



## INSTALLATION, OPERATION & MAINTENANCE MANUAL

### DC Voltage Photovoltaic System Instructions – **Do Not Use for AC Voltage Installation**

**Save These Instructions** - This manual contains important instructions that shall be followed during installation and maintenance of the power system.

Presently, there is no dedicated UL standard for higher voltage DC SPDs. The following SPDEE's comply with most recent regulatory actions including UL 1449 Third Edition Listing (VZCA.E321351) and compliance to the UL Certification Requirement Decision (CRD) regarding DC rated SPDs for Photovoltaic Systems. This SPD is also Listed to UL 1741 (QIIO.E338877) as Interconnection System Equipment for Use with Distributed Energy Resources. Presently, there is no complimentary listing between UL 1449 and UL 1741. This necessitates different model numbers across different UL standards. Models with PV suffix reflect Listing to UL 1741. UL 1449 certification requires AC voltage specific language, which is also included below.

**TABLE 1:**

	Range of Input Operating Voltage	Maximum Input Voltage
S50A300VDC & S50A300VDCPV	0 – 375V DC	424V DC
S50A600VDC & S50A600VDCPV	0 – 750V DC	905V DC
S50A1000VDC & S50A1000VDCPV	0 – 1000V DC	1188V DC

Be aware that photovoltaic systems generate maximum voltage at coldest temperatures and brightest light. For example, full sunup after a cool/cold night produces maximum voltage on photovoltaic systems. The system's maximum voltage rating should take this into account.

The following graphic on the SPD's label represents DC voltage: ----



### WARNING – RISK OF ELECTRIC SHOCK

- Read this manual in entirety prior to installing
- Only qualified licensed electricians should install or service SPDs
- SPDs should never be installed or serviced when energized or during electrical storms
- Use appropriate safety precautions including Personal Protection Equipment
- Failure to follow these instructions can result in death, serious injury, and/or equipment damage
- When used in outdoor applications, customer must seal the conduit nipple using watertight fittings (not included) to ensure a watertight connection

Thank you for choosing an APT SPDEE Surge Protective Device (SPD). SPDEE is a high quality, high energy surge suppressor designed to protect sensitive equipment from damaging transient overvoltages. SPDEE is parallel connected such that circuit ampacity is unlimited. Proper installation is important to maximize performance. Please follow steps outlined herein. These instructions are not intended to replace national or local codes. Follow all applicable electrical codes to ensure compliance.

UL 1449 Third Edition (Sept 2009), 2008 NEC® Article 285 and CSA C22.1 (CEC) generated substantial changes regarding AC voltage SPDs.

Parts List

**1 - SPDee suppressor including 3' (~1m) conductors**

- 1 - Mounting L bracket
- 1 - 3/4" conduit nut
- 2 - Panhead mounting screws
- 1 - Data Sheet
- 1 - Installation Sheet (this document)

TABLE 2: SPECIFICATIONS	
Temperature Operating	-40°C (-40°F) to 65°C (+149°F)
Temperature Storage	-55°C (-67°F) to 65°C (+149°F)
Wire Size & Installation Torque	8 AWG; 25 lb - in 6 AWG (Ground); 35 lb - in
NEMA 250 Enclosure Rating	Type 4X with appropriate sealing & sealing condulets

**Simplified Explanation of Operation**

SPDs sense overvoltage and create a momentary short circuit to redirect harmful surge energy to earth ground. 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.

**SPDEE includes internal overcurrent protection**

Supplemental overcurrent protection is not required to protect this SPD. The SPDEE models listed above have demonstrated 100kA Short Circuit Current Ratings (SCCR) including leads on DC power systems. (See UL Label markings on each SPD or see Data Sheet for specs.)

Follow all applicable codes, which generally require that connecting conductors have overcurrent protection. Based on the SPD's #8 conductor, we recommend an immediate upstream overcurrent protection device rated not greater than 40A. A 40A or smaller circuit breaker or fuse could serve as a disconnect switch and provide NEC® or CEC imposed short circuit protection to the conductors.

Similar SPDEE models have demonstrated 200kA Short Circuit Current Ratings (SCCR) including leads on AC power systems and have been rated for Type 1 applications (NEC® Article 285).

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 replacing the device. SPDEE is ultrasonically welded closed and contains no user serviceable parts.

**Voltage Rating & Application**

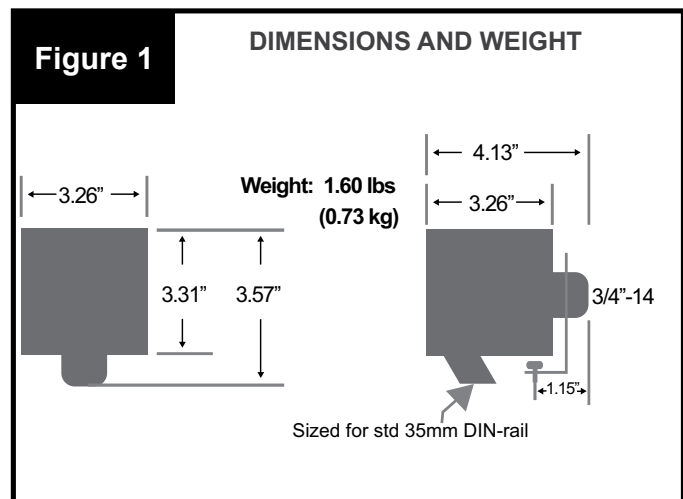
Before installing SPD, verify by nameplate voltage or model number that it has the same voltage rating as the power distribution system. See attached Data Sheet or call APT Tech Support at (800) 237-4567 as appropriate. The SPD's specifier or user should be familiar with the configuration and arrangement of the power distribution system.

**SPDs on Ungrounded Systems**

Caution – Ungrounded AC power systems are inherently unstable and can produce 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.

**DC SPD Installation when DC+ or DC- is grounded**

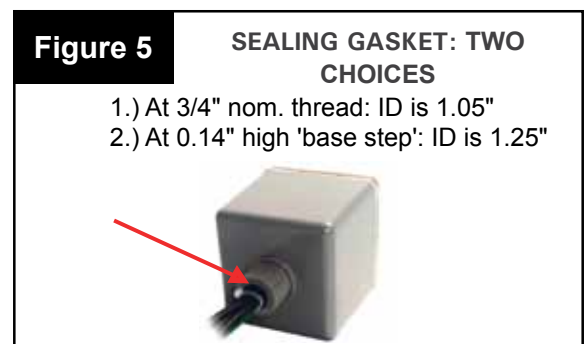
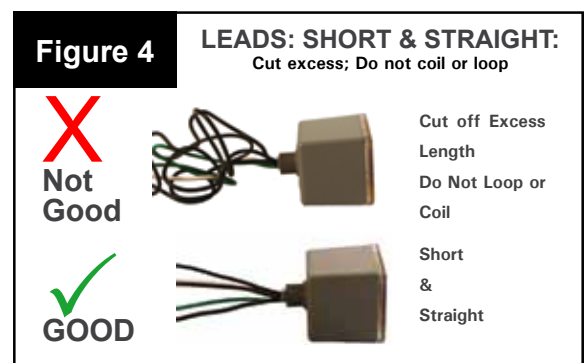
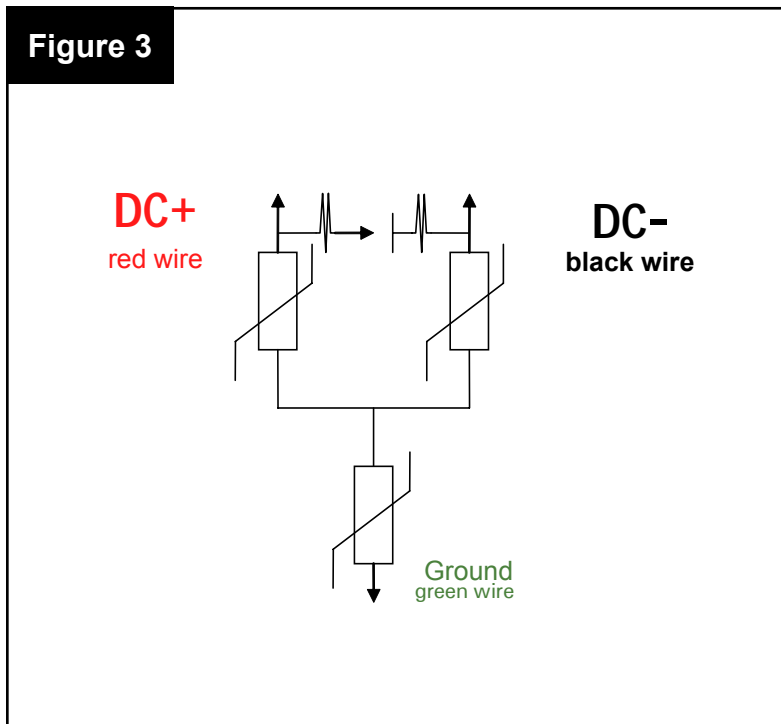
The standard SPDee DC SPD may be used when DC- is bonded to ground. In rare applications where DC+ is bonded to ground, a SPDee DC SPD having the 'G' option suffix must be used. Please consult factory as appropriate.



## INSTALLATION

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

- **Meet all National and Local codes** (NEC® Art. 285 address SPDs, NEC® Art. 690 addresses photovoltaic, Canadian Electric Code, Part 1)
  - **Confirm System voltage to SPD voltage**
  - **Mount SPD as close to panel or equipment as possible to keep leads short** (long leads hurt performance substantially)
  - **Ensure leads are as short and straight as possible, including ground. If using a breaker, use a breaker position that is close to the SPD and the panel's ground**
  - **Make sure system is grounded per NEC® and clear of faults before energizing SPD** (inadvertent system problem may fail SPD)
  - **Never Hi-Pot test Any SPD** (will prematurely fail SPD)
1. Ensure correct SPD; use voltmeter to check voltages as appropriate. (See Figure 3 for wire-outs)
  2. Determine Mounting method (see Figure 2) – weather resistant equipment may be required
  3. Remove power from panel/source. Confirm panel/source is deenergized.
  4. Identify breaker location and SPD location. Position SPD such that LED is best visible.
  5. Mount SPD – weather resistant applications require additional sealing, o-rings, etc. (see Figure 5)
  6. Connect conductors as appropriate - 1000V models require insulated sleeving, included (See Figure 3 for wire-outs) – short & straight as possible (see Figure 4)
  7. Label or mark conductors as appropriate (ground: green, positive: red, negative: black)
  8. Make sure system is grounded per NEC® or CEC and is clear of hazards or faults before energizing
  9. Energize and confirm proper operation of green LED indicator. Be aware that LED requires sufficient voltage to operate. Photovoltaic applications with low light may not generate enough power to illuminate the LED.



**⚠ WARNING**

- Do Not Hi-Pot Test
- Resulting Damage is not Covered Under Warranty

**⚠ DANGER**

Hazardous voltage. Will cause death or serious injury. Keep Out. Qualified personnel only. Disconnect and lock off all power before working on this equipment.

## NORMAL OPERATION

**Green LED Indicator – The LED indicator illuminates when the SPD is energized and operating correctly. Indicator operation: Every suppression element is connected via logic to the green LED. Should any suppression element fail, the green LED will extinguish. Be aware that LED requires sufficient voltage to operate. Photovoltaic applications having limited sunlight may not generate enough power to illuminate the LED.**

### Microswitch Option

A UL Listed 'M' option allows a user to monitor the operational status of internal MOVs. This is similar to a dry contact, but does not require that the SPD remain fully energized. Note that many SPD diagnostic circuits require power to operate. This becomes problematical on a PV application when there is no sunlight, and consequently no power. The diagnostics and/or contacts would change state every time the sun goes up or goes down. In turn, this could falsely indicate problems (sun went down, as opposed to SPD is failed).

The 'M' option monitors each MOV's integral microswitches via logic. Two 20 AWG wires exit the pipe nipple for customer connection to remote sensing equipment. Power must be limited to 50mA at 12VDC. Power inputs above 50mA at 12VDC will damage the microswitches and will not be covered under warranty. At the ends of the 20 AWG wires, correct operational state is Open circuit. If any MOV fails, the microswitch will Close. In simplest terms: Open = Good, Closed/short = problem. The 'M' option consumes the microswitch contacts that would normally be used by the LED circuitry. The diagnostic LED is not available with the 'M' option. (The 'M' option also requires the 'R' option, which removes the LED and its power supply circuitry.)

In most instances, a different label is used such that visual inspection is easier. Each MOV includes small pop-up tabs, which are not visible under the standard label. A revised label allows visual inspection under the clear polycarbonate enclosure lid. Please contact APT Tech Support with any questions at (800) 237-4567.

### Maintenance

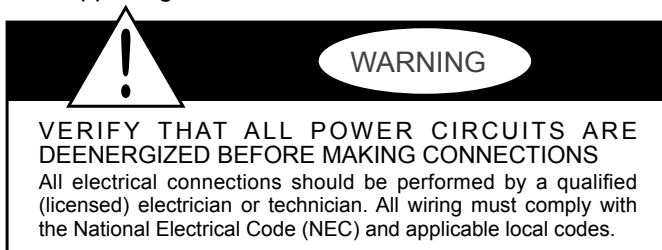
SPDs require minimal maintenance. We recommend periodic inspection of diagnostic indicators to ensure proper operation. We also recommend keeping the SPD clean as appropriate.

### Troubleshooting & Service

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

Quality SPDs withstand severe duty and attempt to protect their load until failure. There are 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 relatively short duration (on AC systems, could be only a few cycles). Failed SPDs tend to be symptoms, not root causes. We suggest treating a failed SPD as a 'canary in the coalmine' as there may be larger issues at play. Be aware that photovoltaic systems generate maximum voltage at coldest temperatures and brightest light. For example, full sunup after a cool/cold night produces maximum voltage on photovoltaic systems. The system's maximum voltage rating should take this into account.

As a generalization, 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.



**WARNING**

VERIFY THAT ALL POWER CIRCUITS ARE DEENERGIZED BEFORE MAKING CONNECTIONS

All electrical connections should be performed by a qualified (licensed) electrician or technician. All wiring must comply with the National Electrical Code (NEC) and applicable local codes.



**WARNING**

- Do Not Hi-Pot Test
- Resulting Damage is not Covered Under Warranty

**Any returns need a Return Authorization (RA) number.**



## Advanced Protection Technologies

14550 58th Street North ▪ Clearwater, Florida 33760  
(800) 237-4567 ▪ (727) 535-6339 ▪ Fax (727) 539-8955  
www.aptvss.com ▪ info@aptvss.com ▪ www.aptspd.com

UL is a registered trademark of Underwriters Laboratories, NEC and National Electrical Code are registered trademarks of National Fire Protection Association,

C62.41.1-2002, C62.41.2-2002, C62.45-2002, C62.72-2007 are registered trademarks of IEEE.