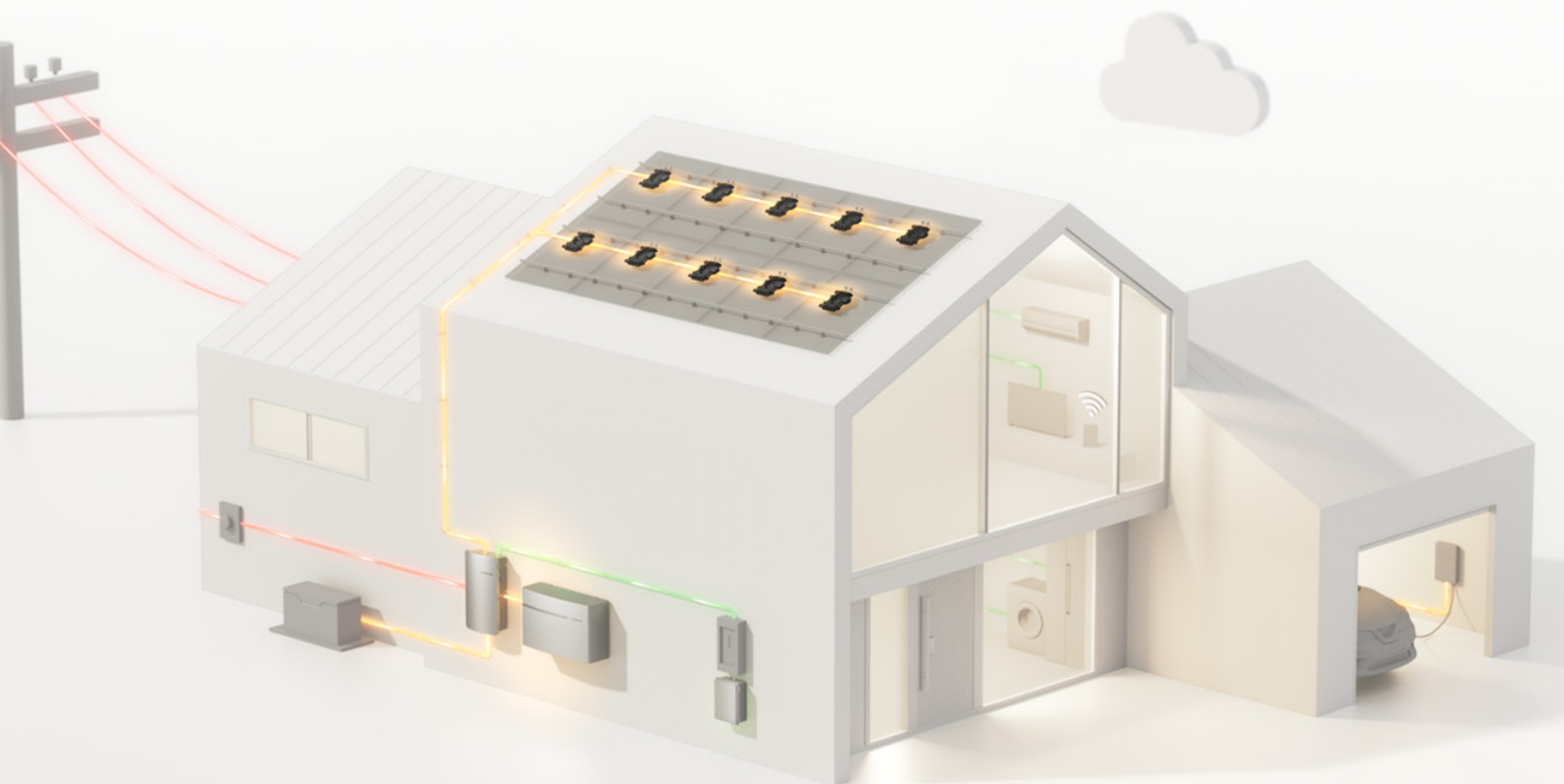


Surge protection device for Enphase Energy System



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Introduction

When installing a photovoltaic (PV) system, the question often arises if lightning protection is necessary for the PV system. Before answering that question, the condition and geographical location of the PV system and the building must be considered.

Enphase microinverters, similar to all electrical components, can be damaged by lightning strikes or voltage surges from the electrical grid. For this reason, Enphase recommends that you protect your system with lightning and surge suppression devices. In addition to having some level of surge suppression, it is essential to have insurance that protects against lightning and electrical surges.

The lightning protection standard DIN EN 62305-3 (VDE 0185-305-3) contains a description of the protective measures and a decision-making aid in Supplement 5, "Lightning and overvoltage protection for PV power supply systems".

This document describes common scenarios for using a surge protection device (SPD) in residential houses with the Enphase Energy System.

Does a PV system on the roof increase the risk of a lightning strike?

This is a frequently asked question, and the answer is no. A PV system on the roof does not increase the risk of a lightning strike.

How can a lightning strike and overvoltage affect my PV system?

A lightning strike produces high voltages and currents, and a direct or nearby lightning strike can affect PV systems.

- Direct strikes: If lightning strikes a PV system directly, then very high lightning currents flow through the PV system, and the system is likely destroyed in the process; fire and mechanical destruction cannot be ruled out either.
- Indirect strikes: If a lightning strike hits near a PV system, then partial lightning currents flow through the electrical installations and supply lines, which can cause damage to the PV system.

When lightning strikes at a distance of up to 500 m, the high magnetic fields of the lightning generate overvoltage in loops of electrical cabling that can damage PV systems.

If lightning strikes at a greater distance than 500 m, capacitive effects, which do not usually cause any damage, can occur.

Does an Enphase Microinverter have integrated surge protection?

Enphase microinverters have integrated surge protection Type 3 in them, but it is always recommended to have additional surge protection installed to account for massive surges, such as ones caused by lightning.

Using SPDs in residential houses with an Enphase Energy System

Consider the following scenarios:

- Scenario 1: An Enphase Energy System without an SPD
- Scenario 2: An Enphase Energy System with a separate SPD
- Scenario 3: An Enphase Energy System with an SPD

Scenario 1: An Enphase Energy System without an SPD

In most cases, in the buildings where an Enphase Energy System is installed, there is no lightning protection system (LPS). In this case, at least an SPD Type 2 must be installed in the main electrical board of the building (commercial and residential).

If the AC cable length from the farthest microinverter to the main board of the building is greater than 10 m, an SPD Type 2 must also be installed in the junction box before the first microinverter. Also, for every 10 m of cable installed on the roof, an SPD Type 2 can be added to the circuit.

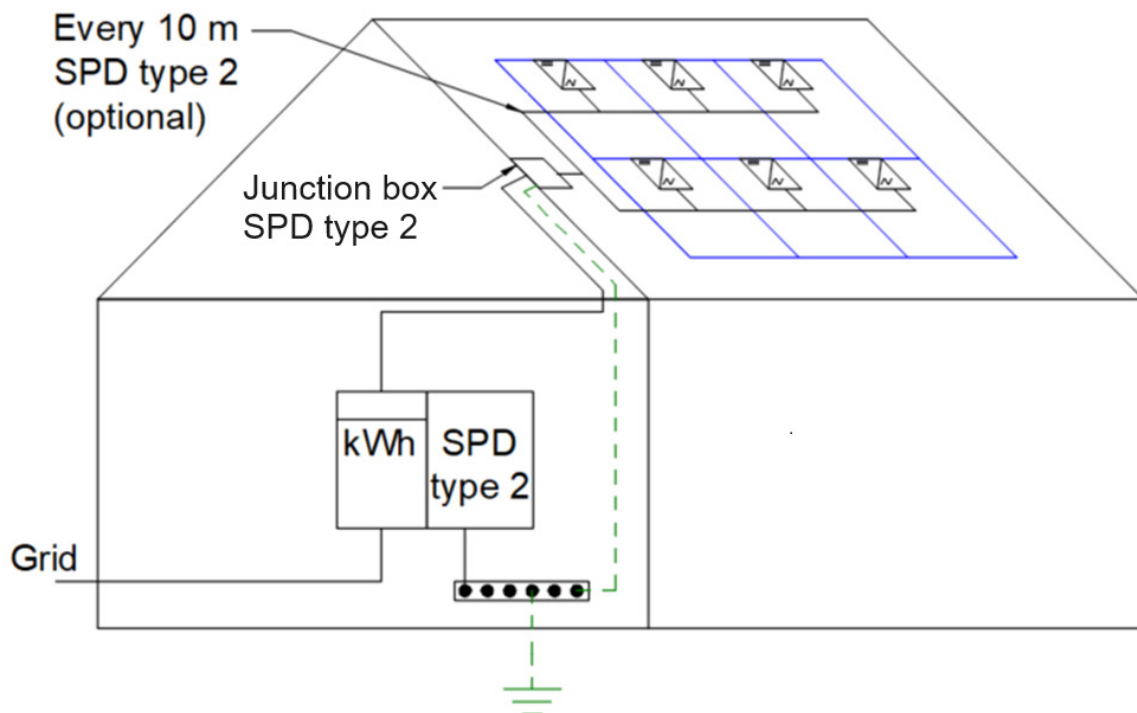


Figure 1: An Enphase Energy System without an SPD

Scenario 2: An Enphase Energy System with a separate SPD

The PV modules, PV mounting structure, and cabling are installed in the protected area, and a direct lightning strike on the PV system is prevented. The lightning protection system conductors are laid at a distance from all parts of the PV system to prevent flashover (separation distance “S,” which is typically 0.5 to 1 m). Enphase recommends keeping the PV system and its parts a minimum of 1 m from the LPS conductors.



IMPORTANT: Connection of the PV mounting structure to the lightning protection system conductors must be avoided.

In this scenario, the following measures must be taken:

- The PV mounting structure is bonded to the main grounding bar. In the case of spatially extended systems, the connection can also end at an equipotential bonding bar. If the cable length from the farthest microinverter to the main board of the building is greater than 10 m, then an SPD Type 2 must be installed after the inverter.
- For every 10 m of cable installed on the roof, an SPD Type 2 must be added to the circuit to prevent fire.
- Electrical installation of the building: SPD Type 1 must be installed in the power grid feed to protect the electrical devices in the building.

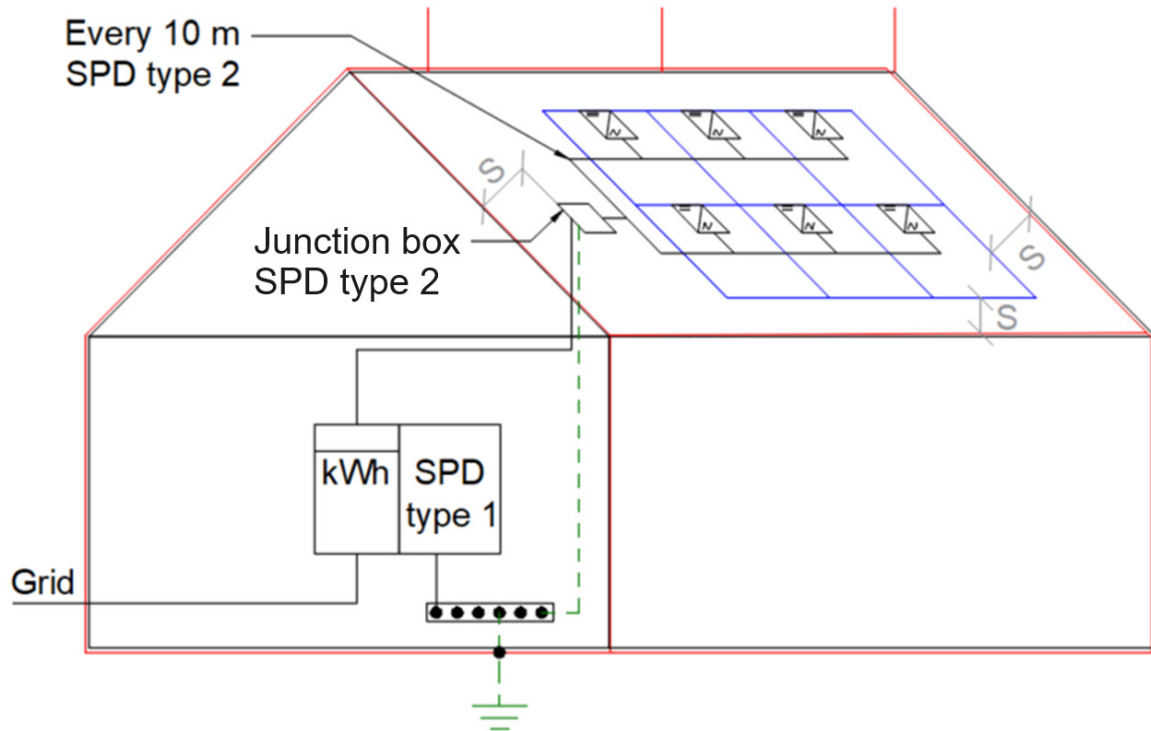


Figure 2: Scenario 2: An Enphase Energy System with a separate SPD

Scenario 3: An Enphase Energy System with an SPD

PV modules, PV mounting structure, and cabling are installed in the protected area, and a direct lightning strike on the PV system is prevented. The LPS conductors are not laid at a distance from all parts of the PV system that prevents flashover (separation distance). The following measures must be taken:

- The air-termination systems are connected to the PV modules or the PV mounting structure in multiple locations. These connections must be designed for partial lightning currents.
- For every 10 m of cable installed on the roof, an SPD Type 2 must be added to the circuit to prevent fire.
- PV module frame and PV mounting structure metal parts must be capable of transmitting partial lightning currents in terms of material and connection technology.
- An SPD Type 1 is installed after the inverter.

To protect the electrical devices in the building, an SPD Type 1 must be installed in the power grid feed.

Other considerations

When installing SPD Type 1, the equipotential bonding must have a cable section of at least 16 mm².
When installing SPD Type 2, the equipotential bonding must have a cable section of at least 6 mm².

References

DIN VDE 0100-712 (VDE 0100-712) – Part 7-712: Requirements for special installations or locations.
Solar Photovoltaic (PV) power supply systems (IEC 64/2514/CD:2021, modified).

For the selection and installation of SPDs in PV Systems, the installation must be carried out in accordance with DIN EN 62305-3 Supplement 5 (VDE 0185-305-3 Supplement 5).

A PV System must be constructed in a way that a building with a lightning protection system is not impaired. In this case, the standard DIN EN 62305 series (VDE 0185-305) must be followed.

DIN CLC/TS 51643-32 VDE V 0675-5-32:2022-12, Low-voltage surge protective devices
IEC 60364-4-44:2007/AMD2:2018, Amendment 2 - Low-voltage electrical installations - Part 4-44:
Protection for safety - Protection against voltage disturbances and electromagnetic disturbances.

IEC 60364-5-53:2019, Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment - Devices for protection for safety, isolation, switching, control, and monitoring.

Sources

VDE: <https://www.vde.com/de/blitzschutz/infos/pv-anlagen>

Enphase: https://www4.enphase.com/sites/default/files/EnphaseTechBrief_Lightning.pdf

For more information about Enphase microinverters, their installation, and how to use them, see the Enphase website: <http://www.enphase.com/support>.

Revision history

Revision	Date	Description
WHP-00015-1.0	March 2024	Initial release.