

Surge Protection Device (SPD) Selection and Installation for Darfon MIG300 Micro Inverter on Residential Applications

Surge Protection Device Selection per Components

Lightning & Surge Suppression

Lightning doesn't actually need to strike the equipment or building where the PV system is installed to cause damage. Often a strike nearby will induce voltage spikes in the electrical grid that can damage equipment. Darfon's micro inverters have integral surge protection; however, if the surge has sufficient energy, the built-in protection in the device would be exceeded and the device could potentially be damaged. It is recommended to install surge protection as a part of any solar installation. We recommend the following protection devices, which have been tested to ensure that they do not interfere with the powerline communications.

Residential: Citel, Part number DS72RS-120 or DS73RS-120, DLA-120D3
Application: DS72RS-120 is applied when neutral and ground are bound together. Or DS73RS-120 where neutral and ground are not bound together. DLA-120D3 is for protection of the data logger across the RS-485 cable.

Device Protection

In any micro inverter design there are several areas or components that may need protection. We will address the logical areas of protection in this white paper. The level of protection is best decided by the customer and the installer. Some areas may want the maximum protection, others may want to select a more limited amount of coverage depending on the location of the site, the level of accepted risk and of course the budget.

Micro Inverters

The first and most expensive devices to be protected are the micro inverters themselves. Because the protection offered by any surge suppression hardware diminishes with the distance between the protection device and the equipment being protected, the surge suppressor for the micro inverters should be installed close to the inverters in a NEMA 4 rated container. Most designs call for a junction box on the roof for a disconnect and to transition from the trunk cable to NM or THWN-2 rated conductors. This is a good place to insert the surge suppressors. The Citel units we are using for this paper are DIN rail mounted and will fit comfortably in a reasonably sized junction box.

This paper assumes a 120/240 single phase design. Each junction box will need its own surge protection device and the Junction box must be rated NEMA 4 or higher. A typical Surge Protection Device would be the Citel DS73US-120T/G or Darfon approved equivalent.

PLC

The next component that may need protection is the PLC device. It is typically located in a junction box just before the grid-tie service panel. Just like on the roof a DIN rail mounted DS73US-120 is a suitable suppression device.

Because the PLC has two connections, one to the 120/240 feed from the inverters and another via the RS-485 cable to the Data Logger we may need another suppressor for complete coverage. Located in the same junction box as the PLC the DLA-12D3 sits on this line and saves the PLC from surges from the Data Logger.

Data Logger

The Data Logger can be protected by a simple surge suppressing power strip available from any electronics supply or hardware store. This will protect the Data Logger through its 12Vdc brick.

Whole House

The last component to be protected is the main distribution panel being fed by the solar array. The Citel M50-120T located in or very near the main distribution panel provides the last link in the protection design. It is waterproof and can be installed in any environment, indoor or outdoor.

SPD Ratings

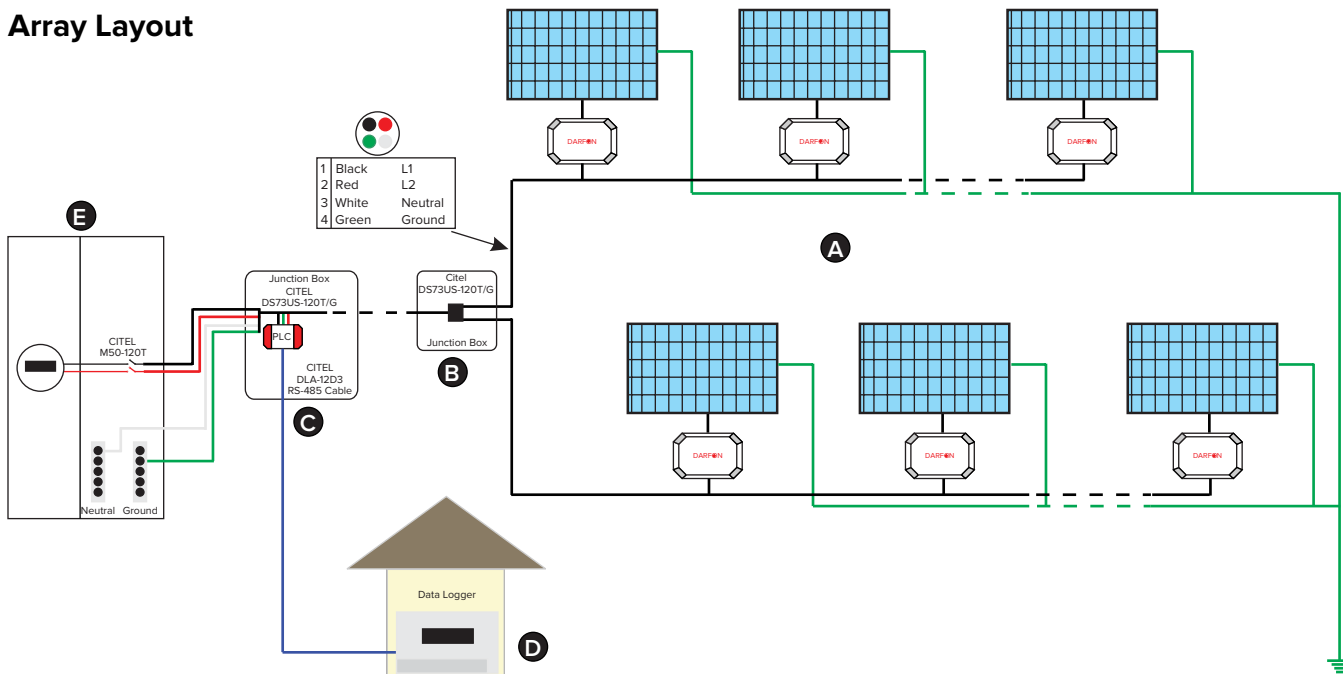
The SPD selected for your design should have at least the following specifications.

1. The Power SPD shall be surge rated at least 50kA 8/20 μ s per phase.
2. The Power SPD shall be UL1449 4th edition compliant.
3. The Power SPD shall not allow any leakage current to ground.
4. The Power SPD shall provide self-protection against TOV (Temporary Over Voltage).
5. The Data SPD shall be surge rated to 15kA 8/20 μ s.
6. The Data SPD shall be UL497B compliant.
7. The Data SPD shall provide galvanic isolation from the ground to eliminate interference.
8. The Data SPD shall provide a shielded connection independent of the SPD ground.

Construction Considerations

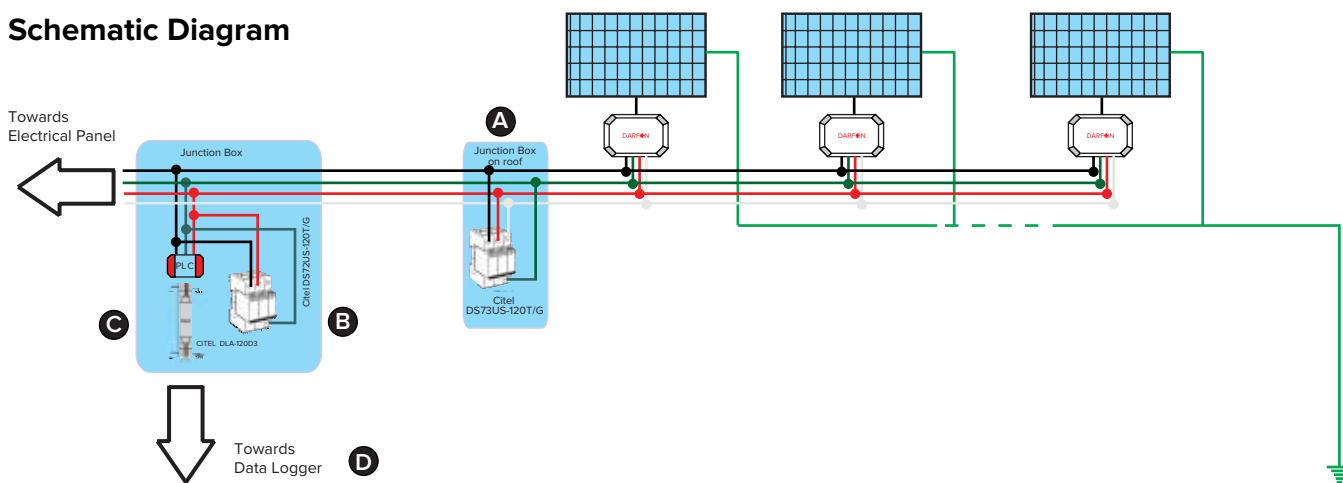
1. All grounds shall be bounded together to provide optimal common mode protection.
2. The total wire length between active cables and ground connection in the SPD branch shall be less than 2ft.
3. SPD shall always be installed as close as possible to the equipment it is intended to protect.
4. SPD shall be installed less than 30ft from the protected equipment or a secondary SPD is required.

Array Layout



- A. Micro inverter circuit.
- B. Roof mounted junction box. It contains the SPD and connects the segments together to form the MI circuit. The AC junction box connections should be as close to the center of the circuit as possible. The segments of the circuit should be balanced in length. Typical circuit layouts are 2 x 12, 3 x 8, 4 x 6 for a full circuit. If you have less than 24 inverters on a circuit, say 15 then segment lengths could be 3 x 5, or 7 & 8, even 6 & 9 inverters. You need to keep the circuit length as short as possible for the SPD to work properly. In addition, PLC signal strength diminishes with distance. This kind of design philosophy works toward those design concerns and minimizes the voltage rise to the inverters at the end of the circuit.
- C. Wall or attic mounted junction box. This contains the PLC gateway and sends the PLC data to the Data Logger via the RS485 cable. (OPTIONAL)
- D. Data Logger for local monitoring and uploading data to the cloud server.
- E. Grid-tie service panel. AC power from the array is fed into this service panel to send power to the home and utility. It contains the breakers that feed the various branch circuits in the home.

Schematic Diagram



- A. The surge suppressor in the roof mounted junction box will protect the inverters under the modules.
- B. The surge suppressors in the PLC junction box will protect the PLC device. (OPTIONAL)
- C. The digital line surge suppressor will protect the Data Logger from surges through the grid or the array.
- D. The Data Logger should be plugged into a surge suppressor at the plug. Because we strip the PLC communications before it enters the house we don't need to worry about GFI or Arc Fault circuitry to plug into. Any source of standard 120 Vac will work fine to plug the Data Logger into.