

## PV Fact Sheet

### 02 | Protection against lightning strikes

#### How do you protect PV installations against lightning strikes?

This fact sheet focuses on photovoltaic installations within the European Union. One essential part of such an installation is the PV combiner box. These boxes are used to combine several strings, to protect against overvoltage and many more functions.

In the event of a lightning strike, overvoltage occurs within a radius of approx. 2 km, which can affect and destroy all electrical equipment - including a PV system and also AC wires close to the PV wires. For this reason, the following rules must be considered within the EU and beyond (all CENELEC members) for the commissioning of a PV system. These requirements are defined in the EN\* 51643-32:2020 and the EN\* IEC 62305-4.

#### What are the advantages of surge protection?

Surge protection devices (SPDs) are used to protect equipment against high voltages caused, for example, by lightning strikes. This is achieved by means of varistors, which reduce their resistance as the voltage increases. In this process, the potential differences between the nominal voltage and the suddenly increased voltage level are compared. If an overvoltage occurs, the varistors drastically reduce their resistance and thereby divert the overload current to the earth conductor.

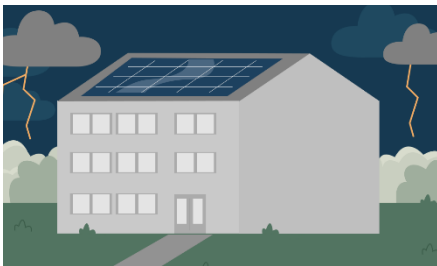
#### What must be considered when installing surge protection?

**According to EN\* 51643-32:2020 and the EN\* IEC 62305-4, all PV systems must be protected against overvoltage.** For this purpose, at least one Type I+II or Type II surge protection device **(1)** must be installed on the DC side. **This surge protection device must be installed at the zone transition / point where the cables enter the building** in order to keep the overvoltage away from the interior of the building.

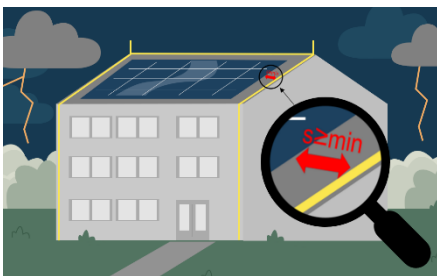
The next question is which type of surge protection arrester must be installed. On the **DC side**, there are **Type I+II** and **Type II** devices. The type to be used depends on whether the building has an external lightning protection system. In general, **buildings with external lightning protection must be equipped with Type I+II arresters**, whereas **for buildings without external lightning protection, a Type II device is sufficient**. Further details are provided in EN 51643-32:2020. These are illustrated in the following three diagrams.

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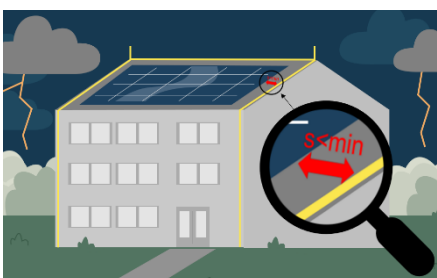
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1. Building without outside lightning protection require a DC SPD\*\* **Type II** (according EN\* 61643-31) with **6 mm<sup>2</sup>** earthing cables.



2. Building with outside lightning protection with a safety distance of  $s \geq 0.7 \text{ m}^{***}$  require a DC SPD **Type II** (according EN\* 61643-31) with **6 mm<sup>2</sup>** earthing cables.



3. Building with outside lightning protection with a safety distance of  $s < 0.7 \text{ m}^{***}$  require a DC SPD **Type I+II** (according EN\* 61643-31) with **16 mm<sup>2</sup>** earthing cables.

\*EN = European regulation \*\*SPD = surge protection device

\*\*\*Depending on the configuration of the lightning protection. Accurate calculation is defined in IEC 62305-3.

In addition, the number of surge protection devices is also regulated. **At least one Type I+II or Type II surge protection device (1) must be installed.** This device is installed at the point where the DC cables enter the building in order to keep overvoltage away from electrical loads inside the building and from AC cables. If the distance between the inverter and the last PV modules (string from the last module) is **more than 10 metres of cable length**, an additional surge protection device (2) must be installed. If this is not done, the DC SPD can no longer fulfil its safety function, which may result in damage to the equipment to be protected. To ensure this protection, integrating an SPD into a combiner box is the most cost-effective solution. If the normative requirements for the PV installation are not observed, insurers may refuse to cover the resulting damage in the event of a claim.

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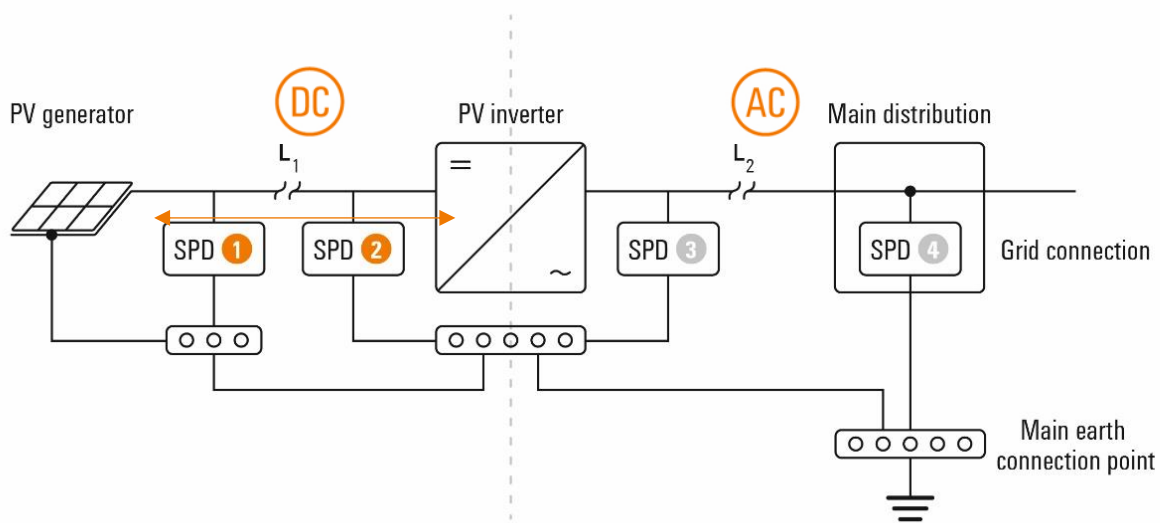


Figure 1: Source: EN 51643-32:2020 — Installation of SPDs on the AC and DC side

In addition to the DC side, protection is also required on the **AC side**. The surge protection device at position (4) protects against overvoltages that can be coupled into the building via the incoming supply lines. Protection at position (3) is required if the **cable length between the inverter and the main distribution board exceeds 10 m**. In practice, this may be the case, for example, if the inverters are installed on the roof and the cables are then routed over several floors to the main distribution board. In this case, a **surge protection device must be installed at the point where the AC cables enter the building**. This is required by EN\* IEC 62305-4, and also makes technical sense in order to prevent flashovers to other cables inside the building.

In another case, an AC cable from a wallbox installed outdoors is routed to the main distribution board. Here too, an AC protection device must be installed at the point where the AC cable enters the building. **If a data cable is routed in parallel, it must also be protected at the point where it enters the building.**

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| <br><b>Question 1:</b><br>External lightning protection system present? | <br><b>Question 2:</b><br>Separation distance maintained?* | <br><b>Question 3:</b><br>Cable length $L_1$ larger than 10 m? | <br><b>Question 4:</b><br>Cable length $L_2$ larger than 10 m? | <br>Installation locations |            | <br>Installation locations |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------|------------|
|                                                                                                                                                          |                                                                                                                                             |                                                                                                                                                 |                                                                                                                                                 | SPD 1                                                                                                       | SPD 2      | SPD 3                                                                                                         | SPD 4      |
| no                                                                                                                                                       | -                                                                                                                                           | yes                                                                                                                                             | yes                                                                                                                                             | Type II DC                                                                                                  | Type II DC | Type II AC                                                                                                    | Type II AC |
| no                                                                                                                                                       | -                                                                                                                                           | no                                                                                                                                              | yes                                                                                                                                             | -                                                                                                           | Type II DC | Type II AC                                                                                                    | Type II AC |
| no                                                                                                                                                       | -                                                                                                                                           | yes                                                                                                                                             | no                                                                                                                                              | Type II DC                                                                                                  | Type II DC | -                                                                                                             | Type II AC |
| no                                                                                                                                                       | -                                                                                                                                           | no                                                                                                                                              | no                                                                                                                                              | -                                                                                                           | Type II DC | -                                                                                                             | Type II AC |
| yes                                                                                                                                                      | yes                                                                                                                                         | yes                                                                                                                                             | yes                                                                                                                                             | Type II DC                                                                                                  | Type II DC | Type I AC                                                                                                     | Type I AC  |
| yes                                                                                                                                                      | yes                                                                                                                                         | no                                                                                                                                              | yes                                                                                                                                             | -                                                                                                           | Type II DC | Type I AC                                                                                                     | Type I AC  |
| yes                                                                                                                                                      | yes                                                                                                                                         | yes                                                                                                                                             | no                                                                                                                                              | Type II DC                                                                                                  | Type II DC | -                                                                                                             | Type I AC  |
| yes                                                                                                                                                      | yes                                                                                                                                         | no                                                                                                                                              | no                                                                                                                                              | -                                                                                                           | Type II DC | -                                                                                                             | Type I AC  |
| yes                                                                                                                                                      | no                                                                                                                                          | yes                                                                                                                                             | yes                                                                                                                                             | Type I DC                                                                                                   | Type I DC  | Type I AC**                                                                                                   | Type I AC  |
| yes                                                                                                                                                      | no                                                                                                                                          | no                                                                                                                                              | yes                                                                                                                                             | -                                                                                                           | Type I DC  | Type I AC**                                                                                                   | Type I AC  |
| yes                                                                                                                                                      | no                                                                                                                                          | yes                                                                                                                                             | no                                                                                                                                              | Type I DC                                                                                                   | Type I DC  | -                                                                                                             | Type I AC  |
| yes                                                                                                                                                      | no                                                                                                                                          | no                                                                                                                                              | no                                                                                                                                              | -                                                                                                           | Type I DC  | -                                                                                                             | Type I AC  |

\*Between PV installation and external lightning protection, according to standard EN 51643-32.

\*\*If the inverter and the main distribution board are connected to the same grounding busbar via a grounding cable whose length does not exceed 0.5 m, no SPD is required at installation location "3".

*Table 1: The following table can be used to easily find the right SPD on the AC and DC side.*

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#### Advantages of Weidmüller products

The Weidmüller surge protection boxes are compact enough to be installed at the building entry point. As a result, they can protect the electrical equipment inside the building in the event of an overvoltage. Thanks to their plug-in design, the arresters are very easy and quick to replace. In addition, the failure of an element can be easily detected via the remote signalling contact or the indicator windows.



Figure 2: Weidmüller PV Next



Figure 3: Weidmüller PV Inline



Figure 4: Weidmüller AC-SPD-Box



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