ASCO®

Surge Protective Devices

Installation & Operation Manual

Model 455

Model 456

Model 455
Model 456

WARNING – IMPORTANT – PLEASE READ – WARNING

Safety First – Hazardous Voltage & Shock Hazard

- Only qualified licensed electricians should install or service SPDs
- Hazardous voltages exist within SPDs
- SPDs should never be installed or serviced when energized
- Use appropriate safety precautions including Personal Protection Equipment
- Failure to follow these instructions can result in death, serious injury, and/or equipment damage
- This manual shall be read in its entirety prior to installing

Bonding and Grounding Hazard

Verify that the neutral conductor in the service entrance equipment is bonded to ground in accordance with the National Electric Code (NEC®), Canadian Electrical Code (CEC) and all applicable codes.

Verify that the neutral terminal (XO) on the secondary side of distribution transformers are grounded to the system ground in accordance with the NEC®, CEC and all applicable codes.

During installation into an electrical system, the SPD must not be energized until the electrical system is completely installed, inspected and tested. All conductors must be connected and functional including the neutral (if required). The voltage rating of the SPD and system must be verified before energizing the SPD.

Failure to follow these guidelines can lead to abnormally high voltages at the SPD. This may cause the SPD to fail. The warranty is voided if the SPD is incorrectly installed and/or if the neutral conductor in the service entrance equipment or downstream of separately derived systems is not bonded to ground in accordance with the NEC® or CEC.

Do Not Hi-Pot Test SPDs

Any factory or on-site testing of power distribution equipment that exceeds normal operating voltage such as high-potential insulation testing, or any other tests where the suppression components will be subjected to higher voltage than their rated Maximum Continuous Operating Voltage (MCOV) must be conducted with the SPD disconnected from the power source. For 4-wire systems, the neutral connection at the SPD must also be disconnected prior to performing high-potential testing and then reconnected after test completion.

Failure to disconnect SPD and associated components during elevated voltage testing will damage the SPD and will void the warranty.

ASCO SURGE PROTECTIVE DEVICE
INSTALLATION, OPERATION AND MAINTENANCE MANUAL

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INTRODUCTION

Thank you for choosing an ASCO Surge Protective Device (SPD). This is a high quality, high energy surge suppressor designed to protect sensitive equipment from damaging transient overvoltages.

Proper installation is important to maximize performance. Please follow steps outlined herein.

This entire Operation & Maintenance Manual should be read prior to beginning installation. These instructions are not intended to replace national or local codes. Follow all applicable electrical codes to ensure compliance. Installation of this SPD should only be performed by qualified electrical personnel.

ASCO SPDs are extensively tested in accordance with industry standards such as ANSI/IEEE C62.41.1, C62.41.2, C62.45, C62.62, C62.72, UL 1449, UL 1283, IEC 61643, etc.

This SPD is a single-port parallel-connected device intended for service entrance, panelboard or downstream installation for IEEE Category C, B or A applications.

Major Industry Nomenclature Changes Effective 2008-2009
Be aware that UL 1449 Fourth Edition and 2008 NEC® Article 285 generated substantial changes.

- The term TVSS changed to SPD
- Types 1, 2, 3 & 4 SPDs are created
- UL 1449 clamping voltage performance testing changed from 500A to 3,000A
- UL 1449 added new I nominal testing (I_n), which consists of more rigorous duty-cycle testing

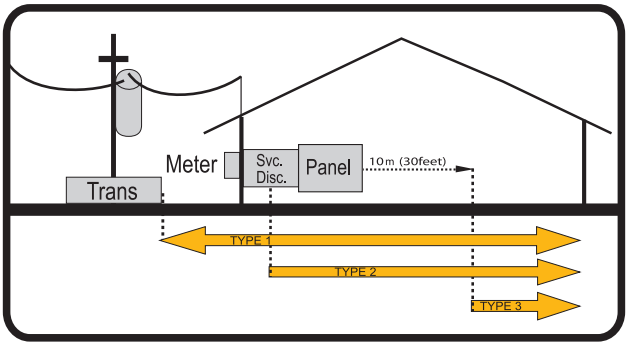
This SPD complies with the latest regulatory actions and is UL Listed as such.

For further information, please review latest editions of NEC® Art. 285, UL 1449 or contact ASCO Tech Support at (800) 237-4567.

FIGURE1: NEC® ARTICLE 285 & UL 1449-4

SPD Types: Types 1, 2, & 3

Based on Location within electrical distribution system
(also coincides with ANSI/IEEE C62.41.2 - 2002 Categories C, B & A)



GENERAL INFORMATION

The Model 455 & 456 families are intended for use as a Type 2 external mount SPD.

This device features internal overcurrent and overtemperature protection that will disconnect effected surge suppression components at the end of their useful life, but will maintain power to the load – now unprotected. If this situation is undesirable for the application, follow these instructions for servicing or replacing the device.

Service of this unit consists of replacing the modules, fuses, and/or display assembly. There are no user-serviceable parts inside replaceable modules. Do not attempt to disassemble modules as they are potted.

Simplified Explanation of Operation

SPDs sense overvoltage and create a momentary short circuit to redirect harmful surge energy to earth ground. Then they reset automatically and wait for the next surge. This is similar to the pressure relief valve on a water heater: pressure goes up, valve opens to relieve pressure and then resets. In an electrical system an SPD senses overvoltage, shorts temporarily sending energy to ground and then resets. SPDs are capable of repeating this function thousands of times.

Precautionary Statement Regarding SPDs on Ungrounded Systems

Caution – Ungrounded systems are inherently unstable and can product excessively high line-to-ground voltages during certain fault conditions. During these fault conditions, any electrical equipment including an SPD, may be subjected to voltages which exceed their designed ratings. This information is being provided to the user so that an informed decision can be made before installing any electrical equipment on an ungrounded power system.

Cascade Surge Protection

For optimum surge protection, cascade or staged surge suppression should be implemented at the service entrance and downstream locations as appropriate. Known or expected surge sources, as well as sensitive loads, should also have localized surge suppression. For interconnected electronic loads (data cabling), SPDs should also be utilized to protect the devices on either end of the interconnecting data cables.

Parallel Connection

This is a Parallel connected SPD – not series connected. As outlined in Figure 1 on page 4, an SPD 'drains off' excessive voltage from an electrical system. Because of connection, installation of the SPD anywhere near the equipment to be protected is satisfactory. This effect is similar to flushing any toilet in a house; pressure in the shower goes down. In an electrical system, a parallel connected SPD will remove excessive voltage off the entire system (assuming reasonable proximity).

> Tip: It is very important that wiring leads be configured as short & straight as possible. Avoid long leads. Avoid sharp bends. Route SPD conductors in the same conduit. Leads do not have to be sized for the entire load – this SPD is parallel connected, not series connected. As a generalization, 6 AWG works fine.

TABLE 1: MODEL NUMBER DECODER

□□□	□□□□	P	□□	□
Series/ Product Line	Voltage Codes	Per Phase kA Rating System	kA Rating Per Phase	Modes of Protection

455
456

Common North American Systems

120S	=	240/120V Split Phase - 1Ø, 3W+Grnd, (Fig 1)
120Y	=	208Y/120V Wye - 3Ø 4W+Grnd, (Fig 2)
240H	=	240/120V High Leg Delta (B High), (Fig 3)
277Y	=	480Y/277V Wye - 3Ø 4W+Grnd, (Fig 2)
347Y	=	600Y/347V Wye - 3Ø 4W+Grnd, (Fig2)
480D	=	480V Delta - 3Ø 3W+Grnd, (Fig4) & HRG Wye

Other Available Systems - Confirmation Encouraged

120N	=	120V Single Phase, 1Ø 2W+G (Fig 5)
240N	=	240V Single Phase, 1Ø 2W+G (Fig 5)
220Y	=	380Y/220V Wye - 3Ø 4W+Grnd (Fig 2)
240C	=	240V B Corner Grnd Delta, 3Ø 3W+Grnd (Fig 6)
240D	=	240V Delta - 3Ø 3W+Grnd (Fig 4)
480C	=	480V B Corner Grnd Delta, 3Ø 3W+Grnd (Fig 6)
600C	=	600V B Corner Grnd Delta, 3Ø 3W+Grnd (Fig 6)
600D	=	600V Delta - 3Ø 3W+Grnd (Fig 4) & HRG Wye

08	=	80kA
12	=	120kA
16	=	160kA

A = All Standard Modes for that Product Line & Voltage Code

Example: 456120SP12ACAE20 - Model 456, 240/120V Split Phase, 120kA, Standard Modes, Compression Lugs or Terminals, LEDs/Audible Alarm/Relay, NEMA 1/12/3R/4, Type 2, No Accessories or Options

Unpacking & Preliminary Inspection

Inspect the entire shipping container for damage or signs of mishandling. Remove the packing materials and further inspect the unit for any obvious shipping damages.

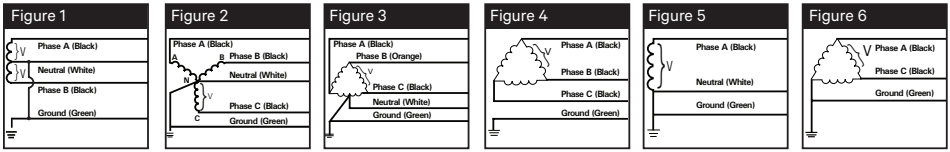
If any damage was found and is a result of shipping or handling, immediately file a claim with the shipping company and forward a copy to ASCO.

Storage Environment

This SPD should be stored in a clean, dry environment. Storage temperature range is -40°C (-40°F) to +60°C (+140°F). Avoid exposure to high condensation.

TABLE 1: MODEL NUMBER DECODER

Connection Type	Monitoring Options	Enclosure	UL 1449 Type1/Type 2	Accessory/ Option(s)
C = Compression Lugs or Terminals *(No Wires Included)*	S = LED(s) only (455) R = LED(s)/Relay (455) U = LED(s)/Aud. Alarm (456) A = LED(s)/Aud. Alarm/Relay (456) C = LED(s)/Aud. Alrm/Relay/ Surge Counter (456)	E = NEMA 1/12/3R/4 *(metal combo)* Size - 12" x 12" x 7.5" J = NEMA 4X *(polycarbonate, display inside door)* Size - 14" x 12" x 6" H = NEMA 4X *(stainless, display inside door)* Size - 12" x 12" x 6" Q = Flush Mount, Wall Cavity Size - 12" x 12" x 6"	2 = Type 2 *(Includes UL1283 Filter)*	0 = No Accessory/Option X = Yes Accessory/Option



SPLIT
2 Phase, 1 Neutral, 1 Ground

WYE
3 Phase, 1 Neutral, 1 Ground

HI-LEG DELTA (B High)
3 Phase, (B HIGH), 1 Neutral, 1 Ground

DELTA & HRG WYE
3 Phase, 1 Ground

SINGLE POLE
1 Phase, 1 Neutral, 1 Ground

CORNER GROUND DELTA (B grounded)
2 Phase, 1 Ground

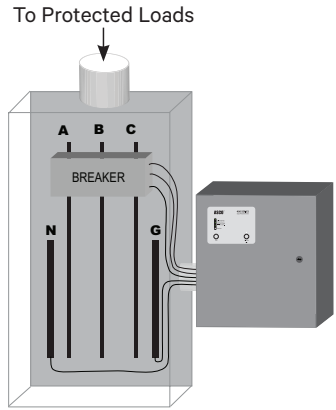
PRE-INSTALLATION & INSTALLATION PLANNING

Operating Environment

The standard unit uses a Type 1/12/3R/4 enclosure. Non-metallic polycarbonate 4X, stainless steel and Type 1 flush mount or pull box enclosures are available as options. Before installing, ensure that your enclosure type and application are appropriate per NEMA 250 with regard to moisture, dirt, excessive dust, flammable materials or atmospheres, corrosive vapors, etc. Please consult factory if enclosure needs to be changed.

This SPD is designed in an ambient temperature range of -40°C (-40°F) to +60°C (+140°F) with a relative humidity of 0% to 95% (non-condensing). Excessive temperature may inadvertently operate internal thermal overtemperature protectors.

FIGURE 2: TYPICAL PARALLEL CONNECTED SPD ON ELECTRICAL PANEL



Load Side Installation

Model 455 & 456 SPDs are tested and qualified as Type 2 SPDs per UL 1449 Fourth Edition and 2008 NEC®. These SPDs are intended for load side installation of the service overcurrent device per 2008 NEC® 285.

When connected on load side of main disconnect, we suggest connecting via a 60A circuit breaker. The circuit breaker is the intended disconnect switch and provides short circuit protection to the connecting conductors. The Model 455 & 456 families have internal overload protection elements within the product. A breaker or disconnect is not required for the SPD's overcurrent protection. Model 455 & 456 SPDs have demonstrated 200kA Short Circuit Current Ratings (SCCR). Confer to label on unit.

Audible Noise

SPD background noise is negligible or non-existent, and does not restrict the location of installation.

Mounting, Dimensions, and Weight

Model 455 & 456 series include enclosures and are intended for wall mounting.

This SPD is designed to be wall mounted. The standard enclosure is: 12" x 12" x 6" (L/W/D), and the weight is 25 lbs. See Table 2 below.

TABLE 2: DIMENSIONS & WEIGHTS		
Model 456	H/W/D (in. / mm.)	Weight
Standard	12"x12"x6" (305x305x152)	25 lbs (11.3 kg)
Model 455	H/W/D (in. / mm.)	Weight
Standard	12"x12"x6" (305x305x152)	25 lbs (11.3 kg)

Lead Lengths & Maximizing SPD Performance

SPD's must be located as close to the circuit as possible to minimize parasitic losses. Surges are high current, high frequency events that cause substantial voltage drops across conductors. This hurts SPD performance. Use the shortest & straightest possible leads. Pre-Plan installations and ensure that nearest breaker positions are used. If new construction, adjust breaker locations as appropriate.

Tip: Voltage drops for normal 120V or 277V lines might be 2-3V per hundred feet. In surge applications, voltage drops might be 100-150V per foot. These voltage drops add to clamping voltage, thus hurting performance. Make every effort to keep leads short and straight. As distribution gear becomes larger, shorter leads are more difficult to accomplish. When longer leads are unavoidable, gently twist leads together (one to two twists per foot), or tie-wrap leads together.

Tip: surges create magnetic fields per the 'right-hand rule'. When current goes in direction of thumb, magnetic field is in direction of curl of fingers. As surge current goes to SPD, fields are created in one direction. When the SPD sends those currents to neutral and/or ground, current goes in the opposite direction. If 'coming & going' are on the same axis, the magnetic fields can be cancelled, thus avoiding performance decrease. Gentle twists, bundling & tie-wraps accomplish this.

Shortest Leads Possible

- Leads must be as short and straight as possible - See NEC® Art. 285.12
- Pretend wire is $1000 per foot coming out of your pocket
- No long leads
- No sharp bends
- No wire nuts
- How short is short enough? As short as you can make it
- How long is too long? If anyone else can make it shorter

Overcurrent Protection

SPDs draw very little current under normal conditions and conduct for a brief duration upon encountering a transient surge current. This SPD contain internal overcurrent and overtemperature protection to protect against abnormal voltage conditions.

Supplemental overcurrent protection is not required to protect this SPD. However, connecting conductors require protection in Type 2 applications. Follow applicable codes.

Voltage Rating

Before installing SPD, verify that it has the same voltage rating as the power distribution system. Compare the SPD's nameplate voltage or model number and ensure that SPD configuration matches the intended power source. See Table 1.

The specifier or the user of the device should be familiar with the configuration and arrangement of the power distribution system in which any SPD is to be installed. The system configuration of any power distribution system is based strictly on how the secondary windings of the transformer supplying the service entrance main or load are configured. This includes whether or not the transformer windings are referenced to earth via a grounding conductor. The system configuration is not based on how any specific load or equipment is connected to a particular power distribution system.

480V System Example: SPDs should be installed per the electrical system, not per a load or motor's wiring connection. For example, a 480V three phase motor might appear to be connected as a 480V Delta. In actuality, the serving distribution system might be a 480Y/277V grounded Wye, with or without a neutral pulled to the motor or MCC. The system is still a 480Y/277V Wye, even though the load is connected as a Delta. A grounded Wye has a defined reference to ground (i.e., neutral is bonded to ground). Some Delta systems are ungrounded, which have no reference to ground and are known to become unstable in certain situations. Such instability can cause line to ground voltage fluctuations that may prematurely fail SPDs. For this reason, the NEC® Article 285 has placed SPD restrictions on ungrounded systems. As generalizations, SPDs for ungrounded systems can be installed on grounded systems with a clamping performance penalty. However, SPDs for grounded systems installed on ungrounded systems are almost certainly destined for premature failure. Call ASCO Tech Support at (800) 237-4567 for further information.

Circuit Breaker and Disconnect Switch

Model 455 & 456 SPDs are tested and qualified as Type 2 SPDs per UL 1449 Fourth Edition and 2008 NEC®. This SPD can be installed on the load side of the service overcurrent device per NEC® Article 285.

When connected on load side of main disconnect, we suggest connecting via a 60A circuit breaker. The circuit breaker is the intended disconnect switch and provides short circuit protection to the connecting conductors. Model 455 & 456 Series have internal overload protection elements within the product. A breaker or disconnect is not required for the SPD's overcurrent protection. Model 455 & 456 SPDs have demonstrated 200kA Short Circuit Current Ratings (SCCR). Confer to label on unit.

Terminals

Terminals will accept 14 - 2 AWG conductor and are provided for line (phase), neutral (if used), and equipment safety ground connections. 8 AWG is the minimum recommended wire size because UL testing and evaluation was performed using 8 AWG.

Wire Size and Installation Torque

This is a parallel-connected SPD; it is not series-connected. The size of the SPD wiring is independent of the ampere rating of the protected circuit. Recommended wire is 6 AWG for phase, neutral and ground connections. Torque connections to 18 inch-pounds. Conductor length should be as short as possible.

If other wire sizes are used, we recommend that all conductors be the same gauge. Note that larger conductor might appear to be beneficial; however, it tends to have the same inductance as smaller conductor and is more difficult to work with.

Terminals accept 14 - 2 AWG conductor with 6 AWG being preferred. Coordinate conductor size and overcurrent protection per applicable codes.

System Grounding

An equipment grounding conductor must be used on all electrical circuits connected to the SPD. For the best performance, use a single point ground system where the service entrance grounding electrode system is connected to and bonded to all other available electrodes, building steel, metal water pipes, driven rods, etc. (for reference see: IEEE Std 142-2007).

For sensitive electronics and computer systems, we recommend that the ground impedance measurement be as low as possible. When metallic raceway is used as an additional grounding conductor, an insulated grounding conductor should be run inside the raceway and sized per the NEC®. Adequate electrical continuity must be maintained at all raceway connections. Do not use isolating bushings to interrupt a metallic raceway run.

A separate isolated ground for the SPD is NOT recommended. Proper equipment connections to grounding system and ground grid continuity should be verified via inspections and testing on a regular basis as part of a comprehensive electrical maintenance program.

On 4-Wire Power Systems, neutral to ground bonding (Main Bonding Jumper) must be installed per the NEC®. Failure to do so WILL damage SPDs.

UL 1283 required language concerning the installation of EMI Filters

a. An insulated grounding conductor that is identical in size and insulation material and thickness to the grounded and ungrounded circuit supply conductors, except that it is green with or without one or more yellow stripes, is to be installed as part of the circuit that supplies the filter. Reference should be made to Table 250-122 of the National Electrical Code regarding the appropriate size of the grounding conductor.

b. The grounding conductor mentioned in item “a” is to be grounded to earth at the service equipment or other acceptable building earth ground such as the building frame in the case of a high-rise steel-frame structure.

c. Any attachment-plug receptacles in the vicinity of the filter are to be of a grounding type, and the grounding conductors serving these receptacles are to be connected to earth ground at the service equipment or other acceptable building earth ground such as the building frame in the case of a high-rise steel-frame structure.

d. Pressure terminal or pressure splicing connectors and soldering lugs used in the installation of the filter shall be identified as being suitable for the material of the conductors. Conductors of dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors unless the device is identified for the purpose and conditions of use.

INSTALLATION

Pre-Plan your installation. You will need to accomplish the following:

- Meet all National and Local codes. (NEC® Article 285 addresses SPDs)
- Mount SPD as close to panel or equipment as possible to keep leads short.
- Ensure leads are as short and straight as possible, including neutral and ground.
  Consider a breaker position that is closest to the SPD and the panel's neutral & ground.
- Suggested breaker & conductor size is 60A-30A with 6 AWG.
- Make sure system is grounded per NEC® and clear of faults before energizing SPD.

The following options or implementations require extra consideration. See appropriate sections within this manual:

- Flush Mount Option (page 14)
- Retro-fit where no breaker positions are available (page 15)
- UL/NEMA 3R Drain Holes (page 14)

1. Use a voltmeter to check all voltages to ensure correct SPD.
2. If SPD has Dry Contact, Remote Monitoring or Remote Display, pre-plan their installation.
3. Remove power for panel. Confirm panel is deenergized.
4. Identify connection/breaker location and SPD location.
5. Make sure leads are short! Reducing inches matter!
   Pretend that connector leads cost you $1000/foot to make leads short!
6. Remove an appropriately sized knockout from panel.
   Create an appropriately sized hole in the SPD enclosure.
7. Mount SPD.
8. Connect conductors as appropriate – short and straight as possible
   (Note that Hi-Legs are Phase B).
9. Label or mark conductors as appropriate
   (neutral: white, ground: green, energized: black, hi-leg: orange).
10. Make sure system is bonded per NEC® and is clear of hazards or faults before energizing.
    (N-G bonding not per NEC® will fail SPDs: #1 cause of SPD failures.)
11. Energize and confirm proper operation of indicators and/or options.

FIGURE 3: TYPICAL PANEL INSTALLATION

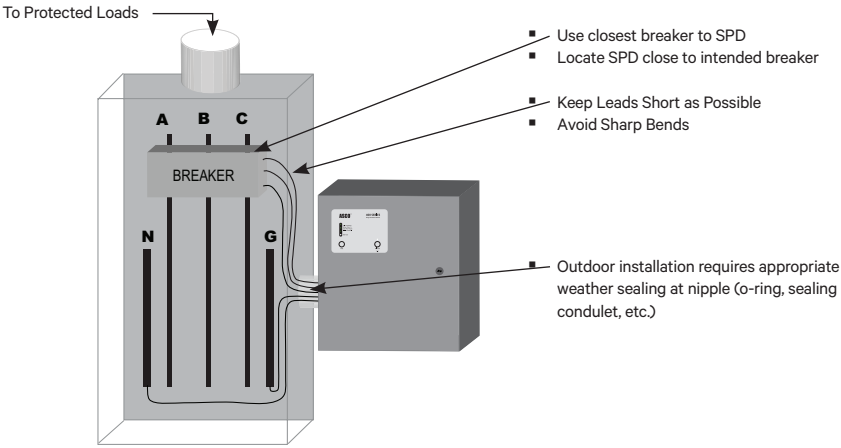
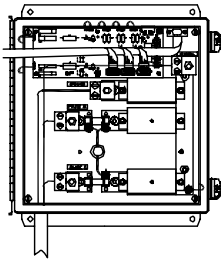
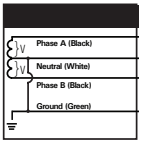


FIGURE 4: ELECTRICAL DRAWINGS FOR CUSTOMER CONNECTIONS

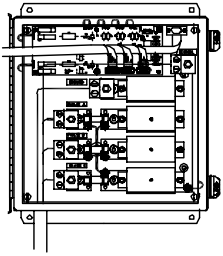
120S

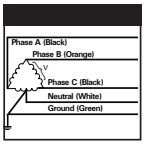




SPLIT
2 Phase, 1 Neutral,
1 Ground

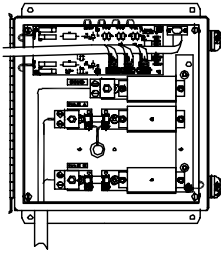
120H

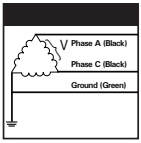




HI-LEG DELTA (B High)
3 Phase, (B HIGH),
1 Neutral, 1 Ground

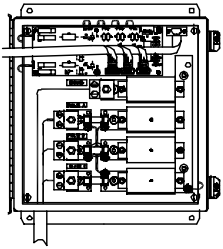
240C, 480C, 600C

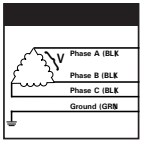




CORNER GROUND
DELTA (B grounded)
2 Phase, 1 Ground

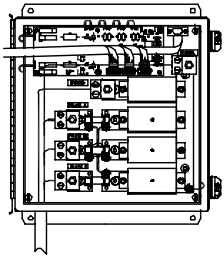
480D, 600D

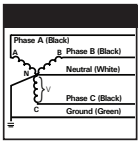




DELTA & HRG WYE
3 Phase, 1 Ground

120Y, 220Y, 277Y, 347Y



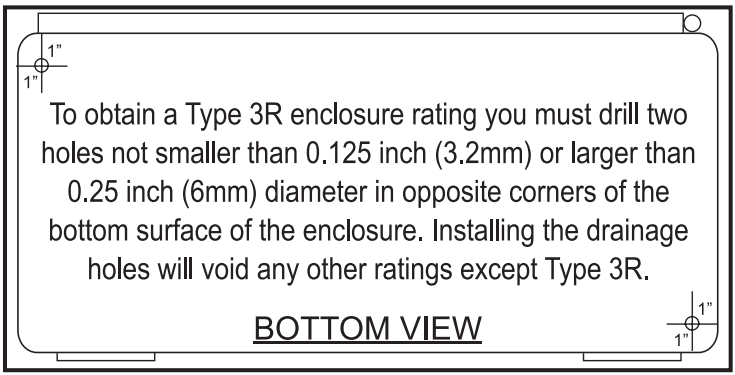


WYE
3 Phase, 1 Neutral,
1 Ground

NEMA 3R Drain Holes for Standard Steel Enclosure

In order to maintain a UL 3R rating, two 0.25" (6mm) holes must be drilled in opposite corners of the bottom surface of the enclosure. Take care to not damage internal SPD components. Remove any drilling remnants. (Do not perform on other enclosures or ratings.)

FIGURE 5: NEMA 3R DRAIN HOLES

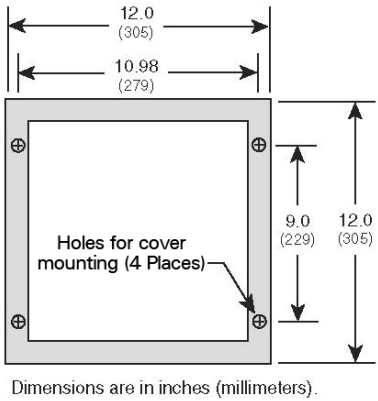


Optional Flush Mount Installation Considerations

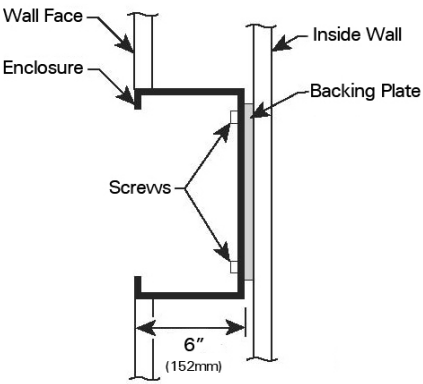
Models 455 & 456 are approximately 6" (152mm) deep. The unit will not mount flush unless there is as least 6" (152mm) of depth clearance. They are not designed to mount flush on a typical 2 x 4 stud wall.

Back Flange Mounting: Mount as close as possible to protected panel. Create a wall opening slightly larger than 12" (350mm) x 12" (305mm). See drawing. Configure a robust backing plate inside the wall cavity 6" (152mm) from the wall face such that the SPD is supported from its back. Note the mounting holes on the back flange. Also note that the Model 455 & 456 weigh 25 lbs. Be careful not to drop the SPD into the wall. See Figure 6.

FIGURE 6: FLUSH MOUNT INSTALLATION



Flush Mount Front View



Flush Mount Side View

Retro-fit Into Existing Panel with No Available Breaker Positions

These can be difficult with limited options because all applicable Codes must be followed:

- Consider consolidating loads in a manner that might free breaker positions.
- A ten foot tap rule in NEC® 240.21(B)(1) allows you to tap the bus as long as the conductors are rated at least 10% of the ampacity of the panel. This works well if the panel is about 600A or less: Tap the bus, run short 6 AWG leads to the SPD. A Disconnect Switch or Safety Switch allows for easier SPD servicing in the future. If the panel starts getting large (>800A), then the conductors may also become too large to fit into the SPD lugs or too cumbersome to work with. Consider tapping the bus per NEC® 240.21(B)(1). Run appropriate size conductors to a safety switch fused to 60A. Mount the SPD immediately adjacent to the safety switch. Connect SPD to the load side of the safety switch with 6 AWG. Keep all leads as short as possible.
- 2014 NEC® 240.21(B)(1)(1)b Exception may be useful: "When listed equipment, such as a surge protective device(s) [SPD(s)], is provided with specific instructions on minimum conductor sizing, the ampacity of the tap conductor supplying that equipment shall be permitted to be determined based on the manufacturer's instructions."
- In no-win situations, consider asking the Authority Having Jurisdiction (AHJ). Some AHJ's appreciate SPD safety benefits on smoke detectors, medical equipment, security equipment, etc. Similarly, some AHJ's appreciate the financial distress of failed microelectronic loads. Depending on situation, an AHJ might approve the 'lesser of two evils'.

OPERATION

Control and Diagnostic Panel

All indicators and controls are located on the front diagnostic panel. Each phase features a Green LED indicator. Green LEDs indicate correct operation.

If an inoperative condition were to occur in the Model 455, the green LED(s) will extinguish.

If an inoperative condition were to occur in the Model 456, the built-in audible alarm will sound and the red Service LED will illuminate. This indicates that the unit needs evaluation by a qualified electrician or technician. Until a qualified person evaluates the unit, press Alarm Silence to silence the alarm. (The LED above Alarm Silence illuminates when the alarm is deactivated. Normal operation occurs with the Alarm Silence LED extinguished.) The red Service LED will remain illuminated even though the Audible Alarm has been silenced. Test tests the red Service LED, the Audible Alarm, and changes the state of Dry Contacts (if equipped).

If LEDs are illuminated in a manner that suggests contradictory information, there may be an internal logic problem and the unit needs replaced. If none of the LEDS are illuminated, the unit may not be installed correctly. If a green LED is not illuminated and is suspected of being faulty, a qualified electrician may attempt to diagnose the problem by deenergizing the unit, opening the door and swapping ribbon cable leads. For troubleshooting assistance, please contact ASCO Technical Support at (800) 237-4567.

Surge Counter Option

The surge counter registers the number of transient overvoltages on all L-N and L-G modes since the counter was last reset. The counter is inductively coupled from each mode of protection. It increments upon significant current change in a short time period (large di/dt).

The surge counter includes Test and Reset buttons on the touchpad display. Pressing Test adds one count. Pressing Reset clears the counter's memory and sets the display to zero.

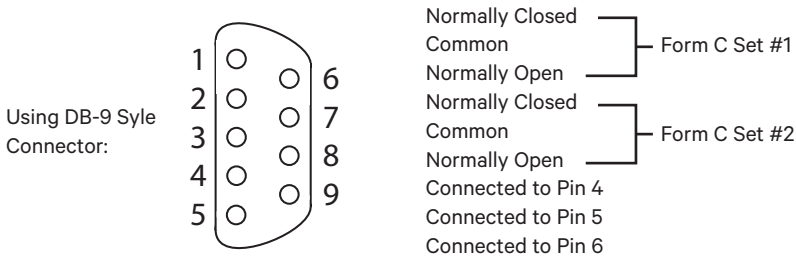
The counter includes a SuperCap charge device to store the surge count in the event of a power loss. The SuperCap requires no maintenance giving it an advantage over replaceable batteries.

Dry Contact Option

Two sets of Form C dry contacts are included with the Dry Contact option. Dry Contacts change state during inoperative conditions, including loss of power. Any status change can be monitored elsewhere via Dry Contacts.

A Terminal Block includes two sets of Normally Open (N.O.) and Normally Closed (N.C) contacts. Both sets of contacts operate the same. This is shown in Figure 7.

FIGURE 7: PINOUT DIAGRAM FOR DRY CONTACTS OF SPD



A typical application using a Normally Closed configuration would connect to one set of the N.C. and Common terminals. During an inoperative condition, the SPD's dry contact would change state from normally closed to open. We generally suggest the Normally Closed configuration because it will detect a wiring defect, such as cut wire(s), where N.O. will not.

Please note: Dry Contacts are designed for low voltage or control signals only.

Maximum switching current is 5A
Maximum switching voltage is 240V DC or AC.
Higher energy applications require additional relay implementation outside the TVSS.

An optional Remote Monitor accessory is available to provide visual and audible status. The Remote Monitor will consume one of the two sets of Dry Contacts.

Remote Monitor Accessory Option

A Remote Monitor is available for remote annunciation. It requires a standalone 120V power source (wall plug transformer) and uses one set of Form C dry contacts. The Remote Monitor can be configured to monitor several ASCO SPDs simultaneously. Installation is detailed in a separate document. Contact factory as appropriate.

FIGURE 8: DIAGNOSTIC DISPLAY PANEL

Phase A, B & C: Green LED indicators—one per phase. Green is good. Out indicates problem. Every suppression element in this SPD is monitored. (N-G indicates on Phase A)

Service LED (Red): LED illuminates in the event of problems. This indicator is logic-connected to the Phase LEDs. Should a Phase LED go out the Service LED will illuminate and the Audible Alarm will sound.

Test: Tests red Service LED and Audible Alarm, and changes state of Dry Contacts.

Alarm Silence: Turns Audible Alarm off. (Alarm is deactivated when the Silence LED is illuminated.)

Surge Counter Count: (if equipped) Increments optional surge counter by one. (+1)

Surge Counter Reset: (if equipped) Resets optional surge counter to zero. (0)

MAINTENANCE

SPDs require minimal maintenance. We recommend periodic inspection of diagnostic indicators to ensure proper operation. We also recommend keeping the SPD clean as appropriate.

Fuse Replacement

Fuses must be replaced with exact fuse included. These are special fuses and not typical fuses. Note that fuses are generally opened by failed modules. Modules can be removed and checked for short circuit with ohm-meter. Any reading other than open circuit suggests a failed module. Any reading <200 Ω positively confirms a failed module. Contact ASCO Technical Support as appropriate.

Module Removal & Replacement Instructions

Disconnect power to the SPD. Using an allen wrench, remove the bolts on both ends of the module, and pull the module out. Make careful note of the location and part number of each module removed, as this part number is not referenced anywhere else on the SPD.

The module(s) should only be replaced with a new module bearing the same part number as the module(s) being removed. Replace with a new module by reversing the procedure. Torque bolts to 65 inch lbs., power up the SPD and verify the green module LED is lit and all alarms have cleared.

Display Replacement
The display is field replaceable. Service should only be performed by qualified persons. Deenergize SPD, confirm with appropriate measurement equipment and discharge internal capacitance to ground. Mark locations and carefully disconnect diagnostic cables, contacts, connecting conductors, etc. Unbolt display and replace. Reinstall in reverse.

Note that a sealing gasket between the display and the enclosure is a key component ensuring weather resistance. Replace the gasket whenever the display is removed.

Diagnostic Board Removal & Replacement Instructions
Disconnect power to the SPD. Remove the board from the standoffs. Remove the connectors one at a time from the existing board and insert them into the appropriate connector on the replacement board. Install the replacement board onto the standoffs.

Troubleshooting & Service
Please contact us for any service related issues. We want to take care of any problems.

Quality SPDs are designed and tested to withstand severe duty. However, there are various electrical anomalies that SPDs cannot protect against. These are generally Sustained Overvoltages also known as Temporary Overvoltages (TOVs). In this context, Sustained Overvoltages may be only a few cycles. Failed SPDs tend to be symptoms, not root causes. A failed SPD should be treated as a 'canary in the coalmine' suggesting further investigation as there may be a larger issue at play. Regardless of cause, SPDs attempt to protect their load until failure.

As noted above, the single largest 'killer' of SPDs is reference to ground issues. If the SPD shows problems on startup, there is reasonable chance of bonding/grounding/misapplication issue. This permanently damages the unit. If not corrected, it will happen again.

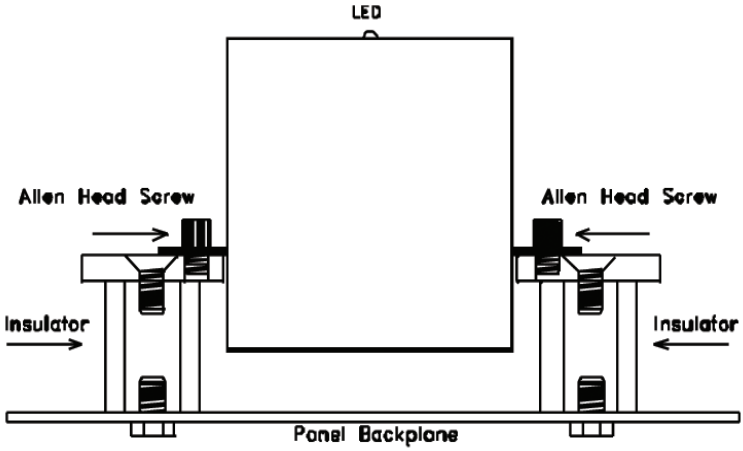
Tip: Visually confirm N-G bonding. Be aware that a voltmeter measuring N-G can be misleading. For example, N-G voltage could read 0V because neutral and ground are at the same potential by happenstance, not because they are bonded. Visually confirm bonding.

Tip: Experience indicates that regulation-challenged generators can cause Sustained Overvoltages, as well as ungrounded generators, and/or unusual load transfer systems.

TABLE 3: MODULE REMOVAL & REPLACEMENT	
Order #	Part Description
MA120	120VAC Module with Indicator LED
MA120CX	120VAC Module with Indicator LED
MA120CL	120VAC Module with Indicator LED
MA120NI	120VAC Module with NO Indicator LED
MA120NICX	120VAC Module with NO Indicator LED
MA120NICL	120VAC Module with NO Indicator LED
MA240	240VAC Module with Indicator LED
MA240CX	240VAC Module with Indicator LED
MA240CL	240VAC Module with Indicator LED
MA240NI	240VAC Module with NO Indicator LED
MA240NICX	240VAC Module with NO Indicator LED
MA240NICL	240VAC Module with NO Indicator LED
MA277	277VAC Module with Indicator LED
MA277CX	277VAC Module with Indicator LED
MA277CL	277VAC Module with Indicator LED
MA277NI	277VAC Module with NO Indicator LED
MA277NICX	277VAC Module with NO Indicator LED
MA277NICL	277VAC Module with NO Indicator LED
MA347	347VAC Module with Indicator LED
MA347CX	347VAC Module with Indicator LED
MA347CL	347VAC Module with Indicator LED
MA347NI	347VAC Module with NO Indicator LED
MA347NICX	347VAC Module with NO Indicator LED
MA347NICL	347VAC Module with NO Indicator LED

TABLE 4: FUSE-ALL SERIES	
Order #	Part Description
7294	ASCO 100-2 Fuse

FIGURE 9: MODULE REMOVAL & REPLACEMENT



USE 5/32 INCH ALLEN WRENCH TO REMOVE MODULES

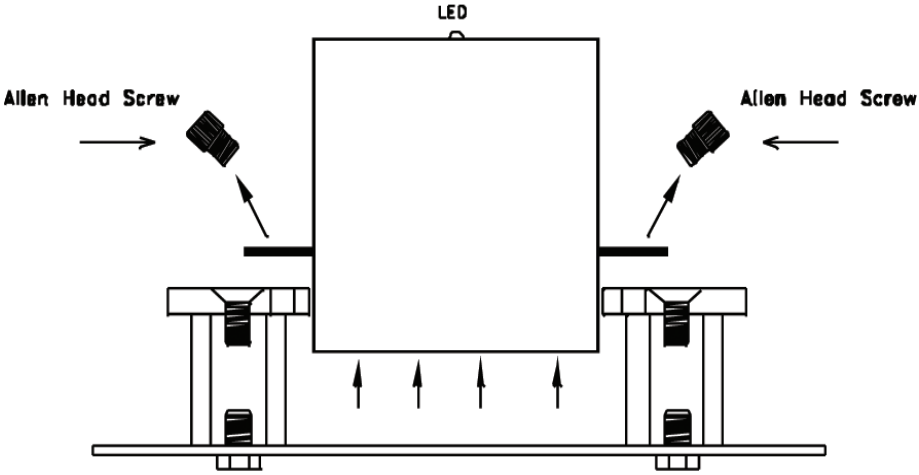
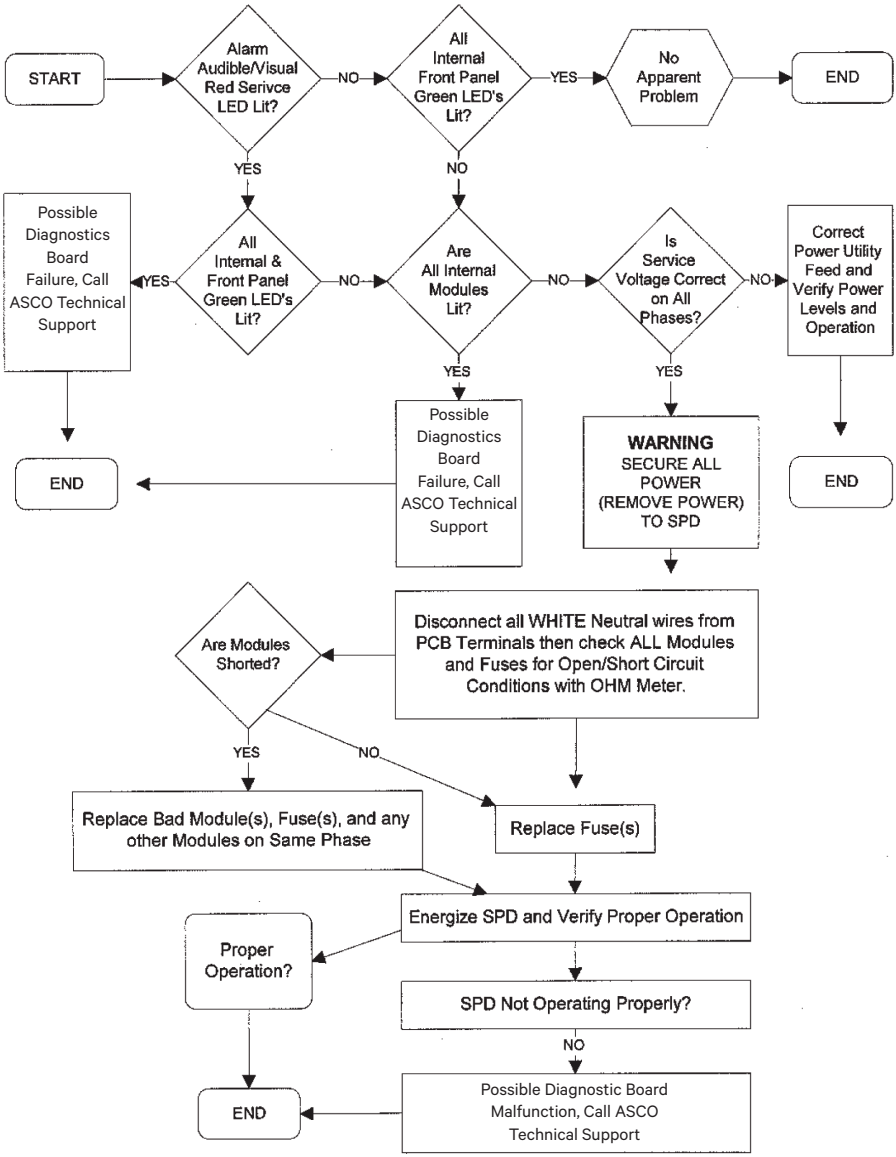


FIGURE 10: TROUBLESHOOTING FLOWCHART



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IO-70062 RevD 03-18