

GUIDE

Photovoltaic systems

Surge protection



Why protect?

Environmental protection and rising energy prices lead directly to the use of renewable energy sources. The most commonly used renewable energy source is based on conversion of sunlight into electricity using photovoltaic (PV) cells. PV applications are able to provide either complete or partial independence from the power grid.

PV applications are becoming very large installations due to the need for the highest possible power output, and thus the risk of overvoltage caused mainly by induced voltage increases significantly. It is therefore necessary to protect sensitive semiconductor elements, for example in frequency changers or other connected equipment, from overvoltage. The causes of equipment damage in PV installations due to overvoltage can be the result of:

- direct lightning strike to the external lightning protection system (LPS) or lightning strike near the PV installation
- by a direct lightning strike to the power network line, by induction from an indirect lightning strike to the power network line or by a switching overvoltage in the power network line
- carrying from a nearby distribution or transmission network due to atmospheric surges or network operations and faults
- changes of the electric field during storms

What to protect?

- Inverter from the DC side
- Inverter from the AC side
- Intrusion of overvoltage into the building
- Signal lines (measurement of temperature, wind speed measurement) entering the control system of PV application
- Data communication with the PV application and within the PV application (Ethernet, RS-485, ...)

How to protect?

The following standards address the design of PV applications and their surge protection:

- IEC (HD) 60364-7-712 standard (Electrical installations of buildings – Solar photovoltaic (PV) systems)
- CLC/TS 51643-32 (Low-voltage surge protectors – Part 32: Surge protectors for the DC side of photovoltaic installations – Principles of selection and use).

CLC/TS 51643-32 – this standard deals with the use of surge protectors (SPDs), replaces the standard CLC/TS 50539-12, and effectively addresses the surge protection.

When establishing a PV installation, well-known rules apply, such as:

- minimization of loops
- create a bonding system

In practice, several types of photovoltaic applications can be encountered, whose surge protection solution can be found on the following pages.

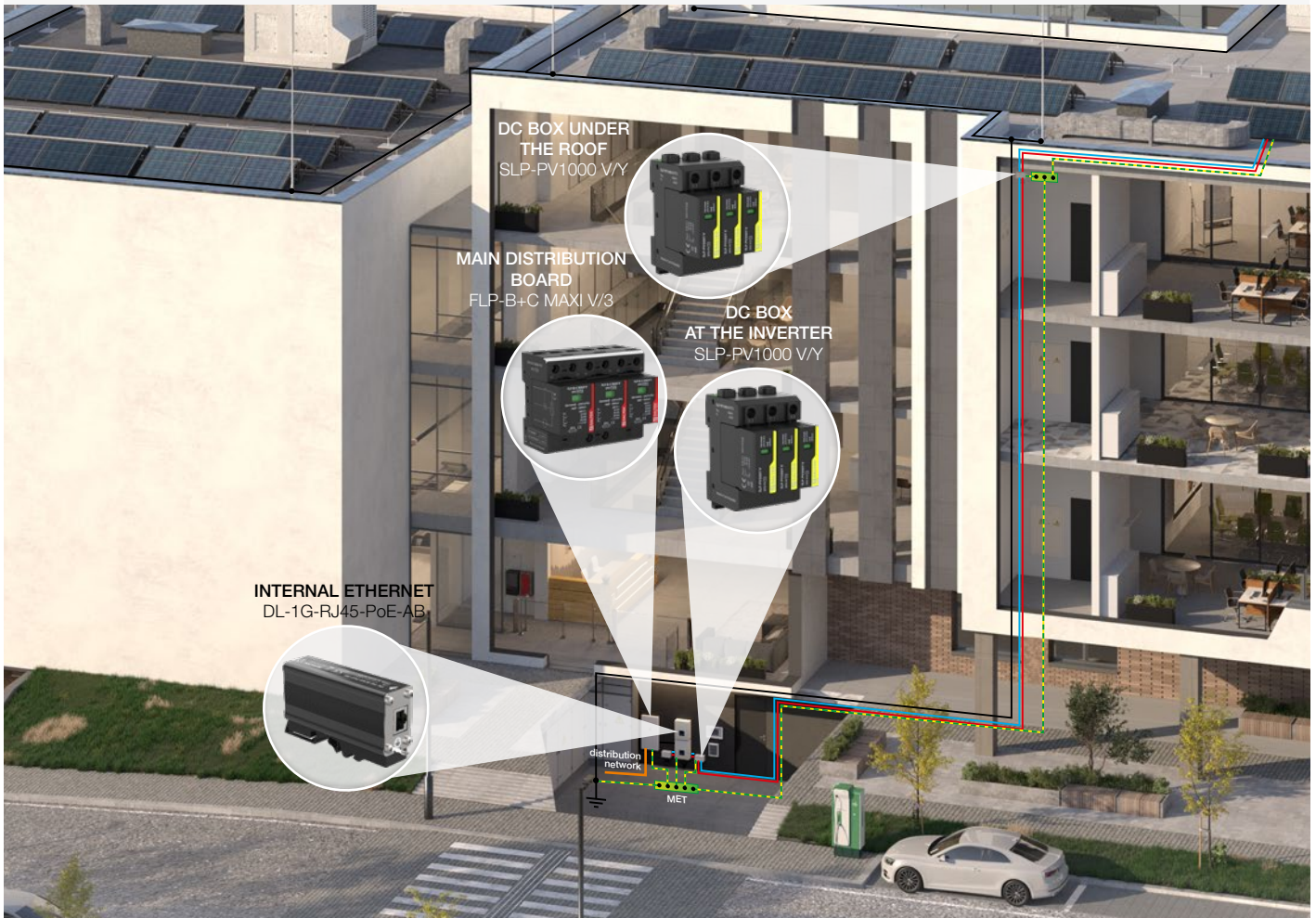


PV installation on the roof

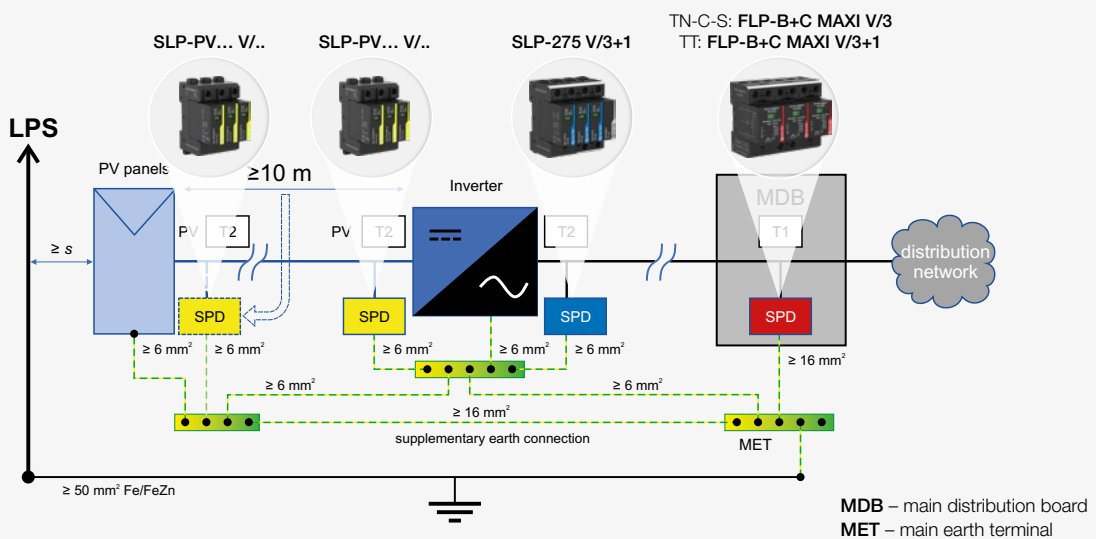
PV roof installation with external LPS¹⁾ – sufficient separation distance is observed (s)

- In particular, the inverter is protected.
- SPD is also recommended for each of the PV strings when distances of PV strings are 10 meters or more from the SPD installed at the inverter.
- In the case of an isolated (remote) lightning conductor, the common point of the LPS and the connected internal electrical installation is earth connection to the MET.

■ Indicative diagram of a PV installation with surge protection



■ Block diagram of a PV installation with surge protection

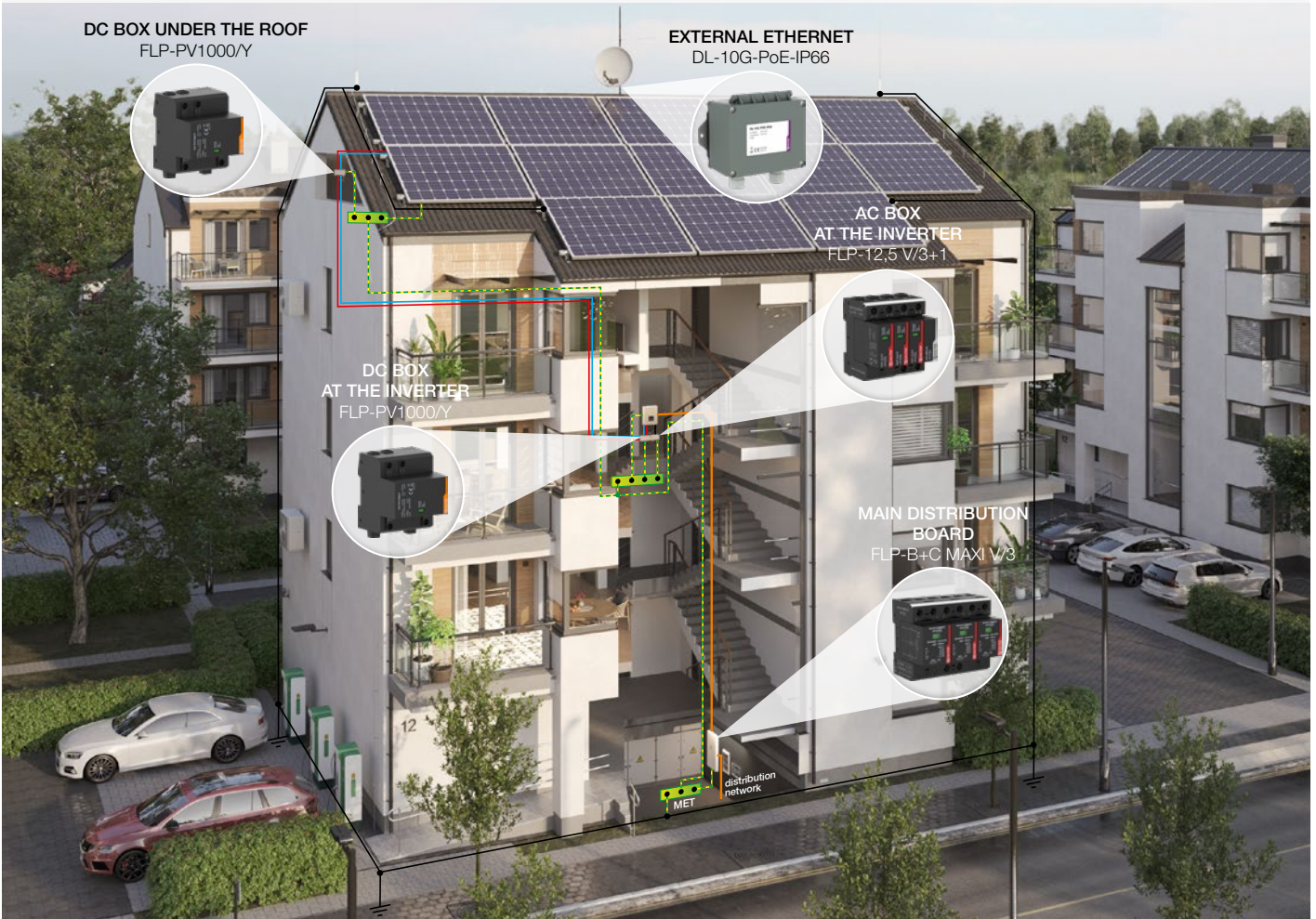


¹⁾ LPS – Lightning protection system – external lightning protection (lightning conductor system)

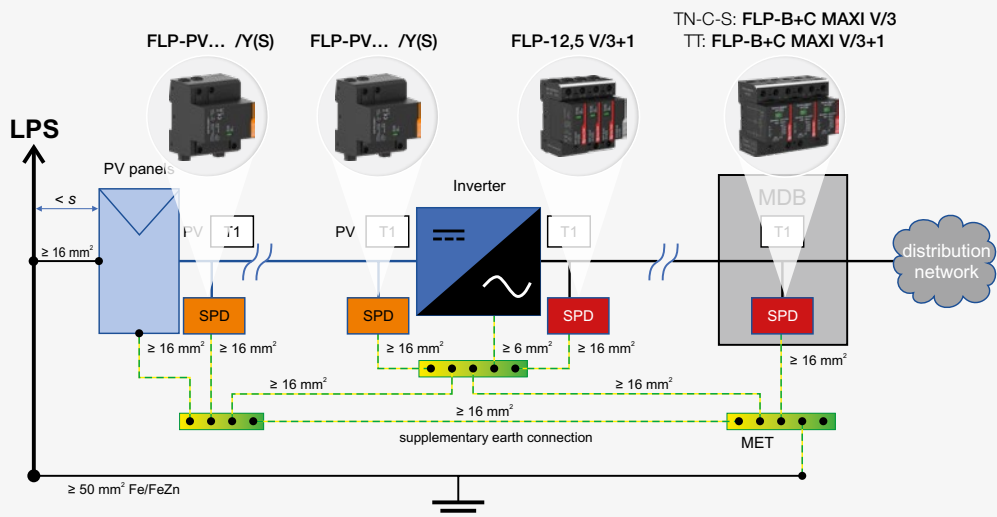
PV installation on roof with external LPS¹⁾ - insufficient distance (s) not observed

- In particular, the inverter is protected.
- When the sufficient separation distance (s) is not observed, the frames of the PV panels must be connected to the LPS.
- In this case, type 1 SPD must be used, which must be installed both on the DC side of the inverter and at the PV string.

- Indicative diagram of a PV installation with surge protection



- Block diagram of a PV installation with surge protection



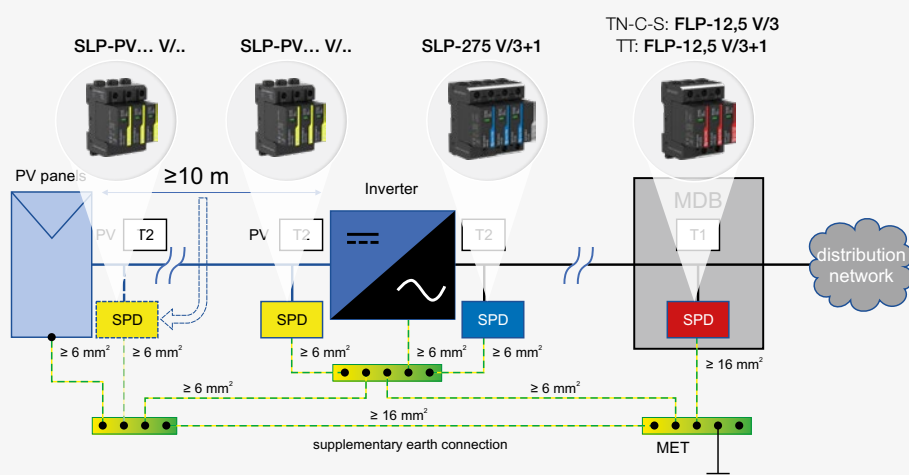
PV roof installation²⁾ without external LPS

- In particular, the inverter is protected.
- If the PV strings are situated at a distance of 10 meters or more from the SPD installed at the inverter, another SPD at the PV string is installed at the same time.

- Indicative diagram of a PV installation with surge protection



- Block diagram of a PV installation with surge protection



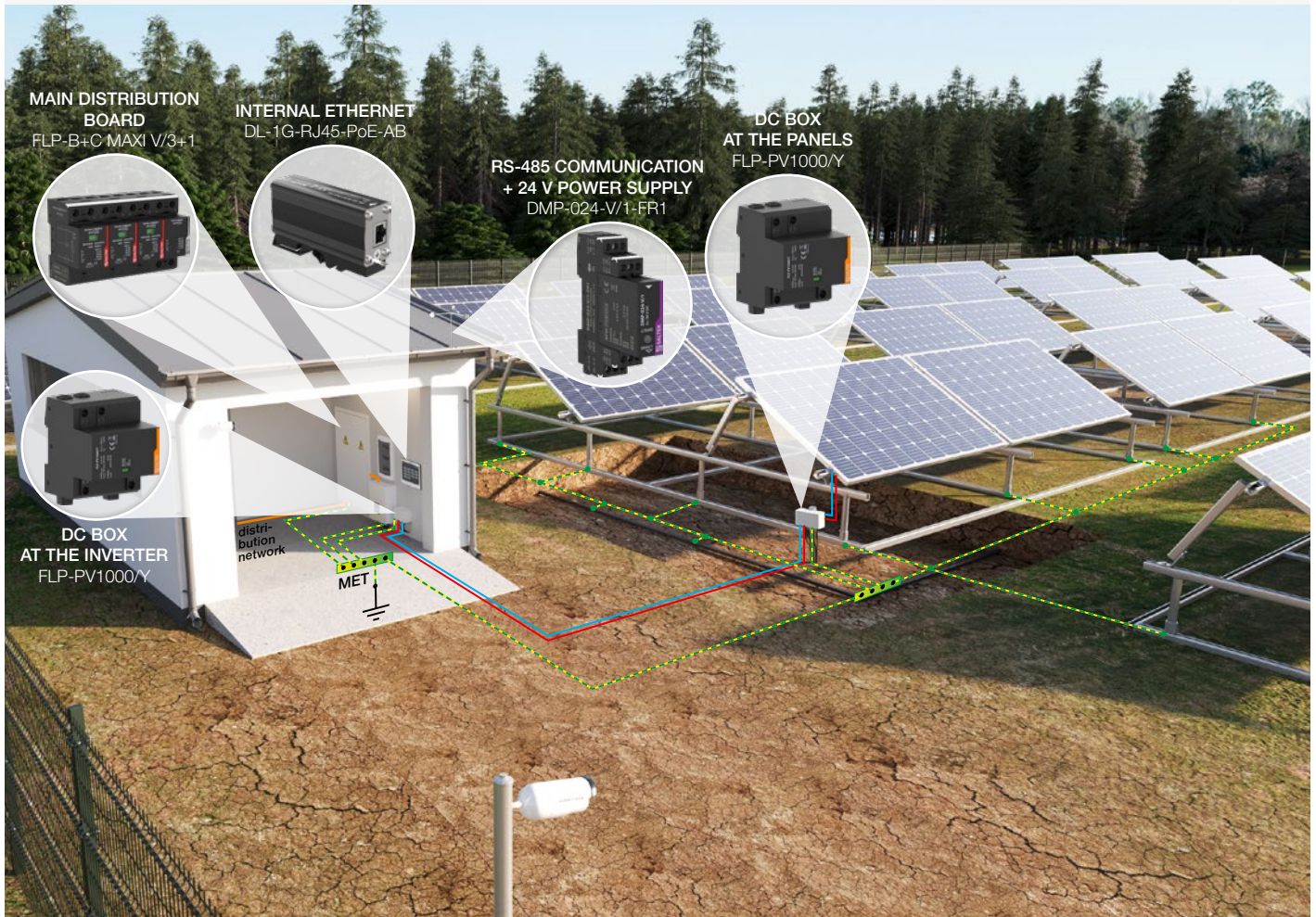
²⁾ It can also be mounted elsewhere on the building structure, e.g. on the wall

PV installation in the open air

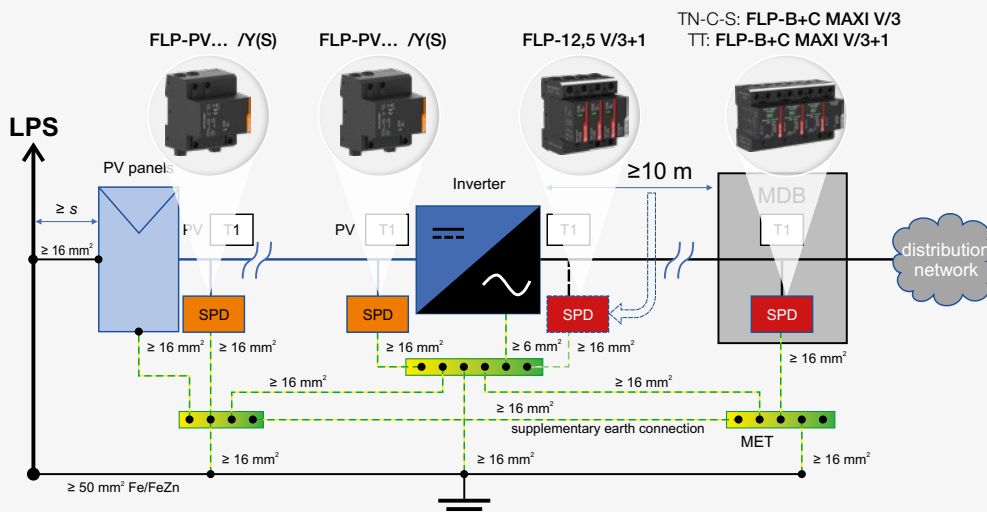
Open air PV installation (field installation) with centralized inverter

- Open air PV applications require multiple-type and grid-type of grounding.
- When the sufficient separation distance (s) is not observed, the structure of the PV panels must be connected to the LPS.
- In this case, type 1 SPD must be used, which must be installed both on the DC side of the inverter and at the PV string.

- Indicative diagram of a PV installation with surge protection



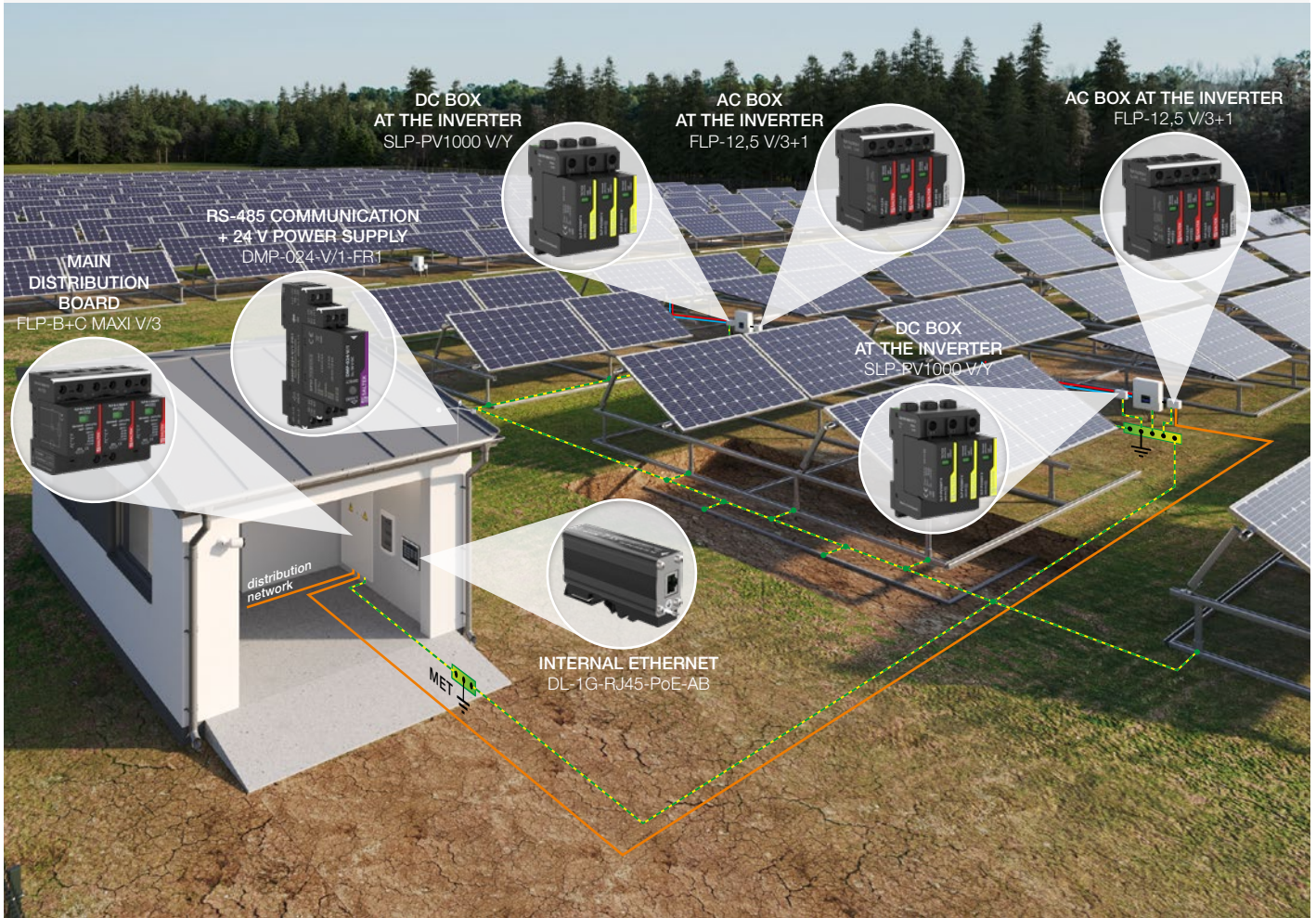
- Block diagram of a PV installation with surge protection



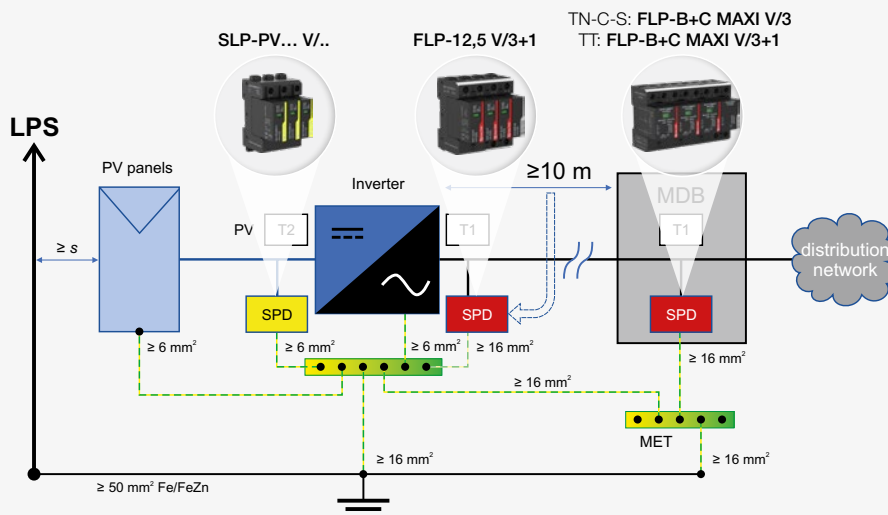
Open air PV installation (field installation) with decentralized inverters

- Open air PV applications require multiple-type and grid-type of grounding.
- Inverters are mounted next to the PV strings.
- On the DC side of the inverter, an SPD of type 2 or type 1+2 is installed; a 1+2 type SPD is installed on the AC side.

- Indicative diagram of a PV installation with surge protection



- Block diagram of a PV installation with surge protection

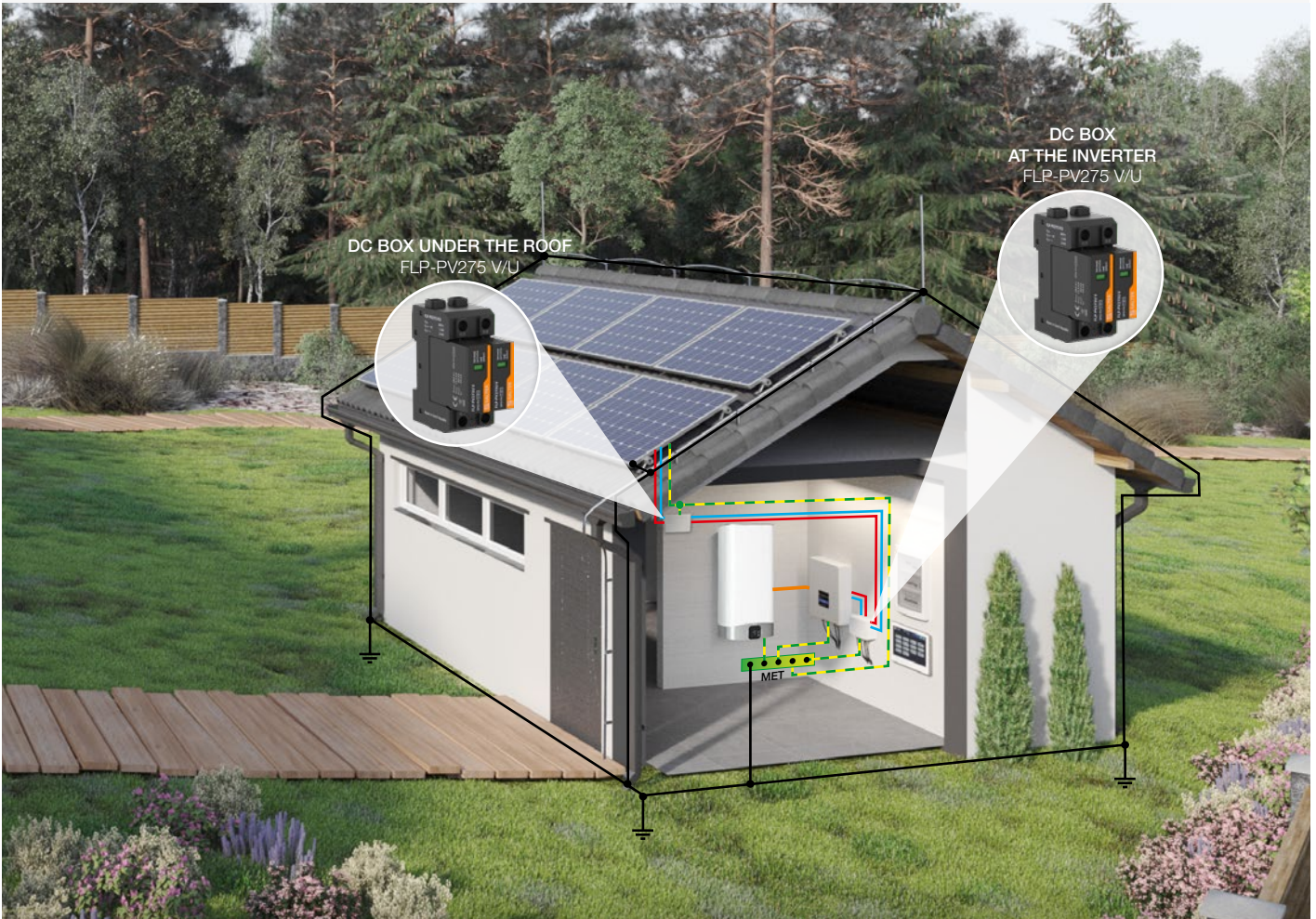


Off-grid systems

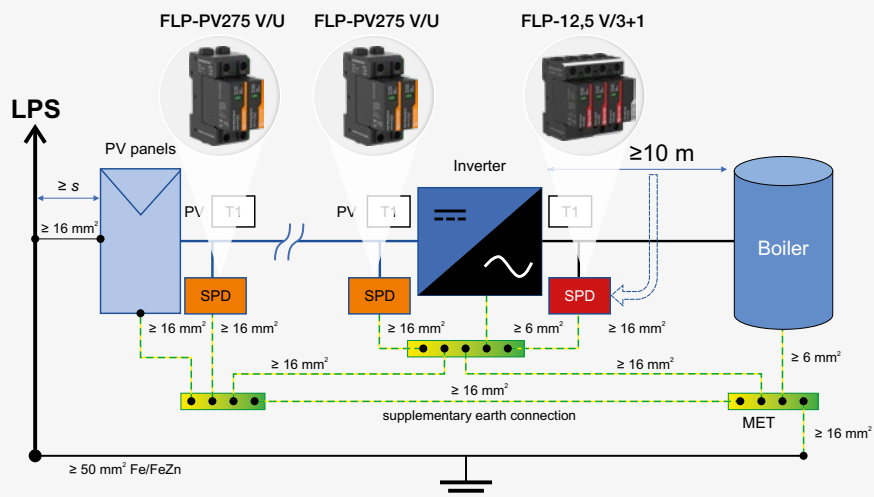
The sufficient separation distance (s) is not observed

- For powering smaller devices up to 230 V, e.g. for heating water, heating, driving garden irrigation, etc.
- In particular, the inverter is protected.
- When the sufficient separation distance (s) is not observed, the frames of the PV panels must be connected to the LPS.
- In this case, type 1 SPD must be used, which must be installed both on the DC side of the inverter and at the PV string.

■ Indicative diagram of a PV installation with surge protection



■ Block diagram of a PV installation with surge protection



Recommended surge protections for PV applications

DC side

FLP-PV1000/Y

Lightning current arrester and surge protector for mounting on the DC side of a PV installation. PV installations with LPS and insufficient separation distance protection. Optimized solution for every type of PV installation. FLP-PV1500/Y, FLP-PV550 V/U is also available. All FLP-PV types are also available in a version with remote signalling.

SPD type	Connection type	$U_{CPV}^{2)}$	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1, T2	Y	1 000 V DC	12,5 kA	20 kA	40 kA	No	A04201

²⁾ $U_{CPV} \geq 1,2 \times U_{OC,STC}$

FLP-PV275 V/U

Lightning current arrester and surge protector for mounting on the DC side of a PV installation. PV installations with LPS and insufficient separation distance protection. Optimized solution for every type of PV installation. Designed primarily for micro PV systems, e. g. for water heating. Minimal dimensions.

SPD type	Connection type	$U_{CPV}^{2)}$	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1, T2	U	280 V DC	25 kA	30 kA	60 kA	No	A07407

²⁾ $U_{CPV} \geq 1,2 \times U_{OC,STC}$

SLP-PV1000 V/Y

Lightning current arrester and surge protector for mounting on the DC side of a PV installation. PV installations with LPS and sufficient separation distance observed or without LPS. The offer includes also the SLP-PV170 V/U, SLP-PV500 V/U, SLP-PV700 V/Y, SLP-PV1500 V/Y types. All SLP types are also available in a version with remote signalling.

SPD type	Connection type	$U_{CPV}^{3)}$	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T2	Y	1 020 V DC	15 kA	40 kA	No	A04302

²⁾ $U_{CPV} \geq 1,2 \times U_{OC,STC}$

AC side

FLP-B+C MAXI V/3

Lightning arrester. Installation at the beginning of the installation (e.g. in main switchboards) for buildings with lightning protection system (LPS). For the TN-C or TN-C-S network system.

SPD type	Connection type	Suitable for power systems	U_c	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1 + T2	3+0	TN-C	260 V AC	25 kA	30 kA	60 kA	No	A05093

FLP-B+C MAXI V/3+1

Lightning arrester. Installation at the beginning of the installation (e.g. in main switchboards). For the TT network system.

SPD type	Connection type	Suitable for power systems	U_c	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1 + T2	3+1	TT	260 V AC	25 kA	30 kA	60 kA	No	A05096

FLP-12,5 V/3

Lightning current arrester for mounting at the beginning of the installation (e.g. in main switchboards) for buildings with lightning protection system (LPS). For the TN-C network system.

SPD type	Connection type	Suitable for power systems	U_c	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1, T2	3+0	TN-C	275 V AC	12,5 kA	30 kA	60 kA	No	A03425

FLP-12,5 V/3+1

Lightning arrester for mounting in front of the inverter on the AC side in cases where there is a risk of partial lightning currents at the location. For the TN-S or TT network system.

SPD type	Connection type	Suitable for power systems	U_c	$I_{imp}^{1)}$ (10/350 μ s)	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T1, T2	3+1	TT	275 V AC	12,5 kA	30 kA	60 kA	No	A03427

SLP-275 V/3+1

Lightning arrester for mounting in front of the inverter on the AC side. For the TN-S or TT network system.

SPD type	Connection type	Suitable for power systems	U_c	I_n (8/20 μ s)	$I_{max}^{1)}$ (8/20 μ s)	Remote signalling	Ordering number
T2	3+1	TT	275 V AC	20 kA	40 kA	No	A01946

Recommended surge protections for PV applications

Communication

DMP-024-V/1-FR1

For modern smart sensors. Combination of two-stage overvoltage protection of two-wire signal lines in the data part (e.g. RS-485) and overvoltage protection for small voltages in the power part (e.g. 24 V).

Location	No. of lines	U_c	I_L (communication)	I_L (powering)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
ST 2+3	1	36 V DC	1 A	16 A	20 kA	46 V	Yes	A05799

BDM-024-V/2-FR1

Lightning arrester with coarse and fine surge protection designed to protect two two-wire signal lines such as RS-485 and others (temperature, wind speed measurement).

Location	No. of lines	U_c	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
ST 1+2+3	2	36 V DC	1 A	2,5 kA	10 kA	46 V	Yes	A06414

DP-024-V/1-F16

Surge protection for low voltages, for powering communication lines (e.g. 24 V).

Location	U_c	I_L	I_n (C2) (8/20 μ s)	U_p (C2) core-core	Ordering number
ST 3	34 V DC	16 A	2 kA	230 V	A05665

DL-1G-RJ45-PoE-AB

Special surge protection of Ethernet and between PoE pairs. Compatible with PoE according to 802.3 af/at/bt standards.

Location	Network type	U_c line/PoE	I_L (per core)	I_n (C2) (8/20 μ s)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
ST 1+2+3	1G	8,5/58 V DC	0,5 A	0,15 kA	45 V	500 V	A06148

DL-10G-PoE-IP66

Ethernet surge protection with PoE for outdoor installation. Protection against dust and water IP66.

Location	Network type	U_c line/PoE	I_L (per core)	I_n (C2) (8/20 μ s)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
ST 1+2+3	10G	8,5/58 V DC	0,5 A	0,15 kA	45 V	500 V	A07098

Our offer of supporting materials

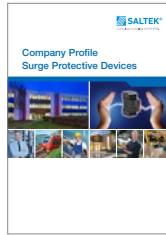
Catalogue and Company Profile



Catalogue 2023-24



Catalogue Voltage Limiting Devices



Company Profile

Practical Guides



Commercial receiving systems



Inspection



DC railways applications



Surge protection of LV power systems



Signal and Data lines

Surge protection for various application areas



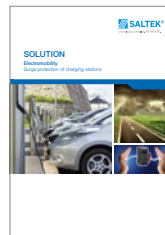
Railway stations and railways



Telecommunications



Ethernet



Electromobility



Electrical energy storage



Wind power plant



Pipelines and cathodic protection stations



Electronic Fire Security Systems



Emergency lights/ Evacuation routes



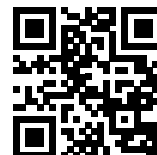
CCTV and IPTV cameras



LED street lighting systems

SALTEK s.r.o.
Drážďanská 85
400 07 Ústí nad Labem
Czech Republic
Phone: +420 272 942 470
E-mail: info@saltek.cz
www.saltek.eu/en

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