

# Surge Protective Devices for photovoltaic systems



Photovoltaic systems



- Protection of PV inverters for photovoltaic systems
- PV solution for family houses
- PV plants
- Protection of off-grid solar inverters
- Protection of battery charges
- Lightning arrester SPD PV Type 1 and 2
- Surge arrester SPD PV Type 2

# Protection of photovoltaic systems

Photovoltaic arrays are costly to install and demanding in terms of technology. Their service life must be measured in decades to see a return on the invested funds. Manufacturers usually provide about a twenty-year guarantee for photovoltaic systems.

To provide trouble-free technology throughout its service life, it is necessary to include comprehensive protection against atmospheric and induced overvoltage at the design stage to implement the technology into the project. Protection must be provided not only at the output side of the inverter, but also at the photovoltaic panels.

Solar photovoltaic arrays are usually installed on rooftops, or on a "greenfield".

As for the anticipated risks (pursuant to IEC (EN) 62305-2), direct or near lightning strikes are considered. Overvoltage or lightning strike can bring about financial loss, and for photovoltaic systems installed on rooftops where individuals could be working, injury should also be considered.

Photovoltaic system designs, including lightning and overvoltage suppression, shall comply with the IEC (HD) 60364-7-712 standard (Electrical installations of buildings – Solar photovoltaic (PV) systems), technical specification CLC/TS 50539-12 (SPD for specific application including DC – Selection and application principles – SPDs connected to PV installations) and standard IEC (EN) 62305 (Lightning protection).

The core (key device) of the whole photovoltaic system is the inverter, so the lightning and surge protection should be focused

on the inverter and, it should be incorporated into the whole lightning and surge protection system. Furthermore, photovoltaic units and their bearing metal structures should be integrated into the grounding design.

### SPD selection for DC side:

- $U_{CPV}$  maximum continuous operating voltage
- $U_{OCSTC}$  standardized test circuit voltage of PV String

$$U_{CPV} \geq 1,2 \times U_{OCSTC}$$

- If separating spark-over distance "s" is kept
  - SPD PV Type 2 is installed
  - If distance "l" between PV modules and inverter is longer than 10m - SPD is installed on both sides of the DC line
- If separating spark-over distance "s" is not kept
  - SPD PV Type 1 and Type 2 is installed
  - It is always necessary to install SPD PV on both sides of the DC line

General circuit diagram of solar photovoltaic systems

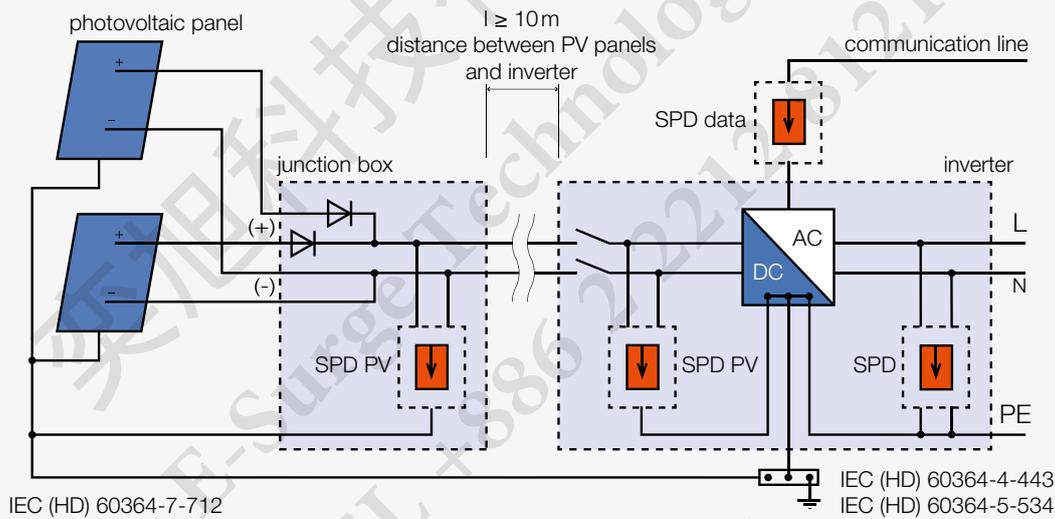


Fig. 1

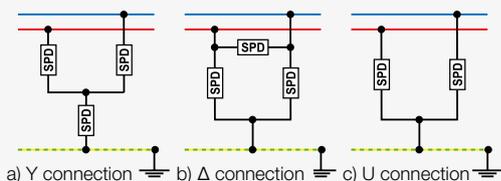
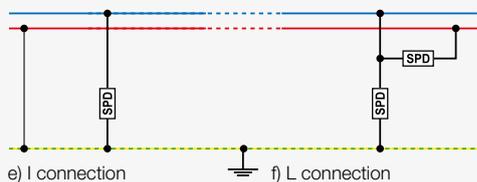


Fig. 2



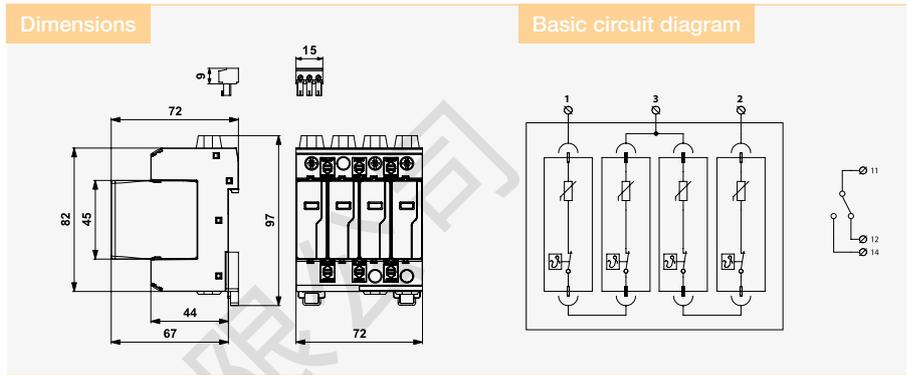
The DC side of the PV system can either be unearthed (insulated) or with one pole earthed. Figures 1 and 2 (see CLC/TS 50 539-12) show how SPDs on the DC side must be connected.

When mounting an SPD, the necessary length of the connecting conductors should be complied with HD 60364-5-534 (IEC 60364-5-53, chapter 534), clause 534.2.9.

# FLP-PV550 V/U (S)

SPD PV type 1 and type 2 – lightning current and surge arresters for PV installation  
pluggable module, visual fault signalling, module locking

- varistor lightning current arrester and surge arrester in 'U' connection
- for protection of PV systems on the roofs, where the separating spark-over distance is not kept (connection to LPS)
- maximum continuous operating voltage for PV application:  $U_{CPV} \geq 1.2 \times U_{OC,STC}$
- optional remote fault signalling (S)



Parameter / Type		FLP-PV550 V/U	FLP-PV550 V/U S
Maximum operating voltage mode 1/2 I-connection	$U_{CPV}$	1 120 V DC	1 120 V DC
Maximum operating voltage mode 1/3, 2/3	$U_{CPV}$	560 V DC	560 V DC
Total discharge current (10/350 $\mu$ s)	$I_{Total}$	25 kA	25 kA
Nominal discharge current (8/20 $\mu$ s)	$I_n$	30 kA	30 kA
Maximum discharge current (8/20 $\mu$ s)	$I_{max}$	60 kA	60 kA
Voltage protection level mode 1/2	$U_p$	4,8 kV	4,8 kV
Voltage protection level mode 1/3, 2/3	$U_p$	2,4 kV	2,4 kV
Short-circuit current rating	$I_{SCPV}$	1 000 A DC	1 000 A DC
Response time	$t_a$	25 ns	25 ns
Cross-section of connected conductors solid (min/max)		1 mm <sup>2</sup> / 35 mm <sup>2</sup>	1 mm <sup>2</sup> / 35 mm <sup>2</sup>
Cross-section of connected conductors stranded (min/max)		1 mm <sup>2</sup> / 25 mm <sup>2</sup>	1 mm <sup>2</sup> / 25 mm <sup>2</sup>
Fault indication		red indication field	red indication field
Remote indication		-	potential-free change-over contact
Remote indication contacts		-	250 V / 0,5 A AC, 250 V / 0,1 A DC
Cross-section of remote indication conductors		-	1,5 mm <sup>2</sup>
Degree of protection		IP 20	IP 20
Range of operating temperatures (min/max)		-40 °C / 80 °C	-40 °C / 80 °C
Mounting		DIN rail 35 mm	DIN rail 35 mm
According to standard		EN 50539-11:2013 / PV T1, PV T2	EN 50539-11:2013 / PV T1, PV T2
Ordering number		A06145	A06146

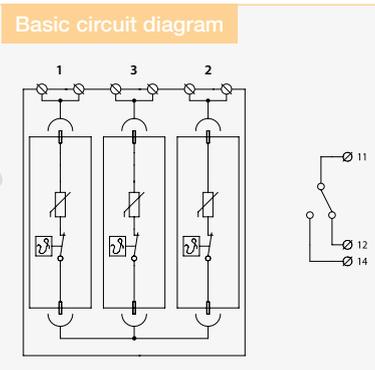
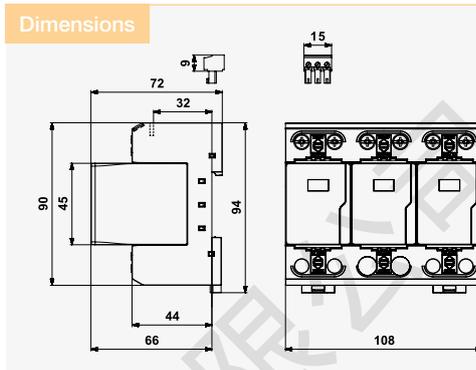
Spare module	FLP-PV275U V/U	FLP-PV275U V/U
Ordering number	A06147	A06147

# FLP-PV1000 V(S)/Y

SPD PV type 1 and type 2 – lightning current and surge arresters for PV installation  
pluggable module, visual fault signalling, module locking

- varistor lightning current arrester and surge arrester in ,Y' connection
- for protection of PV systems on the roofs, where the separating spark-over distance is not kept (connection to LPS)
- maximum continuous operating voltage for PV application:  $U_{CPV} \geq 1.2 \times U_{OC,STC}$
- optional remote fault signalling (S)

Photovoltaic systems



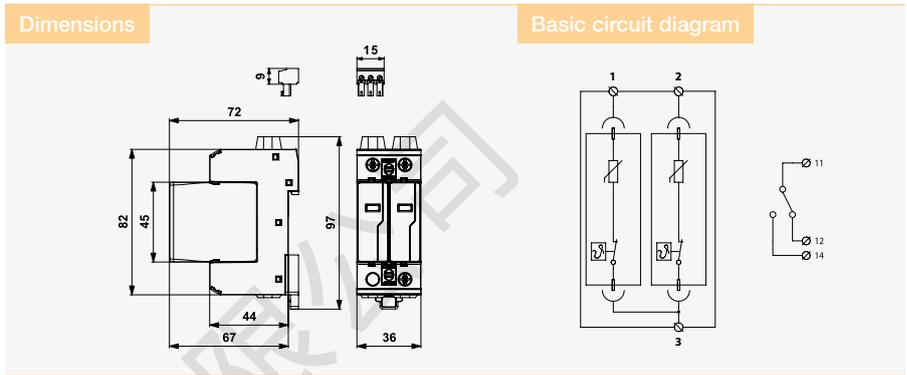
Parameter / Type	FLP-PV1000 V/Y	FLP-PV1000 VS/Y
Maximum operating voltage mode 1/3, 2/3	$U_{CPV}$ 1 000 V DC	1 000 V DC
Lightning impulse current (10/350 $\mu$ s)	$I_{imp}$ 12,5 kA	12,5 kA
Nominal discharge current (8/20 $\mu$ s)	$I_n$ 30 kA	30 kA
Maximum discharge current (8/20 $\mu$ s)	$I_{max}$ 60 kA	60 kA
Voltage protection level mode 1/2	$U_p$ 3,6 kV	3,6 kV
Voltage protection level mode 1/3, 2/3	$U_p$ 3,6 kV	3,6 kV
Short-circuit current rating	$I_{SCPV}$ 1 000 A DC	1 000 A DC
Response time	$t_a$ 25 ns	25 ns
Cross-section of connected conductors solid (min/max)	2,5 mm <sup>2</sup> / 50 mm <sup>2</sup>	2,5 mm <sup>2</sup> / 50 mm <sup>2</sup>
Cross-section of connected conductors stranded (min/max)	2,5 mm <sup>2</sup> / 35 mm <sup>2</sup>	2,5 mm <sup>2</sup> / 35 mm <sup>2</sup>
Fault indication	red indication field	red indication field
Remote indication	-	potential-free change-over contact
Remote indication contacts	-	250 V / 0,5 A AC, 250 V / 0,1 A DC
Cross-section of remote indication conductors	-	1,5 mm <sup>2</sup>
Degree of protection	IP 20	IP 20
Range of operating temperatures (min/max)	-40 °C / 80 °C	-40 °C / 80 °C
Mounting	DIN rail 35 mm	-
According to standard	EN 50539-11:2013 / PV T1, PV T2	EN 50539-11:2013 / PV T1, PV T2
Ordering number	A04059	A04058

Spare module	FLP-PV500Y V/O	FLP-PV500Y V/O
Ordering number	A04211	A04211

# SLP-PV... V/U (S)

**SPD PV type 2 - surge arrester for PV installation**  
 pluggable module, visual fault signalling, module locking

- varistor surge arrester in 'U' connection
- for protection of PV systems where the separating spark-over distance is kept or without LPS
- maximum continuous operating voltage for PV application:  $U_{CPV} \geq 1.2 \times U_{OC\ STC}$
- optional remote fault signalling (S)



Parameter / Type		SLP-PV170 V/U	SLP-PV170 V/U S	SLP-PV500 V/U	SLP-PV500 V/U S
Maximum operating voltage mode 1/2 I-connection	$U_{CPV}$	340 V DC	340 V DC	1 020 V DC	1 020 V DC
Maximum operating voltage mode 1/3, 2/3	$U_{CPV}$	170 V DC	170 V DC	510 V DC	510 V DC
Nominal discharge current (8/20 $\mu$ s)	$I_n$	15 kA	15 kA	15 kA	15 kA
Maximum discharge current (8/20 $\mu$ s)	$I_{max}$	40 kA	40 kA	40 kA	40 kA
Voltage protection level mode 1/2	$U_p$	1,2 kV	1,2 kV	4 kV	4 kV
Voltage protection level mode 1/3, 2/3	$U_p$	0,6 kV	0,6 kV	2 kV	2 kV
Short-circuit current rating	$I_{SCPV}$	1 000 A DC			
Response time	$t_a$	25 ns	25 ns	25 ns	25 ns
Cross-section of connected conductors solid (min/max)		1 mm <sup>2</sup> / 35 mm <sup>2</sup>			
Cross-section of connected conductors stranded (min/max)		1 mm <sup>2</sup> / 25 mm <sup>2</sup>			
Fault indication		red indication field	red indication field	red indication field	red indication field
Remote indication		-	potential-free change-over contact	-	potential-free change-over contact
Remote indication contacts		-	250 V / 0,5 A AC, 250 V / 0,1 A DC	-	250 V / 0,5 A AC, 250 V / 0,1 A DC
Cross-section of remote indication conductors			1,5 mm <sup>2</sup>		1,5 mm <sup>2</sup>
Degree of protection		IP 20	IP 20	IP 20	IP 20
Range of operating temperatures (min/max)		-40 °C / 80 °C			
Mounting		DIN rail 35 mm			
According to standard		EN 50539-11:2013 / PV T2			
Ordering number		A03662	A03663	A03664	A03665

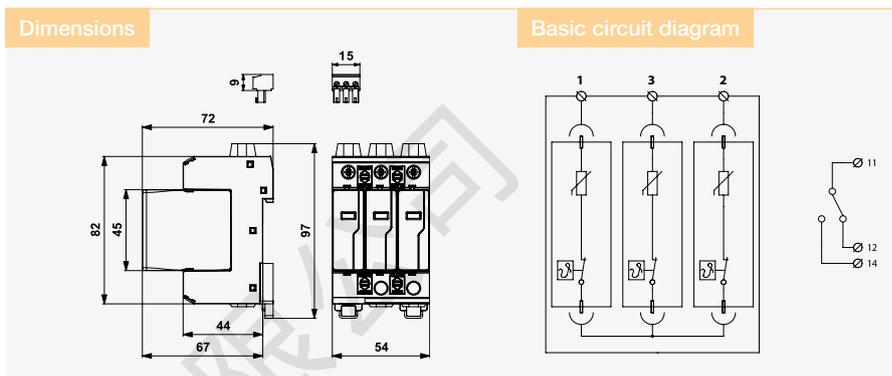
Spare module	SLP-PV170U V/U	SLP-PV170U V/U S	SLP-PV500U V/U	SLP-PV500U V/U S
Ordering number	A03692	A03692	A03694	A03694

# SLP-PV... V/Y (S)

**SPD PV type 2 – surge arrester for PV installation**  
pluggable module, visual fault signalling, module locking

- varistor surge arrester in 'Y' connection
- for protection of PV systems where the separating spark-over distance is kept or without LPS
- maximum continuous operating voltage for PV application:  $U_{CPV} \geq 1.2 \times U_{OC\ STC}$
- optional remote fault signalling (S)

Photovoltaic systems



Parameter / Type	SLP-PV700 V/Y	SLP-PV700 V/Y S	SLP-PV1000 V/Y	SLP-PV1000 V/Y S	SLP-PV1500 V/Y	SLP-PV1500 V/Y S
Maximum operating voltage mode 1/3, 2/3	$U_{CPV}$ 750 V DC	750 V DC	1 020 V DC	1 020 V DC	1 500 V DC	1 500 V DC
Nominal discharge current (8/20 $\mu$ s)	$I_n$ 20 kA	20 kA	15 kA	15 kA	15 kA	15 kA
Maximum discharge current (8/20 $\mu$ s)	$I_{max}$ 40 kA	40 kA	40 kA	40 kA	40 kA	40 kA
Voltage protection level mode 1/2	$U_p$ 3,6 kV	3,6 kV	4 kV	4 kV	6,4 kV	6,4 kV
Voltage protection level mode 1/3, 2/3	$U_p$ 3,6 kV	3,6 kV	4 kV	4 kV	6,4 kV	6,4 kV
Short-circuit current rating	$I_{SCPV}$ 1 000 A DC	1 000 A DC	1 000 A DC	1 000 A DC	1 000 A DC	1 000 A DC
Response time	$t_a$ 25 ns	25 ns	25 ns	25 ns	25 ns	25 ns
Residual current mode 1/3, 2/3	$I_{PE}$ -	-	-	-	0,15 mA AC	0,15 mA AC
Residual current mode 1/3, 2/4	$I_{PE}$ -	-	-	-	0,0008 mA DC	0,0008 mA DC
Cross-section of connected conductors solid (min/max)	1 mm <sup>2</sup> / 35 mm <sup>2</sup>					
Cross-section of connected conductors stranded (min/max)	1 mm <sup>2</sup> / 25 mm <sup>2</sup>					
Fault indication	red indication field					
Remote indication	-	potential-free change-over contact	-	potential-free change-over contact	-	potential-free change-over contact
Remote indication contacts	-	250 V / 0,5 A AC, 250 V / 0,1 A DC	-	250 V / 0,5 A AC, 250 V / 0,1 A DC	-	250 V / 0,5 A AC, 250 V / 0,1 A DC
Cross-section of remote indication conductors	-	1,5 mm <sup>2</sup>	-	1,5 mm <sup>2</sup>	-	1,5 mm <sup>2</sup>
Degree of protection	IP 20					
Range of operating temperatures (min/max)	-40 °C / 80 °C					
Mounting	DIN rail 35 mm					
According to standard	EN 50539-11:2013 / PV T2					
Ordering number	A03668	A03669	A03670	A03671	A06036	A06037

Spare module	SLP-PV350Y V/O	SLP-PV350Y V/O	SLP-PV500Y V/O	SLP-PV500Y V/O	SLP-PV750Y V/O	SLP-PV750Y V/O
Ordering number	A03744	A03744	A03736	A03736	A06040	A06040