NO contact = OPEN, NC contact = CLOSED Power off, fault state—NO contact = CLOSED, NC contact = OPEN
EMI/RFI filtering attenuation (standard with surge counter)	Up to 50 dB from 10 kHz to 100 MHz
Standards / agency certifications	UL 1449 4th Edition—standard for surge protective devices
	UL 1283 5th Edition—standard for EMI filters (Type 2 SPDs only)
	CSA Electrical Notice No. 516 Edition 1—surge/transient voltage suppressor (excludes 230 L voltage code)
	CSA 22.2 NO. 8-M1986 Edition 4—EMI filters
Warranty	15 years from the date of delivery to the purchaser, 20 years if the product is properly registered at www.eaton.com
RoHS compliant	Yes

Dimensions

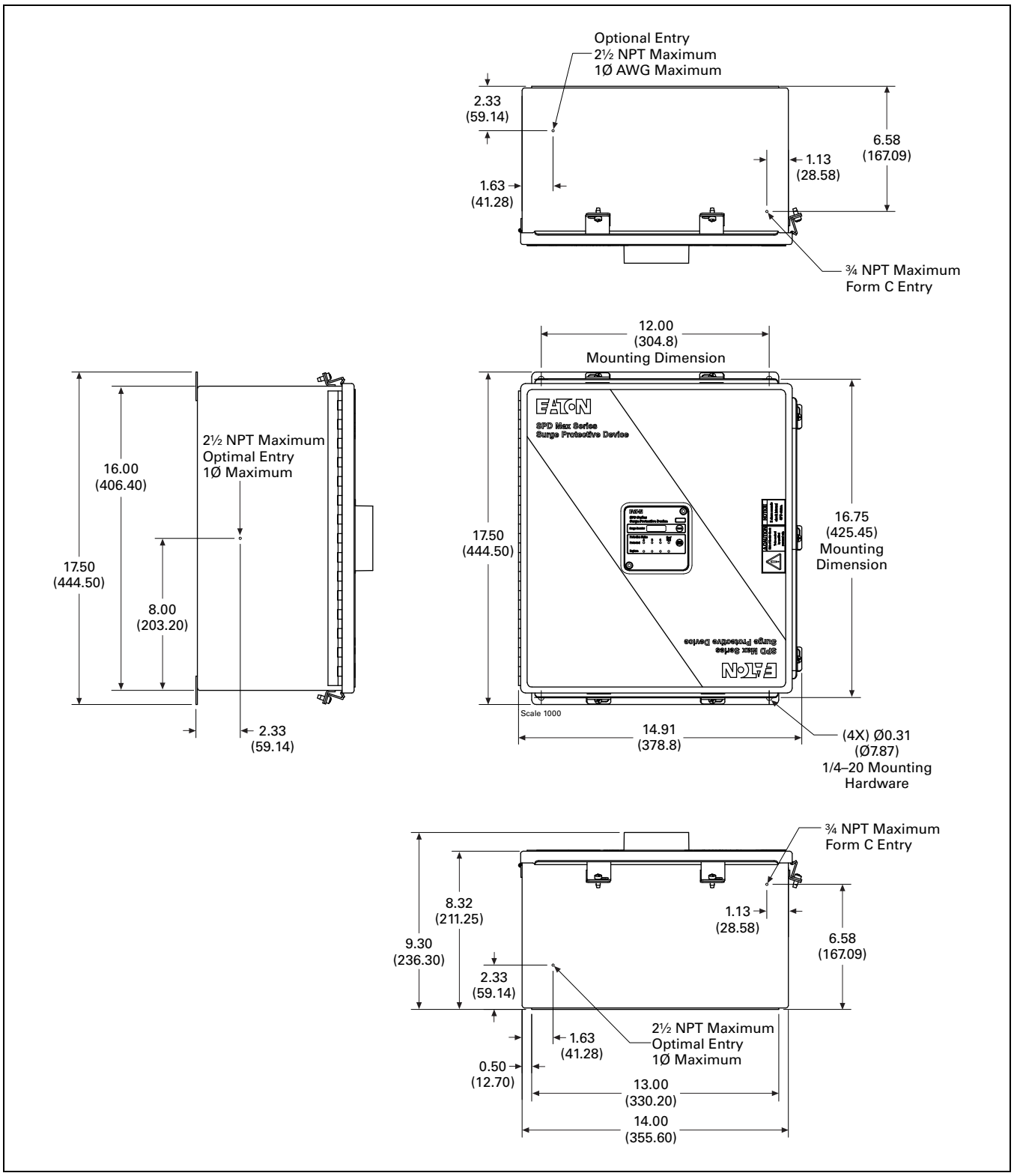

Figure 34.1-14. SPD MAX Dimension in Inches (mm)

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Sidemount Surge Protective Device for Commercial and Light Industrial Applications

SPC Series

General Description

The SPC Series offers robust protection in a compact, flexible design configurable for commercial and light industrial applications. The SPC Series offers maximum flexibility with configurable features such as: EMI/RFI filtering, audible alarm and Form C contacts. SPC Series units are available in all common voltages and configurations, and in a variety of peak surge current capacity ratings from 50 through 200 kA per phase. The compact design and NEMA® 4X enclosure of the SPC Series allows for installation external to an electrical assembly in a wide variety of environments including service entrances, distribution panelboards and point-of-use applications.

Features, Benefits and Functions

- Uses thermally protected metal oxide varistor (MOV) technology
- Proprietary tri-colored LED protection status indicators showing results of continuous self-diagnostic testing, including neutral-ground mode
- 20 kA nominal discharge current (I_n) rating (maximum rating in the UL 1449 4th Edition standard)
- 50 through 200 kA per phase peak surge current capacity ratings
- Configure to order with eight custom feature combinations
- Corrosion-resistant NEMA 4X enclosure with mounting feet
- 200 kA short-circuit current rating (SCCR)
- Factory prewired with 36 inches of 10 AWG wire
- No user-serviceable parts or items requiring periodic maintenance
- 5-year warranty can be extended to 10 years with product registration at www.eaton.com/spc

Standards and Certifications

- UL 1449 4th Edition Type 1 and Type 2
- UL 1283 6th Edition
- Canadian Standards Association (CSA) Type 1 and Type 2
- CSA C22.2 No. 269.1-14 for Type 1 SPD, CSA C22.2 No. 269.2-13 for Type 2 SPD, CSA C22.2 no. 8-13 for EMI filter

SPC Device Mounted to an Eaton Panelboard

Table 34.1-22. SPC Configurable Features

Feature	Standard	Available Option
Surge protection using thermally protected MOV technology	■	
Tri-colored LED protection status indicators for each phase	■	
Tri-colored LED protection status indicators for the neutral-ground protection mode	■	
Audible alarm		■
Form C relay contact		■
EMI/RFI filtering, providing up to 40 dB of noise attenuation from 10 kHz to 100 MHz		■

Catalog Numbering System

Table 34.1-23. SPC Series Catalog Numbering System

SPC 200 208Y 8 P

SPC

kA Rating

050	= 50 kA per phase
080	= 80 kA per phase
100	= 100 kA per phase
120	= 120 kA per phase
150	= 150 kA per phase
160	= 160 kA per phase
200	= 200 kA per phase

Voltage Code

120N	= 120 V single-phase (2W +G)
240N	= 240 V single-phase (2W +G)
277N	= 277 V single-phase (2W +G)
480N	= 480 V single-phase (2W +G)
240S	= 120/240 split-phase (3W +G)
240D	= 240 delta (3W +G)
480D	= 480 delta (3W +G)
600D	= 600 delta (3W +G)
240H	= 240 V high leg delta (4W +G)
208Y	= 120/208 wye (4W + G)
415Y	= 240/415 wye (4W + G)
480Y	= 277/480 wye (4W + G)
600Y	= 347/600 wye (4W + G)

Enclosure Suffix

P	= NEMA 4X

Features

Options	SPD Application
1 = No options (standard configuration)	Type 1
2 = Filtering, UL 1283 6th Edition	Type 2
3 = Audible alarm	Type 1
4 = Form C relay	Type 1
5 = Audible alarm and Form C relay	Type 1
6 = Filtering and audible alarm	Type 2
7 = Filtering and Form C relay	Type 2
8 = Filtering, audible alarm and Form C relay	Type 2

Example: SPC200208Y8P = SPC Series, 200 kA per phase, 208 wye voltage, features: filtering, audible alarm and Form C relay, NEMA 4X enclosure.

The two corrosion-resistant NEMA 4X enclosure sizes are determined by the voltage code and surge rating as shown in **Table 34.1-24**.

Table 34.1-24. SPC Voltage Configurations per Enclosure Size

P1 Enclosure 5.6 x 6 x 3.2 in.; 2.5 lb		**P2 Enclosure 7.6 x 8.5 x 3.2 in.; 4 lb**	
120N/240N/277N/480N	50–200 kA	240S	120–200 kA
240S	50–100 kA	208Y/415Y/480Y/600Y	120–200 kA
208Y/415Y/480Y/600Y	50–100 kA	240D/480D	120–200 kA
240D/480D	50–100 kA	600D	50–200 kA
240H	50–100 kA	240H	120–200 kA

Table 34.1-25. Available Optional Equipment

Available Optional Equipment	Catalog Number
Flush mount plate for P1 enclosure	**FLUSHMNTPLATE13**
Flush mount plate for P2 enclosure	**FLUSHMNTPLATE14**

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Technical Data and Specifications

Table 34.1-26. Specifications

Description	Specification
Peak surge current capacity ratings available	50, 80, 100, 120, 150, 160, 200 kA per phase
Nominal discharge current (I_n)	20 kA
Short-circuit current rating (SCCR)	200 kA
Single phase voltages available (2W + G)	120, 240, 277, 480
Split phase voltages available (3W + G)	120/240
Three-phase wye system voltages available (4W + G)	120/208, 240/415, 277/480, 347/600
Three-phase delta system voltages available (3W + G)	240, 480, 600
Three-phase high leg delta system voltage available (4W + G)	240
Input power frequency	50/60 Hz
Protection modes	Single-phase L-N, N-G, L-G Split-phase L-N, N-G, L-G, L-L Wye L-N, N-G, L-G, L-L Delta L-G, L-L
Maximum continuous operating voltage (MCOV): 120N 240N, 277N 480N 240S, 208Y 240H 415Y and 480Y 600Y 240D 480D 600D	 150 L-N, 150 L-G1, 150 N-G 320 L-N, 320 L-G1, 320 N-G 550 L-N, 550 L-G1, 550 N-G 150 L-N, 150 L-G, 150 N-G, 300 L-L 150 L-N, 150 L-G, 150 N-G, 300 L-L, 470 H-L, 320 H-N, 320 H-G 320 L-N, 320 L-G, 320 N-G, 640 L-L 420 L-N, 420 L-G, 420 N-G, 840 L-L 320 L-G, 300 L-L 550 L-G, 640 L-L 840 L-G, 840 L-L
Ports	1
Operating temperature	–40 °F to +140 °F (–40 °C to +60 °C)
Storage temperature	–40 °F to +140 °F (–40 °C to +60 °C)
Operating humidity	5% through 95%, noncondensing
Operating altitude	Up to 2000 m (6561 ft)
Agency certification/listing	UL 1449 4th Edition, UL 1283 6th Edition, CSA C22.2 No. 269.1-14 for Type 1 SPD, CSA C22.2 No. 269.2-13 for Type 2 SPD, CSA C22.2 no. 8-13 for EMI filter
Durability Repetitive Strike Test	Passed 12,000 strikes to ANSI/IEEE C62.41 (20 kV, 10 kA) Category C Waveform
SPD type	UL 1449 4th Edition and CSA Type 1 and Type 2 SPD (dependent on feature options)
Enclosure dimensions and weights	Refer to **Figure 34.1-15** and **Figure 34.1-16** for enclosure dimensions and weights
Enclosure rating	NEMA 4X enclosure ①
Form C relay contact ratings	2 A at 30 Vdc or 250 Vac
Form C relay contact logic	Power ON, normal state—NO contact = open, NC contact = closed Power OFF or fault state—NO contact = closed, NC contact = open
EMI/RFI filtering attenuation	Up to 40 dB from 10 kHz to 100 MHz
RoHS compliant	Yes
Warranty	5 years standard, 10 years with product registration on www.eaton.com/spc

① Mounting feet required to achieve NEMA 4X rating.

Table 34.1-27 contains representative voltage protection rating (VPR) data for all SPC Series voltage ratings.

Table 34.1-27. ANSI/UL 1449 4th Edition Voltage Protection Ratings

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
120–200 kA Unit VPR				
120N	700	700	700	—
240N	1000	1200	1000	—
277N	1200	1200	1200	—
480N	1800	1800	1800	—
240S	700	700	700	1200
208Y	700	700	700	1200
415Y	1200	1200	1200	2000
480Y	1200	1200	1200	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500
240H ①	700	700	700	1200
80–100 kA Unit VPR				
120N	600	600	600	—
240N	1200	1200	1200	—
277N	1200	1200	1200	—
480N	1800	1800	1800	—
240S	600	600	600	1000
208Y	600	600	600	1000
415Y	1200	1200	1200	2000
480Y	1200	1200	1200	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2500
600D	—	2500	—	2500
240H ①	600	600	600	1000
50 kA Unit VPR				
120N	700	1200	700	—
240N	1200	2000	1500	—
277N	1200	2000	1500	—
480N	1800	1800	1800	—
240S	700	1200	700	1200
208Y	700	1200	700	1200
415Y	1200	2000	1500	2000
480Y	1200	2000	1500	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2500
600D	—	2500	—	2500
240H ②	700	1200	700	1200

① Additional 240H VPRs: 2000 H-L, 1200 H-N, 1200 H-G
② Additional 240H VPRs: 2000 H-L, 1200 H-N, 2000 H-G

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Dimensions in Inches (mm)

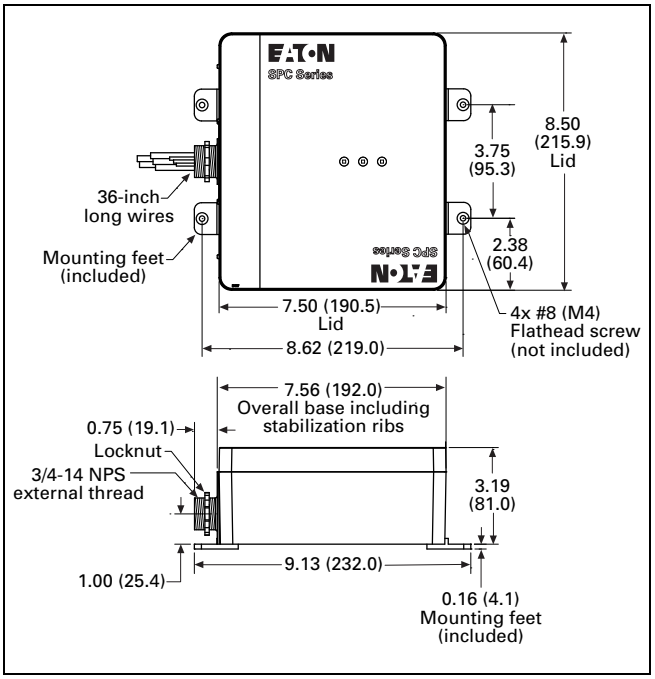

Figure 34.1-15. P1 Enclosure, NEMA 4X with Mounting Feet Dimensions, Weight = 2.5 lb

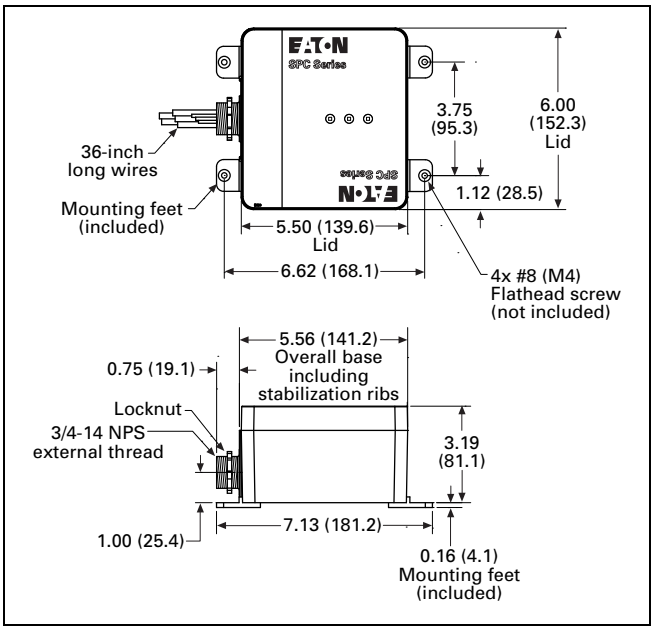

Figure 34.1-16. P2 Enclosure, NEMA 4X with Mounting Feet Dimensions, Weight = 4 lb

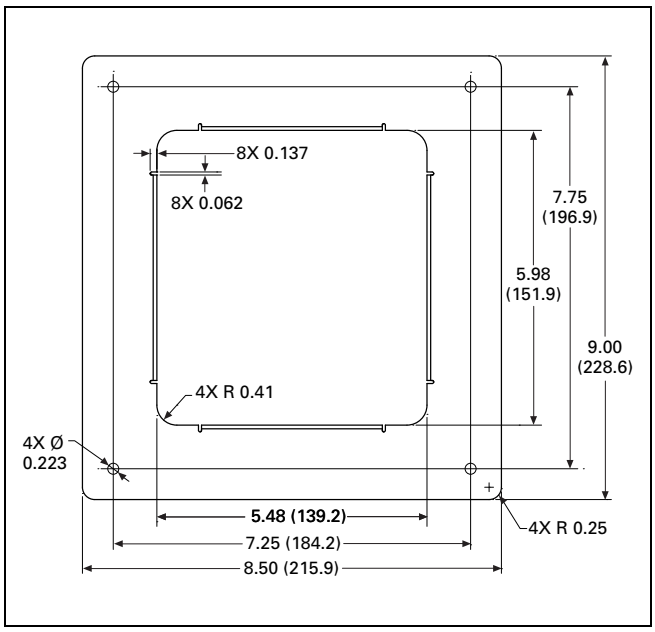

Figure 34.1-17. Optional Flush Mount Plate for P1 Enclosure (Catalog Number FLUSHMNTPLATE13)

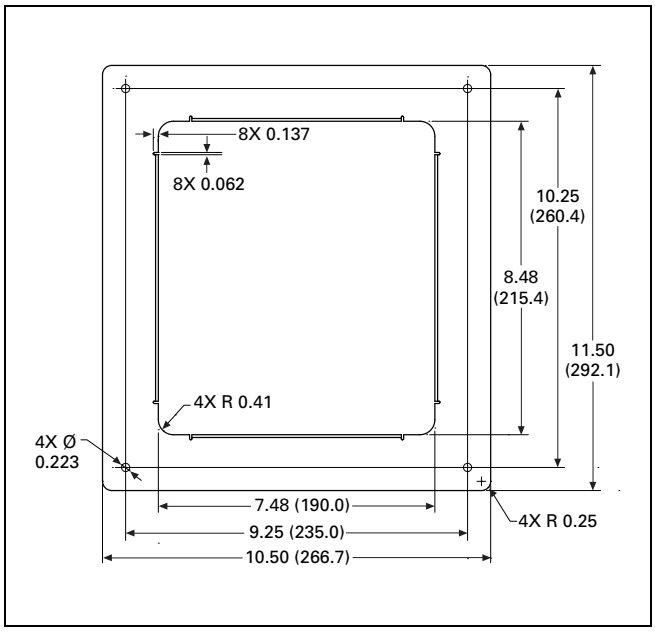

Figure 34.1-18. Optional Flush Mount Plate for P2 Enclosure (Catalog Number FLUSHMNTPLATE14)

CVX050/100

CVX050/100A

General Description

With over two decades of experience in the surge suppression industry and extensive R&D initiatives, Eaton is considered a world leader in surge protective device (SPD) manufacturing. All of Eaton's products are manufactured in an ISO 9001:2000 and ISO 14001 certified facility.

Eaton's CVX050/100 models are rugged, cost-effective, high-quality SPDs that feature thermally protected MOVs that eliminate the failure characteristics of standard Metal-Oxide-Varistors. The TPMOV is a fail-safe device that monitors the status of the metal-oxide disk and connects itself from the power system when the disk is approaching breakdown.

The CVX050/100 is easy to install adjacent or even internal to electrical equipment. When installing an SPD in a retrofit environment, it is important to mount the device as close to the electrical equipment as possible. Keep the wiring (lead length) between the electrical equipment and SPD as short as possible, and twist or wire tie the conductors together to reduce the wire's impedance factor.

Application Description

Eaton's CVX050 and CVX100 SPDs protect electronic equipment from damaging transients. These units are suitable for medium and low exposure level applications that require cost-effective, high quality system protection including:

- Residential/small business
- Light industrial
- Light commercial
- Branch panel protection

Features, Benefits and Functions

- Advanced surge path technology for high fault current capacity, low impedance, high frequency design
- Rugged NEMA 4X (IP65) enclosure
- Large diameter, thermally protected metal oxide varistors provide long life and fail-safe operation
- LED monitoring of each phase
- Wide range of voltage applications from 100 to 480 Vac, and 48 and 125 Vdc
- 5-year free replacement warranty

Optional Features

- External mounting feet (catalog number MNTGFTX)
- Flush mounting plate (catalog number FLUSHMNTPLATE12)

Catalog Number Selection

Table 34.1-28. CVX050/100

CVX 050 - 230L

Per Phase Peak Surge Current
050 = 50 kA
100 = 100 kA ①

Configuration and Voltage Ranges (Vac)
230L = Single-phase–200, 208, 220, 230, 240, 277
480L = Split-phase–380, 400, 440, 460, 480
240S = Split-phase–100/200, 110/220, 120/240
240H = Three-phase high leg delta–120/240
208Y = Three-phase wye (star)–100/174, 110/190, 120/208, 127/220
480Y = Three-phase wye (star)–220/380, 230/400, 240/415, 277/480
600Y = Three-phase wye (star)–305/525, 347/600
240D = Three-phase delta–200, 208, 220, 230, 240
480D = Three-phase delta–380, 400, 415, 440, 480
600D = Three-phase delta–525, 600 Vac (600D available in 50 kA only)
Configuration and Voltage Ranges (Vdc)
048DC = Direct Current 48 Vdc ①
125DC = Direct Current 125 Vdc ①

① DC models only available in 50 kA.

Standards and Certifications

- UL 1449 4th Edition for surge protective devices
- CE marked
- Vibration tested IEC 60255-21-1 and -2

Note: CE, CSA and UL on AC unit only.

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Technical Data and Specifications

Table 34.1-29. CVX050/100 Model Specifications

Description	Specification
Peak kA per phase	50, 100
Peak kA per mode	50
Nominal discharge current	20 kA ①
Short-circuit current rating	100 kA
Single-phase voltages	200, 208, 220, 230, 240, 277, 380, 400, 440, 460, 480
Split-phase voltages	100/200, 110/220/ 120/240
High leg delta voltages	240
Wye system voltages	100/175, 110/190, 120/208, 127/220, 220/380, 230/400, 240/415, 277/480, 305/525, 347/600
Delta system voltages	200, 208, 220, 230, 240, 380, 400, 415, 440, 480, 525, 600
Direct current voltage ②	48 Vdc, 125 Vdc
Input power frequency	47–420 Hz (50/60 Hz typical)
Protection modes	Single-phase: L-N, N-G, L-G Split-phase: L-N, N-G, L-G, L-L High leg delta: L-N, N-G, L-G, L-L, H-N, H-G, H-L Wye: L-N, N-G, L-G, L-L Delta: L-G, L-L Direct current (DC): L-L, L-G ②
Number of ports	1
Specific energy	100 kJ/Ohm
Weight (approximate)	2.0 lb (1.0 kg)
Operating temperature	–13 °F (–25 °C) to +140 °F (+60 °C)
Vibration tested	IEC 60255-21-1 and IEC 60255-21-2

① 480L, 600D and 600Y units rated 10 kA I_n.
② DC models only available in 50 kA.

Table 34.1-30. CVX050/100 Voltage Ratings

Model	System Configuration	Nominal System Voltage	MCOV				UL 1449-4 VPR ③			
			L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G
CVX050										
230L	Single-phase two-wire + ground	200, 208, 220, 230, 240, 277	—	320	640	320	—	1200	1200	1200
480L	Single-phase two-wire + ground	380, 400, 440, 460, 480	—	550	1100	550	—	1800	4000	1800
240S	Split-phase three-wire + ground	100/200, 110/220, 120/240	300	150	300	150	1200	700	1200	800
208Y	Three-phase wye (star) four-wire + ground	100/175, 110/190, 120/208, 127/220	300	150	300	150	1200	700	1200	800
480Y	Three-phase wye (star) four-wire + ground	220/380, 230/400, 240/415, 277/480	640	320	640	320	2500	1200	2000	1200
600Y	Three-phase wye (star) four-wire + ground	305/525, 347/600	840	420	840	420	2500	1500	2500	1500
240D	Three-phase delta three-wire + ground	200, 208, 220, 230, 240	640	—	320	—	2000	—	1200	—
240H	Three-phase high leg delta	240	300	150	150	640	1500	700	1200	700
480D	Three-phase delta three-wire + ground	380, 400, 415, 440, 480	1100	—	550	—	3000	—	1800	—
600D	Three-phase delta three-wire + ground	525, 600	1100	—	700	—	3000	—	2500	—
048DC	Direct current	48 Vdc ④	130	—	65	—	—	—	—	—
125DC	Direct current	125 Vdc ④	288	—	144	—	—	—	—	—
CVX100										
230L	Single-phase two-wire + ground	200, 208, 220, 230, 240, 277	—	320	320	320	—	1200	1200	1200
480L	Single-phase two-wire + ground	380, 400, 440, 460, 480	—	550	550	550	—	1800	1800	1800
240S	Split-phase three-wire + ground	100/200, 110/220, 120/240	300	150	150	150	1200	700	800	700
208Y	Three-phase wye (star) four-wire + ground	100/175, 110/190, 120/208, 127/220	300	150	150	150	1000	600	700	700
480Y	Three-phase wye (star) four-wire + ground	220/380, 230/400, 240/415, 277/480	640	320	320	320	1800	1200	1200	1200
600Y	Three-phase wye (star) four-wire + ground	305/525, 347/600	840	420	420	420	2500	1500	1500	1500
240D	Three-phase delta three-wire + ground	200, 208, 220, 230, 240	640	—	320	—	1800	—	1200	—
240H	Three-phase high leg delta	240	300	150	150	150	1200	700	700	700
480D	Three-phase delta three-wire + ground	380, 400, 415, 440, 480	1100	—	550	—	3000	—	1800	—

③ UL 1449 4th Edition VPR (voltage protection rating) test environment: all tests performed with 6-inch lead length, positive polarity.
④ DC units available in 50 kA only. Voltages shown are the maximum suggested operating voltages and are not UL certified.

Dimensions

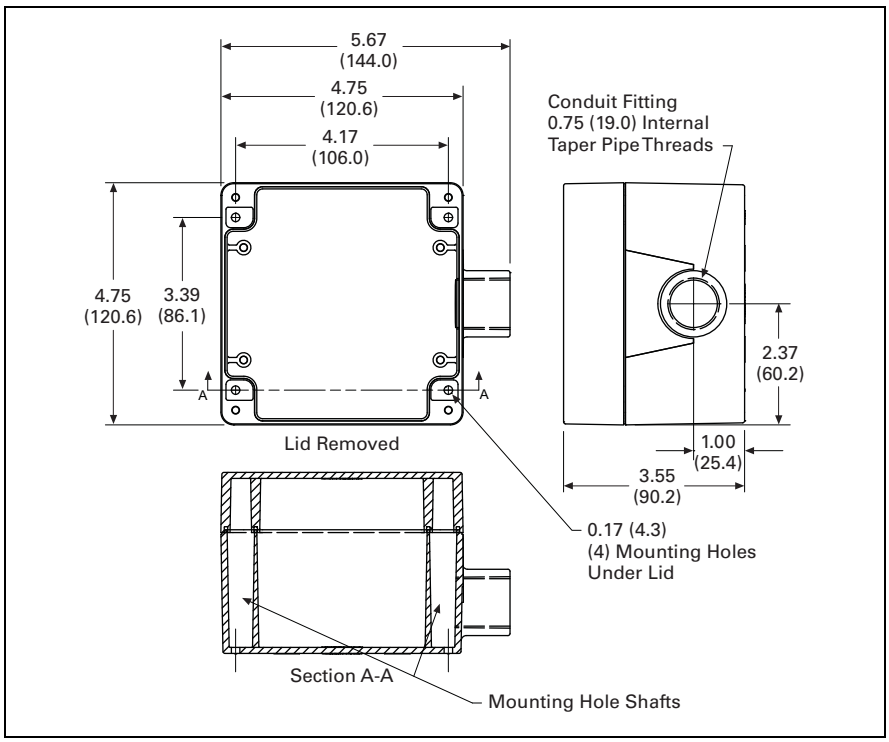

Figure 34.1-19. CVX050/100 Standard Dimensions—Approximate Dimensions in Inches (mm)

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Eaton SP1

Eaton SP1

General Description

Eaton's SP1 is a UL 1449 4th Edition-listed surge protective device that provides reliable, cost-effective surge protection. This Type 1 SPD is capable of being installed on either the line or load side of the service entrance disconnect and can be used as a replacement for devices formerly known as secondary surge arresters or lightning arresters, which could not be manufactured after UL 1449 3rd Edition went into effect on September 29, 2009. The unit is available in many common voltages and configurations. Multiple mounting options coupled with a compact footprint enables installation of the SP1 in a wide range of applications, including panelboards, loadcenters, pump panels, control cabinets, and other electrical assemblies and applications.

Installation and Operation

Installation and operation of the SP1 is simple. The unit comes pre-wired with 24.00 inches (609.6 mm) of 10-gauge wire and is mounted via the 0.50-inch (12.7 mm) nipple that is molded into its enclosure. Wall or DIN rail mounting can also be accomplished with the addition of an optional kit. When powered, the unit's light-emitting diode (LED) indicator reports the status of the protection elements and is active when all of them are intact and providing protection. Any loss of protection is signaled when the LED extinguishes.

Features

- Type 1 SPD capable of installation on either the line or load side of the service entrance disconnect
- 20 kA nominal discharge current rating (I_n) on most models
- 50 kA per phase surge current capacity
- Compact footprint—4.80 inches (121.9 mm) L x 2.90 inches (73.7 mm) W x 2.50 inches (63.5 mm) D
- Pre-wired with 24.00 inches (609.6 mm) of 10-gauge wire
- 0.50-inch (12.7 mm) nipple molded into enclosure enables quick and easy mounting
- Optional kit enables wall or DIN rail mounting
- Two-year warranty

Standards and Certifications

- UL 1449 4th Edition-listed device

Catalog Number Selection

Table 34.1-31. SP1 Catalog Numbering System

SP1 XXXX

Series	Voltage Codes
SP1	**240S** = 120/240 V single split-phase **208Y** = 120/208 wye **480Y** = 277/480 wye **600Y** = 347/600Y wye **240D** = 240 delta **480D** = 480 delta **600D** = 600 delta

Note: SP1MNTGKIT = optional wall or DIN rail mounting kit (order separately—not included with SP1 unit).

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Technical Data and Specifications

Table 34.1-32. Specifications

Description	Rating
Surge current capacity per phase	50 kA
Nominal discharge current (I_n)	20 kA for SP1-240S, 208Y, 480Y, 240D and 480D 10 kA for SP1-600Y and 600D
Short-circuit current rating (SCCR)	200 kA
SPD type	Type 1 (can also be used in Type 2 applications)
System voltages available (Vac) Single split-phase Three-phase wye Three-phase delta	 120/240 120/208, 277/480, 347/600 240, 480, 600
Protection modes Single split-phase and three-phase wye Three-phase delta	 L-N, L-L L-G, L-L
Maximum continuous operating voltage (MCOV) SP1-240S and SP1-208Y SP1-480Y SP1-600Y SP1-240D SP1-480D SP1-600D	 150 L-N, 300 L-L 320 L-N, 640 L-G 420 L-N, 840 L-G 300 L-G, 300 L-L 640 L-G, 640 L-L 840 L-G, 840 L-L
Input power frequency	50/60 Hz
Enclosure rating	NEMA 4
Operating temperature	–20 °C to 50 °C (–4 °F to 122 °F)
Operating humidity	5–95%, noncondensing
Operating altitude	Up to 16,000 ft (5000 m)
Agency certification and approvals	UL 1449 4th Edition listed device
Warranty	2 years

Table 34.1-33. ANSI/UL 1449 4th Edition Voltage Protection Ratings

Protection Mode			Catalog Number
L-N	L-G	L-L	
600	N/A	1000	**SP1-240S**
600	N/A	1000	**SP1-208Y**
1200	N/A	2000	**SP1-480Y**
1500	N/A	2500	**SP1-600Y**
N/A	1000	1000	**SP1-240D**
N/A	2000	2000	**SP1-480D**
N/A	2500	2500	**SP1-600D**

Technical Support Information

If you have any questions or need additional information, please contact the Eaton Technical Resource Center at 800-809-2772, option 4, option 2. You may also submit inquiries via e-mail: spd@eaton.com.

Dimensions in Inches (mm)

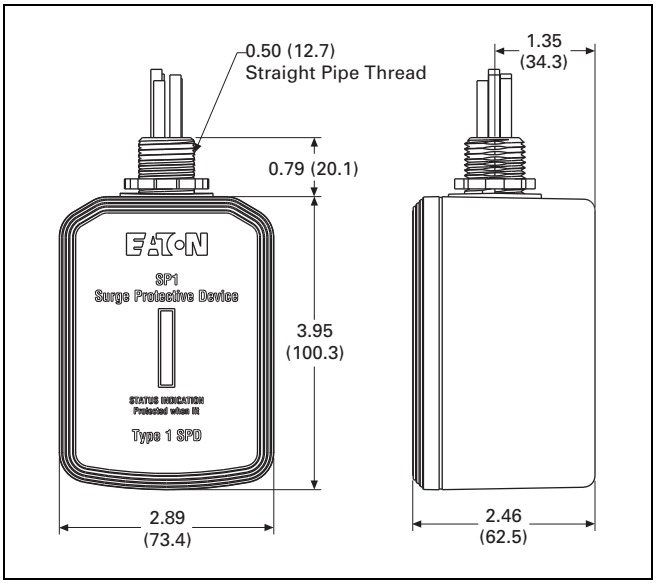

Figure 34.1-20. SP1 Dimensions

34

SP2 Surge Protective Device

Surge Protection for Light Commercial and UL 508A Panel Applications

General Description

The SP2 provides basic surge protection for light commercial electrical systems and OEM equipment requirements. The SP2 is available in the most popular voltage and system configurations and delivers superior surge protection using MOV thermal disconnect technology that eliminates the need for additional overcurrent protection.

Studies have shown that failure to protect sensitive electronic loads costs American manufacturing and commercial and service industries more than $39 billion per year in lost time and revenue. Preventing these losses is a major cost-saving opportunity. The SP2 can be used to protect downstream points in the electrical distribution system along with machinery control panels to keep your facility and processes running.

Application Description

By providing surge protection, the SP2 can suppress the transients that are prevalent throughout the power distribution system to support reliable operations in applications including:

- HVAC systems
- Control panels
- Automation cabinets
- Pumping systems
- Lighting systems
- Commercial facilities
- Food processing
- Warehouses
- Retail facilities
- Manufacturing operations

Standards and Certifications

- UL 1449 4th Edition Type 1 SPD File No. E109835, cULus
- Built in an ISO 9001 facility
- Flammability rating UL 94VO
- Designed and tested in accordance with:
  - IEEE C62.41.1
  - IEEE C62.41.2
  - IEEE C62.43-2005
  - IEEE C62.45-2002
  - IEEE C62.48-2005
  - IEEE C62.62-2010

Features, Benefits and Functions

- Type 1 UL 1449 4th Edition listed SP2s are easily selected and installed on the loadside or lineside of the service entrance overcurrent protective device
- Thermal disconnect technology eliminates the need for additional overcurrent protection
- Compact UV-resistant NEMA 4X enclosure for indoor or outdoor applications
- LED status indicators provide surge protection status at a glance—green when good, red to replace
- Voltage-specific models protect electrical systems and equipment, improving performance by more than 110% over “one-size-fits-all” economy surge arresters
- Compact enclosure takes up less space and can be installed in tight spaces
- Can be used on single-phase, split-phase, wye, delta, and high-leg delta systems
- All SP2 devices are individually marked with a serial number for easy tracking and identification
- Two-year warranty
- Compact design allows for easy installation on an electrical panel or meter socket, or integrated into control cabinets

Product Selection

Table 34.1-34. SP2 Product Selection

Nominal System Voltage	Maximum Continuous Operating AC Voltage (MCOV)	System Type	Voltage Protection Ratings (VPR)	Connection Points	Catalog Number
120	150	Single-phase, two-wire	700 L–N	2	**SP2-120**
240	320	Single-phase, two-wire	1200 L–N	2	**SP2-240**
120/240	150	Split-phase, three-wire	700 L–N, 1200 L–L	3	**SP2-240S**
240	320	Three-phase delta, three-wire + ground	1200 L–G, 2500 L–L	4	**SP2-240D**
480	550	Three-phase delta, three-wire + ground	1800 L–G, 3000 L–L	4	**SP2-480D**
120/208	150	Three-phase wye, three-wire + ground	700 L–G, 1200 L–L	4	**SP2-208Y**
277/480	320	Three-phase wye, three-wire + ground	1200 L–G, 2500 L–L	4	**SP2-480Y**
34/600	420	Three-phase wye, three-wire + ground	1500 L–G, 2500 L–L	4	**SP2-600Y**

Technical Data and Specifications

Table 34.1-35. SP2 Specifications

Description	Specification
Markets	Light commercial and UL 508A panels
Product warranty	2 years
System types	Single, split, delta, and wye
Nominal system voltage	120, 208, 240, 480, 600 Vac
Installation	Two-, three-, four-wire
Maximum continuous operating AC voltage	Matched to nominal voltage
MCOV	150–550 Vac (see table above)
L–N protection	Yes (single-phase units)
L–L protection	Yes
L–G protection	Yes (three-phase units)
Protection	Surges and transients
SCCR	200 kA
Nominal discharge current (8 x 20 µs) In	10 kA
Maximum discharge current (8 x 20 µs) Imax	45 kA per phase
Response time tA	<25 ns
Voltage protection ratings (VPRs)	See table above
Overcurrent device (if required by local code)	Circuit breaker or fuse sized to protect wires per local codes
Frequency	50/60 Hz
Operating status / fault indication	One bi-color LED—green (good) / red (replace)
Conductor gauge/length	10 AWG stranded copper / 18 inches
Mounting	Chase nipple (¾" NPS)
Enclosure rating	NEMA 4X—UL 94-5VA
Degree of protection (installed state)	IP20 (finger-safe)
Install location	Indoor/outdoor
Circuit location	Lineside/loadside
Standards / agency information	UL 1449 4th Edition Type 1 Listed SPD—cULus, RoHS compliant
Operating temperature	–40 °C to +65 °C
Maximum operating altitude	12,000 ft
Weight	17 oz (476 g)

Dimensions in Inches (mm)

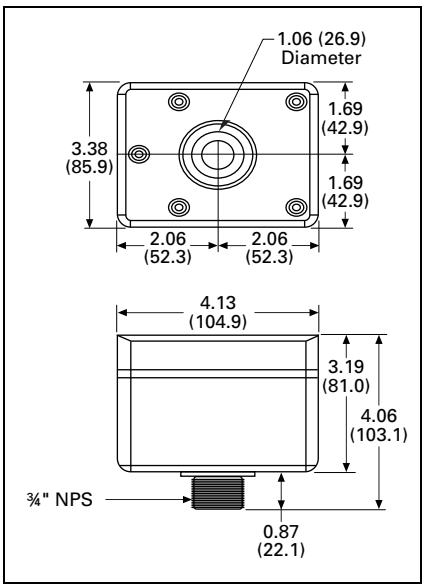

Figure 34.1-21. SP2 Enclosure

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AEGIS Powerline Filters

AEGIS Solutions

General Description

Eaton AEGIS™ Series line filters and surge protectors are specifically designed to protect sensitive electronics from hazards that exist within a facility. The AEGIS Series hybrid filter reacts instantly to changes in voltage regardless of phase angle or polarity. In comparison to other line filters, this technology provides a higher level of suppression, reliability and life expectancy.

Application Description

By providing surge protection and line filtering, AEGIS devices can suppress the noise and transients prevalent throughout the power distribution system to support reliable operations in applications including:

- Instrumentation
- Water treatment facilities
- Pulp and paper operations
- Refrigeration and heating plants
- Petrochemical and refinery
- Food processing
- Textiles
- Automotive assembly
- Manufacturing operations

No matter where transients originate, the application of AEGIS Series devices will help protect sensitive electronic equipment including:

- Programmable logic controllers (PLCs)
- Scanning devices
- Automatic teller machines (ATMs)
- Cash registers
- Alarm systems
- Microprocessor-controlled
- OEM products
- Robotics
- CAD/CAM systems
- Control equipment
- Medical electronics and devices

AEGIS Series devices are available in a variety of common voltages and configurations.

Why Should Sensitive Electronic Loads be Protected?

PLC manufacturers and service technicians recommend the use of surge suppressors and filters to prevent downtime and equipment damage due to surges and electrical line noise. One study shows failure to protect sensitive electronic loads costs American manufacturing, commercial and service industries over $39 billion per year in lost time and revenue. Preventing these losses is a major cost-saving opportunity.

Features, Benefits and Functions

AEGIS powerline filters protect against the full spectrum of transient disturbances.

AEGIS filters the entire sine wave and is effective against both frequently occurring low-energy and occasional high-energy transients. High-energy transients can create immediate damage, while low-energy transients cause microprocessor failure over time.

The AEGIS PH Series Protects Critical Loads up to 20 A

The AEGIS PV Series Protects Critical Loads up to 5 A

Catalog Numbering System

Table 34.1-36. AEGIS Series Catalog Numbering System

AG

Product Family/OEM
AG

Protection/ Filtering	Voltage	Amperage	Options
PH = Premium protection with hybrid filtering	**120** = 120 Vac **240** = 240 Vac	**03** = 3 A **05** = 5 A **10** = 10 A **15** = 15 A **20** = 20 A	
PV = Premium protection with filtering	**120** = 120 Vac **240** = 240 Vac	**01** = 1 A **03** = 3 A **05** = 5 A	
CF = Critical protection with filtering	**120** = 120 Vac **230** = 230 Vac **240** = 240 Vac **024** = 24 Vdc **048** = 48 Vdc	**10** = 10 A **15** = 15 A **30** = 30 A **60** = 60 A	**DIN** = DIN mount ① **DIN2**= DIN2 mount ② **CP** = Compact ③ **RJ** = Telcom protection and Form C status contacts ④
CN = Critical protection without filtering	**120** = 120 Vac **230** = 230 Vac **024** = 24 Vdc **048** = 48 Vdc	**30** = 30 A	

① Not available for 10 A, 230 V or 240 V versions.
② Only available for 10 A, 120 V or 240 V CF version.
③ Only available for 10 A, 120 V CF version.
④ Only available for 30 A and 60 A CF version.

Product Selection

Table 34.1-37. Let-Through Voltages Based on IEEE Std. C62.62-2010 Testing Waveforms ①

Test Impulse	AEGIS Series							
	AGPH120xx	AGPV120xx	AGCF12010	AGCF12010-DIN	AGCF12010-CP	AGCF12030xxx	AGCF12060xxx	AGCn12030
IEEE Category A 100 kHz ring wave 6000 V, 200 A	25 V	30 V	150 V	300 V	300 V	150 V	90 V	400 V
IEEE Category B 100 kHz ring wave 6000 V, 500 A	35 V	40 V	330 V	400 V	400 V	330 V	230 V	500 V
IEEE Category B combination wave 6000 V, 3000 A (UL 1449-4 VPR)	360 V	370 V	470 V	480 V	460 V	460 V	450 V	460 V

① All tests conducted on 120 Vac units.

Technical Data and Specifications

Table 34.1-38. AEGIS Specifications

	AEGIS Series	②	③	④
Rating	**PH**	**PV**	**CF**	**CN**
Application	Single-phase, two- or three-wire grounded systems	Single-phase, two- or three-wire grounded systems	Single-phase, two- or three-wire grounded systems	Single-phase, two- or three-wire grounded systems
Input voltage—AC	100–127 Vac, 200–240 Vac	100–127 Vac, 200–240 Vac	100–127 Vac, 200–240 Vac	100–127 Vac, 200–240 Vac
Input voltage—DC	N/A	N/A	5–38 Vdc, 24–65 Vdc, 48–149 Vdc, 150–300 Vdc	5–38 Vdc, 24–65 Vdc, 48–149 Vdc, 150–300 Vdc
Amperage	3, 5, 10, 15, and 20 A	1, 3, and 5 A	10, 30, and 60 A	30 A
DIN mounting	Yes	Yes	Yes ⑤	No
Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Protection modes	L–N, L–G and N–G	L–N, L–G and N–G	L–N, L–G and N–G	L–N, L–G and N–G
MCOV	150 V and 275 V	150 V and 275 V	150 V and 275 V	150 V and 275 V
Noise attenuation (normal mode)	74 dB at 100 kHz	56 dB at 100 kHz	48 dB at 100 kHz	N/A
Filter bandwidth	10 kHz to 100 MHz	10 kHz to 100 MHz	10 kHz to 100 MHz	N/A
Peak surge current per phase / per mode	60 kA / 30 kA	40 kA / 20 kA	Up to 80 kA / 40 kA	Up to 80 kA / 40 kA
UL nominal discharge current (I_n)	5 kA	5 kA	5 kA	5 kA
UL voltage protection rating (VPR) L–G / L–N ④	330/400	330/400	500/500	500/500
Short-circuit current rating (SCCR)	5 kA	5 kA	10 kA	10 kA
Operating temperature	–40 °F to +122 °F (–40 °C to +50 °C)	–40° F to +122 °F (–40 °C to +50 °C)	–40 °F to +140 °F (–40 °C to +60 °C)	–40 °F to +140 °F (–40 °C to +60 °C)
Response time	<1 nanosecond	<1 nanosecond	<1 nanosecond	<1 nanosecond
Agency approvals	UL 1449 4th Edition, UL 1283 5th Edition and CSA	UL 1449 4th Edition, UL 1283 5th Edition and CSA	AGCFxxxxx UL 1449 4th Edition, UL 1283 5th Edition AGCFxxx10-DIN2 UL 1449 4th Edition, IEC 61000-4.5	AGCNxxx30 UL 1449, UL 1283 5th Edition, EMI filter
UL 1449 Type	Type 2	Type 2	Type 2	Type 2
Warranty ⑥	15 years	15 years	10 years	10 years
Status indicator	LED	LED	LED	LED
Form C contacts	Yes	No	Yes ⑤	No
Communication line protection (UL 497A)	No	No	Optional	No
External circuit breaker ⑦	Eaton P/N: WMZT1C25 or equiv. 25 A circuit breaker	Eaton P/N: WMZT1C07 or equiv. 7 A circuit breaker	10 A—Eaton P/N: WMXT1C15 or equiv. 15 A circuit breaker 30 A—Eaton P/N: WMZT1C40 or equiv. 40 A circuit breaker 60 A—Eaton P/N: EGC3100FFG or equiv. 100 A circuit breaker	Eaton P/N: WMZT1C40 or equiv. 40 A circuit breaker

② Optional on 10 A and 30 A models only.
③ 120 Vac models only.
④ Ratings shown for 120 Vac models, other voltages listed in Technical Data.
⑤ Optional on 30 A and 60 A models only.
⑥ With product registration.
⑦ External circuit breaker sold separately.

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Dimensions in Inches (mm)

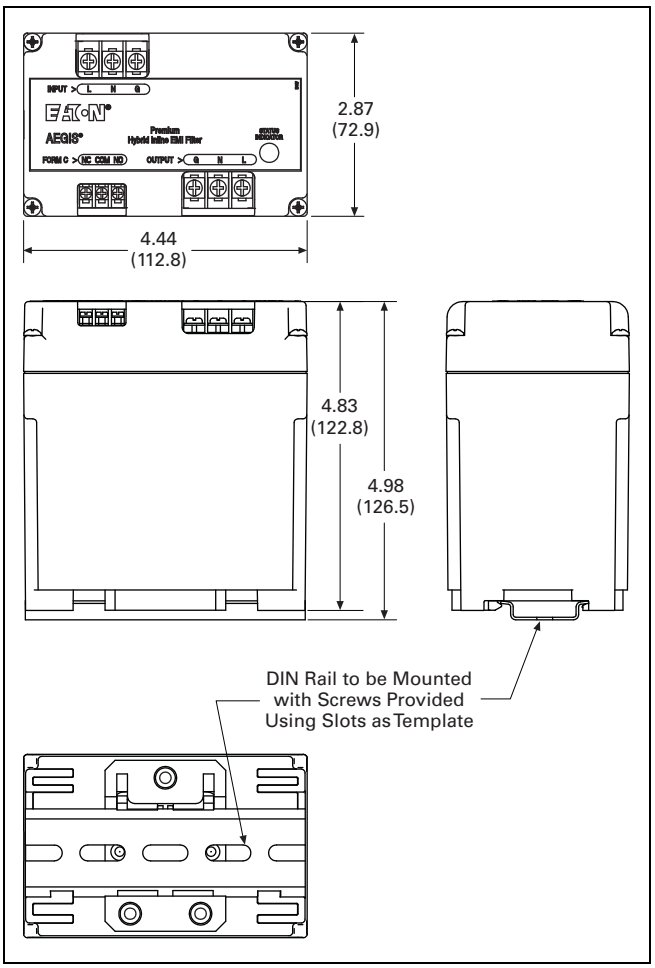

Figure 34.1-22. AGPHxxxxx Dimensions

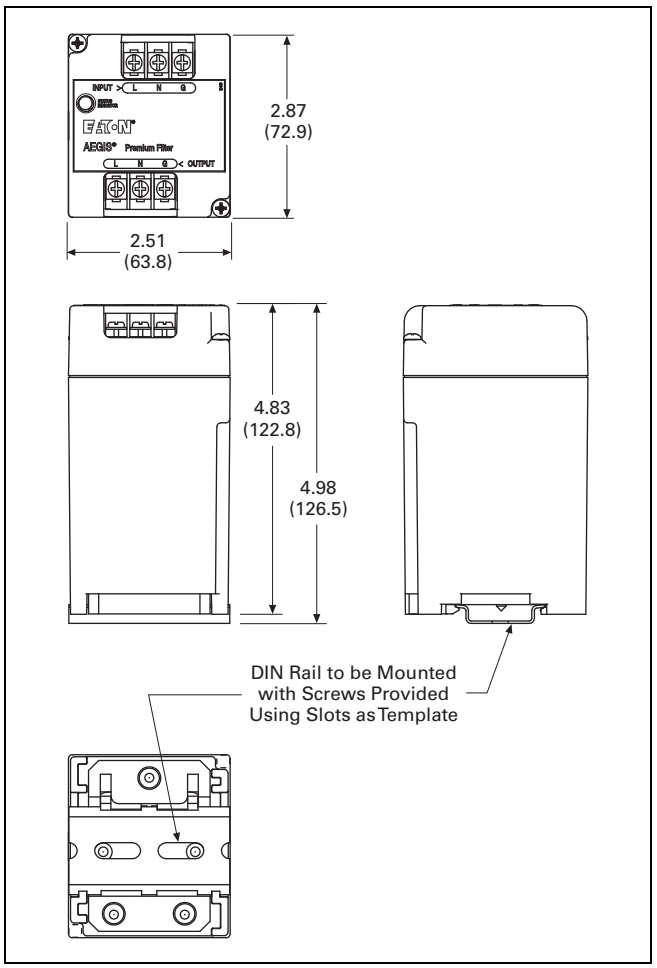

Figure 34.1-23. AGPVxxxxx Dimensions

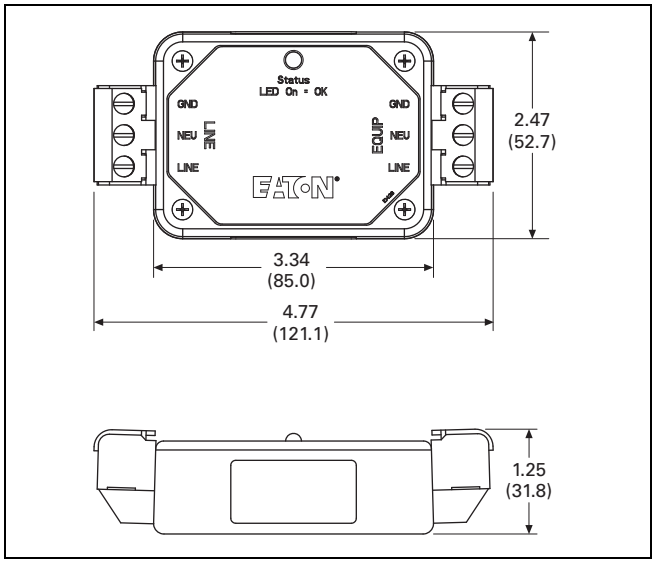

Figure 34.1-24. AGCF12010-CP Dimensions

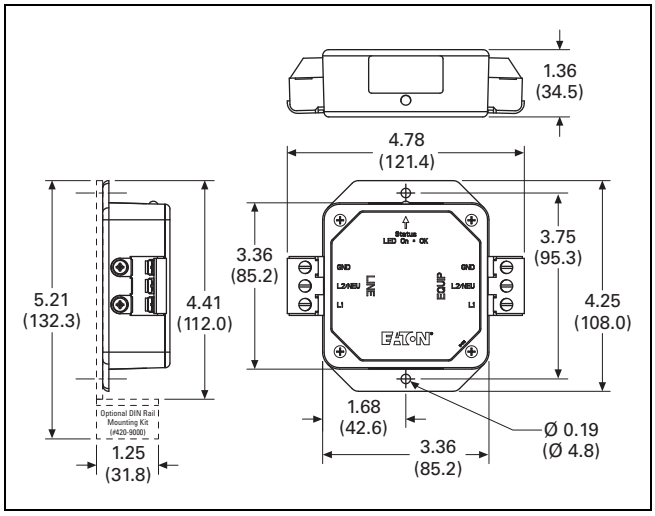

Figure 34.1-25. AGCFxxx10 Dimensions

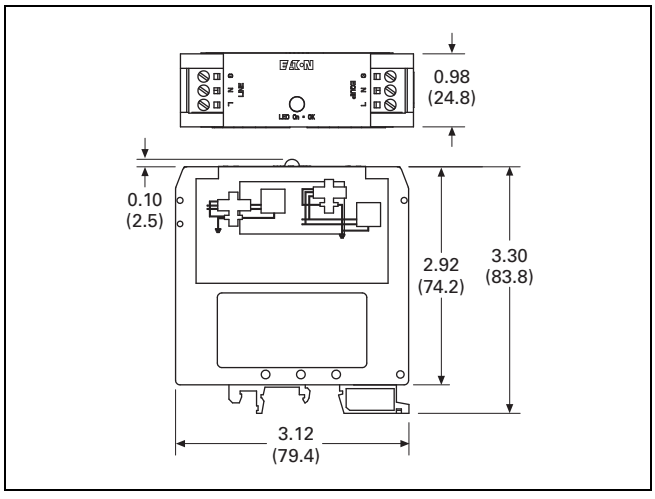

Figure 34.1-26. AGCFxxx10-DIN Dimensions

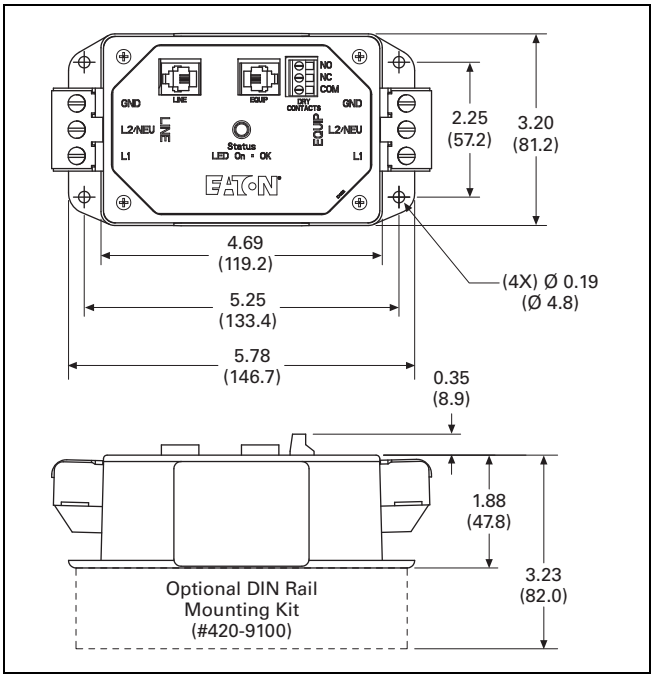

Figure 34.1-27. AGCFxxx30xxx Dimensions

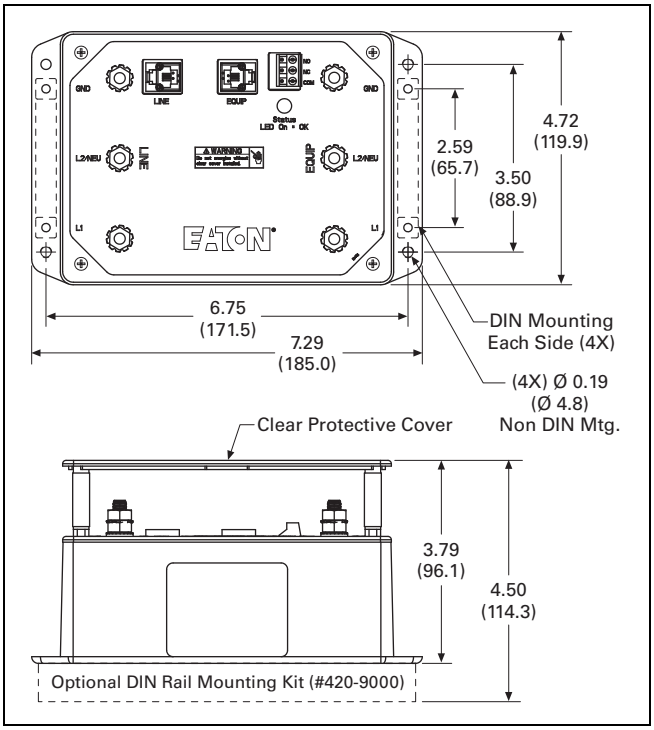

Figure 34.1-28. AGCFxxx60xxx Dimensions

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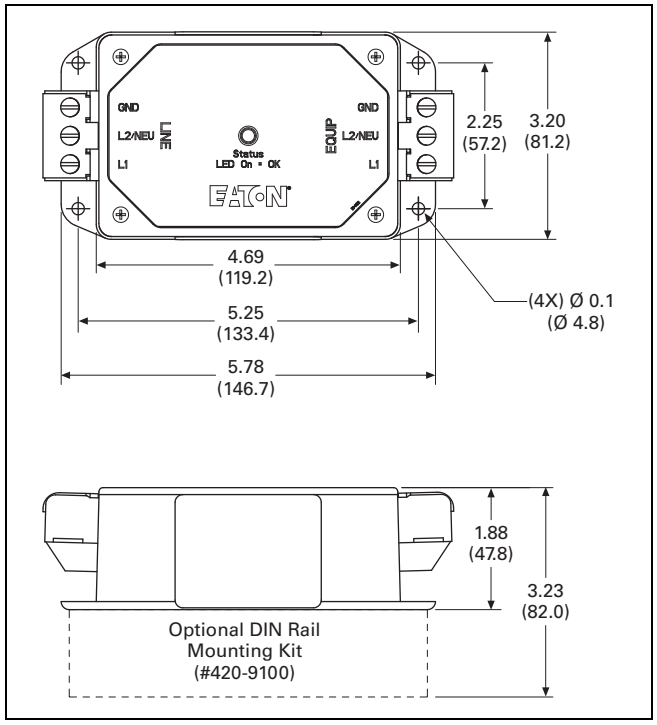

Figure 34.1-29. AGCNxxx30 Dimensions

Sag Ride Through (SRT2)

Sag Ride Through (SRT2)

General Description

The SRT2 is the latest revision of Eaton's sag ride-through products. The operation of the system is designed specifically to meet the demanding requirements of industrial load protection where the following eatures are particularly important:

- Extremely high electrical efficiency, meaning much lower ongoing cost of ownership than traditional UPS solutions and much less needed heat dissipation from the room in which the SRT2 is located
- High reliability due to the three levels of redundancy offered in the SRT2 design
- High levels of fault clearing capacity (typically 20 times current short term) to allow for the discrimination of protection systems
- Ability to cope with industrial loads, such as motor drives, which are high in harmonic draw and also loads that may regenerate power

Application Description

Industries and Applications Affected by Sags

Key industries:

- Semiconductor manufacturers
- Communications
- Steel mills
- Petroleum and chemical processing
- Healthcare
- Paper mills
- Automotives
- Textile
- Printing
- Plastics

Equipment or processes:

- Manufacturing process controllers
- Variable speed drives
- Robotics
- Motor conductor
- Telephone systems
- HID lighting
- HVAC controls
- Medical equipment
- Computers

Features and Benefits

Continuous Sag Regulation

The SRT2 is an active voltage conditioner. This means it will constantly respond to voltage sags and swells in the ±10% range with a regulated output in the ±1% range. The SRT2 can be applied to the main service entrance, at branch locations or in front of critical loads. Eaton's SRT2 provides an outstanding return on investment. It delivers operational productivity that is just not possible with traditional tap switching or ferroresonant technologies.

The SRT2 consists of a voltage source inverter, a bypass circuit and an injection transformer connected in series between the incoming utility supply and the load (**Figure 34.1-30**).

Sag Correction Using the Sag Ride-Through

The SRT2 power conditioner prevents expensive electrical downtime. It is a state-of-the-art solution to today's power conditioning challenges.

Standards and Certifications

The SRT2 meets the stringent requirements of the SEMI-F47 standard, a key requirement for sag correction in the semiconductor industry.

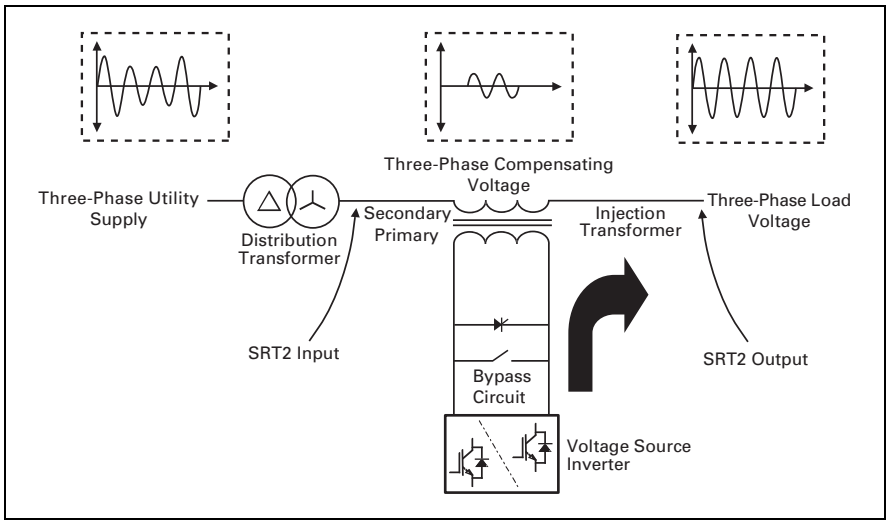

Figure 34.1-30. Block Diagram of the SRT2 Active Voltage Conditioner

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Technical Data and Specifications

Table 34.1-39. SRT2 Specifications

Description	Specifications
Load Capacity	
Capacity (kVA)	150–1800 kVA (consult factory for custom design; up to 36 kVA available)
Displacement power factor of connected load	0 lagging to 0.9 leading
Crest factor for rated kVA	3 at 100% of rated load
Overload capacity (>90% supply voltage)	150%, 30 seconds, once per 500 s
Input Supply	
Nominal supply voltage (according to model)	480 V Voltages up to 36 kV available as custom applications ①
Power system type	Three-phase, center ground referenced
Supply voltage category	Level III transient voltage capability
Fault capacity	Refer to model tables
Operating Voltage Range for Regulation	
Supply voltage for regulation	90–110% of nominal input voltage unit rating
Output Supply	
Nominal voltage (V)	Set to match nominal supply voltage
Three-phase V regulation range	±10% continuous
Three-phase V regulation accuracy	±1%
Three-phase balanced sag/swell correction ability: 40% model	 +40% / –10% at least 30 s at full load
Sag correction accuracy (within specified range)	±2.5%
Sag correction response: Initial Complete	 <250 µs <0.25 cycle
Single-phase sag correction ability: 40% model (15% retained voltage / 85% sag)	 90% nominal
Equivalent series impedance (operating)	<4% typical
Efficiency of system	0.98 to 0.99 (refer to model tables)
Bypass	
Capacity	100% model rating (kVA)
Maximum overload capacity (in bypass): For 10 minutes For 1 minute For 1 second For 200 milliseconds Transfer time: Inverter to bypass	 125% 150% 500% 2000% <0.5 ms
Equivalent series impedance (in bypass)	Equivalent series impedance (in bypass)
Interface	
Access protocol	Access protocol
Environmental	
Enclosure rating	NEMA® 1, IP20
Pollution degree rating	2
Minimum operating temperature	0 °C
Maximum operating temperature	40 °C
Temperature derating	Above 40 °C derate at 2% per °C to a maximum of 50 °C
Capacity elevation derating	–2% every 100 m above 1000 m
Cooling: Inverter Transformer	 Forced ventilation Fan assisted ventilation
Humidity	<95%, noncondensing
EMC emissions	CISPR 22 level G
Noise	65 dBA
Warranty	1 year

① 480 V is standard. If additional voltage is needed, consult factory.

Table 34.1-40. System capacities

Catalog Number ①②③	Load Capacity at Nominal Voltage 480 V (kVA) ④	Terminal Cabinet	Fault Capacity (kVA)	System Efficiency (%)	System Dissipation (Worst Case) (kW)	Airflow (m^3/min)	Cabinet Dimensions H x W x D in Inches (mm)
SRT20150480AA	150	No	40	97.5	3.8	18	85.00 x 32.00 x 32.00 (2159.0 x 812.8 x 812.8)
SRT20150480AA-TC	150	Yes	40	97.5	3.8	18	85.00 x 32.00 x 32.00 (2159.0 x 812.8 x 812.8)
SRT20225480AA	225	No	40	97.7	5.2	18	85.00 x 32.00 x 32.00 (2159.0 x 812.8 x 812.8)
SRT20225480AA-TC	225	Yes	40	97.7	5.2	18	85.00 x 32.00 x 32.00 (2159.0 x 812.8 x 812.8)
SRT20300480AA	300	No	40	98.0	6.1	18	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20300480AA-TC	300	Yes	40	98.0	6.1	18	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20450480AA	450	No	40	98.2	8.0	36	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20450480AA-TC	450	Yes	40	98.2	8.0	36	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20600480AA	600	No	40	98.4	9.8	36	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20600480AA-TC	600	Yes	40	98.4	9.8	36	85.00 x 40.00 x 32.00 (2159.0 x 1016 x 812.8)
SRT20750480AA	750	No	40	98.4	12.2	54	85.00 x 96.00 x 48.00 (2159.0 x 2438.4 x 1219.2)
SRT20750480AA-TC	750	Yes	40	98.4	12.2	54	85.00 x 96.00 x 48.00 (2159.0 x 2438.4 x 1219.2)
SRT20900480AA	900	No	40	98.5	13.2	54	85.00 x 96.00 x 48.00 (2159.0 x 2438.4 x 1219.2)
SRT21200480AA	1200	No	40	98.5	18.1	72	85.00 x 126.00 x 96.00 (2159.0 x 3200.4 x 2438.4)
SRT21500480AA	1500	No	50	98.7	20.2	90	85.00 x 126.00 x 96.00 (2159.0 x 3200.4 x 2438.4)
SRT21800480AA	1800	No	50	98.8	22.1	108	85.00 x 126.00 x 96.00 (2159.0 x 3200.4 x 2438.4)

① For 50 Hz international applications, consult factory.
② Eaton external three-breaker maintenance bypass is recommended. If a bypass is not used, a terminal cabinet may be required. Contact factory.
③ TC in the model number denotes terminal cabinet, which is not required for units of 900 kVA and larger.
④ 480 V is standard. If additional voltage is needed, consult factory.

Wiring Diagram

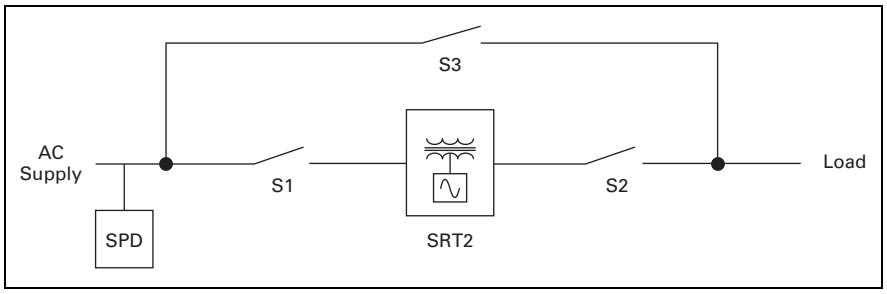

Figure 34.1-31. SRT2 With External Maintenance Bypass Block Diagram

Note: A terminal cabinet may be needed if a bypass cabinet is not used. SRT2 units 900 kVA and larger do not require a terminal cabinet; however, an external three-breaker mechanical bypass with integrated surge protection is recommended.

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Electronic Voltage Regulator (EVR)

Electronic Voltage Regulator (EVR) Tap Changer

General Description

Eaton's Electronic Voltage Regulator (EVR) is the ideal solution for keeping your facility and equipment up and running during brownouts, under-voltage conditions and other power problems. The EVR can significantly reduce the costs of equipment damage and downtime when these situations occur. The state-of-the-art design provides rapid response time, high efficiency, high inrush current capability, and operating advantages exclusive to Eaton.

The EVR maintains a tightly regulated output voltage by automatically activating the appropriate transformer tap through a silicone controlled rectifier (SCR). Tap changer response time is initiated at one cycle, ensuring rapid and precise regulation. Switching at zero current enables noise reduction during tap transitions.

Brownouts

In the United States, most facilities have sufficient voltage regulation. However, in some U.S. locations and many developing countries, regulation problems occur because of overstressed utility distribution systems.

In some cases, due to the excessive demand on the utility system, voltage may be below 10% of nominal (–10%) during the day. This condition is called a **voltage regulation or brownout.** Customers may notice dim lights and reduced power. During the evening, voltage may rise above 10% of nominal (+10%) because large facilities and loads are shut down. This shutdown reduces the power demand on the grid and results in a voltage increase.

The IEEE defines voltage regulation as overvoltage or undervoltage. Voltage regulation events last from a **few minutes to many hours** with voltage varying by ±20%. Long-term regulation problems differ from short duration sags and dips, which are much deeper voltage drops.

The Solution

Prior to installing an expensive solution, Eaton encourages customers to monitor incoming voltage to determine if voltage regulation is a problem. The local utility may also be able to provide information on voltage expected at the facility.

Using a meter, it can quickly be determined if a voltage regulation problem or brownout condition exists. The appropriate solution would be an EVR. EVRs can be installed at the service entrance, branch panel or at critical loads.

Eaton's EVR is a solid-state tap changing power conditioner designed to protect against brownouts and long duration voltage regulation problems.

Features and Benefits

- Coordinated with standard thermal-magnetic breakers to allow motor starts
- Optional 50 kA and 100 kA per phase surge protection
- Input frequency range operation from 57–63 Hz
- Not affected by load power factor. Can operate effectively in low-load applications due to "unique leakage reactance" technology
- Fail-safe bypass circuit, isolation transformer and overtemperature protection
- Less than 1% THD
- Optional Standard and Premium metering to monitor voltage, current, frequency, power, energy, PF with minimum and maximum, and communication capabilities
- Integral manual rotary maintenance bypass switch standard on 50 to 500 kVA units and optional on smaller units

Catalog Number Selection

Table 34.1-41. EVR Catalog Numbering System

EVR 025 208D 400Y B S M1 _

kVA Ratings and Dimensions					
kVA	**Weight Lbs (kg)**	**BTUs/ hr**	**Bypass**	**Metering**	**Cabinet Size Dimensions H x W x D in Inches (mm)**
010	440 (200)	1,025	Optional	No	30.20 x 22.20 x 29.00 (767.1 x 563.9 x 736.6)
010	520 (236)	1,205	Optional	Yes	44.20 x 22.20 x 29.00 (1122.7 x 563.9 x 736.6)
015	465 (211)	1,540	Optional	No	30.20 x 22.20 x 29.00 (767.1 x 563.9 x 736.6)
015	700 (318)	1,540	Optional	Yes	44.20 x 22.20 x 29.00 (1122.7 x 563.9 x 736.6)
025	700 (318)	2,560	Optional	Yes	44.20 x 22.20 x 29.00 (1122.7 x 563.9 x 736.6)
030	720 (327)	3,090	Optional	Yes	44.20 x 22.20 x 29.00 (1122.7 x 563.9 x 736.6)
045	950 (431)	4,600	Optional	Yes	44.30 x 45.90 x 29.00 (1125.2 x 1165.9 x 736.6)
050	1,176 (534)	7,332	Yes	Yes	66.00 x 29.00 x 35.50 (1676.4 x 736.6 x 901.7)
075	1,575 (715)	9,514	Yes	Yes	76.00 x 34.40 x 35.50 (1930.4 x 873.8 x 901.7)
100	2,014 (914)	11,833	Yes	Yes	76.00 x 34.40 x 35.50 (1930.4 x 873.8 x 901.7)
125	2,137 (970)	14,748	Yes	Yes	76.00 x 34.40 x 35.50 (1930.4 x 873.8 x 901.7)
150	2,240 (1017)	17,698	Yes	Yes	76.00 x 34.40 x 35.50 (1930.4 x 873.8 x 901.7)
225	3,300 (1498)	23,000	Yes	Yes	77.40 x 56.00 x 41.50 (1966.0 x 1422.4 x 1054.1)
300	4,000 (1816)	30,750	Yes	Yes	77.40 x 56.00 x 41.50 (1966.0 x 1422.4 x 1054.1)
500	5,500 (2497)	51,250	Yes	Yes	77.00 x 72.40 x 48.40 (1955.8 x 1839.0 x 1229.4)

Nominal Input Voltage (Delta Input: L, L, L, G)
- **208D** = 208
- **240D** = 240
- **400D** = 400
- **480D** = 480
- **600D** = 600

Nominal Output Voltage (Wye Output: L, L, L, N, G)
- **208Y** = 120/208
- **400Y** = 230/400
- **480Y** = 277/480
- **600Y** = 347/600

Frequency
- **A** = 60 Hz
- **B** = 50 Hz

Surge Protection
- **X** = No
- **S** = Yes

Options
- **B** = Bypass switch ①
- **M1** = Standard metering (IQ 130)
- **M2** = Premium metering (IQ 150)

① Bypass is standard on 50 kVA and larger units and an option on 45 kVA and smaller units. The "B" is not included in the part number for units 50 kVA and larger.

Technical Data and Specifications

Table 34.1-42. EVR Specification (10 to 500 kVA)

Feature	Description
Technology	Electronic tap changer
Input voltages	208–600 V, three-phase (three-wire)
Input voltage range	+10% to –23% of nominal rated input
Output voltage	±3% of nominal
Response time	1/2 cycle
Frequency	60 Hz, ±3%
Efficiency	97% typical
Line regulation	Output is ±3% of nominal for input variations of +10% to –23% of nominal
Load regulation	Output is maintained within 3% of nominal from no load to full load
Correction time	Output will be corrected to within ±3% of nominal in 1.5 cycles or less
Harmonic distortion	Less than 1.0% added to the output waveform under any dynamic linear loading conditions presented to the line regulator
Noise attenuation	Common-mode—146 dB
	Normal-mode—3 dB down at 1000 Hz, 40 dB/decade to below 50 dB with resistive load
Turn-on characteristics	When energized, voltage overshoot will be less than 5% of nominal for 1 cycle or less
Overload rating	1000% for 1 cycle and 200% for 10 seconds
Ambient rating	14 °F to +104 °F (–10 °C to +40 °C)
Monitoring	Three green LEDs (phase power on indication), one red LED (alert indication)
Surge protection (optional)	CVX 50 kA SPD device 50 kVA and below, CVX 100 kA SPD device 75 kVA and above
Input breaker	MCCB rated 125% of full rated current
Bypass switch	Normal and bypass selector
Metering (optional)	Standard metering (IQ 130)—voltage and current with minimum and maximum
	Premium metering (IQ 150)—voltage, current, frequency, power, energy, PF, with minimum and maximum, communications capabilities
Warranty	1-year parts

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