





**For UL Type 1, 2, 3 and  
Type 4 component assembly,  
and data signal surge protective devices**

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## The need for surge protection



Today's world is full of electronic products and electrical devices that are susceptible to damage from overvoltage surges.

Surges caused by static discharge, capacitive and inductive loads or lightning can quickly destroy sophisticated electronic equipment and components used in industrial and commercial applications. These surges cripple operations – particularly the data and communication systems that virtually every enterprise relies upon today, including UL® 508A panels with their reliance on control circuits.

Also, the NEC requires a listed SPD to be installed on various equipment types including elevators on emergency systems [NEC 620.51(E)], critical operations data systems (NEC 645.18), industrial machinery with safety interlock circuits (NEC 670.6), wind electric systems [NEC 694.7(D)], fire pump controllers (NEC 695.15), emergency panelboards and switchboards (NEC 700.8) and critical operations power systems (NEC 708.20).

We offer a wide selection of Bussmann™ series surge protection products that help assure power quality by eliminating damaging surges.

### Case studies and references for industrial and commercial applications

- G.W. Allen and D. Segall with IBM – Two year study at over 200 locations in 25 cities – 88.5% of AC power problems are transient voltage related.
- 2011 Erimar Systems Integration — A lightning strike entered the metals fabricating facility and destroyed \$20,000 worth of control panels, electrical infrastructure and Cisco infrastructure. Loss of data system also cost 11 days of production.
- IEEE Emerald Book and NFPA 780 both recommend using surge protection as a part of a building's lightning protection system. Suppressors at the service entrance only reduce, but not completely eliminate, the high-energy transient. A second surge protective device must be applied upstream of critical equipment. All SPDs should comply with UL 1449 4<sup>th</sup> Edition or later.
- 1999-2001 Electric Power Research Institute (EPRI) Study – Concluded downtime from power sags, surges and transients cost US industry:
  - \$50 Billion+ in 1999
  - \$100 Billion+ in 2000
  - \$200 Billion+ in 2001
- Continues to escalate as more electronic equipment is used

- *Plant Services Magazine* – 35% of lost production hours can be attributed to transient voltage problems.
- Florida Light and Power 1999 Study — Sources of Facility Surge and Overvoltage Events:
  - ~60% Internally Generated
  - ~40% Externally Generated

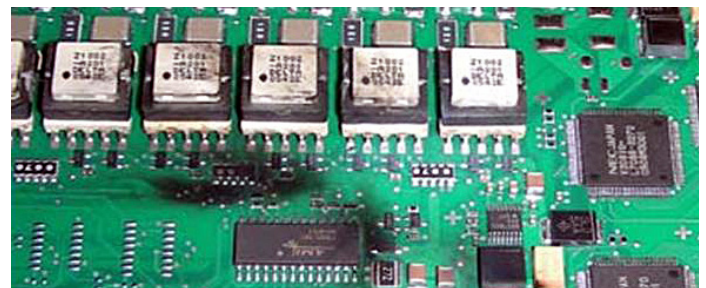
### Causes and relevance of transients and surges

- **Lightning strikes** — Large scale impact, high current and voltage, but least common occurrence.
- **Power switching** — Increasing occurrences:
  - Utility and customer load switching – Motors, large loads, faults, capacitor banks, fuse and circuit breaker operation\*, etc.
  - Source switching — Smart grid, gensets, photovoltaic power systems and wind power generation, etc.

\* During overcurrent events, both circuit breakers and fuses can produce arc voltages 2-3 times the system voltage in accordance with the UL standards.

### Damage caused by transients and surges

- **Disruptive** – A voltage transient enters an electronic component and it interprets the transient as a valid logic command, resulting in system lock-up, malfunction, faulty output or corrupted files.
- **Dissipative** – Associated with short duration repetitive low energy level surges, resulting in equipment failure over time including electronic components, ballasts, motors and controllers, service entrance equipment, panelboards and switchgear.
- **Destructive** – Associated with high level energy surges, resulting in immediate equipment failure including electronic components, ballasts, motors and controllers, service entrance equipment, panelboards and switchgear.



Internal damage — PCB destroyed by a surge



Service entrance destroyed by a surge



## UL SPD types and NEC locations

Both UL and the NEC define surge protective device *Types*, but they are NOT the same. They differ significantly by the following.

### UL SPD standards

**SURGE PROTECTIVE DEVICES** — UL 1449, 4<sup>th</sup> Edition, Section 1 effective August 20, 2014, states the following on UL Types covering enclosed and open-type Surge Protective Devices (SPDs) designed for repeated limiting of transient voltage surges as specified in the standard on 50 or 60 Hz power circuits not exceeding 1000 V and for PV applications up to 1500 Vdc and designated as follows:

**Type 1** — One port, permanently connected SPDs, except for watt-hour meter socket enclosures, intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and Molded Case SPDs intended to be installed without an external overcurrent protective device. Type 1 SPDs for use in PV systems can be connected between the PV array and the main service disconnect.

**Type 2** — Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel and Molded Case SPDs.

**Type 3** — Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. See marking in 80.3. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.

**Type 4 Component Assemblies** — Component assembly consisting of one or more Type 5 components together with a disconnect (integral or external) or a means of complying with the limited current tests in 44.4.

**Type 1, 2, 3 Component Assemblies** — Consists of a Type 4 component assembly with internal or external short circuit protection.

**Type 5** — Discrete component surge suppressors, such as MOVs that may be mounted on a PWB, connected by its leads or provided within an enclosure with mounting means and wiring terminations.

## UL Type 1, 2, 3 and Type 4 component assembly, and data signal surge protective devices

### NEC SPD installation/connection

NEC Article 285, Surge-Protective Devices (SPDs), 1 kV or Less states the following on where in an electrical system SPDs can be installed and or connected.

#### II. Installing SPDs

285.13 Type 4 and Other Component Type SPDs. Type 4 component assemblies and other component type SPDs shall only be installed by the equipment manufacturer.

#### III. Connecting SPDs

285.21 Connection. Where an SPD device is installed, it shall comply with 285.23 through 285.28.

285.23 Type 1 SPDs. Type 1 SPDs shall be installed in accordance with 285.23(A) and (B).

(A) Installation. Type 1 SPDs shall be installed as follows:

(1) Type 1 SPDs shall be permitted to be connected to the supply side of the service disconnect as permitted in 230.82(4) or

(2) Type 1 SPDs shall be permitted to be connected as specified in 285.24.

(B) At the Service. When installed at services, Type 1 SPDs shall be connected to one of the following:

(1) Grounded service conductor

(2) Grounding electrode conductor

(3) Grounding electrode for the service

(4) Equipment grounding terminal in the service equipment

285.24 Type 2 SPDs. Type 2 SPDs shall be installed in accordance with 285.24(A) through (C).

(A) Service-Supplied Building or Structure. Type 2 SPDs shall be connected anywhere on the loadside of a service disconnect overcurrent device required in 230.91, unless installed in accordance with 230.82(8).

(B) Feeder-Supplied Building or Structure. Type 2 SPDs shall be connected at the building or structure anywhere on the loadside of the first overcurrent device at the building or structure.

(C) Separately Derived System. The SPD shall be connected on the loadside of the first overcurrent device in a separately derived system.

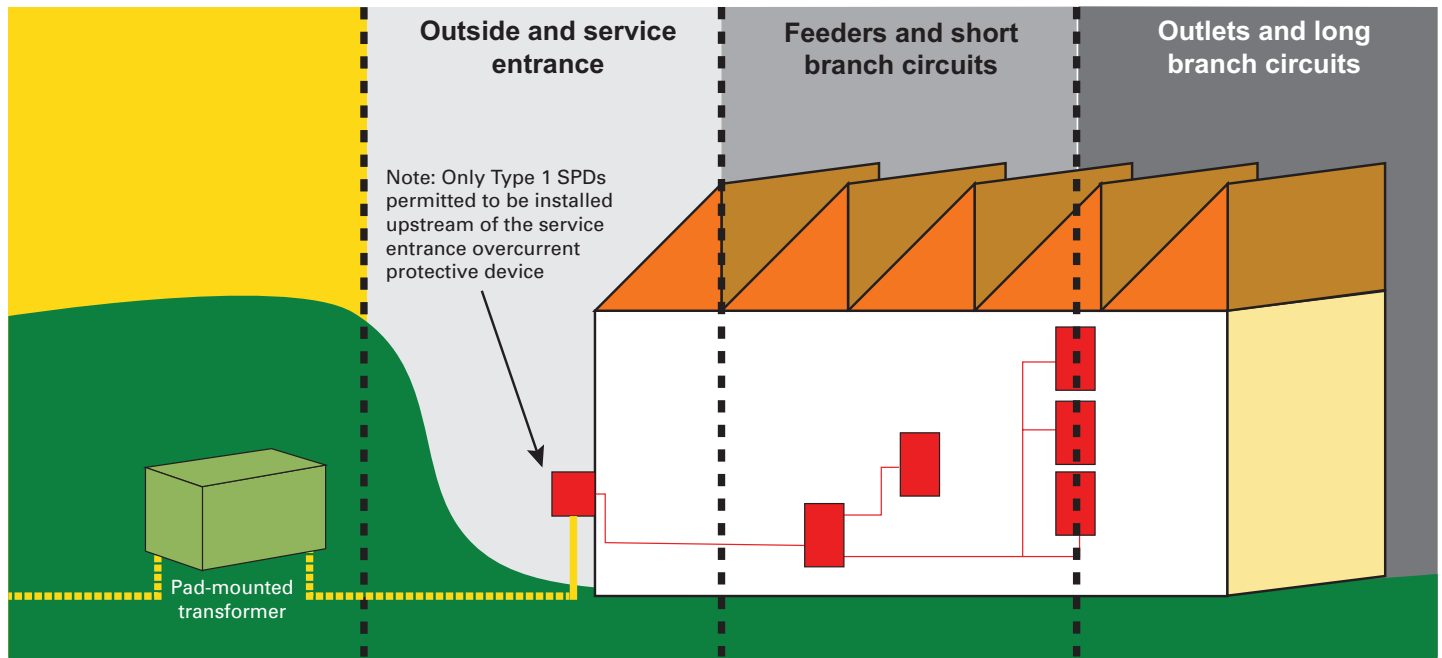
285.25 Type 3 SPDs. Type 3 SPDs shall be permitted to be installed on the loadside of branch-circuit overcurrent protection up to the equipment served. If included in the manufacturer's instructions, the Type 3 SPD connection shall be a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

285.26 Conductor Size. Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

285.27 Connection Between Conductors. An SPD shall be permitted to be connected between any two conductors — ungrounded conductor(s), grounded conductor, equipment grounding conductor, or grounding electrode conductor. The grounded conductor and the equipment grounding conductor shall be interconnected only by the normal operation of the SPD during a surge.

285.28 Grounding Electrode Conductor Connections and Enclosures. Except as indicated in this article, SPD grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Applying UL SPD Types by NEC location



### NEC 285 Type 1

Type 1 SPDs shall be installed as:

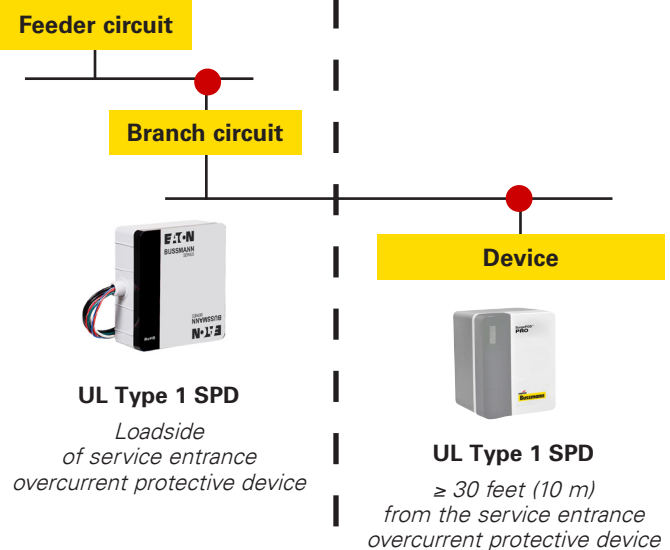
- (1) Type 1 SPDs shall be permitted to be connected to the supply side of the service disconnect as permitted in 230.82(4) or... as well as the loadside, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device.
- (2) Type 1 SPDs shall be permitted to be connected as specified in 285.24.



### NEC 285 Type 2 \*

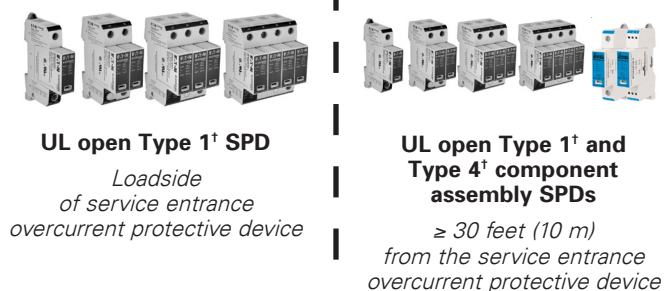
Type 2 SPDs shall be installed in accordance with 285.24(A) through (C).

- (A) Service-Supplied Building or Structure. Type 2 SPDs shall be connected anywhere on the loadside of a service disconnect overcurrent device required in 230.91, unless installed in accordance with 230.82(8).
- (B) Feeder-Supplied Building or Structure. Type 2 SPDs shall be connected at the building or structure anywhere on the loadside of the first overcurrent device at the building or structure.
- (C) Separately Derived System. The SPD shall be connected on the loadside of the first overcurrent device in a separately derived system.



### NEC 285 Type 3\*

Type 3 SPDs shall be permitted to be installed on the loadside of branch-circuit overcurrent protection up to the equipment served. If included in the manufacturer's instructions, the Type 3 SPD connection shall be a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.








\* Includes Type 2 or Type 4 component assemblies.

† Must be installed in an enclosure.

## Busmann series UL power, control and data signal SPD product lineup

This guide suggests which series best meets your needs and applications.

Market	Commercial/industrial		Light commercial	OEMs/UL 508A panel shops	
Equipment type	Main switchgear, switchboard, motor control center, outdoor load		Distribution panelboard, subpanel, loadcenter	Control panel, point of use	
NEC SPD requirements*	620.51(E), 645.18, 694.7(D), 700.8		620.51(E), 645.18, 695.15, 700.8, 708.20	670.6, 695.15, 708.20	
IEEE exposure category	C		B	A	
Typical panel amps	Unlimited	Up to 4000	Up to 1000	Up to 200	Single-phase, point of use
Peak kA rating per phase	120-400	50—200	40	50	40 / N/A
SCCR (kA)	200	200	200	200	N/A
Nominal voltage	120—600 Vac	120—600 Vac	120—600 Vac	120—600 Vac	24-120 Vac 24-200 Vdc
UL 1449/CSA type	1 and 2	1 and 2	1	1	4 component assemblies
UL 1283 EMI/RFI filtering**	50 dB	40 dB	N/A	N/A	N/A
NEMA Enclosure	1 and 4X	4X	4X	N/A	N/A
Agency information	cULus/CSA/RoHS	cULus/CSA/RoHS	cULus/CSA/RoHS	UL Listed open Type 1/ CSA/RoHS	UL/cUL/CSA/KEMA/ RoHS
Warranty (years)	10	5	2	5	5
Features/mounting	Side-mount	Side-mount	Rear nipple	DIN-Rail	DIN-Rail
Status indication	Yes-LED	Yes-LED	Yes-LED	Yes-Local	Yes-Local
<b>Options</b>					
Audible alarm	Yes	Yes	No	No	No
Form C contacts	Yes	Yes	No	Yes - standard	Yes - standard
Surge counter	Yes	No	No	No	No
EMI/RFI filtering	Yes	Yes	No	No	No
Product family					
	BSPD	BSPA	SurgePOD PRO	BSPMA	BSPM1A/BSPH2A
Data sheet	10209	10661	10033	10771 (1-pole), 10772 (2-pole), 10773 (3-pole), 107744 (4-pole)	2056 (1-pole), 2057 (2-pole)

\* Product family and rating is dependent upon the application and exposure to surge activity.

\*\*Selecting filtering option changes normally Type 1 SPDs to Type 2.

† With online registration.

††Available on some models.

## Busmann series UL 497B data signal surge protective devices

These surge protectors complement any power protection SPDs by protecting data signal lines. See pages 36 to 38 for details.



### DIN-Rail universal 4 wire

- For nominal 5 and 24 V systems

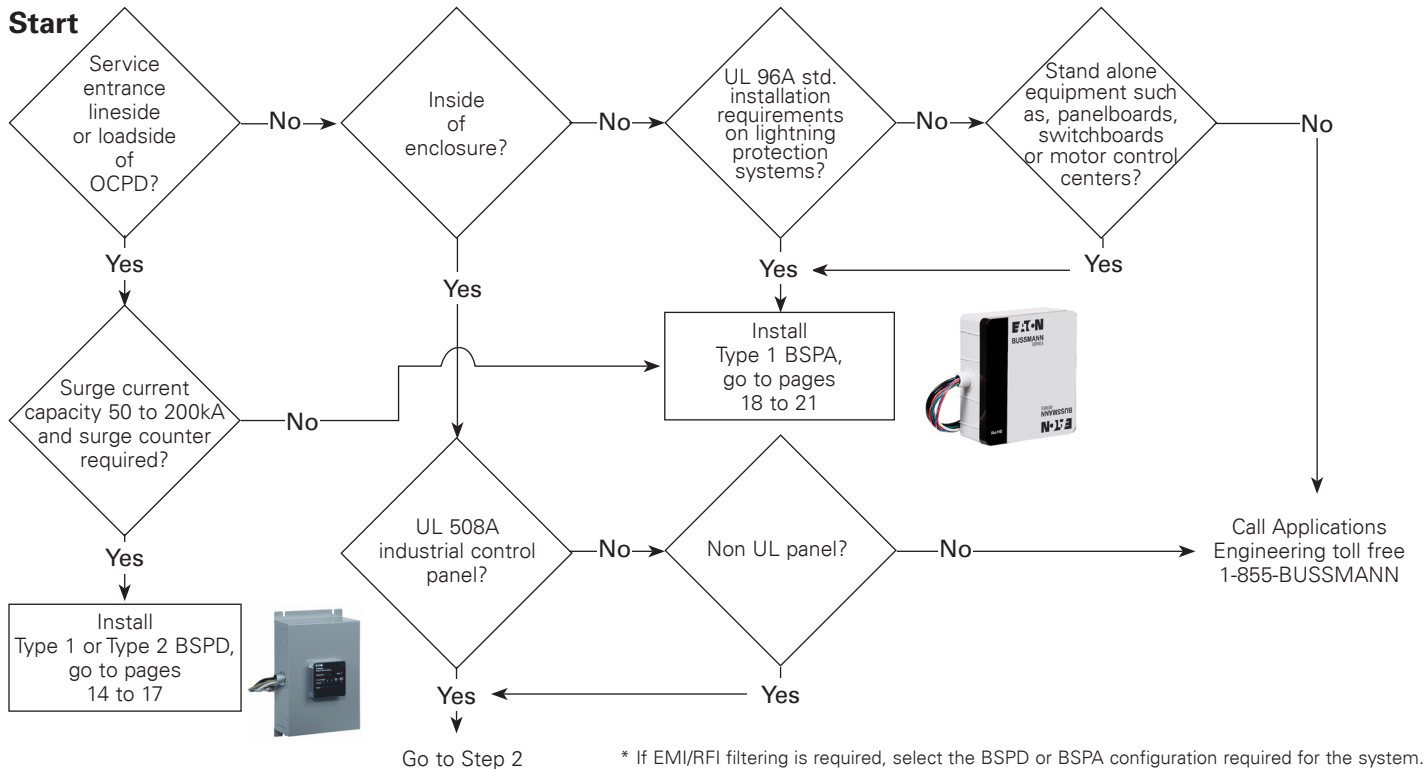


### DIN-Rail RJ45/Ethernet cable

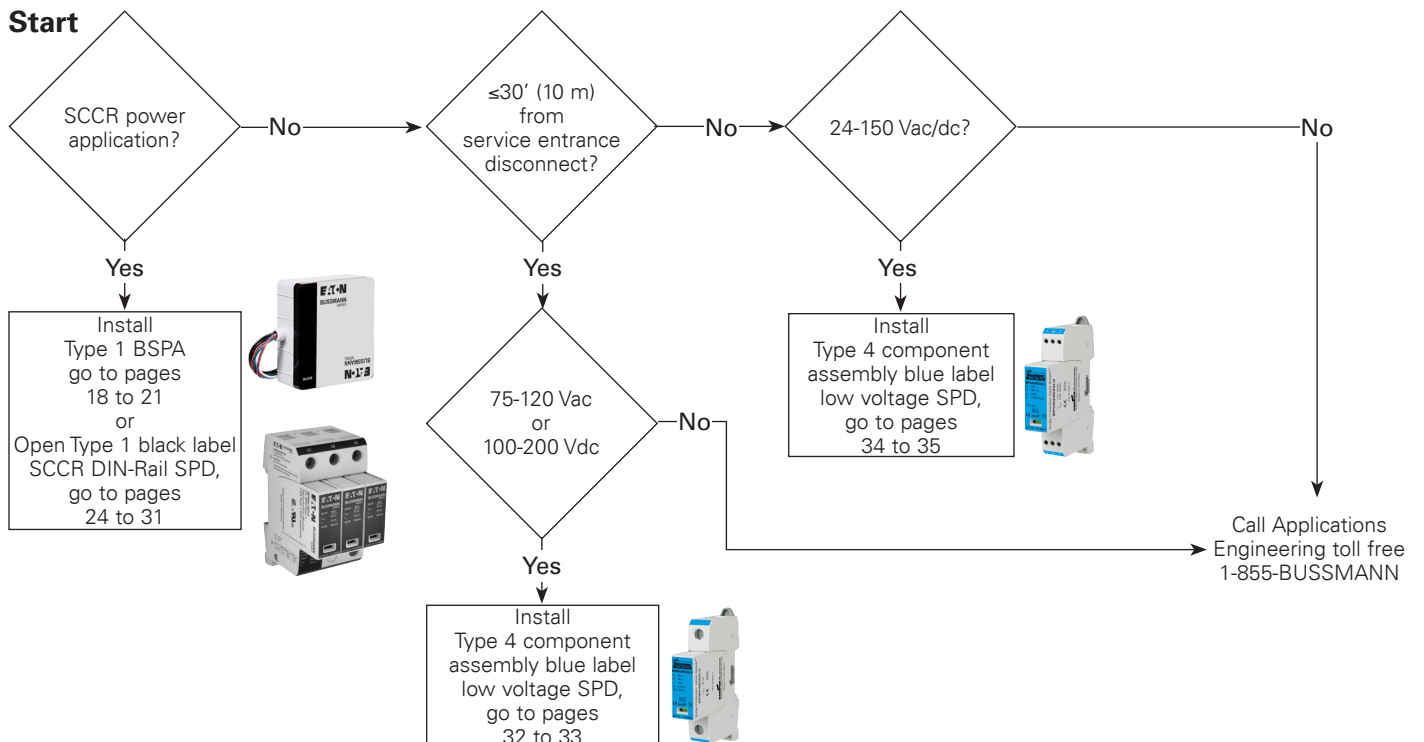
- For nominal voltages up to 48 V

## UL SPD selection flowchart for $\leq 600$ V systems

### Step 1. Determine location and suitable type\*



### Step 2. Determine Type 1, and DIN-Rail open Type 1 and Type 4 (Type 2 and 3 applications) SPDs



## UL SPD types, markets and applications

Markets	UL Types		
	UL Listed Type 1 and Type 2	DIN-Rail UL Listed open Type 1 and Recognized Type 4 component assembly	
	UL Listed Type 1 and Type 2 SPDs SCCR rated 120-600 Vac MOV and thermal disconnect technology	UL Listed open Type 1 SPDs SCCR rated black label 120-600 Vac MOV technology	Type 4 component assembly power and control blue label SPDs 24-120 Vac, 24-200 Vdc MOV or hybrid technology
Agriculture	<ul style="list-style-type: none"> <li>Pump panels requiring SCCR ratings</li> <li>Service panels</li> </ul>	<ul style="list-style-type: none"> <li>Pump panels requiring SCCR ratings</li> </ul>	<ul style="list-style-type: none"> <li>AC/DC Pump panels not requiring SCCR ratings</li> </ul>
Commercial/ institutional	<ul style="list-style-type: none"> <li>Elevator control</li> <li>Emergency generator control</li> <li>Feeders</li> <li>Fire pump control</li> <li>HVAC</li> <li>Lighting panels</li> <li>Main switchgear</li> <li>Motor control centers</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>UPS</li> </ul>	<ul style="list-style-type: none"> <li>Elevator control</li> <li>Emergency generator control</li> <li>Fire pump control</li> <li>HVAC</li> <li>Mission critical panelboards</li> <li>UPS</li> <li>UL 508A panels requiring SCCR ratings</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>Elevator control</li> <li>Emergency generator control</li> <li>Fire alarm</li> <li>Fire pump control</li> <li>HVAC</li> <li>Security systems</li> <li>UPS</li> </ul>
Contractor	<ul style="list-style-type: none"> <li>Installation on outside of enclosure or ahead of service entrance disconnect</li> </ul>	—	—
Data centers	<ul style="list-style-type: none"> <li>Emergency generator control</li> <li>Feeders</li> <li>HVAC</li> <li>Main switchgear</li> <li>Power distribution unit</li> <li>Remote power panel</li> <li>UPS</li> </ul>	<ul style="list-style-type: none"> <li>Emergency generator control</li> <li>HVAC</li> <li>Power distribution unit</li> <li>Remote power panel</li> <li>UPS</li> </ul>	<ul style="list-style-type: none"> <li>Emergency generator control</li> <li>HVAC</li> <li>Servers</li> <li>UPS</li> </ul>
Industrial	<ul style="list-style-type: none"> <li>Emergency generator control</li> <li>HVAC</li> <li>Lighting panels</li> <li>Main switchgear</li> <li>Motor control centers</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>UPS</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>Conveyor systems</li> <li>Crane control</li> <li>HVAC</li> <li>Power supplies</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>Discrete control</li> <li>HMI</li> <li>HVAC</li> <li>PLCs</li> <li>Power supplies</li> <li>Sensors</li> </ul>
OEM	<ul style="list-style-type: none"> <li>Installation on outside of enclosure</li> <li>UL 508A panels requiring SCCR ratings</li> </ul>	<ul style="list-style-type: none"> <li>I/Os</li> <li>PLCs</li> <li>Power supplies</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>HMI</li> <li>I/Os</li> <li>PLCs</li> <li>Power supplies</li> <li>Sensors</li> <li>Step down transformer primary</li> </ul>
Oil and gas	<ul style="list-style-type: none"> <li>Emergency generator control</li> <li>Lighting panels</li> <li>Main switchgear</li> <li>Motor control centers</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>UPS</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>Conveyor systems</li> <li>Crane control</li> <li>Power supplies</li> <li>Step down transformer primary</li> <li>UL 508A panels requiring SCCR ratings</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>Discrete control</li> <li>HMI</li> <li>PLCs</li> <li>Power supplies</li> <li>Sensors</li> </ul>
Residential	<ul style="list-style-type: none"> <li>Service entrance</li> </ul>	N/A	N/A
UL 508A shops	<ul style="list-style-type: none"> <li>Installation on outside or inside of enclosure or ahead of service entrance disconnect</li> </ul>	<ul style="list-style-type: none"> <li>I/Os</li> <li>Installation on the lineside of the enclosure disconnect OCPD</li> <li>PLC</li> <li>Power supplies</li> <li>Step down transformer primary</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>HMI</li> <li>I/Os</li> <li>PLCs</li> <li>Power supplies</li> <li>Sensors</li> <li>Step down transformer primary</li> </ul>
Waste water/ water treatment	<ul style="list-style-type: none"> <li>Main switchgear</li> <li>Motor control centers</li> <li>UL 508A panels requiring SCCR ratings</li> </ul>	<ul style="list-style-type: none"> <li>Control panels</li> <li>UL 508A panels requiring SCCR ratings</li> <li>VFD</li> </ul>	<ul style="list-style-type: none"> <li>PLC</li> <li>Power supplies</li> <li>Sensors</li> </ul>

## Applying UL Type 1, Type 2 and Type 4 SPDs by surge current capacity (I<sub>max</sub>)

Bussmann series product	Installation location	Surge current capacity (I <sub>max</sub> )
BSPD Type 1 and Type 2	Switchboards, service entrance	200 kA to 400 kA
BSPD Type 2	Large panelboards	120 kA to 200 kA
BSPA Type 1 and Type 2	Panelboards, control panels	50 kA to 200 kA
SurgePOD™ PRO Type 1	Panelboards, control panels	40 kA
1-, 2-, 3- and 4-pole high SCCR open Type 1 (black label)	Control panels	50 kA
1-pole non SCCR Type 4 for Type 2 application (blue label)	Control panels (power)	40 kA
2-pole non SCCR Type 4 for Type 3 application (blue label)	Control panels (control)	2-4 kA*

\* Total discharge current.



## NEC surge protection requirements

In recent years, with the proliferation of electronics and devices sensitive to transient voltage and current surges, the need for surge protection has become increasingly important, particularly for equipment and systems used for life safety or where reliability is highly critical.

The NEC recognizes this need and has adopted the following provisions where surge protection is required.

Regardless of whether surge protection is required or not, it's prudent to have surge protection on all circuits as many portable appliances and communications devices with sensitive electronics may be powered from circuits where transient overvoltage surge is an issue.

Below are the major NEC Sections requiring surge protection. On page two is a selection chart for Bussmann series surge protective devices (SPD) based upon application.

### 620.51(E) "Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, surge protection shall be provided."

**Added in 2017**, this section was added to address emergency system loads such as elevators, escalators, moving sidewalks, chairlifts and associated equipment.



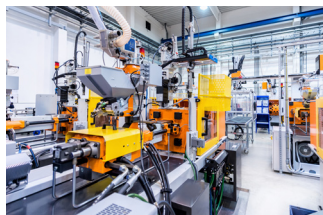
### 645.18 "Surge protection shall be provided for Critical Operations Data Systems."



**Added in 2017**, Critical Operation Data Systems is defined by the NEC as "Information technology equipment systems that require continuous operation for public safety, emergency management, national security or business continuity."

### 670.6 "Industrial machinery with safety interlock circuits shall have surge protection installed."

**Added in 2017**, this section was added to address the concern with safety interlock failure on machinery causing a safety risk to operators who may not be aware of disabled safety mechanisms.



### 694.7(D) "A surge protection device shall be installed between a wind electric system and any loads served by the premises electrical system."

**Added in 2011**, surge protective devices should be on the circuit serving the wind electric system or on the service disconnect's loadside.



### 695.15 "A listed surge protection device shall be installed in or on the fire pump controller."



**Added in 2017**, this NEC provision requires a listed SPD to be installed in or on the fire pump controller to provide protection. A study commissioned by the Fire Protection Research Foundation found that 12% of those surveyed had surges damaging their fire pumps.

### 700.8 "A listed SPD shall be installed in or on all emergency systems switchboards and panelboards."

**Added in 2014**, this requirement helps ensure emergency electrical systems continue powering vital, life-safety loads in the event of damaging surges.



### 708.20 "Surge protection devices shall be provided at all facility voltage distribution levels."



**Added in 2008**, Critical Operation Power Systems (COPS) are power systems that can include HVAC, fire alarms, security, communications and signaling for designated critical operations areas. Surge protection helps ensure these systems will operate as intended in an emergency situation.

## Electrical system connections for SPDs

The following diagrams show the SPD connection points for the various electrical systems likely to be encountered, along with the Bussmann series SPD models that may be applied.

Understanding the following points will help ensure that the correct surge protective device is specified for the electrical system or equipment.

- Typical North American electrical systems include single-phase, split-phase, Delta and Wye.
- Selecting the wrong SPD generally arises from misunderstanding the nominal system voltage, ground and neutral connections.
- General convention has it that a “ground” wire is not counted as a wire in the system description (e.g., 3 wire, 4 wire, etc.), but it is counted as a connection point if the selected SPD has a ground wire.
- Selection of a device voltage rating for Wye systems must be based upon its nominal system voltage rating and not on the leg-to-leg voltages in the Wye.
- Bonded N-G configurations do not require protection at the service entrance transformer, but protection is suggested in downstream bonded N-G systems if the length of conductor making the bond is greater than 10 feet (3 m)\*.

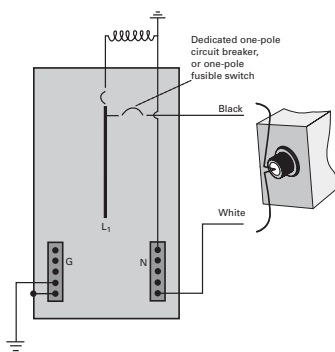
\* See FAQ #25 for more information.

### Two wire single-phase, 2 connection points

Application: Sub-panel or feeder panel

Volts: 120, 240 (L-N)

Note: Must be installed within 10 feet (3 m) of a bonded neutral ground connection per IEEE C62.41-1991.



#### SPD catalog numbers:

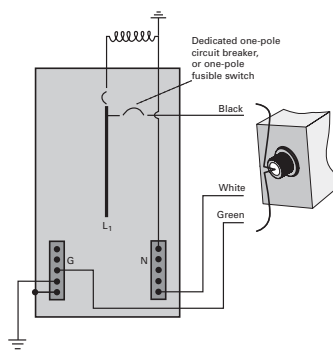
- BSPA
  - Specify from build-a-code catalog number system
- SurgePOD™ PRO
  - SPP40SP1120SN

### Three wire split-phase/ 2-pole, 3 connection points

Application: Service entrance panel

Volts: 120, 240 (L-N)

Note: Installation for where the SPD is greater than 10 feet (3 m) from a bonded neutral-ground connection.



#### SPD catalog numbers:

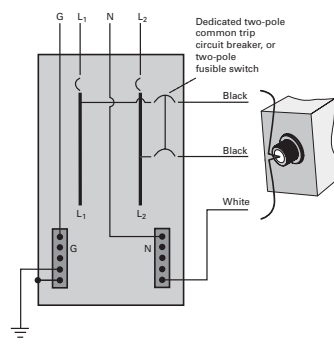
- BSPA
  - Specify from build-a-code catalog number system

### Three wire split-phase/ 2-pole, 3 connection points

Application: Sub-panel or feeder panel

Volts: 120, 240 (L-N), 240, 480 (L1-L2)

Note: Installation at or less than 10 feet (3 m) from the transformer and within 10 feet (3 m) of a bonded-neutral ground connection.



#### SPD catalog numbers:

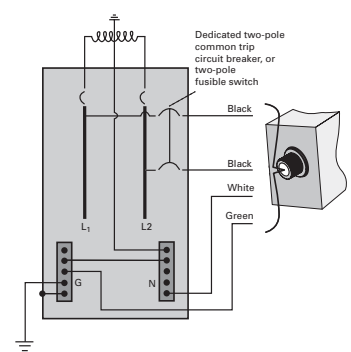
- BSPA
  - Specify from build-a-code catalog number system
- SurgePOD PRO
  - SPP40SP2240PN

### Three wire split-phase/ 2-pole plus ground, 4 connection points

Application: Service entrance equipment

Volts: 120, 240 (L-N), 240 (L1-L2)

Note: Installation where greater than 10 feet (3 m) of a bonded-neutral ground connection.



#### SPD catalog numbers:

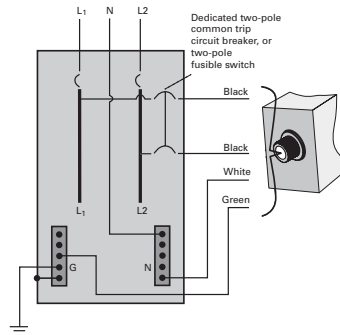
- BSPA
  - Specify from build-a-code catalog number system

### Three wire split-phase/ 2-pole plus ground, 4 connection points

Application: Sub-panel or feeder panel

Volts: 120, 240 (L-N), 240 (L1-L2)

Note: For installation greater than 10 feet (3 m) of a bonded-neutral ground connection.



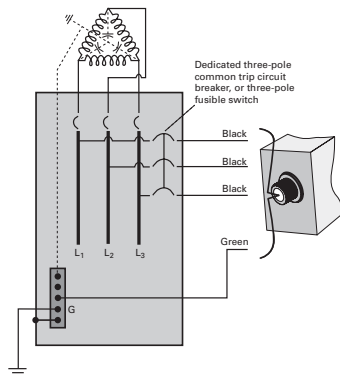
#### SPD catalog numbers:

- BSPA
  - Specify from build-a-code catalog number system

### Three wire Delta plus ground, 4 connection points

Application: Service entrance equipment, sub-panel or feeder panel

Volts: 240, 480, 600 (L-L)



#### SPD catalog numbers:

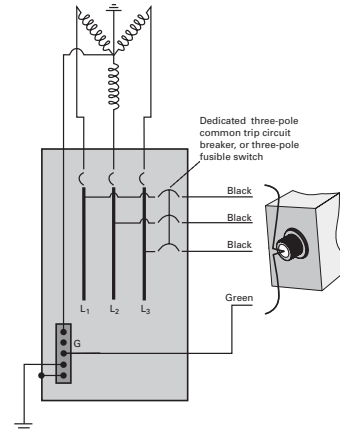
- BSPA
  - Specify from build-a-code catalog number system
- BSPD
  - Specify from build-a-code catalog number system

### Three wire Wye plus ground, 4 connection points

Application: Sub-panel or feeder panel

Volts: 208, 480, 600 (L-L)

Note: A common MCC configuration for pumping and water/waste water treatment.



#### SPD catalog numbers:

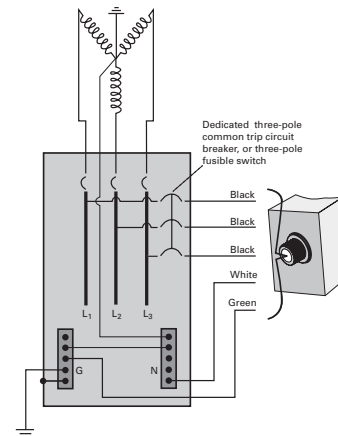
- BSPA
  - Specify from build-a-code catalog number system
- SurgePOD PRO
  - SPP40SP3208WYG
  - SPP40SP3480WYG
  - SPP40SP3600WYG

### Four wire Wye plus ground, 5 connection points

Application: Service entrance equipment

Volts: 120, 127, 277, 347 (L-N), 208, 220, 480, 600 (L-L)

Note: Common system configuration with Neutral pulled into facility and bonded to ground.



#### SPD catalog numbers:

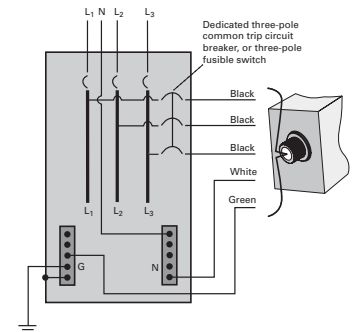
- BSPA
  - Specify from build-a-code catalog number system
- BSPD
  - Specify from build-a-code catalog number system

### Four wire Wye plus ground, 5 connection points

Application: Sub-panel or feeder panel

Volts: 120, 127, 277, 347 (L-N), 208, 220, 480, 600 (L-L)

Note: Common system configuration with Neutral pulled into facility and bonded to ground.



#### SPD catalog numbers:

- BSPA
  - Specify from build-a-code catalog number system
- BSPD
  - Specify from build-a-code catalog number system

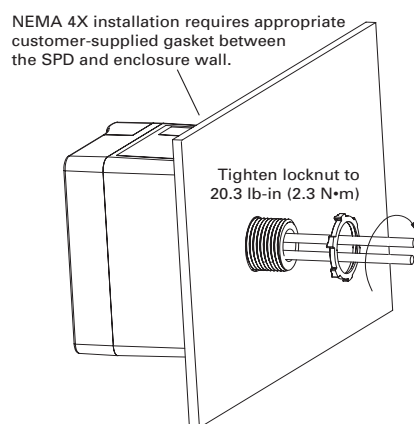
## Installing UL Type 1 and Type 2 SPDs

While differences will arise in the installation of different SPD models on various electrical systems and locations inside an electrical system, the following are general procedures and considerations to follow.

At the start of this section are diagrams indicating the connection points for the Type 1 and Type 2 SPDs contained in this guide and the electrical system to which they can be connected.

### Installation steps

1. Inspect the electrical panelboard to be sure it is properly grounded in accordance with prevailing code requirements.
2. Inspect the SPD unit to determine:
  - It has the correct nominal system and MCOV voltage rating and is the correct configuration for the installation.
  - It is not damaged; If the unit is damaged or not correct for the system, do not install it. Secure a proper replacement before proceeding with the installation.
3. Deenergize panelboard and follow established lockout / tagout procedures. Remove panelboard cover(s) to gain access to the interior. Check to make sure the entire panelboard is deenergized before proceeding.
4. Select a location on the panelboard that accommodates mounting the SPD and allows the leads to reach their intended connection points. Be sure the SPD unit can be positioned so that the LED status indicator(s) is visible. A location that permits the shortest lead lengths is preferred.
5. Remove a 3/4" knockout or make a 1-1/16" diameter hole where the SPD is to be mounted.
6. Remove the locknut from the unit and insert leads through the panelboard wall being careful not to damage the conductor insulation. (For NEMA 4X installations, use appropriate gaskets or sealing means to retain the NEMA 4X rating on the installation — see Figure 1.) Reinstall locknut and tighten to specified torque.



**Figure 1.**

If using conduit, keep the run as straight and short as possible, and avoid using 90 elbows.

**NOTE:** For optimum performance, trim the leads to the shortest length possible and avoid sharp bends. Make electrical connections appropriate for the application.

### Installation option A: using feed through lugs

7. Determine if the lugs are rated for stranded 10 AWG conductors. If lugs are not rated for this size conductor, DO NOT install the SPD unit, or replace lugs with appropriately rated lugs before proceeding, or install the unit using installation option B.
8. Route and trim the leads so they reach their connection points with the least amount of length.
9. Strip the lead ends to lug manufacturer's specifications, insert them into the appropriate ports and torque to the specified value  
**NOTE:** DO NOT install more than one lead into the same lug port.

Go to step 13.

### Installation option B: circuit breaker or fused switch

When using a circuit breaker or fused switch, see suggested ampacities in Table A for the SPD family product being installed.

10. Place in the OFF position and install a new, dedicated common trip circuit breaker or fusible switch with fuses sized by SPD family and located as close as possible to where the SPD unit is mounted.
11. Route and trim the leads so they reach their intended connection points with the least amount of length.
12. Strip the lead end to fit the connection points, insert into the terminal lugs and torque to the specified value.

Go to step 13.

### Finishing the installation

13. Reinstall the panelboard cover(s).
14. Test the SPD installation by energizing the panelboard and placing the circuit breaker or fusible switch (requires fuses to be installed) in the ON position. Verify the LED status indicators are functioning according to the installed SPD model. If LEDs are not properly displaying for a correctly installed and functioning SPD (per model), see the troubleshooting procedures for possible causes and remedy.

SPD family	Suggested minimum ampacity	
	Fused switch	Circuit breaker
SurgePOD PRO (SPP)	30 A	30 A
BSPA	60 A	30 A
BSPD	100 A	30 A

**Table A — Circuit breaker and fused switch sizing guide**



## BSPD, BSPA and SurgePOD PRO comparisons

SPD model / color	BSPD — grey	BSPA — black	PRO — grey
Markets	Commercial and industrial with high surge current	Commercial and industrial	Residential, light commercial and UL 508A panels
Product warranty*	10 years	10 years	2 years
System types	Delta and Wye	Single, Split, Delta	Single, Split, Delta and Wye
Nominal system voltages	120/208, 240, 277/480, 480, 600	120, 240, 120/240, 480, 120/208, 240/415, 277/480, 347/600, 600	120, 208, 240, 480
Max. continuous operating AC voltage (MCOV) [V <sub>C</sub> ]	Sized to nominal voltage (150 V to 840 V)	Sized to nominal voltage (150 V to 840 V)	Sized to nominal voltage (150 V to 550 V)
SCCR	200 kA	200 kA	200 kA
Nominal discharge current (8x20 $\mu$ s) I <sub>n</sub>	20 kA	20 kA	10 kA
Surge current capacity (8x20 $\mu$ s) I <sub>max</sub>	120, 200, 300, 400 kA	50, 100, 150, 200 kA	40 kA
Installation connections	3, 5 Wires	3, 5 Wires	2, 3, 4 Wires
N-G protection	Yes	Yes	No
Response time (ns) t <sub>A</sub>	<25ns	<25ns	<25ns
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Operating status/fault indication	One red and green LED per phase	One red and green LED per phase	One bi-color LED Green (Good) / Red (Replace)
Conductor gauge / length	10 AWG stranded copper / 48 inches	10 AWG Stranded copper/ 36 inches	10 AWG Stranded copper/ 18 inches
Mounting	Chase nipple (NEMA 1) internal hub (NEMA 4X)	Chase nipple, flush or optional mounting plate	Chase nipple or customer supplied bracket
Enclosure rating	NEMA 1 or NEMA 4X	NEMA 4X	NEMA 4X — UL 94-5 VA
Degree of protection (installed state)	IP20 (finger-safe)	IP20 (finger-safe)	IP20 (finger-safe)
Circuit location	Lineside/loadside***	Lineside/loadside***	Lineside/loadside
Standards/agency information	UL Listed 1449 4 <sup>th</sup> Edition Type 1 SPD, UL 1283 Type 2 Recognized, CSA Certified	UL Listed 1449 4 <sup>th</sup> Edition Type 1 SPD, cULus, CSA, RoHS Compliant	UL Listed 1449 4 <sup>th</sup> Edition Type 1 SPD, cULus, RoHS Compliant
Operating temperature	-40°C to +50°C	-40°C to +60°C	-40°C to +65°C
Operating altitude	16,000 Feet	6561 Feet	12,000 Feet
Options†	Form C contact relay	Form C contact relay	—
	EMI/RFI filter (up to 50 db 10 kHz to 100 MHz)	EMI/RFI filter (up to 40 db 10 kHz to 100 MHz)	
	Surge counter		
Data sheets	10209	10661	10033

\* See SPD Limited Warranty Statement (3A1502) for details at Eaton.com/bussmannseries.

† BSPD and BSPA models ordered with Form C contact relay and/or surge counter options are UL Type 2 SPDs and cannot be located on the lineside of the service entrance overcurrent protective device.

## Type 1 NEMA 1 and NEMA 4X UL Listed SPDs



NEMA 1 steel enclosure  
120 kA to 400 kA maximum  
surge current capacity



NEMA 4X 304 Stainless Steel  
enclosure, all surge current  
capacities

### BSPD NEMA 1 and 4X, Type 1 and 2

#### Description

BSPD SPDs are UL Listed 1449 4<sup>th</sup> Edition Type 1 or UL Recognized 1283 5<sup>th</sup> Edition Type 2 surge protectors, depending on the configuration. The BSPD is available for installation external to an electrical enclosure or panelboard. Application of BSPD units throughout a facility will help ensure that equipment is protected.

BSPD units are available for common Delta and Wye voltage systems in a variety of surge current capacity ratings from 120 kA through 400 kA. Available in three configurations, the BSPD's configurations and options make it easy to specify units for many electrical applications; including service entrances, distribution switchboards, panelboards and point-of-use.

- Basic, Standard and Standard with Surge Counter configurations UL Listed 1449 4<sup>th</sup> Edition File E316410 Guide VZCA, CSA Certified Notice 516 File 243397
- Standard and Standard with Surge Counter configurations are also UL Recognized 1283 5<sup>th</sup> Edition File E316410 Guide VZCA2, CSA Component Acceptance Std. C22.2
- RoHS compliant
- Uses Bussmann SurgePOD thermally protected Metal Oxide Varistor (MOV) technology
- 20 kA nominal discharge current ( $I_n$ ) rating (maximum rating assigned by UL)
- 120 kA through 400 kA per phase surge current capacity ( $I_{max}$ ) ratings
- 200 kA Short-Circuit Current Rating (SCCR)
- Two color LED status indicators for each phase on Delta and Wye units, plus N-G on Wye units
- 10-year warranty

#### Configurations

The BSPD provides users with the option of selecting between three configurations:

- Basic (Type 1)
- Standard with Form C contact and EMI/RFI filter (Type 2)
- Standard with Surge Counter (Type 2)

The appropriate configuration can be specified from the catalog number system based on the application's requirements or specifications.

### Catalog number system

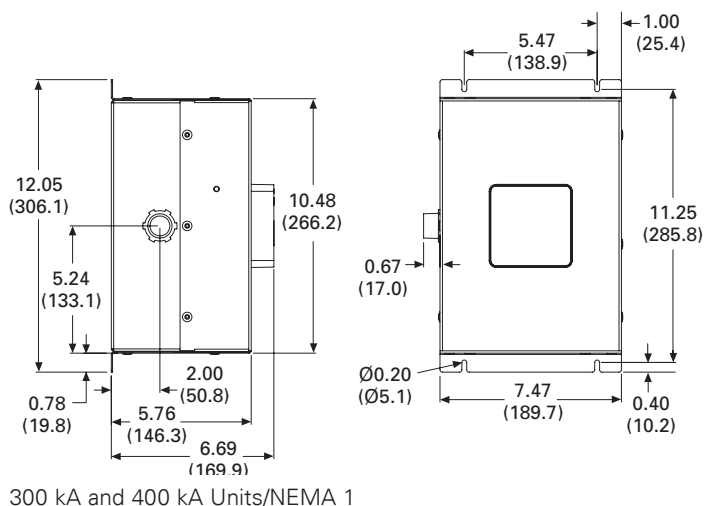
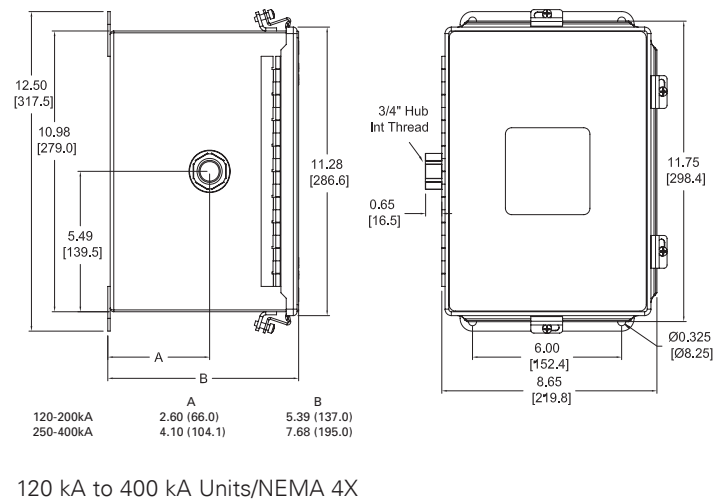
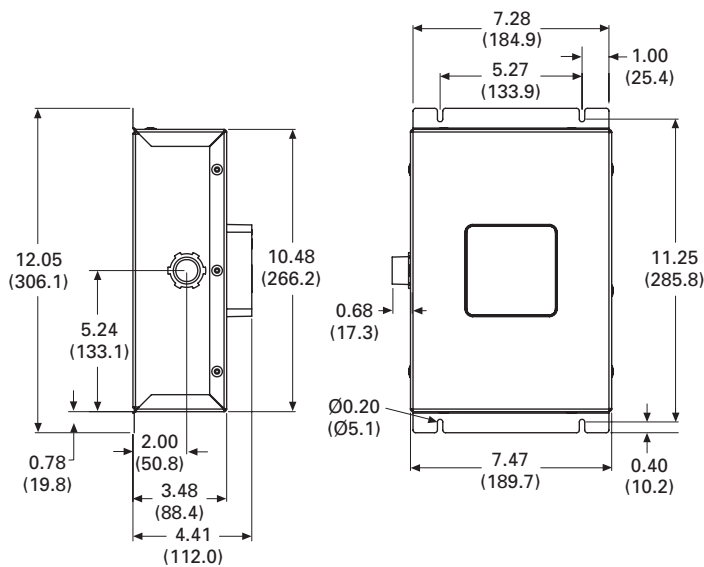
The catalog numbering system permits specifying any combination to meet requirements.

	BSPD	200	480D	2	K
<b>BSPD = Product family</b>					
<b>Surge rating per phase</b>					
<ul style="list-style-type: none"> <li>• 120 = 120 kA</li> <li>• 200 = 200 kA</li> <li>• 300 = 300 kA</li> <li>• 400 = 400 kA</li> </ul>					
<b>Voltage/system code</b>					
<ul style="list-style-type: none"> <li>• 208Y = 120/208 Wye (4W + Gnd)</li> <li>• 480Y = 277/480 Wye (4W + Gnd)</li> <li>• 600Y = 347/600 Wye (4W + Gnd)</li> <li>• 240D = 240 Delta (3W + Gnd)</li> <li>• 480D = 480 Delta (3W + Gnd)</li> <li>• 600D = 600 Delta (3W + Gnd)</li> </ul>					
<b>Configurations</b>					
<ul style="list-style-type: none"> <li>• 1 = Basic <ul style="list-style-type: none"> <li>• Green and red LEDs per phase to indicate protection status.</li> <li>• Green and red LEDs on Wye units to indicate protection status of the neutral-to-ground mode</li> </ul> </li> <li>• 2 = Standard <ul style="list-style-type: none"> <li>• Green and red LEDs per phase to indicate protection status</li> <li>• Green and red LEDs on Wye units to indicate protection status of the neutral-to-ground mode</li> <li>• Audible alarm with silence button</li> <li>• Form C contact relay</li> <li>• EMI/RFI filtering providing up to 50 dB of noise attenuation from 10 kHz to 100 MHz</li> </ul> </li> <li>• 3 = Standard With Surge Counter <ul style="list-style-type: none"> <li>• Green and red LEDs per phase to indicate protection status</li> <li>• Green and red LEDs on Wye units to indicate protection status of the neutral-to-ground mode</li> <li>• Audible alarm with silence button</li> <li>• Form C contact relay</li> <li>• EMI/RFI filtering providing up to 50 dB of noise attenuation from 10 kHz to 100 MHz</li> <li>• Surge counter with reset button</li> </ul> </li> </ul>					
<b>NEMA enclosures</b>					
<ul style="list-style-type: none"> <li>• K = NEMA 1</li> <li>• P = NEMA 4X</li> </ul>					

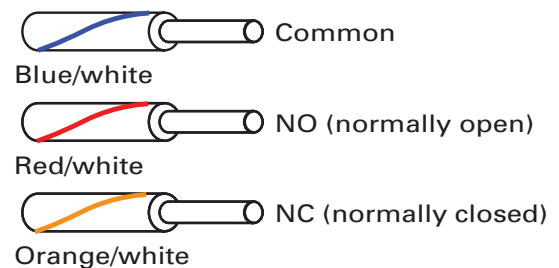
## BSPD configuration comparisons

Features	Configuration		
	Basic (Type 1)	Standard (Type 2)	Standard with Surge Counter (Type 2)
Surge protection using MOV technology	X	X	X
Two color LED protection status indicators for each phase	X	X	X
Two color LED protection status indicators for the neutral-ground protection mode (Wye systems only)	X	X	X
Audible alarm with silence button		X	X
Form C contact relay		X	X
EMI/RFI filtering, providing up to 50 dB of noise attenuation from 10 kHz to 100 MHz		X	X
Surge counter with reset button			X

## Dimensions — in (mm)



## Form C contact relay wire color codes



## BSPD specifications

Description	Specification
Available system voltages	
Three-phase Wye	120/208, 277/480 and 347/600
Three-phase Delta	240, 480 and 600
Input power frequency	50/60 Hz
Maximum Continuous Operating Voltage (MCOV)	
208Y, and 240D voltage/system type codes	150 L-N, 150 L-G, 150 N-G, 300 L-L
480Y Voltage/system type code	320 L-N, 320 L-G, 320 N-G, 640 L-L
600Y Voltage/system type code	420 L-N, 420 L-G, 420 N-G, 840 L-L
480D Voltage/system type code	640 L-G, 640 L-L
600D Voltage/system type code	840 L-G, 840 L-L
Short-Circuit Current Rating (SCCR)	200 kA
Nominal discharge current ( $I_n$ )	20 kA
Surge current capacity per phase ( $I_{max}$ )	120 kA, 200 kA, 300 kA and 400 kA ratings available
SPD Types	Type 1 ( <i>Basic</i> configuration, can also be used in Type 2 applications) Type 2 ( <i>Standard</i> and <i>Standard With Surge Counter</i> configurations)
Enclosure types	NEMA 1, NEMA 4X 304 Stainless Steel
Ports	1
SPD Conductor length/gauge	48" (1.22 m) 10 AWG Stranded copper
Form C contact relay ( <i>Standard</i> and <i>Standard With Surge Counter</i> configurations only)	
Contact ratings	150 Vac or 125 Vdc, 1 A maximum
Lead length/gauge	48 inches (1.22 m) / 14 AWG
Contact logic	Power ON, normal state; NO contact = OPEN, N.C. contact = CLOSED Power OFF, fault state; NO contact = CLOSED, N.C. contact = OPEN
Power consumption	
Basic configuration	
208Y and 240D voltage/system type codes	0.5 W
480Y and 480D voltage/system type codes	1.1 W
600Y and 600D voltage/system type codes	1.3 W
Standard and Standard with Surge Counter configurations	
208Y and 240D voltage/system type codes	0.6 W
480Y, and 480D voltage/system type codes	1.7 W
600Y and 600D voltage/system type codes	2.1 W
Protection modes	Three-phase Delta; L-G, L-L Three-phase Wye; L-N, L-G, N-G, L-L
Operating temperature / humidity	-40 to +50°C (-40 to +122°F) / 5% to 95%, non-condensing
Operating altitude — ft (m)	16,000 (5000)
EMI/RFI filtering attenuation	Up to 50 dB from 10 kHz to 100 MHz ( <i>Standard</i> and <i>Standard With Surge Counter</i> configurations)
Weight — lbs (kg)	NEMA 1: 120-200 kA - 6.8 (3.1), 300-400 kA -13.5 (6.1) NEMA 4X: 120-200 kA - 14.6 (6.6), 300-400 kA - 21.0 (9.5)
Agency information	- <i>Basic</i> , <i>Standard</i> and <i>Standard with Surge Counter</i> configurations UL Listed 1449 4 <sup>th</sup> Edition File E316410 Guide VZCA, CSA Certified Notice 516 File 243397 - <i>Standard</i> and <i>Standard with Surge Counter</i> configurations are also UL Recognized 1283 5 <sup>th</sup> Edition File E316410 Guide VZCA2, CSA Component Acceptance Std. C22.2 No. 8-M1986 File 243397
RoHS compliant	Yes
Seismic withstand capability	Meets or exceeds the requirements specific to I.B.C. 2006, C.B.C. 2007 and U.B.C. Zone 4
Warranty	10 Years (see warranty statement 3A1502 for details at Eaton.com/bussmannseries)



### ANSI/UL 1449 4<sup>th</sup> Edition voltage protection ratings

Voltage Protection Rating ( $V_{PR}$ ) data for all units is included in the following tables. The data varies based upon the configuration and NEMA enclosure.  $V_{PR}$  values for the *Basic* configurations are on the left-hand side of the page. Tables on the right-hand side contain  $V_{PR}$  values for the *Standard* or *Standard with Surge Counter* configurations.

#### NEMA 1 enclosures

Basic (catalog numbers ending 1K)

Voltage/system code	Protection mode			
	L-N	L-G	N-G	L-L
<b>120-200 kA</b>				
208Y	700	700	700	1200
480Y	1200	1200	1200	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2500
600D	—	2500	—	2500
<b>300 kA</b>				
208Y	700	700	700	1000
480Y	1200	1200	1200	1800
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500
<b>400 kA</b>				
208Y	700	700	700	1000
480Y	1200	1200	1200	1800
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500

Standard or standard w/ surge counter (catalog numbers ending 2K/3K)

Voltage/system code	Protection mode			
	L-N	L-G	N-G	L-L
<b>120-200 kA</b>				
208Y	600	800	600	1000
480Y	1200	1200	1200	1800
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2500	—	2500
600D	—	2500	—	2500
<b>300 kA</b>				
208Y	600	700	600	1000
480Y	1000	1200	1000	1800
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500
<b>400 kA</b>				
208Y	600	700	600	1000
480Y	1000	1200	1000	1800
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500

#### NEMA 4X enclosures

Basic (catalog numbers ending 1P)

Voltage/system code	Protection mode			
	L-N	L-G	N-G	L-L
<b>120-200 kA</b>				
208Y	700	800	700	1200
480Y	1200	1200	1000	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2500
600D	—	2500	—	2500
<b>300 kA</b>				
208Y	700	800	700	1200
480Y	1200	1200	1200	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500
<b>400 kA</b>				
208Y	700	800	700	1200
480Y	1200	1200	1200	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	1800	—	2000
600D	—	2500	—	2500

Standard or standard w/ surge counter (catalog numbers ending 2P/3P)

Voltage/system code	Protection mode			
	L-N	L-G	N-G	L-L
<b>120-200 kA</b>				
208Y	900	900	700	1500
480Y	1200	1200	1000	2500
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2500	—	2500
600D	—	2500	—	2500
<b>300 kA</b>				
208Y	800	900	700	1500
480Y	1200	1200	1000	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2000
600D	—	2500	—	2500
<b>400 kA</b>				
208Y	800	900	700	1500
480Y	1200	1200	1000	2000
600Y	1500	1500	1500	2500
240D	—	1000	—	1000
480D	—	2000	—	2000
600D	—	2500	—	2500

## BSPA NEMA 4X, Type 1 and 2

Bussmann series BSPA surge protective devices are UL 1449 4<sup>th</sup> Edition surge protectors. Application of BSPA units throughout a facility will help ensure that equipment is protected from damaging surges.

The BSPA compact NEMA 4X enclosure allows for installation external to an electrical assembly in a variety of environments.

BSPA units are available in all common voltage and system configurations, and in a variety of peak surge current capacity ratings from 50 through 200 kA per phase. Several feature package options (filtering, audible alarm and Form C contacts) extend application flexibility along with a range of configurable options suitable for most commercial and light industrial applications covering service entrances, distribution panelboards and point-of-use applications.

### Agency information

- UL 1449 4<sup>th</sup> Edition Type 1 and Type 2
- UL 1283 6<sup>th</sup> Edition
- Canadian Standards Association (CSAT) 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
- RoHS compliant

### Features

- Thermally-protected metal oxide varistor (MOV) technology
- Tricolored LED status indicators display continuous self-diagnostic testing, including neutral-ground mode
- 20 kA nominal discharge current ( $I_n$ ) rating (maximum rating in the UL 1449 4<sup>th</sup> Edition standard)
- 50 through 200 kA per phase peak surge current capacity ratings
- Configure to order with five feature/option combinations
- Corrosion-resistant NEMA 4X enclosure with detachable mounting feet
- 200 kA short-circuit current rating (SCCR)
- Factory wired with 36 inch 10 AWG leads
- Optional Form C contact relay for integration into remote monitoring systems\*
- Optional EMI/RFI filtering form improved power quality\*
- Optional audible alarm\*
- No user-serviceable parts or items requiring periodic maintenance
- Ten-year warranty

\* See catalog number system for availability.



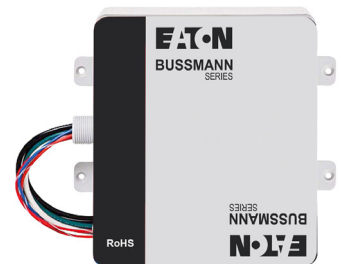
### Catalog number system

The catalog numbering system permits specifying any combination to meet requirements.

BSPA	200	208Y	8	P
<b>BSPA = Product family</b>	<b>Surge rating per phase</b>	<b>Voltage/system code</b>	<b>Options</b>	<b>NEMA enclosure</b>
	<ul style="list-style-type: none"> <li>• 050 = 50 kA per phase</li> <li>• 100 = 100 kA per phase</li> <li>• 150 = 150 kA per phase</li> <li>• 200 = 200 kA per phase</li> </ul>	<ul style="list-style-type: none"> <li>• 120N = 120 V single-phase (2W + Gnd)</li> <li>• 240N = 240 V single-phase (2W + Gnd)</li> <li>• 240S = 120/240 V split-phase (3W + Gnd)</li> <li>• 240D = 240 V Delta (3W + Gnd)</li> <li>• 480D = 480 V Delta (3W + Gnd)</li> <li>• 600D = 600 V Delta (3W + Gnd)</li> <li>• 208Y = 120/208 V Wye (4W + Gnd)</li> <li>• 415Y = 240/415 V Wye (4W + Gnd)</li> <li>• 480Y = 277/480 V Wye (4W + Gnd)</li> <li>• 600Y = 347/600 V Wye (4W + Gnd)</li> </ul>	<ul style="list-style-type: none"> <li>• 1 = No options (standard configuration), Type 1</li> <li>• 4 = Form C relay, Type 1</li> <li>• 5 = Audible alarm and Form C relay, Type 1</li> <li>• 7 = EMI filtering and Form C relay, Type 2</li> <li>• 8 = EMI filtering, audible alarm and Form C relay, Type 2</li> </ul>	<ul style="list-style-type: none"> <li>• P = NEMA 4X</li> </ul>



BSPA wire port and conductors



BSPA with mounting feet

## BSPA configurations

The BSPA allows for selecting along with the standard features the audible alarm, Form C relay contacts and EMI/RFI filtering options shown in table 1.

### Configurable features

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

\* Available on Type 2 SPD units only.

### Tricolored LED status indicators

These LED indicators show continuous self-diagnostic testing, including neutral-ground mode and display:

- Green—Fully protected
- Yellow—Loss of neutral-to-ground protection
- Red—Loss of protection



LED protection status indicators showing full protection and phase faults

### Enclosure ratings, options, dimensions and weights

The BSPA NEMA 4X enclosure is supplied with mounting feet to facilitate installation in a variety of applications. There are two enclosure sizes, P1 and P2, dependent on the voltage code and surge rating.

### Available optional equipment

Available option	Catalog no.
Flush mount plate for P1 enclosure	BSPA-FLUSHPLT1
Flush mount plate for P2 enclosure	BSPA-FLUSHPLT2

### BSPA voltage configurations per enclosure size\*

P1 enclosure		P2 enclosure	
Voltage code	kA	Voltage code	kA
120N/240N	50–200	240S	
240S		208Y/415Y/480Y/600Y	120–200
208Y/415Y/480Y/600Y	50–100	240D/480D	
240D/480D		600D	50–200

\* See catalog number system for voltage code details.

### Voltage protection ratings per ANSI/UL 1449 4<sup>th</sup> Edition

Voltage code	Protection mode			
	L–N	L–G	N–G	L–L
<b>50 kA unit V<sub>PR</sub></b>				
120N	700	1200	700	—
240N	1200	2000	1500	—
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
<b>100 kA unit V<sub>PR</sub></b>				
120N	600	600	600	—
240N	1200	1200	1200	—
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
<b>150–200 kA unit V<sub>PR</sub></b>				
120N	700	700	700	—
240N	1000	1200	1000	—
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

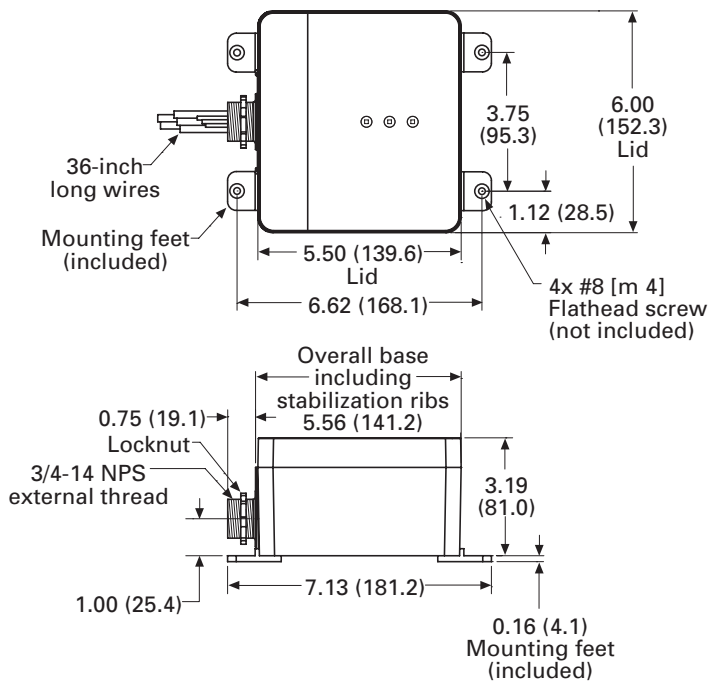
## BSPA specifications

Description		Value
Leads	Length	36"
	Size	10 AWG stranded copper
Mounting		Chase nipple/panel (with mounting feet)
Peak surge current capacity ratings available		50, 100, 150, 200 kA per phase
Nominal discharge current (In)		20 kA
Short-circuit current rating (SCCR)		200 kA
Single-phase voltages available (2W + Gnd)		120, 240
Split-phase voltages available (3W + Gnd)		120/240
Three-phase Wye system voltages available (4W + Gnd)		120/208, 240/415, 277/480, 347/600
Three-phase Delta system voltages available (3W + Gnd)		240, 480, 600
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):	Voltage code	
	120N	150 L–N, 150 L–G, 150 N–G
	240N	320 L–N, 320 L–G, 320 N–G
	240S, 208Y	150 L–N, 150 L–G, 150 N–G, 300 L–L
	415Y, 480Y	320 L–N, 320 L–G, 320 N–G, 640 L–L
	600Y	420 L–N, 420 L–G, 420 N–G, 840 L–L
	240D	320 L–G, 300 L–L
	480D	550 L–G, 640 L–L
	600D	840 L–G, 840 L–L
Ports		1
Operating and storage temperature		–40°F to +140°F (–40°C to +60°C)
Operating humidity		5% through 95%, non-condensing
Operating altitude		Up to 2000 m (6561 ft)
Agency information		UL 1449 4 <sup>th</sup> Edition, UL 1283 6 <sup>th</sup> 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 4 <sup>th</sup> Edition and CSA Type 1 and Type 2 SPD (dependent on feature options)
Enclosure dimensions and weights		Refer to Figure 1 and Figure 3 for enclosure dimensions and weights
Enclosure rating		NEMA 4X enclosure*
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		Ten years standard

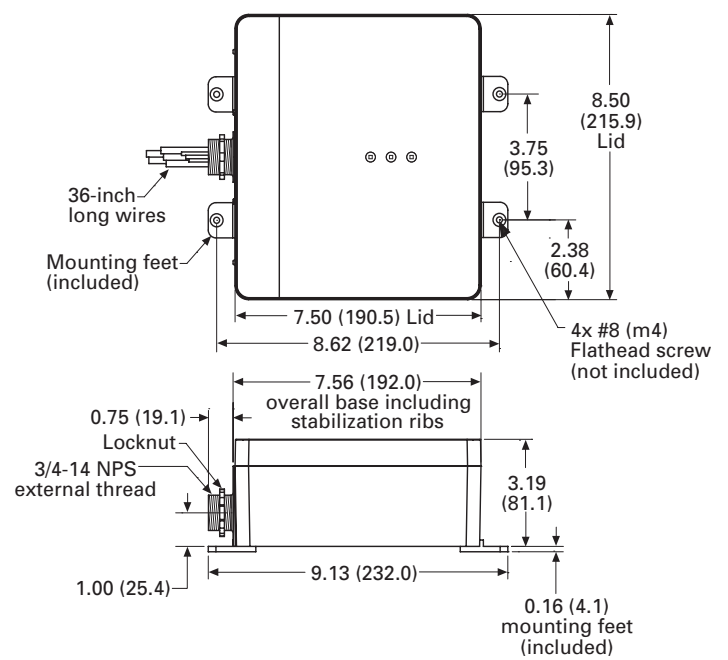
\* Mounting feet required to achieve NEMA 4X rating.



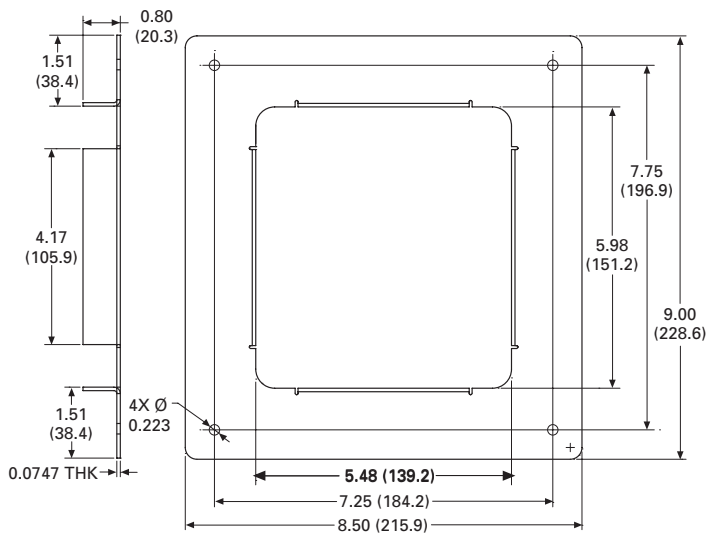
Dimensions — in (mm)



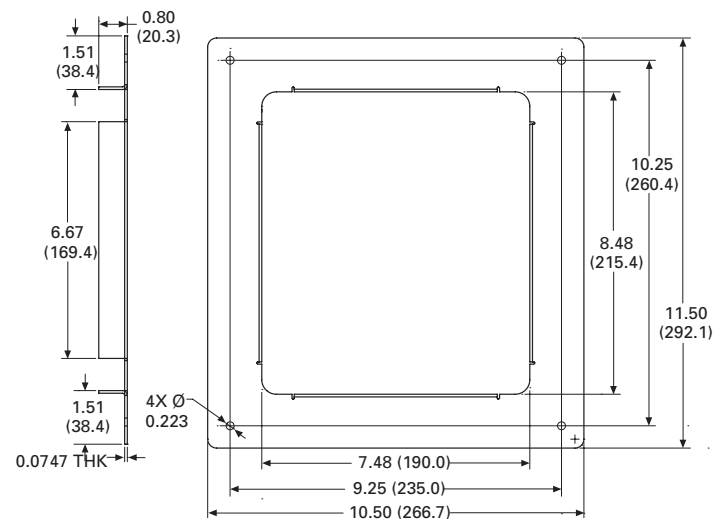
P1 enclosure, NEMA 4X with mounting feet dimensions, weight = 2.5 lb



P2 enclosure, NEMA 4X with mounting feet dimensions, weight = 4 lb



Optional flush mount plate for P1 enclosure (catalog number BSPA-FLUSHPLT1)



Optional flush mount plate for P2 enclosure (catalog number BSPA-FLUSHPLT2)

## SurgePOD PRO NEMA 4X, Type 1

### Description

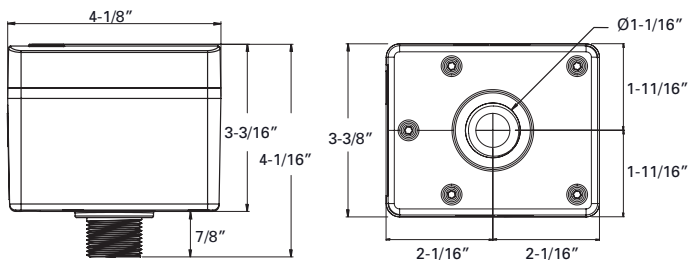
Bussmann series SurgePOD PRO is a Type 1 UL Listed 1449 4<sup>th</sup> Edition surge protective device suitable for installation on both the lineside or loadside of the service entrance overcurrent protective device.

Available in popular voltage and system specific versions to match common residential and light commercial electrical system and equipment requirements, the SurgePOD PRO delivers superior surge protection using MOV thermal disconnect technology.

Parallel connection to the electrical system permits the SurgePOD PRO SPD to be installed on any ampacity panel.

- Type 1 UL Listed 1449 4<sup>th</sup> Edition SPDs are easily selected and installed on the lineside or loadside of the service entrance overcurrent protective device
- Voltage specific models precisely match and protect electrical systems and equipment better than "one-size-fits-all" SPDs
- Thermal disconnect technology eliminates the need for additional fusing
- Compact NEMA 4X enclosure for indoor or outdoor applications
- *easyID*™ LED status indicator provides surge protection status at a glance

### Dimensions — in

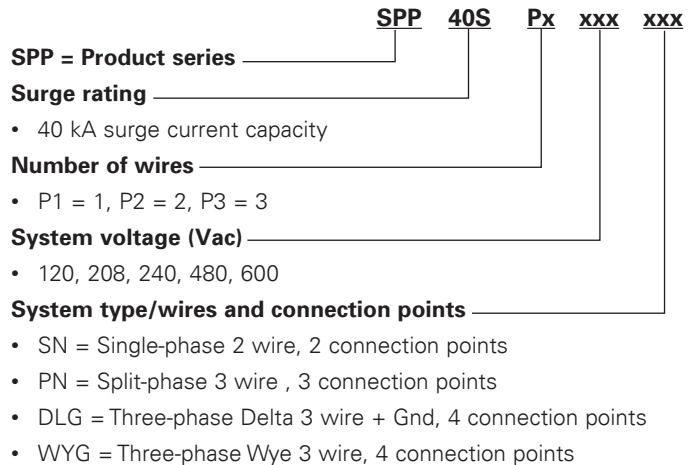


### Available catalog numbers

Catalog no.		
SPP40SP1120SN	SPP40SP3240DLG	SPP40SP3208WYG
SPP40SP2240PN	SPP40SP3480DLG	SPP40SP3480WYG
SPP40SP3600WYG		

See catalog number explanation below for details.

### Catalog number explanation



### *easyID* LED status indicator

The *easyID* LED status indicator will illuminate when the unit is properly installed and the system or equipment being protected is energized. The following LED color/status indicates:



#### GREEN LED = Good

The circuit is energized and protected.



#### RED LED = Replace

The circuit is energized and unprotected.  
The unit needs replacing.



#### LED is Out / Unlit:

- The circuit is most likely deenergized
- The unit's leads are disconnected
- The unit is damaged

Authorized personnel should follow all prescribed lockout/tagout and safety procedures in troubleshooting the cause for the above conditions. Opening SurgePOD PRO enclosure will void the warranty.

## SurgePOD PRO specifications

Catalog no.	Nominal system voltage	Max. continuous operating AC voltage (MCOV) ( $V_c$ )	System type	Connection points
SPP40SP1120SN	120	150	Single-phase 2 wire	2
SPP40SP2240PN	120/240	150	Split-phase 3 wire	3
SPP40SP3240DLG	240	320	Three-phase Delta 3 wire + Gnd	4
SPP40SP3480DLG	480	550	Three-phase Delta 3 wire + Gnd	4
SPP40SP3208WYG	208	150	Three-phase Wye 3 wire + Gnd	4
SPP40SP3480WYG	480	320	Three-phase Wye 3 wire + Gnd	4
SPP40SP3600WYG*	600	420	Three-phase Wye 3 wire + Gnd	4

\* Not CSA Certified.

Specifications (for all SurgePOD PRO units)	Values
Short-Circuit Current Rating (SCCR)	200 kA
Nominal discharge current (8x20 $\mu$ s) ( $I_n$ )	10 kA
Surge current capacity (8x20 $\mu$ s) ( $I_{max}$ )	40 kA
Response time (ns) ( $t_A$ )	<25ns
Frequency	50/60 Hz
Operating state/fault indication	Bi-color LED — green (good) / red (replace)
Conductor length / gauge	18 inches, 10 AWG stranded tinned copper
Mounting	Chase nipple / bracket*
Enclosure / flammability ratings	NEMA 4X — UL 94-5 VA
Degree of protection (installed state)	IP20 (finger-safe)
SPD install location	Indoor/outdoor
Circuit location	Lineside or loadside of service entrance overcurrent protective device
Operating temperature	-40°C to +65°C
Maximum operating altitude	12,000 feet
Agency information	UL Listed, CSA Certified, RoHS compliant
Standard	UL Type 1 1449 4 <sup>th</sup> Edition SPD
Warranty	Two years**

\* Customer-supplied bracket.

\*\*See Limited Warranty Statement 3A1502 for details at Eaton.com/bussmannseries.

## Voltage protection ratings

Catalog no.	Nominal system voltage	MCOV ( $V_c$ )	Voltage Protection Ratings ( $V_{PR}$ )		
			L-N	L-L	L-G
SPP40SP1120SN	120	150	700	—	—
SPP40SP2240PN	120/240	150	700	1200	—
SPP40SP3240DLG	240	320	—	2500	1200
SPP40SP3480DLG	480	550	—	3000	1800
SPP40SP3208WYG	208	150 <sup>†</sup>	—	1200	700
SPP40SP3480WYG	480	320 <sup>†</sup>	—	2500	1200
SPP40SP3600WYG	600	420 <sup>†</sup>	—	2500	1500

<sup>†</sup> SPD voltages are measured from Line-to-Neutral, or Line-to-Ground on systems where there is no neutral present. These units do not have a line-to-neutral, so the line-to-ground voltage is 120 V for the 208 V Wye L-G and 277 V for the 480 V L-G, making the normal voltage applied to the unit less than the MCOV values listed in the table.

## UL Listed 4<sup>th</sup> Edition open Type 1 DIN-Rail high SCCR SPDs

### 1-Pole, UL Type 1 DIN-Rail high SCCR SPDs



#### Catalog symbol:

- BSPMA1\_S2GR

#### Description:

Bussmann series one-pole DIN-Rail UL Listed Type 1 surge protective devices feature a high 200 kA SCCR. Replaceable arrestor modules are mechanically coded with the base to ensure against installing an incorrect replacement. The unique module locking system fixes the module to the base, and allows it to be easily replaced without tools by simply depressing the release buttons.

#### Standard local visual status indication:

The module's visual indicator shows the protective status at a glance: green = good, red = replace.

#### Remote contact signaling:

The standard three-pole terminal remote Form C contact signaling relay has a floating changeover contact for use as a break or make contact, according to circuit concept.

#### Ratings:

- System volts/types
  - 120 Vac single-phase
  - 240 Vac single-phase
- Short-circuit Current Rating (SCCR) 200 kA

#### Agency information:

- UL Listed open Type 1, ANSI/ UL 1449 4<sup>th</sup> Edition, Guide VZCA2, VZCA8
- CSA Type 4-1 Component Assembly, C22.2 No. 269.1-14, Class 2157-27
- RoHS compliant

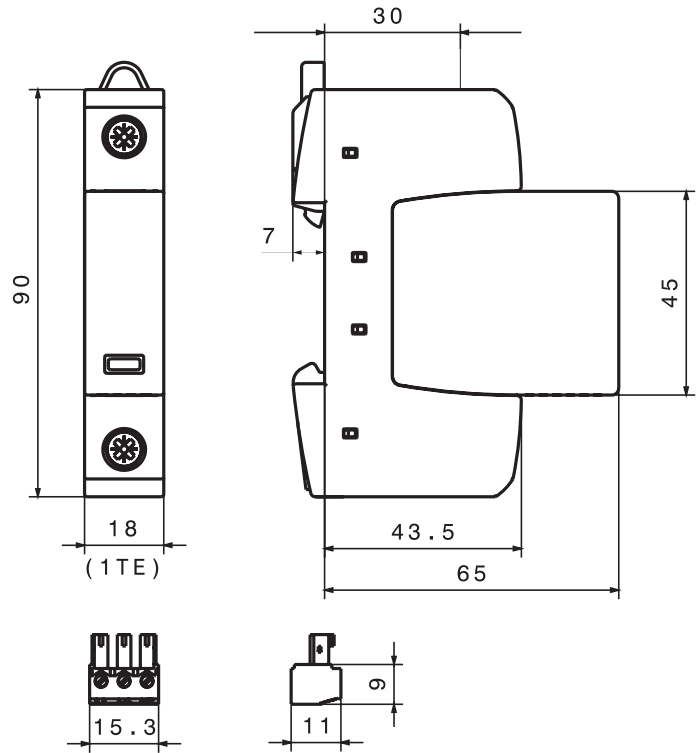
#### Mounting

- 35 mm DIN-Rail

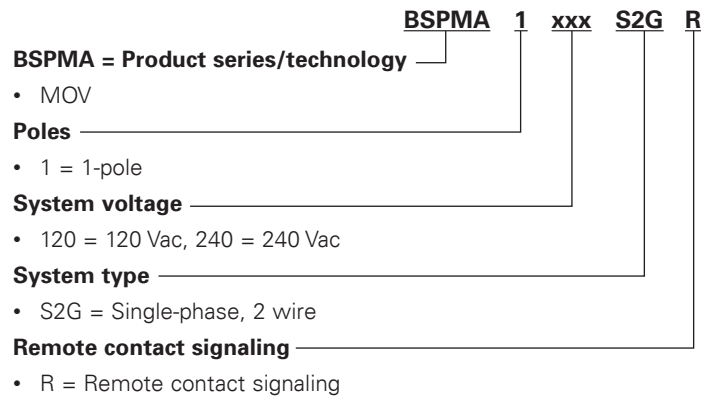
#### Warranty

- Five years

#### Dimensions — mm



#### 1-pole, open Type 1 high SCCR SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available black label high SCCR DIN-Rail SPD catalog numbers.



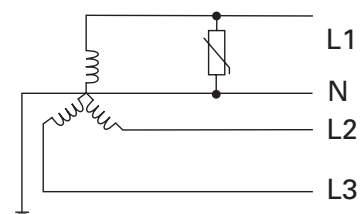
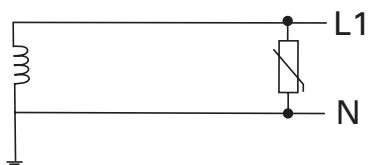
#### Specifications/ordering information

System voltage/type	120 Vac single-phase	240 Vac single-phase
Catalog number	BSPMA1120S2GR	BSPMA1240S2GR
Replacement module catalog number (qty.)	BPMA230UL (1)	BPMA385UL (1)
SPD class per ANSI/UL 1449 4 <sup>th</sup> Ed.	Open-Type 1 SPD	
SPD class per CSA C22.2 No. 269.1-14	Type 4-1 Component Assembly	
Nominal system voltage ( $U_N$ ) [L-N/L-G]	127 Vac	277 Vac
Nominal power frequency	50 / 60 Hz	
Max. continuous operating voltage AC (MCOV) [L-L]	230 Vac	385 Vac
Nominal discharge current ( $I_n$ ) (8x20 $\mu$ s)	20 kA	
Max. discharge current ( $I_{max}$ ) (8/20)	50 kA	
Voltage Protection Rating ( $V_{PR}$ ) [L-L]	700 V <sub>pk</sub>	1200 V <sub>pk</sub>
Short Circuit Current Rating (SCCR)	200 kA	
Operating temperature range ( $T_U$ ) °F (°C)	-31 to 185 (-35 to 85)	
Operating state / fault indication	Green = good ; Red = replace	
Wire range (60/75°C Cu, solid/stranded)	2-14 AWG (2.5-35 mm <sup>2</sup> )	
Terminal torque — lb-in (N•m)	35-45 (4-5.1)	
Mounting	35 mm DIN-Rail per EN 60715	
Enclosure material	Thermoplastic, UL 94 V0	
Protection	IP20 (finger-safe)	
Capacity	1 module(s), DIN 43880	
Agency information	UL Listed, Guide VZCA, VZCA7/CSA Component Acceptance Class 2157-27, RoHS	
Weight — oz (g)	4.13 (117)	4.44 (126)

#### Contact signaling

Signaling type	Floating (dry), Form C (SPDT)
NEC Circuits	NEC Class 2 circuits only
Switching capacity AC (DC)	250 V/5 A (250 V/0.1 A, 125 V/0.2 A, 75 V/0.5 A)
Wire range (60/75°C Cu, solid/stranded)	16-22 AWG (1.5-0.34 mm <sup>2</sup> )
Terminal torque — lb-in (N•m)	1.8 (0.2)

#### Typical installation/system application:



## 2-Pole, UL Type 1 DIN-Rail high SCCR SPDs



### Catalog symbol:

- BSPMA2\_S3GR

### Description:

Bussmann series two-pole DIN-Rail UL Listed Type 1 surge protective devices feature a high 200 kA SCCR. Replaceable arrestor modules are mechanically coded with the base to ensure against installing an incorrect replacement. The unique module locking system fixes the module to the base, and allows it to be easily replaced without tools by simply depressing the release buttons.

### Standard local visual status indication:

The module's visual indicator shows the protective status at a glance: green = good, red = replace.

### Remote contact signaling:

The standard three-pole terminal remote Form C contact signaling relay has a floating changeover contact for use as a break or make contact, according to circuit concept.

### Ratings:

- System volts/types
  - 120/240 Vac split-phase
  - 240/480 Vac split-phase
- Short-circuit Current Rating (SCCR) 200 kA

### Agency information:

- UL Listed open Type 1, ANSI/ UL 1449 4<sup>th</sup> Edition, Guide VZCA2, VZCA8
- CSA Type 4-1 Component Assembly, C22.2 No. 269.1-14, Class 2157-27
- RoHS compliant

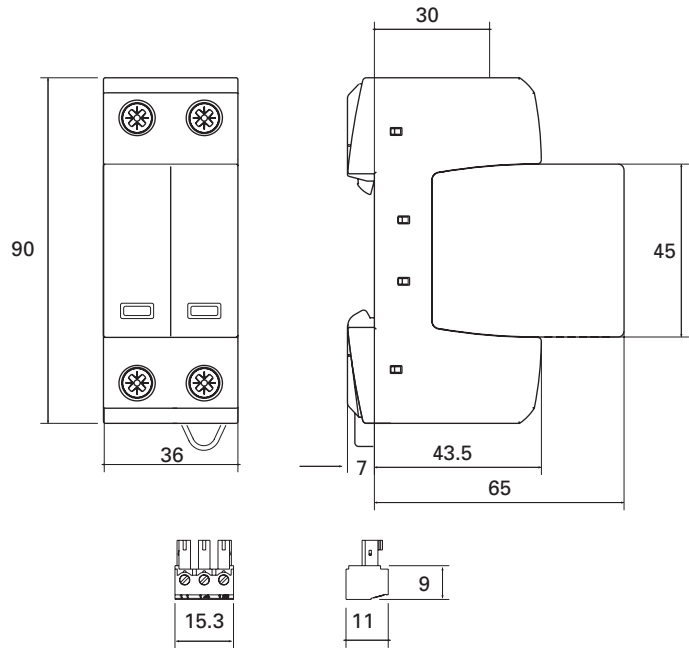
### Mounting

- 35 mm DIN-Rail

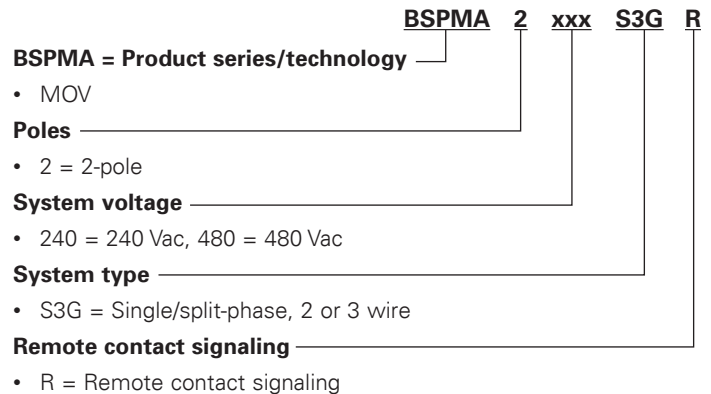
### Warranty

- Five years

## Dimensions — mm



### 2-pole, open Type 1 high SCCR SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available black label high SCCR DIN-Rail SPD catalog numbers.

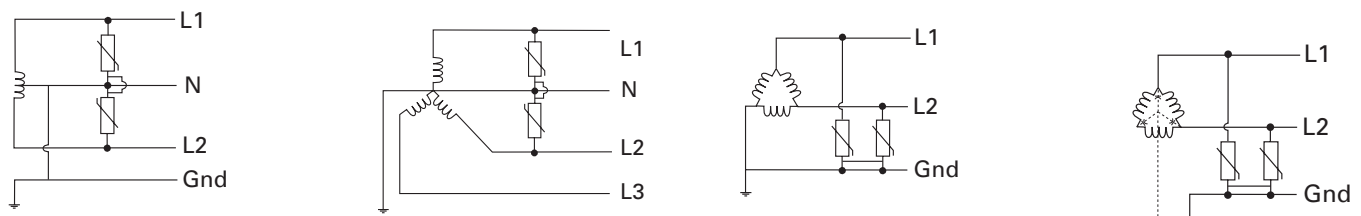
#### Specifications/ordering information

System voltage/type	120/240 Vac split-phase	240/480 Vac split-phase
Catalog number	BSPMA2240S3GR	BSPMA2480S3GR
Replacement module catalog number (qty.)	BPMA230UL (2)	BPMA385UL (2)
SPD class per ANSI/UL 1449 4 <sup>th</sup> Ed.	Open-Type 1 SPD	
SPD class per CSA C22.2 No. 269.1-14	Type 4-1 Component Assembly	
Nominal system voltage ( $U_N$ ) [L-G] / [L-L]	127 Vac / 254 Vac	240 Vac / 480 Vac
Nominal power frequency	50 / 60 Hz	
Max. continuous operating voltage AC (MCOV) [L-G] / [L-L]	230 Vac / 460 Vac	385 Vac / 770 Vac
Nominal discharge current ( $I_n$ ) (8x20 $\mu$ s)	20 kA	
Max. discharge current ( $I_{max}$ ) (8/20)	50 kA	
Voltage Protection Rating ( $V_{PR}$ ) [L-G] / [L-L]	700 $V_{pk}$ / 1500 $V_{pk}$	1200 $V_{pk}$ / 2500 $V_{pk}$
Short Circuit Current Rating (SCCR)	200 kA	
Operating temperature range ( $T_U$ ) °F (°C)	-31 to 185 (-35 to 85)	
Operating state / fault indication	Green = good ; Red = replace	
Wire range (60/75°C Cu, solid/stranded)	2-14 AWG (2.5-25 mm <sup>2</sup> )	
Terminal torque — lb-in (N•m)	35-45 (4-5.1)	
Mounting	35 mm DIN-Rail per EN 60715	
Enclosure material	Thermoplastic, UL 94 V0	
Protection	IP20 (finger-safe)	
Capacity	2 module(s), DIN 43880	
Agency information	UL Listed, Guide VZCA, VZCA7/CSA Component Acceptance Class 2157-27, RoHS	
Weight — oz (g)	7.94 (225)	8.57 (243)

#### Contact signaling

Signaling type	Floating (dry), Form C (SPDT)
NEC Circuits	NEC Class 2 circuits only
Switching capacity AC (DC)	250 V/5 A (250 V/0.1 A, 125 V/0.2 A, 75 V/0.5 A)
Wire range (60/75 °C Cu, solid/stranded)	16-22 AWG (1.5-0.34 mm <sup>2</sup> )
Terminal torque — lb-in (N•m)	1.8 (0.2)

#### Typical installation/system application:



### 3-Pole, UL Type 1 DIN-Rail high SCCR SPDs



#### Catalog symbol:

- BSPMA3\_WYGR
- BSPMA3\_DLGR

#### Description:

Bussmann series three-pole DIN-Rail UL Listed Type 1 surge protective devices feature a high 200 kA SCCR. Replaceable arrestor modules are mechanically coded with the base to ensure against installing an incorrect replacement. The unique module locking system fixes the module to the base, and allows it to be easily replaced without tools by simply depressing the release buttons.

#### Standard local visual status indication:

The module's visual indicator shows the protective status at a glance: green = good, red = replace.

#### Remote contact signaling:

The standard three-pole terminal remote Form C contact signaling relay has a floating changeover contact for use as a break or make contact, according to circuit concept.

Ratings:

- System volts/types
  - 120/208 Vac 3-phase Wye
  - 277/480 Vac 3-phase Wye
  - 347/600 Vac 3-phase Wye
  - 240 Vac 3-phase Delta
  - 480 Vac 3-phase Delta
- Short-circuit Current Rating (SCCR) 200 kA

#### Agency information:

- UL Listed open Type 1, ANSI/ UL 1449 4<sup>th</sup> Edition, Guide VZCA2, VZCA8
- CSA Type 4-1 Component Assembly, C22.2 No. 269.1-14, Class 2157-27
- RoHS compliant

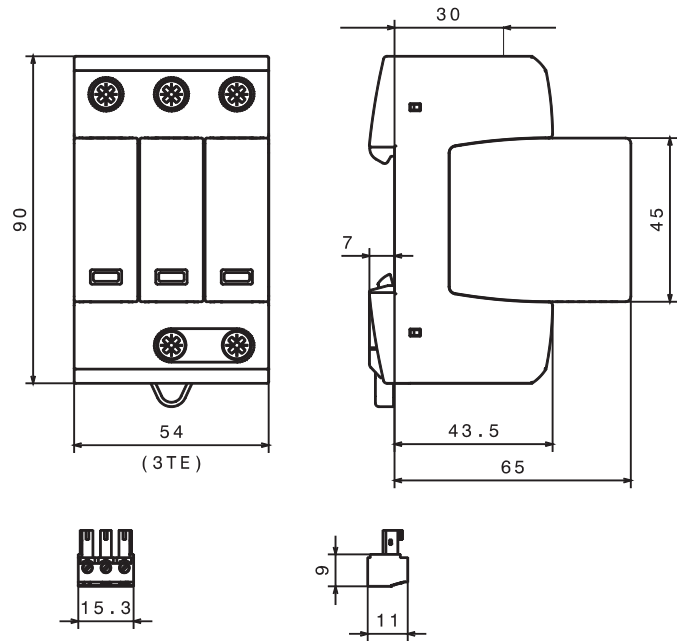
#### Mounting

- 35 mm DIN-Rail

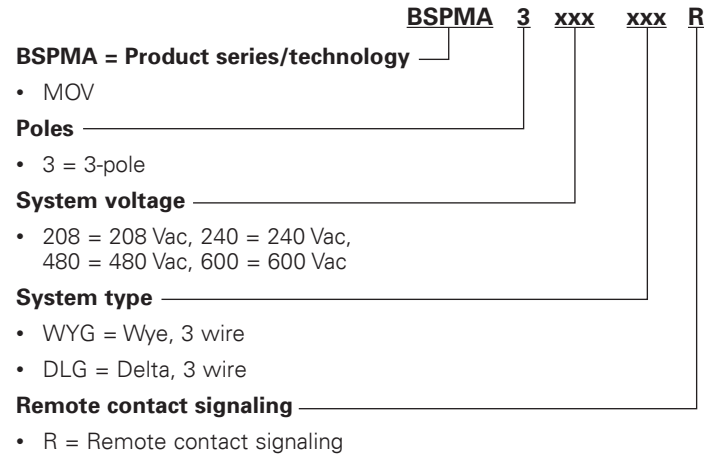
#### Warranty

- Five years

#### Dimensions — mm



#### 3-pole, open Type 1 high SCCR SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available black label high SCCR DIN-Rail SPD catalog numbers.

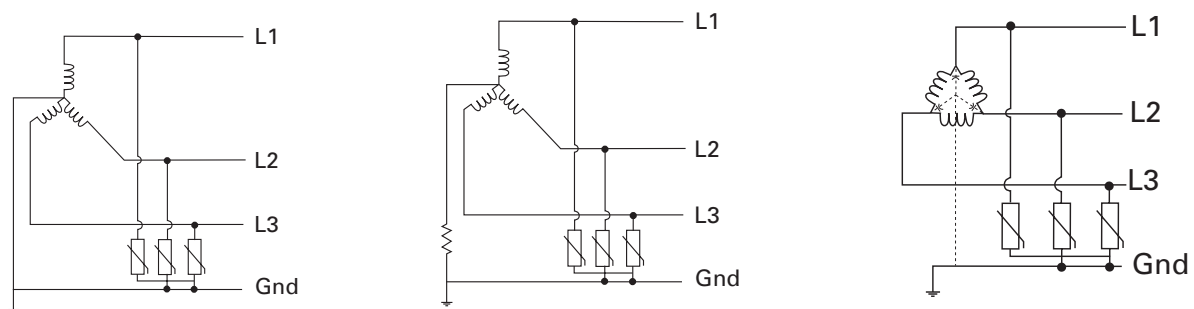
### Specifications/ordering information

System voltage/type	120/208 Vac 3-phase Wye	277/480 Vac 3-phase Wye	347/600 Vac 3-phase Wye	240 Vac 3-phase Delta	480 Vac 3-phase Delta
Catalog number	BSPMA3208WYGR	BSPMA3480WYGR	BSPMA3600WYGR	BSPMA3240DLGR	BSPMA3480DLGR
Replacement module catalog number (qty.)	BPMA180UL (3)	BPMA385UL (3)	BPMA510UL (3)	BPMA275UL (3)	BPMA550UL (3)
SPD class acc. to ANSI/UL 1449 4th Ed.	Open-Type 1 SPD				
SPD class acc. to CSA C22.2 No. 269.1-14	Type 4-1 Component Assembly				
Nominal system voltage ( $U_N$ ) [L-G] / [L-L]	120 Vac / 208 Vac	277 Vac / 480 Vac	347 Vac / 600 Vac	240 Vac / 240 Vac	480 Vac / 480 Vac
Nominal power frequency	50 / 60 Hz				
Max. continuous operating voltage AC (MCOV) [L-G] / [L-L]	180 Vac / 360 Vac	385 Vac / 770 Vac	510 Vac / 1020 Vac	275 Vac / 550 Vac	550 Vac / 1100 Vac
Nominal discharge current ( $I_n$ ) (8x20 $\mu$ s)	20 kA				
Max. discharge current ( $I_{max}$ ) (8/20)	50 kA				
Voltage Protection Rating ( $V_{PR}$ ) [L-G] / [L-L]	600 V <sub>pk</sub> / 1200 V <sub>pk</sub>	1200 V <sub>pk</sub> / 2500 V <sub>pk</sub>	1500 V <sub>pk</sub> / 3000 V <sub>pk</sub>	800 V <sub>pk</sub> / 1500 V <sub>pk</sub>	1800 V <sub>pk</sub> / 3000 V <sub>pk</sub>
Short Circuit Current Rating (SCCR)	200 kA				
Operating temperature range ( $T_U$ ) °F (°C)	-31 to 185 (-35 to 85)				
Operating state / fault indication	Green = good ; Red = replace				
Wire range (60/75°C Cu, solid/stranded)	4-14 AWG (2.5-25 mm <sup>2</sup> )				
Terminal torque	35-45 (4-5.1)				
Mounting	35 mm DIN-Rail per EN 60715				
Enclosure material	Thermoplastic, UL 94 V0				
Protection	IP20 (finger-safe)				
Capacity	3 module(s), DIN 43880				
Agency information	UL Listed, Guide VZCA, VZCA7/CSA Component Acceptance Class 2157-27, RoHS				
Weight — oz (g)	10.93 (310)	12.24 (347)	13.05 (370)	11.46 (325)	13.4 (380)

### Contact signaling

Signaling type	Floating (dry), Form C (SPDT)
NEC Circuits	NEC Class 2 circuits only
Switching capacity AC (DC)	250 V/5 A (250 V/0.1 A, 125 V/0.2 A, 75 V/0.5 A)
Wire range (60/75°C Cu, solid/stranded)	16-22 AWG (1.5-0.34 mm <sup>2</sup> )
Terminal torque — lb-in (N•m)	1.8 (0.2)

### Typical installation/system application:





#### 4-Pole, UL Type 1 DIN-Rail high SCCR SPDs



#### Catalog symbol:

- BSPMA4\_WYNGR

#### Description:

Bussmann series four-pole DIN-Rail UL Listed Type 1 surge protective devices feature a high 200 kA SCCR. Replaceable arrestor modules are mechanically coded with the base to ensure against installing an incorrect replacement. The unique module locking system fixes the module to the base, and allows it to be easily replaced without tools by simply depressing the release buttons.

#### Standard local visual status indication:

The module's visual indicator shows the protective status at a glance: green = good, red = replace.

#### Remote contact signaling:

The standard three-pole terminal remote Form C contact signaling relay has a floating changeover contact for use as a break or make contact, according to circuit concept.

#### Ratings:

- System volts/types
  - 120/208 Vac 3-phase Wye
  - 277/480 Vac 3-phase Wye
- Short-circuit Current Rating (SCCR) 200 kA

#### Agency information:

- UL Listed open Type 1, ANSI/ UL 1449 4<sup>th</sup> Edition, Guide VZCA2, VZCA8
- CSA Type 4-1 Component Assembly, C22.2 No. 269.1-14, Class 2157-27
- RoHS compliant

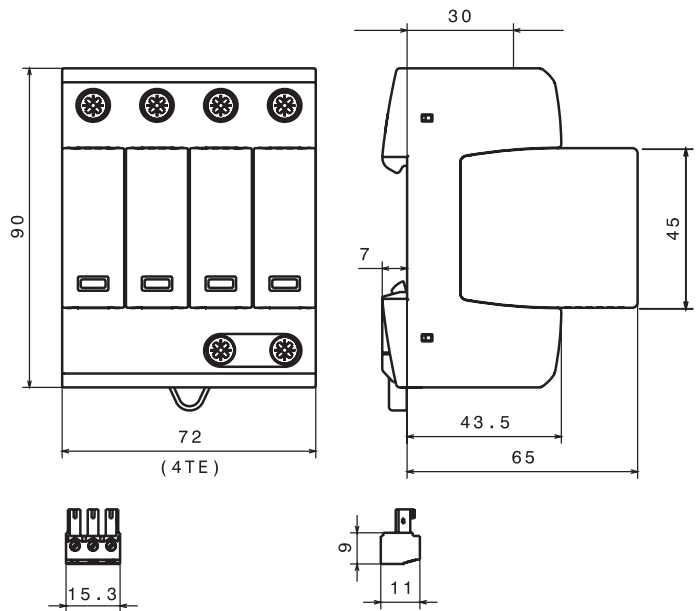
#### Mounting

- 35 mm DIN-Rail

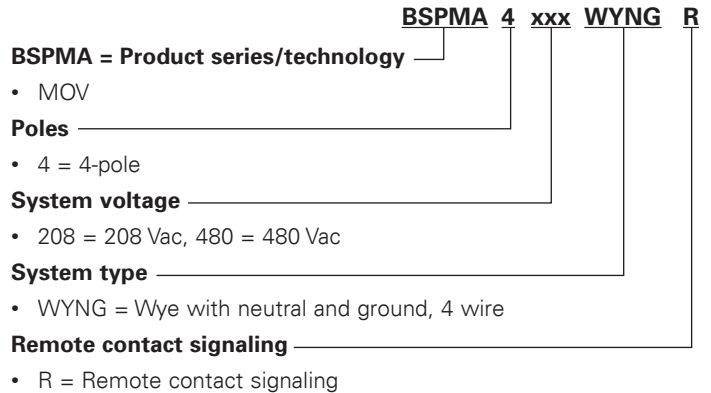
#### Warranty

- Five years

#### Dimensions — mm



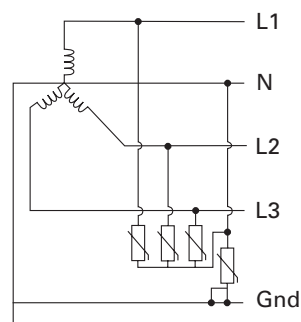
#### 4-pole, open Type 1 high SCCR SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available black label high SCCR DIN-Rail SPD catalog numbers.

Specifications/ordering information		System volts/catalog no.
System voltage/type	120/208 Vac 3-phase Wye	277/480 Vac 3-phase Wye
Catalog number	BSPMA4208WYNGR	BSPMA4480WYNGR
Replacement module catalog number (qty.)	BPMA180UL (4)	BPMA385UL (3), BPMA180UL (1)
SPD class acc. to ANSI/UL 1449 4 <sup>th</sup> Ed.	Open-Type 1 SPD	
SPD class acc. to CSA C22.2 No. 269.1-14	Type 4-1 Component Assembly	
Nominal system voltage ( $U_N$ ) [L-N] / [L-G] / [L-L] / [N-G]	120 Vac / 120 Vac / 208 Vac / 0 Vac	277 Vac / 277 Vac / 480 Vac / 0 Vac
Nominal power frequency	50 / 60 Hz	
Max. continuous operating voltage AC (MCOV) [L-N] / [L-G] / [L-L] / [N-G]	180 Vac / 360 Vac / 360 Vac / 180 Vac	385 Vac / 565 Vac / 770 Vac / 180 Vac
Nominal discharge current ( $I_n$ ) (8x20 $\mu$ s)	20 kA	
Max. discharge current ( $I_{max}$ ) (8/20)	50 kA	
Voltage Protection Rating ( $V_{PR}$ ) [L-N] / [L-G] / [L-L] / [N-G]	600 V <sub>pk</sub> / 1200 V <sub>pk</sub> / 1200 V <sub>pk</sub> / 600 V <sub>pk</sub>	1200 V <sub>pk</sub> / 1800 V <sub>pk</sub> / 2500 V <sub>pk</sub> / 600 V <sub>pk</sub>
Short Circuit Current Rating (SCCR)	200 kA	
Operating temperature range ( $T_U$ ) °F (°C)	-31 to 185 (-35 to 85)	
Operating state / fault indication	Green = good ; Red = replace	
Wire range (60/75°C Cu, solid/stranded)	4-14 AWG (2.5-25 mm <sup>2</sup> )	
Terminal torque — lb-in (N•m)	35-45 (4-5.1)	
Mounting	35 mm DIN-Rail per EN 60715	
Enclosure material	Thermoplastic, UL 94 V0	
Protection	IP20 (finger-safe)	
Capacity	4 module(s), DIN 43880	
Agency information	UL Listed, Guide VZCA, VZCA7/CSA Component Acceptance Class 2157-27, RoHS	
Weight — oz (g)	13.9 (394)	15.24 (432)
Contact signaling		
Signaling type	Floating (dry), Form C (SPDT)	
NEC Circuits	NEC Class 2 circuits only	
Switching capacity AC (DC)	250 V/5 A (250 V/0.1 A, 125 V/0.2 A, 75 V/0.5 A)	
Wire range (60/75°C Cu, solid/stranded)	16-22 AWG (1.5-0.34 mm <sup>2</sup> )	
Terminal torque — lb-in (N•m)	1.8 (0.2)	

**Typical installation/system application:**



## UL Recognized Type 4 component assembly DIN-Rail non-SCCR AC/DC power and control SPDs

## 1-Pole low voltage power SPDs

Bussmann series UL Type 4, 75 Vac/100 Vdc, 120 Vac/200 Vdc single pole, modular surge arresters feature local, *easyID* visual indication and remote contact signaling. The unique module locking system fixes the protection module to the base part. Modules can be easily replaced without tools by simply depressing the release buttons. Integrated mechanical coding between the base and protection module ensures against installing an incorrect replacement module.



## LV power system arresters

The features of these single-pole devices are for use as a single device or in combination with other devices for AC and DC voltage systems.

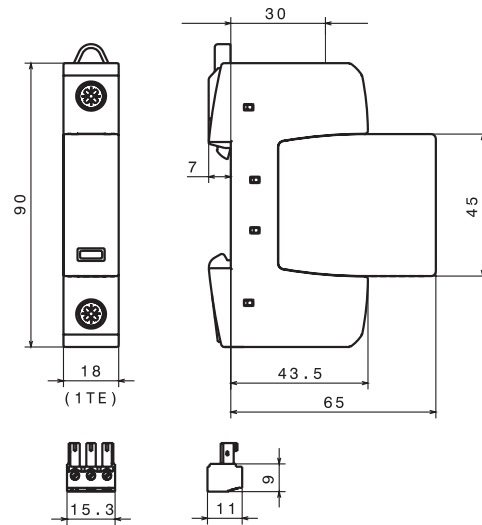
- Surge arrester according to UL 1449 4<sup>th</sup> Edition, Type 4 component assembly helps meet UL 508A requirements\*
- Proven MOV technology for reliable surge protection
- "Thermo Dynamic Control" SPD monitoring device ensures high reliability against surge events
- Module locking system with module release button make module replacement easy without tools
- Remote signaling of all protection modules make status monitoring easy and accurate in any monitoring scheme
- No additional upstream overcurrent protection necessary to make installation easier and more economical
- Vibration and shock tested according to EN 60068-2 to withstand harsh environments

\* Except as noted in data sheet no. 2056.

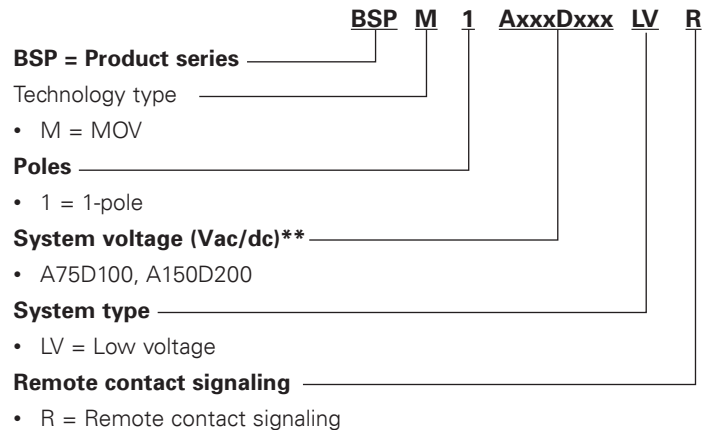
## Remote signaling Form C contact

The remote signaling contact versions have a floating changeover contact for use as a break or make contact for easy adoption in any monitoring application.

### Dimensions – mm



### 1-pole blue label power SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available blue label low voltage power DIN-Rail SPD catalog numbers.

\*\*See specific catalog numbers for exact combinations of AC and DC ratings.

## Catalog numbers and specifications

Ordering information — for 75 Vac/100 Vdc to 120 Vac/200 Vdc		System volts/catalog no.	
System voltage		75 Vac/100 Vdc	120 Vac/200 Vdc
Catalog no. (base + modules)	With remote signaling	BSPM1A75D100LVR	BSPM1A150D200LVR
Replacement modules		BPMA75D100LV	BPMA150D200LV
Specifications			
Max. continuous operating AC voltage [V <sub>c</sub> ]		75 Vac	150 Vac
Voltage protection level [VPL]		≤0.4 kV	≤0.7 kV
Voltage protection level at 5 kA [VPL]		≤0.35 kV	≤0.55 kV
Max. continuous operating DC voltage [V <sub>c</sub> ]		100 Vdc	200 Vdc
Nominal discharge current (8/20 μs) [I <sub>n</sub> ] AC		10 kA	15 kA
Nominal discharge current (8/20 μs) [I <sub>n</sub> ] DC		10 kA	12.5 kA
Surge current capacity(8/20 μs) [I <sub>max</sub> ]		40 kA	40 kA
Temporary overvoltage (TO V)		90 V / 5 sec.	175 V / 5 sec.
Agency information*		UL / cUL, CSA, KEMA	UL / cUL, CSA, KEMA
Specifications — all catalog numbers			
SPD according to EN 61643-11		Type 2	
SPD according to IEC 61643-1		Class II	
Response time [t <sub>A</sub> ]		≤25ns	
TOV characteristics		Withstand	
Operating temperature range [T <sub>U</sub> ]		-40°C to +80°C	
Operating state/fault indication		Green (good) / red (replace)	
Number of ports		1	
Cross-sectional area (minimum)		14 AWG solid/stranded	
Cross-sectional area (maximum)		1 AWG solid — 2 AWG stranded	
Mounting		35 mm DIN-Rail per EN 60715	
Enclosure material		Thermoplastic, UL 94 V0	
Location category		Indoor	
Degree of protection		IP20	
Capacity		1 module, DIN 43880	
Warranty		Five years**	
Remote contact signaling			
Remote contact signaling type		Changeover contact	
AC switching capacity (volts/amps)		250 V/0.5 A	
DC switching capacity (volts/amps)		250 V/0.1 A; 125 V/0.2 A; 75 V/0.5 A	
Conductor ratings / cross-sectional area for remote contact signal terminals		60/75°C Max. 14 AWG solid/stranded	
Ordering information		Order from catalog numbers above	

\* Agency information not applicable to DC ratings.

\*\* See Limited Warranty Statement 3A1502 for details at [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries).

2-Pole low voltage control SPDs

Bussmann series UL Type 4 24 Vac/dc, 48 Vac/dc, 60 Vac/dc, 120 Vac/dc and 230 Vac/dc, two-pole, modular surge arresters feature local, *easyID* visual indication and remote contact signaling. The unique module locking system fixes the protection module to the base part. Modules can be easily replaced without tools by simply depressing the release buttons. Integrated mechanical coding between the base and protection module ensures against installing an incorrect replacement module.



LV system arresters

The features of these two-pole devices are for use in coordination with other upstream SPDs in UL 508A Applications\*.

- Surge arrester according to UL 1449 4<sup>th</sup> Edition, Type 4 component assembly helps meet UL 508A requirements
- Proven MOV and GDT hybrid technology for reliable surge protection
- "Thermo Dynamic Control" SPD monitoring device ensures high reliability against surge events
- Module locking system with module release button make module replacement easy without tools
- Remote signaling on all protection modules make status monitoring easy and accurate in any monitoring scheme
- No additional upstream overcurrent protection needed so installation is easier and more economical
- Vibration and shock tested according to EN 60068-2 to withstand harsh environments

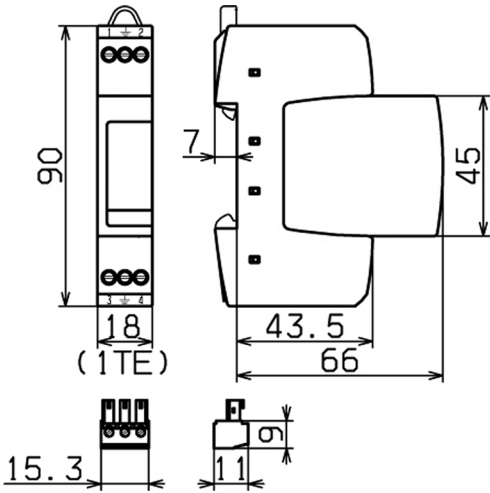
\* UL 1449 4<sup>th</sup> Edition not applicable to DC voltages.

Remote signaling Form C contact

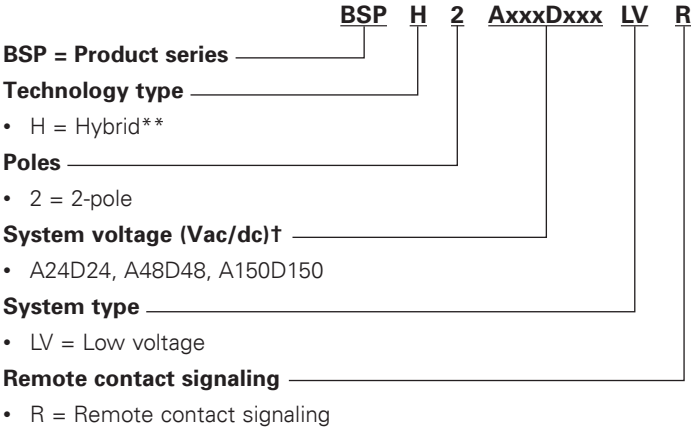
Remote signaling has a floating changeover contact for use as a break or make contact for easy application in any monitoring system.

UL Type 1, 2, 3 and Type 4 component assembly, and data signal surge protective devices

Dimensions — mm



2-pole blue label control SPD catalog number explanation\*



\* This is not a catalog number system for configuring and ordering an SPD for a particular application. It is an explanation of the available blue label low voltage control DIN-Rail SPD catalog numbers.

\*\* Hybrid technology is a combination of one or more technologies in one module such as an MOV with a Gas Discharge Tube (GDT).

† See specific catalog numbers for exact combinations of AC and DC ratings.



## Catalog numbers and specifications

Ordering information		System volts/catalog no.	
System voltage	24 Vac/dc	48 Vac/dc	120 Vac/dc
Max. continuous operating AC voltage (MCOV) [V <sub>c</sub> ]	30 Vac/dc	60 Vac/dc	150 Vac/dc
Catalog no.(base + modules)	BSPH2A24D24LVR	BSPH2A48D48LVR	BSPH2A150D150LVR
Replacement Modules	BPHA24D24LV	BPHA48D48LV	BPHA150D150LV
Specifications			
Nominal AC voltage [V <sub>n</sub> ]	24 V	48 V	120 V
Max. continuous operating AC voltage [V <sub>c</sub> ]	30 V	60 V	150 V
Max. continuous operating DC voltage [V <sub>c</sub> ]	30 V	60 V	150 V
Nominal discharge current (8/20 μs) [I <sub>n</sub> ]	1 kA	1 kA	2 kA
Total discharge current (8/20 μs) [L+N-Gnd] [I <sub>total</sub> ]	2 kA	2 kA	4 kA
Nominal load current AC [I <sub>L</sub> ]	25 A	25 A	25 A
Combined impulse [U <sub>oc</sub> ]	2 kV	2 kV	4 kV
Combined impulse [L+N-Gnd] [U <sub>oc total</sub> ]	4 kV	4 kV	8 kV
Voltage protection level [L-N] [VPL]	≤180 V	≤350 V	≤640 V
Voltage protection level [L/N-Gnd] [VPL]	≤630 V	≤730 V	≤800 V
SPD according to EN 61643-11		Type 3	
SPD according to IEC 61643-1		Class III	
Response time [L-N] [t <sub>A</sub> ]		≤25ns	
Response time [L/N-Gnd] [t <sub>A</sub> ]		≤100ns	
Operating temperature range [T <sub>u</sub> ]		-40°C to +80°C	
Operating state/fault indication		Green (good) / red (replace)	
Number of ports		1	
Cross-sectional area (min.)		18 AWG solid/stranded	
Cross-sectional area (max.)		10 AWG solid/12 AWG stranded	
For mounting on		35 mm DIN-Rail per EN 60715	
Enclosure material		Thermoplastic, UL 94 V0	
Location category		Indoor	
Degree of protection		IP20	
Capacity		1 Module, DIN 43880	
Agency information*		UL / cUL, CSA, KEMA	
Product warranty		Five years**	
Remote contact signaling			
Remote contact signaling type		Changeover contact	
AC switching capacity (volts/amps)		250 V/0.5 A	
DC switching capacity (volts/amps)		250 V/0.1 A; 125 V/0.2 A; 75 V/0.5 A	
Conductor ratings and cross-sectional area for remote contact signal terminals		60/75°C Max. 14 AWG solid/stranded	
Ordering information		Order from catalog numbers above	

\* Agency information not applicable to DC ratings.

\*\*See Limited Warranty Statement 3A1502 for details at [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries).

UL Listed data signal SPDs for telecom and instrumentation data signal applications

Overview

- UL 497B Listed to protect equipment and wiring against the effects of excessive currents caused by lightning
- RJ45 / Ethernet data cable and universal 4 wire versions available for popular data signal applications
- DIN-Rail mount makes installation easy
- Data signal SPDs complement BSPD, BSPA and SurgePOD PRO Type 1, and DIN-Rail UL SCCR and non SCCR low voltage surge product lines for comprehensive system surge protection
- Five year warranty on all data signal SPDs

Universal 4 wire data signal SPDs for measurement, control and regulation circuits, and twisted pairs

Universal 4 wire, DIN-Rail mounted surge arresters provide effective protection with a minimum footprint and are designed for stringent requirements on the availability of measurement, control and regulation circuits, and bus systems.

- Function-optimized design for safe use and easy installation
- Module removal without signal interruption via “make-before-break” circuitry



DIN-Rail universal 4 wire SPDs

The Bussmann series universal four-pole, DIN-Rail mounted surge arrester is UL Listed 497B DIN-Rail mount universal surge protective device. It requires minimum space, while providing effective protection for the stringent requirements of measuring and control circuits, and bus systems.

To ensure safe operation, the arrester provides protection against vibration and shock up to a 30-fold acceleration of gravity. The device's function-optimized design allows quick and easy protection module removal via “make-before-break” terminals that assure data signal continuity in the protected and unprotected state.



For IEC Applications — Instruction for Surge Protective Device Use In Zone 2 Explosive Atmospheres per ATEX.

1. When installed in potentially explosive atmospheres, the Data Signal SPD shall be installed into an enclosure which meets the requirements of a recognized type of protection, in accordance with EN 60079-0.
2. The Data Signal DIN SPD as transient suppressor. This approval applies to the following equipment types:
  - BSPD5DINLHF
  - BSPD24DING

UL Type 1, 2, 3 and Type 4 component assembly, and data signal surge protective devices

RJ45 connector SPD for Ethernet data cables

The DIN-Rail mount BSPD48RJ45 SPD for Ethernet cable systems is easy to install between the patch panel and the active component in new, or retrofitting into existing installations. It is well suited for Gigabit Ethernet, ATM, ISDN, Voice over IP and Power over Ethernet (PoE).



- CAT 6 according to ISO/IEC 11801 and in the channel (Class E)
- Power over Ethernet (PoE+ according to IEEE 802.3at) up to 57 volts

Specifications

Value	Data signal SPD type	
	Universal 4 wire	RJ45 Ethernet
Terminals/connectors	Screws	RJ45
System voltages	5 and 24 V	48 V
MCOV DC	6 and 33 V	48 V
Housing material	Polyamide PA 6.6	Die cast zinc
Grounding	DIN-Rail	
Protection	IP20	
Operating temperature range	-40°C to +80°C	
Agency information	UL Listed 497B	
RoHS compliant	Yes	

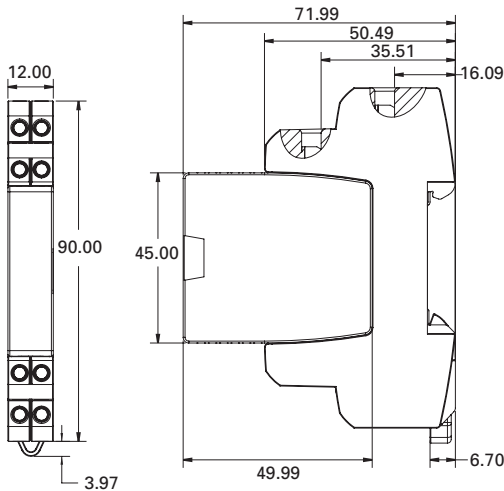
Ambient and temperature class

- -40°C to 80°C, T4: DEKRA 12ATEX0254 X: II 3 G Ex nA IIC T4 Gc
- Standards used for: ATEX: EN60079-0: 2009, EN 60079-15: 2005

Features

- UL 497B Listed
- Function-optimized design for safe use and easy installation
- Four-pole and base mounts on grounded 35 mm DIN-Rail
- Module removal without signal interruption via “make-before-break” circuitry

Dimensions — mm



## Catalog numbers and specifications

Specification	BSPD24DING	BSPD5DINLHF
Nominal voltage ( $U_N$ )	24 V	5 V
Nominal current at 45°C ( $I_N$ )	0.75 A	1.0 A
VPL line-line for $I_{imp}$ D1 ( $U_p$ )	≤102 V	≤25 V
VPL line-PG for $I_{imp}$ D1 ( $U_p$ )	≤66 V	≤550 V
VPL line-line at 1 kV/μs C3 ( $U_p$ )	≤90 V	≤11 V
VPL line-PG at 1 kV/μs C3 ( $U_p$ )	≤45 V	≤550 V
D1 Total lightning impulse current (10/350 μs) ( $I_{imp}$ )	10 kA	10 kA
D1 Lightning impulse current (10/350 μs) per line ( $I_{imp}$ )	2.5 kA	2.5 kA
C2 Total nominal discharge current (8/20 μs) ( $I_n$ )	20 kA	20 kA
C2 Nominal discharge current (8/20 μs) per line ( $I_n$ )	10 kA	10 kA
Series impedance per line	1.8 Ω	1.0 Ω
Max. continuous operating DC voltage ( $U_C$ )	33 V	6 V
Max. continuous operating AC voltage ( $U_C$ )	23.3 V	4.2 V
Cut-off frequency line-PG ( $f_G$ )	6.8 MHz	100 MHz
Capacitance line-line (C)	≤0.5 nF	≤25 pF
Capacitance line-PG (C)	≤1.0 nF	≤16 pF
ATEX Approvals	†	†
Agency information	††	††
IEC 61643-21 test category	D1, C2, C3	
Operating temperature range	-40°C to +80°C	
Degree of protection	IP20	
For mounting on	35 mm DIN-Rails per EN 60715	
Grounding	Via base part	
Color / enclosure material	Grey / Polyamide PA 6.6	
Test standards	IEC 61643-21 / EN 61643-21, UL 497B	
Connection (input / output)	Screw terminal	
Conductors	Solid: 12-28 AWG (4-0.08 mm <sup>2</sup> )	
	Flexible: 14-28 AWG (2.5-0.08 mm <sup>2</sup> )	
Terminal torque	3.5 lb-in (0.4 N•m)	
Warranty	5 Years*	

\* See Bussmann series SPD Limited Warranty Statement (3A1502) for details at [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries).

† DEKRA 12ATEX0254 X: II 3 G Ex nA IIC T4 Gc.

††ATEX, UL, CSA.

## DIN-Rail universal 4 wire SPD applications

A universal 4 wire data signal SPD is specified by the bus system, measuring, control and communication technology.

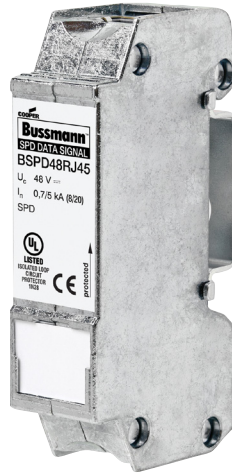
The table below contains the technology in which the BSPD5DINLHF and BSPD24DING are suited to be used.

BSPD5DINLHF applications	
CAN-Bus (data line only)	PROFIBUS DP/FMS
C-Bus (Honeywell)	PROFIBUS SIMATIC NET
Device Net (data line only)	PSM EG RS422 and RS485
FSK	Rackbus (RS485)
IEC-Bus (RS485)	R Bus
Interbus INLINE,	RS 485
LON - TP/XF 78	RS422, V11
MODBUS	SafetyBUS p
MPI Bus	Securilan LON Bus
Procontic T200 (RS422)	SUCONET
BSPD24DING applications	
0-20mA, 4-20mA signals	TTY 4-20mA
Binary signals	

**DIN-Rail RJ45/Ethernet cable SPD**

The Bussmann series DIN-Rail mount BSPD48RJ45 Surge Protective Device (SPD) is a UL Listed 497B universal DIN-Rail mount surge protective device for RJ45/Ethernet cable systems. It is easy to install or retrofit Ethernet cable systems with RJ connectors.

The BSPD48RJ45 is installed between the patch panel and the active component (a switch for example). The snap-in mechanism of the supporting foot allows the SPD to be safely grounded via the DIN-Rail. For single applications, the BSPD48RJ45 comes with a supplied mounting bracket with cable lug.



Fulfilling the requirements of Category 6, the BSPD48RJ45 can be universally used for all data services up to nominal voltages of 48 V. It is well suited for existing services such as Gigabit Ethernet, ATM, ISDN, Voice over IP and Power over Ethernet (PoE+ acc. to IEEE 802.3at up to 57 V) and similar applications in structured cabling systems according to Class E up to 250 MHz. Protection of all pairs by means of powerful gas discharge tubes and one adapter filter matrix per pair.

- UL 497B Listed
- Easy to install or retrofit for protection of all lines
- CAT 6 according to ISO/IEC 11801
- CAT 6 in the channel (Class E)
- Power-over-Ethernet (PoE+ according to IEEE 802.3at)

**DIN-Rail RJ45 SPD applications****BSPD48RJ45 applications****Bus systems, and measuring and control technology**

Industrial Ethernet

**Data networks**

ATM

Ethernet 10/100/1000

FDDI, CDDI

Industrial Ethernet

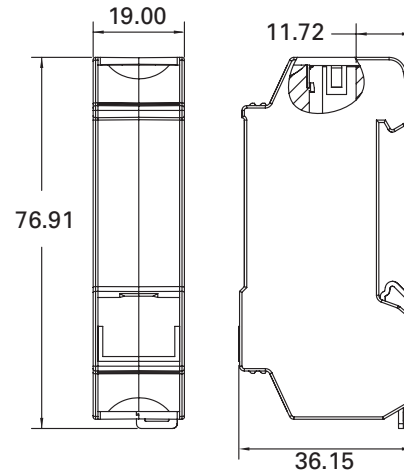
Power over Ethernet (PoE)

Token Ring

VG any LAN

**Video systems**

Video (2 wire)

**Dimensions — mm****Catalog numbers and specifications**

Specification	BSPD48RJ45
Nominal voltage ( $U_N$ )	48 V
Max. continuous operating DC voltage ( $U_C$ )	48 V
Max. continuous operating AC voltage ( $U_C$ )	34 V
Max. continuous DC voltage pair-pair (PoE) ( $U_C$ )	57 V
Nominal current ( $I_n$ )	1 A
C2 Nominal discharge current (8/20 $\mu$ s) line-line ( $I_n$ )	150 A
C2 Nominal discharge current (8/20 $\mu$ s) line-PG ( $I_n$ )	2.5 kA
C2 Total nominal discharge current (8/20 $\mu$ s) line-PG ( $I_n$ )	10 kA
C2 Nominal discharge current (8/20 $\mu$ s) pair-pair (PoE) ( $I_n$ )	150 A
Voltage protection level line-line for In C2 ( $U_p$ )	$\leq 190$ V
Voltage protection level line-PG for In C2 ( $U_p$ )	$\leq 600$ V
Voltage protection level line-line for In C2 (PoE) ( $U_p$ )	$\leq 600$ V
Voltage protection level line-line at 1 kV/ $\mu$ s C3 ( $U_p$ )	$\leq 180$ V
Voltage protection level line-PG at 1 kV/ $\mu$ s C3 ( $U_p$ )	$\leq 500$ V
Voltage protection level pair-pair at 1 kV/ $\mu$ s C3 (PoE) ( $U_p$ )	$\leq 600$ V
Insertion loss at 250 MHz	$\leq 3$ dB
Capacitance line-line (C)	$\leq 30$ pF
Capacitance line-PG (C)	$\leq 25$ pF
Operating temperature range	-40°C to +80°C
Degree of protection	IP10
Mounting	35 mm DIN-Rail per EN 60715
Connection (input / output)	RJ45 socket / RJ45 socket
Pinning	1 / 2, 3 / 6, 4 / 5, 7 / 8
Grounding	Via 35 mm DIN-Rail per EN 60715
Enclosure material	Die cast zinc
Color	Bare surface
Test standards	IEC 61643-21 / EN 61643-21
Agency information	UL 497B
Warranty	Five years*

\* See Limited Warranty Statement 3A1502 for details at [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries).

## Frequently asked questions (FAQs)

### 1. Why are surge protective devices needed?

Electronic devices and equipment often contain microprocessors that rely on fast digital ON/OFF coded sequence signals. Distortion on power or signal lines may disrupt these sensitive signals. As electronic equipment become smaller and more powerful, they become more sensitive to power and signal line distortions — particularly due their circuit density (microchips having literally thousands of transistors on a single chip). To help safeguard microprocessor reliability and uptime, surge protective devices have become the standard technology so that they don't get "upset," "degraded" or "damaged" by surge events, depending on the surge magnitude, the system configuration and load sensitivity.

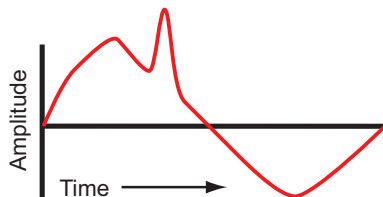
### 2. What are surges, transients and temporary overvoltages (TOVs)?

All these are various forms of voltage disturbances and they are often used interchangeably. The true definition of these terms is related to their defined duration.

Transients as defined by IEEE Standard 1313.1-1996 are "a short-duration highly damped, oscillatory or non-oscillatory overvoltage, having duration of a few milliseconds or less. Transient overvoltage is classified as one of the following types: lightning, switching and very fast front, short duration." These can be generated by voltage spikes which contain very little energy but are sufficient in voltage to cause damage to sensitive electronics.

Surge is an overvoltage condition that usually lasts longer in duration, >10  $\mu$ s and <1 Ms and has higher energy to them that can cause damage to electrical and electronic equipment.

Temporary Overvoltage (TOV) are created by faults on the utility power distribution system and can cause extensive damage since their time domain is much longer (ms to seconds to hours).



Surges & Transients

### 3. What is a surge protector?

A surge protector is a device that limits transient overvoltages to a safe level, thus protecting equipment it is connected to from damage. A surge protector is generally referred to as an SPD (Surge Protective Device). There are different variations of SPDs such as lightning arresters and surge arresters or secondary surge arresters.

### 4. What is the difference between terms "Surge Arrester," "Surge Protective Device (SPD)" and "Transient Voltage Surge Suppressor (TVSS)"?

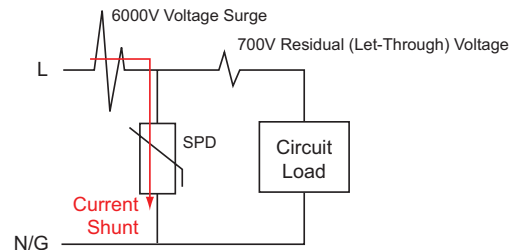
These terms are often used interchangeably and rather loosely. However, the two terms have different meanings as determined by the National Electrical Code® (NEC) ([www.nfpa.org](http://www.nfpa.org)), their UL listing, and applicable IEEE/ANSI standards.

According to NEC Article 285 TVSSs have been redefined as "Surge Protective Devices (SPDs) 1 kV or Less." Previously titled "Transient Voltage Surge Suppressors: TVSSs," this Article now uses the "type" designations that parallel the new requirements in UL 1449, 4<sup>th</sup> Edition. It also includes general, installation, and connection requirements for these SPD types installed on premises wiring systems rated 1 kV or less.

### 5. How does an SPD work?

A surge protector works by momentarily "switching" from a high impedance state into a highly conductive, low impedance state and shunting the surge energy to the ground and in doing so, limits the overvoltage to a lower, acceptable level. When the surge event is over, the protector returns to its high impedance state, ready for the next event or at end of life, fails open safely until replaced.

In other words, the SPD acts as a pressure relief valve. The pressure relief valve (SPD) does nothing until an overpressure (voltage surge) occurs in the supply (power) similar to the pressure relief valve.



### 6. What is shunting?

Shunting is the term used to describe the process by which an SPD redirects voltage transient energy to ground through a low impedance path.

### 7. How do I select and specify an SPD?

When it is determined an SPD is desired or required, specifying an SPD involves:

- Knowing the installation location and whether you can use Type 1, Type 2 or Type 3
- Determining the system type (single-phase, split-phase, Wye or Delta)
- Determining the system voltage

See page 5 for determining the location and suitable Type, and page 10 for specifying electrical system type and voltage.

Once all three are known, you can start the specification process by going to the appropriate product group:

- Type 1 UL Listed, NEMA 4X — SurgePOD PRO
- Type 1 and Type 2 NEMA 1 and 4X — BSPD or BSPA
- Open Type 1 UL Listed DIN-Rail — BSPMA black label high SCCR
- Type 4 component assembly UL Recognized — Blue label low voltage power (BSPMA) and control (BSPH)

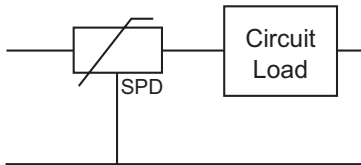
### 8. Can anyone install an AC or DC SPD?

All SPDs, whether AC or DC, should be installed by qualified personnel following established safety procedures. This will help ensure that all the safety requirements and all local codes are met. The most common installation is in "parallel" to the load/device.

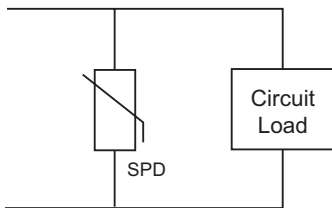


## 9. What are the differences between series vs. parallel SPDs?

Series installed SPD are typically used at the equipment level, either right in front of, or within the equipment they are protecting. These SPD have an “input” and an “output” whereas parallel SPD do not. A common example of a series connected SPD is a “surge strip.” Since they are connected in series with the equipment, they conduct load current. It is also common for a series AC SPD to contain a EMI/RFI noise filter. This filtering is useful when it is right in front of the equipment to filter out noise generated by other loads.

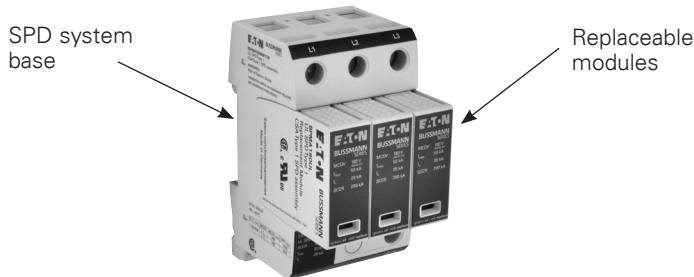


Parallel SPDs do not conduct load current and are commonly used where large surge energies exist. They're used on service entrance panels and switchgear, plus branch and local panels. Parallel connected protectors are essential for all commercial and industrial AC applications.



## 10. What is a DIN-Rail SPD with replaceable modules?

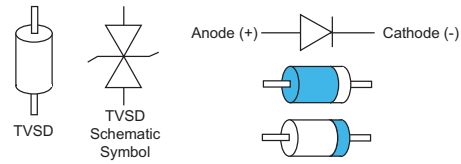
Replaceable module SPDs contain one or more field removable/replaceable modules. The replaceable modules make maintenance easy and minimize downtime. The modules are the heart of the surge protector and usually contain the metal oxide varistors (MOV) and thermal disconnect. In some instances external fusing is required and or used in place of thermal disconnect.



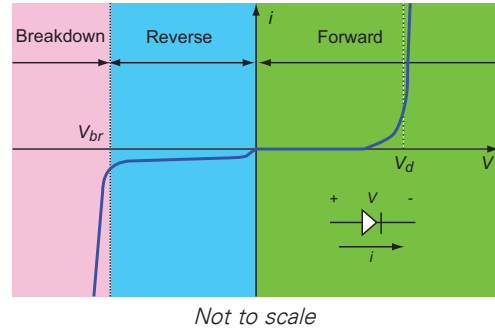
## UL Type 1, 2, 3 and Type 4 component assembly, and data signal surge protective devices

## 11. What technologies are used in making an SPD?

### Silicon Avalanche Diode (SAD) technology



The diode is installed reverse-biased under normal conditions. When the voltage rises above normal conditions the diode becomes forward-biased.



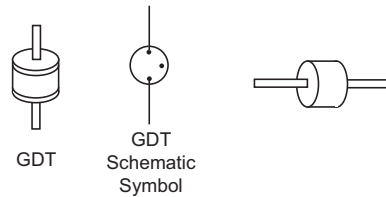
### Advantages

- Excellent voltage clamping
- Sub-nanosecond response time
- Repeatable
- Low capacitance
- Compact

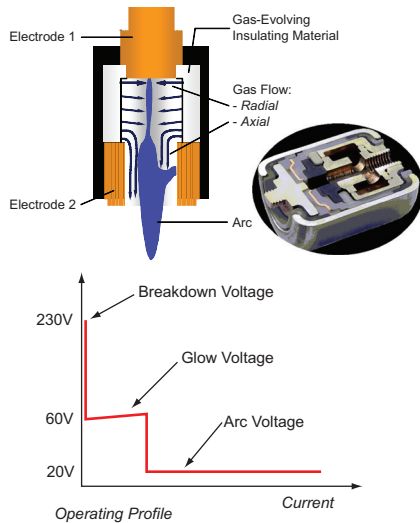
### Disadvantages

- Limited impulse or current capability

### Gas Discharge Tube (GDT)



The GDT may be regarded as a very fast acting switch having conducting properties that change very rapidly when breakdown occurs and transforms from an open-circuit to a quasi-short circuit. The result is an arc voltage of about 20 Vdc. There are four stages of operation before the tube fully switches.



1. **Non-operating domain:** Characterized by practically infinite insulation resistance.
2. **Glow domain:** At the breakdown, the conductance increases suddenly. If the current that's drained off by the gas discharge tube is less than about 0.5 A (rough value that differs from component to component), the glow voltage across the terminals will be in the 80-100 V range.
3. **Arc regime:** As the current increases, the gas discharge tube shifts from glow voltage to the arc voltage (20 V). It is this domain that the gas discharge tube is most effective because the current discharge can reach several thousand amps without the arc voltage across the terminals increasing.
4. **Extinction:** At a bias voltage roughly equal to the glow voltage, the gas discharge tube recovers to its initial insulating properties.

#### Advantages:

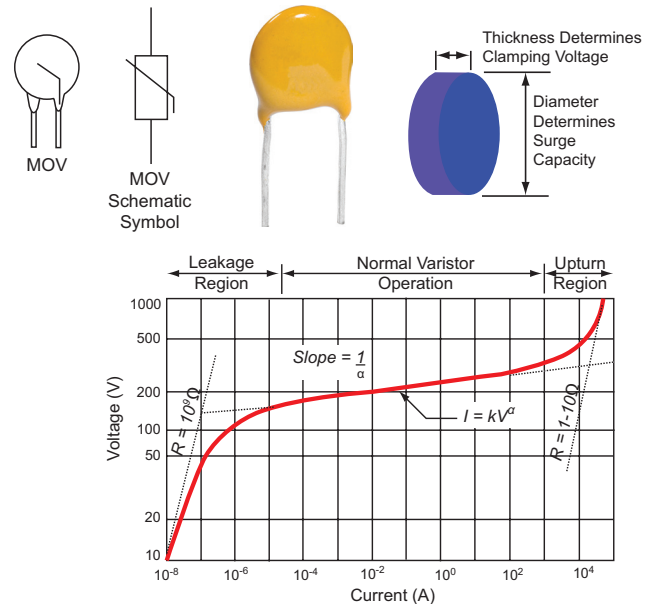
- Handles very high impulse currents, makes it ideal for lightning arresters
- Low capacitance
- Rugged and compact
- Low conduction voltage
- Repeatable

#### Disadvantages:

- Slower, 2 to 3  $\mu$ s response time
- Extinguishing it is a challenge
- Breakdown voltage depends on transient rise time allowing high overshoot voltage

#### Metal Oxide Varistor (MOV):

An MOV is a variable resistor typically made of a large block of zinc oxide grains. They act like semiconductors, an insulator below the conduction voltage and a low value resistor above it. In conduction mode, the MOV diverts and dissipates the transient. MOVs generally connects in parallel to load. The thickness of the MOV determines the clamping voltage and Diameter determines the current capacity.



#### Advantages:

- Fast, sub micro-second response time
- Good voltage conduction clamping, makes it ideal for surge arresters
- Handles high impulse currents
- Rugged
- Repeatable

#### Disadvantages:

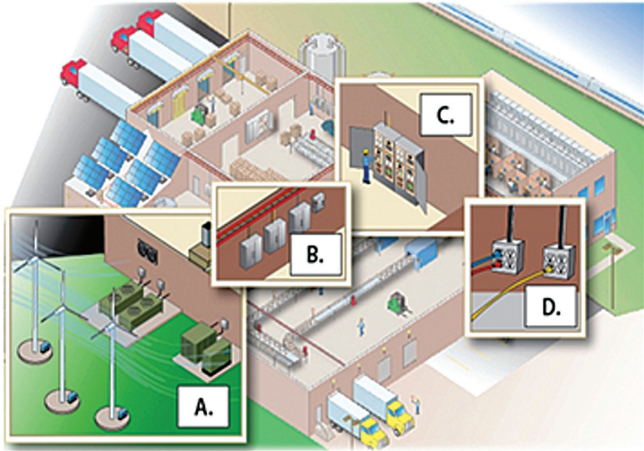
- Large relative size
- High relative capacitance

#### 12. What is a hybrid SPD?

A hybrid protector is a protector that uses more than one protection technology.

### 13. Where is the best place to install an SPD?

Ideally, an SPD should be installed at the main service entrance as close to the neutral-to-ground bond as possible, as shown below. This will ensure that surge energies are routed to earth by the most direct path. In larger facilities where distances between this primary protection and the equipment being protected are long, it is also good practice to use distributed protection all the way to point-of-use.



#### Locations

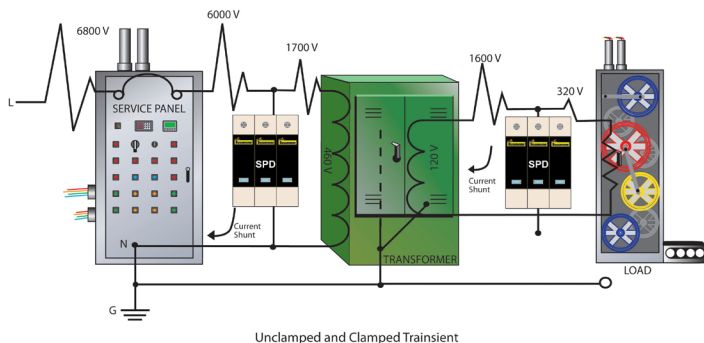
A-Very Exposed, B-Outside & Service Entrance, C-Feeders & Branch Circuits, D-Outlet and Point of Use

### 14. What is distributed (cascaded) surge protection?

Distributed protection, cascaded protection or coordination is the process of coordinating protection between the primary service entrance of a large facility and the internal branch distribution panels. Generally a surge protective device (SPD) with high surge handling capacity is installed at the service entrance while SPDs of lower surge ratings will be installed on the branch panels or dedicated supplies feeding sensitive equipment. This approach can be taken further to include point-of-use SPDs on long lines where they terminate to sensitive or critical equipment. A further example of such a distributed protection philosophy might include hard wired SPDs at the main and sub-panels and additional plug-in protectors on select equipment. (See pages 5 for SPD Types and installation locations.)

Surge Protection Applications

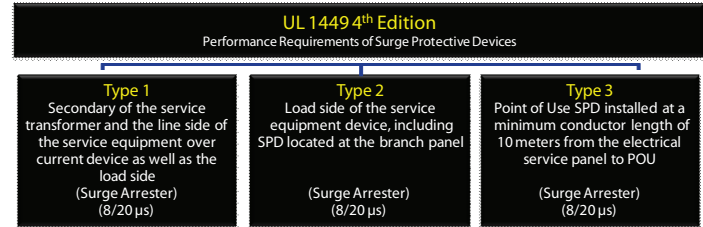
SPD Locations- Coordination (IEC)/ Cascading (UL)



## UL Type 1, 2, 3 and Type 4 component assembly, and data signal surge protective devices

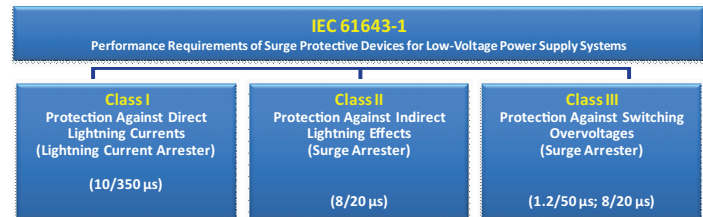
### 15. What standards govern SPDs?

NORTH AMERICA — ANSI / UL 1449 4<sup>th</sup> Edition



Standard for SPDs designed for repeated limiting of transient voltage surges as specified in the UL 1449 4<sup>th</sup> Edition for 50 or 60 Hz power circuits not exceeding 1000 V. Based upon the 1449 4<sup>th</sup> Edition standard, SPDs are either Listed or Recognized.

INTERNATIONAL STANDARD — IEC 61643-1



Low voltage surge protective devices – Part 1: Surge protective devices connected to 50/60 Hz AC and DC power circuits, and equipment rated up to 1000 V<sub>rms</sub> or 1500 Vdc. The IEC standard is a self certification or third party certification, such as KEMA, that will test and validate the results.

### 16. How is the North American surge suppression industry defined by safety standards and regulations?

NEC Requirements that SPDs follow:

- Changes to NEC 700.8 requires a listed SPD to be installed in or on all emergency system switchboards and panelboards.
- Installation of the SPD (Articles 280 and 285)

Institute of Electrical and Electronic Engineers (IEEE) Manages SPD:

- Surge environment C62.41.1
- Characterization C62.41.2
- Testing practices C62.45

National Electrical Manufacturers Association (NEMA) Standards that SPDs follow:

- Receptacles and plugs
- Enclosures

Underwriters Laboratories (UL) Certifies to SPD Standards:

- Standard 1449 4<sup>th</sup> Edition – SPD standard
- As required: Standard 1283 – EMI/RFI filters
- NEMA ratings 1449 4<sup>th</sup> Edition current standard for SPDs

## 17. What is UL 1449?

UL 1449 is the safety standard for AC surge protective devices (SPD) used on systems with voltages of 600 Vac and less. This standard addresses SPDs that are installed on the loadside of the main disconnect. A UL 1449 Listed or Recognized surge protector has been thoroughly tested for safe operations. A Voltage Protection Rating ( $V_{PR}$ ) is assigned to a UL 1449 Listed SPD as a result of these tests to help users compare SPDs. UL 1449 4<sup>th</sup> Edition went into effect in September, 2009, making all previous 2<sup>nd</sup> Edition SPDs obsolete. Any older SPDs should be inspected and may be replaced to meet the new safety standard prescribed by NEC Articles 280 and 285, which call for SPD Type products certified to the UL 1449 4<sup>th</sup> Edition.

## 18. What is NEMA LS 1?

NEMA LS 1 was a surge protector performance standard. A surge protector which meets this standard is typically used in the most hostile surge environments, at the service entrance location. Other protector locations such as branch panel and local panel protection usually do not require such a formidable protector. NEMA LS 1 was rescinded in 2009 because the document was determined to be out of date and many industry standards related to the surge environment and surge suppression had been significantly updated since the original LS 1 standard was published in 1992.

## 19. I have a photovoltaic (PV) system with net metering; does it need a surge protection system?

Yes. For PV systems, DC surge protection should be installed where the DC voltage from the PV arrays terminates at the charge controller/inverter. AC protection should be installed at the inverter's AC output to protect it from transients on the utility power lines. This can be caused by lightning or utility switching transients. In certain cases, protection should be located at the PV array locations, and at the array's local DC control circuits — where applicable. See PV SPD data sheets and installation instructions for more application details. For details on PV SPDs and the entire line of SPD products from Bussmann, visit [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries).

## 20. Why is the lead (wire) length of an AC SPD so critical?

The shorter the lead length between the protector and your panel, the lower the let-through voltages will be to your equipment. This is crucial to the effectiveness of all parallel-connected surge protectors.

SPDs are typically connected in parallel with the load. This means that the protector does not carry load current. But more importantly, it means that the SPD must efficiently divert transient currents through it during an overvoltage event. The SPD must momentarily "look" like an electrical short-circuit in order to efficiently divert large amounts of current. The longer the wire, the more inductance it has, and the greater the ( $L \times d/d_i$ ) factor will be. So when installing parallel surge protectors, keep the leads as close to, but not less than, six inches as possible for best performance.

## 21. What are the different designations for ratings between UL 1449 and IEC 61643-1?

The rating designations used in UL and IEC are in the table below.

Ratings	Agency Designation	
	UL 1449	IEC 61643-1
Nominal system voltage	$V_o$	$U_n$
Surge current capacity 8x20 $\mu$ s	$I_{max}$	$I_{max}$
Nominal discharge current 8x20 $\mu$ s	$I_n$	$I_n$
Impulse Current 10x350 $\mu$ s	—	$I_{imp}$
Voltage protection rating/level	$V_{PR}$	$U_p$
Maximum continuous operating voltage (MCOV)	$V_c$	$U_c$
Temporary overvoltage	TOV	$U_t$

## 22. How long does an SPD last?

How long an MOV-based SPD lasts depends upon how often it experiences a surge and for how long. Every time an MOV becomes conductive to shunt the surge to ground, its life is slightly degraded. The greater the surge, the greater the degradation of the MOV. One hit of 20 kA may degrade the MOV's life just as much as 15 hits at 0.2 kA. So, based upon the size and duration of surges an SPD encounters, it may last a day suppressing a large surge, or years suppressing smaller surges.

## 23. By $V_{PR}$ , what are the IEEE C62.41 defined withstand categories of equipment?

Category	Description	Overvoltage
I	Sensitive electronic circuits	<1500 V
II	Domestic electrical equipment	<2500 V
III	Distribution panels, switchgear	<4000 V
IV	Industrial equipment, meters	<6000 V

## 24. Can a BSPD, BSPA and SurgePOD PRO insulated conductor be permanently identified for equipment grounding at each end using color tape?

No, the NEC only permits changing identification on 6 AWG and larger conductors. The BSPD, BSPA and SurgePOD PRO conductors are 10 AWG and too small. Details are contained in section 250.119 *Identification of Equipment Grounding Conductors*.

NEC 250.119 (A) contains these specific words: "An insulated or covered conductor larger than 6 AWG shall be permitted, at the time of installation, to be permanently identified as an equipment grounding conductor at each end and at every point where the conductor is accessible."

## 25. Why are there requirements for installing some Type 1 or Type 2 SPDs not more than 10 feet from a bonded neutral-ground connection or greater than 10 feet from the bonded neutral-ground connection?

These requirements reflect a best practice for SPD wiring, as opposed to any code requirements. When an SPD is located within 10 feet (3 m) of the main service panel, the system can make use of the neutral line as an effective ground, due to the close proximity to the service entrance grounding conductor.

For distances greater than 10 feet (3 m), it is a best practice to select an SPD that has neutral-to-ground protection. This helps ensure a proper grounding is available for an SPD, which is critical to effectively protect the electrical system.

## 26. Where can I find the agency information for these SPDs?

To see the complete UL and CSA and other agency certificates go online to [Eaton.com/bussmannseries](http://Eaton.com/bussmannseries). Then go to the web page of the desired product and click on the certificate links available.

## 27. Why should I install data signal SPDs in addition to power SPDs?

The need for surge suppression in general is driven by the increased use of sensitive electronic equipment that can be impaired or destroyed by surges on power circuits. And much of the electronic equipment used today is also connected via coaxial cable, twisted pair or Ethernet cables. Using data signal SPDs in addition to power SPDs helps assure the entire data or video system is protected from surges, regardless of the source.



## Installing surge protective devices in accordance with NEC Article 240 and Feeder Tap Rule

### Introduction

A common question heard by technical support is “What size fuse or breaker do I need when installing an SPD?” Discussed here is the need for installing an overcurrent protection device (OCPD) with a surge protective device (SPD), along with adhering to the applicable NFPA® 70 standards, National Electrical Code (NEC) rules, Authority Having Jurisdiction (AHJ), ANSI/UL 1449 ratings, and installation practices.

### SPD design capabilities

Many SPDs employ thermally protected metal oxide varistors (MOV) that detect a transient high voltage surge and quickly shunt that surge to ground. Because the MOV cannot distinguish between transient and sustained overvoltage events, it must have a way to remove itself from the system during the overvoltage event. This keeps the SPD from entering into a thermal runaway situation that can cause internal and external damage.

The thermally protected MOVs have internal components that disconnect the MOV from the system during sustained overvoltage and overcurrent occurrences. This is accomplished by the MOV's temperature rising to a critical value that initiates a mechanical separation from the SPD's conducting components. Because the SPD itself is internally protected, it does not require external overcurrent protection in the form of a fuse or circuit breaker.

Other SPD types exist that don't have component level protection on the MOVs or are built with a different components such as silicon avalanche diodes (SAD). SPDs that are built with these component components typically require external overcurrent protection because they can't take themselves offline during an overcurrent event. If an OCPD is required for the SPD's operation, this will be indicated in the device's UL listing and manufacturers will clearly state this requirement in their installation instructions.

### NEC Article 240.4 (overcurrent protection) protection of conductors

Whether the SPD requires an OCPD or not, the installation methods must meet all applicable electrical codes. NEC Article 240.4 states all conductors (other than flexible cords, flexible cables, and fixture wires) shall be protected with an OCPD in accordance with their ampacity specified in Article 301.15, unless otherwise permitted or required in Article 240.4(A) through (G). This applies to conductors extending beyond the switchboard, switchgear, or panelboard that are used to connect an SPD to the electrical system. Connecting an externally or side mounted SPD directly to a system bus where the conductors leave the enclosure must consider the requirements of NEC 240.21(B)(1). These requirements may require an adequately sized OCPD to be provided for protection of the SPD conductors. Acceptable OCPDs are listed fuses and circuit breakers.

### NEC Article 310.15 (conductors for general wiring) ampacities for conductors rated 0—2000 V

Article 310.15(B)(16) defines the conductor ampacity that drives the maximum OCPD rating to be used to protect the conductors (OCPD rating is based on the conductor's ampacity). E.g., 60°C 10 AWG conductors will require a 30 amp OCPD.

### NEC Article 240.21 SPD installation using Feeder Tap Rule

Article 240.21(B)(1), (known as the 10 ft. Feeder Tap Rule), allows an SPD to be installed without overcurrent protection at the point of connection. The size of the conductors to the SPD are permitted to be sized based on the manufacturer instructions per the exception to NEC 240.21(B)(1)(b). However, if the conductors to the SPD leave the enclosure, they must be protected by an OCPD not sized greater than the 10 times the ampacity of the conductors. For instance, if the conductor ampacity is 30 A, then an upstream OCPD of 300 A or less must be present.

### Summary

When installing SPDs, NEC, local electrical codes and UL requirements must be followed. The proper OCPD must be used upon installation in order to meet the NEC requirements and maintain the SPD's ANSI/UL 1449 Listing. In many instances, the reason the NEC dictates external overcurrent protection is to protect the conductors, not the SPD. SPDs containing an internal OCPD can be connected directly to the electrical bus only if the installation meets all requirements contained NEC Article 240.21(B)(1), the Feeder Tap Rule, the Authority Having Jurisdiction (AHJ), or by strictly following the manufacturer's installations instructions on OCPD recommendations



## ANSI/UL 1449 short-circuit current rating and NEC Article 285.6

SPDs must comply with the current edition of ANSI/UL 1449 Standards for Safety Surge Protective Devices. The SPDs short-circuit current rating (SCCR) is determined as part of the ANSI/UL 1449 testing, and defines the SPD's suitability for use on an AC power circuit that's capable of delivering not more than a declared RMS symmetrical current during a short-circuit. This specification defines the maximum available fault current to which an SPD can be safely connected.

Article 285.7 requires that an SPD be marked with its SCCR and that it shall not be installed at a point on the system where the available fault current is greater than the SPD's SCCR. E.g., an SPD marked 50 kA SCCR shall not be installed at a point in a system with 65 kA available fault current.

### ANSI/UL 1449 testing with and without an OCPD

The NEC may require an externally mounted SPD to be protected by an OCPD if the feeder tap rule limitation is not met. Some manufacturers may choose using an OCPD to obtain their SPD's SCCR or successfully pass the withstand test. For the SPDs requiring an OCPD, the installer must match the OCPD type and rating (fuses or breaker) that was used for their UL testing. E.g., if a fuse was used for UL testing, the same fuse type (fuse class), and voltage and amp ratings must be installed in the distribution equipment when installing an externally mounted SPD. Further, for the SPD to retain its UL Listing, the OCPD must be utilized in the installation.

Conversely, some manufacturers may not use an OCPD to obtain their UL 1449 Listing. When installing these units, UL 1449 may not require using an OCPD, but the NEC may require an OCPD if the feeder tap rule limitation is not met. Some installers assume and some manufacturers incorrectly promote that such externally mounted units can be connected directly to an electrical bus without overcurrent protection. This practice may be incorrect and violate the requirements of Article 240 of the NEC. The conductors of these units must be protected with an OCPD that is properly rated according to NEC Article 310.15 or meet the feeder tap rules of 240.21(B)(1). The fact that an SPD does not require a particular OCPD to pass the UL 1449 testing does not negate the need for overcurrent protection for installation.

### SPDs containing an internal OCPD and the Feeder Tap Rule

There are SPDs that contain an internal OCPD such as a fuse or circuit breaker. A common misconception is that because the SPD's OCPD is internally wired, an externally mounted unit can always be connected directly to the electrical bus without additional overcurrent protection. Failure to protect the conductors connecting the SPD to the system bus directly violates NEC and could lead to safety and liability concerns.

However, there are certain conditions or exceptions that allow installing an externally mounted SPD without an OCPD within the power distribution equipment at its connection point. These are outlined in NEC Article 240.21(B)(1) known as the 10 ft. Feeder Tap Rule.

In order to apply the Feeder Tap Rule to installing an SPD with an internal OCPD, all of the following conditions must be met:

1. The length of the tap conductors must not exceed 10 ft., e.g., the SPDs connecting leads cannot be greater than 10 ft.. (Rules also exist for taps that exceed 10 ft., but discussing them would be impractical for an SPD installation application.) For best performance, SPD connecting leads should be as short as possible (much less than 10 ft. whenever practical) and avoid sharp bends.

2. The tap conductors' ampacity must not be less than the OCPD rating at the tap conductors' termination, e.g., the SPD connecting lead ampacity cannot be less than the internal OCPD's rating. At a minimum, 10 AWG conductors would be used to connect an SPD containing an internal 30 amp OCPD. Using 12 AWG conductors (ampacity = 20 A) would be a code violation and could not be used to connect an SPD containing an internal 30 amp OCPD.

However, a code exception permits tap conductors for specific listed devices, such as SPDs to be sized in accordance with the manufacturer's instructions.

**Exception to #2:** "Where a Listed SPD is provided with specific instructions on minimum conductor sizing, the ampacity of the tap conductors supplying that SPD shall be permitted to be determined based on the manufacturer's instructions."

3. For field installations, if the tap conductors exit the enclosure where the tap is made, the OCPD rating on the tap conductor's lineside must not exceed 10 times the tap conductor's ampacity. For example, the upstream OCPD from where the SPD is tapped from cannot be rated at more than 10 times the SPD's conductors' ampacity. Therefore, if the conductor ampacity to the SPD is 30 A, then an upstream OCPD of 300 A or less must be present.

### Summary

NEC and UL requirements must be followed when installing SPDs. The proper OCPD must be used in order to meet the NEC requirements and maintain the SPD's ANSI/UL 1449 Listing.

If an external OCPD was not used during UL testing, the size and type will not be listed on the manufacturer's product label. Under this condition, it's the installer's responsibility to ensure that the SPD's conductors are protected with a suitable OCPD per the NEC and the local AHJ.

If the SPD was submitted for ANSI/UL 1449 testing with an external OCPD, the size and type required for installation will be listed in the manufacturer's installation instructions and must be installed accordingly.

SPDs containing an internal OCPD can be connected directly to the electrical bus only if the installation meets all the requirements defined in NEC Article 240.12(B)(1), the Feeder Tap Rule, or by strictly following the manufacturer's installations instructions and OCPD recommendations.

## SPD Glossary

### IEC Classes — per IEC 61643-1 Standard

Class I: Protection Against Direct Lightning Currents; based on 10/350  $\mu$ s wave test (Lightning Current Arrester).

Class II: Protection Against Indirect Lightning Effects; based on 8/20  $\mu$ s wave test (Surge Arrester).

Class III: Protection Against Switching Overvoltages; based on 1.2/50  $\mu$ s; 8/20  $\mu$ s wave test (Surge Arrester).

### $I_{imp}$ — impulse current rating (10/350 wave current impulse)

This rating is used for the classification of the SPD for test Class I Lightning Arresters per IEC 61643-1 Standard for surges with a virtual front time of 10  $\mu$ s and a time to half-value of 350  $\mu$ s. Defined by three parameters, a current peak value ( $I_{peak}$ ), a charge Q and a specific energy. Note: This is used for the classification of the SPD for test Class I SPDs under IEC 61643-1 Standard. UL *DOES NOT* have this rating.

### $I_{max}$ — surge current capacity

Crest value of a current through the SPD having an 8/20  $\mu$ s wave shape and magnitude;  $I_{max}$  is the voltage and current development must not show any marks of disruptive obvious damage or aberration from the temperature stability; records of greater than  $I_n$ ; arrester must safely discharge this current without an discharge or spark over. An SPD can withstand a single shot of surge current. In UL markets, this is a self certification rating.

### $I_n$ — nominal discharge current (8/20 wave current impulse)

This rating has a current impulse with a virtual front time of 8  $\mu$ s and a time to half-value of 20  $\mu$ s as defined by UL 1449 4<sup>th</sup> Edition and IEC 61643-1 Standards. Peak value of the current, selected by the manufacturer, through the SPD having a current wave shape of 8/20  $\mu$ s where the SPD remains functional after 15 surges.

### Lightning arrester

An SPD that has an  $I_{imp}$  rating based on IEC 61643-1 Standard. These products are typically DIN-Rail style SPDs.

### MCOV/ $V_c$ / $U_c$ — Maximum Continuous Operating Voltage

The maximum designated root mean-square (rms) value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD. This is also the maximum voltage a system will see under the variance of normal operation and is the voltage at which an SPD starts to conduct and suppress a surge event.

### MOV — Metal Oxide Varistor

MOV is a ceramic mass of zinc oxide grains, in a matrix of other metal oxides (such as small amounts of bismuth, cobalt, manganese) sandwiched between two metal plates (the electrodes).

### Type 4X — electrical enclosure rating

Type 4X Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

### SCCR ( $I_{sc}$ ) - Short-Circuit Current Rating

The suitability of an SPD for use on an AC power circuit that is capable of delivering not more than a declared rms symmetrical current at a declared voltage during a short-circuit condition.

### SPD — Surge Protective Device

A surge protector is a device that limits transient overvoltages to a safe level, thus protecting equipment it is connected to from damage. A surge protector may also be expressed using the term SPD (Surge Protective Device).

There are different variations of SPD such as lightning arresters and surge arresters or secondary surge arresters.

### Surge arrester

An SPD that has an  $I_n$  rating based on IEC 61643-1 or UL 1449 4<sup>th</sup> Edition. These products can be either DIN-Rail Style SPD in an assembly or NEMA Style SPDs (BSPD, BSPA and SurgePOD PRO). Typically in North American markets, surge arrestors are installed at the service entrance to handle large external surges, with additional surge arrestors (SPDs) installed throughout the electrical system down to individual equipment panels.

### Surge current

Normal operation — current through MOV/SPD while conducting a surge – tends to be momentary.

### Thermal disconnect

A means of disconnecting the SPD from the circuit upon reaching a predetermined temperature caused by conducting a surge to ground. This protects the MOV from going into a thermal runaway condition on commonly misapplied voltages or when an end-of-life condition is reached.

### Thermal runaway

Operational condition when the sustained power dissipation of an SPD exceeds the thermal dissipation capability of the housing and connections, leading to a cumulative increase in the temperature of the internal elements culminating in failure.

### TOV — Temporary Overvoltage

Temporary Overvoltages (TOVs) are created by faults on the utility power distribution system and can cause extensive damage since their time domain is much longer (ms to seconds to hours).

### UL SPD Types — Per 1449 4<sup>th</sup> Edition

Type 1 — One port, permanently connected SPDs, except for watt-hour meter socket enclosures, intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and Molded Case SPDs intended to be installed without an external overcurrent protective device.

Type 1 SPDs for use in PV systems can be connected between the PV array and the main service disconnect.

*DIN-Rail SPDs are open Type 1.*

Type 2 — Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel and Molded Case SPDs.

Type 3 — Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. See marking in 80.3. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.

*Note: Type 2 and 3 SPDs were previously known as TVSSs.*

Type 4 Component Assemblies — Component assembly consisting of one or more Type 5 components together with a disconnect (integral or external) or a means of complying with the limited current tests in 44.4.

Type 1, 2, 3 Component Assemblies — Consists of a Type 4 component assembly with internal or external short circuit protection.

Type 5 — Discrete component surge suppressors, such as MOVs that may be mounted on a PWB, connected by its leads or provided within an enclosure with mounting means and wiring terminations.  
 $V_o/U_n$  — nominal system voltage

A nominal value assigned to designate a system of a given voltage class in accordance with ANSI C84.1. Typical voltages include 120, 208, 240, 277, 347, 480, 600 Vac.

### **$V_{PR}$ — Voltage Protection Rating**

A rating selected from a list of preferred values as given in Table 63.1 of UL 1449 4<sup>th</sup> Edition and assigned to each mode of protection. The value of  $V_{PR}$  is determined as the nearest highest value taken from Table 63.1 to the measured limiting voltage determined during the surge test using the combination wave generator at a setting of 6 kV, 3 kA. It is also known as “let-through voltage.”

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